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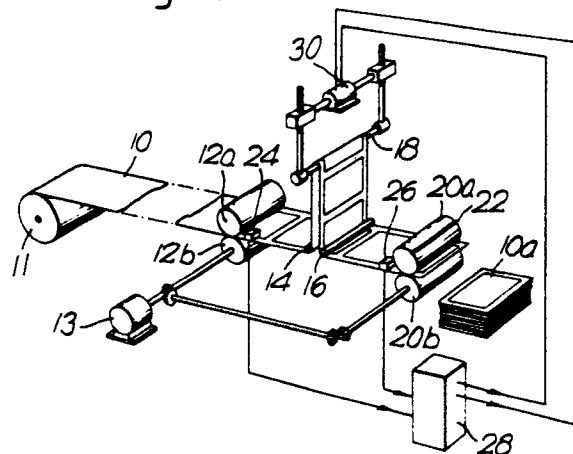
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54 **Register control apparatus.**

57 In printing apparatus in which a web flow path extends from a printing cylinder (12) to a machine - (20) operating in synchronism with the printing cylinder to perform a non-printing operation on the web in register with the printed images, first and second mark detectors (24 and 26) are arranged in the flow path immediately after the first printing cylinder (12) and immediately before the machine performing the non-printing operation (20) respectively. As the printing cylinder (12) rotates synchronously with the cycle of operation of the non-printing machine (20), the signal from the first detector, when it sees the mark applied by the printing cylinder, is indicative of the position of the non-printing machine in its cycle of operation. The signal from the second detector (26) is indicative of the mark position after the web has travelled along the whole of the flow path to the non-printing machine. These two signals are compared and the result of the comparison is used to adjust register control means to correct for any register error between the printed image and the non-printing operation (for example cutting or folding).

Fig. 1.



REGISTER CONTROL APPARATUS

This invention relates to the detection of errors in register in operations performed on a web.

When a continuous web of paper, foil or film is printed with a succession of similar images and other operations are to be performed on the web in positions controlled by the positions of the first images, it is essential to provide some form of register control.

One example of apparatus requiring register-control means is a multi-colour printing press. After the printing of the first colour-component image on the web, the subsequent colour-component images printed on the web must be in register with the first image. In such apparatus, register control is normally effected by printing register marks on the web for each of the colour-component images and using light-sensitive cells to detect the passage and the position of the marks. In one method, the register marks for the different colour components are printed with longitudinal spacings, which are of known value for correct register, in an image-free strip of the web running along the web edge. To avoid confusion with other marks in this strip, a code mark may be provided ahead of the register marks or the first register mark may be of a form capable of recognition by a suitable electronic circuit. In an alternative arrangement, no image-free strip is required along the web edge, the register marks being printed in a narrow transverse strip between the image areas on the web. With such an arrangement, it is generally necessary to generate a "gating" pulse which allows the register control circuit to respond only when the narrow transverse strip is passing under the detector head; this prevents the control circuit from being influenced by signals representing marks within the image area. Bringing printed images into register with one another is known as print-to-print register control.

A register control of a slightly different kind is required when a web on which a repeated image has been printed is to be subjected to an operation such as cutting or folding in register with the printed images. In such a case, one of the signals to be compared can be derived by sensing a register mark printed at the same time as the image print but the other signal must represent the position of the cutter or folder in its cycle of operation. Frequently, such a second signal is derived from the cutting or folding machine by a magnetic pick-up device.

The present invention is particularly concerned with a register control of the kind in which an operation such as folding or cutting is to be performed on the web in register with a printed image.

The present invention relates to printing apparatus having a web flow path extending from a printing cylinder, for printing repeat images and register marks on the web, to a machine operating in synchronism with the printing cylinder to perform a non-printing operation on the web in register with the printed images, the web flow path having a length such that it includes a number of printed images; according to the invention, a first mark detector is arranged in the flow path immediately after the printing cylinder, a second mark detector is arranged in the flow path immediately before the machine performing the non-printing operation, and a register control unit receives signals from the two detectors and adjusts register control means in accordance with any departure in the relative timing of the signals from a desired relative timing.

For example, it may be required that for correct register the signals from the two detectors are received simultaneously by the register control unit; then any interval between the two signals indicates incorrect register and causes the generation of a control signal which may, for example, adjust the position of a compensating roller placed in the flow path so that the web passes over it.

The present invention enables register control to be achieved between the printing operation and a cutting or folding operation without requiring a signal derived from the cutter or folder. It is able to achieve this result because the cutter or folder and the printing cylinder rotate in synchronism and the first detector is located immediately after the printing cylinder, i.e. at a position such that any dimensional change of the web between printing and mark detection is negligible; consequently, the signal derived from the first detector is effectively indicative of the position of the cutting cylinder. The signal from the second detector represents the mark position at the end of the web path between the printing cylinder and non-printing machine and, therefore, takes into account the effect of any stretch in the printed web along the flow path. Consequently, a comparison of the relative phases of these marks is indicative of the degree of register between the printed mark on the web close to the folding or cutting machine and the folding or cutting operation carried out by that machine.

In the preferred embodiment, a code mark is printed ahead of the register mark to indicate to the control circuit that register control signals are to be expected from the detectors.

In order that the invention may be better understood an example of apparatus embodying the invention will now be described with reference to the accompanying drawings.

In Figure 1, a web 10 from a supply roll 11 passes between printing cylinders 12a and 12b driven by a motor 13 and then around rollers constituting a register compensation system. These rollers are the fixed rollers 14 and 16 and an intermediate roller 18 which can be adjusted in a direction perpendicular to the plane of the web in the principal direction of the web path. After leaving the register compensation system, the web passes through a cutting machine having cutting cylinders 20a and 20b, provided with a blade 22 from which emerge the printed cut sheets 10a; the cutting cylinders are also driven by the motor 13.

A first detector 24 is arranged immediately after the printing cylinders 12a and 12b. A second detector 26 is arranged immediately before the cutting cylinders 20a and 20b. Signals from the first and second detectors are applied to a register control circuit 28, the output of which is an error signal which energises a controller 30 to control the position of the intermediate roller 18.

As explained earlier, the printing cylinders and the rollers of the cutting machine are operating in synchronism with one another and with a given phase relationship. In order to maintain correct register the compensator must be adjusted so that the total number of images is equal to a whole number of images plus a portion of an image corresponding to the difference in phase relation between the printing cylinder and a cutting cylinder. The first detector is closely adjacent the exit side of the printing cylinder and consequently, the signal which it generates on seeing a register mark printed by the printing cylinder is representative of the angular position of the printing cylinder and, therefore, of the cutting roller. The signal from the second detector on seeing a register mark takes into account any stretching of the web which has occurred as it passes along the flow path and which would otherwise prevent the above-mentioned desired phase relationship from being achieved. The error signal from the register control unit, indicative of such stretching, adjusts the compensating roller to modify the path length of the flow path and thereby to restore correct register.

In Figure 2, a marginal portion of the web 10 is shown in plan view with code marks 32 and register marks 34. The code marks 32 are recognised by the register control circuit and prepare that circuit for receiving the register control signals derived from the marks 34. It is an unusual feature of the invention that the marks from which the signals are derived for comparison are spaced by a large number of complete image lengths along the flow path.

It will be seen that the invention enables the printer to dispense with the conventional timer linked to the cutting or folding machine.

Claims

1. Printing apparatus having a web flow path extending from a printing cylinder (12a), for printing repeat images and register marks on the web (10), to a machine (20a,20b) operating in synchronism with the printing cylinder to perform a non-printing operation on the web in register with the printed images, the web flow path having a length such that it includes a number of printed images; and characterised by a first mark detector (24) arranged in the flow path immediately after the printing cylinder (12a); a second mark detector (26) arranged in the flow path immediately before the machine - (20a,20b) performing the non-printing operation; and a register control system (28,30) receiving signals from the two detectors and adjusting register control means (18) in accordance with any departure in the relative timing of the signals from a desired relative timing.

2. Printing apparatus having a web flow path extending from a printing cylinder (12a), for printing repeat images and register marks on the web (10), to a machine (20a,20b) for performing a non-printing operation on the web in register with the printed images, the web flow path having a length such that it includes a number of printed images, and including detector means for sensing the condition of register between the non-printing operation performed on the web and the images printed on the web, a register control circuit (28) responsive to the output of the detector means and providing an output indicative of any departure from a desired condition of register, and register correcting means (18,30) responsive to an output of the register control circuit indicative of such departure to restore the condition of register between the non-printing operation and the printed images on the web; and characterised in that the said machine - (20a,20b) operates in synchronism with the operation of the printing cylinder (12a), and in that the detector means includes a first mark detector (24) arranged in the flow path immediately after the printing cylinder and providing a signal indicative of the passage of register marks printed on the web and therefore indicative of the timing of the operation of the printing cylinder and of the said machine synchronised with the printing cylinder; and a second mark detector (26) arranged in the flow path immediately before the machine performing the non-printing operation and providing a signal indicative of the timing of the passage of register marks and therefore of printed images on the web entering the said machine at the end of the said flow path; the register control circuit (28) receiving the said signals from the first and second mark detectors and controlling the register correcting means accordingly.

3. Apparatus in accordance with claim 2, in which the register correcting means includes a compensating roller (18) over which the web passes in following the said flow path, the register control circuit adjusting the position of the compensating roller to increase or decrease the length of the flow path.

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4. Apparatus in accordance with claim 2 or 3, including means printing a code mark ahead of the said register mark, further including a code recognition circuit arranged to render the register control unit effective to respond to signals from the detectors when the code mark has been recognised.

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Fig. 1.

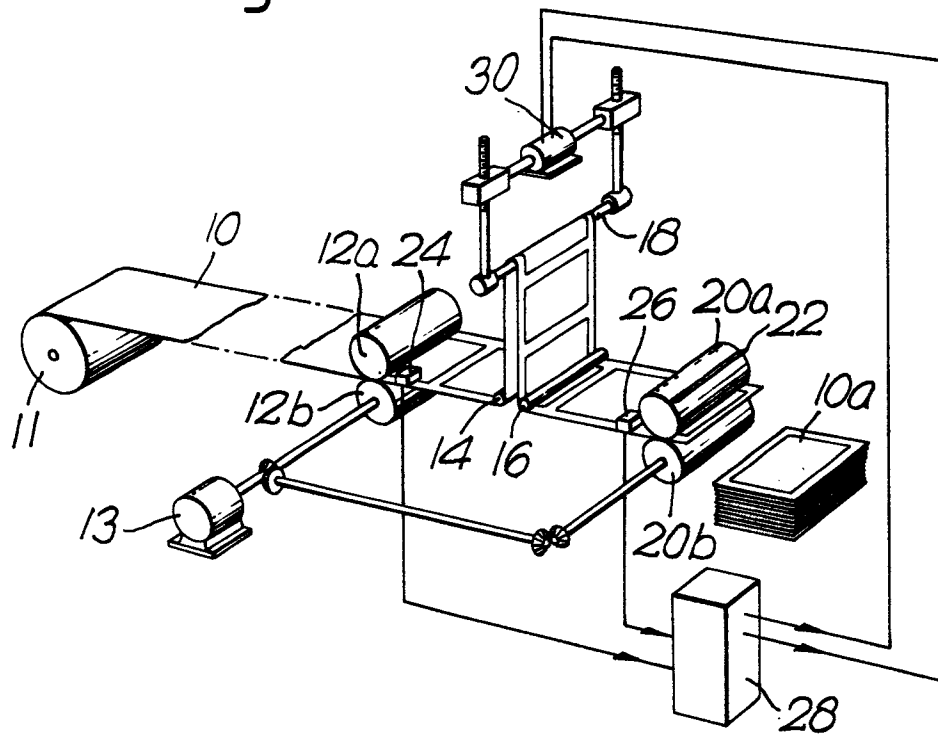
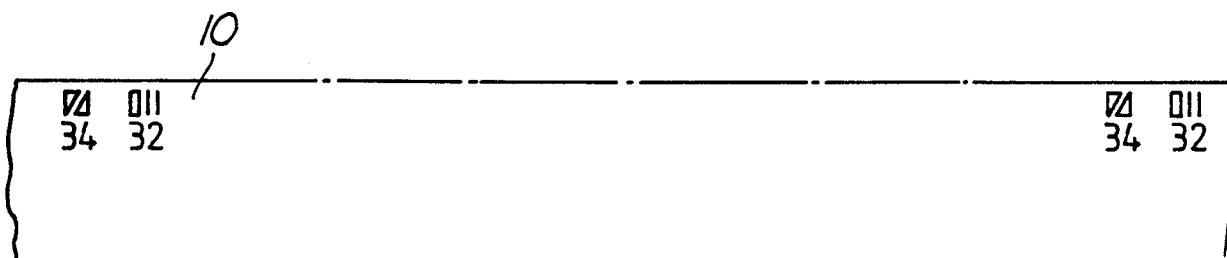


Fig. 2.





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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.4)
X	AUTOMATION, July 1965, pages 80-82; J. S. EINSTEIN: "Register control of web processes" * Page 80, column 1, lines 1-24; page 80, column 2, line 19 - page 81, column 1, line 16; figure 1 *	1-3	B 41 F 13/02
Y	Idem	4	

X	US-A-3 870 936 (D. A. COBERLEY) * Column 2, line 58 - column 3, line 21; figure 1 *	1-3	

X	GB-A- 949 415 (CROSSFIELD ELECTRONICS LTD) * Page 2, lines 69-112; figure 1 *	1-3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)

Y	FR-A-1 456 662 (J. F. Mc CARTHY INC.) * Page 4, column 1, lines 9-21, column 2, lines 35-51; figure 3 *	4	B 41 F

Y	EP-A-0 131 241 (TETRA PAK INTERNATIONAL A.B.) * Page 3, lines 4-16; figure 1 *	4	

Y	EP-A-0 146 403 (THOMAS FORMAN & SONS LTD) * Page 9, lines 4-9; figure 1 *	4	

	-/-		
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		16-01-1987	WEBER P.L.P.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone		T : theory or principle underlying the invention	
Y : particularly relevant if combined with another document of the same category		E : earlier patent document, but published on, or after the filing date	
A : technological background		D : document cited in the application	
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P : intermediate document		& : member of the same patent family, corresponding document	



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DOCUMENTS CONSIDERED TO BE RELEVANT			Page 2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ⁴)
A	FR-A-1 312 238 (BOBST-CHAMPLAIN S.A.) * Abstract, point a; figure 5 * -----	1,2	
			TECHNICAL FIELDS SEARCHED (Int. Cl. ⁴)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 16-01-1987	Examiner WEBER P.L.P.
CATEGORY OF CITED DOCUMENTS			
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		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	