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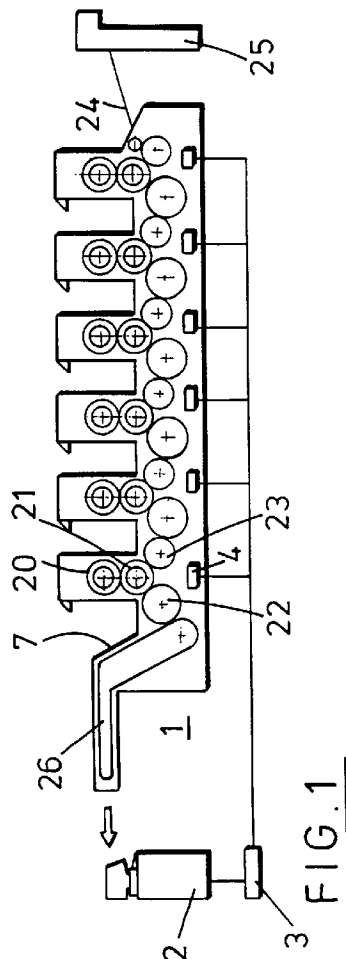
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(54) **Printing plate registration apparatus.**

(57) A retro-fittable multi-colour printing plate registration apparatus comprises drive means (40) such as a servo motor, DC permanent magnet motor, stepper motor etc. which engages the printing plate registration adjustment mechanism (50,52) of a multi-colour printing press for operation thereof to bring the registration marks of all the colours into alignment. The positions of the individual colour registration marks (63) are determined manually or using a scanner or camera and digitised in a computer (2). The digitised positions are compared to a nominal origin (64,66) and corrections calculated. The corrections are used to control the drive means to unlock the adjustment mechanisms and to bring the printing plates into registration.



FIELD OF THE INVENTION

The present invention relates to a multi-colour printing plate registration apparatus which may be retrofitted to existing printing presses.

PRIOR ART

In multi-colour printing processes, the individual colours are printed onto paper by separate printing plates (i.e. printing cylinders) under which the paper travels sequentially. For example there may be four separate plate cylinders for printing the colours yellow, magenta, cyan and black. Additional plate cylinders may be provided for printing special colours required for particular needs. Since the colours are printed individually, it is necessary to ensure that the printed images are in registration with one another in the finished printing. Thus, provision must be made for moving the plate cylinders in the X direction (i.e. transversely of the printing direction) and in the Y direction (i.e. circumferentially) relative to one another. In older printing presses, this is achieved manually by use of printing plate registration adjustment mechanisms which allow for adjustment in the X and Y directions. However, getting the correct adjustment tends to be a matter of experience and trial and error. On the other hand, modern computerised printing presses are provided with automatic computerised plate registration systems. However, such new equipment is expensive.

There is therefore a need for a computer controlled printing plate registration apparatus which can be fitted to existing printing presses equipped with manual printing plate registration adjustment mechanisms to allow these to be updated without the need for replacement by new expensive equipment.

SUMMARY OF THE INVENTION

The present invention provides a retro-fittable multi-colour printing plate registration apparatus which comprises:

- drive means mechanically engageable with existing manual printing plate registration adjustment mechanisms on the printing plate cylinders for each of said multi-colours for operation thereof;
- means for determining and digitising the position of registration marks of each colour on a printed sheet; and
- digital calculation means for calculating corrected positions of the registration marks from said digitised positions and for controlling the drive means to bring the printing plates for the colours into registration.

The drive means may be engageable with the existing registration adjustment mechanisms by means

of gears on the drive means engageable with gears on the existing adjustment mechanisms. Alternatively, the drive means may comprise chain and sprocket means, belts, in-line couplings or other means known in the art. In order to mount the apparatus of the present invention, it is generally only necessary to remove the existing manual adjustment wheel and to replace this by the drive means of the present invention. This also has the advantage that should the registration apparatus of the present invention fail for any reason, the manual registration system may be simply and rapidly reinstated so that the printing press does not become inoperative.

The drive means may include a servo motor, stepper motor, DC permanent magnet motor or other suitable motor for effecting movement of the plate cylinder.

Sheets of colour printed material conventionally include registration marks for each colour, which are used to facilitate bringing the various colours into registration. In the present invention, the position of the registration marks is determined and digitised. This may be achieved by using a mouse to plot the registration marks on a computer grid, or by using a hand-held colour scanner to wand the registration marks, by using a colour CCD camera to capture the registration image, or by utilising cursor direction keys on the computer keyboard. In this way, the position of the individual registration marks can be plotted in both the X and Y directions and compared to nominal origin marks.

The digital calculation means allow the actual positions of the registration marks to be compared with the in-register position and the necessary corrections to be calculated. Preferably, the registration apparatus includes rotary encoders which allow the position of the plate cylinder to be determined and the correct amount of adjustment carried out using either a timed interval or a counted pulse duration.

The digital calculation means is generally an IBM-compatible personal computer adapted for operation in an industrial situation and being capable of operating in an electrically noisy environment.

Usually, the apparatus of the present invention will be required to control from 4 to 6 or more separate colour printing plates. The invention is particularly, though not exclusively, suitable for use with offset litho printing presses.

DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings wherein:

Figure 1 is a schematic elevation of a printing press equipped with registration apparatus of the present invention;

Figure 2 is a side elevation of a gearing arrange-

ment;

Figure 3 is a side view of a motor/gearbox and rotary encoder arrangement;

Figure 4 shows schematically the X and Y adjustments of the printing cylinders; and

Figure 5 shows the cogs required to perform the X, Y adjustments in a conventional offset litho press.

Figure 6A and 6B show respective side and front views of a different typical conventional manual plate adjustment mechanism (Roland 800);

Figure 7A and 7B show respective side and front views of a plate adjustment mechanism equipped with a registration apparatus according to a further embodiment of the invention;

Figure 8 is a representation of the computer screen on which four colour registration marks are plotted; and

Figure 9 is a block diagram of the sequence of operations performed in controlling the registration of the printing plates.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows an offset litho press 1 having a print housing 7. According to the invention, this is provided with a computer 2 and digital input/output cards 3 connected to motor/gearbox encoder assemblies 4.

The press 1 comprises six sets of rollers for printing upto six colours. Each set comprises a plate cylinder 20 which carries the etched printing plate, from which the ink image is transferred onto a rubber coated blanket roller 21. The paper 24 to be printed passes from feeder 25 through the nip between blanket roller 21 and a smooth impression cylinder 23 where printing occurs. Roller 22 assists transfer of the paper.

The multi-colour printed sheet leaves the press via delivery conveyor 26. Plate cylinder 20 is moved to bring the colours into registration.

Figure 2 shows the shaft 6 of the plate cylinder 20 from which the conventional handwheel has been removed and replaced by a cog 8. This engages a drive cog 9 driven by motor 40.

Figure 3 shows motor/gearbox drive means 40 for adjusting the position of the plate cylinder, together with a rotary encoder 10 driven by cog 5 for controlling the movement of the motor according to information fed to and from the computer.

Figure 4 shows plate cylinders 14 and indicates the movement of the lateral X adjustment and circumferential Y adjustment.

Figure 5 shows cogs 12, 13 (having locking levers 30, 31) which respectively control circumferential Y adjustment and lateral X adjustment in a conventional offset litho press. Control of the positioning of the printed image is achieved by turning the two cogs. Rotating the circumferential cog 12 in a clockwise di-

rection advances the image on the printed sheet, whilst rotation in an anti-clockwise direction moves the image back on the printed sheet. Rotating the lateral cog 13 in a clockwise direction moves the image left on the printed sheet and rotation in an anti-clockwise direction moves the image to the right.

In the present invention, these cogs are removed and replaced by gear wheels to allow the rotations to be carried out by the motor 40 under digital control.

The present invention may be operated as follows.

First, a sample sheet is printed and then placed on a measuring table or grid equipped with a magnifier (e.g. 20 x magnification) so that the registration marks of individual colours can be seen. Typically these may be out of registration by 0.025 to 3.5 mm.

Data capture to log the position of the registration marks is effected either by manual data input via a mouse to plot the registration mark on a computer grid, or by using a hand-held colour scanner to wand the registration marks, by using a colour CCD camera to capture the registration image, or by utilising cursor direction keys on the computer keyboard. The registration marks are displayed on the computer registration grid and can be adjusted by using the mouse or the cursor direction keys.

The data values, whether derived manually or by automatic capture are submitted to the plate registration system. The computations required to instruct the computer to reset the plates to a centre position are made possible since the computer stores and updates the current plate positions on computer disc whenever a change is effected. The sequence of calculations is as follows:

Firstly, the system is provided with the new required plate position, plotted relative to a nominal origin in X and Y co-ordinates. The Y co-ordinate relates to the circumferential displacement and the X co-ordinate relates to the lateral displacement.

The system accesses and recalls the plate positions.

The absolute value of each co-ordinate is then multiplied by either a time or a pulse ratio which determines the adjustment factor for the motor. A negative value signifies an anti clockwise rotation, whilst the positive value signifies a clockwise rotation.

The system then adds the plate displacements to the current plate positions held in the computer and updates the computer disc.

Adjustment of the plates to bring the colours into registration may be performed simultaneously when the operator presses the "enter" button on the computer keyboard.

The plates may be reset automatically to a central position when the operator presses the "CTRL-R" buttons.

A second sample sheet will then be run to check

that registration is correct before a print run is commenced.

In this way, the present invention provides a registration apparatus which may be readily retrofitted to existing printing press installations, whilst requiring minimal changes thereto.

Figures 6 to 9 illustrate a practical embodiment of the invention applied to a typical printing press (Roland 800) having a manual plate registration mechanism, it being understood that the invention is equally applicable to other conventional printing press registration mechanisms. Analogous parts are indicated by the same reference numerals.

Figures 6A and 6B show a conventional manual plate registration mechanism provided with a pair of handwheels 12,13 mounted on respective shafts 52,50 which are in turn connected to gear mechanisms (not shown) for effecting Y and X (rotation and transverse) movements respectively of the printing plate cylinders. The handwheels are locked by respective locking levers 30,31 which lock the handwheels via a locking mechanism (not shown).

Figures 7A and 7B show the plate registration mechanism fitted with an apparatus according to the invention. The handwheels 12,13 have been removed to leave shafts 52,50. Onto shaft 50 is connected (via coupling 54) a servo 40 (e.g. a DC permanent magnet motor) mounted on a stub axle 56 having connected thereto a digital encoder 10. A similar servo-encoder assembly is also mounted on shaft 52 but is omitted for clarity. A pneumatic cylinder 58 having a rod 60 is mounted on the housing for operation of the locking lever 31. A similar assembly (not shown) is connected to the other locking lever 30. The rod 60 is pivotally connected to the end of lever 31 and is operated under pneumatic pressure to unlock the shaft 50 (and 52) prior to a plate registration operation, and then to lock the shaft again after registration is completed.

Figure 8 is a view of screen 62 of computer 2 showing four crosses, each cross 63 representing the position of a registration mark of one of the four colours. These are plotted relative to a nominal origin, in this case the intersection of x and y axes 64,66. The computer calculates the corrections needed to bring the registration marks into alignment and applies these. When registration of all four plate cylinders is complete, the four crosses have moved together.

Figure 9 is a block flow diagram showing the sequence of operations in a registration process. Briefly, the trial printed sheet is inspected and the co-ordinates of the four registration marks plotted on the computer screen (or the marks scanned and computer entry performed automatically). The computer (P.C.) then loads the counters in the programmable controller 3 (P.L.C.) which operates the pneumatic cylinders 58 to unlock the registration mechanisms on the four plate cylinders. The servo 40 is then operated to rotate shaft 50. Rotation of the shaft decrements

the respective counter until the counter reaches zero when the required shaft movement is complete. The servo motors are then turned off and the pneumatic cylinders lock the shafts again. As the physical movements of the plate cylinders are undertaken, the crosses 63 on the screen move accordingly until they come into alignment when registration of the four plate cylinders is complete.

Although the invention has been described in detail with regard to certain embodiments of the invention and certain colour printing presses, the invention is widely applicable to many such presses known in the field.

Claims

1. A retro-fittable multi-colour printing plate registration apparatus which comprises:
 - drive means (40) mechanically engageable with existing manual printing plate registration adjustment mechanisms on the printing plate cylinders for each of said multi-colours for operation thereof;
 - means (62,64,66) for determining and digitising the position of registration marks (63) of each colour on a printed sheet; and
 - digital calculation means (2) for calculating corrected positions of the registration marks from said digitised positions and for controlling the drive means to bring the printing plates for the colours into registration.
2. An apparatus according to claim 1 wherein the means for determining and digitising the position of the registration marks comprises a scanner to capture and digitise the positions of the registration marks.
3. An apparatus according to claim 1 or 2 wherein the digital calculation means comprises a programmable controller (3) to control the drive means.
4. An apparatus according to any preceding claim wherein the digital calculation means comprises a rotary encoder (10) for encoding and digitising the position of the printing plate adjustment mechanism.
5. A multi-colour printing press having a manual printing plate registration adjustment mechanism on the printing plate cylinders for each of said multi-colours; comprising
 - drive means (40) mechanically operably engaged with each said printing plate registration adjustment mechanism for adjustment

thereof;

- means (62,64,66) for determining and digitising the position of registration marks of each colour which have been printed on a trial printed sheet printed by said printing press; and 5
- digital calculation means (2) for calculating corrected positions of the registration marks from said digitised positions such as to bring said registration marks into alignment, and for controlling said drive means so as to operate each said printing plate registration adjustment mechanism and to bring the printing plates for all said colours of said multi-colour printing into registration. 10 15

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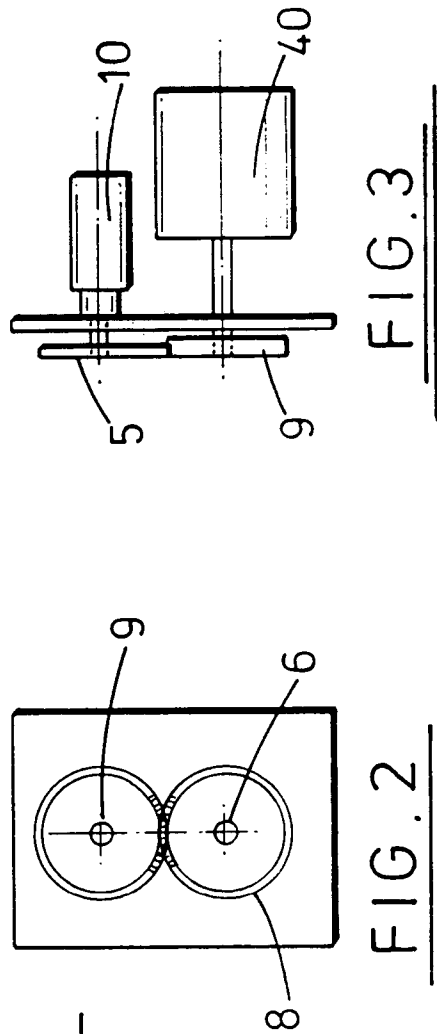
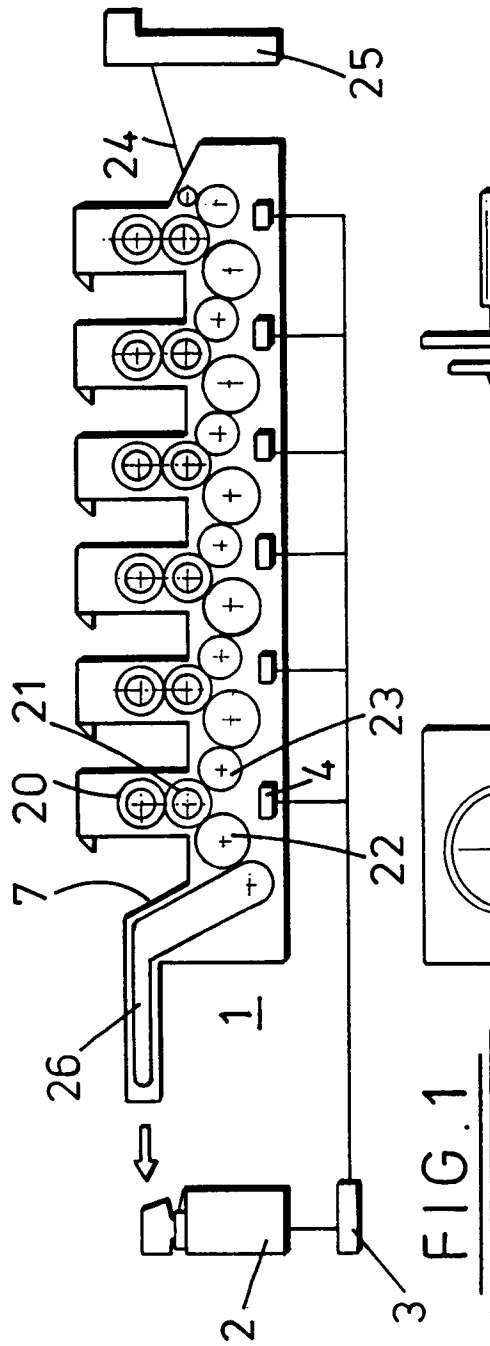
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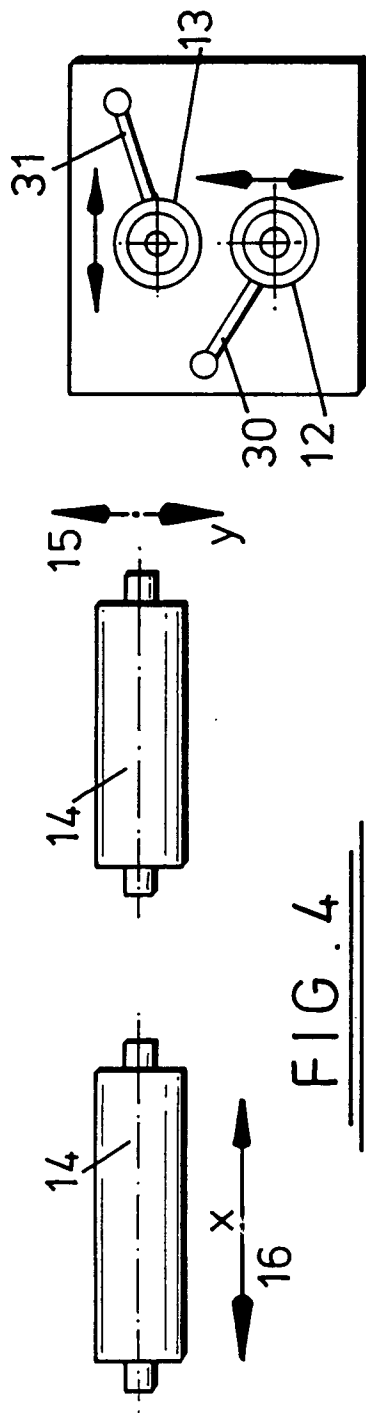


FIG. 5 (prior art)

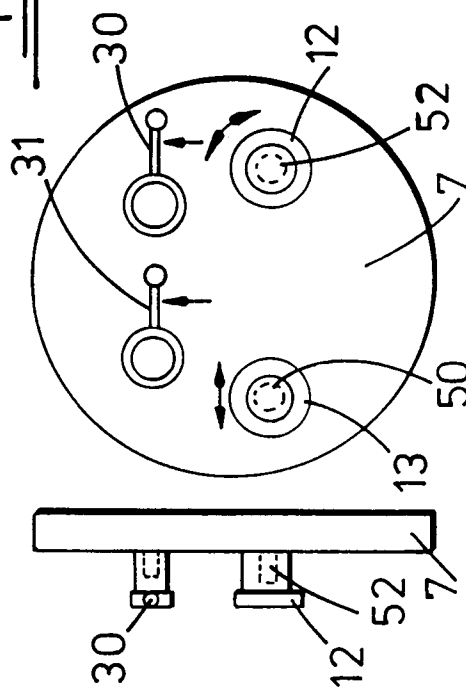
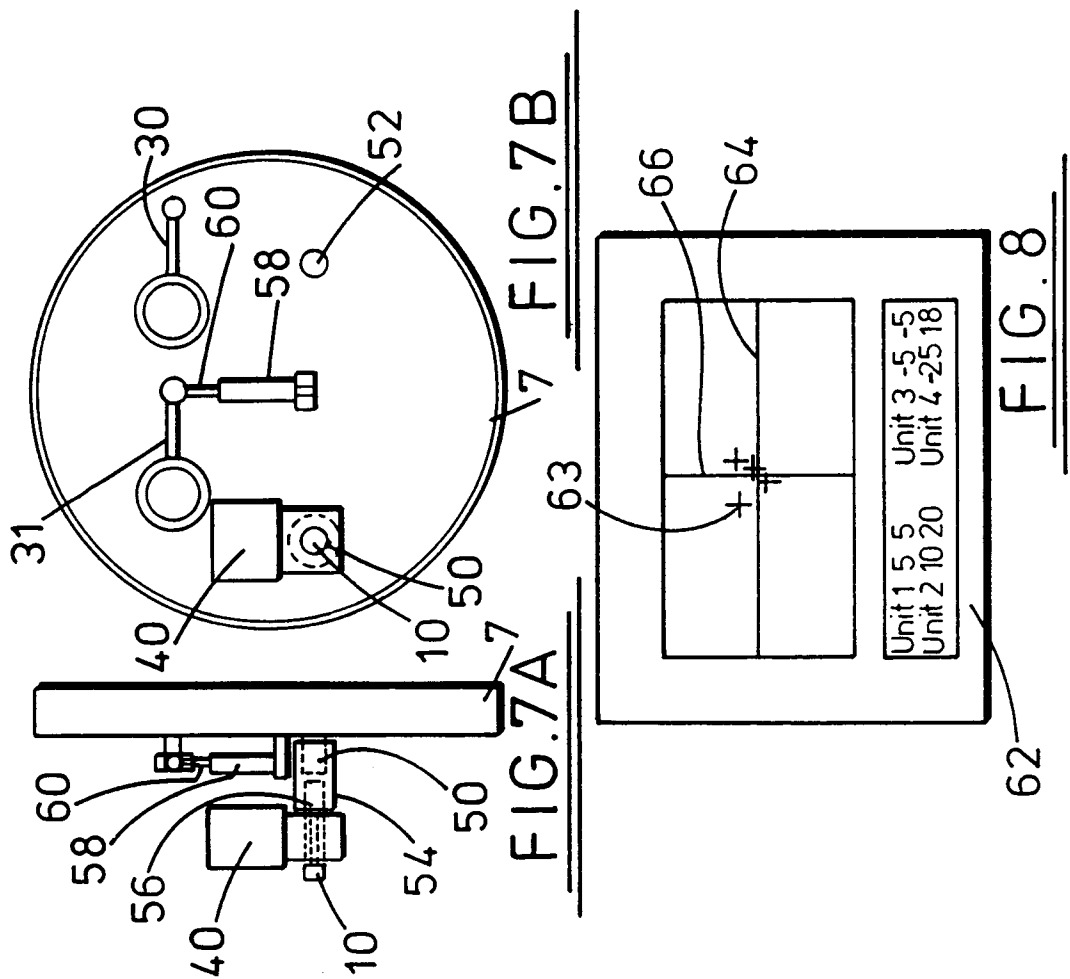


FIG. 6A (prior art) FIG. 6B (prior art)



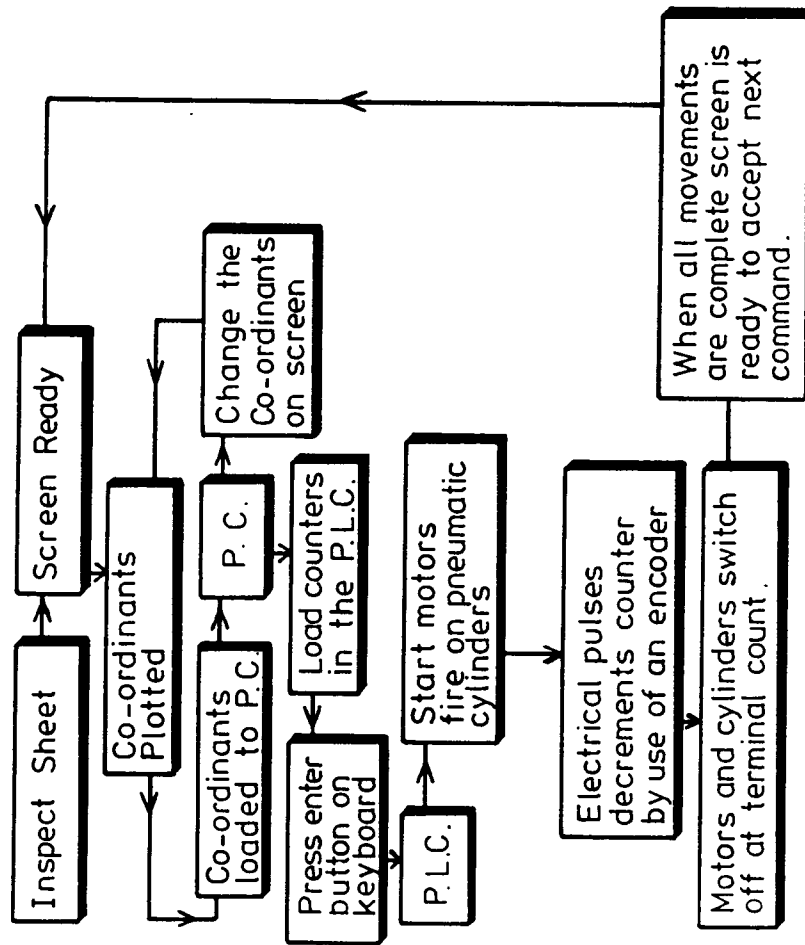


FIG. 9



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 3786

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)
Y	US-A-3 525 305 (PHILIP KENNETH DANIELS) * the whole document *	1-5	B41F13/14
Y	EP-A-0 177 885 (DAI NIPPON INSATSU) * page 4, line 30 - page 21, line 21; figures *	1-5	
A	EP-A-0 081 186 (HEIDELBERGER DRUCKMASCHINEN AKTUENGESELLSCHAFT) * page 3, line 13 - line 23 *	1	
A	FR-A-2 380 137 (HEIDELBERGER DRUCKMASCHINEN AKTIENGESELLSCHAFT) * page 3, line 33 - page 4, line 2 *	1	
A	GB-A-2 103 788 (KOMORI PRINTING MACHINERY) * the whole document *	1	
A	EP-A-0 422 412 (HEIDELBERGER DRUCKMASCHINEN AKTIENGESELLSCHAFT) * the whole document *	1	
A	DE-A-3 225 165 (VEB KOMBINAT POLYGRAPH)	1	<p>TECHNICAL FIELDS SEARCHED (Int. Cl.5)</p> <p>B41F</p>
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 09 SEPTEMBER 1993	Examiner MEULEMANS J.P.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p>		<p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>	

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