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Bischofberger et al.

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[54] **ELECTRICAL COMPRESSION SWITCH**

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[52] **U.S. Cl.** ..... **200/148 R**

[51] **Int. Cl.** **H01h 33/54**

[58] **Field of Search** 200/148

[56] **References Cited**

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[57] **ABSTRACT**

An electrical switch of the compression type wherein gas for arc extinction is compressed prior to disengagement of the contacts by movement of the driven contact itself includes a pair of contact studs arranged coaxially in end-to-end relation. One of the contact studs is positively driven, and the other contact stud which performs a follower function so as to remain temporarily in engagement with the driven contact while the gas is being compressed is mounted elastically within a movable housing structure biased to a rest position by a return spring. The housing structure is coupled to the driven contact stud by a latching mechanism such that the housing structure and follower contact stud are taken along with the driven contact stud during the gas-compressing phase of contact movement. Thereafter the latch mechanism releases thus uncoupling the spring biased housing structure and follower contact stud and permitting them to reverse direction and snap back quickly to the rest position thereby expediting disengagement of the follower contact stud from the driven contact stud as the latter continues to move in the contact separating direction, and at which time the compressed gas is released for flow into the gap formed between the ends of the contact studs.

6 Claims, 4 Drawing Figures

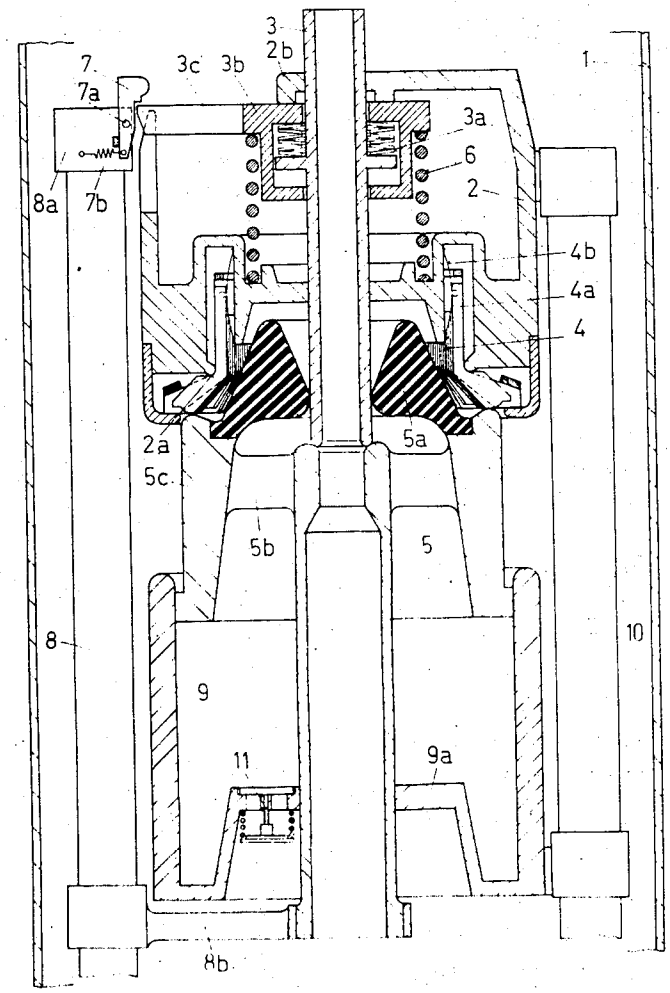
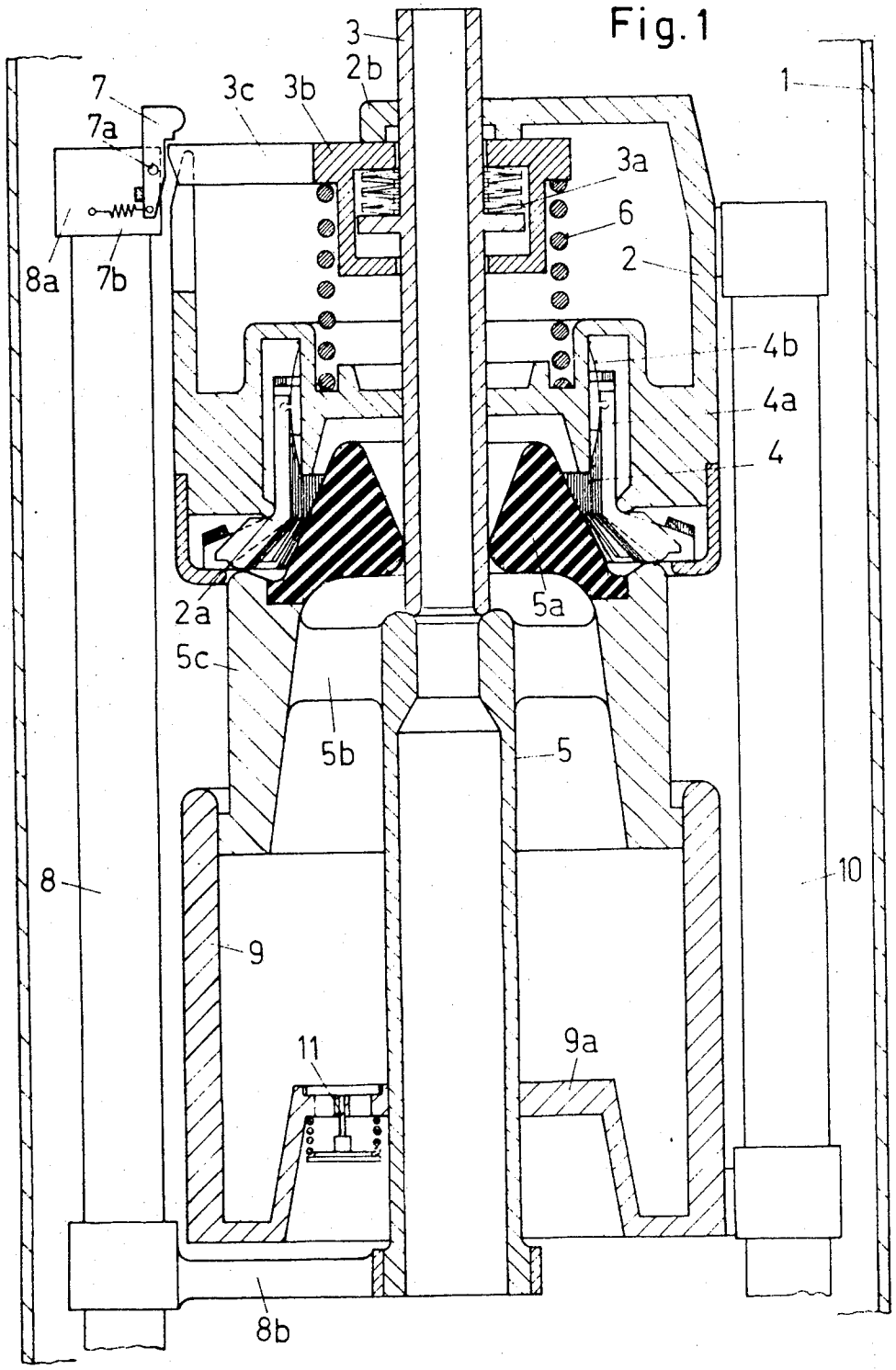


Fig. 1



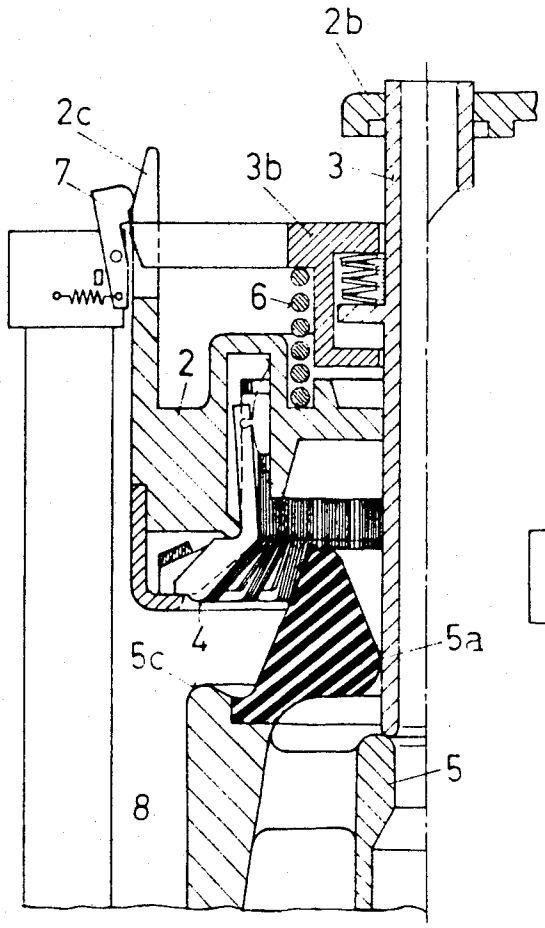


Fig. 2

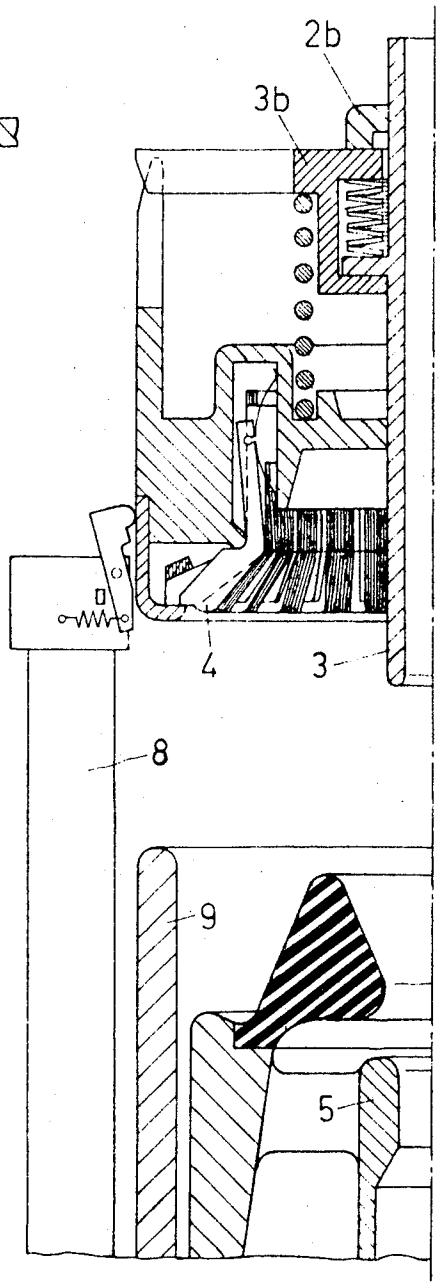
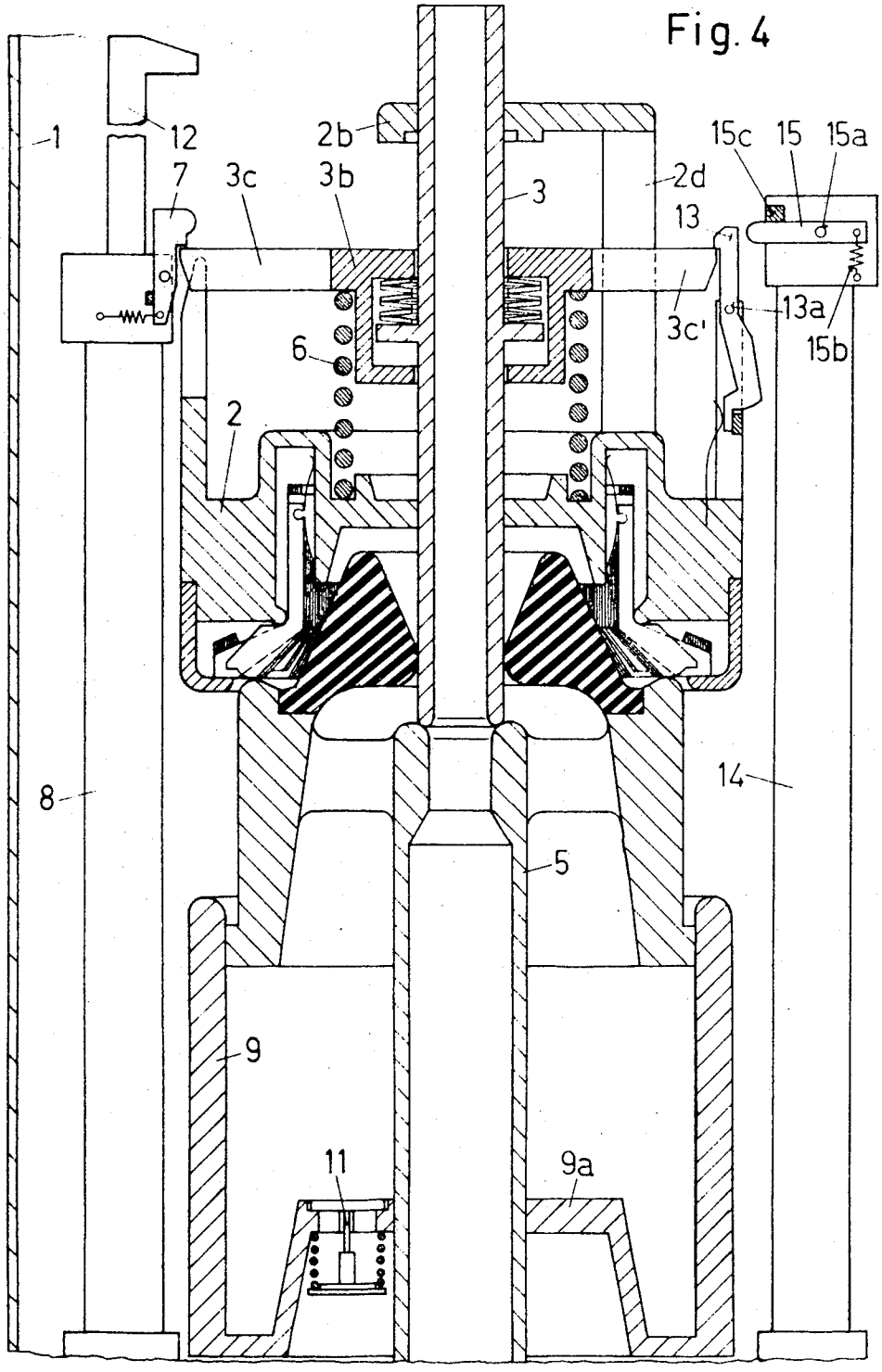


Fig. 3

Fig. 4



ELECTRICAL COMPRESSION SWITCH

This invention relates to an improvement in electrical switches of the so-called compression type wherein, for extinguishing the arc drawn between the contacts as they separate, a stream of quenching gas is directed into the contact gap, this gas stream being produced by a compression system consisting of a piston-cylinder unit. Switches of this type are disclosed, for example, in Swiss Patent No. 494,467, the latter providing a construction wherein the movable contact member of the switch is secured to the movable component of the compression system.

In order that disengagement of the switch contacts will be certain to occur only after a predetermined gas pressure has been built up by the compression system, arrangements are provided for maintaining the contacts in engagement during a so-called "precompression" stroke over a relatively long path of contact movement. This can be effected in either of two different ways. As disclosed in the above mentioned Swiss patent No. 494,467, one contact member remains stationary and the other contact member slides along it for a relatively long time while the gas is being compressed, e.g., during the first half of the disconnecting stroke, before the two contacts disengage. As disclosed in German Patent No. 1,130,028, as the movable contact begins its disconnecting stroke, the other counter contact, which is biased by a spring, follows behind the movable contact for a certain distance under the force of the spring, but still engaged therewith, and is then disengaged, as the counter contact stops.

These prior known arrangements for building gaseous pressure during the precompression period, however, require a considerable length of time to attain a contact separation distance considered optimum for extinction of the arc drawn between the contacts, this being attributable largely to the fact that relatively large masses are associated with the movable contact member which must also be accelerated. In the case of disconnect switches, the use of a lag pin which breaks away at a certain distance and then snaps back under a spring force is disclosed in German Utility Model Patent No. 6,601,558 but its function is to avoid flashover due to capacitance charges when opening the disconnect path between the main contacts.

In contra-distinction, the problem underlying the present invention is, however, concerned with a power switch of the compression type, and the object is to attain as quickly as possible a contact separation distance most favorable for arc extinction and thus obtain a short total disconnect time for the switch mechanism. In accordance with the invention, the compression switch includes a pair of contact studs arranged coaxially in end-to-end relation and which are adapted to be brought into abutting engagement. One of the contact studs is positively driven by an actuating mechanism so as to effect its engagement with, or disengagement from, the other contact stud which performs a follower function, and the latter is mounted elastically in a movable housing structure biased to a rest position by a return spring. The housing structure is coupled to the driven contact stud by means including a latching mechanism such that the housing structure and follower contact stud are taken along with the driven contact stud to keep the contact studs engaged during an initial phase of contact movement, and while the gas is being compressed within its cylinder. Thereafter, the latching mechanism releases, thus uncoupling the spring biased housing structure and follower contact stud from the driven contact stud and permitting them to reverse direction and snap back quickly to their initial rest position under the action of the restoring spring thereby expediting disengagement of the follower contact stud from the driven contact stud as the latter continues to move in the contact separating direction, and at which time, the compressed gas is released for flow into the gap formed between the ends of the contact studs.

The foregoing as well as other objects and advantages inherent in the inventive concept will become more apparent from the following detailed description of a preferred embodiment thereof and the accompanying drawings wherein:

FIG. 1 is a vertical central section through the contact structure of the improved compression switch;

FIG. 2 is a partial vertical section from FIG. 1 illustrating the relative positions of the operating components just before contact separation takes place;

FIG. 3 is a view similar to FIG. 2 but showing the relative positions of the switch components subsequent to contact separation; and

FIG. 4 is a vertical section similar to FIG. 1 but showing a slight modification.

With reference now to FIG. 1, the chamber for the contact mechanism of the power switch is indicated generally at 1. Within this chamber is a support structure 2 of electrically conductive material which is mounted in place by means including a vertically extending bar 10 made of insulating material. The support structure 2 serves as a mount for a follower contact assembly which includes a tubular follower contact stud 3 which is longitudinally slidable and guided in an opening provided in a horizontally extending part 2*b* of the support structure 2. Surrounding the contact stud 3 is a cylindrical housing 3*b*, the upper and lower end walls of this housing being provided with aligned openings to permit the contact stud 3 to pass through it. Within housing 3*b* and surrounding the contact stud 3 is a packet of annular plate springs 3*a* and these cooperate with a flange provided on the contact stud to provide an elastic mounting of the contact stud with respect to housing 3*b*. The latter is arranged for follower movement along the contact axis and is biased in the upper position depicted in FIG. 1 into abutment with support part 2*b* by means of a helical loading spring 6, the lower end of which abuts against the bottom of a circular recess provided in the stationary support 2, and the upper end of which bears against a circular shoulder provided on housing 3*b*.

Also carried by the support structure 2 is a stationary contact assembly 4 which surrounds the contact stud 3, and which is composed of a circular array of elastically supported contact fingers 4*a* and associated springs 4*b*. The contact fingers 4*a* are bent at approximately their middle so as to establish in conjunction with a rounded area 2*a* of the support structure 2 a slight pivotal movement about the latter so as to develop a pressure contact with the movable contact structure of the switch which will now be described.

The driven contact structure includes a tubular contact stud 5, the upper end of which is configured as a nozzle to effect engagement with the nozzled lower end of the follower contact stud 3. Supported at the upper

end of contact stud 5 by means of radially extending ribs 5*b* is a hollow, blast piston 5*c*, made of electrically conductive material, the upper end of which is rounded to establish a pressure contact with the spring finger contact assembly 4. The upper end of piston 5*c* also supports an annular nozzle 5*a* of insulating material the inner periphery of which slidably engages the outer surface of the contact stud 3.

The lower end of piston 5*c* is slidable within a stationary cylinder 9 secured to the support bar 10, and the bottom wall 9*a* of this cylinder which is recessed and includes a central opening through which the driven contact stud 5 passes in sliding contact, is provided with a non-return valve 11 opening inwardly of the cylinder to receive gas from the interior of the chamber 1 for compression as piston 5*c* is moved downwardly into its cylinder 9. The valve 11 opens freely against the slight counterforce created by its reclosing spring, during a closing movement of the switch contacts so as to fill the cylinder 9 as well as the interior of follow blast piston 5*c*.

In order to maintain the follower contact-stud 3 engaged with the driven contact stud 5 during the so-called "pre-compression" period, i.e., while the driven contact stud 5 and piston 5*c* carried by it are being drawn downwardly from the contact-engaged position depicted in FIG. 1 through an initial part of the switching-out stroke, to the release position depicted in FIG. 2, it will be seen that the driven contact stud 5 has secured to it by means of a laterally extending arm 8*b* an insulating bar 8 extending vertically upward, the bar terminating in a cap structure 8*a* and on which a latch lever 7 is pivotally mounted at fulcrum pin 7*a*. The upper end of lever 7 is provided with a latching shoulder engageable with the outer end of an arm 3*c* which extends laterally from housing 3*b*, and the lower end of lever 7 is provided with a spring 7*b* which loads the shoulder into its engaged position with arm 3*c*. Thus, as the driven contact stud 5 and insulating bar 8 are moved downwardly together by actuating mechanism which can be of the conventional type, and hence not illustrated or essential to an understanding of the invention, housing 3*b* will also be drawn downwardly from its upper rest position in contact with the underside of the support part 2*b*, by virtue of the latched connection between latching lever 7 and arm 3*c*. Downward movement of housing 3, which is accompanied by compression of the restoring spring 6, is transmitted to the contact stud 3 through the elastic coupling provided by the stack of plate springs 3*a*, and thus carries contact stud 3 downwardly so as to follow, and remain engaged with, the driven contact stud 5. At the same time, the blast piston 5*c* which forms an integral part of contact stud 5, is likewise driven downwardly into its cylinder 9 to compress the gas stored therein. When, however, the switch components reach the end of the pre-compression phase of the contact movement, as depicted in FIG. 2, it will be seen that a nose on latch lever 7 which in the meantime had been riding against an inclined face 2*c* at the upper end of a vertical extension on the support structure 2, will have been cammed in a counter clockwise direction so as to effect release of the latch lever from arm 3*c*. As soon as this happens, the restoring force built in spring 6 by its compression is released and hence is effective to cause the assembly of housing 3*b* and contact stud 3, which has relatively little overall mass, to rapidly reverse its direction of movement and snap back as contact stud 5 continues its downward movement, thus very quickly establishing the desired optimum separation distance from the follower contact stud 3 at which the arc drawn therebetween can be extinguished by the blast of pre-compressed gas and which is released into the gap between the ends of the tubular contact studs 3,5 as soon as disengagement takes place, for flow through the contact studs, it being noted that the annular insulating nozzle structure 5*a* still remains in contact with contact stud 3 for a while after the latter is separated from contact stud 5 so as to prevent escape of the compressed gas from within cylinder 9 and piston 5*c* in any direction except through the circular gap formed between the ends of the contact studs.

The fully disengaged position of the switch contacts is depicted in FIG. 3. When it is desired to reclose the switch contacts, the driven contact stud 5 together with piston 5*c* is actuated in the upward direction to effect reengagement. The upper end of contact stud 5 is the first to reengage the lower end of the follower contact stud 3 and shift the latter upward to the position depicted in FIG. 1, accompanied by a slight compression of the plate spring assembly 3*a*, this being followed by engagement between the rounded upper end of piston 5*c* and the lower end of the spring finger contact assembly 4, thus rotating the fingers 4*a* slightly inward about their pivots against the counter action of the leaf springs 4*b* so as to provide the desired pressure engagement therebetween.

In certain cases, it may be expedient and advantageous to make the return path of the follower contact stud 3 greater upon disconnection than corresponding to its end position in the stationary, disconnection position. To achieve this, the housing part 3*b* and hence contact stud 3 are permitted to carry out a partial stroke again in the original follow-up direction after the rupture movement, in order to ensure that when executing a reclosing movement of the switch contact structure, the contact studs 3,5 will be the first to reengage. For this purpose, the slightly modified arrangement illustrated in FIG. 4 can be utilized from which it will be seen that the laterally extending part 2*b* of the support 2 is relocated to a more upward position than shown in FIG. 1, this being effected by means of a vertical extension 2*d*. In addition, the bar 8 is provided at its upper end, above latch lever 7, with a tappet 12 also adapted to engage arm 3*c*. The housing 3*b* is also provided with a second laterally extending arm 3*c'* opposite arm 3*c*, i.e., on the right side, as viewed in FIG. 4, and the outer end of arm 3*c'* is adapted to be engaged by the upper end of another latching lever 13 which is pivotally mounted intermediate its ends on fulcrum pin 13*a*, there being a spring associated with the lower end of the lever to bias it in a counterclockwise direction so as to engage the end of arm 3*c'*. The fulcrum pin 13*a* for lever 13 is carried by an upwardly extending projection on the support structure 2.

A second insulating bar 14, similar to bar 8, and carried by the driven contact stud 5 in the same manner as is bar 8, extends upwardly along the side of latching lever 13 and is provided at its upper end with a release lever 15 which is mounted intermediate its ends on a fulcrum pin 15*a*. Also provided in association with lever 15 is a loading spring 15*b* which biases the front, working end of the lever in a clockwise direction into a rest position with a stop 15*c*.

In carrying out a disconnecting movement of the modified construction shown in FIG. 4, after execution of a partial part of the total contact movement, lever 7 disengages from arm 3c, in the same manner as with the embodiment of FIG. 1, and at about the same time as that disengagement takes place, latching lever 13 is likewise disengaged from arm 3c', this being effected by downward movement of bar 14 and lever 15 as the forward working end of this lever rides against a sloped surface of lever 13 below the fulcrum point and cams the latter clockwise into the release position. This conjoint action of the two latching levers thus enables the housing 3b and follower contact stud 3 to snap back in the upward direction and engage stop 2b. In the last part of the disconnecting movement, however, arm 3c will be brought by the tappet or dog 12 into the position depicted in FIG. 4 and then held there by engagement with latch lever 13 at arm 3c'.

We claim:

1. In an electrical switch of the compression type wherein gas for arc extinction is compressed prior to disengagement of the contacts by contact movement, the combination comprising a pair of contact studs arranged coaxially in end-to-end relation, means for driving one of said contact studs to effect contact disengagement and re-engagement, a gas compression device including a piston-cylinder unit actuated by said driven contact stud, the other of said contact studs which performs a follower function and which remains temporarily in engagement with said driven contact stud while the gas is being compressed being mounted elastically within a housing structure biased to a rest position by means of a return spring, means including a latching mechanism for initially coupling said housing structure to said driven contact stud whereby said housing structure and follower contact stud are taken along with said driven contact stud during the gas-compressing phase of contact movement, and means for thereafter releasing said latching mechanism from said housing structure while said driven contact stud continues to move in the contact disengaging direction thereby permitting said housing structure and follower contact stud to reverse direction and snap back thus expediting contact disengagement and which is accompanied by release of the compressed gas from said gas compression device to the gap between the ends of said contact studs.

2. An electrical switch of the compression type as defined in claim 1 wherein said follower contact stud passes through said housing structure and is supported elastically therein by means of a pack of annular plate springs engaged with a flange on said follower contact stud.

3. An electrical switch of the compression type as defined in claim 1 wherein said return spring for said housing structure is constituted by a helical compression spring having one end thereof in abutment with said housing structure and the other end in contact with a fixed abutment provided by a support which also includes aligned openings through which said follower contact stud passes and is guided.

4. An electrical switch of the compression type as defined in claim 1 wherein said return spring for said housing structure is constituted by a helical compression spring having one end thereof in abutment with said housing structure and the other end in contact with a fixed abutment provided by a support which also includes aligned openings through which said follower contact stud passes and is guided, wherein the piston component of said gas compression device is carried by said driven contact stud and operates in a stationary cylinder, and wherein there is further provided an annular spring contact unit composed of resiliently mounted contact fingers surrounding said follower contact stud and in electrical contact therewith, said contact fingers being engaged by the end of said piston when said contact studs are engaged.

5. An electrical contact switch of the compression type as defined in claim 4 and which further includes means for re-actuating said housing structure and follower contact stud from the rest position to an intermediate position in the follow-up direction after the contact studs have been disengaged and the arc extinguished to ensure re-engagement of the ends of said contact studs upon executing a contact closing operation prior to engagement between said piston and said annular spring contact unit, and means for latching said housing structure in said intermediate position.

6. An electrical contact switch of the compression type as defined in claim 1 and wherein said gas compression device includes a hollow piston secured to said driven contact stud operating in a stationary cylinder, the end of said piston terminating in an annular insulating nozzle surrounding and in contact with said follower contact stud, and disengagement of said contact studs being effected within said hollow piston whereby the compressed gas within the piston is directed into the gap formed between the contact studs.

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