

Sept. 14, 1954

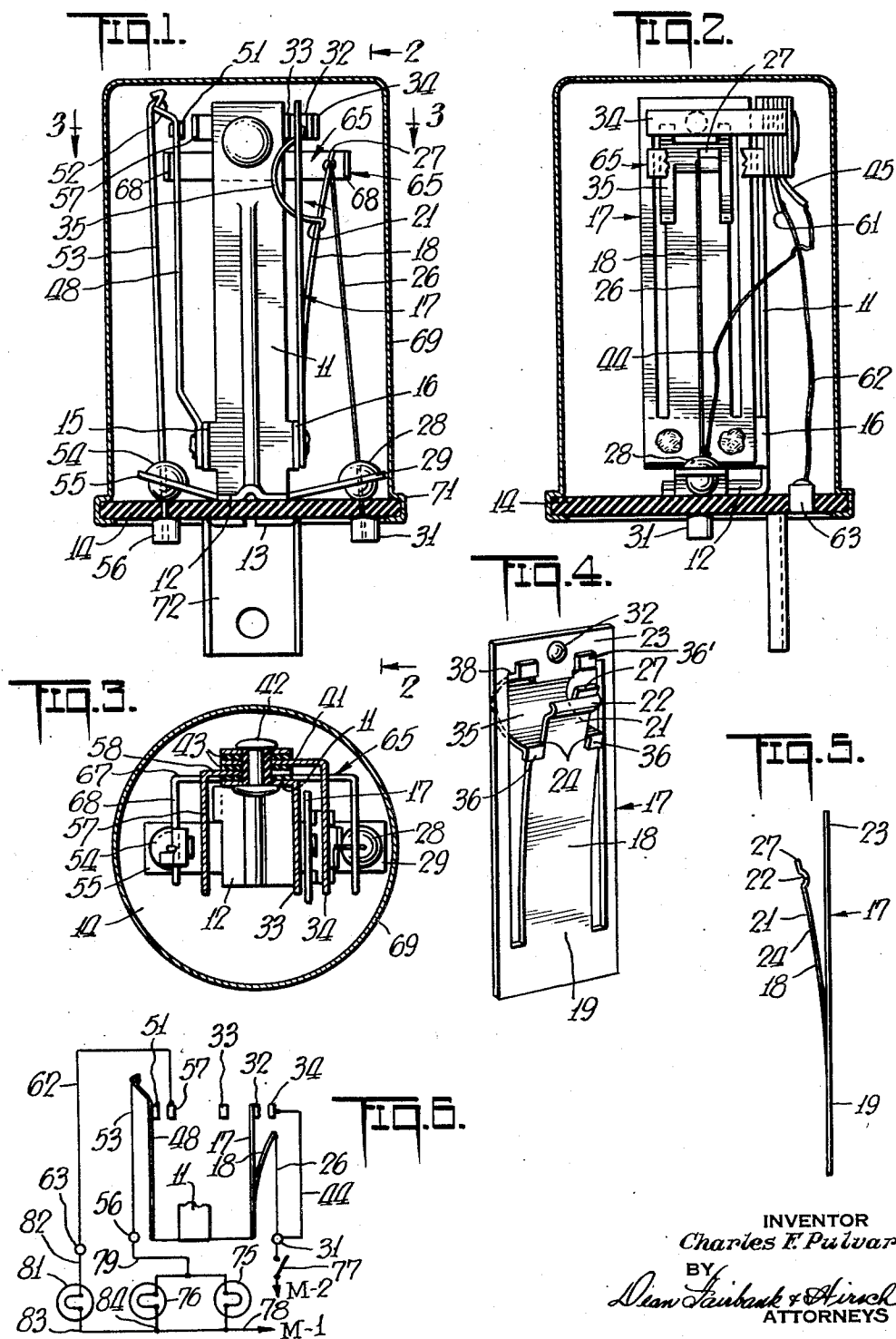
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ELECTRIC SWITCH

Filed Oct. 31, 1951

2 Sheets-Sheet 1



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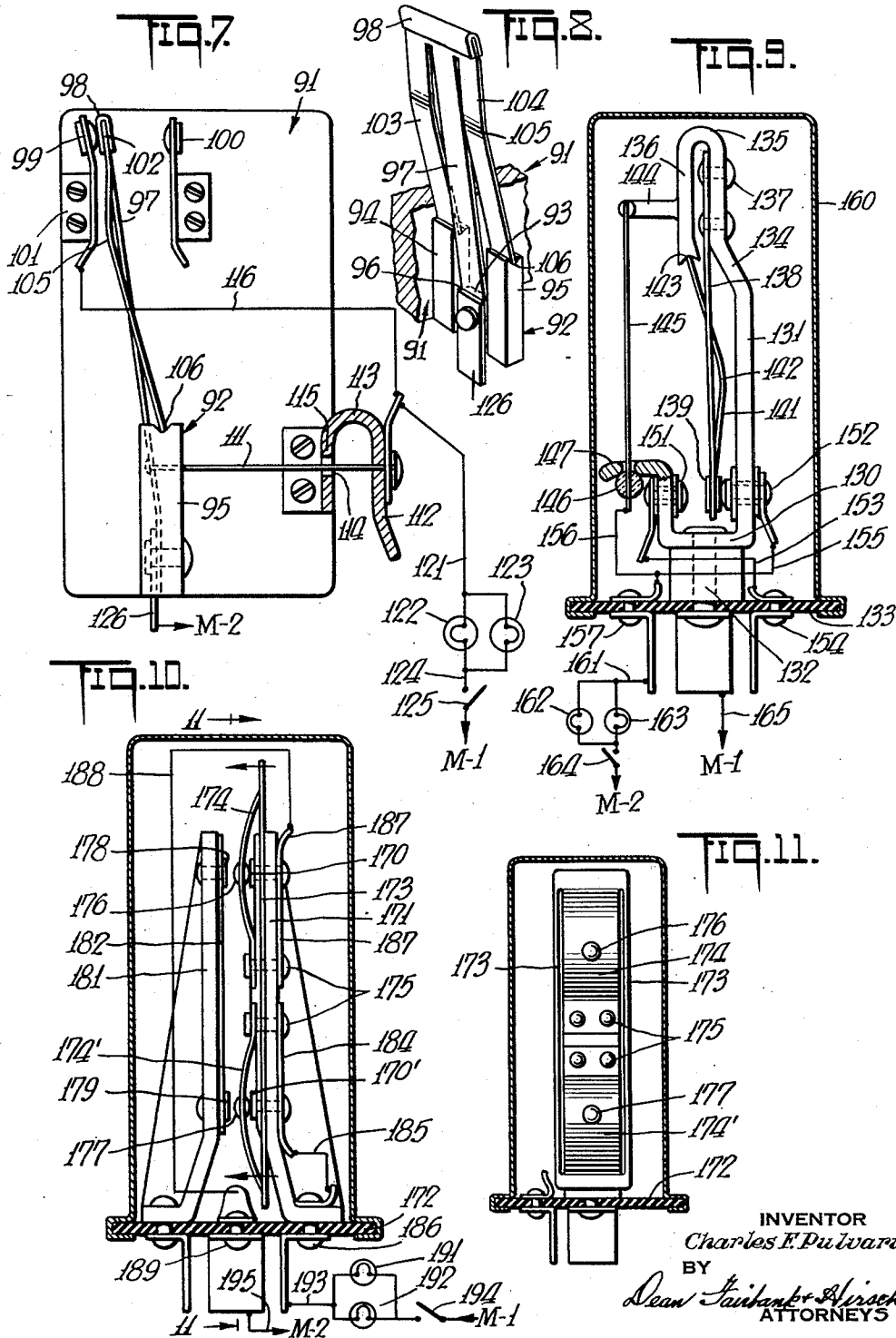
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UNITED STATES PATENT OFFICE

2,689,283

ELECTRIC SWITCH

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9 Claims. (Cl. 200—113)

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This invention relates to electric switches, more particularly of the thermally controlled snap action type.

It is among the objects of the invention to provide an inexpensive switch of the above type that is light in weight, compact, yet rugged and durable, that has but few parts which may readily be assembled by mass production methods and do not require critical adjustment, which switch is not likely to become deranged even with long continued use and will operate dependably, automatically to effect opening and closing of a circuit at a predetermined frequency without likelihood of arcing between its contacts.

Another object is to provide a switch of the above type which utilizes a high resistance conduit or wire as the control element and which will retain such conduit or wire under a minimum of strain so that it will not stretch even after long periods of time, thereby ensuring dependable operation.

Another object is to provide a circuit incorporating a switch of the above type and having a pair of signal lamps associated therewith as well as a pilot lamp, said lamps being so correlated that in the event one or more of the signal lamps should burn out the pilot lamp will so indicate.

According to the invention the switch comprises a resilient switching unit comprising a contact carrying arm fixed at one end and movable between two extreme positions, to bring a contact on said arm into and out of engagement with an associated fixed contact at one or the other of said extreme positions. The switch is constructed and arranged for normal biasing of said contact carrying arm to one of said extreme positions and has an intermediate position of unstable equilibrium for said contact arm between said two positions, from which, upon application of tension thereto, the contact will snap to the other extreme position so that upon movement of such movable contact into and out of engagement with the fixed contact, arcing will be avoided. The contact arm is controlled by a heat extensible conduit or wire operatively connected thereto and upon cooling and contraction of said wire will move from its normally biased position past said position of unstable equilibrium so that the snapping movement of the contact on such arm will be effected. The switch is so designed that when, for example, the contact arm has moved to its normally biased position upon expansion of said wire by flow of current therethrough, the wire will be short circuited with resultant reduction of such current flow and

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cooling and contraction of the wire and resultant movement of the movable contact past the position of unstable equilibrium to effect snapping movement of such contact to the other extreme position. Such movement of the contact will remove the short circuit about the wire with resultant heating and expansion thereof and movement of the contact arm past the position of unstable equilibrium to effect snapping of the contact thereon back to the first extreme position.

In the circuit hereinafter described, to illustrate the invention, the switch is connected to a pair of parallel connected signal lamps in such manner that when the wire is short circuited the lamps will become incandescent and when the short circuit is removed the lamps will be out.

In a preferred embodiment of the invention, the switch desirably includes a second contact carrying arm connected in series with the parallel connected lamps, a source of current and the first contact carrying arm and is also controlled by a heat extensible wire of less resistance than said first heat extensible wire. The second heat extensible wire when contracted, due to insufficient current flow therethrough normally is spaced from a fixed contact which may be connected in series with an electric device such as a pilot lamp and upon expansion of said second heat expansible wire and movement of the contact carrying arm into engagement with the fixed contact, the pilot lamp will be connected in parallel with said signal lamps to turn on and off in synchronization therewith. If one or more of the signal lamps should be defective, insufficient current will flow through the second heat extensible wire to retain the contact arm against the fixed contact and the pilot lamp will not be illuminated.

In the accompanying drawings in which are shown one or more of various possible embodiments of the invention,

Fig. 1 is a longitudinal view of an electric switch partly in cross section,

Fig. 2 is a longitudinal sectional view taken along line 2—2 of Fig. 1,

Fig. 3 is a transverse sectional view taken along line 3—3 of Fig. 1,

Fig. 4 is a perspective view of the switch assembly,

Fig. 5 is a side elevational view of the contact arm and switch arm,

Fig. 6 is a circuit diagram incorporating the switch of Figs. 1 to 5,

Fig. 7 is a front elevational view of another embodiment of the switch,

Fig. 8 is a detail perspective view of a portion of the switch shown in Fig. 7.

Fig. 9 is a longitudinal view partly in cross section of another embodiment,

Fig. 10 is a view similar to Fig. 9 of still another embodiment of the switch, and

Fig. 11 is a longitudinal sectional view taken along line 11-11 of Fig. 10.

Referring now to the drawings, the switch shown in Figs. 1 to 6 inclusive, desirably comprises a supporting post 11 preferably of conducting material having a laterally extending member 12 at one end thereof with depending ears 13 which may be passed through corresponding openings in an insulating disc 14 and bent over, securely to mount the post on the disc.

The post 11 desirably has a laterally extending wing 16 preferably formed integral therewith at one edge thereof adjacent the disc 14. Affixed to wing 16 as by welding, is the lower end of a switch assembly which is of resilient sheet metal, preferably spring steel. As shown in Fig. 4, the switch assembly includes a contact arm 17 which is desirably substantially rectangular and of greater length than width having its central portion cut away to define a switch arm 18 integral therewith and desirably stressed so that it is normally urged to the left as shown in Fig. 5 with respect to contact arm 17. The switch arm 18 is of reduced width as at 21 near its free end 22 which is spaced from the cross piece 23 of the contact arm which carries a contact 32.

Associated with switch arm 18 is a high resistance conduit 26, preferably of Nichrome wire, one end of which is affixed as by soldering to an outwardly extending finger 27, desirably formed integral with the switch arm 18 at the free end thereof. The other end of the wire 26 is affixed to an insulating bead 28 desirably mounted on an arm 29 extending laterally outward from member 12 and is connected to a terminal 31 mounted on disc 14.

The wire 26 when cold is of such length as to pull and retain the switch arm 18 well to the right of contact arm 17 as shown in Fig. 1. By reason of the stress or tension of such switch arm 18 when pulled to the right as shown in Fig. 1, wire 26 would normally be under considerable strain. To reduce such strain and also to impart a toggle-like snap action movement to the contact arm 17 for movement of contact 32 into and out of engagement with spaced stop 33 and contact 34 positioned on each side of contact 32 respectively, a bowed leaf spring 35 is provided, preferably of resilient spring steel normally under tension and tending to straighten out. The spring 35, as shown in Figs. 2 and 4, is so positioned that the fingers 36 at one end thereof will rest on shoulders 24 laterally of the reduced end 21 of the switch arm 17 and the fingers 36' at the other end thereof will rest in notches 33 formed in the inner edge of the cross piece 23 at the end of the contact arm 17.

The spring 35 normally will exert tension in opposed directions against the cross arm 23 of contact arm 17 and against the switch arm 18 so that when the shoulder portion 24 of the switch arm is to the left of the contact arm, the cross arm of the latter will be retained in the extreme position to the right against contact 34 and when the shoulder portion 24 is to the right of the contact arm the cross arm of the latter will be retained in the other extreme position to the left against stop 33. When the shoulder portion 24 lies in the same plane as the contact arm the latter will be in an intermediate position of unstable equilibrium

for the spring member will urge the cross piece 23 neither to the left nor to the right and any slight movement of the shoulder portion 24 beyond such intermediate position in either direction will effect a snapping action of the cross piece in the opposite direction to the corresponding extreme position.

As the tension of switch arm 18 is desirably greater than that of spring 35, the arm 18 will tend to move to the position shown in Fig. 5. However, such movement is restrained by the wire 26, which, when cold, retains the switch arm 18 in the position shown in Fig. 1, with contact 32 on contact arm 17 in engagement with stop 33. Desirably, the stop 33 is a laterally extending finger formed integral with post 11 near the upper end thereof and positioned on one side of contact 32 and the fixed contact 34 is mounted on post 11 and insulated therefrom. To this end the contact 34 desirably is an angle bar with a mounting portion 41 affixed to the upper end of the post 11 as by a rivet 42, insulating means 43 desirably intervening between mounting portion 41 and the post 11. A lead 44 affixed to a lug 45 integral with portion 41 connects contact 34 to terminal 31 mounted on disc 14.

A second heat responsive switch is also desirably mounted on post 11. As shown in Figs. 1 and 3, such switch desirably comprises an arm 48 preferably of resilient spring steel affixed at one end as by welding to wing 16 opposite wing 16. Arm 48, which carries a contact 51, is bent outwardly at its extremity 52 to which is affixed, as by soldering, one end of a high resistance wire 53 desirably of greater thickness and less resistance than wire 26. The other end of wire 53 is desirably affixed in an insulating bead 54 mounted on an arm 55 extending laterally outward from member 12 and is connected to a terminal 56 mounted on disc 14.

Associated with contact 51 is a fixed contact 57 which is desirably a finger extending parallel to the plane of arm 48. Contact 57 may be an angle bar, one face of which is a mounting portion 58 affixed to post 11 as by the rivet 42 and insulated from the post and from contact 34 by means of insulators 43, said mounting portion 58 having an integral lug 61 which is connected by lead 62 to a terminal 63 on the disc 14.

The spring arm 48 is so stressed that it would normally move the contact 51 thereof into engagement with fixed contact 57. However, the wire 53 associated with arm 48 is of such normal length when cold as to retain the contact 51 spaced from fixed contact 57 and when the wire elongates due to flow of current therethrough, it will do so sufficiently to permit contact 51 to move into engagement with fixed contact 57.

Desirably, means are provided to limit the outward movement of arms 18 and 48 under the urging of the associated wires 26 and 53 when cold. To this end a limiting member 65 may be affixed to post 11 by rivet 42 and insulated therefrom and has lateral arms 67, each with an end finger 68 extending at right angles thereto, one of said fingers being interposed between arm 48 and wire 53 and the other in the path of movement of the free end 22 of arm 18 under the urging of cold and contracted wire 26.

The entire unit is desirably enclosed in a suitable tubular casing 69 affixed in any conventional manner as at 71 to the disc 14. Desirably the disc 14 also has a bracket 72 affixed thereto to afford ready mount of the unit in any suitable place as, for example, in an automobile in which the unit is to be used.

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Although the device heretofore described may be used in many different types of installations, the example herein described is the control for the turning signal lamps of an automobile. One pair of lamps 75 and 76, preferably connected in parallel, as shown in Fig. 6, and at one side of the automobile front and rear, is controlled by means of a switch 77 which may be mounted, for example, on the dashboard of such automobile. One side of the parallel connected lamps is connected by lead 78 to one main M-1 as for instance the battery of the car. The other main M-2 is connected through switch 77 to the terminal 31 of the device and the other side of the pair of parallel connected lamps is connected by lead 79 to the terminal 56 of the device.

In the event that one or more of such lamps 75, 76 should be defective, it is desirable to provide a signal which will indicate this condition to the driver of the car. To this end a pilot lamp 81 may be mounted on the dashboard of the car. One side of the pilot lamp 81 is connected by lead 82 to the terminal 63 of the device and the other side of the pilot lamp is desirably connected by lead 83 to the parallel connected lamps 75, 76 as at 84.

To indicate a turn the driver closes switch 77 on the dashboard of the automobile. As a result, a circuit will be completed from the power main M-2, switch 77, terminal 31, high resistance wire 26, switch arm 18, contact arm 17, through the metal post 11, contact arm 48, high resistance wire 53, terminal 56, lead 79 through parallel connected lamps 75 and 76 and lead 78 to the power main M-1.

By reason of the high resistance of wire 26 and wire 53 in series therewith, the voltage drop across the parallel connected lamps 75 and 76 will be insufficient to effect illumination thereof. As the pilot lamp 81 is connected to the contact 57, which is not yet engaged by the contact arm 48, the lamp 81 will also not be illuminated.

With the flow of current through wires 26 and 53, they will heat up and elongate. The elongation of wire 26 will permit the tensed switch arm 18 to move to the left as shown in Fig. 1 against the tension of the spring member 35. As such spring member 35 is exerting tension against spring arm 18, the resultant tension applied to the wire 26 will be the difference between the tensions of spring arm 18 and spring member 35. These tensions are initially adjusted so that the tension of spring arm 18 will be only slightly greater than that of spring member 35, thereby retaining the relatively thin wire 26 under but slight tension.

With continued elongation of wire 26 with passage of current therethrough, the shoulder portion 24 of spring arm 18 engaged by spring member 35 will move in the direction of the arrow shown in Fig. 1 into the same plane as the contact arm or the position of unstable equilibrium. Up to and including this position the contact 32 carried by cross piece 23 of the contact arm will be retained to the left against stop 33. Further elongation of wire 26 will permit the shoulder portion 24 of the spring arm 18 to move slightly past the plane of the contact arm at which time the spring member 35 will snap the cross piece 23 in a toggle like action to the right so that contact 32 will quickly engage contact 34.

Inasmuch as the spring member 35 will retain the contact 32 against stop 33, until the switch arm 18 moves past the plane of the contact arm, there will be substantially no movement of the

contact 32 away from stop 33 until such snap action occurs. In addition, current flow through wire 53 will cause it to heat up and become elongated so that the free end of the arm 48 will gradually move to the right for engagement of contacts 51 and 57.

The resultant circuit due to the movement above described of contact 32 into engagement with contact 34 will effect a short circuiting of wire 26. Thus the circuit will be from main M-2, switch 77, terminal 31, lead 44 to contact 34, contact 32, contact arm 17 through post 11, arm 48, wire 53, terminal 56, lead 79 through the parallel connected lamps 75 and 76, and lead 78 to the other power main M-1.

By reason of the short-circuiting of the high resistance wire 26, the voltage drop across lamps 75 and 76 will be increased sufficiently to cause them to light. In addition, as contacts 51 and 57 are also in engagement, the pilot lamp 81 will be connected in parallel with lamps 75 and 76 so that it will also light. The circuit for the pilot lamp 81 is from main M-2, switch 77, terminal 31, lead 44, contacts 34 and 32, contact arm 17, post 11, arm 48, contacts 57 and 51, lead 62, terminal 63, lead 82 to one side of the lamp 81 and from the other side of the lamp through lead 83 to the other power main M-1.

Wire 26, being short circuited, will cool and contract, which will cause the free end 22 of the switch arm 18 to move to the right to the position shown in Fig. 1, thereby also moving to the right, the end of the spring member 35 engaging the shoulders 24 of switch arm 18. When such end of the spring member 35 moves past the plane of the contact arm 17, the pressure of the spring member will be exerted against the cross piece of the contact arm in opposed direction to effect a toggle-like action thereby to snap the contact carrying end of the latter, which had been until this time retained against contact 34, to the left, quickly to disengage contacts 32 and 34 without likelihood of arcing therebetween and moving contact 32 into engagement with stop 33. The above cycle of operation continues as long as switch 77 remains closed.

As a result of the disengagement of the contacts 32 and 34, the wire 26 will again be in series with the source of current and the parallel connected lamps. Consequently, the voltage drop across such lamps will be reduced as will the voltage drop across the pilot lamp 81 and the lamps will be extinguished. As current will flow through the wire 53 regardless of the position of contact arm 17, the wire 53 will remain in elongated condition and contacts 51 and 57 will remain in engagement so that the pilot lamp 81 will be retained in parallel with lamps 75 and 76 to be turned on and off in synchronization with such lamps.

In the event that one of the lamps, 75, 76, i. e., lamp 75 should be broken, the current flow through the circuit will be correspondingly decreased and as a result the current flow through the wire 53 will not heat such wire for sufficient elongation to retain the contacts 51 and 57 in engagement. Under the resultant cooling and contraction of wire 53 the contacts 51 and 57 will separate, breaking the circuit from the source of power to the pilot lamp and though the good lamp 76 will still function and turn on and off, the pilot lamp 81 will not and the driver of the automobile is advised that one of his signal lamps is not operating.

As the switch arm 48 does not move repeatedly during operation of the switch as does contact

arm 17, although contacts 51 and 57 will move apart slowly in the event one of the signal lamps is defective, and arcing may occur, such arcing is relatively infrequent and hence no objectionable pitting of contacts 51 and 57 will result.

The embodiment of the switch shown in Figs. 7 and 8 desirably comprises a base 91 of insulating material having a supporting post 92 affixed thereto. The supporting post which also desirably is of insulating material, is substantially U-shaped, having its cross piece 93 extending at right angles to the base and having its legs 94 and 95 extending longitudinally of the base and parallel thereto, the leg 94 desirably being suitably affixed to said base. Affixed at one end to the cross piece 93, which is desirably recessed as at 96, is a contact arm 97 of resilient material such as spring steel normally biased so as to have its free end move to the left, as shown in Fig. 7, so that the contact 98 at the free end of the contact arm, may engage a fixed contact 99 securely affixed to the frame by means of a bracket 101 and is spaced from a contact 100 affixed to base 91. Arm 97 desirably has a cross bar 102 at the free end thereof with depending switch arms 103 and 104 at each end thereof respectively, said switch arms also being of resilient material such as spring steel and bowed, as shown at 105, with the free ends of said switch arms being seated in notches 106 respectively in the upper ends of legs 94 and 95.

With the construction and arrangement of contact arm 97, switch arms 103 and 104 and mount 92, above described, when the lower portion of the contact arm adjacent the fixed end thereof is to the left of said notches, the contact 98 will be retained by the bowed switch arms in the extreme position to the left against contact 99. When such lower portion of contact arm 97 is to the right of notches 106, the contact 98 will be retained in the other extreme position, i. e., to the right against stop 100. When such lower portion of the contact arm 97 lies in the same plane as the notches 106, the contact arm will be in an intermediate position of unstable equilibrium and with any slight movement of such lower portion of the contact arm beyond such intermediate position in either direction the contact carrying end 98 of the contact arm will be snapped to the corresponding extreme position.

Associated with the contact arm 97 and controlling the latter is a high resistance wire 111, one end of which is affixed as by soldering to the contact arm 97 between its mounted end and the pivot points 106 of the switch arms 103 and 104. The wire 111 which extends outwardly from the contact arm 97 has its free end affixed to one of the legs 112 of a supporting bracket 113 which desirably is substantially U-shaped as shown and has an opening 114 in the other leg 115 thereof through which the wire extends, the bracket 113 being connected to contact 99 by means of a lead 116.

To install the device above described, the bracket 113 is connected by lead 121 to one side of parallel connected turning signal lamps 122 and 123 which may be installed, for example, in conventional manner at one side of the front and rear of an automobile. The other side of said lamps 122, 123 is connected by lead 124 to switch 125, desirably on the dashboard of the automobile, and from the switch to main M-1 of a source of power, the other main M-2 of the source of power being connected by lead 126 to arm 97.

When the switch 125 is in normal open posi-

tion, the high resistance wire 111 will be contracted so that the contact 98 on arm 97 will be engaging stop 100 affixed to the base. When switch 125 is closed to signal a turn, current will flow from main M-1, switch 125, lead 124 through parallel lamps 122 and 123, lead 121, high resistance wire 111, contact arm 97, lead 126 to main M-2. By reason of the voltage drop across the wire 111, there will be insufficient voltage across lamps 122 and 123 to illuminate the latter. As wire 111 heats up and elongates with flow of current therethrough, contact arm 97 which is normally tensed to the position shown in Fig. 7, will tend to move toward such position. However, the contact 98 at the free end thereof will be retained at the extreme position to the right in engagement with stop 100 by reason of the bowed switch arms 103, 104 which urge the contact 98 thereagainst.

With continued elongation of the high resistance wire 111, the contact arm 97 will move past or to the left of the pivot point 106 of the switch arms 103, 104. At this time a toggle-like snap action will occur which will quickly move the contact 98 away from stop 100 and into engagement with contact 99. Consequently the high resistance wire 111 will be short circuited, the circuit being from power main M-1, closed switch 125, lead 124 through parallel lamps 122 and 123, leads 121 and 116, through contacts 99 and 98, contact arm 97, lead 126 to main M-2.

As a result of such connection, substantially the only resistance in the circuit will be that of the lamps 122, 123 and the voltage drop thereacross will be sufficient to effect illumination thereof.

The short circuited high resistance wire 111 will then cool, thereby exerting tension on the contact arm 97 to move the lower end thereof to the right. As the bowed switch arms 103, 104 urge the contact 98 at the end of contact arm 97 against fixed contact 99, such contacts will be retained in engagement. When the contracting wire 111 has moved the lower end of the contact arm 97 to the right of the pivot points 106 of the switch arms 103 and 104, a snap action will be imparted to contact arm 97 quickly to disengage contacts 98 and 99 without likelihood of arcing therebetween and to move contact 98 again into engagement with stop 100. The above cycle of operation will continue as long as switch 125 remains closed.

The embodiment shown in Fig. 9 desirably comprises a supporting post 131 of conducting material affixed at its base 130 as by rivet 132 to an insulating disc 133. The upper end of the supporting post, which is offset as at 134, is reversely bent as at 135 to define a pivot arm 136, which is desirably resilient and tensed so that its free end will normally be urged away from the post 131. Affixed to the upper end of post 131 as by rivets 137 is a contact arm 138 of resilient material such as spring steel, extending substantially parallel to the post 131 and having a contact 139 at its lower end. Associated with contact arm 138 is a switch arm 141 also of resilient material bowed as at 142 and affixed at one end to the contact carrying end of arm 138, the free end of said switch arm 141 being pivotally mounted in a seat 143 at the free end of pivot arm 136. Extending laterally outward from pivot arm 136 is a lever 144, to the free end of which is affixed one end of a high resistance wire 145, the other end of said wire being affixed in an insulating bead 146 carried on a supporting arm 147, preferably formed integral

with the base 130 of the post, the tension on said wire 145 being adjustable by bending arm 147. Desirably, the base 130 carries a pair of contacts 151 and 152 which are insulated from each other and from the base 130 and which are positioned respectively on each side of contact 139 on contact arm 138. Contact 151 is desirably connected by lead 153 to a terminal 154 mounted on insulating disc 133 and contact 152 and high resistance wire 145 are desirably connected by leads 155 and 156 respectively, to a terminal 157 mounted on said disc 133, the entire unit being housed in a casing 160.

With the construction and arrangement of contact arm 138, switch arm 141 and pivot arm 136, when the pivoted end of switch arm 141 is to the left of contact arm 138, the contact 139 will be retained in the extreme position to the right by bowed switch arm 141 against contact 152. When the pivoted end of switch arm 141 is to the right of contact arm 138, the contact 139 will be retained in the other extreme position to the left against contact 151. When the pivoted end of switch arm 141 lies in the same plane as contact arm 138, the contact arm will be in an intermediate position of unstable equilibrium and any slight movement of the pivoted end of the switch arm beyond such intermediate position in either direction will effect a snapping action of the contact 139 to one or the other extreme positions.

To install the device shown in Fig. 9 in an automobile, for example, the terminal 157 is connected by lead 161 to one side of parallel connected turning signal lamps 162 and 163 which are mounted in conventional manner at one side of the front and rear of the automobile. The other side of the lamps is connected to a switch 164 desirably on the dashboard of the automobile and thence to power main M-2. The other power main M-1 is desirably connected by lead 165 to rivet 132 to complete the circuit.

In the operation of the device shown in Fig. 9, with contact 139 engaging contact 151, when the switch 164 is closed, current will flow from main M-1 through lead 165, rivet 132, post 131, pivot arm 136, lever 144, high resistance wire 145, lead 156, terminal 157, lead 161, through parallel lamps 162, 163, switch 164 to main M-2. By reason of the voltage drop across the high resistance wire 145, there will be insufficient voltage drop across the lamps to light the same. As the wire 145 heats up and elongates with passage of current therethrough, the tension on lever 144 will be relieved and pivot arm 136 will move outwardly from post 131 to its normal position shown in Fig. 9. By reason of the bowed switch arm 141, the contacts 139 and 151 will be retained in engagement until the pivotal seat 143 of the switch arm moves to the left of the plane of the contact arm 138 at which time the contact 139 at the end of arm 138 will snap out of engagement with contact 151 and into engagement with contact 152.

With contacts 139 and 152 in engagement as shown in Fig. 9, the high resistance wire 145 will be short circuited. This circuit will be from main M-1, lead 165, rivet 132, post 131, contact arm 138, contacts 139 and 152, lead 155 to terminal 157, through lead 161, lamps 162, 163 and closed switch 164 to main M-2. As substantially the only resistance in circuit will be that of the lamps, they will light.

Since it is short circuited, the high resistance wire 145 will cool and contract with increased tension on lever 144. This will tend to move the

lower end 143 of the pivot arm 136 to the right of the position shown in Fig. 9, past the plane of the contact arm 138. When this occurs the switch arm 141 will effect a toggle-like snapping movement of the contact arm 138 quickly to move contact 139 thereon out of engagement with fixed contact 152 without likelihood of arcing between such contacts and into engagement with contact 151 thereby again to place the high resistance wire 145 in series with the lamps 162 and 163.

In the embodiment shown in Figs. 10 and 11, an upright post 171 of insulating material is desirably mounted on an insulating disc 172. Post 171 carries a length of resilient sheet metal, preferably of Nichrome which desirably is stamped to define heat responsive portions 173 and tongues or contact arms 174, 174', the adjacent inner ends of contact arms 174, 174' being affixed to insulating post 171 by rivets 175. As shown in Fig. 11, the heat responsive portions 173 are relatively high resistance thin strips or conduits on each side respectively, of the contact arms 174, 174', which are relatively wide and of low resistance. The contact arms 174, 174' are desirably bowed, as shown, and each carries a contact 176, 177 at substantially its mid portion, normally engaging contacts 170 and 170' mounted on and insulated from post 171 and spaced respectively from fixed contacts 178 and 179 electrically connected by strip 182 and mounted on an insulating post 181 affixed to disc 172.

Desirably the rivets 175 associated with contact arm 174' are connected by strip 184 and lead 185 to a terminal 186 on disc 172 and the rivets 175 associated with contact arm 174 are connected by strip 187 and lead 188 to terminal 189 on disc 172.

With the construction and arrangement of contact arms 174, 174' and strips 173, when the portions of the strips 173 adjacent the fixed ends of arms 174, 174' are to the right of said arms, the contacts 176, 177 will be retained in the extreme position to the right against fixed contacts 170, 170'. When such portions of strips 173 are to the left of the fixed ends of arms 174, 174', the contacts will be retained in the other extreme positions to the left against fixed contacts 178, 179. When the strips and the fixed ends of contact arms 174, 174' are in the same plane, the contact arms will be in an intermediate position of unstable equilibrium and any slight movement of said strips beyond such intermediate position will effect a snapping action of the contacts 176, 177, to one or the other extreme position.

The device shown in Figs. 10 and 11 when used, for example, to control the parallel connected turning signal lamps 191, 192 on one side of an automobile, has its terminal 186 connected by lead 193 to one side of the parallel connected lamps and the other side of the lamps is connected to a switch 194 desirably on the dashboard of the automobile and thence to power main M-1, the other power main M-2 being connected by lead 195 to terminal 189.

In the operation of the device shown in Figs. 10 and 11, when no current flows through the high resistance strips 173, they will be contracted so that, as shown in Fig. 10 they will lie in a plane slightly to the right of the plane of the adjacent inner ends of the bowed contact arms 174 and 174'. In this position the contacts 176, 177 on the contact arms will be spaced from con-

tacts 178 and 179 and in engagement with contacts 170 and 170' on post 171.

When switch 194 is closed, a circuit will be completed from the power main M-1 through switch 194, lamps 191, 192 and lead 193 to terminal 186, thence through lead 185, strip 184, rivet 175, bowed contact arm 174', high resistance strip 173, bowed contact arm 174, rivet 175, strip 187, lead 188 to terminal 189 and thence by lead 195 to main M-2.

As the lamps are in series with the high resistance strip 173, the voltage drops across the lamps will be insufficient to light the same. As current flows through high resistance strips 173, the latter will heat and elongate causing the ends thereof to move in the direction indicated by the arrows. During the initial portion of such movement the contacts 176, 177 on bowed contact arms 174, 174' will remain in engagement with their associated contacts 170 and 170'. As the high resistance strips 173 continue to elongate, the outer ends thereof will move to the left of the plane of the adjacent inner ends of the bowed contact arms. When this occurs, a toggle-like action will occur to snap the bowed contact arms to the left, thereby moving the contacts 176, 177 thereon into engagement with contacts 178 and 179 on post 181. Consequently the high resistance strips 173 will be effectively short circuited as substantially all the current will flow through the strip 182 connecting contacts 178 and 179 and the lamps will light as they will be substantially the only resistance in circuit.

Due to such short circuiting of high resistance strips 173, the latter will cool and contract causing the outer ends thereof to move to the right. When the outer ends of the high resistance strips move to the right of the adjacent inner ends of the bowed contact arms, the latter will snap to the right thereby quickly disengaging contacts 176 and 177 from contacts 178 and 179 without likelihood of arcing therebetween and moving such contacts 176 and 177 into engagement with contacts 170 and 170' so that the high resistance strips 173 are again in circuit with resultant turning off of the lamps.

With the constructions above described, the movable contacts will not be displaced until the switching period and such switching period will occupy but a short interval of time. As a result, there is no likelihood of arcing of the contacts as they are moved away from each other and in addition no critical adjustment of the parts is required for the snap action has a throw of sufficient distance to take care of mechanical variations in manufacture.

It is of course to be understood that in each of the embodiments herein an identical device would be used to control the turning signal lamps on the other side of the front and rear of the automobile and the control switch would be of the single pole double throw type. In addition, if desired a pilot light and control therefor similar to that shown in Figs. 1 to 6 could be provided in the other embodiments herein.

As many changes could be made in the above construction, and many apparently widely different embodiments of this invention could be made without departing from the scope of the claims, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I

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

1. An intermittent switch comprising a contact carrying arm fixed at one end, having a contact at the other end and movable at the contact carrying end between two extreme positions, a flexible switch arm having one end fixed with respect to the fixed end of the contact carrying arm and having its other end movable in the plane of movement of the contact carrying arm, resilient means operatively connected to both said flexible switch arm and said contact arm and reacting against both of said arms, said resilient means normally urging said contact arm to one of said extreme positions and providing an intermediate position of unstable equilibrium for said contact arm between said two extreme positions from which, upon application of tension to the movable end of said switch arm and change of relative position of both said resilient means and switch arm with respect to said contact arm, the contact on the contact arm will snap over to the other extreme position, and a heat extensible wire connected at one end to the movable end of the switch arm and fixed at the other end to apply tension to said switch arm to move the latter upon cooling and contraction of said wire, from its normally biased position to that of unstable equilibrium for snapping of said contact by said resilient means to the other extreme position, whereby upon extension of said wire upon heating thereof, said switch arm will change its relative position with respect to said resilient means and said contact arm, and again cause the contact arm to pass the position of unstable equilibrium so that said resilient means will effect snapping of said contact back to the first extreme position, said contact when in one extreme position closing a circuit to short circuit said heat extensible wire, said circuit being open when said contact is in the other extreme position.

2. An intermittent switch comprising a contact carrying arm fixed at one end, having a contact at the other and movable at the contact carrying end between two extreme positions, a resilient switch arm having one end fixed with respect to the fixed end of said contact arm and having its other end movable in substantially the same plane of movement as said contact arm, said switch arm extending longitudinally of said contact arm and being normally tensed so that its free end will tend to move away from said contact arm on one side thereof, resilient means coacting with the free ends of said contact arm and said switch arm to urge said ends in opposed directions when the free end of said switch arm is spaced from said contact arm on either side thereof thereby to bias said contact arm to one or the other of said extreme positions, said switch arm, said contact arm and said resilient means affording a position of unstable equilibrium when said switch arm and said contact arm are in the same plane, a heat extensible wire fixed at one end to said switch arm to draw the same upon cooling and contraction of said wire from its normally biased position to that of unstable equilibrium for snapping of said contact by said resilient means to the other extreme position, whereby upon expansion of said wire upon heating thereof, said switch arm will be released and when the position of unstable equilibrium has been passed by said arm, said resilient means will then snap said contact back to the position of normal bias, said contact when in one extreme

position closing a circuit to short circuit said wire, said circuit being open when said contact is in the other extreme position.

3. The combination set forth in claim 1 in which said resilient means comprises a compressed bowed spring member between the contact carrying end of said contact arm and the free end of said switch arm.

4. The combination set forth in claim 1 in which said contact arm is a strip of resilient spring metal and said switch arm is stamped from said strip with one end of said switch arm being integral with that of said contact arm and said resilient means comprises a bowed spring member compressed between the contact carrying end of said contact arm and the free end of said switch arm, the tension of said switch arm being greater than that of said bowed spring member.

5. The combination set forth in claim 1 in which a second contact carrying arm is provided of resilient material, a fixed contact, a second heat extensible wire of less ohmic value than said first heat extensible wire normally retains said second contact arm spaced from said fixed contact, circuit means connects said two contact arms in series and terminals are connected respectively to said first heat extensible wire, said second heat extensible wire and said fixed contact.

6. An intermittent switch comprising a fixed contact, a mount, a contact carrying arm of resilient material having a contact at one end thereof and fixed at its other end on said mount, a resilient spring arm fixed at one end to the contact carrying end of said contact arm and extending substantially lengthwise thereof and pivoted at its other end on said mount, said contact arm being biased, normally to urge the contact thereon into engagement with said fixed contact, said contact arm, said mount and said spring arm being constructed and arranged to afford a position of unstable equilibrium when the contact arm and the spring arm are in the same plane, a heat extensible wire fixed at one end to said contact arm to draw the latter upon cooling and contraction thereof from said normal position past said position of unstable equilibrium for snapping of said contact by said spring arm away from said fixed contact, whereby upon expansion of said wire upon heating thereof said contact arm will be released and when the position of unstable equilibrium has been passed by said contact arm, said spring arm will then snap said contact back into engagement with said fixed contact, said contact when engaging said fixed contact closing a circuit to short circuit said wire, said circuit being open when said contact is in the other extreme position.

7. An intermittent switch comprising a mount, a pair of spaced fixed contacts, a contact carrying arm of resilient material having a contact at one end thereof and fixed at its free end to said mount, said mount having a resilient pivot arm, a resilient switch arm affixed at one end to the contact carrying end of said contact arm and having its free end pivotally mounted at the end of said pivot arm, said pivot arm being biased normally to move outwardly from said contact arm and to move the contact into engagement with one of said fixed contacts, said contact arm, said switch arm and said pivot arm being constructed and arranged to afford a position of unstable equilibrium when the end of the pivot arm and said contact arm are in the same plane, a lever extending outwardly from said pivot arm,

a heat extensible wire fixed to the end of said lever to urge said pivot arm inwardly upon cooling and contraction of said wire past said position of unstable equilibrium for snapping of said contact into engagement with the other of said fixed contacts, whereby upon expansion of said wire upon heating thereof, said pivot arms will be released to move said switch arm past the position of unstable equilibrium and said switch arm will then snap said contact back into engagement with said first fixed contact, said contact when engaging said other fixed contact closing a circuit to short circuit said wire, said circuit being open when said contact engages said first fixed contact.

8. An intermittent switch comprising a substantially rectangular resilient member having bowed portions defining contact arms extending longitudinally inward from the ends thereof and having a pair of narrow heat extensible lateral strips integral therewith on each side of said contact arms, a post of insulating material, means fixing the adjacent inner ends of said contact arms to said post, a contact carried by each of said contact arms, a pair of spaced contacts associated with each of the contacts on said contact arms on each side thereof, one of the contacts of each of said pair being engaged by the associated contact on said contact arm when said strips are cool and contracted, said contact arms and said lateral strips being constructed and arranged to afford a position of unstable equilibrium for said contact arms when the lateral strips lie in the same plane as the fixed ends of said contact arms, whereby upon expansion of said lateral strips upon heating thereof and lateral movement thereof with respect to said contact arms, the contacts thereon will remain fixed until the position of unstable equilibrium has been passed by said strips to snap said contacts into engagement with the other of said spaced contacts, said contacts when engaging said last named pair of spaced contacts closing a circuit to short circuit said strips, said circuit being open when said contacts are engaging the first pair of spaced contacts.

9. The combination set forth in claim 1 in which said contact arm is a substantially rectangular strip of resilient spring metal and said switch arm is also a substantially rectangular strip of resilient spring metal, said contact arm being conformed to have a central opening of substantially the length of the switch arm, one end of the switch arm being integral with said contact arm at one end of said central opening therein and extending the length thereof, and said resilient means comprises a bowed spring member having one end positioned against the end of the contact arm adjacent the end of the central opening remote from the end to which the switch arm is mounted and the other end against the switch arm adjacent its free end.

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