L. E. HUTT.

ELECTROMAGNETIC SWITCH.

APPLICATION FILED MAY 18, 1916.

1,337,072. **Patented Apr. 13, 1920.**

Fig. 1.

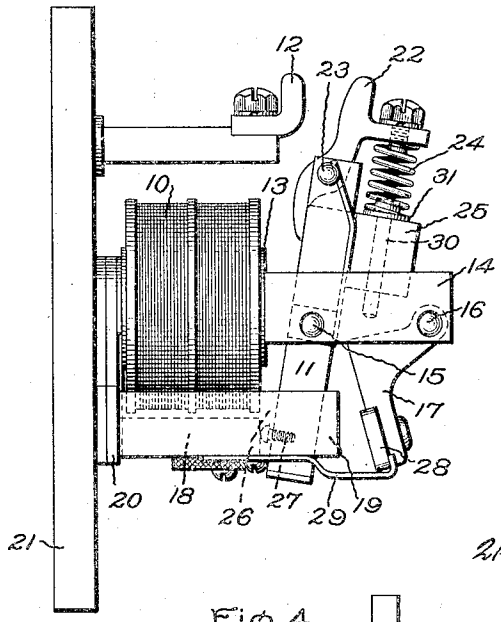


Fig. 2.

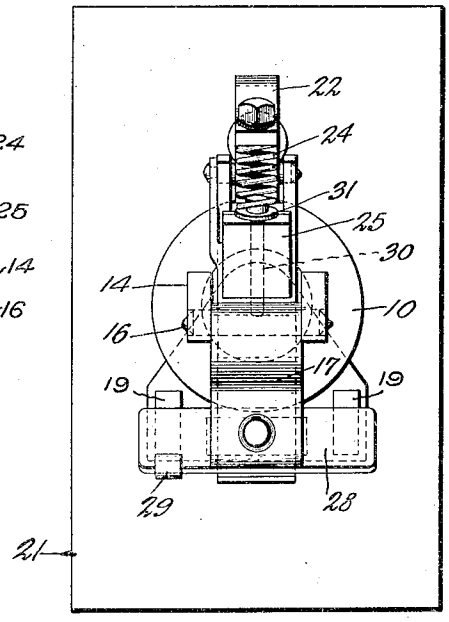


Fig. 4.

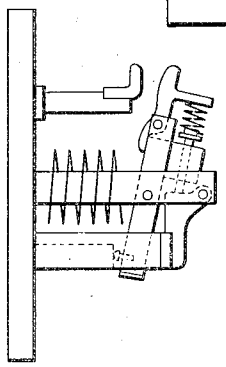


Fig. 3.

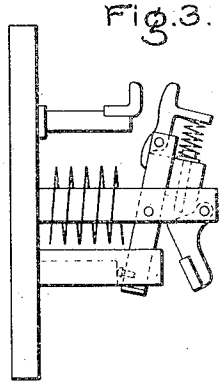


Fig. 5

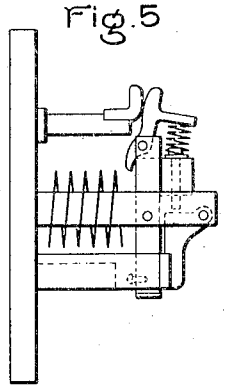
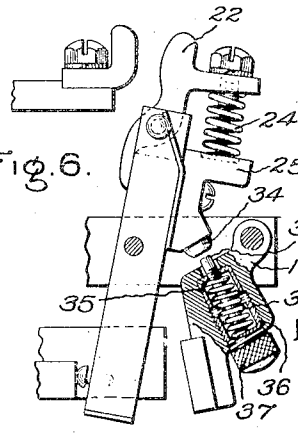


Fig. 6.



Inventor:
Leonard E. Hutt,
by Albert G. Davis
His Attorney.

UNITED STATES PATENT OFFICE.

LEONARD E. HUTT, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTROMAGNETIC SWITCH.

1,337,072. Specification of Letters Patent. **Patented Apr. 13, 1920.**

Application filed May 18, 1916. Serial No. 98,420.

To all whom it may concern:

Be it known that I, LEONARD E. HUTT, a subject of the King of Great Britain, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electromagnetic Switches, of which the following is a description.

This invention relates to electromagnetic switches for the control of electric circuits and has for its object the provision of improved means whereby an electric circuit may be controlled in a reliable, simple and efficient manner.

My invention relates more specifically to electromagnetic switches for controlling electric motor circuits, one of the objects being to provide a device of this character which will effect the automatic starting of the motor under the control of the motor current. In the operation of electric motors it is common to both start the motor and control its speed by means of a resistance which is cut in and out of circuit. Every time a section of resistance is cut out the current temporarily rises above normal value. The increase in speed which is caused by the cutting out of the section of resistance immediately reduces the current. During the starting of the motor, therefore, there is a temporary rush of current for each section of resistance which is cut out. These sections are frequently cut out of circuit by electromagnetic switches which operate automatically in succession. In order to prevent the switches from operating too rapidly and increasing the current beyond a safe value, various means have been devised. An ideal switch for this purpose is one having an operating winding which carries the motor current and a switch member controlled thereby for cutting out the resistance, the arrangement being such that the switch member will not be operated to cut out the resistance until the current has fallen to a predetermined value, and will assume an open position when the winding is deënergized. A switch of this character was invented by Walter O. Lum and forms the subject matter of an application, Serial No. 611,151, filed February 27, 1911, assigned to the same assignee as this application.

My present invention is in the nature of an improvement on the device covered by the aforesaid application. The improvement consists in arranging the parts so that the magnetic circuits are more efficient and the switch as a whole is more compact, and at the same time more accurate and reliable in operation. The construction and arrangement of parts is likewise simpler and requires a minimum of machine work, thereby reducing the cost of production.

In the accompanying drawing, Figure 1 is a side elevation of a switch embodying my invention; Fig. 2 is an end view of the same; Fig. 3 is a diagrammatic view showing the position of the parts when the switch is open; Fig. 4 shows a similar view when the coil has been energized and before the switch is closed; Fig. 5 shows the switch in closed position; and Fig. 6 shows a modified form of the switch.

Referring to the drawing 10 represents the operating winding of the switch, 11 is the movable switch member, which is held in open position and out of contact with the stationary contact 12 when the current in the winding 11 is above a predetermined value and closes when the current falls to the proper value. The magnetic structure for the winding 10 comprises a U-shaped frame one of the legs of which is the central core 13 for the coil. This core is formed at its outer end into a yoke 14 in which the switch arm 11 is pivoted at 15 and in which is also pivoted at 16 the auxiliary arm 17. The outside leg of the U-shaped frame consists of three members, a short main pole piece 18 and two longer auxiliary pole pieces 19 one on each side of the main pole piece and spaced therefrom. The two legs of this magnetic frame, that is the central pole piece 13 and the three members of the outside pole piece are magnetically joined by the member 20 mounted upon the slate base 21. The switch member 11 has at its upper end a contact 22 pivoted at 23 and coöperating with the stationary contact 12. A spring 24 is interposed between the contact 22 and a lug 25 on the switch arm to cause a yielding pressure between the movable and fixed contacts. This spring also has another function hereinafter pointed out. The switch member 11 normally rests against the pole piece 18 so as to form an air gap 26. As shown there is a non-magnetic screw 27 in the switch arm which is adjustable so as to adjust the air gap. The

arrangement of the switch arm with reference to the pole piece 18 is such that when the winding is energized with the switch arm in its normal position against the pole piece, it will be held in this position in the absence of any influences to change this condition.

Secured to the auxiliary member 17 which is of non-magnetic material is an armature 28 which is adapted to engage the two auxiliary pole pieces 19 and magnetically bridge the same. This armature is so supported that it will normally assume the position shown in Fig. 1, the hook 29 preventing it from moving farther from the pole pieces. The auxiliary member 17 is angular in shape so as to form at its upper end a shoulder which engages a pin 30. This pin 30 slides in the lug 25 and has at its upper end a collar 31 upon which the spring 24 bears so that when the pin is moved upward, the spring will be compressed. This pin is of such a length that it will be engaged by the shoulder and compress the spring when the auxiliary arm moves toward the pole piece. As shown the shoulder will not engage the pin until toward the end of its movement, that is, just before the armature 28 bridges the pole pieces.

The operation of my device will now be understood. When the winding 10 is energized above a value at which it is desired that the switch should close, the switch member will remain in its normal position and be held there by the pull across the air gap 26. At the same time, the auxiliary member 17 will be moved inward into engagement with the pole pieces 19. During this movement of the auxiliary arm the spring 24 is compressed by the engagement of the shoulder on the arm with the pin 17. This gives the switch member a bias or tendency to close which is resisted by the pull across the gap 26. When the armature 28 reaches the pole pieces 19 it shunts flux away from the gap 26 thereby decreasing the magnetic holding out force upon the switch arm. It also sets up a magnetic force tending to close the switch by reason of the fact that the armature 28 becomes an active part of the magnetic circuit and is near enough to the switch arm to act upon it effectively. The parts will now be in the position shown in Fig. 4, and the forces acting upon the switch arm are first the force of the spring tending to close the switch supplemented by the pull of the armature 28 on the switch arm. These two forces are opposed by the holding out force across the gap 26. The adjustment is such that with a relatively high value of current in the winding 10, the holding out force will overcome the two forces tending to close the switch and the switch will remain open. When the current decreases however, the two opposing magnetic forces acting on the switch arm will decrease proportionately, but since the force of the spring remains constant, the closing force will overpower the holding out force and the switch will close. As soon as the switch starts to close by reason of the spring pressure, the armature 28 takes control of the switch arm and closes it. The parts will now be in the position shown in Fig. 5. It is therefore only necessary that the spring shall initiate the closing movement since the holding out gap increases and the closing gap decreases very rapidly. The switch member will now be held in closed position very effectively since there is a closed magnetic circuit around through the U-shaped magnet to the pole piece 28 and the switch member. At a low value of current, that is below the value at which it is desired the switch be held open, the switch will immediately close. The auxiliary arm will move first and be followed by the switch member.

In Fig. 6, I have shown a modification of the switch mechanism in which instead of employing only a single spring for applying the closing pressure to the switch arm and also wiping the contacts, I employ two springs, one to perform each function. Referring to Fig. 6, it will be seen that the spring 24′ is interposed between the contact 22 and the fixed bracket 25′ so that the spring has no other function than to cause a yielding pressure between the contacts. The spring for providing the closing tendency is arranged on the auxiliary arm 17′. As shown, this arm is chambered out to receive a spring 32. A pin 33 extends through this chamber so as to engage the switch member at the projection 34 when the auxiliary member is moved inward, the adjustment being such that when the pin engages the switch arm, a spring 32 will be compressed. For this purpose the spring is inclosed between the two cup shaped portions 35 and 36 which are spaced apart. The cup 36 is threaded into the chamber so as to be adjustable by means of the knurled head 37. The pin 33 is threaded into the cup shaped portion 35 so that the spring forces the pin outward. When the pin is forced inward the cup 35 moves and compresses the spring. By turning the head 37, the pressure of the spring may be adjusted. This arrangement while it employs two springs has some slight advantage over the other form, especially with reference to the ease of adjustment. Otherwise the operation of the switch with this modification will be the same as above described.

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

1. An electromagnetic switch comprising a magnetic structure and an operating winding for magnetizing the same, and setting up a magnetic flux through the mag-

netic structure which exerts a force tending to hold the switch open and another force tending to close the switch, a switch arm normally in open position and initially held by the holding-open force in said position upon the energization of said winding above a predetermined value, a member arranged to be moved by the operating winding and means whereby said movement causes a constant force to be applied to the switch arm tending to move it to closed position against said initial force, said member having a pole piece which holds the switch member in closed position when the current in the operating winding falls to said predetermined value and the closing force overcomes the holding-open force.

2. An electromagnetic switch comprising a magnetic structure and an operating winding for magnetizing the same, and setting up a magnetic flux through the magnetic structure which exerts a force tending to hold the switch open and another force tending to close the switch, a switch arm normally in open position and magnetically held by the holding-open force in said position upon the energization of said winding above a predetermined value, a member arranged to be moved by the operating winding and means whereby said movement causes a constant force to be applied to the switch arm tending to move it to closed position and reduces the said magnetic holding open force, said member having a pole piece which holds the switch member in closed position when the current in the operating winding falls to said predetermined value and the closing force overcomes the holding-open force.

3. An electromagnetic switch comprising a magnetic structure and an operating winding for magnetizing the same and setting up a flux through the magnetic structure which exerts a force tending to hold the switch open and another force tending to close the switch, a switch arm normally in open position and magnetically held by the holding-open force in said position upon the energization of said winding above a predetermined value, a member arranged to be moved by the operating winding, means whereby after the completion of said movement a constant mechanical force and a magnetic force are applied tending to move the switch arm to closed position, and the magnetic holding-open force is reduced, said member having a pole piece which holds the switch arm in closed position after the energization of said winding falls to a predetermined value and the closing force overcomes the holding-open force.

4. An electromagnetic switch comprising a magnetic structure and an operating winding for magnetizing the same and setting up a flux through the magnetic structure which exerts a force tending to hold the switch open and another force tending to close the switch, a switch arm normally in open position and magnetically held by the holding-open force in said position upon the energization of said winding above a predetermined value, a member arranged to be moved by the operating winding, means whereby said movement causes a constant force to be applied tending to move the switch arm to closed position, an armature carried by said member which short circuits some of the holding-open flux of the magnetic structure in its attracted position and exerts a magnetic force upon the switch arm tending to move it to closed position, said armature holding the switch arm closed after the energization of the operating winding falls to said predetermined value and the closing force overcomes the holding-open force.

5. An electromagnetic switch comprising a magnetic structure and an operating winding for magnetizing the same and setting up a flux through the magnetic structure which exerts a force tending to hold the switch open and another force tending to close the switch, a switch arm normally in open position and initially acted upon by the magnetic force which tends to hold the switch open, a member arranged to be moved by the operating winding, means whereby said movement causes a constant force to be applied tending to move the switch arm to closed position, said member having a pole piece initially in the unattracted position which in the attracted position of said member tends to close the switch after the energization of the operating winding falls to said predetermined value and the closing force overcomes the holding-open force.

6. An electromagnetic switch comprising an operating winding and a magnetic structure therefor through which a flux is set up by the operating winding which exerts a force tending to hold the switch open and another force which tends to close the switch, a pivoted switch arm normally in open position and held there magnetically by the holding-open force upon the energization of the winding, a pivoted member moved by the operating winding, a spring, means whereby the movement of said member causes spring pressure to be applied to the switch arm tending to move it to closed position, and means for short circuiting some of the holding-open flux after said movement, said short circuiting means also acting to hold the switch arm in closed position.

7. An electromagnetic switch comprising a single operating winding and a magnetic structure therefor having projecting portions, a pivoted switch arm normally in

open position having an armature in an air gap between said portions and the main part of the magnetic structure, the said winding when energized setting up a magnetic force in the air gap which tends to hold the switch in open position and another magnetic force which tends to close the switch, a pivoted member moved by the operating winding to bridge said projecting portions, and means whereby the movement of said member causes spring pressure to be applied to the switch member tending to move it to closed position.

8. An electromagnetic switch comprising an operating winding and a magnetic structure therefor having projecting portions, a pivoted switch arm normally in open position between said portions, and a pivoted member moved by the operating winding to bridge said projecting portions in its attracted position, said member in its attracted position attracting the switch arm when the switch arm is in its closed position so as to magnetically hold the switch arm in the closed position.

In witness whereof, I have hereunto set my hand this 17th day of May, 1916.

LEONARD E. HUTT.