

[54] **REGISTERING MECHANISM FOR PRINTING PRESS**

[75] Inventor: **James N. Crum, Stonington, Conn.**

[73] Assignee: **Harris-Intertype Corporation,**
Cleveland, Ohio

[22] Filed: Nov. 23, 1970

[21] Appl. No.: 91,675

[52] U.S. Cl.....101/248, 101/181

[51] **Int. Cl.**.....**B41f 13/14**

[58] **Field of Search** 101/248, 181; 318/603

[56] **References Cited**

UNITED STATES PATENTS

2,948,216	8/1960	Thompson.....	101/248
3,562,619	2/1971	Hyoguchi et al.	318/603

3,465,217	9/1969	Kress.....	318/603 X
3,500,154	3/1970	Arp et al.....	318/603 X
3,264,983	8/1966	Lewis et al.....	101/248 X
3,182,590	5/1965	Johnson.....	101/248
3,566,241	2/1971	Ross.....	318/599 X
3,109,131	10/1963	Byrd.....	318/599 X

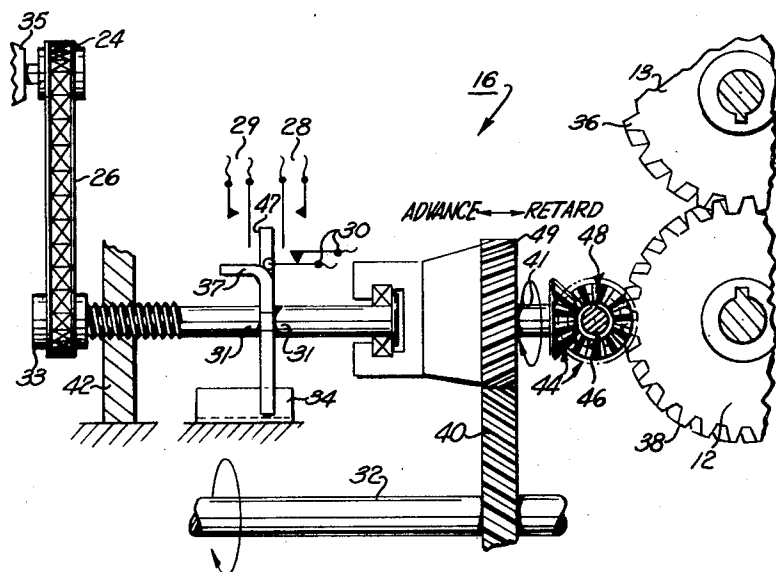
Primary Examiner—J. Reed Fisher

Attorney—Yount and Tarolli

[57] **ABSTRACT**

Printing press in which digital control equipment is utilized to effect register adjustments and automatic positioning of plate cylinder in a make-ready position. When lateral adjustments are made, circumferential adjusting mechanism is operated to compensate for changes in circumferential position which would occur because of lateral adjustment.

14 Claims, 6 Drawing Figures



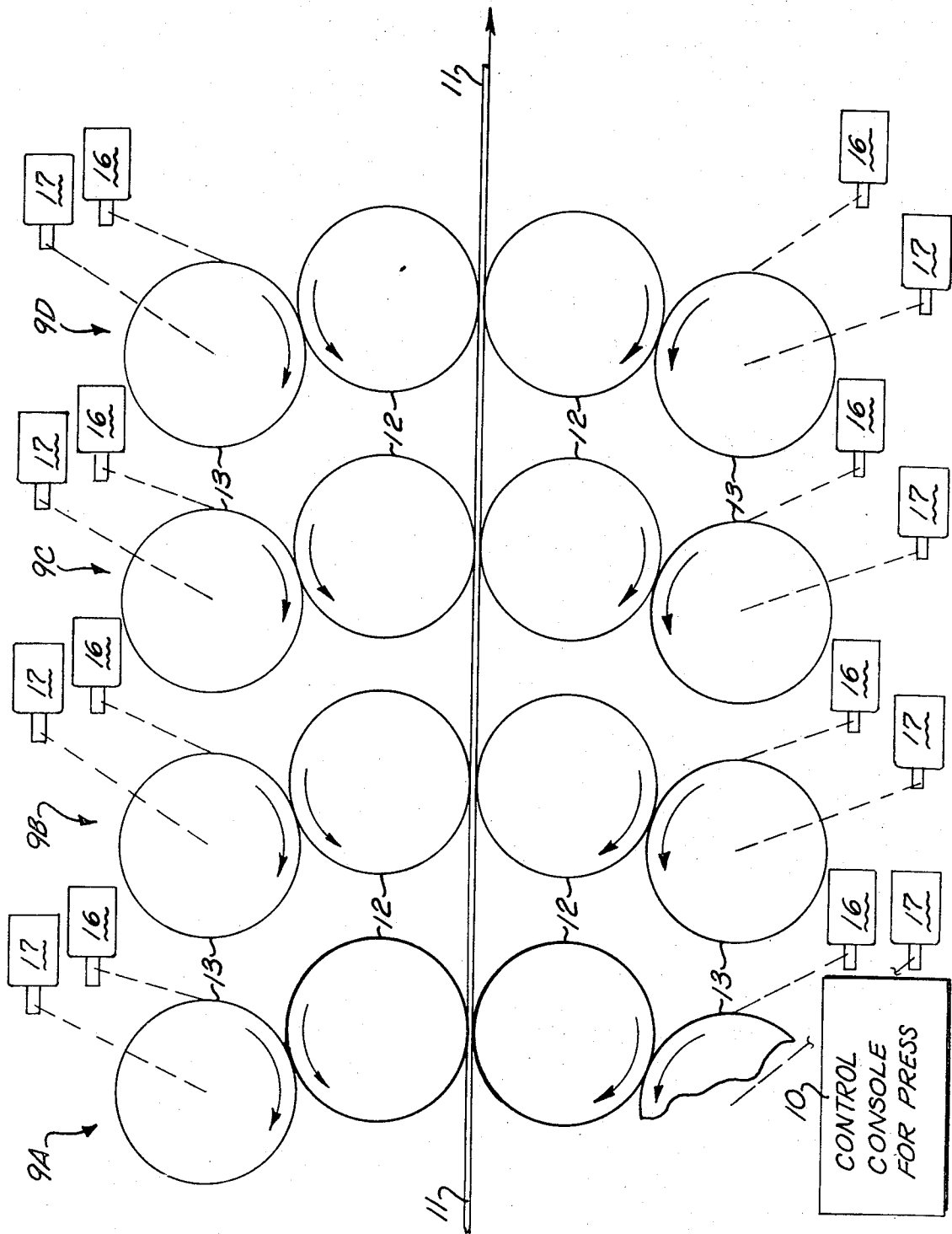


FIG. 1

INVENTOR
JAMES N. CRUM

BY *Yount and Tarolli*
ATTORNEYS

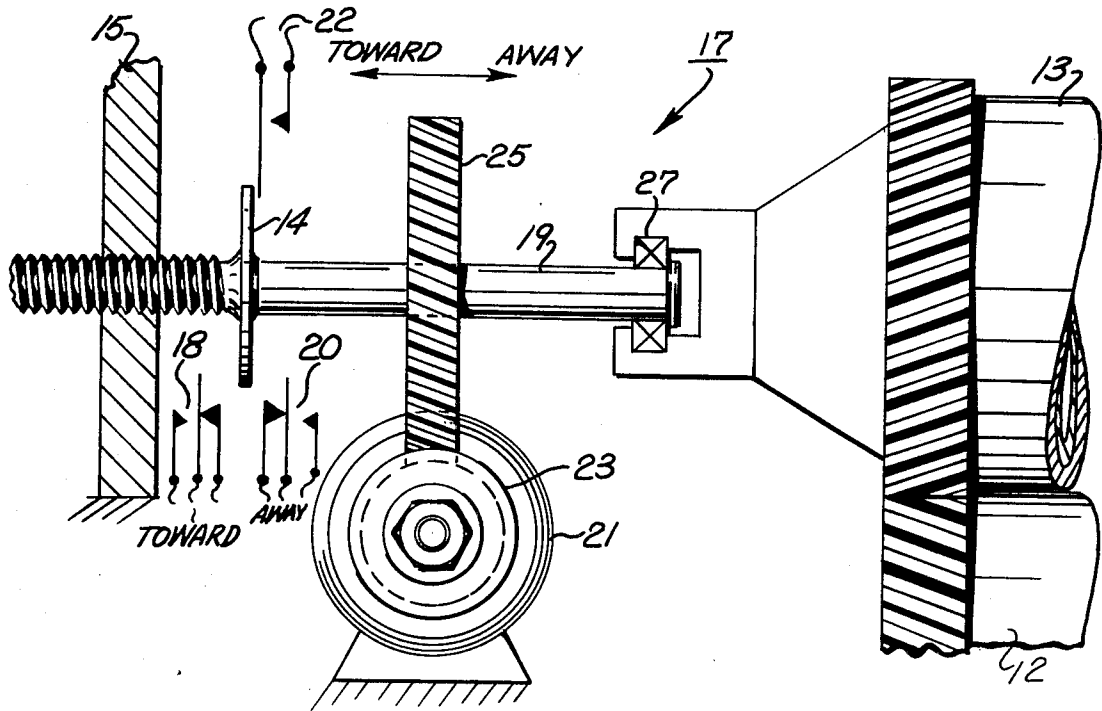


FIG. 2

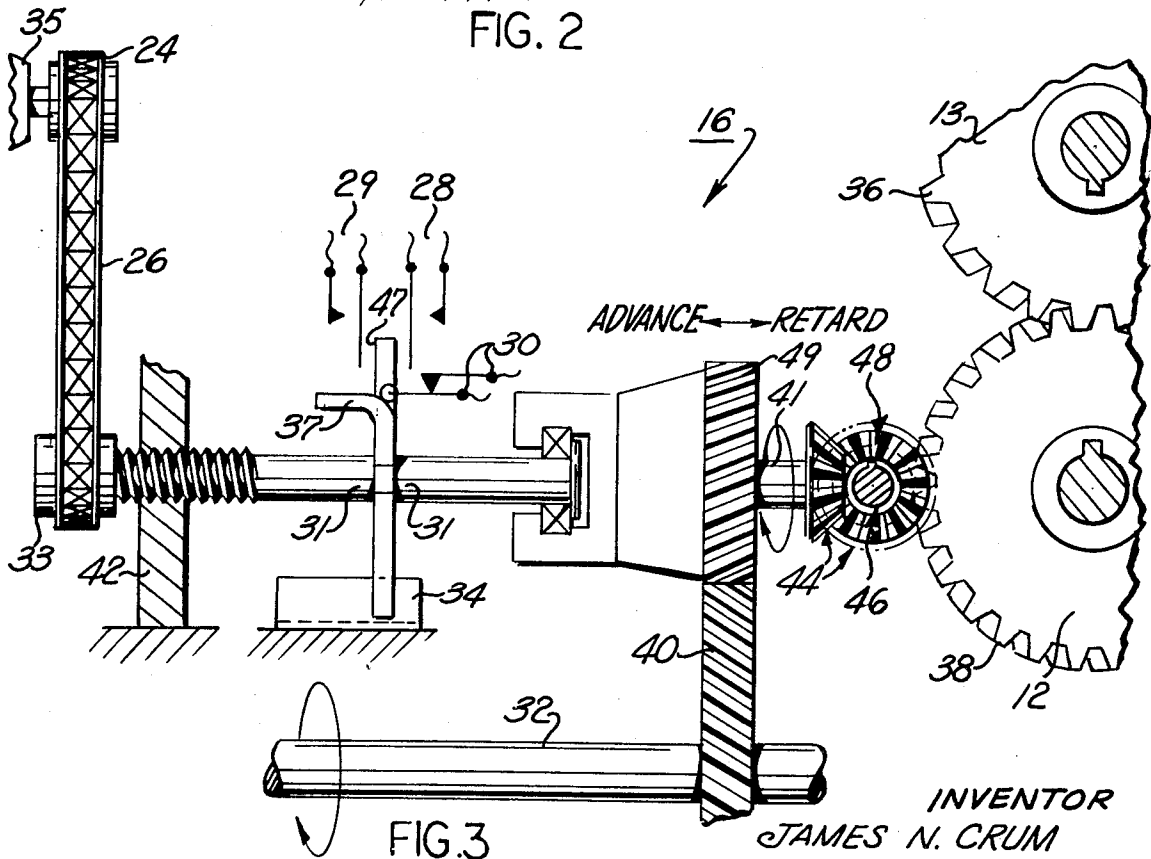


FIG. 3

INVENTOR
JAMES N. CRUM

BY *Yount and Tarolli*
ATTORNEYS

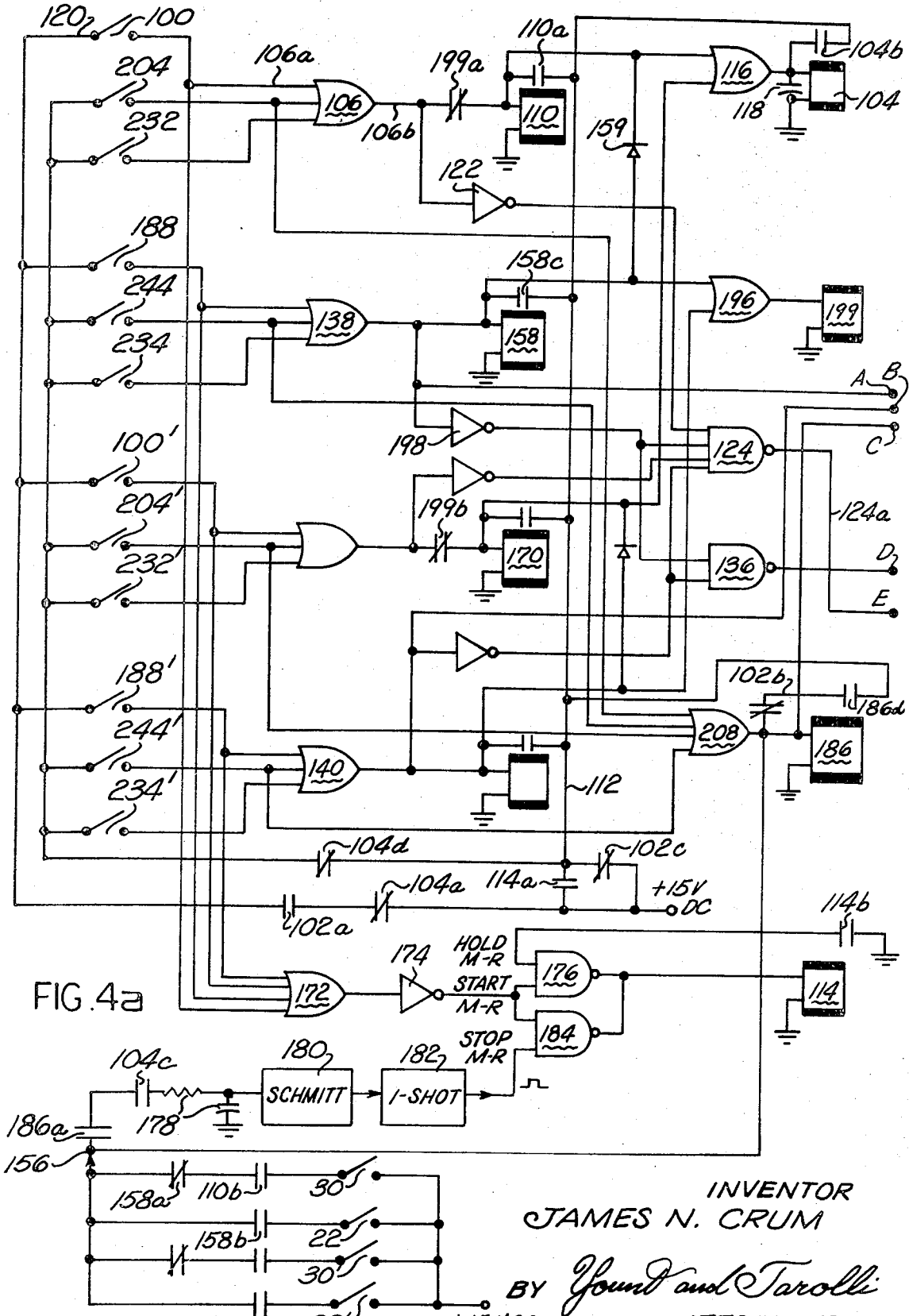
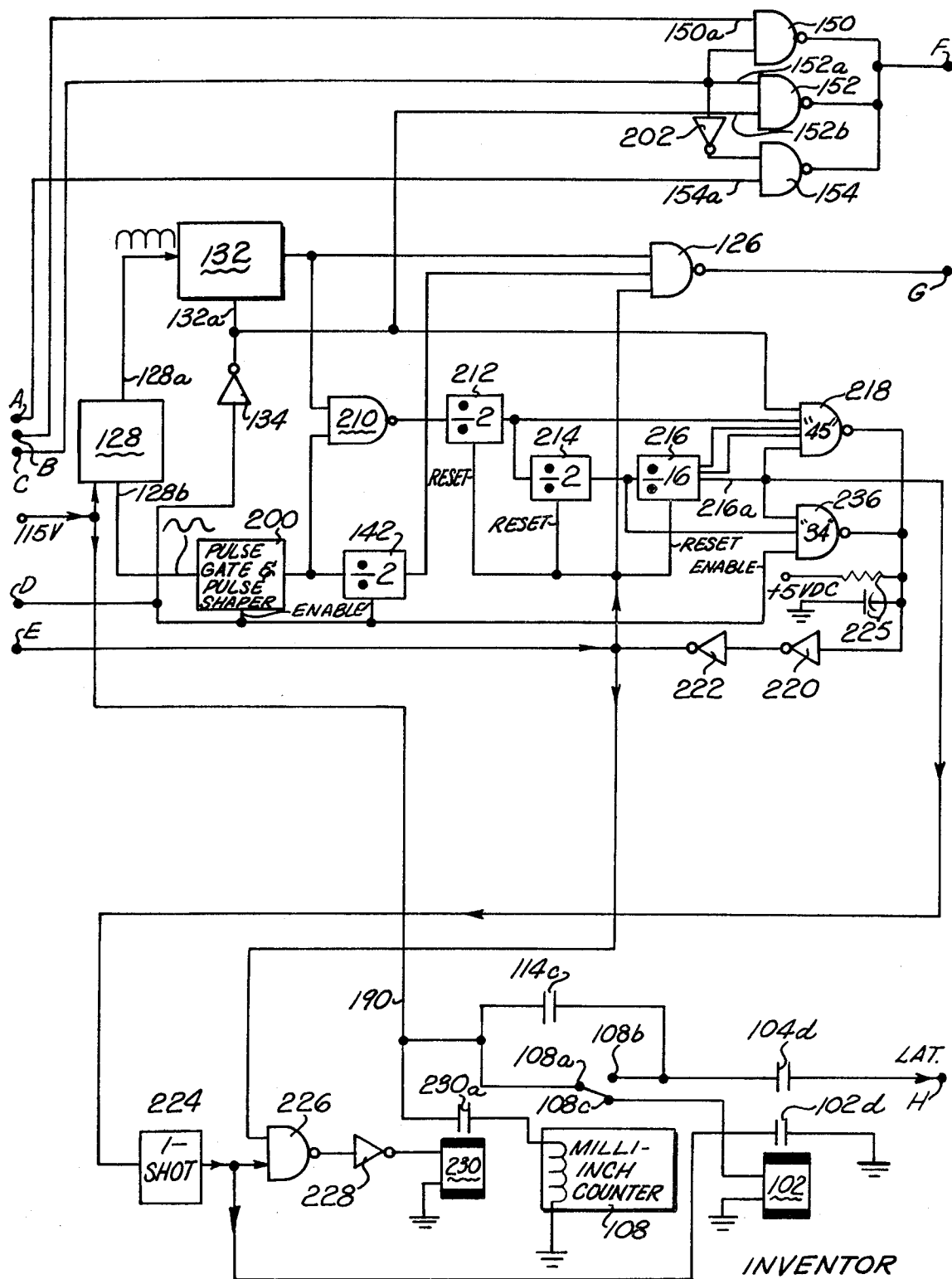


FIG. 4a

INVENTOR
JAMES N. CRUM

BY *Yount and Tarolli*
ATTORNEYS



INVENTOR
JAMES N. CRUM

FIG. 4b

BY *Yount and Tarolli*
ATTORNEYS

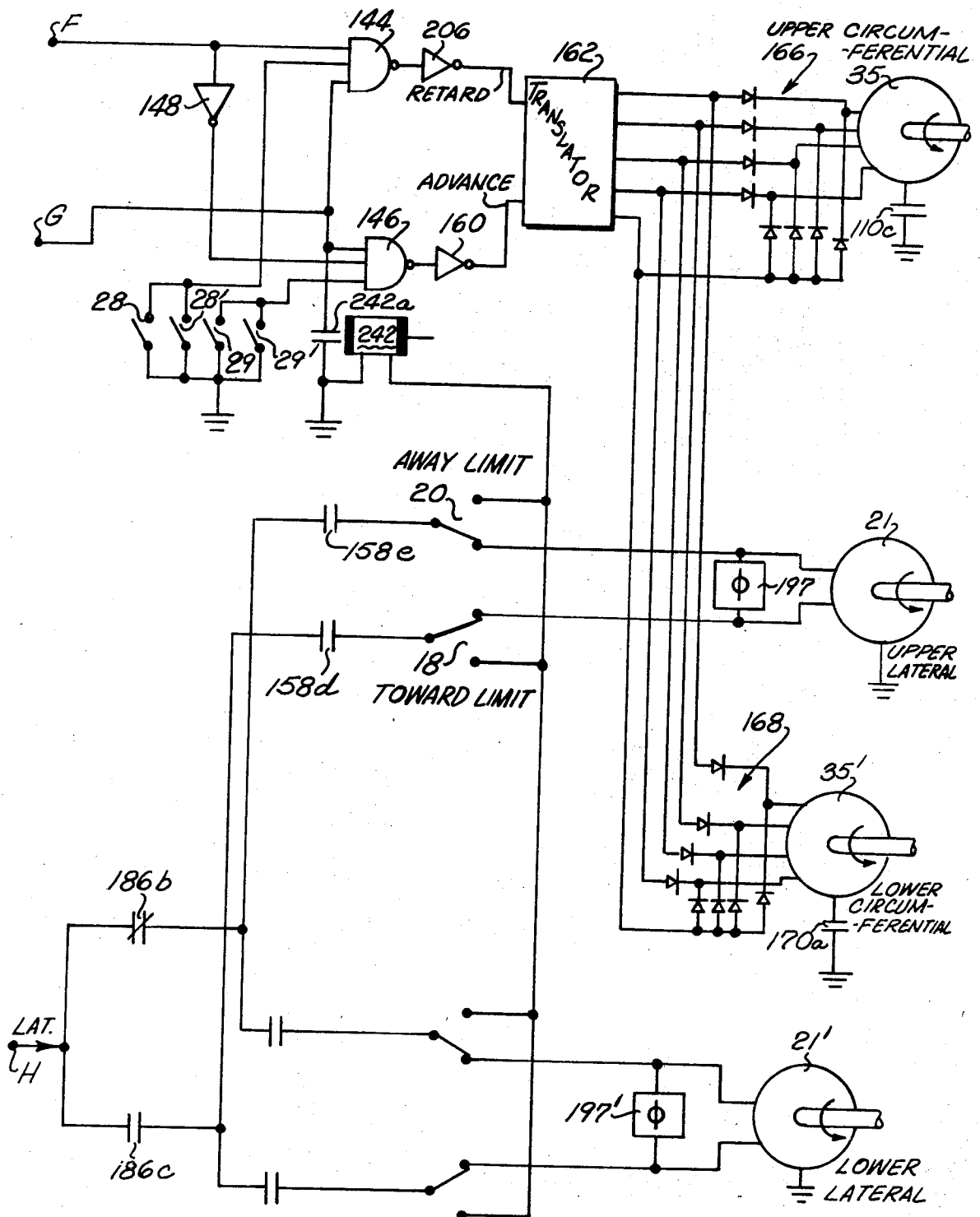


FIG. 4c

INVENTOR
JAMES N. CRUM

BY *Yount and Tarolli*
ATTORNEYS

REGISTERING MECHANISM FOR PRINTING PRESS

The present invention relates to printing presses and more particularly to a printing press having mechanism for facilitating the making ready of the press for printing.

In a multi-unit printing press, the units print color images which are superimposed upon each other to form a complete color picture and it is necessary for the images to have precise registration. Consequently, the plate cylinder of each unit has been provided with mechanism for moving the cylinder axially to adjust lateral registration of the image printed by the unit and circumferentially relative to its drive to adjust the position of the image orthogonally relative to the lateral adjustment.

When a printing press is being made ready for a printing run and after the printing plates for the new run have been mounted on the cylinders, the pressman will conventionally adjust the second unit to register the image printed by the second unit to that printed by the first unit, then adjust the third unit to register its image to the image of the first unit, etc., until all of the units are in register.

An object of the present invention is to provide a new and improved printing press in which the plate cylinders of the press may each be readily and easily set while readying the press for printing in a known predetermined position, preferably the position in which the printing plates on the cylinders should theoretically be in register.

A further object of the present invention is to provide a new and improved printing press in which a plate cylinder may be quickly and readily returned to a predetermined position which is preferably in the center of its range of adjustment to facilitate the registration of the unit to print an image in a desired position on a stock being printed.

A further object of the present invention is to provide a new and improved printing press in which the plate cylinder of a printing unit may be automatically, in response to a command, centered in the middle of its range of adjustment for circumferential or lateral registration.

A further object of the present invention is to provide a new and improved printing press in which a motor for effecting adjustment of circumferential registration is automatically operated in response to signals indicative of operations of the motor for effecting lateral registration to compensate for misregistration in a circumferential direction caused by operation of the motor for adjusting lateral registration.

A still further object of the present invention is to provide a new and improved printing press in which the position of the plate cylinders of all of the printing units may be quickly and readily operated to change their positions by a selectable specified increment to facilitate registration of a multi-unit printing press.

In accordance with the invention, a printing unit is provided in which mechanisms may operate on command to adjust the plate cylinder to a predetermined position in its ranges of adjustment for effecting lateral and circumferential registration of the unit and preferably each unit of a printing press is provided with such mechanism.

By way of illustration, a specific embodiment for the present invention is disclosed in the following specification and the accompanying drawings:

FIG. 1 is a diagram of a four-color perfecting web printing press embodying the present invention;

FIG. 2 shows a plate cylinder of one of the color units and also a mechanical diagram of the lateral register adjustment mechanism;

FIG. 3 shows a blanket cylinder and a plate cylinder of one of the color units and also a mechanical diagram of the circumferential register adjustment mechanism; and

FIGS. 4a, 4b, and 4c are a diagram of the control circuits for adjusting the cylinders of FIGS. 2 and 3 wherein conventional subcircuits are shown in block form.

While the present invention is susceptible of various modifications and forms and of embodiment in various types of printing presses, a specific form of the preferred embodiment is illustrated herein as embodied in a four-color perfecting offset lithographic web press.

Referring to FIG. 1, the printing press shown therein comprises four perfecting offset lithographic units 9A, 9B, 9C and 9D for printing onto a web 11. The units each comprise upper and lower blanket cylinders 12 and upper and lower plate cylinders 13 which respectively cooperate with the upper and lower blanket cylinders of the unit. The web 11 runs between the blanket cylinders 12 of each unit so that the blanket cylinders print on the opposite sides of the web.

As is well understood in the art, the blanket cylinders each receive the image to be printed from a printing plate mounted onto the plate cylinder 13 cooperating with the blanket cylinder and the plate is dampened and inked by conventional dampeners and inkers well known in the art but not illustrated in the drawings.

During printing, each printing unit will print one color of an image being printed and the image on the printing plate on the plate cylinder of each unit will correspond to the color separation image of the total image being printed and is to be superimposed on the image printed by the first unit of the printing press in precise registration with the image of the first unit. The image which is printed onto a web may be adjusted longitudinally of the web to adjust longitudinal (circumferential) registration of the image on the web by operating a circumferential register mechanism 16 for advancing or retarding the angular phase position of the plate cylinder relative to the drive shaft 32 of the machine. Similarly, the lateral registration of the image may be adjusted by operating a lateral adjusting mechanism 17 for moving the plate cylinder axially, i.e., laterally of the web 11. Registration equipment is controlled by circuits located in part in the control console 10 for the press. Mechanical mechanisms for effecting lateral and circumferential adjustments are well known and various types may be used with the present invention. However, a specific embodiment of the preferred form of the invention is shown diagrammatically in FIGS. 2 and 3 and will be explained in more detail.

Referring to FIG. 2, which illustrates the plate cylinder of an adjusting mechanism used in the units, the plate cylinder 13 has the lateral register mechanism 17 mounted at one end of the cylinder and arranged so

that the plate cylinder 13 can be moved axially by the lateral register mechanism. Internal screw threads on a portion 15 of the frame engage screw threads on a rotatable shaft 19 which is geared to a lateral motor 21 by means of a worm gear 23 and wheel gear 25. A conventional two-way roller thrust bearing 27 transmits only the axial movements of the shaft 19 to the plate cylinder 13. The lateral motor 21 can be operated in either direction of rotation so as to adjust lateral register by driving the plate cylinder 13 toward or away from the lateral motor by means of the screw threads on shaft 19 and on portion 15 of the frame.

Lateral limit switches 18 and 20 prevent lateral over-travel of the plate cylinder in either direction. Those switches detect when the plate cylinder has come to an extreme position in either direction and stop the lateral motor from displacing the cylinder 13 any further in that direction. A disc 14 is fastened to shaft 19 and therefore moves laterally with the plate cylinder 13 when the plate cylinder is displaced axially and also rotates whenever shaft 19 rotates.

A lateral position indicator switch 22 is so located that it is closed when the plate cylinder is on a first side of the midpoint of its available range of lateral position and open when the plate cylinder is on the second side of the midpoint of the range, switch 22 being actuated by disc 14. The position indicator switch 22 serves to determine the required direction of motion of the lateral motor to bring the plate cylinder to a central position of its lateral range of adjustment and to indicate the arrival of cylinder 13 at its central position.

With respect to circumferential adjustment, as shown in FIG. 3, plate cylinder 13 is rotated from the main press drive shaft by drive means including a secondary shaft 41. A helical gear 40 is driven from the main press drive and meshes with a helical gear 49 which is slidably keyed to the secondary shaft 41 which drives a pair of bevel gears 44 for driving another shaft 46 to which is mounted a helical gear 48 which engages a helical gear 38 fixed to the blanket cylinder which in turn drives a gear 36 fixed to the plate cylinder to effect rotation of the cylinders.

The circumferential register mechanism 17 operates to change the phase relationship between gears 40 and 49 so as to alter the circumferential register of the image printed by plate cylinder 13, i.e., its position longitudinally of the web. To adjust the plate cylinder circumferentially, the phase relationship between helical gears 40 and 49 is changed by sliding the gear 49 axially on shaft 41. Because gears 49 and 40 are of a helical type, displacement of gear 49 parallel to its principal axis rotates the gear 49 relative to the gear 40 and thereby changes the phase relationship between gears 49 and 40. The gear 40 is held axially by the main drive when the helical gear 49 is moved axially. The circumferential register mechanism controls the axial position of gear 49 by means of a pushrod 31 which is threaded and which passes through a threaded block 42. Block 42 is fixedly mounted to the frame of the printing press. Rotation of rod 31 advances rod 31 within block 42 because of the engagement of the screw threads of rod 31 with those of block 42. Rod 31 is rotatably driven during periods of circumferential register correction by circumferential motor 35 through sprocket 24, chain 26, and sprocket 33.

The circumferential motor 35 may be operated in a forward or a reverse direction as determined by control circuits to be described below. Operation of the circumferential motor results in rotation of rod 31 and axial movement of helical gear 49. In this way the circumferential motor controls the relative phase relationship between the gears 36 and 40 and, therefore, controls the circumferential register of the plate cylinder 13 to the plate cylinders of other printing units.

The phase relationship between gears 36 and 40 is also altered, without any operation of circumferential motor 35, if plate cylinder 13 is moved laterally by the lateral motor 21 and the mechanical elements of the lateral register mechanism 17. Gear 49 does not move axially under those conditions, but helical gear 36 moves axially relative to helical gear 38, changing the phase relationship between gears 36 and 38, and therefore changing also the phase relationship between plate cylinder 13 and press drive shaft 32. Thus, operation of lateral motor 21 changes both the lateral register and the circumferential register of the plate cylinder 13. To prevent changes in the lateral register from affecting the circumferential register, the circumferential motor 35 may be operated at the same time as the lateral motor 21 is operated so that gear 49 is moved axially during lateral register correction by an amount such as to compensate for changes that would otherwise occur in the circumferential register due to gear 36 being displaced axially on gear 38.

In all presses, the circumferential adjustment has mechanical limits and in some it is desirable to limit the range of adjustability electrically. Accordingly, circumferential limit switches 28 and 29 are provided. They are actuated by a slidably mounted dog 47 which is constrained from rotation by a guide block 34 and, therefore, moves only with a sliding motion parallel to the axis of rod 31.

The slidable dog 47 has a second arm 37 for actuating a circumferential make-ready position indicator switch 30. When the circumferential register equipment is on a first side of the midpoint of its available range of travel, the arm 37 engages and displaces a switch actuating roller 39 which in turn operates the circumferential make-ready position indicator switch 30. The arm 37 extends in a direction axially of the cylinder and maintains the switch 30 closed as long as the cylinder is displaced in one direction from the midpoint of its available range of circumferential adjustment and, therefore, the open or closed condition of switch 30 indicates the direction of displacement of the cylinder with respect to its angular position at the midpoint of its range of circumferential adjustment achievable by circumferential motor 35.

The control circuits which are shown on FIGS. 4a, 4b, and 4c operate the upper circumferential register motor 35, the upper lateral register motor 21, the lower circumferential motor 35' and the lower lateral motor 21'. The lateral and circumferential limit switches and make-ready sensing switches of FIG. 2 and FIG. 3 interconnect with the control circuits to assist in the control operations. FIGS. 4a, 4b and 4c together are a circuit diagram showing the control equipment for both the upper and lower printing assemblies of one printing unit; they are in part a block diagram and in part a logic diagram.

Generally speaking, control actions flow from left to right on the composite diagram. Commands are manually entered by pushbutton switches such as switch 100 in FIG. 4a and in a presettable counter 108 in FIG. 4b. The commands are processed by the control circuits shown and they control the motors 35, 21, 35' and 21' at the right side of FIG. 4c. The upper halves of FIGS. 4a, 4b and 4c generally relate to the upper printing assembly of one printing unit while the lower halves relate to the lower printing assembly. However, certain equipment is used in common both by upper and lower printing equipment and by lateral and circumferential circuits.

In the illustrated embodiment, the control console 10 has, for controlling the upper printing assembly, a circumferential make-ready switch 100, a circumferential advance switch 204, and a circumferential retard switch 232. In addition control console 10 has, for controlling the upper printing assembly, a lateral make-ready switch 188, a lateral toward switch 244, and a lateral away switch 234, the lateral direction being referenced with respect to the control console. Switches corresponding to switches 100, 204, 232, 188, 244 and 234 are provided for performing similar functions for the lower printing assembly and are designated by the same reference numerals with a prime mark appended thereto.

When the press operator wishes to position the upper plate cylinder circumferentially in a make-ready position, he depresses the make-ready switch 100 shown on FIG. 4a for the unit to be moved. The closing of switch 100 applies a positive voltage to one input 106a of an OR circuit 106 to activate the circuit and energize the upper selector relay 110 through normally closed contacts 199a of relay 199. Contacts 199a will be closed if the plate cylinder for neither the upper nor lower assembly is being adjusted laterally. Relay 110 closes its contacts 110a so as to provide a holding circuit from a holding bus 112 for the coil of relay 110 after the pushbutton 100 is released by the operator and for the input of an inverter 122 having its output connected to an input of a NAND gate 124 whose output is connected to enable a NAND pulse gate 126 for supplying pulses to the upper circumferential motor 35 when the NAND gate 124 is activated by a logic 0 from the inverter 122. A pulse circuit 132 passes pulses from a pulse source 128 to one input of the pulse gate 126. It is these pulses which are now transmitted by the gate 126 when it is enabled by the output of NAND gate 124.

The signal from output 106b of OR gate 106 is applied also to an OR circuit 116 whose output energizes relay 104 after a time delay caused by capacitor 118 to close self-holding contacts 104b and to open contacts 104a to de-energize the power bus 120 for supplying power to the make-ready switches 100, 188, 100', 188'. This prevents other make-ready circuits from being established while a make-ready is in progress. In the illustrated embodiment, the pulse source 128 has a frequency of 120 Hz on its output 128a.

The pulse gate 132, which is also a pulse shaper and through which the pulses are applied to NAND gate 126 from the pulse source 128, is normally enabled to pass the pulse. If the gate is disabled, the output of the gate 132 is a logical 1. In the illustrated circuit, the pulse gate 132 is enabled to pass pulses to the NAND

gate 126 only if the lateral adjusting circuits for upper and lower plate cylinders are not in use. A third input of NAND gate 126, which comes from the frequency divider 142, has a logical 1 under these conditions, as will be shown later.

Pulses from pulse gate 126 are connected to one input of each direction NAND gate 144 and 146 (FIG. 4c) for determining the direction of operation of the motor 35. If the gate 144 is enabled, the motor 35 operates in the retard direction while if the gate 146 is enabled, the motor 35 operates in the advance direction. A plurality of NAND gates 150, 152, 154 determine whether gate 144 or 146 is enabled. The gates 150, 152, 154 have their outputs wired together and normally have a logic 1 output which changes to a logic 0 if two inputs to any one of the gates 150, 152, 154 have logic 1's thereon. During circumferential make-ready, the inputs to the NAND gate 152 control the output from the gates 150, 152, 154 to determine the direction of operation of the motor 35. The output of NAND gate 152 is under control of the upper circumferential make-ready sensing switch 30, as will now be described. FIGS. 3 and 4a show switch 30.

Switch 30 is closed whenever the cylinder is on the retard side of its midrange position so that the cylinder must be advanced to move it to the midrange position. Assuming that this is the case at the time of pressing the make-ready switch 100, voltage is applied to a direction bus 156 through the switch 30, normally open contacts 110b of relay 110 and normally closed contacts 158a of lateral selector relay 158. Normally open contacts 110b are closed at this time because relay 110 is energized by the actuation of make-ready switch 100. Relay 158 is energized only when an upper lateral adjustment is being made and, therefore, is now de-energized. Accordingly, in the assumed case, the direction bus has a potential thereon which is applied to input 152a of NAND gate 152 which at this time causes the NAND gate 152 to have a logic zero on its output since the other input of NAND gate 152 has a logic 1 which it receives from inverter 134 which has a logic 1 on its output except when a lateral adjustment is being made. Consequently, when the switch 30 is closed, the NAND gate 152 has a logic 0 output to condition gate 146 through inverter 148 to operate the motor 35 in an advance direction. If the switch 30 is open, the gate 152 will have a logic 1 on its output to condition gate 144 to pass pulses and operate the motor 35 in a retard direction. The gates 144, 146 may be disabled by limit switches 28, 28' and 29, 29', respectively, if closed. These limit switches connect one input of the respective gates to ground to establish a logic 0 on the input to close the gates to pulses and prevent circumferential change of the register mechanism for the upper printing assembly. The pulses from NAND gates 144, 146 are applied through inverters 206, 160, respectively, to the reverse and advance terminals of a translator 162, which is a conventional control device for stepping motors. The translator then produces output signals at its five output lines which are such as to steppably drive the circumferential motor 35 in an advance or retard direction. The outputs of translator 162 are connected both to motor 35 and to lower circumferential motor 35' by means of groups of diodes 166 and 168, respectively, so that the translator may be used for circum-

ferential adjustment of both the upper and lower units. In the assumed case, only the upper circumferential motor 35 operates because it has been selected by energizing relay 110 to complete the return circuit of the motor through contacts 110c of relay 110 to ground, while the lower circumferential motor is disabled by contacts 170a of a selector relay 170 which are open. The upper circumferential motor 35 drives the register mechanism 16 in an advance direction until it reaches the upper circumferential make-ready sensing switch 30 at which time it stops because of operation of a make-ready stopping circuit which will now be described.

When pushbutton switch 100 is depressed at the start of the make-ready operation it energizes a make-ready relay 114 by applying a logic 1 to one of the inputs of OR circuit 172, the output of which is inverted by inverter 174 to put a logic 0 at one input of NAND gate 176. The output of gate 176 becomes a logic 1, energizing make-ready relay 114. Make-ready relay 114 supplies power via contacts 114a to the holding bus 112 and is maintained energized until the operation selected is completed and is de-energized to stop the operation by actuation of midrange switches 30, 30', 22, 22'. The de-energization of relay 114 removes the power from holding bus 112 which in turn de-energizes relay 110 to open its contacts 110 in the return circuit for motor 35. The relay 114 also has normally open contacts 114b which close, grounding one input of the NAND circuit 176 to maintain a logic 1 at the output of the NAND gate 176 to hold relay 114 energized while the make-ready operation is being carried out by the motor 35.

When the make-ready mechanism in the circumferential mode of operation operates switch 30, the opening of switch 30 removes voltage from bus 156 to operate a NAND gate 184 whose output is wired with the output of gate 176 to de-energize the make-ready relay 114 when the switch 30 opens. The decreasing voltage on bus 156 is applied to a time-delay circuit 178 which is connected to an input of a Schmitt trigger 180. The decreasing voltage at the output of Schmitt trigger 180 triggers a one-shot multivibrator 182 to its unstable state so that it produces a logic 1 at its output. The output of the one-shot multivibrator is connected to one input of the NAND gate 184, the other input of which has a logic 1 because none of the pushbuttons 100, etc., are depressed at that time. NAND gate 184, therefore, produces a logic 0 output which is capable of overcoming the logic 1 output of NOR gate 176 so as to remove voltage from the coil of relay 114 and de-energize it. Contacts 114b then open and relay 114 remains de-energized even after one-shot multivibrator 182 has returned to its stable state. It will be noted that the bus 156 will have power thereon only if the direction switch, e.g., switch 30, is closed to indicate movement in a particular direction. Also, the direction relay 186 has contacts 186a connecting the time delay circuit 178 to the bus 156 only when the relay 186 is energized by the bus 156. Consequently, if the switch 30, or other selected midrange switch, is open, the bus 156 will not be energized. Accordingly, when the direction bus indicates that the circumferential motor 35 must operate in the retard direction to return the cylinder to midrange, it must move through center and close

switch 30 to energize the bus 156 and relay 186 to reverse the motor to move it to open the switch 30 to de-energize relay 114 and stop the motor. Contacts 104c in series with contacts 186a prevent transients that might be present on direction bus 156 due to a race between relay contacts 158a and 110b, from operating the make-ready reset circuits 178, 180, etc.

When relay 114 de-energizes at the end of the make ready operation, it opens its contacts 114a which had been providing voltage for the holding bus 112 for holding relays 104, 110 energized. This causes relay 110 to de-energize and stop pulses to the motor 35 by putting a logic 0 on the input of the inverter 122, a logic 1 on its output, a logical 0 on the output of NAND gate 124 and a logical 0 on an input to NAND gate 126, thereby blocking the pulses from the pulse source 128 and stopping operation of the motor 35.

The description which was just completed shows that if an operator presses the circumferential make-ready switch 100 for the upper printing assembly at a time when the mechanism is located on the retard side of midrange, the upper circumferential motor 35 drives the mechanism 16 to the midpoint of its mechanical range and relay 114 then stops the make-ready operation. If the register mechanism had been on the advance side of midrange at the time of pressing of make-ready switch 100, the resulting operation would have been similar except that direction bus 156 would have had a logic 0 and, therefore, NAND gate 152 of FIG. 5b would have produced a logic 1 and enabled NAND gate 144 instead of NAND gate 146.

The motor 35 would then have operated in a retard direction until it reached the make-ready sensing switch 30, at which time that switch would close. This would apply a logic 1 to the direction bus 156, NAND gate 144 would then be disabled and NAND gate 146 would be enabled. The upper circumferential motor 35 would then operate in the advance direction for a very short time until the mechanism 16 actuated the make-ready switch 30 in an opening direction. Only an opening transition of make-ready switch 30 produces a transition of proper polarity, namely, falling voltage, at the input of Schmitt trigger 180 to de-energize relay 114. This motor-reversing technique of operation causes the mechanism 16 always to approach its final midrange position from the same direction, namely, the advancing direction, and eliminates a hysteresis which may otherwise be present.

If the operator wishes to move the plate cylinder of the upper printing assembly laterally to its make-ready position, he depresses switch 188 which, in a manner similar to that described above, connects a logic 1 to an input of OR gate 172 for energizing the holding relay 114 and also to an OR gate 138 whose output energizes the control relay 104 to relay 110, and a lateral selector relay 158 which has normally open contacts 158e and 158d, each located in one of two circuits for supplying power to operate the lateral motor 21 in an away direction and in a toward direction, respectively. The contacts 158e are in series with normally closed contacts 186b of direction relay 186 so that if this relay is not energized, the motor will operate in an away direction by power supplied through the contacts 186b and the contacts 158e. The contacts 158d of lateral selector relay 158 are in series with normally open con-

tacts 186c of the direction relay 186 so that if the relay 186 is energized, power can be supplied to the motor through contacts 186c and 158d to operate the motor in a toward direction. Limit switches 20 and 18 are connected in series with contacts 158e, 158d, respectively, to prevent overtravel of the motor.

When the relays 114 and 104 are energized on the depression of the lateral selector switch 188, the energization of the relays will close contacts 114c and 104d of the relays 114, 104 which are connected in series with the contacts 186b, 186c of the direction relay 186 to supply power to these contacts for operating the motor in the direction dependent upon the condition of the direction relay 186. As explained hereinbefore, the direction relay 186 is connected to the direction bus 156 and will be energized if there is a potential on the bus and will be de-energized if there is no potential on the direction bus. If the plate cylinder is toward one side of its midrange position, the midrange switch 122 will be open and if it is on the opposite side, the switch will be closed. When the selector button 188 for selecting the lateral make-ready operation was depressed to energize the selector relay 158, the energization of the relay 158 closed its contacts 158b in series with the direction bus 156, the midrange position switch 22 and the positive side of the power supply so that during the lateral make-ready operation, the direction bus will have a potential thereon to energize the direction relay 186 if the switch 22 is closed and will not have a potential thereon so that the relay 186 is de-energized if the switch is open. During lateral adjustment with the switch 22 closed and the relay 186 energized, AC voltage through the contacts 186c of the direction relay is applied to the toward input terminal of the lateral motor 21. The lateral motors 21 and 21', unlike motors 35 and 35', are synchronous motors. A phase shifting network 197 is connected between the toward and away terminals of the upper lateral motor 21 so that the motor operates in a toward direction when the AC voltage is applied through contacts 186c and it operates in the away direction when the AC voltage is applied through the contacts 186b. When the motor moves to its midrange position, the opening of the switch 22 will stop the motor because it will remove the potential from the direction bus 156 and this will, in turn, cause a falling signal to go to the reset circuitry 178, 180 to de-energize the holding relay 114 as described above. However, if the motor is operating in an away direction in response to the actuation of the selector switch to energize the selector relay 158 and the holding relay 114, the closing of the switch 22 when the cylinder reaches a midrange position will not stop the motor but will apply a potential to the direction bus 156 to energize the relay 186 to cause the upper lateral motor to operate in a toward direction to move the cylinder to open the switch to establish a falling voltage at the input of the reset circuitry 178, 180, etc., to de-energize the holding relay and stop the motor.

While the upper lateral motor is operating to drive the upper lateral register mechanism toward its midrange position, the upper circumferential motor 35 must also operate, at a reduced speed, to prevent the lateral mechanism from causing unwanted changes in the circumferential position of the plate cylinder which would otherwise result from mechanical interaction of

the mechanisms. Compensation for interaction is accomplished in the following way. When the operator depresses pushbutton 188 for upper lateral make-ready, a signal is applied to one input of OR gate 138 producing a logic 1 at its output, as was described above in explaining how motor 21 is controlled. This does four things: It (a) Energizes lateral selector relay 158 which energizes relays 110 and 104; (b) Energizes relay 199 through OR gate 196 in order to open contacts 199a and 199b in the circuits for energizing the circumferential selector relays and thereby prevents simultaneous operation of the circumferential controls; (c) Applies a logic 1 to NAND gate 154 as will be discussed later, and (d) Applies a logic 1 to the input of an inverter 198 whose inverted output operates NAND gate 124 to put a logic 1 on an input of the pulse gate 126 (FIG. 4b) for supplying pulses to the direction pulse gates for the circumferential translator. A second connection on the output of inverter 198 is to one of the input terminals of NAND gate 136 whose output then has a logic 1 to disable the circuit 132 from supplying pulses to the pulse gate 126 and to establish a logic 1 on the input of gate 126 connected to the circuit 132. In addition to disabling circuit 132, the output of NAND gate 136 enables pulse gate 200 having an input connected to a pulse output 128b of pulse source 128 to cause pulses to pass through the gate to the frequency divider 142. In the illustrated embodiment, pulses at the rate of 60 Hz appear at the output 128b and 30 Hz at the output of frequency divider 142. It will be understood by those in the art that the required frequency of the pulses is a function of gear ratios in the adjusting mechanisms and is that necessary to compensate the error introduced by a given lateral movement. As will be noted, the frequency of the AC power determines the extent of the lateral adjustment as well as the number of pulses supplied through the pulse gate 126.

The pulses which pass the pulse gate 126 from the frequency divider 142 are connected to both NAND gate 144 and NAND gate 146. Only one of the latter NAND gates is enabled, however, the other being disabled by the output of the logic circuit 150, 152 and 154 which controls direction of circumferential motor operation. The particular one of the direction gates which is enabled is determined by the signal on the direction bus 156 which also determines the direction of operation of the lateral motor. Accordingly, the respective direction that the circumferential motor is to operate when a logic 1 or 0 is on the direction bus is initially chosen to operate the motor in the proper direction to compensate, upon lateral adjustment. It will be noted that the NAND gates 150, 152, 154 control the direction signal to the direction gates 144, 146. When the selector circumferential make-ready switch 100 is depressed as described above to effect operation of the upper circumferential motor, the NAND gates 150, 154 each have a 0 on one of their inputs connected to a respective one of the upper and lower lateral adjusting control circuits. The NAND gate 154 has an input connected to the output of OR gate 138 for effecting the lateral adjustment of the upper plate cylinder and the NAND gate 150 has an input connected to the output of a corresponding OR circuit in the control circuitry for effecting a lateral adjustment of the lower plate cylinder. Consequently, inputs of the

NAND gates 150, 154 are clamped at 0 level but the output of NAND gate 152 will swing with the potential on the direction bus 156 since the other input of gate 152 has a logic 1 applied thereto when the lateral control circuitry has not been activated to effect a lateral positioning operation.

When switch 188 is activated to effect a lateral positioning operation, the output of NAND gate 136 is a logic 1 because lateral selector relay 158 is energized. This clamps the output of NAND gate 152 at a 1 level so that it does not affect the signal to direction gates 144, 146. When the upper lateral control circuitry is activated, the input from the upper lateral control circuitry to input 154a of NAND gate 154 will be a logic 1 instead of a logic 0 as long as the selector relay 158 is energized. This means that the signal on the direction bus 156 which is applied to the second input of an NAND gate 154 through an inverter 202 will cause operation of the upper circumferential motor in the opposite direction than it would for the same signal on the direction bus in a circumferential make-ready operation. In the illustrated embodiment, this reversal of direction of operation is required to effect the necessary compensation for the error produced by the lateral motor. Consequently, it can be seen that when the lateral motor operates in a toward direction, the upper circumferential motor operates in a retard direction to effect the necessary compensation.

If the control circuitry for the lower plate cylinder is operated to effect a lateral adjustment, the NAND gate 150 will be conditioned by the circuitry to have its output swing with the signal on the direction bus 156 and in this case, there is no inversion and the circumferential motor for the lower plate cylinder will operate in the same direction for a given signal on the direction bus as it does during circumferential adjustment. In the illustrated embodiment, the gearing which is used in the press necessitates this change in operation in order to effect the proper compensation of the error introduced by the lateral adjustment.

The pulses to the circumferential motor 35 during lateral adjustment will terminate when the lateral make-ready is stopped since the de-energization of relay 114 at that time to de-energize relay 158 causes the loss of the logic 1 signal to pulse gate 126.

If at the time that the pushbutton make-ready switch 188 for the upper lateral register mechanism 17 is pressed by the operator, the mechanism 17 is located on the toward side of its midpoint, the circuit operation is very similar to that just described except that switch 22 is open. When the switch 22 is open, direction bus 156 has a logic 0 and relay 186 is not energized so its contacts 186b on FIG. 4c are closed. AC voltage is therefore applied through relay contacts 158e and through the away limit switch 20 to the away terminal of upper lateral motor 21. Upper lateral motor 21 then drives the upper lateral mechanism 17 in the away direction which brings it toward the midpoint of its mechanical range.

At the same time, inverter 202 of FIG. 4b applies a logic 1 to an input of NAND gate 154. The other input of NAND gate 154 also has a logic 1 because holding contacts 158c keep a logic 1 at the input terminal of relay 158. NAND gate 154, therefore, has a 0 output which overcomes the outputs of gates 150, 152 and dis-

ables NAND gate 144. Inverter 148 enables NAND gate 146 and upper circumferential motor 35 is operated at the necessary speed in the advance direction so as to compensate for interaction during the lateral correction. This concludes the description of the make-ready operation.

To make an incremental adjustment in a circumferential direction, the desired increment of adjustment is preset in thumbwheel switches of a milli-inch counter 108 (FIG. 4b), the milli-inch counter being of a type for displaying the amount so registered and the amount not yet accomplished, comprising a visual display device responsive to the numerical contents of the presettable numerical counter. The operator then presses the pushbutton corresponding to the desired direction of incremental adjustment, for example, upper circumferential advance switch 204. Briefly stated, the equipment then operates motor 35, which is driven by pulses applied to it by pulse source 128. When the desired incremental change in position of the plate cylinder has been fully accomplished, milli-inch counter 108 has been counted down to 0, and it stops the operation. Details of this sequence of events will now be related.

If the operator now presses a selector switch for selecting an advance, e.g., switch 204 which is the upper circumferential advance switch, a logic 1 is applied to diode OR gate 106 and to diode OR gate 208. The output of diode OR gate 106 energizes relay 110 which latches itself in by means of contacts 110a. Also, relay 104 is energized after a short time delay caused by capacitor 118. The output of diode OR gate 208 energizes direction relay 186 to cause it to operate in latching itself in by means of contacts 186d because contacts 102b of counter relay 102 are closed. Relay 102 is in a de-energized position because the milli-inch counter 108 is not in its 0 position. The activation of OR gate 106 and energization of relay 110 causes a logic 1 signal which is inverted by inverter 122 to apply a logic 0 to an input of NAND gate 124 whose output enables pulse gate 126 (FIG. 4b). At another input to pulse gate 126, 120 Hz pulses from pulse source output 128a are applied to the gate through the circuit 132 which is in an enabled condition except during a lateral adjustment. 120 Hz pulses pass from circuit 132 through NAND gate 126 to NAND gates 144 and 146. In the assumed case, gate 144 is disabled and 146 is enabled because of the status of direction logic gates 150, 152, 154, just as during make-ready operation. Motor 35 operates in the advance direction.

The upper circumferential motor 35 continues to operate until milli-inch counter 108 counts down to zero and stops the operation. The manner in which the counting is accomplished will now be described.

Pulses at the output of gate circuit 132 are also applied to a NAND gate 210, then divided by 2 in a frequency divider 212. The pulses are again divided by 2 in frequency by divider 214, and by 16 in divider 216. The pulses from the divider 216 are applied to a coincidence decoder 218 which produces a logic 0 at its output when 45 pulses have been counted. In the circumferential example being described, 45 pulses correspond to 0.001 inch of movement of the circumferential printing register.

The output of decoder 218 is connected through series connected inverters 220, 222 to the output of

NAND gate 124 for enabling the pulse gate 126. When a logic zero appears at the output of the decoder, the output of inverter 222 becomes a 0 to disable the gate 126 and to reset the counters 212, 214, 216 which have their reset lines connected to the output of inverter 222. Consequently, these counters are operable only when a logic 1 is present at the output of inverter 222. A "pulse stretcher" circuit 225 in conjunction with 236 and 220 is connected to the output of the decoder to insure proper reset.

When the 45th pulse count is reached, terminal 216a of counter 126 produces a logic 1 on an output which is applied to a one-shot multivibrator 224 to cause a positive-going output pulse from the multivibrator 224 which is applied to a NAND gate 226. The NAND gate 226 has a second input connected to the output of decoder 218 by the inverters 222, 220. Consequently, the NAND gate 226 is not activated immediately when pulsed from the multivibrator 224 because of the action of the pulse stretcher circuit 225; however, this delay is very small and of no consequence. The input of gate 226 connected to the decoder 218 has a logic 1 thereon when the multivibrator first provides a logic 1 to the other input so that a logic 0 momentarily occurs on the output of gate 226. This is applied to the input of inverter 228 whose output is connected to energize relay 230 to close its contacts 230a. The contacts 230a apply AC voltage from the power line 190 to the coil of the milli-inch counter 108 to cause it to count down by one count from its original setting. When the pulse output of one-shot multivibrator 224 terminates, voltage is removed from relay 230 and, therefore, from the milli-inch counter 108. The contacts of milli-inch counter 108 are still in position 108b because the counter has not yet counted down to its 0 position; its contents have been decreased by only one unit count. In counter 108, each unit count corresponds to one milli-inch of register change.

Pulses to motor 35 continue because the reset signal to the counters 212, 214 and 216 and the pulse-gate-disabling signal from the decoder 118 is only momentary. The next time a count of 45 has been achieved by the counters 212, 214 and 216, the coincidence decoder 218 goes through the same routine as before, causing resetting of counters 212, 214 and 216 and the signal from the divider 216 causes a further reduction of one count in the milli-inch counter 108.

This sequence of operation is continued until finally the milli-inch counter 108 has counted down to 0. At that time its contacts 108b open to energize the counter relay 102 and close contacts 108c. The energization of relay 102 opens its contacts 102c (FIG. 4a) removing voltage from holding bus 112. The de-energization of holding bus 112 deenergizes relay 110 to cause a loss of input voltage of the NAND gate 124 to change its output to a logic 0 to disable pulse gate 126 to stop pulses to the upper circumferential motor 35.

Thus, it is seen that the motor 35 starts to run when switch 204 is depressed and continues until such time as the count in milli-inch counter 108 has been decreased from the setting initially entered by the operator, to a 0 count, at which time the operation is terminated by the action of relay 102 (FIG. 4b).

When an incremental adjustment in the upper circumferential retard direction is to be made, the amount

of the desired change is again entered in the thumbwheel switches of milli-inch counter 108 by the operator, then switch 232 is depressed. The operation of the equipment is very similar to that which was just described except that the direction relay 186 is not energized and, as a result, the pulses pass through gate 144 and inverter 206 to retard terminal of translator 162 and the motor operates in the retard direction. The counters operate in exactly the same way and shut off when a full count has been accomplished.

When the operator wishes to make an incremental adjustment in the position of the upper lateral register mechanism in the away direction, he enters the desired increment in milli-inch counter 108 and presses momentarily the pushbutton switch 234. This applies a signal to OR gate 138, energizing the lateral selector relay 158 which locks itself in by means of its contacts 158c.

When the self-holding contacts 158c latch in the relay 158, they also hold a logic 1 on the output of OR gate 138 which is applied through diode 159 to relay 110 and OR gate 116. This energizes circumferential selector relay 110 and, soon after, relay 104. Motor directions are selected by the relay 186 which is energized by the output of OR gate 208 only when the toward lateral selector switch 244 is depressed and is in a de-energized condition when, as in the present example, the away switch 234 is depressed. The energizing of relay 104 causes contacts 104d on FIG. 4b to close, conducting power from AC line 190 to the upper lateral motor 21 through direction contacts 186b of direction relay 186 and selector relay contacts 158e (FIG. 4c). Thus, the upper lateral motor operates in an away direction.

The latching in of lateral selector relay 158 also maintains a logic 1 at the input of inverter 198 to provide a logical 0 input to NAND gate 124 and a logic 1 input at an enabling input of the pulse gate 126 (FIG. 4b). Pulses then pass through NAND gate 126 to the upper circumferential motor 35. In the case of lateral operation the pulses enter the pulse gate 126 from frequency divider 142 because relatively low frequency pulses are required, the circuit 132 connected to the other pulse input of gate 126 being disabled by inversion of the output from NAND gate 136 which also has an input derived from the latching contacts of the lateral selector relay 158. The cycles applied to the pulse source 128 produce 60 Hz cycles at its output 128b which are shaped and gated by circuit 200 into square 60 Hz pulses and applied to NAND gate 210 and frequency divider 142. The output of frequency divider 142 provides pulses to NAND gate 126 and, hence, to upper circumferential motor 35 as stated above. While the motor is running, the 60 Hz pulses that enter NAND gate 210 are applied by the output of NAND gate 210 to the frequency divider 212, thence to another frequency divider 214, then to another frequency divider 216. The pulses are counted by these circuits until the count is 34, at which time that count is recognized by the coincidence decoder 236 which is now enabled by the output of NAND gate 136. When a count of 34 is reached, the output of coincidence decoder 236 decreases to 0 and "pulse stretcher" circuit 225 operating in conjunction with 236 and 220 produces a positive-going step which it applies to in-

verter 222 which produces a negative-going step at its output to reset the counters. The operation of the counter circuit is identical in the case of lateral operation with that described above for circumferential operation except that decoder 236 is utilized instead of decoder 218 because a count of 34 is desired to be decoded instead of the count of 45. Each time a count of 34 is achieved, the milli-inch counter 108 decreases its count by one unit. Finally, when the count in counter 108 has decreased to 0, contacts 108c close, relay 102 is energized, contacts 102b on FIG. 4a open, and voltage is removed from holding bus 112, de-energizing relays 110, 158, 104 and 199. This stops the operation of both the lateral and circumferential motors because contacts 104d on FIG. 4b open and there is a 0 output at point 124a of NAND gate 124, disabling gate 126.

When an incremental adjustment of the upper lateral register is to be made in the toward direction, the operation is very similar to that just described for the away direction except that direction relay 186 is now energized and power goes to the toward terminal of the upper lateral motor and pulses which go to the upper circumferential motor 35 operate that motor in the opposite direction.

If the upper circumferential register mechanism travels too far in the advance direction, limit switch 29, which is normally open, closes. This disables NAND gate 146 so that the upper circumferential motor 35 can be operated only in a retard direction until such time as the limit switch 29 is re-opened. Similarly, if the upper circumferential register mechanism is driven too far in the retard direction, upper circumferential limit switch 28 closes, disabling NAND gate 144 and stopping the upper circumferential motor 35.

If the upper lateral register mechanism is driven to its extreme limit in a toward direction, limit switch 18 operates, disconnecting AC power from the toward terminal of upper lateral motor 21 and applying AC power to relay 242 whose contacts 242a close, short circuiting one input of each of NAND gates 144 and 146 to ground. Thus, the operation of a lateral limit switch both stops the lateral motor from traveling further in that extreme direction and disables the circumferential compensating movements also. Operation of the upper lateral register mechanism to an extreme position in the away direction causes actuation of limit switch 20 which disables the upper lateral away direction of the motor and also stops the circumferential motors by means of relay 242 as before.

The lower printing assembly controls are similar to those for the upper printing assembly of one color unit. One difference is that the compensation applied to the circumferential mechanism at the time of operating the lateral mechanism is in an opposite direction for the lower printing assembly than it is for the upper printing assembly due to differences in direction of rotation of the gears. For this reason the direction of movement of the circumferential motor during lateral registration must be opposite for the lower register from that for the upper; this is accomplished by NAND gates 150 and 154 which are under the control of the outputs of OR gates 140 and 138, respectively. For example, when the upper lateral register assembly is operated in the away direction by means of switch 234, both inputs of

NAND gate 154 are 1 and the output of NAND gate 154 is 0 so that NAND gate 146 is enabled and the translator operates in the advance direction.

An indicator may be provided, if desired, to indicate the available remaining range in either direction of the register mechanism's travel or to indicate the position of a register mechanism.

From the foregoing, it can be seen that the illustrated embodiment provides a simple system for effecting register adjustments in precise incremental amounts. Not only does this facilitate the registering of one unit to another but it also minimizes or eliminates a problem of registering the press when after registering some of the units, the next unit requires adjustment which is outside of the range of the adjusting mechanism for the unit. When the plate cylinder of one of the units reaches a limit position during adjustment, the actuation of the limit switch, for example, limit switch 29, lights a lamp, not shown on the drawings, on the control console. This indicates that the unit is at a limit of adjustment and the operator can observe on the display on milli-inch counter 108 the increment of adjustment which is still to be made. Using this as a guide, the pressman can preset the counters in the earlier registered units to displace the cylinders thereof the amount required to bring their plate cylinders to positions such that registration can be accomplished within the range of adjustment for the unit which had reached its limit. In other words, the other adjusting units may be further adjusted to position their plate cylinders so that the position required for the limiting plate cylinder under adjustment is within the range of the adjusting mechanism for the unit under adjustment. Heretofore, in such a situation it has been necessary for the pressman to start the registration procedure again by moving the first unit in the proper direction to provide the necessary range of adjustment and then re-registering all the other units to the first unit in order to obtain sufficient range in adjustment in the problem unit since the units could not be accurately changed heretofore by an increment.

What is claimed is:

1. A printing press comprising:

a frame,

a plate cylinder,

means supporting said plate cylinder in said frame for adjusting movement through predetermined distances in opposite directions from a central position,

a reversible-direction drive motor means having two directions of motor output for effecting adjusting movement of said cylinder relative to said frame,

means interconnecting said motor means and said plate cylinder for transmitting driving power from said motor means to effect movement of said plate cylinder upon energization of said motor, and

a control circuit for energizing said reversible drive motor means selectively in the two directions of motor output, said control circuit comprising, sensing means responsive to plate cylinder position for sensing on which side of the central position the plate cylinder is located and for producing a signal accordingly,

means connected with said sensing means and said motor means for receiving the signal and for

energizing said motor means for moving the plate cylinder toward the central position,
 means for de-energizing said motor means when the plate cylinder is at the central position comprising means for detecting presence of the plate cylinder at the central position and for producing a stop signal that de-energizes said motor means when said plate cylinder is at the central position, and

means actuatable to initiate energization of said motor means,

whereby after the means to initiate energization of said motor means is actuated by the plate cylinder automatically moves from wherever it may be toward the central position.

2. A printing press as defined in claim 1 wherein said means for detecting the presence of said cylinder at the central position comprises a switch means actuated by movement of said plate cylinder to said central position.

3. A printing press as defined in claim 1 wherein said means for de-energizing said motor means comprises means responsive to the adjusting movement of said cylinder to said central position in one direction only to de-energize said motor means, whereby when the motor means is operating to move said plate cylinder in the opposite direction through said central position the plate cylinder is moved through its central position by said means for energizing the reversible motor means and then reversed because of said signal produced by said sensing means to return it to the central position and de-energize said motor means.

4. A printing press as defined in claim 1 wherein said control circuit further comprises:

means for initially registering a desired amount of change of position of said plate cylinder,

means for registering a desired direction of change of position of said plate cylinder,

means responsive to the amount and the direction so registered and communicating with said reversible-direction motor means for energizing the motor means to move the plate cylinder the desired amount and direction,

means responsive to the movement of said plate cylinder for producing a number of signals dependent upon the amount of said movement accomplished, and

means responsive both to the desired amount of change as initially registered and to decrements of said desired amount due to said signals dependent upon said amount of movement of said plate cylinder for displaying the remaining amount of initially registered change of position that is not yet accomplished by said drive motor means.

5. A printing press as defined in claim 4 wherein said control circuit comprises means for limiting said adjusting movement within said predetermined distances and wherein said means for displaying continues to display said remaining amount when one of said predetermined distances is reached by said plate cylinder.

6. A press as defined in claim 4 wherein said control circuit produces pulses and said reversible-direction drive motor means is steppably driven in response to said pulses from said control circuit and wherein said means for producing a number of signals dependent

upon the amount of said movement accomplished comprises means for producing a number of signals numerically proportioned to said pulses that steppably drive said reversible-direction drive motor means, and wherein said means for initially registering a desired amount of change of position of said plate cylinder comprises a presettable numerical counter countably responsive to count said signals numerically proportioned to said pulses, and wherein said means for displaying the remaining amount not yet accomplished comprises a visual display device responsive to effect a display in proportion to the numerical contents of said presettable numerical counter.

7. A printing press as defined in claim 6 wherein said counter is manually actuatable to be preset to numerically register said desired amount.

8. A printing press comprising:

a frame,

a plate cylinder having an axis,

means supporting said plate cylinder in said frame for circumferential adjusting movement of said plate cylinder and for axial adjusting movement to change the lateral position of said plate cylinder relative to said frame,

main drive means for rotating said plate cylinder about said axis, said main drive means comprising: a main drive shaft,

a drive member intermediate said main drive shaft and said plate cylinder, and

third means for effecting circumferential movement of said plate cylinder relative to said intermediate drive member upon said axial adjusting movement of said cylinder,

a first reversible-direction motor for effecting said circumferential adjusting movement of said plate cylinder,

first means interconnecting said first motor and said plate cylinder through said intermediate drive member for effecting said circumferential adjusting movement of said plate cylinder upon energization of said first motor,

a first control circuit for energizing said first motor, means actuatable for activating said first control circuit to effect said circumferential adjusting movement,

a second reversible-direction motor for effecting said axial adjusting movement of the cylinder,

second means interconnecting said second motor and said plate cylinder for effecting said axial adjusting movement of said plate cylinder upon energization of said second motor,

a second control circuit for energizing said second motor for effecting said axial adjusting movement, means actuatable for activating said second control circuit to effect said axial movement, and

means for compensating for the circumferential adjusting movement of said plate cylinder relative to said intermediate drive member caused by said second motor so that the net circumferential adjusting movement of said plate cylinder is zero, including means interconnecting said first and second control circuits for energizing said first motor upon energization of said second motor, whereby upon actuation of said second control circuit for axial adjusting movement of said plate

cylinder, circumferential adjusting movement of said plate cylinder due to said third means is effectively prevented and only an axial adjusting movement is effected.

9. A printing press as defined in claim 8 wherein said drive member comprises a driving helical gear and said third means comprises a driven helical gear engaging the driving helical gear, the plate cylinder being fixedly attached to the driven helical gear, and wherein said second means effects said axial adjusting movement by axially displacing said driven helical gear in relation to said driving helical gear, and said first means effects said circumferential adjusting movement of said plate cylinder by angularly advancing and retarding said driving helical gear in relation to said main drive shaft.

10. A printing press as defined in claim 8 wherein said first reversible-direction motor is a steppable motor operated in response to pulses, and said means interconnecting said first and second control circuits comprises means for supplying a number of pulses to said first motor dependent upon the magnitude of the axial adjusting movement.

11. A printing press comprising:

a frame,

a plate cylinder supported for adjusting movement in said frame and bearing an image and having an axis,

a main drive for rotating said plate cylinder about said axis,

first means for adjustably moving the plate cylinder circumferentially relative to said main drive to adjust the circumferential position of said image, and second means for adjustably moving the plate cylinder axially with respect to said frame to effect

an axial positioning of the image, said second means comprising:

an alternating current synchronous motor,

means for applying A.C. power to said motor to effect an axial position adjustment of said image,

means for converting the cycles of said A.C. power to periodic pulses to indicate the extent of axial adjustment accomplished by said motor, and

means operated in response to said pulses for controlling said motor.

12. A printing press as defined in claim 11 wherein said means for controlling said motor comprises a presettable counter connected to receive said periodic pulses for counting said periodic pulses and presettable to a predetermined count for producing a signal to terminate the axial adjustable moving of said plate cylinder after said predetermined count is accomplished.

13. A printing press as defined in claim 11 wherein said first means comprises third means for adjustably moving said plate cylinder circumferentially an increment for each pulse applied thereto, said third means including a pulse-responsive motor, and wherein said means for controlling comprises means for directing a numerically proportioned number of said periodic pulses to said pulse-responsive motor for effecting a predetermined circumferential adjustment for a given axial adjustment of said image.

14. A printing press according to claim 13 wherein said means for controlling comprises a counter for counting a numerically proportioned number of said periodic pulses and presettable to terminate said adjustment after a predetermined count.

* * * * *

35

40

45

50

55

60

65