Oct. 19, 1954 G. S. ELLITHORPE 2,692,309

COMBINATION ROTARY SWITCH AND CIRCUIT BREAKER

Filed Aug. 11, 1949

3 Sheets-Sheet 1

FIG. 1

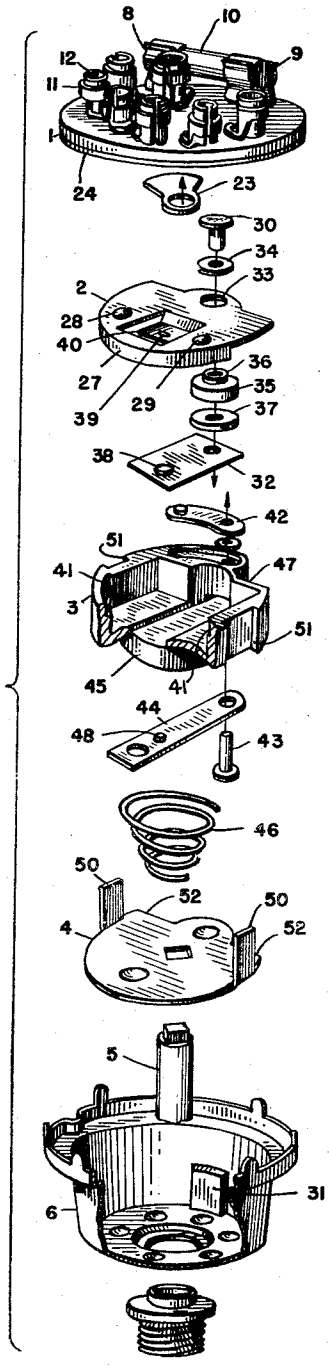


FIG. 2

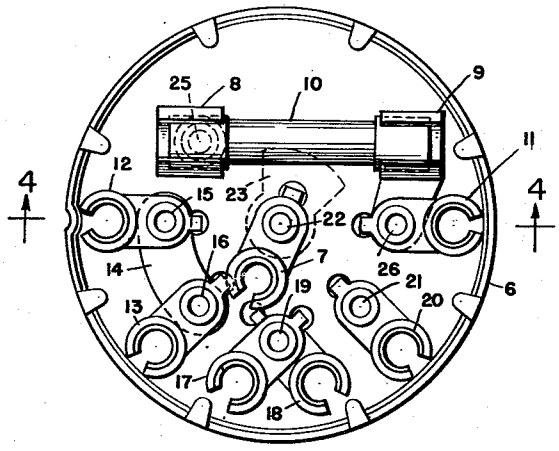


FIG. 3

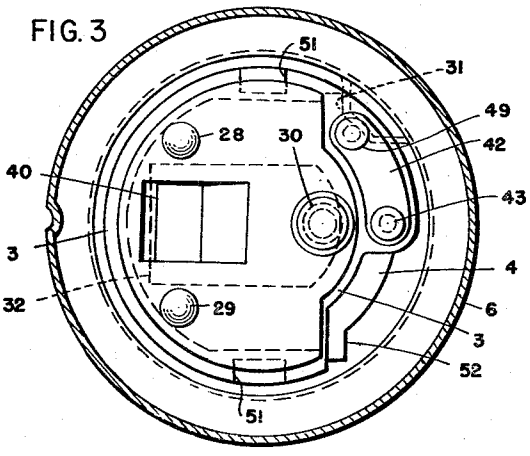
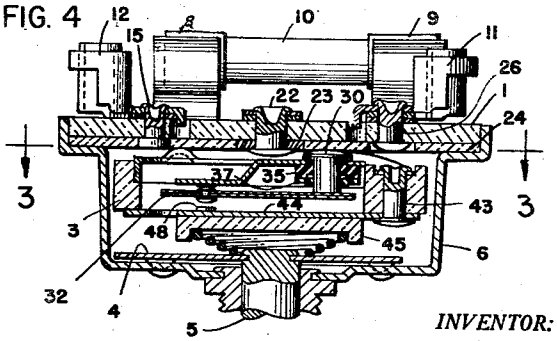


FIG. 4



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FIG. 6

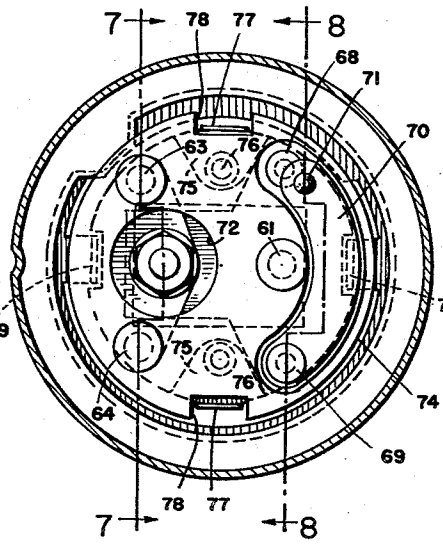


FIG. 7

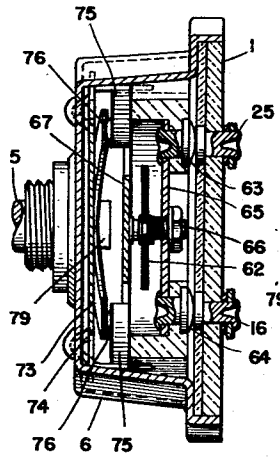


FIG. 8

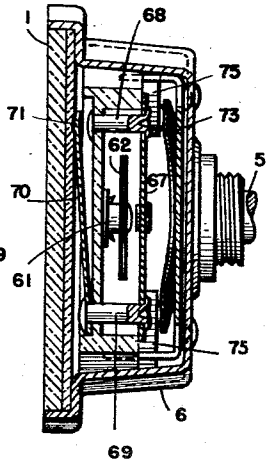
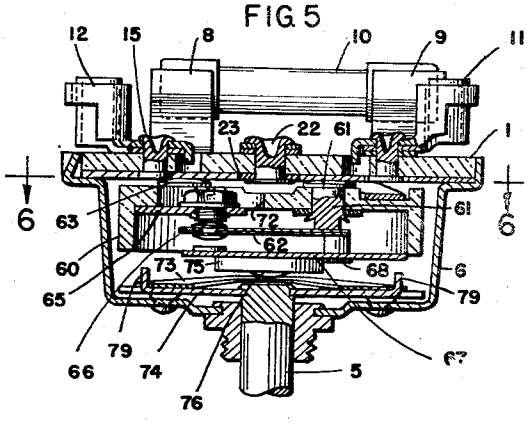


FIG. 5



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FIG. 9

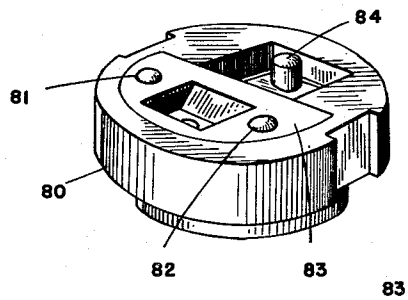


FIG. 10

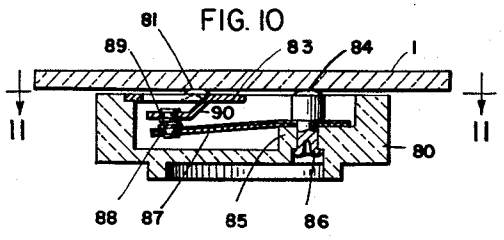


FIG. 11

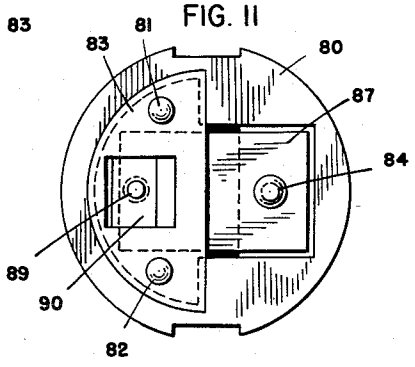


FIG. 12

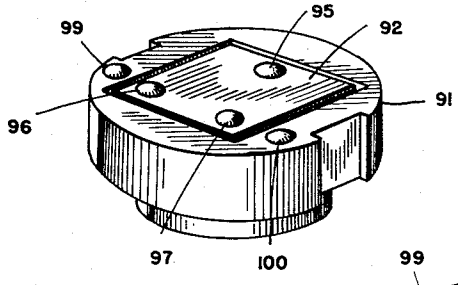


FIG. 13

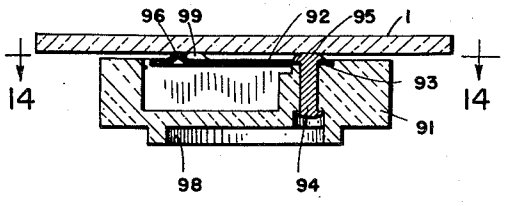
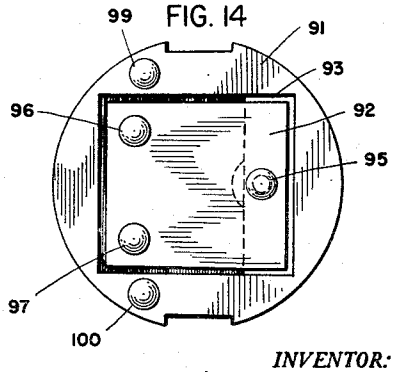


FIG. 14



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UNITED STATES PATENT OFFICE

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COMBINATION ROTARY SWITCH AND CIRCUIT BREAKER

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Application August 11, 1949, Serial No. 109,788

20 Claims. (Cl. 200—3)

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This invention relates to electric switch mechanisms having self-contained circuit protective means and particularly to such devices adapted to control selectively a plurality of circuits energized from a common power source.

The main objects of this invention are to provide an improved switch mechanism; to provide an improved switch having an internal circuit breaker; to provide an improved combination switching contact carrier and circuit breaker; to provide such a device in which the circuit breaker is associated with the operative switch element but in which the adjustment of operation of such circuit breaker is uneffected by the mechanical switching operations or the wear of the contacts or other switch parts; and to provide such a device in which the circuit breaker is protectively housed within the body of the movable switching element.

Other principal objects of this invention are to provide an improved overload protected switch mechanism having an automatic emergency circuit; to provide such a device in which the emergency circuit is operated automatically upon overload in the principal operating switch position; to provide such a device having a circuit breaker operable under overload conditions to close the emergency circuit; to provide an improved overload protected rotary switch for automotive lighting circuits; and to provide such a device having a separate emergency lighting circuit operable automatically upon overload of the principal lighting circuit.

A specific embodiment of this invention is shown in the accompanying drawings in which:

Figure 1 is an exploded view of a rotary switch embodying the improvements and showing its component parts in perspective and in sequential arrangement.

Fig. 2 is a rear view of the switch assembly showing the arrangement of its terminals and the relative position of the terminal contacts on the inner face of the terminal board.

Fig. 3 is a sectional plan view of the switch, as taken on line 3—3 of Fig. 4, showing the switching element or carrier and its contacting elements, the carrier being in "off" position relative to the contact elements shown in Fig. 2.

Fig. 4 is a sectional elevation of the switch assembly as taken on line 4—4 of Fig. 2.

Fig. 5 is a sectional view of a modified form of the switch assembly, taken from the same position as Fig. 4.

Fig. 6 is a sectional plan view of the same as taken on line 6—6 of Fig. 5.

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Fig. 7 is a sectional view of the same as on line 7—7 of Fig. 6.

Fig. 8 is a sectional view of the same as line 8—8 of Fig. 6.

Fig. 9 is a perspective view of another arrangement of the improved switch carrier in which a contact plate and circuit breaker are independently mounted in the carrier body.

Fig. 10 is a sectional view of the same showing the manner of contact engagement with the surface of a terminal board.

Fig. 11 is a top plan view of the same as taken on line 11—11 of Fig. 10.

Fig. 12 is a perspective view of an improved carrier construction in which the circuit breaker blade carries the switching contacts which engage the terminal board.

Fig. 13 is a sectional view of the same similar to Fig. 10, and

Fig. 14 is a top plan view of the same as on line 14—14 of Fig. 13.

As shown in Figs. 1 to 4 inclusive of the drawings, my improved switch construction is embodied in a rotary switch which generally comprises a terminal board or block 1; a switching means or contact plate 2; a carrier or rotor 3, adapted to carry the contact plate, a carrier plate or actuator 4, to drive the rotor; a drive shaft 5; and a housing 6 arranged for mounting on or attachment to the terminal board for enclosing the switching mechanism. These elements or components of the switch are assembled and operate in substantially the usual manner. However, the arrangement of the switch circuits and the contacts therefor on the terminal board 1, and the construction and assembly of the contact plate 2, together with the rotor 3, are novel and it is to the improvements of these devices that the present invention is particularly directed.

As shown in Figs. 1, 2 and 4, the terminal board 1 is a disc-like member, made of any suitable dielectric material, which has a plurality of connector terminals mounted thereon, in angularly spaced relation, for the several leads of the circuits that the switch is to control. An incoming power or battery terminal 7 is also provided at the center of the terminal board and all of these terminals are mounted by means of rivets which have their heads disposed on the opposite or inner side of the terminal board in the usual manner. In addition to the primary circuit terminals the terminal board also carries, on its rear or outer side, a pair of fuse clips 8 and 9 for a removable cartridge type of fuse 10, the purpose of which will be later explained. The

clips 8 and 9 are mounted by means of rivets which also have their heads disposed on the inner side of the terminal board, in substantially the same manner as the rivets of the primary circuit terminals, and the clip 9 is directly connected, by its rivet, with its own terminal or connector 11.

In the form shown, the switch is particularly designed for controlling automotive lighting circuits. Thus, the tail light terminal 12 and the instrumental panel light terminal 13 are connected together by a bus bar 14, which extends between the respective rivets 15 and 16 on the rear of the terminal board, since these circuits are to be energized in any "on" position of the switch. Also, the ignition switch light terminal 17 and the packing light terminal 18 are mounted by a common rivet 19 since they function together at the first "on" position of the switch. The headlight terminal 20 is mounted separately by its own rivet 21.

These terminals are disposed on the terminal board so that they will lie adjacent the outer periphery of the same, and the securing rivets 15, 16, 19 and 21, are located equidistant from the center of the terminal board or the axis of the rotary switch mechanism, and are angularly spaced from each other in equal increments of 45 degrees. The battery terminal 7 is mounted by a rivet 22 at the axial center of the terminal board and the head of this rivet secures a segment shape contact element 23 which projects radially, from the axial center of the terminal board, in a direction opposite the light circuit terminal rivets. The segment shape contact element 23 has an arcuate length of slightly more than 45 degrees and is positioned relative to the heads of the light circuit terminal rivets so as to be engageable by the contact plate 2 only at the "on" positions of the switch mechanism as will hereafter appear.

As shown in Fig. 4, the contact element 23, as well as the heads of all the terminal rivets, are disposed in suitable openings of a dielectric spacer plate 24 so that their surfaces will be flush with the inner surface of the plate 24, as is a common practice in rotary switch constructions.

As shown, the rivet 25 for the fuse clip 8 is located on the same circle as the light circuit rivets and is likewise spaced 45 degrees angularly from the first light circuit rivet 15, the head of the rivet 25 also serving as a contact element. The rivet 26 which secures the fuse clip 9 does not, however, function as a contact element and hence its location on the terminal board is more or less optional so long as it is disposed in a position spaced from the battery contact element 23.

The contact plate 2, by means of which the switch circuits are operated, comprises a generally circular plate made of a suitable conductor material, one side of which is cut away for a purpose which will hereafter be explained, and the opposite margin of which is provided with a depending flange 27 which serves to secure the plate in its proper position on the rotor 3. This plate is provided with a pair of upwardly projecting contact knobs or bosses 28 and 29, spaced apart 90 degrees angularly on the periphery of a circle which has the same radius from the axis of rotation of the switch parts as the rivets 15, 16, 19, 21 and 25 on the terminal board. These bosses 28 and 29 are substantially hemispherical in shape and serve as plate contact means for engaging the heads of the several rivets for the light circuits. The contact plate 2 also carries a third contact element 30 which is located on a line equidistant from the bosses 28 and 29, and which is spaced from the axis of rotation of the switch parts a distance lesser than the spacing of the bosses 28 and 29, but sufficient to lie within the area of the battery terminal contact element 23.

The contacting elements of the contact plate 2 and the terminal board 1 are thus arranged so that upon rotation of the contact plate 2, the battery terminal contact element 23 and the heads of alternate ones of the light circuit terminal rivets will be simultaneously engaged by the contact plate 2. The normal "off" position of the contact plate 2 is that shown in Fig. 3, in which the bosses 28 and 29 are in engagement with the heads of the rivets 15 and 16, and the contact 30 is out of engagement with the battery terminal plate 23. However, upon 45 degrees rotation of the contact plate, in the counterclockwise direction as viewed in Fig. 3, the contact 30 is brought into engagement with the plate 23 and the bosses 28 and 29 engage the heads of the rivets 15 and 19 respectively. This is the first "on" position of the switch mechanism and in such position the tail light and instrument panel light circuits, as well as the ignition switch light and parking light circuits, will be connected, through the contact plate 2, with the battery terminal plate 23, and thereby energized.

The second "on" position of the switch mechanism is had by rotating the contact plate 2 through an additional 45 degrees, in the counterclockwise direction, at which position the contact 30 will still be in engagement with the battery terminal plate 23 and the bosses 28 and 29 will be in engagement with the heads of the rivets 16 and 21. At this position of the switch, the tail light and instrument panel light circuits, which are connected to the terminals 12 and 13 respectively, and the head light circuit, which is connected to the terminal 20, will be energized; and the circuit through the terminals 17 and 18, for the ignition and the parking lights, will be opened.

A suitable limit stop 31, formed in the housing 6, is provided to limit the rotary movement of the switch parts, and hence the contact plate 2, to the 90 degree arc between the "off" position of the contact plate 2 and the second or "on" position. The operation of the limit stop 31 will be later described in connection with the driving means for the rotating switch parts.

As shown in Figs. 1 and 4, the rotor, or movable contact carrier, 3 for my improved switch construction is a substantially circular cup-shaped shell molding from a suitable dielectric material and is designed to support and carry the contact plate 2, to house a circuit breaker mechanism associated with the contact plate 2, and to support an independent switching mechanism arranged to operate an emergency lighting circuit upon being actuated through operation of the circuit breaker associated with the contact plate 2.

As indicated in Fig. 1, and as shown in Fig. 4 the circuit breaker comprises a bimetal strip 32 suitably mounted on the lower end of the contact 30, which is in the form of a rivet that extends through a suitable opening 33 in the contact plate 2. The rivet 30 is insulated from the contact plate 2 by means of an insulating washer 34 disposed beneath the head of the rivet 30, and by a second insulating washer 35 which is provided with a collar 36 designed to enter into the opening 33 in the contact plate 2, and to thereby provide an insulating bushing for the shank for the rivet 30.

The rivet 30 is then securely fastened to the contact plate by means of a friction type lock washer 37 which is forced over the end of the shank of the rivet 30 before the bimetal strip 32 is attached. Thus the bimetal strip 32 becomes an integral part of the contact plate structure but is at the same time insulated therefrom.

The bimetal strip 32 is provided with a contact 38 at the end opposite its point of attachment to the shank of the rivet 30 and the contact plate 2 is provided with a coacting contact 39 which is formed on the bottom side of a tongue 40, which is struck from the body of the contact plate 2 between the bosses 28 and 29 and bent downwardly therefrom, as shown in Fig. 4, to bring the contact 39 into engagement with the contact 38 on the bimetal strip when the latter is in its normal position. Thus current entering the switch through the battery terminal 7 and its contact element 23, is transmitted through the contact 30 of the contact plate 2 to the bimetal strip, and thence to the body of the contact plate 2 where it may flow through the bosses 28 and 29 to the respective lighting circuits, whose rivets are engaged by the bosses 28 and 29, and any overload that may be occasioned in the lighting circuits when they are energized, will immediately effect the bimetal strip 32 so as to cause it to heat and bend in the direction to break the engagement between the contacts 38 and 39, thereby opening the electric circuit.

As shown, the contact plate 2 together with its circuit breaker assembly is positioned on the upper side of the rotor 3 so that the circuit breaker is housed inside of the cup-shaped body of the rotor and thereby fully protected. The contact plate 2 is secured to the rotor 3 by the seating of the depending flange 27 in a peripheral groove 41 formed on the inside wall of the sides of the rotor shell, and the margins of the contact plate 2 lie flatly on the upper ends of the walls of the rotor shell so that the contact plate 2 is at all times held firmly in place.

As before mentioned, the rotor or contact carrier 3 is provided with independent means for actuating an emergency lighting circuit and such means, in the form shown, comprises an arcuately shaped spring arm 42 mounted on the upper side of the rotor 3 and positioned on the opposite side of the rotor from the location of the contact plate bosses 28 and 29. It is to provide space on the top side of the rotor 3 for the spring arm 42 that the adjacent portion of the contact plate 2 is cut away. The spring arm 42 is mounted on the rotor 3 by means of a rivet 43, which rivet also connects one end of a conductor bar 44 which extends parallel with and below the movable thermal member or bimetal strip 32. As shown, the rotor 3 is provided with a depending portion 45, which is of lesser diameter than the main body of the rotor, and which is cupped on its bottom side to provide a seat for a spiral spring 46 which normally bears between the rotor and its actuator or driving element 4 so as to constantly urge the rotor axially in the direction toward the terminal board 1. The conductor bar 44 extends above the reduced portion 45 through suitable slots 47 formed in the rotor side walls so that the upper surface of the conductor bar 44 faces the bottom side of the bimetal strip 32. Also, the conductor bar 44 is provided with a contact 48 positioned to be engaged, by the thermal member or bimetal strip 32 when it bends downwardly upon being heated by an overload in a lighting circuit. Thus, as the bimetal strip 32 is actuated to open a lighting circuit, it contacts the conductor bar 44 and closes a circuit between the battery contact 30 and the spring arm 42.

As shown in Fig. 3, the spring arm 42 carries a contact boss 49 at its free end and the boss 49 is so located that when the contact plate and the rotor are rotated through 90 degrees, from the "off" position to the second "on" position, wherein the headlight circuit is energized, the boss 49 will be in engagement with the head of the rivet 25 which secures the fuse clip 8.

The terminal 11 which is connected to the fuse clip 9 is intended for connection with an emergency lighting means which could be, for example, the fog lights that are installed on many automotive vehicles. Thus, with my improved rotary switch construction, an overload in the headlight circuit sufficient to actuate the circuit breaker mechanism associated with the contact plate 2, and which would otherwise render the vehicle without lights, will automatically, through operation of the circuit breaker, close the emergency circuit through the connector bar 44, the spring arm 42, the fuse clip rivet 25, the fuse 10, and the clip 9, to the emergency circuit terminal 11, thereby causing the emergency lights to burn so long as the overload condition in the headlight circuit exists. The fuse 10 is provided to protect this emergency circuit.

The rotating switch parts, namely, the rotor 3 and the switching mechanism carried thereby, are driven by the actuator or carrier plate 4 secured and keyed to the inner end of a drive shaft 5, which extends through a suitable bushing mounted in a central opening in the cover 6, and the connection between the carrier plate 4 and the rotor 3 is provided by a pair of upstanding arms or lugs 50 disposed on diametrically opposite sides of the carrier plate 4 and adapted to engage slidably in suitably located axially extending slots 51 formed in the outer side walls of the rotor 3. The spring 46 is disposed between the carrier plate 4 and the rotor 3 and is under compression so as to urge the parts 3 and 4 away from each other. Thus, since the carrier plate 4 is mounted fast on the end of the drive shaft 5 and normally bears against the inner surface of the end of the housing 6, the rotor is urged axially toward the terminal board to assure pressure engagement of the contacting elements.

As shown, the carrier plate or actuator 4 is provided with downwardly projecting knobs or bosses adapted to engage in suitable detents formed in the end of a cover 6, which serve as indicators of the several switch positions. Also, the switch housing 6 is provided with a limit stop 31, which is formed by pressing the housing side wall inwardly at an appropriate location, to limit the angular movement of the switch parts upon turning of the drive shaft 5. In order to accomplish this purpose, the carrier plate 4 is cut away at one side and is provided with a pair of stop shoulders 52, located on opposite sides of the diameter of the carrier plate which runs normal to a line through the lugs or arms 50. The location of the shoulders 52 on the carrier plate is made so that upon 90 degrees rotation of the carrier plate, one or the other of the shoulders 52 will engage the housing stop 31.

In the modified form of this invention illustrated in Figs. 5 to 8 inclusive, the terminal board 1, together with its terminal contact rivets and the fused emergency circuit, are exactly the same as has been described for the switch construction shown in Figs. 1 to 4. Also, the housing 6 and

the drive shaft 5 are the same. A modified form of the rotor or contact carrier and its combined circuit breaker and emergency circuit means is, however, shown. Also, a somewhat different arrangement of the spring means for urging the rotor toward the terminal board 1 is employed.

In the modified construction, the rotor or carrier member 60 is an inverted cup-shaped element, molded from a suitable dielectric material, and the circuit breaker mechanism together with the battery contact of the rotor is mounted in the top wall of the rotor independently of the rotor contacts which engage the rivet heads of the several terminals on the terminal board. Thus, as shown in Fig. 5, the rotor battery contact 61 is mounted directly in the upper wall of the rotor and extends downwardly therefrom into the interior of the rotor where the bimetal strip 62 is mounted on the end of the battery contact stud. The circuit contacts 63 and 64 are likewise formed by studs extending through the upper wall of the rotor body, and these last mentioned studs support the ends of a transversely extending conductor plate 65 which carries a threaded and adjustable contact 66, located midway between the studs 63 and 64, adapted to engage a suitable contact on the bimetal strip or thermal member 62. The location of the rotor contacts 61, 63 and 64 relative to the axis of the rotor and relative to each other, is exactly the same as the corresponding contacts on the contact plate 2 of the switch construction illustrated in Figs. 1 to 4, and the switching operation together with the operation of the circuit breaker is exactly the same.

In the modified form of the device, the emergency light contact plate 67 is mounted on the bottom side of the rotor, below the bimetal strip 62, and is supported by a pair of spaced rivets 68 and 69. The rivet 69 also secures one end of the emergency circuit contact spring 70 which is disposed on the upper side of the rotor 60 diametrically opposite the location of the switching contacts 63 and 64. In this case, because the emergency circuit contact spring 70 must be supported by the rivets 69 which also provides support for one side of the emergency circuit contact plate 67, the spring arm must extend through substantially 90 degrees around the margin of the rotor in order to position the spring arm contact button, or boss 71, 90 degrees clockwise from the location of the contact 63. The location of the spring arm contact button 71 is such that the contact button will engage the head of the rivet 25, see Fig. 2, which mounts the fuse clip 8, when the rotor has been revolved counterclockwise to the second "on" position so as to energize the headlight circuit.

As shown in Figs. 5 and 6, the upper wall of the rotor 60 is provided with an annular opening 72 directly above the location of the adjustable screw contact member 66 which engages the bimetal strip 62. The purpose of the opening 72 being to provide for access to the adjusting screw for calibration of the circuit breaker operation.

Also, as shown in Fig. 5, the means for normally urging the rotor 60 toward the terminal board comprises a flat ring type of spring in which diametrically opposite portions are bulged upwardly so that the spring will be of wavy form with diametrically opposite high points and diametrically opposite low points, each 90 degrees from the other. Thus, the high points of the spring 73 support the rotor 60 and the low points of the spring 73 rests on the carrier plate or actuator 74. In this case the rotor is provided with a pair of supporting posts 75 located at diametrically opposite sides of the rotor, on a line normal to a diameter which bisects the location of the contacts 63 and 64, and each of these posts is provided on its bottom end with a pivot button 76 which engages the high points of the spring 73. Thus, the rotor or contact carrier member can pivot laterally on a line which intersects the triangle formed by the contacts 61, 63 and 64 and a uniform contact pressure on the heads of the terminal rivets on the terminal board is assured at every position of the rotor during the switching operation.

The actuator or carrier plate 74, which drives the rotor 60, is of substantially the same form as the carrier plate 4 shown in Fig. 1 and is provided with stop shoulders in the same manner. This carrier plate also engages the rotor by means of upwardly extending arms 77 which fit into axially extending notches 78 formed in the outer periphery of the rotor body; and in addition the carrier plate 74 is provided with upstanding arms 79 at diametrically opposite points, 90 degrees removed from the arm 77, which engage in suitable notches formed in the periphery of the spring element 73. Thus the spring element cannot become displaced angularly relative to the pivots 76 on the bottom side of the rotor body.

The operation of the modified form of switch is exactly as that described for the switch illustrated in Figs. 1 to 4 inclusive, and the operation of the emergency circuit when the switch is turned to the second "on" position, where the headlight circuit is energized, is the same as has been described. Thus, the difference between the two forms of switches shown reside wholly in the construction of the rotor and the arrangement of the circuit breaker therein, and in the arrangement of the spring means for normally urging the rotor toward the terminal board.

The form of switching contact carrier or rotor shown in Figs. 9, 10 and 11, is similar to the carrier shown in Fig. 4, in that the rotor 80 is a cup-shaped device molded on dielectric material and the switching contacts 81 and 82 are carried on a contact plate 83 mounted with a press fit in a recess formed around the margin of the open end of the rotor body. In the modified rotor form, however, the battery or power source contact 84 is in the form of a solid stud projecting upwardly from a step or shelf 85, formed within the interior of the rotor body, the stud 84 having a hollow rivet-like shank 86 which extends through a suitable opening in the step 84 and is staked over at its bottom end to secure the stud rigidly to the rotor body. In this case the thermal member or bimetal blade 87 is mounted directly on the step 85 and is firmly clamped by the power source contact stud 84; and the contacting end 88 of the circuit breaker blade is disposed to engage a suitable contact 89 carried on a depending finger 90 pressed from the central portion of the contact plate 83. Thus this form of the rotor provides for a simplified mounting of the circuit breaker blade within the rotor body. Also, the circular shape of the contact plate 83 reduces the amount of metal required for that element, and the necessity of insulating the power source contact 84 from the contact plate, is obviated.

In the form of the carrier or rotor illustrated in Figs. 12 to 14 inclusive, the carrier 91 is again a cup-shaped body and is similar in that respect to the rotor shown in Fig. 4. However, in this

case, the bimetal blade of the circuit breaker also serves the function of a contact plate which carries the switching contacts. In this form of the carrier, the bimetal blade 92 of the circuit breaker is mounted at one end, on a shelf 93 recessed into one side of the open end of the carrier body, by means of a rivet or stud 94 which extends through the body, the circuit breaker blade being thus disposed slightly below the plane of the face of the open end of the body.

The mounting stud 94 is located in the position of the power source contact and its upper end 95 is formed to serve that function. The switching contacts 96 and 97 are formed on the outer or free end of the circuit breaker blade and are spaced from each other and from the power source contact element 95, in the same manner as the switching contacts of the other forms of carriers so as to be registerable with predetermined pairs of the terminal contacts on the terminal board 1 when the carrier 91 is shifted in a plane parallel with the contact surface of the terminal board.

Since the carrier or rotor 91 is normally urged toward the terminal board by a spring seated in the recess 98 on the bottom side of the rotor body, it is necessary to provide some means for preventing the pressure exerted on the rotor, to urge it toward the terminal board, from being transmitted to the bimetal blade of the circuit breaker through the contact elements 96 and 97. This is accomplished by providing a pair of embossments 99 and 100, on the upper surface of the rotor body, which embossments are formed to have a height above the upper face of the rotor body, that is the same as the height of the contact head 95. The embossments 99 and 100 are located on the opposite side of the center of the rotor from the position of the contact 95, and preferably as close as possible, to a line through the contacts 96 and 97. These embossments, together with the contact 95, take the pressure of the spring action against the seat 98 and serve to keep the rotor spaced a constant predetermined distance from and parallel with the contact face of the terminal board 1 regardless of the action of the circuit breaker blade 92. Thus, the contact pressure of the contacts 96 and 97 against the terminal board is derived solely from the tension provided in the circuit breaker blade at the time of its calibration; and the three point support provided by the contact 95 and the embossments 99 and 100 being such that the axial center of the rotor lies within the triangle formed by the embossments and the contact 95, the rotor 91 is maintained constantly in a plane parallel with the terminal board regardless of any eccentricity unevenness in the axial pressure of the spring seated in the recess 98.

In order to maintain constancy of the calibration of the circuit breaker blade, it is absolutely essential that the circuit breaker blade be independent of any forces urging the carrier or rotor toward the contact face of the terminal board and that the spacing of the rotor from the face of the terminal board be constant and equal at all points. This is accomplished by the arrangement shown in Figs. 12 to 14 inclusive and the construction provides a practical means for utilizing the circuit breaker itself for the switching contacts while at the same time maintaining the circuit breaker substantially independent of any of the forces acting on the various switch parts during its operation.

It will be understood that while the emergency circuit feature heretofore described is not shown embodied in the rotor construction illustrated in Figs. 9 to 14 inclusive, such emergency circuit provision may be made in substantially the same manner as that shown for the rotor constructions illustrated in Figs. 1 to 8 inclusive.

The main advantages of this invention reside in the unitary construction of the switching contact carrier and circuit breaker mechanism wherein overload protection is provided for all of the switching circuits by means that is independent of and uneffected by the motion of the carrier or the operating forces exerted on the switch parts during the switching operation; and in the arrangement wherein the circuit breaker is protectively housed and in no way affects the balance of contact pressure between the several movable and stationary contacts.

Other advantages of the improved switch reside in the simple construction and arrangement for providing an emergency circuit which becomes activated automatically upon the occurrence of an overload condition in one of the principal circuits; and in the construction whereby the circuit breaker may be accurately calibrated and the calibration will remain undisturbed by any of the switch operations or contact carrier movements.

Although several embodiments of this invention have been herein shown and described, it will be understood that numerous details of the constructions shown may be altered or omitted without departing from the spirit of this invention as defined by the following claims.

I claim:

1. An electric switch comprising a terminal board having a pair of spaced terminal contacts on one face, a carrier movable over the said one face of the terminal board and having a pair of contacts insulated from each other and spaced and adapted to be engaged with the said terminal contacts on said terminal board to complete a circuit therebetween upon predetermined movement of said carrier, and a circuit breaker mounted on said carrier electrically in series with the contacts thereof and mechanically independent of the engagement of the contacts of said carrier and said terminal board, said circuit breaker comprising a movable switch member having current responsive means for operation between two positions to interrupt a circuit.

2. An electric switch comprising a terminal board having a pair of spaced terminal contacts on one face, a carrier movable over the said one face of the terminal board and having a pair of contacts insulated from each other and movable to engage with the said terminal contacts on said terminal board to complete a circuit therebetween, a movable switch member mounted on said carrier electrically in series with the contacts thereof and mechanically independent of the engagement of said carrier and said terminal board contacts with each other, said switch member having current responsive means for operation between two positions to interrupt a circuit, a third contact on said carrier independent of the others and insulated therefrom, a third terminal contact on said terminal board positioned to be engaged by the third contact of said carrier when the first mentioned contacts are engaged, and means on said carrier operable to complete a circuit between said switch member and the third contact of said carrier upon overload actuation of said switch member.

3. An electric switch comprising a terminal

board having a plurality of spaced terminal contacts on one face and a separate contact on said face leading to a power source, a carrier shiftable over said one face of the terminal board, a pair of switching contacts on said carrier insulated from each other and movable to engage respectively with said power source contact and selected ones of said terminal contacts to complete a circuit therebetween, a movable switch member mounted on said carrier electrically in series with said switching contacts and mechanically independent of the engagement of said carrier and terminal board contacts with each other, said switch member having current responsive means for operation between two positions to interrupt a circuit, and means to shift said carrier.

4. An electric switch comprising a terminal board having a plurality of spaced terminal contacts on one face and a separate contact on said face leading to a power source, a carrier shiftable over said one face of the terminal board, a pair of switching contacts on said carrier insulated from each other and movable to engage respectively with said power source contact and selected ones of said terminal contacts to complete a circuit therebetween, a movable switch member mounted on said carrier electrically in series with said switching contacts and mechanically independent of the engagement of said carrier and terminal board contacts with each other, said switch member having current responsive means for operation between two positions to interrupt a circuit, means to shift said carrier, an independent emergency circuit contact on said terminal board, a third contact on said carrier disposed to engage the emergency circuit contact when one of said switching contacts is engaged with a predetermined one of said terminal contacts, and means on said carrier adapted to close a circuit between said switch member and said third contact upon overload actuation of said current responsive means.

5. An electric switch comprising a terminal board having a plurality of spaced terminal contacts on one face, one of said terminal contacts being connected to a power source, a hollow carrier having a pair of switching contacts insulated from each other and movable to engage with said terminal contacts, said carrier being shiftable in a plane parallel with said one face of said terminal board for engaging and disengaging said switching and terminal contacts, a movable switch member mounted within the body of said carrier and fixedly connected thereto, said switch member having current responsive means for operation between two positions to interrupt a circuit, means normally connecting said switch member in series with said switching contacts, and means normally urging said carrier toward the face of said terminal board.

6. In an electric switch the combination with a terminal board having a plurality of spaced terminal contacts thereon one of which connects with a power source, a carrier movable over the face of said terminal board and having a pair of spaced switching contacts for engaging with said terminal contacts, said switching contacts being electrically insulated from each other, and a circuit breaker mounted on said carrier and connected electrically in series with said switching contacts, said circuit breaker comprising a movable member responsive to a predetermined current condition for operation between two positions to interrupt a circuit; of an emergency circuit comprising a separate terminal contact on said terminal board, a third contact means on said carrier disposed to engage said separate terminal contact at a predetermined position of said carrier, and means operable upon overload actuation of said circuit breaker for completing a circuit therethrough to said third contact means.

7. An electric switch comprising a terminal board having a pair of terminal contacts on one face spaced angularly about a common axis, one of which contacts connects with a power source, a carrier mounted for rotation on said axis and having switching contact means movable to engage said terminal contacts to close a circuit therebetween, means to rotate said carrier, and means normally urging said carrier axially toward the contact face of said terminal board, said carrier and switching contact means comprising a body having a pair of contact elements disposed relative to its axis and to each other to be registerable with the said terminal contacts, said contact elements being insulated from each other, a movable switch member having current responsive means for operation between two positions to interrupt a circuit and having one end fixed to one of said contact elements on the side thereof opposite said terminal board, and a conductor means connected to the other contact element and disposed to be normally engaged by the free end portion of said switch member.

8. An electric switch comprising a terminal board having a pair of terminal contacts on one face spaced angularly about a common axis, one of which contacts connects with a power source, a carrier mounted for rotation on said axis and having switching contact means movable to engage said terminal contacts to close a circuit therebetween, means to rotate said carrier, and means normally urging said carrier axially toward the contact face of said terminal board, said carrier and switching contact means comprising a hollow body having a pair of contact elements facing axially from one end and disposed relative to each other and the carrier axis to be registerable with the said terminal contacts, one of said contact elements being insulated from the other, a movable switch member mounted within said body and having one end fixedly connected to said one contact element, said switch member having current responsive means for operation between two positions to interrupt a circuit, and a conductor means connected to the other contact element and disposed to be normally engaged by the other end of said switch member.

9. An electric switch comprising a terminal board having three terminal contacts on one face spaced radially from a common axis, one of which contacts connects with a power source, a carrier mounted for rotation on said axis and having switching contact means for engaging said terminal contacts to close a circuit between the power source contact and the others, means to rotate said carrier, and means normally urging said carrier axially toward the contact face of said terminal board, said carrier and switching contact means comprising a body having three contact elements, each insulated from the others and mounted for engagement with the corresponding terminal contact when the others are so engaged, a bimetal circuit breaker blade having one end fixed to the contact element which engages the power source terminal con-

tact, a conductor means normally engaging the free end portion of said blade and connected to one of the other contact elements, and means connected to the remaining contact element and disposed for engagement by the said blade when the same becomes actuated by an overload condition.

10. In a rotary electric switch, a rotatably mounted switching contact carrier comprising a hollow cup-shaped body having a transverse end wall of dielectric material, a pair of spaced contact elements on the outer side of said end wall, each of said contact elements extending through the end wall to the interior of said body, a bimetal circuit breaker blade movable in response to a predetermined current condition disposed within said body and having one end rigidly secured on one of said contact elements, a conductor plate on the inner side of said end wall having connection with the other contact element, and contact means on said conductor plate normally engaging the movable portion of said circuit breaker blade, said contact means having threaded engagement with said plate for adjustment toward and away from said circuit breaker blade, and said contact elements being movable with said carrier for engagement with complementary contacts on a stationary terminal board.

11. In a rotary electric switch, a rotatably mounted switching contact carrier comprising a hollow cup-shaped body having a transverse end wall of dielectric material, a pair of spaced contact elements on the outer side of said end wall, each of said contact elements extending through the end wall to the interior of said body, a bimetal circuit breaker blade movable in response to a predetermined current condition disposed within said body and having one end rigidly secured on one of said contact elements, a conductor plate on the inner side of said end wall having connection with the other contact element, contact means on said conductor plate normally engaging one face of the movable portion of said circuit breaker blade, said contact means having threaded engagement with said plate for adjustment toward and away from said circuit breaker blade, a conductor bar mounted on said body in spaced relation with the other face of said circuit breaker blade and disposed to be engaged by said blade when the same is actuated by an overload current condition, and a third contact element mounted on the outer side of said body end wall and electrically connected with said conductor bar, said contact elements being movable with said carrier for engagement with complementary contacts on a stationary terminal board.

12. In an electric switch, a movable contact carrier comprising a dielectric body having a plurality of fixed means projecting from one face of the body adapted to space said body parallel with and a substantially constant predetermined distance from the surface of a terminal board with which the carrier is intended to coact, one of said means being a contact element fixedly mounted on said carrier body, a circuit breaker blade movable in response to a predetermined current condition disposed substantially parallel with said one face of said body and having one end fixedly secured by said contact element, and a contact projecting beyond the face of said body from the other end of said circuit breaker blade for engaging the surface of the terminal board under tension from said blade only.

13. An electric switch comprising a terminal board having a flat face and a plurality of spaced terminal contacts substantially flush therewith, a contact carrier movable over the face of said terminal board, and means normally urging said carrier toward the face of said terminal board, said contact carrier comprising a body having a contact element fixedly mounted thereon and projecting from one face toward said terminal board, a plurality of embossments on said one face of said body spaced from each other and from said contact element angularly about a common axis, a circuit breaker blade movable in response to a predetermined current condition having one end mounted fixedly on said body by said contact element, said blade extending substantially parallel with the face of said body between said embossments, and a contact on the other end of said blade projecting toward and engageable with the face of said terminal board, said blade contact and said contact element being spaced from each other for engaging selected pairs of said terminal contacts.

14. In an electric switch, the combination with a terminal board having a pair of spaced terminal contacts thereon one of which connects with a power source, a carrier movable over the face of said terminal board and having a pair of switching contacts for engaging with said terminal contacts, and a movable switch member mounted on said carrier electrically in series with said switching contacts and having current responsive means for operation between two positions to interrupt a circuit; of an emergency circuit comprising a separate terminal contact on said terminal board, a third contact means on said carrier positioned for engaging said separate terminal contact when said switching contacts are engaged with the first mentioned terminal contacts, and means operable upon current-overload actuation of said movable switch member for completing a circuit therethrough to said third contact means.

15. An electric switch comprising a terminal board member having a pair of spaced terminal contacts on one face, a carrier member movable over the said one face of the terminal board member and having contact means thereon spaced for engagement with said terminal contacts simultaneously, one of said members having a circuit breaker blade mounted thereon and movable in response to a predetermined current condition to interrupt a circuit, means on said carrier for connecting said circuit breaker blade electrically in series with said terminal contacts when said carrier contact means are in engagement therewith, separate contact means for engaging said circuit breaker blade upon current-overload actuation thereof, and means for connecting said separate contact means to a second circuit from said terminal board independently of the normal circuit through the terminal contacts thereof.

16. The combination with an electric switch comprising a terminal board having a pair of spaced terminal contacts thereon one of which connects with a power source, and a carrier movable over the face of said terminal board and having a pair of spaced switching contacts movable therewith for engaging said terminal contacts, said switching contacts being electrically in series with each other for completing a circuit through said terminal contacts, of a movable switch member normally in circuit with the power source and the other terminal contact when said switching contacts are engaged with

the terminal contacts and having current responsive means for operation between two positions to interrupt said circuit, and other contact means for engaging said movable switch member upon current-overload actuation thereof and closing a second circuit including the power source.

17. A movable switching contact carrier for an electric switch comprising a body having a pair of switching contacts mounted on one side thereof and insulated from each other for engagement with the contacts of a switch terminal board, a movable thermal member mounted on said body and comprising means responsive to a predetermined current overload condition for operation between two positions to interrupt a circuit, means normally connecting said movable member in series with said switching contacts, and means on said contact carrier for coupling said carrier to an actuator.

18. A movable switching contact carrier for an electric switch comprising a body having a pair of switching contacts mounted on one side thereof and insulated from each other for engagement with the contacts of a switch terminal board, a movable thermal member mounted on said body and comprising means responsive to a predetermined current condition for operation between two positions to interrupt a circuit, means normally connecting said movable thermal member in series with said switching contacts, a third switching contact on said body insulated from the other switching contacts, means electrically connected to said third switching contact for engaging said movable member upon current-overload operation thereof, and means on said contact carrier for coupling said carrier to an actuator.

19. A movable switching contact carrier for an electric switch, said carrier comprising a body having a pair of switching contacts on one side thereof and movable therewith for engagement with the contacts of a switch terminal board, a movable thermal member mounted on said body electrically in series with said contacts and comprising means responsive to a predetermined overload condition for operation between two positions to interrupt a circuit, a third switching contact on said body insulated from the other switching contacts, means electrically connected to said third switching contact for engaging said movable member upon current-overload operation thereof, and means on said contact carrier for coupling said carrier to an actuator.

20. In an electric switch, a terminal board having at least one contact for cooperation with a movable contact carrier, said carrier comprising a body having a plurality of spaced rigid means projecting a uniform distance from one face of the body for spacing said body parallel with and at a substantially constant predetermined distance from the surface of said terminal board, one of said means being a contact element fixedly mounted on said carrier body, a circuit breaker blade movable in response to a predetermined current condition mounted on said carrier and having one end free and the other end fixedly secured by said contact element, and means movable with said carrier for completing a circuit to the contact on said terminal board from said contact element through the free end of said circuit breaker blade.

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