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(54) **Apparatus for regulating the registration of screens in an automatic screen printing machine.**

(57) Disclosed is an apparatus for regulating the registration of screens in an automatic screen printing machine, which comprises:

screen-supporting members (18,19) confronting each other;

a screen (5) to be supported and fixed onto one of the screen supporting members (18,19);

three sets of screen regulating mechanisms (30,50,70), disposed in said screen-supporting members (18,19) which can regulate the registration of the screen (5) in the repeat direction (X), the direction (Y) orthogonal thereto and the rotating direction (θ);

a registration-regulating motor (32,52,73) and a pulse generator (41,61,73) for detecting the regulating amount, disposed in each screen-regulating mechanism (30,50,70); and

a registering operation panel comprising switches for performing the regulation of the registration and digital display mechanisms for displaying the regulation amount. In this screen registration-regulating apparatus, the registration of the screen (5) in the printing machine can be regulated by a switching operation, and even in case of an inexperienced operator, the registration of the screen (5) can be performed with a high precision in a short time only by digitally displaying the set value on a display.

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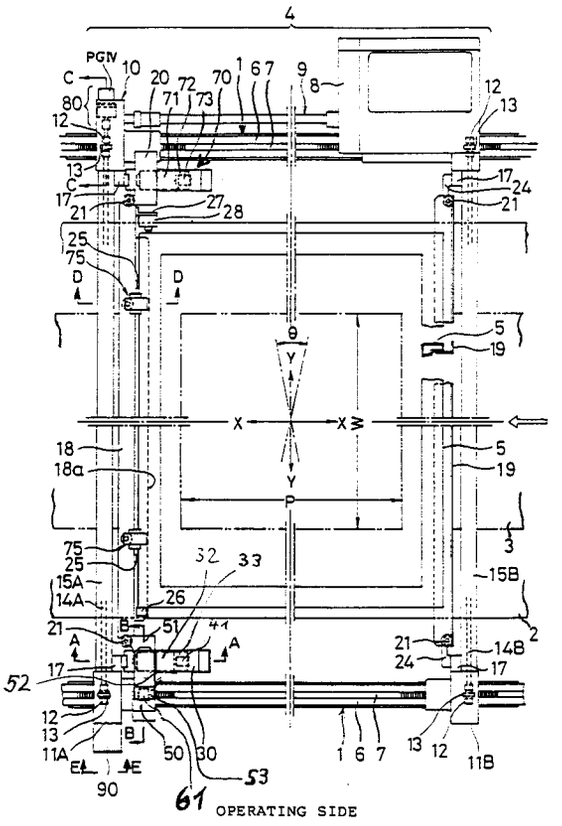
FIG. 1


4
PGIV
C
80
12
13
17
21
25
75
D
10
20
72
71
73
70
1
6
7
9
8
12
13
17
24
21
27
28
9
Y
X
X
Y
P
5
19
18
18a
3
15B
2
14B
15A
14A
26
32
33
51
41
A
B
52
11A
E
90
50
30
53
61
1
6
7
13
12
11B
OPERATING SIDE

This invention relates to an apparatus for regulating the registration of screens in an automatic screen printing machine, and more specifically, to an apparatus for regulating the registration of screens, by which even those who are inexperienced in screen printing can perform the regulation of the registration of screens in a short period with a high precision.

In multiple color printing in an automatic screen printing machine, several to 20 or more screens are used per pattern according to the number of printing colors. At the beginning of the printing operation, with respect to a predetermined position of an endless belt of a printing machine, the screens must be accurately, registered in the repeat direction, the widthwise direction of the fabric and the distortioned direction composed of these directions.

Japanese Patent Publication No. 46952/78 discloses an apparatus comprising a screen supporting member having three positioning pins, a round hole for fitting of these pin at one corner of a screen frame, a long pin hole elongated in the repeat direction in one corner confronting the round hole in the repeat direction, a long pin hole elongated in the widthwise direction in one corner confronting the round hole in the width direction, and two pins confronting each other in the repeat direction arranged movably in the widthwise direction through a widthwise direction-adjusting screw, wherein the screen-supporting member is movably arranged in the repeat direction through a repeat direction adjusting screw, and an adjusting handle for rotating the screw is disposed on one side of the screen printing machine.

Conventionally, the regulation of the registration of screens is mostly carried out by a screwing operation and a manual operation, and requires experts and long periods of time. Since it lacks accurateness, the screen position must be inevitably regulated after the beginning of the main screen printing operation. This regulation is to be performed every time a design of the printing pattern varies, and at each regulation man powers and long periods of time are required. Therefore, the efficiency of screen printing is low, and the quality of the printed fabric is degraded. In recent years, multiple-color and small-lot printing becomes thriving, and the above problem becomes serious. Furthermore, since the registering operation depends upon the feeling or experience of the operator, accurate data on the registration cannot be obtained, and the precision is generally insufficient.

It is an object of the present invention to provide an apparatus for regulating the registration of screens, by which even an inexperienced operator can regulate the registration of screens with a high precision in a short period of time by a switching operation whereby the regulated registration values are digitally displayed in a display.

Another object of this invention is to provide an apparatus for regulating the registration of screens, in which the regulation of the registration of screens can be carried out with a good precision based on preset values, and according to the actual registration state of screens, fine regulation can be performed with a good precision by remote control.

Still another object of this invention is to provide an apparatus which can be adapted not only to the regulation of the registration of screens in each screen unit, but also, if desired, to an apparatus for automatically setting positions of screens.

The above objects are met by the invention providing an apparatus for regulating the registration of screens in an automatic screen printing machine, which comprises:

screen-supporting members confronting each other;

a screen to be supported and fixed onto one of the screen-supporting members;

three sets of screen regulating mechanisms, disposed in said screen-supporting member, which can regulate the registration of the screen in the repeat direction, the direction orthogonal thereto and the rotating direction;

a registration-regulating motor and a pulse generator for detecting the regulation amount, disposed in each screen-regulating mechanism; and

a registering operation panel comprising a switch for performing the regulation of the registration and a digital display mechanism for displaying the registration regulation amount.

According to this invention, there is also provided an apparatus which further comprises:

a television camera disposed on the endless belt discharge side of the automatic screen printing machine;

a monitor television displaying the actual registration state on an enlarged scale from said camera; and

a second operation panel for finely regulating the registration based on the image of the television.

In the apparatus of the present invention, the first characteristic feature resides in that a screen is supported and fixed on one of two confronting screen-supporting members, and that three sets of screen-regulating mechanisms are disposed in this supporting member in the repeat direction, the direction orthogonal thereto (widthwise direction), and the rotating direction (distorted direction). Since the screen is supported and fixed on one supporting member alone, deformation or distortion does not happen in the screen, and a natural condition at the time of design making is main-

tained. Furthermore, the screen can be rapidly mounted and dismounted. This makes the adjustment possible in all the directions including the repeat direction, the direction orthogonal thereto (widthwise direction), and the rotating direction (distorted direction).

The second characteristic feature of the present invention is that in each of the three sets of screen-regulating mechanisms, a registration-regulating motor and a pulse generator for detecting the regulation amount are disposed, and they are combined with the registration operation panel provided with switches for operating the registration regulation and the digital display mechanism displaying the registration regulation amount. Namely, the amount of the regulation of each screen regulating mechanism is displayed as the amount of pulses by the pulse generator. According to this regulation amount, by on and off of the switch of the operation panel and control of the driving of the registration-regulating motor, the registration regulation is accomplished. When the regulation amount of the screen-regulating mechanism is displayed digitally with a good accuracy by an on-and-off screen-regulating operation, many advantages are brought about. Since the regulation amount is displayed not as a conventional intuition but as a measured value, a control of the amount of the regulation is accurate and easy. There is naturally a certain relation between the actual registration state in the automatic screen printing ascertained by human eyes and the monitor television and the amount of regulation to be added. Based on this relation, a certain amount to be regulated can be predetermined, and the regulation to this predetermined amount can be carried out. By preserving this digital regulation amount in each direction of the screen as data, it can be reused for the next time operation.

In the apparatus of this invention, the registration regulation is a one-touch switching operation, and the operation is easy and rapid. Even the inexperienced can perform it. The registration regulation values are digitally expressed. The registering condition can be easily confirmed, and the reproducibility at the time of repeating the order is high. Since the arrangement and preset position of each screen unit are displayed digitally, the movement and positioning of the screen unit can be easily performed. From the non-operating side of the operation of the screen printing, the regulation of the registration is possible. The entire structure of the registration-regulating apparatus can be simplified.

In the screen registration regulating apparatus of the automatic screen printing machine according to the present invention, preferably a television camera is arranged on the endless belt discharge side. There are provided a monitor television which displays the actual screen-registering condition from that camera on an enlarged scale and a second operation panel for finely regulating the registration on the basis of images of the television.

According to the above operation, the screen registration condition immediately after the completion of the printing is caught by the CCD camera, etc. on the endless belt, and electrically transmitted and displayed to the monitor television provided in the centralized operation panel (second operation panel). The operator sees the monitor image and according to the screen registration condition, the operator performs the regulation of the registration on the regulating operation panel attached to the centralized operation panel. The regulation operation panel performs the same control as the first registration operation panel attached to each screen unit, and the registration regulation can be completely remote-controlled.

For this reason, the effort of confirming and regulating the state of the registration for every screen on the side of the screen printing machine can be saved, and the state of the registration of the printing machine can be inspected by one person for several machines. The screen registration condition of the printing surface can be displayed on an enlarged scale 2 to 4 times (4 to 16 times in area for one side). Hence, the subtle screen registration state can be confirmed with a higher precision by the monitor television than by the naked eye inspection.

The invention is now explained in more detail by means of the enclosed drawings.

Figure 1 is a top plan view of a screen unit as a whole containing the apparatus of regulating the registration of screens according to the present invention.

Figure 2 is a detailed sectional view of the screen regulation mechanism (I) in section A-A of Figure 1.

Figure 3 is a detailed sectional view of the screen regulation mechanism (II) in section B-B in Figure 1.

Figure 4 is a sectional view showing supporting and fixation of a screen in section D-D of Figure 1.

Figure 5 is a detailed sectional view of the screen unit position detecting mechanism in section C-C of Figure 1.

Figure 6 is a front view of a registering operation panel in E-E section in Figure 1.

Figure 7 is a perspective view showing the set condition of a CCD camera disposed at the rear portion of a screen printing machine.

Figure 8 is a perspective view of a centralized operation panel.

Figure 9 is a front view of a registering operation panel attached to the centralized operation

panel.

Figure 10 is a block diagram showing the outline of the control.

In Figure 1 showing the screen registration-regulating apparatus of the automatic screen printing machine, this apparatus comprises confronting screen supporting members 18 and 19, a screen 5 supported and fixed onto one screen supporting member 18, three sets of screen regulating mechanisms 30, 50 and 70 which can regulate the registration of screens in the repeat direction (X), the direction (Y) orthogonal thereto and the rotating direction (θ) provided in the supporting member 18, screen registration-regulating motors 32, 52 and 71 provided in each screen regulating mechanism, regulating amount-detecting pulse generators 41, 61 and 73, and a registration operation panel 90 (Figure 6) provided with registration-regulating operation switches 94, 95, 97, 99 and 100 (Figure 6) and digital display mechanisms 93, 96 and 98 (Figure 6) displaying the registration regulation amount.

The structure of the entire machine will now be described in detail.

A guide rail 6 is secured to the whole length of a machine stand 1 of the automatic screen printing machine, and on both sides of its central portion, racks 7 are provided. On the guide rail 6 on the machine frame 1, a plurality of screen units 4 are arranged and set according to the printing repeat length P. Every time the endless belt is intermittently sent in the arrow direction, a textile cloth 3 is printed by a known means.

The screen unit 4 is mainly operated on the lower portion in Figure 1, namely on the left side in the advancing direction of the endless belt 2 as the main operation side.

The screen units 4 are movably loaded on guide rails 6 by guide rollers 12 provided at squeeze drive apparatuses 8 and bearing apparatuses 10 on four corner portions, and bearing apparatuses 11A and 11B on the operation side. A pinion 13 is integrally bonded to the guide rollers 12, and is engaged with racks 7. The confronting guide rollers 12 and pinions 13 on both sides are bonded integrally to each other though linking shafts 14A and 14B.

The screen unit is moved easily and accurately without deformation, and by a moving position detecting mechanism 80 of the screen unit 4, the present position is accurately recognized and memorized.

Between the squeeze drive apparatus 8 and the bearing apparatus 11B on the operation side and between the bearing apparatus 10 on the other side and the bearing apparatus 11A on the operating side are secured squeeze guide frames 15A and 15B. In the inside, a roller chain 16 (Figure 5) is stretched for driving the squeeze apparatus not shown.

Securing blocks 17 are arranged on both ends of the guide frames 15A and 15B, and to the securing block 17 on the operation side of the guide frame 15A, the screen regulating mechanism (I) 30 in the X direction in Figure 1 is secured. Furthermore, at right angles to the regulating mechanism (I) 30 there is mounted the screen regulating mechanism (II) 50 in the Y direction of Figure 1.

The screen regulating mechanism (III) 70 in the X direction of Figure 1 is secured to the securing block 17 on the opposite side of the guide frame 15A. A slide bracket 20 slidable in the Y direction in Figure 1 is mounted on the regulating mechanism (III) 70 in the direction orthogonal thereto. In this case, the difference in the amount of regulation between the screen-regulating mechanism (I) 30 and the screen-regulating mechanism (III) 70 corresponds to the regulation in the rotating direction (θ).

Figure 2 shows details of the section of the screen regulating mechanism (I) 30. It is composed of a regulation frame 31, a regulation mechanism motor (MI) 32, a reduction gear (GI) 33, regulating gears 34 and 35, a ball screw 36, a ball nut 37, a cross slider 38, a slide guide 39, a slide bearing 40, a pulse generator (PGI) 41, pulse generator gears 42 and 43, a gear case 44, a wiring box 45, an approximate switch 46 and a cover 47.

By these, a regulation frame 51 of the screen regulating mechanism (II) 50 provided on the upper portion is rotated by the regulation motor (MI) 32 normally and in the reverse direction and becomes slidable in the X direction of Figure 1.

The screen regulation mechanism (II) 50, as shown in detail in Figure 3, like the regulation mechanism (I) 30, is composed of a regulation frame 51, a regulation motor (MII) 52, a reduction gear (GII) 53, regulation gears 54 and 55, a ball screw 56, a ball nut 57, a cross slider 38, a slide guide 59, a slide bearing 60, a pulse generator (PGII) 61, pulse generator gears 62 and 63, a gear case 64, a wiring box 65, an approximate switch 66 and a cover 67.

The cross slider 38 is the same as that of the regulating mechanism (I) 30 and is integrally formed in a cross shape. To the regulating mechanism (I) 30, by the normal rotation and reverse rotation of the regulation motor (MII) 52, the regulating frame 51 is rendered slidable in the Y direction in Figure 1.

The detailed showing of the screen regulating mechanism (III) 70 will be omitted. It has a similar structure as the screen regulating mechanism (I) 30 (Figure 1) together with a regulation motor (MIII) 71, a reduction gear (GIII) 72 and a pulse generator

(PGIII) 73, and as stated above, in the upper portion of this, the slide bracket 20 is mounted slidably in the Y direction in Figure 1.

Of these screen-regulating mechanisms, the mechanisms (I) 30 and (III) 70 cause the screen 5 to be registered in the X direction of Figure 1 and the mechanism (II) 50 causes the screen 5 to be registered in the Y direction by the normal and reverse rotations of the regulation motors 32, 52 and 71. Furthermore, by the operations of the regulation mechanism (I) 30 and the regulation mechanism (III) 70, the screen 5 can be inclination-regulated in the rotating direction θ.

The pulse generators (PGI) 41, (PGII) 61 and (PGIII) 73 are provided at the screen regulating mechanisms (I) 30, (II) 50 and (III) 73. The amount of the rotation of the ball screws 36 and 56 is detected through the pulse generator gears 42, 62 and 63 and the registration regulation amount is digitally displayed on the surface of the operation panel 90.

The approximate switches 46 and 66 are provided for each of the screen regulating mechanisms (I) 30, (II) 50 and (III) 70. By them, as shown in Figures 2 and 3, the distance S between the approximate switch 46 and the regulating frame 51 and the approximate switch 66 and the regulating frame 31 are detected and the regulation-starting point between the regulating mechanisms is maintained.

When printing of one pattern is completed and a new screen is set, an original point returning switch in each regulation mechanism is operated by the operation panel 90, whereupon the regulation mechanisms operate automatically, and the approximate switch confirms the distance S and stops at the original point. This distance S is preset, for example, at 12.5 mm but can be changed arbitrarily. This return to the original point may be carried out, as required for other than pattern changing.

One end of the regulating frame 51 of the screen regulating mechanism (II) 50 and one end of the slide bracket 20 mounted on the mechanism (III) 70, as shown in Figures 1 and 3, are provided with a height regulating screw 21. The height regulating screw 21 is screwed into supporting metals 23 fixed at both ends of the screen supporting member 18, and by operating a nob 22, the height of the screen 5 is regulated (Figure 3).

In the other screen supporting member 19, the height-adjusting screws 21 are provided likewise in the supporting brackets 24 fixed to securing blocks 17 in the other screen supporting member 19 to regulate the height of the screen 5 (Figure 1).

In the supporting member 18 in the left side of Figure 1, as shown in Figures 1 and 4, a screen receiving plate 18a is integrally fixed to its lower portion, and supports the screen 5. The supporting member 18 has two positioning bolts 25 fixed thereto, and by pressing the screen 5 to it, the position in the X direction is determined.

A stopper 26 is provided on the operation side of the screen receiving plate 18a, and an air cylinder 28 is secured on the opposite side by a bracket 27. The position in the Y direction of the screen 5 is determined by these members.

Screen fixing mechanisms 75 are further provided in at least two parts of the screen supporting member 18. As shown in Figure 4, in the screen fixing mechanisms 75, an air cylinder 76 is fixed to the inside of the screen supporting member 18. A piston rod 76a pushes up a clamp lever 77 by an air pressure. This pushes up the screen 5 onto the receiving plate 18a to fix the screen 5 positioned as above to avoid variations.

The clamp lever 77 is supported rotatably by supporting metals 78 and supporting shafts 79 on both sides. On the loss pressure of the air cylinder 76, the clamp lever 77 has its forward end released by its own weight as shown by the chain line in Figure 4.

The air cylinder 76 and the air cylinder 28 are remote-controlled by a switch-over valve or switch not shown.

The other screen supporting member 19, as partly shown in its section in Figure 1, has an L-shaped section, and the screen 5 is merely placed on the top face thereof. Hence, the screen 5 is positioned and fixed in all the directions on one screen supporting member 18 on the left side, but the other side of the screen 5 is quite free. For this reason, the screen 5 does not develop deformation and distortion, and the state at the time of forming a screen pattern is faithfully maintained, and the screen can be performed in high precision.

Since the screen regulating mechanisms 30, 50 and 70 are centralized on the side of the screen-supporting member 18, the operation becomes easy. Furthermore, a linking rod connecting screen supporting members on both sides as required in the conventional type becomes unnecessary and the structure can be simplified (see Japanese Utility Model Application 79115/57).

A moving position-detecting mechanism 80 of the screen unit 4 is disposed, as shown in Figure 5, in the lower portion of the bearing apparatus 10 on the non-operation side. This position-detecting mechanism 80 is composed of a pulse generator (PGIV) 81, pulse generator gears 82 and 83, and a gear case 85, and a moving guide roller 12 for the screen unit 4, the linking shaft 14A for the pinion 13, and a gearing shaft 84 for the position detecting unit 80 are combined by a coupler 86.

As the screen unit 4 moves, the engagement of the rack 7 with the pinion 13 is transmitted to the

pulse generator (PGIV) 81, and the present position of the screen unit 4 is digitally displayed on the operation panel 90 as stated below.

The registration operation panel 90 in Figure 1 is attached to the one bearing apparatus 11A on the operation side. By this, the screens are operated by the regulating mechanisms (I) 30, (II) 50 and (III) 70. Furthermore, the present position of the screen unit 4 is displayed. The front operation panel surface of the operation panel 90 is shown in Figure 6, and the operation panel is manipulated and used in the following manner.

a. The digital display 91 at the center of the upper portion of the operation panel displays the present position of the screen unit 4. Various methods can be considered for using this display. In an example of the present invention, the display is connected to a computer or a sequencer for controlling the operation of the screen printing machine, and the set position of the screen unit is indicated according to the prescribed repeat length. An electrical circuit is constructed such that if the position is correct, the displayed value of the digital display 91 becomes zero.

If the set position of the screen unit is in error, the error alone is digitally displayed, and its direction is indicated by the lighting of a display lamp 92 on the left or right side. Hence, the screen unit is moved in the arrow direction in which the display lamp 92 is lighted, and the displayed value decreases. When it becomes zero, it shows a correct position.

b. The digital display 93 displays a registration regulation amount in the X direction on the non-operation side. Namely, the rotation direction and rotation amount of the regulation motor mechanism (MIII) 71 of the screen regulation mechanism (III) 70 are detected by the pulse generator (PGIII) 73. The registration regulation amount is displayed plus (+) or minus (-) according to the direction from the original point.

The operation is performed on the touch switches on the left and right, and the returning to the original point of the screen regulation mechanism is performed by a touch switch 95.

c. A digital display 96 located at a lower portion displays the registration amount regulated in the X direction on the operation side, and as mentioned above, the display 96 expresses the action of the screen regulation mechanism (I) 30, and is operated in the same way as described above by the left and right touch switches 97.

d. The digital display 98 in the lower portion displays the registration amount regulated as mentioned above in the Y direction of the screen obtained with the screen regulation mechanism (II) 50, and the display 98 is operated in any arrow direction by one of the touch switches 99 on the left and right.

By the operation described in c. above and the operation of a touch switch 100, the screen regulation mechanisms (I) 30 and (II) 50 are returned to the original point.

The touch switches for the registration regulation act in the directions shown by arrows. The registration regulation of this invention is digitally displayed, for example, in units of 0.1 mm.

In Figures 7 to 10 showing the screen registration regulation apparatus of a preferred automatic screen printing machine, this apparatus further comprises a television camera 110 provided on the discharge side of an endless belt 2 of the automatic screen printing machine, a television monitor 113 for displaying on an enlarged scale the actual registration state from the camera, and a second operation panel 114 for finely-regulating the registration of the screen on the basis of the image of the television.

The screen printing registration condition just after completion of screen printing is photographed by the CCD camera 110 on the endless belt 2, and transmitted and displayed onto the color monitor 113 disposed in the centralized operation panel 112. The operator, while seeing the image on the monitor, performs the screen registration regulation by the second registration operation panel 114 attached to the centralized screen registration operation panel 112 (Figure 8) according to the screen registration condition. The screen registration operation panel 114 is controlled in the same way as the screen registration operation panel 90 attached to each screen unit 4, and the screen registration becomes possible completely by the remote-controlling operation.

Figure 7 is a perspective view showing the state of setting the CCD camera 110 at the rear part of the screen printing machine. Figure 8 is a perspective view of the centralized operation panel 112. Figure 9 is a front view of the screen registration operation panel 114 attached to the centralized operation panel 112. Figure 10 is a block diagram showing the general aspect of the control.

In Figure 7, the cloth 3 printed in a predetermined color in each screen unit 4 (drawing not shown) on the printing machine is sent intermittently while adhering to the endless belt 2 in the arrow direction, deprived at the last portion of the printing machine, and sent to a post treatment such as drying.

Just before the printed cloth 3 is peeled from the endless belt 2, namely immediately after the final color is printed at the endless belt 2, four CCD cameras 110 are disposed for watching and confirming the condition of the automatic screen printing matching. The four CCD cameras 110 as

shown in the drawing are arranged so that the four corners of one section formed by a repeat length P and a printing width W can be watched.

In the Example, four CCD cameras are used as shown above, but 2 CCD cameras for watching the corners of one section are sufficient. Besides the CCD camera, there can be used a television and a video camera.

The screen registration state as taken by the CCD camera 110 is electrically transmitted to the color monitor 113 provided in the centralized operation panel 112 of Figure 8, and displayed in the monitor. In case of the ordinary operation, the information in the four CCD cameras 110 is taken simultaneously at four places by dividing the image of the monitor 113 into four parts. In this case, one side is enlarged 2 times, and the area is enlarged 4 times. When one of the four places is desired to be confirmed on an emphasis, only one place is taken up on the entire image by channel switch-over of the picture image. In this case, one side is enlarged 4 times and the area is enlarged 16 times, and a finer screen registration condition than by the naked eye observation is indicated in the monitor.

The operator watches the color monitor 113, and if regulation of the registration is required, this is performed by the screen registration operation panel 114 attached to the centralized operation panel 112. This screen registration-regulating operation panel 114 exerts function shown in Figure 9, and can be performed in the same way as the operation panel 90 attached to each screen unit 4. The only difference from the operation panel 90 is that on the uppermost portion of the screen registration-regulating operation panel 114, the digital display 115 showing the number according to the arrangement of the screen unit 4 and the touch switch 116 for change-over of screen units are disposed.

The operator confirms what screen unit of which number (which color) needs registration by the color monitor 113. Then the operator operates the change-over touch switch 116 on the left or right, and calls up the requiring screen unit number to the digital display 115. Then, the touch switches 94', 97' and 99' are operated according to the screen registration condition while seeing the image on the monitor 113. The touch switches 94', 97' and 99' have the same functions as the touch switches 94, 97 and 99 disposed in the operation panel 90 attached to the screen unit 4, and control the screen regulating mechanisms (I) 30, (II) 50 and (III) 70 provided in each screen unit 4. The regulation numbers are displayed in digital displays 93', 96' and 98'. The touch switches 95' and 100' likewise perform the return of the screen regulating mechanism to the original point.

Figure 10 is a block diagram showing the control system of the example.

The information on the screen registration photographed in the CCD camera 110 is photographed by the color monitor 113 through the controller 111. From the computer 117 for controlling the screen printing machine, the data for the repeat length, the number of colors (screen unit numbers), the screen arrangement and other printing operations are instructed to the screen unit 4-1 to 4-N through the motor control apparatus.

The information on the screen registration operation panel 114 of the centralized operation panel 112 or the information on the screen registration operation by the operation panel 90 attached to each screen unit are fed back from pulse generators 41, 61 and 73 attached to each screen unit 4 to the computer 117 through the motor control apparatus 118. Thus, final data on the screen registration are input and preserved for use as operating date.

The screen registration condition can be confirmed by the color monitor 113 as a stationary image even at the time of intermittent feeding on the endless belt.

In the computer 117, finely regulated data or further modified data in the repeat direction (X), the orthogonal direction (Y) and the rotating direction (θ) were stored with respect to the screen unit 4-1 to 4-N, and on the basis of these data, regulation motors (MI, MII, MIII) 32, 52 and 71 for respective screens are driven to automatically finely regulate each screen in the repeat direction, the orthogonal direction and the rotating direction.

Furthermore, in the computer 117, the repeat length data of each screen and the arrangement data of the screen unit carrying the printing screen are stored. The stored repeat length data and arrangement data are moved automatically to positions at which the screen units 4-1 to 4-N are set, on the basis of the signals from the position detecting mechanisms 80 of each screen unit. These data may be fixed to control the screen unit position regulating mechanisms to move and fix the screen units 4-1 to 4-N to predetermined positions automatically.

The position deviation data, the repeat length data or the data on the arrangement of screen units are peculiar to respective screens and are invariable. Thus, if the above data are once stored, in the case of color changing with the same screen or of using the screen again after storing, it is only necessary to input merely the number or the like that can identify the screen. Then, by simply calling the position deviation data, the repeat length date and the arrangement data, the positioning and the fine regulation of the position can be performed automatically.

Desirably, in the present invention, position de-

viation data in the repeat direction, the orthogonal direction and the rotating direction are detected and set as pulse numbers on a plurality of screens, and the above repeat length data of the screen and the arrangement data of the screen units are as pulse numbers. Thus, each screen unit is moved from the standard position on the screen printing machine to the position where the pulse numbers are as set and fixed. The screen on the screen unit fixed is moved according to the number of the set pulses in the repeat direction, the orthogonal direction and the rotating direction to make possible a fine regulation of the screen registration

A pulse generator (PGIV) is disposed on the screen unit position regulating mechanism 80. The screen position determining regulation mechanism is provided with servo-driven mechanisms (MI, MII and MIII) for driving the screen in the repeat direction, the orthogonal direction and the rotating direction and pulse generators (PGI, PGII and PGIII) to be attached thereto. The computer and the screen unit position regulation mechanism are associated with each other so that each screen unit is moved from the standard position on the screen printing machine to the position correspodning to the pulse number set and is fixed at said position so that the screen of the fixed screen unit is moved and adjusted in the repeat direction, the orthogonal direction and the rotating direction according to the pulse numbers set. This makes it possible to perform all positioning operations automatically or semi-automatically.

The invention provides the following advantages:

(1) Since the screen registration is accomplished by a switch operation by one touch, the operation is easy and rapid and even those who are inexperienced can perform the operation easily.

(2) The screen registration regulation amount can be digitally displayed. Confirmation of the screen registration condition and reproducibility at the repeat order time are excellent.

(3) Since the screen is supported and fixed only on one supporting member, deformation and distortion are not developed and the natural condition at the time of design making is maintained.

(4) The screen can be mounted and dismounted easily and rapidly.

(5) The screen registration regulation is possible on the operating side or the non-operating side of the screen printing machine.

(6) The structure of the screen registration-regulating apparatus on the whole is simplified.

(7) The arrangement and set condition of each screen unit are digitally instructed. Hence, the movement and positioning of the screen unit can be easily accomplished.

(8) The screen registration regulation can be performed with a high precision on the basis of the preset value, and the screen registration can be finely regulated in accordance with the actual condition of the screen registration with a high precision by remote control.

Claims

1. An apparatus for regulating the registration of screens in an automatic screen printing machine, characterized by

screen supporting members (18, 19) confronting each other;

a screen (5) to be supported and fixed onto one of the screen supporting members (18, 19);

three sets of screen regulating mechanisms (30, 50, 70), disposed in said screen supporting member (18, 19), which can regulate the registration of the screen (5) in the repeat direction (X), the direction (Y) orthogonal thereto and the rotating direction (θ);

a registration-regulating motor (32, 52, 71) and a pulse generator (41, 61, 73) for detecting the regulating amount, disposed in each screen-regulating mechanism (30, 50, 70) and

a registering operation panel (90) comprising switches (94, 95, 97, 99, 100) for performing the regulation of the registration and digital display mechanisms (93, 96, 98) for displaying the regulation amount.

2. An apparatus of claim 1, characterized by further comprising

a television camera (110) disposed on the endless belt discharge side of the automatic screen printing machine;

a television monitor (113) displaying the actual registration state on an enlarged scale from said camera (110); and

a second operation panel (112) for finely regulating the registration based on the image of the television.

FIG. 1

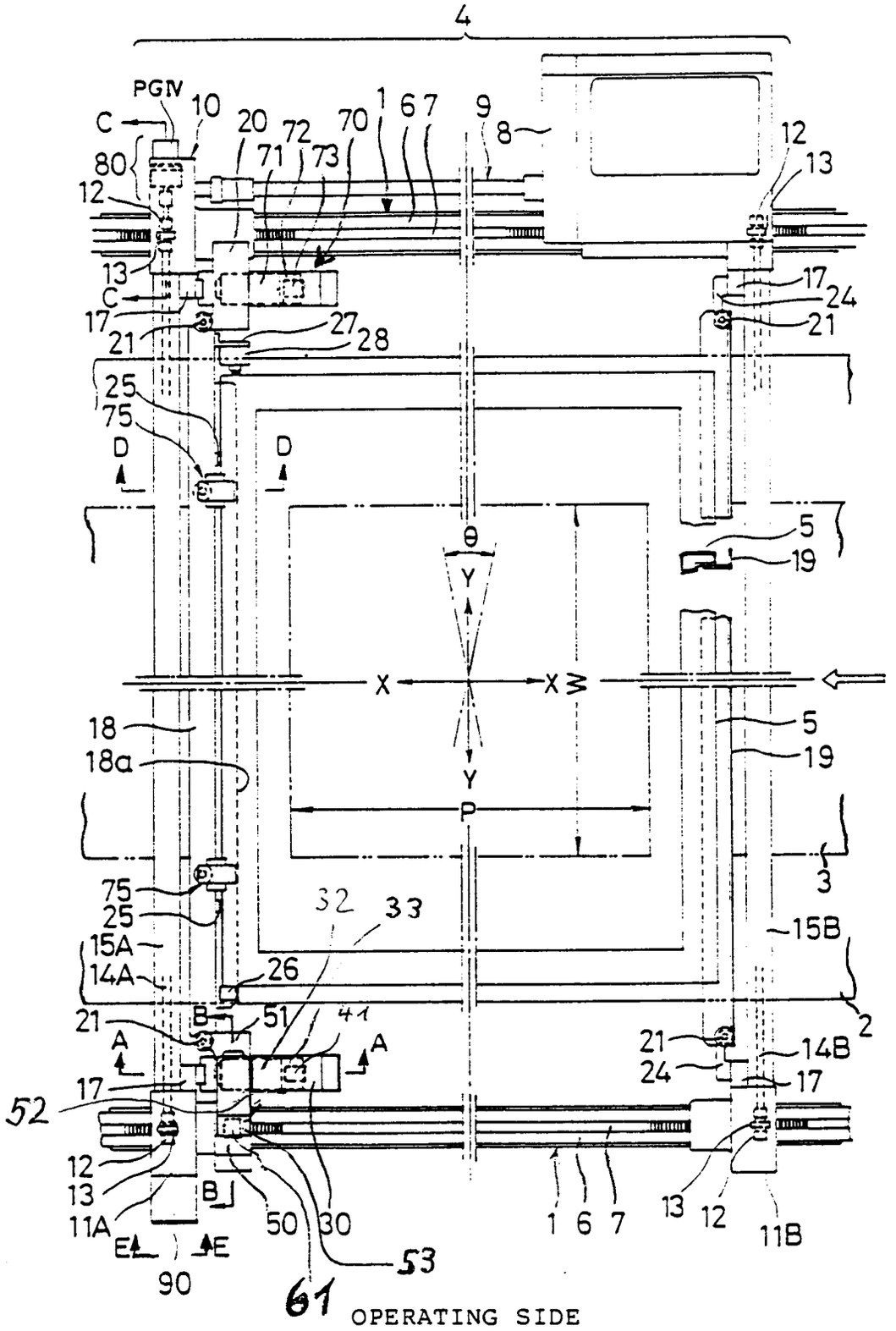

4
PGM
C
10
20
72
71
73
70
1
6
7
9
8
12
13
80
12
13
C
17
21
27
28
17
24
21
25
75
D
D
θ
Y
5
19
X
X
18
18a
Y
P
5
19
3
75
25
32
33
15A
14A
26
15B
2
21
A
B
51
41
A
21
24
14B
17
17
52
12
13
11A
E
E
90
B
50
30
53
61
1
6
7
13
12
11B
OPERATING SIDE

FIG. 2

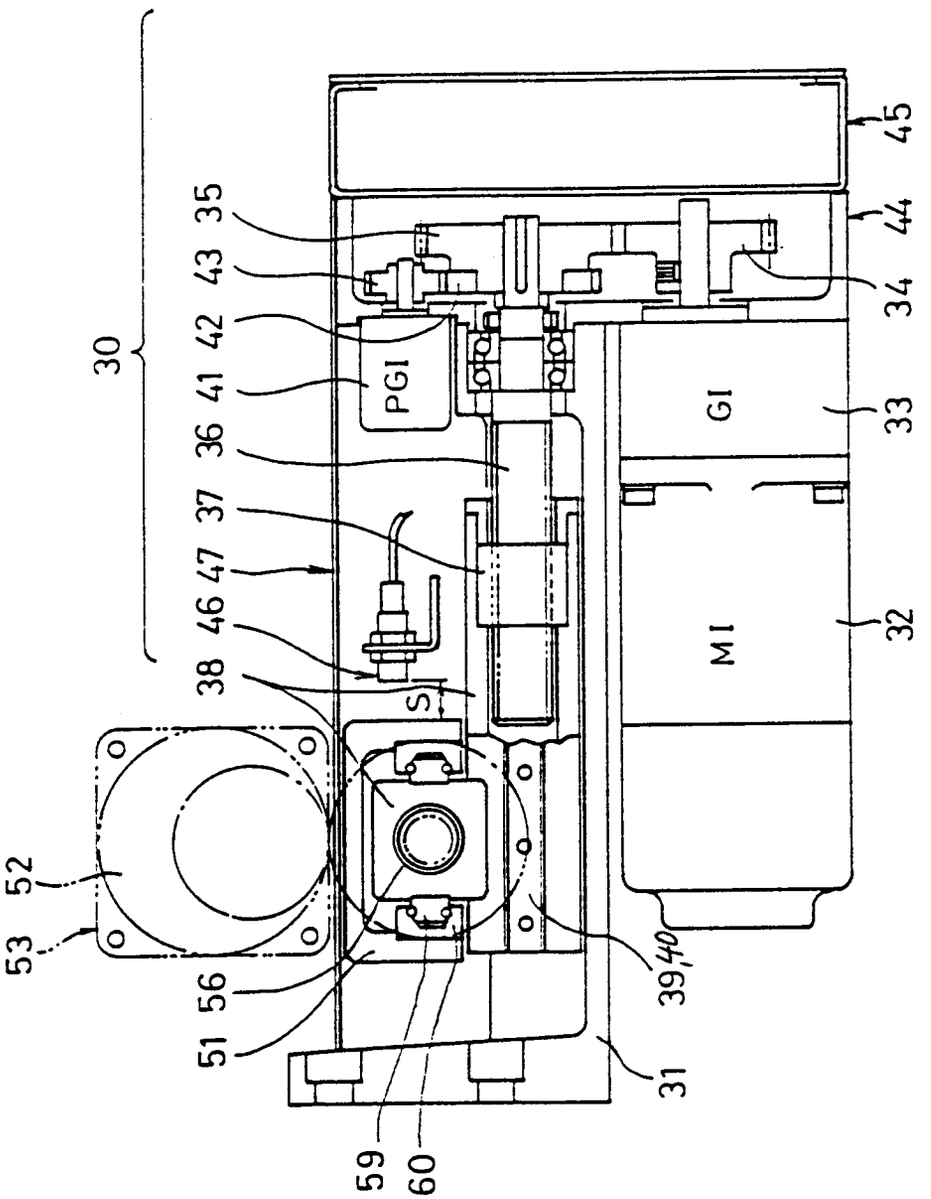

30
35
43
42
41
36
37
47
46
38
52
53
56
51
59
60
PGI
S
GI
MI
45
44
34
33
32
39,40
31

FIG. 3

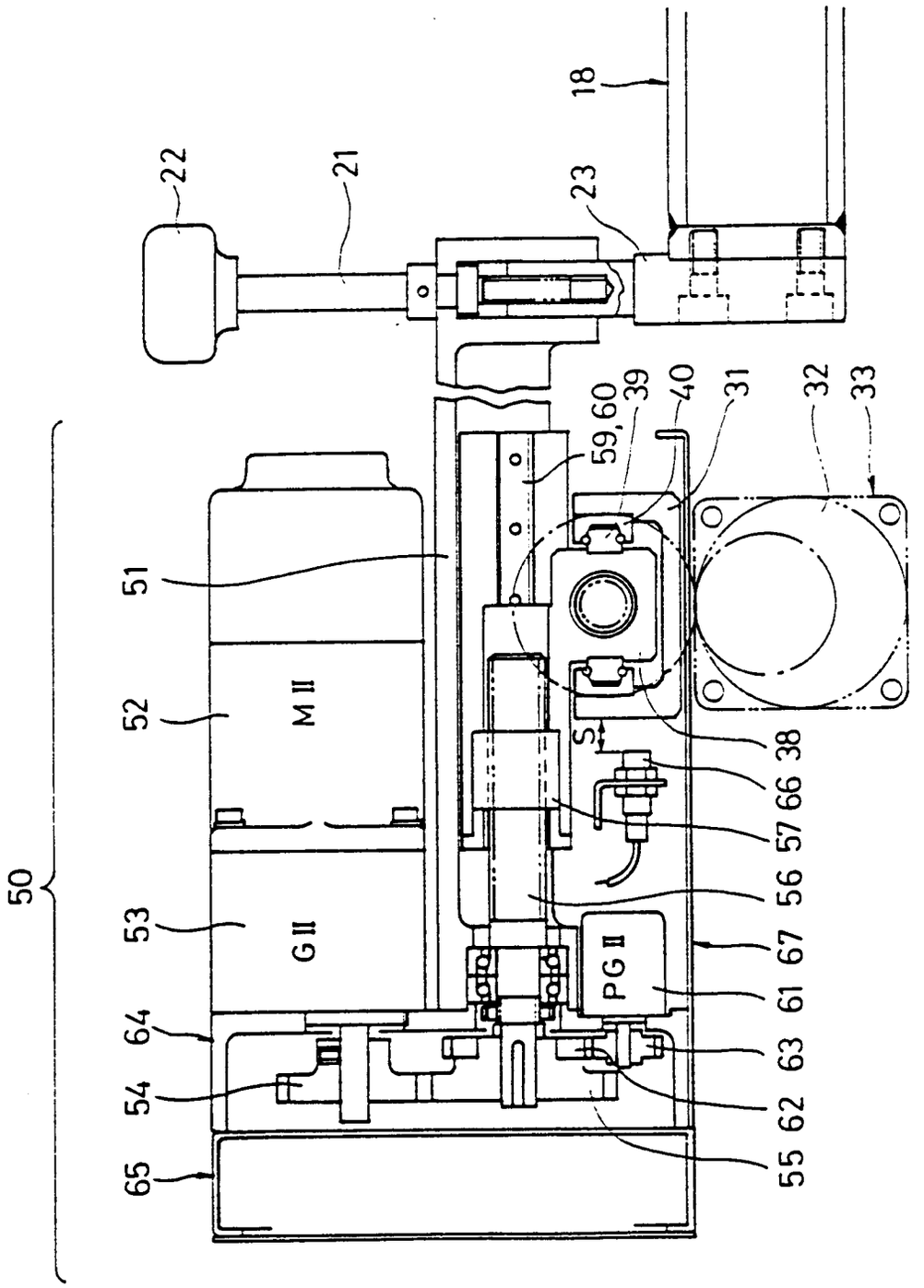

18
22
21
23
59,60
39
40
31
32
33
51
52
M II
53
G II
64
54
65
50
S
38
66
57
56
67
PG II
61
63
62
55

FIG. 4

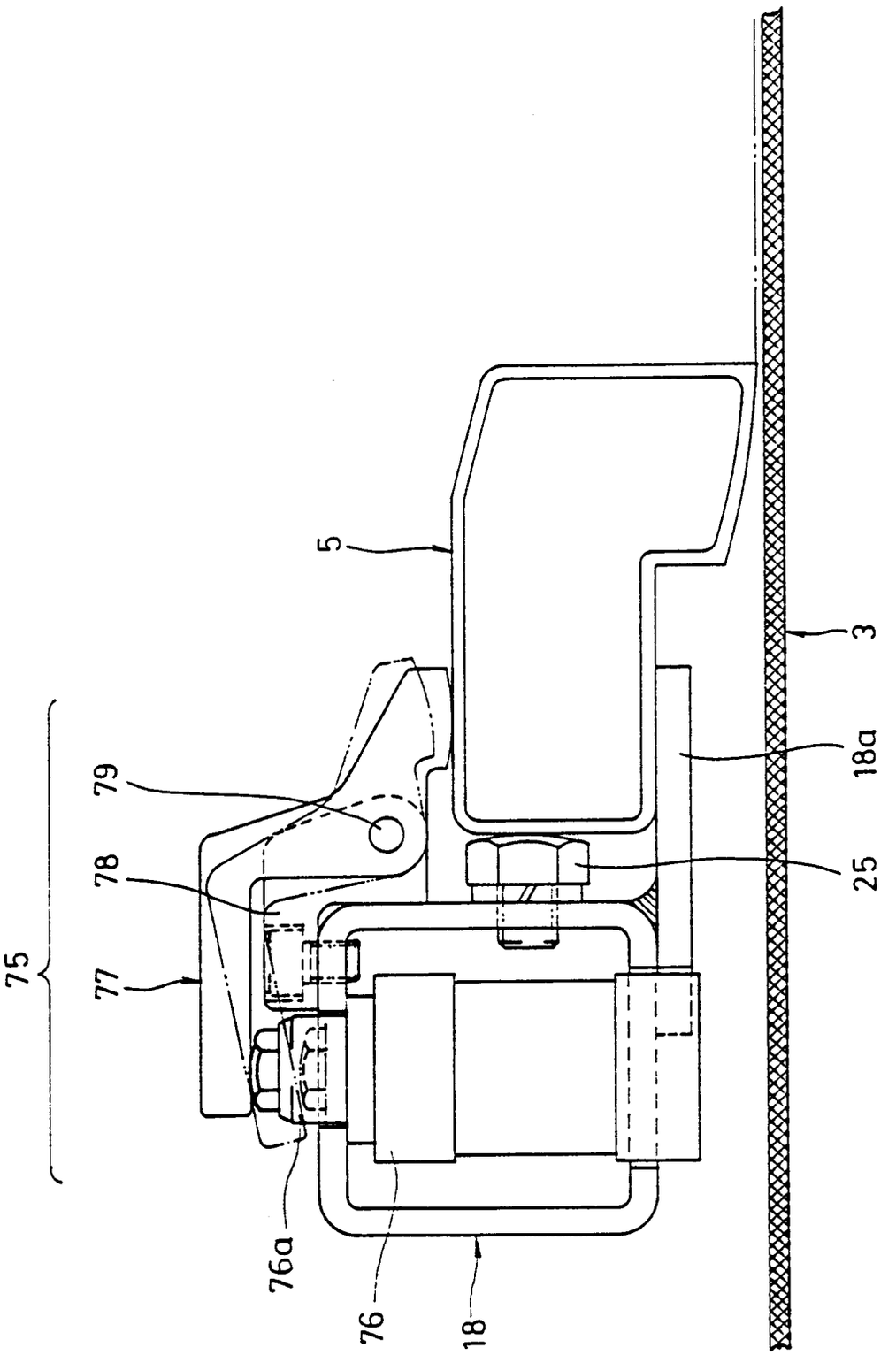


FIG. 5

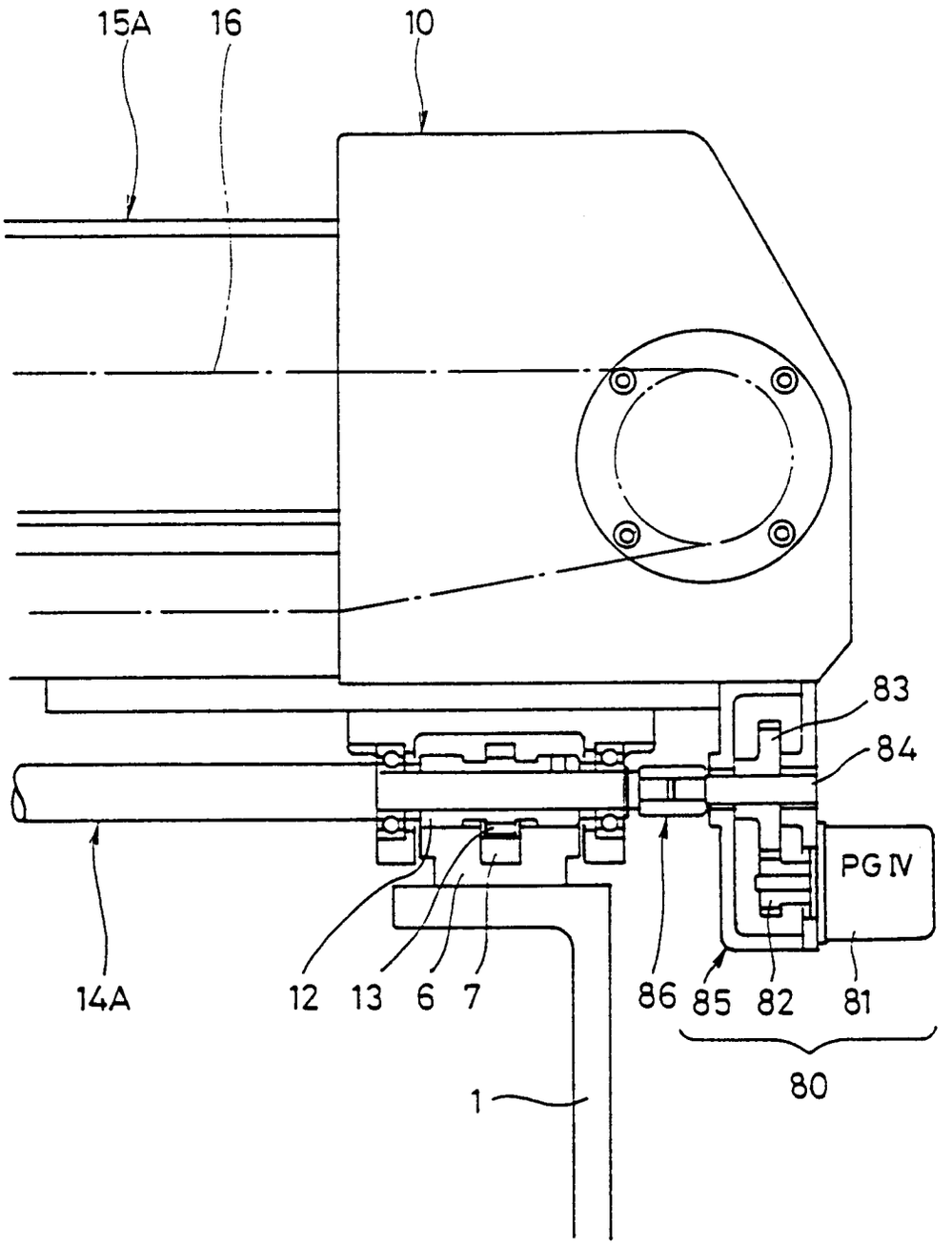


FIG. 6

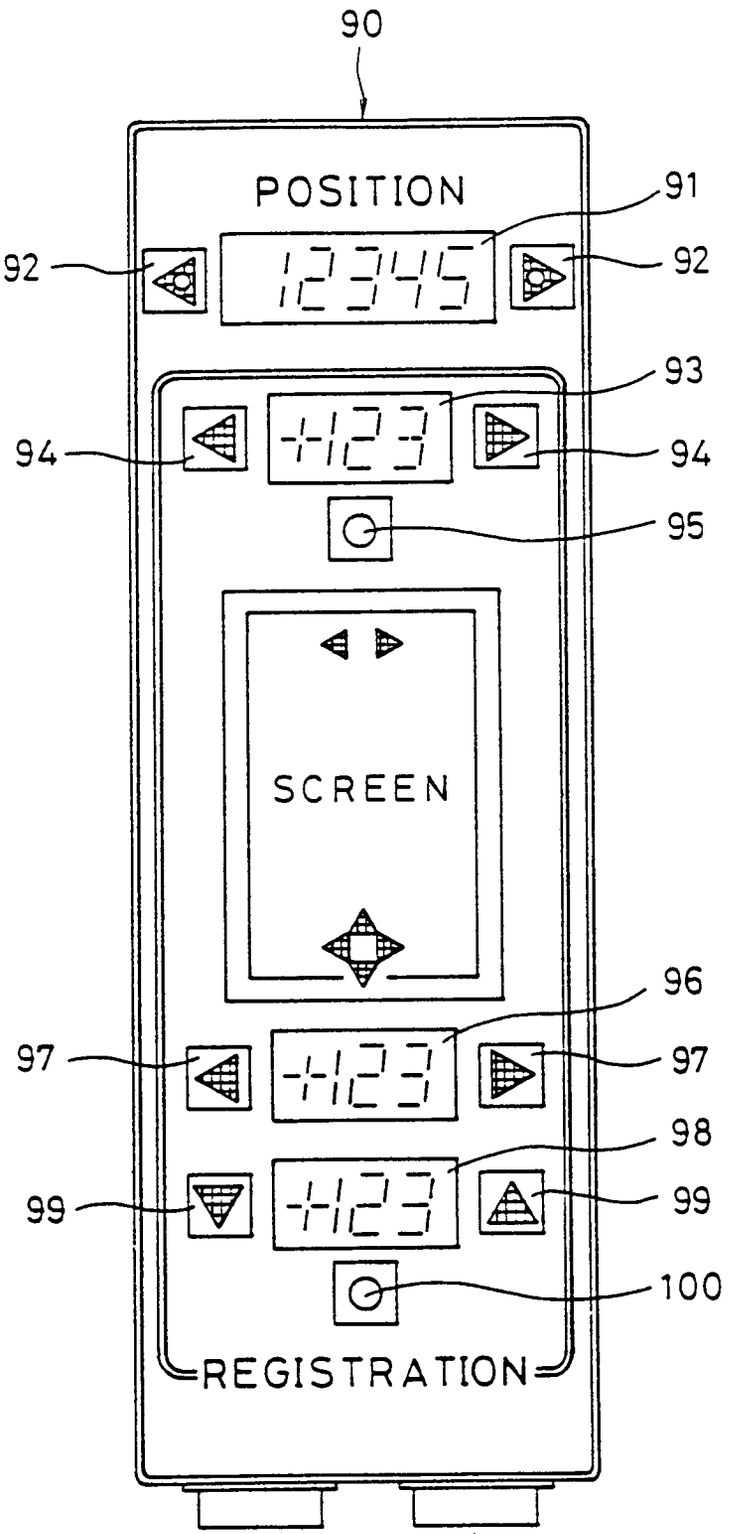

90
POSITION
91
12345
92
92
93
-H123
94
94
95
SCREEN
96
-H123
97
97
98
-H123
99
99
100
REGISTRATION

FIG. 7

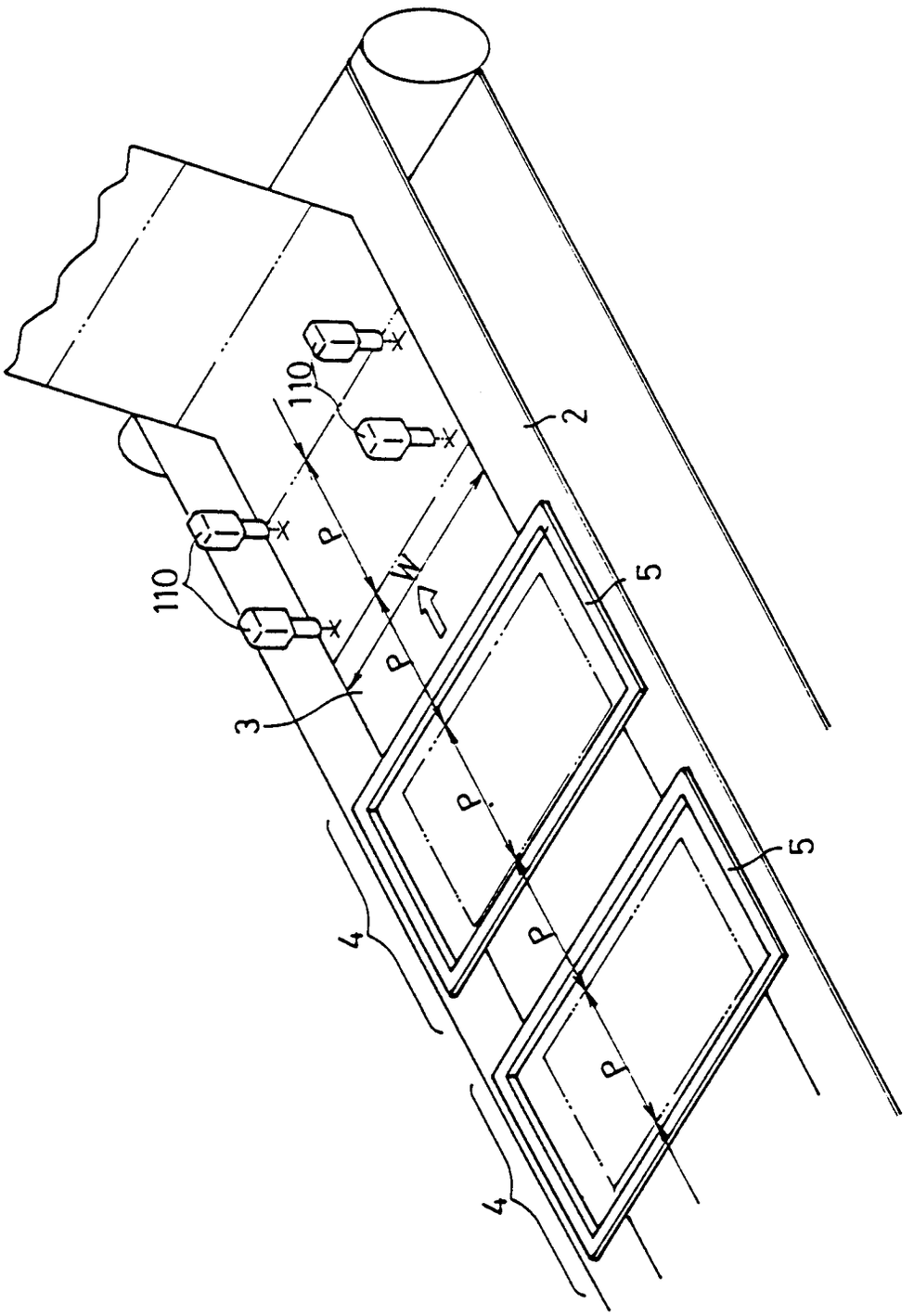


FIG. 8

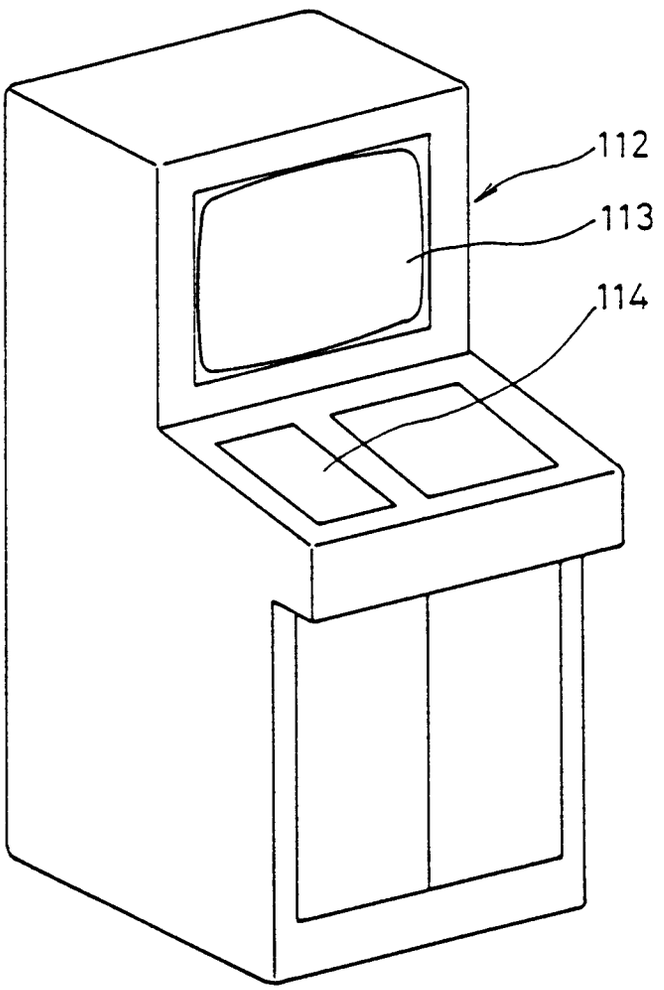


FIG. 9

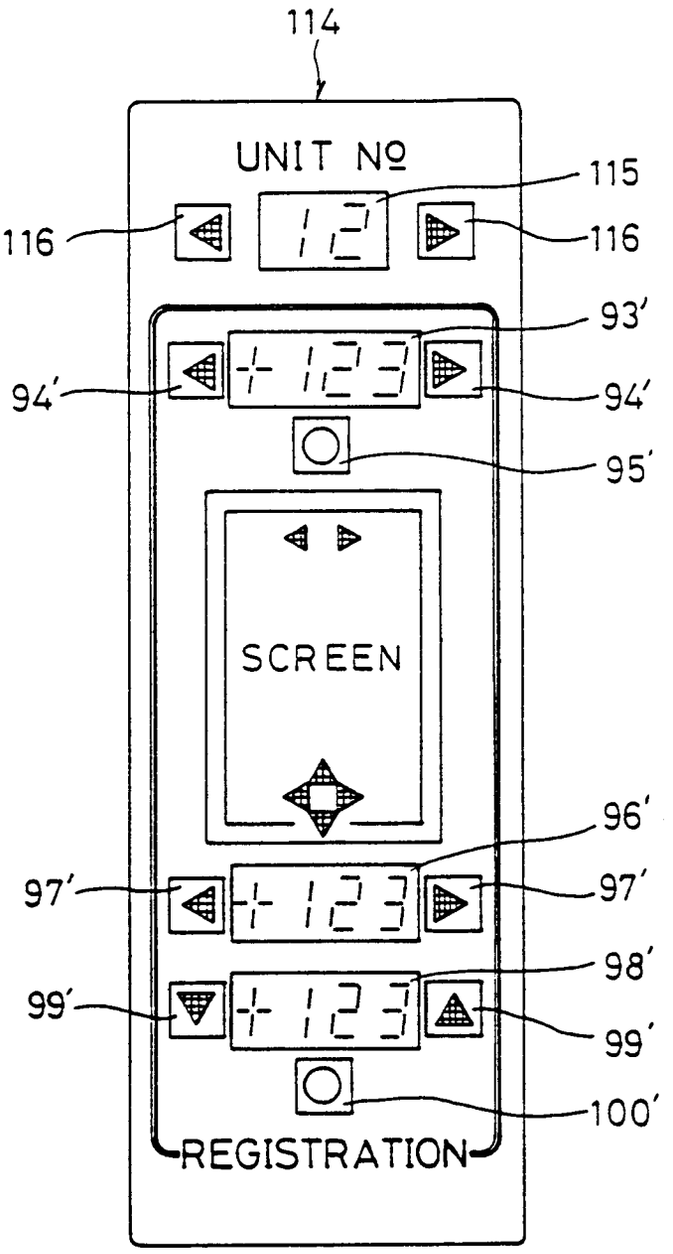
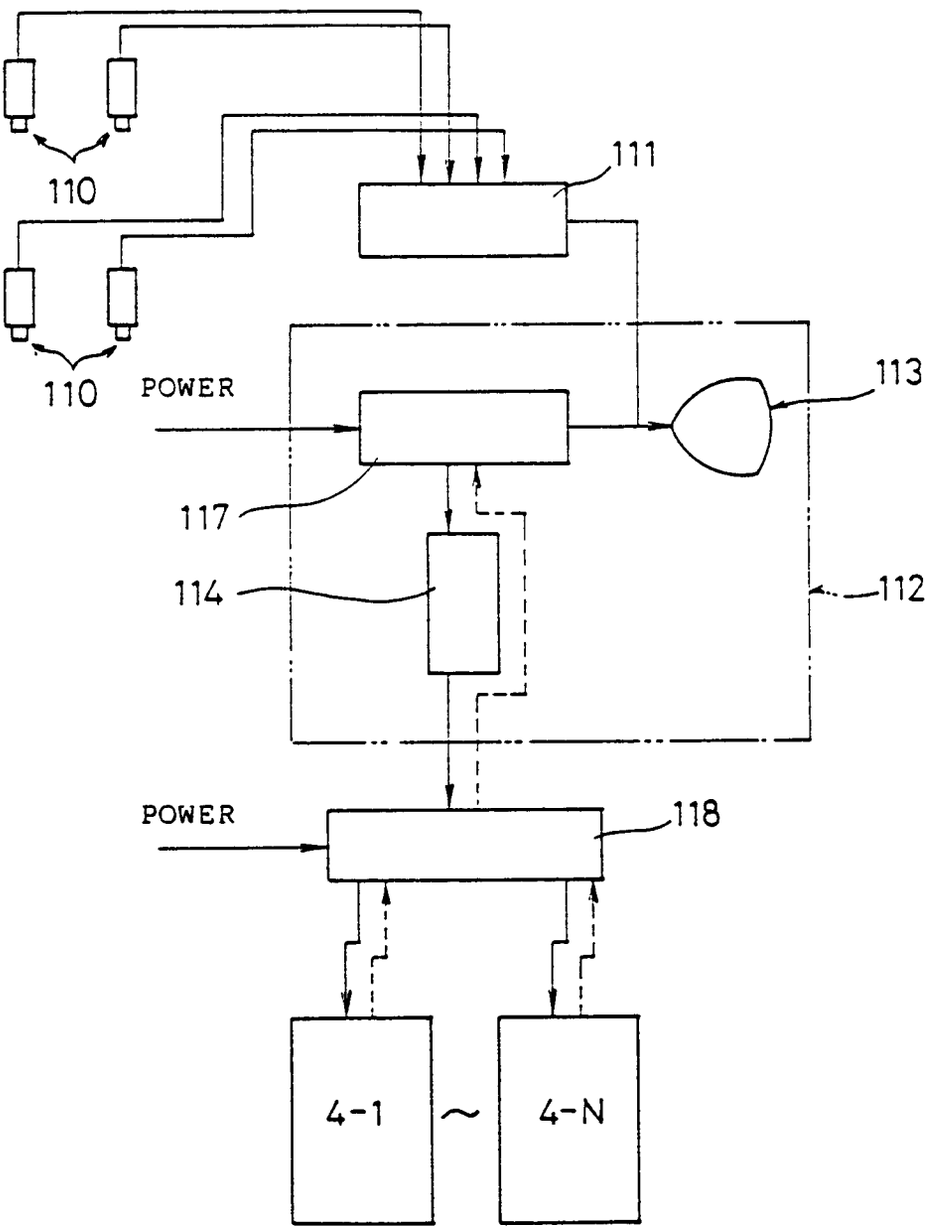

114
UNIT Nº
115
116
12
116
93'
+ 123
94'
94'
95'
SCREEN
96'
97'
+ 123
97'
98'
99'
+ 123
99'
100'
REGISTRATION

FIG. 10



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 11 2709

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.5)
A	DE-A-3 904 863 (INDUSTRIE-SIEBDRUCK-SYSTEME NECKARWEIHINGEN GMBH) * the whole document *	1	B41F15/10 B41F15/08 B41F15/36
A	US-A-4 610 200 (METSO)		
A	EP-A-0 364 424 (SVECIA SILKSCREEN MASKINER AB)		
A	EP-A-0 093 701 (SVECIA SILKSCREEN MASKINER AB)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 JUNE 1992	MADSEN P.

CATEGORY OF CITED DOCUMENTS

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