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(54) Improvements in or relating to printing.

(57) A gravure printing press includes an inking device comprising a substantially closed ink duct for containing ink under pressure. The duct is defined by the surface (6) carrying the gravure image, a first trailing doctor blade (41), a sealing member (11) and end seals (7). The duct is divided into a first pressure zone (15) and a second non-pressure zone (16) by a second doctor blade (12) intermediate the sealing member (11) and the first doctor blade (41). Ink is supplied to the duct via the first zone (15) and is removed from the duct via the second zone (16).

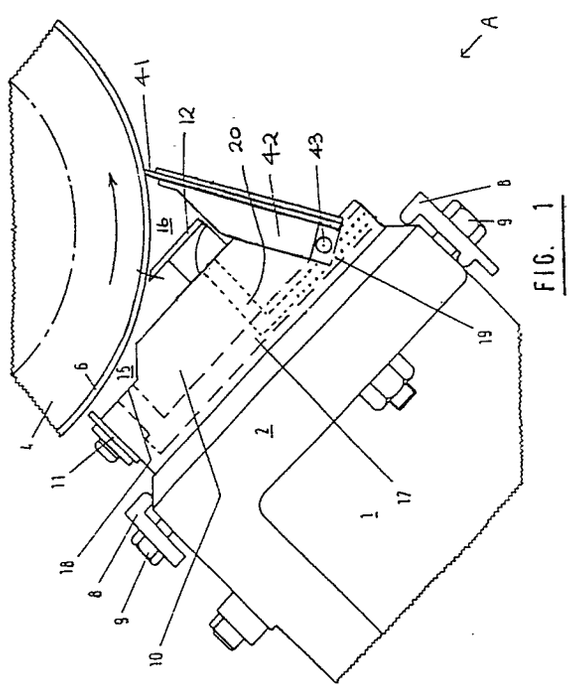

FIG. 1

EP 0 294 022 A1

IMPROVEMENTS IN OR RELATING TO PRINTING

This invention relates to printing and is concerned with a printing press for effecting gravure printing.

In gravure printing, a surface carrying a gravure printing image is used wherein the printing areas comprise a series of individual cells separated from one another by lands constituting the non-printing area. In use, ink is applied to the surface carrying the gravure printing image and the excess ink over and above that which enters the cells is removed by a doctor blade supported by the lands. Thereafter, the material to be printed is pressed against the inked image and ink is transferred from the cells onto the material. The cells vary in size. Thus they may be of constant area and varying depth, of varying area and constant depth, or a combination of the two. Hence there are variations in the quantity of ink held in the cells and these quantity variations enable tonal reproductions to be obtained on the material being printed.

Various methods have been devised for applying ink to the surface carrying the gravure printing image in gravure printing and it is an object of the present invention to provide an improved and more economic inking system for this purpose.

One form of conventional rotary letterpress printing machine for newspaper production includes a plate cylinder which carries a curved metal printing plate cast by stereotyping and including a relief image. In another form the plate cylinder carries a printing plate having a relief image formed by image-wise exposure and development of a photopolymerisable layer. Such printing plates place a limitation on the quality of letterpress newspaper production, and they cannot match the quality achieved by gravure or web-offset printing. The reason for this is that, in printing, pictures are reproduced as a series of dots formed by a screen. Generally, the coarser the screen, the less detailed is the picture. Conventional rotary letterpress machines are in the main restricted to a screen of 65 dots per linear inch. Web-offset and gravure printing allows the use of more than 120 dots per linear inch. Also, a conventional rotary letterpress machine is limited to using a mainly oil based ink which is formulated so as to remain 'open' (i.e. non-drying) on the machine and, as a consequence, it does not dry completely on the newspaper. This is a source of constant complaint by readers of the newspaper. Furthermore, conventional letterpress machines are expensive to operate because of their high energy requirements. This is due in part to the large roller trains which are required to ensure even ink application to the plate cylinder. Proposals have been made for replacing these ink trains with a single engraved drum and, while this does lower the power requirement and optimise the print quality from the printing plates, the overall result is still inferior to gravure or offset systems.

It is another object of the present invention to provide a high speed printing press for newspaper production which avoids the foregoing disadvantages.

Letterpress newspaper printing machines are extremely expensive and a press may have a working life of 25 years or more. Because of the high cost of re-equipping, newspaper production cannot economically take advantage of new printing technology.

It is a further object of the present invention to enable an existing letterpress machine for newspaper production to be converted to a gravure printing machine.

Newspaper production operates to very tight time schedules and requires frequent changes of the printing plates during the printing run to keep the newspaper up to date. It is essential that these changes are carried out as rapidly as possible. A recent development allows gravure plates to be made by a photo-polymerization process in which the image is formed in a polymer layer applied over a steel base sheet. Such plates can be made rapidly and give a high quality image.

It is a still further object of the present invention to provide a high-speed rotary printing machine for the production of newspapers or for other commercial printing purposes which utilises a gravure plate produced by such a photo-polymerisation process.

According to the present invention there is provided a gravure printing press comprising:

(i) a cylindrical surface carrying a gravure printing image,

(ii) a means of rotating said surface about its cylindrical axis,

(iii) an inking device for applying ink to said surface comprising:-

(a) a substantially closed axially extending ink duct for containing ink under pressure, said ink duct being bounded by said surface, by a first axially extending doctor blade in trailing contact with said surface, by an axially extending sealing member and by seals at the axial ends of the duct, said duct including intermediate said first doctor blade and said axially extending sealing member, a second axially extending doctor blade mounted to divide the ink duct into first and second zones,

(b) a means of supplying ink from an ink source to said duct and thence into contact with said surface, and

(c) a means of returning ink from said duct to said source, and

(iv) a means of contacting said surface with material to be printed so as to transfer ink from said surface to the material.

The axially extending sealing member will generally be spaced from the cylindrical surface by as small a distance as possible so that the ink duct is, to all intents and purposes, substantially closed. Typically the gap between the sealing member and the cylindrical surface will be less than 0.5 mm and preferably less than 0.2 mm. However, in some circumstances it may be desirable for the axially extending sealing member to be in contact with the cylindrical surface.

The inking device may be a single device extending along the entire axial length of the cylindrical surface and sealed at the ends of said surface so that it has a width corresponding to the maximum width of the material to be printed. Alternatively, the press may include a plurality of narrower inking devices closely arranged together side by side along the axial length of the cylindrical surface with each device being individually sealed at its ends against the cylindrical surface. This enables the printing of a material narrower than the normal maximum width simply by taking out of service the superfluous device(s) or by removing the superfluous device(s). In this way, the number of inking devices to be used in a given case can be selected in dependence upon the width of the material being printed. Moreover, a particularly useful advantage of this embodiment is that the inking devices may be mounted on the printing press in such a way that they can be readily detached and be replaced by another inking device (together with its ink reservoir containing ink of a different colour and its associated ink feed and discharge pipes) so that different colour printing across the full width of the material is readily facilitated. Moreover, it is particularly preferred for these detachable inking devices to be interchangeable, one with the other, along the axial length of the cylindrical surface to facilitate printing in different colours. Alternatively this can be achieved by feeding different coloured inks to the inking devices without detaching and replacing the devices.

The cylindrical surface carrying the gravure printing image may be in the form of a gravure cylinder. Such may be produced by a photomechanical process in a conventional manner by exposing carbon tissue or other suitable radiation sensitive material to a gravure screen to provide the image to be printed. The material is hardened to a variable degree by the exposure depending upon the amount of light it receives. The exposed material is then transferred to the surface of a copper cylinder and developed so as to selectively remove the radiation sensitive material depending upon the degree to which this material has become hardened during the exposure step. Thereafter, the surface of the copper cylinder is etched to produce the desired cells. The photomechanical resist constituted by the developed material is of differing hardness and thickness and the etchant, e.g. aqueous ferric chloride, breaks through the resist gradually, depending upon the amount of hardening and the thickness, and etches the surface of the cylinder. Those areas of the resist most exposed to light are the most resistant to etching. Thus the copper surface beneath the completely exposed areas, corresponding to the screen, does not etch at all and hence this part of the copper surface forms the lands for the doctor blade to run on. The remainder of the copper surface is etched out in inverse proportion to the amount of light received by the overlying resist and forms the cells of differing depth and/or size.

Alternatively, the surface carrying the gravure printing image may be constituted by a gravure printing plate which has been fixed to a plate cylinder. Such plates may be produced from a radiation sensitive plate comprising a radiation sensitive material coated onto a suitable substrate such as a synthetic resin or a metal sheet. The radiation sensitive material may be a photopolymer in which case the radiation sensitive plate may be produced from the photopolymer by moulding. Any suitable photopolymer may be used and it is particularly preferred to use, as the photopolymer, photosensitive linear polyamides such as those disclosed in British patent specifications No.767,912, No.795,961, No.862,276 and No.875,378. In the use of such photopolymer plates, the photopolymer is image-wise exposed to a continuous tone positive and a half tone screen and the light entering the photopolymer insolubilises it. In those areas which receive most light, there is substantially complete photo insolubilisation and in those areas which receive the least amount of light there remains the greatest proportion of non-photo insolubilised polymer. Thereafter the plate is developed by applying a solvent for the photosensitive polymer so that the remaining photosensitive areas are selectively washed away leaving the insolubilised areas. There is thus obtained a gravure image comprising cells of differing volumes which are capable of receiving different quantities of ink to produce tonal reproductions on printing.

In the case where a gravure printing plate is used, it will be detachably mounted on the plate cylinder by a locking means. The locking means

and the printing plate will preferably be adapted to provide for rapid attachment and detachment of said plate to and from said cylinder whilst providing a smooth and substantially uninterrupted surface for contact with the material to be printed.

The locking means may comprise a modified version of the mechanical plate locking arrangement used to secure the conventional cast stereotypes and photopolymer plates to a plate cylinder.

Where a letterpress printing press is converted to a gravure printing press in accordance with the invention, the ink train associated with the printing press is discarded and the required inking unit is fitted adjacent to the plate cylinder.

The arrangement whereby a printing press is converted to accept a gravure printing plate has in practice substantial advantages. Firstly, the use of a gravure plate produced by the photo-polymerisation process provides higher print quality than the conventional letterpress printing plates. Secondly, the proposed direct inking system eliminates the ink trains used in conventional systems and thereby substantially lowers the energy requirements. Thirdly, the use of a gravure plate will more readily permit the use of water and emulsion-based inks that in turn provide rapid drying, reducing 'rub-off' of the ink and 'strike-through', (penetration of ink through the paper). Both ink mist and noise are substantially reduced, and the requirement for either ink column controls or engraved ink drums is eliminated.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:-

Figure 1 is a side view of a part of an inking device of a printing press in accordance with one embodiment of the present invention,

Figure 2 is a view of the inking device of Figure 1 in the direction A on a reduced scale,

Figure 3 is a drammatic view from underneath of a part of the inking device of Figures 1 and 2,

Figure 4 is a diagrammatic side view of the printing press of Figures 1, 2 and 3 and,

Figure 5 is a diagrammatic side view of a part of a conventional rotary letterpress printing machine for newspaper production.

Referring first to Figure 2, this shows one side only of the press. The other side corresponds and hence has been omitted in the interests of clarity.

The printing press shown in Figures 1 to 4 comprises a pair of side frames 1 (one side frame only being shown) with a rigid cast iron stretcher 2 pivotally mounted between the two. The press includes a printing unit comprising a plate cylinder 4 mounted for rotation about its cylindrical axis 5 in journals 3 carried by the side frames and an impression cylinder 29 similarly mounted for rotation in journals carried by the side frames and located so as to define, with the plate cylinder 4, a nip through which a web 28 of paper to be printed is passed. Cylinders 4 and 29 carry gears 35 and 36 respectively which are meshed together. The press includes a main drive motor 37 which rotates cylinders 4 and 29 via gears 38 and 39. The press may include a plurality of such printing units (not shown) in which case they will all be driven by a suitable drive mechanism in conventional manner by the motor 37.

A printing plate 6 having a gravure printing image is wrapped around the plate cylinder 4 and fixed thereto. The gravure printing image of the printing plate 6 was produced by exposing a photosensitive polyamide coating on a steel substrate to a continuous tone positive and to a half tone screen and then developing the exposed coating.

A plurality of inking devices is included in the printing press to apply ink to the printing image. Two of these are denoted by references B and C (Figure 2). Each inking device is secured to the stretcher 2 by means of retaining plates 8 clamped to the stretcher 2 by bolts 9. Up to four such inking devices are provided and they are mounted on the printing press side by side along the axial length of the plate cylinder 4 or, alternatively, one full width inking device may be present.

Each inking device comprises a body portion 10 carrying an axially extending sealing member in the form of a plastics baffle 11 arranged to fit in close proximity to but spaced from the cylindrical surface of the plate 6 and mounted normally with respect to the surface of the plate 6. The body portion 10 also carries a first axially extending dootor blade 41 which contacts the cylindrical surface of the plate 6 in a trailing disposition with respect to the direction of rotation of the plate cylinder 4. The blade 41 is mounted in a holder 42 which is pivotally attached to the body portion 1 so that it can pivot towards and away from the plate 6 about axis 43. The holder is loaded (by mechanical, hydraulic or pneumatic means) so that the first doctor blade 41 is positively urged against the plate surface 6. A second axially extending doctor blade 12 is also fixed to the body portion 10 so as to be in the reverse angle disposition with respect to the direction of rotation of the plate cylinder 4. (If desired, the second doctor blade 12 could be in the trailing disposition with respect to the direction of rotation of the plate cylinder 4). This blade 12 is flexible and formed, for example, of steel and is displaceably mounted on the body portion 10 so that it can be moved towards or away from the cylindrical surface of the printing plate 6 by suitably rotating an adjusting bolt (not shown). Ordinarily, there will be a small gap (preferably less than

0.5 mm) between the second doctor blade 12 and the cylindrical surface of the plate 6 and once this gap has been set it does not normally need to be altered. The second blade 12 divides the ink duct into a first zone 15 and a second zone 16.

Seals 7 bearing against the plate cylinder are provided at each end of the inking device. The baffle 11 and blade 41, together with the body portion 10 and the surface of the printing plate 6, define an essentially closed ink duct extending along the width of the inking device.

The body portion 10 incorporates an ink feed conduit 17 (shown as a line of dashes in Figures 1 and 2) which terminates in an inlet port 18 in the first zone 15 of the ink duct between the baffle 11 and the second blade 12. The inlet port 18 is positioned approximately midway between the ends of the ink duct. The body portion 10 also incorporates an ink discharge conduit 19 (shown as a dotted line in Figure 1) including branch conduits 20 which terminate in outlet ports (not shown) spaced along the axial length of the second zone 16 of the ink duct. This arrangement enables ink to egress from the second zone 16 of the ink duct wherein the pressure is low.

The free end of the ink feed conduit 17 terminates in a connector 31 (see Figure 2) whereby an ink feed pipe 26 including a throttle valve 61 (see Figure 4) may be detachably connected thereto so that ink can be fed to the duct from a reservoir 22 via a pump 23 and a filter 24. The free end of the ink discharge conduit 19 terminates in a connector 32 whereby an ink discharge pipe 27 (see Figure 4) may be detachably connected thereto so that ink can be conducted back to the reservoir 22.

The first doctor blade 41 has a length such that it extends beyond the end seals 7 and the holder 42 for the first doctor blade 41 includes an air/oil feed conduit 51 (see Figure 3) connected to a pair of branch conduits 52. Each branch conduit terminates in an inwardly directed discharge orifice 53. The free end of the conduit 51 is connected to a feed pipe 54 in communication with a metered supply of air and oil (not shown).

The ink duct is mounted so as to be able to reciprocate in a direction parallel to the axis 5 of the plate cylinder 4. It is mechanically connected by arm 55 to a piston 56 slidably located in a cylinder 57. The cylinder 57 includes ports 58 and 59. The ports 58 and 59 are connected to a supply of hydraulic fluid which can be introduced into the cylinder 57 at alternate sides of the piston 56 via the ports 58 and 59 so as to cause the piston 56 to move from one end of the cylinder to the other in succession and hence reciprocate the first doctor blade 41 with respect to the plate 6. In this way, the speed of reciprocation is constant throughout the travel of the duct but is capable of variation as is the extent of travel.

In use ink, which may be a quick drying ink containing water, is pumped from the reservoir 22 under pressure through the filter 24 and into the first zone 15 of the ink duct via ink feed pipe 26, conduit 17 and port 18. The ink flows between the edge of the second doctor blade 12 and the surface of the plate 6 and into the second zone 16 of the ink duct and thence returns via ports 21, conduits 20 and 19, and ink discharge pipe 27 back to the reservoir 22. The plate cylinder 4 rotates in the direction indicated by the arrow, i.e. in the same direction as the ink flow. The throttle valve 61 in the ink feed pipe 26 is adjusted so that the pump 23 forces a minimal amount of ink past baffle 11 and the second doctor blade 12. The blade 12 defines the boundary of the high pressure zone and meters the ink. The pressure in the first zone 15 ensures that the cells of the gravure printing image of the printing plate 6 are de-aerated and filled with ink. The small amount of ink passing the doctor blade 12 enters the second zone 16 which is very highly vented. Thus the pressure in this second zone 16 is very much less than in the first zone and hence only light pressure needs to be applied to the holder 42, and thence to the first doctor blade 41, in order to ensure that the thin ink film passing the doctor blade 12 is removed from plate 6 by first doctor blade 41. The ink removed from the plate 6 by the first doctor blade 41 is returned to the reservoir 22 via conduits 20 and 19 and pipe 27. Any unwanted ink escaping past the end of seals 7 along the extended doctor blade 41 of the ink duct is deflected back towards the centre of the duct by the air jets emanating from the discharge orifices 53 and is then removed from the duct via conduits 20 and 19 and pipe 27. The air entrains fine drops of oil which lubricate the edges of the first doctor blade 41 where they are in contact with the relatively ink free peripheral area of the printing plate. The ink remaining in the cells is transferred to the web 28 which passes between the plate cylinder 4 and the impression cylinder 29 so that the desired image is printed onto the web. The baffle 11 prevents contaminants entering the duct and also confines the ink within the duct during operation. Access to the plate cylinder 4, for example when fitting the printing plate 6, is facilitated by tripping the inking devices away from the plate cylinder by pivoting the stretcher 2 about the side frames 1.

In the embodiment shown, four inking devices are provided across the width of the printing press and the press is such that it can receive a web which has a width corresponding to four pages, each page being associated with one of the inking devices. In this way, four pages can be printed simultaneously. If, however, it is desired to use a

narrower web and print less than four pages simultaneously, the appropriate number of inking units can be taken out of service or be removed altogether after slackening bolts 9. In this way, only the number of inking devices appropriate to the width of the web being printed are used. If desired, each inking device may contain ink of a different colour so that, for example, four colours can be applied to a four page width web simultaneously. The inking devices are interchangeable so that they may readily be moved axially along the plate cylinder from one position to another as desired to facilitate printing in different colours. Printing in different colours can also be effected by disconnecting the ink feed and ink discharge pipes of a given inking device and connecting the device to ink feed and ink discharge pipes associated with a reservoir containing ink of a different colour.

The press is intended for printing newspapers and typically has been converted from a letterpress machine. The press, prior to conversion, is shown in Figure 5 where parts corresponding to parts of Figures 1 to 4 are denoted by like reference numerals. More particularly, the plate cylinder 4 mounted in side frames 1 is provided with a thick steroeotype or photopolymer letterpress printing plate and receives ink from ink source 22 by means of a train of ink rollers comprising a duct roller 42, rubber rollers 43, oscillating drums 44 and forme rollers 45.

It will be appreciated that, on conversion, the major components of the press, such as the side frames 1, the impression cylinder 29, the press drive, and optionally the plate cylinder 4, are retained and that the ink train is removed and replaced by the inking device in accordance with the present invention. Also, in the case where the conventional plate cylinder 4 is retained, shims are fitted to compensate for the difference in thickness between the gravure plates used in accordance with the invention and the cast stereotype or photopolymer plates conventionally used and the clamping device conventionally used for securing the cast stereotype or photopolymer plates to the plate cylinder 4 is modified to receive the gravure plates. Such a conversion provides a gravure system suitable for a high-speed newspaper press with lower operational costs than a conventional letterpress system and at only a fraction of the replacement cost normally associated with a change in printing technology.

It will be apparent from the foregoing that the invention offers the following advantages over known techniques;

i) it enables letterpress printing presses to be converted to gravure techniques;

ii) it provides the capability of applying ink to detachable gravure plates in one or two-page wide increments, thus enabling economic printing by gravure of partial width webs, i.e. webs less than the normal full width of four pages;

iii) the printing system it proposes has the capability of using oil-based, oil-emulsion, water-emulsion or water-based printing inks; and

iv) it provides a gravure printing system which has the ability to meet the timescales imposed by normal newspaper deadlines.

Although the above described embodiment is primarily a press which has been produced by converting a letterpress machine used for newspaper production, it will be apparent that the press of the present invention may be a completely new press which has not been produced by converting an existing press and that the press of the present invention may be used for printing purposes other than for newspaper production.

Claims

1. A gravure printing press comprising:

a cylindrical surface (6) carrying a gravure printing image,

a means (37,38,39) of rotating said surface (6) about its cylindrical axis,

a means of applying ink to said surface (6), and

a means (29) of contacting said surface with material (28) to be printed so as to transfer ink from said surface (6) to the material (28) characterised in that said means of applying ink to said surface (6) is an inking device comprising:-

(a) a substantially closed axially extending ink duct for containing ink under pressure, said ink duct being bounded by said surface (6), by a first axially extending doctor blade (41) in trailing contact with said surface (6), by an axially extending sealing member (11), and by seals (7) at the axial ends of the duct, said duct including intermediate said first doctor blade (41) and said axially extending sealing member (11), a second axially extending doctor blade (12) mounted to divide the ink duct into first and second zones (15,16),

(b) a means (23,24,61,26) of supplying ink from an ink source (22) to said duct and thence into contact with said surface (6), and

(c) a means (27) of returning ink from said duct to said source.

2. A press as claimed in claim 1 wherein the axially extending sealing member (11) is spaced from the surface (6) by less than 0.5 mm.

3. A press as claimed in claim 1 or 2 wherein the second doctor blade (12) is spaced from the surface (6) by less than 0.5 mm.

4. A press as claimed in claim 1, 2 or 3 wherein said means of supplying ink to said duct is connected to said first zone (15) and the means of returning ink to said source is connected to said second zone (16).

5. A press as claimed in any one of claims 1 to 4 wherein said second doctor blade (12) is in the reverse angle disposition with respect to the direction of rotation of the surface (6).

6. A press as claimed in any one of claims 1 to 5 and including means to reciprocate the inking device in a direction parallel to said cylindrical axis.

7. A press as claimed in claim 6 wherein said means to reciprocate the inking device comprises a piston (56) to which the device is connected, the piston being slidably located in a cylinder (57) including ports (58,59) at alternate sides of the piston (56) for the introduction of fluid into the cylinder (57) to reciprocate the piston (56) within the cylinder (57).

8. A press as claimed in any one of claims 1 to 7 wherein the first doctor blade (41) is mounted in a holder (42) including a means to deflect ink away from the ends of the first doctor blade (41) and towards the centre of the ink duct.

9. A press as claimed in claim 8 wherein said means to deflect ink comprises orifices (53) for discharging air.

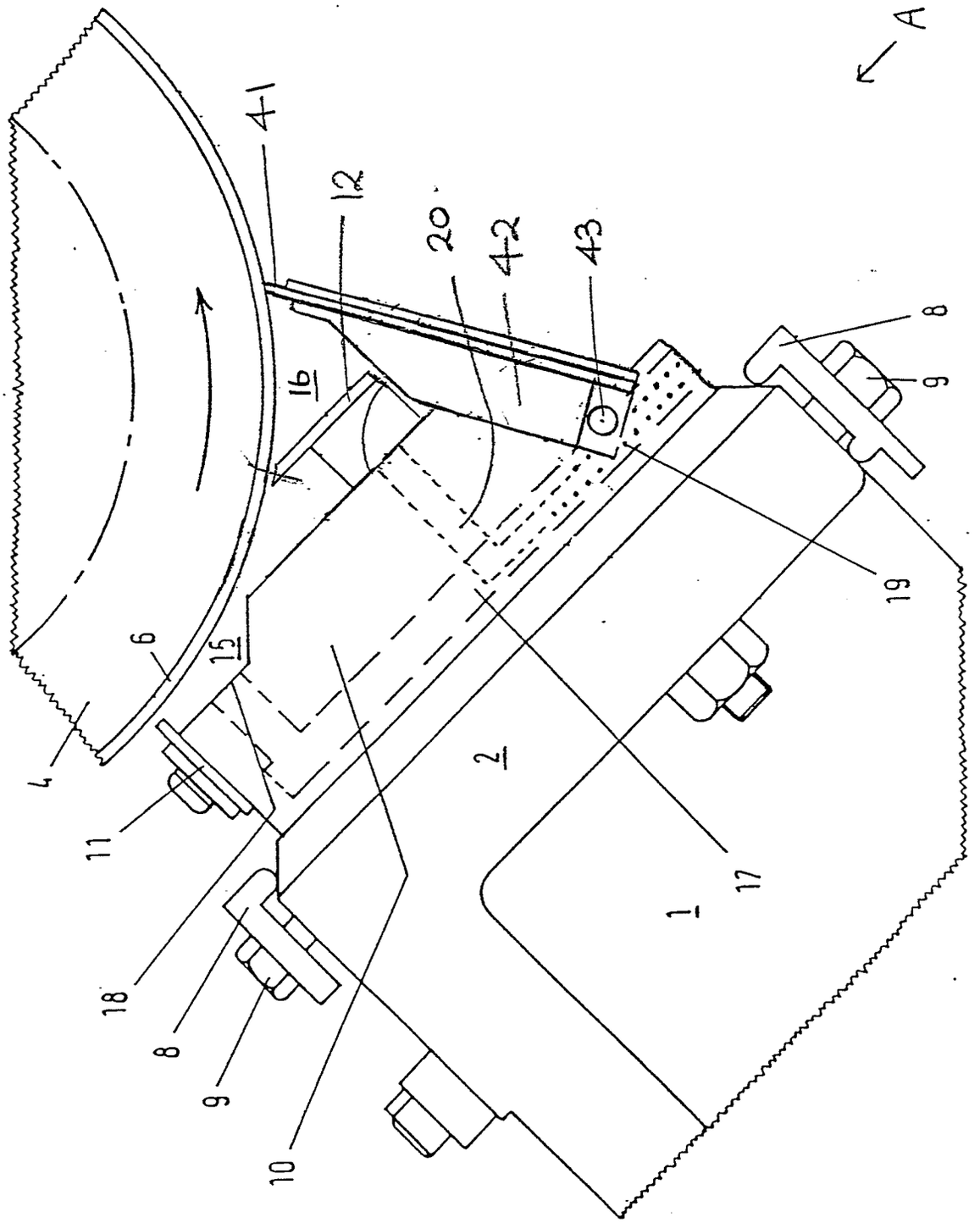

FIG. 1

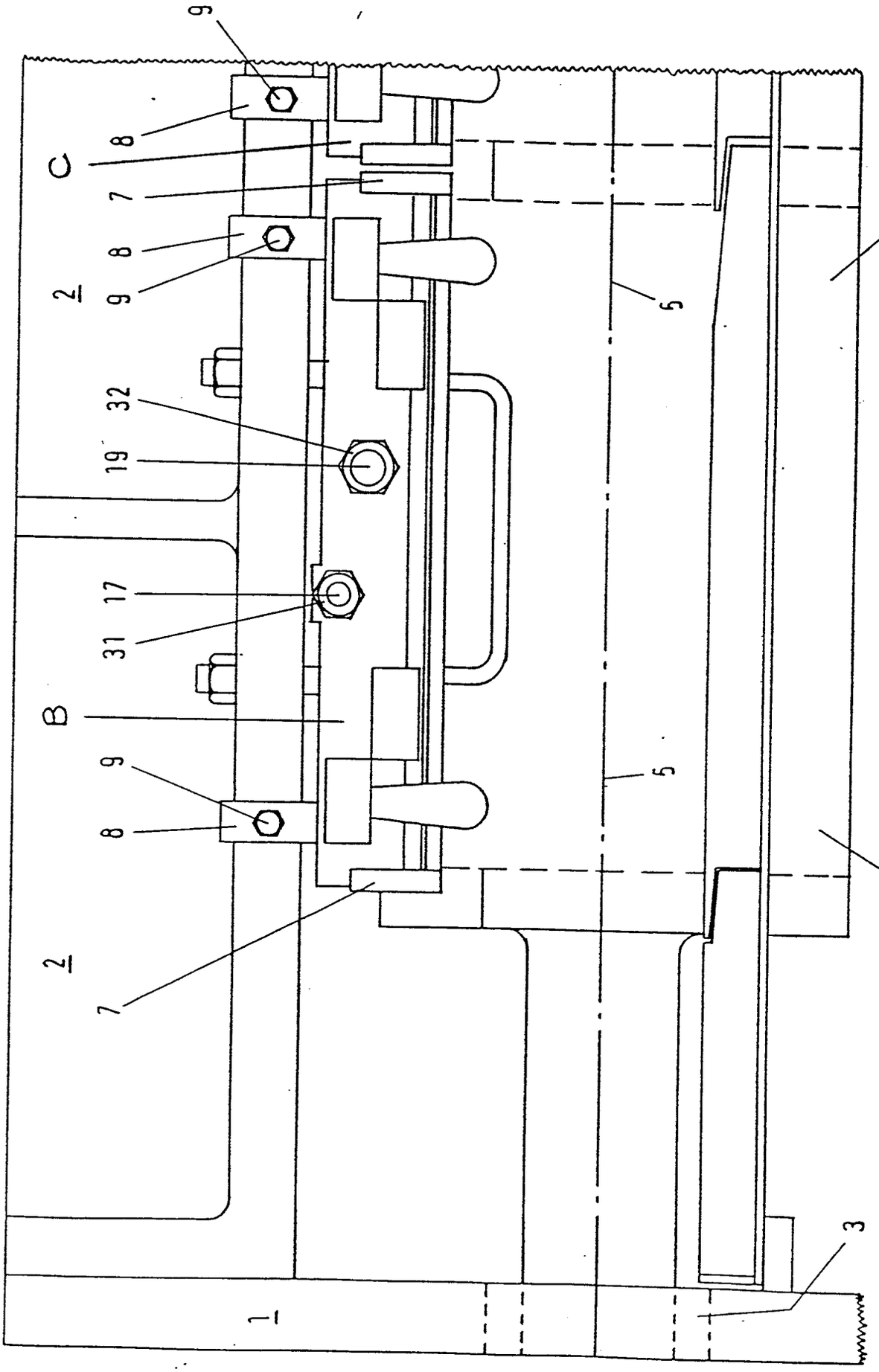

FIG. 2

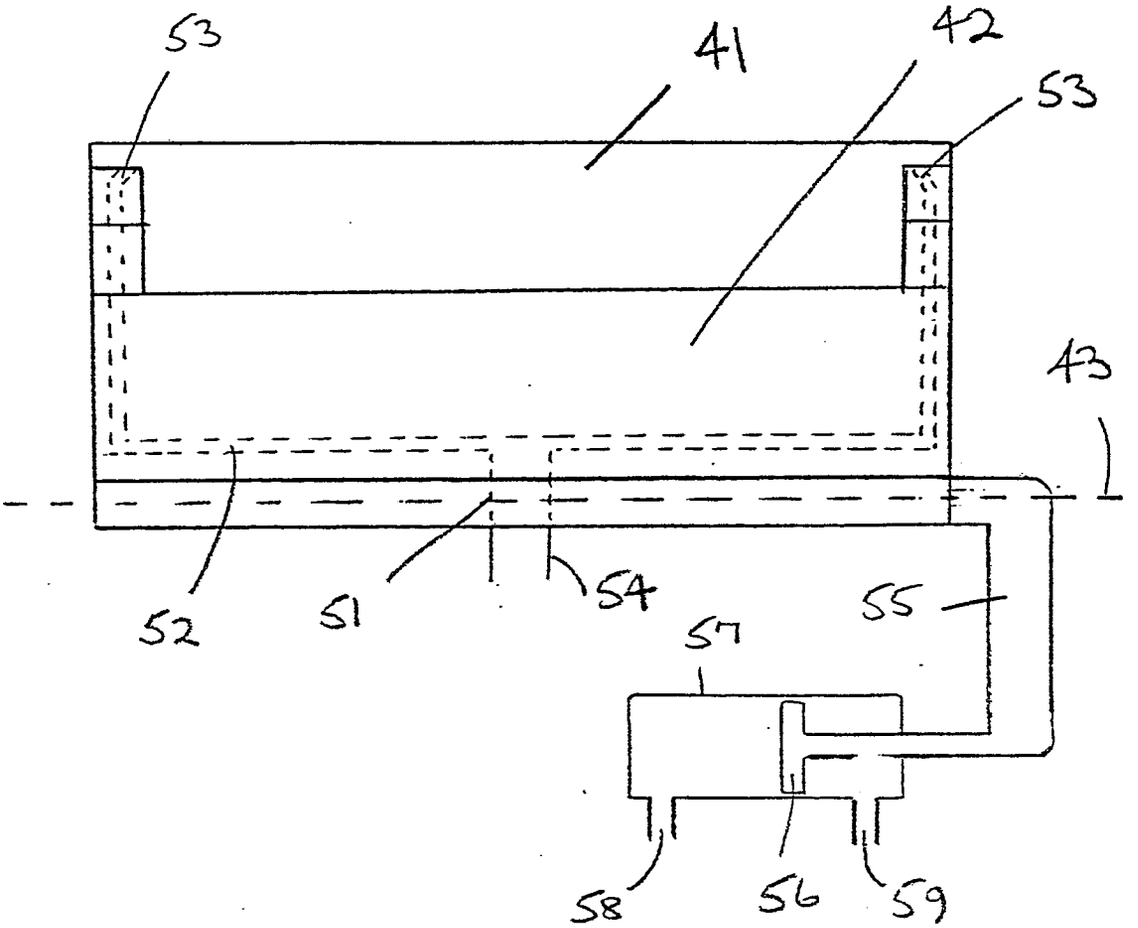

FIG. 3

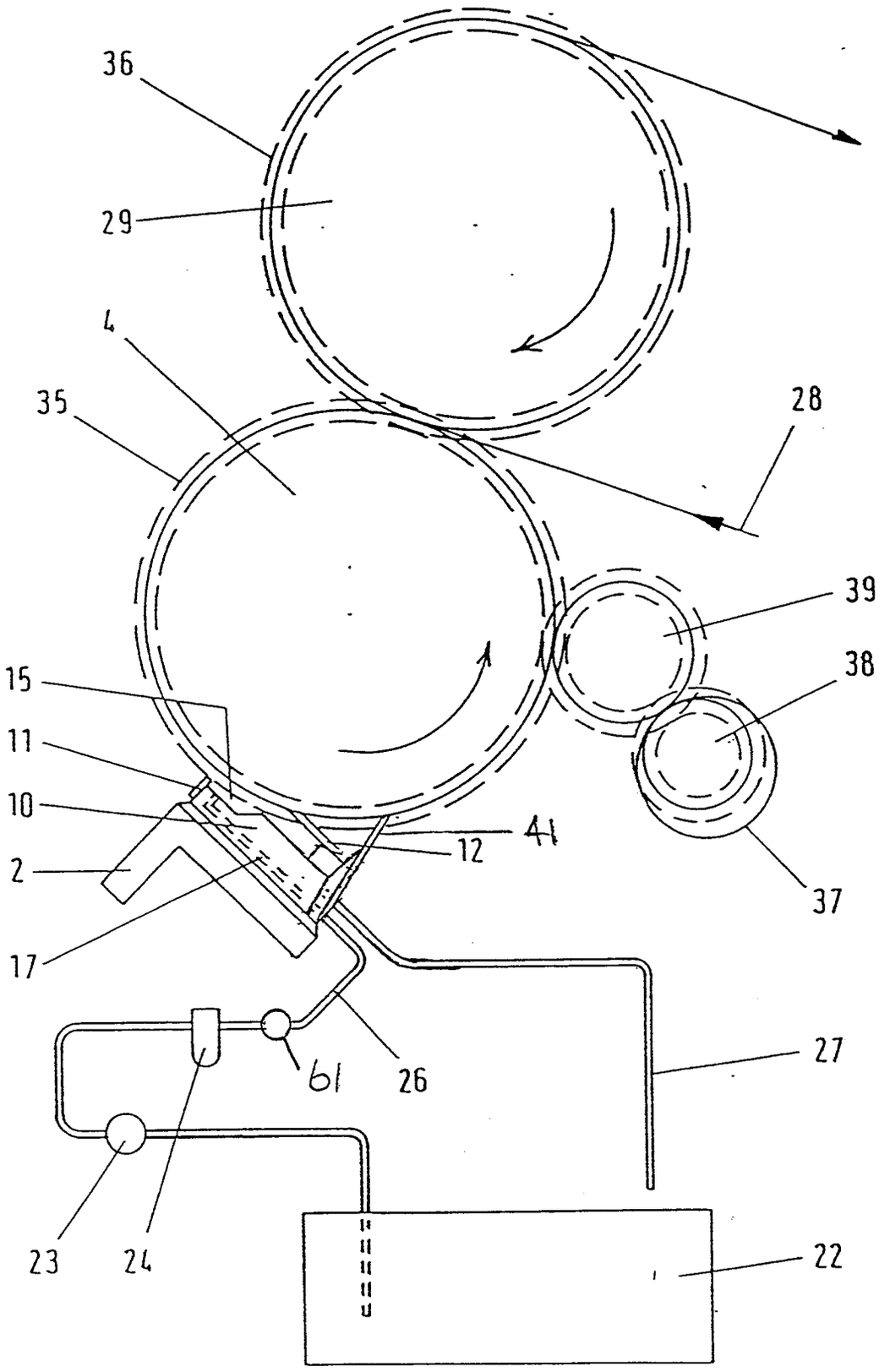

FIG. 4

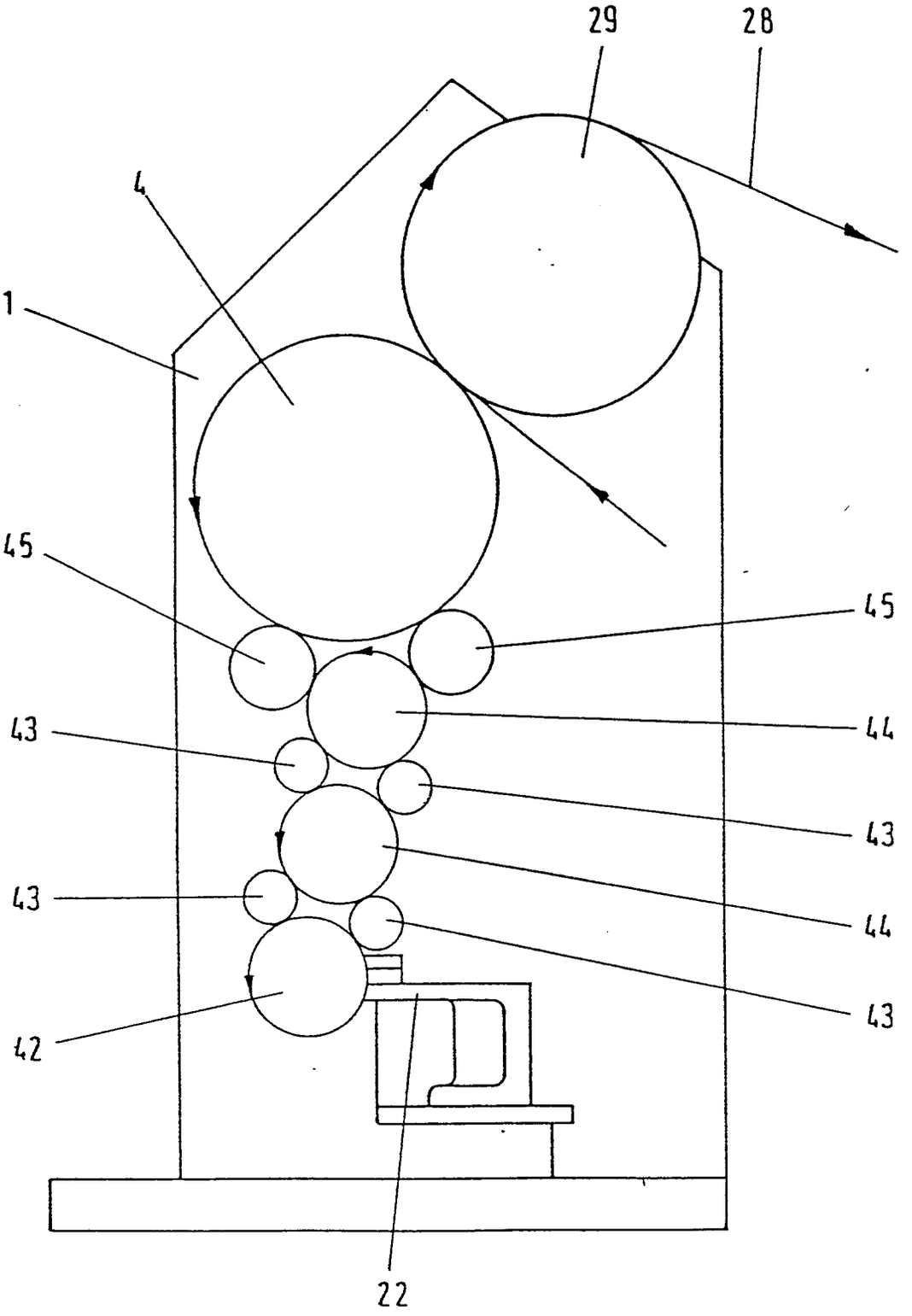

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 3175

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	GB-A-2 032 852 (VEB KOMBINAT POLYGRAPH) * Whole document *	1-4	B 41 F 9/06
Y	EP-A-0 199 520 (VICKERS) * Whole document *	1-4	
Y	FR-A-2 477 969 (MASCHINENFABRIK WIFAG) * Whole document *	1-4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 41 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-09-1988	EVANS A.J.

CATEGORY OF CITED DOCUMENTS

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