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Richardson

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[54] **PROGRAMING SYSTEM FOR PRESS BRAKES OR THE LIKE**

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[73] Assignee: **Canron, Inc.,** Oakland, Calif.

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[52] **U.S. Cl.** **72/36,** 72/461, 72/DIG. 21

[51] **Int. Cl.** **B21c 51/00**

[58] **Field of Search** ...... 72/7, 22, 36, 461, DIG. 21; 83/71, 207

[56] **References Cited**

UNITED STATES PATENTS

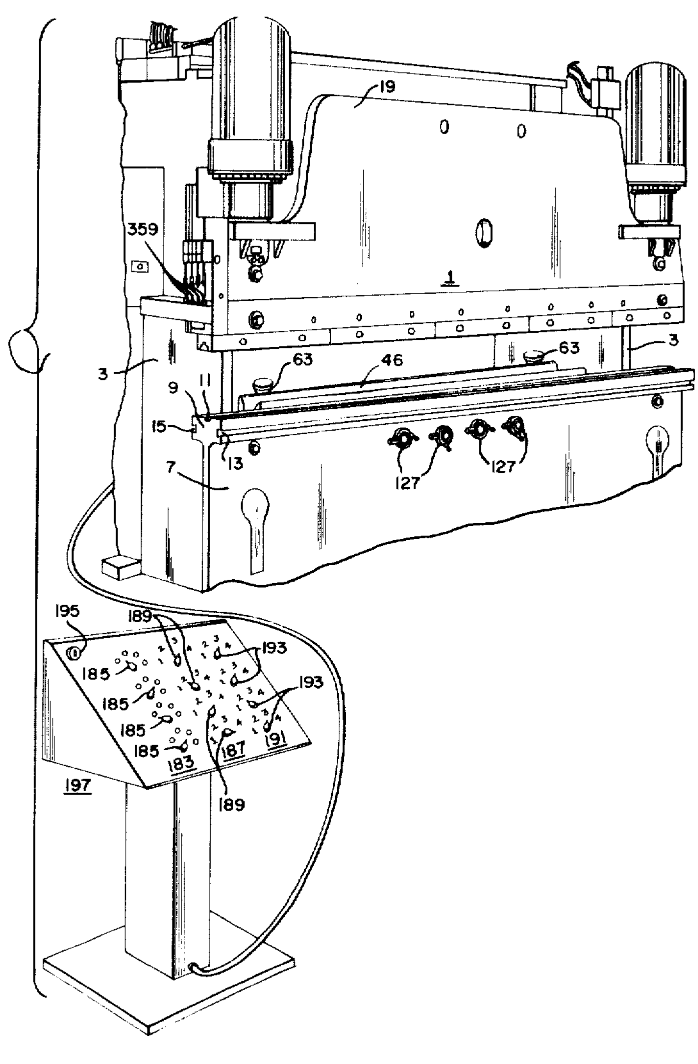
3,126,045	3/1964	Streit	72/421
3,176,556	4/1965	Roberts et al.	83/71
3,192,750	7/1965	Richardson	72/22
3,245,556	4/1966	Thumim	83/71
3,587,375	6/1971	Thumim	83/71
3,600,993	8/1971	Williams	83/71
3,618,349	11/1971	Roch	72/36
3,691,887	9/1972	Roch	83/71
3,733,885	5/1973	Brauer	72/461

Primary Examiner—Charles W. Lanham
Assistant Examiner—M. J. Keenan

[57] **ABSTRACT**

A programing system for press brakes or the like wherein a plurality of backgauge positioning means are pre-set in nonfunctioning condition and then activated to functioning condition in accordance with a predetermined sequence program. A plurality of adjustable depthgauges are provided and these are also selected in accordance with a predetermined sequence program. Changes from one setting to another are made responsive to actuation of a depth limit switch on the machine.

13 Claims, 13 Drawing Figures



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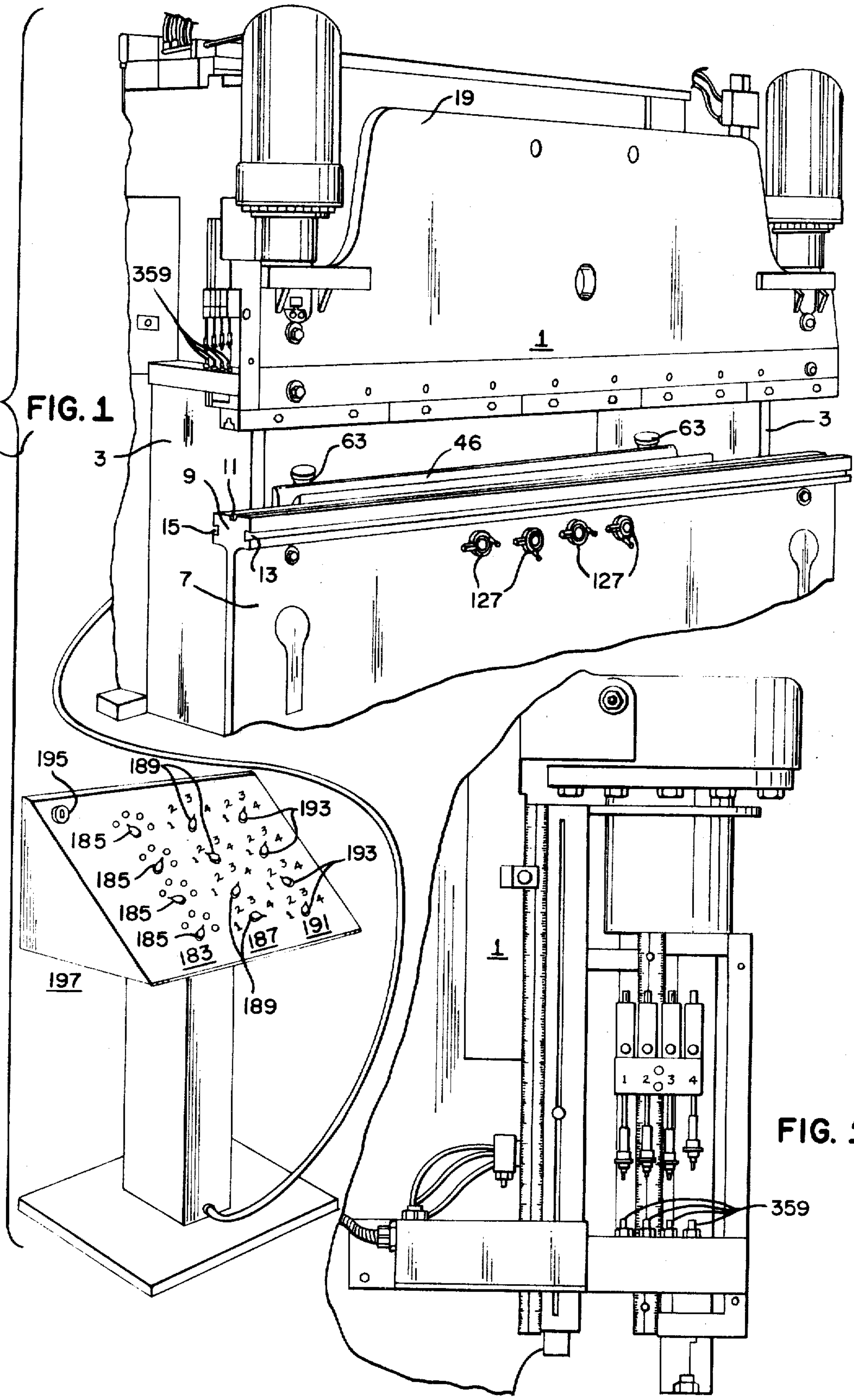

FIG. 1

FIG. 11

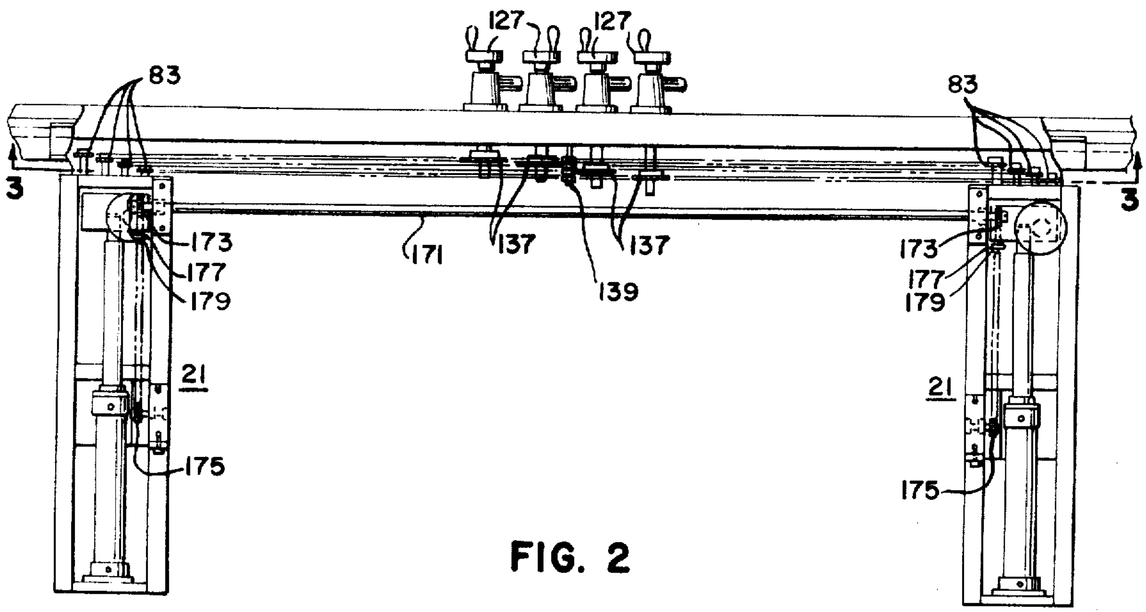
127
127
83
83
3
3
173
177
179
171
137
137
139
173
177
179
21
21
175
175

FIG. 2

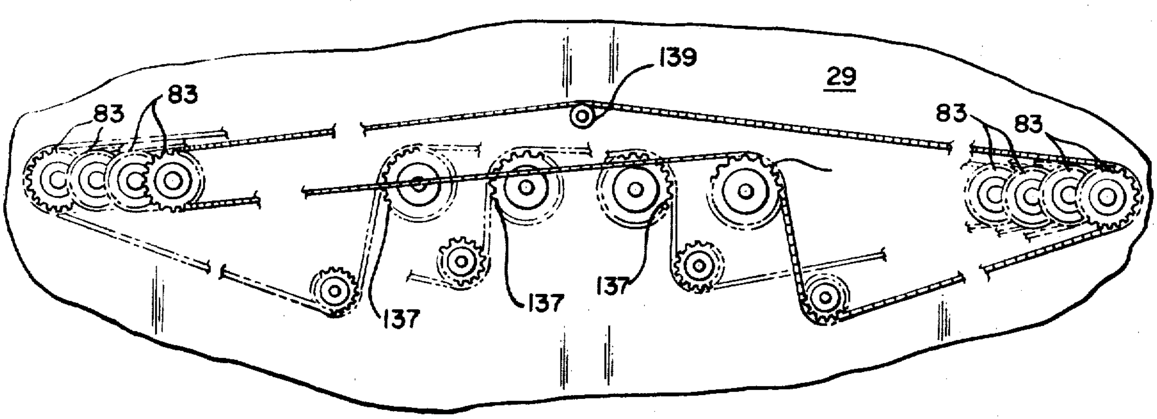
139
29
83
83
83
83
137
137
137
137

FIG. 3

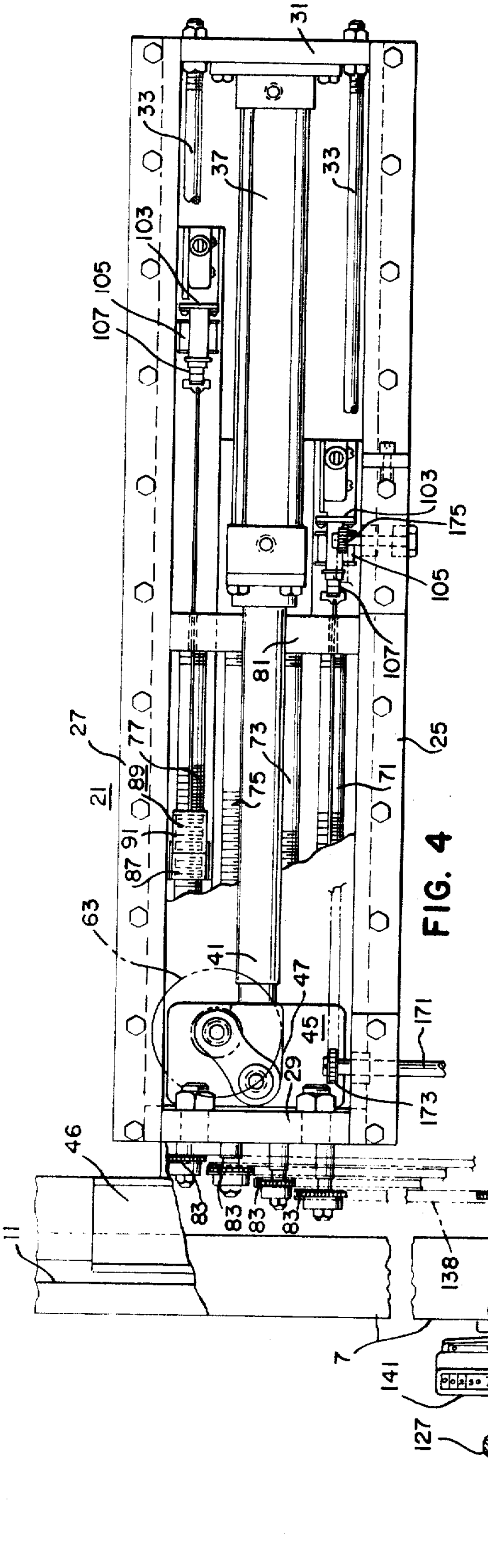
31
33
37
33
103
105
107
103
175
105
107
81
27
77
21
89
91
87
75
73
71
25
63
41
47
45
29
171
173
46
11
83
83
83
83
137
138
129
7
141
135
127

FIG. 4

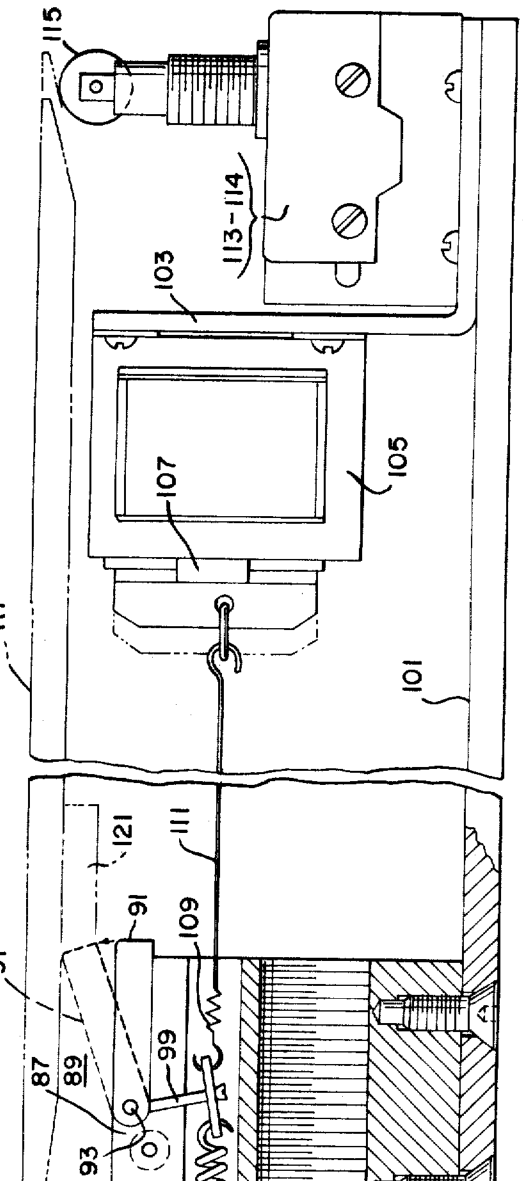
115
113-114
103
107
105
117
101
121
111
91
109
91
99
87
89
93
95
97

FIG. 7

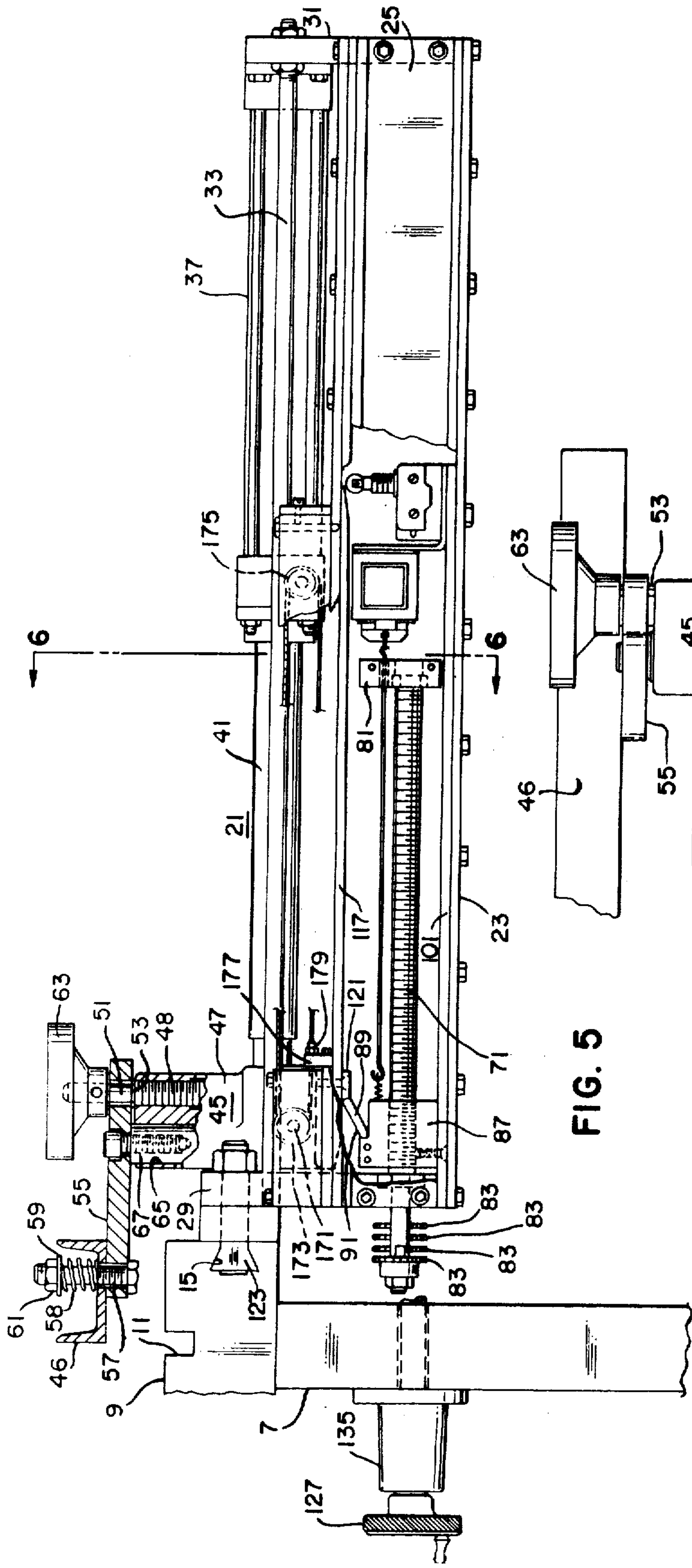

FIG. 5

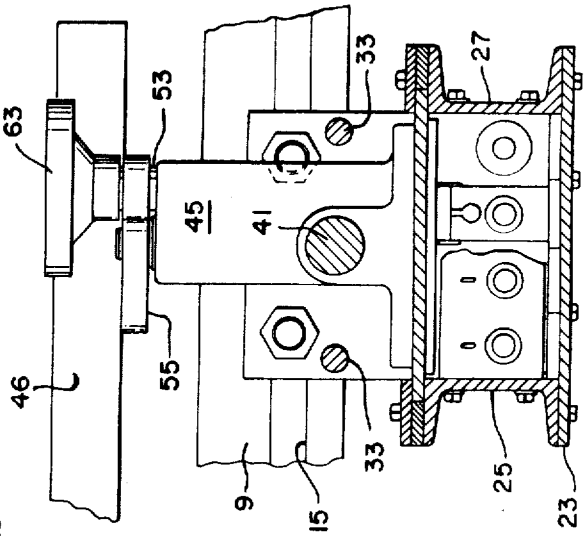

FIG. 6

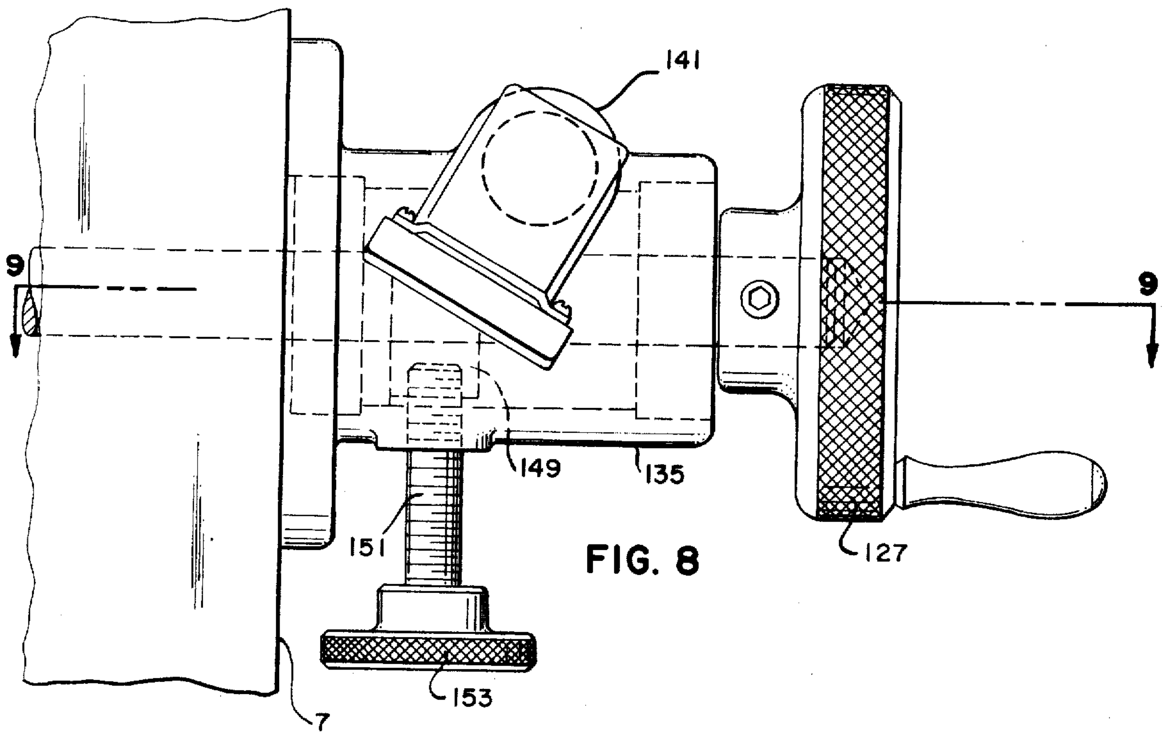
141
9
9
149
135
151
127
153
7

FIG. 8

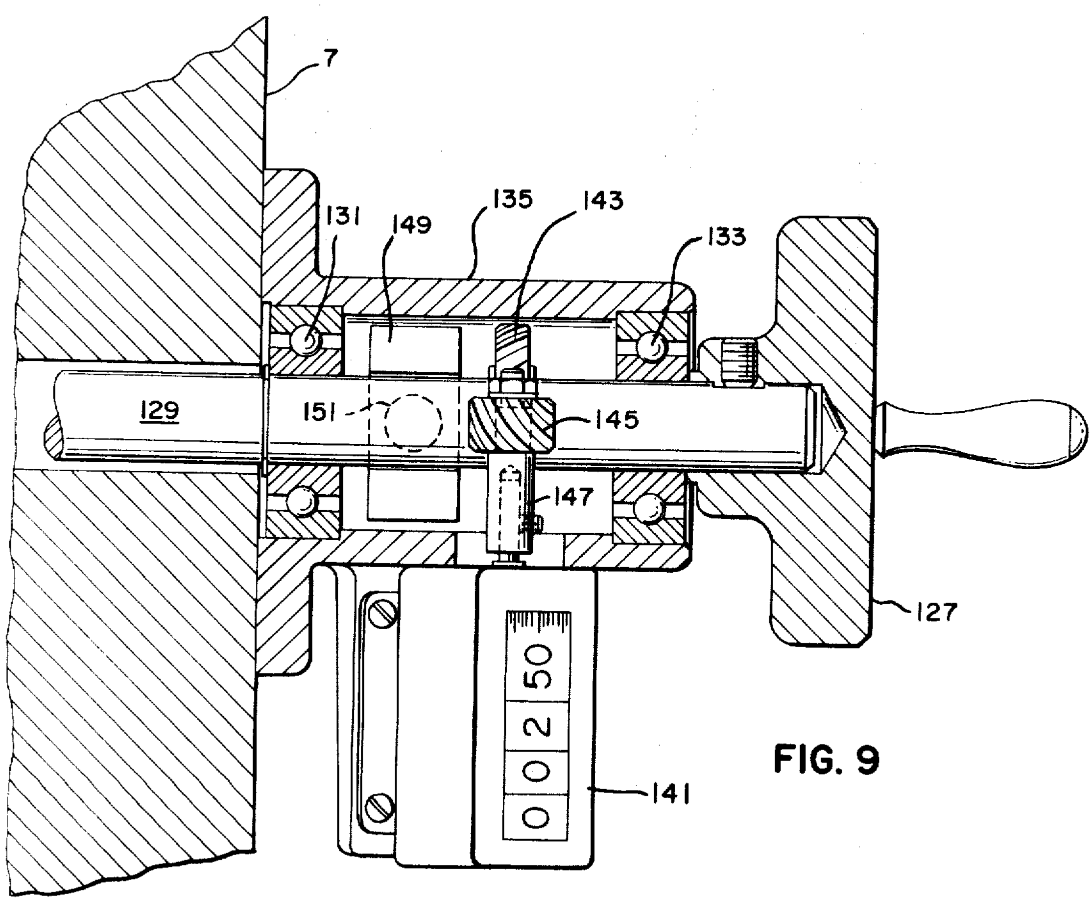
7
131
149
135
143
133
129
151
145
147
127
50
2
0
0
141

FIG. 9

STEP	LOAD SWITCHES ON STEP SWITCH CLOSED: X																			
	203	205	207	209	211	213	215	217	219	221	223	225	227	229	231	233	235	237	239	241	248
1																	X				X
2	X	X															X				
3	X		X														X				
4	X			X													X				
5	X				X													X			
6	X					X												X			
7	X						X											X			
8	X							X										X			
9	X								X										X		
10	X									X									X		
11	X										X								X		
12	X											X							X		
13	X												X							X	
14	X													X						X	
15	X														X					X	
16	X															X				X	

FIG. 12

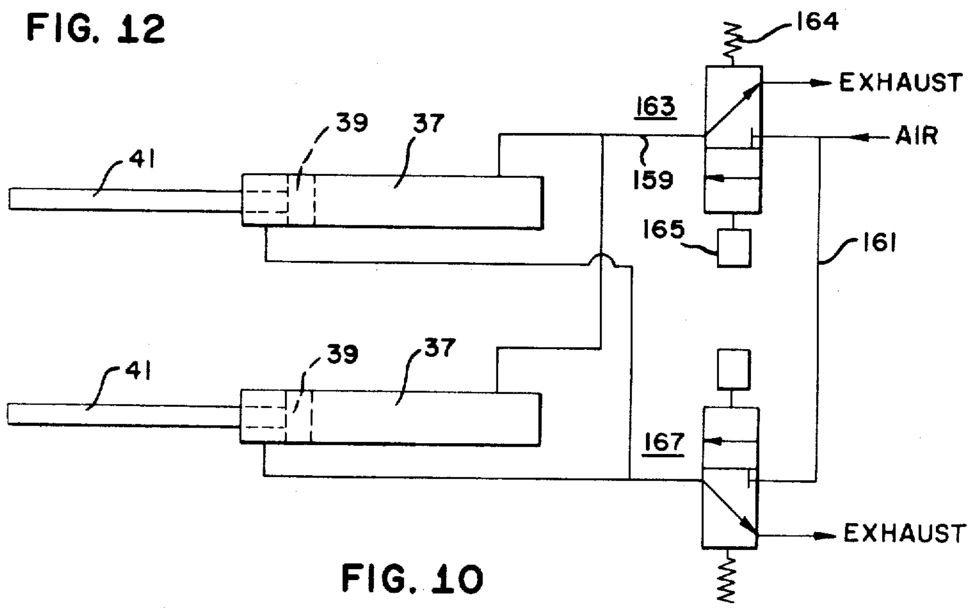

FIG. 10

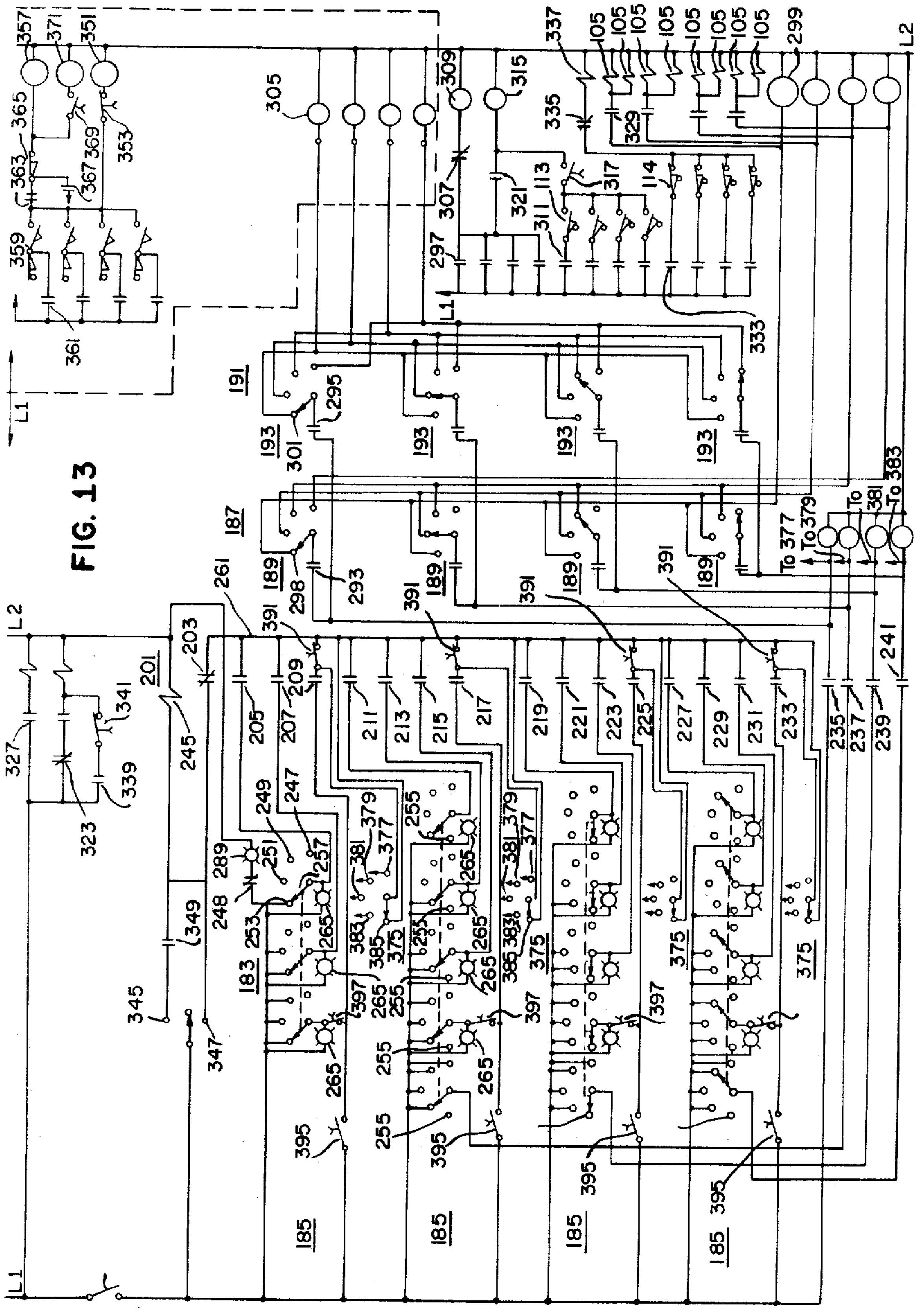

FIG. 13

PROGRAMING SYSTEM FOR PRESS BRAKES OR THE LIKE

My invention relates primarily to press brakes and more particularly to a programming system for backgauge and stroke control.

In the bending of sheet metal to form a structure involving a plurality of bends and particularly when some of such bends involve angles of different sizes, considerable time is involved in the setting up of the machine for each of such bends and for each of such strokes. Further, all items of a particular batch must be run through the machine for each separate step, thus necessitating piling or stacking the items after each operation.

Among the objects of my invention are;

1. To provide a novel and improved program system for all of the brake operations to be performed in the fabrication of a particular device, so that all bending operations may be performed in sequence on each device before fabrication of the next item is undertaken;

2. To provide a novel and improved program system for a press brake or the like which is adapted to take care of both backgauge and stroke control adjustments;

3. To provide a novel and improved program system for press brakes or the like which can be adapted for either backgauge or frontgauge control;

4. To provide a novel and improved program system for press brakes or the like wherein a backgauge adjustment or stroke control may be repeated sequentially when required in the production of a particular item;

5. To provide a novel and improved program system for press brakes or the like, which is rugged and positive in its action.

Additional objects of my invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawing wherein;

FIG. **1** is a three dimensional view of a machine incorporating the present invention;

FIG. **2** is a fragmentary plan view of the machine of FIG. **1** depicting the backgauge adjusting apparatus;

FIG. **3** is a view depicting chain drives in the apparatus of FIG. **2**;

FIG. **4** is a plan view of a backgauge adjustment assembly involved in the apparatus of FIG. **2**;

FIG. **5** is a side view of the assembly of FIG. **4**, partly fragmentated and sectioned;

FIG. **6** is a view in section taken in the plane **6—6** of FIG. **5**;

FIG. **7** is a side view in elevation of a slide assembly in the apparatus of FIG. **4**;

FIG. **8** is a side view in elevation of an adjusting wheel and indicator assembly involved in the apparatus of FIG. **2**;

FIG. **9** is a view in section taken in the plane **9—9** of FIG. **8**;

FIG. **10** depicts an air drive system for the backgauge drive pistons;

FIG. **11** is a fragmentary view of FIG. **1** depicting depthgauge switches involved in the present invention;

FIG. **12** is a chart depicting switch operating contacts of a stepping switch involved in operating of the present system; and

FIG. **13** is an electrical circuit diagram associated with the operation of the apparatus of FIGS. **1** through **7**.

Referring to the drawings for details of my invention, the same has been illustrated as embodied in a machine **1** of the press brake type, only the pertinent components which have been illustrated. Such components, include a pair of slide housings **3** connected by a vertical bed plate **7** with a platen **9** mounted on the upper edge thereof and provided with an upper slot **11** and front and back side slots **13, 15** respectively, preferably of dovetail contour. Above this platen and in line therewith is a reciprocably mounted ram **19**.

The bed plate platen is adapted to mount a lower die component while the ram is adapted to carry a complementary die component for cooperation with the lower component to perform a particular operation on a piece of work, in the present instance, a bending operation.

The present invention involves in part, a pair of backgauge adjustment assemblies **21** each mounted at an end of the machine on the backside of the vertical bed plate, adjacent the upper edge thereof.

Each such backgauge adjustment assembly comprises a frame including a bottom **23**, side walls **25, 27**. A front end wall **29** and a rear end wall **31**, the end walls extending above the side walls and being connected and braced by a pair of connecting rods **33**.

A cylinder **37** is fixedly mounted at one end to the rear end wall between the bracing rods, and carries a piston **39** having a piston rod **41** extending through the opposite end of the cylinder toward the front end wall. On the free end of the piston rod is mounted a carrier assembly **45** for supporting one end of a backgauge **46**.

The carrier assembly involves a substantially rectangular metal block **47** having a vertical bolt opening in the upper end to receive an adjusting screw **48** having an expsoed end portion **51** of smaller diameter extending upwardly and forming a shoulder on which is positioned a steel washer **53**.

Installed about the exposed end portion of the adjusting screw and resting on the washer, is a bracket plate **55**, on the end of which is supported one end of a backgauge, which may be of channel section, bolted to the bracket plate by a bolt **57** extending upwardly through the plate and channel, with a compression spring **58** about the bolt and maintained under slight compression by a washer **59** and nut **61**.

An adjusting wheel **63** fixed to the exposed end of the adjusting screw, preferably with a washer intermediate the bracket plate and adjusting wheel, will enable elevational adjustments of the associated bracket plate and the proximate end of the backgauge supported by this bracket plate. Such adjustments become necessary to level the backgauge with respect to a particular die being used, such dies varying as to height.

Being that it would be difficult to manually adjust both ends of the backgauge simultaneously, the compression spring associated with each backgauge mounting bolt, permits of adequate independence in the adjustment of each end of the backgauge, to enable independent end adjustments toward realizing level adjustment of the backgauge.

To stabilize the bracket plate, a recess **65** in the upper side of the block receives a guide shaft **67** which in turn is bolted to the bracket plate. With such guide installed, swing movements of the bracket plate, while vertical adjustments are being effected, cannot occur.

As thus far described, the piston is capable of full stroke movement to carry the backgauge through its full range of adjustment without programming.

To program the backgauge, it must be restricted as to position, to certain predetermined adjustments, and then sequenced as to the use of such adjustments in accordance with the bending operations to be performed.

To first accomplish the prescribed adjustments to be used in the performance of a particular job, each gauge adjustment assembly includes a plurality of screw drives **71, 73, 75, 77 . . .** etc., one end of each being rotatably mounted in a bearing in a partition wall **81** carried by and between the side walls of the frame, just below and just to the front of the cylinder. The opposite end of each screw drive passes through a bearing in the front end wall of the frame, and on the exposed end of each screw drive is fixed a chain sprocket **83,** with each sprocket offset with respect to the plane of the other sprockets, the spacing of the various sprockets with respect to the front end wall of the frame, being the same for the corresponding sprockets of the other gauge adjustment assembly.

Driven by each screw drive, is a slide assembly including a drive nut **87** on the screw, a latch **89** carried by the drive nut, and means enabling switching of the latch between a latching position in line of travel of a portion of the backgauge supporting means and a position out of line of travel of said backgauge supporting means.

Said latch includes a substantially rectangular plate **91** and means hingedly securing said plate to the nut on a hinge axis **93** enabling said latch to swing into latching position from its normal out of latching position.

The means for normally holding of the latch in its out of latching position includes means in the form of a spring **95** disposed in a channel **97** in the nut and anchored at one end to a wall of the channel and at its other end to a lever arm **99** extending from the latch and urging the latch toward its out of latching position.

To provide for swinging the latch to its latching position, a platform **101** is connected to the nut and extends rearwardly beneath the partition wall **81** and to a point beyond. On the portion of this platform beyond the partition, is a bracket **103** for supporting a solenoid **105** having a core **107** protruding in the direction of the latch. Connecting this core to the latch operating lever arm via a small spring **109,** is a length of wire **111** whereby, upon energization of the solenoid, the movement of the core into the solenoid winding is sufficient to rotate the latch to its latching position against the urging of the spring **95** toward its out of latching position.

Behind the solenoid mounting bracket on the sliding platform, of each screw drive of one of the adjustment assemblies is installed a normally open roller switch **113** while the corresponding roller switch **114** of the other adjustment assembly will be of the normally closed type, each of the switches having a vertically extended actuating stem terminating in a roller **115** lying in the path of movement of a stop slide **117** affixed to the underside of the backgauge supporting block. With both the backgauge supporting block and drive nut in its forwardmost position, the slide terminates at the roller switch with the proximate end of the slide tapered to preclude engagement with such switch. Accordingly, as the backgauge supporting block is retracted rearwardly, the slide will engage the stem of the roller switch and depress the same to alter the condition of the circuit in which the switch may be located. In actual use, however, the drive nut and associated components will be adjusted to various positions and the point in the return stroke of the backgauge supporting block at which the roller switch would be so actuated, will depend upon the prevailing adjustment of the slide assembly on the screw drive.

Adjacent the forward end of the stop slide is a stop plate **121** adapted to abut against the latch during forward movement of the backgauge supporting block, the point of abutment in the forward stroke of the backgauge being a function of the prevailing position of the drive nut and associated latch. To permit the stop slide to initiate forward movement beyond the latch, should the latch be in its up or functioning position at the time, the forward end of the stop slide is tapered.

Each backgauge supporting assembly is supported in its position behind the bed of the machine, by affixing to the front wall of the bed, a dovetailed key **123** which is slidably installed in the proximate side slot **15** formed in the platen of the bed.

When so installed, rotation of the screws to effect adjustments of the respective nuts thereon, is provided for at the front side of the bed of the machine within convenient and easy access of an operator.

This may take the form of an adjusting hand wheel **127** for each corresponding pair of adjusting screws, such adjusting wheel being mounted on the end of a shaft **129** supported on bearings **131, 133** within a housing **135** mounted on the front face of the machine bed, the shaft passing through the wall of the machine.

On the end of the shaft behind the bed of the machine, is keyed a sprocket **137** in the plane of the sprockets of the corresponding screws which it is to control. A chain **138** wrapped around the corresponding sprockets of the two adjusting assemblies, and in driving engagement with the adjusting wheel sprocket, will enable simultaneous adjustments of the corresponding screw drives of both adjusting assemblies. To maintain the drive chain in positive engagement with the adjusting wheel sprocket, a chain roller **139** is mounted on the rear of the bed in the plane of the aforementioned sprockets and in a position to hold the chain in positive engagement with the adjusting wheel sprocket.

Inasmuch as there are four pairs of corresponding screw adjustments, there will be four adjusting wheels mounted on the front side of the bed.

To enable an operator to make proper adjustments he must have some means for indicating the adjustments as they are being made. For this purpose, with each adjusting wheel, there is associated a digital readout **141** which indicates to the operator, screw adjustments as they are being made.

Such digital readout is driven from the adjusting wheel shaft by providing on such shaft within the shaft supporting housing, a helical gear **143** and meshing it with a helical pinion **145** mounted on a shaft **147** controlling the digital movements within the indicator. By matching the ratio of the helical gear and pinion to the thread of the adjusting assemblies, very accurate adjustments may be made.

Once an adjustment is completed, it becomes desirable to assure that such adjustment will be maintained as long as desired, and to assure this, locking means is provided for restraining the adjusting wheel and its shaft from accidental shifting.

Toward this end, a locking block **149** on the shaft within the shaft supporting housing, is affixed to the end of a screw **151** threadedly passing through the wall of the housing and carrying on its exposed end, a knob **153**, which upon rotation will cause the locking nut to move into pressure engagement with the shaft to lock the same against turning.

With the apparatus as thus described, the drive nuts on each pair of corresponding screws, will be adjusted simultaneously and can be moved to any position within the permissible range provided on the adjusting screws. With four pairs of adjusting screws, four different settings can be established at any time and such settings can then be employed in performing a sequence of bends in a sheet of metal, the angles of such bends being determined by stroke adjustments of the machine.

Adjustable movement of the backgauge requires simultaneous actuation of the pistons in their respective cylinders. The pistons are preferably air actuated from a source of air under compression, the cylinders being preferably supplied in parallel from such source, one line **159** from such source branching and supplying the corresponding ends of the cylinders. while another line **161** from such source branches to supply the opposite ends of the cylinders. A switching valve assembly **163** installed in one line **159**, is actuated in one direction to an exhaust position by a spring **164** and in the opposite direction by a solenoid **165** to an air feed position. A similar switching valve assembly **167** is located in the other line **161**. One is thus enabled to reverse flow of air to the cylinders, whereby to selectively perform an advance stroke and a return stroke.

To assure synchronism between the movement of both pistons, a cross shaft **171** is mounted in bearings on the facing side walls of the backgauge adjusting assemblies, and at each end carries a sprocket **173**. Each sprocket is chain coupled to an idler sprocket **175** mounted on the same side wall, while the chain itself is mechanically tied in with the proximate stop slide by a connection **177** having a chain anchoring screw **179** installed therein. Thus, should one piston tend to advance ahead of the other, the advancing piston will drive through the cross shaft to maintain the other piston in synchronism therewith.

Since either piston maintains a drive connection through the cross shaft to the other piston, it becomes apparent that one might eliminate the air drive to one of the cylinders, and drive from only one cylinder, relying on the cross shaft to transmit drive power to the opposite end of the backgauge.

To realize maximum utility from such equipment, it becomes necessary to program the machine so as to obtain the proper bends and angles and in proper sequence and without having to rely on the operator for such adjustments.

Multiple presettable stroke control apparatus is known, such being disclosed in the U.S. Pats. to Walldow No. 2,797,724 of July 2, 1957 for Selective Multiple Control Machanism For Machine Tools, and the U.S. Pat. to Jones No. 3,485,071 of Dec. 23, 1969 for Multiple Stroke Depth Selector For Hydraulic Press Brakes. The stroke control elements in such apparatus, through preset, are manually selected as and when needed, and are not related to any backgauge adjustments except as selected by the operator in the course of performing an operation on a piece of work. In accordance with the present system, depth stop or stroke control adjustments are programmed along with backgauge adjustments, both being made responsive to actuation of depth limit or stroke control switches.

To shift from a prevailing backgauge setting to another setting, necessitates first a de-energization of the solenoid **105** actuating the latch of the prevailing setting, and then retract slightly the stop slide with its stop plate **121** so as to free the latch and permit its restoring spring to restore the latch to its nonfunctioning position.

What happens next depends upon whether the stop plate on the slide stop associated with the next adjustment in the sequence, is in advance of or behind the latch associated therewith.

If in advance of such latch, then the pistons and everthing tied to it must be retracted to bring the stop plate to the rear of the latch so that it may engage the latch and position the backgauge at its proper distance behind the bed of the machine.

On the other hand, if the stop plate is behind its associated latch, then all that is required is to advance the pistons until the stop plates engage their respective latches, which in the meantime will have been elevated to their functioning positions by energization of their associated solenoids.

One manner of accomplishing this shifting of the backgauge from one setting to another and in accordance with a predetermined sequence, may be realized through the electrical control of circuitry of FIG. 13 on which the various solenoids and rotor switches have been identified by reference numerals corresponding to those on the apparatus drawings.

Also depicted in the circuitry are three switch banks, a first bank **183** involving four switches **185** for determining the program selector sequence, a second bank **187** comprising four switches **189** constituting backgauge position selector switches, each having four contacts, while a third bank **191** involves four depth stop selector switches **193**, each also having four contacts.

These three banks of switches, along with a main line on/off switch **195**, are mounted on the panel of a console **197** for use by an operator in programming, in advance, the operations to be performed by the machine, while in the upper right hand corner of the circuitry and enclosed by a dash line, are circuit components normally to be found on the machine itself and which are functionally related to the programming procedure.

Electrically associated with the program selector sequence switches is a stepping switch **201** of the type having a plurality of cam operated contacts **203, 205, 207, 209, 211, 213, 215, 217, 219, 221, 223, 225, 227, 229, 231, 233, 235, 237, 239** and **241**, the intermittent cam movement being controlled by a stepping switch winding **245.** Such a switch designated "MT" series step switch (Bulletin **780** c) is available under the name Eagle Signal, a division of E. W. Bliss Company of 736 Federal Street, Davenport, Iowa 52803 and includes means for adjusting cam action to establish which contacts will respond to cam action and when. For the purpose of the present invention, the contacts are set to function in accordance with the schedule as set forth in FIG. 12 of the drawings.

To this stepping switch was added another contact **248.**

Each program selector sequence switch **185** includes five sets **185***a*, **185***b*, **185***c*, **185***d* and **185***e*, each involving five contacts **247, 249, 251, 253** and **255,** with a rotatable switch contact **257** for each set, and all rotatable contactors being ganged simultaneous adjustment through a single knob **259,** the first of these switches not making use of the first and last set of contacts.

Considering each of the program selector sequence switches **185** except the first, it will be noted that only contact **255** of the first set is wired for connection to an external circuit, while the contacts **253** and **255** only of the second set are wired for external connection. As for the third set, contacts **251, 253** and contact **255** are wired for connection to an external circuit, whereas with regard to the fourth set, contacts **249, 251, 253** and **255** are so wired, and as for the last set, contacts **247, 249, 251** and **253** are so wired, leaving contact **255** blank.

These wired contacts are connected to line L1 of a power source while each of the rotatable contacts **257** is connected through its own associated stepping switch contact to a common line **261,** which line passes through the first contact **203** of the stepping switch to the control winding **245** of the stepping switch, and from there to L2 of the power source. The stepping switch contact **203** through which the common line **261** passes to the control winding, is normally closed for all positions of the stepping switch except the first position as designated on the chart of Figure.

The first four sets of contacts are employable in determining repeat strokes where a particular backgauge setting can be used more than once and up to four times in succession in a particular sequence. The fifth or last set of contacts is employed in correlating these sequence switches to the operation of the backgauge and depth stop controls.

A signal light **265** parallels the wired contacts of each of these first four sets of contacts, to indicate when such wired contacts are functioning in a circuit.

The first of the program selector sequence switches, which does not require use of the first and last sets of contacts, is otherwise wired the same as the other switches in this bank.

Coming back to the stepping switch **201,** the chart of FIG. **12** indicates that preliminary to the start of a sequence of programmed operations, contacts **235** and **248** are closed. All others are open.

Contacts **235** place a relay **291** in action. This relay closes its normally open contacts **293, 295** and **297.**

The contacts **293** close a circuit through a selected contact **298** of the first backgauge position selector switch to a backgauge relay **299.**

Contacts **295** similarly close a circuit through a selected contact **301** of the first depth stop selector switch, such circuit including a depth stop relay **305.**

Contacts **297** complete a circuit through normally closed contacts **307** to a time delay relay **309.**

Relays **299, 305** and **309** are thus energized.

The relay **299** when energized, closes a pair of normally open contacts **311** in circuit to a relay **315** via a normally open roller switch **113** and the normally open slow make contacts **317** of the time delay relay **309.**

The time delay relay **309** in addition to the slow make contacts **317,** has a pair of normally open instantaneous contacts **319** which close a circuit to the solenoid of the switching valve assembly **167,** causing retraction of the backgauge and connected apparatus from its prevailing position, which means also, rearward movement of the stop slides **117** to, at some point in their movement, depress their associated roller switches.

At the moment, one is concerned only with those roller switches in circuit with contacts associated with backgauge relay **299.** Thus normally open roller switch **113** in circuit with contacts **311** will close, along with the slow make contacts **317** of the time delay relay **309,** and thereby cause gauge relay **315** to energize.

This relay **315** closes a pair of normally open contacts **321** to establish a holding circuit for itself.

Relay **315** also opens a pair of normally closed contacts **323** in the circuit to the solenoid of the return switching valve assembly **167,** while at the same time closing a pair of normally open contacts **327** to cause energization of the solenoid of the advance switching valve assembly **163,** thus halting the rearward movement of the backgauge and initiating an advance movement.

Simultaneously, relay **315** closes a pair of normally open contacts **329** to energize corresponding solenoids **105** in the two adjusting assemblies, to flip up corresponding latch plates **91** controlling the next stop position in the sequence. Thus, these latch plates are now awaiting engagement by the associated advancing stop plate **121.**

As these stop plates may conceivably engage the latches with substantial impact, provision is made for braking the advance movement of the backgauge as these stop plates approach impact with their respective latch plates. This is accomplished through closing of another pair of normally open contacts **333** associated with the backgauge relay **299.** These contacts are in series with the pertinent normally closed roller switch **114,** a pair of normally open instantaneous contacts **335** (now closed) associated with time delay relay **309,** and the winding of a time delay relay **337.**

Bearing in mind that the normally closed roller switch **114** is, during advance of the backgauge, being depressed by the stop slide, it will be in open condition until the stop slide moves off the roller as the backgauge approaches its new position. At this moment, the roller switch closes to complete the circuit through time delay relay **337** which then becomes energized.

This relay **337** has a pair of normally open instantaneous contacts **339** and a pair of normally closed slow opening contacts **341,** these being connected in series to close a circuit through the solenoid of the return switching valve assembly **167** upon energization of this relay **337,** which circuit remains closed but a brief time, as determined by the opening of the slow opening contacts **341.**

During this brief period, air under compression will be fed into the forward end of each cylinder to oppose and brake the forward or advancing movement of the backgauge, thus slowing it down, and without cutting off the air supply which advances the pistons. As a backgauge comes to a stop at its new position, the air supply can then build up and maintain pressure behind the pistons to forcibly maintain the stop plates against their associated latch plates.

Also associated with the operation of the stepping switch **201**, is a circuit adapted to include the stepping switch winding **245** directly across the power source, such circuit including the contact **345** of a 3-way single pole switch **347** and a pair of normally open contacts **349**.

These latter contacts belong to a relay **351** located on the machine in circuit with the slow release contacts **353** of a time delay relay **357**, which is also mounted on the machine, the contacts of a normally open depth limit switch **359** and a pair of normally open contacts **361** on the relay **305**.

The relay **357** is in series with the same normally open contacts **361**, the same depth limit switch **359**, a second pair of normally open contacts **363** associated with the aforementioned relay **351**, and the back travel limit switch **365** of the machine.

When energized, relay **357** closes a pair of normally open contacts **367** to establish a holding circuit, while at the same time opening its slow opening contacts **353** to disconnect relay **351**, and closing a pair of slow closing contacts **369** which complete a circuit through an "Up" relay **371** located on the machine and controlling the return of the ram from its position at the end of a work stroke.

Thus, with contacts **361** closed, a work stroke of the ram, will cause depth limit switch **359** to close at the end of the work stroke, thereby energizing relay **351** which, in turn, not only closes contacts **363** to energize time delay relay **357** and ultimately return the ram and ready it for another stroke, but at the same time, relay **351** closes contacts **349** to energize the stepping switch winding **245** and advances this switch one step.

In the meantime the time delay **357** will have opened the circuit to the relay **351** which, as a result, will de-energize and drop out its contacts **349** to open that circuit to the stepping switch winding **245**.

According to the chart of FIG. **12** contacts **203, 205** and **235** at this stage are closed.

With the contact **203** of the stepping switch now in closed position, the stepping switch winding **245** can be energized anytime that a circuit including this winding is completed through any of the program selector sequence switches **185**. If no circuit is completed at the first set of contacts of any one switch, the backgauge position will remain undisturbed and ready for the next stroke of the ram.

Thus, if the first switch **185** were adjusted to contact **247** for example, the closing of the associated contact **205** would still leave the circuit open to the stepping switch winding **245**, thus leaving the stepping switch unaffected, which means that the same backgauge and depth stop settings will be utilized on the next stroke.

On the next stroke, due to energization of the stepping switch winding via contacts **349**, the switch will advance a step to close contact **207**. Since a circuit through this contact **207** to the winding **245** would still be open at the program selector sequence switch, the backgauge and depth stop settings will remain for a third stroke of the ram . . . etc.

On a subsequent stroke of the ram, however, the advance of the stepping switch one step in response to the closing of the contacts **349**, will place the stepping switch winding **245** in circuit through the wired contact **253** of the program selector sequence switch under consideration, and cause the selector switch to advance another step, and this will repeat each time the winding **245** is placed in circuit by a wired contact in that switch until a stepping switch contact associated with the contacts of the next switch **185** is closed, and the stepping switch winding circuit is broken.

In the meantime, when the transfer from the first program selector sequence switch to the second occurs, contact **235** will have been opened and contact **237** closed, this having the effect of setting the circuitry into operation to change the backgauge and depth gauge settings in accordance with that dictated by the setting of the second backgauge selector switch and the second depthgauge selector switch, and in the manner previously discussed in connection with the setting of the first switch in each bank.

It will be recalled that the contact **255** of the last set of contacts associated with the second, third and fourth of the program selector sequence switches **185** has been left unwired to any circuit. It is also noted that the related rotatable contact **257** functions to place in circuit one of the relays **291**, which in turn activates the circuitry to change the backgauge and depthguage settings to the next in the sequence.

If the rotatable contact rests on the free or unwired contact, the pertinent relay **291** cannot be energized and nothing happens except that the stepping switch winding **245** will be energized through the corresponding contacts **255** of the same switch causing the stepping switch to step its way to the next program selector switch **185** in the bank.

Thus, it becomes possible to by-pass any of the program selector sequence switches following the first.

To add additional flexibility to the system, a single rotary switch **375** having a number of contacts **377, 379, 381, 383** and **385** and a rotary contact **387**, all corresponding to those in each set of contacts **247–255** of a program selector sequence switch **185**, is associated with the first program selector sequence switch.

Contact **377** is connected to the first relay **291**, contact **379** to the second relay **291**, contact **381** to the third of these relays, and contact **383** to the fourth. Contact **385** is connected to the line **261**.

The rotary contact **387** of this switch is connected to that side of contacts **209** which were previously connected to line **261**. However, to render rotary contact **387** active, (a) the connection from contacts **209** to the line **261** must be open, and this can be made possible by inclusion of a switch **391** in the connection, (b) a connection **393** through a switch **395** from the line L1 to the contacts **209** must be completed, and (c) the connection to the last rotary contact **265** of the first program selector sequence switch must be open, which can also be accomplished through the insertion of a switch **397**.

All three switches **391, 295** and **397** may be ganged to facilitate the inclusion of the additional switch **375**.

A second such switch **375** associated with the second program selector sequence switch will be related to stepping switch contacts **217** and will be similarly connected in circuit.

A third such switch associated with the third program selector sequence switch will be related to stepping switch contacts **225**, while a fourth such switch associated with the fourth program selector sequence switch, will be related to stepping switch contacts **233**. Both will be connected in circuit like the first two.

With these switches **375** added to the system, one may now pre-selectively energize any of the relays **291** when the related stepping switch contacts close, and since these relays determine the next backgauge and depthgauge adjustment to come up, these added switches make it possible to selectively introduce into a program at various points in the sequence, any one of the available adjustments.

From the foregoing, it will be apparent that once the backgauge, depthgauge and program selector sequence switches have been adjusted for a desired program of operation, all the operator need do is insert the work into the machine as many times as will be necessary to complete the sequence. The adjusting mechanism and associated circuitry will cause the machine to perform in accordance with the program established.

While the system described above involves the use of four switches to a bank, it should be apparent that the invention may utilize more or less switches per bank.

While I have illustrated and described the invention in considerable detail, the same is subject to further alteration and modification without departing from the underlying principles involved, and I, accordingly, do not desire to be limited in my protection to the specific details illustrated and described except as may be necessitated by the appended claims.

I claim:

1. A programming system for a press brake or the like having a ram for performing operation on work, said programming system including a backgauge, a backgauge adjusting assembly comprising means for controlling movement of said backgauge through a range of adjustability, a plurality of mechanical backgauge position determining means, each capable of being rendered functional or non-functional, means for prelocating, from a remote station, the individual mechanical backguage position determining means in a nonfunctional condition, and means, between work strokes of said machine, for establishing said various mechanical backgauge position determining means to a functioning condition in accordance with a predetermined sequence program.

2. A programming system in accordance with claim **1**, characterized by a second backgauge adjusting assembly with each said assembly coupled to a backgauge adjacent an end thereof, and means for simultaneously advancing the backgauge movement controlling means of each of said backgauge adjusting assemblies until said movement controlling means engages a mechanical backgauge position determining means in its functioning position.

3. A programing system in accordance with claim **1**, characterized by said means for controlling movement of a backgauge, including a frame, a cylinder supported by said frame, a piston in said cylinder having a piston rod extending through an end of said cylinder, means connecting said rod to a backgauge, and means for selectively supplying power to either end of said cylinder.

4. A programing system in accordance with claim **3**, characterized by each of said backgauge positioning means including a screw drive supported for rotation in said frame, a latch threadedly carried on said screw drive, means for shifting said latch between a nonfunctioning position and a functioning position, and means, on a movable component of said backgauge movement controlling means, for engaging said latch in its functioning position, to halt forward movement of said movement controlling means.

5. A programing system in accordance with claim **2**, characterized by means interconnecting both said means for controlling movement of said backgauge, for maintaining synchronism between the two backgauge movement controlling means.

6. A programing system in accordance with claim **2**, characterized by said backgauge movement controlling means maintaining pressure against said backgauge positioning means, following engagement thereof with said backgauge positioning means.

7. A programing system in accordance with claim **1**, characterized by said means for establishing said various backgauge positioning means to a functioning condition in accordance with a predetermined sequence program, including a plurality of backgauge selector switches, each having a plurality of contacts with each contact controlling the functioning condition of one of a plurality of backgauge positioning means, and a rotatable contact for preselecting one of said plurality of contacts to condition a desired one of said backgauge positioning means when said switch is connected in circuit, and stepping switch means for sequentially connecting said backgauge selector switches in circuit.

8. A programming system in accordance with claim **6**, characterized by a plurality of program selector sequence switches, each having a plurality of sets of contacts and a rotary contact, with each succeeding set of contacts having a progressively larger number of contacts wired for connection in circuit, and means connecting said wired contacts in common to one side of a power source, with each of said rotary selector contacts connected to a different contact of said stepping switch, and means for maintaining one of said backgauge selector switches in circuit so long as an associated program selector sequence switch is functioning.

9. A programming system in accordance with claim **1**, characterized by said means for establishing said various backgauge position determining means to a functioning condition being responsive to operation of a depthgauge switch on said machine.

10. A programing system in accordance with claim **1**, characterized by a plurality of depthgauges, means for adjusting said depthgauges, and means for utilizing said depthgauges in accordance with a predetermined sequence program.

11. An assembly for pre-setting the adjustments of a backgauge in a gauge programing system, comprising a frame, a piston drive assembly including a cylinder supported by said frame and a piston within said cylinder having a rod extending through an end of said cylinder for reciprocal movement within the full stroke of said piston, means connected to said piston rod for supporting one end of a backgauge, adjustable stop means in the path of a portion of said backgauge supporting means for arbitrarily limiting the travel of said backgauge supporting means in one direction, said adjustable stop means including a drive supported by said frame substantially parallel to said piston rod, a slide assembly in drive engagement with said drive including a drive nut, a latch carried by said drive nut, means enabling switching of said latch between a latching position in line of travel of a portion of said backgauge supporting means and a position out-of-line of travel of said backgauge supporting means, means for actuating said drive to adjust the position of said latch, and means for indicating such adjustment as it is being made.

12. An assembly in accordance with claim **11,** characterized by said latch including a substantially rectangular plate and means hingedly securing said plate to said nut on a hinge axis enabling said latch to swing into and out of latching position, and said means enabling switching said latch into and out of latching position including means normally urging said latch toward its out of latching position, a platform connected to said nut, and electrically energizable solenoid means carried by said platform for moving said latch to latching position.

13. An assembly in accordance with claim **12,** characterized by a plurality of said drives supported in said frame with associated slide assemblies.

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