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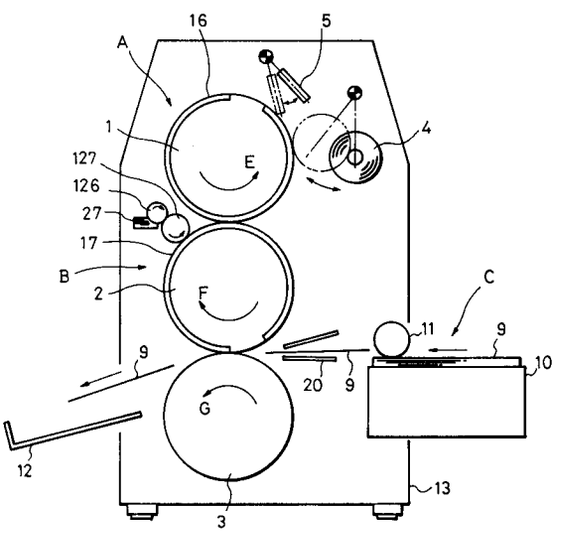
(54) Image recording apparatus and method having an efficient ink supply means.

(57) An image recording apparatus includes a printing plate having an image area and an ink supply device for supplying ink to the printing plate. The ink is supplied within a range almost corresponding to the image area by the ink supply device.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image recording apparatus using a printing plate, and to an image recording method for use in the apparatus.

Description of the Related Art

In desktop publishing (DTP) which has recently attracted attention, various kinds of image recording apparatuses are used as output means. Typical image recording apparatuses are, for example, a thermal transfer printer, an impact printer, a laser beam printer, a mimeograph printer, an offset printer and so on. For example, Japanese Laid-open Patent No. Sho 64-20138 discloses a plate-making device which uses a mimeograph obtained by forming holes through a stencil by a thermal head.

In the case of a medium scale printing system in an office, the thermal printer, the impact printer and the laser printer each are not so suited for DTP with regard to printing speed, the maximum number of prints and running cost, while the mimeograph printer has a problem in image quality.

Therefore, only the offset printer can achieve high-speed printing, many prints, low running cost and high quality which the medium scale printing system like the DTP needs. However, In the case of the offset printer, a plurality of inking rollers are necessary in order to control the thickness of an ink layer, thereby complicating the construction of the printer, and furthermore, a special operator is also necessary. Thus, it is difficult to say that the offset printer is suitable as an output means in DTP.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an image recording apparatus which has a simple construction and can obtain a minute image with little fog, and an image recording method for use in the apparatus.

An image recording apparatus of the present invention comprises a printing plate having an image area defining an image to be recorded and an ink supply means for supplying ink to the printing plate. The ink is supplied to an area of the printing plate having a size and shape substantially corresponding to a size and shape of the image area by the ink supply means.

An image recording method of the present invention records by transferring ink onto a recording material by a printing plate having an image area. The ink is supplied to an area of the printing plate having a size and shape substantially corresponding to a size and shape of the image area.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view of an image recording apparatus according to an embodiment of the present invention;

Fig. 2 is a sectional side view of an ink supply means incorporated in the image recording apparatus shown in Fig. 1;

Fig. 3 is a sectional front view of the ink supply means shown in Fig. 2;

Fig. 4 is a cross-sectional view of another ink supply means;

Fig. 5 is a plan view showing the positional relationship between an image pattern of a printing plate and supplied ink;

Fig. 6 is a cross-sectional view of an image recording apparatus according to another embodiment of the present invention;

Fig. 7 is a perspective view of the printing plate used in the present invention;

Figs. 8(A) and 8(B) are side views explaining the behavior of conductive ink used in the present invention; and

Fig. 9 is a side view of an image recording apparatus according to still another embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows an image recording apparatus for carrying out an image recording method of the present invention. The image recording apparatus is mainly constituted by an ink supply station A, a recording station B and a sheet feed station C.

The ink supply station A has an ink supply means 1 for supplying ink to a printing plate 17 and a piercing or hole forming device 5.

The ink supply means 1 is in the shape of a cylinder having a diameter of, for example, 60~100mm, and, as shown in Figs. 2 and 3, formed with a meshed outer wall 24 made of metal or resin, ring end portions 21 and 22 fixed to both ends of the outer wall 24, and flanges 121 and 122 fitted in the ring end portions 21 and 22. The flanges 121 and 122 which have supporting shafts 121a and 122a for supporting the ink supply means 1 in a housing 13 in their respective centers, are fixed to the housing 13, and the ring end portions 21 and 22 and the outer wall 24 are rotatably supported on the flanges 121 and 122.

A cylinder 30 disposed inside the ink supply means 1 is fixed to one of the flanges 121, and a piston 15 is mounted slidably on the inside of the cylinder 30, and moved by a rod 115 fixed to the piston 15. The rod 115 penetrates through the

center of the flange 121 so as to be connected to an unillustrated driving means.

Ink 14 is filled between the outer wall 24 and the cylinder 30 and in a part inside the cylinder 30, and supplied with the force in the direction from the outer wall 24 outward in response to the movement of the piston 15 in the direction of the arrow D.

As the ink 14, well-known printing inks each containing at least one of a die, pigment, oil, resin, solvent, plasticizer and so on can be used. The oil contained in the ink 14 is, for example, a vegetable oil, an artificial oil or a mineral oil. As the resin, a natural resin, such as rosin or shellac, and a phenol or ketone composite resin can be used. It is preferable that the solvent have appropriate dissolving and diluting powers with respect to the resin contained in the ink and a desired evaporation rate, and can endow necessary viscosity and fluidity to the whole ink. Such a solvent is, for example, an aliphatic hydrocarbon such as n-hexane, an aromatic hydrocarbon such as cyclohexane and toluene, an ester such as methyl acetate and ethyl acetate, an alcohol such as methyl alcohol and ethyl alcohol, a ketone such as acetone and methyl ethyl ketone, a glycol such as ethylene glycol, propylene glycol and dipropylene glycol, a glycolic ether, a glycolic ether ester, and so on. As the plasticizer which applies flexibility and cold resistance to a dry film of the ink, a phthalic ester such as dibutyl phthalate and dioctyl phthalate, an ester such as adipic acid and citric acid, paraffin chloride, castor oil, an epoxy plasticizer, a polyester plasticizer, and so on are available. The pigment is, for example, an inorganic or organic pigment such as titanium oxide, carbon black, bronze powder, diazo yellow or copper phthalocyanine blue.

Furthermore, the ink 14 may be a conductive ink described below.

An ink pass sheet 16 is detachably wound around the outer wall 24, and formed with holes easily formed by the heat of a thermal head or laser or the mechanical pressure of a pin. The ink pass sheet 16 is obtained by, for example, meshing a heat-resistant resin (for example, a polyester resin or a nylon resin) and impregnating the meshed resin with a heat-fusible wax or the like. Furthermore, the ink pass sheet 16 may be polyethylene terephthalate, paper, or metallic foil.

A preferable thickness of the ink pass sheet 16 is approximately 10~100μm.

Referring to Fig. 1, the ink pass sheet 16 is supplied from a sheet roll 4 onto the outer periphery of the ink supply means 1 on demand. The sheet roll 4 comes into contact with the ink supply means 1 only when supplying the ink pass sheet 16 therefrom, and the ink pass sheet 16 is wound around the ink supply means 1 in correlation to the rotation of the ink supply means 1, and fixed to the outer periphery of the outer wall 24 by a fixing means 124 (shown in Fig. 3).

The piercing or hole forming device 5 is located near the ink supply means 1 so as to form holes through the ink pass sheet 16 with heat, mechanical pressure or the like. The ink 14 contained in the ink supply means 1 is, as described in detail below, supplied to the printing plate 17 through the holes formed in the ink pass sheet 16.

A thermal head used as the hole forming device 5 is of a well-known type which is ordinarily used in the conventional thermal transfer recording method, and has a plurality of heating elements for heating according to image signals on a substrate.

An ink extruding means 23 is disposed near the contact point of the ink supply means 1 and the plate 17, as necessity requires, so that the ink 14 is easily supplied to the plate 17 through the holes. The ink extruding means 23 is attached to the flanges 121 and 122 in contact with the inside of the outer wall 24 inside the ink supply means 1, and always located near a position where the ink supply means 1 and the plate 17 are in contact with each other even if the ring end portions 21 and 22 and the outer wall 24 rotate.

The ink extruding means may be a roller 23 shown in Fig. 3, or a blade 25 shown in Fig. 4.

As shown in Fig. 1, recording onto a recording material 9, such as a paper or resin sheet, is performed at the recording station B with the ink 14 supplied from the ink supply station A. The recording station B includes a rotatable plate cylinder 2, the printing plate 17 wound around the plate cylinder 2, and an impression cylinder 3 for pressing the recording material 9 against the plate 17.

The plate cylinder 2, the printing plate 17 and the impression cylinder 3 each may be of a well-known type in printing technology. For example, the plate cylinder 2 and the impression cylinder 3 may be made of metal, such as aluminium or stainless steel. A preferable diameter of the plate cylinder 2 and the impression cylinder 3 is 60~100mm. Although the printing plate 17 may be of a lithography, letterpress or gravure type, the lithography type plate is most effective in the present invention. Furthermore, if a conductive ink described below is used, a plate whose image pattern is composed of a conductive portion and an insulating portion is used.

A lithographic plate which forms an image pattern having a hydrophilic portion and a lipophilic portion is used in the embodiment shown in Fig. 1. Therefore, damping water 27 is supplied onto the lithographic plate 17 through rollers 126 and 127.

Although an ink image on the plate 17 is directly transferred and recorded onto the recording material 9 in Fig. 1, it may be transferred onto a

blanket cylinder disposed between the plate cylinder 2 and the impression cylinder 3, and then recorded on the recording material 9.

The sheet feeding station C includes a stacker 10 containing the recording material 9, a guide 20 for transporting the recording material 9, and a tray 12 for containing the recording material 9 after recording. The recording material 9 in the stacker 10 is fed out by a timing roller 11 in correlation to the rotation of the plate cylinder 2. The recording material 9 fed from the stacker 10 is sent between the plate 17 and the impression cylinder 3 through the guide 20, thereby performing recording on the recording material 9.

In the present invention, the ink 14 is supplied from the ink supply means 1 within a range almost corresponding to an image area of the plate 17 (an area of the plate 17 to which the ink adheres) by the contact of the ink supply means 1 and the plate 17. As shown in Fig. 5, the ink 14 is supplied as dots to an area almost corresponding to an image area 17a of the plate 17. Therefore, the ink pass sheet 16 wound around the ink supply means 1 is formed with dot-like piercing holes corresponding to the image area 17a of the plate 17. Furthermore, the image area 17a and the portion of the ink pass sheet 16 where piercing holes are formed substantially correspond to each other.

It is preferable that the ink 14 from the ink supply means 1 cover 30~80%, more preferably 40~70%, of the image area 17a immediately after it is supplied onto the image area 17a.

Thus, the ink 14 is supplied onto all image areas of the plate 17 by the rotation of the ink supply means 1 in the direction of the arrow E and the rotation of the plate cylinder 2 in the direction of the arrow F. The ink 14 is transferred onto the recording material 9 passing between the plate 17 and the impression cylinder 3 rotating in the direction of the arrow G, and then, recording is completed.

After the completion of recording, the used ink pass sheet 16 is collected and a new ink pass sheet 16 is wound around the ink supply means 1. Since the ink pass sheet 16 without any piercing holes makes the inside of the ink supply means 1 airtight, it is possible to preserve the ink 14 in the ink supply means 1 for a long time.

The ink 14 may be conductive. If a conductive ink is used, as shown in Fig. 6, a voltage V_1 is applied between the meshed outer wall 24 of the ink supply means 1 and the plate 17. Other construction is the same as that shown in Fig. 1. In this case, the outer wall 24 of the ink supply means 1 is made of a conductive material, such as metal, and the plate 17 is formed with an image pattern having a conductive portion and an insulating portion by forming an image area 17b made of an insulating material on a conductive base 17c made of metal or the like as shown in Fig. 7. Such a plate 17 is formed by, for example, photochemically polymerizing an ultraviolet curing resin in a desired pattern on a copper plate having a thickness of approximately 0.1mm.

The image recording apparatus of the present invention which uses a conductive ink 114 utilizes the phenomenon that, when voltage is applied to the conductive ink through a pair of electrodes, the conductive ink does not adhere to one of the electrodes. This phenomenon will be described in detail with reference to Fig. 8.

The conductive ink 114 is supplied between a pair of electrodes 117 and 118, and a voltage V_1 is applied between the electrodes 117 and 118 (shown in Fig. 8(A)). The electrode 117 has an image pattern composed of conductive portions and insulating portions. In other words, image portions 117b made of insulating materials are formed on the electrode 117.

While the voltage V_1 is applied between the electrodes 117 and 118, the electrodes 117 and 118 are separated (Fig. 8(B)). Then, the ink 114 does not adhere to the conductive portions on the electrode 117, but only to image portions 117b made of insulating materials. As a result, an ink pattern is formed on the electrode 117. On the other hand, the adhesion of the ink 114 does not change on the side of the electrode 118. A preferable voltage V_1 is practically a direct voltage of 3~100V, more preferably, 5~80V. By additionally applying an alternating bias voltage (10~100V) having high frequency (10Hz~100KHz), the image quality can be made even sharper.

Although the electrode 117 is negative and the electrode 118 is positive in Fig. 8, the electrode 117 may be positive and the electrode 118 may be negative according to the characteristics of the ink to be used.

It seems that the conductive ink does not adhere to one of the electrodes when the voltage is applied to the ink since the ink causes electrolysis and generates gas due to the voltage supply, and the gas separates the ink from the electrode. In order to electrolyze the ink so as to generate the gas, a solvent, such as water, methanol, ethanol, glycerine, ethylene glycol or propylene glycol, or a solvent in which an electrolyte, such as sodium chloride or potassium chloride, is dissolved, is contained in the ink. It is preferable that the ink have a low electrical resistance and a volume resistivity less than $10^5\,\Omega\cdot$cm. If the volume resistivity is more than $10^5\,\Omega\cdot$cm, the amount of supplied electricity is decreased, or high voltage is necessary to prevent the amount of electricity from being decreased. It is preferable that 40~95 parts, more particularly, 60~85 parts by weight of the above solvent be

contained in 100 parts by weight of the ink.

As a colorant in the conductive ink, a dye, a pigment or the like which are generally used in printing and recording technology, such as carbon black, can be used without special restriction.

Furthermore, particles of an inorganic compound, such as colloidal silica, titanium oxide or tin oxide, may be added to the conductive ink in order to enhance the printing resistance of the image.

When recording is performed by the image recording apparatus shown in Fig. 6 with the above-mentioned conductive ink 14, as shown in Fig. 8, the conductive ink 14 does not adhere to portions of the plate 17 other than the image portion 17b, thereby obtaining a clearer recorded image.

An image recording apparatus of the present invention shown in Fig. 9 uses a laser, for example, as the piercing or hole forming device. The apparatus optically reads an image pattern of the plate 17 sent to be attached to the plate cylinder 2, and operates the laser as the piercing or hole forming device based on the read information. In other words, the image pattern of the plate 17 sent by transport rollers 32 is read by an illumination device 33, a "SELFOC" lens 34, a light receiving device 28, such as a CCD, and piercing holes are formed on the ink pass sheet 16 by a laser 29, a polygon mirror 31 and an optical device 35, such as an $f \cdot \theta$ lens, based on the image information.

As described above, the present invention has the following advantages:

(1) The thickness of an ink layer on a printing plate can be easily controlled without a plurality of conventional inking rollers, and the construction of the apparatus is simplified.

(2) Since the ink is supplied only to an image pattern of the plate or to the adjacency of the pattern, a minute image with little fog can be obtained.

(3) Since the ink in the apparatus is made airtight by an ink pass sheet, long-term preservation of the ink in the apparatus is possible.

While the present invention has been described with respect to what is currently considered to be the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims to be accorded the broadest interpretations so as to encompass all such modifications and equivalent structures and functions.

An image recording apparatus includes a printing plate having an image area and an ink supply device for supplying ink to the printing plate. The ink is supplied within a range almost corresponding to the image area by the ink supply device.

Claims

1. An image recording apparatus comprising:

a printing plate having an image area defining an image to be recorded; and

ink supply means for supplying ink to said printing plate in an area of said printing plate having a size and shape substantially corresponding to a size and shape of the image area.

2. An image recording apparatus according to claim 1, wherein said ink supply means comprises a cylinder having a meshed outer wall and an ink pass sheet wound around said outer wall, wherein holes are formed in said ink pass sheet in an area having a size and shape substantially corresponding to the size and shape of the image area.

3. An image recording apparatus according to claim 2, further comprising a thermal head for forming the holes.

4. An image recording apparatus according to claim 2, further comprising a pin for forming the holes.

5. An image recording apparatus according to claim 2, further comprising a laser for forming the holes.

6. An image recording apparatus according to claim 5, further comprising means for optically reading image information represented by the image area of said printing plate, wherein said laser is operated based on the read image information.

7. An image recording apparatus according to claim 2, wherein said ink supply means further comprises pressure generating means within said cylinder for generating pressure in the ink in said cylinder.

8. An image recording apparatus according to claim 2, wherein said ink supply means further comprises an ink extruding means within said cylinder for extruding the ink through the holes of said ink pass sheet.

9. An image recording apparatus according to claim 1, wherein said printing plate comprises a lithographic plate having a hydrophilic portion and a lipophilic portion.

10. An image recording apparatus according to claim 1, wherein said printing plate comprises a letterpress plate.

11. An image recording apparatus according to claim 1, wherein said printing plate comprises a gravure plate.

12. An image recording apparatus according to claim 1, wherein the ink comprises a conductive ink, said printing plate comprises a lithographic plate having a conductive portion and an insulating portion, and voltage is applied between said ink supply means and said printing plate.

13. An image recording method using a printing plate having an image area defining an image to be recorded, said method comprising the steps of:

supplying ink onto an area of the printing plate having a sized and shape substantially corresponding to a size and shape of the image area; and

transferring the ink from the printing plate to a recording medium.

14. An image recording method according to claim 13, further comprising the steps of forming holes in an ink pass sheet in an area having a size and shape substantially corresponding to the size and shape of the image area of the printing plate, the ink being supplied through the holes of the ink pass sheet to the image area.

15. An image recording method according to claim 14, wherein the holes are formed with a thermal head.

16. An image recording method according to claim 14, wherein the holes are formed with a pin.

17. An image recording method according to claim 14, wherein the holes are formed with a laser.

18. An image recording method according to claim 17, further comprising the steps of optically reading image information represented by the image area of the printing plate, wherein in said hole forming step the laser is operated based on the read image information.

19. An image recording method according to claim 13, wherein the printing plate comprises a lithographic plate having a hydrophilic portion and a lipophilic portion.

20. An image recording method according to claim 13, wherein the printing plate comprises a letterpress plate.

21. An image recording method according to claim 13, wherein the printing plate comprises a gravure plate.

22. An image recording method according to claim 13, wherein the ink comprises a conductive ink, the printing plate comprises a lithographic plate having a conductive portion and an insulating portion, and further comprising the step of supplying electricity to the conductive ink such that the conductive ink adheres only to the insulating portion of the lithographic plate.

FIG. 1

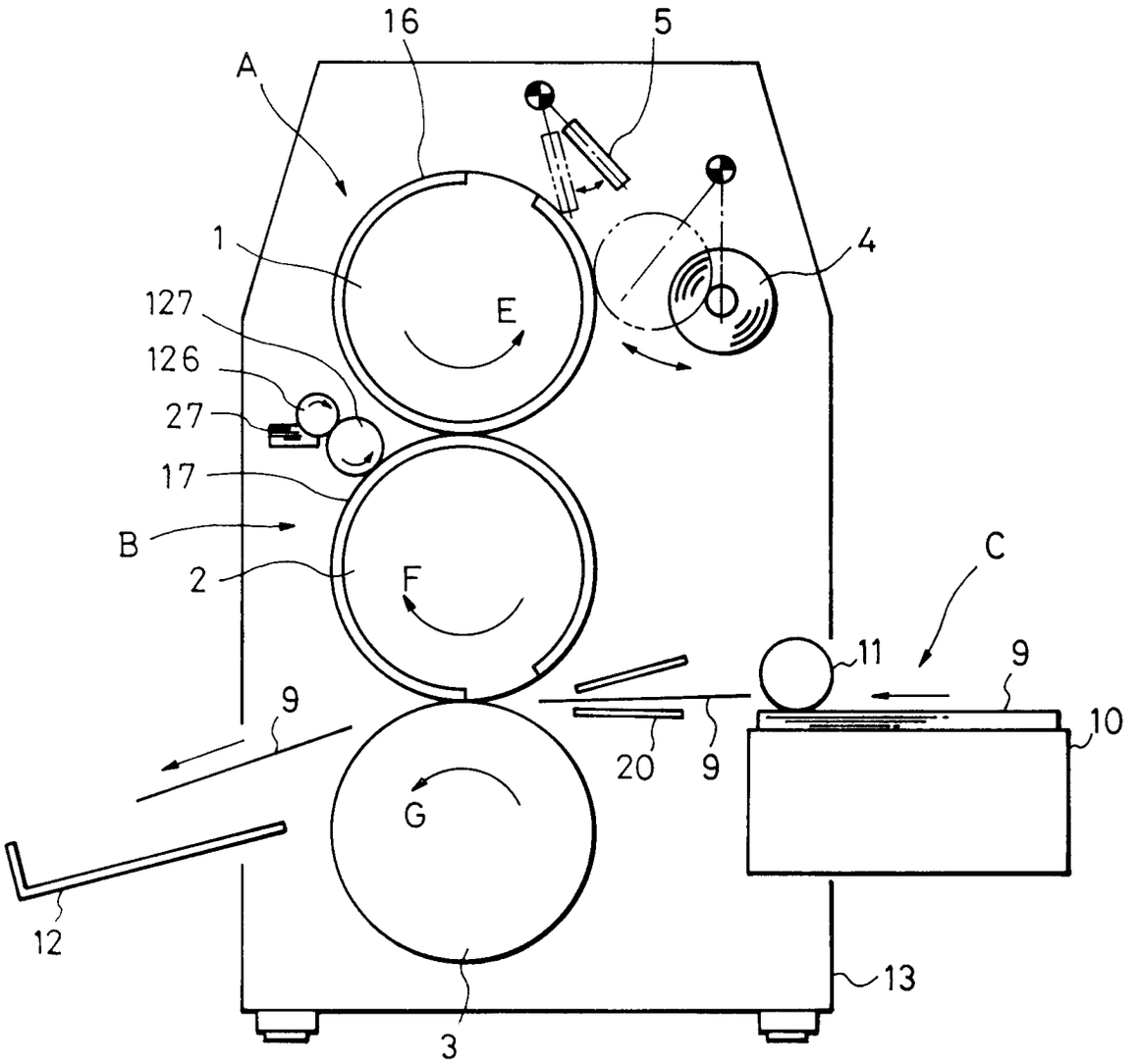

FIG. 2

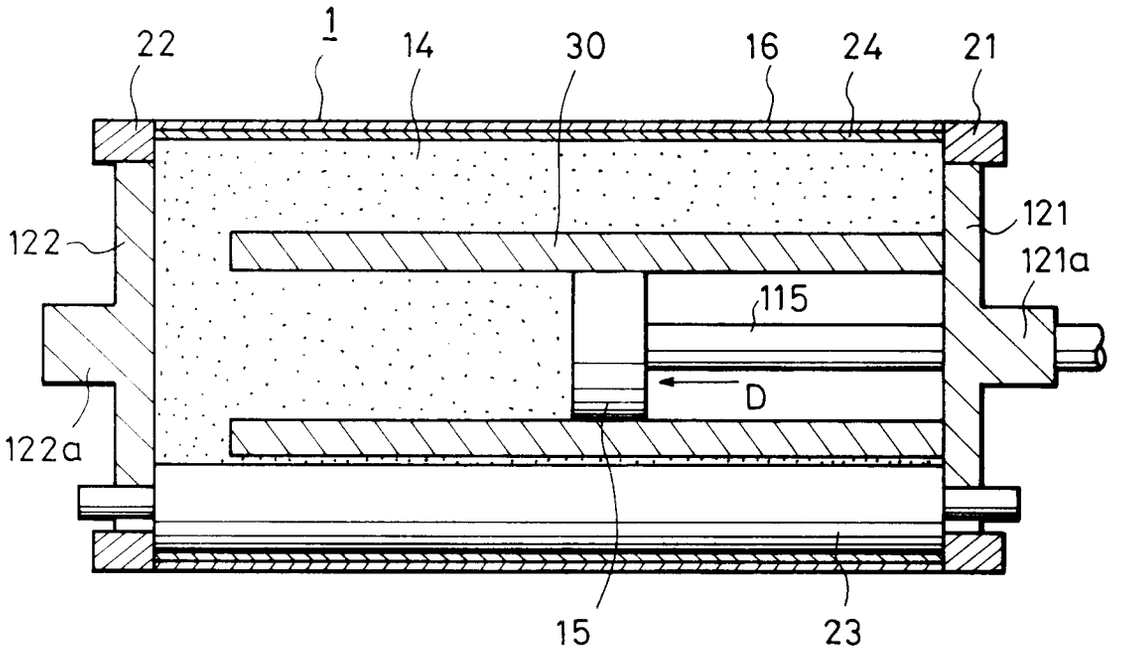
22
1
14
30
16
24
21
121
121a
122
115
D
122a
15
23

FIG. 3

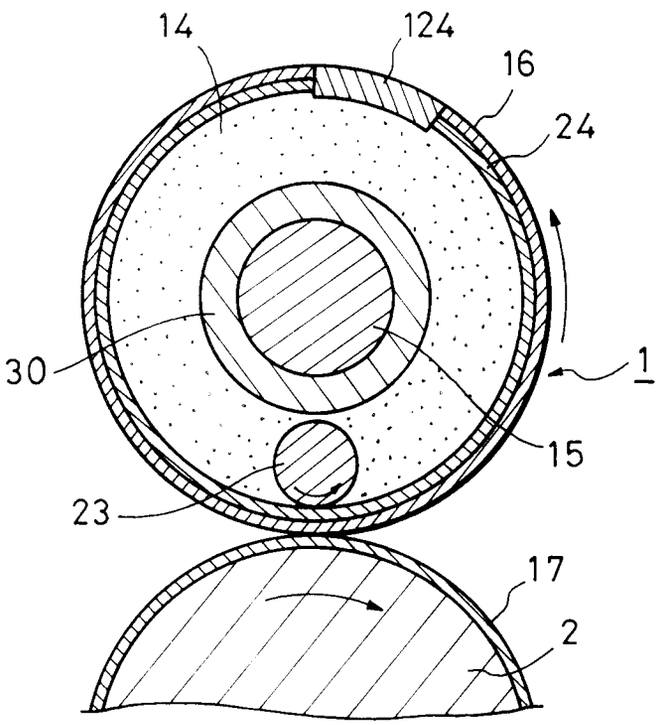
14
124
16
24
30
1
15
23
17
2

FIG. 4

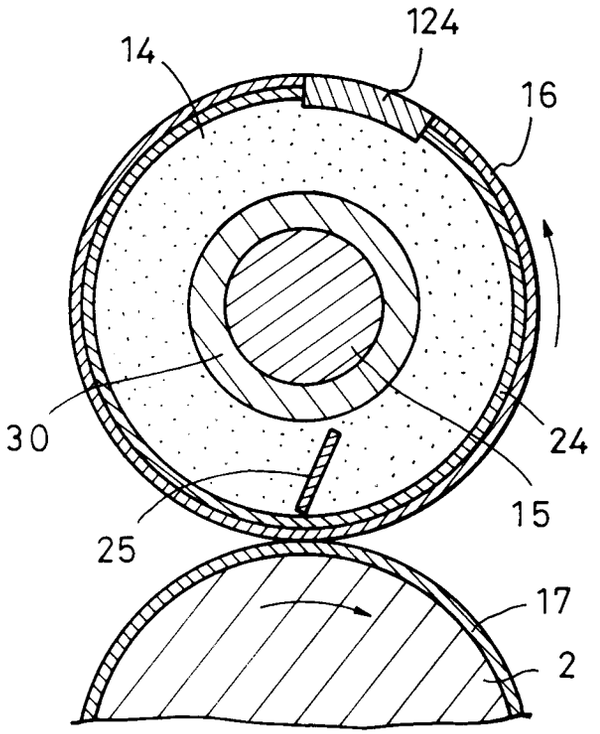

FIG. 5

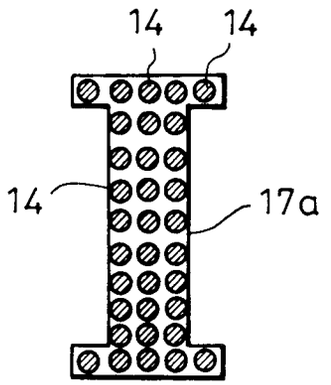

FIG. 6

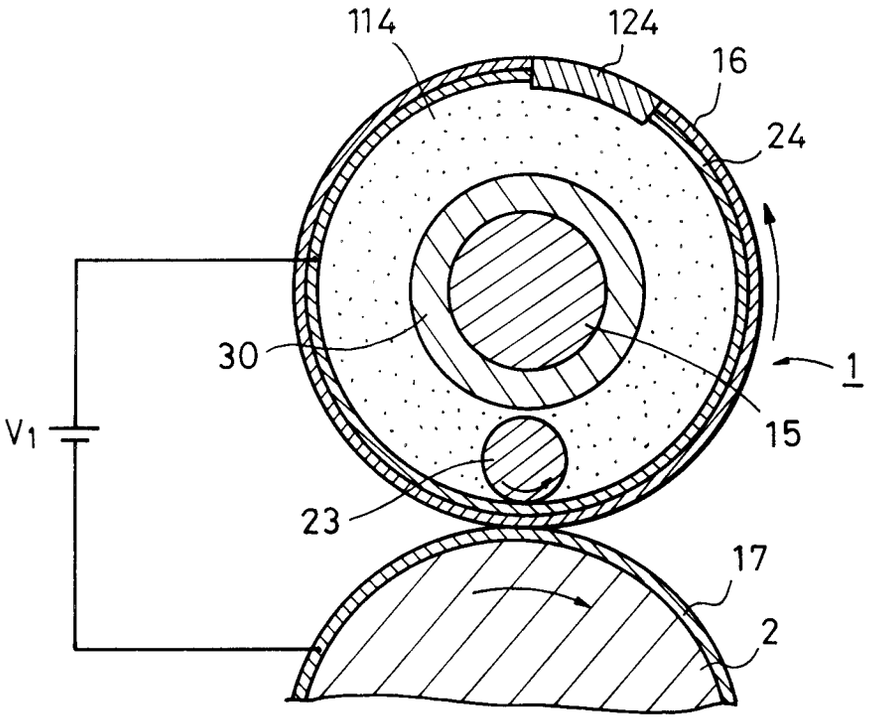

FIG. 7

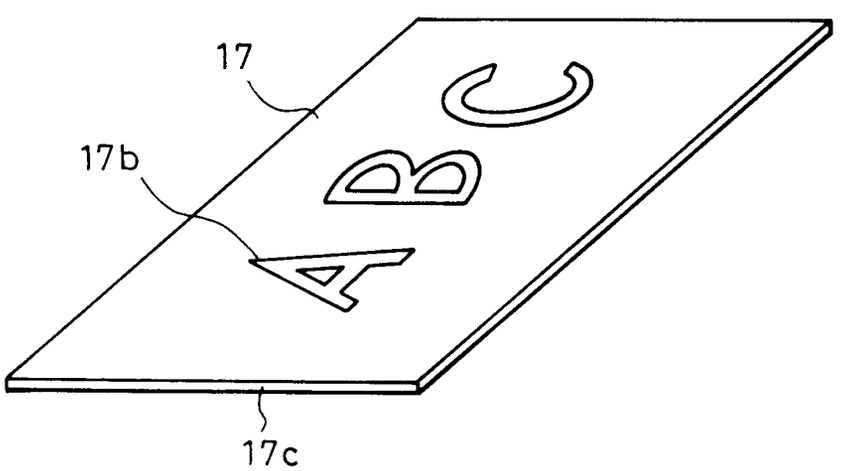

FIG. 8 (A)

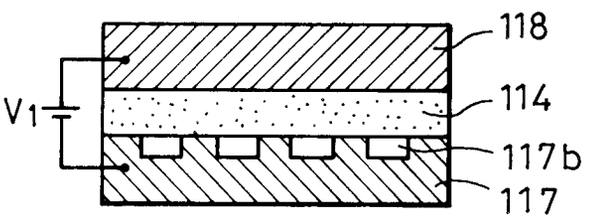

FIG. 8 (B)

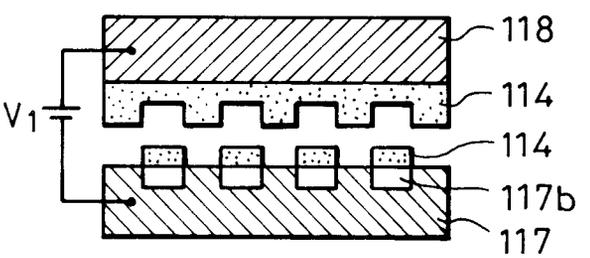

FIG. 9