April 5, 1932. M. M. SAMUELS ET AL 1,852,336

ELECTRICAL SWITCH

Filed June 24, 1926

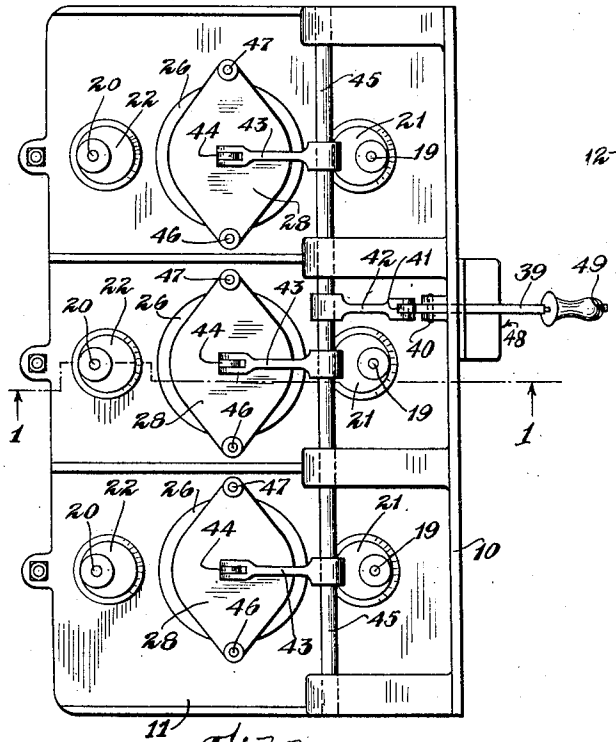

Fig. 2.

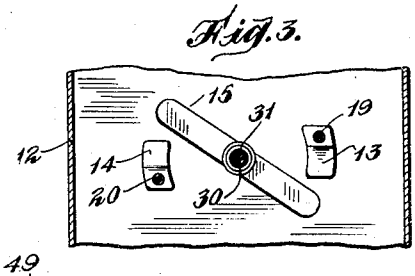

Fig. 3.

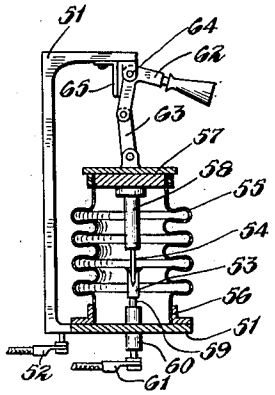

Fig. 4.

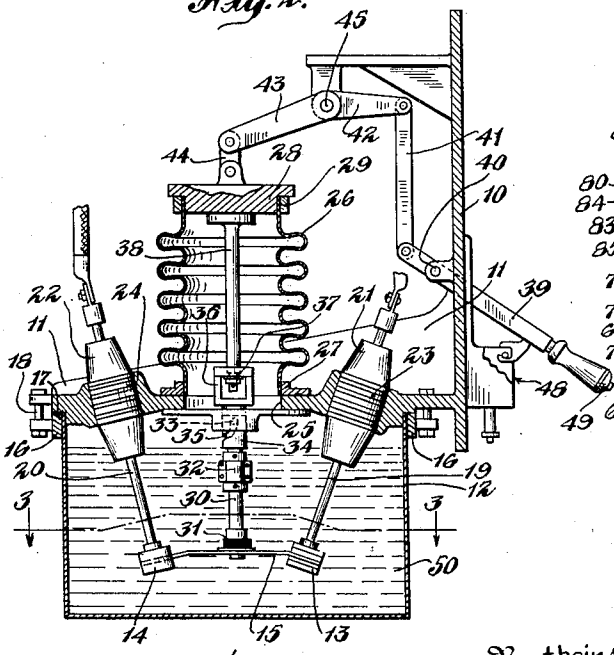

Fig. 1.

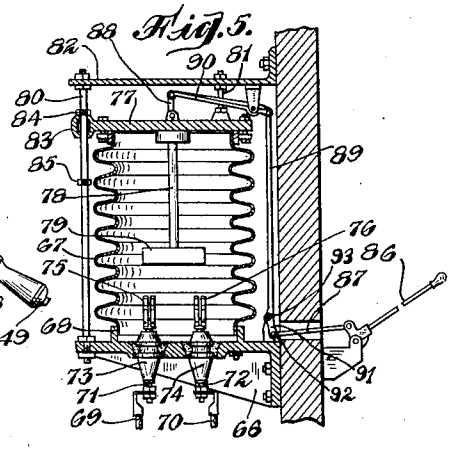

Fig. 5.

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UNITED STATES PATENT OFFICE

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ELECTRICAL SWITCH

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This invention relates to electrical switches and more particularly to improved forms of enclosed electrical switches.

The main object of the invention is to provide an electrical switch arrangement which is not only simple in construction and dependable and efficient in operation, but which also has improved safety features.

Further and more specific objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification.

In the drawings Fig. 1 is a sectional elevational view illustrating one embodiment of the invention, taken on the line 1—1 of Fig. 2;

Fig. 2 is a plan view showing a group of switch units of the type shown in Fig. 1;

Fig. 3 is a sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is a sectional elevational view illustrating another embodiment of the invention; and

Fig. 5 is also a sectional elevational view of still another form of construction incorporating features of the invention.

Referring to the construction as shown in Fig. 1, a switchboard is illustrated at 10 formed with a switch supporting frame 11 which cooperates with a container portion 12 to form an enclosure for a cooperating pair of switch contacts as at 13 and 14 which are arranged to be bridged by a rotatable contact member 15. The container portion 12 may be secured upon and sealed in respect to the frame 11 in any suitable manner as by providing a peripheral flange 16 around the upper edge of the container portion 12, which flange engages a complementary flanged portion 17 formed on the frame 11. Suitable bolts as at 18 may be used to retain the container portion 12 in hermetically sealed relation to the frame 11.

The contacts 13 and 14 respectively may be supported upon leading-in conductors 19 and 20, which are insulated from the frame 11 by suitable insulators 21 and 22. The insulators 21 and 22 may be hermetically sealed within apertures as at 23 and 24 formed in the frame 11. The conductors 19 and 20 may also be hermetically sealed through the insulators.

The enclosure formed by the container portion 12, cooperating with the frame 11 acting as a cover therefor, may be filled with suitable insulating fluid which may be either gaseous, or an arc-suppressing liquid partially filling the container with the remaining space filled with a readily compressible gas. For example, the enclosure may be filled with air or if preferred, may be partially filled with an insulating liquid such as oil or fire extinguishing fluids, such as carbon tetrachloride. Heretofore the use of carbon tetrachloride or other volatile insulating liquids has been generally limited in electrical apparatus to use in fuses wherein there are no moving parts extending to the exterior of the enclosure. In order to prevent rapid evaporation of the volatile liquid, it is desirable to provide an hermetically sealed container, but in switch constructions this has heretofore been difficult inasmuch as moving parts of the switch operating mechanism usually extend from the contacts within the container to points externally of the container. The difficulties of providing a permanent hermetical seal at the point where these moving parts pass through the container wall has heretofore inhibited the general use of desirable but volatile fire extinguishing fluids such as carbon tetrachloride, for the immersion of electrical switch contacts.

According to the present invention, means are provided for actuating the contacts within the switch enclosure by the operation of actuating mechanism outside the container, the whole container, nevertheless, being hermetically sealed. Referring to Fig. 1, the frame 11 is provided with a large aperture 25 through which the switch contact operating mechanism extends. To hermetically seal this aperture, however, a flexible or resilient, deeply corrugated and substantially cylindrical metallic member 26 is provided. The member 26 at one end has its peripheral edges securely sealed as by solder to a retaining ring 27 secured at the periphery of the aperture 25. At the other or free end of the member 26 a rigid end plate 28 is securely

sealed in place as by the use of a peripheral ring 29 soldered or otherwise fixed to the member 26 and to the end plate. Internally of the enclosure the end plate 28 is operatively connected to the switch contact member 15 in a manner such that when the member 26 is compressed the circuit through the switch contacts will be closed. However, upon release of the member 26, the member 26 will be permitted to expand and the switch operating mechanism will be retracted to open circuit position.

One form of switch operating mechanism as shown in Fig. 1 will now be described. The rotatable contact bridging member 15 may be mounted upon a rotatable shaft 30 and insulated therefrom in any suitable manner as by a suitable insulating sleeve 31. The shaft 30 may be mounted within a suitable bearing 32 and formed at its upper end with a radially extending pin 33. Collars may be fixed upon the shaft 30 just above and below the bearing 32, as shown, in order to fix the vertical position of the shaft. The upper end of the shaft may be loosely fitted within a sleeve member 34 formed with a spiral slot 35 for slidably receiving the pin 33. The sleeve member 34 may be formed with a yoke 36 suitably connected at 37 with a reciprocating rod 38 which is secured to the end plate 28. Vertical movements of the rod 38 will accordingly result, by reason of the spiral slot and pin connection, in rotational operation of the contact 15.

Externally of the enclosure suitable switch operating mechanism may be provided including an operating lever 39 pivotally mounted at 40 upon the rear of the switchboard 10 and operatively connected through link 41, bell crank levers 42 and 43 and link 44 to the end plate 28. The bell crank levers 42 and 43 may be secured upon a shaft 45 which may be common to a plurality or group of switch units as shown in Fig. 2. In this arrangement the single operating handle 39 may be used to control, for example, the three switch units for opening and closing the three conductors of a three phase circuit.

By referring to Fig. 2 it will be noted that the upper or free end of the compressible member 26 may be restrained against sidewise movement by vertically extending guide rods as at 46 and 47, which slidably engage apertures through the end plate member 28.

In the position shown in the drawings, the operating lever 39 is retained in the closed circuit position and may be locked in such position by any well known form of remotely controlled magnetic trip device as indicated at 48, which also, if desired, may be arranged to be tripped manually in a conventional manner by pressing a thumb button 49.

The switch enclosure here shown is partially filled with a body of insulating fluid 50 such as carbon tetrachloride which immerses the switch contacts. The remainder of the enclosure is filled with a readily compressible fluid such as air, or carbon tetrachloride vapor, either at atmospheric pressure or, if desired under special circumstances, at a higher or lower pressure. Therefore, when the switch is moved to closed circuit position, the member 26 will be compressed and the volume of fluid therein will be decreased, thus building up a substantial potential force within the switch tending to open the same. Accordingly, when either the manual or automatic trip devices are operated, the pressure of the entrapped fluid within the enclosure supplemented by the resiliency of the member 26 will cause the switch operating parts to quickly jump to their open circuit positions. Thus a quick break at the contacts is insured. The quick break made possible by this arrangement and also the possibility of using highly efficient arc-suppressing liquids, even though volatile, renders it possible to use this switch for breaking short circuit currents of great magnitude.

When an electric circuit is automatically interrupted, with over-current or over-voltage conditions, if the circuit breaking contacts are in oil or other mediums, gases are often formed in sufficient quantity and of such character that the vessel containing the oil or other insulating medium is caused to explode unless provided with a large opening to the atmosphere. Such large opening also, of course, permits the insulating medium to escape by evaporation or capillary action. However, with the present invention the enclosure being formed with an expansible portion is able to readily accommodate sudden increases in volume of gases therein without danger of the enclosure being ruptured. In fact, according to our invention the sudden increase in pressure resulting from the formation of or expansion of gases due to arcing at the first moments of the circuit breaking action, are utilized to good advantage to hasten the expansion of the container. Positive and quick circuit breaking action is thus insured even though heavy currents are broken. Also, the switch in its preferred form being hermetically sealed, is available for the control of electric power, lighting or heating circuits in regions where inflammable or explosive media prevails as in chemical plants, oil refineries, garages, etc., where the arc produced by the opening or closing of the switch must be covered to avoid danger of fire or explosion. The switch is also well adapted for use where the light produced by the arcing at the switch contacts, if not covered, would damage the products being manufactured at the establishment, such as in the photographic industry.

In Fig. 4 another embodiment of the in-

vention is illustrated. Here a desirable construction is provided for small enclosed switches which may be operated directly and manually. A frame 51 is provided which also comprises a conductor for one side of the electric circuit, a line wire 52 being secured thereto. A pair of cooperating switch contacts 53 and 54 are provided and are enclosed within a collapsible drum 55, which if desired may be constructed in a manner similar to the compressible member 26 above described. The lower end of the drum 55 is hermetically sealed at 56 to the base of the frame 51 while the upper or free end of the drum is closed off and hermetically sealed by an end plate member 57. The contact 54 is supported and electrically connected to the end plate 57 by a support member 58. The contact 53 is provided with a supporting and leading-in conductor 59 passing through a sealed-in insulating sleeve 60 which extends to the exterior of the drum. Externally of the drum the supporting conductor 59 is connected to a line wire 61. To operate the switch it is merely necessary to raise or lower the end plate 57, thereby compressing or releasing the drum and bringing the contacts 53 and 54 into or out of engagement. This if desired may be readily accomplished by a simple toggle mechanism comprising a bell crank lever 62 pivotally connected to a link 63 which in turn is pivotally attached to the end plate 57. The bell crank member 62 may be pivotally mounted at 64 upon the frame 51. With the parts as shown the switch is in closed position and is held in this condition by the toggle mechanism, the bell crank 62 being lodged in an over center position and held in such position by a stop member 65. On raising the handle of the bell crank member the toggle locking mechanism may be released whereupon the compressible drum is permitted to expand, separating the contacts with a quick breaking action, which interrupts the circuit therethrough without excessive arcing.

Referring to Fig. 5, a further embodiment of the invention is illustrated. A wall bracket 66 is provided which also forms the base portion of a switch enclosure, the wall portions of which comprise a compressible drum member 67 of the general type above described. The drum 67 may be hermetically sealed at 68 to the bracket or frame member 66. Line wires 69 and 70 respectively are attached to the leading-in conductors 71 and 72 which extend through insulators 73 and 74 and terminate at contacts 75 and 76 within the enclosure. The insulators 73 and 74 may be hermetically sealed both to the leading-in conductors and to the wall bracket at the apertures where they pass through the bracket. At the upper end of the compressible drum a rigid end plate 77 may be hermetically sealed in place. This end plate carries a supporting member 78 upon which a contact bridging member 79 is mounted. The upper end of the compressible drum may be restrained against sidewise movement by means of guide rods 80 and 81 having their lower ends secured in the wall bracket 66 and their upper ends secured in another wall bracket 82. Apertured lugs at 83 may be provided upon the end plate 77 for slidably engaging the guide rods. The up and down movement of the end plate 77 may be limited if desired by stop members 84 and 85 adjustably secured to the guide rods 80 and 81. For operating the switch a suitable lever 86 may be provided and operatively connected to the end plate 77 by an arrangement of levers and links including links 87 and 89 pivoted to link 91 at 92, the other end of link 91 being pivoted to the frame at 93. A bell crank lever 90 suitably connects link 89 with link 88 which in turn is connected to the head 77 as will be readily understood from the drawings.

While we have described our improvements in great detail and with respect to certain preferred forms thereof, we do not desire to be limited to such forms or details, since many changes and modifications may be made and the improvements embodied in widely different forms without departing from the spirit and scope of the invention in its broader aspects. Hence, we desire to cover all modifications and forms coming within the language of any one or more of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. An electric switch comprising cooperating contacts, an hermetically sealed container for said contacts, an arc-suppressing volatile liquid immersing said contacts and partially filling the container, the remaining space therein being filled with a readily compressible fluid, a portion of said container comprising a flexible corrugated substantially cylindrical and compressible wall member, a reciprocating contact operating member secured in respect to the free end of said flexible portion within the container, whereby when said wall member is compressed the circuit through said contacts will be closed. switch actuating mechanism secured externally to said flexible portion and retaining said wall portion under compression when the circuit is closed, said compressed flexible portion and the fluid pressure therein serving upon actuation of said operating mechanism to quickly move the switch parts to open circuit position thereby providing a quick break at said contacts.

2. An electric switch comprising cooperating contacts within a container, an insulating liquid immersing said contacts and partially filling the container, the remaining space therein being filled with a readily compressible fluid, a portion of said container

comprising a flexible corrugated and compressible wall member having its exterior exposed to the atmosphere, a reciprocating contact operating member secured in respect to the free end of said flexible portion within the container whereby when said wall member is compressed said contacts will be retained in one position, switch operating linkage secured externally to said flexible portion and retaining said wall portion under compression, said compressed flexible portion and the fluid pressure therein serving upon actuation of said operating mechanism to quickly move the switch parts to their opposite position.

3. An electric switch comprising cooperating contacts, an hermetically sealed container surrounding said contacts, at least one insulated leading-in conductor passing through the container walls for said contacts, an arc-suppressing liquid immersing said contacts and partially filling the container, the remaining space therein being filled with a readily compressible fluid, an extension to said container having a compressible wall member, a reciprocating contact operating member secured to said extension within the container, whereby when said wall member is compressed the circuit through said contacts will be closed, switch operating mechanism secured externally to said extension and retaining said wall portion under compression when the circuit is closed, said compressed extension and the fluid pressure therein serving upon actuation of said operating mechanism to quickly move the switch parts to open circuit position thereby providing a quick break at said contacts.

4. An electric switch comprising cooperating contacts, an hermetically sealed container surrounding said contacts, insulated leading-in conductors passing through the container walls for said contacts, an insulating liquid immersing said contacts and partially filling the container, the remaining space therein being filled with a readily compressible fluid, an extension to said container having a compressible wall member and a rigid end plate member, a reciprocating contact operating member secured to said end plate within the container, and a rotatable contact bridging member having a spiral slot and pin connection with said reciprocating member whereby when said wall member is compressed the circuit through said contacts will be closed and when said wall member is released the circuit through said contacts will be opened.

5. An electric switch comprising cooperating contacts, an hermetically sealed container surrounding said contacts, arc-suppressing fluid immersing said contacts, at least a portion of said container comprising a flexible corrugated wall member, a contact operating member secured in respect to the free end of said flexible portion within the container whereby when said wall member is compressed the circuit through said contacts will be closed, switch operating mechanism secured externally to said flexible portion and retaining said wall portion under compression when the circuit is closed, quick-releasable retaining means for said mechanism, said compressed flexible portion and the fluid pressure therein serving upon release of said retaining means to quickly move the switch parts to open circuit position thereby providing a quick break at said contacts.

6. An electric switch comprising cooperating contacts, a sealed container surrounding said contacts, arc-suppressing fluid immersing said contacts, a portion of said container comprising a flexible corrugated compressible wall member, a contact operating member secured in respect to the free end of said flexible portion within the container, whereby when said wall member is compressed the circuit through said contacts will be closed, switch operating mechanism secured externally to said flexible portion and retaining said wall portion under compression when the circuit is closed, quick-releasable tripping means for said operating mechanism, said compressed extension and the fluid pressure therein serving upon actuation of said tripping means to quickly move the switch parts to open circuit position thereby providing a quick break at said contacts.

7. An electric switch comprising cooperating contacts, a container surrounding said contacts, a portion of said container comprising a flexible compressible wall member, a contact operating member secured in respect to said flexible portion within the container whereby when said wall member is compressed the circuit through said contacts will be closed, switch operating mechanism secured externally to said flexible portion and retaining said wall portion under compression when the circuit is closed, quick-releasable tripping means for said operating mechanism, said compressed extension and the fluid pressure therein serving upon actuation of said tripping means to quickly move the switch parts to open circuit position thereby providing a quick break at said contacts.

8. An electric switch comprising cooperating contacts, an hermetically sealed container surrounding said contacts, insulated leading-in conductors passing through the container walls for said contacts, an arc-suppressing volatile liquid immersing said contacts and partially filling the container, the remaining space therein being filled with a readily compressible fluid, an extension to said container having a resilient corrugated substantially cylindrical and compressible wall member and a rigid end plate member, a reciprocating contact operating member secured to said

end plate within the container, contacts operated by said reciprocating member whereby when said wall member is compressed the circuit through said contacts will be closed, switch operating mechanism secured externally to said end plate and retaining said wall portion under compression when the circuit is closed, quick releasing tripping means for said operating mechanism, said compressed extension and the fluid pressure therein serving upon actuation of said magnetic means to quickly move the switch parts to open circuit position thereby providing a quick break at said contacts.

9. An electric switch comprising cooperating contacts, an hermetically sealed container surrounding said contacts, insulated leading-in conductors passing through the container walls for said contacts, an arc-suppressing volatile liquid immersing said contacts and partially filling the container, the remaining space therein being filled with a readily compressible fluid, an extension to said container having a flexible corrugated substantially cylindrical and compressible wall member and a rigid end plate member, a reciprocating contact operating member secured to said end plate within the container, a rotatable contact bridging member having a spiral slot and pin connection with said reciprocating member whereby when said wall member is compressed the circuit through said contacts will be closed, and when said wall member is released the circuit through said contacts will be opened.

10. A quick-break electrical switch construction having contacts for making and breaking a circuit carrying heavy current or a high potential and having a sealed enclosure surrounding the contacts, said contacts being fixed respectively to relatively movable wall portions of said enclosure and being immersed in a volatile insulating liquid, the enclosure being of such dimensions and the liquid being sufficiently volatile to substantially hasten the expansion of the enclosure upon formation of heavy current arcs at the first moments of the circuit breaking action.

11. An electrical switch construction having contacts for making and breaking a circuit carrying heavy current or a high potential and having a sealed enclosure surrounding the contacts, said enclosure having a portion which is freely expansible upon breaking the circuit at the contacts, to accommodate the increased volume of gases therein, means operatively connecting one of said contacts with said expansible portion, and external means for operating the expansible portion.

In testimony whereof we have signed our names to this specification.

MAURICE M. SAMUELS.
TOMAS BOCEK.