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2,576,609

ELECTRIC SWITCH OPERATING MECHANISM

Filed Dec. 31, 1949

2 SHEETS—SHEET 1

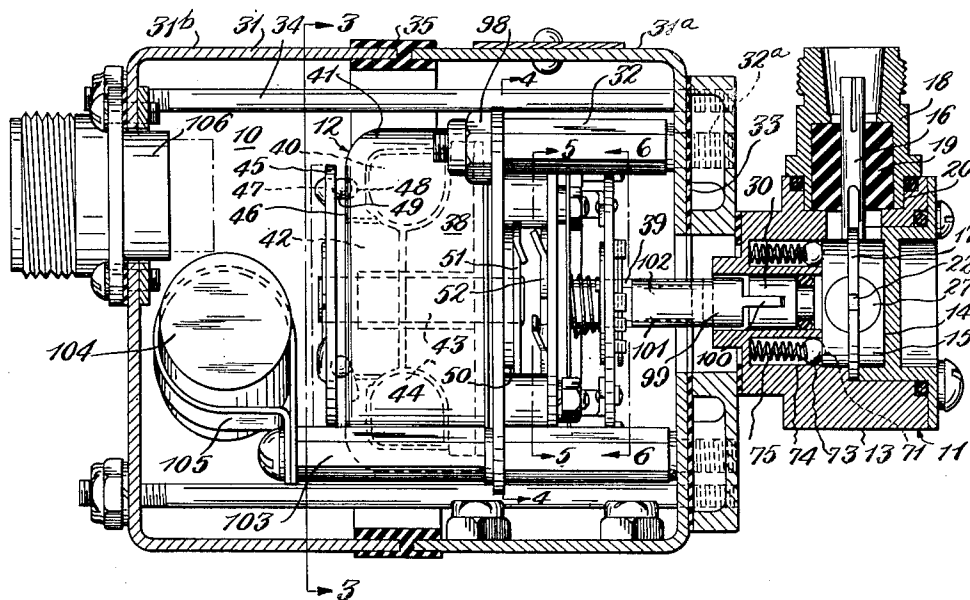


Fig. 1

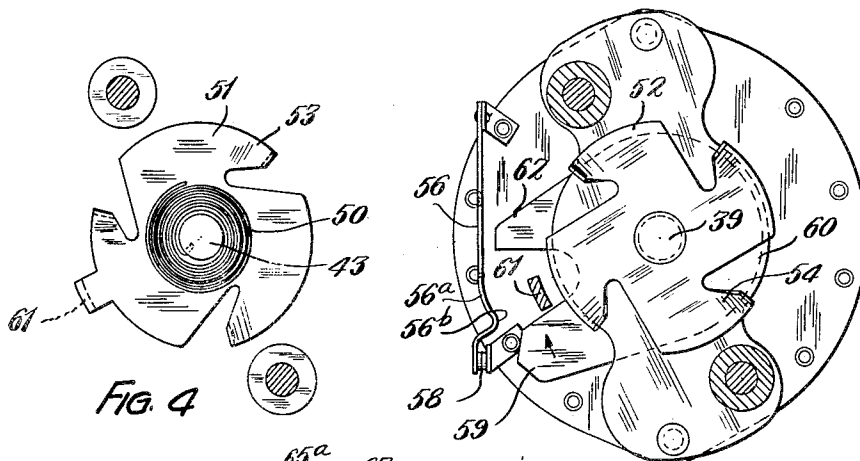


Fig. 4

Fig. 5

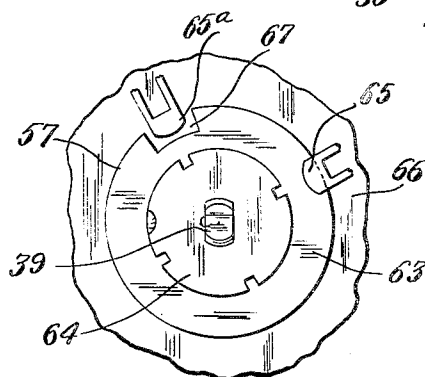


Fig. 6

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2 SHEETS—SHEET 2

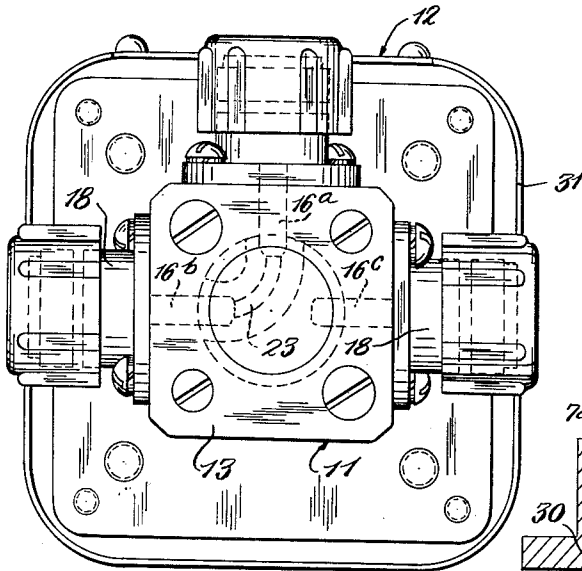


FIG. 2

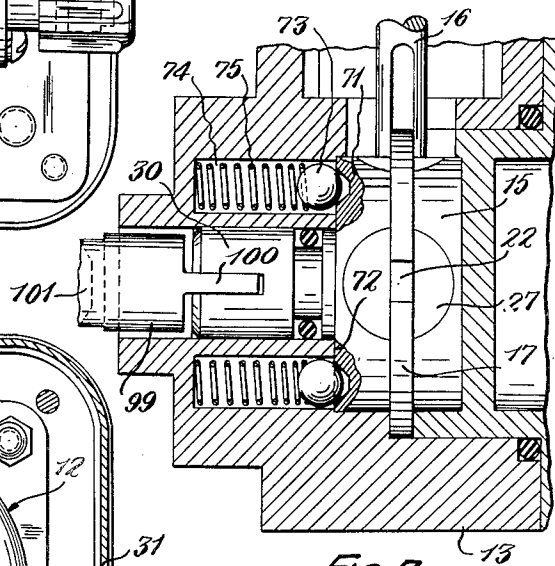


FIG. 7

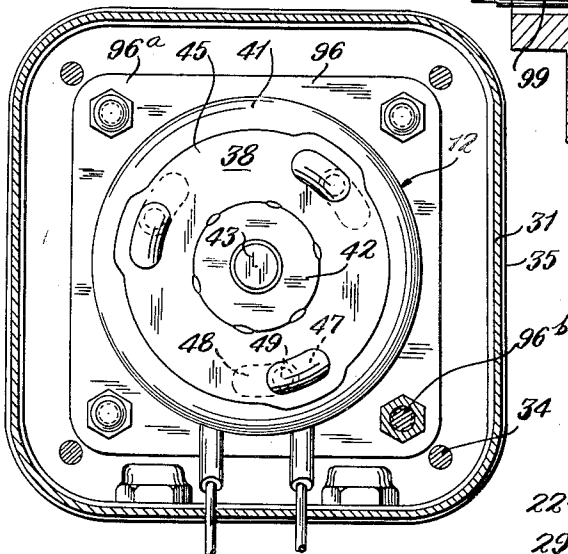


FIG. 3

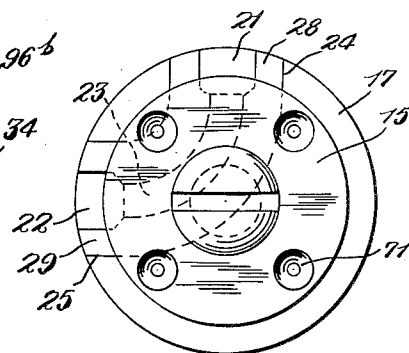


FIG. 8

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ELECTRIC SWITCH OPERATING
MECHANISM

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1 Claim. (Cl. 200—153)

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This invention relates to electric switch mechanisms and, more particularly, to an improved actuating mechanism for an electric switch of the coaxial type.

In the operation of a coaxial switch it is very important that when the movable contact means is moved to an engaged switch position it assume an accurately aligned relation with respect to the stationary contact means engaged thereby. The present invention is especially concerned with an actuating means for the movable switch member or rotor of such a coaxial switch and provides novel positioning means by which such an accurately aligned relation will be automatically obtained during each movement of the movable contact means to its engaged switch position.

In a coaxial switch mechanism of the type in which the movable contact means, or the rotor carrying the same, is actuated by a power means such as an electromagnetic device, the need for such a positioning means is even more imperative because the momentum of the moving parts and the irregularities or variations inherent in the functioning of the power device prevent the movable contact means from regularly assuming an accurately aligned position relative to the stationary contact means engaged thereby.

As one of its objects the present invention accordingly provides an improved coaxial switch mechanism in which a novel positioning means is effective for locating the movable switch member or rotor during the shifting thereof to an engaged switch position, such that the movable contact means will always assume an accurately aligned relation with respect to the stationary contact means engaged thereby.

Another object is to provide an improved coaxial switch mechanism in which the positioning means for producing the desired accurate alignment between the movable and stationary contact means comprises cooperating detent element carried respectively by the housing structure and the movable switch member.

A further object is to provide an improved coaxial switch mechanism of the character mentioned, in which the positioning means for producing the desired accurate alignment between the movable and stationary contact means comprises detent means contained in the housing of the coaxial switch and movable in the direction of the rotation axis of the switch rotor.

Yet another object of this invention is to provide an improved coaxial switch mechanism of the kind referred to, in which the switch rotor is

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confined in the switch chamber for movement in one plane only and the positioning means for producing the desired accurate alignment between the movable and stationary contact means comprises cooperating detent elements contained in the housing of the coaxial switch and one of which elements is a convergently tapered socket and the other is movable in the direction of the axis of rotation of the switch rotor for self-centering positioning engagement in such socket.

As another of its objects this invention provides a coaxial switch mechanism of the character mentioned having arcuately spaced stationary contacts and a rotor carrying a movable contact means and confined in the switch chamber for movement in one plane only to different switch positions represented by such stationary contacts and driven by an electromagnetic power device having a power output shaft which is intermittently rotatable through increments of angular movement bearing a modular relation to the spacing of the stationary contacts and in which a positioning means effective on the rotor for locating the movable contact means in aligned relation to the stationary contact means comprises cooperating detent elements contained in the housing of the coaxial switch and one of which elements is a convergently tapered socket and the other is movable in the direction of the axis of rotation of the switch rotor for self-centering positioning engagement in such socket.

The invention can be further briefly summarized as consisting in certain novel combinations and arrangements of parts hereinafter described and particularly set out in the claim hereof.

In the accompanying sheets of drawings,

Fig. 1 is a longitudinal section taken through a coaxial switch mechanism embodying the present invention;

Fig. 2 is an outside end view of the mechanism looking toward the coaxial switch;

Fig. 3 is a transverse section taken through the mechanism adjacent the outer end of the electromagnetic power device, as indicated by section line 3—3 of Fig. 1;

Fig. 4 is a transverse section taken through the power device adjacent the ratchet mechanism thereof, as indicated by section line 4—4 of Fig. 1;

Fig. 5 is a partial transverse section taken through the power device substantially at the location of the ratchet mechanism thereof, as indicated by section line 5—5 of Fig. 1;

Fig. 6 is a partial transverse section taken

through the power device adjacent the indexing switch means thereof, as indicated by section line 6—6 of Fig. 1;

Fig. 7 is a partial longitudinal section taken through the coaxial switch similar to and corresponding with a portion of Fig. 1 but being on a larger scale to further illustrate the detent means; and

Fig. 8 is an end view of the switch rotor showing the same in detached relation.

As shown in the drawings, the improved coaxial switch mechanism 10 comprises, in general, a coaxial switch 11 and a switch actuating mechanism 12 operably connected with such coaxial switch. The coaxial switch 11 is more fully disclosed in related copending application Serial No. 780,059, filed October 15, 1947, now Patent No. 2,565,643, August 28, 1951.

The coaxial switch 11 is of the type comprising a switch housing 13 formed of connected sections defining a switch chamber 14, and a rotor 15 substantially filling said chamber and confined therein for movement in one plane only. This coaxial switch also includes a plurality of arcuately spaced stationary switch contacts 16, in this instance three such stationary contacts, which extend into the switch chamber and engage a circumferential flange 17 carried by the rotor 15. Each of the stationary contacts 16 is mounted in coaxial relation in a carrier 18 by a body of electrically insulating plastic material 19 contained therein. The carrier 13 is mounted on the housing 13 so as to have a snug fitting engagement in a socket opening 20 of the latter and locates the contact 16 in proper position for running engagement with the rotor flange 17. The switch 11 is here shown as having three of the stationary contacts 16 of which the contact 16a (see Fig. 2) is the common terminal contact representing an incoming signal channel and the contacts 16b and 16c are terminal contacts representing branch outlet signal channels.

The rotor 15 of the coaxial switch 11 carries a pair of movable contacts 21 and 22 which are formed by the ends of a conductor 23 and are located in interruptions or gaps 24 and 25 of the rotor flange 17. The conductor 22 is coaxially mounted in a passage 26 of the rotor by a body of plastic insulating material 27 contained in such passage. The contacts 21 and 22 are of the same thickness as the rotor flange 17 and form smooth, flush continuations of this flange. The portions of the gaps 24 and 25 are closed on opposite sides of the contacts 21 and 22 by portions 28 and 29 of the insulating body 26 so that these insulating portions also form smooth, flush continuations of the rotor flange.

By movement of the rotor 15 in the plane of the flange 17 the contacts 21 and 22 can be shifted to an engaged switch position in engagement with the stationary contacts 16a and 16b as shown in Fig. 2 or to another engaged switch position in which the contacts 21 and 22 are in engagement respectively with the stationary contacts 16c and 16a. The rotor 15 is provided with a shaft extension 30 which is journaled in the housing 11 and to which actuating torque can be applied for driving the rotor. When the rotor contacts 21 and 22 have been engaged with a desired pair of the stationary contacts 16 it is necessary for the proper functioning of the coaxial switch 11, as mentioned above, that the rotor contacts be accurately aligned or oppositely positioned with respect to the stationary contacts so engaged. The present invention,

provides novel positioning means for obtaining this accurate alignment and which positioning means will be described in detail hereinafter.

The switch actuating mechanism 12 includes an outer housing 31 formed by complementary cup-shaped housing sections 31a and 31b. The housing section 31a is connected with the switch housing 13 by a plurality of posts 32, in this instance four, having threaded ends 32a which are screwed into the switch housing for clamping the housing member 31a thereagainst with a gasket 33 interposed therebetween. The housing section 31a forms the base of the outer housing and the housing section 31b forms a cover which is held in assembled relation to the base by a group of tie rods 34. As shown in Fig. 1, the adjacent ends of the housing sections 31a and 31b engage in oppositely extending grooves of a sealing ring 35.

Also included in the switch actuating mechanism 12 is an electromagnetic power device 38 having an intermittently rotatable power output shaft 39. This electromagnetic power device is a so-called rotary solenoid of the kind forming a part of the mechanism disclosed in U. S. Patent No. 2,430,940, granted November 18, 1947. The power device 38 also includes a magnet coil 40 located in a casing 41 and an axially movable armature 42 connected with a rotary shaft 43 which is axially aligned with the power output shaft 39. The armature 42 is movable toward and away from a core 44 which is also located in the casing 41 and is adapted to be magnetized by the coil 40.

At its outer end the armature 42 is connected with a plate 45 which is disposed in spaced relation to the end wall 46 of the casing 41. The adjacent faces of the plate 45 and the end wall 46 are provided, respectively, with shallow arcuate recesses 47 and 48 located in overlapping relation to each other and forming a pocket in which an antifriction ball 49 is confined. Three groups of the paired arcuate recesses 47 and 48 are provided and, as shown in Fig. 3, these paired recesses are disposed in circumferentially spaced relation around the axis of the rotary shaft 43. A spiral spring 50 disposed around the shaft 43 and having one of its ends anchored thereon transmits thrust through the shaft to the armature 42 normally urging the same toward the left, as seen in Fig. 1, or, in other words, away from the core 44.

When the coil 40 is electrically energized, the magnetic pull on the armature 42 overcomes the spring 50 and moves the armature toward the core, that is, toward the right as seen in Fig. 1. During this movement of the armature 42, the plate 45 travels in an axial direction from its dotted line position to its full line position and the thrust applied to the balls 49 by this axial movement causes the plate to rotate through the limited arcuate movement represented by the permissible travel of the balls in the paired arcuate recesses 47 and 48. This combined rotary and axial movement of the plate 45 causes a corresponding combined rotary and axial movement of the shaft 43.

The adjacent ends of the shafts 43 and 39 are operably connected by a ratchet mechanism formed by a pair of cooperating plate members 51 and 52 mounted on these shafts. These plate members carry groups of circumferentially spaced inclined fingers 53 and 54 which are deflected toward each other out of the planes of the respec-

tive plate members, the driving plate member 53 having three such fingers and the driven plate member 52 having four such fingers. During the combined rotary and axial movement of the shaft 43 a similar combined rotary and axial movement is imparted to the plate member 51, causing one of the fingers 53 thereof to engage one of the fingers 54 of the plate member 42 and impart rotary movement to the latter plate member and to the shaft 39 connected therewith. Thus, during each such combined rotary and axial power stroke of the shaft 43, one of the fingers 53 of the plate member 51 engages and drives one of the fingers 54 of the plate member 52 and successive power strokes of the shaft 43 impart a step-by-step rotary movement to the shaft 39. During the retracting movement imparted to the shaft 43 in the opposite direction by the spiral spring 50, the plate member 51 is rotated in the reverse direction thereby disengaging the finger 53 from the finger 54 and causing the plate member 51 to have a rotary ratchet movement with respect to the plate member 52.

The power device 38 also includes two switch devices 56 and 57 for intermittently energizing and deenergizing the magnet winding 40. The switch device 56 comprises a pair of normally closed contacts 58, one of which is a movable contact carried by a spring arm 56a. The contacts 58 are adapted to be opened by an actuating finger 59 of a plate member 60 which is formed of insulating material and is rotatable about the shaft 39. The switch actuating member 60 is adapted to be oscillated by movement transmitted thereto from the plate member 51. For this purpose, the plate member 51 carries an axially extending finger 61 which extends between the finger 59 of the plate member 60 and an adjacent finger 62.

When rotary movement is imparted to the plate member 60 in a clockwise direction, as seen in Fig. 5, the finger 59 will engage the portion 56b of the spring arm 56a and cause opening of the contacts 58. Since these contacts are in the circuit of the magnet coil 40, the opening thereof will deenergize the magnet and permit the spiral spring 50 to retract the armature 42. The reverse rotary movement imparted to the plate member 51 during the retraction of the armature 42, causes the switch actuating member 60 to be shifted in the opposite direction to permit closing of the contacts 58 for reenergizing the magnet coil 40.

The energizing circuit for the magnet coil 40 is also controlled by the switch device 57 which comprises a flat ring 63 of conducting material connected with the shaft 39 so as to be driven thereby through an insulating disk 64. The switch device 57 also includes a number of contacts 65 mounted on an insulating support 66 and having sliding engagement with the contact ring 63. As shown in Fig. 9, the contact ring 63 has a gap or interrupting recess 67 therein which passes under the contacts 65 in succession during the rotation of this contact ring by the shaft 39.

The energizing current for the magnet 40 passes through the contact ring 63 and a selected one of the contacts 65. So long as the energization of the magnet coil 40 is interrupted only by the self-closing switch device 56, the power device 38 will operate to drive the rotor output shaft 39 with a step-by-step angular movement. When the gap 67 of the contact ring 63 arrives at the contact which is then included in the magnet energizing circuit, such as the contact 65a, the circuit will be broken and the magnet will remain

deenergized regardless of the reclosing of the contacts 58 of the switch device 56.

The outer end of the power output shaft 39 of the power device 38 is connected with the shaft extension 30 of the rotor 15 of the coaxial switch 11 and the operation of the power device imparts a similar step-by-step rotary movement to the rotor. In the coaxial switch 11 here shown the stationary contacts 16 are spaced apart an angular distance of ninety degrees, and in the construction here shown for the power device 38 each energization of the magnet 40 causes the shaft 39 to be rotated through an angular distance of thirty degrees which bears a modular relation to the ninety degree spacing of the stationary contacts 16 of the coaxial switch. The magnet 40 of the power device 38 is energized through a selected one of the contacts 65 of the switch device 57, such as the contact 65a, which will result in operation of the power device continuously until the rotor contact 21 reaches the stationary contact 16 desired to be engaged for the signal circuit to be completed, whereupon the gap 67 of the contact ring 63 will arrive at a position under the selected contact 65a to deenergize the circuit of the magnet coil 40, thereby leaving the rotor contact 21 in engagement with the desired stationary contact 16.

As has already been indicated above, it is important in the operation of the coaxial switch 11 that the rotor contacts 21 and 22 be accurately aligned with the stationary contacts 16 which are engaged thereby. To this end the present invention provides a positioning means which is effective for locating the rotor contacts 21 and 22 in such accurately aligned relation with respect to the stationary contacts 16 engaged thereby. This positioning means comprises a pair of cooperating detent elements contained in the housing 13 of the coaxial switch 11. One of these detent elements is a convergently tapered socket 71 formed in an end face 72 of the rotor 15 and the other detent element is a ball 73 movable in a bore 74 of the switch housing and engageable in such socket. A compression spring 75 located in the bore 74 acts on the ball 73 tending to project the same from the bore and produces a self-centering seating engagement in the convergently tapered socket 71.

It is important to observe that, as shown in Fig. 7 of the drawings, the bore 74 extends in parallel relation to the axis of rotation of the rotor 15 and that the movement of the ball 73 in engaging in the socket 71 is along a directional line extending parallel to such axis. A plurality of pairs of these cooperating detent elements 71 and 73 are provided and, in this instance, the rotor 15 of the switch 11 is provided with four of the sockets 71 located in a circumferential series around the rotor axis and spaced apart an angular distance of ninety degrees. The switch housing 13 is provided with two of the axially extending bores 74 and a corresponding number of the balls 73.

As shown in Fig. 8, the detent sockets 71 are displaced forty-five degrees from the locations of the rotor contacts 21 and 22. The bores 74 are located in the housing 13 so as to lie in a circumferential series around the axis of rotation of the rotor and are located at points which are offset forty-five degrees from the stationary contacts 16a, 16b, and 16c. When the switch housing and rotor members 13 and 15 are constructed with the detent sockets 71 and the bores 74 located therein as just described above, it will be seen that when the rotor contacts 21 and 22 are in engagement

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with a pair of the stationary contacts 16 and are in accurately aligned relation with respect thereto, the axes of the detent sockets 71 will coincide exactly with the axes of the bores 74 registering therewith.

Since the switch rotor 15 substantially fills the chamber 14 of the housing 13 and is confined in this chamber so that it can have movement in one plane only, namely rotary movement in the plane of the flange 17, it will be seen that as the rotor is driven by the power device 38, the detent sockets 71 will come into registering relation with the bores 74 for engagement of the balls 73 in these sockets when the rotor contacts 21 and 22 are brought into engagement with a pair of the stationary contacts 16. The action of the balls 73 on the inclined side faces of the sockets 71 under the influence of the springs 75 will cause the balls to exert a self-centering action on the rotor by which the rotor will be made to assume a final position in which the rotor contacts 21 and 22 will be in the desired accurately aligned relation with respect to the stationary contacts 16 engaged thereby. The engagement of the balls 73 in the sockets 71 will also serve as a releasable holding force for retaining the rotor contacts in such accurately aligned relation with respect to the engaged stationary contacts.

Mounting means is provided by which the electromagnetic power device 38 can be firmly connected with the switch housing 13. This mounting means comprises a plate member 96 which is connected with the casing 41 of the power device and projects laterally therefrom so as to provide mounting portions 96a lying in a transverse plane disposed in substantially normal relation to the axis of the power output shaft 39. The mounting portions 96a are here shown as being the corner portions of a substantially square shape for the plate member 96 and are provided with openings 96b which receive the reduced and threaded upper ends of the posts 32 and 83. When the power device 38 has been inserted into the outer housing 31 of the switch mechanism and the ends of the post engaged in the openings 96b of the mounting plate 96, the power device will be located with its power output shaft 39 in properly aligned relation with respect to the shaft extension 30 of the switch rotor 15. The posts 32 and 83 have shoulders 97 thereon against which the mounting portions 96a of the plate are clamped by the nuts 98 applied to the threaded ends of these posts.

A flexible driving connection between the power output shaft 39 of the power device 38 and the shaft extension 30 of the switch rotor 15 is formed by a coupling member 99 having a tongue portion 100 on the inner end thereof which engages in a corresponding transverse slot provided in the end of the shaft extension 30 and at its other end the coupling member is provided with a pair of spaced axial arms 101 which embrace the outer end of the power output shaft 39 and define a transverse slot 102 in which a flattened end portion of the power output shaft is received. Since the coupling member 99 is partially housed in the shaft opening of the switch housing 13, it will always be maintained in assembled relation with respect to the ends of the shafts 30 and 39 connected thereby. The shaft opening of the switch housing is of a size to provide a small clearance around the coupling member 99 so that this member will be capable of limited shifting in two directions for correcting small misalignments of the shafts 30 and 39.

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As shown in Fig. 1, one of the mounting posts 83 is provided at its outer end with an extension post member 103 instead of one of the clamping nuts 98, and this extension post member provides a mount on which a condenser 104 can be mounted by means of a clamping bracket 105. The section 31b of the outer housing 31 is shown in Fig. 1 as being provided with an electric coupling member 106 with which the various electrical conductors servicing the power device 38 can be connected and which provides a terminal means for electrically connecting the switch actuating mechanism with external circuit conductors.

From the foregoing description and the accompanying drawings, it will now be readily understood that this invention provides an improved coaxial switch mechanism in which a desired accurate alignment of the rotor contacts with respect to the stationary contacts engaged thereby can be consistently obtained during the operation of the mechanism. It will now also be understood that this improved coaxial switch mechanism embodies novel positioning means which is effective on the movable switch member or rotor of the coaxial switch for producing and releasably maintaining the desired accurate contact alignment. As already explained in detail herein, this invention also provides simple and efficient positioning means effective on the switch member or rotor of a coaxial switch and permitting the use of an electromagnetic power device of the rotary solenoid type having an intermittently rotatable power output shaft, as a satisfactory driving means for the switch rotor and also provides a novel construction in which the positioning means is contained within the housing of the coaxial switch and comprises a detent member movable in the direction of the axis of rotation of the switch rotor for self-centering engagement in a convergently tapered detent socket.

Although the improved coaxial switch mechanism of this invention has been illustrated and described herein to a detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope but includes all changes and modifications coming within the terms of the claim hereof.

Having thus described my invention, I claim:

In a coaxial switch mechanism, a housing having a substantially cylindrical chamber therein, stationary contacts supported by said housing and located in arcuately spaced relation adjacent the periphery of said chamber, a substantially cylindrical switch rotor disposed in said chamber and being rotatable therein, contact means carried by said rotor for selective engagement with said stationary contacts and required to be accurately aligned with respect to the stationary contact or contacts engaged thereby, said housing being closed on one side of said rotor and on the opposite side having a main bore communicating with said chamber, said rotor being of a size and shape to substantially fill said chamber and having a shaft portion extending into but not through said main bore, an electromagnetic power device of the type having an intermittently driven power output shaft, connecting means substantially rigidly connecting said power device with said housing in a position for locating an end of said output shaft substantially in coaxial alignment with the end of said shaft portion, the adjacent shaft ends of said output shaft and said shaft portion being provided with tongue and slot elements, means forming a flexible drive connection

between said power device and said rotor for actuation of the latter to and from an engaged switch position comprising a coupling member confined in said main bore and having slot and tongue elements engaging the tongue and slot elements of said shaft ends, and sets of cooperating detent elements carried by said rotor and housing and effective as a positioning means for said rotor for locating said contact means in said required accurate alignment with respect to the stationary contact or contacts engaged thereby, one set of said detent elements comprising a group of concavely convergent sockets formed in said rotor in arcuately spaced surrounding relation to said shaft portion and the other set of said detent elements comprising a group of auxiliary bores formed in said housing parallel with and in arcuately spaced surrounding relation to said main bore and spring-actuated convex plungers projecting from said auxiliary bores and engageable in said sockets.

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