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(54) **Apparatus for forming two toner images in a single frame**

(57) A web image member (1) is conveniently exposed through its base (3) by a printhead (17) mounted in an assembly (50) including a positioning bar (70) for properly spacing the printhead (17) and a lens (54) from the image member (1).

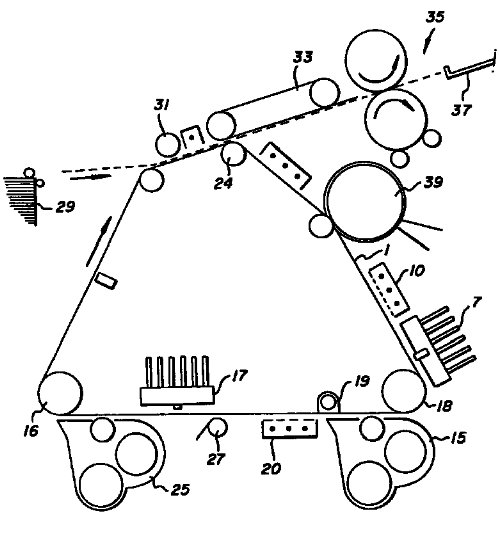

Fig. 1

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Description

This invention relates to the formation of two or more toner images in a single frame or area of an image member. Although not limited thereto, it is particularly usable in an apparatus which forms accent color images on a single frame of an image member in a single pass.

US-A-5,001,028 is representative of a number of references describing a process in which a photoconductive image member is uniformly charged and imagewise exposed to create an electrostatic image. Toner is applied to the electrostatic image to create a toner image. Usually, in this process, discharged area development is used. Thus, the toner applied is of the same polarity as the electrostatic image. It deposits in the areas of lowest charge (the discharged areas) to form a toner image having a density which is greatest in the portions of the image receiving the greatest exposure.

Although the process is not necessarily limited to such applications, it is most commonly used to provide accent color prints or copies with laser or LED printhead electronic exposure.

It is an object of the invention to provide a printhead writer assembly readily mounted for exposure through a web support.

Thus it is also an object of the invention to provide at least first and second toner images on an image member with less tendency of one of the images to move into adjacent portions of the image member not intended to be part of that toner image. Additionally, the printhead used in the apparatus should be so that it is less likely to become dirty from airborn toner.

This and other objects are accomplished by an apparatus according to claim 1.

In a preferred embodiment of the invention, the feature of exposure through the support can be used in process color imaging as well as accent color imaging. Exposure through the support has many advantages other than avoiding the earlier images. For example, there is often more room for a printhead writer assembly on the side of the image member opposite the toning station. The printhead is less likely to become dirty from airborn toner. Charged area development is easier to use.

Another advantage of exposure through the support is that a simple and accurate mount can be designed for the printhead writer assembly. This assembly can be used in other applications as well.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side schematic of an image forming apparatus.

FIGS. 2, 6, 7 and 8 are perspective views of portions of an LED printhead writer assembly.

FIGS. 3-5 and 8 are side views of an LED printhead writer assembly with FIG. 4 showing an alternative embodiment to FIGS. 3 and 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows an apparatus for producing two color images in which the second exposure is through the base. According to FIG. 1, an image member 1 is in the form of an endless belt trained about a series of rollers, including a tension roller 16 and a drive roller 18, to continuously move through `a series of electrophotographic stations well known in the art. Image member 1 is charged by a charging device 10 to uniform potential, for example, a negative potential. It is imagewise exposed by an exposure device, for example, LED printhead 7 to create a first electrostatic image. The first electrostatic image is toned at a first toning station 15 by the application of toner having a polarity the same as the original charging station 10, for example, a negative polarity and having a small particle size, for example, 8 microns. Toner is, thus, applied to the areas discharged by exposure station 7.

The image member is recharged by an additional charging station 20 which evens up the charge of the first polarity on the image member at a predetermined level. This level need not be the same as the charge applied by station 10. However, before recharging, the image member is exposed to overall blanket radiation through its support by erase lamp 19. As described above, this causes the toner to be more firmly held to the image member, despite charge from the charging station 20. A magnetic scavenger 27 is positioned to attract any carrier inadvertently picked up by the image member in the first toning step. The position of scavenger 27 before toning station 25 is to prevent carrier used in station 15 from carrying dark toner into station 25.

The image member 1 is then imagewise exposed by a second exposure station, for example, a second LED printhead 17 which is positioned inside image member 1 and exposes image member 1 through its transparent support to create a second electrostatic image. The second electrostatic image is toned by a second toning station 25 which applies toner preferably of a color different than that applied by station 15 to create a second toner image on the image member, preferably with toner of a larger particle size, for example, 12 microns, thereby forming a two color or multicolor image on the image member.

A receiving sheet is fed from a receiving sheet supply 29 into overlying contact with the two color toner image. The two color toner image is transferred to the receiving sheet at a conventional biased roller electrostatic transfer station 31 and the receiving sheet separates from the image member as the image member goes around a small roller 24. The receiving sheet is transported by a vacuum transport 33 to a fuser 35 where the two color image is fixed to the receiving sheet. The receiving sheet is ultimately deposited in an output tray 37. The image member is cleaned by cleaning device 39 so that the process can be continued.

This apparatus doubles the speed of doing two color images, compared to conventional approaches in which the images are formed on separate frames and transferred in registration. It also avoids the complexity of registering two image transfers with the attendant complex receiver handling.

Toning stations 15 and 25 are preferably constructed as in US-A-5,001,028,. For highest quality, the first toning station 15 is spaced from the image member 1 by an amount less than the nap of the magnetic brush. The brush, thus, directly contacts the image member, providing a high quality dense image. The second toning station 25 is spaced from image member 1 by enough that the nap does not directly contact image member 1. An AC component on the bias on station 25 helps provide the density desired in the second image despite the gap between the nap and the image member.

FIGS. 2-9 show the details of a linear printhead writer assembly 50 suitable for use as either printhead 7 or printhead 17 in FIG. 1. However, its construction makes it particularly adaptable to backside location and is, therefore, particularly usable as printhead 17 in FIG. 1.

Referring especially to FIGS. 2, 3 and 7, linear printhead writer assembly 50 includes a linear source of radiation, for example, a linear LED array 52 (FIGS. 3 and 8), a linear focusing means, for example, a linear lens 54 such as a conventional Selfocâ (trademark of Hitachi, Ltd.) lens and a suitable support housing. The LED array is supported on support tiles 64 (FIG. 2) which, in turn, are supported on a mother board 62 which, in turn, is supported on a baseplate 60. The baseplate 60 is fixed with respect to a pair of support or datum plates 56 and 58 which are positioned at each of the baseplate ends.

As shown in FIG. 7, the lens 54 is fixed to a lens support 55 to which is affixed a pair of end supports 67 and 69 using a thermal compensating means which will be described below.

End supports 67 and 69 each contain screw holes 76 which are positioned in alignment with oversized holes 66 in support plates 56 and 58 (FIG. 2). Screws 65, each with an oversized washer 68 (FIGS. 3 and 9) are inserted through holes 66 and into screw holes 76. The screws 65 can be moved within holes 66 to position lens 54 with respect to LED array 52 for final factory adjustment of those two components.

According to FIGS. 2 and 3 a single positioning bar 70 is mounted between support plates 56 and 58. The LED array 52, the lens 54 and the positioning bar 70 are all elongated parallel to a Z axis. (Orthogonal X, Y and Z axes are shown in FIG. 2.) The upper surface of positioning bar 70 contacts image member 1, as shown in FIGS. 3 and 9, to control the distance (in a Y direction) between image member 1 and lens 54 and LED array 52.

Both factory and field adjustment of positioning bar 70 is accomplished by mounting positioning bar 70 eccentrically on a shaft 74. Shaft 74 is mounted on support plates 56 and 58. A knob 72 is used to rotate shaft 74 to rotate bar 70. Because of the eccentric mounting of bar 70 with respect to shaft 74, the top surface of bar 70 moves toward and away from LED array 52 as bar 70 is rotated.

Focusing of lens 54 with respect to both conjugates is best shown by reference to FIG. 9, in which unnecessary details are eliminated. In the factory, writer assembly 50 is mounted in a suitable fixture for adjusting focus (see, for example, US-A-4,928,139). Lens 54 is moved in the fixture until LED array 52 is imaged, by lens 54, at a desired linear exposure locus 78, which locus is also parallel to the Z axis. This movement is accomplished by movement of screws 65 within oversized holes 66 in plates 56 and 58. When the proper focus is obtained, the screws 65 are tightened to fix lens 54 with respect to LED array 52 and plates 56 and 58. Factory adjustment of positioning bar 70 can be accomplished at the same time by rotating knob 72 to rotate positioning bar 70 around eccentric shaft 74. A length of web, for example, a web having the same thickness as the proposed image member 1, can be tensioned across bar 70 to help in determining whether the appropriate side of the web is positioned in exposure locus 78 as the knob 72 is rotated. Determination of focus can also be done with appropriate instrumentation, known in the art.

When the assembly 50 is inserted in the image forming apparatus shown in FIG. 1, assembly 50 is fixed to the mechanism plates of the apparatus. As shown in FIG. 9, assembly 50 is positioned so that the positioning bar 70 intersects the path of image member 1 and, thus, lightly pushes the image member away from its normal path, for example, its path between rollers 16 and 18 in FIG. 1. If toning stations 15 and 25 have parts which control the position of image member 1, then bar 70 would intersect the path of image member 1 between the developing stations. Thus, the positioning bar 70 partially defines the path of image member 1.

During setup, copies or prints are run and the resolution of the image measured or observed. At this point, knob 72 can be rotated to move image member 1 toward or away from lens 54. This movement, using the backside location shown, would move the first side 77 of image member 1 having the radiation-sensitive layer associated with it into the exposure locus 78. The exposure locus 78, of course, is fixed with the fixing of assembly 50 in the apparatus. Positioning bar 70 has the function of moving the lateral position of image member 1 to assure proper location of the sensitive part of image member 1 with respect to the exposure locus 78. Note that this positioning structure is not dependent upon the use of springs to urge the printhead assembly against backing members or the image member itself. The printhead assembly is fixed with respect to the mechanism plates of the apparatus. Extremely accurate positioning of the printhead in the apparatus is also not critical providing bar 70 intersects the path of image member 1.

Positioning bar 70 is shown in the FIGS. as adjustable as a unit from one end by rotation as described. Alternatively, eccentric mounts at each end can be provided which would allow field adjustment of each end of bar 70 with respect to the exposure locus. This is ordinarily not necessary, since skew adjustment of lens 54 in the factory (using screws 65) assures a parallel relation between the exposure locus 78 and bar 70.

FIG. 4 illustrates an alternative embodiment in which two positioning bars 70 and 80 are positioned on opposite sides of lens 54 and both contact image member 1. This structure is very similar to the embodiment shown in FIGS. 2, 3 and 9. It has the advantage of precisely determining the location of image member 1 without regard to orientation of the assembly 50 in the apparatus. The embodiments shown in FIGS. 2, 3 and 9, however, have the advantage of simplicity and also have no danger of being overconstrained, a condition that can occur with two positioning bars. Note that either of the positioning bars can be adjustable, or both can be adjustable, depending upon the amount of adjustment desired.

Note also that image member 1, when in contact with positioning bar 70, will have a slight break to it because the direct mounting for assembly 50 assumes intersection by positioning bar 70 with the path of image member 1 so that the path of image member 1 can be controlled by positioning bar 70.

Positioning bar 70 is shown as being rotatable only to adjust its spacing from lens 54. However, it could also be a roller rotatable with the image member 1. This has the advantage of reducing friction between the bar 70 and the image member 1, but it makes the eccentric mount of the bar somewhat more complicated.

FIGS. 5-8 illustrate a thermal compensation device for lens 54. As described above, lens 54 is fixed to lens support 55 which, in turn, is secured to end supports 67 and 69. As the LED array is used, it gradually heats up the lens and the lens support. The lens and lens support can be made of similar materials and expand together. However, the housing for example, baseplate 60, does not necessarily expand at the same rate. Thus, it is conventional to provide a thermal compensation coupling between the housing and the lens support.

As shown in FIG. 8, lens support 55 has a pair of pins 82 at each end. The pins have an axis oriented in the X direction (FIG. 2) and generally transverse to the longitudinal orientation of the lens support 55 (Z direction). The pins are inserted in oversized holes 84 in end supports 67 and 69, as best seen in FIG.5. Thermal expansion in the Z direction would cause a buckling of lens support 55 if not compensated for. Such thermal expansion is permitted by the looseness of fit between pins 82 and oversized holes 84. Actual location of pins 82 within oversized holes 84 is controlled by suitable a dampener 90, for example, a spring or elastomer, which is positioned to resiliently resist movement of pins 82 in the Z direction away from the center of the lens support 55. The dampeners 90 are held in end supports 67 and 69 by spring loaded shoulder screws 86. Preferably, they are rubber shock absorbers which can be loosened or tightened by screws 86 to vary their force on pins 82.

This approach to thermal compensation has the distinct advantage over prior approaches of also dampening vibration in the Z direction. The vibration to lens 54 will cause slight movements of the image. The extent to which such movements cause noticeable defects in the final image depends on the extent of the vibration. Prior thermal compensating devices that secured the lens support at one end have no dampening effect on such vibrations. However, the approach shown in FIGS. 5-8, in addition to allowing for thermal expansion, dampens vibrations. Notice that both ends of the lens support are isolated from the housing by the dampening structure 86. Further, the dampening structure itself absorbs much of any vibration without it getting to the lens support 55. If one end of the lens support were fixed and the other one allowed to move, as in conventional thermal expansion approaches, the vibration would be transmitted completely to the lens support through the fixed end. In this instance, by providing resilient dampening structures as well providing them at both ends, vibrations from other parts of the machine that are transmitted to the housing are, at least to some extent, not passed on to the lens. Further, using the preferred rubber shock absorbers for dampeners 90, an adjustment can be made to the dampening force which allows it to be tuned to dampen particular frequencies that are more troublesome in the particular unit.

Lens support 55 is secured to each of end supports 67 and 69 using a shoulder screw, not shown, secured in a hole 96 in lens support 55 through an oversized hole 98 in the end support. The shoulder screw is tightened against a spring that fits between it and a shoulder of the end support.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

Claims

1. A linear printhead writer assembly for use with a web type image member (1) that is movable in a path having at least one radiation-sensitive layer on a first side (77), said writer assembly comprising:

   an elongated linear source of radiation (52),

   an elongated linear focusing device (54) for focusing radiation from said linear source of radiation at an elongated exposure locus (75),

   a support housing (56) for supporting both said source of radiation (52) and focusing device (54) in a fixed relation to each other and to the exposure locus (78) with said source of radiation (52), said focusing device (54) and said exposure locus (78) being elongated in a direction with respect to path of the image member and fixed with respect to each other by the support housing (56), and

at least one positioning bar (70) also elongated in the cross-track direction and supported by the housing (56) and accurately positioned with respect to the exposure locus, to engage the imaging member (1) and control the position of the image member (1) with the radiation-sensitive layer in the exposure locus (78).

2. The-printhead writer assembly according to claim 1 wherein she positioning bar (70) is adjustable with respect to the support housing (56) and the focusing device (54) to adjust the distance between an engaged image member (1) and the focusing device (54).

3. The printhead writer assembly according to claims 1 or 2 in combination with an image member having a transparent base (3), said positioning bar being positioned to contact said base (3) for exposure through the base (3).

4. The combination according to claim 3 wherein the linear source of radiation is a linear array of LEDs.

5. The combination according to claim 4 including a second positioning bar, the two positioning bars being located on opposite sides of the exposure locus.

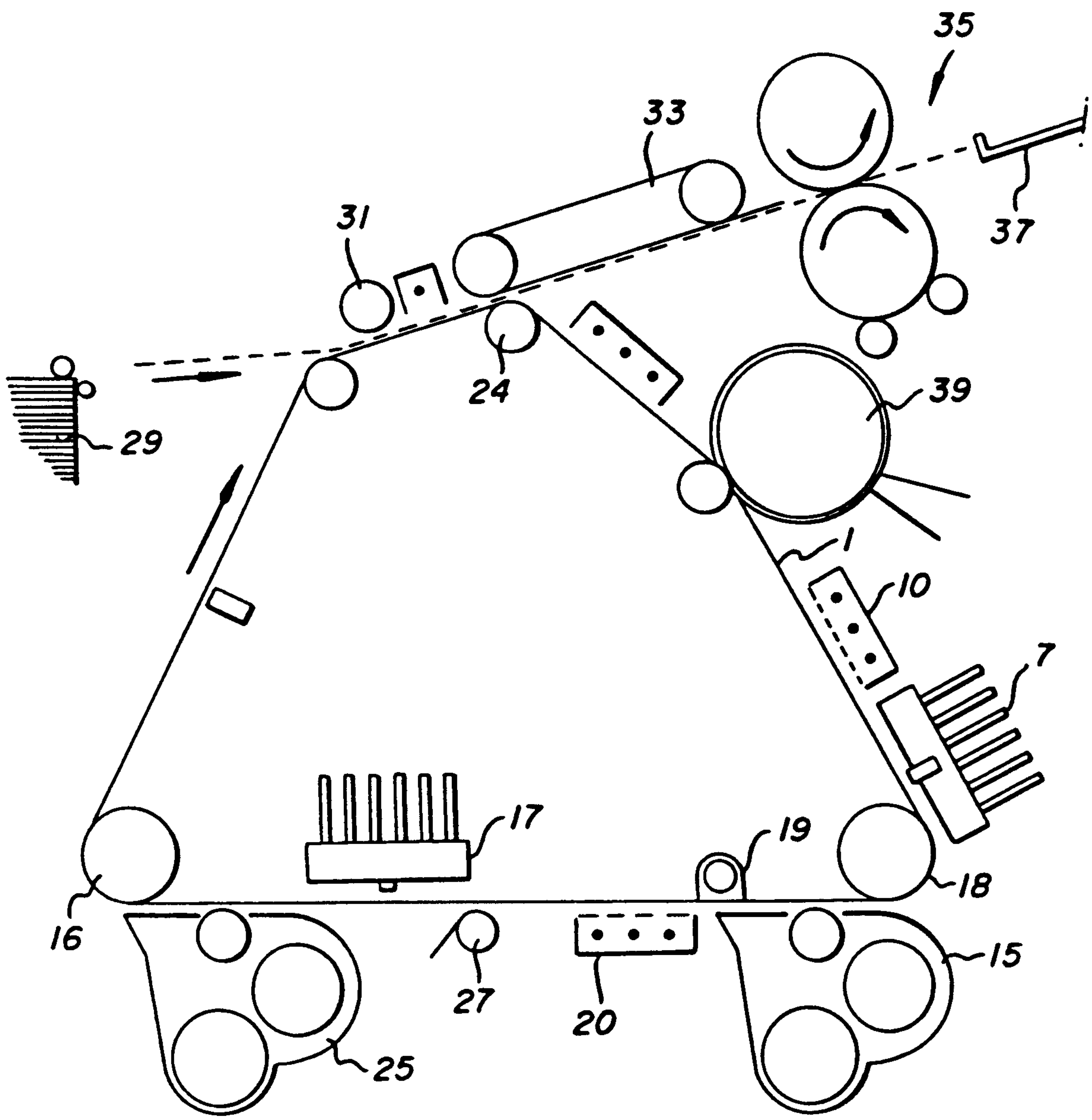

Fig. 1

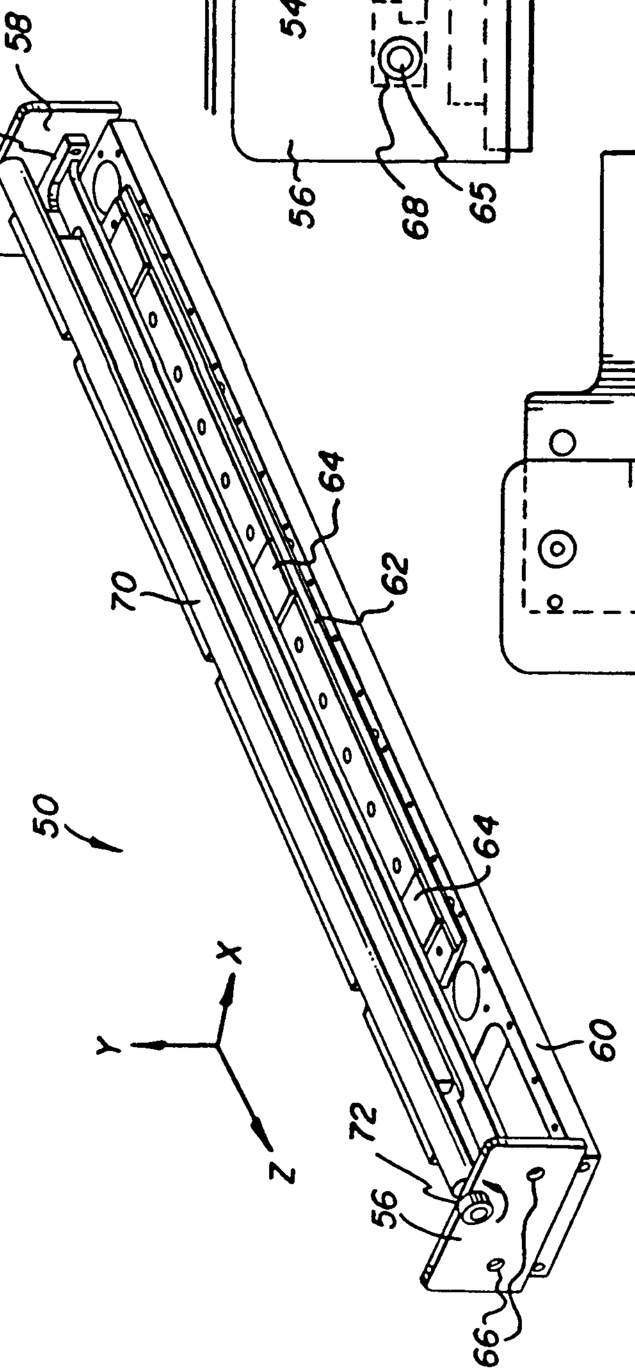

Fig. 2

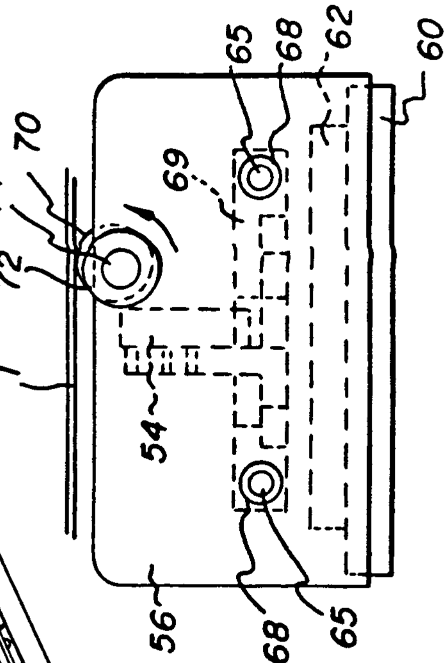

Fig. 3

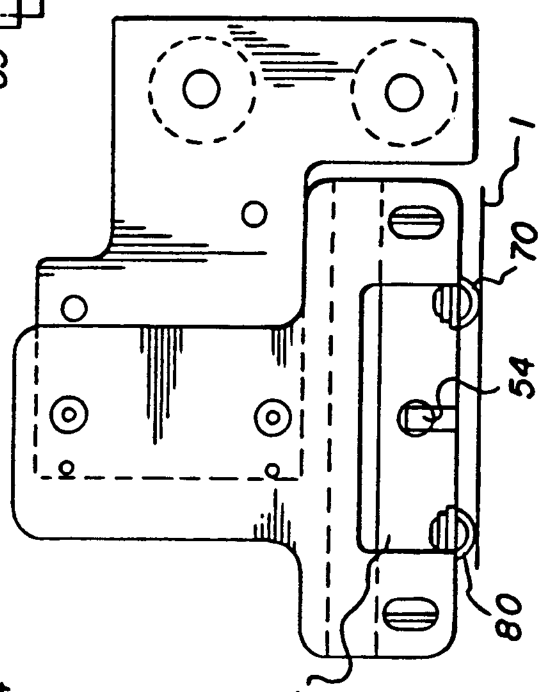

Fig. 4

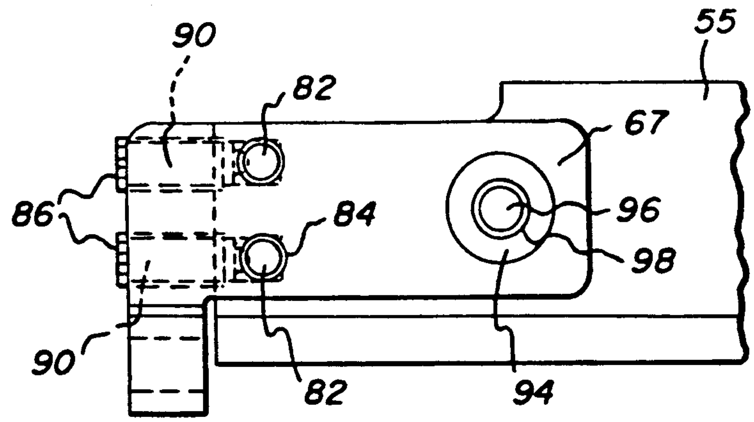

Fig. 5

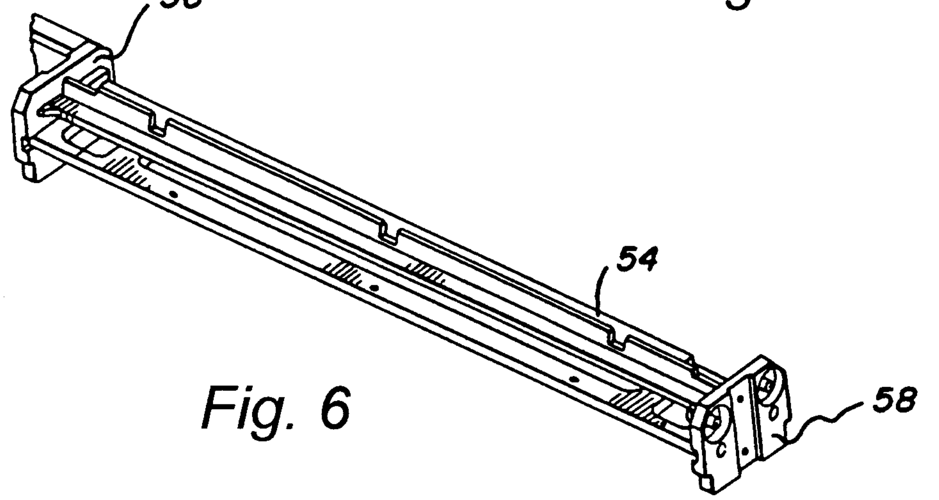

Fig. 6

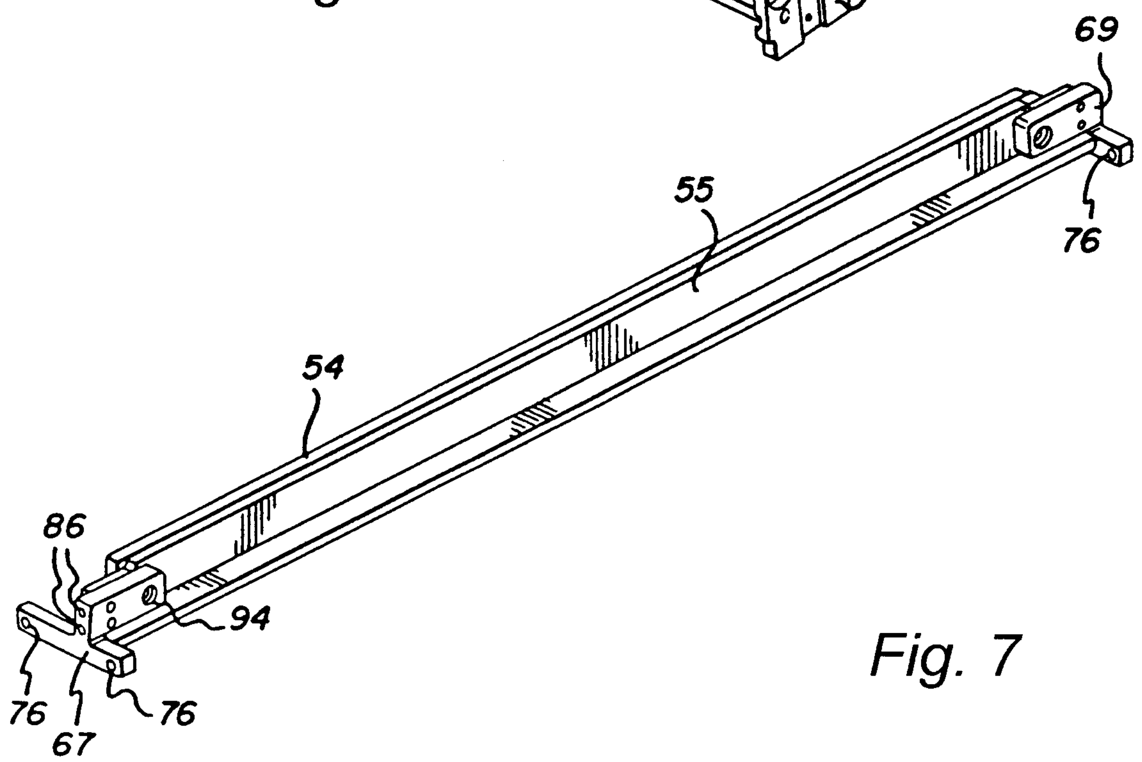

Fig. 7

Fig. 8

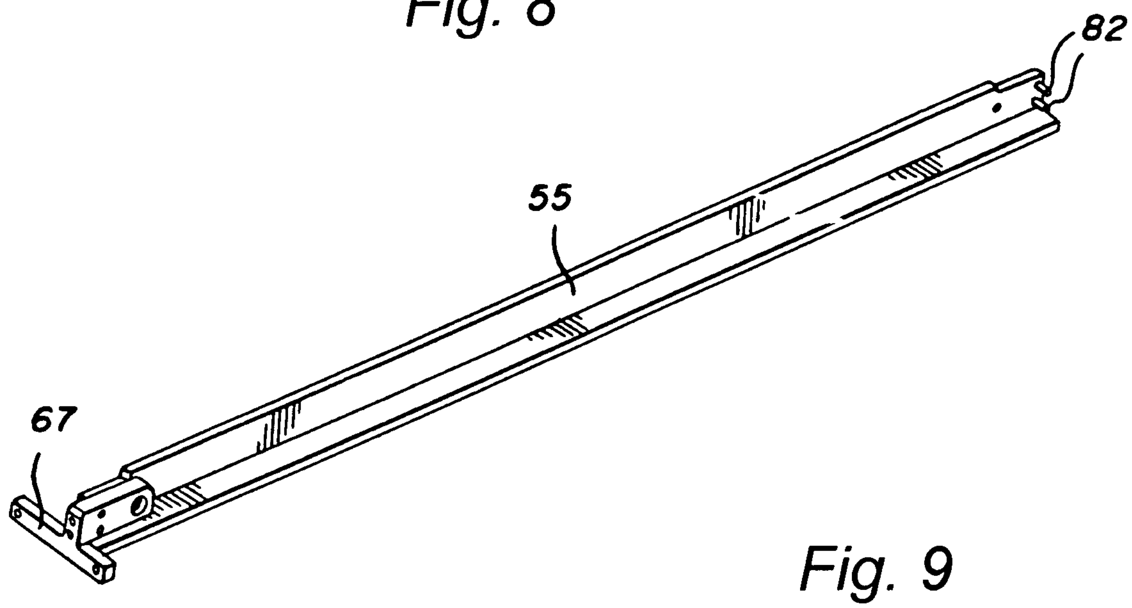

Fig. 9