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(54) An infeed mechanism for a paper press or the like

(57) In presses for printing on a continuous web of paper, various units disposed in series are driven in synchronisation by a line-shaft, and an infeed friction cylinder has been driven independently by an electric motor so controlled by sensors as to modulate the rotation ratio between the line-shaft and the friction cylinder to control lengthwise stretching of the web, and also control the position or phase of the web when it is re-inserted for subsequent printing. Accuracy has been limited by the independent friction cylinder drive and also by transmission errors in the sensor drives. Superior accuracy is achieved by driving the friction cylinder 50 directly from the line-shaft 54 by way of a phase-shifting gearbox 72 in series with a bevel gearbox 74, the phase-shifting gearbox additionally being driven by an electric servomotor 102 controlled by a first position encoder 98 driven directly by the line-shaft and a second position encoder 100 driven directly by the friction cylinder so as to modulate the rotation ratio, and also controlled by marks printed on the web 38 and by a reference point on a gear driven directly by the line-shaft so as to synchronise the position of the web.

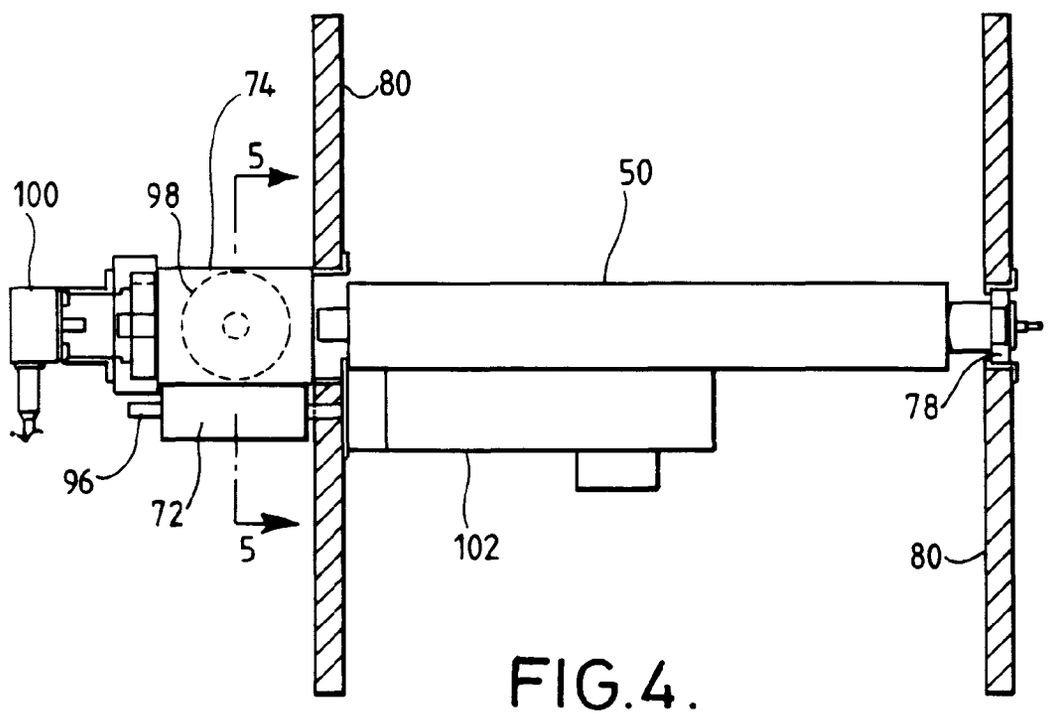

FIG.4.

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Description

This invention relates to an infeed mechanism for a paper press or the like, hereinafter referred to as a press, and particularly for a press designed to print a repeated pattern on a continuous web of paper and/or to process such web by, for example, repeatedly sprocket hole punching, perforating, and rolling, folding, or cutting it. A typical but not exclusive product of such a press is multiple copy business forms.

Such a press has a line-shaft for driving its printing and/or processing units in synchronisation, and also a web infeed mechanism with two functions. The first function is to control lengthwise stretching of the web of paper on an initial pass through the machine by carefully modulating the rotation ratio between the line-shaft and a friction cylinder of the infeed mechanism around which the web passes without slipping. This ratio control is responsible for determining the page length of the web when measured in its relaxed condition. The second function of the infeed mechanism is to control the position or phase of the web of paper when it is re-inserted for subsequent printing. This effectively positions the new print relative to the existing print.

Hitherto, the friction cylinder of the infeed mechanism has been driven independently by an electric motor so controlled as to regulate all aspects of the paper feed, that is to say both phase-synchronising and speed. The necessary signals for controlling the motor have been provided by a microprocessor-based combined phase-synochronising and ratio-modulating controller. Due to the independent nature of the friction cylinder drive, and also to other transmission errors, for instance in toothed belt drives hitherto employed, this existing arrangement has only been able to control the accuracy of the aforesaid functions to within about 0.5 millimetres.

The object of the present invention is to provide an improved infeed mechanism which is able to control said functions with superior accuracy.

According to one aspect of the invention, in an infeed mechanism for a paper press or the like having a line-shaft for driving various units of the press and an infeed friction cylinder driven in timed relationship with the line-shaft, the friction cylinder is arranged to be driven directly from the line-shaft.

Preferably, the friction cylinder is driven from the line-shaft by way of a phase-shifting gearbox in series with a bevel gearbox.

Preferably, also, the friction cylinder is supported between the output shaft of the bevel gearbox and a bearing mounted in the frame of the press.

Preferably, the phase-shifting gearbox comprises epicyclic gearing having an annulus with a wormwheel on its periphery and a worm meshing with the wormwheel, the worm being on an additional drive shaft of said gearbox.

Preferably, also, the epicyclic gearing effects a reduction in speed and the bevel gearbox effects an increase in speed of the same order.

Preferably, a first position encoder is driven directly by the line-shaft and a second position encoder is driven directly by the friction cylinder.

The second encoder may be driven from the friction cylinder by way of the output shaft of the bevel gearbox.

The phase-shifting gearbox is preferably additionally driven by an electric servo-motor so controlled by the first and second encoders as to modify the speed of the rotation imparted to the friction cylinder by the line-shaft.

Preferably, also, the electric servo-motor is controlled by output signals from a combined phase-synchronising and ratio-modulating controller which receives ratio-modulating input signals from the first and second encoders.

Preferably, also, the combined phase-synchronising and ratio-modulating controller also receives phase-synchronising input signals sensed from marks printed on the web and from a reference point on a gear driven directly by the line-shaft.

According to another aspect of the invention, a paper press of the so-called Morgan type is provided with an infeed mechanism according to any one of the preceeding ten paragraphs.

A preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings of which:-

Figure 1 is a semi-diagrammatic side elevation of the input half of a paper press of so-called Morgan type;

Figure 2 is a corresponding elevation of the output half of said press;

Figure 3 is an elevation of an improved web infeed mechanism for said press viewed from the opposite side to Figure 1;

Figure 4 is an end elevation of the improved web infeed mechanism viewed from the input end of the press; and

Figure 5 is a diagrammatic section on the line 5-5 in Figure 4 through a phase-shifting gearbox forming part of said infeed mechanism.

Referring now to Figures 1 and 2 of the drawings, a known paper press of the so-called Morgan type is built up from a series of units comprising an unwind unit 10, a web guide unit 12, an infeed unit 14, an infeed tower base unit 16, a basic tower base unit 18, a tower-plus-motor-drive base unit 20, a process unit 22, a folder/tension unit 24, and a rewind unit 26. A control console 27 is mounted on the units 24 and 26. Each of the tower base units 16, 18 and 20 carries an identical offset litho print tower 28, and more than one basic tower base unit 18 can be provided depending on the number of different colours to be printed in one pass. In known manner, each print tower 28 includes an ink duct 30 from which ink is transferred through a series of cylinders in-

dicated generally at 32 to a plate cylinder 34 which takes up the ink selectively over its surface and transfers it to a blanket cylinder 36 which transfers it in turn to the web 38 of paper as it passes between the blanket cylinder 36 and an impression cylinder 40. The plate cylinder 34 and the blanket cylinder 36 are mounted in knowm manner in a quick-change cartridge (not shown). In the unwind unit 10, the web 38 is drawn from a roll 42 through a festoon arrangement of cylinders indicated generally at 44 which includes dancing rolls 46 moveable vertically by changes in tension in the web. This movement pneumatically controls a brake (not shown) for the roll 42 so as to keep the unwinding tension constant. The web guide unit 12 includes an electronic eye (not shown) which senses one edge of the web 38 as it passes over a table 48 and in known manner controls the correction of any misalignment. The infeed unit 14 includes an infeed friction cylinder 50 around which the web 38 passes without slipping, thereby drawing the web from the roll 42, to which end said cylinder is sprayed with metal and then lightly ground so that its periphery remains rough although its diameter is extremely accurate. The friction cylinder 50 forms part of an improved infeed mechanism hereinafter described which constitutes the present invention. A web turnover mechanism 52 mounted in the infeed tower base unit 16 can turn the web 38 over in known manner if so desired after the first printing operation. The tower-plus-motor-drive base unit 20 houses drive means (not shown) for a sectional line-shaft 54 (see Figures 1 and 3), said means comprising an electric motor, pulleys and a toothed belt. The line-shaft 54 conventionally supplies synchronised drive to all of the units 16, 18, 20, 22 and 24. The friction cylinder 50 operates in accordance with known general principles whereby the ratio of its rotational speed relative to that of the line-shaft 54 is modulated to control lengthwise stretching of the web 38, and its angular position relative to that of the line-shaft 54 is adjusted to control the the phase of the web 38 when it is re-inserted for a second or subsequent passes through the press in order to position the new print relative to the existing print. However, in this case the line-shaft 54 uniquely supplies drive to the infeed unit 14 as will be hereinafter described. The process unit 22 includes a sprocket hole punching mechanism 56 and two perforating cylinders 58 and 59 running against respective anvil cylinders 60 and 61. The cylinder 61 acts as a metering cylinder for pulling the web 38 through the press in a controlled manner, to which end it runs against rubber nip rollers. The folder/tension unit 24 includes a web tension control cylinder 62 after which there is disposed an optional folding station (not shown). The rewind unit 26 comprises a roll 64 driven by an independent electric motor (not shown) which, if rolling rather than folding is required, draws the web 38 from the tension control cylinder 62 around a dancing roll 66 moveable vertically by changes in tension in the web. This movement regulates the speed of the motor which drives the roll 64. A brake (not shown) which is controlled manually by way of a potentiometer acts on a cylinder 68 so as to regulate the rewinding tension.

Referring now to Figures 3 to 5 of the drawings, an improved web infeed mechanism comprises, in addition to the friction cylinder 50, an extension 70 of the line-shaft 54 which drives the friction cylinder directly by way of a phase-shifting gearbox 72 which is close-coupled in series with a bevel gearbox 74. The output shaft 76 of the bevel gearbox 74 projects from both sides thereof, and the friction cylinder 50 is supported between one end of the shaft 76 and a bearing 78 mounted in one of the side frames 80 of the press. The phase-shifting gearbox 72 comprises epicyclic gearing consisting of a sun wheel 82 driven by the line-shaft extension 70, a plurality of planet pinions 84, say six as shown, which mesh with the sun wheel 82 and are rotateably mounted on a planet carrier 86 which drives the input shaft 88 of the bevel gearbox 74, and an internally-toothed annulus 90 which meshes with the planet pinions 84. A wormwheel 92 is formed on the periphery of the annulus 90, and a worm 94 which meshes with the wormwheel is formed on an additional or subsidiary drive shaft 96 of the phase-shifting gearbox 72. The epicyclic gearing of the gearbox 72 effects a reduction in speed of 3 to 1 to avoid overspeeding of the planet pinions 84, and the bevel gearbox effects an increase in speed of 1 to 3 to restore the status quo. A first position encoder 98 is driven directly by the line-shaft extension 70, and a second position encoder 100 is effectively driven directly by the friction cylinder 50 by way of the other end of the output shaft 76 of the bevel gearbox 74. The additional drive shaft 96 of the phase-shifting gearbox 72 is driven by an electric servomotor 102 which is controlled by output signals from a combined phase-synchronising and ratio-modulating controller (not shown) which receives ratio-modulating input signals from the first and second encoders 98 and 100 whereby the speed of the rotation imparted to the friction cylinder 50 by the line-shaft extension 70 is continuously modified or trimmed. The combined phase-synchronising and ratio-modulating controller also receives phase-synchronising input signals sensed in known manner from equally-spaced marks printed on one margin of the web 38 and from a reference point on a gear (not shown) driven directly by the line-shaft 54, whereby the web is positioned to align new and existing printing. Said gear is crowded into mesh with a mating gear (not shown) on the line-shaft 54 to eliminate backlash.

By virtue of the direct mechanical drive between the line-shaft 54 and the friction cylinder 50, the improved infeed mechanism is able to control ratio-modulating and phase-synchronising to within about 0.1 millimetres. This degree of accuracy is aided by the direct drives between the line-shaft 54 and the first encoder 98, and between the friction cylinder 50 and the second encoder 100, as well as between the line-shaft and the gear bearing the reference point, which eliminate transmission errors from the associated measurements.

In a modification, the second encoder 100 is driven directly from that end of the friction cylinder remote from the bevel gearbox 74. In another modification, the brake in the rewind unit 26 for regulating the rewinding tension is controlled automatically instead of manually. In a further modification, a press according to the invention has no print towers and base units therefor, but is simply designed for the dedicated processing of a continuous web of paper by, for example, repeatedly sprocket hole punching, perforating, and rolling, folding or cutting it. In a complementary modification, a press is simply designed to print without performing any such processing.

Claims

1. An infeed mechanism for a paper press or the like having a line-shaft for driving various units of the press and an infeed friction cylinder driven in timed relationship with the line-shaft, wherein the friction cylinder is arranged to be driven directly from the line-shaft.

2. An infeed mechanism according to claim 1, wherein the friction cylinder is driven from the line-shaft by way of a phase-shifting gearbox in series with a bevel gearbox.

3. An infeed mechanism according to claim 2, wherein the friction cylinder is supported between the output shaft of the bevel gearbox and a bearing mounted in the frame of the press.

4. An infeed mechanism according to claim 2 or claim 3, wherein the phase-shifting gearbox comprises epicyclic gearing having an annulus with a wormwheel on its periphery and a worm meshing with the wormwheel, the worm being on an additional drive shaft of said gearbox.

5. An infeed mechanism according to claim 4, wherein the epicyclic gearing effects a reduction in speed and the bevel gearbox effects an increase in speed of the same order.

6. An infeed mechanism according to any one of claims 2 to 5, wherein a first position encoder is driven directly by the line-shaft and a second position encoder is driven directly by the friction cylinder.

7. An infeed mechanism according to claim 6, wherein the second encoder is driven from the friction cylinder by way of the output shaft of the bevel gearbox.

8. An infeed mechanism according to claim 6 or claim 7, wherein the phase-shifting gearbox is additionally driven by an electric servo-motor so controlled by the first and second encoders as to modify the speed of the rotation imparted to the friction cylinder by the line-shaft.

9. An infeed mechanism according to claim 8, wherein the electric servo-motor is controlled by output signals from a combined phase-synchronising and ratio-modulating controller which receives ratio-modulating input signals from the first and second encoders.

10. An infeed mechanism according to claim 9, wherein the combined phase-synchronising and ratio-modulating controller also receives phase-synchronising input signals sensed from marks printed on the web and from a reference point on a gear driven directly by the line-shaft.

11. A paper press of the so-called Morgan type provided with an infeed mechanism according to any one of the preceeding claims.

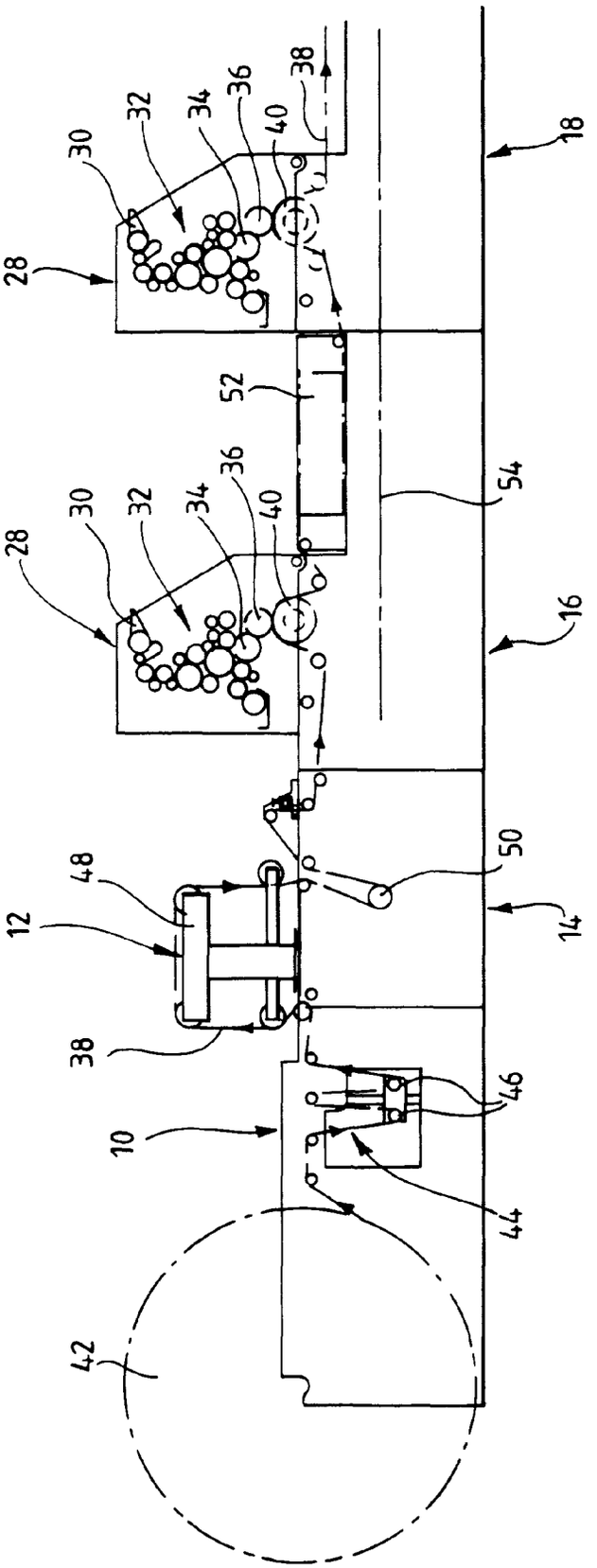
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FIG.1.

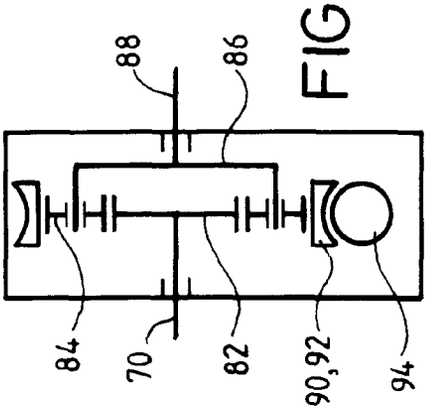
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FIG.5.

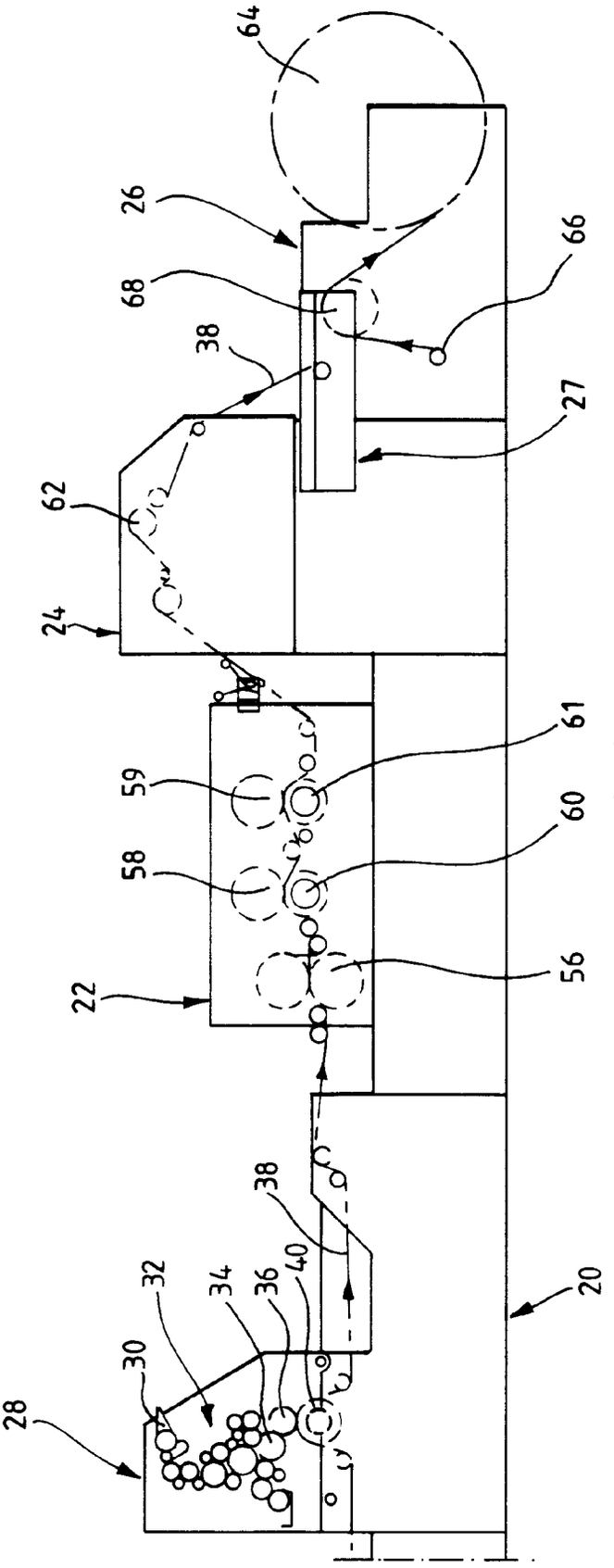

FIG.2.

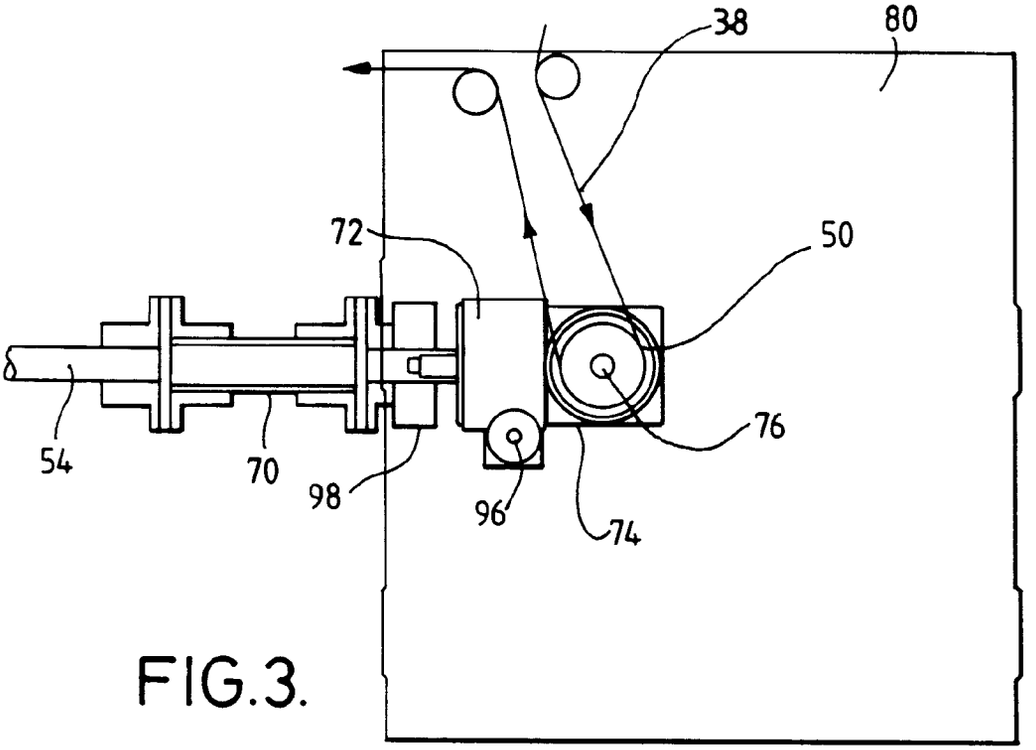

FIG.3.

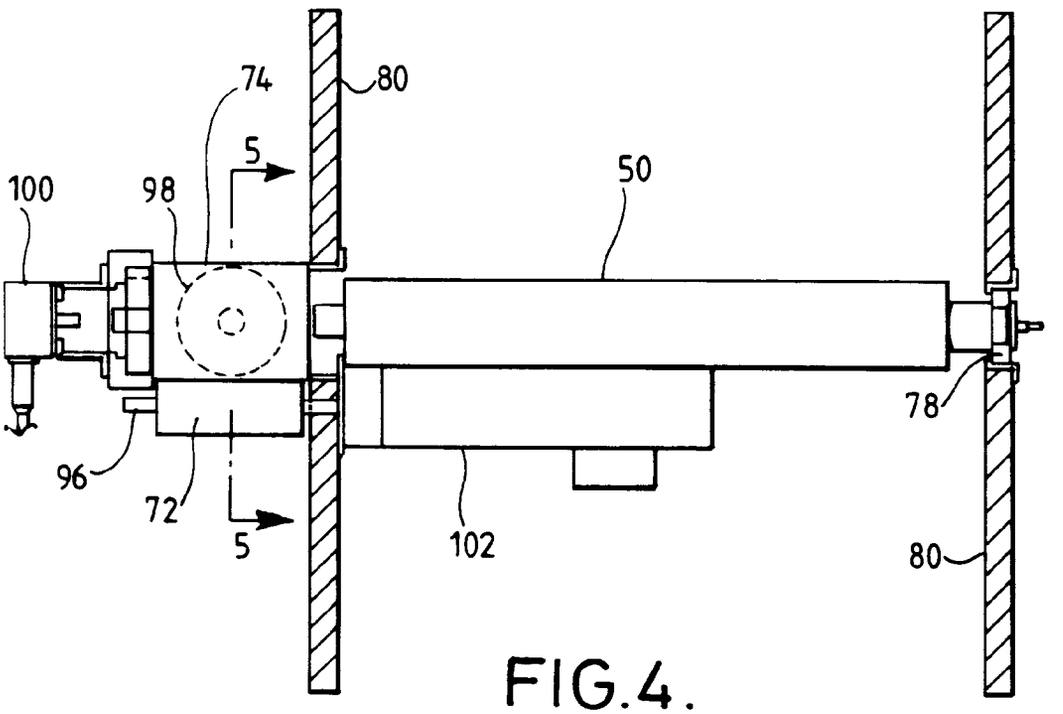

FIG.4.