

Dec. 16, 1952

J. B. CATALDO

2,622,164

SEQUENCE RELAY

Filed June 17, 1950

2 SHEETS—SHEET 1

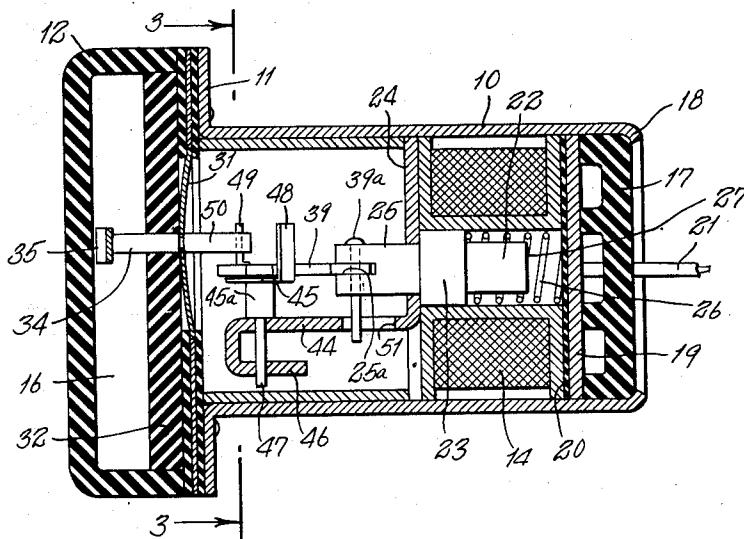
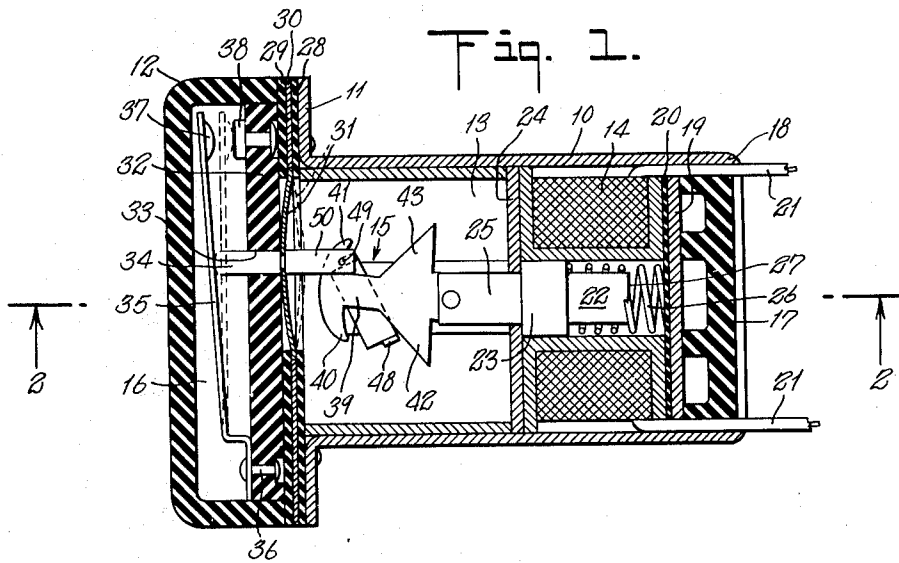


Fig. 2.

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2 SHEETS—SHEET 2

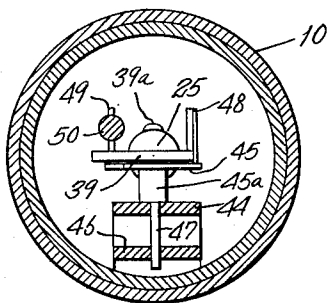


Fig. 3.

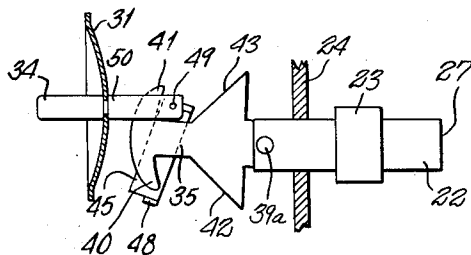


Fig. 4.

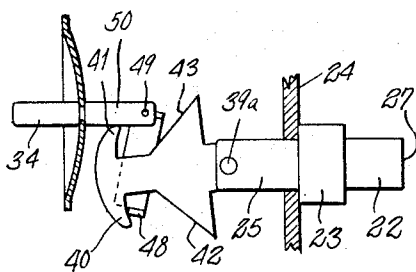


Fig. 5.

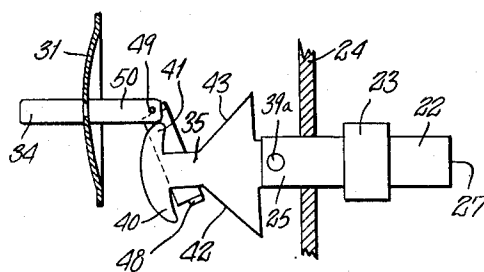


Fig. 6.

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2,622,164

SEQUENCE RELAY

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Application June 17, 1950, Serial No. 168,811

2 Claims. (Cl. 200—87)

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This invention relates to relays and more particularly to relays adapted to perform sequential control operations.

Relay devices have been devised according to the prior art utilizing motion-modifying driving connections between the input means, such as a solenoid device, and the output means, such as electrical contact means, whereby a series of repeating input movements are transformed into a given sequence of movements in the output. Springs of various types have been used to implement this sequential action. It has been found, however, that springs are subject to variations in their characteristics through wear and also that they have null points at which their action is sluggish, rather than positive. Moreover, springs reacting between two relatively movable components, for example, may introduce skewwise forces which necessitates the use of costly guide bearing assemblies to insure the necessary ease of movement.

It is accordingly an object of this invention to provide a relay affording sequential control action by means of positive driving connections.

It is a further object of the invention to provide a simplified relay assembly utilizing a minimum of operative parts adapted to afford long wear with constant performance characteristics.

It is a further object of the invention to provide an electro-magnetic relay assembly susceptible of economical manufacturing procedures.

These and other objects may be attained according to the invention by providing a novel driving linkage between the reciprocating armature of an electro-magnetic relay, for example, and the separable electrical contacts representing the output means. The interposed linkage may comprise a swinging link pivoted to the armature and an oscillatory member centrally pivoted and adapted to be selectively engaged by the swinging link on opposite sides of this pivot center. In order to effect oscillatory movement of the member, sequential swinging movement of the link alternately in opposite directions is provided by a pair of laterally extending camming surfaces formed on the shank portion of the link. When the link partakes of endwise reciprocatory movement in a given direction one cam engages a cooperating shoulder of the oscillatory member to urge the link in an angular direction toward the remote extremity of the oscillatory member where a unidirectional driving connection is established. A second cam effects movement in the opposite direction on the next stroke in the given direction, thereby to afford an oscillatory move-

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ment of the member for each pair of reciprocatory armature movements.

This simplified motion converting linkage operates without springs in the reversing linkage and also facilitates the use of a simplified assembly for the electro-magnetic armature apparatus of the relay, all as described below with reference to the accompanying drawing in which:

Fig. 1 is a view in longitudinal cross section of a relay constructed according to the invention and taken substantially through the center line thereof;

Fig. 2 is a view in longitudinal cross section of a portion of the relay taken along the line 2—2 of Fig. 1 looking the direction of the arrows;

Fig. 3 is a view in transverse cross section taken on the line 3—3 of Fig. 2; and

Figs. 4, 5 and 6 are a series of plan views of the motion-modifying driving connections in the relay showing the sequential operation thereof.

Referring to Fig. 1 of the drawing, there is shown a relay formed according to the invention and comprising an outer cylindrical shell portion 10 having a radial flange 11 formed at its left end, as viewed in the drawing, and to which is secured an enlarged base member 12 formed of insulating material. The cylindrical shell forms a chamber 13 adapted to receive a solenoid coil 14 and a motion-modifying driving linkage indicated generally at 15, and the enlarged base portion forms a chamber 16 for housing an electrical contact assembly to be described.

The solenoid coil 14 is mounted in the right hand end of the chamber 13 and is abutted against an insulating cap 17, the latter being abutted against an inwardly rolled edge 18 formed on the shell 10. A magnetic end plate 19 having an overlying face of resilient sheet material 20, such as semi-hard rubber for example, is interposed between the cap 17 and the coil 14 to afford a buffer, and suitable openings or notches (not shown) are provided in the end plate 19 for receiving conventional pigtail conductor leads 21 for energizing the coil.

The coil 14 is centrally apertured to receive slidably a magnetic plunger or armature 22 having a shoulder 23 formed thereon. A second magnetic end plate 24 is mounted at the left hand end of the coil, the end plate 24 being centrally apertured to receive an extension 25 formed on the relay plunger. The end plate 24 also forms an abutment or stop for the shoulder 23 of the plunger 22, and a coil spring 26, received in the circular space between the plunger and the bore of the coil, is interposed between the shoulder 23

and the end plate 29 to urge the armature toward its outer or left hand position. The right hand end 27 of the plunger 22 is spaced from the rubber buffer 20 by an amount representing the travel of the plunger when the coil 14 is actuated. The end 27 is flat to afford a good bearing against the buffer 20 to prevent chattering.

Abutted against the flange 11 and confined by the base member 12 are a pair of discs 28 and 29 eccentrically apertured and spaced apart by a shim 30 to afford a peripheral mounting assembly for a snap spring disc 31. The snap spring disc 31 is adapted to be displaced between two configurations of equilibrium as shown in Figs. 5 and 6, for example, and may be formed according to known methods such as disclosed in the following copending applications: Patent No. 2,571,170, dated October 16, 1951, entitled Toggle Springs; Serial No. 635,956, filed December 19, 1945, now Patent No. 2,604,316, dated July 22, 1952, entitled Snap Disc Springs, and Serial No. 139,182, filed January 18, 1950, entitled Snap Springs and Methods of Manufacture.

An insulating barrier 32 is mounted in the enlarged chamber 16 and is formed with a bore 33 in concentric alignment with the center of the snap spring disc 31. A shaft extension 34 is slidably received in the bore 33, the inner end of the shaft extension being affixed to the center or movable portion of the snap spring disc 31.

The free end of the shaft 34 is adapted to engage a resilient conductor arm 35 secured at its end to the insulating barrier at 36. The free end of the arm 35 carries a contact element 37 and a corresponding stationary contact element 38, adapted to be engaged thereby, is mounted in the barrier 32. The contacts 37-38 are spaced apart in open-circuit relationship when the snap spring disc 31 is disposed in its configuration as shown in Fig. 1. When the configuration of the disc is reversed as shown in broken lines, the contacts will close due to the action of the resilient arm 35, and a closed electrical circuit through the relay, including suitable external terminals or leads (not shown), is established. The disc 31 and contact mechanism comprise the work output means for the motion modifying mechanism of the relay.

In order to effect sequential operation of the relay contacts by means of intermittent energization of the relay through the 2-wire control leads 21, the motion-modifying driving linkage indicated generally at 15 is provided. This linkage includes a swinging link 39 received in a slot 25a formed in an extension 25 of the plunger 22, the link being pivotally secured in the slot by a pin 39a. The free end of the swinging link 39 is formed with a pair of laterally extending shoulders 40 and 41 respectively, and a pair of laterally flared cam surfaces 42 and 43 are formed on the arm intermediate its ends. A bracket 44 (Fig. 2), preferably formed integrally with the end plate 24, is arranged in the chamber 13 to lie parallel to the link 39 and has journaled thereon an oscillatory member 45 formed with a central hub portion 45a. In order to provide a good bearing for the oscillatory member 45, the free end of the bracket 44 is doubled back to form a reversely extending arm 46 which is apertured to receive an extension 47 formed of the hub of the oscillatory member 45.

The oscillatory member 45 is formed with a pair of parallel arms 48 and 49 disposed on opposite sides of its axis and between which the free end of the link 39 is adapted to be swung. A connecting link 50 is formed adjacent its right hand

end with a bore which receives the arm 49 of the oscillatory member in a driving connection. The left hand end of the link 50 is affixed to the center of the snap spring disc 31 so that oscillatory movement of the member 39 may drive the snap spring disc 31 between its configuration of equilibrium as described below.

The sequential operation of the relay is best seen with reference to Figs. 1 and 4 to 6. In Fig. 1 the swinging link 39 is shown with its shoulder portion 41 in pulling engagement with the arms 49 of the oscillatory member. Thus when the relay coil 14 is energized and the plunger 22, which comprises the input member for the motion modifying linkage, drawn to the right, the swinging link pulls against the oscillatory member 45 to effect limited clockwise turning movement. This causes the snap disc 31 to be urged into its configuration as shown in Fig. 4 through the connecting link 50, and the relay contacts 37-38 close by virtue of the action of the resilient conductor arm 35.

Deenergizing the coil 14 permits the plunger 22 to return through the action of the coil spring 26 to its inactive position as shown in Fig. 5, and in so doing the camming surface 43 of the swinging link 39 engages the arm 49 of the oscillatory member, thereby camming the link in counterclockwise direction about its pivot 39a to the position shown in Fig. 5, in which position the shoulder 40 is positioned behind the arm 48 of the oscillatory member 44. The return movement of the plunger does not affect the oscillatory member. The next subsequent energization of the coil 14, in drawing the plunger to the right, will rotate the oscillatory member in a counterclockwise direction, and the connecting link 50 will be driven to the right. This causes the snap spring 31 to revert to its initial configuration of equilibrium as shown in Fig. 6, which forces the shaft extension 34 against the conductor arm 35 to separate the contacts 37 and 38, thereby to complete one cycle of operation of the relay. Deenergization of the coil 14 then permits the spring 26 to return the plunger to its inoperative position, and on this stroke the camming surface 42 engages the arm 48 which causes the link 39 to swing in a clockwise direction to permit a unidirectional driving engagement to be established between the shoulder 41 on the link 35 and the arm 49 on the oscillatory member 45. In this fashion the linkage is prepared for the next subsequent momentary energization of the coil which will begin the cycle of operations described above.

In order to prevent rotation of the plunger 22 about its axis which would destroy the precise orientation of the swinging link 39 with respect to the oscillatory member 45, the pivot pin 39a may be formed with an elongated shank which is received in a slot (Fig. 2) formed in the bracket 44.

It will be understood, therefore, that a highly effective linkage is provided according to the invention for converting successive reciprocatory movements of an armature or plunger of a relay into a make-break action of an electrical contact assembly, the motion-modifying driving connections being positively controlled by camming action to insure continued and faultless operation of the mechanism.

It will be understood that the illustrative embodiment of the invention disclosed herein is susceptible of numerous modifications in form and detail within the scope of the invention. The

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embodiments described and shown in the drawing therefore, are not to be regarded as limiting the scope of the following claims.

I claim:

1. A relay device including in combination an armature member adapted to be moved between two positions in periodically recurring cycles, work means having at least two controlled positions, and motion-modifying driving connections between said input and said work member for effecting sequential movements of the latter, including a toggle spring member adapted to be moved between two configurations, means connecting said work member to said toggle spring, an oscillatory member, means connecting said toggle spring member to said oscillatory member at a point spaced from the center of oscillation thereof, spaced abutment means formed on said oscillatory member on opposite sides of the center of oscillation thereof, a swinging link pivotally connected to said armature member and adapted to be swung between said abutments to selectively engage the oscillatory member on opposite sides of its center of oscillation, means forming a separable unidirectional driving connection between said swinging link and said oscillatory member, said swinging link being adapted upon movement of said armature member in one direction to rotate said oscillatory member in one angular direction when in driving engagement with one side of the oscillatory member and to rotate the oscillatory member in the opposite angular direction when in engagement with the opposite side thereof, and a pair of cam surfaces on said swinging link adapted to engage said oscillatory member to effect swinging movement of the link alternately in opposite angular directions when said armature member is moved in the opposite direction from that affording a driving connection with the oscillatory member.

2. A relay device including in combination, a snap spring member adapted to be snapped between two configurations, electrical contact means operatively connected to said snap spring member to be actuated thereby, a reciprocatory member and electromagnetic means for reciprocating said member, an oscillatory member, shoulder means formed on said oscillatory member on opposite sides of the center of oscillation

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thereof, means forming a driving connection between the snap spring member and said oscillatory member at a point spaced from the center of oscillation thereof, a swinging link pivotally connected to the reciprocatory member and having its free end disposed between the shoulders on the oscillatory member for swinging movement therebetween, shoulder means formed on the free end of said swinging link adapted to selectively engage either of the shoulders formed on opposite sides of the oscillatory member, said oscillatory member being moved in one direction when the reciprocatory member is moved in one direction and the swinging link is in driving engagement with one side thereof, said oscillatory member being adapted to be moved in the opposite direction when the link is in engagement with the other side thereof and the reciprocatory member is displaced in said one direction, said shoulder means of the link adapted to become disengaged from the shoulder means of the oscillatory member when the reciprocatory member is moved in its other direction, and a pair of cam surfaces formed on said swinging link adapted to selectively engage the shoulder means of the oscillatory member to cause the link to swing from the side of the oscillatory member whence the most recent driving connection was effected to the opposite side thereof.

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