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Luska

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[54] **CONTROL APPARATUS FOR THE REGISTRATION OF A PRINTING PRESS OR THE LIKE**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **250/548,** 250/214 R, 250/557, 250/233, 101/248

[51] **Int. Cl.** **B41f 13/44**

[58] **Field of Search** ..... 250/548, 557, 233, 561, 250/223, 548, DIG. 21, 214 R; 356/162; 101/248

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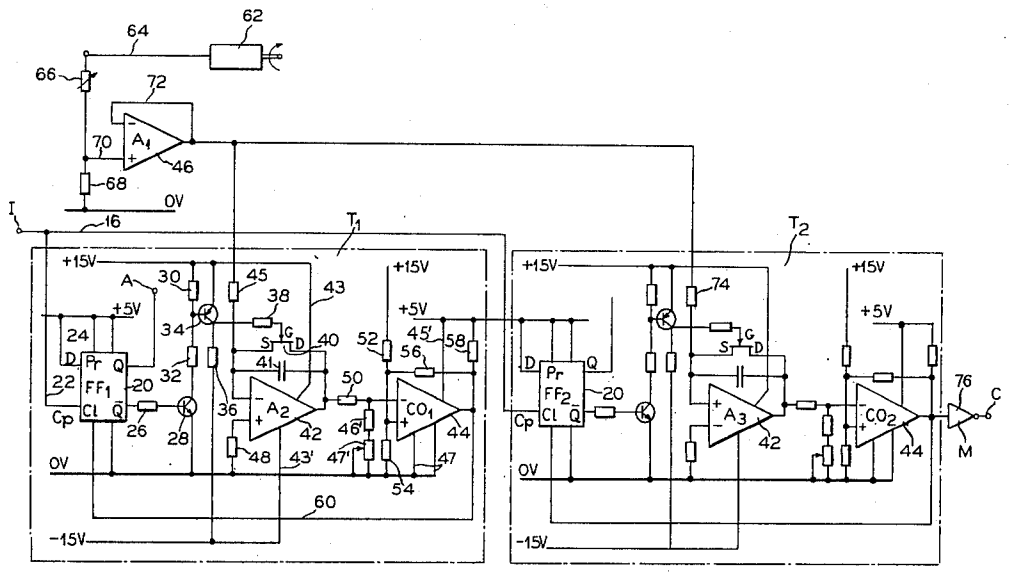
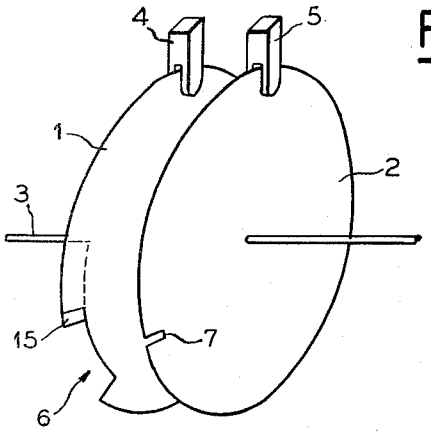
[57] **ABSTRACT**

Control apparatus for the registration of a printing press or the like incorporates means for generating a pulse of predetermined length, referred to as a window pulse, and a short reference pulse which is centered within the window pulse. The window pulse is generated by a flip-flop which is triggered at a predetermined time during each revolution of a printing cylinder, and an integrator, operative in response to triggering of the flip-flop, integrates an input signal proportional to the speed of the press until a predetermined level is reached, at which time the flip-flop is reset. A reference pulse is derived from a second integrator which integrates an input signal which is twice the rate of that of the first integrator so that the reference pulse always falls in the center of the window pulse.

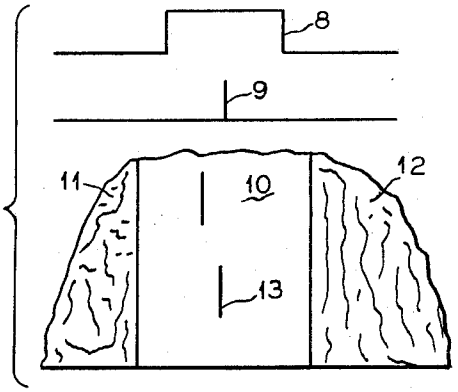
15 Claims, 5 Drawing Figures





PRIOR ART

FIG. 1



PRIOR ART

FIG. 2

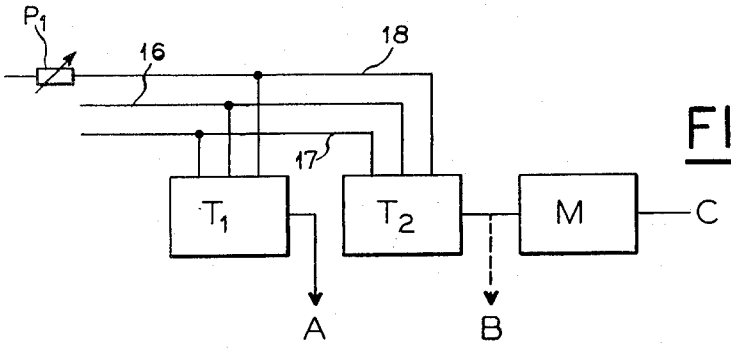


FIG. 3

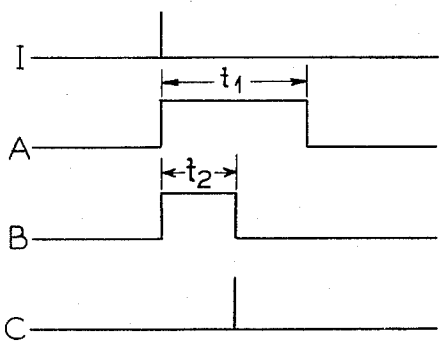
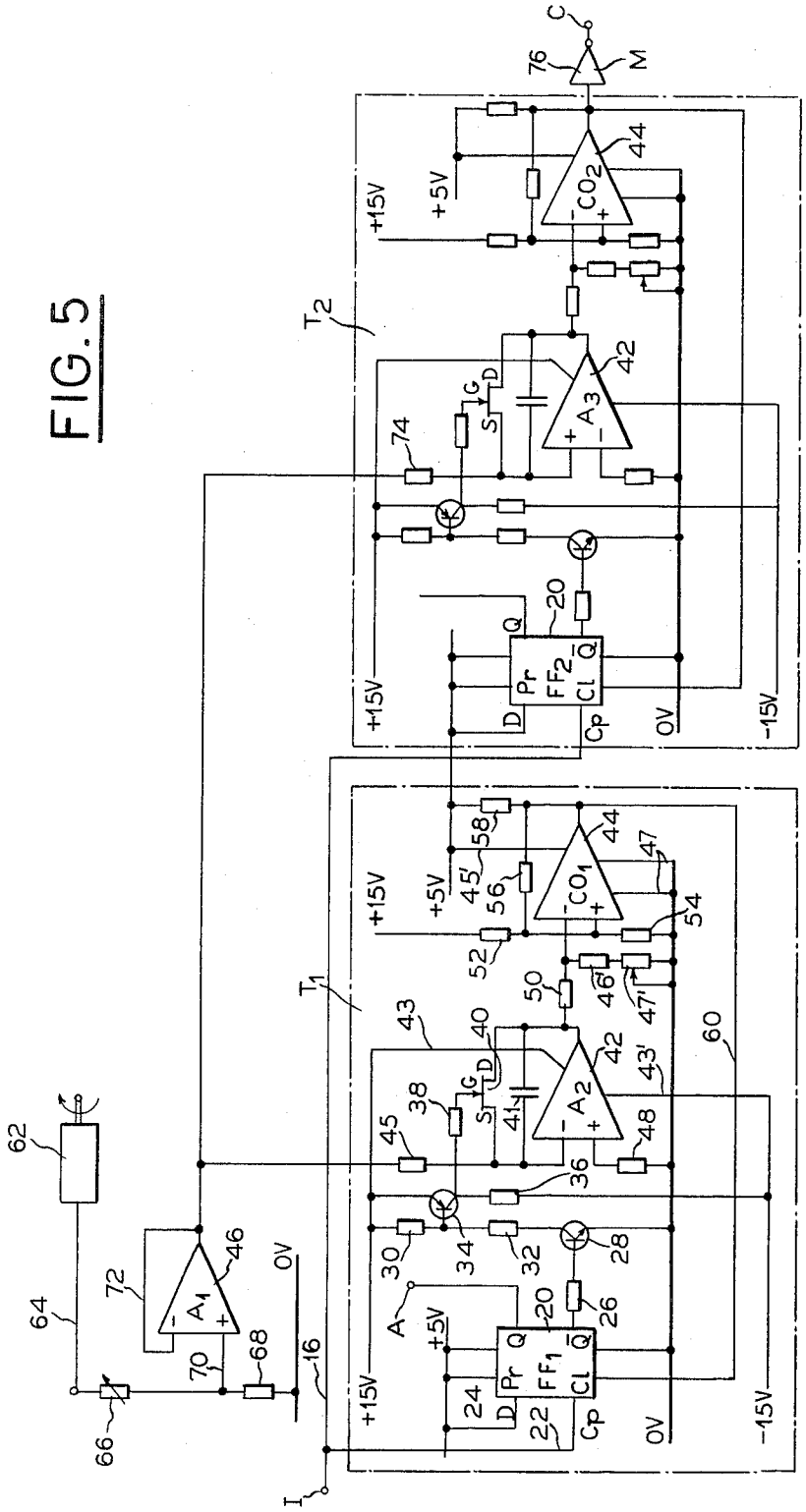


FIG. 4

FIG. 5



CONTROL APPARATUS FOR THE REGISTRATION OF A PRINTING PRESS OR THE LIKE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to control apparatus and more particularly to control apparatus adapted to assist in attaining proper registration of a printing press or the like.

2. The Prior Art

A "window" is typically employed in connection with the registration of material which is processed by a printing press or the like. The window is identified by the occurrence of a window pulse which coincides with the passage of register marks beneath a photoelectric reader, the marks being printed by the press in an area which is free of any other marks or indicia.

When the so-called "cylinder mark" method is used to effect registration, a reference pulse is produced by a device similar to that which produces the window pulse, at a predetermined time during each revolution of a printing cylinder, and the reference pulse must appear in the window. Apparatus which is conventionally used to accomplish the generation of the window and reference pulses are sometimes referred to as "automatic reading cams." In a conventional form, the cams are driven by a motor and are readable by means of a phase detector or by a magnetic sensing device for producing the window pulse and the reference pulse.

The use of the "automatic reading cams" are accompanied by the disadvantage that the duration of the window pulse is defined in terms of the angle of rotation of the printing cylinder. It is therefore not particularly applicable to a machine which accommodates a wide variety of formats employing cylinders of different diameters, for in that event the length of the window pulse produced by the cams is proportional to the circumference, of the printing cylinder, which is generally not desirable, especially with large diameter cylinders.

While reading cams are known which may be modified in order to produce window pulses of different durations, it is desirable to provide a mechanism in which no such modification is required.

SUMMARY OF THE INVENTION

It is therefore a principle object of the present invention to provide apparatus for generating window and reference pulses which avoids the need for manually manipulating the reading cams employed in the prior art.

Another object of the present invention is to provide means for automatically compensating for variations in the speed of the printing press.

A further object of the present invention is to provide means for automatically compensating for a variety of different diameters of printing cylinders for use on the press.

These and other objects and advantages of the present invention will become manifest upon an examination of the following description and the accompanying drawings.

In one embodiment of the present invention there is provided a pulse generator for generating a short pulse at a predetermined time during each revolution of a printing cylinder, a timing unit controlled by the pulse and by a signal representative of the speed of operation

of a printing press for providing a reading window pulse of a predetermined width, synchronized with the speed of operation of a printing press, and related to the speed of operation of the printing press.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference will now be made to the accompanying drawings in which:

FIG. 1 is a diagramatic illustration of a set of automatic reading cam systems employed in the prior art;

FIG. 2 is a plan view of a portion of the surface of a printing cylinder, together with a pair of wave forms illustrating the relationship of the register marks, the window pulse and the reference pulse;

FIG. 3 is a functional block diagram of apparatus incorporating an illustrative embodiment of the present invention;

FIG. 4 is an illustration of a series of waveforms generated during operation of the apparatus of FIG. 3; and

FIG. 5 is a schematic diagram, partly in functional block diagram form, illustrating the details of the apparatus illustrated in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In order to appreciate the advantages of the present invention, reference must first be made to a conventional way of obtaining a timing window pulse, and the relation of the various signals to the printing cylinder of a printing press. FIG. 1 illustrates in diagramatic form a pair of cams 1 and 2 conventionally employed in the prior art to generate a timing window pulse and a reference pulse. The two cams 1 and 2 are each mounted in fixed relation to a shaft 3, which is driven by the printing press drive. The peripheral zone of the two cams 1 and 2, which are both circular in shape, passes by two sensing devices 4 and 5, which function to emit signals in response to the shape of their respective cams. In some arrangements the sensing devices 4 and 5 are photoelectric transducers, while in others, they operate by sensing changes in the inductance or capacitance of the cams 1 and 2.

The cam 1 is provided with a cut-out portion 6, the length of which determines the time interval of the window pulse. The cam 2 has a relatively narrow slit 7 which, upon passing the transducer 5, generates the cylinder reference pulse. The waveforms of the pulses produced by the sensing devices 4 and 5 are illustrated in FIG. 2. The waveform of the window pulse 8 is generated in response to the slot 6, and the waveform of the reference pulse 9 is generated in response to the slit 7 provided in the cam 2.

FIG. 2 also illustrates a zone 10 separating two adjacent printed portions 11 and 12 which have been printed on a web by the printing press. A register mark 13 is located within the zone 10. Other register marks may also be located within the zone 10, but only one such mark is operative at a time. The register mark 13 is detected by photoelectric means or the like and its detection must coincide with the reference pulse 9, when correct registration is achieved. It is apparent from FIG. 1 that the window pulse 8, produced by the notch 6, has a duration defined in terms of the cylinder diameter. If the diameter of the printing cylinder is increased, the length of the window pulse 8 becomes longer. This is because the angle defined by the notch

6 extends over a greater peripheral distance on a larger cylinder.

In order to compensate for this disadvantage, the cam may be provided with adjustable means 15, whereby the angular extent of the notch 6 may be adjusted.

Apparatus incorporating an illustrative embodiment of the present invention is shown in FIGS. 3, 4 and 5. The cam 2 and the transducer 5, or equipment equivalent thereto, is employed to produce a pulse at a predetermined point during each cycle of the printing cylinder. This pulse is made available on a line 16 which is connected to inputs of two timing devices T1 and T2. The two timing devices T1 and T2 generate at their outputs, A and B, respectively, the waveforms A and B of FIG. 4. The period of the timing device T1 is twice as long as that of T2, so that the pulse produced by the timing device T2 has a trailing edge at the midpoint of the pulse produced by the timing device T1. A monostable device M is connected to the output of the timing device T2 to produce, on an output line C, a short pulse coincident with the trailing edge of the pulse produced by the timing unit T2. As illustrated in FIG. 4, this occurs in the midpoint of the pulse produced by the timing unit T1. The pulse produced by the timing unit T1 is equivalent to the window pulse 8 shown in FIG. 2, while the pulse produced by the monostable device M is equivalent with the reference pulse 9 of FIG. 2.

A line 17 is connected to both of the timing units T1 and T2, and functions to regulate the time interval produced by both of these timing devices, in accordance with the speed of operation of the printing press. For faster speeds of operation the waveforms illustrated in A and B are both made proportionally shorter, and they are made longer for slower speeds of operation. Change in the size of the cylinder diameter does not effect the length of the pulses of the waveforms A and B.

A potentiometer P1, which is manually adjustable, is connected via a line 18 to both of the timing units T1 and T2, and serves to render the length of the pulses produced thereby manually adjustable, as desired.

FIG. 5 illustrates a schematic diagram of the apparatus illustrated in functional block diagram form in FIG. 3. The two timing units T1 and T2 are identical, and so a description of the timing unit T1 will suffice for both.

The timing device T1 incorporates a D-type flip-flop 20 having its clock input connected over a line 22 to the line 16, and its D input connected to a source of positive potential by a line 24. The Q output is connected through a resistor 26 to the base of a transistor 28, which has its emitter and collector terminals interconnected in series with a pair of resistors 30 and 32 between a source of positive potential and a source of a reference potential or ground, indicated in FIG. 5 by the designation OV. The junction of the resistors 30 and 32 is connected to the base of a transistor 34, the emitter of which is connected to a source of positive potential and the collector is connected through a resistor 36 to ground. The collector of the transistor 34 is also connected via a resistor 38 to the gate of an FET 40. The drain of the FET 40 is connected to the output of an amplifier 42, while the source of the FET 40 is connected to the inverting input of the amplifier 42. A capacitor 41 is connected in parallel with the FET 40, between the output of the amplifier 40 and its inverting input. The inverting input is also connected through a resistor 45 to the output of an amplifier 46, and the noninverting input is connected through a resistor 48 to ground.

The output of the amplifier 42 is connected by a resistor 50 to the inverting input of a comparator 44, and the inverting input of the comparator 44 is also connected to ground through a resistor 46' and a rheostat 47'. The noninverting input of the comparator 44 is connected to the junction between a pair of resistors 52 and 54, which are connected as a voltage divider between a source of positive potential and ground. A positive feedback resistor 56 is connected from the output of the comparator 44 to its noninverting input, and the output of the comparator 44 is also connected by a resistor 58 to a source of positive voltage for biasing. A line 60 connects the output of the comparator 44 to the clear input of the flip-flop 20.

The input of the amplifier 46 is derived from a tachometer 62 connected with the drive of the printing press so as to furnish on a line 64 a d.c. potential proportional to the speed of the drive, which is also proportional to the speed of the web running through the press. The line 64 is connected through a voltage divider, including a rheostat 66 and a resistor 68, to ground. The output of the voltage divider, which is made available at the junction between the rheostat 66 and the resistor 68, is connected by a line 70 to the noninverting input of the amplifier 46. A feed-back connection 72 between the output of the amplifier 46 and its inverting input is also provided. The amplifier 46 provides a low impedance output with no voltage gain.

In operation, the state of the flip-flop 20 is initially such that the $\overline{Q}$ output is high and the Q output is low. The high level at the $\overline{Q}$ bar output of the flip-flop 20 causes both of the transistors 28 and 34 to be conductive, and the FET 40 is also conductive, by application of a positive potential to the gate terminal. When a pulse appears on the line 16, it is conveyed to the clock input of the flip-flop 20 over the line 22, causing the flip-flop 20 to change its state so that the Q output goes high and the $\overline{Q}$ output goes low. This results in cutting off the transistors 28 and 34, and the FET 40 is also cut off. The capacitor 41 is held in discharged condition by the conduction of the FET 40 as long as the latter has a positive signal applied to its gate. After the pulse arrives on the line 16, and the flip-flop 20 changes its state, the FET is cut off and the capacitor 41 is therefore no longer short circuited, so that it may be charged to the difference between the output of the amplifier 42, and its inverting input. The amplifier 42 accordingly functions as an integrator. As a result, the output of the amplifier 42 is a ramp function which gradually increases as the capacitor 41 is charged. The ramp function starts from approximately ground potential. Power is supplied to the amplifier 42 by means of lines 43 and 43', by which the amplifier is connected, respectively, to sources of positive and negative potential. Similarly, the comparator 44 is connected to a source of a positive voltage by a line 45' and to ground by the lines 47.

The comparator 44 has its noninverting input biased at a particular voltage level by virtue of the voltage divider comprising the resistors 52 and 54. As long as the output from the amplifier 42 remains relatively low, the comparator 44 remains saturated, and produces a high level output. When the ramp function at the output of the amplifier 42 becomes equal to the voltage available

at the non-inverting input, however, the level at the output of the comparator **44** drops sharply, aided by the positive feedback resistor **56**, and produces a low level output on the line **60**, which clears the flip-flop **20** back to its initial state. This restores the transistors **28** and **34** to conduction, and discharges the capacitor **41** through the FET **40**. The output of the comparator **44** then resumes its high value, but this has no effect on the state of the flip-flop **20**. The time interval over which the integration of the capacitor **41** is progressing is manifested by a signal on the output terminal A which is connected to the Q output of the flip-flop **20**, and is illustrated in the waveform A of FIG. **4**.

The construction and operation of the timing device T2 is identical to that of T1, with the exception that a resistor **74**, by which the output of the amplifier **46** is connected to the noninverting input of the amplifier **42** of the timing device T2, is lower in resistance than the comparable resistor **45** of the timing unit T1, with the result that the timing unit T2 integrates at a faster rate. The resistance values of the resistors **45** and **74** are chosen so that the slope of the ramp produced in the timing unit T2 is twice that produced by the timing unit T1. The comparator units **44** and both of the timing units have the same voltage value connected to their noninverting inputs, so they are both triggered at the same amplitude of their respective ramp functions. As the ramp function has twice the slope in the timing unit T2, the triggering of the comparator 44 in the timing unit T2 is triggered at the mid-point of the pulse produced at the terminal A of the timing unit T1.

The output of the comparator 44 of the timing unit T2 is connected to a monostable unit **76**, which is adapted to produce a short pulse coincident with the beginning of the pulse produced by the comparator **44** of the timing unit T2. This pulse is indicated in waveform C of FIG. **4**. The monostable unit **76** may alternately be connected to the Q output of the flip-flop **20** of the timing unit T2, which goes low at the same time as the output of the comparator 44.

The signal which is integrated in both of the timing units T1 and T2 is derived from the generator **62**, so that the slope of both of the ramp functions produced by the two timing units is proportional to the speed of operation of the printing press. Therefore, the window pulse represented by the waveform A of FIG. 4 varies in duration in accordance with the speed of the printing press, but corresponds to a constant distance along the length of the web being printed. The adjustment of the rheostat P1 also functions to change the level of voltage presented at the output of the amplifier **46**, so that the duration of the window pulse may be varied at will. The reference pulse always occurs in the center of the window, however.

The rheostat **47'** in each timing unit is provided for adjustment, when necessary, to insure that the slope of the ramp functions applied to the comparators of the timing units are in the correct proportion.

It will be appreciated that the operation of the present invention provides a reference pulse which is centrally located within the window pulse, and that the window pulse is automatically regulated in length in accordance with changes in operating speed of the printing press. Changes in the diameter of the printing cylinder do not affect the duration of the window pulse.

Although the present invention has been described with particular reference to a web fed press, it is obvious that it is equally applicable to a press in which the material to be printed comprises moving sheets or the like.

In one typical embodiment of the present invention, the following components were used:

Flip-flop 20	SN7474N	
Amplifiers 42 and 46	μA741	Fairchild
Comparators 44	LM311	National
Transistor 28	2N3904	
Transistor 34	2N3906	
FET 40	U1899	

What is claimed is:

1. For use with a printing press having means for removably mounting printing cylinders having different respective diameters, apparatus for obtaining a reading window pulse for assisting in the control of registration of material printed on such press, comprising a pulse generator adapted to generate a starting pulse for each revolution of one of said mounted printing cylinders, means for producing a control signal representative of the speed of travel of the material being printed by said press, and a timing device connected to receive said starting pulse and said control signal for producing a window pulse in response to said starting pulse, said window pulse having a duration which is a function of the speed of travel of said material being printed and which is independent of the diameter of said one mounted cylinder.

2. Apparatus according to claim **1**, wherein the duration of said window pulse is proportional to the speed of said material being printed.

3. Apparatus according to claim **1**, wherein said pulse generator comprises a member rotating with said cylinder, and a transducer juxtaposed with said member for producing a pulse at a predetermined time during each revolution of said member.

4. Apparatus according to claim **1**, wherein said means for producing a control signal comprises a tachometer.

5. Apparatus according to claim **1**, wherein said timing device comprises an integrator for integrating said control signal until a predetermined value is produced by said integrator, and means for manifesting said window pulse during the operation of said integrator.

6. Apparatus according to claim **5**, wherein said means for manifesting said window pulse comprises a bistable device connected to receive said starting pulse, said bistable device being set to one state in response to said starting pulse and reset to its other state when said integrator produces said predetermined value.

7. Apparatus according to claim **6**, wherein said bistable device comprises a flip-flop.

8. For use with a printing press, apparatus for obtaining a reading window pulse for assisting in the control of registration of material printed on such press, comprising a pulse generator adapted to generate a starting pulse for each revolution of a printing cylinder, means for producing a control signal representative of the speed of travel of the material being printed by said press, and a timing device connected to receive said starting pulse and said control signal for producing a window pulse in response to said starting pulse, said window pulse having a duration which is a function of the speed of travel of said material being printed, said timing device comprising an integrator for integrating said control signal until a predetermined value is pro-

duced by said integrator, and means for manifesting said window pulse during the operation of said integrator, said means for manifesting said window pulse comprising a flip-flop connected to receive said starting pulse, said flip-flop being set to one state in response to said starting pulse and reset to its other state when said integrator produces said predetermined value, said integrator comprising a differential amplifier having an input connected to receive said control signal, a feedback capacitor connected between the output of said amplifier and its inverting input, and means for selectively short-circulating said feedback capacitor prior to said starting pulse.

9. Apparatus according to claim **8,** wherein said shortcircuiting means comprises an FET having its drain and source terminals connected across said capacitor, and means connecting the gate terminal of said FET with said bistable device for rendering said FET conductive prior to said starting pulse.

10. Apparatus according to claim **1,** including a second timing device connected to receive said starting pulse, for producing a reference pulse at an interval following said starting pulse which is a predetermined fraction of the duration of said window pulse.

11. For use with a printing press, apparatus for obtaining a reading window pulse for assisting in the control of registration of material printed on such press, comprising a pulse generator adapted to generate a starting pulse for each revolution of a printing cylinder, means for producing a control signal representative of the speed of travel of the material being printed by said press, and a timing device connected to receive said starting pulse and said control signal for producing a window pulse in response to said starting pulse, said window pulse having a duration which is a function of the speed of travel of said material being printed, and including a second timing device connected to receive said starting pulse, for producing a reference pulse at an interval following said starting pulse which is a predetermined fraction of the duration of said window pulse, said second timing device comprising a second integrator for integrating said control signal, at a rate bearing a predetermined relationship to the rate of integration of the first integrator, until a predetermined value is produced by said second integrator, and means for manifesting said reference pulse when said predetermined value is reached by said second integrator.

12. Apparatus according to claim **11,** wherein the predetermined value reached by said second integrator is identical to the predetermined value reached by the first integrator.

13. Apparatus according to claim **11,** including connecting means for connecting said control signal with said first and second integrators, said connecting means furnishing predetermined fractions of said control signal to said first and second integrators.

14. Apparatus according to claim **12,** wherein the fraction of the control signal furnished to said first integrator is one half the fraction furnished to said second integrator, such that said reference pulse always falls in the center of said window pulse.

15. Apparatus according to claim **10,** including monostable means connected with said second timing device for producing said reference pulse with a predetermined duration.

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