June 16, 1942. W. A. RAY 2,286,375

SAFETY SWITCH

Filed Sept. 26, 1941

Fig. 1

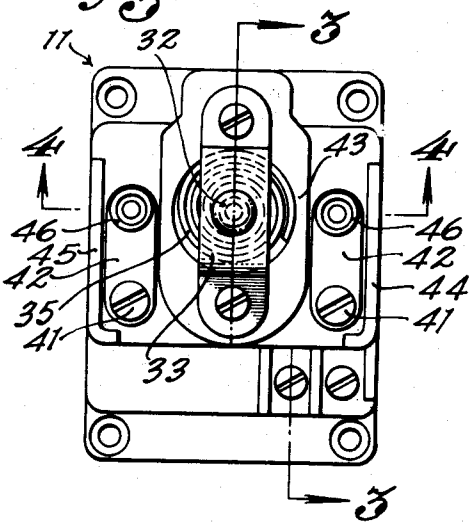



Fig. 2

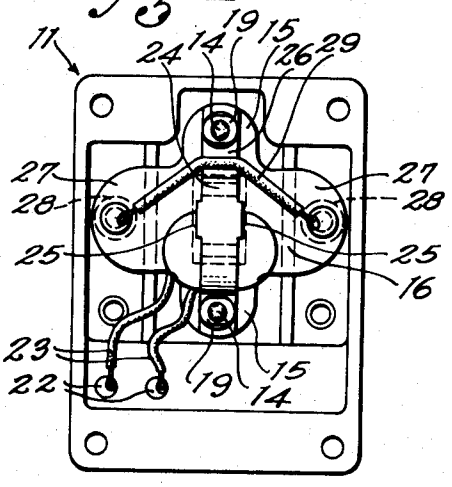



Fig. 3

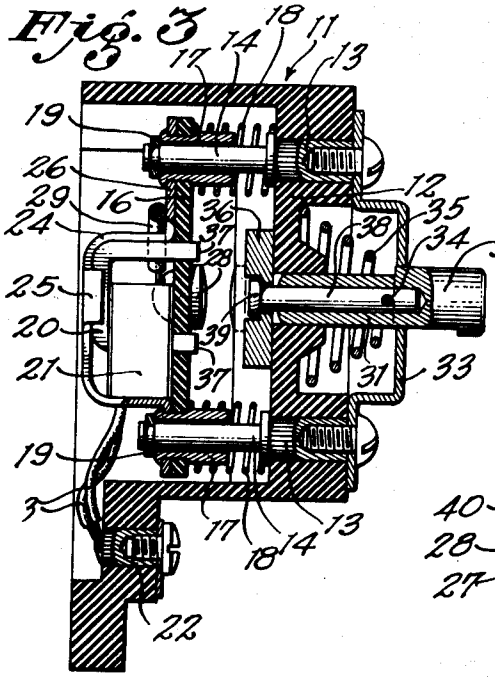
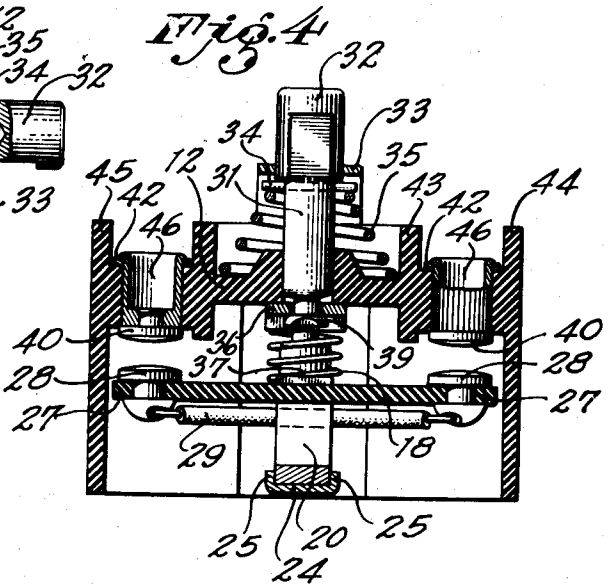



Fig. 4




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# UNITED STATES PATENT OFFICE

2,286,375

## SAFETY SWITCH

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5 Claims. (Cl. 200—87)

My present invention relates to manually operable, electromagnetically controlled, switches of the type wherein manual means are provided for moving switching means into a controlling position, in which position they are maintained by electromagnetic means, the energization of which is controlled by means responsive to a condition such as temperature, pressure or the like. In the event that the degree of said condition attains an abnormal value, the electromagnetic means are deenergized, permitting the switching means to return to their unmoved positions.

It is an object of my invention to provide a switch of the type indicated having means for preventing actuation of the switching means by movement of the manual means unless the magnetic means are energized.

Another object is to provide a novel switch of the type indicated that is simple in construction, economical to manufacture, and comprises but a single pair of normally independently movable elements.

In the prior art, the current capacity of similar switches has been limited because of the necessity for flexible connections to one or more of the movable contacts. It is therefore another object of my invention to provide a switch of the type indicated, in which the necessity for flexible leads is eliminated and is no longer a factor in determining the capacity of the switch.

Other objects and advantages of my invention will be found in the description, the drawing, and the appended claims.

For complete understanding of the invention, reference may be had to the following detailed description and accompanying drawing, wherein:

Figure 1 is a plan of a switch embodying my invention;

Figure 2 is a bottom view of the same;

Figure 3 is a longitudinal section taken along the line 3—3 of Fig. 1; and

Figure 4 is a transverse section taken along the line 4—4 of Fig. 1.

In the drawing, the numeral 11 indicates a casing, preferably molded of insulating material such as "Bakelite", having a thickened top wall or mounting base 12 in which are embedded the enlarged upper end portions 13 of two parallel-spaced downwardly-extending posts 14. In openings near the outer ends of two opposed arm portions 15 of a cross-shaped insulating disk 16, are bushings 17 which are riveted over at their lower ends to secure them to the disk. The bushings 17 are so spaced as to cooperate with the posts 14, which provide free guiding means for the disk 16, the bushings being a loose fit on the posts. Compressed between the mounting base 12 and the disk 16 are springs 18 constantly urging the disk in a direction parallel with the posts and away from the mounting base. The lower end portions of the posts 14 are provided with annular grooves for lock washers 19 which limit the downward movement of the disk.

Mounted on the disk 16 is an electromagnet having a U-shaped core 20, the upper end portions of the arms of which extend through openings in the disk 16 between the bushings 17. Around one of the arms of the core 20 is wound an energizing coil 21, connected with terminals 22 by flexible leads 23. The core 20 is held in position, with the coil 21 clamped between it and the underside of the insulating disk 16, by a U-shaped metal band 24, the outwardly turned end portions 26 of which are secured to the disk by the riveted-over end portions of the bushings 17. A widened portion 25 of the band 24 is bent over the sides of the core 20 to hold these two members in alignment.

Located on two other opposite end portions or arms 27 of the cross-shaped disk 16 are contacts 28, interconnected by a conductor 29. The contacts 28, extending through openings in the disk 16, are riveted over at their lower ends to hold them securely to the disk, and the interconnecting conductor is soldered to the riveted ends.

Extending through an opening in the mounting base 12, centrally of the posts 14, is a rod 31 adapted for reciprocable motion parallel to the posts. The upper end portion 32 of the rod 31 is slightly enlarged, and D-shaped in cross section to conform to a similarly shaped opening in a metal band 33, which prevents rotation of the rod and also provides additional guiding means therefor.

A rod 38, having a head 39 on its lower end, extends loosely through a centrally disposed opening in an armature 36, and into an axial opening in the rod 31 where it is secured by means of a pin 34 extending through aligned transverse openings in the two rods. Encircling the rod 31, and compressed between the pin 34 and the upper side of the mounting base 12, is a spring 35 constantly urging the rod upward. The armature 36, rectangular in shape, and cooperable with the pole faces 37 of the electromagnet core 20, has a square-cut channel across its contacting face to receive the rod head 39, which is flattened on two sides to conform to the sides of the chan-

nel and thus prevent rotation of the armature. The armature 36 is loosely mounted on the rod 38, and space is provided between the lower end of rod 31 and the upper side of the armature so that the armature is free to rock on the rounded portion of the head 39 adjacent the rod 38. The rockable mounting of the armature 36 on rod 38 will permit proper engagement of the pole faces 37 with the armature 36 even though the surface of one, or both, be initially in a tilted position. This is of considerable importance as the electromagnet is usually energized by very little power, such as that produced by a pilot-burner-heated thermoelectric generating device, and is not designed to attract the armature through space. By preventing rotation of the armature it is possible to make it rectangular in shape, instead of the usual circular form, and of only slightly greater area than that of the pole-faces and the area between them. Since the nickel-iron alloy, of which the armature is preferably constructed, is not only expensive, but also difficult to obtain at this time, the saving in this material, effected by the present construction is of considerable importance.

Embedded in the mounting base 12, and extending therethrough are metallic tubular members 46, in the lower ends of which are secured contact elements 40, adapted to be bridged by the interconnected contacts 28. For connecting the switch in an external circuit, terminal screws 41 are provided which are connected to the upper portions of the members 46 by straps 42 lying in protective channels formed by the raised portions 43, 44 and 45 of the mounting base. Should one of the contacts 28 or 40 become of unequal length for any reason, such as due to unequal wear, tilting of the disk would be necessary in order that the contact elements 40 might be bridged. This eventuality is taken care of by the loose fit of the bushings 17 on the posts 14 and by the rockable mounting of the armature on the rod 31 which permit the contact elements to be bridged although considerable tilting of the disk may be necessary.

In operation, if sufficient pressure is applied on rod 31 to overcome the force of spring 35, the armature 36 will be moved into engagement with the pole faces 37 of the electromagnet core 20, and spring 35 will be compressed. At this time, if the core is sufficiently energized, the electromagnetic holding force will be greater than the force of spring 35, and pressure on rod 31 may be released. The force of spring 35 being greater than the total force of springs 18, but less than that of the electromagnetic holding force, causes the disk 16 to move toward the mounting base until contacts 28 engage and bridge the contact elements 40. Engagement of the contacts 28 with contact elements 40 has prevented the rod and armature from fully returning to their normal positions, and consequently the spring 35 is still slightly compressed and is exerting a force tending to separate the armature from the core. The contacts remain closed until the occurrence of some abnormal condition of means controlling the energization of the electromagnet. When this condition arises, the electromagnet is deenergized and spring 35 pulls the armature away from the core. The disk assembly is moved to its original position under the constant bias of springs 18 and the rod and armature are moved to their original position by the force of spring 35. Before the contacts may be closed again, the electromagnet must be energized and the resetting operation repeated.

Obviously, the respective positions of the electromagnet core 20 and its cooperating armature 36 could be reversed without changing the operation of the switch in any way. An important feature of this invention is the capability of the switch for handling a large amount of current without impairing the freedom of operation of its moving parts by heavy connecting wires. The only movable leads are those connecting the coil 21 with terminals 22, which carry a very small amount of current and consequently are made of light wire which presents no problem in flexibility.

While I have herein shown and described, by way of illustration, a specific embodiment of my invention, I wish it to be understood that modifications may be made without departing from the spirit of my invention and that I intend, therefore, that my invention be limited only by the scope of the appended claims.

I claim as my invention:

1. In a manually-operable electromagnetically-controlled switch: a base member; a pair of spaced contact elements insulatingly mounted in said base member and exposed at one surface thereof; a member movable toward and away from said surface and biased in said last-named direction; said movable member comprising a conducting member cooperable with said contact elements to bridge the same when moved toward said surface; a manually operable rod extending through an opening through said base member; and an electromagnet comprising a core member and a cooperable armature member; one of said electromagnet members being mounted on the end of said rod adjacent said surface and the other on said movable member; said rod being movable in one direction to a position in which the electromagnet members engage each other and are then magnetically retained in engagement while the core element is energized, so that subsequent movement of the rod in an opposite direction is effective to move said movable member, against the force of said bias, to a position wherein said contact elements are bridged by said conducting member.

2. In a manually-operable electromagnetically-controlled switch: a base member of insulating material; a pair of spaced contact elements in said base member and exposed at one surface thereof; a member movable toward and away from said surface; means biasing said movable member in said last-named direction; said movable member comprising a conducting member cooperable with said contact elements to bridge the same when said movable member is moved toward said surface; a manually operable rod extending through an opening through said base member; and an electromagnet comprising a core member and a cooperable armature member; one of said electromagnet members being mounted on said rod and the other on said movable member; said core member having a pole face directed toward said armature so that when the rod is moved in one direction the armature and pole face are brought into engagement, in which engagement they are magnetically retained while the core member is energized, so that subsequent movement of the rod in an opposite direction is effective to move said movable member, against the force of said bias, to a position wherein said contact elements are bridged by said conducting member.

3. In a manually-operable electromagnetically-controlled switch: a base member of insulating material; a pair of spaced contact elements molded in said base member and exposed at one surface thereof; a member arranged substantially parallel to said surface and movable toward and away from the same; means biasing said movable member in said last-named direction; said movable member comprising a conducting member cooperable with said contact elements to bridge the same when said movable member is moved toward said surface; a manually operable rod extending through an opening through said base member substantially centrally of said contact elements; an electromagnetic core member and cooperating armature member; one of said electromagnet members being mounted on said rod, the other being mounted on said movable member; said core member having a pole face directed toward said armature so that when the rod is moved in one direction the armature and pole face are brought into engagement, in which engagement they are magnetically retained while the core member is energized; and means urging the rod and electromagnet member thereon in an opposite direction; subsequent movement of the rod in said opposite direction being effective to move said movable member against the force of said bias to a position wherein said contact elements are bridged by said conducting member.

4. In a manually-operable electromagnetically-controlled switch: a base member of insulating material; a pair of spaced contact elements molded in said base member and exposed at one surface thereof; an elongated member arranged substantially parallel to said surface and movable toward and away from the same; means biasing said movable member in said last-named direction; said movable member comprising a conducting member cooperable with said contact elements to bridge the same when said movable member is moved toward said surface; guide means for said movable member comprising a pair of spaced posts extending from said surface and cooperable with openings in opposite ends of the movable member; a manually operable rod extending through an opening through said base member substantially centrally of said contact elements; an armature carried by the end of said rod adjacent said surface; an electromagnet mounted on said movable member and having a pole face directed toward said armature so that when the rod is moved in one direction the armature is brought into engagement with said pole face, in which engagement it is magnetically retained while the electromagnet is energized; and means urging the rod and armature in an opposite direction; subsequent movement of the rod in said opposite direction being effective to move said movable member, against the force of said bias, to a position wherein said contact elements are bridged by said conducting member.

5. In a manually-operable electromagnetically-controlled switch: a base member of insulating material; a pair of spaced contact elements molded in said base member and exposed at one surface thereof; an elongated member arranged substantially parallel to said surface and movable toward and away from the same; means biasing said movable member in said last-named direction; said movable member comprising a conducting member cooperable with said contact elements to bridge the same when said movable member is moved toward said surface; guide means for said movable member comprising a pair of spaced posts extending from said surface and cooperable with openings in opposite ends of the movable member; a manually operable rod extending through an opening through said base member substantially centrally of said contact elements; an armature carried by the end of said rod adjacent said surface; a U-shaped electromagnet core, the arms of which extend through openings in said movable member so that their pole faces are exposed on the side of the movable member adjacent said armature, so that when the rod is moved in one direction the armature is brought into engagement with said pole faces and is magnetically retained in such engagement during the energization of said core; and means urging the rod and armature in an opposite direction; subsequent movement of the rod in said opposite direction being effective to move said movable member, against the force of said bias, to a position wherein said contact elements are bridged by said conducting member.

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