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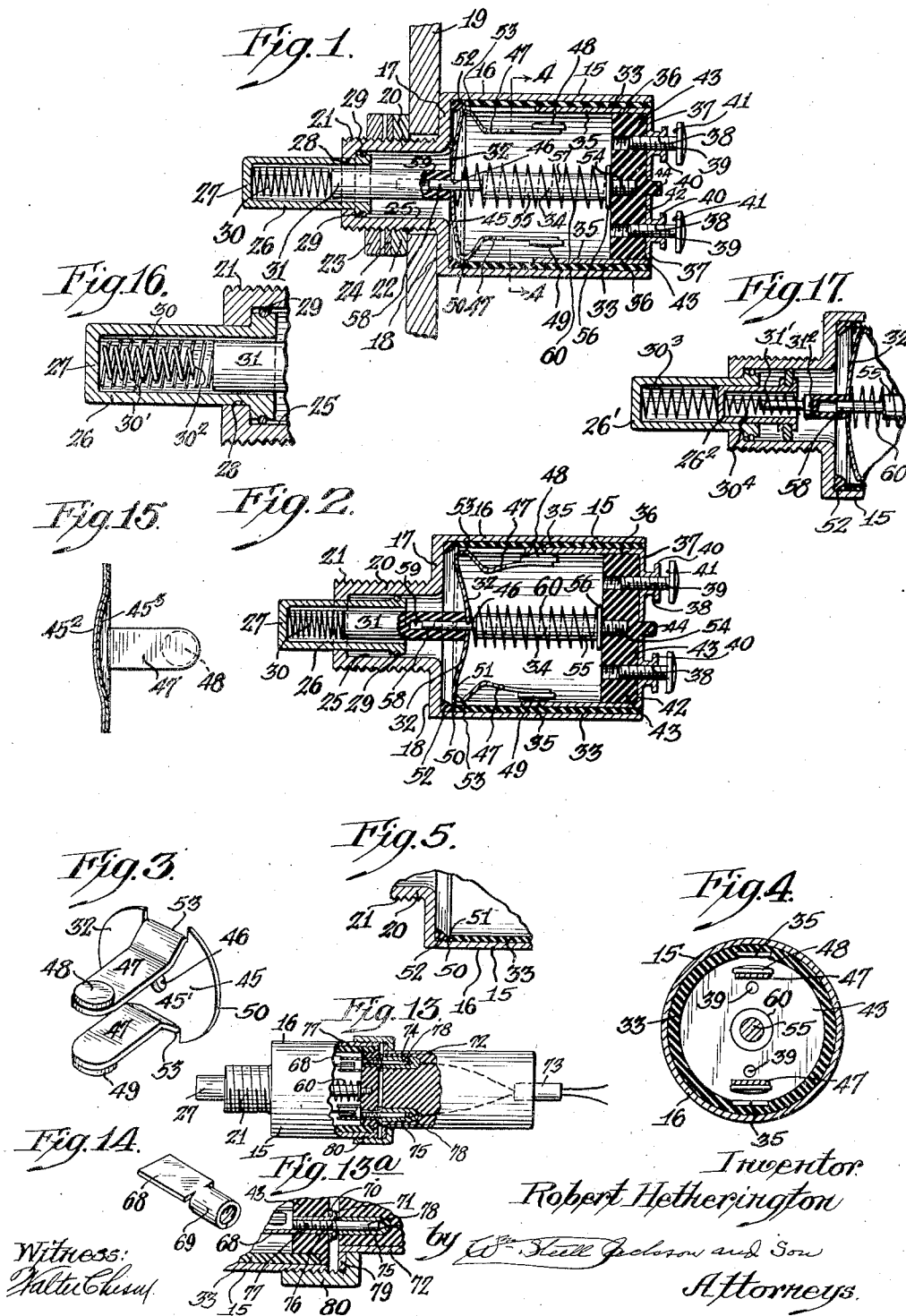
R. HETHERINGTON

2,301,874

CLICKER PLUNGER SWITCH

Filed Sept. 30, 1940

2 Sheets-Sheet 1



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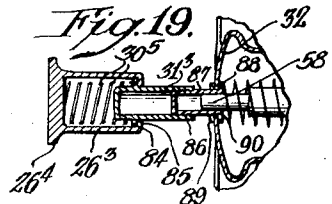
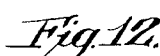
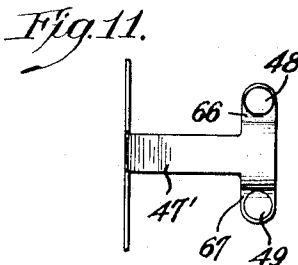
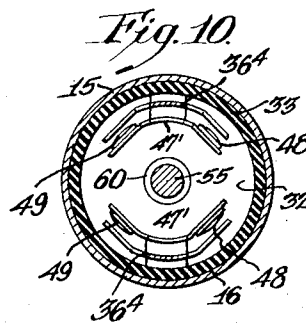
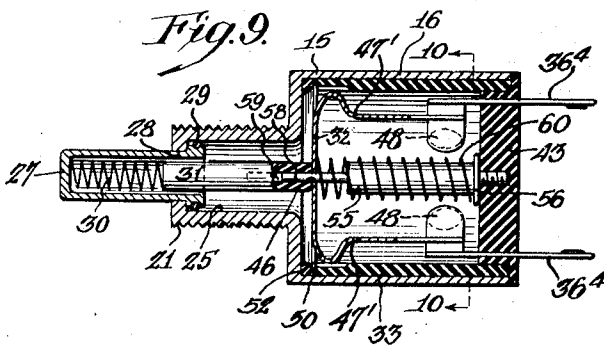
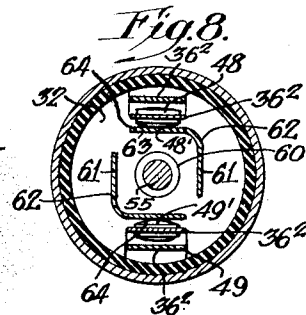
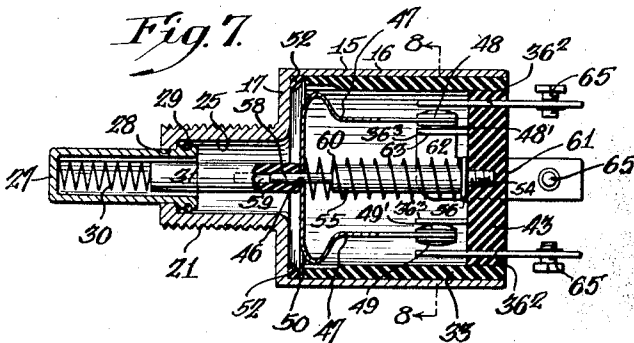
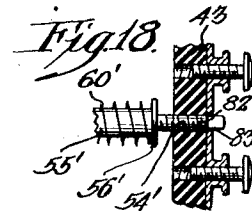
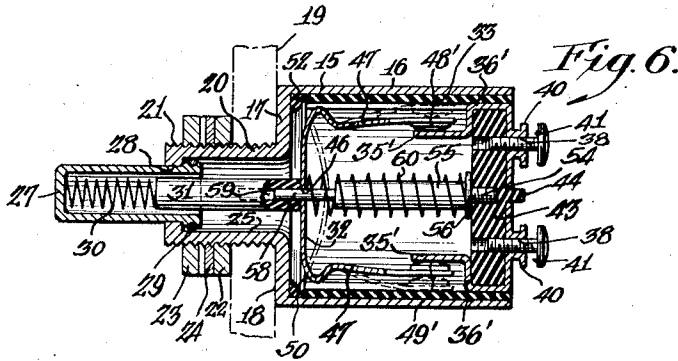
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CLICKER PLUNGER SWITCH

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CLICKER PLUNGER SWITCH

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20 Claims. (Cl. 200—113)

My invention relates to snap switches particularly of a plunger operated type.

One of the purposes of my invention is to provide a snap switch whose snap element is a disc, pressed in one direction of movement and automatic in return. Contacts rigid with the rim of the disc are moved by the "snap" in generally radial direction to engage and disengage outside or inside fixed contacts, or both outside and inside contacts thus closing or opening the connections.

A further purpose is to provide a plunger operated snap disc switch having disc-carried contact arms terminating in contacts by which a circuit is opened or closed simultaneously at two points.

A further purpose is to provide a snap-actuated switch operating through a snap plate with reinforcement for the disc adapted to continue its operation even in the event of fatigue of the metal of the plate and consequent failure of the plate to continue to "snap."

A further purpose is to provide for opposite spring pressure in the directions of snap actuation and return whereby energy is stored in one spring for operation and reliable return of the switch to initial position is provided by the other spring.

A further purpose is to use beryllium copper for the disc, to harden it after it has been given a clicker concavity and subsequently to peen the body of the disc to improve its clicking quality.

A further purpose is to use bi-metal for the disc with the metal having one greater coefficient of expansion on the normally convex side so that, if an undue current pass through the disc the increase in temperature will open the switch.

A further purpose is to provide a snap switch which is at the same time a circuit breaker and to make the circuit breaker operation adjustable to different electrical circuit conditions.

A further purpose is to adapt a snap disc switch to push-pull operation.

Further purposes will appear in the specification and in the claims.

The invention relates not only to the switch but to the methods involved.

Figures 1 and 2 are central longitudinal sections in open and in closed positions, respectively, of a normally open snap-actuated switch embodying my invention.

Figure 3 is a perspective view of the snap-actuating element of the switch seen in Figures 1 and 2.

Figure 4 is a section of Figure 1 upon line 4—4 thereof.

Figure 5 is a fragmentary enlarged central longitudinal section showing a part of Figure 1.

Figure 6 is a longitudinal section corresponding generally with Figures 1 and 2 of a normally closed snap-actuated switch.

Figures 7 and 9 are longitudinal sections corresponding generally to Figure 1 but showing respectively a single pole double throw switch of normally closed type and a double pole single throw switch of normally open type, both snap-actuated.

Figure 8 is a section of Figure 7 taken upon line 8—8 thereof.

Figure 10 is a section of Figure 9 taken upon line 10—10.

Figures 11 and 12 are elevations of the contact disc with its arms and of a fixed contact seen in Figure 9.

Figure 13 is a side elevation, partly in section, showing a union-connected switch and cable terminal.

Figure 13a is an enlarged fragmentary section of a part of Figure 13.

Figure 14 is a perspective view of a terminal used in Figure 13.

Figure 15 is a section of a modified form of disc.

Figures 16 and 17 are fragmentary longitudinal sections of switch structure showing modified forms of operating spring.

Figure 18 is a fragmentary longitudinal section showing resetting spring adjustment.

Figure 19 is a fragmentary longitudinal section of a push-pull adaptation of the invention.

In the drawings similar numerals indicate like parts.

My invention applies to various plunger switches in which the tilt of the side near the rim of a snap disc, when the disc is snapped, is applied to switch movement by correspondingly tilting contact arms attached to the disc at or near the rim. It also uses the snap of the action initially to throw the disc arms, and thus their contacts, farther in switch opening movement than the ultimate resting positions of the arms. This gives an excess arc-breaking opening movement which is quite desirable.

Normally a metal casing 15 is used both for mechanical protection and for convenient and rigid mounting of the parts. As illustrated this casing comprises an outer cylindrical shell 16, terminating preferably in an abrupt shoulder 17 whose outer face 18 is intended to bear against a panel 19 upon which the switch is mounted.

The casing—or whatever support and cover is used for the switch—conveniently terminates in a mounting neck 20 threaded at 21. The panel is intended to lie with one face against shoulder 18 and with the other face engaged tightly by a mounting nut 22 locked by nut 23. A lock washer 24 may be used.

Besides the mounting function of the neck its interior wall 25 provides a convenient support and guide for a cupped plunger sleeve 26 closed at the outer end at 27 and guided at one point by interior flange 28 carried by the neck and at another point by a bearing ring 29 upon the outer surface of the plunger near its open end. Fiber is suitable for this ring.

The bearing ring 29 rides against the interior wall 25 of the neck and supports the plunger against rocking movement.

Within the plunger a spring 30 engages the outer end of an insulating thrust rod 31 whose opposite end pushes and subsequently releases the snap disc 32. Means for holding the inner end of the thrust rod against lateral movement is later described.

The spring is intended to store energy by compression during initial movement of the plunger, so that when the snap takes place it will take place quickly. This also ensures full stroke.

In Figures 1 and 2 the main shell of the casing is lined by an insulating bushing 33 which in Figures 1 and 2 is longitudinally slotted on the inside on opposite sides of the switch axis 34 so as to receive the inner terminals 35, respectively, of contact strips 36. Each of these strips is bent across that end of the switch opposite to the presser plunger, as at 37, and is there apertured and internally threaded at 38 to receive a binding post 39. The walls of the apertures are flanged at 40 to provide additional annular width for contact with conductors beneath the heads 41 of the binding posts.

The two contact strips in these figures are mounted on the outer face 42 of an insulating closure plate 43, one on one side of the plunger axis and the other on the opposite side of the axis. The binding posts are screwed into threaded openings in the closure disc and may be used to hold the portions 37 of the strips to the insulating closure disc.

An insulation rib 44 separates the two contact strips to protect against accidental cross connection.

The snap disc may be the same in all of the forms, except as the arms and contact are varied. As shown it comprises the metal snap body 45 normally convex toward the plunger and apertured at 46, and the metal arms 47 desirably integral with the body. The arms are provided with electrically conducting contact pads 48, 49 preferably slightly convex in sections longitudinal as well as in sections transverse to the switch. The convex faces extend outwardly in normally open switch forms, inwardly in normally closed forms.

The operation of my invention is based upon the fact that snap movement of the disc tilts the metal where the arms are supported and hence swings the arms and their pads away from each other or toward each other according to the direction of snap movement.

Excellent results have been secured using a disc and arms from a plate or uniform alloy known on the market as beryllium copper. It is shaped, including the concaving to "click" properly. It is then hardened. In the harden-

ing operation it very generally loses its "click." This is restored by peening the interior part of the concave side 45' of the normally convex disc, by which a good permanent "click" can be secured.

While the same snap disc may be used for all of the different forms, and this disc may be the disc previously described, normal uses may permit and special uses may require a different kind of a disc, which as with the form shown in the earlier figures, may be used in Figures 1 and 2, 6, 7 and 9. This is particularly true when it is desired to use the same click disc for all purposes and that one of these purposes shall include special duty, such as circuit breaking when excess current passes through the circuit closed.

A good click capable of general use has been secured also by use of bi-metal comprising strips 45², 45³, such for example as brass on the normally convex side, away from the arms 47' and nickel on the side toward those arms.

This bi-metal strip is effective as is the one previously described to secure full stroke in a push-pull construction, or for use as previously described, in which the disc is pressed in one direction by the plunger and is reversed by its resetting pressure and the pressure of a resetting spring.

There is also a special advantage in using bi-metal when the click is intended to reset at an overload of current (and hence of temperature of the disc) as a current interrupter or circuit breaker. In this latter case the resetting spring is desirably adjustable (see Figure 18) to the intended voltage and current at which resetting (circuit breaking) shall take place. The circuit remains closed until interruption and then open.

Because the resetting at the intended temperature (voltage and current) for circuit breaking purposes is automatic under conditions intended, this use of the bi-metal disc will be described at this point, while a push-pull form of the same invention permitting the plunger to be pushed in one direction for switch closure and pulled in the opposite direction for switch opening will be described later.

When the bi-metal disc is used for any purpose contemplating circuit interruption the arms 47' are not made of bi-metal but are made of separate strips of metal fastened to the disc near its perimeter. For instance the bi-metal discs have used successfully a brass layer 45², a tin layer 45³ and copper arms 47'.

The reason for not having bi-metal arms is that with bi-metal arms the current in them would cause them to act independently of the snap of the disc and without the speed secured by the snap of the disc.

Where bi-metal is used under the conditions of Figures 1 and 2, to snap automatically in both directions, with the assistance of an additional spring 50 to help in the resetting snap of the disc the operation will be the same as in Figures 1 and 2 up to the time when an excess current flows through the disc. When excess current heats the disc the difference in coefficients of expansion of the two layers of the bi-metal tends to cause resetting of the disc to the position of Figure 1 from that of Figure 2 even when the plunger is still pushed in. The result is interruption of the circuit until the disc has cooled, causing a succession of makings and breakings of the current. The circuit cannot long be main-

tained closed at one time, giving notice of trouble on the line.

Complete resetting of the disc notwithstanding that the plunger is pushed in of course presupposes that there is enough remaining compressive range within the spring 30 including the expansion of the spring when the initial snap took place to permit take-up of the distance of thrust rod travel during the resetting.

Even through the circuit be not thus permanently opened it will be seen that it will be initially and successively opened whenever there is a short circuit or other condition causing excess current.

The outer part 50 of the disc 32, at and near its rim is held within an annular space 51 between a ring 52 fitting into the corner of the inside of the shoulder of the casing and the forward end of bushing 53 and is thus supported by the front end 33' of this bushing when the disc is pressed by the plunger to cause snap actuation. As set, the arms are in position so that, when moved radially outwardly the contact pads will engage the inner (forward) end sections, respectively, of the fixed contact strips.

In order to avoid interference of the support for the disc at or near its rim with free movement of the disc arms, these arms are bent from the disc metal at points 53 slightly inside the normal rim contour of the disc. Their contours between their attachment points and their pads, in section through the switch axis may vary greatly, but the shape shown has proved quite acceptable in practice.

Within the closure plate 43 is threaded the pin end 54 of a guide bar 55. The bar is screwed into the closure disc until flange 56 of the bar engages the disc. The body 57 of the bar at the end opposite the flange 56 carries a guide pin 58 which passes through the aperture 46 in the snap disc and into an opening 59 in the end of the insulating thrust rod 31. The opening is deep enough so that the pin 58 does not bottom in it during snap movement of the snap disc. The thrust rod is thus restrained laterally at one end by the interior walls of the plunger and at the other end by the pin 58.

In order to avoid danger of failure of the snap disc to return to its initial position because of fatigue of the metal, and also for the purpose of speeding the return movement of the disc (in Figures 1 and 2 the opening movement of the switch), a retracting spring 60 is provided which surrounds the guide bar 55, abuts the flange 56 or closure plate at the rear end and presses against the snap disc at the front end of the spring.

In normal position the disc 32 is convex toward the left as shown in Figure 1. When the plunger is pressed inwardly, i. e., toward the right, the spring within the plunger is first compressed, storing energy until the pressure of this spring acting through the thrust rod overcomes the resistance of the snap to actuation and also overcomes the resistance of the retraction spring. The disc then snaps and becomes concaved toward the left and convex toward the right in some such position as that seen in Figure 2. In the meantime, with the reversal of the direction of convexity and concavity, the contact arms 47 are swung outwardly until the two contact pads come into contact with the inner surface of the respective contact strips, closing the circuit which had previously been open at these two points.

The capacity of the spring within the plunger again to compress, after it has extended some-

what because of the snapping of the disc, is sufficient protection against injury from overtravel of any operating mechanism used.

When pressure upon the plunger is released the combined retractive energy of the snap disc and of the retracting spring 59 causes the disc 32 to snap quickly to the position seen in Figure 1. The first switch opening movement of the contact arms and pads has been found to start vibration of the arm as of reeds, so that they swing past their normal position of rest, giving a greater opening of the contacts than would otherwise be attainable.

In Figure 6 the construction is similar to that of Figures 1 and 2. However since this switch is intended to be normally closed the fixed contact strips 36' have their inner terminals 35' between the contact arms. The pads 48', 49' are located inside the disc arms, instead of outside, and are normally in contact, the pads with the respective fixed terminals. Outward movement of the arms 47 therefore opens the switch contacts. Here also there is vibration of reed type along with the opening movement, giving a wider initial spacing of the contacts than would otherwise exist.

The operation presents a reversal of that of the normally open switch, pressure upon the plunger compressing the spring within the plunger, and through it accumulating pressure against the thrust bar, until the snap disc "snaps" the circuit open.

In Figure 7 the construction combines the features of Figures 1 and 2 and of Figure 6, in that the same character of snap disc and of contact arms is used as in these several figures but the terminals of the contact arms carry contact pads 48 and 48', 49 and 49', one on each side of each arm, to engage respectively a fixed contact upon strip 36² on the outside and a fixed contact upon strip 36³ on the inside. This provides a single pole double throw construction by which with the snap at one end of its movement, the position shown in Figure 7, the contact pads, disc arms and snap disc form a connection between the pads 48', 49' and the fixed contacts for strips 36² and 36³ to provide a normally closed connection within the circuit to which these are connected, whereas with snap of the switch to the other position contact is made between the outer pads 48 and 49 and the outer fixed contacts on connector strips 36² and 36², connecting these contact strips together when the plunger is pushed in.

In order to avoid insulation complications the fixed contact strips are supported within the insulating closing disc 43 in quadrant positions. Thus the outer contact strips 36² and 36² pass directly through this insulation and are supported in the insulating closure plate or disc, as seen in Figure 7, whereas the fixed contacts for strips 36³ and 36³ are supported in the insulating closure disc in quadrant positions at 61, as seen in Figure 7, extend laterally each at 62 forming an L with the straight portion of the strips and are turned laterally approximately 90 degrees at 63 to afford outer facing surfaces 64 for engagement by those disc arm pads which face inwardly.

Both sets of strips are conveniently provided with binding posts 65 outside of the switch casing, to the rear of it.

In Figure 9 a double pole single throw switch is shown corresponding generally with the other forms described in the use of the same casing insulation, snap disc, guide plunger, return spring, etc., but differing in that each of the arms

and each of the fixed contacts provides for two contact positions. Each arm 47' is laterally extended in circumferential directions on both sides of the arm at 66, 67 to carry two contact pads, 48 and 49 which pads are mounted in quadrant positions each in the illustration, each being located 45 degrees about the switch, in different angular directions one with respect to the other, from the arm by which it is supported. Likewise each fixed contact strip 36' is bifurcated or laterally extended in opposite angular directions to provide surfaces for engagement by the two pads. These surfaces are spaced the same angular distance that the pads are spaced, namely, 90 degrees in the illustration. The fixed contact strips as well as the arms upon the snap disc, are located exactly midway between the two contact pads for the arms and between the two contact terminals for the strips.

In Figure 9 is shown a normally open switch which is obviously adapted to be used also in a normally closed construction such as that in Figure 6, or in a double throw construction such as is shown in Figure 7.

In the form of Figures 1 and 2 the pads rest inside the fixed contact strips and are spaced from them. When the plunger is pushed the plunger spring first is compressed until, acting through the thrust rod, sufficient pressure is accumulated to overcome the resistance of the snap disc to snap actuation and also to overcome the resistance of the retracting spring. Note permissive additional compression of the spring within the plunger as well as the fact that after snap actuation this spring has extended somewhat to take care of any overthrow of the plunger.

While the plunger is snapping to the position of Figure 2 the arms 47 carried by the disc are canted or tilted by the canting or tilting of the outer portion of the disc to which the arms are attached, with the result that these arms move outwardly in nearly radial planes. The arms move to a sufficient distance so that the pads engage the fixed contacts 35 upon strips 36 on opposite sides of the interior of the switch, thus connecting across from one fixed contact to the other through the contact pad, connecting disc arm, snap disc, the second disc arm and second contact pad, to the fixed contact strip on the opposite side of the switch.

The disc arm is resilient and in practice preferably has sufficient resilience so that when snapped free from engagement of the pad with the fixed contact strip, the arm vibrates like a reed. This vibration is not of moment during the making of the contact, but is of value during the breaking of the contact because, in breaking snap movement of the disc, the vibration causes the pads to swing farther from the fixed contact strips than would otherwise be the case, giving a larger initial arc break than the arc break would be between the fixed contact strips and the position of rest of the pads.

When the plunger is released the pressure of the spring within the plunger is likewise released from the thrust rod permitting the pressure of the retraction spring and the snap action return tendency of the disc together to reverse the position of the snap actuation disc from convexity toward the right in the Figure 2 to convexity toward the left as in Figures 1, 6, 7 and 9. The retraction spring speeds this return greatly.

The same operation takes place in Figure 6, with the exception that, the fixed contacts being

now interior to the pads instead of exterior to them, the normal disc position of Figure 1 corresponds with a closed position of the circuit in Figure 6, and this figure presents a normally closed switch. The opening of these contacts of the switch takes place when the plunger is pressed to such an extent as to cause snap actuation to a snap disc position like that in Figure 2.

In Figure 7 the contact pads on opposite sides of the disc arm terminals engage successively with inside and outside pairs of fixed contacts in different circuits resulting in a normally closed switch condition considered with respect to the inner fixed contact strips and a normally open circuit condition when considered with respect to the outer fixed contacts. Contact with one or other pair of the pairs of fixed contacts takes place in each of the two snap positions.

For the form of Figure 9, as a matter of illustration the normally open circuit connection has been chosen though it is obvious that this construction is suitable for use with inside fixed contacts in a normally closed construction, corresponding in that particular with Figure 6, or with both inside and outside pairs of fixed contacts to close connection between one pair of contacts at each stroke of the snap actuation, if preferred. The operation in the form illustrated corresponds with that of Figures 1 and 2 with the difference that support of a pair of contact pads from each disc arm and engagement with a pair of contact strip surfaces in each case gives a larger contact area for current flow.

It will be evident that in each of the forms the retraction spring not only insures resetting movement of the disc in case of fatigue of the snap disc, but during the entire actuation it speeds the movement of the disc, speeding the breaking movement of the contact pads where the switch is of the normally open type.

In Figures 13, 13a and 14 a different binding post and fixed contact construction with a coupling connection to an A and N connector is shown forming a desirable type of connection which may be used without affecting the other features of my invention.

The binding post and the fixed contact strip used are shown in Figure 14, where the strip 68 is cut from a width wider than that shown in the strip itself, the wider section is rolled into a sleeve at 69 and the edges are fastened together by solder. The interior of the sleeve is threaded to form a binding post. The sleeve is long enough not only to pass through the rear end closure insulation but to pass through a washer 70 and to be turned over at 71 to hold it tightly against the washer. This gives a thread for a binding post, comparable with the binding post thread shown in the other figures.

In Figures 13 and 13a it is desired to show the hook-up of such a construction with an A and N terminal pair, comprising a casing 72 into which the twisted pair passes at 73, the sockets 74 and 75 being supported by insulation within the sleeve.

In the present form of the invention I apply pins 76 in the binding posts, which pins are threaded at one end 77 to pass within the threads of the binding post sleeve and which are straight and not threaded at 78 for sliding engagement within the sockets 74, 75.

In order to hold the parts together a collar 79 is secured to the outside of the connector sleeve which collar is engaged by a coupling 80 and the coupling is threaded into engagement with the

threaded exterior at 81 of the shell of casing 15. Ordinarily the casing 15 will require reinforcement by an additional shell or extra thickness if it is to be threaded for such a purpose. So that what is left of the counterbore becomes effective as a seat for the ring. The springs 29 and 30 press respectively against collars 34 and 35 rigid with plunger 24.

A light plunger spring compression may be used up to approximately the point at which the snap action takes place, using a much stiffer spring and hence shorter spring compression for distances of plunger movement at and after the position for snap actuation. Additional compression of the spring or springs accommodates over-travel.

A two spring construction is shown in Figure 16 where two springs 30 and 30' are indicated, the spring 30 bearing at all times upon the thrust rod or bar 31 and a stiffer spring 30' is brought into action later after compression of the spring 30 is completed or nearly completed. The end 30² of the heavier spring then comes into engagement with the thrust rod. The proportionate strengths and sizes are intended to be such that when the second spring begins to act a slight movement only of the plunger is needed to cause snap actuation. The pressure which caused the actuation follows up the snap and continues to press the disc in its concaved position. Consequently on the return snap movement, a critical distance is thus provided within which the return snap of the disc will take place. This makes the snap action very exact in the positions of the parts at which the snap takes place.

In Figure 17 a slightly different arrangement of parts is shown for the same general purpose. Except as indicated the parts are permissibly the same as in Figure 1. Of course the disc may be of bi-metal.

The plunger 26' contains a light spring 30³ which is compressed by a cupped plunger 26² open toward the snap disc. Within the cupped plunger 26² is a plunger spring 30⁴ whose interior guides the reduced end 31' of a thrust rod 31². The shoulder between 31' and 31² engages the end of the spring 30⁴ to compress it. Thrust rod 31² contains a recess for a pin 58 which passes through the disc.

In operation the spring 30³ is compressed when the plunger 26' is moved inwardly, the spring 30⁴ being compressed later against the resistance of the thrust rod, giving the same range of permissible adjustment of strengths of springs and timing of the beginning of compression of the stronger spring as in the case of Figure 16. The construction gives opportunity also to select the lengths and strengths of the springs so as to have the snap action occur within a selected short range of plunger movement and to select the range of plunger movement within which resetting of the disc will take place.

In Figure 18 a construction is shown whereby the strength of a resetting spring 60' may be adjusted in place. This can be applied to any of the forms but is particularly useful where a bi-metal disc is used and it is intended that the disc shall interrupt the current flow under given voltage and current conditions. The conditions can be established and the spring 60' can then be adjusted until the snap takes place.

In this Figure 18 the construction is intended to correspond generally with that of Figures 1, 2, 6, 7 or 9, for example, the selection of the

binding posts of the earlier figures not being intended to require their other construction, except that ordinarily the adjustment will not find its greatest usefulness unless a bi-metal disc be used. The guide and support 55' is threaded at 54' tightly within the closure insulation 43, or may be set ultimately by any suitable means, and is notched at the rear as at 82 for screw driver engagement. The insulation is cut away at 83 so that the support can be adjusted to bring collar 56' closer to or farther away from the snap disc, increasing or decreasing the effective expansive strength of the spring 60'.

It is recognized that this is one only of many forms of adjustment by which the strength of this spring may be altered in place.

The forms so far described have depended upon the return snap reaction of the disc, with or without additional spring assistance, for resetting of the disc, whether the snap has been intended to be effective during pressure upon the plunger only or for an extended time until current conditions in a circuit increase the return snap capacity of the disc. In Figure 19 a push-pull construction is shown containing various features of the invention and making it possible to snap the switch manually in both directions.

The plunger 26³ is provided with handle projections 26⁴ and encloses spring 30⁵ which presses against a collar 84 upon a thrust rod 31³. The end of the plunger is spun inwardly at 85 to prevent removal of the plunger from the thrust rod.

At its inner end the thrust rod is threaded at 86 to the outside of a shell 87 fastened to the snap disc, as by turning its edges outwardly inside the disc at 88 and holding the disc to the shell between this turned over portion and an outside collar 88. The shell 87 provides an opening 90 for the pin 58' of any suitable support 55.

It will be evident that the shoulder between the support 55 and the pin 58 makes a convenient, very desirable and under most circumstances quite necessary stop to protect the disc against being strained by being pushed too far in its snapping from the position of Figure 1 to the position of Figure 2.

It will be evident that the system afforded by my different types of construction and operation is very flexible, permitting use as a push switch in which the plunger is kept pushed in all the time and will retract automatically when the plunger is no longer pushed in—in which case it may use either the beryllium copper or the bi-metal disc—or as a push pull switch in which it is operated manually in both directions or as an automatic circuit breaking switch in which the bi-metal disc is used and the disc stays in the position, say of Figure 2, when pressure upon the plunger is withdrawn and until an excessive temperature of disc due to excessive current causes the disc to reset. Furthermore, all these different forms are permissible with substantially the same mechanical construction, capable of using the same dies for almost all of the parts, having the same appearance, and occupying the same space.

In view of my invention and disclosure variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all

such in so far as they fall within the reasonable spirit and scope of my invention.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a plunger switch, a casing, an insulating lining in the casing, a snap disc held at its edges in position within the casing and having arms extending in a direction generally lengthwise of the switch, contacts carried by the arms, fixed contacts with which the arm contacts are adapted to engage and plunger means for snapping the disc to move the arms outwardly or inwardly from the axis of the switch to engage or disengage the fixed contacts.

2. A plunger having a casing, an electrically conducting snap disc secured within the casing, electrically conducting arms extending generally lengthwise of the switch from the outer parts of the disc, connecting with it near the periphery of the disc and carrying contacts near the outer ends of the arms, fixed electrical contacts with which the arm contacts are adapted to engage and plunger means for snapping the switch to cause engagement of the arm contact with or disengagement from the fixed contacts.

3. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery insulated therefrom and having arms extending lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing, in position to be engaged by the arm contacts or disengaged therefrom, a plunger, a thrust connection between the plunger and the disc on the front side of the disc and a spring between the plunger and thrust connection, the disc being operated in one direction by the plunger and snapping in the opposite direction to initial position.

4. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery insulated therefrom and having arms extending lengthwise of the switch from disc positions near the disc periphery and terminating in contacts, fixed contacts insulated from the casing in position to be engaged or disengaged by the arm contacts, a plunger, a thrust connection between the plunger and the disc on the front side of the disc, a spring between the plunger and thrust connection, and a second spring engaging the rear of the disc the disc being operated in one direction by the plunger and in the opposite direction snapping to initial position because of its snap return and the second spring.

5. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery insulated therefrom and having arms extending lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, plunger means for pressing the disc in one snap direction and spring means on the opposite side of the disc from the plunger means for assisting in retraction of the disc to initial position.

6. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery, insulated therefrom and having arms extending lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, a hollow plunger, a spring therein, a thrust bar between the spring and the front of the disc, a guide for the thrust bar having a part of the guide passing through

the disc and insulated from the casing and a spring surrounding the guide and supported laterally by it for insuring return of the disc to initial position.

7. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery insulated therefrom and having arms extending from near the periphery of the disc lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, the fixed contacts being outside the arm contacts whereby the switch is normally open and is closed by initial snapping of the disc, thrust means for snapping the disc to close the contacts, a spring in the thrust means providing for accumulation of pressure therein, the snap disc being adapted automatically to retract to initial position.

8. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery, insulated therefrom and having arms extending from near the disc periphery lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, the fixed contacts being outside the arm contacts whereby the switch is normally open and is closed by initial snapping of the disc, thrust means for snapping the disc to close the contacts, a spring in the thrust means providing for accumulation of pressure therein, the snap disc being adapted automatically to retract to initial position and spring means for pressing the disc toward retracting position.

9. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery, insulated therefrom and having arms extending from near the periphery of the disc lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, the fixed contacts lying between the arm contacts, and the switch being normally closed, plunger means including a spring in series for snapping the disc to open the switch and spring means for retracting the disc to closed position.

10. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery, insulated therefrom and having arms extending from near the periphery of the disc lengthwise of the switch and terminating in contacts, pairs of fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, the separate pairs of fixed contacts lying one pair within and the other pair outside of the arm contacts and spring plunger means for snapping the disc to shift the arm contacts outwardly, the disc automatically retracting to initial position when the plunger is released.

11. In a plunger switch, a casing, an electrically conducting snap disc mounted therein at its periphery, insulated therefrom and having arms extending lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, a support and guide mounted behind the disc and at its forward end passing through an aperture in the disc, a spring about the support and guide, a hollow plunger, a thrust rod engaging the front of the disc, a plunger spring between the hollow plunger and the thrust rod whereby the plunger

accumulates energy in its spring until the disc snaps, at which time the arms are thrown outwardly, altering the contact connection and the spring about the support speeds automatic retraction of the disc.

12. In a plunger switch having an axis, a casing adapted to be held in a support, a ring of insulation within the front of the casing, an insulating lining for the casing, a snap disc, having its periphery held between the ring and lining, disc arms extending lengthwise of the switch and terminating in contacts, an insulating closure for the back of the casing, fixed contacts supported in the insulation and adapted to be engaged by the arm contacts in one position thereof, a guide extending longitudinally of the switch at its axis and extending through an aperture in the disc, a spring surrounding the guide and pressing against the disc at one end, a thrust member engaging the front of the disc and positioned laterally by the extension of the guide through the disc, a hollow plunger surrounding the thrust member and a spring between the thrust member and the bottom of the plunger.

13. A plunger switch having an insulation disc closing the rear of the switch, threaded contact sleeves secured within the insulation, pins threaded into the sleeve and having straight unthreaded projections, a cord terminal having sockets for the pins, a flange on the terminal and a loose threaded coupling adapted to connect the plunger switch and the terminal flange.

14. In a plunger switch, a casing, an electrically conducting bi-metal snap disc mounted therein at its periphery, insulated therefrom and having arms extending lengthwise of the switch and terminating in contacts, fixed contacts insulated from the casing in position to be engaged by the arm contacts or disengaged therefrom, a plunger for operating the snap disc and a spring interposed between the plunger and the disc whereby energy is stored in the spring until the disc is snapped, the bi-metal being so placed in the snap that excess current in the disc causes the disc to snap reversely and interrupt the circuit.

15. In a plunger switch, a casing, an electrically conducting bi-metal snap disc mounted

therein at its periphery, insulated therefrom and having arms extending lengthwise of the switch from disc positions near the disc periphery and terminating in contacts, fixed contacts insulated from the casing and in position to be engaged or disengaged by the arm contacts, a plunger, a thrust connection between the plunger and the disc on the front side of the disc, a spring between the plunger and thrust connection and a second spring engaging the rear of the disc, the disc being normally operated in one direction by the plunger and snapped to initial position because of its snap return and the second spring and the bi-metal being so placed that it will cause return of the disc, even when the plunger is pressed, when excess current in the circuit passes through the disc and heats the disc.

16. A snap disc convex on one side and concave on the other having arms forming continuations of the edge of the disc, extending from the disc near its periphery on the normally concave side of the disc and terminating in contacts.

17. A snap disc comprising a disc body normally convex on one side and concave on the other and having arms extending away from the general planes of the disc on the concave side, the body being peened on the concave side to increase its snap action.

18. A bi-metal snap disc normally convex on one side and concave on the other and having arms continuous with the disc, extending away from the concave side from points near the periphery of the disc, the metals being so placed that with abnormal heating of the disc when it has been snapped its tendency to snap back to normal position will be increased.

19. A snap disc convex on one side and concave on the other, having a bi-metal body and arms of single metal extending as continuations of the perimeter of the disc.

20. A snap switch comprising a casing, a snap disc supported therein, a plunger adapted to operate the snap disc, arms carried by the snap disc, contacts made and broken by operation of the disc and a stop for movement of the disc supporting the disc against strain from excessive snap movement.

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