(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 295 606**
A2

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 88109377.7

(22) Date of filing: 13.06.88

(51) Int. Cl.4: **B41F 33/00 , B41F 31/08**

(30) Priority: 15.06.87 JP 148373/87
25.08.87 JP 211124/87
25.08.87 JP 129073/87
29.08.87 JP 132128/87

(43) Date of publication of application:
21.12.88 Bulletin 88/51

(84) Designated Contracting States:
DE FR GB

(71) Applicant: Dainippon Screen Mfg. Co., Ltd.
1-1, Tenjinkitamachi Teranouchi-agaru
4-chome Horikawa-dori
Kamikyo-ku Kyoto 602(JP)

(72) Inventor: Oda, Osamu c/o Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)
Inventor: Mizuta, Masaji c/o Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)
Inventor: Tsuchimoto, Shuji Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)
Inventor: Okuda, Hideharu Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)
Inventor: Nakajima, Masahiro Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)
Inventor: Sumi, Kenji c/o Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)
Inventor: Kadota, Tomoyuki Dainippon Screen Mfg. Co., Ltd.
Kuze Plant of 465-1 Tsukiyama-cho
Kuze Minami-ku Kyoto(JP)

(74) Representative: Goddar, Heinz J., Dr. et al
FORRESTER & BOEHMERT
Widenmayerstrasse 4/I
D-8000 München 22(DE)

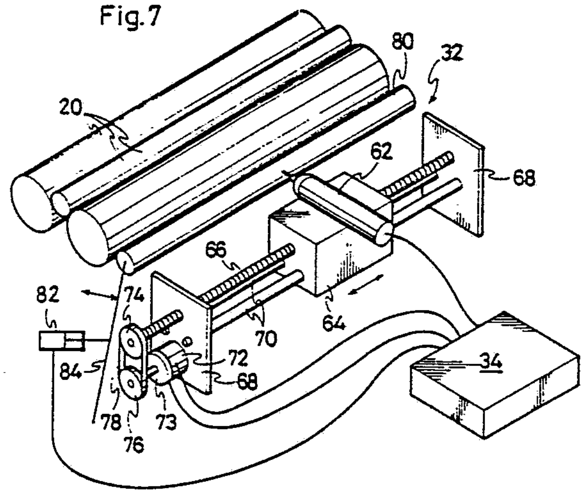
(54) **An automatic ink feeding apparatus in an offset proof press machine.**

(57) In an automatic ink feeding apparatus in an offset proof press machine, which feeding apparatus includes an ink feeding unit (32) including ink feeding part (62) movable along the axial direction of inking rollers (18, 20) for feeding ink (94) to the inking rollers (18, 20), a density measuring unit (24)

EP 0 295 606 A2

measures a plurality of patches (40) for use in density control of printings impressed on a blank of an image (38) of a printing paper (6) by the proof press machine, and an operation means (28, 28a, 28b) makes a comparison of printing density (A, A′n, A″n) of the patches (40) detected by the measuring means (24) with preset target density (B, Do, D′o) and finds data concerning required amounts of ink to be fed to predetermined axial positions of the inking rollers (18, 20) respectively corresponding to the patches (40) on the basis of the comparison, and a control unit (34) actuates the ink feeding means (32) to feed the amounts of ink (94) to the axial positions of the inking rollers (18, 20) on the basis of the data.

Fig.7



AN AUTOMATIC INK FEEDING APPARATUS IN AN OFFSET PROOF PRESS MACHINE

The present invention relates to an automatic ink feeding apparatus in an offset proof press machine. Fig. 1 schematically illustrates a generally accepted flatbed proof press machine. In the machine, there are formed a plate bed 4 and a printing bed 6 approximately on the central portion of a frame 2, respectively. At one end side of the frame 2, there is disposed a damping unit 8 for supplying a damping water, while at the other end side thereof there is provided an inking unit 10. At an upper surface of the frame 2, there is mounted a carriage 12 which is capable of reciprocating between the two ends of the frame 2. In the carriage 12, there are rotatably supported a blanket cylinder 14 having its outer peripheral surface covered with a blanket such as rubber, damping rollers 16, and inking rollers 18, respectively. The inking unit 10 is assembled of a plurality of inking rollers 20 which are rotated and swung by a driving device such as a motor not illustrated, and adapted to feed ink to the rollers 18 and to knead fed ink. Reference numeral 22 designates a cover for the inking rollers 18 made of a transparent material.

In press proofing, the carriage 12 reciprocatorily travels on the frame 2 after a printing plate and a printing paper are mounted on the plate bed 4 and the printing bed 6, respectively. Specifically, when the carriage 12 is positioned at the right end side of the frame 2 in fig. 1, oily ink is fed to the inking rollers 18 from the inking rollers 20 of the inking unit 10. As the carriage 12 horizontally runs toward the left side of the frame 2 in Fig. 1, the damping rollers 16 supply damping water to hydrophilic non-image formation portions of the surface of the printing plate while making rotational contact with the surface of the printing plate in the first place, and thereafter the inking rollers 18 feed ink to lipophilic image-formed portions thereof while having rotational contact with the surface of the printing plate, until the carriage 12 reaches the left end side of the frame 2 in Fig. 1. If desired, the damping rollers 16 receive damping water from the damping unit 8 at the left end side of the frame 2.

As the carriage 12 returns toward the right side of the frame 2 in Fig. 1 subsequently, the inking rollers 18 further furnish the ink to the lipophilic image-formed portions while again having rotational contact with the surface of the printing plate, and thereafter the blanket cylinder 14 makes rotational contact with the surface of the printing plate so that ink thus applied solely to image-formed portions of the surface of the printing plate is transferred to the outer peripheral surface of the blanket cylinder 14. Subsequently, the damping rollers 16 further supply damping water to the non-image-formed portions of the surface of the printing plate while having rotational contact with the surface of the printing plate once more. Meanwhile, the blanket cylinder 14 makes rotational contact with the printing paper on the printing bed 6 in order to transfer the inked image to the printing paper, thus accomplishing an offset printing. When the carriage 12 is restored to the right end of the frame 2 in Fig. 1, one press proofing operation is completed.

The aforementioned proofing is intended to check the conditions and quality of the plate-making prior to the running-on of a printing press and also to obtain a standard printing for use in the production run of the press. A main factor that determines the final quality of the proof is a control of ink feeding amount to the inking rollers.

Conventionally, the operator has manually applied ink in the required amount to the inking rollers on the basis of his experience utilizing an ink knife. Specifically, the operator produces two or three sheets of printings after application of the amount of ink with the ink knife. Then, viewing the conditions of the produced printings he judges the ink amount of correction needed totally and/or locally of the inking rollers based on his trained experience, so that he manually replenishes ink in the judged amount with the ink knife to those portions of the inking rollers along the axial direction thereof which appear deficient in ink.

However, such manually controlling of feeding ink in the needed amount requires a high degree of skillfulness from the operator when conducted in pursuit of reasonable adequacy, and actually, it is difficult to always control the feeding amount of ink with extreme accuracy, thereby causing variances or dispersion of the produced proof printings in quality.

With regard to the control of the ink feeding amount in the case of the production run of the press machine, for example, Japanese Patent Application Kokai No.58-201008 discloses a proposal that the feeding amount of ink from an ink doctor is determined on the basis of the measurement of the ratio of the image area on the plate surface of the printing plate. Specifically, according to this proposal, the feeding amount of ink is set by estimating a consuming amount thereof based on the measuring of that ratio of the image area at the outset. Then, dozens of printings are produced until the density of the produced printings and the feeding amount of ink seem to be substantially equilibrated with each other, and thereafter the density of printings is checked, so that the feeding amount is adjusted again upon consideration of the cheked density. Subsequently, after dozens of printings are further made, the density of the printings is examined again, so that the feeding amount is adjusted once more. Thus, the above procedure is repeated until the feeding amount is completely equilibrated with the desired printing density.

On the contrary, in the case of the proofing by the offset proof press, it is neccessary to control the feeding amount so that the target density of the printings can be attained after from two to five printings are poduced because of the fact that the total number of printings made is as small as ten or so. Moreover, not only replacement of the printing plates is frequently performed, but also conditions that affect the density of printings change to a great extent. For exmaple, variances of the conditions of the damping water take place, and the time intervals among the pressings of the individual printing plates are quite irregular. Thus, it is impossible to practically apply to the proofing the above ink control system for the running-on of the printing press by equilibrating the ink consuming and feeding amounts.

Another proposal is disclosed by Japanese Utility Model Application Kokai No.60-175637, according to which there is provided an automatic ink feeding device for the proof press adapted such that a feeding part is equipped on an equal velocity reciprocatory transportion unit disposed along the inking rollers and that a prescribed amount of ink is uniformly fed to the inking rollers along the axial direction thereof by the feeding part being moved therealong at equal velocity by the unit. However, the ink consuming amount varies to a large degree in different portions of the plate surface of the printing plate in respect to the direction perpendicular to the direction in which the carriage advances in press proofing or "printing direction", depending on the size of the printing plate and the images formed thereon. Accordingly, it is neccessary to adjust the ink feeding amount to such variable consuming amount as regards these portions. Thus, it is apparent that the above proposed device is incapable of employment for the actual operation.

Furthermore, Japanese Patent Application Kokai Nos.60- 151051 and 60-214960, Japanese Utility Model Application Kokai No.61-158436, and the like disclose a technique wherein there is provided a printing control data detection unit on the carriage of the proof press for measuring printing control scales printed on the printing paper together with the image, and the so obtained data is utilized for the qualty control of the printings produced by the press proofing.

However, the technique taught by the above publications is intended to obtain the printing control data only, and no disclosure is made as to the control of the ink feeding amount to the inking rollers in the press proofing whatsoever.

The invention as claimed is intended to remedy the aforementioned drawbacks, and the problem underlying the inveniton is to enable the accurate control of the feeding amount of ink to the inking rollers to be always executed without the operator's skillfulness in the offset proof press machine which encounters with the difficulties that the number of printings required to be produced is small and that the replacement of the printing plates is frequently conducted and further great variances of printing conditions take place.

The problem is solved, accoding to the invention, by providing an automatic ink feeding apparatus in an offset proof press machine, said automatic ink feeding apparatus comprising ink feeding means comprising ink feeding part movable along the axial direction of inking rollers for feeding ink to said inking rollers, wherein density measuring means measures a plurality of patches for use in density control of printings impressed on a blank of an image of a printing paper by said proof press machine, and that operation means makes a comparison of printing density of said patches detected by said measuring means with preset target density and finds data concerning required amounts of ink to be fed to predetermined axial positions of said inking rollers respectively corresponding to said patches on the basis of said comparison, and control means actuates said ink feeding means to feed said amounts of ink to said axial positions of said inking rollers on the basis of said data.

The problem is also solved by providing an ink feeding method in an offset proof press machine, wherein an amount of ink is fed to axial positions of inking rollers, a plurality of patches for use in density control of printings are impressed on a blank of an image of a printing paper by said proof press machine, and density of said patches is detected and compared with preset target density and there is found required amounts of ink to be fed to predetermined axial positions of said inking rollers corresponding to said patches.

The advantage offered by the invention is mainly that there is attained accurate and continual control of the feeding amount of ink to the inking rollers without the operator's skillfulness in the offset proof press machine, which leads to the accomplishment of the stable and improved quality of the produced printings.

Furthermore, as mentioned above, the main factor that determines the final quality of the proof is the control of the feeding amount of ink to the inking rollers. The provision of the ink feeding apparatus that is capable of supplying ink to the inking rollers with high precision is prerequisite for that control.

Specifically, as a first requirement of such ink feeding apparatus, it is pointed out to invariably control of the ink feeding amount regardless of the viscosity of ink being employed. The viscosity of ink differs in the type of ink being employed, and further greatly affected by the ambient temperature. Accordingly, it is neccessary to adjust the ink feeding amount every time a different type of ink is employed and the temperature variesa if the ink feeding amount varies with the change of the viscosity of ink, which would otherewise lead to the excess or deficiency of the feeding amount of ink so as to disable the stable maintainace of the ink feeding amount. A second requirement is to effect the accurate control of feeding ink in a fine amount. To attain the precise and minute control of the printing density, it is neccessary to control the ink feeding amount in regard to axial numerous divisions of the inking rollers, each division having a length of, for example, 30-40 mm, which inking rollers are disposed along the direction intersecting at right angles with the direction in which the carriage travels, and hence the feeding amount of ink to each division will be extremely small.

A third requirement is a short cycle of feeding ink by the subject ink feeding apparatus. Where such axial numerous small divisions are set and the ink feeding amount is determined per division, the ink feeding operation is repeated for each division over the entire lengths of the inking rollers. Accordingly, when the ink feeding cycle of the device is long, it takes a long time to complete feeding ink to the inking rollers, and thus, the time required for one press proofing is also long. Consequently, for example, the amount of the damping water varies, thereby adversely affecting the printing quality.

A fourth requirement is to enable an employment of any type of ink, since different kinds of ink manufactred by a variety of makers are utilized in the offset press proofing, and further cases frequently occur in which ink in a special color is prepared by admixing ink in two different colors or more and, varnish, compouns and the like are added.

A fifth requirement is to accomplish the control of feeding amount of ink with the precision that is hard to be affected to bubbles mixed into ink. Ink for use in press proofing is usually kneaded on a lithographic plate etc. by the ink knife to improve its fluidity after taken from an ink cam, and admixed to two or more kinds of ink if desired for the printing, and kneaded to mix thereto varnish or compounds for the purpose of altering its property such as viscosity. In the above procedure, mingling of the bubbles into ink is unavoidable.

Other requirements are to achieve simple construction, small size, light weight, excellence in washability, and also in separation so as to be free of dangling.

With regard to printing ink feeding devices in the press, a variety of types of feeding system have been conventionally proposed and practiced. Examples of these are systems in which ink is fed by utilizing a gear pump, in which ink accommodated in an ink tank is pushed out by application of air or hydraulic pressure, in which ink accommodated in a tubelar receptacle is squeezed out, and in which ink contained in a small-sized ink doctor is fed therefrom.

No conventional ink feeding apparatus for the press proofing, however, has met the above all requirements. Specifically, according to the gear pump system, it is difficult to accurately control feeding of ink in the minute amount, and the controlling precision in the feeding amount is readily affected by the bubbles mixed in ink. Furthermore, ink is liable to dangle from an exit part of the device. According to the air or hydraulic pressure system, since the amount of ink being fed varies with the viscosity of ink employed, it is impposible to maintain the stable control of feeding amount of ink, and also the dangling of ink from the exit often takes place. In the case of the tubular receptcle squeezing system, it is difficult to perform the accurate control of feeding ink in the fine amount, and the feeding cycle is long. Further, the number of types of ink that are capable of use are limited and dangling of ink is liable to occur as well. The small sized ink doctor system has drawbacks that feeding ink in the minute amount is hard to control and that the feeding apparatus is complicated in construction.

The present invention as claimed is also intended to remedy the above drawbacks, and the problems underlying the invention is to achieve the above whole requirements. The problem is solved, according to a preferred embodiment, by providing an ink feeding pump device in an offset proof press machine, said pump device comprising an ink tank part for accommodating therein ink to which pressure is always applied by pressure means, wherein a piston rod is provided which is driven to push out ink in a feeding passage by a driving part, and there is provided a valve part for closing an opening end of said feeding passage.

The further advantage offered by the invention is that upon the ink feeding pump device in the offset press proof machine is bestowed simple construction, small size, light weight, excellence in washability, and also in separation so as to be free of dangling.

In the offset proof press, although ink is replenished to ink rollers upon the judgment that printing density is low as compared with the desired one by the analisys of a first sheet of produce printing, the printing density will not rise to a desired degree in the case of a second sheet of printing produced subsequently to the first sheet of printing. The printing density will reach its maximum after two or three sheets of printings are produced following such replenishment of ink, and will thereafter decrease. The reason for this phenomenon is inferred to be that supplied ink is successively transferred many times, i.e. from the ink rollers to the printing plate, from the printing plate to the blanket, and from the blanket to the printing paper in the press proofing. Thus, although ink feeding continues or disconditnues upon making a decision as to the neccessity of the feeding from the density of the printing produced by the press proofing, a resultant effect follows after an interval. Consequently, it is difficult to stably keep approximating the printing density value to a target density value where there exists a great difference in the two values, at such a time that the proofing operation starts, or ambient conditions like damping water condition, air-conditioning etc. change, or the like. Specifically, when the printing density is lower than the target density to a large degree, the printing density will not immediately increase after ink is replenished, and, if there is accordingly repeated such replenishing ink in the amounts decided from the density of respective printings sequentially produced in the press proofing operations repeatedly conducted until the target density is reached, then the excessive quantity of ink will have been supplied to the inking rollers at the time the target density is attained. Therefore, even if the ink feeding is stopped at attained. Therefore, even if the ink feeding is stopped at that time, the printing density will continue to rise up far beyond the target density, and at last begin to decline after reaching its maximum value. On the contrary, where the proofing operation is repeated without replenishing ink when the printing density is at a greatly higher level than that of the target density, the printing density will abruptly decrease every time one sheet of printing is produced. Even if ink is replenished at a time the printing density becomes lower than the target density, the printing density will not immediately increase but still keep decreasing. The printing density will start rising in the end after its minimum value is reached.

The inveniton as claimed is also intended to remedy the above drawbacks. The problem underlying the invention is to attain the accurate control of the feeding amount of ink to the inking rollers to be always executed without the operator' skillfulness in the offset proof press which encounters with difficulties that the number of printings required to be produced is small and that the replacement of the printing plates is frequently conducted and further that great variances of printing conditions take place. The still further problem is to promptly and stably approximating the printing density to the target density where there exists a large gap therebetween, at the start of proofing, or because of the environmental variances of conditions such as those of damping water and air-conditioning. These problems are solved, according to another embodiment of the invention, by providing an automatic ink feeding apparatus, wherein a memory stores data concerning density of said patches on at least a latest produced sheet of printing, and said operation means judges whether or not said density of said patches is within a preset density range and finds a density variation between said density and said stored density of said patches of a precedingly produced sheet of said patches in the case where said density is within said preset density range, so as to make a comparison of said density variation with a preset density variation, and said control means enables or disables said ink feeding means to feed required amounts of ink to said axial positions of said inking rollers corresponding to said patches, respectively, on the basis of said comparison.

The problems are also solved by providing an ink feeding method, wherein said density of said patches is detected after every sheet of printings is produced, and said density of said patches of at least a latest produced sheet of printing is stored, and in the case where said density is lower than said target density, feeding ink in said required amounts is exclusively disabled on condition that said density is within a preset density range and at the same time that a density increase variation between said density and said stored density of said patches on a precedingly produced sheet of printing is larger than a preset variation, whereas, in the case where said density is higher than said target density, said feeding ink in is higher than said target density, said feeding ink in said required amounts is exclusively enabled on condition that density is within a preset density range and at the same time that a density decrease variation between said density and said stored density is larger than said preset variation.

In the press proofing, when an initial proofing is conducted or the operation starts after replacement of printing plates, there exist great differences of the amounts of ink to be transferred to the surface of the printing plate from the inking rolles among the individual axial positions of the rollers not only in the case where printing ink has already been unevely applied to the inking rollers in regard to the discrete axial positions but also because of differences of image areas among portions in the direction intersecting at right angles to the printing direction even with the uniform application of ink. Thus, the problem arises that the application amount of ink to the inking rollers drastically differ among individual axial positions of the rollers. Consequently, the portions of the plate surface having large image areas will temporarily render the density of the printing being produced greatly low as compared with the portions having small image areas. Accordingly, cases often occur in which it is not until nemerous sheets of printings are yielded that the target printing density is attained for those portions of large image size while ordinary amounts of ink only being fed. Against such problem, may be taken measures that ink in a conformably increased quantity fed to those portions in one feeding operation. Nevertheless, another problem will be brought about that even after the target printing density is approximately reached the printing density rises up at an excessive high rate by such increased amount ink feeding in one feeding operation, so as to disable the stable density control.

The invention is further intended to remedy these drawbacks. The yet further problems underlying the invention are to promptly approximate the printing density to the target density with the small number of printings consumed therefor and to effect the stable density control once the target density is approximately reached, even in the case where those portions of the plate surface which have large image areas in the direction intersecting at right angles with the printing direction temporarily render extremely low the density of the printing being produced when the initial proofing is performed or at a time the proofing is started after the repacement of the printing plates. These problems are solved, by a further embodiment of the invention, by providing an automatic ink feeding apparatus, wherein said operation means detects a density range of at least two different density ranges in which said measured density of said patches falls, in the case where said density is lower than said target density, and said control means actuates said ink feeding means to feed said required amounts of ink to said axial positions of said inking rollers corresponding to said patches respectively in such a staged manner as determined according to said detected density range.

The problems are also solved by providing an ink feeding method, wherein in the case where said detected density is lower than said target density, there are made comparisons of said density with at least two different prescribed density, and said required amounts of ink is fed to said predetermined axial positions of said inking rollers in such a staged manner as determined according to said comparisons.

The advantages offered by the invention are that there is accomplished prompt approximation of the printing density to the target density with the small number of printings consumed therefor and to effect the stable density control once the target density is approximately reached, even in the case where those portions of the plate surface which have large image areas in the direction intersecting at right angles with the printing direction temporarily render extremely low the density of the printing being produced when the initial proofing is performed or at a time the proofing is started after the repacement of the printing plates.

One way of carrying out the invention is described in detail below with reference to drawings which illustrate specific embodiments, in which :

Figure 1 is a schematic view illustrating one of the generally accepted flatbed proof press machines described above; Figure 2 is a block diagram depicting an arrangement of an automatic ink feeding apparatus according to an embodiment of the present invention; Figure 3 is a plan view partially showing the flatbed offset proof press machine incorporating the feeding apparatus of the invention; Figure 4 is a front view illustrating an example of a measuring head 42 of a printing density measuring unit 24 of the apparatus; Figure 5 is a view explaning the fundamental arrangement of the head 42; Figure 6 is a perspective view illustrating another printing density measuring unit 50; Figure 7 is a perspective view depicting an example of ink feeding unit 32; Figure 8 is a vertically sectional view illustrating an arrangement of an ink pump 90 of the unit 32; Figures 9A through 9C are vertically sectional views explaning an operation of the ink pump 90; Figure 10 is a flow chart showing an operation of the feeding apparatus of the invention; Figure 11 is a vertically sectional view illustraing an example of an ink feeding pump device in the offset proof press machine according to another embodiment of the invention; Figure 12 is vertical section taken along the ling II - II′; Figures 13A through 13C are vertically sectional views explaning an operation of the pump device of the invention; Figure 14 is a block diagram illustrating an arrangement of an automatic ink feeding apparatus according to still another embodiment of the invention; Figure 15 is a flow chart showing an operation of the apparatus of Figure 14; Figures 16 and 17 are views depicting density changes of patches 40 made on the same positions of printings sequentially produced by the press proof machine adopting an ink feeding method according to yet another embodiment of the invention; Figure 18 is a block diagram showing an arrangement of an automatic ink feeding apparatus according to a further embodiment of the invention; Figures 19 and 20 are flow charts illustrating operations of the apparatus of Figure 18; Figure 21 is a view showing an example of density dispersion in the printing density data of the patches 40 in the direction parallel to the axial direction of inking rollers 18, 20; and Figure 22 is a view illustrating an example of density changes of the patches 40 formed on the same positions of the printings successively produced by the offset press proof machine adopting the ink feeding method according to yet another embodiment of the invention.

FIRST EMBODIMENT

Fig. 1 is a block diagram illustrating an arrangement of an automatic ink supplying apparatus according to a first embodiment of the invention, which is applied to, for example, the offset proof press machine as shown in Fig. 1.

The apparatus is generally constituted by a printing density measuring unit 24, a printing density displaying and recording unit 26, printing density judging and ink supply amount setting unit 28, a target density inputting member 30, an ink feeding unit 32, and a control circuitry 34.

The printing density measuring unit 24 is designed to measure the density of a plurality of density control patches that have been impressed on a blank or margin of an image on a printing paper by an offset press proofing process. Such measuring takes place, for example, every time the execution of the press proofing for one sheet of printing paper is completed. The unit 24 is mounted on one edge of the carriage 12 so as to move above the frame 2 together therewith, as illustrated in Fig. 2 which is a plan view partially depicting a flat bed offset proof press machine. In Fig. 2, the printing paper designated by reference numeral 36 is set on a printing bed 6. The image 38 is transferred on the printing paper 36 from the printing plate and also the desity control patches 40 are transferred therefrom onto the margin or blank on the paper 36. The density control patches 40 are printed in a row at regular intervals, for example, at a pitch of 40mm, in a direction 48 intersecting at a right angle with a directin in which the carriage 12 runs to perfom a pressing operation, as shown in Fig. 3.

Figs. 4 and 5 illustrate an example of a measuring head 42 of the printing density measuring unit 24. The measuring head 24 is adapted such that a light source 44 and photodetectors 46 are disposed in a fixed positional relationship with each other, as depicted in Fig. 4. The photodetectors 46 are divided into numerous units each of which consists of, for example, a cyan density measuring photodetector c, a magenta density measuring photodetector m, a black density measuring photodetector k, and a yellow density measuring photodetector y. The photodetectors 46 are so provided in a large number at a pitch corresponding to that of the transferred patches 40, for example, at a pitch of 10mm, that the phtodetectors 46 are capble of measuring the whole printed density of the density control patches 40. The measuring head 40 is supported by the carriage 12 in a manner to be movable in the direction 48 in order that the respective photodetectors 46 exactly confront the printed positions of the density control patches 40 by adjustment.

The construction of the printing density measuring unit 12 is not limited to that as aforementioned and may be appropriately modified insofar as is met a requirement that there is measured the whole printing density of the density control patches 40 printed over the entire width of the printing paper 36. For example, it may be arranged that only one unit of the photodetectors is provided on the carriage and that the photodetectors successively measure the density of a plurality of the density control patches while being moved in the direction intersecting the travelling direction of the carriage, according to the technique conventionally known to the art. Furthermore, the printing density measuring unit is not neccessarily confined to the above type which is equipped with the carriage to perform the measuring of the density of the patches during the carriage is moved. As the measuring unit may be applied a separate installation type of a printing density measuring unit 54 as depicted in Fig. 6, in which the printing paper 36 is released from the printing plate and placed at a predetermined position on an upper surface of a table 52 and the density control patches 40 that have been transferred on the paper 36 along with the image 38 are then scanned by a scanning head 54 to measure the printing density thereof, every time the offset proof press machine completes one offset press proofing operation. In Fig. 6, reference numeral 56 denotes a data inputting member, 58 a display member, and 60 a recording member such as a printer.

The printing density displaying and recording unit 26 is provided for displaying and recording the measured density data obtained by the printing density measuring unit 24.

The printing density judging and ink feeding amount setting unit 28 is provided with an operational circuit that compares the printing density of the respective printing density control patches 40 measured by the measuring unit 24 and target density set in advance therefor and that calculates the neccessary amounts of ink to be fed to the respective predetermined axial positions on the inking rollers 18.

The provision of the target printing density inputting unit 30 is intended to input discrete target density data concerning respective coloring ink materials to a random access memory (RAM) of the printing density judging and ink feeding amount setting unit 28. Needles to say, the kinds of the coloring ink materials to be employed are freely chosen according to the printings required. Therefore just one coloring material may be employed. In the case of the employment of different coloring materials, levels of the target density of the patches 40 to be inputted to the unit 28 are the same in regard to the same coloring material. The unit 30 is, for example, a keyboard. Alternatively, such unit 30 may be omitted where the target density data are beforehand inputted to a read only memory (ROM) of the unit 28.

The ink feeding unit 32 fulfills the function of feeding a required amount of ink to the inking rollers 18 while reciproating along the axial direction of the rollers 18. Fig. 7 illustrates an example of the construction of the ink feeding unit 32. The unit 32 is assembled of an ink feeding part 62, a supporting block 64 to which the part 62 is fixed, a screw bar 66 inserted through and screwed on the block 64 and rotatably supported at both ends thereof by a pair of a securing boards 68, a pair of guide bars 70 idlely or freely inserted through the block 64 and also held at both ends thereof by the boards 68, a motor 72 fixed on the one board 68, pulleys 74 and 76 secured on one end of the screw bar 66 and on a rotation shaft of the motor 72 respectively, and a belt 78 wound on and between the pulleys 74 and 76.

In Fig. 7 reference numeral 80 designates an ink replenishing roller, which is moved between the ink feeding part 62 and the inking rollers 20 by actuating a cylinder 82 to swing a swinging bar 84 linked with a piston bar of the cylinder 82, in order to relay the ink jetted from the part 62 to the rollers 20. Alternatively, such ink replenishing roller 80 may be omitted to directly feed the ink to the ink feeding rollers 20.

The driving of the ink feeding part 62, the motor 72, and the cylinder 82 are under control of a control circuitry 34. Specifically, the motor 72 is driven by a motor controlling circuitry 86 shown in Fig. 2. The rotating force of the motor 72 is transmitted to the screw bar 66 through the pulley 76, the belt 78, and the pulley 74 to enable rotation of the bar 66. Such rctation of the bar 66 causes the blocks 64 to be guided by the bars 70 and moved along the axes of the rollers 20. The motor 72 is designed for normal and reverse rotation, and therefore the reciprocating motion of the ink feeding part 62 is effected by normally and reversely rotating the motor 72. An amount of the rotation of the motor 72 is detected by a rotation transducer 73, which yields an output signal representative of the position of the part 62 in the axial direction of the rollers 20. The driving of the ink part 62 is under control of an ink pump control circuitry 88 of the control circuitry 34, so that predetermined axail positions on the rollers 20 (for example positions corresponding to desity detection positions of the control patches 40) are supplied with required amounts of ink, respectively. The ink feeding unit may be provided on the ink rollers 18 of the carriage 12 instead of on the inking rollers 20 of the inking device 10.

Fig. 8 shows an example of a specific construction of an ink pump 90 which effects the feeding part 62 of the feeding unit 32. In the pump 90, secondary compression 96 is always applied to ink 94 accommodated in an ink tank 92, and ink 94 is fed from an ink feeding outlet 102 by actuating the ink pump control circuitry 88 to control an amount of air supply to a double-acting cylinder 98 in order to vertically move a piston 100 thereof. Specifically, a narrow pipe portion P is filled with ink 94 which has entered thereinto through a communication passage 104 by the application of the secondary compression 94 and at the same time an exit of the portion P is closed by a ball valve 108 urged by a spring 106, when the piston 100 is located at an uppermost position as illustrated in Fig. 8. Then, ink 94 so occupying the space within the portion P is pushed out of the exit of the portion P agaist the valve 108 and fed from the outlet 102 when the piston 100 is lowered from the uppermost position by actuating the control circuitry 88 to drive the air cylinder 98, as depicted in Fig. 9A which concretely illustrates the state in which the piston 100 has reached a lowermost position. Next, the space within the narrow pipe portion P is rendered vacuous as the piston 100 is moved up from the lowermost position, as shown in Fig. 9B. Thereafter, ink 94 is forced to enter into and fill in the portion P by suction resulting from so produced vacuum and by the secondary compression 96 , as illustrated in Fig. 9C, and restored to the state of Fig. 8 when the piston 100 is further raised.

The control circuitry 34 controls the driving of the ink feeding unit 32 on the basis of the ink feeding data found by the printing density judging and ink feeding amount setting unit 28.

Described hereunder is an offset proof press printing operation procedures conducted by the automatic ink feeding apparatus according to the invention, with reference to a flow chart shown in Fig. 10.

In the first place, on the plate bed 4 there is mounted a printing plate having undergone an exposure treatment wherein exposures of the image 38 and the printing density control patches 40 are made on a suitable portion of the surface of the printing plate and on a portion to be a blank or margin of the image 38 of the plate, respectively. Next, the positions of the printing density measuring unit 24 and the ink outlet 102 of the ink feeding unit 32 are so adjusted as to properly correspond to the positions of the control patches 40, respectively.

Subsequently, initial ink application to the ink feeding rollers 20 is performed by the ink feeding unit 32 which feeds ink to the predetermined individual axial positions of the inking rollers 20 in equal quantities or required quantities suitable for the the size of the image. Then, after the impressing of the image 36 and the density control patches 40 onto a first sheet of printing paper 36 is completed, the density of the patches 40 is measured by the printing density measuring unit 24 at step (a). Thus, printing density data A is obtained at step (b). Such data A is displayed and recorded by the printing density displaying and recording unit 26 at step (c), and at the same time sent to the printing density judging and .ink feeding amount setting unit 28.

Independently, the target density data B is beforehand inputted to the unit 28 by the target density value inputting unit 30 at step (d). These two data A and B are compared with each other at step (e). When the printing density is equal to or higher than the target density, a proofing operation of a second sheet of printing paper 36 follows at step (i). Where the printing density is lower than the target density, there is found based upon the comparison of the two data ink feeding data including of the neccessary amount of ink to be fed at step (f).

The ink feeding data obtained at step (f) is then delivered to the control circuitry 34. Upon receipt of the data, the control circuitry 34 actuates the ink feeding unit 32 at step (g), so that ink in neccessary amounts is fed by the unit 32 to the respective positions of the ink feeding rollers 20 corresponding to the density control patches 40 at step (h). Such ink replenishing of the ink feeding rollers 20 by the ink feeding unit 32 is completed before the carriage 12 returns to the home position in contact with the inking device 10 after the printing density measuring operation is terminated, or while the carriage 12 is kept stationary to stand by a succeeding proofing operation. However, the ink replenishing may be conducted while the carriage 12 is in reciprocating motion to perform the pressing.

The ink kneading on the inking rollers 20 is executed for a predetermined time after the rollers 20 receive replenished ink, and thereafter a next proofing operation is performed at step (i).

SECOND EMBODIMENT

Described hereunder is a piston type pump device for use in printing ink feeding according to another embodiment of the invention, which is applied to, for example, the automatic ink feeding apparatus of the preceding embodiment described above, referring to Figs. 11, 12, and 13A through 13C.

Fig. 11 is a vertically sectional view illustrating an example of the pump device, and Fig. 12 is a section taken along the line of II - II of Fig. Fig. 11. Like or corresponding parts are also denoted in like reference marks of the first embodiment. The ink feeding pump device is assembled of an ink tank part 278, a pump body 280, and a driving part 282. The ink tank part 278 is constituted by an outer receptacle 284, a lid part 286 for sealing an upper opening of the receptacle 284, and a cassette type inner receptacle 288. Printing ink 94 is accommodated in the inner receptacle 288 which is releasably mounted in the outer receptacle 284. Accordingly, ink replacement is conveniently performed after ink as accommodated in the inner receptacle 288 is extraced from the outer receptacle 284. At the bottom of the receptacle 288, there is formed a drain mounth 292, with which is communicated a liquid passage 294. In the lid part 286 there is formed an air supply opening 296 to which is communicated a compressed air supply source not shown via a pipe 298. By the compressed air is always applied a pressure of, for example, 6 kg/cm^2 to ink 94 within the receptacles. Such unbroken application of pressure to ink 94 accommodated in the ink tank part 278 renders bubbles contained in ink 94 compressed and reduced in volume. For example, when a pressure of 6 kg/cm^2 is applied, the volume of the bubbles decrease to one sixth under atmospheric pressure, thus reducing the adverse influence by the bubbles to the ink feeding amount. Further, since ink 94 is arranged to be firstly accommodated in the ink tank part 278 and then to be fed out therefrom, employment of any type of ink is enabled. In the drawing, reference numeral 300 designates a floating lid, 302 and 306 packings, respectively. Although the drain mouth 292 is provided at the bottom portion of the ink tank part 278 in this embodiment, the arrangement of the mouth 292 is not limited thereto, and, for example, the mouth 292 may be provided at side portions of the ink tank part 278.

The pump body part 280 is assembled of an ink feeding part 308, a valve part 310, and a spouting pipe 312. In the feeding part 308 there extends a feeding passage 314, to whose central portion is communicated an end of the passage 294. From one opening end of the passage 314 is inserted a piston rod 316 into the passage 314. The piston rod 316 is capable of reciprocating such that the front end thereof passes that portion 318 of the feeding passage 314 which is communicated with the passage 294 while keeping liquid-tight contact with the interior surface of the passage 314. The valve part 310 has a room 320 connected with the other opening end of the feeding passage 314. At that portion of the room 320 which is connected with the opening end, there is formed a valve seat 322 with which a ball valve body 324 releasably abuts. In the possage 320, there is disposed a coil spring 326 for urging the ball valve body 324 toward the valve seat 322. With the passage 320 of the valve part 310 is connected the spouting pipe 312. In the drawing, a reference numeral 328 denotes a bearing for the piston rod 316, 330 a stop screw, and 332 and 334 packings, respectively.

The driving part 282 is constituted by a double-acting cylinder 336, a cylinder piston rod 338, a base plate 340 and a spouting amount varying unit 342. By means of a coupling 346, one end of the rod 338 is detachably linked with a linkage 344 on which the rear end of the piston rod 316. Like the case of the first embodiment, the cylinder piston rod 318 is reciprocated by actuating the control circuitry 88 to control an amount of air supply to the double-acting cylinder 336 in order to reciprocate the piston rod 316 via the linkage 344. The spouting amount varying unit is assembled of two stroke varying plates 348 and 350 different in thickness, coupling members 352 and 354 for the respective plate 348 and 350, and a pair of solenoids 356 and 358. The stroke changing plates 348 and 350 are switched to pivot by the solenoids 356 and 358 through the couplings 352 and 354 so that the plates 338 and 350 are selectively inserted between the base plate 340 and a stopper plate 360 formed at an end of the cylinder piston rod 338. Thus, the motion of the cylinder piston rod 338 in the right to left direction in the drawing is controlled at a three-staged stroke by choosing among the modes in which the stopper plate 360 is caused to abut against either of the plates 348 and 350, and in which the plate 360 is rendered to directly abut on the base plate 340 without any of the plates 348 and 350 intervening therebetween. Such staged control of the right to left motion enables the staged control of the extending positions of the front end of the piston rod 316, depending upon which extending positions is determined the amount of ink to be pushed out by the piston rod 316. The spouting amount changing unit 342 may not neccessarily provided. The driving part 282 thus constructed is run by a driving force sufficiently greater than the viscosity resistance of ink and at such a high speed that ensures the desired short cycle of the ink feeding.

In the ink feeding pump, the ink pushing pressure of the pistion rod 316 of the ink feeding part 308 is arranged to be larger than the pushing pressure of the ball valve body 324 against the valve seat 322 of the valve part 310, i.e. than the urging force of the coil spring 326 applied to the ball valve body 324. At the same time, the pushing pressure of the ball valve body 324 against the valve seat 322 is designed to be larger than the pressure of feeding downward ink in the ink tank part 278, i.e. than the compressed air pressure applied to ink 94 contained in the tank 278.

Described hereunder is an operation of the ink feeding pump device, referring to Fig. 11 and Figs. 13A through 13C.

When the piston rod 316 is located at a rightwardmost position as shown in Fig. 1, part of ink 94 is caused to occupy whole capacity of the narrow pipe portion P of the passage 314 by the application of the compressed air pressure through the passage 294, which portion P is defined by the communication portion 318 of the passage 314 and that portion of the passages 314 which adjoins the room 320 of the valve part 310. The exit of the portion P is closed by the ball valve body 324 being urged by the spring 326. Then, as illustrated in Fig. 13A, part of ink 94 in the fine amount so occupying the space within the portion P is pushed out of the exit of the portion P into the room 320 against the ball valve body 324 to which is applied by the spring 326 the rightward urging force lower than the ink pushing force of the piston rod 316, and spouted from the spouting pipe 312 through the room 320, when the piston rod 316 is pushed leftward, passing the communication portion 318 by actuating the ink pump control circuitry 88 to drive the double-acting air cylinder 336 in order to move leftward the piston rod 316 via the cylinder piston rod 338 and the linkage 344. Thus, a prescribed amount of ink is capable of finally being spouted from the spouting pipe 312 with accuracy irrespective of the viscosity of ink employed.

Subsequently, when the piston rod 316 is returned rightward by the driving part 282 from its leftwardmost position depicted in Fig. 13A, the ball valve body 324 is urged rightward to abut on the valve seat 322 by the coil spring 326, so as to completely shut the entrance of the room 320, as illustrated in Fig. 13B. Thus, the excellence in the separation of ink is attained to prevent the occurrence of the dangling of ink. As the piston rod 316 is restored, the space within the narrow pipe portion P is rendered vacuous. Thereafter, even if the viscosity of ink 94 is high, part of ink 94 is forced to promptly enter into and fill in the portion P, as depicted in Fig. 13C, not only by the suction resulting from the vacuum pressure so yielded in the portion P but also by downwardly pushing compressed air pressure being applied to ink 94 in the ink tank 278, after the front end of the piston rod 316 is further rightward restored from the communication portion 318, so as to return the position shown in Fig. 11. Since the urging force of the ball valve body 324 toward the valve seat 322 is larger than the force of pushing down ink as aforementioned, the entrance of the room 320 of the valve part 310 remains closed, thereby preventing leakage of ink from taking place.

THIRD EMBODIMENT

Fig. 14 is a block diagram illustrating an arrangement of an automatic ink feeding apparatus according to the current embodiment of the invention, wherein like or corresponding parts are also designated by like reference symbles of the first embodiment.

In this embodiment, the automatic ink feeding apparatus is generally constituted by the printing density measuring unit 24, a memory 426, the printing density displaying and recording unit 26, a printing density judging and ink feeding amount setting unit 28a, a density data inputting member 30a, the ink feeding unit 32, and the control circuitry 34.

The differences between the first embodiment and the third embodiment are described below.

Unlike the first embodiment, the memory 426 is additionally provided for storing therein the density data obtained by the unit 24 concerning the individual density control patches 40 on one sheet of produced printing after sequentially deleting a preceding data for the one sheet of printing.

The printing density judging and ink feeding amount setting unit 28a is provided with an operation circuit that compares printing density $A'n$ of the respective patches 40 detected by the unit 24 and the target density set beforehand therefor so as to judge whether or not each of the detected density $A'n$ falls within a density range respectively preset, and that finds a density variation of each density $A'n$ from a density $A'n$-1 of the corresponding patches 40 of the preceding printing stored in the memoty 426 in the case where the density $A'n$ is within the range so as to further judge whether or not the variation is larger than a preset value, and further that calculates the required amount of ink to be replenished to the respective axial predetermined positions of the inking rollers.

The density data inputting member 30a is provided to input discrete target density data Do for respective coloring materials, density difference data d, and variation data Δd to a random access memory (RAM) of the printing density judging and ink feeding amount unit 28a. Like the case of the first embodiment, the member 30a is a keyboard, for example, and may be omitted where thses data are in advance inputted to a read only memory (ROM) of the unit 28a.

Described hereunder is an offset press proofing procedure conducted by the automatic ink feeding apparatus of this embodiment, referring to a flow chart shown in Fig. 15.

In the first place, on the plate bed 4 there is mounted a printing plate having undergone an exposure treatment wherein exposures of the image 38 and the printing density control patches 40 are made on a suitable portion of the surafce of the printing plate and on a portion to be a blank or margin of the image 38 of the plate, respectively. Next, the positions of the printing density measuring unit 24 ant the ink spouting outlet 102 of the ink feeding unit 32 are so adjusted as to properly correspond to the positions of the control patches 40, respectively.

Subsquently, the initial ink application to the inking rollers 20 is performed by the ink feeding unit 32 which feeds ink to the predetermined individual axial positions of the inking rollers 20 in equal quantities or required quantities suitable for the size of the image to be transferred to the printing paper 6 from the printing plate. Then, after the press proofing operation is repeated a plurality of n times, the density of the patches 40 is measured by the printing density measuring unit 24 at step (a1). Thus, the printing density data $A'n$ is obtained at step (b1). Such data $A'n$ is displayed and recorded by the printing density displaying and recording unit 26 at step (c1), and the same time delivered to the printing density judging and ink feeding amount setting unit 28a.

Independently, the target density data Do is beforehand inputted to the unit 28a by the density data inputting member 30a at step (d1). These two data $A'n$ and Do are compared with each other at step (e1) to find a difference therebetween. Then, the difference is compared with the density difference data d, which has been previously inputted to the unit 28a at step (f1), in order to detect whether or not the measured density is within the predetermined density range at steps (g1) and (g'1). Specifically, the press proofing operation continues producing an n + 1st sheet of printing at step (o1), where the printing density data $A'n$ is judged to be equal to or larger than the target density data Do at step (e1) and at the same time the difference of the data $A'n$ from the data Do is judged to be equal to or larger than the density difference data d at step (g1), which means that the measured density of the patches is larger than the target density and beyond the predetermined density range.

Where the printing density data $A'n$ is equal to or larger than the target density data Do and at the same time the difference of the data $A'n$ from the data d is smaller than the density difference data d, which means that the detected density is within the predetermined density range, there is further found a difference between the printing density data $A'n$

and a printing density data $A'n$-1 which has been obtained in connection with a preceding n - 1 st sheet of printing at step (a1) and stored in the memory 426 at step (k1) to be accessed from the memory 426 at step (l1), so that at step (i1) the difference of the data $A'n$-1 from the data $A'n$ is compared with the density variation data d which has been inputted in the unit 28a by the member 30a at step (h1), in order to determine whether or not a density decrease amount is larger than a preset amount.

Where the difference of the data $A'n$-1 from the data $A'n$ which represents the density decrease amount is equal to or smaller than the variation data d, i.e., the preset amount, the proofing continues to yield the n + 1st of sheet of printing at step (o1). On the contrary, where this difference is larger than the variation data Δ d, which means that the density decrease amount is greater than the preset amount, the proofing does not continue for the production of the n + 1st sheet of printing even when the measured density is larger than the target density. In that situation, there is found an ink replenishing data representative of the amount of ink to be replenished on the basis of the comparison of the two density values at step (j1). The replenishing data is delivered to the control circuitry 34, which then drives the ink feeding unit 32 at step (m1) upon the receipt of the data, so as to respectively supply ink in the neccessary quantities to the positions of the inking rollers 20 corresponding to the density control patches 40 at step (n1). Such ink replenishing to the inking rollers 20 by the unit 32 is completed before the carriage 12 returns to the home position in contact with the inking device 10 after the printing density measuring operation is terminated, or while the carriage 12 is kept stationaly to stand by a scceeding printing operation. However, the ink replenishing may be conducted while the carriage 12 is in reciprocating motion to perform the proofing. The ink kneading is executed for a predetermined time after the rollers 20 receive replenished ink, and thereafter the following n + 1 sheet of printing is produced at step (o1).

Meanwhile, where the printing density data $A'n$ is detected to be smaller than the target density data Do at step (e1) and at the same time a difference of the latter from the former is judged to be equal to or larger than the density difference data d at step (g'1), which means that the measured density is lower than the target density and beyond the predetermined density range, the ink replenishing data is found on the basis of the comparison of the two density values as aforementioned at step (j1). Then, the data is transmitted to the control circuitry 34, which, upon the receipt of the data, actuates the ink feeding unit 32 at step (m1), so as to respectively supply ink in the necessary amounts to the axial positions of the inking rollers 20 corresponding to the patches 40 at step (n1). After the ink kneading is conducted for a predetermined time, the succeeding n + 1st sheet of printing is yielded at step (o1).

In the case where the printing density $A'n$ is smaller than the target density data Do and at the same time the difference of the latter from the former is smaller than the difference data d, which means that the detected density is within the predetermined density range, there is found a difference between the printing density data $A'n$ and the printing density data $A'n$-1 which has been obtained in connection with the preceding n-1 st sheet of printing at step (a1) and stored in the memory 426 at step (k1) to be accessed from the memory 426 at step (11), so that at step (i'1) the difference of the data $A'n$ from the data $A'n$-1 is compared with the density variation data d which has been inputted in the unit 28a by the member 30a at step (h1), in order to determine whether or not a density increase amount is larger than a preset amount.

Where the difference of the data $A'n$ from the data $A'n$-1 which represents the density increase amount is equal to or smaller than the variation data d, the proofing does not continue for the production of the n+1 st sheet of printing, and ink in the neccessary quantites is replenished to the inking rollers as in the above procedures at steps (j1) through (n1). Then, after the ink kneading, the n+1 sheet of printing is produced at step (o1).

On the contrary, where the difference of the data $A'n$ from the data $A'n$-1 is greater than the variation data Δd, i.e., where the density increase amount is larger than the preset amount, the proofing continues to yield the n+1 st sheet of printing at step (o1) without replenishing ink even if the detected density is lower than the target density.

After completion of the above operations performed by the operation circuit in the unit 28a on the basis of the printing density data $A'n$ obtained in connection with the nth sheet of printing, the menory 426 is renewed to store the data $A'n$ instead of the data $A'n$-1 concerning the n-1 st sheet of printing at step (k1).

Although the density difference data d is equally set in the case where the detected density is higher than the target density and in the converse case in the above embodiment, the data d may be not neccessarily equally set, and may be suitably changed together with variation data d depending on the type of the press proof machine, the characteristics of ink employed, and the like.

Figs. 16 and 17 depict density changes of the patches impressed on the same position of the printings sequentially produced by the aforementioned steps shown in Fig. 15.

Fig. 16 illustrates the case where a measured density value a1 of one patch on a first sheet of printing is extremely low as compared with the target density value Do. The measurement of the printing density is sequentially conducted in connection with each sheet of printing successively produced. The ink replenishment is conducted after a third sheet of printing is produced so as to obtain printing density values a1 through a3 in connection with the three sheets of printings successively produced, respectively. As apparent from the drawing, it is true that a printing density value a4 detected in connection with a fourth sheet of printing is lower than the target density Do, but the value a4 falls within the range of the density difference value d. In addition, since a density increase amount calculated by subtracting the value a3 from the value a4 is larger than the predetermined density variation Δ d, ink is not replenished after the fourth sheet of printing is produced. As a result, the printing density is promptly approximated to the target density value Do and stably kept as such, changing in level from the value a4 to the through a10, as shown in a solid line of Fig. 16. In contrast, such is not the case, as illustrated in a broken line of Fig 16, where ink feeding is still performed even after the printing density a4 is measured and the proofing continues without ink replenishment to sequentially produce a fifth through tenth sheets of printings while obtaining density values a′5 through a′10 in connection therewith.

Thus, it is evident that the former case according to the invention is superior to the latter case in stably keeping the printing density approximated to the target density. .

On the contrary, Fig. 17 depicts the case where a measured density value b1 of one patch 40 on the first sheet of printing is extremely high as compared with the target density value Do. The ink replenishment is not yet executed upon completion of the measurement of the printing density in connection with the fourth sheet of printing to obtain a density value b4 therefor. Although a density value b5 detected in connection with the fifth sheet of printing is still above the target density value Do, ink feeding is conducted after such detection of the value b5 because of the fact that the value b5 is within the density difference range d and further that a density decrease amount which is found by subtracting the density value b5 from a density value b4 of the patch in connection with the fourth sheet of printing is larger than the predetermined variation Δd. Consequently, the printing density, varying in level from the value b5 to the value b10 as shown in a solid line of Fig. 17, is more promptly approximated to the target density value Do and more stably maintained as such, than the printing density of the case where the ink feeding is not performed even after the fifth sheet of printing is produced and a density value b5 is obtained in connection therewith so that as shown in a broken line of Fig. 17 the printing density changes in level from the value b5 to values b6 to b10 which are subsequently obtained in connection with the sixth through tenth sheets of printigs.

FOURTH PREFERRED EMBODIMENT

Fig. 18 is a block diagram depicting an arrangement of an automatic ink feeding apparatus according to the fourth embodiment of the invention, wherein like or corresponding parts are denoted by like reference symbles of the first embodiment.

In this embodiment, the automatic ink feeding apparatus is generally constituted by the printing density measuring unit 24, the printing density displaying and recording unit 26, a printing density judging and ink feeding amount setting unit 28b, a density data inputting member 30b, the ink feeding unit 32, and the control circuitry 34.

The differences between the first embodiment and the fourth embodiment are described below.

The printing density judging and ink feeding amount setting unit 28b is provided with an operation circuit that compares printing density (A″n) of the respective patches 40 detected by the unit 24 and the target density preset therefor, and that compares the density with one or more ink feeding amount changing density when the density is lower than the target density, so as to calculate required amounts of ink to be replenished to the repective axial predetermined positions on the inking rollers.

The density data inputting member 30b is provided to input discrete target density data Do, and predetermined density data D′1 and D′2, for respective coloring materials to the random access memory (RAM) of the unit 28b. These data D′1 and D′2 are such as demanding that an ordinary feeding amount of ink be varied. Like the case of the first embodiment, the member 30b is a keyboard, for example, and may be omitted where these data are in advance inputted to the read only memory (ROM) of the unit 28b.

Unlike the first embodiment, a memory 532 may be additionally provided for storing therein ink feeding data found for individual operation processes.

Described hereunder is offset press proofing procedures conducted by the automatic ink feeding apparatus .of this embodiment, with reference to flow charts shown in Figs. 19 and 20.

Referring to Fig. 19, in the first place, on the plate bed 4 there is mounted a printing plate having undergone an exposure treatment wherein exposures of the image 38 and the printing density control patches 40 are made on a suitable portion of the surface of the printing plate and on a portion to be a blank or margin of the printing plate, respectively. Next, the positions of the printing density measuring unit 24 and the ink spouting outlet 102 of the ink feeding unit 32 are so adjusted as to properly correspond to the positions of the control patches 40, respectively.

Subsequently, initial ink application to the inking rollers 20 is performed by the ink feeding unit 32 which feeds ink to the axial predetermied positions on the inking rollers 20 in equal quantites, or required quantities suitable for the size of the image. Then, after the press poofing operation is conducted to produce a first sheet of printing, the density of the patches 40 is measured by the unit 24 at step (a2). Thus, the printing density data $A''1$ is obtained at step (b2). Such data $A'1$ is displayed and recorded by the unit 26 at step (c2), and at the same time delivered to the unit 28b. Independently, the target density data $D'o$ is beforehand inputted to the unit 28b by the inputting member 30b at step (d2). These two data $A''1$ and Do are compared with each other at step (e2). Where the printing density data $A''1$ is equal to or larger than the target density data $D''o$ with resect to all the patches 40, the proofing operation for a second sheet of printing follows at step (s2). On the contrary, where there is detected dispersion or scattering in the obtained printing density data $A''1$ of the patches in the direction parallel to the axial direction of the inking rollers and the printing density data $A''1$ of any patch 40 is lower than the target density data $D'o$, there is found an ink feeding data F that teaches and specifies those axial positions of the inking rollers 20 which respectively correspond to the pathes of lower density than the target density data $D'o$ at step (f2). For example, where such dispersion or scattering in printing density as shown in Fig. 21 is detected, the data F teaches that it is neccessary to supply ink with the positions of the inking rollers corresponding to patches P1, and P4 through P11 except for P2 and P3. The data F thus found is then transmitted to the control circuitry 34, which drives the ink feeding unit 32 upon receipt of the data F at step (g2), so that a fixed amount of ink is respectively fed to the positions of the inking rollers 20 corresponding to the patches P1 and P4 through P11 by the unit 32 while the ink feeding part 62 of the unit 32 is moved along the axial direction of the rollers 20 from the left to right end thereof (see Fig. 4) at step (h2).

Subsequently, at step (j2) a comparison is made between the printing density data $A''1$ and the density data $D'1$ that is in advance inputted to the unit 28b at step (i2). Where the printing density data $A''1$ is equal to or larger than the data $D'1$ with respect to all the patches 40, the proofing operation for the second sheet of printing follows at step (s2) after ink kneading is completed.

On the contrary, where there is detected such dispersion or scattering in the printing density data $A''1$ of the patches 40 as depicted in Fig. 21 in the direction parallel to the axial direction of the inking rollers 20 and the printing density data $A''1$ of any of patches 40 is lower than the data $D''1$, there is found an ink feeding data S for use in a second ink feeding that teaches and specifies those positions of the inking rollers 20 which individually correspond to the patches of lower density than the density of the data $D''1$ at step (k2). In regard to the case shown in Fig. 21, such data S teaches that the axial positions of the inking rollers corresponding to the patches P6 through P10 are required to apply a second ink feeding. The data S is then delivered to the control circuitry 34, which upon receipt of the data drives the ink feeding unit 32 at step (12), so that the amount of ink equal to that in the the preceding feeding operation is respectively supplied to the positions of the inking rollers 20 corresponding to the patches p6 through p10 by the ink feeding unit 32 at step (m2) while the feeding part 62 travels along the axial direction of the inking rollers 20, for example, from the right end to the left end thereof.

Thereafter, at step (o2) a further comparison is made between the printing density data $A''l$ and the feeding amount changing density data $D'2$ which is beforehand inputted to the unit 28b at step (n2). Where the printing density data $A''1$ is equal to or larger than the density data $D'2$ with regard to the all the patches 40, the press proofing follows to produce the second sheet of printing at step (s2) after the ink kneading is completed. On the contrary, where the density data $A''1$ of any of the patches 40 in the direction parallel to the axial direction of the inking rollers is lower than the density data $D'2$, there is obtained an ink feeding data R for use in a thrid ink feeding that specifies those axial positions of the inking rollers which correspond to the ones of the patches having lower density than the density of the data $D'2$ at step (p2). In the case illusrated in Fig. 21, the density data $A''1$ of the patch p8 is detected to be lower than the data $D'2$ and accordingly the data R shows that the axial positions of the inking rollers corresponding to the patch p8 are required to apply a thrid ink feeding thereto.

Then, the data R is transmitted to the control circuitry 34, which upon the receipt of the data actuates the ink feeding unit 32 at step (q2), so that the amount of ink equal to that in the preceding first or second feeding operation is fed to the axial positions of the inking rollers corresponding to the patch p8 by the feeding part 62 of the unit 32 at step (r2) while the part 62 is moved along the axial direction of the inking rollers, for example, from the left end to the right end thereof. After ink kneading is executed for a predetermined time, the press proofing for the second sheet of printing follows at step (s2).

Such ink replenishing onto the inking rollers 20 by the feeding unit 32 is completed before the carriage 12 returns to the home position in contact with the inking device 10 after the printing density measuring operation is termintated, or while the carriage 12 is kept stationary to stand by a succeeding proofing operation. However, the ink replenishing may be conducted while the carriage is in reciprocating motion to perform the pressing.

With regard to an example shown in Fig. 20, the same procedure as in the case of Fig. 19 is taken insofar as step (a′2) through (f′2) are concerned. Namely, the density measuring step through the data F obtaining step are conducted in the same manner. However, unlike the case of Fig. 19, the data F so obtained is not immediately delivered to the control circuitry 34 for the purpose of acutating the feeding unit 32 to feed ink. Instead, the data F is stored in the memory 532 at step (t), which shows, as regards the case shown in Fig. 21, for example, that the axial positions of the inking rollers corresponding to the patches p1 and p4 through p11 except for those p2 and p3 are to receive ink in the first feeding operation.

Thereafter, there is found the data S which teaches that the second ink feeding is to be conducted with regard to the positions corresponding to the patches p6 through p10 after steps (i′2), (j′2) and (k′2) are taken in the same manner as in the preceding example of Fig. 19. Also, the data S is stored in the memory 532 at step (u). Furthermore, the data R is obtained which shows that the third ink feeding is to be performed in regard to the position corresponding to the patch p8 by taking steps (n′2), (o′2), and (p′2). The data R is likewise stored in the memory 532 at step (v). Thus, after these data F, S, and R are successively stored in the memory 532, they are delivered to the control circuitry 34. Upon receiving them, the circuitry 34 actuates the feeding unit 32 at step (q′2), so that the fixed amount of ink is applied by the unit 32 once to the axial positions of the inking rollers 20 corresponding to the patches p1, p4, p5, and p11, twice to those corresponding to the patches p6, p7, p9 and p10, and thrice to those corresponding to the patch p8, repectively, at step (r′2) during, for example, the feeding part 62 of the unit 32 reciprocates along the axial direction of the inking rollers one and a half times. Then, after the ink kneading is conducted for a predetermined time, the press proofing operation for the second sheet of printing follows at step (s′2).

Fig. 22 illustrates an example of density changes of patches formed on the same positions of the printings successively produced by the press proofing operation adopting the staged plural times ink feeding technique as explained above. Detected density z1 of the patch on a first sheet of printing which is produced immediately after the initial press proofing starts is extremely lower than the target density data D′o. Precisely, since the density z1 is detected to be lower than the density data D′2 after the measurement of the density of the first sheet of printing, the fixed amount of ink is thrice fed to the axial positions of the inking rollers corresponding to the patch of the density z1. After a second sheet of printing is produced and the measurement of the density thereof is conducted, measured density z2 of the patch corresponding to the patch of the first sheet of printing is detected to be intermediate between the data D′1 and D′2. Accordingly, the fixed amount of ink is twice fed to the axial positions of the inking rollers corresponding to the patch of the density z2. Thereafter, the printing density rises up rapidly. After a third sheet of printing is produced and density of the impressed patches is measured, it is detected that density z3 of the patch corresponding to the patch of the density z2 is intermediate between the target density data D′o and the feeding amount changing data D′1. Accordingly, that amount of ink is fed just one time to the axial positions of the inking rollers corresponding to the patch having density z3.

After a fourth sheet of printing is produced and density of patches thereof is measured, measured density z4 of the patch corresponding to the patch of the density z3 of the preceding sheet of printing reaches above the target density data D′o. Therefore, ink feeding is not executed while fifth through ninth sheets of printings are produced and the density measurements therefor are successively performed. Thus, density changes are exhibited as depicted in a solid line of Fig. 22. The density of the printings is promptly elevated and becomes stable in this way.

In contrast, a density change drawn by points z′2 through z′10 in a broken line of Fig. 22 is detected where the fixed amount of ink is fed after respective density measurements of the first through seventh sheets of printings irrespective of any difference between the detected density thereof and the target density.

From the drawing, it is apparent that the former case according to the invention is superior to the latter case in promptly approximating the printing density to the target density with a small number of printings required therefor.

In the case where the printing density of the patches 40 are detected as shown in Fig. 21, the axial positions of the inking rollers corresponding to the patchs P2 and P3 receive no ink, since the density thereof is above the target density $D'o$. The density level shown in Fig. 21 is divided into three regions, i.e., a region (1) defined by the levels of the target density data $D'o$ and the density data $D'1$, a region (2) between the data $D'1$ and $D'2$, and a region (3) below the data $D'2$. Then, in the memory 532 is stored a data that the fixed amount of ink is to be fed one time to the axial positions of the inking rollers corresponding to the patches p1, p4, p5, and p11 each density of which belong to the region (1). Also, there is strored in the memory (532) another data that the amount of ink is to be fed two times to the axial positions of the inking rollers corresponding to the patches p6, p7, p9, and p10 the density of each of which pertains to the region (2). Furthermore, there is stored in the memory 532 still another data that the amount of ink is to be applied three times to the axial positions of the inking rollers corresponding to the patch p8 the density of which belongs to the region (3). Thses stored data are delivered to the control circuitry 34, in order to control the feeding amount of ink.

Although in the above description, the two feeding amount changing data are set and the required amount of ink is reached at two stages. However, the mode of such staged feeding is not limited to this one whatsoever.

Where the ink pump of the type feeding a fixed amount of ink in one feeding operation as illustrated in Fig. 8 is applied to the above staged feeding, the prescribed amount of ink is fed to the inking rollers plural times by the pump while the feeding part reciprocates along the axial direction of the inking rollers at equal velocity as mentioned above. Alternatively, it may be that the feeding part is stopped at predetermined positions while in the reciprocating motion and that the fixed amount of ink is fed plural times when the feeding part is at each predetermined position. Furthermore, it may be that the feeding part is moved at reduced velocity at predetermined positions and that the prescribed amount of ink is fed plural times when the feeding part is at each of the predetermined postions.

Moreover, according to this embodiment, the ink feeding may be performed by utilizing such a fixed amount feeding type ink pump as in the second embodiment shown in Figs. 11 through 13C, which is so arranged that its effective ink spouting stroke can be instantaneously changed and hence that the amount of ink to be spouted in one feeding operation can be changed.

Thus, according to this embodiment, there is enabled feeding a voluntarily variable amount of ink in each of plural feeding times is enabled, as well as feeding the fixed amount of ink in each of plural feeding times.

The features disclosed in the foregoing description, in the claims and/or in the accompanying drawings may, both separately and in any combination thereof, be material for realising the invention in diverse forms thereof.

Claims

1. An automatic ink feeding apparatus in an offset proof press machine, said automatic ink feeding apparatus comprising ink feeding means (32) comprising ink feeding part (62) movable along the axial direction of inking rollers (18, 20) for feeding ink (94) to said inking rollers (18, 20) characterized in that density measuring means (24) measures a plurality of patches (40) for use in density control of printings impressed on a blank of an image (38) of a printing paper (6) by said proof press machine, and that operation means (28, 28a, 28b) makes a comparison of printing density (A, $A'n$, $A''n$) of said patches (40) detected by said measuring means (24) with preset target density (B, Do, $D'o$) and finds data concerning required amounts of ink to be fed to predetermined axial positions of said inking rollers (18, 20) respectively corresponding to said patches (40) on the basis of said comparison, and that control means (34) actuates said ink feeding means (32) to feed said amounts of ink (94) to said axial positions of said inking rollers (18, 20) on the basis of said data.

2. An automatic ink feeding apparatus as recited in claim 1, wherein said ink feeding part (62) comprises an ink pump (90) in which an ink tank part (90, 278) accommodates therein ink (94) to which pressure (96) is always applied by pressure means, and a piston rod (100, 316) is driven to push out ink (94) in a feeding passage (104, 314) by a driving part (282), and a valve part (310) closes an opening end of said feeding passage (104, 314).

3. An automatic ink feeding apparatus as recited in claim 1, wherein a memory (426) stores data concerning density ($A'n$-1) of said patches (40) on at least a latest produced sheet of printing, and said operation means (28a) judges whether or not said density ($A'n$) of said patches (40) is within a preset density range and finds a density variation ($A'n$ $A'n$-1, $A'n$-1 - $A'n$) between said density ($A'n$) and said stored density ($A'n$-1) of said patches (40) of a precedingly produced sheet of said patches (40) in the case where said density ($A'n$) is within said preset density range, so as to make a comparison of said density variation ($A'n$ - $A'n$-1, $A'n$-1 -$A'n$) with a preset density variation (Δd), and said

control means (34) enables or disables said ink feeding means (32) to feed required amounts of ink (94) to said axial positions of said inking rollers (1 8, 20) corresponding to said patches (40), respectively, on the basis of said comparison.

4. An automatic ink feeding apparatus as recited in claim 1, wherein said operation means (28b) detects a density range ((1), (2), (3)) of at least two different density ranges ((1), (2), (3)) in which said measured density ($A''n$) of said patches (40) falls, in the case where said density ($A''n$) is lower than said target density ($D'o$), and said control means (34) actuates said ink feeding means (32) to feed said required amounts of ink (94) to said axial positions of said inking rollers (18, 20) corresponding to said patches (40) respectively in such a staged manner as determined according to said detected density range.

5. An ink feeding pump device in an offset proof press machine, said pump device comprising an ink tank part (278) for accommodating therein ink (94) to which pressure (96) is always applied by pressure means, characterized in that a piston rod (316) is provided which is driven to push out ink (94) in a feeding passage (314) by a driving part (282), and that there is provided a valve part (310) for closing an opening end of said feeding passage (314).

6. An ink feeding pump device as recited in claim 5, wherein said valve part (310) comprises a valve seat (322) connected with said opening end of said feeding passage (14), a valve body (324), and a coil spring (326) for urging said valve body (324) toward said valve seat (322).

7. An ink feeding pump device as recited in claim 6, wherein ink pushing pressure of said said piston rod (316) by said driving part (282) is set larger than urging pressure of said valve body (324) by said coil spring (326) toward said valve seat (322), and at the same time said urging pressure of said said valve body (324) by said coil spring (326) is set larger than said pressure applied to said ink (94) by said pressure means.

8. An ink feeding method in an offset proof press machine, wherein an amount of ink (94) is fed to axial positions of inking rollers (18, 20), characterized in that a plurality of patches (40) for use in density control of printings are impressed on a blank of an image (38) of a printing paper (6) by said proof press machine, and that density (A, A', A'') of said patches (40) is detected and compared with preset target density (B, Do, $D'o$), and that there is found required amounts of ink of ink (94) to be fed to predetermined axial positions of said inking rollers (18, 20) corresponding to said patches (40).

9. An ink feeding method as recited in claim 8, wherein said density ($A'n$) of said patches (40) is detected after every sheet of printings is produced, and said density ($A'n$-1) of said patches (40) of at least a latest produced sheet of printing is stored, and in the case where said density ($A'n$ is lower than said target density (Do), feeding ink in said required amounts is exclusively disabled on condition that said density ($A'n$) is within a preset density range and at the same time that a density increase variation ($A'n$ - $A'n$-1) between said density ($A'n$) and said stored density ($A'n$-1) of said patches (40) on a precedingly produced sheet of printing is larger than a preset variation (Δd), whereas, in the case where said density ($A'n$) is higher than said target density (Do), said feeding ink in said required amounts is exclusively enabled on condition that density ($A'n$) is within a preset density range and at the same time that a density decrease variation ($A'n$ - $A'n$-1) between said density ($A'n$) and said density ($A''n$-1) is larger than said preset variation (Δ d).

10. An ink feeding method as recited in claim 8, wherein in the case where said detected density ($A''n$) is lower than said target density ($D'o$), there are made comparisons of said density ($A''n$) with at least two different prescribed density ($D'1$, $D'2$), and said required amounts of ink (94) is fed to said predetermined axial positions of said inking rollers (18, 19) in such a staged manner as determined according to said comparisons.

Fig.1

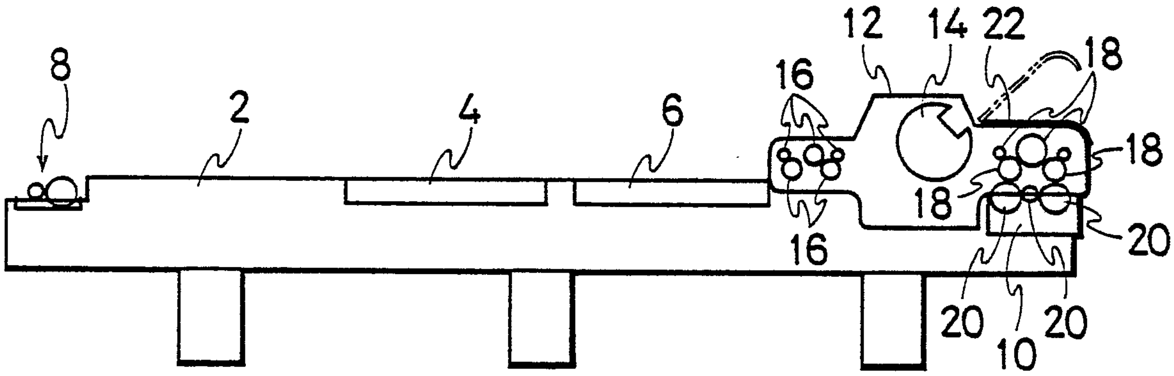


Fig.3

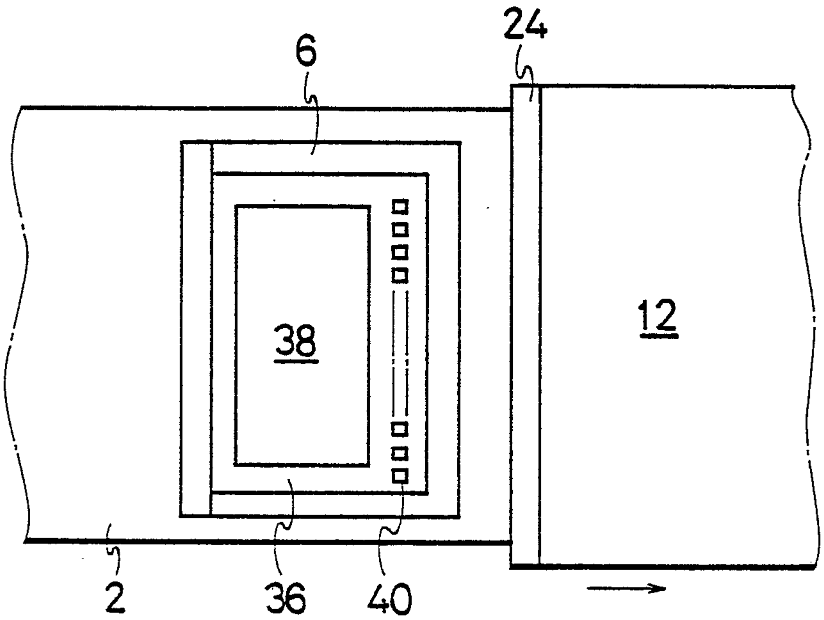


Fig.2

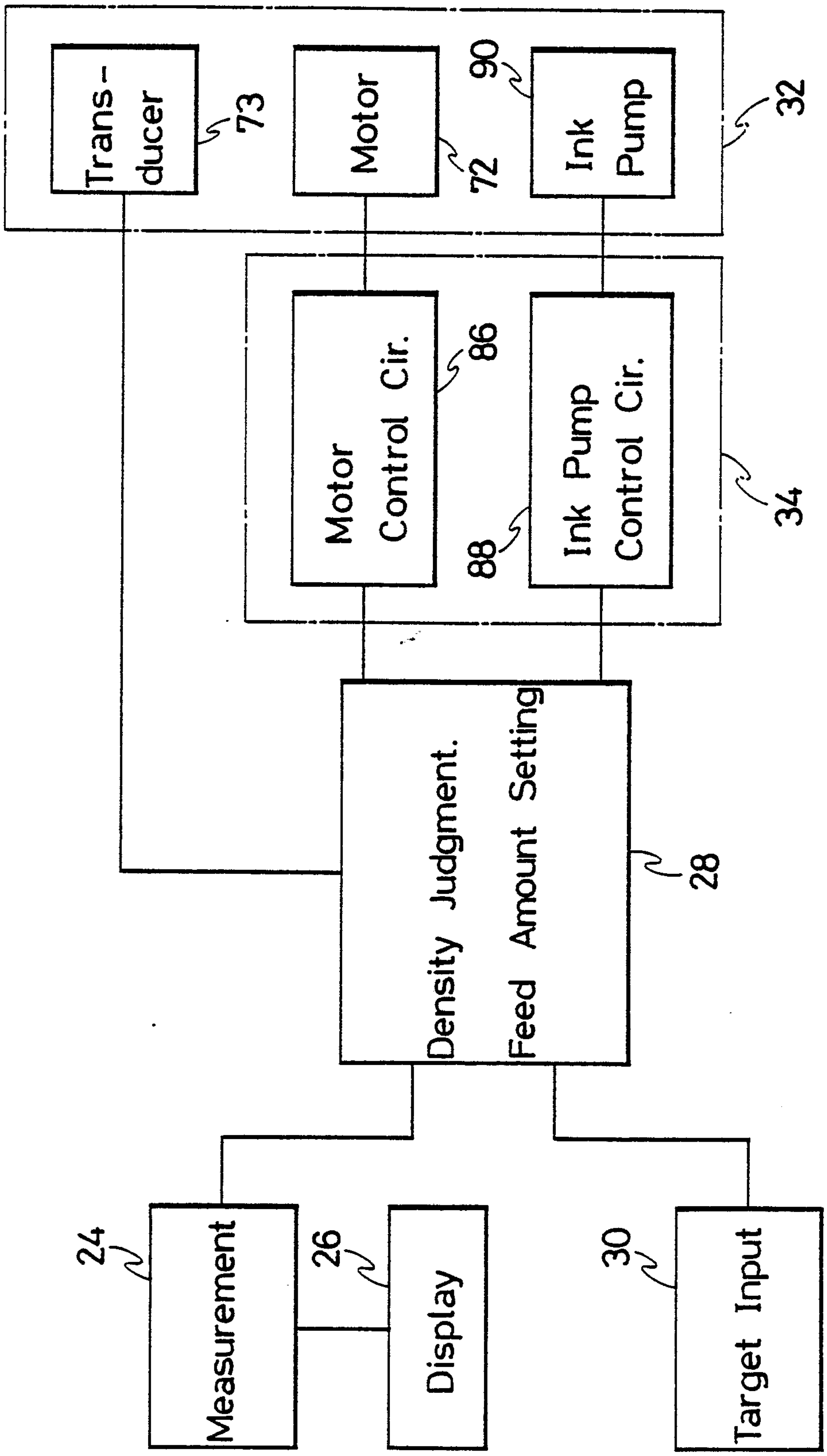

Trans-
ducer
73
Motor
72
90
Ink
Pump
32
Motor
Control Cir.
86
Ink Pump
Control Cir.
88
34
Density Judgment.
Feed Amount Setting
28
24
Measurement
26
Display
30
Target Input

Fig.4

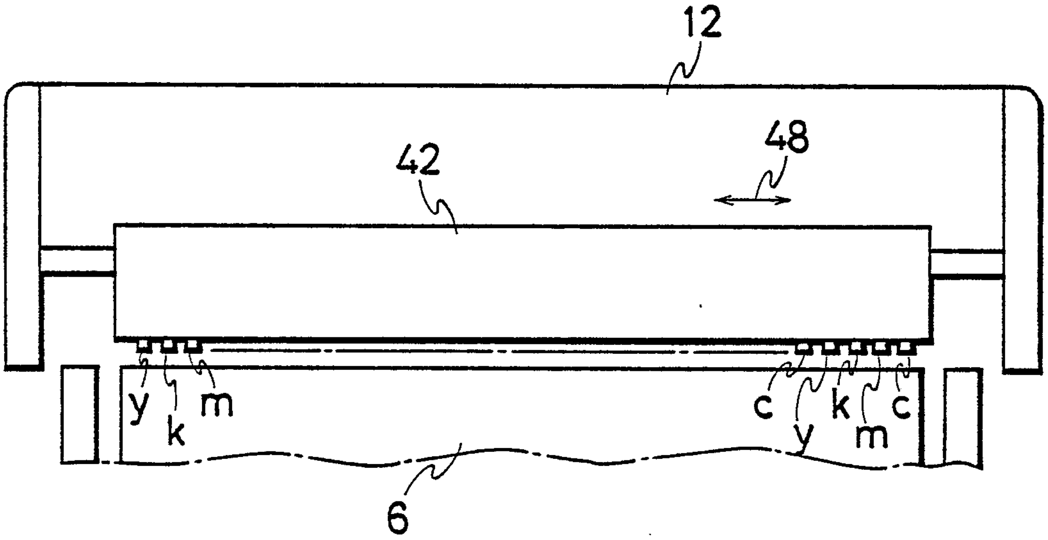


Fig.6

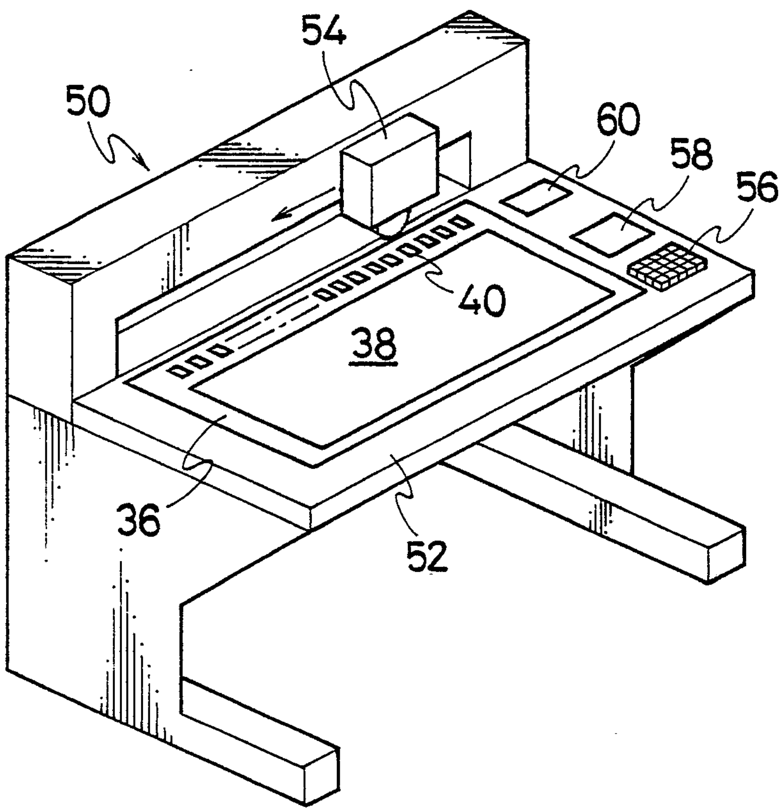


Fig. 5

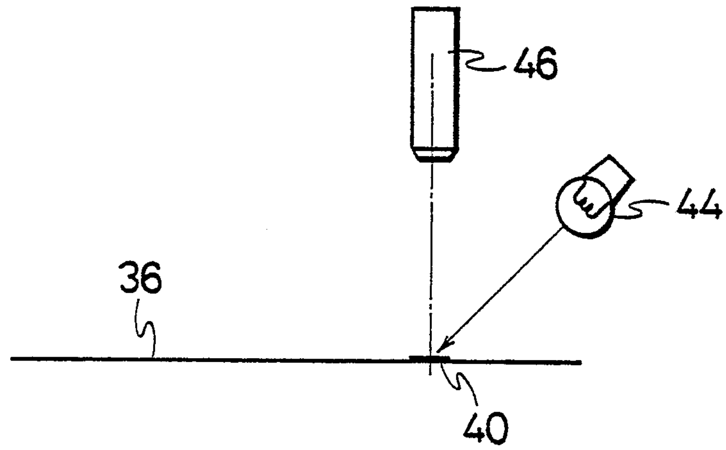


Fig. 7

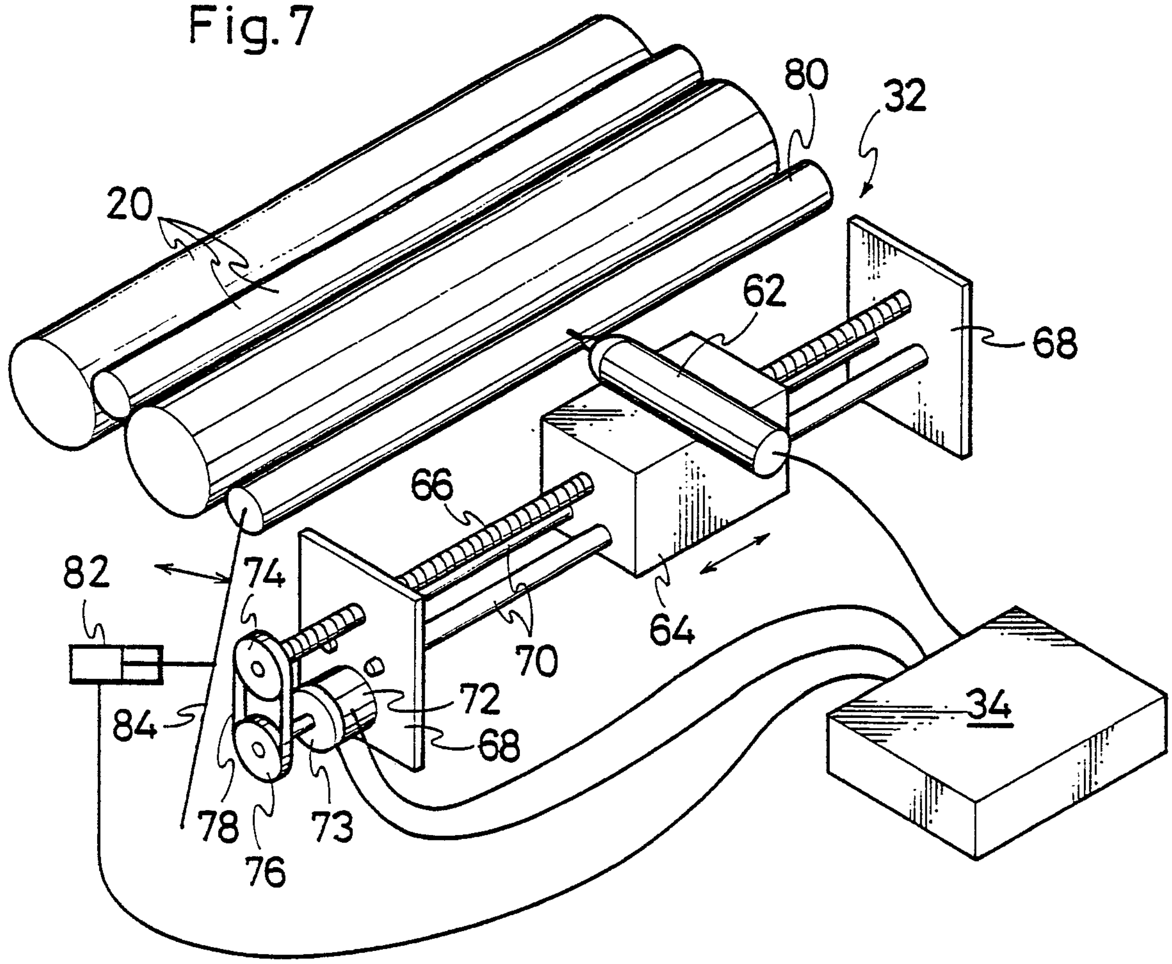


Fig.8

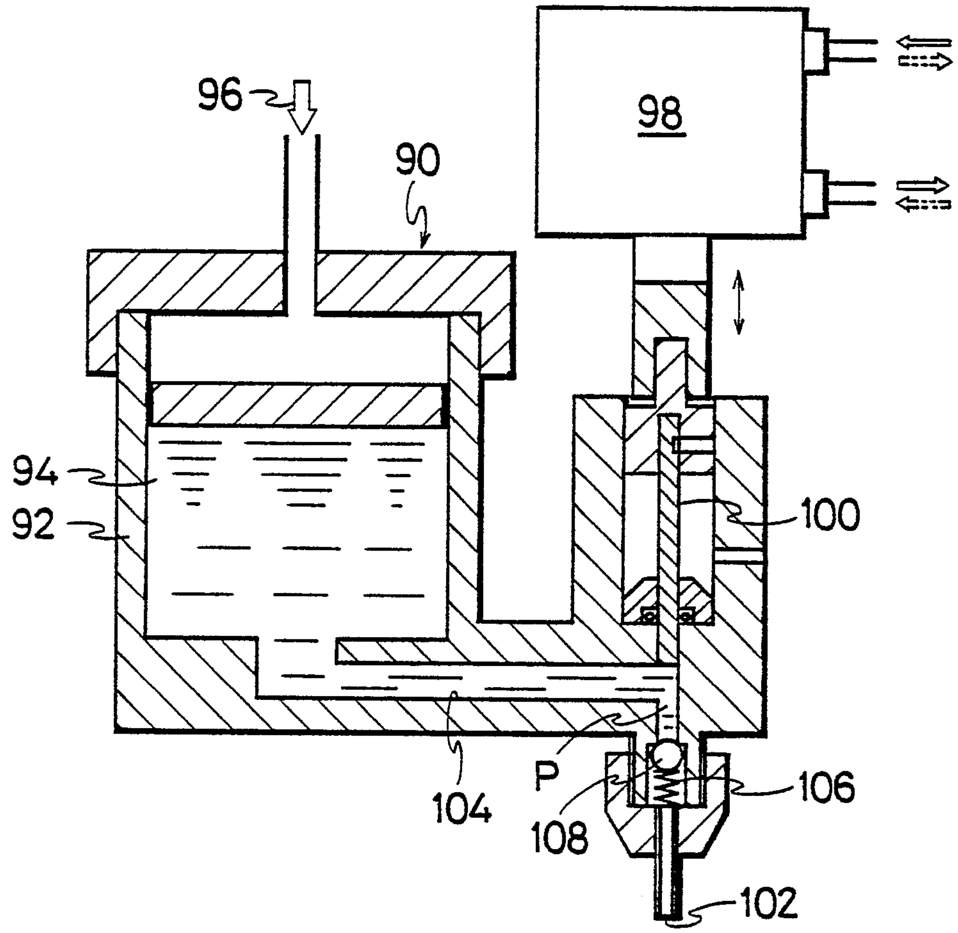


Fig.9A

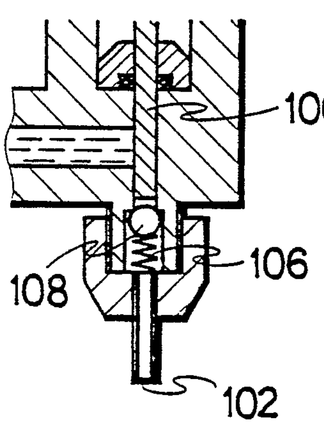


Fig.9B

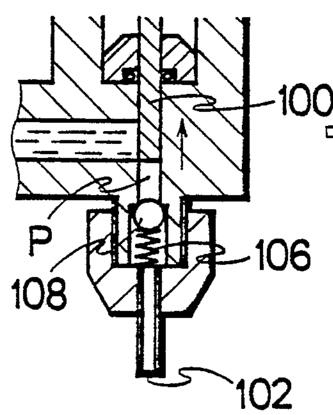


Fig.9C

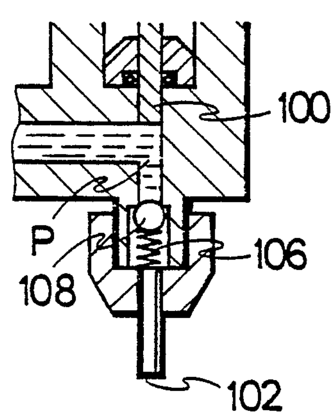


Fig.10

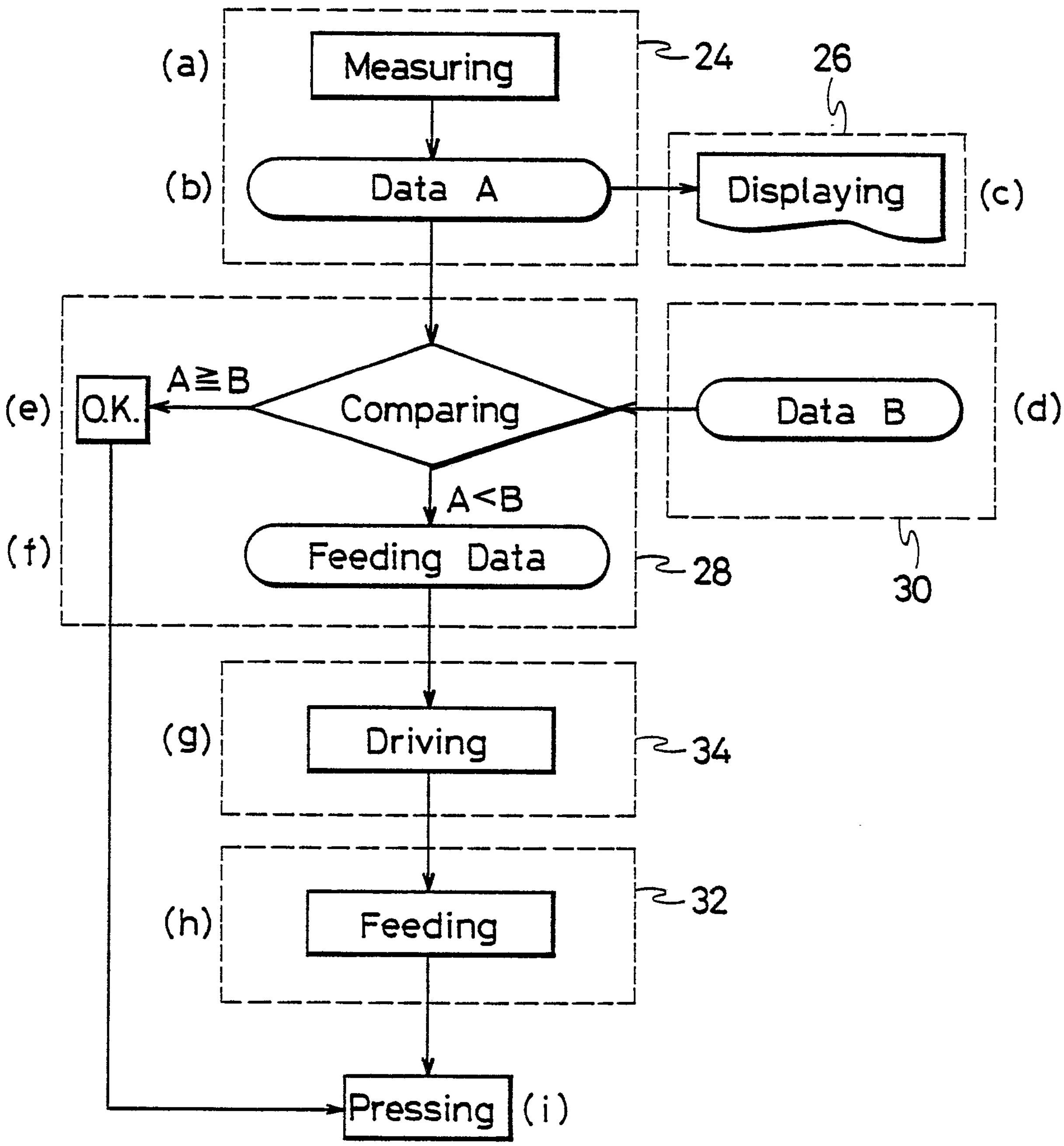
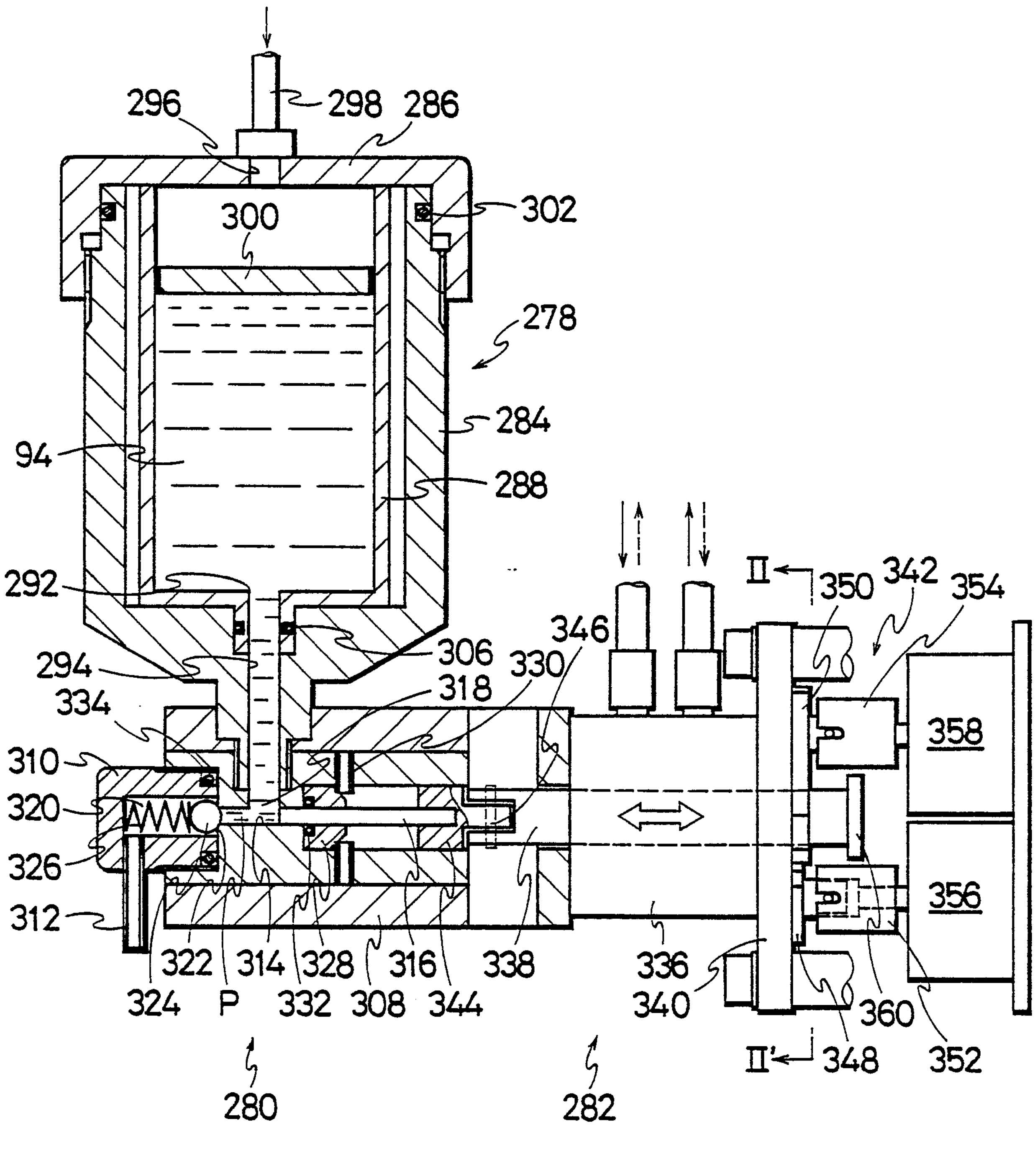

(a)
Measuring
24
26
(b)
Data A
Displaying
(c)
(e)
O.K.
A≧B
Comparing
Data B
(d)
A<B
(f)
Feeding Data
28
30
(g)
Driving
34
(h)
Feeding
32
Pressing
(i)

Fig.11



296
298
286
300
302
278
284
94
288
292
306
294
346
330
318
334
310
320
326
312
322
314
328
316
338
336
324
P
332
308
344
340
280
282
II
II'
350
342
354
358
356
360
348
352

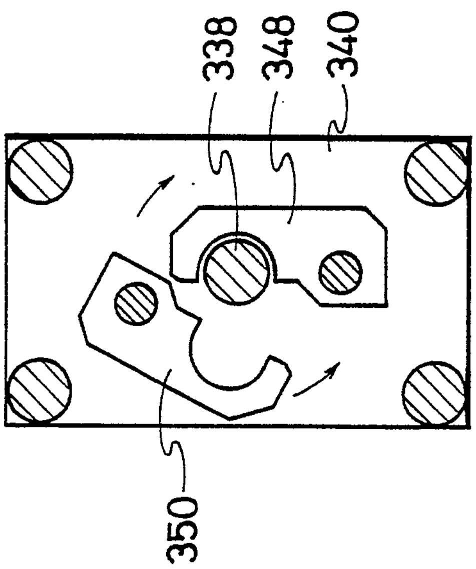


Fig.12

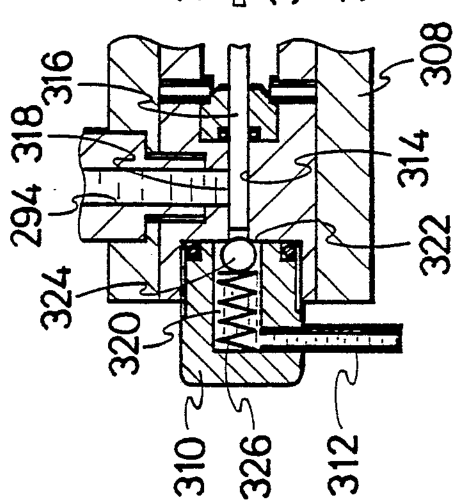


Fig.13A

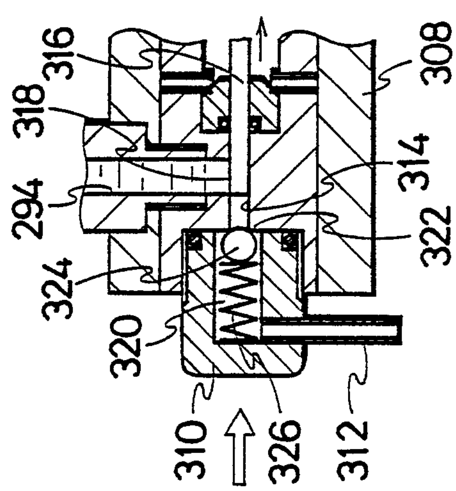


Fig.13B

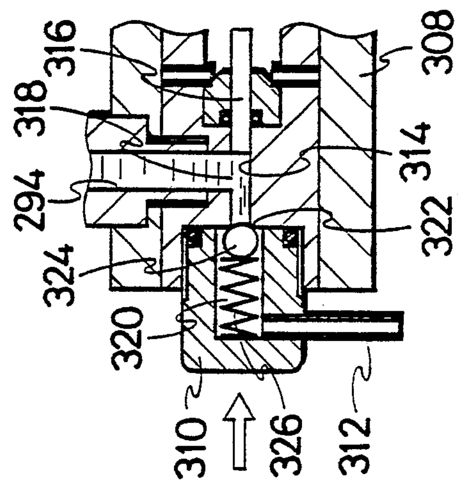


Fig.13C

Fig.14

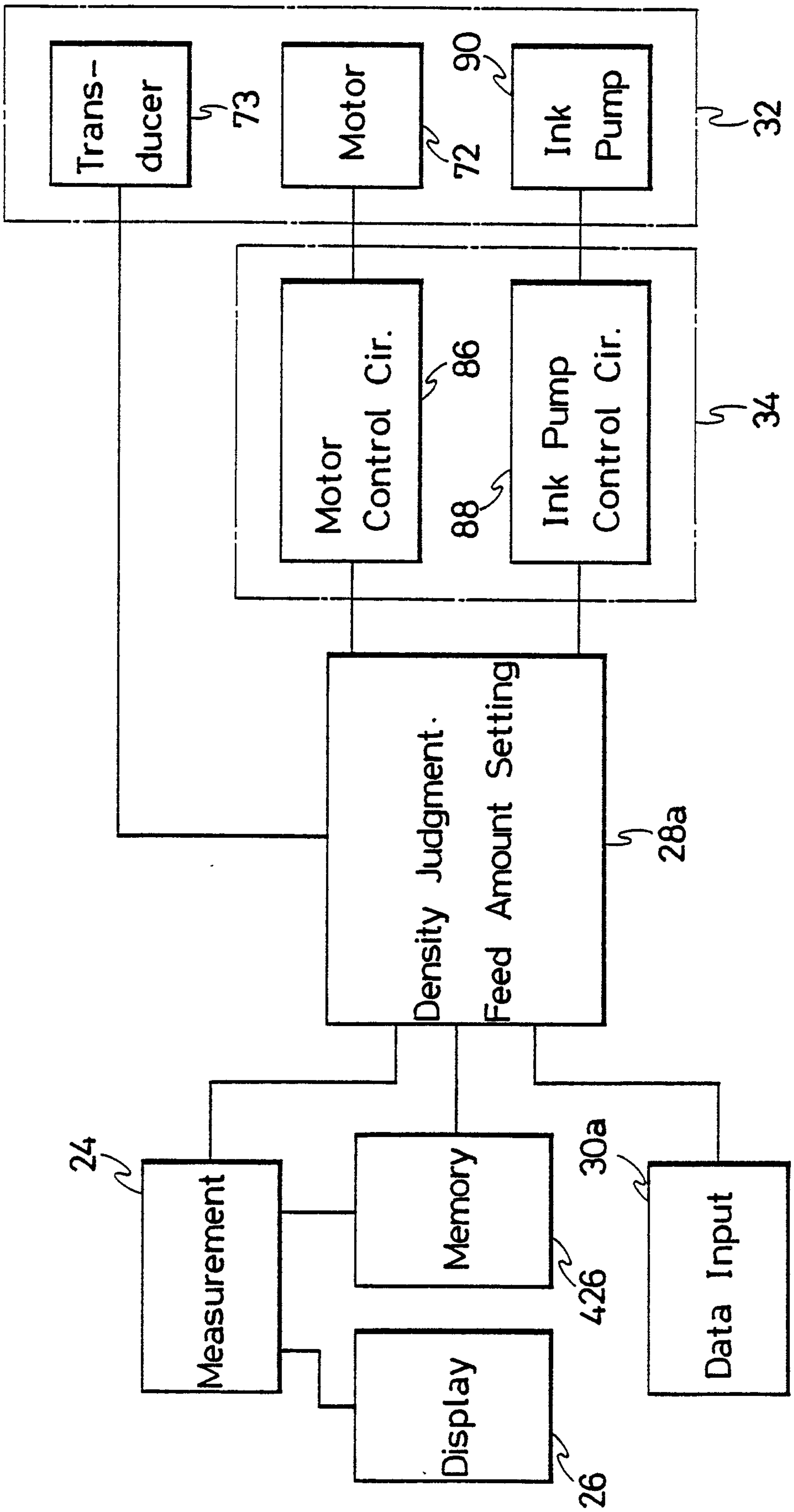

Trans-
ducer
73
Motor
72
90
Ink
Pump
32
Motor
Control Cir.
86
88
Ink Pump
Control Cir.
34
Density Judgment·
Feed Amount Setting
28a
24
Measurement
Memory
426
30a
Data Input
Display
26

Fig.15

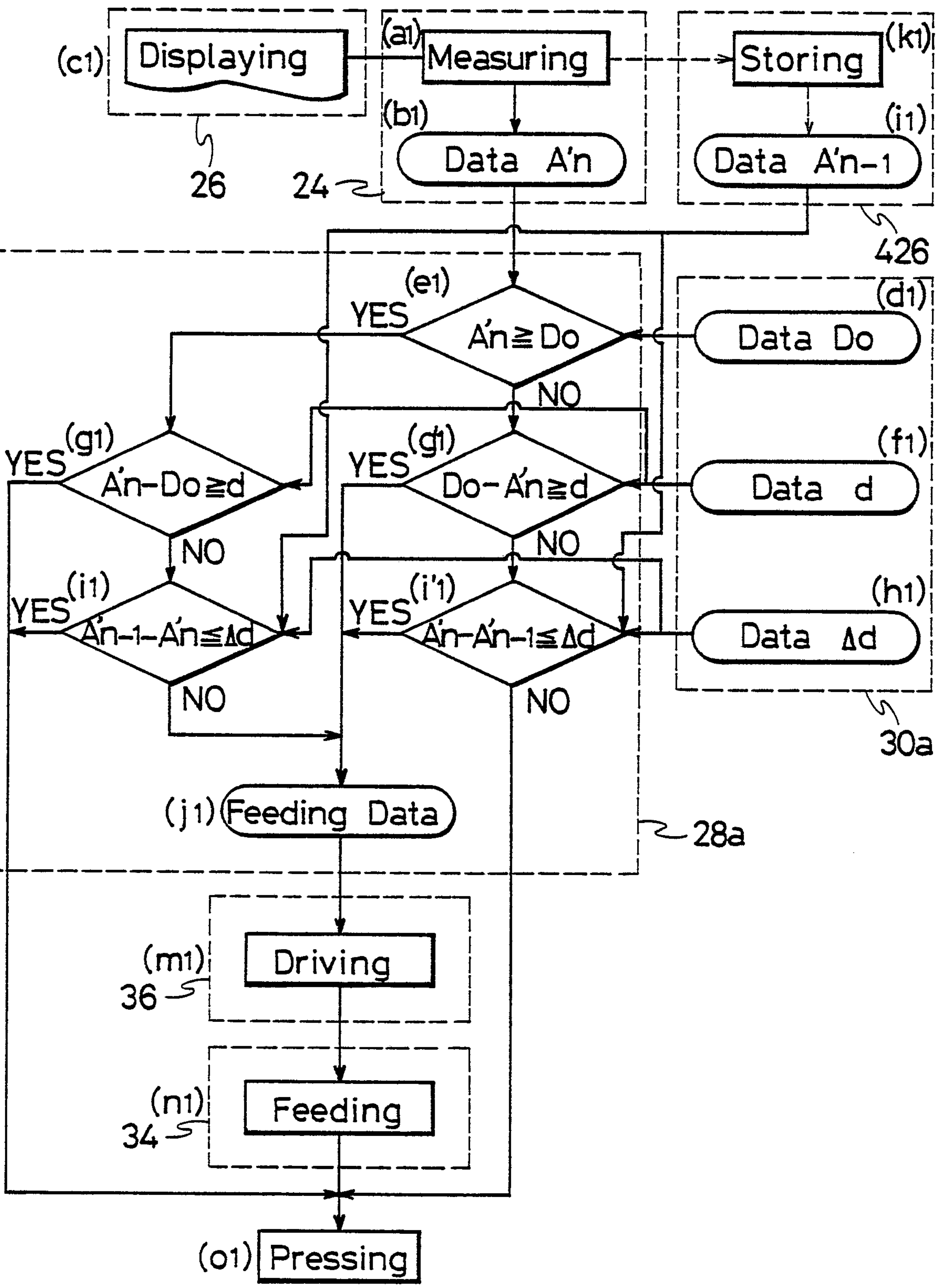

(c1)
Displaying
(a1)
Measuring
Storing
(k1)
(b1)
Data A'n
(i1)
Data A'n-1
26
24
426
(e1)
YES
A'n≧Do
(d1)
Data Do
NO
(g1)
YES
A'n-Do≧d
(g'1)
YES
Do-A'n≧d
(f1)
Data d
NO
NO
(i1)
YES
A'n-1-A'n≦Δd
(i'1)
YES
A'n-A'n-1≦Δd
(h1)
Data Δd
NO
NO
30a
(j1)
Feeding Data
28a
(m1)
36
Driving
(n1)
34
Feeding
(o1)
Pressing

Fig.16

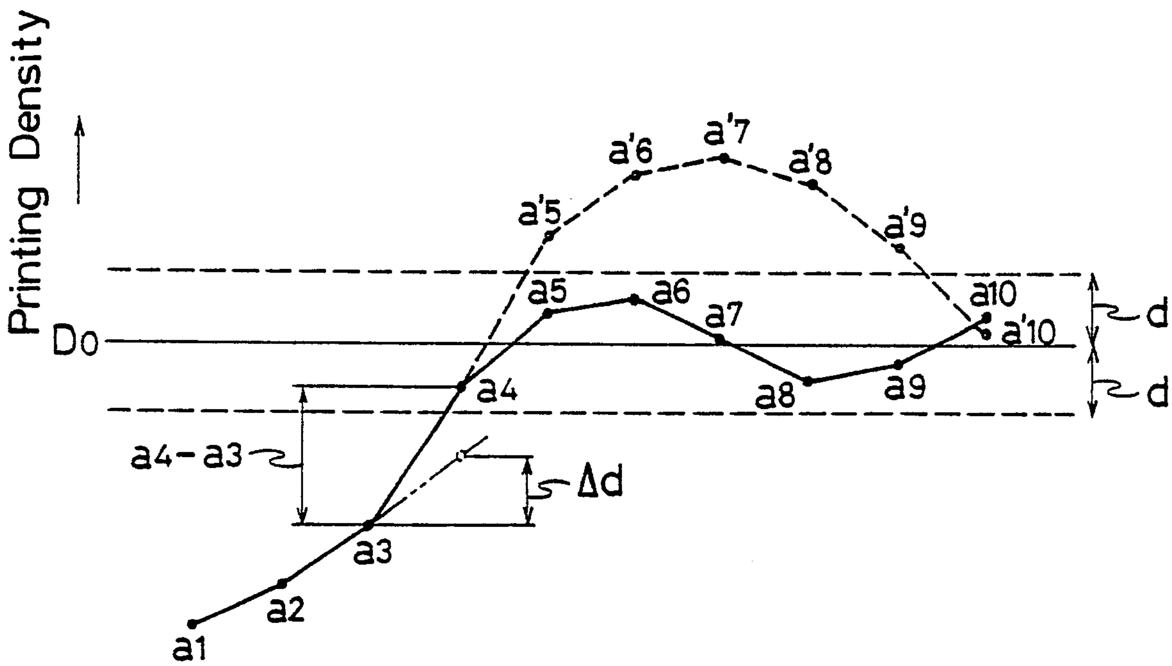

Printing Density
a'5
a'6
a'7
a'8
a'9
a5
a6
a7
a10
a'10
Do
a4
a8
a9
d
d
a4−a3
Δd
a3
a2
a1

Fig.17

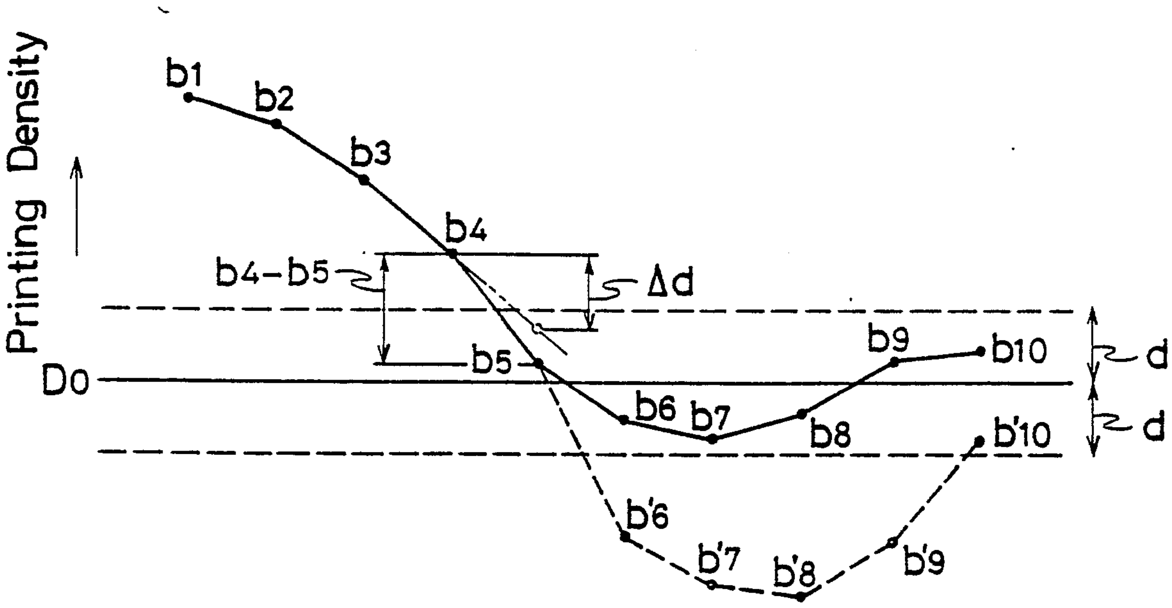

Printing Density
b1
b2
b3
b4
b4−b5
Δd
b5
Do
b6
b7
b8
b9
b10
b'10
d
d
b'6
b'7
b'8
b'9

Fig.18

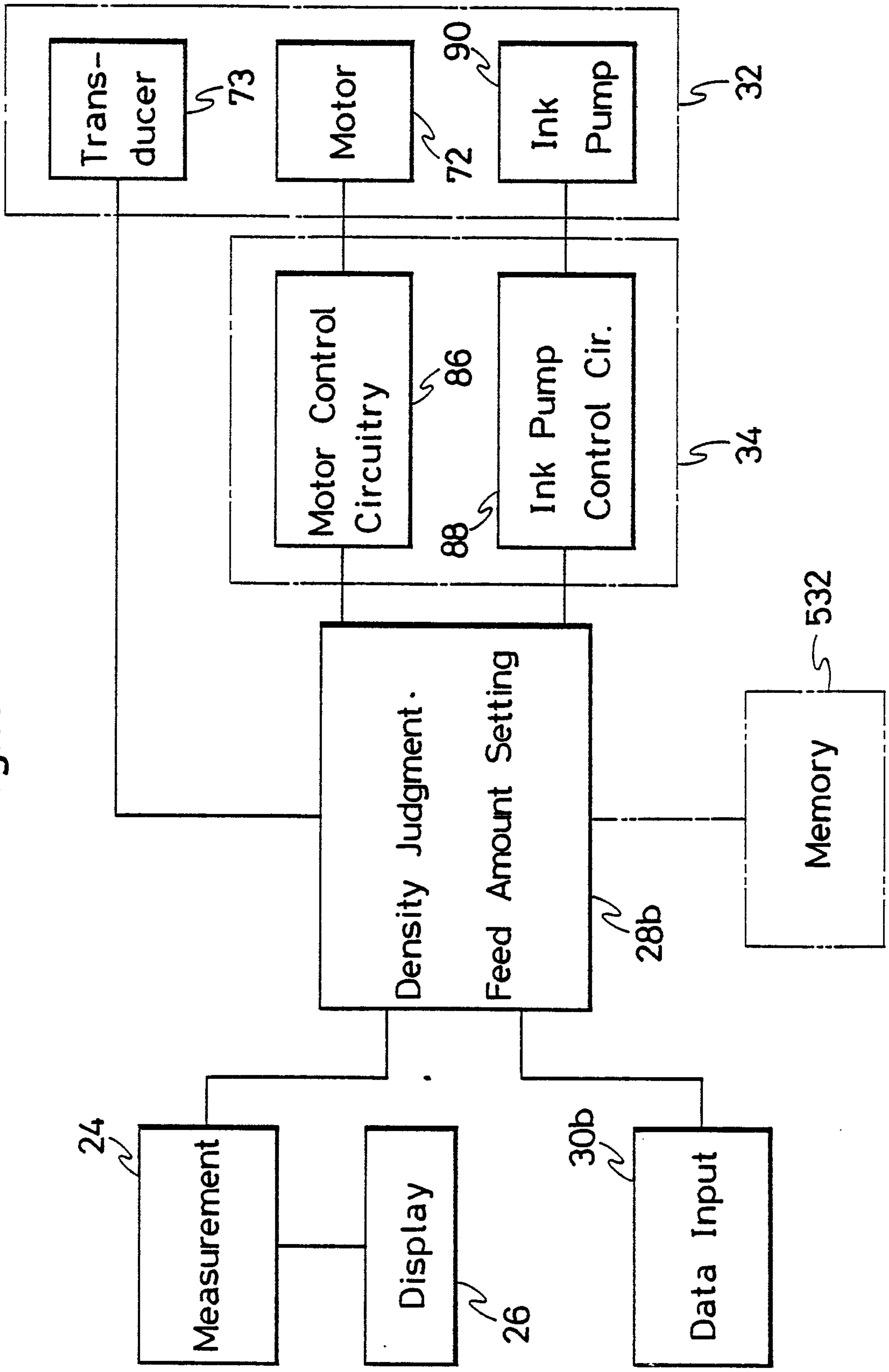

Trans-
ducer
73
Motor
72
90
Ink
Pump
32
Motor Control
Circuitry
86
Ink Pump
Control Cir.
88
34
532
Density Judgment·
Feed Amount Setting
28b
Memory
24
Measurement
Display
26
30b
Data Input

Fig.19

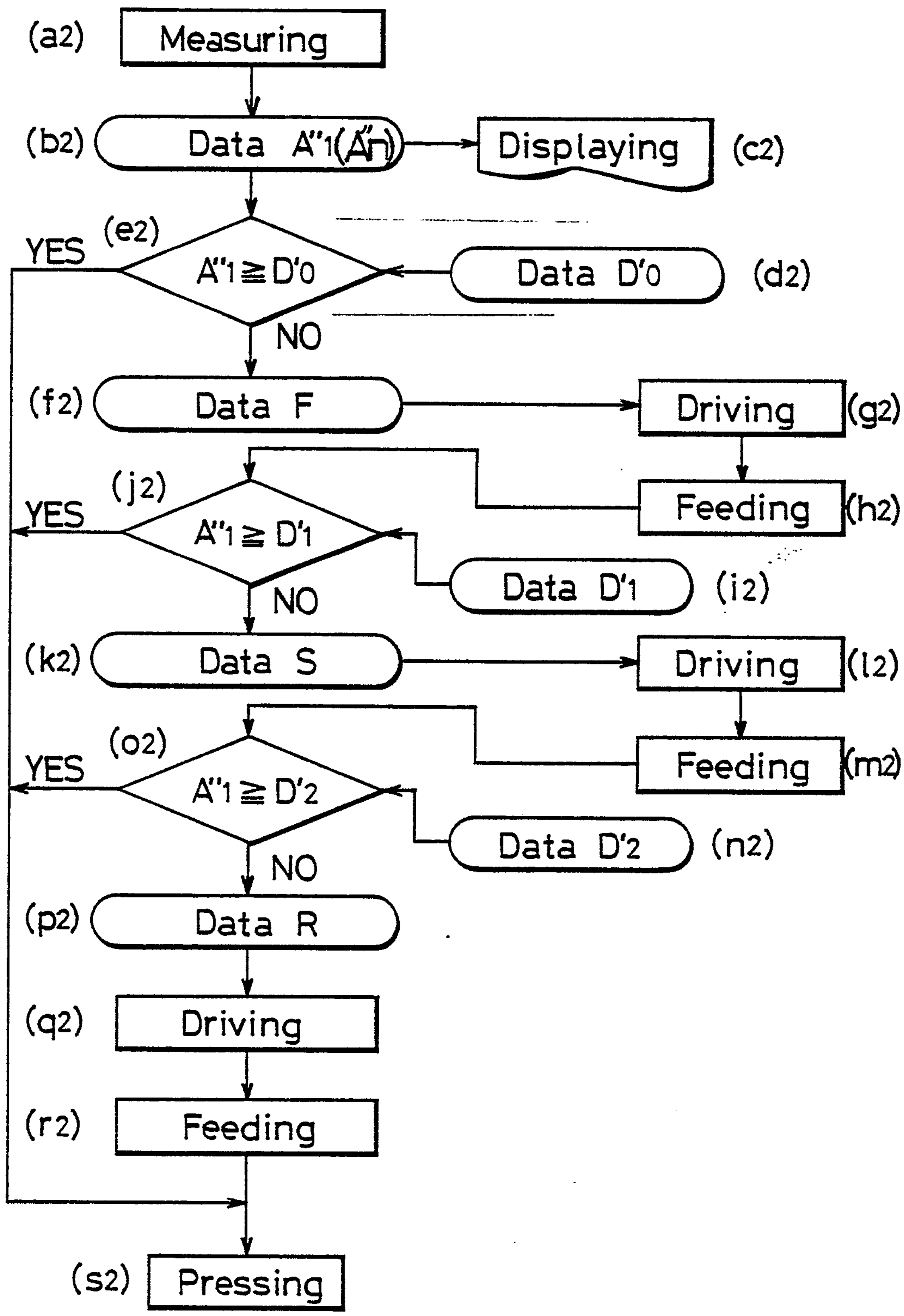

(a2)
Measuring
(b2)
Data A''1(A''n)
Displaying
(c2)
(e2)
YES
A''1 ≧ D'0
Data D'0
(d2)
NO
(f2)
Data F
Driving
(g2)
(j2)
Feeding
(h2)
YES
A''1 ≧ D'1
Data D'1
(i2)
NO
(k2)
Data S
Driving
(l2)
(o2)
Feeding
(m2)
YES
A''1 ≧ D'2
Data D'2
(n2)
NO
(p2)
Data R
(q2)
Driving
(r2)
Feeding
(s2)
Pressing

Fig.20

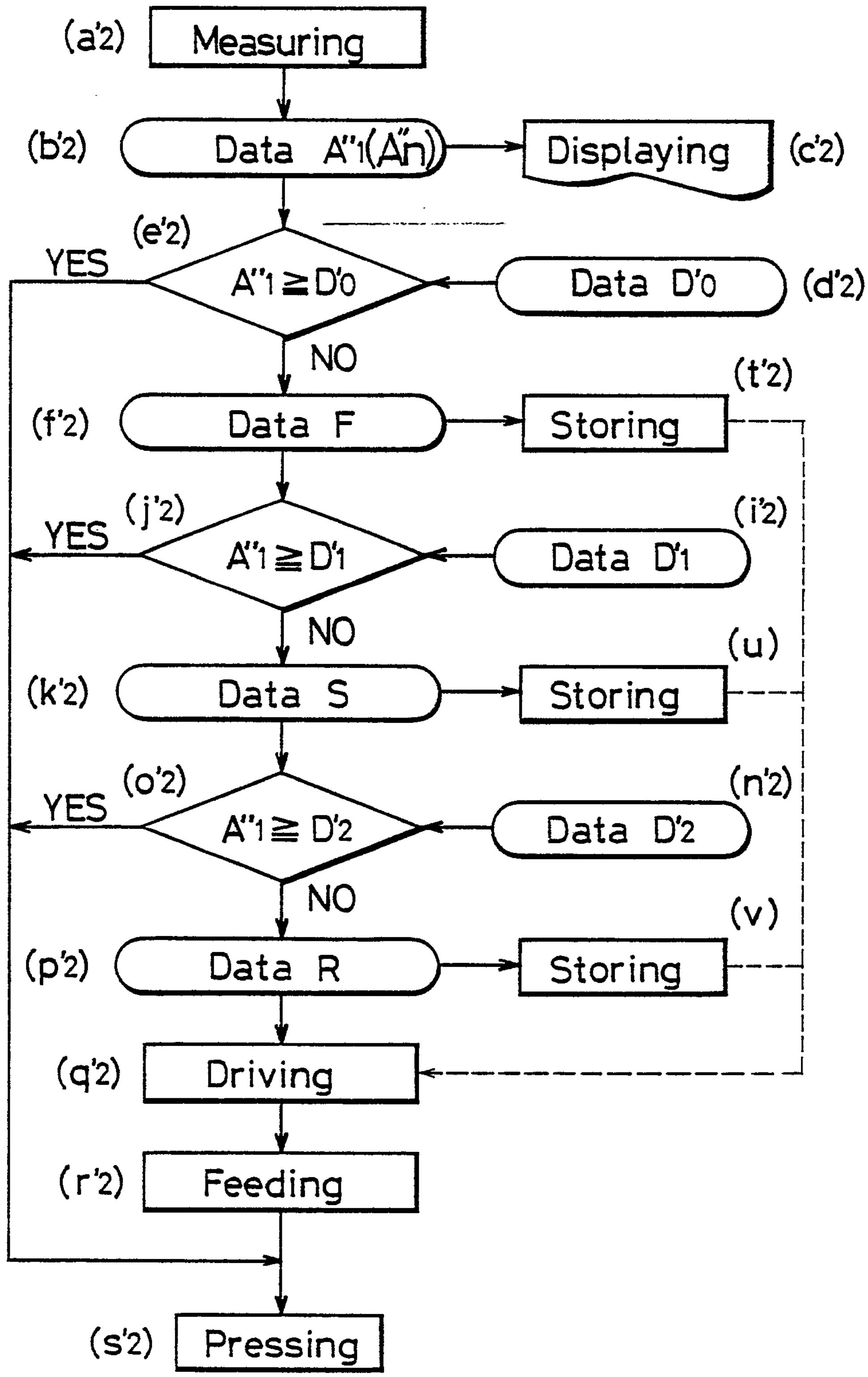

(a'2) Measuring
(b'2) Data A''1(A''n)
Displaying (c'2)
(e'2) A''1 ≧ D'0
YES
NO
Data D'0 (d'2)
(f'2) Data F
Storing (t'2)
(j'2) A''1 ≧ D'1
YES
NO
Data D'1 (i'2)
(k'2) Data S
Storing (u)
(o'2) A''1 ≧ D'2
YES
NO
Data D'2 (n'2)
(p'2) Data R
Storing (v)
(q'2) Driving
(r'2) Feeding
(s'2) Pressing

Fig.21

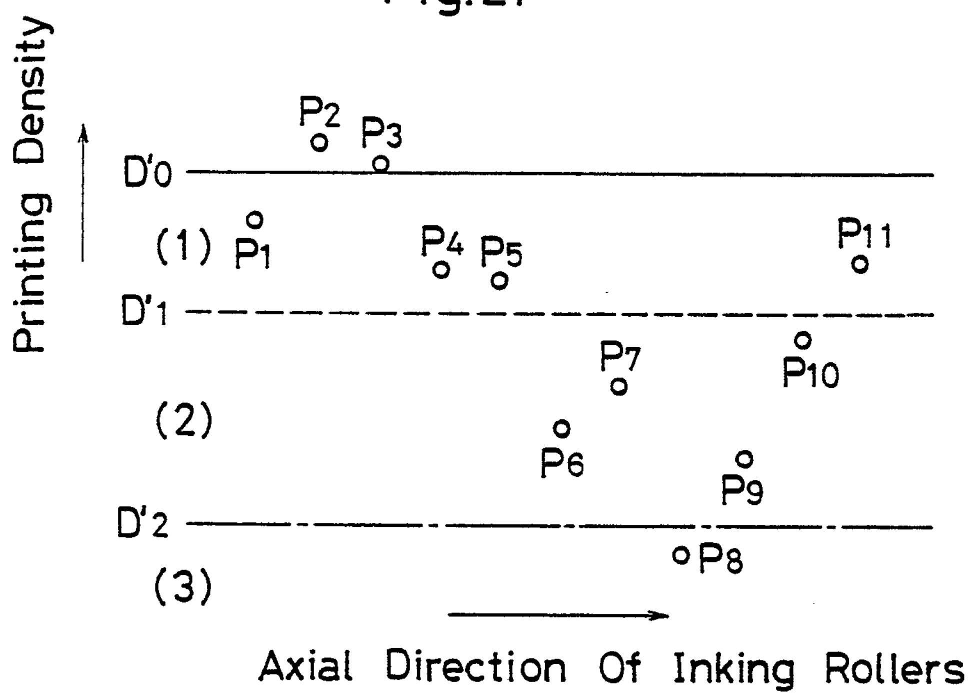
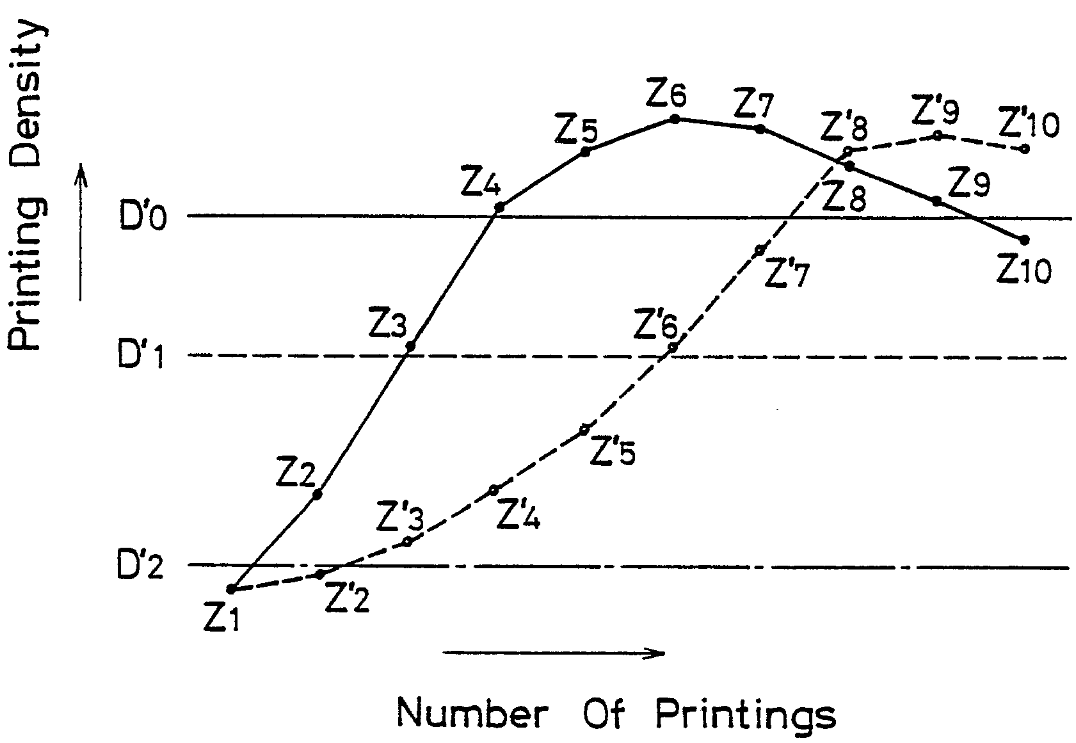

Printing Density
D'0
D'1
D'2
(1)
(2)
(3)
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
Axial Direction Of Inking Rollers

Fig.22


Printing Density
D'0
D'1
D'2
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
Z9
Z10
Z'2
Z'3
Z'4
Z'5
Z'6
Z'7
Z'8
Z'9
Z'10
Number Of Printings