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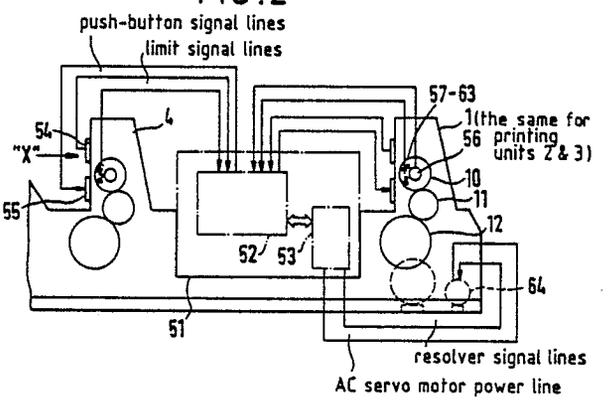
(54) Automatic plate exchange control system for a sheet offset printing machine.

(57) In a sheet offset printing machine including means for mounting and dismounting a plate, means for tensioning the plate, means for stopping a plate cylinder at a predetermined position and means for detecting a plate mount position, a control system for automatically exchanging the plate is provided, which comprises a control circuit for a rotary actuator for tensioning a plate, a control circuit for air cylinders for opening and closing plate vices, a control circuit for a servo motor for stopping a plate cylinder at a predetermined position, and a control circuit for a plate mount position detector.

FIG.2



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AUTOMATIC PLATE EXCHANGE CONTROL SYSTEM FOR A SHEET OFFSET PRINTING MACHINE

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to an automatic plate exchange control system for automatically performing exchange of a plate on a plate cylinder in a sheet offset printing machine.

Description of the Prior Art:

A general construction of a tetra-color sheet offset printing machine is illustrated in Fig. 7. In this figure, the printing machine is constructed of printing sections 1 to 4 for the respective colors, a paper sheet feeding section 5, a paper sheet ejecting section 6, a drive section 7, a control section 8 and a manipulation panel section 9. In the drive section 7 are provided a main motor 7a and a slow drive motor 7b. In each of the printing sections 1 to 4 are provided a plate cylinder 10, a rubber cylinder 11, a press cylinder 12 and an intermediate cylinder 13. The plate cylinder 10, the rubber cylinder 11, the press cylinder 12, the intermediate cylinder 13 and a paper sheet ejection cylinder 14 are rotated in synchronism with each other by driving power applied from the drive section 7.

Details of each printing section are shown in Fig 8. In this figure, reference numeral 16 designates a plate, numeral 16a designates a front side of the plate, numeral 16b designates a rear side of the plate, numeral 17a designates a front side vice, numeral 17b designates a rear side vice, and numeral 15 designates a paper sheet to be printed. In Fig. 7, paper sheets 15a to be printed which are stacked at the paper sheet feeding section 5, are printed while they are passing through the respective printing sections 1 to 4, and at the paper sheet ejecting section 6 they are stacked as printed paper sheets 15b. After finishment of the printing, when the machine is switched for printing new print matters, the plates 16 mounted to the plate cylinders 10 in the respective printing sections 1 to 4 are exchanged. This plate exchanging work is carried out through the following process:

(1) An operator enters between adjacent printing units, for instance, between the printing units (or printing sections) 1 and 2, and makes the plate cylinder 10 rotate with the aid of the slow drive motor 7b so that the front side vice 17a and the rear side vice 17b may come to the positions where the operator can dismount the plate. When the plate cylinder 10 has stopped, the operator manipulates the vices 17a and 17b fixing the plate in position to relax the fixing and dismounts it from the plate cylinder 10.

(2) Next, the operator prepares a new plate 16 and makes the plate cylinder 10 rotate with the aid of the slow drive motor 7b so that the vices 17a and 17b may come to the positions where the plate can be easily mounted. Then, the plate cylinder 10 is stopped, the plate 16 is fixed to the vice 17a, while the plate cylinder 10 is being rotated, the plate 16 bitten by the vice 17a is pulled by hands so as to be brought into tight contact with the plate cylinder 10, and it is fixed in position by the vice 17b. Subsequently, the plate is tensioned by pulling the vice 17b with the aid of bolts or the like.

(3) For the above-mentioned series of rotations of the plate cylinder 10 [the preceding paragraphs (1) and (2)], manipulations for both normal rotation and reverse rotation are necessary, and they are effected by manual operations by means of push-button switches.

(4) The series of operations described above are carried out repeatedly for the plurality of printing sections 1 to 4, and then exchange of the plates 16 is finished.

However, the above-described plate exchange operations in the conventional sheet offset printing machine involved various problems to be resolved as enumerated in the following:

(1) Upon mounting or dismounting a plate, in order to rotate the slow drive motor in the normal or reverse direction for positioning the plate cylinder at a favorable angular position, experience is necessitated and the work is laborious. If this operation is automated, the positioning can be achieved at a speed several times as fast as the speed when the slow drive motor is employed, and hence an efficiency can be improved (Because of manual operations, a slow drive motor rotating at a slow speed is employed.).

(2) As clamping of a plate and releasing of the same are carried out through manual operations, in a multi-color printing machine the number of the printing sections is large, hence mounting and dismounting of a plate must be carries out as many times as the number of the printing sections, and so, the work is laborious.

(3) When a plate is mounted to a plate cylinder, after the plate has been bitten by a vice, since the plate must be mounted as the rear side of the plate is pulled by hands while the plate cylinder is being rotated in order to bring the plate into tight contact with the plate cylinder, the number of operators must be increased.

(4) After the plate has been mounted to the plate cylinder, the vice must be pulled by manual operations for the purpose of tensioning the plate.

As enumerated above, since all the operations are manual works, upon mounting a plate, there is a fear that the plate may be damaged, also it takes much time, skill is necessitated and a number of operators must be increased. Especially, as the printing machine is large-sized and accordingly the plate becomes large, this tendency would become more remarkable.

SUMMARY OF THE INVENTION:

It is therefore one object of the present invention to provide an automatic plate exchange control system for a sheet offset printing machine, which can control automatic exchange operations for plates without necessitating experience, skill and laborious time-consuming work of an operator.

According to the present invention, in order to automate exchange of a plate, the following counter-measures are taken in a sheet offset printing machine:

(1) Means for automatically tensioning a plate and means for mounting and dismounting a plate are combined in a sheet offset printing machine.

(2) In place of the slow drive motor in the known sheet offset printing machine, a servo motor (for instance, an AC servo motor) which can select a number of steps of speed including a slow drive speed, a speed for exchanging a plate and the like, is mounted, and thereby it is made possible to stop a plate cylinder at a predetermined angular position for the purpose of plate exchange.

(3) For the purpose of detecting a plate mounting position, an absolute position detector (for instance, an absolute type rotary encoder) is mounted at an end of a shaft of a plate cylinder.

(4) A circuit for controlling an electromagnetic valve which actuates a cylinder in a plate mounting/dismounting device, is provided.

(5) A circuit for controlling a limit switch which detects a position of the above-mentioned cylinder, is provided.

(6) A circuit for controlling the operations described in the preceding paragraphs (2) and (3), is provided.

(7) A circuit for controlling a rotary actuator for tensioning a plate, is provided.

(8) A circuit for controlling a reversible motor which raises and lowers a tightening roller unit.

Owing to the above-mentioned features of the present invention, the following advantages can be obtained:

Firstly, as a result of the features (1) and (7) above, tensioning of a plate can be automated.

Also, owing to the features (1), (2), (3), (4), (5), (6) and (8) above, control for mounting and dismounting of a plate and stopping at a fixed position of a plate cylinder becomes possible, and so it is possible to stop a plate cylinder at a position favorable for mounting and dismounting a plate.

Furthermore, it is possible to bring a plate into tight contact with a plate cylinder.

The above-mentioned and other objects, features and advantages of the present invention will become more apparent by reference to the following description of a preferred embodiment of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

In the accompanying drawings:

Figs. 1A, 1B and 1C, respectively, show flow charts of a plate dismounting process, a plate mounting process and a positioning process in one preferred embodiment of an automatic plate exchange control system for a sheet offset printing machine according to the present invention;

Fig. 2 is a diagrammatic representation of the control system according to the present invention;

Fig. 3 is a schematic partial view as viewed in the direction of arrow X in Fig. 2;

Fig 4 is side view of a plate mounting/dismounting mechanism;

Fig. 5 is a side view of a plate tensioning mechanism;

Fig. 6 is a plan view of the same;

Fig. 7 is a schematic view showing a general construction of a tetra-color sheet offset printing machine; and

Fig. 8 is a detailed partial view of a plate cylinder and its proximity in one printing section in the printing machine shown in Fig. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

As described previously in the description of the prior art, in order to mount a plate on a plate cylinder, after the plate has been mounted on a plate cylinder the plate must be tensioned. Upon dismounting the plate, operations inverse to those described above are effected.

An automatic plate mounting/dismounting apparatus has the structure shown, for example, in Fig. 4, and an automatic plate tensioning apparatus has the structure shown, for example, in Figs. 5 and 6.

In Figs. 5 and 6, a forked lever 81 is mounted to a portion of a plate tensioning cam shaft 80 for moving a plate tensioning device (not shown) along a plate cylinder 10, which portion projects sidwards externally of the plate cylinder 10. At the respective end portions of the fork of the lever 81 are mounted rollers 82. A shaft 84 of a kicker 22 is rotatably supported by a bracket 83 provided on a frame of a printing machine, and this shaft 84 is coupled via a universal joint 85 to an output shaft 21A of a rotary actuator 21.

Upon normal operation, the kicker 22 is held at a standby position which is attained by rotating the kicker 22 by 90° about the shaft 84 starting from the position shown in Figs. 5 and 6, and hence, it is not engaged with the roller 82.

In the case of tensioning the plate, as a result of rotation of the rotary actuator, the kicker 22 rotates from the standby position to the illustrated position and is engaged with the roller 82 on the forked lever 81. Under this condition, if the plate cylinder 10 is rotated in the direction of an arrow, then the plate tensioning cam shaft 80 rotates, hence the plate tensioning device moves along the plate cylinder 10, and thereby the plate is tensioned.

On the contrary, in the case of relaxing the plate, the plate cylinder 10 is rotated in the opposite direction with the kicker 22 held under the illustrated condition. In the above-described manner, automatic tensioning or relaxing of a plate can be effected by rotating the plate cylinder 10 in the normal of reverse direction when the kicker 22 is projected at the illustrated position by actuation of the rotary actuator 21. However, if the rotary actuator 21 rotates by 90° with respect to the above-described position, then the kicker 22 is retracted from the position engageable with the roller 82, and so, the automatic tensioning or relaxing operation cannot be effected.

An automatic plate exchange control system 51 shown in Fig. 2 contains therein a circuit for controlling rotation of this rotary actuator 21.

Now, description will be made on an automatic plate mounting/dismounting apparatus with reference to Figs. 2, 3 and 4. In these figures, reference numerals 31, 32 and 33 designate air cylinders, numeral 32a designates a piston shaft, numeral 34 designates a fork, numeral 35 designates a tightening roller, numeral 36 designates a reversible motor, numeral 37 designates a front cam shaft, numeral 38 designates a rocking arm, numeral 39 designates a roller, numeral 40 designates a rear cam shaft, numeral 41 designates a rocking arm, numeral 42 designates a roller, numeral 43 designates a support table, numeral 44 designates a screw shaft, numeral 51 designates a control system, numeral 52 designates a main control unit, numeral 53 designates an AC servo motor controller, numeral 54 designates a manipulation panel, numeral 54a designates a plate dismount preparation push button, numeral 54b designates a plate removal start push button, numeral 54c designates a plate mount preparation push button, numeral 54d designates a plate bite start push button, numeral 54e designates a plate wrap start push button, numeral 55 designates an air cylinder control circuit, numeral 56 designates an absolute type rotary encoder, numerals 57, 58 and 59 designate limit switches (for the cylinder 31), numerals 60 and 61 designate limit switches (for the cylinder 32), numerals 62 and 63 designate limit switches (for the cylinder 33), numeral 64 designates an AC servo motor, reference character a designates a standby position, character b designates a front side vice actuation position, character c designates a rear side vice actuation position, character d designates an in position (of the cylinder 32), character e designates an out position (of the cylinder 32), character f designates an in position (of the cylinder 33), character g designates an out position (of the cylinder 33), characters ad designate a standby in position, characters ae designate a standby out position, characters bd designate a front side vice actuation in position, characters be designate a front side vice actuation out position, characters cd designate a rear side vice actuation in position, characters ce designate a rear side vice actuation out position, and character A designates a fulcrum of the air cylinder 32.

The air cylinder 32 is rocked about the fulcrum A by the air cylinder 31, and depending upon the position of the air cylinder 31, the positions of the air cylinder 32 are named a standby position a, a front side vice actuation position b and a rear side vice actuation position c At the tip end of a piston shaft 32a of the piston 32 is mounted a fork 34, which takes an in position d or an out position e depending upon the position of the piston shaft 32a. At the out position ae in the standby position a of the fork 34, it stands by above the position where the upper tooth of the front side vice 17a or the upper tooth of the rear side vice 17b in Fig. 8 (neither of the upper teeth being shown) is opened by the front side cam shaft 37 or the rear side cam shaft 40 (at the position for mounting or dismounting the plate 16) (on a circular locus depicted by the fork 34 when it rotates about the fulcrum A). Also, at the in position ad, the fork 34 stands by above the position where the upper tooth of the front side vice 17a or the rear side vice 17b is closed. At the out position be in the front side vice actuation position b, the fork 34 fits about a roller 39 mounted on a rocking arm 38 that is fixed to the front side cam shaft 37 for opening and closing the upper tooth of the front side vice 17a, and then the

upper tooth is open. When the fork 34 comes to the in position bd, it pulls in the roller 39 towards the air cylinder 32, thus moves the rocking arm 38 and thereby rotates the front side cam shaft 37, so that the upper tooth is closed to fixedly bite the plate 16. The upper tooth is opened through operations in the inverse order to the above-described operations. At the out position ce in the rear side vice actuation position c, the fork 34 fits about a roller 42 mounted on a rocking arm 41 that is fixed to the rear side cam shaft 40 for opening and closing the upper tooth of the rear side vice 17b, and then the upper tooth is open. When the fork 34 comes to the in position cd , it pulls in the roller 42 towards the air cylinder 32, thus moves the rocking arm 41 and thereby rotates the rear side cam shaft 40, so that the upper tooth is closed to fixedly bite the plate 16. The upper tooth is opened through operations in the inverse order to the above-described operations. The air cylinder 33 presses, at the out position f, the plate 16 with the tightening roller 35 so as to come into tight contact with the plate cylinder 10. At the in position g, the air cylinder 33 separates the tightening roller 35 from the plate 16. The component parts such as the air cylinder 33, the tightening roller 35 and the like are mounted on a support table 43. The support table 43 is placed at an operative position (the position shown in Fig. 4) when the plate is to be mounted, but it is placed at an inoperative position separated from the plate cylinder at the other time, as driven by a reversible motor 36 via a screw shaft 44.

As shown in Fig. 2, the control system 51 includes a main control unit 52 (a sequencer) and an AC servo motor controller 53. Each of the printing units 1 to 4 is associated with a manipulation panel 54 and an air cylinder control circuit 55, and at an end of the shaft of the plate cylinder 10 in the last color stage is disposed an absolute type rotary encoder 56. On the manipulation panel 54 are provided five push buttons, that is, a plate dismount preparation button 54a and a plate removal start button 54b for automatically dismounting a plate, and a plate mount preparation button 54c, a plate bite start button 54d and a plate wrap start button 54e for automatically mounting a plate.

As shown in Fig. 4, the respective air cylinders 31, 32 and 33 are provided with limit switches 57, 58 and 59 (for the air cylinder 31), limit switches 60 and 61 (for the air cylinders 32) and limit switches 62 and 63 (for the air cylinder 33) at different piston positions, and these limit switches would send signals to the main control unit 52 (Fig. 2) when the respective pistons of the air cylinders 31, 32 and 33 have come to the corresponding piston positions. The reversible motor 36 is also coupled to the main control unit 52. In place of the slow drive motor 7b (Fig. 7) described previously in connection to the system in the prior art, an AC servo motor 64 is provided as shown in Fig. 2, and it is connected to the AC servo motor controller 53. The AC servo motor is adapted to run at two different rotational speed including the slow drive speed in the heretofore known system and a speed three times (for example) as fast as the slow drive speed to be employed for mounting or dismounting a plate. The manipulation panel 54, the air cylinder control circuit 55 and the absolute type rotary encoder 56 are also connected to the main control unit 52 in the control system 51. The air cylinder control circuit 55 is a control circuit for operating electromagnetic valves (not shown) which control flow of air into and out of the respective air cylinders 31, 32 and 33.

Now description will be made on control for mounting and dismounting of the plate 16 with reference to the flow charts in Figs. 1A, 1B and 1C.

As shown in Fig. 1A, in order to start dismounting of a plate (101), at first the plate dismount preparation push button 54a on the manipulation panel 54 is depressed (102). As a result of actuation of the rotary actuator 21 in the plate tensioning apparatus (See Figs. 5 and 6), the kicker 22 projects to relax the plate 16. Subsequently, through the process indicated by the flow chart of positioning (Fig. 1C) as will be described later, the rear side vice 17b of the plate cylinder 10 comes to a dismount position and the plate cylinder 10 stops. Thereafter, the air cylinder 32 in the plate mounting/dismounting apparatus (See Fig. 4) takes the position ce, and the upper tooth of the rear side vice 17b is opened (the above operations being carried out automatically). Then, the rear side of the plate 16 is gripped by hands (103). Next, the plate removal start button 54b is depressed (104). The air cylinder 32 takes the position cd, and the upper tooth of the rear side vice 17b is closed. The plate cylinder 10 is rotated in the reverse direction, and when the front side vice 17a has come to the dismount position (through the process shown in Fig. 1C), the plate cylinder 10 stops. Subsequently, the air cylinder 32 takes the position be, and the upper tooth of the front side vice 17a is opened (the above operations being carried out automatically). Then, the plate 16 is removed (105). About 2 seconds after the upper tooth of the front side vice 17a has been opened, the air cylinder 32 would automatically come to the position bd, and so the upper tooth of the front side vice 17a is closed. Then, the dismounting has been finished (106).

As shown in Fig. 18, in order to start mounting of a plate (201), at first the plate mount preparation button 54c on the manipulation panel 54 is depressed (202). Then the plate cylinder 10 rotates in the normal direction, and when the front side vice 17a has come to a mount position (through the

process shown in Fig. 1C), the plate cylinder 10 stops. Subsequently, the air cylinder 32 takes the position be (Fig. 4), and the upper tooth of the front side vice 17a is opened (the above operations being carried out automatically). Then, the plate 16 is inserted into the front side vice 17a by hands (203). Next, the plate bite start push button 54d is depressed (204). The air cylinder 32 takes the position bd, and the upper tooth of the front side vice 17a is closed. The tightening roller 35 rises jointly with the support table 43 and takes an operative position (Fig. 4). Thereafter, when the plate wrap start push button 54e is depressed (205), the plate cylinder 10 rotates in the normal direction, and the tightening roller 35 advances to press the plate 16 against the plate cylinder 10 for bringing the plate 16 into tight contact with the plate cylinder 10 (introduced condition). Under this condition, the plate cylinder 10 is further rotated, and when the rear side vice 17b of the plate cylinder 10 has come to the plate mount position, the plate cylinder 10 stops. Next, the air cylinder 32 comes to the position ce, and the upper tooth of the rear side vice 17b is opened. Furthermore, the tightening roller 35 rises up to the rear side vice 17b, then the rear side of the plate 16 is inserted into the vice 17b, after a while the upper tooth of the rear side vice 17b is closed (because the air cylinder 32 comes to the position cd), the tightening roller 35 is brought to the in position g by the air cylinder 33, and thus it is separated from the plate 16 and is returned to an inoperative condition located below as driven by the reversible motor 36. Also, in parallel to the operation of the tightening roller 35 being returned to the inoperative condition, by making use of the plate tensioning apparatus (Figs. 5 and 6) the plate 16 is tensioned as a result of actuation of the rotary actuator 21 and the kicker 22 (the above operations being carried out automatically). Then the mounting of the plate 16 has been finished (206).

Fig. 1C shows the process of positioning by means of a flow chart. The positioning (301) is started when the plate dismount preparation push button 54a or the plate mount preparation push button 54c has been depressed. The current stop position of the plate cylinder 10 is input from the absolute type rotary encoder 56 (302) That position is represented by a (in terms of a rotational angle with respect to a reference angular position). Next, a target position (a plate mount or dismount position) is determined (303). This target position is represented by b . And an amount of movement is calculated (304). (amount of movement c = b -a) Next, an amount of rotation d of the AC servo motor 64 is calculated (305). Assuming that K represents a speed reduction ratio of the AC servo motor 64 to the plate cylinder 10, the relation of d = K•c is fulfilled. Hence, the AC servo motor 64 is driven by the amount of d (306), thereby the plate cylinder is stopped at the target position, and the positioning is finished (307).

While a method for exchanging a plate for one color stage has been described above, it is also possible to control in a similar manner the operation in which exchanges of plates are performed in parallel for a plurality of color stages. Also, while it is not shown in the illustrated embodiment, there are provided alarm means to operate when an abnormal condition has occured during an automatic operation and display means for informing the location of the abnormal condition as well as a control circuit for these means.

As will be apparent from the above description, according to the present invention the following advantages can be obtained:

(1) Since various operations such as stoppage of a plate cylinder at a predetermined position, automatic opening and closing of vices for mounting and dismounting a plate, automatic tensioning of a plate on a plate cylinder and the like during plate exchange, can be carried out by simple push button manipulation, saving of energy and labor as well as operation by non-skilled persons can be realized.

(2) By employing an AC servo motor, a rotational speed for exchanging a plate can be made faster than the speed of the slow drive motor in the prior art, and therefore, the operation time is shortened.

(3) Since a plate can be pressed against a plate cylinder by means of a tightening roller, and also since it is possible to automatically tension the plate, there is no need to pull the plate by hands, and consequently, necessary human labor can be saved.

Since many changes and modifications can be made to the above-described construction without departing from the spirit of the present invention, it is intended that all matter contained in the above description and illustrated in the accompanying drawings shall be interpreted to be illustrative and not in a limiting sense.

Claims

1. An automatic plate exchange control system for a sheet offset printing machine including means for mounting and dismounting a plate, means for tensioning the plate, means for stopping a plate cylinder at a predetermined position and means for detecting a plate mount position; characterized in that said control system is provided with a control circuit for a rotary actuator for tensioning a plate, a control circuit for air cylinders for opening and

closing plate vices, a control circuit for a servo motor for stopping a plate cylinder at a predetermined position, and a control circuit for a plate mount position detector.

FIG.1A

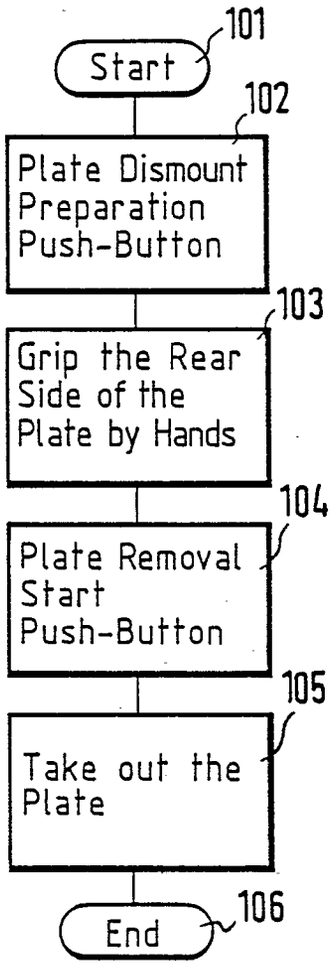


FIG.1B

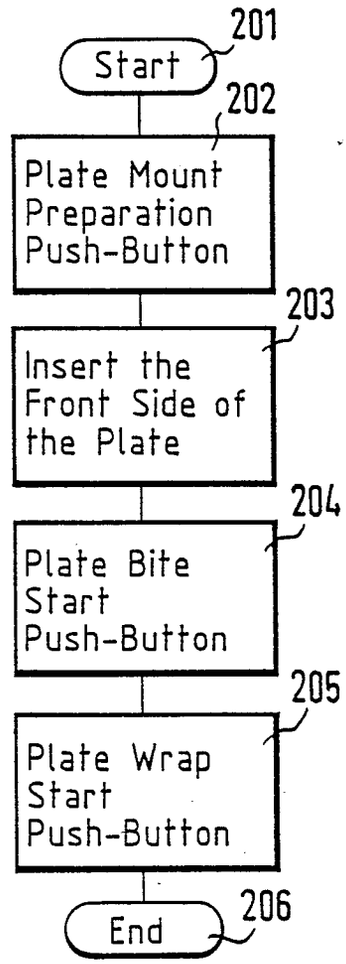


FIG.1C

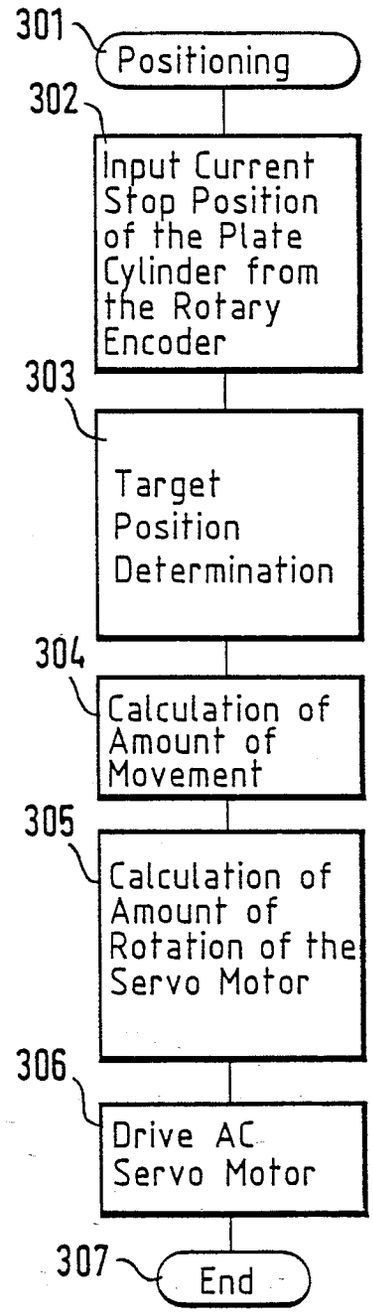


FIG.2

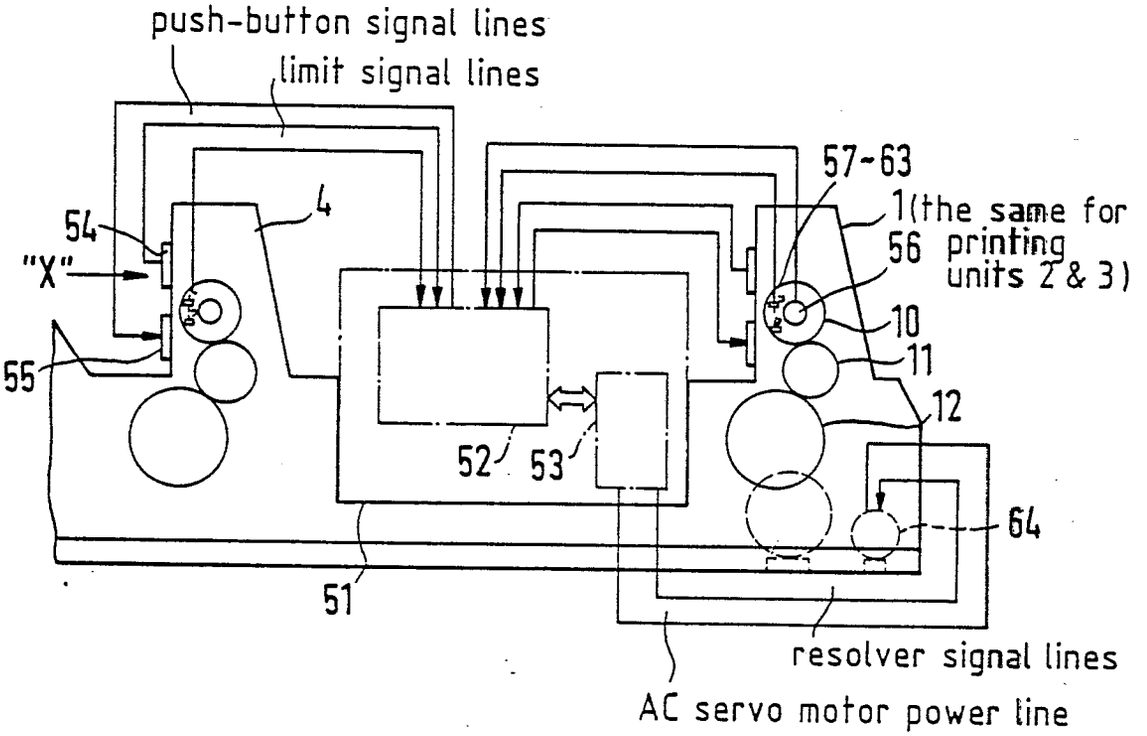


FIG.3

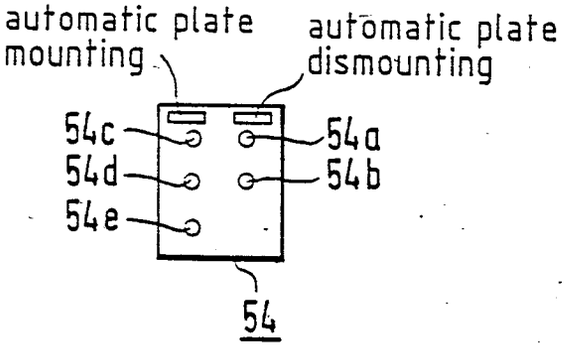


FIG . 4

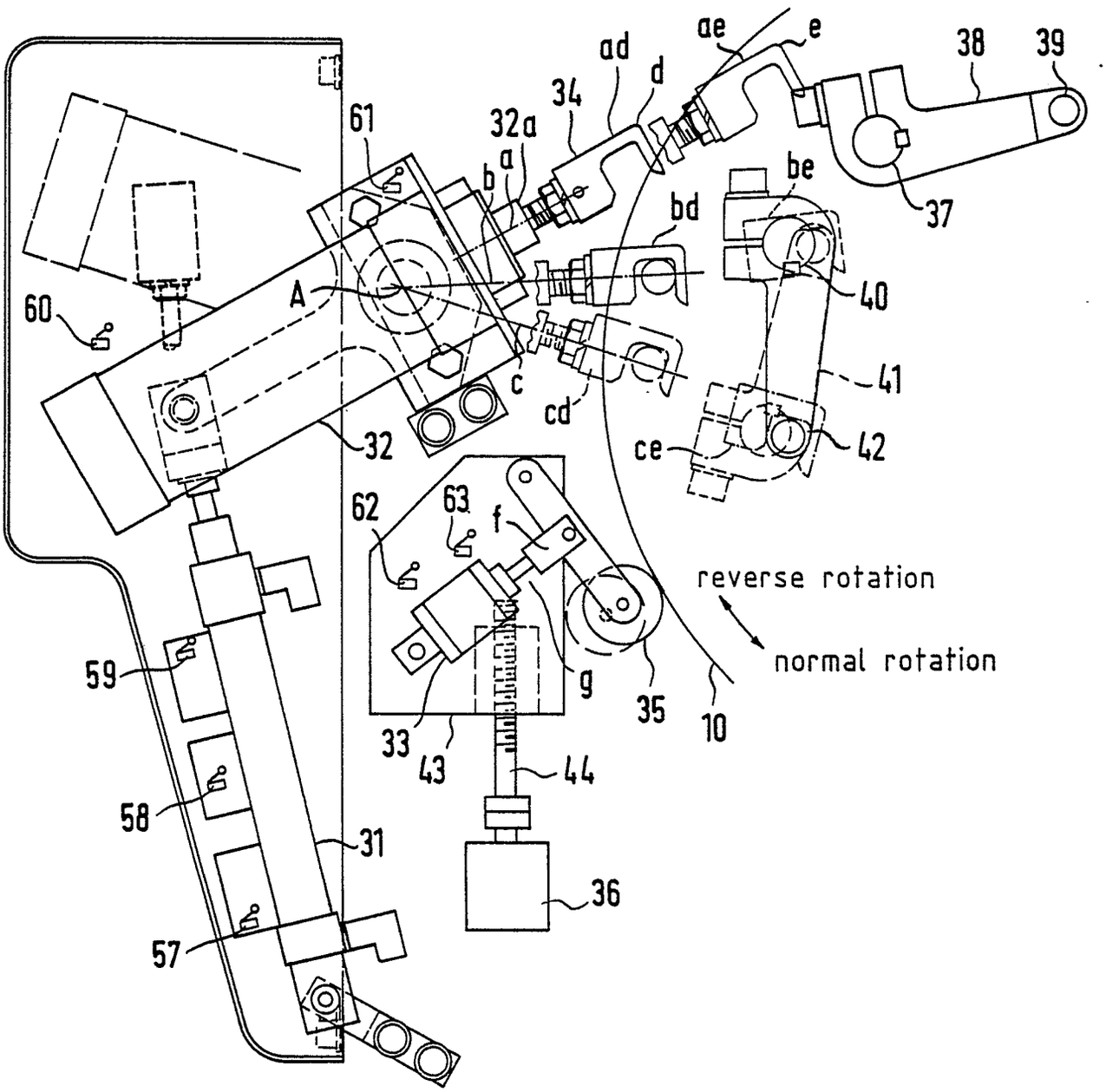


FIG.5

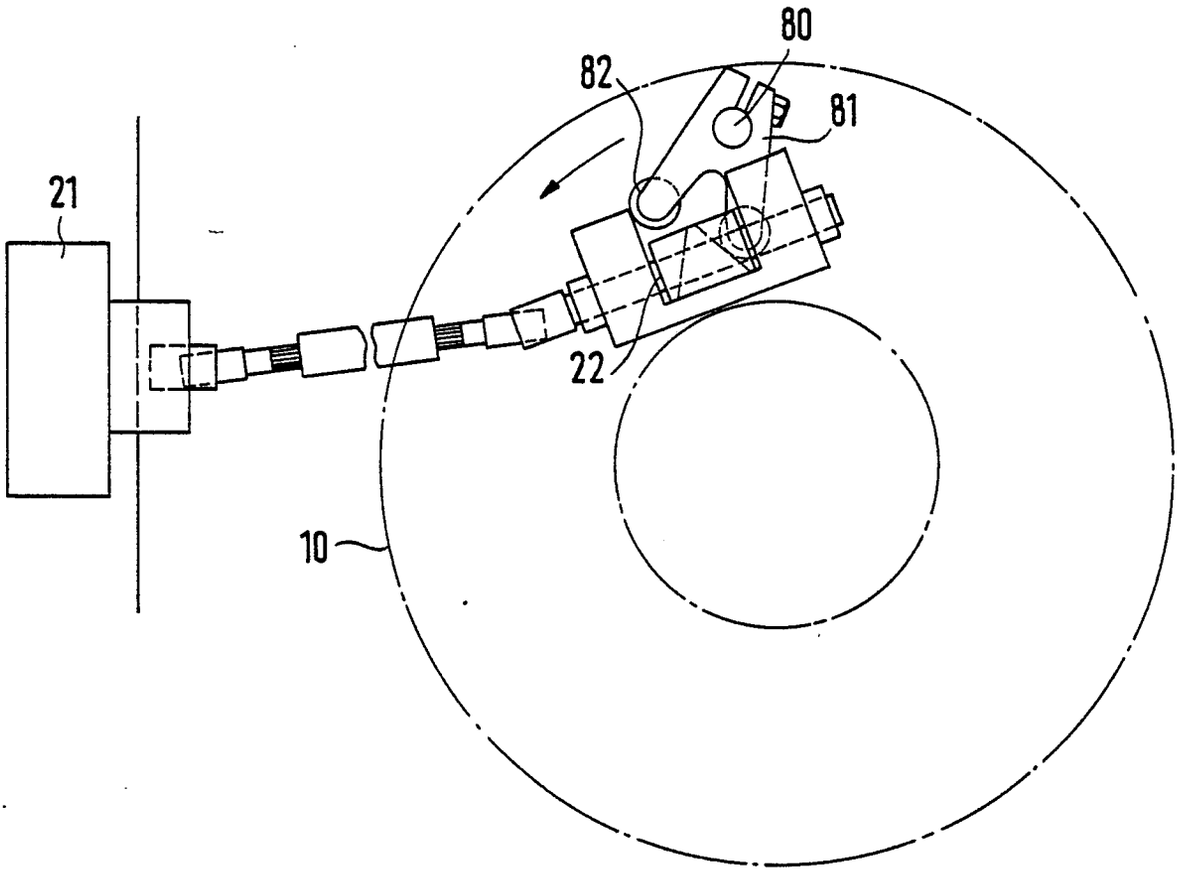
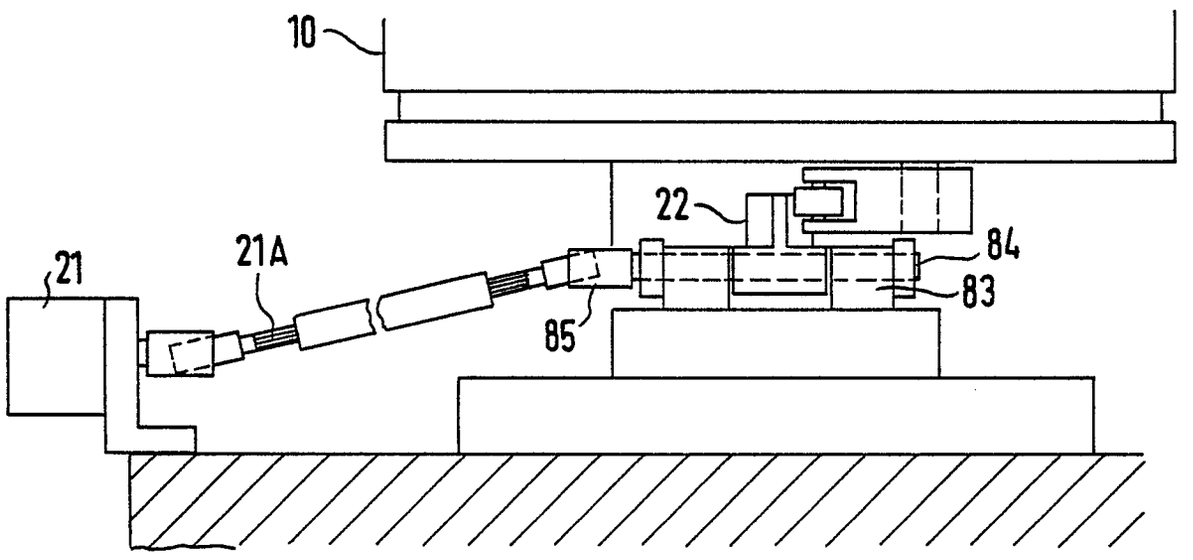


FIG.6



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Nouvellement déposé

FIG.7

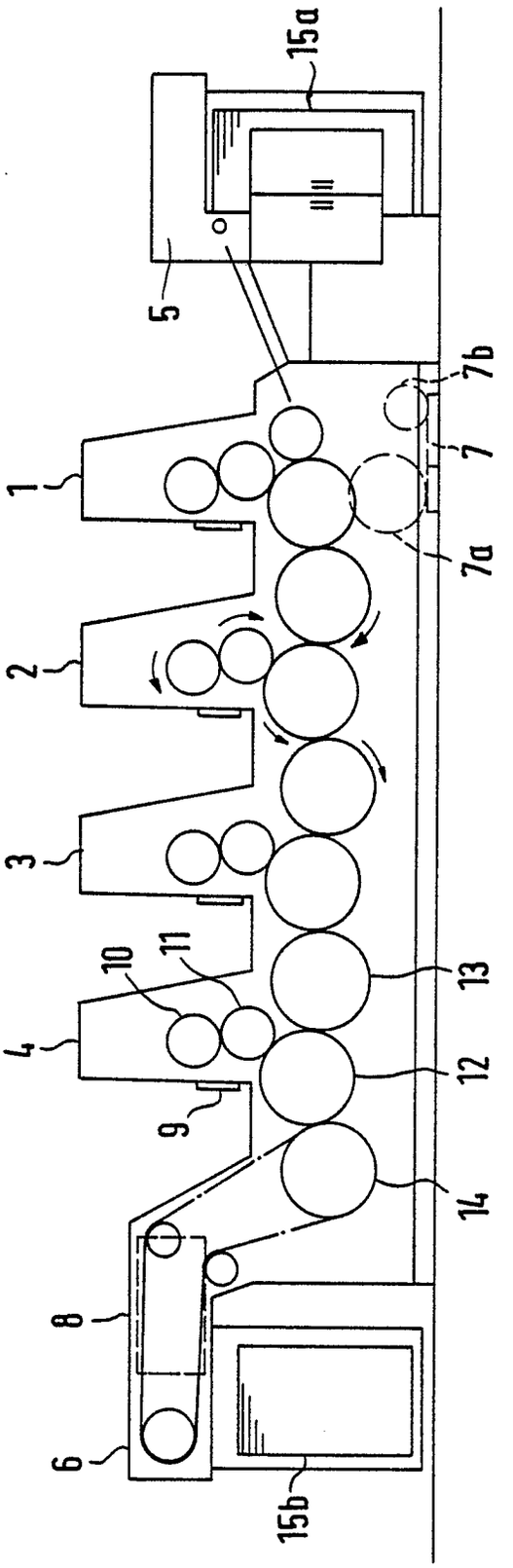

FIG.8