

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 474 268 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **91201230.9**(51) Int. Cl.⁵: **B41F 15/10**, B41F 15/08,
B41F 15/36(22) Date of filing: **24.05.91**(30) Priority: **04.09.90 JP 232397/90**(43) Date of publication of application:
11.03.92 Bulletin 92/11(84) Designated Contracting States:
CH DE FR GB IT LI NL(71) Applicant: **TOSHIN KOGYO CO. LTD.**
11-36, 9-chome, Minami-Mukonosu
Amagasaki-shi Hyogo-ken(JP)(72) Inventor: **Ichinose, Shiro**
3-11, Sanno-cho, Koyoen
Nishinomiya-shi, Hyogo-ken(JP)
Inventor: **Onda, Minoru**

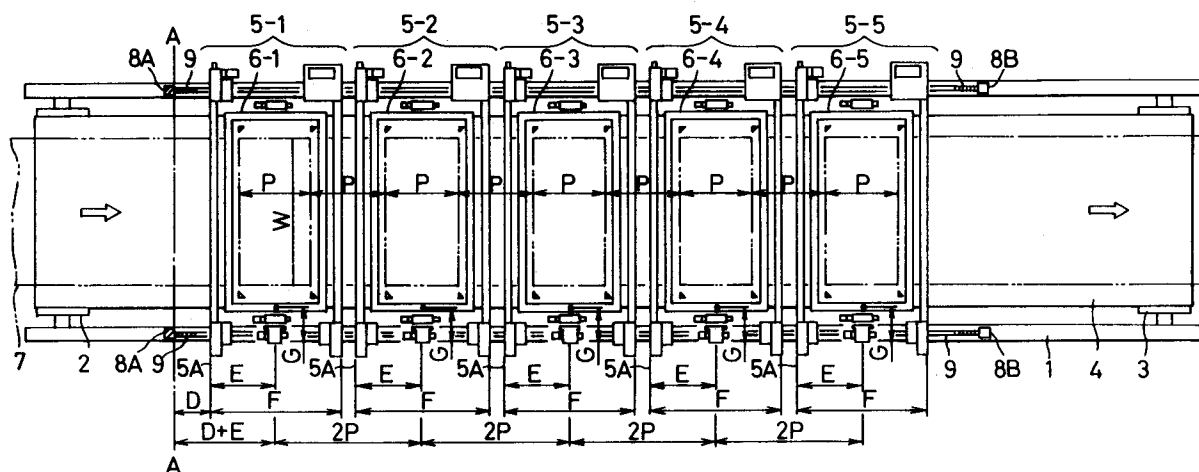
1-1-509, Shoji 2-chome
Toyonaka-shi, Osaka-fu(JP)
Inventor: **Dohi, Katsumi**
2-506, Doshodai 1-chome, Suma-ku
Kobe-shi, Hyogo-ken(JP)
Inventor: **Fukui, Mineki**
8-3-308, Konakajima 2-chome
Amagasaki-shi, Hyogo-ken(JP)

(74) Representative: **Smulders, Theodorus A.H.J.,**
Ir. et al
Vereenigde Octrooibureaux Nieuwe Parklaan
107
NL-2587 BP 's-Gravenhage(NL)

(54) **Method of registering screens in an automatic printing machine and apparatus for the same.**

(57) Positional deviation data of each screen are pre-
liminarily detected and stored. When the screen is
mounted on the screen, the registration between the
screen and the screen unit is performed by finely

adjusting the position of the screen relative to the
screen unit by a fine adjusting mechanism according
to the stored deviation data.

FIG.1**EP 0 474 268 A1**

Background of the Invention

(1) Filed of the Invention

The present invention relates to a method of registering screens in an automatic printing machine and an apparatus for the same. More particularly, the present invention relates to a method in which initial presetting and registration of screens is automatically or semi-automatically and rationally performed in an automatic screen printing machine and apparatus for the same.

(2) Description of the Related Art

Several to twenty and several screens are used for one pattern depending on the number of printing colors in multi-color printing of an automatic screen printing machine. Prior to starting the printing, it is necessary to present each screen in an accurate position on the printing machine depending on the intermittent transport length (repeat length) so that no misregistration of patterns occurs.

Presetting of the initial position or registration of screens has heretofore been achieved by a method as follows:

- 1) Each screen unit is moved depending on the printing repeat length while the space between the screen units is calculated by using a measure or a gauge and the like and is fixed to a substantially predetermined position and respective screen is set on the fixed screen unit.
- 2) Only the endless belt of the printing machine is intermittently transported in an idle manner by a given repeat length. A part of a pattern of a first screen having a first color or register marks are provisionally printed on the surface of the endless belt.
- 3) The provisional printing is manually performed by using white powders or white aqueous pigments and the like on each transport of the endless belt so that the registration marks are applied on the endless belt along the entire length of a printing table.
- 4) The second and subsequent screens are successively registered and finely adjusted while the pattern or register marks are visually aligned with the provisionally printed white marks.
- 5) After completion of registration of all screens, a guide fabric is introduced into the printing machine prior to introduction of a fabric to be printed. Fine registration adjustment of the screens is performed while usual printing work is performed.

Since conventional screen registration works all rely upon manual work, man power, experience and an extended period time are required and the

registration and an extended period time are required and the registration is inaccurate. Accordingly, readjustment of the screen positions is often inevitable even after starting the printing work. The registration work is necessary each time when printing patterns are changed. Man power and an extended period of time are necessary on each time. The printing efficiency is thus low and this gives an adverse influence upon the printing quality. Registration has become an important subject in association with the recent strong trend of variety in kinds and less production and multi-color printing.

"Register mark" used herein is represented at 6D in Fig. 3-A and is also referred to as star mark or reference mark. The shape of the register mark may be various shapes such as cross and circle other than the represented triangle. The register mark is reproduced on the screen simultaneously with the printing pattern as a reference for accurately indicating the repeat length and the seam of the patterns.

Therefore, it is an object of the present invention to provide an automatic screen multi-color printing machine in which all registration and presetting of screens are automated and semi-automated so that they can be achieved in quick and highly accurate manner for enhancing the working efficiency of the printing machine, saving man power and improving printing quality in multi-color printing of the automatic screen printing machine.

It is another object of the present invention to provide an automatic control system for the whole of a printing machine in which informational data on registration of each screen for one pattern are all expressed numerically.

In accordance with the present invention, there is provided a method of registering screens in an automatic screen printing machine, comprising the steps of:

detecting and presetting positional deviations of reference marks of a plurality of screens used for printing as data in a repeat direction, in a direction normal to the repeat direction and in a rotational direction based on the original points;

presetting data on repeat length of said screens and on the arrangement of screen units on which the screens are placed;

moving and fixing each screen unit in the present position based upon present data on repeat length and arrangement; and

finely adjusting the position of each screen.

In accordance with the present invention, there is also provided an apparatus for registering screens in an automatic screen printing machine, comprising:

a plurality of screens for printing each includ-

ing an origin and reference marks;

screen units, one on which each screen is placed for performing the printing through the screen;

a mechanism for adjusting the position of each screen unit which is capable of moving each screen unit in the repeat direction and stopping the same;

screen registration adjusting mechanisms, one for each screen unit, which is capable of finely adjusting the screen by moving the same in the repeat direction, in the direction normal thereto and in the rotational direction;

screen reference position detecting mechanisms, one for each screen, for detecting the positional deviation of the reference mark of each screen as data in the repeat direction, in the direction normal thereto and in the rotational direction based upon the origin; and

a computer for presetting data on the repeat length of the screen and data on the arrangement of the screen units upon which the screens are placed for controlling the screen unit position adjusting mechanism to move each screen unit to the present position and fix it thereto based upon the present repeat length data and the arrangement data, for storing the data on the positional deviation of each screen from the screen reference position detecting mechanism and for finely adjusting the position of each screen in the present direction, in the direction normal thereto and in the rotational direction based upon the positional deviation data.

The positional deviation of the printing machine is expressed as data in the repeat direction (X direction), in the direction normal thereto (Y direction) and in the rotational direction (θ direction) with respect to a given position of the origin. In accordance with the present inventions, the positional deviation of the reference mark of each printing screen is detected as data in the repeat direction, in the direction normal thereto and in the rotational direction based upon the origin and is preset. Each screen is provided on the screen unit so that the position of the screen is finely adjustable in the repeat direction, in the direction normal thereto and in the rotational direction. Adjustment of the position of the screen is performed according to the preset data or the positional deviations. Data on the repeat length of each screen and on the arrangement of each screen unit are preliminarily preset and the arrangement of the screen units to predetermined positions is performed accordance to the data on the arrangement.

The data on the positional deviation and the repeat length of each screen and the data on the arrangement of the screen unit are specific for each screen and are fixed. Accordingly, if the data of each screen are preset (stored) once, when the

colors are changed for the same screen or stored screen is used again, the positional deviation data, repeat length data or the arrangement data can be read by merely inputting a number which can identify the screen so that registration and fine adjustment of the position can be automatically performed.

In the present invention, it is preferable that the positional deviation data of a plurality of screen in the repeat direction, in the direction normal thereto and in the rotational direction be detected as the number of pulses and be preset and that the repeat length data of the screens and the arrangement data of the screen units be preset. By doing so, each screen can be moved from the reference position on the printing machine to a position where the preset number of pulses is counted out and can be fixed thereto and the screen on the fixed screen can be finely adjusted by moving it in the repeat direction, in the direction normal thereto and in the rotational direction according to the preset number of pulse.

The screen unit position adjusting mechanism is provided with a pulse generators and a combination of a servo drive mechanism and a pulse generator, and the screen registration mechanism is provided with a servo drive mechanism which drives the screen in the repeat direction, in the direction normal thereto and in the rotational direction and a pulse generator attached thereto. The computer and the screen unit position adjusting mechanism are operatively associated for moving each screen unit from the reference position to a position on the printing machine where the preset number of pulses is counted out and for fixing the same thereto. The computer and the screen registration adjusting mechanism are operatively associated for finely adjusting the screen on the fixed screen unit by moving the screen in the repeat direction, in the direction normal thereto and in the rotational direction. This automates or semi-automates all registration working.

In accordance with the present invention, registration and presetting of each screen can be performed, for example, according to the steps as follows:

- 1) The reference position (reference mark) of each screen is preliminarily measured by a measuring device.
- 2) Each of a plurality of screen units which are mounted on the printing machine is automatically or semi-automatically moved to a predetermined position according to a given printing repeat length and is fixed thereto.
- 3) The position of the screen is finely adjusted by automatically moving the screen in an X, Y and directions according to the measured value of the reference position by means of the screen

registration adjusting device provided on each screen unit.

4) The values of the movement amount of each screen unit and the fine adjusting amount of the screen are all uploaded into a host computer where the values are controlled. On repeat order, the values are immediately downloaded for performing registration and adjustment as is similar to the previous case.

5) Movement of the screen unit and fine adjustment of the screen position may be manually performed by switching actuation of a push button on a control panel (remote controller) annexed to the screen unit.

In accordance with the present invention, all registration and presetting of screens are automated and semi-automated so that they can be achieved in quick and highly accurate manner. This can enhance the working efficiency of the printing machine, resulting in saving in power and improvement in printing quality in multi-color printing of the automatic screen printing machine. Informational data on registration of each screen for one pattern are all expressed numerically so that automation of the whole of the printing machine becomes possible.

Brief Description of the Drawing

Fig. 1 is a plan view showing the whole of an automatic screen printing machine having screen units mounted thereon each including a device for automatically registering the screen of the present invention;

Fig. 2 is a plan view showing a screen unit of the present invention;

Fig. 3-A is a plan view showing a screen in the present invention;

Fig. 3-B is a plan view showing the engagement of a reference hole of the screen with a reference pin in Fig. 3-A.

Fig. 4 is a perspective view showing a device for measuring the reference position of the screen.

Figs. 4-A and 4-B are perspective views showing the screen reference positions which are taken by a CCD camera in the measuring device;

Fig. 5 is a block diagram for schematically showing a control of the present invention; and

Fig. 6 is a flow chart illustrating the control of each mechanism.

Description of the Embodiment

(Whole Structure)

Referring now to Fig. 1, front and rear rollers 2 and 3 are provided at the opposite front and rear

ends of a machine base 1, respectively. An endless belt 4 is tensioned between the front and rear rollers 2 and 3 and is intermittently driven by a known method (refer to Japanese Examined Patent Publication No. 60-31728). A plurality of screen units 5 (5-1 through 5-5) are disposed above the endless belt 4. One of screens 6 (6-1 through 6-5) is mounted on each screen 5.

A fabric 7 to be printed is introduced upon the endless belt 4 in a direction of an arrow from the left side as viewed in the drawing. After the fabric has been printed through the screens 6 by a known method, it will be conveyed out of the machine toward subsequent installation such as drier.

Stoppers 8-A are secured to the opposite sides of the machine base 1 at the left end (front side to which the fabric to be printed is introduced) thereof. An imaginary line A-A passing through the end face between the opposite sides is defined as a reference line serving as an origin of the movement of the screen unit 5. Stoppers 8-B are secured to the both sides of the machine base at the opposite end (rear end left as viewed in the drawing). These stoppers only serve to define a limit of the movement of the screen unit 5. A pair of racks 9 extend along the entire length of the printing machine between the stoppers 8-A and 8-B above the machine base 1 and are secured to the opposite sides of the machine base so that they perform the parallel movement of the screen unit 5 as will be described.

(Screen Unit)

Referring now to Fig. 2, there is shown a detailed plane of each of the screen units 5. Each screen unit comprises two squeeze guide rail 10 along which a squeeze device (not shown) travels for printing, a squeeze driving device 11, bearing devices 12 and 13 for squeeze delivering chains (not shown), a screen supporting and adjusting devices 14 and 15, and beams 16 on which the screen supporting and adjusting devices are mounted. These components are integrally assembled into a screen unit like a framework.

The screen unit is mounted on the machine base 1 while two pinions 17 are coupled to each of pinion shafts 18 in such a manner that two pinions 17 are threadably engaged with each of a pair of racks 9 extending along the entire length of the printing machine and provided on the opposite sides of the machine base 1 and can be positively moved in a parallel relation ship with each other. A motor 19 is integrally mounted on the other bearing device 12 together with a reduction gear 20 and transmits a rotational driving force to the pinion shaft 18 via a bevel gear mechanism 21. This causes the two pinions 17 borne by the bearing

devices 12 and 13 to be integrally rotated so that the whole of the screen unit 5 is parallel moved on the machine base 1. The movement amount is detected by a pulse generator 22 which is directly connected with the pinion shaft 18 through a coupling and the like for performing the operation which will be described. Fixing devices 12-A and 13-A are attached to respective bearing devices 12 and 13 for fixing the screen unit 5 in the machine base 1 in place by applying a gripping force exerted by a pneumatic actuator and the like on completion of the registration of the screen unit 5.

The screen supporting and adjusting devices 14 and 15 are mounted on the beams 16 which are located on the opposite sides (lower and upper sides as viewed in the drawing) of the screen unit 5, respectively with respect to the center thereof. The screen supporting and adjusting device 14 which is located in the lower side as viewed in the drawing is provided with a central adjusting block 23 in such a manner that the block 23 is finely movable relative to a bracket 24 secured on the beam 16 in an either X or Y direction by the rotation of screws 25 and 26. In order to move the adjusting block 23 in an X direction, a motor 27 and a reduction gear 28 are mounted on the bracket 24 so that they are directly coupled to a screw 25 for imparting the rotation thereto. A pulse generator 29 is directly connected with one end of the screw 25 for detecting the rotational amount, that is, the movement amount of the adjusting block 23 in the X direction.

A pair of guide shafts 30 slidably pass through the adjusting block 23 and a bracket 31 secured to the shafts 30 at one end thereof so that the adjusting block 23 is movable in a Y direction. A motor 32 and a reduction gear 33 mounted on the bracket 31 for imparting rotation to the screw 26 via a bevel gear mechanism 34. The rotational amount is detected by a pulse generator 35 directly connected with the motor 32 and the reduction gear 33.

An arm 36 is secured to the other end of the two guide shafts 30. A bracket 37 and a reference pin 38 are integrally secured to the arm 36 at the center thereof. The reference pin 38 is engaged with a reference hole 6A of the screen 6 as shown in Figs. 3-A and 3-B and will be hereafter described so that the screen is allowed to move by adjustment in X and Y directions as is similar to the adjusting block 23. The arm 36 is provided at the opposite ends thereof with height adjusting screws 39 and receptacle fittings 40 with which the screws 39 are threadably engaged for vertically moving the same. The screws and fittings bear the screen 6 so that the space between the screen 6 and the fabric 7 to be printed can be finely adjusting by the adjusting screws 39.

The other (upper as viewed in the drawing)

screen supporting and adjusting device 15 is also provided with an adjusting block 41 at the center thereof so that the adjusting block 41 can be finely moved relative to the bracket 42 secured on the beam 16 in only an direction of X' in the drawing by the rotation of the screw 43. In order to move the adjusting block 41 in an X' direction, a motor 44 and a reduction gear 45 are mounted on the bracket 42 that they are directly coupled to a screw 43 for imparting the rotation thereto. A pulse generator 46 is directly connected with one end of the screw 43 for detecting the rotational amount, that is, the movement amount of the adjusting block 41 in the X' direction.

As is similar to the above-mentioned supporting and adjusting device 14, the supporting and adjusting device 15 also includes two guide shafts 15 which pass through adjusting block 41. An arm 36 is secured to one end of the guide shaft 15, and a bracket 37 and a reference pin 38 are integrally secured to the arm 36 as is similar to the device 41. However, the adjusting device 15 is different from the adjusting device 14 in that an engagement portion of the screen 6 of the adjusting device 15 is an elongated groove 6B with which the reference pin 38 is engaged so that the reference pin 38 is slidable in the groove 6B when the screen is moved in a Y direction by an adjustment by the adjusting device 14, and the reference pin 38 serves to lock the screen only in an X' direction. (Refer to Fig. 3-A). The arm 36 is similarly provided with height adjusting screws 39 and receptacle fittings 40 at the opposite ends thereof for supporting the screen 6 and for finely adjusting the height thereof. The above-mentioned beams 16 which are provided on the opposite sides of the machine are extendably secured to mount fittings 48 at the both ends thereof. By means of fittings 50, the mounting fitting 48 are movably secured to slide rails 49 which are in parallel secured to the squeeze guide rails 10. This enables each screen unit 5 to cope with changes in dimension of the screen 6 in a repeat direction (X direction in the drawing) and a printing width direction (Y direction).

According to the above mentioned structure, each screen unit 5 can be automatically moved to a given position by the motor 19. The screen 6 is finely adjusted in X, Y and X' directions by the motors 27, 32, 44 provided in the screen supporting and adjusting devices 14 and 15. In contrast to the X direction adjustment on the side of supporting and adjusting device 14, the X' direction adjustment on the side of supporting and adjusting device 15 enable the unit 5 to adjust the screen 6 in a direction of an arrow. Accordingly, these enable the screen 6 to be automatically adjusted in

three components such as repeat direction (transport direction), printing width direction and the torsional direction. Suitable motor used for these adjustments includes d.c. motor, various servo motors, stepping motor and reversible motor and the like.

(Screen and screen reference position measuring device)

The whole of the screen 6 is shown in Fig. 3-A. The screen 6 is conventionally known and comprises a frame made of an aluminium alloy and a mesh woven by polyester filaments and the like which is tensioned within and bonded to the frame. Printing pattern 6C is reproduced on the mesh.

In accordance with the present invention, the screen supporting and adjusting devices 14 and 15 include reference pins 38 and the screen 6 is provided with the reference hole 6A and the elongated groove 6B corresponding to the pins 38 of the devices 14 and 15, respectively as illustrated in the drawings and mentioned above so that the registration of the screen 6 can be adjusted in X, Y and directions.

The pattern 6C for printing is reproduced on the screen 6 and register marks 6D are reproduced simultaneous with the reproduction of the pattern 6C at the four corners which are in positions separated in a repeat direction by a distance equal to the repeat length P and separated in a width direction by a distance equal to a width W plus 2w. The register marks 6D indicate reference positions of the pattern in the screen. That is, if the register marks 6D are accurately registered for each screen, the patterns would automatically be registered. In accordance with the present invention, in order to automatically achieve the registration adjustment of each screen as mentioned above, it is necessary to preliminarily determine the spaces Q and Q' between the reference hole 6A, elongated groove 6B and the register marks 6D in the repeat direction and the space U between the reference hole 6A and the register mark 6A in the width direction (refer to Fig. 3-A). To this end, a screen reference position measuring device 60 shown in Fig. 4 is used.

Two CCD (Charged Coupled Device) cameras 62, the detailed illustration of which is omitted are disposed above a table 61 of the screen reference position measuring device (hereafter merely referred to as measuring device) 60 by a moving mechanism (not shown) which is capable of finely adjusting the position of the cameras 62 in X and Y directions. Two measurement reference pins 63 relevant to the reference pins 38 of the screen supporting and adjusting devices 14 and 15 are provided on the opposite sides of the table 61 with

respect to the center thereof so that the positions of the pins 63 cannot be changed by fixing them to the table 61 in this case. However, one of the measurement reference pins may be movably secured to the table if the dimension W of the screen 6 in the width direction changes.

The position of each screen, that is, the spaces Q, Q' and U between the reference hole 6A, elongated groove 6B and the register marks 6D are measured by using the measuring device 60 as follows:

For registration of each screen in multi-color printing, the positions of second and subsequent screens are adjusted with respect to the position of a first screen. Accordingly, the deviations of the reference positions of the second and subsequent screens from the first screen are measured by the measuring device 60.

The number of the screens for one patterns is several to 20 and several according to the number of colors. The first screen is first placed upon the table 61 of the measuring device 60 so that the measurement reference pins 63 are aligned with the reference hole 6A and the elongated groove 6B of the screen. The CCD camera 62 is moved in X and Y directions in Fig. 4 by the fine adjusting and moving mechanism (not shown) so that the two sides of the register marks 6D of the first screen are aligned with reference lines x and y of the CCD camera 62 shown in Fig. 4-A. Then the position of the screen is fixed. After completion of the alignment, each of values of the spaces Q, Q' and U of the first screen defining the reference position of the screen is inputted to and stored in a control device which will be described hereafter.

Although only the reference position of the first screen is determined by moving the CCD cameras 62 in such a manner 62, the deviations X' or X'' and Y' or Y'' of each of the second and subsequent screens from the first screen are determined by only aligning the reference hole 6A and the elongated groove 6B of each screen with the measurement reference pins 63 without moving the CCD cameras 62. A measuring field 62A is present for the CCD camera 62 as shown in Fig. 4-A. Although the measuring field 62A is desirably changed by adjusting the height of the camera and the lens according to the purpose, 5 mm x 5 mm measuring field is used in the present invention.

Although the unit of length to be measured is changeable according to the purpose, 5 mm equally divided by 500, that is, 0.01 mm is measured as an unit of length to be measured in accordance with the present invention.

The deviations of reference positions of all of the second and subsequent screens from of the first screen are determined as x' or x'', and y' or y'' in such a manner and then stored in the control

device as registration data of each screen.

(Control Device and Control Method)

The control device of the present invention comprises a controller 70 for the CCD cameras 62, a computer device 71, a motor control device 72, motors 19, 27, 32, 44 and pulse generator 22, 29, 35 and 46 for each screen unit 5 as shown in schematic block diagram of Fig. 5.

Control of each mechanism is performed in accordance with a flow chart of Fig. 6.

Registration data, that is, values of x' or x'' , and y' or y'' of Fig. 4-B for each screen measured by the above mentioned measuring device 60 are inputted to the computer device 71 via the controller 70 and stored therein according to preliminarily defined identification number of each screen for one pattern.

On the other hand, prior to starting the printing mark, the screen units (5-1 through 5-5 in Fig. 1) should be equally spaced at spacing 2P in a line as shown in Fig. 1. Although the space between screen units is usually set a double of the repeat length P, it may be 3P or 4P according to the conditions of printing working. Accordingly, it is always necessary to monitor which positions each screen unit is located in by the pulse generator 22.

Therefore, when the screen unit 5 is first mounted upon the machine base 1, the screen unit 5-5 at the rightmost end in Fig. 1 is placed upon the base 1 so that the end face of the above-mentioned stopper 8A, that is, the line A-A is aligned with one end face of the screen unit. The count of pulses generated by the pulse generator 22 is reset to zero so that this position is considered as an origin of the movement of the screen unit.

Then, the motor is driven by the operation of a remote controller 75 annexed to each screen unit 5 to move the screen unit 5-5 in a right direction in Fig. 1 to a desired position in the vicinity of the stopper 8B. The movement amount is detected by the pulse generator 22 so that the current position from the origin is stored. Similarly, the screen units 5-4, 5-3, 5-2 and 5-1 are successively mounted on the machine. Every screen unit is desiredly moved so that the current position is stored as the number of pulses by respective pulse generator 22.

Prior to starting the printing work, the present length, the number of screen units, and space (N times of repeat length) are present in a screen unit arranging and presetting device (not shown) provided in the motor control device 72 of Fig. 5 and each screen unit 5-1 through 5-5 is automatically moved to a prescribed position by the switching operation of a screen unit moving device similarly provided in the motor control device 72. As mentioned above, each screen unit stores its own

current position and is moved by a distance corresponding to the number of instruction pulses in either direction and is stopped. On completion of the movement, (when the number of the instruction pulses matches the number of the movement pulses), the fixing devices 12A and 13A of each screen unit are operated to fix the screen unit in that position and a lamp of each screen unit is illuminated to indicate the completion of movement to the motor control device 72.

In this case, the end face 5A of the first screen unit 5 (left end in Fig. 1) may be aligned with the line A-A or is separated therefrom at a space D according to conditions. In the latter case, it is instructed that the number of the pulses corresponding to the space D be added to each of screen units 5-1 through 5-5.

Then, the screen 6 is mounted upon each screen unit to perform registration there between. Prior to this, it is necessary to define the original or home position of the pulse generators 29, 35 and 46, respectively as is similarly to the foregoing. The position far from one end face by the distance E is defined as the origin for the pulse generators 29 and 46. The distance E is one half of the full width F of the screen unit 5 and is defined as the distance between the one end 5A of the screen unit 5 and the center of the reference pin 38 provided in the screen supporting and adjusting devices 14 and 15. The distance E is determined by using the same measuring gauge or measuring tool and the count of pulses generated by the pulse generators 29 and 46 of each screen unit is reset to zero by considering this point as an origin.

The distance G between the end face of the machine base 1 and the center of the reference pin 38 is equally preset for every screen unit by using the same measuring tool and the like and the count of the pulses generated by the pulse generator 35 is reset to zero by defining this point as an origin.

Other method for determining an origin for registration of each screen includes a method using a mother screen. In this method, a single mother screen having the same repeat length and printing width as the screen used for printing and having no pattern, on which only register marks 6D are accurately reproduced is used for determining an origin.

This mother screen is mounted on the first screen unit 5-1 and the register marks 6D are provisionally printed on the endless belt in positions which are separated by a repeat length with white powders and the like as mentioned in the preamble of the specification and each pulse generator is reset to zero for the origin of the first screen unit 5-1 under the condition as it is. Then, the mother screen is moved to the second screen unit 5-2 and the provisionally printed register marks

on the endless belt is aligned with the register marks of the mother screen and the aligned position is considered as on origin. The origin can be determined by similarly moving the same mother screen to the screen units 5-3, 5-4 and aligning the register marks.

When all the screens are in their original positions, the screen register switch provided in the motor control device 72 is actuated. This causes the register data, x' or x'' and y' or y'' to be downloaded into the motor control device 72 from the computer device 71, which provides the number of pulses as a register instruction to each motor of respective screen unit. each motor drives each of screws 25, 26 and 43 to rotate in a direction by an amount as instructed by the instructions so that the registration of all screens is quickly and automatically achieved. Adjusting amount for registration of each screen is detected by respective pulse generators 29, 35 and 46 and is fed back to the motor control device 72. When the number of the pulses for movement for adjustment reaches the number of the instruction pulses, the registration of each screen is terminated. The adjustments for registration can be individually performed by the remote controller 75 which is provided in each screen unit. As an control of registration data of each screen, a bar code printer 73 connected with the computer device 71 so that a bar code 74 can be issued each time when the screen is measured by the measuring device 60. The bar code 74 is in advance applied to each screen at a given place and the model identification number of the screen is read by a bar code reader to request the computer device 71 to download the registration data of the screen. This method of control can be adopted and is advantageous when the number of the stored screens is large so that the control of the screens becomes more complicated.

Although the embodiment has been described with reference to the case in which two positions of the reference hole 6A and the elongated groove 2B of the screen are defined as reference positions for determining the reference positions of the screen adjustment in X and Y directions may be performed by using the external sides of vertical and lateral members of the screen frame as reference positions without providing the screen with the reference hole and the elongate groove.

As mentioned above, in accordance with the present invention, operations from arrangement and presetting of the screen units to registration of all screens is full-automatically performed in a short period of time. Since in recent automatic screen printing machine, intermittent transport of the endless belt has been realized in very precise manner by methods disclosed in the Japanese Examined Patent Publication Nos. 60-31728 and 63-62393,

automation of register adjustment of screens by the present invention contributes to further rationalization of printing work.

Although the pulse generator 22 which is directly coupled to the pinion shaft 18 in the screen unit position adjusting device is essential in view of position control of the screen unit in the apparatus of the present invention, it is to be understood that the screen unit driving motor 19 can be omitted. In this case, the movement of the screen unit is manually carried out by an operator. Position adjustment would be performed in an easy and efficient manner by stopping the screen when the preset and indicated distance is zero and by fixing the screen by means of the fixing device 13A.

In accordance with the present invention, the position deviations of reference mark of each screen for printing is detected and preset as data in a repeat direction, in a direction normal thereto and in a rotational direction based on the origin point, each screen is provided on the screen unit so that it is finely adjustable in the repeat direction, in the direction normal thereto and in the rotational direction and the adjustment of the screen may be performed based upon the preset data on the positional deviation, and data on the repeat length and arrangement of each screen unit are preliminarily preset and the screen unit is arranged in a given position of a machine based upon the arrangement data. Accordingly, all registration and presetting of screens are automated and semi-automated so that they can be achieved in quick and highly accurate manner. This can enhance the working efficiency of the printing machine, resulting in saving in power and improvement in printing quality in multi-color printing of the automatic screen printing machine. Informational data on registration of each screen for one pattern are all expressed numerically so that automation of the whole of the printing machine becomes possible.

Claims

1. A method of registering screens in an automatic screen printing machine, comprising the steps of:

detecting and presetting positional deviations of reference marks of a plurality of screens used for printing as data in a repeat direction, in a direction normal to the repeat direction and in a rotational direction based on the original points;

Presetting data on repeat length of said screens and on the arrangement of screen units on which the screens are placed;

moving and fixing each screen unit in the preset position based upon present data on repeat length and arrangement; and

finely adjusting the position of each screen.

2. A method of registering screens in an automatic screen printing machine as defined in Claim 1 in which said data on the positional deviations of the plurality of screens in the repeat direction, in the direction normal thereto and in the rotational direction are detected and present as the number of pulses; said data on the repeat length and the arrangement of the screen units are present as the number of pulses; each screen unit is moved from a reference position to a position on the printing machine where the preset number of pulses is counted out and fixed thereto, and the position of the screen on the fixed screen unit is finely adjusted in the repeat direction, in the direction normal thereto and in the rotational direction according to the preset number of pulses. 5 10 15 20
3. An apparatus for registering screens in an automatic screen printing machine, comprising:
 - a plurality of screens for printing, each including an origin and reference marks; 25
 - screen units, one on which each screen is placed, for performing the printing through the screen;
 - a mechanism for adjusting the position of each screen unit which is capable of moving each screen unit in the repeat direction and stopping the same; 30
 - screen registration adjusting mechanisms, one for each screen unit, which is capable of finely adjusting the screen by moving the same in the repeat direction, in the direction normal thereto and in the rotational direction; 35
 - screen reference position detecting mechanisms, one for each screen, for detecting the positional deviation of the reference mark of each screen as data in the repeat direction, in the direction normal thereto and in the rotational direction based upon the origin; and 40
 - a computer for presetting data on the repeat length of the screen and data on the arrangement of the screen units upon which the screens are placed for controlling the screen unit position adjusting mechanism to move each screen unit to the present position and fix it thereto based upon the present repeat length data and the arrangement data, for storing the data on the positional deviation of each screen from the screen reference position detecting mechanism and for finely adjusting the position detecting mechanism and for finely adjusting the position of each screen in the repeat direction, in the direction normal thereto 45 50 55

and in the rotational direction based upon the positional deviation data.

4. An apparatus for registering screens in an automatic screen printing machine as defined in which said screen unit position adjusting mechanism include pulse generators, said screen registration adjusting mechanism includes servo drive mechanisms for driving the screen in the repeat direction, in the direction normal thereto and in the rotation direction and pulse generators attached to the servo driving mechanism, the computer and the screen unit position adjusting mechanism being operatively associated for moving each screen unit from the reference position to the position on the printing machine where the preset number of pulsed is counted out and for fixing the same thereto; and computer and the screen registration adjusting mechanism being operatively associated for finely adjusting the screen on the fixed screen unit by moving the screen in the repeat direction, in the direction normal thereto and in the rotation direction.

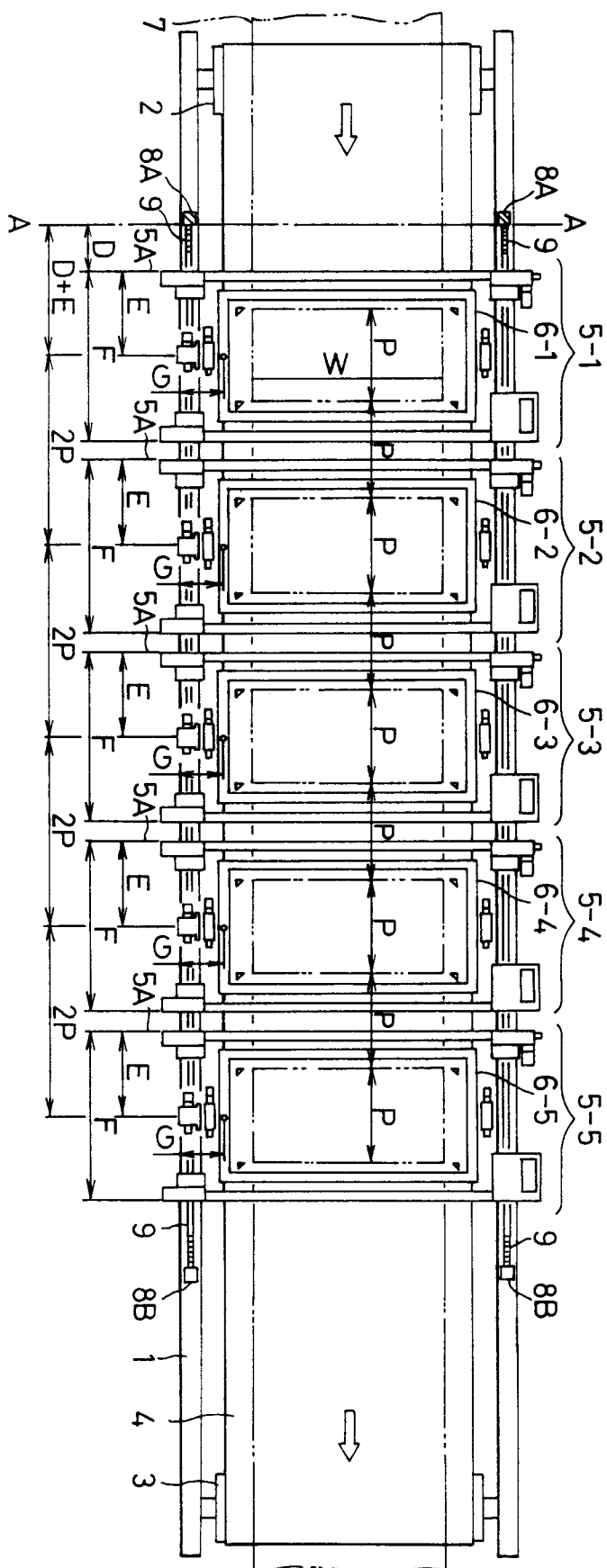


FIG. 1

FIG. 2

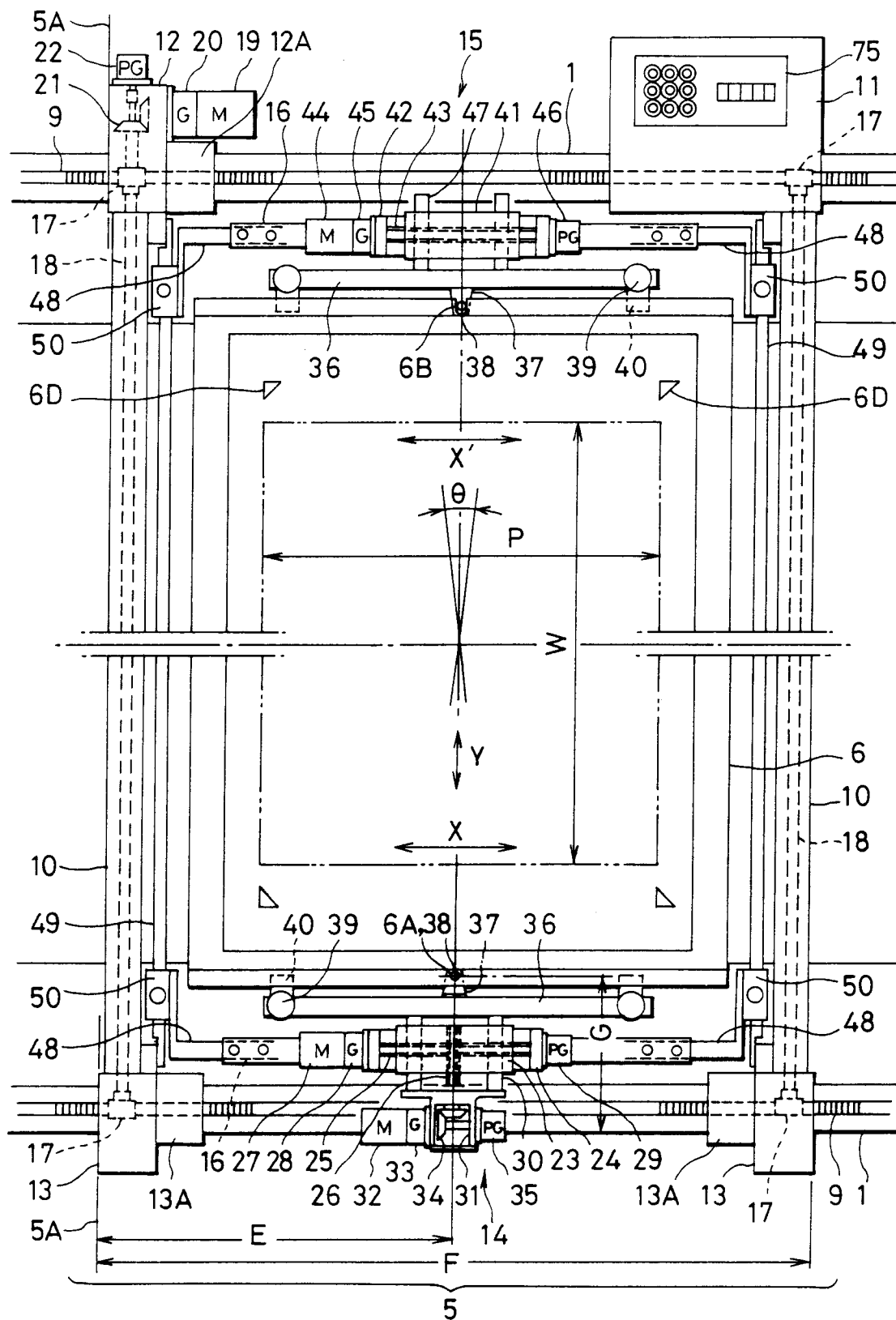


FIG. 3A

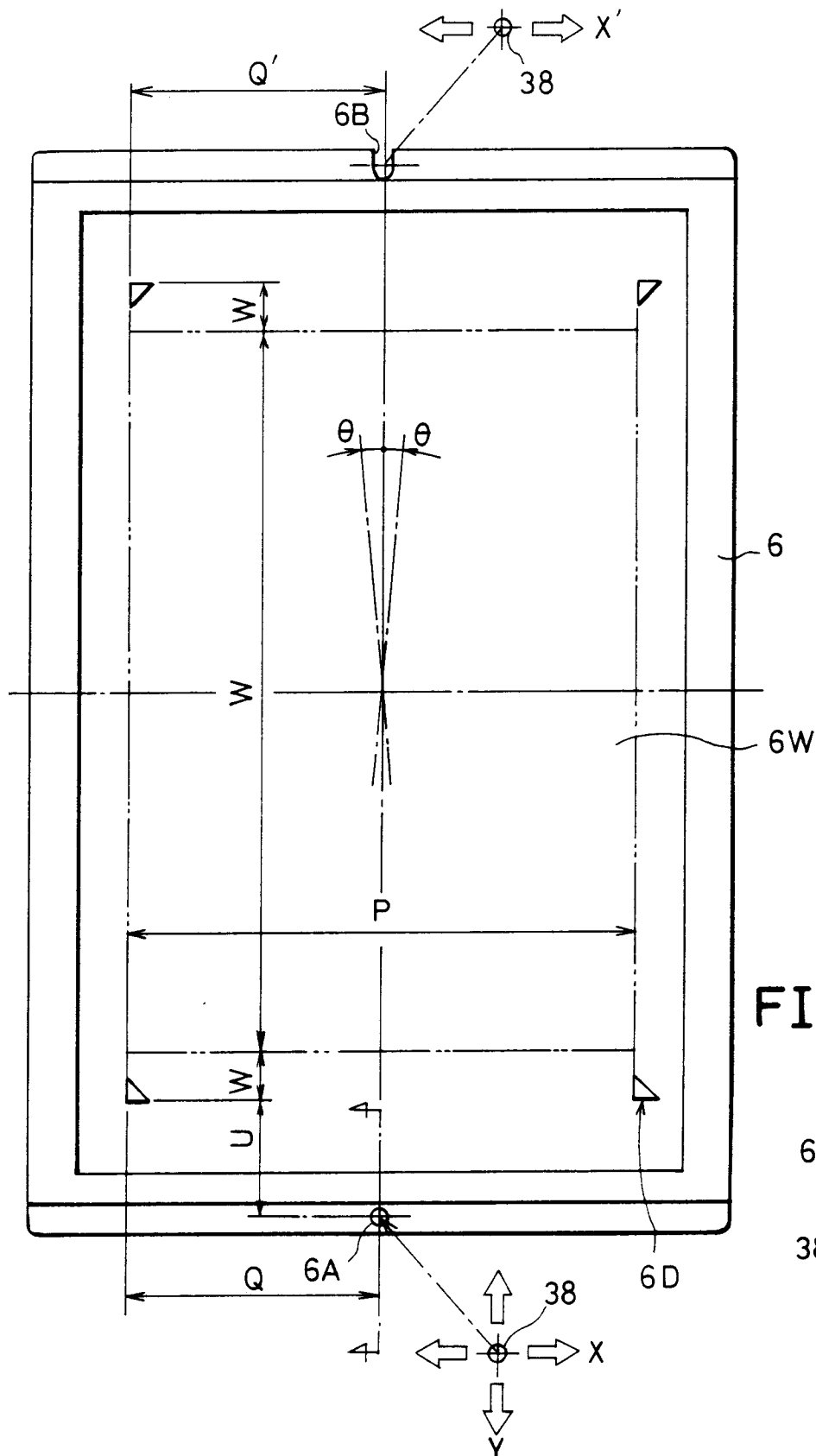


FIG.3B

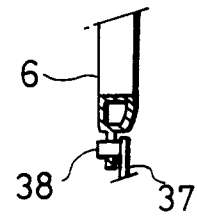


FIG. 4A

FIG. 4B

FIG. 4

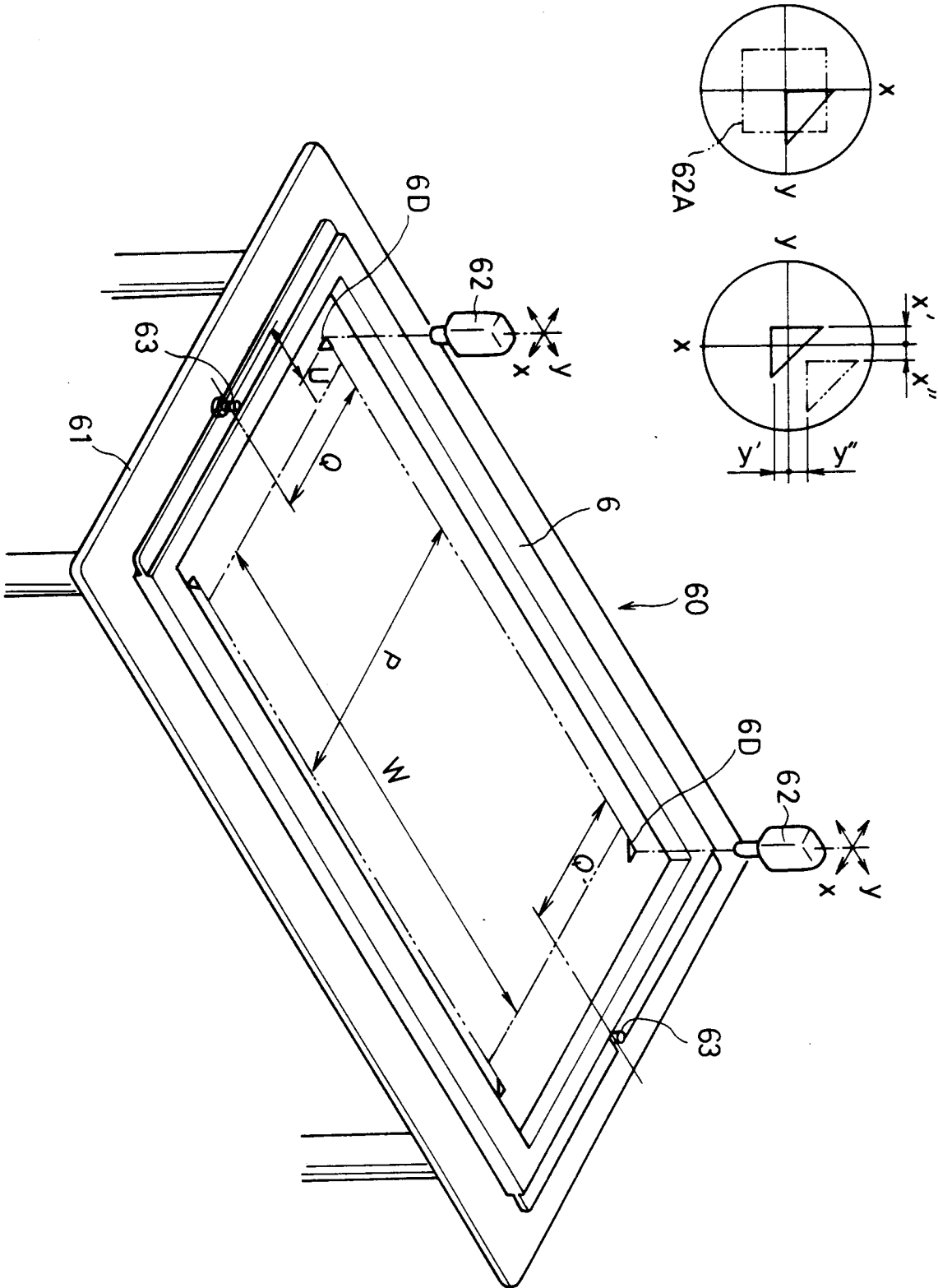


FIG. 5

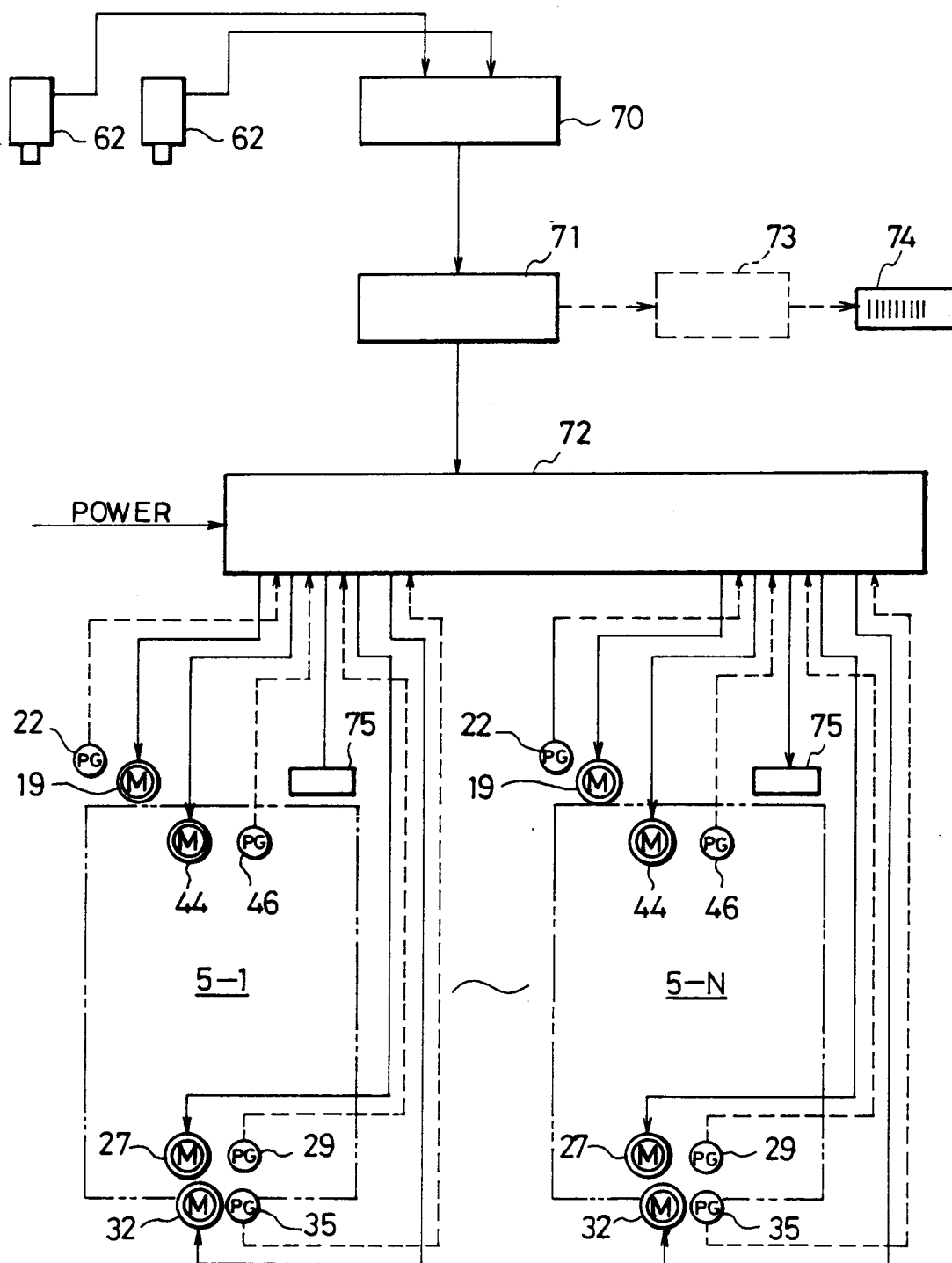
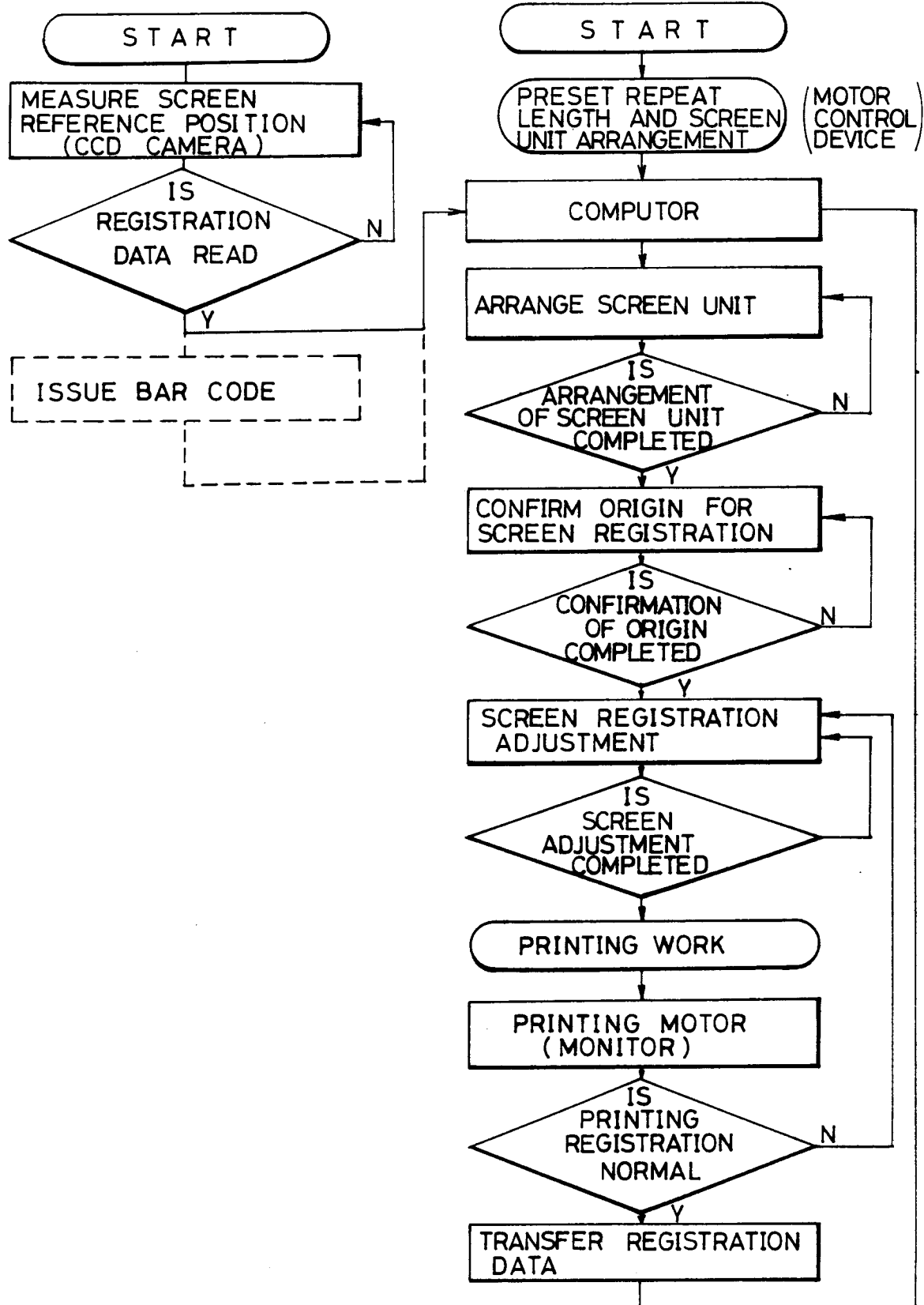


FIG. 6





European
Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 20 1230

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	EP-A-0 364 424 (SVECIA SILKSCREEN MASKINER AB) * the whole document ** - - -	1,3	B 41 F 15/10 B 41 F 15/08 B 41 F 15/36
A	US-A-4 610 200 (METSO) * column 2, line 1 - column 2, line 40; claim 1; figures 1,9 ** - - -	1,3	
A	DE-A-3 904 863 (INDUSTRIE-SIEBDRUCK-SYSTEME NECKARWEIHINGEN GMBH) * claims; figures ** - - -	1,3	
A	PATENT ABSTRACTS OF JAPAN vol. 10, no. 134 (M-479)(2191) 17 May 1986 & JP-A-60 259 446 (PILOT PEN K. K.) 21 December 1985 * abstract ** - - - - -	1,3	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B 41 F
Place of search		Date of completion of search	Examiner
The Hague		27 November 91	MADSEN P.A.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		E : earlier patent document, but published on, or after the filing date	
Y : particularly relevant if combined with another document of the same category		D : document cited in the application	
A : technological background		L : document cited for other reasons	
O : non-written disclosure		-----	
P : intermediate document		& : member of the same patent family, corresponding document	
T : theory or principle underlying the invention			