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ELECTROMAGNETIC CONTACTOR

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Fig. 1.

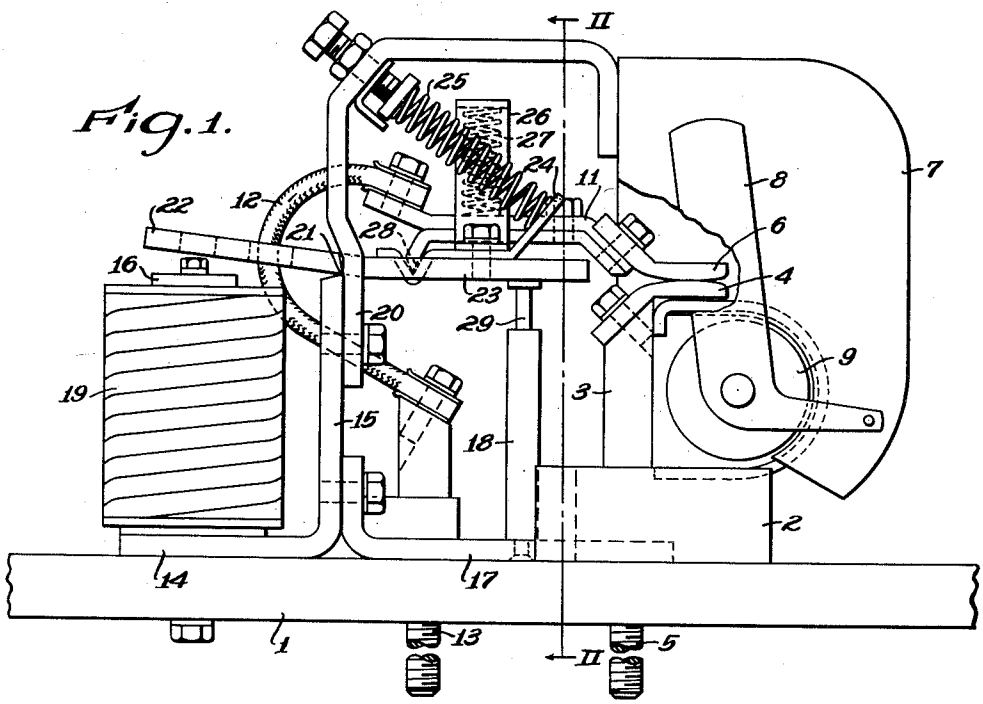
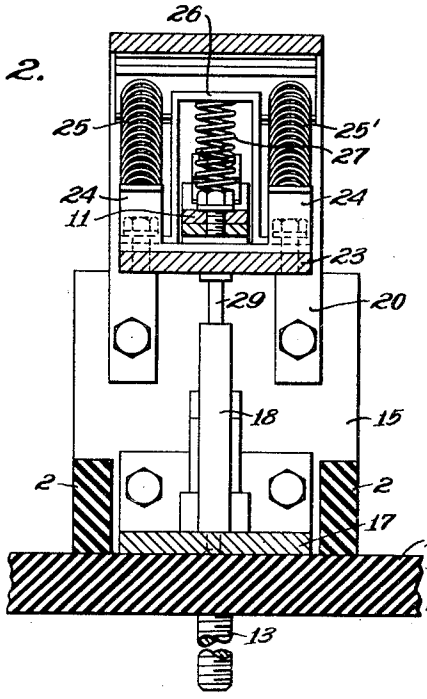


Fig. 2.



WITNESSES:

Robert C. Baird

Wm. C. Groome

INVENTOR

Lawrence Pierce.

BY C. M. Avery

ATTORNEY

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ELECTROMAGNETIC CONTACTOR

Lawrence Pierce, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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My invention relates to electromagnetic relays, switches and the like contactors whose armature is biased toward one position and magnetically moved to another position for controlling electric contacts by the armature movement. In a more specific aspect, my invention relates to contactors whose contacts are normally closed by spring bias and are opened by the energization of a magnet coil preferably energized by direct current.

It is an object of my invention to reduce or eliminate the tendency of a sluggish or temporarily hesitant armature movement often encountered with such contactors. In conjunction therewith, it is also an object of the invention to permit increasing the current carrying capacity of the contact device of such contactors, or to reduce the sparking, contact burning or sticking tendency that such contactors may show when operating with relatively high currents.

With particular reference to contactors with spring-closed and electromagnetically opened contacts, a more specific object of the invention will be explained in the following. Contactors of this type usually operate poorly as current interrupting devices. In order to keep the size of the magnet coil as small as possible, the armature closing or biasing spring should be just strong enough to overcome the opposing force of the contact pressure spring. As a result, the armature is in nearly balanced condition when the contacts are closed. When the direct current coil is energized, the magnetic flux builds up slowly due to the inductance of the coil. However, since the armature is nearly balanced, little flux is required to produce a magnetic pull sufficient to move the armature. Hence, the armature movement starts almost immediately. As long as the armature moves through its range of overtravel, the contacts remain closed. At the moment when the moving armature starts engaging the movable contact, the reaction force of the contact spring, which has been counteracting the force of the armature closing spring, is entirely lost. Hence, the force required to continue moving the armature goes up to a much higher value. Since the magnet coil is building up its field rather slowly, it will likely not have enough pull as yet to overcome the increase in spring load that it now encounters. As a result, the armature tends to stop at the contact touch position until the coil flux has built up to a sufficiently high value. Under these conditions, the contact separation occurs initially at a relatively slow rate. This results in excessive contact burning, especially if relatively high current loads

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are to be interrupted. Besides, the inertia of the moving armature may cause the contacts to open a little and then to reclose before they are finally separated by the increased force of the magnetic pull. The arc drawn during such temporary opening may produce a small molten spot on the contact surfaces which may solidify during the subsequent temporary closing of the contacts and then cause the contacts to stick. It is therefore also an object of the invention to eliminate the stopping or hesitating tendency of the armature at the contact touch position in order to avoid the just-mentioned detrimental effects.

In order to achieve the above-mentioned objects and in accordance with my invention, I design electromagnetic contactors in such a manner that the coil-energized magnet or field structure and the armature of the contactor form together not only a main magnetic circuit or flux path for moving the armature against its spring bias but establish also an auxiliary magnetic circuit or flux path which extends in magnetic parallel relation to the main path and exerts a magnetic pull on the armature in the direction of the armature spring bias when the armature is in its biased position of rest.

This and other features of my invention will be understood from the following description of the embodiment exemplified by the drawing, in which:

Figure 1 shows an electromagnetic contactor in side view, and

Fig. 2 the same contactor in a sectional front view, the section being taken along the plane indicated in Fig. 1 by the dot-and-dash line denoted by II—II.

The illustrated contactor when properly installed is so directed that its base plate, shown horizontally in Fig. 1, is attached to a vertical wall or panel so that the arc chute of the contactor lies on top and the magnet coil at the bottom of the installed apparatus.

An insulating body 2 is firmly secured to the base plate 1 and carries a standard 3 equipped with a stationary contact 4 which is conductively connected with a terminal screw 5. The movable contact to cooperate with stationary contact 4 is denoted by 6. Both contacts are disposed within an arc chute 7 which is flanked by arcing horns, such as the one denoted by 8, between which a magnetic blowout field is produced by means of a blowout coil 9. This coil is electrically series-connected between the stationary contact 4 and the appertaining terminal 5. The movable contact 6 is mounted on a rigid carrier 11 which is

electrically connected by a flexible conductor 12 to a second terminal screw 13.

The field magnet of the contactor is a composite structure which has a base portion 14, contiguous with a leg portion 15 that extends at a right angle to the base portion. A core portion 16 is firmly secured to the base portion 14 and extends in parallel to the leg portion 15. A second base portion 17 is firmly screwed to the leg portion 15 so as to form an extension of the base portion 14. A magnetizable member 18 is attached to the second base portion 17 and extends in parallel to leg portion 15 and core portion 16. It will be recognized that the magnetic frame or field structure just described has generally the shape of the letter E with three mutually parallel portions 15, 16, 18 extending at a right angle to the base portions 14 and 17. The control coil 19 for magnetizing the field structure is disposed on the core portion 16.

A bracket 20 is attached to the leg portion 15 and forms together therewith a pivot bearing 21 on which the armature is fulcrumed. The armature has generally the shape of a double-armed lever, the two arms being denoted by 22 and 23. A bracket 24, attached to the arm 23 of the armature, forms abutments for two biasing or armature closing springs 25 and 25' whose respective other ends abut against adjusting screws mounted on the bracket 20. Attached to the armature arm 23 is a stirrup 26 which is equipped with a contact spring 27 whose lower end presses against the contact carrier 11 and forces it toward the armature. The contact carrier 11 has a pivot edge inserted into a corresponding groove 28 of the bracket structure 24 so that the carrier 11 with contact 6 is capable of pivotal movement about the pivot axis in groove 28 in opposition to the contact spring 27.

The member 18 has a smaller cross-section than the core member 16 and hence higher magnetic reluctance than the core portion. Member 18 is further provided with a neck portion 29 of still smaller diameter to provide a section of further increased magnetic reluctance. The top of member 18 forms a stop which abuts against the armature 23 when the latter is in the illustrated contact-closing position.

The above-described field structure and armature form together two magnetic circuits or flux paths. The main magnetic circuit extends through the core portion 16, the base portion 14, the leg portion 15, and the armature arm 22. This main circuit, when magnetized by the coil 19, provides the magnetic pull for moving the armature and the associated contact structure into the contact opening position. The second auxiliary magnetic circuit extends through the base portion 17, the member 18 and the arm 23 of the armature and extends in magnetic parallel or shunt relation to the above-mentioned main magnetic circuit. Due to the above-mentioned dimensions of the member 18 the auxiliary magnetic circuit has higher reluctance than the main circuit. When the coil 19 is energized by direct current and builds up a magnetic flux in the field and armature structure, the member 18 exerts a magnetic pull on arm 23 of the armature. This pull acts in the same direction as the armature closing springs 25 and 25' and hence prevents the armature from starting a creeping movement before the flux in the main magnetic circuit is strong enough to effect a rapid opening movement. When the magnetic field has built up to a value sufficient to overcome the combined spring bias and auxiliary magnetic pull, the armature movement is initiated and occurs without the above-mentioned sluggishness or hesitancy of the known devices. A definite release value is secured by the necking of member 18, at 29. The cross-section and length of portion 29 determine the flux value at which the iron becomes saturated. Hence the magnetic pull produced by the auxiliary magnetic circuit increases only to a predetermined maximum which corresponds to a definite magnitude of the increasing magnetic flux. When this value is exceeded during the building up period of the coil energization, the magnetic pull in the main airgap between core 16 and arm 22 overpowers the holding force of the auxiliary circuit so that then the armature movement is started. Since then the pull of the main circuit is much higher than if it would be without the effect of the auxiliary circuit and since further the biasing action of the auxiliary circuit immediately decreases once the armature movement has started, more than enough pull is available at the contact touch point to overcome the spring loading. Consequently, the hesitating tendency of the armature is eliminated. As a matter of fact after the armature starts moving, the airgap between member 18 and arm 23 increases to such an extent that, at the moment when the armature reaches the contact touch point, the reluctance of the auxiliary magnetic circuit is extremely large as compared with that of the main magnetic circuit so that at the point where the magnetic opening pull is supposed to be largest and where the sudden change in the spring loading must be encountered, virtually only the advantageous effect of the increased magnetization of the main circuit is effective while the opposing pull previously exerted by the auxiliary circuit has virtually completely vanished.

It will be understood by those skilled in the art on the basis of the foregoing disclosure, that contactors according to the invention can be modified in various respects, for instance, as regards the structure, design and arrangement of the magnetic and contact elements of the device without departing from the gist of the invention and within the scope of its essential features as set forth in the claims annexed hereto.

I claim as my invention:

1. A normally closed electromagnetic contactor, comprising a magnetizable field structure having a core portion and a leg portion extending substantially parallel to each other, an armature pivoted on said leg portion and having two arms of which one forms a main flux path together with said core portion and said leg portion, a stationary contact, a movable contact mounted on said other arm and capable of limited movement relative to said other arm, a spring biasing said armature toward closed position of said contacts, a contact pressure spring disposed between said movable contact and said other arm so as to be stressed in opposition to said biasing spring when said armature is in said position, a coil disposed on said core portion for moving when energized said armature toward open position of said contacts in opposition to said biasing spring, a magnetizable member disposed between said field structure and said other arm and spaced from said core portion to form an auxiliary flux path together with said other arm for exerting magnetic pull on said other arm in the biasing direction of said biasing spring, said member extending parallel to said core portion and having over substantially its entire

length a higher magnetic reluctance than said core portion, and said member having over a fraction of its length a restricted cross section so as to saturate when the attractive force of said core portion exceeds a given value sufficient to move said armature toward said open position against the combined spring bias and magnetic pull.

2. A normally closed electromagnetic contactor, comprising a magnetizable field structure having a core portion and a leg portion extending substantially parallel to each other, an armature pivoted on said leg portion and having two arms of which one forms a main flux path together with said core portion and said leg portion, a stationary contact, a movable contact mounted on said other arm and capable of limited movement relative to said other arm, a spring biasing said armature toward closed position of said contacts, a contact pressure spring disposed between said movable contact and said other arm so as to be stressed in opposition to said biasing spring when said armature is in said position, a coil disposed on said core portion for moving when energized said armature toward open position of said contacts in opposition to said biasing spring, a magnetizable member disposed between said field structure and said other arm and spaced from said core portion to form an auxiliary flux path together with said other

arm for exerting magnetic pull on said other arm in the biasing direction of said biasing spring, said member extending parallel to said core portion and having over substantially its entire length a smaller cross section than said core portion, and having a neck portion of further reduced cross section near said other arm of said armature.

LAWRENCE PIERCE.

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