Sept. 15, 1964 J. P. WATSON 3,149,209

MULTICONTACT SWITCH

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FIG.1

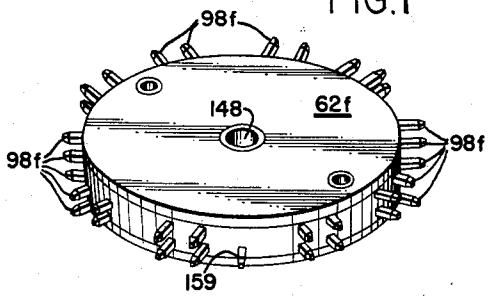



FIG.2

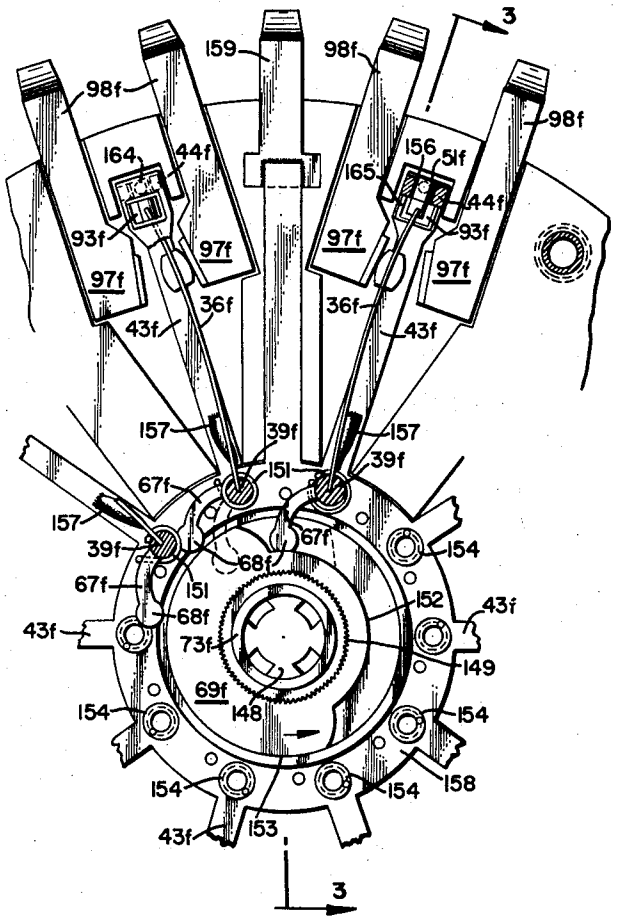
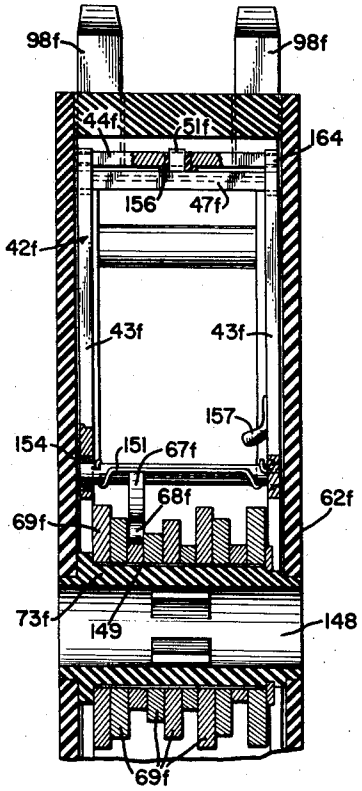



FIG.3




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FIG. 4

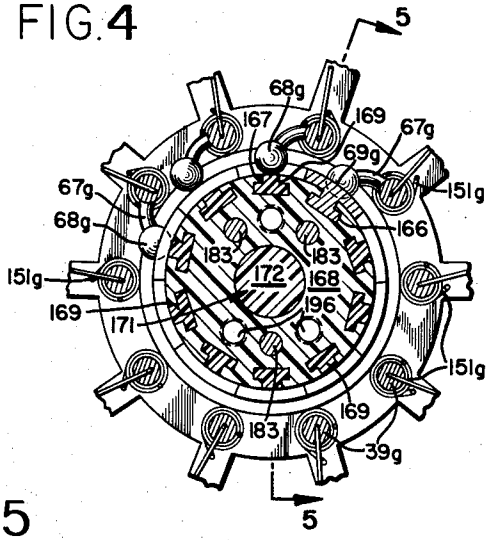
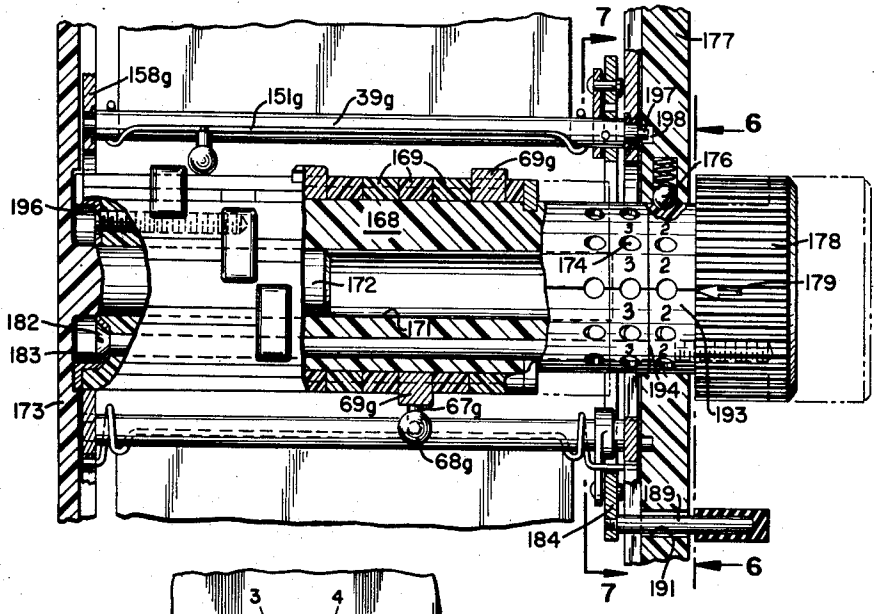



FIG. 5



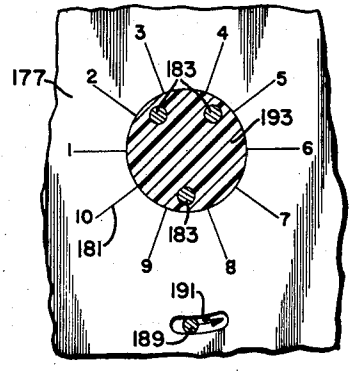




FIG. 6

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FIG. 7

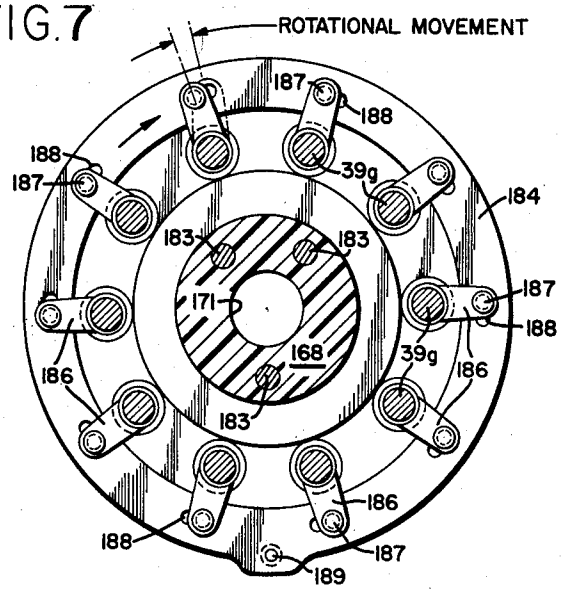



FIG. 8

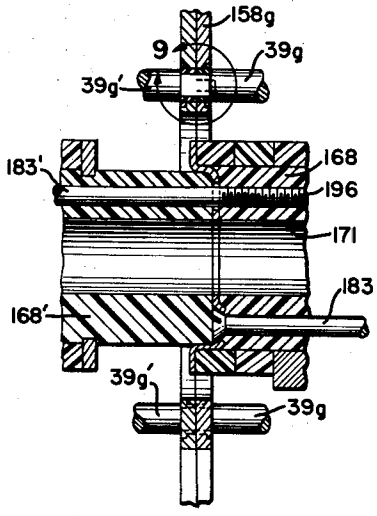



FIG. 9

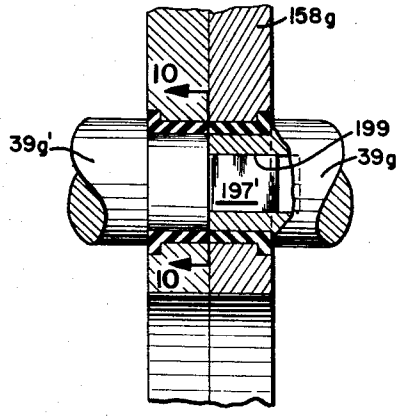
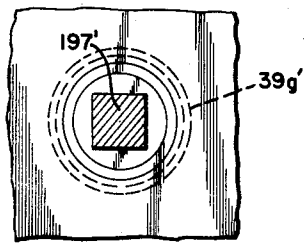



FIG. 10




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3,149,209

# MULTICONTACT SWITCH

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Original application Apr. 2, 1956, Ser. No. 575,467, now Patent No. 2,964,602, dated Dec. 13, 1960. Divided and this application Apr. 1, 1960, Ser. No. 24,192
2 Claims. (Cl. 200—6)

This invention relates primarily to snap acting mechanisms, and more particularly to a snap acting leaf-spring-type electric switch.

It is an object of this invention to provide a snap acting mechanism having a very long operating life.

This application is a division of application Serial No. 575,467 which has now issued as Patent 2,964,602.

It is another object of this invention to provide such a mechanism of simple structure having a minimum number of separate parts.

It is another object of this invention to provide a snap acting mechanism, and particularly a snap acting switch having compact size and low weight compared to its current-breaking capacity.

It is another object of this invention to provide a snap acting mechanism which may be effectively operated by shaft rotation with a minimum complexity between the rotating shaft and the snapping action of the switch.

In modern engineering the importance of small or miniature switches is growing rapidly. Such switches, although themselves small, are generally complicated by the fact that the operating means or mechanism for the switch is so cumbersome as to vitiate largely the miniaturization of the switch itself.

It is an object of this invention to provide an integrated switch and operating mechanism which together will be small in weight and bulk and simple in operation.

It is another object to provide a switch and operating mechanism as above which is uniquely adapted for the operation of the switch by rotary motion, as through a shaft.

It is another object of this invention to provide a switch and operating assembly as above wherein a number of such assemblies may be ganged together for operation from a single shaft.

It is another object of this invention to provide a cam mechanism including a shaft which may be moved either rotationally or axially to cause a cam to operate upon a cam follower.

It is another object of this invention to provide a mechanism as above wherein the cams on the shaft may be readily interchanged to introduce a different cam follower action pattern.

It is a further object of this invention to provide an assembly of snap acting switches of compact bulk and weight which may be operated from a single shaft.

In accordance with these and other objects which will become apparent hereinafter, preferred forms of the present invention will now be described in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view illustrating a multi-switch form of the present invention;

FIG. 2 is a fragmentary cross-section of the switch shown in FIG. 1;

FIG. 3 is a sectional view taken on line 3—3 in FIG. 2;

FIG. 4 is a cross section of a modified form of cam actuating mechanism for the switch shown basically in FIG. 1;

FIG. 5 is a cross section taken on line 5—5 in FIG. 4;

FIG. 6 is a cross section taken on line 6—6 in FIG. 5;

FIG. 7 is a cross section taken on line 7—7 in FIG. 5;

FIG. 8 is a fragmentary section taken generally in the same plane as FIG. 5, showing the manner in which two



switches of the kind shown in FIG. 5 may be ganged together to be operated by a single shaft means;

FIG. 9 is an enlarged view of that portion shown at 9 in FIG. 8; and

FIG. 10 is a cross section taken on line 10—10 in FIG. 9.

In FIGS. 1–3, the switch of the present invention has been shown adapted into a multi-contact switch consisting of a plurality of members all actuated from a single rotating shaft. As shown in FIG. 2, the several leaf members 36*f* are disposed radially, i.e., in spoke fashion, about a center opening 148 through which the operating shaft extends. Each of the leaf members 36*f* has associated therewith four terminals 98*f* which project radially out of the circular housing 62*f*.

Each pivot shaft 39*f* is provided with a curved cam-follower arm 67*f* terminating in a ball 68*f* which rides against a preselected cam 69*f*. A plurality of cams 69*f* are provided disposed axially upon the sleeve 73*f*, each cam 69*f* serving to actuate one of the arms 67*f*. Each cam 69*f* is splined to the sleeve 73*f* as shown at 149 so that it may be removed from the sleeve 73*f* and readjusted thereon in any angular position desired.

The ball heads 68*f* are all biased radially inward by means of torsion springs 151 encircling the respective pivot shafts 39*f* and having their ends embedded in the respective frame arms 43*f* with the intermediate portions of the springs 151 bearing resiliently against the respective arms 67*f* to bias the ball heads 68*f* inwardly.

Each of the cams 69*f* is cut in any desired fashion, so that at any desired predetermined angular position, the corresponding arm 67*f* is forced outward with consequent snapping of the associated leaf 36*f*, and allowed to drop back under urging of the spring 151 wherever the cam 69*f* is relieved inward. Each cam 69*f* thus has a surface 152 of relatively small radius and a surface 153 of relatively large radius.

To isolate each leaf 36*f* electrically, each pivot shaft 39*f* is journaled in a pair of insulating grommets 154 in which is likewise secured the projecting ends of each spring 151. The upper end of the leaf is also insulated by a suitable insulating grommet 156. If desired, these insulating points may be deliberately by-passed by respective flexible pigtail members 157 connected between each leaf 36*f* and its corresponding frame 42*f*.

To adapt the switch selectively for a wide variety of applications, the lower end of each of the frame arms 43*f* may be connected to or made integral with a common ring 158 from which extends radially a common terminal 159.

In this way, if desired, current may be selectively fed from a single input terminal 159 to any pair of associated terminals 98*f* in any desired pattern of operation, depending upon the shape and placement of the cams 69*f*.

This use of the switch employs the several radial leaf spring members 36*f* as distributing arms.

Whenever it is desired that the switch leaves 36*f* be electrically isolated, it is only necessary to remove the pigtails 157, thus isolating the terminal 159 and allowing each of the switches to operate electrically independently.

It will be clear that where the common terminal 159 is employed, and connected to each of the leaves 36*f*, the insulating grommets 154 and 156 may, if desired, be omitted.

The switch shown in FIGS. 1–3 also illustrates a manner of pivotally mounting the upper or outer end of the leaf members 36*f*.

In the switch shown in FIGS. 1–3, the pivot pin 51*f* is formed integral with the upper shaft 47*f* and is journaled in the cross piece 44*f* through the intermediacy of the insulating sleeve or grommet 156 alluded to hereinbefore. To permit the necessary slight pivoting of the

shaft 47*f* the cross piece 44*f* is then journaled at each end 164 in the upper ends of the respective arms 43*f*.

The shaft 47*f* projects into the windows or opening 93*f* formed in the arms 43*f* to prevent excessive twisting of the upper end of the leaf 36*f* which might cause diagonal bridging of the stationary contacts 97*f*. For those uses of this switch where the leaf 36*f* must be electrically isolated, it is thus necessary to provide insulating bushings 165 at each side of the windows 93*f* to prevent electrical contact between the shaft 47*f* and the frame arms 43*f*.

In FIGS. 4–7, there is illustrated a modification of the pancake or radial type switch illustrated in FIG. 1. In this form, the cam action is effected by a plurality of individual cam members 69*g*. Each cam is provided with a T-section base 166 adapted to slide into an undercut groove 167 of similar shape formed axially in the surface of a cylinder 168 forming the shaft means carrying the cams 69*g*. A plurality of such axial grooves 167 are formed in the cylinder 168, completely therearound, so that if and when each groove 167 is completely occupied with cams 69*g*, the entire surface of the cylinder 168 is overlaid with cams. In order to achieve the necessary back and forth movement of the cam follower arms 67*g*, spacers 169 are provided as alternates to the cams 69*g*. The spacers 169 are identical with the base portions 166 of the cams 69*g*. Thus wherever a spacer 169 is used the ball 68*g* of the cam follower drops down on the spacer 169, even with the surface of the cylinder 168. In this manner, any desired cam pattern may be placed on the surface of the cylinder 168 varying both circumferentially and axially.

The cylinder 168 has an axial bore 171 which fits slidably over an axial stud 172 projecting into the housing of the switch from the external wall 173. The cylinder 168 is thus mounted over the stud 172 for both axial and rotative movement.

Three circumferential rows of detents 174 are provided at the forward end of the cylinder 168 in which seats a spring pressed ball 176 mounted in the housing wall 177. By means of an external knob 178 the cylinder 168 may thus be rotated to bring the cams 69*g* rotatively into engagement with the various cam followers 68*g*. In the embodiment shown the cylinder 168 may also be pulled out in two steps, thereby bringing the cams 69*g* axially into engagement with the cam followers 68*g*. The switch is thus readily adapted for operation either by rotation or axial reciprocation of the cylinder 168. If desired, both methods of operation may be successively employed. Thus rotation of the knob 178 produces a given switching pattern depending on the placement of cams 69*g* and spacers 169. By pulling the knob 178 out one notch, a second pattern is effected. In similar fashion pulling the knob 178 out another notch effects a third rotary switch pattern.

When the knob 178 is pulled out one notch, the numeral 2 is visible on the cylinder 168 to show the operator that the knob is in the number 2 axial position; similarly further pulling out of the knob 178 reveals the numeral 3 to indicate that the switch is in the third axial position.

An indexing arrow 179 on the circumferential surface of the knob 178 cooperates with a plurality of numbered radial lines 181 imprinted on the wall 177 to indicate the rotational position of the switch.

The cams 69*g* and spacers 169 are held in place against radial and tangential movement by the natural mating configuration of the undercut slot and corresponding shape of the base or spacer member. They are held against axial movement by being stacked against each other, the entire stack being held in place by a recessed cap 182 held in place by three counter sunk flat head bolts 183 threaded into the end of the cylinder 168.

As in the switch shown in FIG. 1 et seq., the follower arms 67*g* are biased inwardly toward the cylinder 168 by individual torsion springs 151*g*. Means are provided for simplifying removal and replacement of the shaft



means carrying the cams 69*g* i.e. the cylinder 168, as well as to permit movement of the shaft means to a given axial and rotative setting, without running through all of the intervening switch sequences. This is a means for lifting and holding all of the switch arms 67*g* away from the cams 69*g*, and consists of a ring 184 mounted circumjacent the several auxiliary or operating shafts 39*g* carrying the respective follower arms 67*g*. Each shaft 39*g* has a short arm 186 projecting radially therefrom. A pivot pin 187 links the outer end of each arm 186 through a slot 188 to the ring 184. As shown in FIG. 7, when the ring 184 is rotated clockwise each of the arms 186 is likewise pivoted slightly clockwise causing a corresponding pivoting of each shaft 39*g* with consequent pivoting of each arm 67*g* away from the cams 69*g*. The slots 188 permit each shaft 39*g*, in normal operation, to pivot individually without affecting the others.

Rotation of the ring 184 is effected through a finger 189 threaded into the ring 184 and projecting through a radial slot 191 in the wall 177.

The switch of FIG. 5 is so constructed and designed that a number of such switches may be ganged together in alignment to be operated by a single operating knob 178. The manner in which this is accomplished will be explained by assuming that the switch shown in FIG. 5 is to have secured to the end thereof an identical switch whose parts or elements will be referred to by the same numerals as are contained in FIG. 5 but carrying a prime.

To adapt the switch of FIG. 5 for the ganging arrangement mentioned above, the forward end of the cylinder 168 is made of a separate part 193, to which the knob 178 is secured or made a part of. The parting line between the cylinder 168 proper and its front end 193 is shown at 194. The bores for the bolts 183 are made smooth in the cylinder 168 proper and are tapped only in the forward section 193. In this manner, bolts 183 serve the double function of holding the retaining cap 182 in place and also of securing the front end of the cylinder 193 to the cylinder proper 168.

The first step in ganging two switches together is to remove the rear wall 173 which forms the outer case for the switch. This operation of course also removes the stud 172. As explained hereinbefore, the bolts 183 are spaced around the cylinder 168, but as shown in FIG. 4, this spacing is not symmetrical, thereby providing a unique keying relation between the cylinder 168 and the knob 178 carrying the index 179. Removal of the rear wall 173 exposes three additional bores 196 (FIG. 4) in the rear end of the cylinder 168, these bores being tapped in the same manner as the front cylinder portion 193. The flat heads of the bolts 183 are recessed in the cap 182, as shown in FIG. 5, and the rear face of the cylinder 168 is thus ready to receive flush thereagainst the front face of its homologue 168'.

The second switch is prepared for ganging to the first switch by unscrewing and removing the finger 189', unscrewing the three bolts 183' and removing the forward cylinder portion 193' and knob 178'. The front wall 177' is also removed. The cylinder 168' is thus ready to be ganged in alignment with the cylinder 168 by screwing the three bolts 183' into the tapped bores 196 formed in the end of the cylinder 168. The resultant connection appears as shown in the fragmentary view FIG. 8.

In order that the finger 189 of the front or first switch may still serve to lift all of the cam followers 67*g* of the ganged combination, means are provided to link the several switch operating shafts 39*g* together.

This means comprises squaring and extending the front end of each shaft 39*g* as shown at 197. In the front switch this squared end resides in a clearance bore 198 formed on the interior of the front wall 177. The rear end of each shaft 39*g* is provided with a square opening 199 (FIG. 9) which receives the squared extension 197' of the ganged switch as shown in FIG. 9.

In this manner, any number of switches identical with that shown in FIG. 5 may be ganged together.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be afforded the full scope of the claims.

What is claimed is:

1. Multi-contact switch mechanism comprising a housing, shaft means mounted in said housing for both rotary and axial movement, a plurality of leaf spring members mounted in said housing, said leaf spring members being disposed substantially radially with respect to said shaft, means mounting said leaf spring members to be compressed longitudinally thereby to form an arch, said shaft means comprising a portion of enlarged diameter having a plurality of undercut grooves extending parallel to the axis of said shaft means, a plurality of cam segments each having a base corresponding to the shape of one of said grooves, and slid axially into one of said grooves to be retained therein against radial separation from said shaft means, means for confining said cam segments in said grooves against axial displacement, the upper portions of said cam segments proportioned to abut one another when installed in adjacent positions in the same or adjacent said grooves so as to form desired circumferential axial cam patterns, a plurality of auxiliary shafts, one for each of said leaf spring members, said auxiliary shafts being journalled in said housing and disposed around and substantially parallel to said shaft means, a plurality of cam follower means coupled to respective ones of said auxiliary shafts for engaging said cams thereby flexing said leaf spring members to snap the arch thereof from one position to the other, movable contact means carried by said leaf spring members, and stationary contact means carried by said housing and by said movable contact means, to selectively open and close electric circuits, whereby upon movement of said shaft, said leaf spring members are operated from one position to another.

2. Mechanism in accordance with claim 1 including ring means disposed circumjacent said shaft means, means linking said ring means with each of said auxiliary shafts, and operating means for oscillating said ring means about said shaft means, thereby to pivot said linking means and said auxiliary shafts and lift said cam follower means away from the respective cam means.

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