

[72] Inventors **Neal W. Merrill**  
**Bethlehem;**  
**Charles R. Nippert, Allentown, Pa.**

[21] Appl. No. **782,197**

[22] Filed **Dec. 9, 1968**

[45] Patented **May 25, 1971**

[73] Assignee **Bethlehem Steel Corporation**

[56]		References Cited	
UNITED STATES PATENTS			
3,393,543	7/1968	Van Gelder .....	72/26
2,627,890	2/1953	Lloyd et al. ....	72/27
2,430,899	11/1947	Wallace.....	72/388
3,336,776	8/1967	Zerlaut.....	72/14

*Primary Examiner*—Charles W. Lanham  
*Assistant Examiner*—Michael J. Keenan  
*Attorney*—Joseph J. O'Keefe

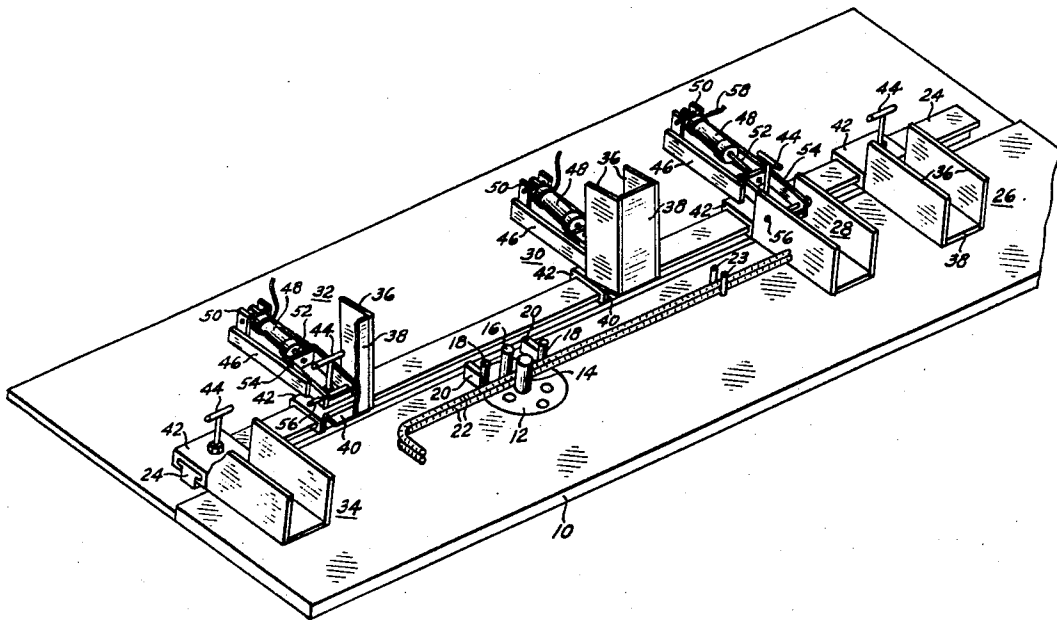
[54] **AUTOMATED STOPS FOR BAR BENDING MACHINE**  
**2 Claims, 8 Drawing Figs.**

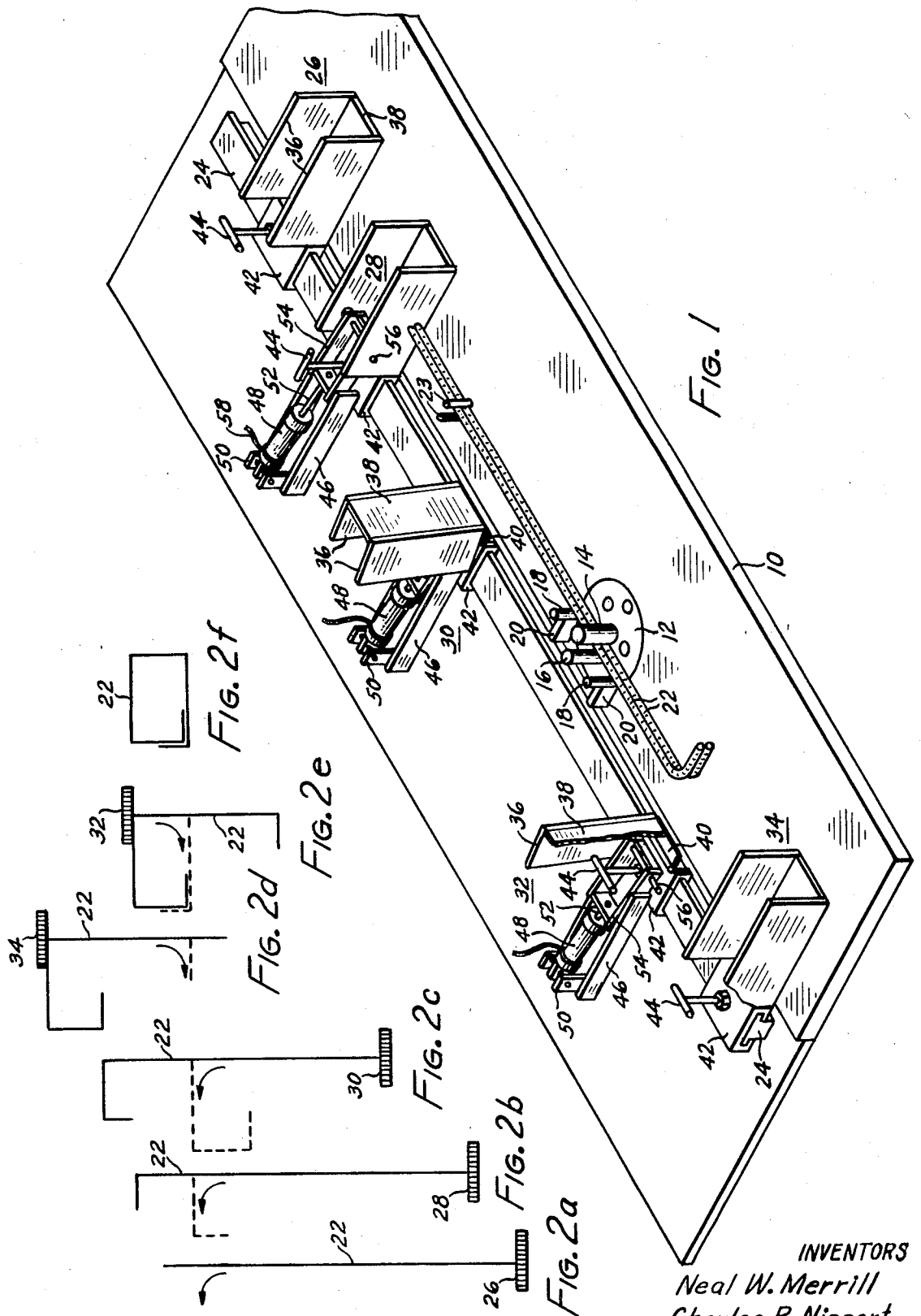
[52] U.S. Cl. .... 72/22,  
 72/461

[51] Int. Cl. .... B21j 7/26

[50] Field of Search..... 72/22, 23,  
 27, 30, 461, (Digest), 6, 21; 83/467, 396, 393, 391

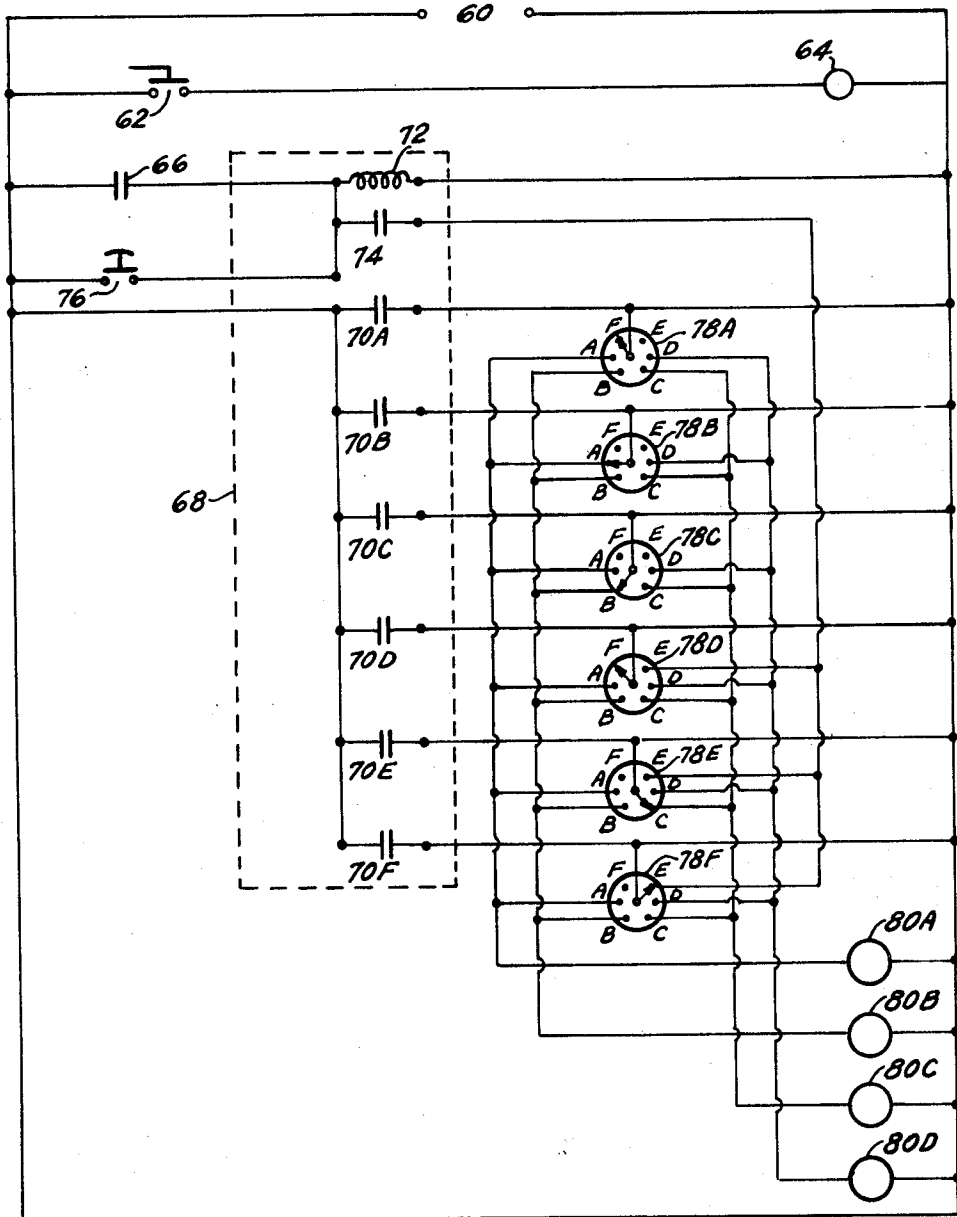
**ABSTRACT:** A bar bending machine comprising a rotatable bending disc having a central pin and a bending pin is provided with a plurality of stops for positioning a bar longitudinally prior to the actuation of said disc. The machine is programmed whereby said disc sequentially rotates through predetermined angles, bending the bar a plurality of times, each rotation being controlled by a switch. The stops are connected to a circuit whereby the proper stop is sequentially moved into and out of the path of the bar during the bending operation.





INVENTORS  
Neal W. Merrill  
Charles R. Nippert

FIG. 3



INVENTORS  
Neal W. Merrill  
Charles R. Nippert

## AUTOMATED STOPS FOR BAR BENDING MACHINE

## BACKGROUND OF THE INVENTION

This invention relates to stops for a bar bending machine, and more particularly to means for sequentially moving stops into and out of the path of a bar during a sequential bending operation.

Bar bending machines known in the art may comprise a tabletop having a rotatable bending disc mounted therein with its face in substantially the same plane as said tabletop. The disc is provided with a central pin and a bending pin; and is connected to control means for sequentially rotating said disc through predetermined angles, said disc automatically returning to its original position following each rotation. The machine is also provided with means on the table top for resisting the binding torque of the bar during a bending operation, and a plurality of horizontally adjustable stops is provided for positioning the bar longitudinally. The control means may be actuated by a foot switch to cause the disc to rotate through the next step in its sequence.

In general, a plurality of bars, e.g. five or 10, is bent at the same time. The bending machine operator is required to use both hands during the bending operation for such tasks as guiding the bars into abutment with the stops.

Following each bend of the bending sequence, the operator must reposition the bars longitudinally prior to initiating the next bend. Except for the outermost stops, the stops provided for this purpose are normally disposed out of the path of the bars and are provided with linkage whereby they may be moved into and out of the path of the bar at the proper step in the sequence. In the past, these stops were moved manually. Following each bend in a sequence in which the next bend required a stop to be placed in the path of the bars, the operator had to: (1) move the bars longitudinally to a position just beyond the desired position of the next stop to be used, (2) release his hands from the bars, (3) move the stop into position on the table, (4) grasp the bars, and (5) move the bars into abutment with the stop. Upon completion of a sequence, the operator had to: (6) manually move all but the outermost stops from the work area of the table prior to placing the next group of bars to be bent on the table.

It is an object of this invention to provide means for moving the stops of a bending machine whereby the above steps (2), (3), (4) and (6) are eliminated.

## SUMMARY OF THE INVENTION

We have discovered that the foregoing object can be attained by connecting to each stop intermediate the outermost stops a pneumatic cylinder adapted to move the stop connected thereto into and out of the path of the bar, and by providing a stepping switch comprising a plurality of sets of contacts which sequentially open and close, the opening of a set of contacts resulting in the automatic closing of the next set of contacts in the sequence. Each pneumatic cylinder is connected to one of said sets of contacts through a selector switch and a relay adapted to actuate said cylinder, whereby closing of said contacts actuates one of the pneumatic cylinders to move the stop connected thereto into the path of the bar, while opening of said contacts actuates one of the pneumatic cylinders to move the stop connected thereto out of the path of the bar. A foot switch is provided having a first position which actuates control means to perform a step in the sequence of rotation of the binding disc and a second position which results in the actuation of the stepping switch to open the closed set of contacts and close the next set of contacts in its sequence.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatic isometric view showing the salient features of a bar bending machine.

FIGS. 2a-2f are sequential views of a bar during a bending operation.

FIG. 3 is a schematic diagram of an electrical circuit for controlling the automatic positioning of the stops.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, the bar bending machine broadly comprises a table top 10 having a rotatable bending disc 12 mounted therein with its face in substantially the same plane as said table top. The bending disc 12 is provided with a central pin 14 and a bending pin 16. Disposed on either side of the central pin 14 are backup pins 18 connected to suitable means, not shown but indicated by the box 20, which permits a small degree of lateral and longitudinal adjustment of said backup pins. The backup pins 18 function to resist the bending torque of a plurality of bars 22, stacked between guide pins 23, during the bending operation. Suitable control means, not shown, is provided for sequentially rotating the disc 12 through predetermined angles, said disc automatically returning to its original position following each rotation.

Disposed longitudinally along the table top is a rail 24 to which a plurality of stops 26, 28, 30, 32 and 34 are slidably mounted. Each stop broadly comprises a pair of vertical plates 36 separated from each other by a spacer plate 38 and pivotally connected, e.g. by hinge 40 (see stop 32) to a slidable block 42 engaging the flange of the rail 24 whereby the longitudinal position of each stop may be varied. Each block 42 is provided with a T-handle bolt 44 for securing the block 42 to the desired position along the rail 24.

Each stop intermediate the outermost stops 26 and 34 is provided with means for automatically moving said stop into and out of the path of the bars 22. This means broadly comprises a housing 46 having a pneumatic cylinder 48 pivotally mounted therein. The outer end of the cylinder 48 is pinned to a bracket 50 mounted at the rear of the housing 46, while the piston rod 52 of said cylinder is provided with an extension arm 54 which is pivotally connected to a pin 56 secured to the vertical plates 36. Retraction of the piston rod 52 results in substantially a 90° rotation of the plates 36. The cylinder 48 is provided with a hose 58, the air supply of which is controlled by means hereinafter to be described.

FIGS. 2a-2e show the bending sequence employed to produce the tie rod shown in FIG. 2f. As can be seen, the sequence consists of five steps, the first three bends being counterclockwise and the last two bends being clockwise. The stops 26-34 are indicated by shaded rectangles in FIG. 2.

FIG. 3 shows the electrical circuit which actuates control means to effect the bending sequence and also controls the pneumatic cylinders 48 to move the stops 28, 30 and 32 into and out of the path of the bars 22. Said circuit broadly comprises a power supply 60 having a foot switch 62, in series with a relay 64, connected thereacross. Depressing the foot switch 62 energizes the relay 64, which causes the bending disc 12 to rotate through a predetermined angle and then return to its original position. In addition, energization of relay 64 results in the closing of contacts 66, which are connected across said power supply in series with a stepping switch 68. A suitable stepping switch is Eagle Signal-MT-6-A606-02+06.

The stepping switch 68 comprises six sets of contacts 70A-70F which, upon deenergization of a solenoid 72, sequentially open and close, the opening of a set of contacts resulting in the automatic closing of the next set of contacts in the sequence. In addition, the stepping switch 68 is provided with a set of skip contacts 74 which can be actuated to close and open, thereby deenergizing solenoid 72 and causing the one closed set of the group of contacts 70A-70F to open and the next set of contacts to close. The solenoid 72 is also connected to a reset switch 76, the actuation of which advances the contacts 70A-70F one step in their sequence.

Each of the sets of contacts 70A-70F is respectively connected to the dial of one of six selector switches 78A-78F. Each selector switch is provided with six positions, identified as A-F. Positions A-D of each selector switch are respectively connected to solenoids 80A-80D, the energization of any one of these solenoids resulting in the closing of contacts which actuates one of the pneumatic cylinders 48 to extend its piston rod 52 and move the stop connected thereto into the path of the bars 22. Similarly, the deenergization of any one of

these solenoids 80A—80D results in the opening of contacts which actuates one of the pneumatic cylinders 48 to retract its piston rod 52 and move the stop connected thereto out of the path of the bars 22.

Positions E and F of selector switches 78A, 78B and 78C are open circuited, as is position F of switches 78D, 78E and 78F. Position E of switches 78D—78F is connected to the skip contact of the stepping switch 68. The reasons for these connections will become clear from the following description of the bending sequence for the tie rod shown in FIG. 2.

The bending sequence shown in FIG. 2 requires the use of five stops, stops 26 and 34 being disposed in the path of the bars during the entire bending operation, while stops 28, 30 and 32 are initially disposed out of the path of the bars. Selector switch 78A is dialed to position F (or E), switch 78B is dialed to position A, switch 78C is dialed to position B, switch 78D is dialed to position F, switch 78E is dialed to position C, and switch 78F is dialed to position E. The stepping switch 68 is initially set with contacts 70A closed. Relays 80A, 80B, and 80C are connected so as to energize the cylinders which actuate stops 28, 30 and 32, respectively, while relay 80D is connected so as to energize the cylinder which actuates an additional stop, not shown, which is used in a bending sequence requiring six bends rather than five.

The operator initially places the bars 22 against stop 26 and depresses the foot switch 62 which actuates the bending disc 12 to perform the first bend in the sequence (see FIG. 2a). The operator then moves the bars longitudinally to a position just beyond the desired position of stop 28 and removes his foot from the foot switch, said switch automatically returning to its original position and deenergizing relay 64.

The deenergization of relay 64 results in the opening of contacts 70A of stepping switch 68 and the closing of contacts 70B thereof. Closing of contacts 70B results in the energization of relay 80A and the movement of stop 28 into the path of the bars 22. The operator then moves the bars 22 against stop 28 and depresses the foot switch 62 to perform the second step in the sequence as shown in FIG. 2b. Following this bend, the operator moves the bars longitudinally to a position just beyond the desired position of stop 30 and removes his foot from the foot switch 62, thereby deenergizing relay 64.

Deenergization of relay 64 results in the opening of contacts 70B and the closing of contacts 70C. Opening of contacts 70B results in the movement of stop 28 out of the path of the bars, while closing of contacts 70C results in the movement of stop 30 into the path of the bars. The operator then moves the bars against the stop 30 and depresses the foot switch to perform the bend shown in FIG. 2c. Following this bend, the operator moves the bars against stop 34, which is in the path of the bars during the entire bending operation, and removes his foot from the foot switch to advance the stepping switch 68. Contacts 70C open, resulting in the removal of the stop 30 from the path of the bars, and contacts 70D close. Inasmuch as contacts 70D are connected to an open circuit, the removal of stop 30 from the path of the bars is the only function during this advance of the stepping switch.

Following the bending of the bars as shown in FIG. 2d, the operator moves the bars longitudinally to a position just beyond the desired position of stop 32 and removes his foot from the foot switch. This results in the opening of contacts 70D, performing no function, and the closing of contacts 70E, which results in the energization of relay 80C and the movement of stop 32 into the path of the bars. The operator then moves the bars against stop 32 and depresses the foot switch to perform the bend shown in FIG. 2e, the final bend in this particular sequence. Following this bend, the operator removes his foot from the switch, resulting in the opening of contacts 70E and the closing of contacts 70F. The opening of contacts 70E removes stop 32 from the path of the bars, while the closing of contacts 70F actuates the skip contacts 74 to advance the stepping switch, thereby opening contacts 70F and closing contacts 70A. Inasmuch as contacts 70A are connected to an open circuit, no stops are actuated and the bending machine is set to repeat the above-described bending sequence.

We claim:

1. In a bar bending machine comprising a tabletop, a rotatable bending disc mounted in said table top with its face in substantially the same plane as said table top, said disc being provided with a central pin and a bending pin, means on said table top for resisting the bending torque of the bar during the bending operation, a plurality of horizontally adjustable stops for positioning said bar longitudinally, control means for sequentially rotating said disc through predetermined angles, said disc automatically returning to its original position following each rotation, the improvement comprising:

- a. means, connected to each of said stops intermediate the outermost stops, for moving the stop connected thereto into and out of the path of said bar,
- b. a stepping switch comprising a plurality of sets of contacts which sequentially open and close, the opening of a set of contacts resulting in the automatic closing of the next set of contacts in the sequence,
- c. means connecting each means (a) to one of said sets of contacts of means (b) whereby closing of said contacts actuates one of means (a) to move the stop connected thereto into the path of said bar, while opening of said contacts actuates said one of means (a) to move the stop connected thereto out of the path of said bar, and
- d. means for alternately:
  - i. actuating said control means to perform a step in the sequence of rotation of said bending disc; and
  - ii. actuating said stepping switch to open said closed set of contacts and close the next set of contacts in its sequence.

2. The improvement as recited in claim 1, in which means (d) comprises a switch having a first position which actuates said control means to perform a step in the sequence of rotation of said bending disc and a second position which results in the actuation of said stepping switch to open the closed set of contacts and close the next set of contacts in its sequence.

60

65

70

75