Nov. 21, 1950 M. N. YARDENY ET AL 2,531,186

SWITCHING DEVICE

Filed March 30, 1948

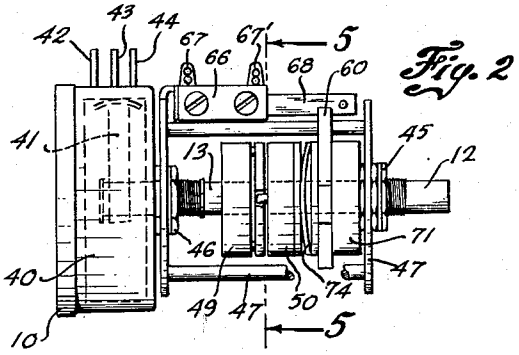


Fig. 2

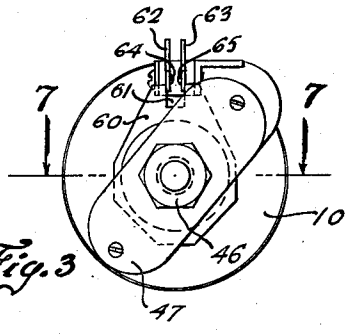


Fig. 3

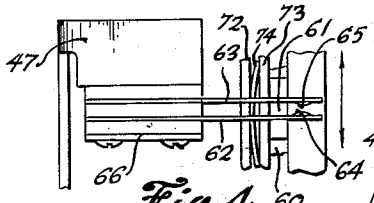


Fig. 4

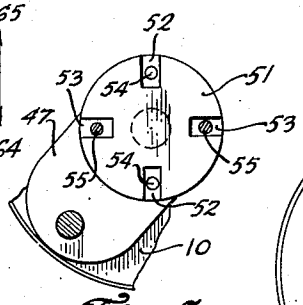


Fig. 5

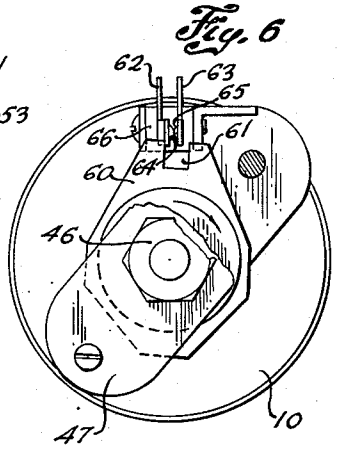


Fig. 6

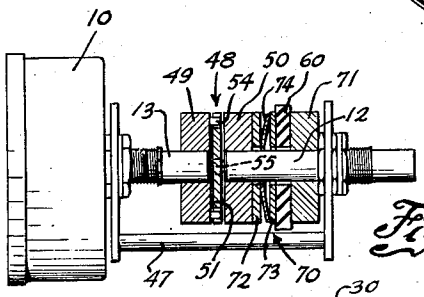


Fig. 7

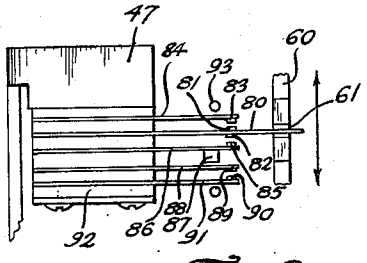


Fig. 8

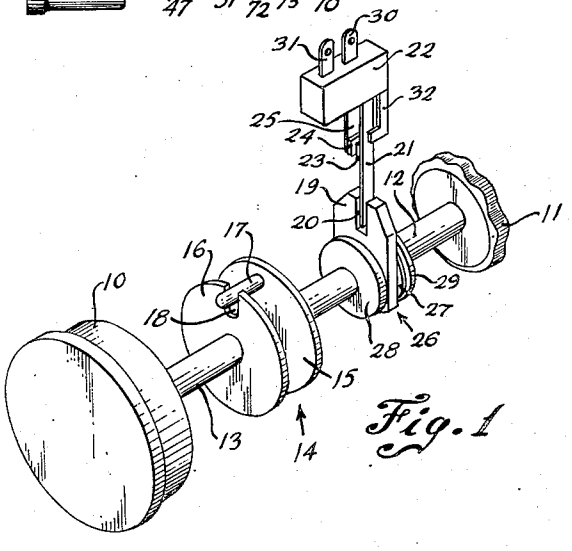


Fig. 1

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SWITCHING DEVICE

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Application March 30, 1948, Serial No. 17,883

11 Claims. (Cl. 201—48)

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This invention relates to switching and control apparatus, particularly to apparatus for moving two or more contacts into engagement or disengagement when and while an actuating means for controlling said apparatus is operated.

One of the objects of the invention is to provide an apparatus of the general type above referred to which effects control of one or more pairs of contacts for engagement or disengagement in response to the operation of an actuating member for control of said apparatus and an automatic return of the contacts into the initial relative position when the operation of the actuating member is discontinued independently of the position in which the actuating member is released.

Another object of the invention is to provide a novel and improved switching and control apparatus of the general type above referred to, effecting closing or opening of one or more pairs of contacts when and while the actuating member of the apparatus is operated and permitting continued displacement of the actuating member beyond the distance required to effect the aforesaid contact control.

Another object of the invention is to provide a novel and improved switching and control apparatus for controlling the position of a movable element of a suitable device controllable by the position of said control element, for instance a potentiometer, a switch, a gauge etc. by moving an actuating member, and also for controlling the closing or opening of one or more pairs of contacts by the same movement of the actuating member in such manner that the said contacts are closed or opened, as the case may be, when and while the actuating member is moved, and are automatically returned into their respective initial positions when the actuating member is released.

Another and more specific object of the invention, allied with the preceding one, is to provide means by which the device to be controlled and said contacts are actuated in a predetermined sequence or at selected adjustable intervals.

Other and further objects, features and advantages of the invention will be pointed out hereinafter and appear in the appended claims forming part of the application.

The switching and control apparatus according to the invention lends itself to many useful applications, partcularly in the field of control of electrical circuit systems. One of the more outstanding advantages of the invention is that

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the contacts are displaced only during adjustment of the device to be controlled and return automatically into their initial relative position upon completion of the adjustment of the controlled device, and that the freedom of movement of the actuating member is not restricted by the control of the contacts.

The apparatus according to the invention permits for instance the control of one or more circuit systems by opening or closing of the said contacts while simultaneously controlling the said controlled device and restoration of the original circuit connections by the automatic return of the contacts into their initial positions upon completion of the control of the device. It also permits an arrangement in which one or more pulses are sent through a circuit system including the said contacts prior or subsequent to or during adjustment of the controlled device. A particularly useful application of the last mentioned arrangement is fully described in our copending patent application Ser. No. 5,276, filed January 30, 1948, now abandoned.

In the accompanying drawing several now preferred embodiments of the invention are shown by way of illustration and not by way of limitation.

In the drawing:

Fig. 1 is an isometric view of a switching and control apparatus according to the invention.

Fig. 2 is an elevational side view of a modification of a switching and control apparatus according to the invention.

Fig. 3 is an end view of Fig. 2, as seen from the right hand side.

Fig. 4 is a fragmentary top view of Fig. 2.

Fig. 5 is a section along line 5—5 of Fig. 2.

Fig. 6 is a view similar to Fig. 3 on an enlarged scale showing the contacts to be controlled in a different relative position.

Fig. 7 is a section along line 7—7 of Fig. 3, and

Fig. 8 is a fragmentary view of a modified contact arrangement.

Referring first to Fig. 1 in detail, this figure shows a switching and control apparatus according to the invention comprising a controlled device 10 diagrammatically shown as a box. This box may contain any suitable device including a movable control element and controllable by the position of this element. Devices of this type are for instance conventional potentiometers having a stationary resistor engaged by a rotatable wiper arm. Since various devices of this kind are well known in the art it is not believed to be essential for the under-

standing of the invention to describe them in detail. The position of the movable control element, such as a wiper arm, is controlled by means of a manually operable knob 11. This knob is secured to a driving shaft 12 while the wiper arm (not shown) of the potentiometer is secured to a driven shaft 13. Shafts 12 and 13 are coupled by means of a clutch or coupling, generally designated by 14. This clutch is shown as comprising a male coupling member 15 shown as a disk fastened to shaft 12 and a female coupling element 16 shown as a disk fastened to shaft 13. A pin 17 is extended from disk 15 and engages a radial slot 18 in disk 16. The cross section of pin 17 is so selected that a certain play is provided between disks 15 and 16.

As will be evident, rotation of knob 11 in one or the other direction will cause a corresponding rotation of shaft 13 while permitting an angular rotation of the shafts relative to each other within the limits of the play introduced by the clearance between pin 17 and slot 18. Shaft 12 further supports a control member 19 shown as a disk rotatably supported on shaft 12. The disk is provided with a slot 20 engaged by one end of a spring 21, the other end of the spring being inserted in an insulation block 22. Spring 21 supports a contact 23 arranged to coact with a second contact 24 supported by a second spring 25 also inserted in insulation block 22. Springs 21 and 25 are so biased that they tend to hold contacts 23 and 24 in a predetermined relative position; according to Fig. 1, the springs tend to hold the contacts in a disengaged position.

As previously mentioned, disk 19 is rotatably mounted on shaft 12. For the purpose of transmitting rotation of shaft 12 to disk 19, a frictional clutch generally designated by 26 is provided. This clutch as shown as comprising a collar 27 fixed to shaft 12 on one side of disk 19 and a second collar 28 secured to shaft 12 on the other side of the disk. A spring washer 29 disposed between collar 27 and disk 19 serves to press the disk against collar 28. As will be apparent, elements 27, 28 and 29 constitute a frictional clutch capable of transmitting a limited torque from shaft 12 to disk 19, the magnitude of this torque generally depending upon the pressure of spring washer 29 and to a minor degree upon the friction between collar 28 and disk 19.

Contacts 23 and 24 are connected through springs 21 and 25 to contact ears 30 and 31 which in turn may be connected to a circuit system to be controlled. The portion of spring 21 engaging disk 19 may either be made of or covered with insulation material or disk 19 may be made of insulation material. To limit deflection of spring 21 towards the side opposite to contact 24, a stop 32 is provided supported by block 22. A similar stop may be provided to limit deflection of spring 25 also.

The operation of the apparatus according to Fig. 1 is as follows:

Let it be assumed that knob 11 is rotated in clockwise direction, then the rotation of the knob will be transmitted through shafts 12, 13 and clutch 14 to the wiper arm of potentiometer 10 which will be adjusted accordingly (the circuit connections of the controlled device 10 are not shown to simplify the drawing). In addition, the rotation of shaft 12 causes rotation of disk 19 through the agency of frictional clutch 26. As a result, spring 21 and also spring 25 are so deflected that contacts 23 and 24 are now engaged. The combined strength of springs 21 and 25 will now overcome the torque transmittable by frictional clutch 26 so that disk 19 begins to slip on shaft 12. Consequently, the rotation of knob 11 and with it of driven shaft 13 can be continued while contacts 24 and 23 remain engaged. If, after completion of the adjustment of controlled device 10, knob 11 is released, the deflected springs will return into their initial position by slightly rotating disk 19 and with it shaft 12. As a result, contacts 23 and 24 become automatically disengaged as soon as knob 11 is released.

As it will be apparent, the springs are easily capable of turning disk 19 and shaft 12. Due to the play between pin 17 and slot 18, the springs have merely to overcome the resistance in the bearings (not shown) of shaft 12. It will further be noted that the slight rotation of shaft 12 does not affect the angular position of shaft 13 and hence also not the adjustment of the controlled device 10.

In this connection it should be noted that the torque transmittable by clutch 26 and the biasing strength of spring 21 and also of spring 25 may be so selected that the torque is just high enough to cause the desired deflection of spring 21 towards spring 25, yet small enough to permit slipping of disk 19 after engagement of the contacts. In the event knob 11 is rotated in a counterclockwise direction, controlled device 10 can be similarly adjusted. However, contacts 23 and 24 will remain disengaged.

According to the modification shown in Figs. 2 to 7 inclusive, the switching and control device again comprises a controlled device contained in box 10, the controlled device being shown as a potentiometer having a resistor 40 slidably engaged by a wiper arm 41. The ends of the resistor and the wiper arm may be connected to contact ears 42, 43 and 44 respectively. Wiper arm or control element 41 is secured to a driven shaft 13 mounted in alignment with driving shaft 12. The shafts are rotatable in bearings 45 and 46 respectively, supported by a frame 47. For the purpose of coupling the two shafts, a clutch generally designated by 48 is provided. This clutch comprises a disk 49 fastened to shaft 13 and a second disk 50 fastened to shaft 12. A floating disk 51 is disposed in the space between disks 49 and 50. As can best be seen on Fig. 5, this disk is provided with four radial slots 52 and 53 respectively in crosswise arrangement. Slots 52 are engaged by pins 54 extended from disk 49 and, similarly, slots 53 are engaged by pins 55 extended from disk 50. The slots are so dimensioned that they allow for a limited play of the pins within the slots in radial and circumferential direction. As a result of the circumferential play, a certain relative angular rotation between disks 49 and 50 and with it between the shafts is possible. By reason of the provided radial play, a satisfactory transmission of a rotation of shaft 12 to shaft 13 will take place even though the center axes of the shafts may not be in perfect alignment, thereby facilitating the manufacture and assembly of the apparatus.

Driving shaft 12 supports a control element shown as an insulation disk 60 having a slot 61 therein. Slot 61 is engaged by two contact springs 62 and 63 each supporting a contact 64 and 65 respectively. The springs are supported at one end by an insulation block 66 secured to frame 47. Contact ears 67 and 67' serve to connect the springs to a circuit system (not shown).

The springs are so biased that contacts 64 and 65 are disengaged from each other when the springs are in normal or undeflected positions.

For the purpose of transmitting a limited torque from shaft 12, to disk 60, a frictional clutch, generally designated by 70, is provided. As can best be seen on Fig. 7, this frictional clutch comprises an abutment disk 71 secured to shaft 12 on one side of contact control disk 60 and two disks 72 and 73 axially slidable on shaft 12 and disposed between the other side of control disk 60 and clutch element 50. A spring washer 74 between disks 72 and 73 serves to press disk 60 against disk 71. As will be apparent, the torque transmittable by frictional clutch 70 thus formed will largely depend upon the pressure of spring washer 74 and can be easily adjusted by properly selecting the strength of this spring washer.

Shaft 12 can be rotated by any suitable means such as a manual knob 11 or by any suitable drive means operatively connected with shaft 12.

The operation of the apparatus according to Figs. 2 to 7 is similar to the apparatus according to Fig. 1.

Let it be assumed that it is desired to adjust the position of wiper arm 41 and also to control the circuit system connected to contact ears 67, 67'. Shaft 12 is then rotated in one or the other direction. As a result, the position of wiper 41 relative to resistor 40 will be adjusted accordingly. Furthermore, control disk 60 will be moved from the position shown in Fig. 3 in which contacts 64 and 65 are disengaged into the position shown in Fig. 6 in which springs 62 and 63 are sufficiently deflected by the displacement of slot 61 to cause engagement of the contacts. As soon as disk 60 has reached the position shown in Fig. 6, it begins to slip when the rotation of shaft 12 is continued. However, the pressure exerted by the edge of slot 61 engaging the adjacent spring remains sufficiently strong to maintain the spring deflected and the contacts engaged while the rotation of shaft 12 continues. Upon release of shaft 12, the biasing force of the springs rotates disk 60 and with it shaft 12 back into the position shown in Fig. 3 in which slot 61 is in such relative position to the springs that the latter can resume their normal undeflected positions in which contacts 64 and 65 are disengaged.

As will be noted the position of wiper arm 41 will remain unchanged by the return movement of disk 60 since the corresponding relative rotation of shaft 12 is absorbed by the play in clutch 48.

The torque transmittable by frictional clutch 70 and the biasing force of springs 62 and 63 must of course be adjusted relative to each other as has been explained in connection with Fig. 1.

The contact arrangement according to Figs. 5 to 7 inclusive provides for closing of the contacts upon rotation of shaft 12 in either direction while according to Fig. 1 the contacts are closed only upon rotation of one direction.

It is also quite practical to control several circuit systems by the control member of the switching and control apparatus according to the invention. Fig. 8 shows such an arrangement. According to this figure, a spring 80 engaging slot 61 of disk 60 is provided on both sides with contacts 81 and 82 respectively. Upon deflection of spring 80 in one direction, contact 81 engages a contact 83 supported on a spring 84, thereby controlling one circuit system. Upon deflection of spring 80 in the opposite direction, contact 81 engages a contact 85 supported on a spring 86 thereby controlling a second circuit system. Spring 86 supports an insulation block 87 for deflecting a spring 88. This spring supports a contact 89 which upon deflection of spring 88 engages a contact 90 supported on a spring 91 thereby controlling a third circuit system. All springs are supported by a common insulation block 92. Stops 93 provided adjacent to the outer springs serve to limit the spring deflections and also to furnish sufficient resistance to cause slipping of control disk 60 upon continued rotation of shaft 12.

While the invention has been described in detail with respect to certain now preferred examples and embodiments of the invention it will be understood by those skilled in the art, after understanding the invention, that various changes and modifications may be made without departing from the spirit and scope of the invention and it is intended, therefore, to cover all such changes and modifications in the appended claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a switching and control apparatus, in combination, a controlled device including a movable control element and controllable by the position of said element, a pair of relatively movable contacts, yieldable means coacting with said contacts and biasing the same into a predetermined relative position, a movable actuating member, means including a coupling member operatively connecting said actuating member with the control element for entrainment thereof by the actuating member, a contact control member operatively connected with the actuating member for movement in unison therewith, said contact control member being arranged and constructed to engage a movable one of said contacts for displacement of the contacts relative to each other against the action of said yieldable means in response to a movement of the actuating member, and frictional means included in said operative connection between the actuating member and the contact control member providing for continued movement of the actuating member independently of the control member upon engagement of the latter with said movable contact, said yieldable means including a spring engaging said contact control member and tending to maintain same in a predetermined position, said coupling member permitting relative displacement between said actuating member and said control element under the control of said spring, thereby enabling said spring to return the contacts into the initial relative position thereof by causing displacement of the contact control member together with the actuating member when the latter is released.

2. In a switching and control apparatus, in combination, a controlled device including a movable control element and controllable by the position of said element, a pair of relatively movable contacts, a spring supporting one of said contacts and biasing the same into a predetermined position relative to the other of said contacts, a movable actuating member operatively connected with the control element for positioning thereof, a contact control member loosely supported on the actuating member and provided with a slot engaged by said spring, and frictional means oper-

atively connecting the contact control member with the actuating member for causing movement of the contact control member in unison with the actuating member and for permitting movement of the contact control member relative to the actuating member by overcoming the torque transmittable by said frictional means, said contact control member thereby causing deflection of the spring and displacement of the spring supported contact relative to the other contact upon movement of the contact control member by movement of said actuating member, said spring returning said contacts into the initial relative position thereof when the actuating member is released.

3. In a switching and control apparatus, in combination, a controlled device including a movable control element and controllable by the position of said element, a pair of relatively movable contacts, a pair of springs each supporting a respective one of said contacts and biased to hold the contacts in disengaged position, a movable actuating member operatively connected with the control element for positioning thereof, a contact control member loosely supported on the actuating member and provided with a slot engaged by said springs, and frictional means operatively connecting the contact control member with the actuating member for causing movement of the contact control member in unison with the actuating member and for permitting movement of the contact control member relative to the actuating member by overcoming the torque transmittable by said frictional means, said contact control member causing relative displacement of said springs and, thereby, engagement of said contacts upon movement of the contact control member by movement of said actuating member, said springs returning said contacts into the initial relative position thereof when the actuating member is released.

4. In a switching and control apparatus, in combination, a controlled device including a movable control element and controllable by the position of said element, a pair of relatively movable contacts, yieldable means coacting with said contacts and biasing the same into a predetermined relative position, a rotatably supported driven shaft operatively connected with said control element for positioning thereof, a rotatably supported driving shaft, clutch means coupling said shafts, said clutch means being arranged and constructed to provide for a limited angular rotation of said shafts relative to each other, a contact control member rotatably supported on the driving shaft, and frictional means arranged and constructed to transmit a limited torque from the driving shaft to the contact control member, said contact control member being arranged to engage a movable one of said contacts for displacement of the contacts relative to each other against the action of the yieldable means upon rotation of the driving shaft, said frictional means permitting continued rotation of the driving shaft by overcoming the torque transmittable by the frictional means when the contact control member is held substantially stationary upon engagement thereof with said movable contact, said yieldable means being arranged to return the movable contact into its initial position by causing rotation of the contact control member together with the driving shaft within the limits of said relative angular rotation of the shafts as provided by the clutch means.

5. A switching and control apparatus as described in claim 4, wherein said clutch means comprise a male clutch element supported on one shaft, a female clutch element supported on the other shaft, and a pin extending from the male clutch element, said female clutch element having a recess therein engaged by said pin with play in circumferential direction to provide for said limited relative angular rotation of the shafts.

6. A switching and control apparatus as described in claim 4, wherein said clutch means comprise a pair of clutch elements each supported on one shaft, and a floating disk having a plurality of spaced radial slots and disposed between said clutch elements, and wherein pins on each clutch element engage said slots with play in radial and circumferential directions, the pins of one clutch element engaging certain of said slots and the pins of the other clutch element engaging the other slots to transmit rotation of the driving shaft to the driven shaft while permitting the said limited relative rotation of the shafts.

7. A switching and control apparatus as described in claim 4, wherein a spring supports at least one of said contacts and is biased to hold the contacts in said predetermined relative position, and wherein said contact control member comprises a substantially disk-shaped element having a slot therein positioned to be engaged by said spring for causing deflection of the spring ensuing displacement of the contact supported thereon upon rotation of the driving shaft.

8. A switching and control apparatus as described in claim 4, wherein each of said contacts is supported by a spring, said springs being biased to hold said contacts disengaged from each other, and wherein said springs engage said slot for causing deflection of the springs toward engagement of the contacts upon rotation of the driving shaft and disengagement of the contacts when the driving shaft is released.

9. A switching and control apparatus for displacing a controlled device and altering the connections of an electric circuit for the duration of such displacement only, comprising a driven element for displacing the controlled device, a driving element, lost-motion coupling means interconnecting said elements for entrainment of the driven element by the driving element with a certain amount of play, a plurality of relatively movable contacts, a contact control member, frictional coupling means operatively coupling said contact control member with said driving element in such manner that the contact control member moves in unison with the driving element, thereby coacting with a movable one of said contacts so as to alter the circuit relationship between said contacts, upon an initial movement of said driving element substantially not exceeding said amount of play, stop means for preventing the contact control member from following unidirectional movement of said driving element substantially exceeding said amount of play, and resilient means tending to oppose entrainment of said contact control member by said driving element through said frictional coupling means, said resilient means being adapted to import a reverse movement substantially not exceeding said amount of play to the contact control member and, through the intermediary of said frictional coupling means, to the driving element upon release of said driving element, thereby restoring the initial circuit relationship between said contacts.

10. A switching and control apparatus for displacing a controlled device and selectively closing a pair of circuits, depending on the direction of displacement, for the duration of such displacement only, comprising a driven shaft for displacing the controlled device, a manually rotatable driving shaft, lost-motion coupling means interconnecting said shafts for entrainment of the driven shaft by the driving shaft with a certain amount of play, a pair of normally open contacts, a contact control member, frictional coupling means operatively coupling said contact control member with said driving shaft in such manner that the contact control member moves in unison with the driving shaft upon an initial rotation of said driving shaft, substantially not exceeding said amount of play, in either direction, thereby selectively coacting with a respective pair of contacts to close the contacts thereof, stop means for preventing the contact control member from following a continued rotation of the driving shaft, substantially exceeding said amount of play, in the same direction, and resilient means tending to oppose entrainment of said contact control member by said driving shaft through said frictional coupling means, said resilient means being adapted to impart a reverse rotation substantially not exceeding said amount of

play to the contact control member and, through the intermediary of said frictional coupling means, to the driving shaft upon release of said driving shaft, thereby re-opening the pair of contacts closed during said initial rotation.

11. A switching and control apparatus according to claim 10 wherein said resilient means comprises a contact arm common to both pairs of contacts, the contact control member being provided with a recess engaged at all times by said contact arm.

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