

[72] Inventor **John A. Cortelli**
Old Mill Road P. O. Box 22, Gates Mills,
Ohio 44040
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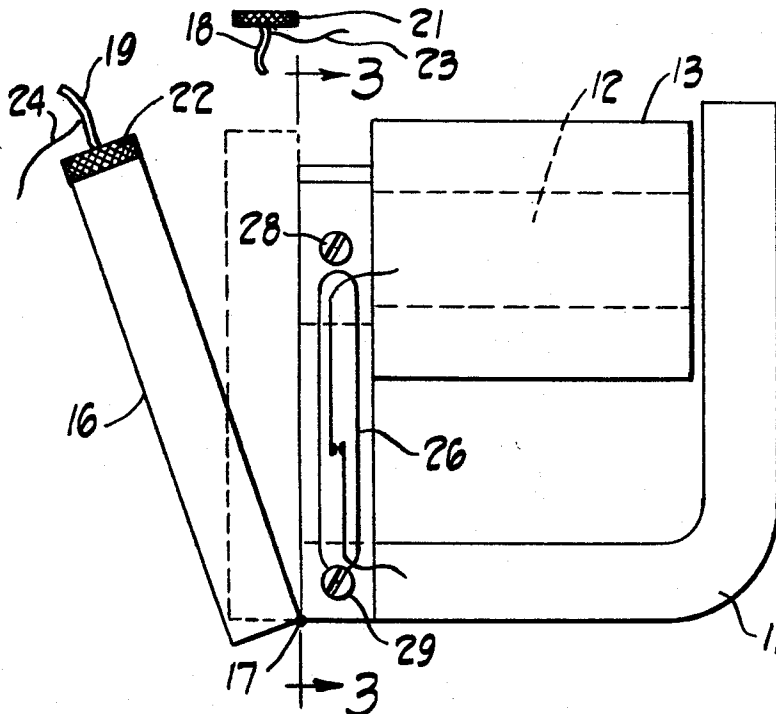
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Primary Examiner—J. D. Miller
Assistant Examiner—Harry E. Mouse, Jr.
Attorney—Frederic B. Schramm

[54] **DIRECT-CURRENT MAGNET WITH
 ECONOMIZING REED CONTACT**
 7 Claims, 6 Drawing Figs.

[52] U.S. Cl. 317/154,
 317/151, 335/236
 [51] Int. Cl. H01h 47/04
 [50] Field of Search 317/154,
 155, 150, 151, 156, 155.5; 335/151—154, 220,
 236

ABSTRACT: In a contactor or other movable armature device a direct current magnet with an iron core is employed. Economizing means are provided. For instance, an economizer resistor is connected in series with the magnet winding and a reed switch, subject to magnet flux before the armature has picked up and sealed, is connected to shunt out the economizing resistor or other economizing means until the armature has picked up and sealed.



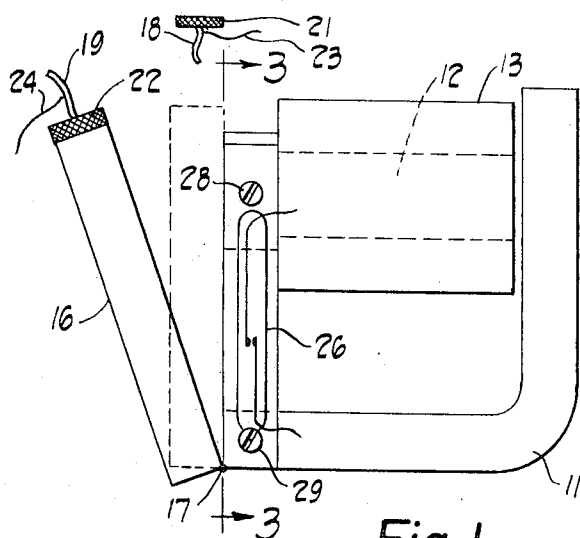


Fig. 1

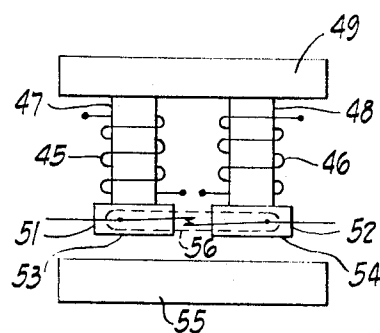


Fig. 2

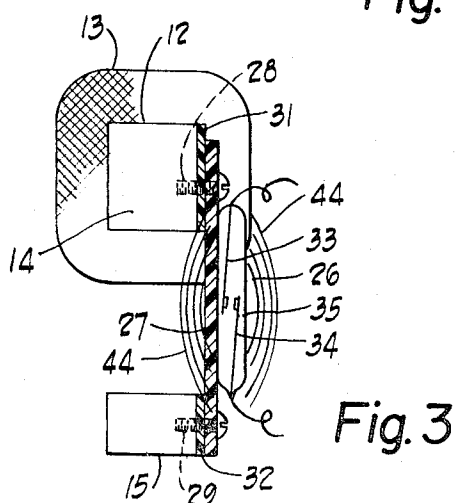


Fig. 3

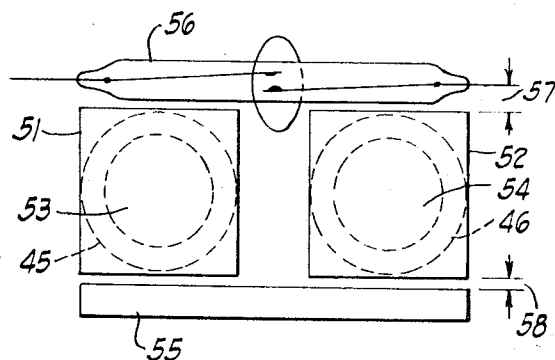


Fig. 4

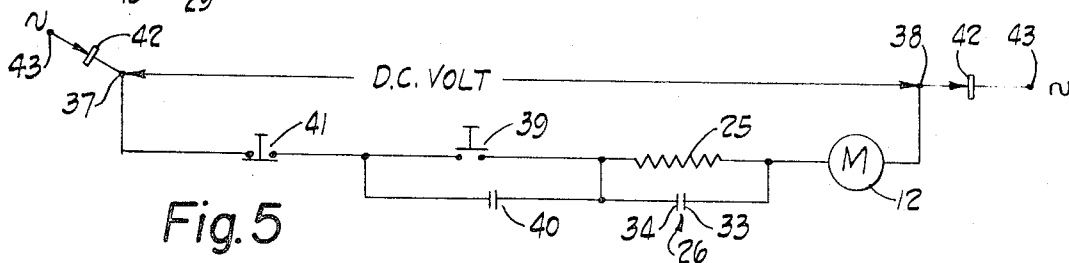


Fig. 5

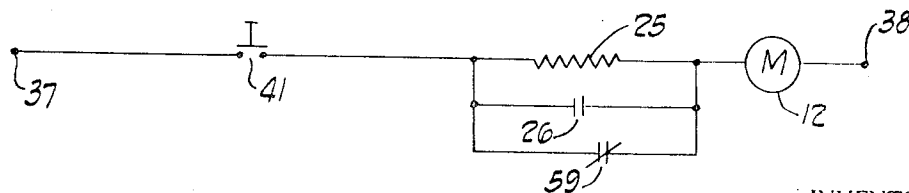


Fig. 6

INVENTOR.
JOHN A. CORTELLI
BY *James B. Schorr*

ATTORNEY.

DIRECT-CURRENT MAGNET WITH ECONOMIZING REED CONTACT

BACKGROUND OF THE INVENTION

Direct current magnets for contactors and other movable armature devices are preferable to alternating current magnets from the standpoint of cost, because alternating current magnets must be laminated to avoid excessive heating, current consumption and copper and iron losses. On the other hand, from the technical standpoint, alternating current magnets are preferable because as long as the armature is away from the pole face there is a large airgap which results in a low reactance and sufficiently strong current to overcome the inertia of the armature and to move it toward the pole face. Then when the armature picks up and contacts the pole face, the airgap is substantially eliminated so that the reactance becomes high, the current becomes low and there is a material saving in control circuit current. A small current is adequate for holding the contactor or armature but not adequate for picking up the armature in the first place.

Direct current magnets can be employed with alternating control circuits by interposing rectifiers so as to utilize rectified alternating current. However, the magnet circuit is then a direct current circuit and the advantage of automatic reduction in the magnet-winding current flow after the armature picks up does not occur. To avoid excessive current flow a resistor is generally connected in series with the magnet winding after the armature has picked up.

It is an object of the invention to provide a simple, inexpensive, reliable arrangement for automatically connecting economizing means in the magnet-winding circuit after the armature has picked up and sealed but to eliminate the economizing means from the circuit before the armature has picked up.

Other and further, objects, features and advantages of the invention will become apparent as the description proceeds.

SUMMARY OF THE INVENTION

A contactor or other movable armature device is provided with a direct current, actuating electromagnet or a solenoid with a simple iron core that need not be laminated. In one embodiment of the invention, an economizer resistor is connected in series with the magnet winding or coil to reduce the current after the magnet has picked up the armature. For connecting and disconnecting the economizer resistor a reed switch is employed. The reed switch is provided with contacts connected across the economizer resistor to shunt the economizer resistor until the armature has been picked up and has sealed. For actuation of the reed switch it is mounted within the path of flux of the magnet so as to close when the armature is away from the magnet and the flux is relatively strong, but to open when the armature reaches the magnet pole face, shunting out the flux.

A better understanding of the invention will be afforded by the following detailed description considered in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of an embodiment of the invention employing a single coil and a pivoted armature.

FIG. 2 is a side view of another embodiment of the invention employing two coils.

FIG. 3 is an end view of the embodiment of FIG. 1, illustrating the location of the reed switch in relation to the magnet pole faces.

FIG. 4 is a corresponding view of the embodiment of FIG. 2.

FIG. 5 is a circuit diagram illustrating the connections of the magnet coil, economizing resistor and reed switch contacts.

FIG. 6 is a circuit diagram of alternative connections for the economizing resistor.

Like reference characters are utilized throughout the drawing to designate like parts.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the embodiment of FIGS. 1 and 3 a direct current magnet is utilized having a yoke 11, to which is secured a core 12 carrying a winding or magnetizing coil 13. The end 14 of the core 12 and the end 15 of the yoke 11 serve as pole faces. An armature 16 is provided which is adapted to be drawn against the pole faces 14 and 15 by the attraction of the electromagnet. The armature 16 is movably supported, for example pivoted, as indicated schematically by a pivot point 17. The electromagnet and the armature 16 may be employed in an electric contactor having a stationary contact 18 and a movable contact 19, represented schematically as supported by insulating blocks 21 and 22, secured, directly or indirectly respectively, to a stationary portion of the apparatus and to the armature 16, with suitable pigtailed 23 and 24 or other suitable means for making electrical connections to the contacts.

In order to control the insertion of an economizer resistor 25 automatically in the circuit of the coil 12 when the armature 16 picks up, a magnetic reed switch 26 is provided. The latter is mounted close enough to the pole faces 14 and 15 so as to be affected by the magnetic flux when the armature 16 is away from the pole faces 14 and 15. For example, as illustrated in FIG. 3 the reed switch may be tied, cemented or otherwise secured to a nonmagnetic strap 27 secured to the side of the core 12 and the yoke 11, near the ends thereof, adjacent the pole faces 14 and 15, respectively. Preferably suitable means are provided for adjusting the position of the strap 27 for adjustably locating the reed switch 26 with respect to the magnetic field from the electromagnet. For example, as shown in FIG. 3, the nonmagnetic strap 27 may be secured to the core 12 and the yoke 11 by means of machine screws 28 and 29. Shims 31 and 32 of nonmagnetic material selected for thickness according to the desired location adjustment of the reed switch 26 may be interposed under the supporting strap 27.

The reed switch 26 is of the normally open type. The reed switch 26 itself is not a part of the present invention and may be of a type known to those skilled in the art comprising relatively movable contacts 33 and 34 carried by light magnetizable springs in an evacuated tube 35.

Reed switches of the general type which may be employed in the present invention are described in various patents, for example, in U.S. Pat. No. 3,433,065 issued to Mergler as shown on FIGS. 8 and 9, and in U.S. Pat. No. 3,158,761 to Bullock, FIGS. 2 and 4, No. 3,117,202 to Everett W. Werts, No. 3,056,868 to Jacobson et al., and No. 3,390,361 to Bodge.

As shown in FIG. 5 a direct current control circuit is utilized having supply terminals 37 and 38. The magnet coil 12 and the economizing resistor are connected in series to the supply terminals 37 and 38 in series with a normally open "close" pushbutton switch 39 and a normally closed "open" pushbutton switch 41. The reed switch 26 has its contacts 33 and 34 connected to the ends of the economizing resistor 25 so as to shunt out the economizing resistor 25 when the reed switch contacts 33 and 34 close. The source of direct current to which the terminals 37 and 38 are connected may, if desired, be an alternating current circuit with a rectifier interposed. This is represented schematically by rectifiers 42 in series with alternating current terminals 43.

The coil 12 is provided with holding contacts 40 which close when the coil 12 is energized to shunt the pushbutton switch 39 to avoid the necessity for holding it down. When it is desired to deenergize the direct current magnet the "open" pushbutton 41 is depressed to break the circuit to the coil 12.

Referring to FIG. 3 it will be observed that, with the armature 16 separated from the pole faces 14 and 15, the magnetic field will produce lines of flux 44 and the magnetic reed switch 26 being in the path of these lines of flux will be affected thereby. Thus as soon as the pushbutton switch 39 is closed and the current flows through the coil 12 the lines of flux 44 will appear, causing the reed switch contacts 33 and 34 to close. This will shunt out the economizing resistor 25 and per-

mit an adequate pulse of current to flow through the coil 12 to overcome the inertia of the armature 16 and bring it into position against the pole faces 14 and 15, thus sealing the armature and closing the contacts 18 and 19.

However, as soon as the armature 16 reaches the pole faces 14 and 15 and seals it will shunt the path of the lines of flux 44. Owing to the fact that the armature 16 has much less magnetic reluctance than the airgap, the major portion of the flux will flow instead through the armature 16 and there will be insufficient flux to maintain the reed switch contacts 33 and 34 in the closed position. Accordingly, the economizing resistor 25 will be interposed in the circuit of the coil 12, reducing the current therein to that sufficient to hold the armature 16 against the pole faces 14 and 15. The location of the reed switch 26 is adjusted if necessary by selecting shims 31 and 32 of greater or less thickness to produce the requisite relationship between the flux and the location of the reed switch 26. The invention has been described in an embodiment utilizing a series resistor as economizing means but other economizing means are not excluded, such as a connection of one of the reed switch contacts to a tap on the coil 12, with or without a resistor in series with the coil 12, so that during pickup current flows with greater strength through an active portion of the coil.

The invention is not limited to the structure of FIGS. 1 and 3 and may be employed also in other magnetic devices having a flux which is varied in strength or location upon actuation of the device. For example, as illustrated in FIGS. 2 and 4 a direct current magnet may be constructed having a pair of coils 45 and 46, ordinarily connected in series, mounted respectively upon cores 47 and 48, integral with or joined to a yoke 49. Preferably the cores 45 and 46 are provided with pole shoes 51 and 52 having pole faces 53 and 54 respectively. In this case also, a moving armature 55 is provided which may be suitably mounted for transverse motion toward and from the pole faces 53 and 54.

A reed switch similar to the reed switch 26 is mounted at the side of the pole shoes 51 and 52 so as to be affected by a magnetic field passing between the pole shoes 51 and 52 when the armature 55 is away from the pole shoes. The location of the reed switch 56 is adjusted by suitable means for example, such as described in connection with FIG. 3, so that the magnetic reluctance of the path through the reed switch 56, as determined by adjustment of the spacing 57, is less than the reluctance of the path through the pole shoes 51 and 52 when the armature 55 is in its dropped-out position. This is desirable in order that the armature 55 will pick up promptly when the pushbutton 39 is depressed to cause current to flow through the windings 45 and 46.

The invention may also be employed in momentary circuits such as in FIG. 6 and positive action of magnets as well as in maintained circuits. In the circuit of FIG. 6 the coil 12 is provided with normally closed auxiliary contacts 59 connected in parallel with the economizing resistor 25 and the reed switch contacts 26 in order to make sure of the sufficiently large initial pulse of current to start the moving armature and close the contacts of the magnetic reed switch 26. It is essential that the reed switch 26 is provided, otherwise there is danger that the

moving armature will fall out again when the normally closed auxiliary contacts open before the armature has reached contact with the pole faces.

While the invention has been described as embodied in concrete form and as operating in a specific manner in accordance with the provisions of the patent statutes, it should be understood that the invention is not limited thereto, since various modifications will suggest themselves to those skilled in the art without departing from the spirit of the invention.

What I claim is:

1. A magnet comprising:

a. a core

b. a coil upon the core, whereby magnetic flux passes through the core when the coil is energized, some of which flux follows a divergent flux path

c. a movable armature adapted to be attracted to the core having a path of movement such as to weaken such flux when the armature approaches the core

d. a reed switch mounted to be responsive to the flux

e. economizing means

f. said reed switch having normally open contacts connected to the economizing means which close when the flux is relatively strong and open when the flux weakens to eliminate the economizing means, and

g. means for energizing said coil with said economizing means applied to said coil, whereby the flux produced when said coil is energized closes the reed switch to eliminate the economizing means and the weakening of the flux as the armature approaches the core permits the reed switch to open and apply the economizing means to the coil.

2. A magnet as described in claim 1 in which the economizing means comprises a resistor, the reed switch contacts are connected across the economizer resistor and the coil is energized in series with said economizer resistor.

3. A magnet as described in claim 2 in which a pair of current supply terminals is provided and the economizing resistor is connected to said terminals in series with said coil.

4. A magnet as described in claim 3 in which the coil is provided with normally closed contacts paralleling the economizing resistor, which open when the armature is moved toward the coil to permit larger initial current flow until the reed switch has been energized to shunt the economizing resistor during initial movement of the armature.

5. A magnet as described in claim 4 in which a normally open pushbutton switch and a normally closed pushbutton switch are connected in circuit in series with the coil, economizing resistor and the current supply terminals, and normally open holding contacts actuated by the coil are connected in parallel with the normally open pushbutton switch.

6. A magnet as described in claim 5 in which the current supply terminals are connected to a source of direct current.

7. A magnet as described in claim 6 wherein a rectifier is provided and alternating current supply terminals are provided with the rectifier interposed between the alternating current supply terminals and the direct current supply terminals.