Nov. 13, 1934. A. G. STEINMAYER ET AL 1,980,506

OIL FUSE

Original Filed June 27, 1930 4 Sheets-Sheet 1

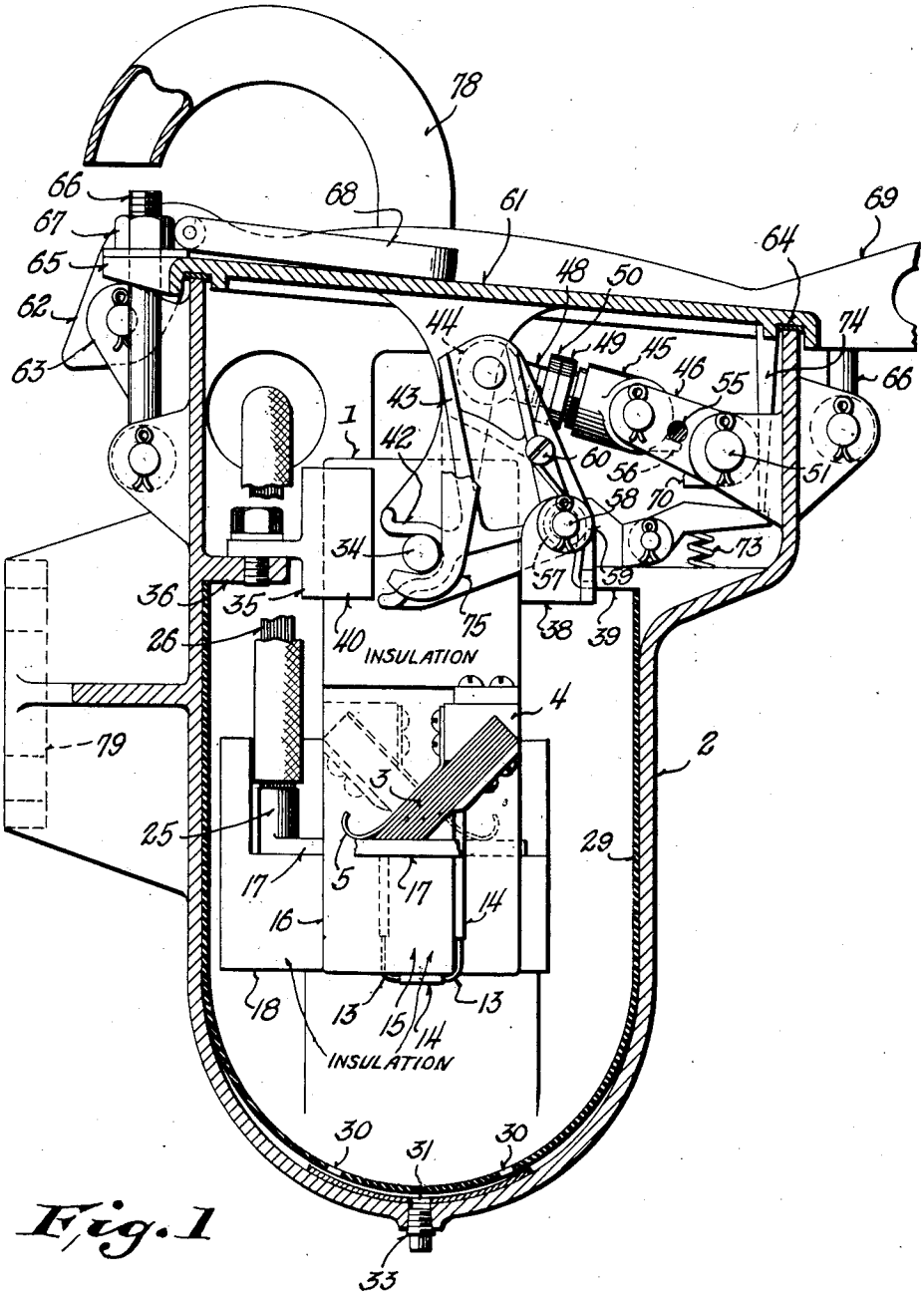


Fig. 1

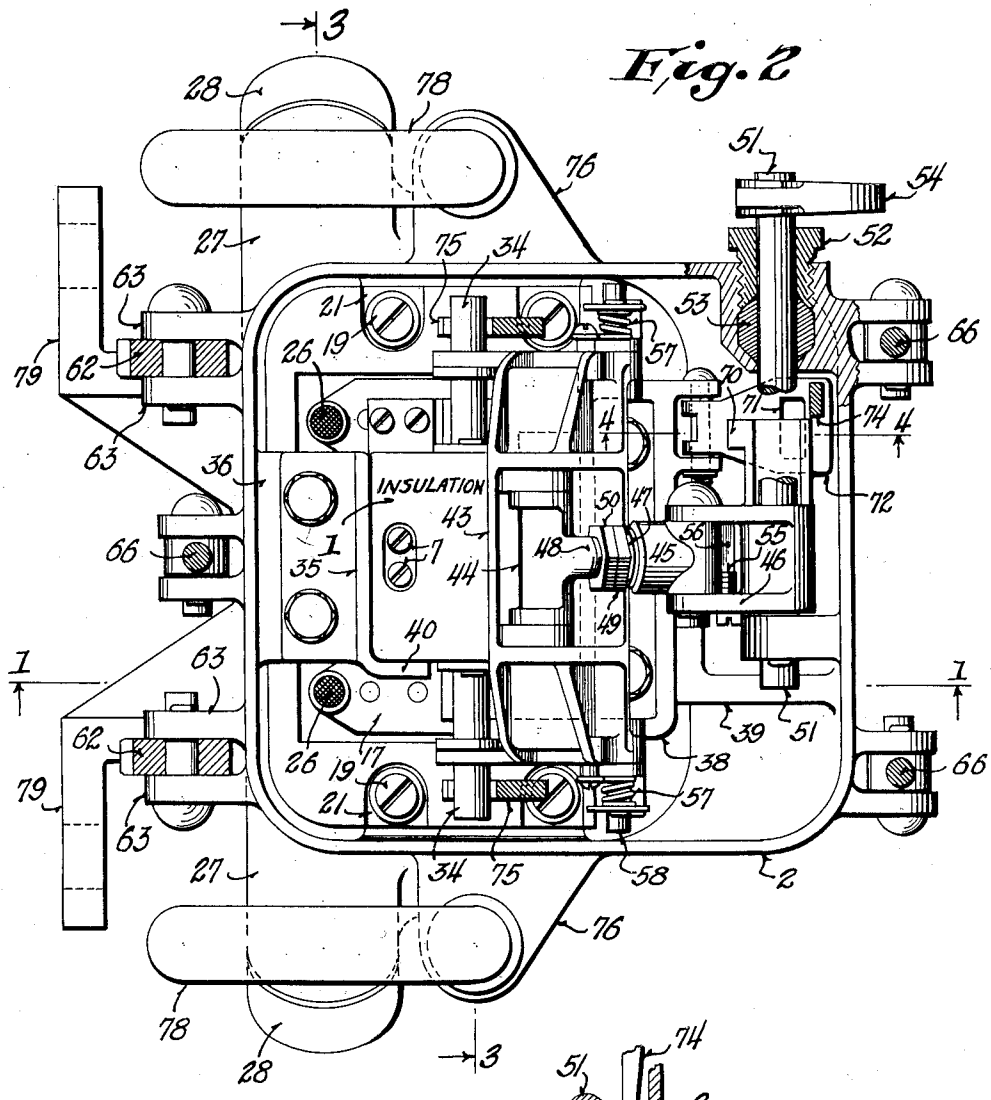
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OIL FUSE

Original Filed June 27, 1930 4 Sheets-Sheet 2

Fig. 2



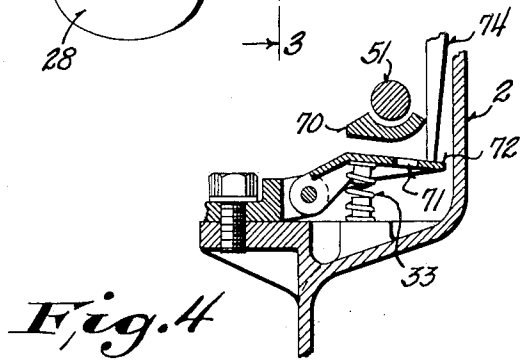


Fig. 4

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OIL FUSE

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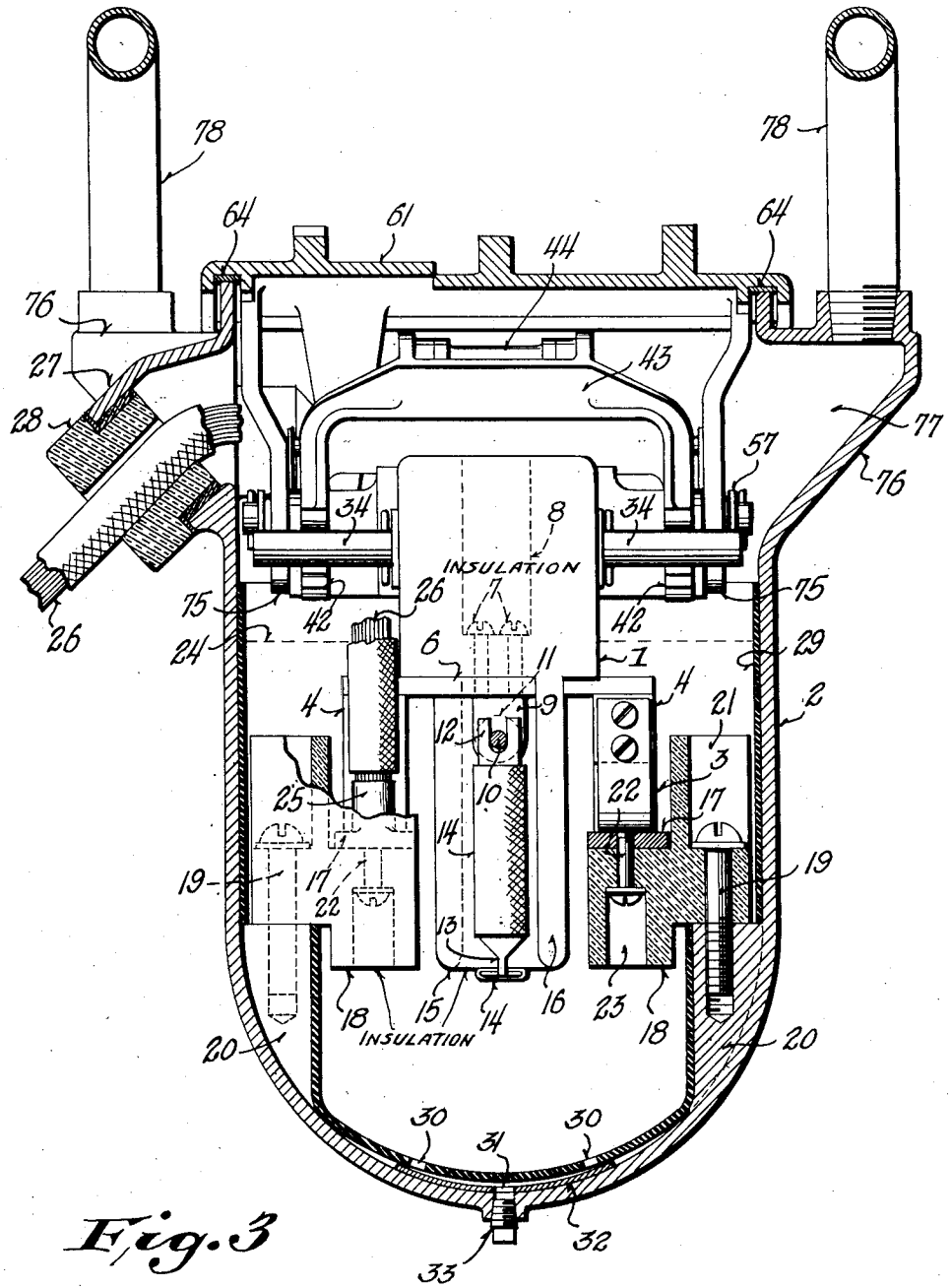


Fig. 3

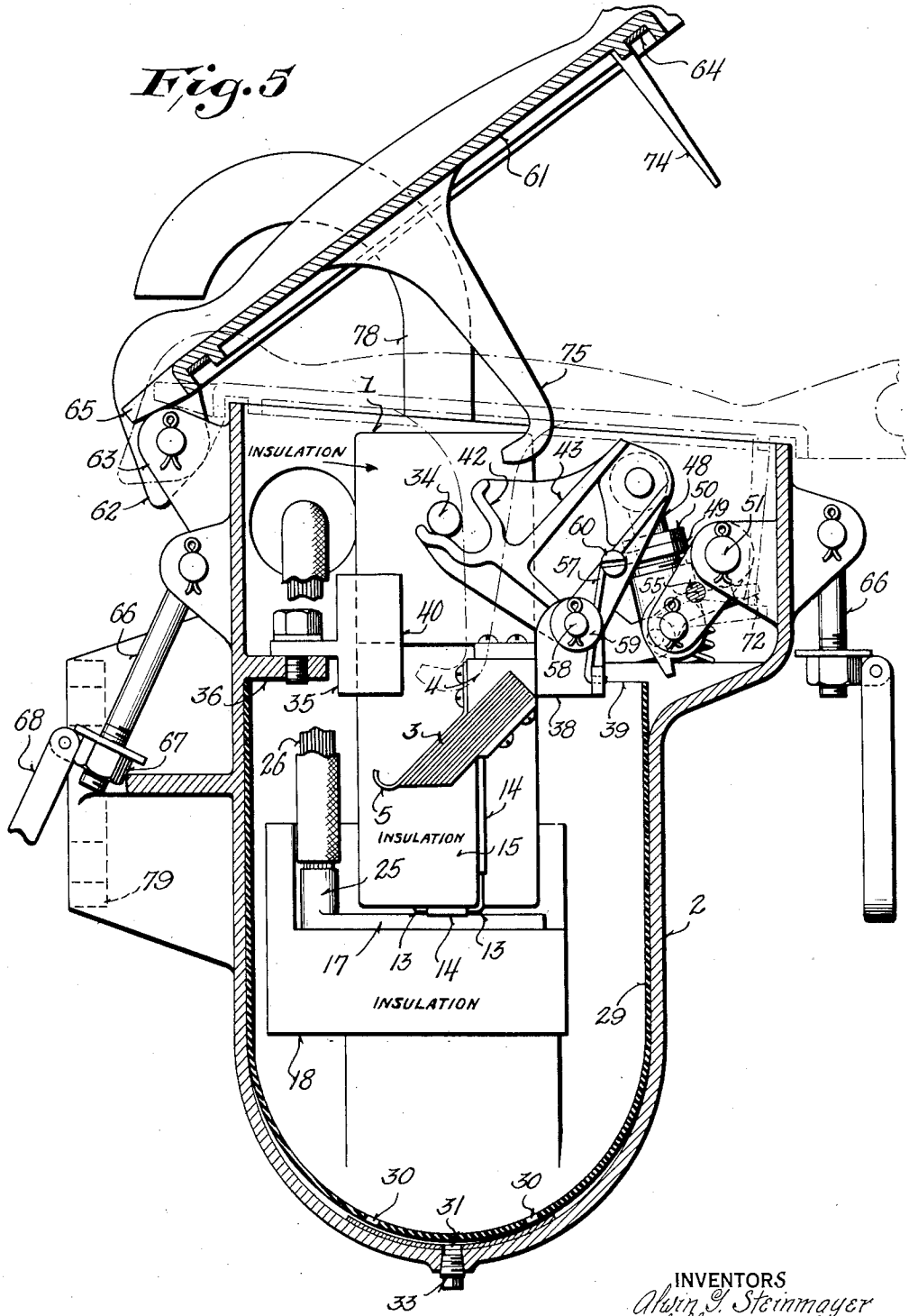
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Fig. 5



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OIL FUSE

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Original application June 27, 1930, Serial No. 464,220. Divided and this application December 23, 1931, Serial No. 582,744

5 Claims. (Cl. 200—50)

This invention relates to oil fuses, and is a division of our application filed June 27, 1930, Serial Number 464,220 for Oil fuses.

In oil fuses, as heretofore constructed, it has usually been necessary for the operator to be relatively close to the fuse when the circuit is closed and it has frequently happened that the closing of the circuit occurred when an excessive load existed resulting in immediately blowing the fuse. From actual tests with different types of oil fuses it has been found that the sudden generation of gas produced dangerous pressures which sometimes resulted in a violent explosion of the device, with flying metal fragments and heated or burning oil.

This invention is designed to overcome the defects noted above, and objects of this invention are to provide an oil fuse which may be operated by a "switch stick" or by remote control to open or close the circuit thereby allowing the operator or lineman to remain at a safe distance, which is so constructed that the device can be used also as a switch to open the circuit even under load, and which is provided with means insuring safety of operation under all conditions.

Further objects are to provide an oil fuse in which a novel arrangement of vents is provided for relieving the gas pressure, in which discharge of the gases from immediately adjacent the fused portion or from the switch contacts is provided, in which a direct path free from constriction is provided for discharging the gases without requiring the gases to pass along a circuitous or round about path, in which means are provided for guiding the gases directly to the vents, and in which double safety means are provided for venting the gases.

Further objects are to provide a construction which, in reality, combines both the features of a switch and fuse, which is positive in its closing and opening action, which is positively locked in closed position, which is fully encased or housed, and which cannot blow open when the fuse blows.

Further objects are to provide a fuse switch in which the cover cannot be opened when the switch is in the locked or closed position, and in which the fuse switch cannot be closed when the cover is in the open position or in the unlocked position, but which can be closed only when the cover is closed and positively locked in closed position.

A further object is to provide a construction such as outlined immediately above which is so made that a special tool may be inserted to permit the closing of the fuse switch for testing purposes while the cover is open although under normal conditions and without the use of the special tool such closing of the fuse switch cannot occur when the cover is either open or unlocked.

Further objects are to provide a toggle action oil fuse switch in which the movable and stationary contacts are held in firm engagement under pressure by means of locking toggle mechanism, and in which a quick motion occurs both in opening and closing.

Further objects are to provide an oil fuse switch in which a block carries both the fuse and the movable contacts, in which the block is removable to permit ready renewal of the fuse while the block is removed from the rest of the mechanism, in which the block may be made of any suitable insulating material, whether brittle or not, as it is free from pressure bearing lugs or projections but is of a simple, easily molded shape, in which barriers carried by the block are so arranged that they guide the gases to the adjacent vents, in which a metallic pin or rod extends through the block and transmits the opening or closing force or pressure directly to the body of the block, in which the block itself has only sliding motion, and in which the pin or rod not only connects the fuse and contact carrying block to the operating mechanism but also directly interlocks the block with the cover to prevent opening of the cover when the fuse switch is closed.

Further objects are to provide an oil fuse switch in which the pressure of the engaged contacts may be readily adjusted, in which a fitting provided with right and left threads is provided for securing this adjustment, and in which this fitting is readily accessible and may be both adjusted and locked in adjusted position after the fuse switch is completely assembled.

Further objects are to provide a construction of oil fuse in which the fuse has a double reduced section, in which the reduced sections are so located and positioned that very little heat conduction can occur, in which the bottom part of the fuse drops down upon fusing at the reduced sections, thereby producing a long gap in addition to that produced by the actual fusing, in which wrapped portions of the fuse link or element are provided to both reduce conduction and provide additional insulation between the fuse link and the casing or other portions of the device so that even if the fuse is distorted at fusing undesirable contact cannot occur, and to provide such a construction that any suitable

conducting material such as the low melting alloys, aluminum, or any other metal, even copper, may be employed for the fuse link.

Further objects are to provide a novel form of oil fuse switch which is so made that the cover can be opened by means of a switch stick, and which may, if desired, be so made that the vent pipes or members may be used as hangers during hoisting, or in another form suitable for underground installation, for instance, may have its vents piped to a common vent pipe provided with a down turned end, the vents being preferably downturned under all conditions to either shed water or to prevent water from rising into the casing.

Further objects are to provide a rugged, simple type of oil fuse switch which will handle large loads at high voltage, which may be easily produced, and which is easy to operate.

While oil is the preferred liquid to be used in the apparatus, it is intended that the use of the term "oil" is not to be construed as specifically limiting the invention other than as indicating a suitable insulating liquid.

An embodiment of the invention is shown in the accompanying drawings, in which:—

Figure 1 is a vertical, sectional view through the device, such view corresponding to a section on the line 1—1 of Figure 2.

Figure 2 is a view of the device with the top sectioned off and with some other parts of the apparatus in section.

Figure 3 is a sectional view on the line 3—3 of Figure 2.

Figure 4 is a sectional view on the line 4—4 of Figure 2 showing the latch mechanism.

Figure 5 is a sectional view corresponding to Figure 1, showing the operator mechanism in open position and showing the cover in full lines in open position and in dotted lines in closed position.

Referring to the drawings, it will be seen that the combined oil fuse and switch comprises a movable block or member 1 which is formed of suitable insulating material and may, if desired, be formed of porcelain, as no projecting, pressure bearing lugs are necessitated in this construction. This block is slidably mounted approximately centrally of the casing 2 and carries the movable contacts 3, which are removably held to metal terminal blocks 4 and which are preferably provided with removable arcing strips 5, as shown most clearly in Figure 1.

The terminal blocks 4 are located on opposite sides of the movable member or block 1 and are each carried by means of an inwardly projecting metal arm 6, see Figure 3, which extends beneath overhanging shoulders formed on the insulating, movable block 1, and which are held in place by means of screws 7 accessible through openings 8 formed in the insulating movable block 1.

The arms 6 carry downwardly extending lugs 9 which carry threaded stems 10 adapted to receive thumb nuts or clamping nuts indicated in dotted lines at 11 in Figure 3.

A removable fuse link is held in contact with each of the lugs 9 by means of the thumb nuts 11. This removable fuse link is shown in Figures 1 and 3, and comprises forked ends 12 adapted to straddle the threaded stems 10, so that the fuse may be readily renewed when needed. The fuse is provided with two reduced sections 13, and preferably the intermediate portions of the fuse are wrapped with paper, fiber, or other insulating material, which is indicated at 14, which not only prevents inadvertent contact of the fuse with other portions of the apparatus in the event that the fuse blows and becomes distorted, but also prevents rapid conduction of heat from the fuse.

The reduced sections 13 of the fuse are located at the bottom corners of the lower portion 15 of the insulating block 1. The central portion of the fuse is located immediately below the lower central portion of the fuse carrying, insulating block 1. Preferably the block 1 is provided with barriers 16 formed integrally therewith and projecting from opposite faces thereof, as shown in Figure 3. These barriers, it will be noted, are adjacent the movable contacts 3 and provide insulating portions located between the adjacent movable contacts and the fuse, as is most clearly shown in Figure 3, as developed in greater detail in our original application Serial No. 464,220, filed June 27, 1930, for Oil fuses. The barriers 16 extend outwardly substantially flush with the faces of the upper rectangular portion of the fuse block, as is apparent from such figure.

The movable contacts 3 are adapted to engage the flat stationary contacts 17, see Figures 1 and 3, when the block 1 is forced downwardly into its lowermost position, as shown in such figures.

The stationary contacts 17 are carried by inwardly projecting insulating members 18 which are rigidly secured by means of screws 19 to inwardly projecting lugs 20 formed integrally with the casing 2, as shown most clearly in Figure 3. It is also preferable to inset the heads of the screws 19 within apertures 21 formed in the insulating members 18, and to correspondingly inset the heads of the screws 22 which hold the stationary contacts 17 in place within apertures 23 formed in the insulating members 18.

These insulating members 18 are symmetrically placed on opposite sides adjacent the lower portion of the apparatus, and it is to be noted that the entire fuse link and the movable and stationary contacts are located well below the normal oil level, such as indicated at 24 in Figure 3.

The rear end of each of the stationary contacts 17 is provided with a conductor or cable receiving socket 25, see Figure 3, within which the corresponding conductor or cable 26 is securely fixed.

The conductors or cables 26 extend upwardly adjacent the rear portion of the apparatus and are heavily insulated and pass outwardly through downwardly projecting pipe-like extensions 27, preferably formed integrally with the casing 2 and located on opposite sides thereof, as shown most clearly in Figures 2 and 3. If desired, insulating bushings 28 may be provided for the outlet members 27 if the device is to be used out of doors, or else wiped lead joints are formed between the outlet members 27 and suitable lead pipes if the device is used underground.

It is to be noted that the interior of the casing 2 is insulated by means of a fiber sheet 29 which lies against the interior faces or walls of the casing. Obviously, this fiber sheet may be made of one portion or of several portions, as found most expedient in the manufacture of the apparatus. The lower portion of the fiber sheet is provided with a plurality of holes 30 which are spaced from a centrally located hole 31 formed in a bottom fiber sheet 32, see Figure 3. The centrally located hole 31 is immediately over the drain plug 33.

The purpose of this construction is to prevent

the striking of an arc from the fuse through any of the holes 30 to the metal portion of the casing. These holes 30, formed in the fiber sheet, are staggered or spaced with reference to the hole 31 formed in the bottom fiber sheet 32.

The mechanism for operating the movable fuse carrying and contact carrying block 1 will now be described.

The block 1 is roughly of rectangular cross section, as has been previously indicated, and is provided with an aperture therethrough through which a transverse operating pin 34 projects, as shown in Figures 1, 2 and 3, suitable washers and cotter pins or split pins being provided for loosely retaining the rod or pin 34 in place. This rod forms the sole means of communicating pressure or force to the movable block 1 and has a substantial contact area with the block. The block obviously may be formed of any suitable insulating material, as previously described, and in view of the fact that it is free from projecting, pressure bearing ears or lugs, it is clear that there is no danger of cracking or breaking the block, even if the block is formed of relatively brittle material, such as porcelain. The block 1 is loosely guided for vertical reciprocatory motion by means of a rear guide 35, see Figure 1, bolted to an inwardly projecting lug 36 of the casing 2, and by a forwardly located guide indicated in dotted lines at 37 in Figure 2, which is provided with an integrally formed bracket 38.

The guide 37 and its integrally formed bracket 38 are bolted to an inwardly projecting forward lug 39, see Figures 1 and 2, formed integrally with the casing. The guides 35 and 37 are provided with oppositely located, inwardly turned flanges 40 and 41 respectively, see Figure 2, for preventing lateral shifting of the slidable or reciprocatory block 1.

The operating rod or pin 34, see Figure 1, is normally positioned within the forked arms 42 of a yoke-shaped, bell crank lever indicated generally at 43 in Figures 1, 2 and 3. It is to be noted from Figures 2 and 3 that the forked arms 42 are located on opposite sides of the insulating block and thus insure parallel motion for opposite ends of the pin or rod 34, thus freely lifting or depressing the slidable block 1 without danger of tilting such block.

The bell crank lever 43 is provided with spaced bearings between which the head 44 of an operating link is positioned, see Figure 2. This operating link has a forward head 45 pivoted between the ears of a short lever 46. The heads 44 and 45 of the connecting link are joined by means of a fitting consisting of a plug-like member 47 which is threaded into the head 45 and which receives the threaded extension 48 of the head 44. Preferably the external and internal threads of the fitting or member 47 are right and left hand threads, so that if such member is rotated, the distance between the heads 45 and 44 of the composite connecting link may be readily adjusted. It is preferable to provide the fitting 47 with a nut-shaped portion 49 that may be engaged by a wrench during adjustment, and to provide a lock nut 50 for locking the device in place. This construction is very clearly shown in Figure 2.

The lever 46, see Figures 1 and 2, is rigidly mounted upon an operating rock shaft 51 carried in suitable bearings and projecting outwardly through the wall of the casing. A stuffing box is preferably provided for the shaft 51 and may consist of the packing gland 52 and any suitable packing 53, as shown in Figure 2, to prevent loss of oil. The outer end of the rock shaft 51 is provided with an operating lever 54, which is preferably apertured to receive the hooked end of a switch stick. Very obviously this operating lever may be connected by links and levers with a remote control lever, or with any other suitable remote control device.

It is to be noted from the description thus far given of the operating mechanism, that the levers 43 and 46 and the intermediate link joining such levers constitute toggle mechanism, so that when the rock shaft 51 is rocked in a clockwise direction, the toggle mechanism is straightened out and slightly passes dead center to thereby force the forked arms 42 of the bell crank lever downwardly, thus carrying the insulating block 1 downwardly and forcing the movable contacts 3 into binding engagement with the stationary contacts 17. In order to prevent the toggle mechanism from passing beyond the predetermined locking position, a screw or stop member 55, see Figure 1, is carried by the lever 46 and engages a lip 56 formed integrally with the head 45 of the connecting link. This holds the toggle mechanism in locked position just past dead center and secures the positive locking of the combined fuse and switch in closed position.

It is preferable to provide some form of spring, such as coiled springs 57, see Figures 1 and 2, for urging the mechanism towards switch open position. These coiled springs 57 are preferably loosely wrapped about the pivot pins 58 which pivotally join the bell crank lever 43 to the bracket 38, the spaced arms of such bell crank lever being positioned between upwardly projecting lugs formed on the bracket 38, see Figures 1 and 2. It is preferable to provide the pins 58 with heads at their inner ends, and to provide split pins 58 and washers 59 adjacent the outer ends of such pins to hold the pins in place, the washers also serving to retain the coiled springs 57.

One end of each coiled spring is engaged in an aperture formed in the bracket 38, and the other end engages a screw 60 on the bell crank lever 43, as shown most clearly in Figure 1.

From the description thus far given, it is clear that an operator may control the device either through remote control mechanism connected to the lever 54, or else by means of a switch stick, and may at all times remain a considerable distance from the apparatus during the opening or closing of the switch.

The casing 2 is provided with a hinged cover 61, preferably ribbed for strength, and provided with rearwardly projecting lugs 62 pivoted between ears 63 formed integrally with the casing 2, as shown in Figures 1 and 2, the lugs 62 constituting stops to hold the cover in open position when it is swung upwardly just past center, as is obvious from an inspection of Figure 1. The cover 61 is provided with a downwardly opening channel within which packing 64 is positioned to thus seal against the upper edge of the casing 2 when the cover is closed. The cover is also provided with projecting slotted ears 65, see Figure 1, which are adapted to receive the threaded locking bolts 66 pivotally carried by the casing and provided with clamping nuts 67. The clamping nuts 67 may, if desired, be provided with pivoted handles 68 in the usual manner. When the cover is closed, the pivoted bolts 66 are rocked into position and the cover is clamped tightly to the casing by the nuts 67 in the well known manner.

The cover 61 is provided with a projecting, apertured tongue or ear 69, see Figure 1, which may be engaged by a switch stick when it is desired to open or close the cover.

Returning again to the operating mechanism, it will be seen from Figures 1 and 2 that the lever 46 is provided with an extension having an integral tongue or catch 70 which is projected inwardly when the switch is in closed position, but which extends downwardly when the mechanism is rocked to open position. Under certain conditions hereinafter described, the tongue 70 is adapted to be received within a hole 71 formed in a pivoted latch or lever 72, see Figures 2 and 4, which is pressed upwardly by means of a spring 73, see Figures 1 and 4.

The cover 61 is provided with a downwardly projecting finger 74, see Figures 1 and 2, which, when the cover is locked in closed position, engages and depresses the latch or lever 72 and holds such latch out of engagement with the tongue 70, thereby permitting the switch to be readily closed. However, assuming that the switch is open and the cover is open, it is apparent that the switch cannot be closed, as the tongue 70 is held by the latch 72 and motion of the switch operating mechanism is thereby prevented. However, when the cover is closed, the switch operating mechanism is free and may be rocked to closed position.

It is also apparent that it is undesirable to open the cover while the switch is in closed position. This is readily prevented by providing the cover with hook-shaped downwardly and rearwardly projecting arms 75 which are in the path of the pin 34, see Figure 1, when the cover is in closed position. In view of the fact that the switch is locked in closed position by the toggle mechanism, it is apparent that the cover is also locked closed due to the engagement of the hooked arms 75 with the pin 34, and consequently such cover cannot be opened until the switch is moved to open position.

When the switch is moved to open position, it is clear that the pin 34 is sufficiently raised to permit the cover to be rocked upwardly, the arms 75 being free of the pin.

It will be seen, therefore, that simple and reliable means have been provided for preventing the closing of the oil fuse switch when the cover is opened, and for preventing opening of the cover when the oil fuse switch is closed.

It is apparent, however, that for testing purposes a special tool may be used to depress the latch or lever 72 and permit the closing of the switch for testing purposes while the cover is open. This, however, is not the normal operation of the apparatus, as is apparent from the immediately preceding description.

It is apparent that whatever liquid is used, as the insulating liquid within the combined fuse and switch apparatus, that gases will be generated either when the contacts are separated and the current flowing or when the fuse blows under load. From actual experience with oil fuses, it has been found that the generation of gas is extremely sudden and that with certain designs of oil fuses dangerous and even explosive pressures sometimes occur. This generation of pressure occurs with the utmost rapidity and is somewhat in the nature of an explosion.

This invention provides an unrestricted, direct and free venting of the gases when the fuse blows.

The casing 2 is provided with upwardly slanting projections 76, see Figures 2 and 3, which form upwardly opening side chambers 77 which open directly into the fuse casing from opposite sides thereof and directly above the contacts, as may be seen from Figure 3. The baffles 16 aid in separating the outwardly flowing gases into two separate streams and thereby cooperate with the chambers 77, as has been developed in greater detail in our co-pending application of which this is a division. From Figure 3 it is apparent that the gases have a free passage upwardly to the venting chambers and outwardly through the vent pipes 78. These vent pipes are arched and bent downwardly so as to shed water, and they may be turned either as shown in the drawings or laterally to each side of the apparatus, or, in fact, in any direction desired.

In view of the fact that the gases are provided free passage outwardly from adjacent each contracted portion 13 of the fuse link, it is apparent that, although the fuse may blow under heavy load, nevertheless no damage whatsoever can occur.

Assume that the switch is in closed position and that the fuse blows or melts under load. It is apparent that the contracted portions 13, which are only in contact with the insulating block at the extreme lower corners, will melt and allow the central portion to drop downwardly, thereby materially increasing the length of the gap. The evolution of gases is readily taken care of by the vents described above, as free passage is afforded on each side of the main or slidable block.

When it is desired to renew the fuse, the cover cannot be opened until the mechanism is rocked to open position. This may be readily accomplished by a switch stick or by remote control, as previously described, and the cover may be opened by a switch stick, if desired. Thereafter the slidably mounted insulating block may be lifted directly upwardly, as it will clear all portions of the mechanism and as the pin or rod 34 will then pass directly upwardly from the upwardly positioned forked arms 42, see Figure 1, of the bell crank lever 43. This block may, therefore, be freely removed from the apparatus and a new fuse link substituted for the used link. Thereafter the block 1 is dropped back into place, the guides 35 and 37, see Figure 2, guiding the block downwardly into correct position, with the pin or transverse rod 34 seating itself within the forked arms 42. However, the switch cannot be closed to put the fuse into circuit until the cover is locked in closed position, thereby holding the latch 72, see Figures 1 and 4, depressed. Under these conditions, however, the switch may be rocked to closed position.

When the device is initially assembled and adjusted, any desired pressure may be secured between the movable contacts 3 and the stationary contacts 17 after assembling the device by merely adjusting the fitting 47, see Figures 1 and 2, thereafter locking such fitting with the lock nut 50.

Also, it is to be noted that when the toggle mechanism moves past dead center during opening motion, that the switch opens with a quick movement due to the springs 57, and consequently a quick break or quick opening movement is secured.

The casing 2 may be obviously supported in any suitable manner, as by means of apertured brackets 79, see Figures 1 and 2, formed integrally with the casing. It is also apparent that the device may be easily hoisted into position,—the

curved vent pipes 78 being used as hangers to facilitate this operation.

It is to be noted particularly that every active portion of the combined switch and oil fuse is adequately and fully insulated, and that no destructive arcing can occur.

The device is very simple, is eminently practical, and may be most easily manufactured, assembled and adjusted.

Although this invention has been described in considerable detail, it is to be understood that such description is intended as illustrative rather than limiting, as the invention may be variously embodied and is to be interpreted as claimed.

We claim:

1. In a device of the class described, a casing, a cover for said casing, one unit of an interlocking means carried by said cover, a movable member having movable contacts and a fuse normally connecting said contacts, stationary contacts carried within said casing and engageable by said movable contacts when said movable member is moved to switch closed position, operating means for moving said movable member to open and closed position, said movable member being freely removable when said operating means is in open position, means cooperating with and releasable by said cover for locking said operating means in open position when said cover is open, and a second unit of said interlocking means carried by said movable member and interlocking with said first unit when said movable member is in closed position.

2. In a device of the class described, a casing, a cover for said casing, one unit of an interlocking means carried by said cover, a reciprocatory plunger guided within said casing and having a projecting pin forming the other of said interlocking means and cooperating with said first mentioned interlocking means in one position of said reciprocatory plunger, a forked lever pivotally mounted within said casing and having open ended slots in its forked arms for receiving said pin, stationary and movable contacts whose engagement and disengagement is controlled by said reciprocatory plunger, and means operable externally of said casing for rocking said plunger to move said plunger into switch open position, said forked lever when in switch open position presenting the open end of said slots upwardly, whereby said plunger may be bodily lifted from said casing.

3. In a device of the class described, a casing, a cover for said casing, one unit of an interlocking means carried by said cover, a reciprocatory plunger guided within said casing and freely removable directly from said casing by an outwardly sliding motion, said plunger having a projecting pin forming the other unit of said interlocking means and co-operating with said first interlocking means when said plunger is in switch closed position, stationary contacts mounted within said casing, movable contacts carried by said plunger for engaging said stationary contacts when said plunger is in switch closed position, a fuse carried by said plunger and normally electrically joining said movable contacts, a forked lever pivotally mounted within said casing and having open ended slots in its forked arms for receiving said pin, and means for rocking said forked lever to cause said plunger to move inwardly to switch closed position or outwardly to switch open position, said forked lever when in switch open position presenting the open ends of said slots upwardly, whereby said plunger may be lifted free of said forked lever as it is slid outwardly from said casing during removal.

4. In a device of the class described, a casing, a cover for said casing, one unit of an interlocking means carried by said cover, a reciprocatory plunger guided within said casing and freely removable directly from said casing by an outwardly sliding motion, said plunger having a projecting pin forming the other unit of said interlocking means and co-operating with said first interlocking means when said plunger is in switch closed position, stationary contacts mounted within said casing, movable contacts carried by said plunger for engaging said stationary contacts when said plunger is in switch closed position, a fuse carried by said plunger and normally electrically joining said movable contacts, a forked lever pivotally mounted within said casing and having open ended slots in its forked arms for receiving said pin, and toggle link mechanism for rocking said forked lever, said toggle link mechanism being moved past dead center when said forked lever is in switch closed position, said forked lever when in switch open position presenting the open ends of said slots upwardly, whereby said plunger may be lifted free of said forked lever as it is slid outwardly from said casing during removal.

5. In a device of the class described, a casing, a cover for said casing, one unit of an interlocking means carried by said cover, a reciprocatory plunger guided within said casing and freely removable directly from said casing by an outwardly sliding motion, said plunger having a projecting pin forming the other unit of said interlocking means and co-operating with said first interlocking means when said plunger is in switch closed position, stationary contacts mounted within said casing, movable contacts carried by said plunger for engaging said stationary contacts when said plunger is in switch closed position, a fuse carried by said plunger and normally electrically joining said movable contacts, a forked lever pivotally mounted within said casing and having open ended slots in its forked arms for receiving said pin, toggle link mechanism for rocking said forked lever, said toggle link mechanism being moved past dead center when said forked lever is in switch closed position, and means carried within said casing and controlled by said cover for locking said forked lever in switch open position when said cover is open, said forked lever when in switch open position presenting the open ends of said slots upwardly, whereby said plunger may be lifted free of said forked lever as it is slid outwardly from said casing during removal.

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