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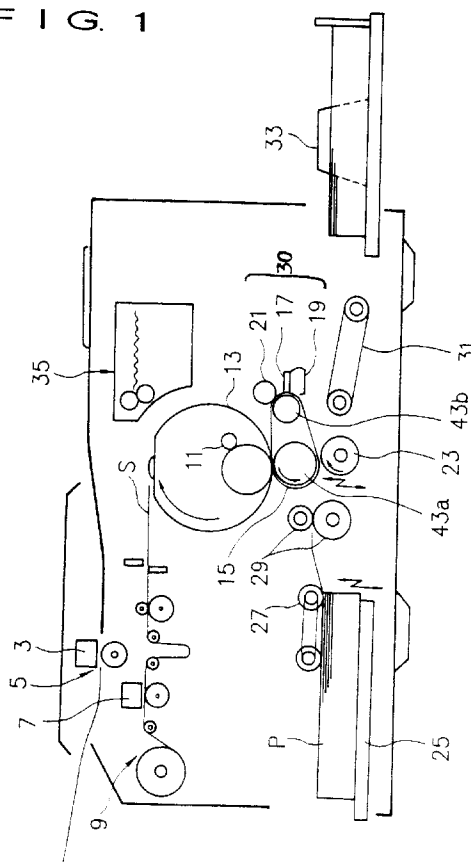
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(57) A transfer printing machine comprises a press-plate drum (13), a transfer body (15), and a press roller (23); the press-plate drum (13), which is rotatable, contains a printing ink feeding means (11) and includes a press-plate (S) on its outer peripheral surface. The transfer body (15) is rotated at a rotational speed different from that of the press-plate drum (13) in the state of being in contact with the press-plate drum for receiving a printing ink image from the press-plate (S) of the press-plate drum, and the press roller (23) is adapted to impress an article (P) to be printed to the image of printing ink image formed on the transfer body (15), thereby printing the image ink on the article (P).

FIG. 1

Description

The present invention relates to a printing machine such as a lithographic printing machine or a stencil printing machine, and particularly to a printing machine which has a size being small enough to be easily installed at a narrow location and which suppresses inconveniences such as set-off, bleeding, and strike-through generated in a printed matter.

Referring to Fig. 7, the structure of a prior art stencil-direct printing machine will be described. A document image reading-out unit 5 has an image scanner 3 for reading-out an image of a document to be printed. A perforating unit 9 has a perforating device 7 for forming a perforated image on a stencil sheet S in accordance with document image data read out by the document reading-out unit 5. The stencil sheet S thus perforated at the perforating unit 9 is wound around the outer peripheral surface of a stencil drum 13. An ink feeder 11 is provided in the stencil drum 13 for feeding ink on the inner peripheral surface of the stencil drum 13. A vertically movable press roller 23 is provided under the stencil drum 13. A paper P to be printed is supplied between the stencil drum 13 and the press roller 23. The press roller 23 carries the paper P while holding it between the stencil drum 13 and the press roller 23, to form an image on the paper P. Papers P on a feed board 25 are fed by a jogger roller 27 one by one, and each paper P is fed between the press roller 23 and the stencil drum 13. The paper P after being printed is separated from the stencil drum 13 by a separating claw 37, and is delivered onto a delivery board 33 through a carrier 31 having a belt conveyor mechanism. After completion of the printing, the stencil sheet S is separated from the stencil drum 13 and is discarded by a stencil discarding unit 35.

In the above-described stencil-direct printing machine using a liquid ink, when papers already printed are stacked directly after printing, there is a fear in causing set-off. The set-off is a phenomenon that ink forming a printing image on the front surface of one paper adheres on the back surface of the next paper. In some cases, there occur other inconveniences such as bleeding and strike-through of printing ink. Here, the strike-through is a phenomenon that ink printed on the front surface of a paper permeates up to the back surface. These inconveniences tend to be generated when a relatively large amount of ink is used for forming a printing image on a paper.

In the above-described stencil-direct printing machine, printing is performed by holding a paper P to be printed between the stencil sheet S of the stencil drum 13 and the press roller 3 and directly transferring ink from the stencil drum 13 to the paper P. In such a direct printing machine, the amount of ink transferred to the paper is varied depending on a surface smoothness and an ink absorbing property of a paper to be printed. Consequently, there arises a problem that a uniform image is difficult to be formed on the paper. Moreover, a printing image formed on the paper is sometimes raised due to spinnability of ink as shown in Fig. 8.

The above-described stencil-direct printing machine has a structure in which a paper P after being printed is separated from the stencil drum 13 using the separating claw 37. In this structure, the separating claw 37 cannot be brought in contact with the stencil drum 13. As a result, the paper P after being printed cannot be certainly separated from the peripheral surface of the stencil drum 13, and in some cases, the paper P whirls up in the state being stuck on the peripheral surface of the rotating stencil drum 13. Also, when the separating claw 37 is brought in contact with a printing image surface of the paper P, particularly, in contact with a printing image surface having a large area of a solid portion of the paper P, a contact trace of the separating claw 37 is liable to remain on the printing image surface. As a result, there occurs a problem that the paper P is difficult to strictly ensure a printing image corresponding to that of a document.

To reduce the inconveniences such as set-off, bleeding and strike-through generated on a paper to be printed in the above-described direct printing, there have been proposed various techniques for suppressing the amount of ink for forming a printing image as much as possible. One of these techniques is the well-known offset printing method which is of an indirect printing type. The offset printing method is characterized in that a transfer drum is provided near a stencil drum, and ink in the minimum amount is transferred from the stencil drum to the transfer drum for printing a paper. Accordingly, this method makes it possible to suppress the generation of set-off, bleeding and strike-through.

The inconveniences such as set-off tend to be generated, particularly, for stencil printing which requires a relatively large amount (thickness) of ink forming a printing image on a paper to be printed. This is because stencil printing is generally of a direct-printing type. In the case where direct-printing is performed for a paper to be printed, the amount of ink forming a printing image is varied depending on the surface condition of the paper, thus largely generating set-off, bleeding, and strike-through.

To solve the problems such as set-off generated in the stencil-direct printing method, a stencil-indirect printing method has been proposed, for example in Japanese Patent Laid-open No. Hei 5-31889.

Referring to Fig. 9, the structure of the above stencil-direct printing machine will be described. In this figure, parts corresponding to those shown in Fig. 7 are designated by the same characters, and the explanation thereof is omitted. A transfer drum 15 is provided under a stencil drum 13. The transfer drum 15 is the same as the stencil drum 13 in outside diameter and rotational speed. The transfer drum 15 is brought in contact with the stencil drum 13. At this time, a stencil image of ink is transferred from the stencil drum 13 to the peripheral surface of the transfer drum 15. An press roller 23 impresses a paper P to be printed against the transfer drum 15, so that the stencil image of ink on the transfer

drum 15 is transferred on the paper P. The paper P is thus printed.

In the prior art indirect printing method, however, as seen in the above-described stencil-indirect printing machine, the transfer drum is set to be equal in size (outside diameter) and in rotating speed to the stencil drum. As a result, the size of the entire printing machine is enlarged, leading to another problem in that the printing machine cannot be miniaturized.

In the above-described indirect printing method, the transfer drum is equal in rotational speed to the stencil drum, and accordingly, upon continuous printing, the same printing image is transferred at the same position on the transfer drum every time. This is advantageous in eliminating the necessity of cleaning the peripheral surface of the transfer drum for every rotation of the transfer drum and in only removing ink remaining on the peripheral surface of the transfer drum after completion of printing. However, the transfer drum is generally formed of a rubber member being difficult to be cleaned, and thereby a large scale of an ink removing device is necessary for removing and cleaning an excessive ink on the transfer drum. Consequently, there occurs a new problem that the printing machine is enlarged in size by the presence of the ink removing device.

In such circumstances, the offset printing machine of an indirect-printing type has been not installed in a common office but employed by specialized markers. For the same reason, the stencil-indirect printing machine has been not commonly used.

A method has been disclosed for suppressing the inconveniences such as set-off, bleeding and strike-through, particularly, for reducing set-off. In this method, ink transferred on a paper to be printed is dried by means of heat or hot air using a halogen lamp, heater, heat roller or the like. In this method, however, a large sized drier is required for perfectly drying ink transferred on a paper to be printed, and the printing machine is further enlarged in size by mounting such a large size drier.

In the direct-printing method, when a hard paper is printed, there is a fear that the durability (printing resistance) of a press-plate (stencil, in the case of stencil printing) is deteriorated. Moreover, in this method, since an impression force applied from an press roller to a press-plate drum (stencil drum, in the case of stencil printing) is increased for directly transferring ink onto the paper, resulting in the increased noise. In view of these problems, the indirect-printing method seems to be more effective; however, as described, the indirect-printing method has the disadvantage that the size is enlarged by provision of a transfer drum. In other words, the indirect-printing method is required to solve such a disadvantage in order to be adopted as an effective printing means.

An object of the present invention is to provide an indirect printing machine capable of obtaining a printed matter being less in set-off, bleeding and strike-through, being excellent in durability and noise reduction of a press-plate, and also being reduced in size and excellent in handling.

According to the first aspect of the invention, there is provided a transfer printing machine comprising:

a press-plate drum containing a printing ink feeding means and including a press-plate on the outer peripheral surface, the press-plate drum being rotatable;

a transfer body which is rotated at a rotational speed different from that of the press-plate drum in the state being in contact with the press-plate drum for receiving an image of printing ink from the press-plate of the press-plate drum; and

an press roller for impressing a matter to be printed to an image of printing ink formed on the transfer body, thereby forming the image of printing ink on the matter to be printed.

According to the second aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the first aspect, wherein the transfer body comprises:

a plurality of rollers; and

an endless belt hung between a plurality of the rollers, which endless belt is rotated at a rotational speed different from that of the press-plate drum in the state being in contact with the press-plate drum for receiving an image of printing ink from the press-plate of the press-plate drum.

According to the third aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the second aspect, further comprising an excessive ink removing means for removing excessive part of printing ink transferred from the press-plate drum to the endless belt of the transfer body, the excessive part of printing ink being not transferred on the matter to be printed and remaining on the endless belt.

According to the fourth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the third aspect, wherein the excessive ink removing means comprises:

a cleaning means for removing, from the endless belt, an excessive part of printing ink transferred from the press-plate drum to the endless belt of the transfer body, the excessive part of printing ink being not transferred on the

matter to be printed:

a containing means for containing an excessive part of printing ink removed by the cleaning means; and
a coating means for coating the surface of the transfer body with an excessive ink removing liquid.

According to the fifth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the fourth aspect, wherein the endless belt of the transfer body is made of a material having a repellency against the printing ink.

According to the sixth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the fifth aspect, wherein the press-plate is one kind selected from a group consisting of an intaglio, a letterpress, a lithography, and a stencil.

According to the seventh aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the first aspect, wherein the transfer body comprises a transfer drum which is rotated at a rotational speed different from that of the press-plate drum in the state being in contact with the press-plate drum for receiving an image of printing ink on the outer peripheral surface from the press-plate of the press-plate drum.

According to the eighth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the seventh aspect, further comprising an excessive ink removing means for removing excessive part of printing ink transferred from the press-plate drum to the outer peripheral surface of the transfer drum, the excessive part of printing ink being not transferred on the matter to be printed and remaining on the transfer drum.

According to the ninth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the eighth aspect, wherein the excessive ink removing means comprises:

a cleaning means for removing, from the transfer drum, an excessive part of printing ink transferred from the press-plate drum to the outer peripheral surface of the transfer body, the excessive part of printing ink being not transferred on the matter to be printed;

a containing means for containing an excessive part of printing ink removed by the cleaning means; and
a coating means for coating the surface of the transfer drum with an excessive ink removing liquid.

According to the tenth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the ninth aspect, wherein at least the outer peripheral surface of the transfer drum is made of a material having a repellency against the printing ink.

According to the eleventh aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the tenth aspect, wherein the press-plate is one kind selected from a group consisting of an intaglio, a letterpress, a lithography, and a stencil.

According to the twelfth aspect of the present invention, there is provided a transfer printing machine defined in the invention described in the first aspect, further comprising a press-plate making unit for making a positive press-plate.

The function of the present invention will be described below.

As a press-plate provided on a press-plate drum of the printing machine of the present invention, either of an intaglio, a letterpress, a lithography, and a stencil can be used. A line image portion and a non-line image portion, which constitute a stencil image, are formed on the press-plate. The stencil image of ink formed on the press-plate drum is transferred on a transfer body rotated in the state being in contact with the press-plate drum, before being transferred on a matter to be printed.

A matter to be printed is fed between the transfer body transferred with ink and an press roller, and is carried while being held between the transfer body and the press roller. The ink on the transfer body is applied with a pressure by the press roller, and is transferred on the matter to be printed which is pressed on the transfer body. A printing image is thus formed on the matter to be printed.

The rotational speed of the transfer body is different from that of the press-plate drum, and thereby a printing image transferred on the transfer body is varied in position for each rotation. After transfer of ink on the matter to be printed from the transfer body, excessive ink not transferred on the matter to be printed is removed from the transfer body by an excessive ink removing means. An excessive ink removing liquid is applied on the transfer body at a specified portion stuck with ink by a coating means of the excessive ink removing means. Of the ink transferred from the press-plate drum to the transfer body, the remaining part of the ink on the transfer body after printing on the matter to be printed is thus perfectly collected by a cleaning means, to be recovered in a containing unit.

At least a portion, being contact with ink, of the transfer body may be formed of a material having a repellency against ink for accelerating the removal of ink remaining on the transfer body by the ink removing means.

Embodiments of the present invention will now be described in more detail by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a view of a first embodiment of a transfer printing machine of the present invention;

Fig. 2 is an enlarged view of a transfer body and the neighborhood of the printing machine shown in Fig. 1;

Fig. 3 is a table showing results of evaluation for a stencil printing machine according to the first embodiment as compared with a prior art stencil printing machine in terms of items 1 to 5;

Fig. 4 is a view of another embodiment of the transfer printing machine of the present invention;

Fig. 5 is an enlarged view of a transfer body and the neighborhood of the printing machine shown in Fig. 4;

Fig. 6 is a table showing results of evaluation for a stencil printing machine according to the second embodiment as compared with a prior art stencil printing machine in terms of items 1 to 6;

Fig. 7 is a sectional view of a prior art stencil printing machine;

Fig. 8 is an enlarged view of a press roller and the neighborhood of the prior art stencil printing machine shown in Fig. 7; and

Fig. 8 is a sectional view of a prior art transfer type stencil printing machine.

Fig. 1 is a view of a first embodiment of a transfer printing machine of the present invention. This machine is of a stencil printing type, and therefore, parts corresponding to those in the prior art stencil printing machine shown in Fig. 7 are designated by the same characters.

The stencil printing machine in this embodiment includes: a document image reading-out unit 5 having an image scanner 3 for reading-out an image of a document to be printed; a perforating unit 8 having a perforating device 7 for copying a perforated image on a stencil sheet S in accordance with image data read out by the document reading-out unit 5; and a stencil drum 13 containing an ink feeder 11 and mounting the stencil sheet S perforated by the perforating unit 9 in such a manner that the stencil sheet S is wound around the outer peripheral surface.

It should be noted that a press-plate formed with an image and wound around a press-plate drum is represented by the stencil in this embodiment; however, it may be further selected from a group consisting of an intaglio, a letterpress, and a lithography.

On the press-plate, a line image portion and a non-line image portion for forming a press-plate image corresponding to an image of a document are formed.

A transfer body 15 is provided, to which printing ink is transferred from the stencil drum 13 before printing a paper to be printed. The transfer body 15 is provided with a cleaning unit 17 for cleaning the transfer body 15.

A recover dish 19 is provided for recovering the excessive part of printing ink collected by the cleaning unit 17. An excessive ink removing liquid is applied on the transfer body 15 by a coater 21. A press roller 23 is provided at a position facing to the transfer body 15 for impressing the transfer body 15.

Papers P to be printed are fed from a feed board 25, and are jogged one by one by a jogger roller 27. The paper P is then fed between the transfer body 15 and the press roller 23 by a paper feed timing roller 29. The paper P is printed and is delivered onto a delivery board 33 by a delivering carrier 31 having a belt conveyor mechanism.

After completion of the printing, the stencil sheet S is separated from the stencil drum 13, to be discarded by a stencil discarding unit 35.

In this stencil printing machine, the stencil sheet S is formed with a positive image relative to an image of a document by the perforating unit 9. The stencil sheet S is mounted around the stencil drum 13, and is shifted to the printing action.

The stencil drum 13 is rotated around its center axis clockwise in the figure by means of a rotating means (not shown), and the transfer body 15 being in contact with the stencil drum 13 is rotated counterclockwise.

The paper feed timing roller 29 feeds the paper P between the transfer body 15 and the press roller 23 at a predetermined timing synchronized with the rotation of the transfer body 15 (in the figure, the paper P is fed from the left to the right). The press roller 23 presses the paper P on the transfer body 15. A reversed printing image formed on the transfer body 15 is transferred on the paper P. The stencil printing is thus performed.

The paper P thus printed is fed to the delivery board 33 by means of the delivering carrier 31 in such a manner that the surface having the positive printing image is directed upward.

Fig. 2 is an enlarged view of the transfer body of the printing machine.

As shown in Fig. 2, the transfer body 15 includes a plurality of rollers 43a, 43b, and an endless belt 42 hung between the rollers 43a, 43a. The rollers 43a, 43a, each having a diameter smaller than that of the stencil drum 13, are disposed substantially in the horizontal direction in such a manner as to be spaced from each other at a specified interval. The endless belt 42 extends substantially in the horizontal direction where the rollers 43a, 43a are disposed, so that the vertical size of the printing machine can be reduced.

A printing ink K transferred on the endless belt 42 from the stencil drum 13 is transferred on the paper P which is fed at a specified speed between the transfer body 15 and the press roller 23 by the paper feed timing roller 29. The feed speed of the paper P by the paper feed timing roller 29 corresponds to the carrying speed of the endless belt 42.

In the example shown in the figure, since the length of the endless belt 42 is shorter than the peripheral length of the stencil drum 13, the rotational speed of the rollers 43a, 43a is higher than that of the stencil drum 13. Such a relationship of the rotational speed is determined by the length of the endless belt 42 relative to the peripheral length of the stencil drum 13. As the length of the endless belt 42 comes near the peripheral length of the stencil drum 13,

the rotational speed of the endless belt 42 comes near that of the stencil drum 13.

The endless belt 42 constituting the transfer body 15 may be suitably changed in length and arrangement, other than the case shown in the figure, by disposing a plurality of the rollers 43a, 43a in different empty spaces of the printing machine, thus miniaturizing the printing machine.

In this way, the rotational speed of the endless belt 42 is different from that of the stencil drum 13, so that after the printing ink K is transferred on the paper P, excessive part Kn of printing ink not transferred on the paper P must be perfectly removed. This is because, at the second rotation of the endless belt 42, a printing image is formed on the endless belt 42 at a position different from that of the printing image formed at the first rotation of the endless belt 42.

The excessive part Kn of printing ink not transferred on the paper P is perfectly scraped by a cleaning member 17 of an excessive ink removing means 30 slidably contacted with part of the endless belt 42.

The excessive part Kn of printing ink scraped by the cleaning member 17 is collected in a containing unit 19 disposed under the cleaning member 17.

To perfectly scrape the excessive part Kn of printing ink from the transfer body 15, an excessive ink removing liquid may be applied on the endless belt 42 of the transfer body 15.

Such a cleaning member 17 may be formed in a blade-like shape. In the case where the excessive part Kn of printing ink is small, it may be formed of non-woven fabric, woven fabric or an ink absorbing paper. When the amount of the excessive ink removing liquid is automatically controlled, the coater 21 for coating the endless belt 42 with the excessive ink removing liquid may be mounted at a position rearward of the cleaning member 17 relative to the rotational direction of the endless belt 42. On the other hand, when the liquid amount is not automatically controlled, it may be controlled by the cleaning member 17, and accordingly, the coater 21 can be mounted forward of the cleaning member 17.

The excessive ink removing liquid has a property being insoluble to a printing ink K used for the printing machine and being lower in surface tension than the printing ink K. Specific examples of the excessive ink removing liquids include a dimethyl silicone oil; modified silicone oils modified by phenyl, polyether, fluorine, amino, epoxy, carboxyl, carbinol, methacryl, mercapto and phenol groups; and a water solution added with a surface active agent, an organic solvent and the like.

The surface active agent to be added to water may be selected from anion, cation and ampholytic surface active agents, and a nonionic surface active agent.

The organic solvent to be added to water is required to be soluble to water. Specific examples of the organic solvents include methanol, ethanol, isopropyl alcohol, n-propyl alcohol, ethylene glycol and glycerol.

The surface layer of the endless belt 42 constituting the transfer body shown in Fig. 2 is made of a material having a repellency against a printing ink K used for the printing machine.

In accordance with the kind of a printing ink K used for the printing machine, the above ink-repellent material may be suitably selected from tetrafluoroethylene (PTFT), tetrafluoroethylene-hexafluoropropylene copolymer (FEP), tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA) and the like. The thickness of the surface layer of the endless belt 42 may be suitably thinned for making the best use of the property of an elastic member constituting the inner layer of the endless belt 42. The inner layer is made of a rubber material as an elastic material and/or a metal material.

Since the endless belt 42 of the transfer body 15 is formed, as described above, of the material having a uniform surface smoothness and an excellent ink absorbing property, the printing ink K is allowed to remain on the surface of the endless belt 42 without excessive spinnability.

The paper P to be printed is impressed on the endless belt 42 using the press roller 23 so that the printing ink K on the surface of the endless belt 42 is transferred on the paper P. In the case where the transfer body 15 is made of an elastic material, the press roller 23 is made of a non-elastic material. On the other hand, in the case where the transfer body 15 is made of a non-elastic material, the press roller 23 is made of an elastic material.

Since either the transfer body 15 or the press roller 23 is made of an elastic material and the other is made of a non-elastic material, when the press roller 23 impresses the paper P onto the transfer body 15, the elastic body side is deformed against the non-elastic body side at a specified elastic modulus. As a result, the printing ink K is impressed in the paper P to be printed, and thereby it is prevented from being raised from the surface of the paper P.

Incidentally, the paper P thus printed can be delivered without the separating claw which has been used in the prior art printing machine.

Specifically, since the rotational speed of the endless belt 42 of the transfer body 15 is changeable to be increased (in the case where the diameter of the transfer body 15 is smaller than that of the stencil drum 13), the paper P is allowed to go straight ahead along the carrying direction without the separating claw. As a result, the paper P can be delivered in the direction of the delivery board 33 in the state not stuck on the transfer body 15.

To perfectly eliminate the whirling-up of the paper P, the printing may be performed in the state that the separating claw is brought in contact with the endless belt 42 of the transfer body 15.

Actually, such a separating claw can be used in cooperation with the cleaning member 17. The reason for this is

as follows. When the separating claw is brought in contact with the endless belt 42 of the transfer body 15, the trace of the separating claw remains on the surface of the endless belt 42; however, the trace of the separating claw can be perfectly removed by the cleaning member 17 provided slidably on the endless belt 42.

Next, the various printing characteristics of the stencil printing machine of the present invention will be evaluated as compared with the prior art stencil printing machine shown in Fig. 7. The printing characteristics evaluated here include step-off of a paper after being printed; fixing, bleeding, and strike-through of a printing ink at the time when a paper after being printed is delivered to the delivery board 33; durability (printing resistance) of a stencil; and noise generated during printing. The evaluated results are shown in Fig. 3.

	inventive stencil printing machine	prior art stencil printing machine
1. set-off	○	×
2. fixing of ink	○	×
3. bleeding	○	×
4. strike-through	0.12	0.20
5. durability of stencil	40,000 pieces	3,500 pieces
6. noise	○	×

Criterion for Evaluation

1. Set-off: This is evaluated for 20 pieces of papers continuously printed.

○: set-off, not generated

×: set-off, generated (slight generation is included)

2. Fixing of Ink: A printing image of a paper printed and delivered to a delivery board is rubbed by the finger, and it is evaluated whether or not the printing image is kept in shape.

○: image, kept in shape

×: image, not kept in shape

3. Bleeding: A printing image of a paper printed and delivered to a delivery board is observed by a microscope (×100), and it is evaluated whether or not bleeding is generated.

○: bleeding, not generated

×: bleeding, significantly generated

4. Strike-through: A printing image of a paper printed and delivered to a delivery board is measured in printing density from the back surface of the paper, and the strike-through is represented by a relative value equivalent to the printing density.

5. Durability of Stencil: Printing is continuously performed, and the durability is represented by the number of papers each strictly ensuring a printing image corresponding to an image of a document.

6. Noise: Noise generated upon impression of the press roller during printing is evaluated on the basis of the feeling of the ears.

○: noise, slightly generated

×: noise, significantly generated

Embodiment 2

Referring to Figs. 4 and 5, the structure of a stencil-indirect printing machine in this embodiment will be described. A document image reading-out unit 5 has an image scanner 3 for reading-out an image of a document to be printed. A perforating unit 9 has a perforating device 7 for forming a perforated image on a stencil sheet S in accordance with document image data read-out by the document reading-out unit 5. A stencil drum 13 has a peripheral wall allowing ink to flow therethrough, and it is rotated around its center axis clockwise in the figure by a rotating means (not shown). A holding means for holding the leading end of the stencil sheet S is provided on the outer peripheral surface of the stencil drum 13. The stencil drum 13 contains an ink feeder 11.

When the leading end of the stencil sheet S already processed by the perforating device 7 is held by the holding means and then the stencil drum 13 is rotated clockwise in Fig. 4, the stencil sheet S functioning as the printing plate is wound around the outer peripheral surface of the stencil drum 13. Subsequently, the ink feeder 11 feeds ink on the inner peripheral surface of the stencil drum 13, to form a stencil image on the surface of the stencil drum 13.

A transfer drum 15a is provided under the stencil drum 13. The transfer drum 15a is rotated counterclockwise in Fig. 4 in the state being in contact with the stencil drum 13, and thereby the stencil image formed on the stencil drum 13 is temporarily transferred on the transfer drum 15a. The transfer drum 15a is smaller in diameter than the stencil drum 13 and is rotated at a rotational speed different from that of the stencil drum 13.

At least the surface layer of the transfer drum 15a is smoothly formed of a material having a repellency against a printing ink used for the printing machine. In accordance with the kind of a printing ink, the above ink-repellent material may be suitably selected from tetrafluoroethylene (PTFT), tetrafluoroethylene-hexafluoropropylene copolymer (FEP), tetrafluoroethylene-perfluoroalkylvinylether copolymer (PFA), silicon rubber and the like. By forming the surface layer of the transfer drum 15a of such an ink-repellency material, the transfer of ink from the transfer drum 15a to the paper P to be printed can be smoothly performed, and the ink remaining on the surface of the transfer drum 15a after transfer of ink can be easily performed.

The transfer drum 15a in this embodiment is composed of an inner layer made of a rubber material as an elastic material and/or a metal material, and the surface layer made of the ink-repellent material. The surface layer is preferably thinned for making the best use of the elastic material constituting the inner layer.

A vertically movable press roller 23 is provided under the transfer drum 15a. A paper P to be printed is fed between the transfer drum 15a and the press roller 23. The press roller 23 carries the paper P thus fed while holding it between the transfer drum 15a and the press roller 23, to form a printing image on the paper P. Papers P on a feed board 25 are fed one by one by a jogger 27, and the paper P is fed between the press roller 23 and the transfer drum 15a by a paper feed timing roller 29. The paper P after being printed is separated from the transfer drum 15a, and is delivered to a delivery board 33 by a delivering carrier 31 having a belt conveyor mechanism. After completion of printing, the stencil sheet S is separated from the stencil drum 13 by a stencil discarding unit 35, to be discarded.

In the case where the transfer drum 15a has an elastic property, the press roller 23 is made of a non-elastic material. If the transfer drum 15a has a non-elasticity, the press roller is made of an elastic material.

In this embodiment, the rotational speed of the transfer drum is different from that of the stencil drum, so that after the printing ink is transferred on the paper to be printed, excessive part of printing ink not transferred on the paper must be perfectly removed. This is because, at the second rotation of the transfer body, a printing image is formed on the transfer body at a position different from that of the printing image formed at the first rotation of transfer body.

To perfectly remove an excessive ink, an ink removing means 30 is provided in such a manner as to be adjacent to the transfer drum 15a on the right side, that is, on the side where the paper P already printed is delivered. Of the ink transferred from the stencil drum 13 to the transfer drum 15a, excessive part thereof not transferred to the paper P to be printed and remaining on the transfer body 15a is removed by the ink removing means 30.

The ink removing means 30 has a cleaning member 17 for collecting excessive ink remaining on the peripheral surface of the transfer body 15a. The cleaning member 17 is disposed rearward of the press roller 23 relative to the rotational direction of the transfer body 15a. The ink removing means 30 also has a containing unit 19 and a coater 21. The containing unit 19 is adapted to contain excessive ink collected by the cleaning member 17. The coater 21 is adapted to feed an excessive ink removing liquid on the surface of the transfer body 15a for effectively removing excessive ink.

The cleaning member 17 in this embodiment is formed in a blade-like shape being contact with the peripheral surface of the transfer drum 15a. When excessive ink remaining on the peripheral surface of the transfer drum 15a is relatively small, the cleaning member 17 may be made of non-woven fabric, woven fabric or ink absorbing paper.

The coater 21 in this embodiment is provided in such a manner as to be adjacent to the rear portion of the cleaning member relative to the rotational direction of the transfer drum 15a. The coater 21 automatically controls the amount

of an excessive ink removing liquid and feeds it on the peripheral surface of the transfer drum 15a. For the coater 21 having no ability of automatically controlling the amount of an excessive ink removing liquid, it may be mounted forward of the cleaning member 17 relative to the rotational direction of the transfer drum 15a. With this arrangement, the amount of the excessive ink removing liquid applied on the peripheral surface of the transfer drum 15a can be controlled by the cleaning member 17.

The excessive ink removing liquid is insoluble to ink used in the printing machine and is low in surface tension than the ink. Concretely, either of the materials described in the first embodiment can be used.

In the stencil printing machine in this embodiment, the stencil sheet S is perforated with a positive image by the perforating unit 9, and is mounted around the stencil drum 13. The printing is thus started. Referring to Fig. 4, the stencil drum 13 is rotated clockwise. The transfer drum 15a being contact with the stencil drum 13 is rotated counter-clockwise at a rotational speed different from that of the stencil drum 13. A paper P to be printed is carried between the transfer drum 15a and the press roller 23 by the paper feed timing roller 29 at a specified timing synchronized with the rotation of the transfer drum 15a. As shown in Fig. 5, ink 39 of a stencil image, which is transferred from the stencil drum 13 to the transfer drum 15a, is transferred on the paper P by an impression force applied from the press roller 23.

The stencil printing machine in this embodiment does not have the separating claw for separating the paper from the stencil drum which has been used in the prior art printing machine. In this embodiment, however, since the diameter of the transfer drum 15a is smaller than that of the stencil drum 13 and the rotational speed of the transfer drum 15a is higher than that of the stencil drum 13, the paper after being printed can be easily separated from the peripheral surface of the transfer drum 15a. The paper P after being printed is fed to the delivery board 33 by the delivering carrier 31 in such a manner that the surface having the printing image is directed upward.

It is to be noted that in this embodiment, to perfectly eliminate the whirling-up of the paper, the separating claw may be provided. In this case, the printing can be performed in the state that the separating claw is brought in contact with the transfer drum 15a. When the separating claw is brought in contact with the transfer drum, a trace of the separating claw is generated on the surface of the transfer drum; however, in this embodiment, the trace of the separating claw can be perfectly removed by the cleaning member 17 of the excessive ink removing means 30.

As shown in Fig. 5, an excessive ink 41 not transferred on the paper P and remaining on the transfer drum 15a can be perfectly removed by the cleaning member 17 of the excessive ink removing means 30. The excessive ink 41 is collected in the containing unit 19. The excessive ink removing means 30 in this embodiment has the coater 21 for feeding an excessive ink removing liquid on the peripheral surface of the transfer drum 15a. Accordingly, the removal of the excessive ink 41 by the cleaning member 17 can be perfectly performed as compared with the case having no coater 21.

As described above, in the prior art stencil-direct printing machine shown in Fig. 8, the amount of ink transferred from the stencil drum 13 to the paper P to be printed is varied depending on the surface smoothness and the ink absorbing property of the paper P. Moreover, a printing image formed on the paper P is raised by spinnability of ink used for stencil printing.

On the contrary, in the stencil printing machine in this embodiment shown in Fig. 5, the surface layer of the transfer drum 15a is made of a material having a uniform surface smoothness and an ink-repellent property. As a result, ink forming a stencil image on the stencil drum 13 is transferred from the stencil drum 13 onto the surface of the transfer drum 15a without excessive spinnability. Subsequently, the ink is impressed onto the paper P by the press roller 23. In the case where the transfer drum 15a has an elasticity and the press roller 23 has no elasticity as in this embodiment, ink 39 present on the surface of the transfer drum 15a is forcibly impressed in the paper P by an impression force applied from the press roller 23, so that ink is not raised from the surface of the paper P. The same is true for the case where the transfer drum 15a has no elasticity and the press roller 23 has an elasticity.

Next, the various printing characteristics of the stencil printing machine in this embodiment will be evaluated as compared with the prior art stencil printing machine. The printing characteristics evaluated here include step-off of a paper after being printed; fixing, bleeding, and strike-through of a printing ink at the time when a paper after being printed is delivered to the delivery board; durability (printing resistance) of a stencil; and noise generated during printing. The evaluated results are shown in Fig. 6.

inventive stencil printing machine		prior art stencil printing machine
1. set-off	○	×
2. fixing of ink	○	×
3. bleeding	○	×
4. strike-through	0.13	0.20
5. durability of stencil	30,000 pieces	3,500 pieces
6. noise	○	×

Criterion for Evaluation

- 5 1. Set-off: This is evaluated for 20 pieces of papers continuously printed.
- : set-off, not generated
×: set-off, generated (slight generation is included)
- 10 2. Fixing of Ink: A printing image of a paper printed and delivered to a delivery board is rubbed by the finger, and it is evaluated whether or not the printing image is kept in shape.
- : image, kept in shape
×: image, not kept in shape
- 15 3. Bleeding: A printing image of a paper printed and delivered to a delivery board is observed by a microscope (× 100), and it is evaluated whether or not bleeding is generated.
- : bleeding, not generated
×: bleeding, significantly generated
- 20 4. Strike-through: A printing image of a paper printed and delivered to a delivery board is measured in printing density from the back surface of the paper using a measuring device (trade name: RD-920, sold by Macbeth Company), and the strike-through is represented by a relative value equivalent to the printing density.
- 25 5. Durability of Stencil: Printing is continuously performed, and the durability is represented by the number of papers each strictly ensuring a printing image corresponding to an image of a document.
6. Noise: Noise generated upon impression of the press roller during printing is evaluated on the basis of the feeling of the ears.
- 30 ○: noise, slightly generated
×: noise, significantly generated

35 According to the transfer printing machine of the present invention, the transfer body can be miniaturized by setting the rotational speed of the transfer body to be higher than that of the press-plate drum. This method is of a transfer printing type using a transfer body, and accordingly, it is effective to suppress the inconveniences such as set-off, bleeding and strike-through, to enhance the durability of a press-plate, and to reduce noise generated in the printing machine.

The transfer body can include an endless belt. The endless belt can be freely changed in shape. As a result, the freedom in layout of the interior of the printing machine can be increased, thus reducing the size of the printing machine.

40 The transfer body can be constituted of a transfer drum. In this case, the rotational speed of the transfer drum is set to be different from that of the press-plate drum, so that the diameter of the transfer drum can be made smaller than that of the press-plate drum, thus reducing the size of the printing machine.

An excessive ink removing means for removing excessive ink from the transfer body can be provided. In this case, excessive ink on the transfer body is substantially perfectly removed from the transfer body, so that the printing quality can be improved.

45 In the case where at least the surface of the transfer body is made of a member having a repellency against ink, excessive ink can be perfectly removed from the transfer body.

The press-plate can be selected from a group consisting of an intaglio, a letterpress, a lithography, and a stencil, as needed.

50 A press-plate making unit for making a press-plate in a positive image can be incorporated in the printing machine. In this case, since a press-plate used in the printing machine can be made in the same printing machine, the press-plate making and the printing can be simply and consistently performed, that is, the printing can be performed directly after press-plate making.

55 **Claims**

1. A transfer printing machine comprising:

a press-plate drum containing a printing ink feeding means and including a press-plate on the outer peripheral surface, said press-plate drum being rotatable;

a transfer body which is rotated at a rotational speed different from that of said press-plate drum in the state being in contact with said press-plate drum for receiving an image of printing ink from said press-plate of said press-plate drum; and

an press roller for impressing a matter to be printed to an image of printing ink formed on said transfer body, thereby forming the image of printing ink on said matter to be printed.

2. A transfer printing machine according to claim 1, wherein said transfer body comprises:

a plurality of rollers; and

an endless belt hung between a plurality of said rollers, which endless belt is rotated at a rotational speed different from that of said press-plate drum in the state being in contact with said press-plate drum for receiving an image of printing ink from said press-plate of said press-plate drum.

3. A transfer printing machine according to claim 2, further comprising an excessive ink removing means for removing excessive part of printing ink transferred from said press-plate drum to said endless belt of said transfer body, said excessive part of printing ink being not transferred on said matter to be printed and remaining on said endless belt.

4. A transfer printing machine according to claim 3, wherein said excessive ink removing means comprises:

a cleaning means for removing, from said endless belt, an excessive part of printing ink transferred from said press-plate drum to said endless belt of said transfer body, said excessive part of printing ink being not transferred on said matter to be printed;

a containing means for containing an excessive part of printing ink removed by said cleaning means; and
a coating means for coating the surface of said transfer body with an excessive ink removing liquid.

5. A transfer printing machine according to claim 4, wherein said endless belt of said transfer body is made of a material having a repellency against said printing ink.

6. A transfer printing machine according to claim 5, wherein said press-plate is one kind selected from a group consisting of an intaglio, a letterpress, a lithography, and a stencil.

7. A transfer printing machine according to claim 1, wherein said transfer body comprises a transfer drum which is rotated at a rotational speed different from that of said press-plate drum in the state being in contact with said press-plate drum for receiving an image of printing ink on the outer peripheral surface from said press-plate of said press-plate drum.

8. A transfer printing machine according to claim 7, further comprising an excessive ink removing means for removing excessive part of printing ink transferred from said press-plate drum to the outer peripheral surface of said transfer drum, said excessive part of printing ink being not transferred on said matter to be printed and remaining on said transfer drum.

9. A transfer printing machine according to claim 8, wherein said excessive ink removing means comprises:

a cleaning means for removing, from said transfer drum, an excessive part of printing ink transferred from said press-plate drum to the outer peripheral surface of said transfer body, said excessive part of printing ink being not transferred on said matter to be printed;

a containing means for containing an excessive part of printing ink removed by said cleaning means; and
a coating means for coating the surface of said transfer drum with an excessive ink removing liquid.

10. A transfer printing machine according to claim 9, wherein at least the outer peripheral surface of said transfer drum is made of a material having a repellency against said printing ink.

11. A transfer printing machine according to claim 10, wherein said press-plate is one kind selected from a group consisting of an intaglio, a letterpress, a lithography, and a stencil.

12. A transfer printing machine according to claim 1, further comprising a press-plate making unit for making a positive

press-plate.

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FIG. 1

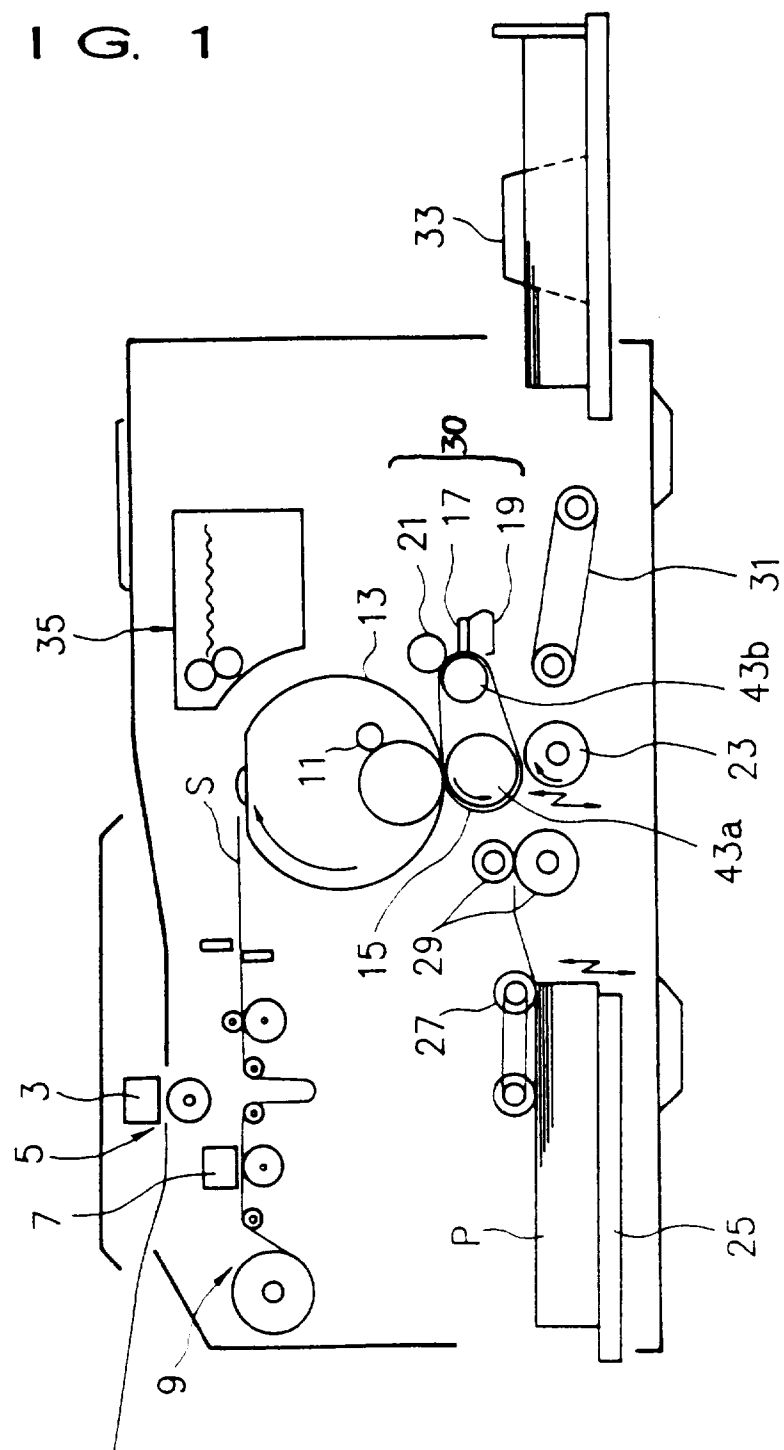
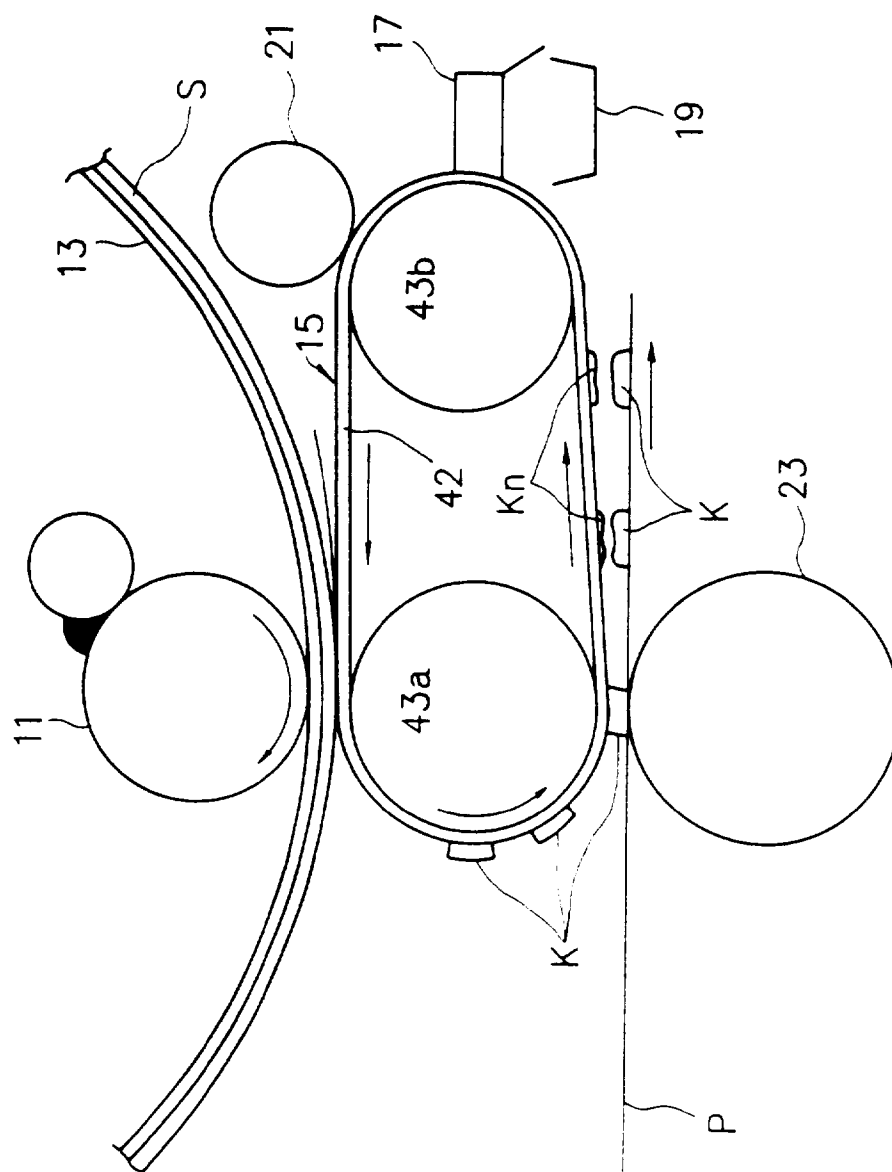


FIG. 2



F I G . 3

	INVENTIVE STENCIL PRINTING MACHINE	PRIOR ART STENCIL PRINTING MACHINE
1.SET-OFF	○	×
2.FIXING OF INK	○	×
3.BLEEDING	○	×
4.STRIKE-THROUGH	0.12	0.20
5.DURABILITY OF STENCIL	40,000 PIECES	3,500 PIECES
6.NOISE	○	×

F I G. 4

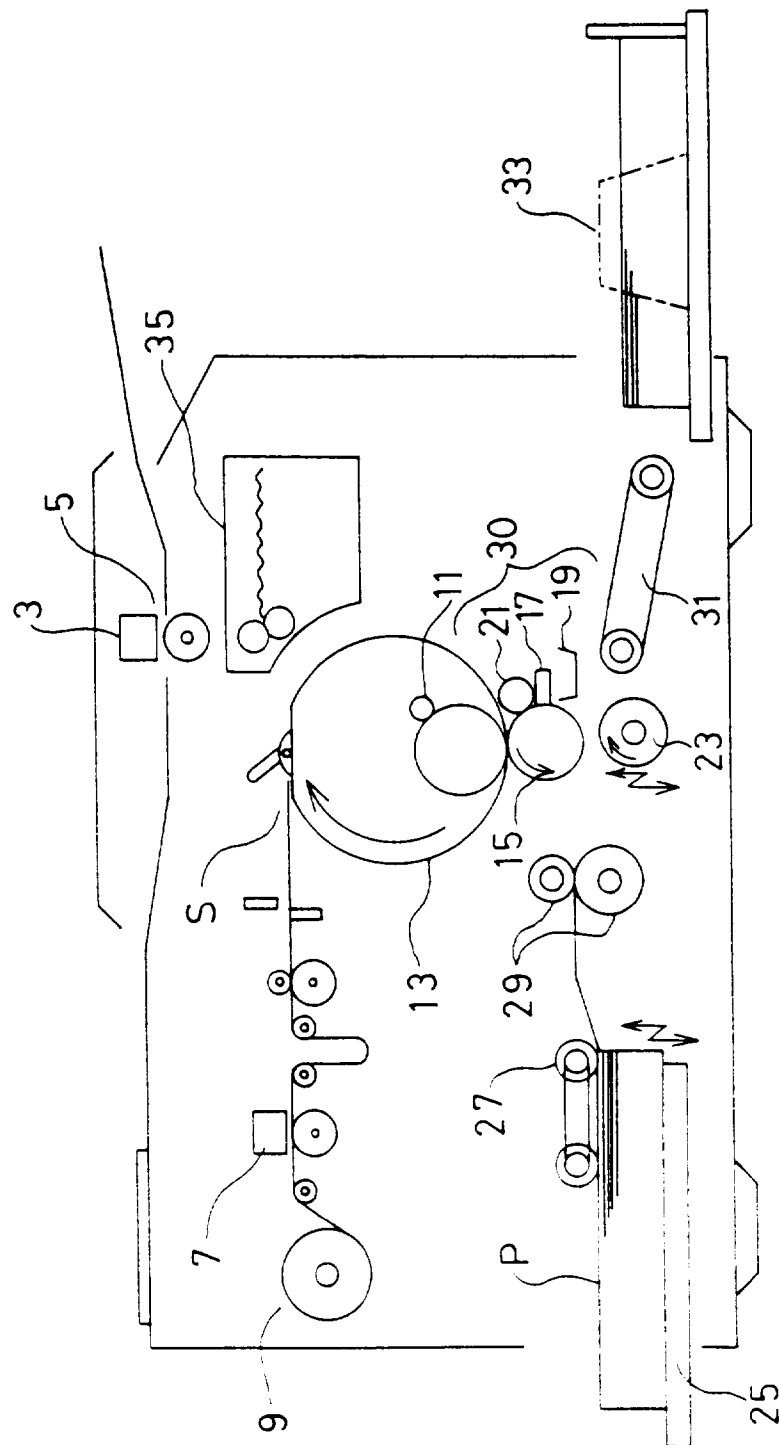
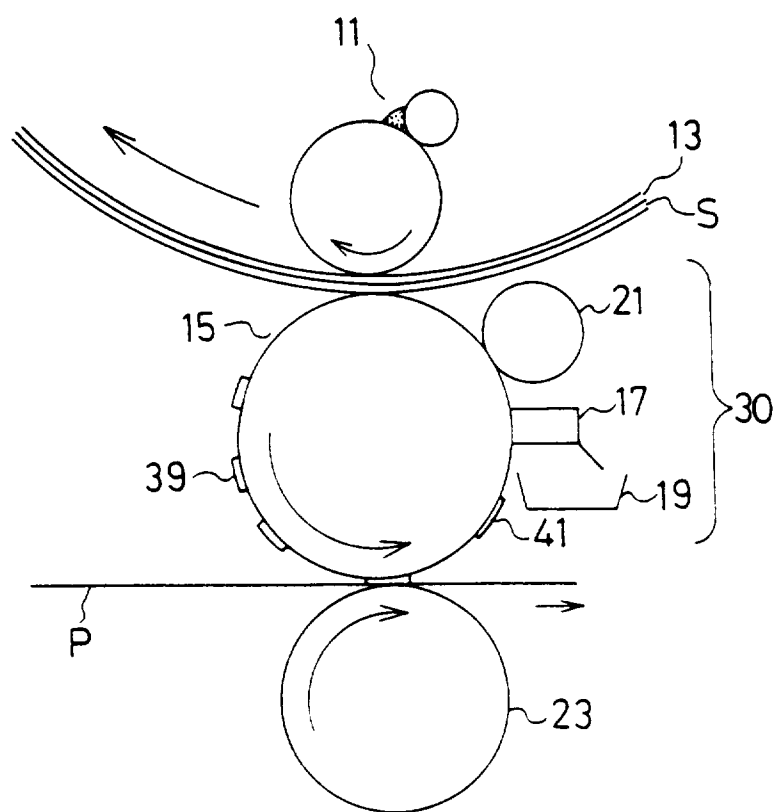


FIG. 5



F I G . 6

	INVENTIVE STENCIL PRINTING MACHINE	PRIOR ART STENCIL PRINTING MACHINE
1.SET-OFF	○	×
2.FIXING OF INK	○	×
3.BLEEDING	○	×
4.STRIKE-THROUGH	0.13	0.20
5.DURABILITY OF STENCIL	30,000 PIECES	3,500 PIECES
6.NOISE	○	×

F I G. 7

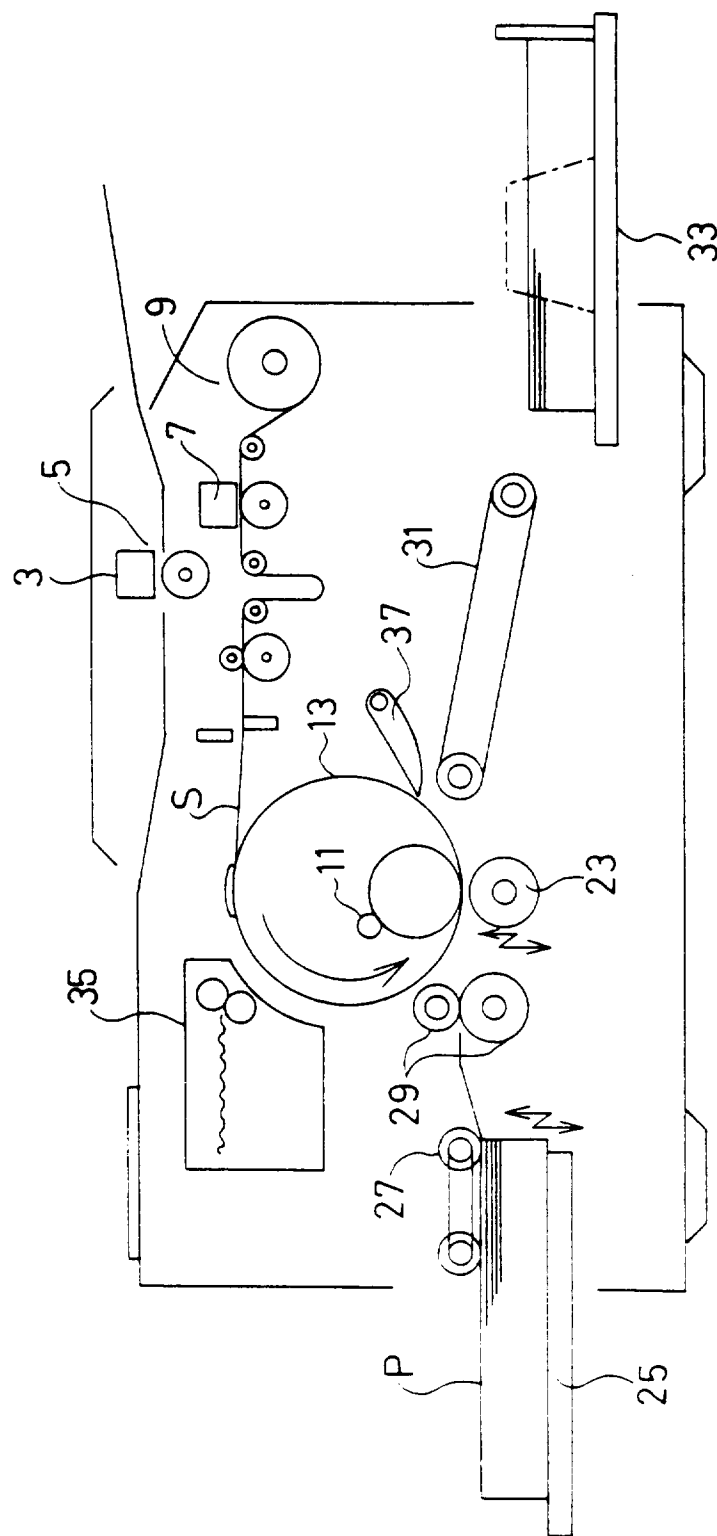


FIG. 8

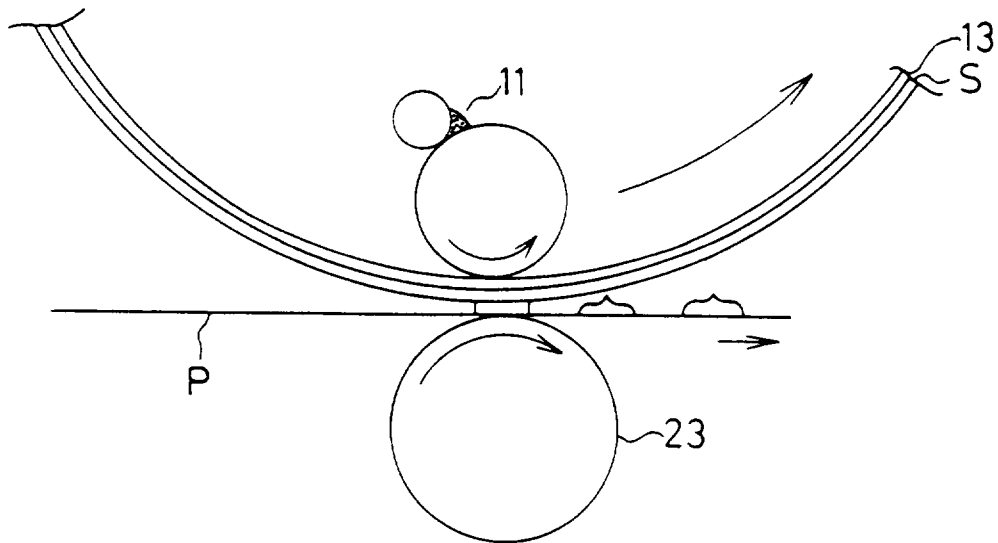


FIG. 9

