

Aug. 15, 1950

W. H. WILSON ET AL
MAGNETIC SNAP ACTION SWITCH

2,518,966

Filed Dec. 27, 1946

FIG. 1

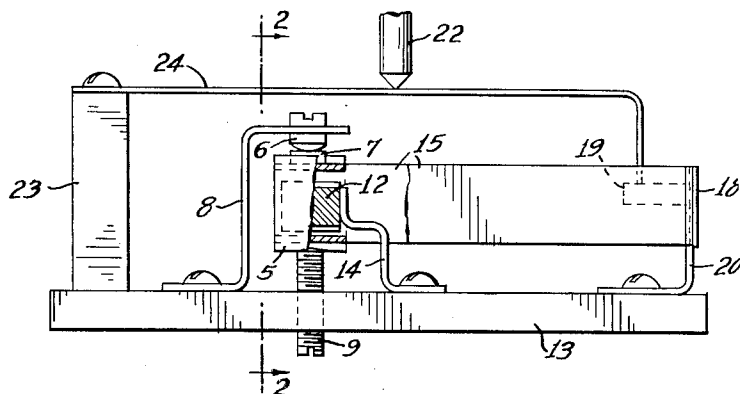


FIG. 2

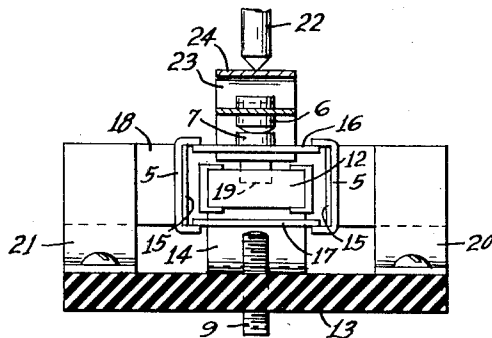
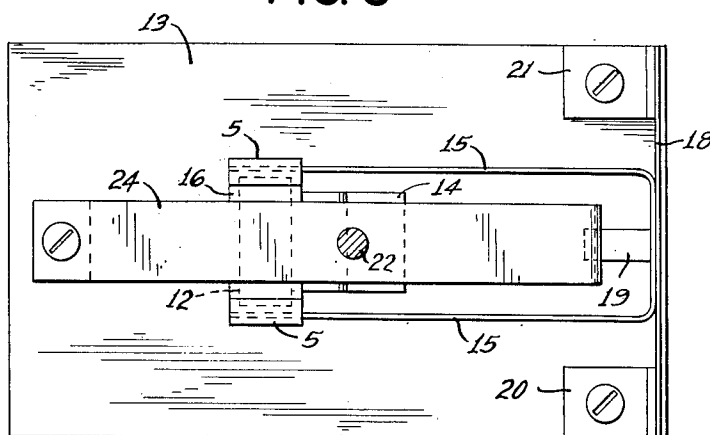


FIG. 3



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2,518,966

MAGNETIC SNAP ACTION SWITCH

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Application December 27, 1946, Serial No. 718,636
In Great Britain January 9, 1946

7 Claims. (Cl. 200—87)

1

This invention relates to magnetic snap action switches, for use on alternating current circuits, of the microgap type in which contacts of relatively large mass and of a metal having good heat conductivity are associated with an armature, a spring lever and permanent magnet, the moving contact being arranged to have a movement of separation from the fixed contact limited to an amount sufficient only to prevent the restriking of an arc at the voltage of the circuit broken and at such a speed as to reach this distance within the time of half a cycle.

It is well known that such switches are capable of interrupting several kilowatts of power at line voltages commonly used with domestic apparatus from very small initiating movements of the order of .001" or even less, and this invention has for its object the provision of an improved switch of this type.

In such switches the resilient lever is usually arranged by the ratio provided to give a greater movement at the switch contacts than at the point where the initiating movement is applied and the movement of the resilient lever is equal to the switch contact travel. The load on the end of the resilient lever at the moment of contact opening is equal to the total pull of the magnet on the armature. The load at the end of the opening movement is still substantially unaltered being lessened only by the decrease in the magnetic pull on the armature due to its having moved away from the magnet through the small opening distance.

In such switch arrangements this total load continually operative on the switch lever is inconvenient to provide for mechanically having regard to the smallness of the parts used in such switches and the physical characteristics of the materials available for such parts, and this invention has for its purpose the reduction of such load on switch levers to a value more nearly equivalent to the relatively small load represented by the force required for contact pressure which is well within the possibilities of such constructions.

A further object is to improve the stability and contact pressure of such switches by providing separate elements for the movement increasing lever and the resilience. By this separation it is possible to limit the movement of the resilience at its operative end to a minimum.

In this invention the load imposed by the magnet pull is in part cancelled by the provision of a second armature mechanically attached to the first but mounted on the opposite side of the

2

magnet poles so that as one armature approaches the magnet the other recedes from it. The resulting pull from the pair of armatures is adjusted by regulating the gaps between each armature and the magnet. By such regulation a balance of force always in one direction is obtained, as in the case of a single armature arrangement, the amount of bias being determined by the suitable adjustment of the position of the two armatures. Thus with the travel arranged so that the gap between one armature and the magnet is in all positions smaller than between the second armature and the magnet, then the switch is self-returning towards the magnet on the side which has the smaller gap.

For making and breaking of currents in the order of 10 to 15 amperes at line voltage, it is desirable that certain minimum pressures between contacts at the moment of make be used. In magnet switches this pressure is proportional to the flux change which takes place in the armature as it moves towards the magnet. It follows therefore that the larger the total flux the larger can be the change of flux taking place in the armature for a given travel of, say, 0.005".

The employment of powerful magnets with single armature switches results in a very heavy total load on the switch lever, but by the use of two armatures in the manner described, magnets having a large total flux, which in turn will give a large flux change, can be used without the disadvantage of the heavy load on the lever. Additionally, with the double armature arrangement described a greater total flux change can be obtained than in the case of a single armature, as the armature approaching the magnet will be subject to a greater magnetising force from the fact that simultaneously with its approach the armature on the other side of the magnet is receding.

It has been stated that the contact pressure is proportional to the flux change, but in switches in which the armature is carried on the end of a resilient lever the contact pressure realised is not equal to the force brought about by the flux change but is less by the amount of force used in bending the resilient lever through the switch movement.

In switches according to this invention the main lever carrying the armatures and contact is made non-resilient, the end remote from the armatures being suitably pivoted, the preferred form being a flexible strip used as a pivot by twisting action, but the force absorbed at this point, being virtually the pivot pin of the lever,

is negligible. It is then provided that the resilient transmission necessarily imposed between the slowly changing initiating force and the switch lever shall be provided by a separate element pressing the non-resilient switch lever, preferably at a point very near its pivot. By this means the movement of the resilient member is reduced to a fraction of the contact opening movement and the force change resulting from the bending of the resilient member is therefore very small. As during contact closure such force change is subtracted from the resulting contact pressure, it will be seen that by reducing the movement of the resilience to a minimum such loss of pressure is reduced to a very small amount.

The invention is illustrated in the accompanying drawing, in which Fig. 1 is a side elevation partly in broken section, of a switch constructed in accordance with the invention; Fig. 2 is a sectional view taken on line 2—2 of Fig. 1; and Fig. 3 is a plan view of the switch shown in Figs. 1 and 2.

The drawings show one arrangement of the elements of a switch constructed in accordance with our invention, in which a magnet 12 is mounted on a base 13 by a bracket 14. A non-resilient switch lever 15, shown as a U-shaped structure, and carrying two armatures 16 and 17, is supported from the base 13 on a flexible spring strip 24, one end of which is attached to a pillar 23, while the other end is bent down and pressed on an anvil 19 attached to the pivotally-mounted rigid lever 15.

We do not wish the order of the lever illustrated to be considered as the only possible arrangement, as obviously other dispositions of the pivot and push points could be used. The switch, as shown and described, comprises a pair of cooperating electrical contacts 6 and 7, one of which is carried on a bracket 8 attached to the base 13, while the other is attached to the upper portion of the movable armature 16. The extent of the movement of the armature assembly, including the contact 7, is limited by an adjustable stop 9 threaded into the base 13. The position of the contact 6 and the stop 9 should be adjusted so that the gap between the armature 17 and the magnet 12 is smaller than the gap between armature 16 and the magnet in both the open and closed positions of the switch contacts. This relationship is to insure that the switch will be magnetically self-closing on release of pressure from the actuator 22.

The magnetic snap action switch according to this invention therefore comprises a non-resilient switch lever arm carrying two armatures so arranged in relation to a magnet that while one armature approaches the magnet, the second armature is receding from it, their positions in relation to the magnet being such that in any position of the switch one armature remains slightly closer to the magnet than the other, and a resilient member adapted to press the rigid switch lever, such resilient member serving to store the initiating movement until sufficient force is generated in it to operate the non-resilient switch.

The fulcrum of the lever may consist of a spring strip supporting the lever at its pivoted point, the pressure of the support being taken in the edgewise direction of the strip. The very small angular movement of the switch lever acts at right angles to the plane of the support strip

and is accommodated by a slight twisting of the strip.

In copending application Serial No. 39,276, filed July 17, 1948, there is disclosed and claimed a somewhat similar magnetic snap action switch in which the armature carrying the lever is resilient. In another copending application, Serial No. 64,326, filed December 9, 1948, there is disclosed and claimed a thermostatically controlled device employing a switch of the type disclosed in said application Serial No. 39,276.

We claim:

1. A magnetic snap action switch comprising a magnet, a non-resilient switch lever arm carrying a pair of armatures respectively disposed on opposite sides of the magnet at unequal distances from the magnet and movable in unison relative to the magnet so that while one armature approaches the magnet the other recedes therefrom, a pair of switch contacts, one of which switch contacts is actuated by the non-resilient switch lever arm, the movement of the armature being limited in one direction by the closure of said switch contacts and limited in the opposite direction by a stop, the armature which was closer to the magnet in the closed position of the switch also remaining the closer of the two in the open position of the switch, and a resilient member adapted to press the non-resilient switch lever arm to move said closer armature in a direction away from the magnet, such resilient member serving to store an initiating movement until sufficient force is generated in it to move the lever arm in opposition to the resultant attractive force of the magnet on the pair of armatures.

2. A magnetic snap action switch comprising a magnet mounted in a fixed position, a non-resilient switch lever arm carrying a pair of armatures respectively disposed on opposite sides of the magnet at unequal distances from the magnet and movable in unison so that while one armature approaches the magnet the other recedes therefrom, means for so limiting the movement of the lever arm that the armature which was closer to the magnet in the closed position of the switch also remains the closer of the two in the open position of the switch, and a resilient member adapted to press the non-resilient switch lever arm to move said closer armature in a direction away from the magnet against the attractive force consisting in the difference between the magnetic pull on the two armatures, such resilient member serving to store an initiating movement until sufficient force is generated in it to move the lever arm in opposition to the resultant attractive force.

3. A magnetic snap action switch comprising a magnet mounted in a fixed position, a non-resilient switch lever arm carrying a pair of armatures respectively disposed on opposite sides of the magnet at unequal distances from the magnet and movable in unison so that while one armature approaches the magnet the other recedes therefrom, said lever arm being rigidly mounted on a spring strip in a position to pivot in a plane at right angles to the lengthwise dimension of the spring strip whereby when the lever arm is pivoted the spring strip is twisted, means for so limiting the movement of the lever arm that the armature which was closer to the magnet in the closed position of the switch also remains the closer of the two in the open position of the switch, and a resilient member adapted to press the non-resilient switch lever

5

arm to move said closer armature in a direction away from the magnet against the attractive force consisting in the difference between the magnetic pull on the two armatures, such resilient member serving to store an initiating movement until sufficient force is generated in it to move the lever arm in opposition to the resultant attractive force.

4. A magnetic snap action switch as claimed in claim 1 characterized by including a spring strip to which the lever arm is attached and upon which the arm is pivoted, the arm being mounted for pivoting in a path approximately normal to the lengthwise direction of the strip and arranged to twist the strip when pivoted.

5. A magnetic snap action switch comprising a magnet, a switch lever arm carrying a pair of armatures respectively disposed on opposite sides of the magnet at unequal distances from the magnet and movable in unison relative to the magnet so that while one armature approaches the magnet the other recedes therefrom, a pair of switch contacts, one of which switch contacts is actuated by the switch lever arm, the movement of the armatures being limited in one direction by the closure of the said switch contacts, and means for so limiting the movement of the lever arm in the opposite direction that the armature which was the closer to the magnet in the closed position of the switch also remains the closer of the two armatures in the open position of the switch, whereby a force and a counterforce are exerted on said armatures, the resultant of said forces being in the same direction in all positions of the lever arm.

6. A magnetic snap action switch comprising a magnet, a movable switch lever arm, a pair of armatures carried by said switch lever arm for movement therewith and disposed on opposite sides of said magnet at unequal distances therefrom in switch closed position, a contact carried by said switch lever arm for movement therewith, a second contact fixed in position relative

6

to said first contact and adapted to cooperate therewith, and means for so limiting the movement of said switch lever arm in switch opening direction that the one of said armatures which is the nearer to the magnet in switch closed position remains the nearer to the magnet in all other positions of the switch lever arm.

7. A magnetic snap action switch comprising a first contact, a movable switch lever arm, a second contact carried by said switch lever arm and adapted to cooperate with said first contact in one position of the switch lever arm, a first magnetic means, a second magnetic means carried by said switch lever arm and having at least two magnetic elements for cooperation with said first magnetic means, one element being positioned on one side and another element on the opposite side of said first magnetic means; and means for maintaining one of said elements nearer to the first magnetic means than the other of said elements in all positions of the switch lever arm, whereby a force and a counterforce are exerted by one of said first and second magnetic means on the other of said first and second magnetic means, the resultant of said forces being in the same direction in all positions of switch lever arm.

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