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MULTI-POINT ROTARY SWITCH WITH IMPROVED DETENT ARRANGEMENT

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Fig. 1

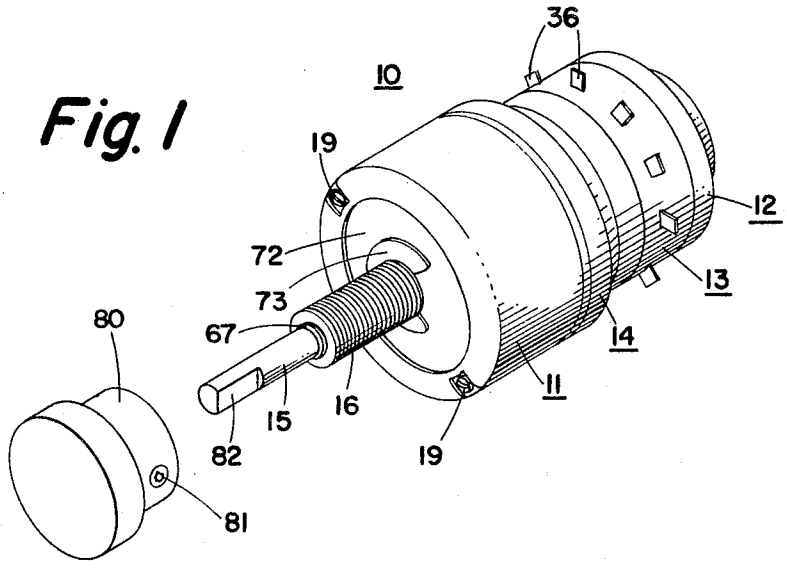
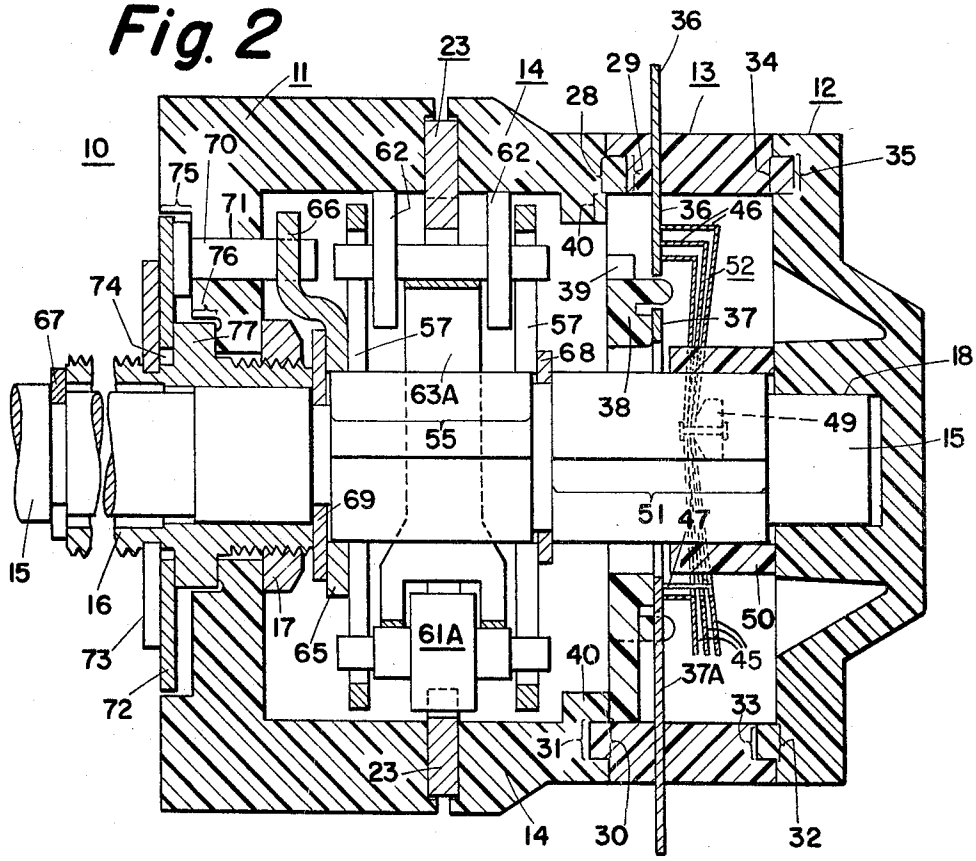


Fig. 2



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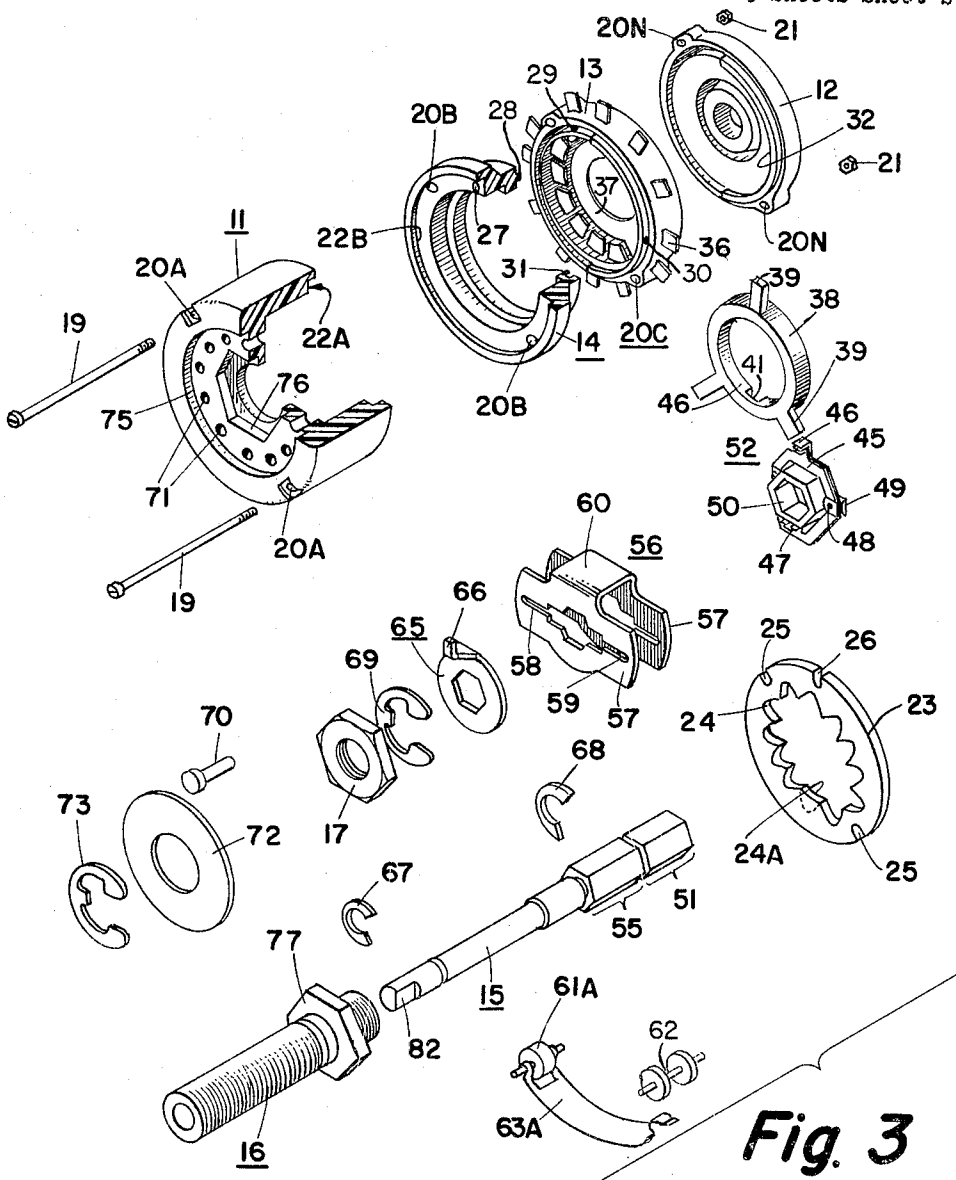


Fig. 3

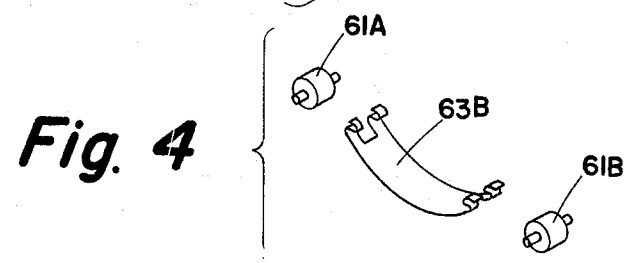


Fig. 4

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MULTI-POINT ROTARY SWITCH WITH IMPROVED DETENT ARRANGEMENT

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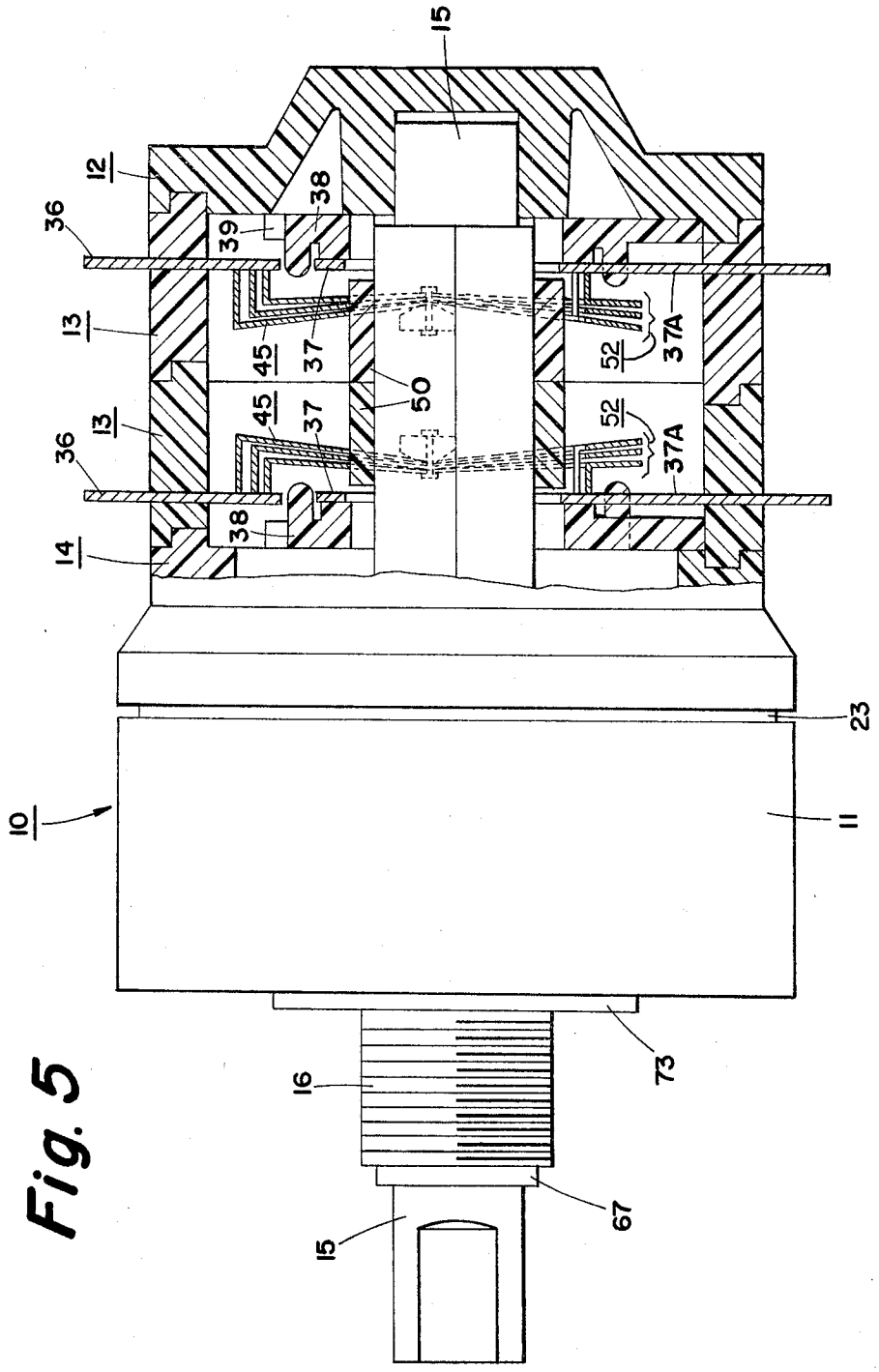


Fig. 5

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MULTI-POINT ROTARY SWITCH WITH IMPROVED DETENT ARRANGEMENT

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4 Claims. (Cl. 200—11)

This invention relates to multi-point rotary switches and particularly those of type having a detent arrangement for releasably restraining the contact-operating shaft in its various point-positons.

In accordance with one aspect of the present invention, the detent arrangement of the switch assembly comprises a stationary annulus having a notched inner periphery engaged by at least one of a pair of rollers disposed on opposite sides of the switch shaft and whose axles are slidably received by radial slots of a carriage mounted on the shaft. The detenting force is supplied by a free leaf spring whose opposite ends respectively engage the axles of the rollers. Such spring and roller arrangement imposes no frictional load on the shaft but does require application of a predetermined minimum torque for movement of the shaft in either direction from one detent position to the next.

More particularly, the aforesaid stationary annulus is clamped between two housing members of the switch assembly to extend between the side members of the roller carriage. In one form of the invention, the inner periphery of such housing members provides a smooth track for one of said pair of rollers whereas in another modification both rollers ride the notched periphery of the annulus to increase the turning torque required for a given roller-biasing spring.

Also in accordance with the invention, the one or more movable contact assemblies of the switch each includes a hub slidably but non-rotatably mounted on the shaft, with the contact pressure balanced to avoid binding of the hub on the shaft. More particularly, the hub bores are hexagonal or other multi-sided shape to fit a similarly shaped shaft: Accordingly, the contact assemblies of a multi-pole switch may be mounted on the shaft in any of various fixed angular relations to the other and may be paired in back-to-back relationship to equalize the pressure applied by them to their associated fixed contacts.

Further in accordance with the invention, an array of fixed contacts corresponding with each movable contact assembly is integrally molded in a housing element keyed to an adjacent housing element to insure proper correspondence between the contact positions and the notches of the detent annulus which is also keyed to one of the housing elements.

Further in accordance with the invention, the switch assembly includes one or more backing spiders each engaged by one of said adjacent housing elements to resist bending of a fixed contact ring by the associated movable contact brush.

Also in accordance with the invention, the switch assembly includes a stop arm slidably but non-rotatably received by the hexagonal or other multi-sided shaft and engagable by at least one stop pin as inserted through a selected one of a series of angularly spaced holes extending through a front housing member of the switch assembly. The stop pin or pins are retained by a washer arrangement removable for resetting of the stop pin positions without disassembly of the switch.

More particularly, the stop arm and roller carriage are held in fixed axial position on the shaft by a pair of split washers; one of said washers cooperates with a third split washer and a shaft bearing sleeve in said front housing member to prevent axial movement of the shaft, the stop arm and the roller carriage, all with respect to the stop pins and detent annulus as mounted on the housing members.

The invention further resides in a multi-point rotary switch having novel and useful features of construction, combination and arrangement hereinafter described and claimed.

For a more detailed understanding of the invention, reference is made to the following description of embodiments thereof and to the accompanying drawings in which:

FIG. 1 is a perspective view of an assembled switch unit;

FIG. 2 is a sectional view, on enlarged scale, of the switch unit of FIG. 1;

FIG. 3 is an exploded view showing in perspective the various individual components of the switch unit of FIGS. 1 and 2;

FIG. 4 shows, in perspective, the components of a modification of a sub-assembly of the detent roller and spring arrangement of FIGS. 2 and 3; and

FIG. 5 is a sectional view similar to FIG. 2 but including a second movable contact assembly and its associated fixed-contact housing component.

Referring to FIGS. 1 to 3, the switch unit **10** comprises a front housing **11**, a rear housing **12** and a fixed-contact housing ring **13**, and a spacer housing ring **14**. The operating shaft **15** for the movable contact structure of the switch is supported at one end by a bearing sleeve **16** held in the front housing **11** by nut **17** and at the other end by a blind bearing sleeve **18** formed in the rear housing **12**. The housings **11**, **12**, one or more contact-housing rings **13**, spacer ring **14** and detent annulus **23** are releasably clamped in assembled relation by the bolts **19** which pass through the holes **20A–20N** and slots **25**, **25** of the stack of housing members for threaded engagement by nuts **21**.

The adjacent faces of housing members **11** and **14** are respectively provided with grooves **22A**, **22B** to receive the detent annulus **23** whose inner circumference has a series of notches or teeth **24** in number corresponding with the number of active switch positions. The particular annulus shown in FIG. 3 is for an 11-position switch; for a 12-position switch, an additional notch would be cut at location **24A**. In all cases from a 2-position switch to a 12-position switch, the same notch size may be used. The pair of slots **25** in the edge of annulus **23** is to pass the clamping bolts **19**, **19**; the unsymmetrically-located slot **26** is for engagement by stud **27** of housing member **14**, so to orient the detent annulus. The desired orientation of the detent teeth or notches with respect to fixed electrical contacts of the contact ring **13** is insured by providing the adjoining faces of ring **13** and spacer ring **14** with complementary pairs of tongues and grooves. Specifically, the 180° tongue **28** of the housing member **14** is received by the 180° recess **29** of contact ring **13** and the 180° tongue **30** of ring **13** is received by the 180° recess **31** of housing member **14**. For ganging or stacking of several contact rings **13** in a multi-pole switch, the opposite face of ring **13** is also provided with a groove **33** and a tongue **34** each having an angular extent of 180°. Accordingly, to permit the end housing **12** to be assembled, its inner face is provided with a tongue and recess each 180° in angular extent to mate with the groove **34** and recess **33** of the rearmost contact ring **13**.

As shown in FIGS. 2 and 3, the group of fixed contacts **36** projects through the housing ring **13** in an array of angularly spaced contacts concentric with the shaft **15**. Preferably, such contact arrangement is made from a single silver punching whose ears **36**, **37** are molded in

the plastic ring 13. After molding, the silver web is punched out to form the contact configuration desired. The particular contact wafer shown in FIG. 3 is for an 11-position shorting type switch with a common contact ring 37. The outer ends of contacts 36 extend exteriorly of the housing ring 13 for attachment of wires to the controlled circuits. The inner ends of contacts 36 extend freely inwardly of the ring for sequential engagement by the long brush ends 46 of the bridging contacts 45 of the movable contact assembly 52. The common contact ring 37 is supported in the plane of fixed contacts 36 by its tail extension 37A which extends through the housing ring 13 for external connection to a circuit conductor. The contact ring 37 is continuously engaged by the shorter brush ends 47 of the two outer contact springs of the brush assembly 45. To maintain firm contact pressure, flexing of the contact ring 37 by brush pressure is precluded by its backing engagement with the plastic spider 38 (FIG. 2). The arms 39 of spider 38 are engaged by the backing flange 40 of the spacer housing ring 14. The notch 41 (FIG. 3) in the hub of spider 38 accommodates the tail extension 37*a* of contact ring 37.

As best shown in FIG. 2, the bridging contacts 45 encircle the hub element 50 and at two points spaced somewhat less than 90° on each side of their selector end 46 are held as by rivets 48 to the arms 49 extending in opposite directions outwardly from hub 50. The bore of hub 50 of the movable contact assembly 52 is hexagonal or other straight-sided configuration, slidably to fit the correspondingly shaped section 51 of the operating shaft 15 of the switch. In FIG. 2, the rear face of hub 50 of contact assembly 52 is pressed by the contact springs against the rear bearing 18 in housing member 12. The hub 50 is free to slide with respect to shaft 15 to maintain a contact pressure which is independent of any force applied to shaft 15.

It is to be noted that the common brush 47 and the selector brush 46 both tend to push the contact assembly 52 in the same direction axially of the shaft, and their 180° orientation further precludes any tendency for the assembly 52 to lock or bind on the shaft. In a 2-pole assembly, such as shown in FIG. 5, the two assemblies 52 may be placed back-to-back so that the contact forces oppose one another so to minimize torque losses due to friction of the contact assemblies against any stationary parts of the switch. Also, in a multi-pole switch, one movable brush assembly can be oriented in any of its six positions on the hexagonal shaft 15 so that its selector brush 46 may be set to lead or lag the selector brush of the other assembly by 0°, 60°, 120°, 180°, 240° or 300°.

The second non-circular section 55 of the operating shaft 15 slidably but non-rotatably receives the roller carriage 56. The opposite ends of each of the side members 57 of the carriage are respectively provided with radial slots 58, 59. The side members 57 of the carriage are held in fixed spaced relation to span the detent ring 23 by the bridging structure 60 or equivalent. One pair of slots, for example, 58, 58, receives the opposite ends of the axle of the detent roller 61A, and in the arrangement shown in FIGS. 2 and 3, the other pair of slots, for example, 59, 59, receives the opposite ends of the axle of the dual idler roller 62. The movable detent sub-assembly is made by inserting the rollers 61, 62 through the central hexagonal opening in carriage 56, moving them radially in their respective pairs of slots, and then snapping the C spring 63A to engage the roller axles. With such sub-assembly incorporated in the switch unit, the detent ring 23 is clamped in fixed position between the housing members 11, 14. The roller 61A is biased by spring 63A to engage the notched inner periphery of ring 23 and the dual idler roller 62 is biased against the smooth inner peripheries of the housings 11, 14. With shaft 15 in any of its detent positions, the roller 61A is seated in one of the notches of detent ring 23 and attempt to turn shaft 15 causes the roller 61A to ride up one side of the notch, its axle moving in the slots 58, 58 against the compression force of spring 63. A substantial minimum torque is required to move roller 61A in either direction from one detent position to the next. It is to be noted that the single leaf spring 63A which supplies the detenting force receives its reaction force from the switch housing without loading the switch shaft in any way. Use of detent rollers affords relatively large contacts area with the fixed detent plate, so keeping stresses to a minimum; the construction shown also allows the biasing spring to bear on and provide a bearing for a diameter much smaller than the diameter of the rolls so assuring a rolling rather than a sliding action in one detent position to the next. With the construction shown in FIG. 2, the minimum torque requirements may, of course, be increased by using a heavier C-spring.

Alternatively, to increase the torque requirements, the dual idler roll 62 may be replaced by a second detent roll 61*b* (FIG. 4), in which case spring 63*a* is replaced by spring 63*b*, both of whose ends are forked to straddle the detent rolls 61A, 61B for engagement with the respective axles thereof. In this modification, the rollers 61A, 61B are concurrently received by diametrically opposite notches of the stationary detent plate 23. The forward end of the hexagonal shaft section 55 also receives the stop member 65 having a mating hexagonal bore and an offset leg 66. The split spring washers 68, 69 as sprung into the grooves at opposite ends of shaft section 55 hold both the stop member 65 and the detent carriage 56 in fixed position axially of shaft 15. A third split spring washer 67 is received by a groove in shaft 15 to bear against the outer end of bearing sleeve 16; thus, with washer 69 bearing against the inner end of sleeve 16, the shaft 15 is prevented from having any appreciable axial movement or end-play with respect to the housing members 11 et seq.

The range of angular movement of shaft 15 is determined by one or more stop pins 70 which can be inserted through any one of the twelve holes 71 in the front face of housing member 11. For the 11-position switch shown, one stop pin may be used to define both limits of rotation of shaft 15. Two stop pins are used for a lesser number of active switch positions. The stop pin or pins 70 are held in selected position by ring washer 72 which overlies the enlarged pin-head structure and is engaged by the split washer 73 as sprung into groove 74 of sleeve 16. The circular recess 75 in the front face of housing 11 may be of depth such that the retaining washer 73 is substantially flush with the front face of the housing 11. The position of stop pin 70 can be adjusted, without disassembling the switch unit, by removing washers 73, 72 and inserting pin 70 in its new position. The washers 72, 73 are then replaced to retain pin 70 in its new adjusted position. The central hexagonal recess 76 of housing 11 mates with the similarly shaped boss 77 of the shaft bearing sleeve 16, so that the sleeve is prevented from turning without need for excessive tightening of nut 17. For manual operation of shaft 15, there may be provided a knob 80 having a set screw 81 for engaging a flat 82 of shaft 15.

It is to be understood the invention is not limited to the specific construction shown, but comprehends modifications and equivalents within the scope of the appended claims.

What is claimed is:

1. A multi-position rotary switch comprising

a housing for at least one group of angularly spaced fixed contacts,

a rotatable shaft carrying at least one movable contact assembly, each of said contact assemblies comprising resilient brush structure extending radially from said shaft for selectively engaging a corresponding group of said fixed contacts and applying contact pressure in direction axially of said shaft,

a pair of carriage members mounted on said shaft for rotation therewith, each of said members having radial slots on opposite sides of the shaft and paired with parallel radial slots of the other carriage member,

a stationary internally-notched annulus mounted on said housing concentric to said shaft and in a plane which extends between said carriage members,

a pair of rollers having axles respectively received by a corresponding one of the pairs of said radial slots, and

a leaf spring structure freely spanning said shaft and having its opposite ends respectively engaging said axles to bias said rollers in opposite directions away from said shaft, each of said spring ends being shaped to provide a bearing for the axle of the associated roller and at least one of said rollers cooperating with said internally notched annulus and said leaf spring structure to apply detent pressure in direction radially of said shaft.

2. A multi-position rotary switch as in claim 1 in which each of both ends of said leaf spring structure is fork-shaped to embrace the associated roller and to provide bearings for axle extensions at opposite ends of said roller, both of said rollers as biased by said leaf spring structure engaging the notched inner periphery of said annulus.

3. A multi-position rotary switch as in claim 1 in which one end of said leaf spring structure is fork-shaped to embrace a first of said rollers and to provide axle bearings at opposite ends of said roller; the other end of said leaf spring structure is shaped to extend between the spaced roller elements of the second roller and to provide a bearing for the axle extending between said spaced roller elements; said leaf spring structure biasing said first roller against the notched inner periphery of said annulus and the roller elements of said second roller against the smooth inner periphery of said housing.

4. A multi-position rotary switch as in claim 1 which includes

at least one pair of said movable contact assemblies, each of said assemblies comprising hub structure slidably but non-rotatably mounted on said shaft and having a dual arm contact brush straddling said shaft in avoidance of binding of the hub structure on said shaft, and

two housings for each pair of said movable contact assemblies, each of said housings having angularly-spaced fixed contacts for selective engagement by one arm of the dual arm contact brush of the associated one of said assemblies and having a contact ring for continuous engagement by the other arm of said assembly,

the movable contact assemblies of each pair thereof being oriented back-to-back on said shaft for equalization of the contact pressures respectively produced by them axially of said shaft.

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