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Lipschutz

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[54] **ELECTRIC SWITCH ASSEMBLY AND COMBINATION THEREOF WITH SAFETY LOCKS**

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Apr. 21, 1972 France 7214101

[52] **U.S. Cl.** ..... **200/44,** 200/8 R, 200/17 R
[51] **Int. Cl.** **H01h 27/00**
[58] **Field of Search** ..... 200/42 R, 44, 11 J, 200/11 K, 11 R, 8 R, 8 A, 17 R, 6 B

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Primary Examiner—Herman J. Hohauser
Attorney—Nolte and Nolte

[57] **ABSTRACT**

An assembly incorporating an electric switch including movable contact pieces displaceable by the switch rotor for making and breaking contact with corresponding stationary contact pieces selectively, bearing elements co-operating with said movable contact pieces and mounted in corresponding radial orifices of the switch stator opening to the outside through the side wall of the latter whereby said bearing elements are radially movable therein and constantly project outwards therefrom and at least one resiliently yielding sleeve tightly surrounding the switch stator and covering said bearing elements to resiliently bias them inwards.

6 Claims, 7 Drawing Figures

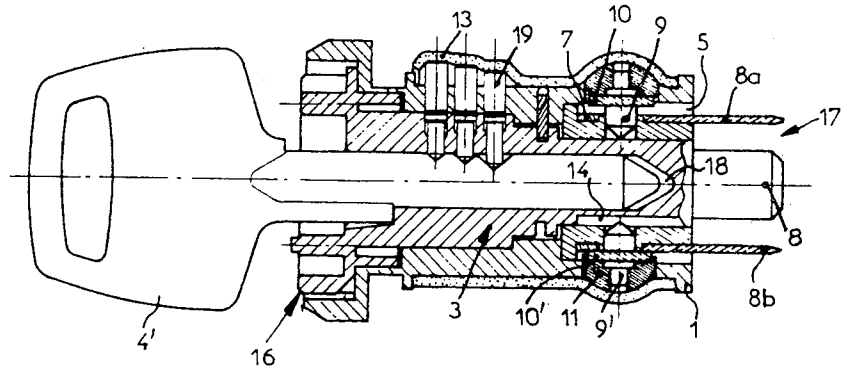


Fig.2

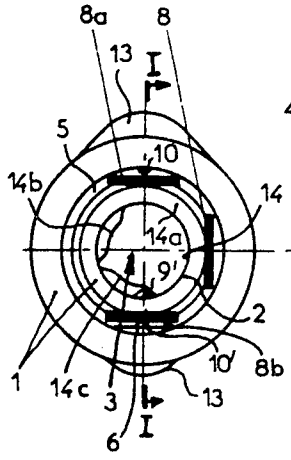


Fig.1

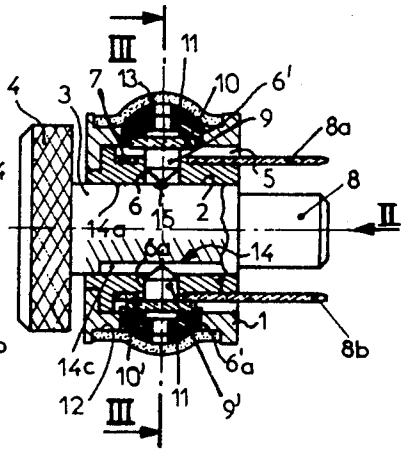


Fig.3

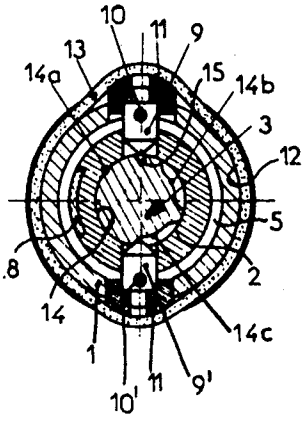


Fig.4

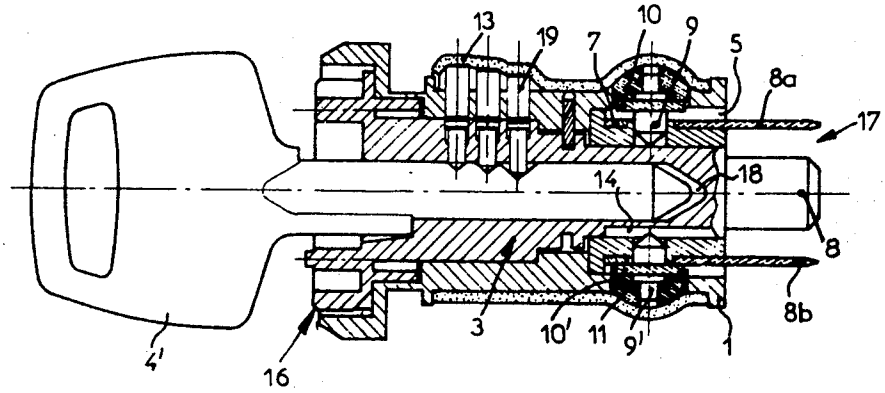


Fig.6.

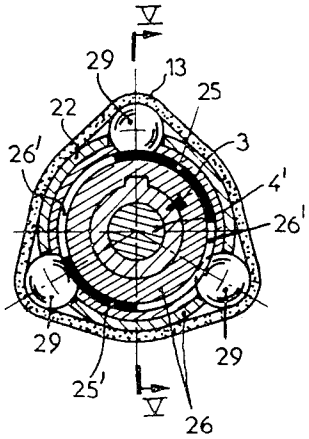


Fig.5.

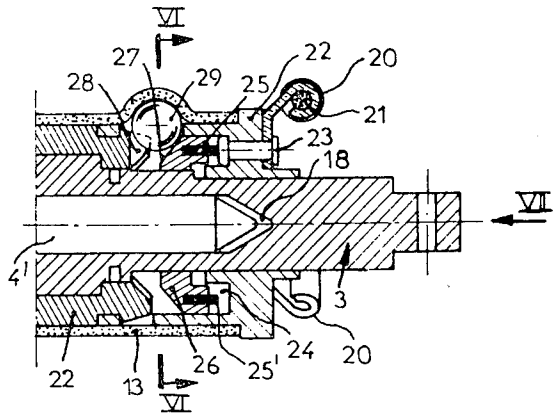
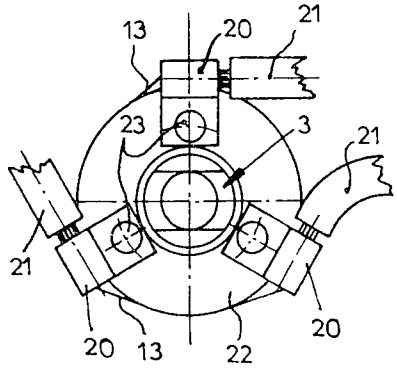


Fig.7.



ELECTRIC SWITCH ASSEMBLY AND COMBINATION THEREOF WITH SAFETY LOCKS

The present invention relates to an assembly incorporating at least one multiple-throw or multiple-way rotary electric switch.

A large variety of electric switches of such a type is known each one of which meets a specific operating requirement. The known devices however exhibit the disadvantage of being relatively cumbersome and bulky in particular in the direction of their longitudinal extent especially in view of the use of biasing or return metal springs for the contact pieces which require a housing or recess of suitable size to accommodate same. Moreover when the metal springs used for making contact consist of metal reeds, strips, blades or like laminations, the useful life of such strips is limited by the fatigue stress imparted to a member of relatively small size.

The object of the invention is to remove the aforesaid inconveniences and to provide a new and improved apparatus of small size and in particular relatively short and wherein the resilient biasing means exhibit a substantially increased durability while requiring a very reduced space only for housing them.

For this purpose in order to solve the technical problem set the invention proposes a rotary electric switch of the multiple-throw type comprising a stator of insulating material carrying a plurality of spaced stationary conducting contact pieces, a manually operable rotor rotatably mounted within said stator, a plurality of movable conducting contact pieces equal in number to that of said stationary contact pieces and displaceable by said rotor to make and to break contact selectively with said stationary contact pieces, respectively, and resilient biasing means urging said movable contact pieces towards said stationary contact pieces, wherein the improvement consists in that it comprises several bearing or pressure elements which are respectively in connection with said movable contact pieces and mounted in mating radial recesses respectively of said stator opening through the outer side wall surface thereof whereby said elements are radially movable in said recesses and constantly project outwards therefrom, as well as at least one resiliently deformable sleeve or hose tightly encompassing said stator and covering said bearing or pressure elements to form said resilient biasing means.

Owing to the technical progress achieved in the field of elastomers as well as of natural and synthetic rubbers, it is advantageous to make said sleeve or hose from one of these materials thereby resulting in an arrangement using the elastic properties of such materials with a view to remove the aforementioned inconveniences of the known devices.

The invention will be better understood and further objects, characterizing features, details and advantages thereof will appear more clearly as the following explanatory description proceeds with reference to the accompanying diagrammatic drawings given by way of example only, illustrating various species or embodiments of the invention and wherein :

FIG. 1 shows a view in longitudinal section taken upon the line I—I of FIG. 2 through a double-throw electric switch according to the invention ;

FIG. 2 is an end view seen in the direction of arrow II in FIG. 1, showing said device from the side of its connecting terminals, plugs or tags ;

FIG. 3 is a cross-section taken upon the line III—III in FIG. 1 ;

FIG. 4 is a longitudinal axial section through a pin-tumbler safety lock combined with an electric switch of the kind shown in the preceding Figures ;

FIG. 5 is a fragmentary view in longitudinal axial section taken upon the line V—V of FIG. 6 of an alternative embodiment of the electric switch according to the invention ;

FIG. 6 is a cross-section taken upon the line VI—VI of FIG. 5 ; and

FIG. 7 is an outside end view, from the right-hand side, of the apparatus shown in FIG. V, seen in the direction of arrow VII.

According to the embodiment shown in FIGS. 1 to 3, the electric switch with for example two active positions or ways comprises a stator or casing **1** made from electrically insulating material and of a preferably generally cylindrical shape provided with an axial bore **2** wherein is rotatably mounted a rotor **3** provided at one end thereof with a hand-actuated operating member such as a knurled or milled control knob **4** or like control handle. The stator **1** is formed with a longitudinal ring-shaped for instance substantially cylindrical recess **5** extending in coaxial relation to the bore **2** while surrounding same and opening to the outside in the end face located on the side opposite to the control knob **4**. The stator **1** is moreover formed with several radial holes **6** , **6'** ; **6***a*, **6'***a* corresponding to the number of active positions or ways desired and angularly distributed in the stator about the axis of rotation of the switch while being preferably located in a same radial plane extending transversely of said axis, each hole extending entirely through the stator walls to open with its opposite ends to the outside and into the bore **2**, respectively, and extending through the angular recess **5**. These holes are for example two in number and are desirably aligned with or diametrally opposite to each other.

On the radially inner wall surface of the annular recess **5** of stator **1** and on the side lying for example towards the control knob **4** with respect to the transverse normal plane passing through the common axis of the orifices **6**, **6'** and **6***a*, **6'***a* is mounted a conducting for example metal ring **7** the radial thickness of which is smaller than the radial width of the annular recess **5**. With this conducting ring is integral a conducting reed or strip **8** extending longitudinally i.e. in parallel relation to the rotor axis and desirably set in or flush-recessed in the inner wall surface defining the annular recess **5** while being substantially of the same thickness as the ring **7**. This strip **8** protrudes outwards from the switch on the opposite side from the control knob **4** and is used as a connecting terminal or plug for connection with one pole, for example the positive pole, of an electric in particular d.c. power source such as a storage battery or the like.

Further conducting strips **8***a*, **8***b* equal in number to that of the active positions or ways to be obtained hence two in number in the present case are mounted in parallel relation to the stator axis on the inner wall surface defining the annular recess **5** so that the longitudinal axis of each strip intersects the longitudinal axis of an associated radial orifice **6**, **6'** or **6***a*, **6'***a* and the radially outer surface of each strip is substantially aligned or in registering relationship with that of the conducting ring **7**. The conducting ring and said strips

are desirably built-in or flush-recessed in the inner wall surface defining the annular recess 5 so as to be flush therewith the thickness of each strip being smaller than the radial width of the said annular recess. The ring 7 and the strips 8*a*, 8*b* thus form stationary contact pieces and the ring 7 is spaced from each strip with which it is axially aligned by a gap at least equal to and possibly larger than the diameter of the hole 6, 6a extending through the inner wall of the stator.

In each radial orifice 6, 6' ; 6*a*, 6'*a* is slidably received a radially movable contact holder 9, 9' with a conducting cross-pin 10,10' extending therethrough and projecting from each side of member 9, 9' in parallel relation to the stator axis while being constantly located in the annular recess 5. The length of each pin 10, 10' is greater than the spacing between each strip 8*a*, 8*b* and the conducting ring 7 so that upon shifting the associated contact holder 9, 9' by a sufficient amount radially inwards the pin 10, 10' forming a movable contact piece may thus be applied simultaneously in engaging relationship against the conducting ring 7 and the associated strip 8*a*, 8*b* so as to achieve an electrical connection therebetween or reversely to break or cut off this connection through a sufficient displacement of the contact holder in the opposite direction i.e. radially outwards. For this purpose each movable contact holder 9, 9' consists desirably of a piston made from insulating material the radially inner end portion of which is slidably mounted in the associated orifice 6, 6*a* of the inner annular wall of the stator whereas its opposite end portion is provided with a shoulder forming an enlarged guide-head 11, 11' also made from insulating material and either integral with the piston or secured thereto and slidably mounted in the associated orifice 6',6'*a* extending through the outer annular wall of the stator, its diameter being desirably larger than that of the orifice 6, 6*a* formed in the inner annular wall of the stator. The pin 10, 10' is desirably partially set in or recessed in the corresponding shoulder 11, 11' so as to project radially inwards into the annular recess 5. The total length of each piston together with its shoulder in its longitudinal direction is greater than the whole radial thickness of the wall of the stator 1 between its bore 2 and its outer periphery 12 and this length is such that the shoulder 11 constantly projects radially outwards from the stator irrespective of the actual position assumed by the piston 9, 9' i.e. in particular in each one of its two opposite end positions which are a radially inner (contact making) and a radially outer (contact breaking) position, respectively. The outer surface of each shoulder 11 is desirably rounded or bulged for instance in the shape of a convex spherical dome.

The outer peripheral surface 12 of stator 1 is tightly encompassed by a resiliently yielding sleeve or hose 13 made for example from natural or synthetic rubber and long enough to cover all outward projecting shoulders 11, 11'. This sleeve is desirably set with its opposite end portions in the peripheral surface 12 of the stator and due to its elastic reaction force always applied to each shoulder 11 it tends to urge or force each piston 9, 9' radially inwards i.e. in the direction of its relative contact making position.

At least at its intermediate portion located substantially in the plane of the pistons 9, 9', the rotor 3 is formed with a cam-shaped peripheral surface 14 adapted to co-operate with pistons 9, 9' simultaneously. For this purpose the cam 14 is formed with a substantially cylindrical convex profile portion which is concentric with the axis of rotation of the rotor and is of constant radius for example equal to that of the bore 2 of the stator. On the opposite side the cam 14 exhibits at least two concave or re-entrant active profile portions 14*b*, 14*c* for example substantially symmetrical with respect to the axial or meridian plane halving the cylindrical profile portion 14*a*. The curvilinear or circumferential length of the cylindrical profile portion 14*a* is in the present case for example slightly greater than the half perimeter of a circle of same radius so that when one of the end parts of the cylindrical profile portion is registering with one piston 9, the opposite end part is also in registering relation to the other diametrally opposite piston 9'. The depth of each recessed profile portion 14*b*, 14*c* is adequate to allow a contact closing through sufficient travel of the associated piston radially inwards.

The number and extent of the convex cylindrical and concave active profile portions of the contour of cam 14 are of course adapted or correspond to the number of desired positions or ways for the electric switch.

The operation of this device is the following when assuming that initially the contact pin 10' is applied against the strip 8*b* and the conducting ring 7 thus providing a conducting connection between these two parts whereas the pin 10 is spaced from the strip 8a and from the conducting ring 7 so as to separate the strip 8*a* from the conducting ring 7. In this condition which is illustrated by FIGS. 1 to 3 the piston 9' is in its retracted end position wherein it engages the corresponding hollow or recessed portion 14*c* of the cam towards that end thereof which is adjacent to the cylindrical portion 14*a* whereas the other piston 9 engages the cylindrical portion 14*a* of the cam towards the opposite end part of this cylindrical portion. When turning the control knob 4 in the counterclockwise direction as seen in FIG 3, the piston 9' is gradually urged radially outwards by the ramp connecting the profile portion 14*c* with the cylindrical portion 14*a* and when the adjacent end part of the cylindrical portion 14*a* moves past the piston 9', the opposite piston 9 is still also on the opposite adjacent end part of the cylindrical portion 14*a* so that at that time both pistons are in their radially outer inactive end positions wherein the pins 10, 10' are spaced from the strips 8*a*, 8*b* and from the ring 7, so that all the contacts are broken or open. By further turning the control knob 4 by hand in the same direction as previously the concave profile portion 14*b* engages the piston 9 so that the latter may shift gradually inwards upon being engaged by the ramp connecting the recessed profile portion 14*b* with the cylindrical portion 14*a* until the associated pin 10 makes simultaneous contact with the conducting ring 7 and with the strip 8a thereby providing a conducting connection therebetween whereas the opposite piston 9' remains in engagement with the cylindrical profile portion 14*a* so that the conducting connection is kept cut off between the associated strip 8*b* and the conducting ring 7. The resilient sleeve 13 by constantly applying a centripetal pressure force upon the pistons 9, 9' keeps same constantly in engagement with the cam 14.

For indexing or locating and slightly snap-locking the rotor 3 in the various desired operating positions it is advantageous to provide stop recesses such as notches, depressions or like catches 15 in the peripheral surface

of the cam at locations corresponding to the desired operating positions, respectively, and each piston **9, 9'** then preferably terminates in a sharp tip or point likely to engage the corresponding catch notches **15.**

FIG. **4** shows a safety lock **16** for example for an anti-joy ride or anti-theft device adapted to lock a movable member such as the steering shaft or spindle in particular of an automotive vehicle and for example of the kind described in the French patent No. 2,040,823 and in its first certificate of addition Serial No. E.N. 71–10 860. With such a safety lock is directly combined an electric switch of the kind previously described and shown in FIGS. **1** to **3.** The safety lock **16** is operable by means of a removable key **4'** insertable into a suitable keyhole **18** of the lock rotor or barrel **3** rotatably mounted within a stator or stationary casing **8.** The electric switch **17** according to the invention is coaxially incorporated into the safety lock **16** in substantially aligned extension thereof on the side opposite to the keyhole and the switch stator **8** is rigidly connected to the lock stator by being for example made at least partially integral therewith. The switch rotor is rigidly connected to the lock rotor, plug or cylinder and is preferably made integral with the latter so that the lock and switch comprise a common rotor **3.** The safety lock comprises as is well known in the art of pin-tumbler cylinder locks, a plurality of pairs of radially movable aligned pins **19** of which both pins of each pair comprise an inner pin movable within a radial bore of rotor **3** extending through the annular wall of this rotor to open into the keyhole **18** and at the outer peripheral surface of the rotor, respectively, as well as an outer pin radially movable within a corresponding bore which is substantially aligned with the bore accommodating the inner pin and extending throughout the annular wall of the lock stator so as to constantly project outwards therefrom. Each inner pin-tumbler is adapted as known per se to engage a notch, ward or corresponding recess of the key **4'** the arrangement of said notches corresponding to a particular code selected to enable actuation of the lock and blocking same. In the known safety or pin-tumbler cylinder lock, the outer tumbler pin of each pair of aligned tumbler pins **19** is subjected to the permanent action of a metal for example coil or compression thrust spring urging the outer tumbler pin to move radially inwards so that when it is aligned with the associated inner tumbler pin it may push the latter radially inwards into a corresponding notch of the key **4'.** In the construction according to the invention shown in FIG **4** these metal springs are replaced by the resiliently deformable sleeve **13** of the electric switch **17,** this resilient sleeve being then of a sufficient axial length to tightly encompass also the stator of the lock **16** so as to cover the outer tumbler pins **19** thereof whereby the sleeve is then common to the electric switch and to the safety lock. It is apparent that instead of one single resilient sleeve two resilient sleeves could as well be provided for the electric switch and for the safety lock, respectively.

The use of the resilient sleeve enables to operate with one and a same member the various pistons of the electric switch and possibly also the various pin tumblers of the associated safety lock in particular irrespective of the position of the piston at the periphery of the electric switch thereby enabling to increase at will the number thereof and to vary at will their arrangement according to the various possible angular positions all of the pistons being then subjected to a same resilient thrust force directed radially inwards and exerted by a same sleeve. The electric switch according to the invention thus makes its possible to selectively connect the connecting strip **8** either with the connecting strip **8***a* or with the connecting strip **8***b* or possibly to fully cut off the flow of an electric current through the switch.

In the previous embodiments as well as in the following embodiment all the strips such as **8, 8***a*, **8***b* may form either connecting tags and thimbles or connecting terminals, clamps or like binding posts or connecting plugs, lugs and like plug-in pins.

In the form of embodiment shown in FIGS. **5** through **7,** the electric switch, shown as being for example combined with a safety lock or being separate and operable by an individual hand-actuated control member comprises for example three outer connecting thimbles, tags or like wire grips or cable clamps **20** wherein are tightly clamped or clipped three conducting wires or connecting cables **21** and which are secured to that terminal end face of the switch stator **22** which is located on the opposite side from its manually operable control member, by three rivets or the like **23,** respectively extending through the transverse end wall of the stator **22** so as to project into an inner cavity **24** of the stator to form thereby each one a stationary contact stud. One of said tags or thimbles **20** is adapted to be connected through its associated cable **21** like the strip **8** of the previous embodiment to one pole of a source of electric current whereas the two other tags or thimbles are connected like the two other strips **8***a*, **8***b*, to electric circuits, respectively, coupled to the other pole of the electric power source. The movable contact pieces consist in this instance of two ring segments **25, 25',** respectively, carried by a common annular member **26** preferably made from insulating material so that the arcuate cylindrical contact pieces **25, 25'** are electrically insulated from each other by intermediate insulating portions **26.** The annular contact segments **25, 25'** are angularly spaced from each other and for example diametrally opposite to each other whereas the stationary contact studs **23** are preferably equally spaced angularly from each other. The rotary contact holder **26** is non-rotatably mounted in coaxial relationship on the rotor **3** so as to be rotatable therewith while being preferably slidably movable axially or longitudinally thereof for example by being slidably keyed or splined thereon. The annular contact segments **25, 25'** have same centers and same radii of curvature and their common radius of curvature is substantially equal to the common radial distance of each rivet **23** to the axis of rotation of rotor **3.** The annular contact segments **25, 25'** are desirably flush-recessed or set in the annular holder member **26** so that their free terminal surface which is exposed in the axial direction is substantially flush or aligned with the remaining surface of the insulating material of the annular member **26.** On the axially opposite side from the annular contact segments **25, 25',** the annular holder **26** is formed with a substantially frusto-conical surface **27** coaxial with the rotor **3** and tapering towards the center line thereof on the opposite side from the arcuate contact segments **25, 250'.**

The stator **22** is formed in its periphery with several radial bores or like passageways **28** extending throughout its annular wall to communicate with the inner cavity **24** of the stator and desirably located in a same

transverse plane normal to the axis of rotation of rotor 3. These bores are for example three in number and equally spaced angularly from each other and adapted to accommodate and to guide each one a ball 29 of a diameter large enough to cause it to project radially on the one hand inwards into the stator cavity 24 so as to be in permanent engagement with the frusto-conical surface 27 of the member 26 and on the other hand outwards of the stator, the orifices 28 being desirably shaped and arranged so as to form a kind of ball-race or cage. The switch comprises as in the previous embodiment a resilient sleeve 13 slipped over the stator so as to cover all the balls 29 thereby to exert constantly upon the latter a centripetal pressure force. The pressure force transmitted by each ball 29 to the frusto-conical surface 27 of the annular contact holder 26 has a thrust component parallel with the axis of rotation of rotor 3 and directed towards the stationary contact studs 23 so as to press the annular contact holder 26 constantly against the stationary contact studs 23.

The curvilinear or circumferential length and the relative angular position of each arcuate contact segment 25, 25' are such that through manual rotation of rotor 3 a conducting connection may be provided at will on the one hand between that contact stud 23 which is always connected directly to one pole of a source of electric power and on the other hand either of the two other stationary contact studs 23 or both of them or also that any flow of electric current through the switch may be cut off thereby wholly isolating the stationary contact studs from each other. The number of balls is selected according to the diameter of the device and the centring to be carried out.

As seen in FIG. 5 the rotor 3 may be driven rotatably by one of its ends, the right-hand end for example which protrudes outwards and is formed endwise with a hole to receive therein an operating cross-arm or the like. Said rotor may also be operatively connected on the opposite (left-hand) side to a drive member such as the pin-tumbler cylinder, plug or barrel of a safety lock.

The electric switch according to the invention thus enables to control the closing or opening of several (in particular at least two or more) different or distinct electric circuits in particular of an automotive vehicle either simultaneously or successively for example according to a given operating program or sequence.

It is understood that the invention should not be construed as being limited to the embodiments described and shown herein which have been given by way of examples only. In particular it comprises all the means forming technical equivalents of those described as well as their combinations if same are carried out in accordance with the gist of the invention and put into practice within the scope of the following appended claims.

What is claimed is:

1. In an assembly incorporating a rotary multiple-throw electric switch comprising a stator made from insulating material and carrying a plurality of spaced stationary conducting contact pieces, a manually operable rotor rotatably mounted within said stator, movable conducting contact pieces equal in number to that of said stationary contact pieces and displaceable by said rotor for selectively making and breaking contact with said stationary contact pieces, respectively, and resilient biasing means urging said movable contact pieces towards said stationary contact pieces, the improvement consisting in the provision of a plurality of bearing elements co-operating with said movable contact pieces, respectively, and mounted in corresponding radial passageways of said stator which open through the outer side wall surface thereof whereby said bearing elements are radially movable in said passageways and project constantly outwards therefrom, and of at least one flexible and resiliently yielding sleeve tightly encompassing said stator and covering said bearing elements to form said resilient biasing means.

2. An arrangement according to claim 1, comprising a cylinder safety lock with radial pin-tumblers resiliently biased inwards and a rotor operable by a removable key, said electric switch being incorporated into said lock and having its rotor operatively connected to the rotor of said lock, said pin-tumblers constantly projecting outwards from said lock and said resilient sleeve being long enough to extend in tightly encompassing relationship also over said lock so as to cover the pin-tumblers thereof.

3. An arrangement according to claim 1, comprising a stationary conducting ring mounted in said stator in coaxial relation to said rotor an in permanent conducting connection with one of said stationary contact pieces, the other stationary contact pieces being axially spaced from said ring and substantially aligned in the axial direction with the generating lines of said ring whereas each one of said movable contact pieces is located in the axial plane containing an associated stationary contact piece and exhibits a dimension parallel with the axis of said rotor which is greater than the axial spacing between said ring and said associated stationary contact piece, each movable contact piece being carried by a piston made from insulating material and forming one aforesaid bearing element guidingly mounted in a corresponding radial orifice extending through the wall of said stator, so as to be constantly applied against an intermediate portion of said rotor, the lateral surface of said intermediate portion having the shape of a cam for selectively displacing said pistons to cause at least some of said movable contact pieces to engage said ring and their associated stationary contact pieces and at the same time to cause at least some other movable contact pieces to be disengaged and held disengaged from their associated stationary contact pieces.

4. An arrangement according to claim 3, wherein said cam is formed on its active profile contour with catch notches adapted to be engaged by at least some of said pistons, respectively, for indexing and slightly snap-locking said rotor in the desired operating positions thereof.

5. An arrangement according to claim 1, comprising a ring-shaped contact holder non-rotatably and slidably mounted in coaxial relationship on said rotor so as to be rotatable therewith and slidable therealong, said contact holder carrying said movable contact pieces shaped as arcuate conducting segments forming part of a same ring portion of said contact holder and angularly spaced and insulated from each other, said annular contact holder being applicable with its terminal surface comprising said arcuate segments against said stationary contact pieces lying in front thereof, said arcuate segments being of such circumferential lengths and angular positions that they enable to selectively provide a conducting connection between one of said

stationary contact pieces and at least some of the other stationary contact pieces, said annular contact holder being formed on its opposite side from said arcuate segments with a frusto-conical surface coaxial with said rotor and tapering towards the center line thereof on the opposite side from said terminal surface, whereas said bearing elements consist of balls slidably mounted in radial orifices of said stator so as to project constantly radially on the one hand inwards of said stator to be always in engagement with said frusto-conical surface and on the other hand outwards of said stator for being covered by said resilient sleeve.

6. An arrangement according to claim **1**, wherein said resilient sleeve is made from an elastomer material.

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