

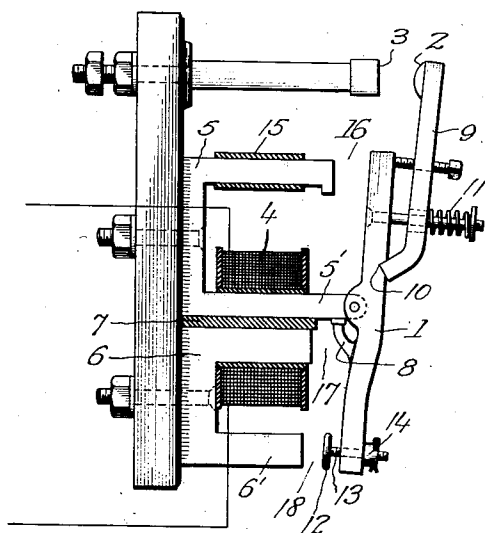
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E. R. STOEKLE

ELECTROMAGNET

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UNITED STATES PATENT OFFICE.

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ELECTROMAGNET.

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To all whom it may concern:

Be it known that I, ERWIN R. STOEKLE, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Electromagnets, of which the following is a specification.

This invention relates to electromagnets.

It is particularly applicable to lockout switches, although it may be useful in other fields.

Lockout switches are designed to remain open when current in their operating windings is above a predetermined value, and to close when the current is below a predetermined value. Such switches are particularly adapted for use in starting systems for electric motors, since they may be made to remain open to keep a resistance in circuit when the motor is subjected to an abnormal current, and to close to remove the resistance when the current decreases to a safe value.

Lockout switches usually comprise two magnets, one for moving the switch arm to close the switch, and the other for preventing closing movement of the switch arm. The two magnets exert relatively different pulls for different current values, so that for currents below a predetermined value the closing magnet will predominate and close the switch, but for currents above a predetermined value the holding magnet will predominate and hold the switch open.

An object of this invention is to provide improved means for controlling the movable member of an electromagnet whereby for currents above a predetermined value the member is maintained in one position and for currents below the predetermined value the member is moved to another position.

Another object is to provide an improved lockout switch which employs but a single magnet winding.

Another object is to provide an improved lockout switch having independent magnetic circuits controlled by a single magnet winding.

Another object is to provide a lockout switch which is simple, reliable and efficient.

Other objects and advantages will appear from the following description and claims.

The invention is illustrated in the accompanying drawing, which shows a vertical

longitudinal section of a lockout switch constructed in accordance with the invention.

The switch comprises in general a movable switch arm or beam and a magnet controlling the beam through independent magnetic circuits. The magnet has a single winding for producing a flux in both magnetic circuits. The flux in one of these magnetic circuits acts on the switch beam in a direction to close the switch, while the flux in the other magnetic circuit acts upon the switch beam in a direction to restrain the switch from closing. These magnetic circuits may, for convenience, be considered as the closing and restraining circuits respectively. The flux in the two magnetic circuits exert relatively different pulls for currents of different values through the magnet winding, so that the flux in the closing circuit predominates over that in the restraining circuit for relatively low current values and closes the switch, and the flux in the restraining circuit predominates over that in the closing circuit for relatively high current values and holds the switch open. The switch beam is normally biased to open position. During the relatively short period of time in which the current is rapidly rising from below the predetermined value to above that value, the movement of the switch beam and consequently the closure of the switch is prevented by the inertia of the switch assisted if need be by a damping coil associated with the closing magnetic circuit.

The lockout switch has a switch arm or beam 1. This switch arm carries a movable contact 2, which cooperates with the stationary contact 3. The switch has a single energizing winding 4, which is provided with two independent cores 5 and 6. These cores are separated by suitable non-magnetic material 7, such as fiber. The magnet winding 4 surrounds a leg of each of the cores 5 and 6 so that both cores are subjected to the same magnetomotive force. The relative magnitude of flux in these cores may vary, for the flux density in each is determined independently by its reluctance.

The switch beam 1 is pivoted intermediate its ends to the free end of leg 5' of the core 5 and its upper end acts as an armature for that core. The switch beam 1 carries a stop 8 which abuts the under

surface of the leg 5' and limits the opening movement of the beam.

The upper portion of the switch beam 1 carries a contact arm 9 with which the contact 2 is associated. The contact arm 9 is fulcrumed at 10 on the switch arm 1, and is yieldingly urged towards the switch beam by a coil spring 11. The arrangement is such that the contact 2 is adapted to engage the stationary contact 3, before the switch beam seals with the free end of the upper leg of the core 5. After the contacts 2 and 3 come into engagement further movement of the switch beam 1 causes spring 11 to be compressed. The contact 2 is thereby closed against the pressure of the spring 11 and is given sufficient movement after engagement of the contacts to produce a wiping action.

The lower portion of the switch beam 1 carries an adjustable armature 12, which cooperates with the lower leg 6' of the core 6. The armature 12 is carried by a threaded pin 13, which passes through the switch beam. The armature 12 may be adjusted by turning the same, as will be obvious from the drawing, and may be locked in its adjusted position by the lock nut 14. The adjustment of the armature 12 varies the length of the air gap between the armature and the leg 6' of the core 6. The effectiveness of the restraining magnetic circuit in which the core 6 is included is thereby varied.

The core 5 is made of smaller cross section than the core 6. An air gap 16 is provided between the free end of the upper leg of the core 5 and the beam 1. The restraining magnetic circuit includes an air gap 17 between the upper leg of the core 6 and the beam, and the adjustable air gap 18 between the lower leg and the armature 13. The total air gap in the restraining magnetic circuit is greater than the air gap in the closing magnetic circuit which includes the core 5, air gap 16 and the upper portion of the beam.

The relation of the two magnetic circuits is such that for currents above a certain predetermined value in the winding 4 the core 5 is relatively saturated, while the core 6 is relatively unsaturated. Under such conditions the pull exerted on the armature by the flux in the restraining magnetic circuit exceeds that exerted by the flux in the closing magnetic circuit. As the current through the magnet winding 4 decreases, the flux in both magnetic circuits decreases. However, the flux in the restraining magnetic circuit decreases very much more rapidly than the flux in the closing magnetic circuit. When the current through the magnet winding 4 falls below the value at which the switch is set to remain open, the flux in the restraining

magnetic circuit has so decreased that the pull exerted thereby is overcome by the pull exerted by the flux in the closing magnetic circuit, and the switch closes.

Since the switch must not close during the relatively short period of time in which current is rapidly rising from below the predetermined value to above that value, some means may be necessary to prevent the closure of the switch upon the first application of current to the magnet winding. The inertia of the switch beam and the contact arm carried thereby, may be sufficient to prevent the movement of the beam during this short period of time. The inertia of the beam and the contact arm carried thereby may be assisted by a damping coil 15, which may take the form of a copper sleeve provided on the upper leg of the core 5.

While but one embodiment has been illustrated and described, it is obvious that the invention contained herein is susceptible of various other embodiments and adaptations.

I claim—

1. An electromagnet having a movable member, two substantially independent magnetic circuits, the flux in one tending to move the member and the flux in the other tending to hold the member against movement, and a single winding for creating flux in both circuits.

2. An electromagnet having a movable member acted upon by two opposing and substantially independent forces, one to move the member and the other to prevent movement thereof, a single winding for providing both forces, and two magnetically independent cores energized by the winding and applying the forces to the member.

3. An electromagnet having a movable member, and two opposing magnets acting thereon, said magnets comprising two magnetically independent cores and a single winding for energizing both cores.

4. An electromagnet having a movable member, a single energizing winding, and two independent magnetic circuits having relatively varying reluctances under variations in current through the winding and associated with the member so that the fluxes exert opposing and relatively varying pulls thereon under variations in current through the winding.

5. An electromagnet having a movable member, two independent magnets acting in opposition upon the member and exerting relatively varying pulls thereon so that for abnormal current one magnet predominates to hold the member against movement and for normal current the other magnet moves the member, and a common winding for energizing the magnets and creating the relatively varying pulls thereof.

6. An electromagnet having a movable member, two magnetically independent magnets acting in opposition upon the member and exerting relatively varying pulls thereon for currents of different values so that for abnormal current one magnet predominates to hold the member against movement and for normal current the other magnet predominates and moves the member, a common winding for energizing both magnets and creating the relatively varying pulls thereof, and means for retarding a rise in pull of the first magnet when the current increases suddenly.

7. An electric switch having a pair of relatively movable switch contacts, a movable member for opening and closing the contacts, a closing magnet for moving the member to close the contacts, a holding magnet for causing the member to hold the contacts open, said magnets having independent magnetic circuits of relatively varying reluctance for different current values so that the holding magnet predominates for abnormal current and the closing magnet predominates for normal current, and a common energizing winding for both magnets.

8. An electric switch having a pair of switch contacts adapted to be opened and closed, a movable member for opening and closing the contacts, two independent magnetic circuits in which independent fluxes create opposing and relatively varying pulls upon the member for currents of different values, a common energizing winding for creating the independent fluxes in the two circuits, and means for delaying the increase in the flux in one circuit when the current through the winding rises suddenly.

9. An electric switch having a pair of contacts adapted to be opened and closed, a pivoted member for opening and closing the contacts, a substantially U-shaped core associated with the member on one side of its pivot, a substantially U-shaped core associated with the member on the other side of its pivot, a nonmagnetic separator between the cores, and a common winding for energizing both cores and creating therein independent fluxes which vary relatively for different current values.

In witness whereof, I have hereunto subscribed my name.

ERWIN R. STOECKLE.