(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 743 179 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.11.1996 Bulletin 1996/47

(51) Int. Cl.[6]: **B41F 13/12**

(21) Application number: **96107349.1**

(22) Date of filing: **09.05.1996**

(84) Designated Contracting States:
DE GB

(30) Priority: **17.05.1995 US 442927**

(71) Applicant: **ROCKWELL INTERNATIONAL CORPORATION**
Downers Grove, Illinois 60515 (US)

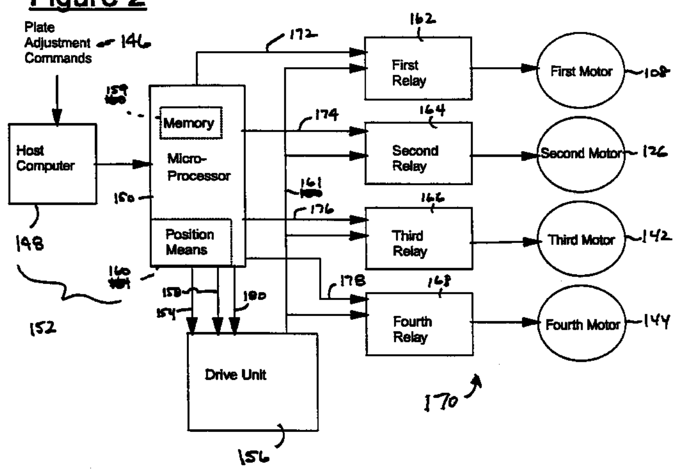
(72) Inventors:
- **Momot, Stanley**
LaGrange, IL 60525 (US)
- **Fedrigon, Richard**
Oak Park, IL 60302 (US)

(74) Representative: **Leiser, Gottfried, Dipl.-Ing.**
Prinz & Partner,
Manzingerweg 7
81241 München (DE)

(54) Control system for a plate register mechanism for a rotary printing press and method therefor

(57) A control system (100) for a plate register mechanism (102) for controlling lateral and/or circumferential position of a plate cylinder (104) in a rotary printing press wherein a pulse train signal (154) is generated comprised of a number of pulses representative of desired adjustment of the plate cylinder (104) and the plate register mechanism (102) is activated based on the pulse train signal (154). Preferably, the control system (100) is comprised of a microprocessor (150) for generating the pulse train signal (154) and transmitting the pulse train signal (154) to a drive unit (156). The microprocessor (150) stores the number of pulses sent to the drive unit (156) and uses the number of pulses to determine the instantaneous position of the plate cylinder (104). The drive unit (156) provides drive power (161) to a plurality of relays (162, 164, 166, 168) connected to a plurality of stepper motors (108, 126, 142, 144) based on the pulse train signal (154). The microprocessor (150) energizes one of the relays (162, 164, 166, 168) which, in turn, connects a corresponding one of the stepper motors (108, 126, 142, 144) to the drive power (161). Each of the stepper motors (108, 126, 142, 144) is connected to the plate register mechanism (102) such that the stepper motors (108, 126, 142, 144) operate the plate register mechanism (102) to control the position of the plate cylinder (104).

Figure 2



EP 0 743 179 A2

Description

Background of the Invention

The present invention is related generally to control systems for plate register mechanisms in printing presses and, more particularly, to a control system for a plate register mechanism in a rotary printing press and a method for controlling the plate register mechanism.

Modern web fed printing presses pass the web through a plurality of printing stands to perform a printing function at each stand. This is true, for example, in a printing operation where multiple colors are being printed on the web. When applying multiple colors to the moving Web, it is extremely important that each successive area where printing is to be effected be precisely positioned. Consequently, the plates on the plate cylinders in the successive printing stands must be in precise, predefined locations with respect to both lateral and circumferential positions. When proper alignment is attained, the printing plates are referred to as being in register.

Press manufacturers are continually endeavoring to improve the accuracy of plate register control systems. Several methods for controlling plate register having various degrees of effectiveness have resulted from these endeavors. Devices for adjusting circumferential or lateral register, or both, are disclosed in U.S. Patent Nos. 4,207,815, 4,336,755 and 4,709,634.

The accuracy of the plate register control system significantly effects the performance of the plate register mechanism. Manufacturers are therefore continually devising improved control systems Which are accurate, reliable and cost efficient. Older control systems used manual operator control by means of hand-wheels and screw threads and/or gearing.

Electronic control systems were subsequently developed to replace these antiquated manual systems. The electronic control systems typically consisted of alternating current (AC) motors, such as synchronous motors, which electrically activate the appropriate screw threads and gearing of the plate register mechanisms. Operation of the AC motors is typically controlled by a conventional feedback circuit. The feedback circuit includes a feedback network comprised of sensors which detect the position of the motor shafts. This position information is then used by a microprocessor, or other logic device, to control operation of the AC motors. Unfortunately, the necessity of a feedback network in these previous control circuits increases the complexity and cost of the control systems. In addition, the accuracy and response of these feedback systems are less than desired.

Manufacturers then designed control systems employing stepper motors which control operation of the motors based on time. For example, suppose a stepper motor rotates at 7,000 steps in 10 seconds. To rotate the motor 7,000 steps, the control system connects electrical power to the motor for 10 seconds. The motor would ostensibly have moved 7,000 steps in 10 seconds. Unfortunately, this is not exactly the case.

Stepper motors do not instantaneously achieve full speed. The stepper motor therefore spends an initial portion of the 10 seconds at less than full speed and does not rotate the full 7000 steps in the 10 seconds. This causes accuracy errors in the prior control systems. In addition, these errors accumulate as the motors continue to operate.

Accordingly, there is a need for an improved control system for a plate register mechanism which accurately and economically controls the plate register in a printing press.

Summary of the Invention

This need is satisfied by a control system and method for a plate register mechanism in a printing press for controlling position of a plate cylinder wherein a pulse train signal is generated having a number of pulses representative of the desired adjustment of the plate cylinder. By using the number of pulses to control the plate adjustment mechanism, the present invention provides accurate control without a feedback circuit.

In accordance with one aspect of the present invention, a control system for a plate register mechanism for adjusting position of a plate cylinder in a rotary printing press comprises a computer circuit for receiving plate adjustment commands representative of desired plate adjustment from an operator of the printing press, and for generating a pulse train signal comprised of a number of pulses which is representative of the desired plate adjustment. A drive unit supplies drive power based on the number of pulses in the pulse train signal. A drive mechanism drives the plate register mechanism in response to the drive power to produce the desired plate adjustment.

The computer circuit may comprise position means for determining lateral position of the plate cylinder based on the number of pulses in the pulse train signal. In addition or alternatively, the position means for determining circumferential position of the plate cylinder based on the number of pulses in the pulse train signal. Preferably, the drive mechanism comprises at least one stepper motor for driving the plate register mechanism in response to the drive power.

The computer circuit may generate a drive enable signal in response to the desired plate adjustment for selecting one of the at least one stepper motor. In response to the drive enable signal, at least one relay in the drive mechanism supplies the drive potter to the selected one of the at least one stepper motor.

These and other features and advantages of the present invention will become apparent from the following detailed description, the accompanying drawings and the appended claims.economically controls the plate register in a printing press.

Brief Description of the Drawings

Fig. 1 is a partially cut away view of a plate register mechanism for adjusting lateral and circumferential position of a plate cylinder in a rotary printing press; and

Fig. 2 is a block diagram of a control system for controlling the plate register mechanism shown in Fig. 1.

Detailed Description of the Invention

A control system, shown generally as reference numeral 100 in Fig. 2, for a plate register mechanism 102 provides accurate control of the lateral and circumferential position of a plate cylinder, generally designated by reference numeral 104, in a rotary printing press. The plate register mechanism 102 comprises a plate register frame 106 for mounting the mechanism 102 on the printing press.

A first stepper motor 108 effects the lateral position, commonly designated sidelay, of a journal 110 on one end of the plate cylinder 104. The motor 108 activates a sidelay drive gear 112 through a worm gear 114. The sidelay drive gear 112 drives a sidelay sprocket 116 which, in turned, drives a cylinder drive gear 118.

The cylinder drive gear 118 turns an externally threaded shaft 120 to effectuate lateral movement of the journal 110, and thus the plate cylinder 104, via a journal attachment mechanism 122. The shaft 120 is in threaded engagement with an internally threaded, stationary sidelay nut 124 such that rotation of the shaft 120 tends to cause longitudinal movement of the shaft 120. Consequently, the first stepper motor 108 controls lateral movement of the plate cylinder 104.

A second stepper motor 126 controls the circumferential position of the plate cylinder 104. The second motor 126 drives a circumferential drive gear 128 through a worm gear 130. The worm gear 130, in turn, rotates a circumferential sprocket 132 having teeth which are meshed with teeth of a circumferential rotational gear 134. The circumferential rotational gear 134 is rigidly connected to an internally threaded sleeve 136 and a cylinder drive gear attachment assembly 138. The cylinder drive gear attachment assembly 138 consists of a shoulder 138a rigidly mounted on the sleeve 136 and a thrust bearing 138b interposed between the shoulder 138a and an attachment ring 138c which is connected to a main cylinder drive gear 140 mounted on one end of the journal 110.

The internal threads of the threaded sleeve 136 are meshed with the external threads of the shaft 120 and, therefore, rotation of the sleeve 136 causes the sleeve 136 to move either toward or away from the cylinder drive gear 118. The axial movement of the sleeve 136 creates an axial stress in the thrust bearing 138b which is transmitted to the main cylinder drive gear 140. Helical teeth on the drive gear 140 translate this axial force into rotational, or circumferential, movement of the plate cylinder 104. Since the specific structure and philosophy behind the plate register mechanism 102 is not important to the present invention beyond producing lateral and circumferential adjustment of the plate cylinder 104 in response to the first and second stepper motors 108, 126, they will not be further discussed. However, a detailed description of such a mechanism is provided in commonly assigned U.S. Patent No. 4,709,634, the disclosure of which is hereby incorporated by reference. Although plate register mechanism 102 is shown being a unitary device for adjusting both lateral and circumferential position of the plate cylinder 104, the control system 100 of the present invention may be advantageously employed with plate adjustment mechanisms which include only lateral or circumferential position adjustment.

A block diagram of the control system 100 for controlling the operation of the plate register mechanism 102 to adjust the position of the plate cylinder 104 is shown in Fig. 2. The system 100 is shown having first, second, third and fourth stepper motors 108, 126, 142, 144 for providing lateral and circumferential register for a dual web printing press. Preferably, the motors 108, 126, 142, 144 are M062-TE09 SLO-SYN® DC Step Motor manufactured by Superior Electric Of Bristol, Connecticut. First and third motors 108, 126 control the lateral adjustment of the plate cylinder of each web and second and fourth motors 142, 144 control the circumferential adjustment of the plate cylinder of each web. As will be apparent to those skilled in the art, the third and fourth motors 142, 144 are connected to a plate register mechanism which operates in a manner similar to the operation of the plate register mechanism 102 described above.

The operator of the printing press provides plate adjustment commands 146 to a host computer 148. The plate adjustment commands 146 are representative of desired plate cylinder register, preferably both lateral and circumferential adjustment, as typically determined by the operator based on a visual inspection of the printed web in a well known manner. As will be readily comprehended by those skilled in the art, the operator may use any of a number of means, such as a keyboard, mouse, a touch screen and the like, to provide the commands 146 to the host computer 148.

The host computer 148 transmits these commands 146, or a signal representative thereof, to a microprocessor 150. In combination, the host computer 148 and the microprocessor 150 comprise a computer circuit 152. In response to the commands from the host computer 148, the microprocessor 150 generates a pulse train signal 154 which is transmitted to a drive unit 156. One drive unit which may be advantageously employed in the present invention is the Superior Electric SLO-SYN® Model SS2000MD4 Translator/Drive. The number of pulses in the pulse train signal 154 being representative of desired plate cylinder adjustment. The microprocessor 150 also sends a direction signal 158 to the drive unit 156 representative of the direction (clockwise or counterclockwise) one of the stepper motors is to be driven.

The microprocessor 150 determines the number of pulses contained in the pulse train signal 154 based on various factors, such as the number of pulses required to complete a rotation of a stepper motor shaft and the gear ratios of the gearing in the plate register mechanism 102. For example, a typical stepper motor has two hundred (200) steps per revolution or, alternatively, four hundred (400) half-steps per revolution. The gearing in the plate register mechanism 102 may, for example, be selected such that approximately 90,000 pulses are required to move either the sidelay or circumferential registration across its entire range of motion. As those skilled in the art will readily understand, the above numbers are only exemplary and can easily be designed to any specific application of the invention.

The microprocessor 150 stores the number of pulses contained in the pulse train signal 154 in a memory 159. Position means 160 tracks the number of pulses transmitted to continually monitor the sidelay and circumferential positions of the plate cylinder 104. In one embodiment of the present invention, the microprocessor 150 sends out a plurality of pulses to drive the shafts of the motors 108, 126, 142, 144 into a mechanical stop. This provides a reference position from which the microprocessor 150 can monitor the positions of the shaft of each motor 108, 126, 142, 144.

The drive unit 156 provides drive power 161 in response to the pulse train signal 154. The drive power 161 is supplied to first, second, third and fourth relays 162, 164, 166, 168. Each relay 162, 164, 166, 168 is connected to a corresponding one of the stepper motors 108, 126, 142, 144. When energized, each relay 162, 164, 166, 168 connects the drive power 161 to its respective motor 108, 126, 142, 144. The relays 162, 164, 166, 168 and the motors 108, 126, 142, 144, in combination, comprise a drive mechanism 170.

Each of the relays 162, 164, 166, 168 is energized by a corresponding drive enable signal 172, 174, 176, 178 from the microprocessor 150. For example, the microprocessor 150 sends the drive enable signal 172 to the relay 162 to connect the drive power 161 to the motor 108. As will be readily apparent to those skilled in the art, the microprocessor 150 may be programmed to energize one or more of the relays at any one instant. The microprocessor 150 generates an reset signal 180 which enables and disables output transistors in the drive unit 156. The present invention thus advantageously permits operation of four stepper motors 108, 126, 142, 144 with the single drive unit 156. In a commercial embodiment of the present invention, the relays 162, 164, 166, 168 are conventional four pole double throw relays.

Having thus described the invention in detail by way of reference to preferred embodiments thereof, it will be apparent that other modifications and variations are possible without departing from the scope of the invention defined in the appended claims.

Claims

1. A control system for a plate register mechanism for adjusting position of a plate cylinder in a rotary printing press comprising:

   a computer circuit for receiving plate adjustment commands representative of desired plate adjustment from an operator of the printing press, and for generating a pulse train signal comprised of a number of pulses which is representative of the desired plate adjustment;
   a drive unit for supplying drive power based on the number of pulses in the pulse train signal; and
   a drive mechanism for driving the plate register mechanism in response to the drive power to produce the desired plate adjustment.

2. The control system as recited in claim 1 wherein the computer circuit comprises position means for determining lateral position of the plate cylinder based on the number of pulses in the pulse train signal.

3. The control system as recited in claim 1 wherein the computer circuit comprises position means for determining circumferential position of the plate cylinder based on the number of pulses in the pulse train signal.

4. The control system as recited in claim 1 wherein the drive mechanism comprises at least one stepper motor for driving the plate register mechanism in response to the drive power.

5. The control system as recited in claim 4 wherein the computer circuit generates a drive enable signal in response to the desired plate adjustment for selecting one of the at least one stepper motor, and

   the drive mechanism comprises at least one relay for supplying the drive power to the selected one of the at least one stepper motor in response to the drive enable signal.

6. A method for controlling position of a plate cylinder in a rotary printing press, the printing press having a plate register mechanism for adjusting the position of the plate cylinder, the method comprising the steps of:

   receiving plate adjustment commands representative of desired adjustment of the position of the plate cylinder;
   generating a pulse train signal comprised of a number of pulses representative of the desired adjustment; and

activating the plate register mechanism based on the pulse train signal to produce the desired adjustment of the position of the plate cylinder.

7. The method as recited in claim 6 wherein the step of receiving plate adjustment commands comprises the step of receiving the plate adjustment commands representative of desired adjustment of lateral position of the plate cylinder.

8. The method as recited in claim 6 wherein the step of receiving plate adjustment commands comprises the step of receiving the plate adjustment commands representative of desired adjustment of circumferential position of the plate cylinder.

9. The method as recited in claim 6 comprising the steps of:

storing the number of pulses in the pulse train signal; and
monitoring the position of the plate cylinder based on the stored number of pulses.

10. The method as recited in claim 6 wherein the step of activating the plate register mechanism comprises the steps of:

providing the pulse train signal to a drive unit;
generating drive power by the drive unit based on the number of pulses in the pulse train signal; and
activating a drive mechanism in response to the drive power to activate the plate register mechanism.

11. The method as recited in claim 10 wherein the step of activating a drive mechanism comprises the step of supplying the drive power to at least one stepper motor.

12. The method as recited in claim 6 comprising the step of

generating at least one drive enable signal in response to the plate adjustment commands; and

wherein the step of activating the plate register mechanism comprises the steps of:

applying the drive power to a drive mechanism connected to the plate register mechanism; and
activating the drive mechanism to drive the plate register mechanism based on the at least one drive enable signal.

13. The method as recited in claim 12 wherein the step of activating the drive mechanism comprises the step of providing the drive power to at least one stepper motor.

14. A method for controlling position of a plate cylinder in a rotary printing press, the printing press having a plate register mechanism for adjusting the position of the plate cylinder, the method comprising the steps of:

receiving plate adjustment commands representative of desired adjustment of the position of the plate cylinder;
generating a pulse train signal comprised of a number of pulses based on the plate adjustment commands representative of the desired adjustment;
generating a drive enable signal based on the plate adjustment commands;
generating drive power by a drive unit based on the number of pulses in the pulse train signal; and
providing the drive power to at least one stepper motor connected to the plate register mechanism based on the drive enable signal to drive the plate register mechanism.

15. The method as recited in claim 14 wherein the step of providing the drive power comprises the steps of:

providing the drive power to at least one relay; and
transmitting the drive power from the at least one relay to the at least one stepper motor in response to the drive enable signal.

16. The method as recited in claim 14 wherein the step of receiving plate adjustment commands comprises the step of receiving the plate adjustment commands representative of desired adjustment of lateral position of the plate cylinder.

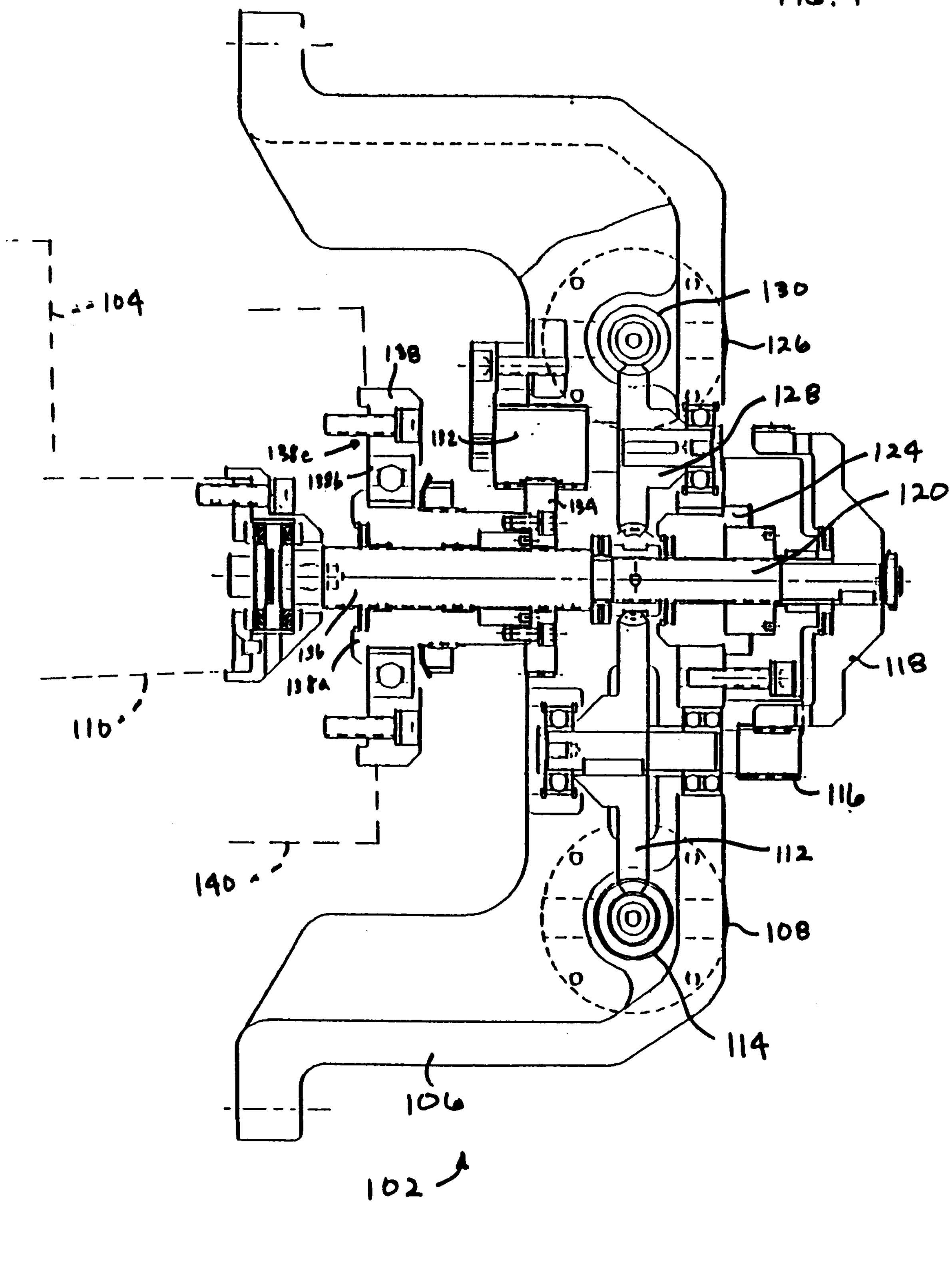
17. The method as recited in claim 14 wherein the step of receiving plate adjustment commands comprises the step of receiving the plate adjustment commands representative of desired adjustment of circumferential position of the plate cylinder.

18. The method as recited in claim 14 wherein the step of receiving plate adjustment commands comprises receiving plate adjustment commands representative of desired adjustment of lateral and circumferential position of the plate cylinder.

19. The method as recited in claim 14 comprising the steps of:

storing the number of pulses in the pulse train signal; and monitoring the position of the plate cylinder based on the stored number of pulses.

FIG. 1


104
138
138c
138b
132
130
126
128
124
120
138A
136
138A
110
118
116
112
140
108
114
106
102

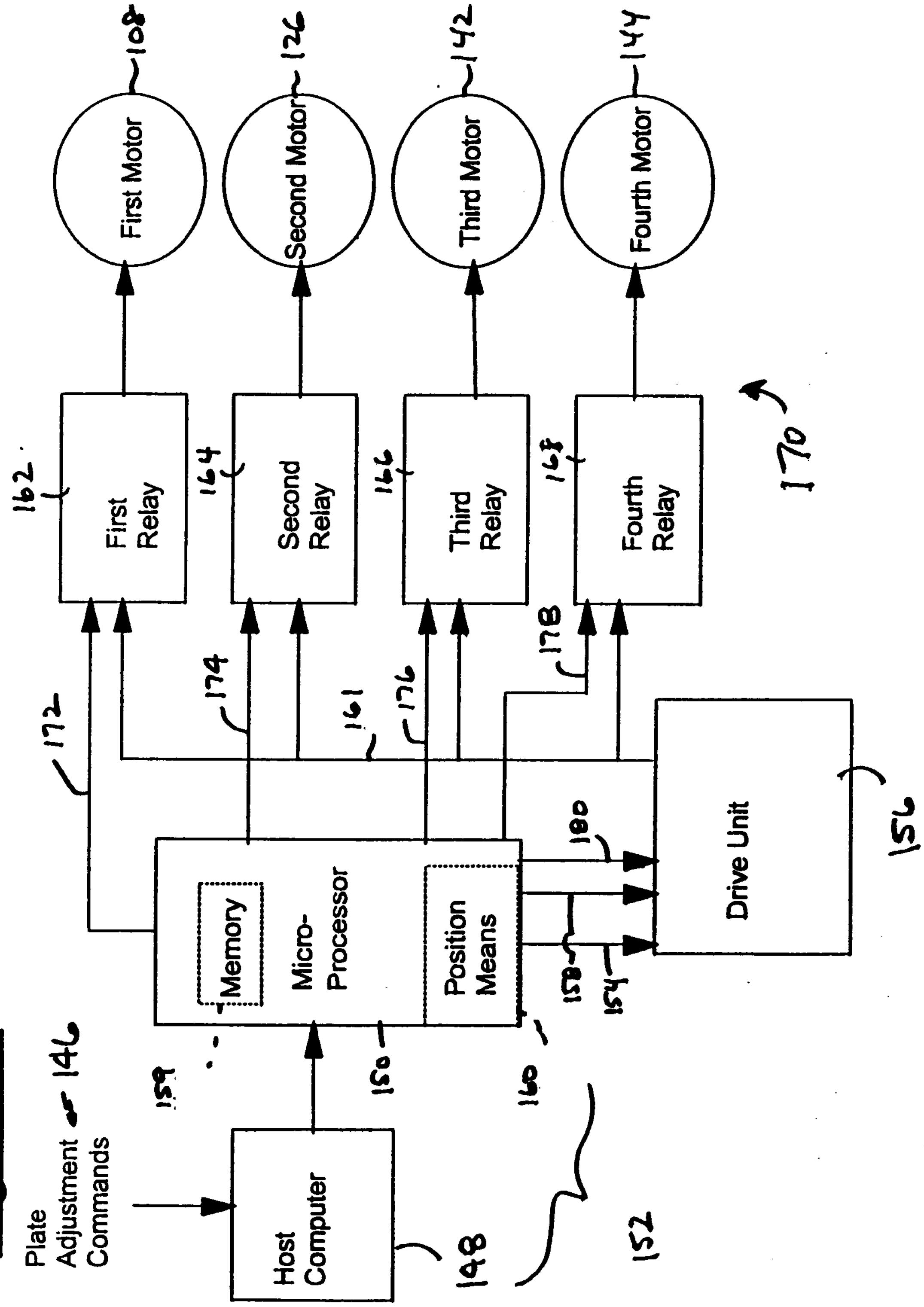


Plate Adjustment Commands
146
Host Computer
148
152
Memory
Micro-Processor
Position Means
159
150
160
158
154
180
Drive Unit
156
172
174
161
176
178
First Relay
Second Relay
Third Relay
Fourth Relay
162
164
166
168
170
100
First Motor
Second Motor
Third Motor
Fourth Motor
108
126
142
144

Figure 2