

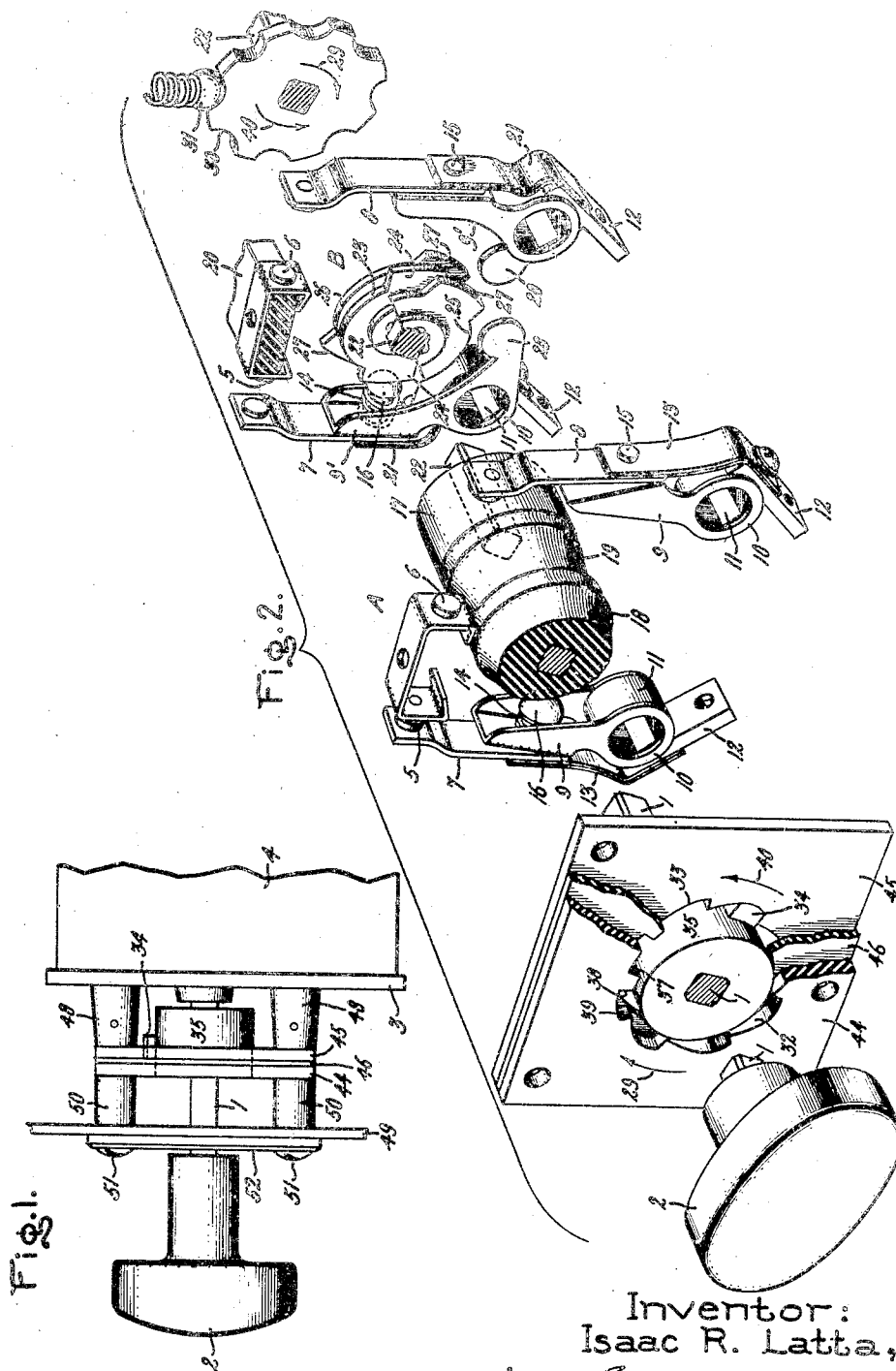
Jan. 18, 1949.

I. R. LATTA
CONTROL DEVICE

2,459,564

Filed April 17, 1946

2 Sheets-Sheet 1



Inventor:
Isaac R. Latta,
by *Ernest Britton*
His Attorney.

Jan. 18, 1949.

I. R. LATTA
CONTROL DEVICE

2,459,564

Filed April 17, 1946

2 Sheets-Sheet 2

Fig. 3.

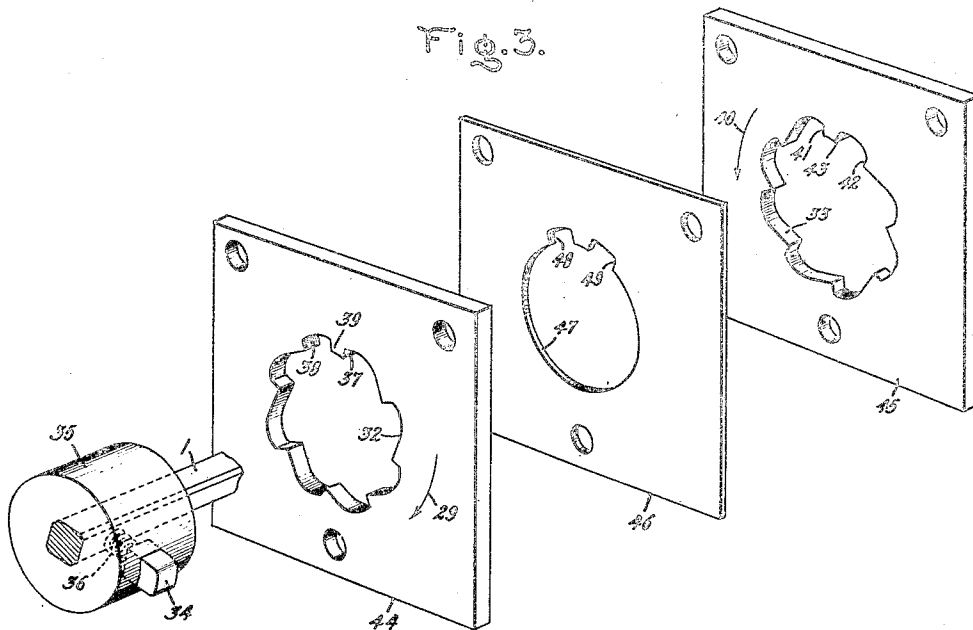
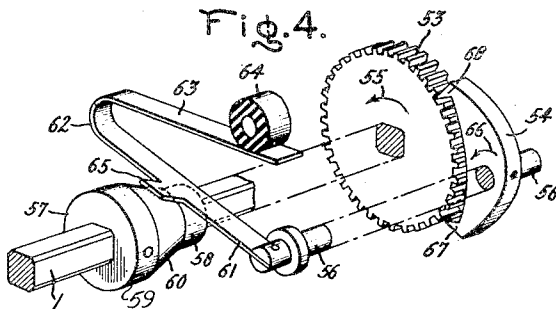


Fig. 4.



Inventor:
Isaac R. Latta,
by *Ernest C. Britton*
His Attorney.

UNITED STATES PATENT OFFICE

2,459,564

CONTROL DEVICE

Isaac R. Latta, Drexel Hill, Pa., assignor to General Electric Company, a corporation of New York

Application April 17, 1946, Serial No. 662,674

9 Claims. (Cl. 200—5)

1

My invention relates to improvements in control devices and more particularly control devices for electric switches which require operation in a predetermined sequence.

High frequency induction furnaces comprise a heating coil surrounding a crucible. The coil is supplied from a high frequency inductor alternator through a circuit including a main line contactor. Loose pieces of the material to be melted are placed in the crucible. Consequently, the power factor of the furnace initially is low and a suitable amount of permanently connected capacitance is used to obtain unity power factor at the start of the melt. As the melt progresses, the material settles in the crucible thereby lowering the level of the material and the change in coupling reduces the over-all power factor. Since the inductor alternator is designed to run at unity power factor, it is necessary, in order to avoid the abnormally high field currents consequent upon lagging power factor, to add capacitance across the furnace coil from time to time. This is usually done by connecting capacitors across the coil through contactors, several of which are required. It is customary to use contactors which may be closed under load but which cannot be opened under load because magntic blowout contactors capable of handling high frequency power are complicated and costly. It is therefore necessary that the main line contactor and the capacitor connecting contactors be operated in a definite sequence for closing and opening. The sequence usually employed is close the main line contactor, then successively close the capacitor connecting contactors, open the main line contactor and then open the capacitor connecting contactors in reverse order. Obviously any control device for obtaining this sequence must be reliable and foolproof otherwise damage to apparatus and danger to personnel are probable.

An object of my invention is to provide an improved control device for obtaining a definite sequence of operation of a single device and a plurality of other devices, each of which is operable to two different positions. Another object of my invention is to provide an improved control device wherein an operating member, arranged for translation and rotation, controls at least one electric switch by its translatory movement and a plurality of electric switches by its rotary movement so as to effect a predetermined sequence in the closing and opening of all the switches. A further object of my invention is to provide an improved "foolproof" control device

2

for relatively economically obtaining a desired sequence of operations between the opening and closing of a single switch and a group of switches. These and other objects of my invention will appear in more detail hereinafter.

In accordance with my invention, I provide an improved control device comprising a member mounted for translation and rotation, a device to be operated to one position upon translatory movement of the member in a predetermined direction and to another position upon reverse translatory movement of the member and a plurality of devices adapted to be operated in a predetermined order upon rotary movement of the member in one direction and to be operated in reverse order upon rotation of the member in the opposite direction. Also in accordance with my invention, I provide pawl and ratchet means for preventing rotary movement of the member in the one direction until translatory movement of the member in the predetermined direction including means for preventing the opposite rotary movement of the member until reverse translatory movement thereof. Further in accordance with my invention, I provide means permitting translatory movement of the member only when it has been rotated in either direction to one or the other of its extreme positions.

My invention will be better understood from the following description when considered in connection with the accompanying two sheets of drawings, and its scope will be pointed out in the appended claims.

In the accompanying two sheets of drawings, Fig. 1 is a partial side elevation of a control device embodying my invention; Fig. 2 is an exploded perspective of the control device only partially illustrated in Fig. 1, parts being broken away and omitted for clearness; Fig. 3 is an exploded perspective of a pawl and ratchet mechanism embodying my invention and shown in Figs. 1 and 2; and Fig. 4 illustrates in perspective a modification of my invention.

In the embodiment of my invention shown in Figs. 1, 2 and 3, I have illustrated a control device comprising a member such as a shaft 1 which is mounted for rotation and translation and which has rigidly secured thereto a handle 2 for effecting such movements. As shown, the shaft 1 is slidably and rotatably mounted in a bearing plate 3 which forms a part of a control switch structure having a housing 4 indicated in part in Fig. 1.

The control switch structure comprises a switch A which is arranged to be closed when the shaft

3

1 is moved in, that is from left to right as viewed in Fig. 1 to the position shown in Figs. 1 and 2, and when the handle is moved out, the switch is arranged to be opened. As shown, the control switch structure, shown in Fig. 2, comprises two interconnected stationary contacts 5 and 6, and respectively cooperating movable contacts 7 and 8. These movable contacts are mounted on pivotally supported carriages 9, the supports passing through openings 10 in the carriages but not being shown for clearness in illustration. Also, while the contacts 5 and 7 are shown in the closed position and the contacts 6 and 8 should be likewise, the contact 8 is bodily displaced for clearness of illustration of other parts. The supports for the contact carriages 9 may be in the form of octagonal rods, not shown, of suitable insulating material. Mounted on these rods between the sides of the contact carriages and nonrotatable relatively to the supports are terminal hubs 11, each carrying a terminal 12. Interconnecting these terminals and the respectively associated movable contacts 7 and 8 are suitable biasing means such as leaf springs 13 which tend to move the movable contacts into engagement with their respective stationary contacts. Also, as shown, each movable contact has a limited movement relatively to its carriage through a resilient connection comprising a spring 14 around a post 15 which is secured to the contact and is movable through an opening in the carriage, the pin being terminated by a rounded head 16 for contact actuating purposes.

For moving the contacts 7 and 8 into and out of engagement with the respective stationary contacts 5 and 6 in response to translatory movement of the shaft 1, I rigidly mount thereon an operating member such as a cylindrical cam 17 of suitable insulating material. As shown, this cam is provided with two circumferentially recessed portions such as grooves 18 and 19 which are shaped so as slidably to receive the rounded heads 16 of the pins 15. The diameter of the groove 18 is small enough to permit the circuit closing movement of the contacts 7 and 8 when the handle 2 is pushed in as shown in Fig. 2, and the groove 19 is large enough to insure the circuit opening movement of the contacts 7 and 8 when the handle is pulled out. In other words, the switch A comprising the contacts 5, 6, 7 and 8 is adapted to be operated to one circuit controlling position upon translatory movement of the shaft 1 in a predetermined direction and to another circuit controlling position upon reverse translatory movement of the shaft.

The control device further includes a plurality of switches B arranged to be actuated sequentially in response to rotation of the shaft 1 in either direction. The number of these switches B is immaterial, as far as my invention is concerned, and, although seven will be assumed in further explanation of my invention, only one is shown in Fig. 2 in the circuit open position since all have essentially the same structure. As in the showing of the switch A, the movable contact 8 and its supporting structure are bodily displaced from the longitudinal center line of the control device for clearness in illustration. This structure is generally similar to that of switch A in that it comprises two interconnected stationary contacts 5 and 6 and two respectively cooperating movable contacts 7 and 8, the contacts 5 and 6 being mounted on a longitudinal insulating support 20 which it is to be understood extends through and similarly supports the contacts 5 and

4

6 of the switch A. The movable contacts 7 and 8 are mounted on pivotally supported brackets 9' for a limited movement relatively thereto in the same manner as in switch A. The terminal links 11, however, are connected to the movable contacts by flexible leads 21 instead of biasing springs 13.

For actuating the movable contacts 7 and 8 of the switches B into and out of engagement with their respectively cooperating contacts 5 and 6, I provide a shaft 22, shown in Fig. 2 with portions broken away for clearness. This shaft fits into a suitable recess in the rear end of the cam 17 so as to rotate therewith and yet allow the cam to have longitudinal sliding movement relatively to the shaft. On the shaft 22, for actuating the contacts 7 and 8 to and from the circuit closing position, are mounted an opening cam 23 provided with two diametrically opposite raised portions 24 for engaging the rounded heads 16 of the pins 15 and two closing cams 25 and 26 each provided with raised portions 27 for engaging opposing extensions 28 on the movable contact supporting brackets 9'. Thus, when the shaft 22 is turned a predetermined amount in the direction indicated by the arrow 29 in Fig. 2, the cams 24 will move off the heads 16 and the cams 25 and 26 will engage the bracket extensions 28 to effect the circuit closing movement of the contacts 7 and 8. By varying the contour of the cams 23, 25 and 26 and their angularity relatively to the shaft 22, a plurality of switches B can be arranged for operation in practically any desired sequence, as is well known to the art. In the electric furnace application heretofore referred to, the desired sequence is to have all switches B open and then to close one after another until all are closed and then to open them in reverse order.

For centering the shaft 22 in any rotary switch operating position, the shaft is shown as provided with an indent 30 and a cooperating spring biased centering ball 31. The feel of the action of this ball 31 as it drops into one of the hollows in the peripheral surface of the indent 30 indicates to the operator that the handle 2 has been turned from one rotary switching position to another.

In order to prevent the closing of the switches B before the switch A is closed and also to prevent the opening of the switches B before the switch A is opened, I provide pawl and ratchet means for preventing rotary movement of the shaft 22 in the direction indicated by the arrow 29 in Fig. 2 until the handle 2 and the shaft 1 rigidly associated therewith are pushed in to the position shown in Figs. 1 and 2 and to prevent reverse rotation of the shaft 22 until the handle is pulled outwardly from the position shown in Figs. 1 and 2. As shown more clearly in Fig. 3, the ratchet device comprises two sets of running pawl surfaces 32 and 33 in reverse order and a cooperating pawl 34 which is mounted for movement with the shaft 1 and relatively thereto at right angles so as to ride along the pawl surfaces. Thus, as shown, the pawl 34 is resiliently mounted in a suitable opening in a cylindrical hub 35 rigidly secured to the shaft 1 and is biased outwardly by a spring 36. The ratchet set or element 32 is so shaped relatively to the pawl 34 as to permit rotation of the shaft 1 only in the direction indicated by the arrows 29 in Figs. 2 and 3 from a stop shoulder 37 to a stop recess comprising shoulders 38 and 39 which so engage the pawl as to prevent rotation thereof in either direction until the pawl is moved transversely of the ratchet element 32. The ratchet element 33 is so shaped relatively to

the pawl 34 as to permit rotation of the shaft 1 only in a direction indicated by the arrows 40 in Figs. 2 and 3 from a stop shoulder 41 to a stop recess comprising shoulders 42 and 43 which so engage the pawl as to prevent rotation thereof in either direction until the pawl is moved transversely of the ratchet element 32. In order to permit movement of the pawl 34 from one ratchet to another when the pawl is in one of the stop recesses, the stop shoulder 37 of the ratchet 32 is substantially coplanar with the shoulder 43 of the stop recess on the ratchet 33 and the stop shoulder 41 of the ratchet 33 is substantially coplanar with the shoulder 39 of the stop recess on the ratchet 32.

As shown, each of the ratchets has seven sliding positions and an extreme or stop position. While the ratchets 32 and 33 may be formed in a unit by machining, casting or the like, I prefer as a matter of practical manufacturing and economy to form them by punching, for example, separate plates 44 and 45, respectively. In this way, both plates are punched alike and then one is reversed and the plates are mounted back to back. In order to prevent any possibility of transverse movement of the shaft 1 except when in one of its extreme positions, I provide blocking means such as a blocking plate 46 which is mounted between the ratchet plates 44 and 45. As shown more clearly in Fig. 3, the plate 46 is provided with a central opening 47 which is just large enough to permit translatory movement of the hub 35. To permit such movement only when the shaft 1 is in one of its extreme positions, defined by the stop shoulders 37 and 41, the plate 46 is provided with two passing pawl recesses 48 and 49 which are aligned with the stop recesses in the ratchet sets 32 and 33, respectively. As shown in Fig. 1, the ratchet plates 44 and 45 and the blocking plate 46 are mounted on posts 48 which extend outwardly from the bearing plate 3. Between the ratchet plate 44 and a switchboard panel 49, assumed to be of the relatively thin metallic type, are spacers 50. Screws 51 extending through an escutcheon plate 52, the switchboard panel 49, the spacers 50, the ratchet plates 44 and 45 and the blocking plate 46 into the posts 48 serve to maintain the assembly.

As shown in Figs. 1 and 2, the handle 2 is pushed in to close the switch A and the pawl 34 is in the ratchet 33 so that the handle can be turned in the direction indicated by the arrow 40. Starting from the stop shoulder 41 in this ratchet, each time the pawl 34 is advanced a notch one of the switches B is closed until finally the pawl comes to one of its extreme positions in the stop notch 42-43. The switch A and all of the switches B are now closed. Before any of the switches B can be opened, the handle 2 must be pulled outwardly to move the pawl 34 through the notch 49 in the blocking plate 46 and into the first notch with the stop shoulder 37 in the ratchet 32. This longitudinal or translatory movement of the shaft 1 moves the cam 17 to effect the opening of the switch A. The handle 2 can now be turned in the direction indicated by the arrow 29, and the switches B opened sequentially in the reverse order to their closing. When the pawl 34 reaches its extreme position in the stop notch 38-39, all switches are open. Before any of the switches B can be closed, the handle 2 must be pushed in to pass the pawl through the notch 48 in the blocking plate 46

and into the notch in the ratchet 33 having the stop shoulder 41.

While I have shown and described a switch sequence such as is used in capacitor switching for high frequency electric furnaces wherein the switches B are closed one after the other and opened in the reverse order, it will be apparent to those skilled in the art that any predetermined sequence of operation of the switches B can be obtained in one direction of rotation of the handle 2 and the reverse sequence for the opposite direction of rotation.

In the modification of my invention shown in Fig. 4, I have illustrated another pawl and ratchet arrangement for accomplishing the same result as the pawl and ratchet arrangement shown in Figs. 1, 2 and 3. In the arrangement shown in Fig. 4, the shaft 1 is slidable through a central opening in a rotatably mounted ratchet 53, the shape of the opening and the shaft being such that the ratchet and shaft must turn together. Cooperating with the ratchet 53 is a pawl 54 so mounted that when the shaft 1 is pulled outwardly into the position shown in Fig. 4, the shaft can be turned only in the direction indicated by the arrow 55, and when the shaft is pushed inwardly, it can be turned only in the opposite direction. For this purpose, the pawl 54 is rigidly secured to a rotatably mounted member such as a shaft 56 which is arranged to be turned in one direction or the other as the shaft 1 is moved lengthwise. Thus, as shown, the shaft 1 is provided with a generally cone shaped cam 57 having cylindrical bearing surfaces 58 and 59 and a conical surface 60. In the position shown, one leg 61 of a hairpin shaped spring 62 bears on the cylindrical surface 58. The end of the leg 61 is rigidly secured to the shaft 56 and the other leg 63 bears against a fixed abutment 64. Also, as shown, the leg 61 of the spring is provided with an upturned transverse portion or shoe 65 for guiding the spring leg 61 upward on the conical surface 60 when the shaft 1 is pushed inwardly from the position shown in Fig. 4.

In the position shown in Fig. 4, the spring 62 is so stressed that the shaft 56 is turned in the direction indicated by the arrow 66 to disengage the lower point 67 of the pawl 54 from the ratchet 53 and to cause the upper point 68 of the pawl to engage the ratchet. The shaft 1 can then be turned only in the direction indicated by the arrow 55. When the shaft 1 is pushed inwardly, the cam 57 moves under the leg 61 of the spring 62 until the leg rests on the cylindrical portion 59 thereby so stressing the spring that the shaft 56 is turned oppositely to the direction indicated by the arrow 66. The upper point 68 of the pawl is disengaged from the ratchet 53, and the lower point 67 is caused to engage the ratchet so that the shaft 1 can be turned only in a direction opposite to that indicated by the arrow 55.

While I have shown and described my invention in considerable detail, I do not wish to be limited to the exact arrangements shown and described, but seek to cover in the appended claims all those modifications that fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric switch comprising a member mounted for rotation and translation, a switch adapted to be operated to one circuit controlling position upon translatory movement of said member in a predetermined direction and to another

circuit controlling position upon reverse trans-
latory movement of the member, a plurality of
switches adapted to be operated in a predeter-
mined order upon rotary movement of said mem-
ber in one direction and to be operated in reverse
order upon rotary movement of the member in
the opposite direction, and pawl and ratchet
means for preventing rotary movement of said
member in said one direction until translatory
movement of the member in said predetermined
direction constructed and arranged to prevent
the opposite rotary movement of the member
until reverse translatory movement thereof.

2. An electric switch comprising a member
mounted for rotation and translation, a switch
adapted to be closed upon translatory movement
of said member in a predetermined direction and
to be opened upon reverse translatory movement
of said member, a plurality of switches adapted
to be closed consecutively upon rotary movement
of said member in one direction and to be opened
reversely upon rotary movement of the member
in the opposite direction, and means for prevent-
ing rotary movement of said member in said one
direction until translatory movement thereof in
said predetermined direction and for preventing
the opposite rotary movement of the member
until the reverse translatory movement thereof
comprising a ratchet device having two sets of
running pawl surfaces in reverse order and a
cooperating pawl mounted for movement with
said member and relatively to said pawl recesses.

3. An electric switch comprising a member
mounted for rotation and translation, a switch
adapted to be closed upon translatory movement
of said member in a predetermined direction and
to be opened upon reverse translatory movement
of said member, a plurality of switches adapted
to be closed consecutively upon rotary movement
of said member in one direction and to be opened
reversely upon rotary movement of the member
in the opposite direction, means for preventing
rotary movement of said member in said one
direction until translatory movement thereof in
said predetermined direction and for preventing
the opposite rotary movement of the member
until the reverse translatory movement thereof
comprising a ratchet device having two sets of
running pawl recesses in reverse order and a
cooperating pawl mounted for movement with
said member and relatively to said pawl recesses,
and means for permitting translatory movement
of said member to shift said pawl from one set
of ratchet recesses to the other only when all of
said plurality of switches are either open or closed.

4. A control switch comprising a member
mounted for rotation and translation, a switch
adapted to be closed upon translatory movement
of said member in a predetermined direction and
to be opened upon reverse translatory movement
of said member, a plurality of switches adapted
to be closed consecutively upon rotary movement
of said member in one direction and to be opened
reversely upon rotary movement of the member
in the opposite direction, and means for prevent-
ing rotary movement of said member in said one
direction until translatory movement thereof in
said predetermined direction and for preventing
the opposite rotary movement of the member
until the reverse translatory movement thereof
including a pawl carried by said member, a first
ratchet element cooperating with said pawl and
shaped to permit rotation of said member only
in said one direction to a number of positions
greater by one than the number of said plurality

of switches, a second ratchet element cooperating
with said pawl and shaped to permit rotation of
said member to said positions only in the reverse
direction and blocking means between said ele-
ments for permitting translatory movement of
said member to effect movement of said pawl
from engagement with one of the elements into
engagement with the other element only when
the member is in one of its extreme positions.

5. A control device comprising a member
mounted for rotation and translation, an electric
switch adapted to be operated to one circuit con-
trolling position upon translatory movement of
the member and to another circuit controlling
position upon reverse translatory movement of
the member, a plurality of electric switches
adapted to be operated in a predetermined order
upon rotary movement of said member in one
direction and to be operated in reverse order upon
rotary movement of the member in the opposite
direction, and means for preventing rotary move-
ment of said member in said one direction until
translatory thereof in said predetermined direc-
tion and for preventing the opposite rotary move-
ment of the member until the reverse translatory
movement thereof including a pawl carried by
said member and two oppositely disposed ratchet
elements cooperating with said pawl and respec-
tively shaped to permit rotation of said mem-
ber to a predetermined number of positions first
in one direction and reverse and to require trans-
latory movement of the member before a change
in the direction of rotation thereof can be ef-
fected.

6. A control device comprising a member
mounted for rotation and translation, a pawl car-
ried by said member, a first ratchet element co-
operating with said pawl and shaped to permit
rotation of said member through a predeter-
mined number of positions only in one direction, a
second ratchet element cooperating with said
pawl and shaped to permit rotation of said mem-
ber through said positions only in the reverse
direction, and blocking means between said ele-
ments for permitting translatory movement of
said member to effect movement of said pawl
from engagement with one of the elements into
engagement with the other element only when the
member is in one of its extreme positions.

7. A control device comprising a member
mounted for rotation and translation, a pawl car-
ried by said member, a first ratchet element co-
operating with said pawl and shaped to permit
rotation of said member through a predetermined
number of positions only in one direction, a sec-
ond ratchet element cooperating with said pawl
and shaped to permit rotation of said member
through said positions only in the reverse direc-
tion, said pawl being movable out of engagement
with one of said ratchet elements into engage-
ment with the other upon translatory movement
of said member, and means for permitting trans-
latory movement of said member only when the
member is in one or the other of its extreme po-
sitions.

8. A control device comprising a member
mounted for rotation and translation, a device
to be operated to one position upon translatory
movement of said member in a given direction
and to another position upon reverse translatory
movement of the member, a plurality of devices
adapted to be operated in a predetermined order
upon rotary movement of said member in one
direction and to be operated in reverse order
upon rotary movement of the member in the op-

posite direction, and pawl and ratchet means for preventing rotary movement of said member in said one direction until translatory movement of the member in said given direction including means for preventing the opposite rotary movement of the member until reverse translatory movement thereof.

9. A sequence control device comprising a sequencing member mounted for both rotation and axial movement and having a radially movable pawl carried thereby, a first ratchet element for engaging with said pawl in one axial position of the member and having a series of recesses shaped to permit a partial revolution of said member and pawl through a corresponding series of angular positions only in one direction, a second ratchet element for cooperating with said pawl in another axial position of the member

and having a series of recesses reversely shaped to permit only a reverse partial revolution of said member and pawl through said angular positions, and blocking means laterally engaging said pawl for preventing axial movement of said member between said axial positions intermediate the beginning and end of each partial revolution of said member.

ISAAC R. LATTA.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,333,549	Novak	Nov. 2, 1943