

[54] **REED RELAY CIRCUIT FOR CONTROLLING INDUCTIVE LOADS**

[75] Inventors: **Herbert E. Meier, Vestal; James C. Yarrington, Endicott, both of N.Y.**

[73] Assignee: **International Business Machines Corporation, Armonk, N.Y.**

[22] Filed: **Aug. 13, 1971**

[21] Appl. No.: **171,667**

[52] U.S. Cl. **317/11 A, 317/155, 317/155.5, 307/136, 335/19, 335/153**

[51] Int. Cl. **H01h 83/00, H01h 9/30**

[58] Field of Search **307/136; 317/DIG. 6, 317/155.5, 11 R, 11 A; 335/19, 153**

[56] **References Cited**

UNITED STATES PATENTS

3,319,128 5/1967 Nilssen335/153

3,348,121 10/1967 Murthy317/11 A

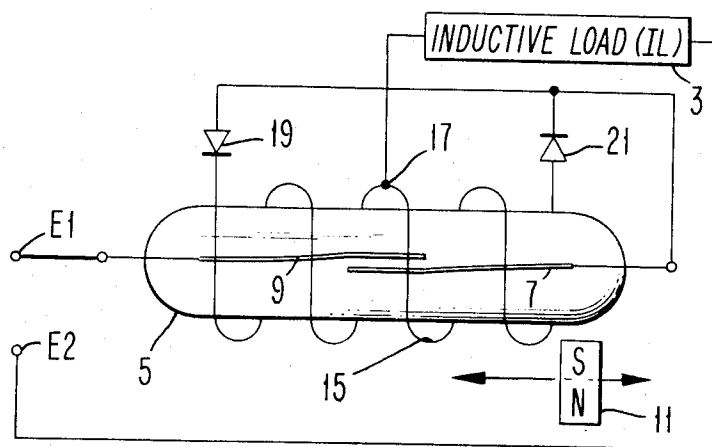
Primary Examiner—L. T. Hix

Attorney—Paul M. Brannen, Wesley De Bruin and J. Jancin, Jr.

[57] **ABSTRACT**

A reed relay circuit may be utilized to govern highly inductive loads without destructive arcing at the reed relay contacts by governing the relay in such manner that an auxiliary flux field is supplied by rectification of the current to the load, which provides an auxiliary field in which the current and the flux decay to zero at least once during each cycle. When the controlling flux is removed, the reed relay contacts will not open until the auxiliary flux decreases to a point at which its generating current is sufficiently low that adverse arcing and other current effects at the contacts are eliminated.

8 Claims, 5 Drawing Figures



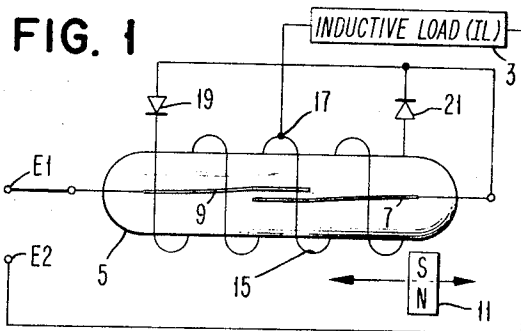
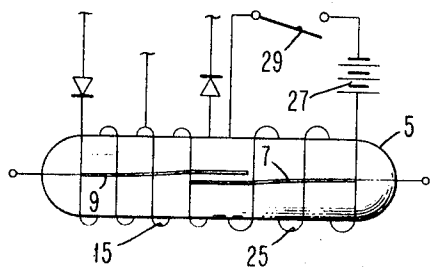


FIG. 2

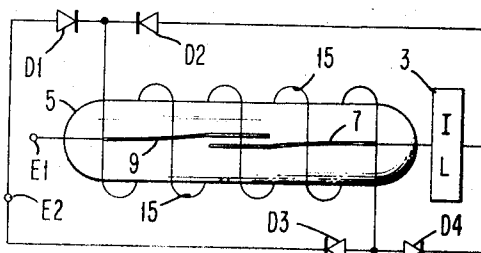


FIG. 3

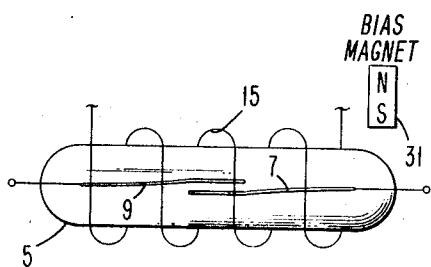


FIG. 4

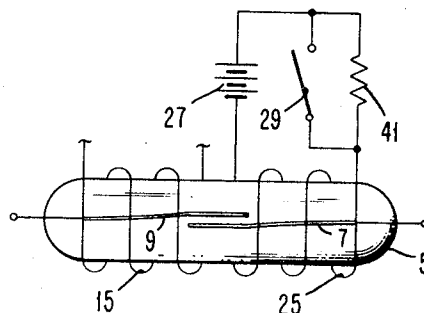


FIG. 5

INVENTORS

HERBERT E. MEIER

JAMES C. YARRINGTON

BY *Paul M. Brannen*

AGENT

REED RELAY CIRCUIT FOR CONTROLLING INDUCTIVE LOADS

FIELD OF THE INVENTION

This invention relates generally to reed relay circuits and particularly to a reed relay circuit which is especially suited for governing the supply of power to highly inductive loads.

DESCRIPTION OF THE PRIOR ART

Generally speaking, the interruption of highly inductive loads carrying alternating currents has required the use of special heavy duty contact structures on relays or controllers. Because of the necessarily light construction of reed relay contacts, it has heretofore been considered impractical to use such relays for the control of AC inductive loads. However, because of their size and economy, it is desirable to use these relays if some method of circumventing the destructive arcing, which otherwise would occur, can be employed.

SUMMARY OF THE INVENTION

Generally stated, it is an object of the invention to provide an improved reed relay circuit for supplying alternating current power to an inductive load.

More specifically, it is an object of this invention to provide an inductive load controlling circuit utilizing a reed relay, in which auxiliary holding flux is supplied to the reed relay by virtue of the load current itself. Suitable unidirectional conductive means are employed in the circuitry in such manner that the auxiliary flux generated by the load current is reduced to or near zero one or more times in each cycle, and the reed relay contacts will only open when the auxiliary flux drops to a level concomitant with a low level of current.

Another object of the invention is to provide a reed relay circuit of the type described, in which an auxiliary bias magnet may be utilized to improve the operation of the arrangement. Still a further arrangement employs a permanent magnet controlling magnet for supplying the control field.

A further object of the invention is to provide an arrangement of the type described in which a suitable auxiliary circuit is provided to provide a small bias field in addition to the principal control field.

In practicing the invention a reed switch is provided which has its contacts connected in series with an inductive load to be controlled. Also in series with this circuit is the winding of a suitable coil which supplies auxiliary flux to the reed relay. Suitable unidirectional conducting devices such as conventional diodes are connected within the circuitry in such a manner that a unidirectional flux of varying magnitude is supplied when the reed relay contacts are closed. This flux is such that it reaches a maximum value and a predetermined minimum value at least once during each cycle of the alternating current. Also, a control flux is provided either by a permanent magnet or an electromagnet which may be moved to a suitable control position or a non-control position, or a separate control winding may be utilized to generate this control flux. When the control flux is supplied, the reed relay contacts will close. Thereafter, the control flux may be removed, but the auxiliary flux provided by the auxiliary winding will maintain the reed switch contacts closed until the alternating current approaches or reaches zero at which time the auxiliary flux is reduced to a value such that it cannot maintain the reed switch contacts closed and

they thereupon open. Since the opening of the contacts is deferred until the current is at or near zero value, little or no arcing will be experienced at the contacts. Various rectifying configurations including center tap circuitry and bridge circuitry may be employed, and bias fields may also be applied by either suitably located permanent magnets or electromagnets or by suitable circuitry arrangements for supplying small values of biased current to a control winding.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a schematic circuit diagram showing one embodiment of a reed relay control circuit for an AC-supplied inductive load.

FIG. 2 is a fragmentary view of an arrangement in which an electromagnetic winding is used to provide the control flux.

FIG. 3 is illustrative of an arrangement employing a bridge type rectifier for energizing the auxiliary field winding.

FIG. 4 is a fragmentary view showing the use of a permanent magnet for supplying a suitable biasing magnetic field.

FIG. 5 is a fragmentary view showing the use of a bypass resistor to provide a small biasing current in the normal control winding.

Similar reference characters refer to similar parts in each of the views.

DETAILED DESCRIPTION

Referring to FIG. 1, an inductive load indicated generally by reference character 3 is to be supplied with alternating current energy supplied at the input terminals designated by the reference characters E1 and E2. Supply of power to the load is to be governed by the reed switch including the shell 5, and the contacts 7 and 9. The reed switch is constructed and arranged in a conventional and well-known manner so that when appropriate magnetic field is applied thereto, the contacts 7 and 9 will flex and come into contact with each other thereby completing an electrical circuit through the switch. This construction is conventional and it is not considered necessary to describe it in any further detail. A control field for causing the contacts 7 and 9 to become engaged is supplied by a permanent magnet 11, which is arranged to be moved from a non-operative position where it is shown, to a position closer to the center of the reed switch, as indicated by the double-ended arrow. When the magnet is moved toward the center of the switch, the magnetic field including the contacts 7 and 9 is sufficiently strong to cause the contacts to close. On the other hand, when the permanent magnet 11 is withdrawn, the field is weakened to the point where the contacts 7 and 9 will separate thus opening any circuit controlled through the contacts. The circuit further includes a winding 15, surrounding the reed switch, which has a center tap 17. At the ends of the winding, conventional diodes 19 and 21 are connected, the diodes being poled in opposite directions as shown. One side of the diodes is connected in parallel to the contact 7, and the center tap 17 of the winding is connected to one side of the inductive load, the other side of the load being connected to the terminal E2. The arrangement is shown in its normal or unoperated state. If it is now desired to supply power to the load, the magnet 11 is moved to a position

in which the flux therefrom will cause the contacts 7 and 9 to close, whereupon energy from the alternating current source will flow through the circuit, which may be traced from terminal E1, through the contacts 9 and 7, through either diode 19 or 21 depending upon the direction of the alternating current at the moment, and from the center tap 17 through the inductive load 3 and to terminal E2. It will be apparent that the current flowing in the coil 15 will be rectified to the extent that the flux produced will be unidirectional, and will be such that it rises from a minimum value to a maximum value and then decreases to a minimum value twice during each full cycle of the alternating current. This fluctuating auxiliary flux also will affect the contacts of the reed switch 5. Since it is unidirectional, the parts can be proportioned and arranged so that it aids the controlling flux supplied by the control magnet 11.

Now assume that it is desired to cut off the supply of power to the load 3. The control magnet 11 is moved to its non-operative position, so that the control flux is no longer present to hold the contacts 7 and 9 closed. Accordingly, the only flux which is now effective to maintain the contacts 7 and 9 closed is that supplied by the winding 15. The parts are proportioned and arranged so that as the flux drops toward a zero value as a result of the current through the winding being reduced to or near a zero value, the field will be sufficiently weakened that contacts 7 and 9 will separate, and the system is thereby restored to its normal condition with the inductive load 3 de-energized.

From the foregoing it will be apparent that this arrangement provides a unique circuit interrupter system in which a reed switch is provided with a control field which is capable of closing the switch contacts, to thereby supply energy to an inductive load. The current flow causes an auxiliary field to be set up which is pulsating and unidirectional, and has such a value that it aids the control field. When the control field is reduced or eliminated, the pulsating or fluctuating field provided by the auxiliary energizing means is depleted and when it reaches at or near zero, it is accompanied by a current value at or near zero, the reed contacts will no longer be magnetized sufficiently to remain closed and they will open the circuit. Since the circuit is opened at a time when the current is at zero or some very small value, there is little or no arcing or destructive erosion of the reed switch contacts.

FIG. 2 shows a modification of the arrangement shown in FIG. 1 and described hereinbefore, in which the control field is provided by an auxiliary or control winding 25, which is energized by a source of power such as the battery 27 when a switch 29 is closed. Other than providing an electromagnetic source for operating the reed switch contacts, the circuit configuration and the operation will be the same as that previously described in connection with FIG. 1.

FIG. 3 is a modification of FIG. 1 in which four diodes D1, D2, D3 and D4 are connected in the circuit in a conventional bridge fashion, so that the winding 15 requires no center tap. Other than this change, the construction of the remainder of the circuit and its operation are similar to that previously described in connection with FIG. 1.

FIG. 4 shows an arrangement in which a small extraneous bias field is supplied to the apparatus by means of a separate bias magnet, which in this case comprises a permanent magnet 31, arranged and disposed in

proximity to the reed switch in such a manner that the bias field strength can be set just below the flux level required for the opening of the reed switch. With such bias it makes it possible to have the current approach closer to a zero value before the flux becomes low enough to open the contacts 7 and 9 of the reed switch.

FIG. 5 shows a modification in which the control field winding is supplied with a small constant current via the resistor 41, providing a biasing magnetizing force similar to that provided by the biasing magnet 31 in FIG. 4.

It will be appreciated by those skilled in the art that various ferromagnetic core structures might also be employed as flux enhancing and guiding structures, in conjunction with the winding and switch configurations disclosed.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. Switching apparatus for selective connection of a source of alternating current to a load, comprising, in combination,

a reed switch having contacts which are closed when influenced by a magnetic field greater than a first predetermined value, and open when influenced by a magnetic field less than a second predetermined value, said contacts being connected to said source by a series circuit including said load,

control means for selectively supplying a magnetic field greater than said first predetermined value to thereby close said contacts and energize said load and auxiliary magnetizing means for generating a fluctuating magnetic field having a maximum amplitude greater than said second value, to thereby retain said contacts closed when said auxiliary magnetizing means is effective,

said auxiliary magnetizing means comprising a winding and a unidirectional conductive device connected so that current to said load flows through said winding and said unidirectional conductive device to produce a fluctuating magnetic field which approaches or reaches a zero value at least once during each cycle of said alternating current.

2. The combination as claimed in claim 1, in which said control means comprises a movable magnet, movable between a first position in which it supplies a field greater than said first value and a second position in which it supplies a field less than said second value.

3. The combination as claimed in claim 2, in which said magnet is a permanent magnet.

4. The combination as claimed in claim 1, in which said control means comprises a control winding and means to energize said winding to selectively produce a field greater than said first value.

5. The combination as claimed in claim 1, in which bias magnetizing means are provided for supplying a bias field having a value less than said second value.

6. The combination as claimed in claim 1, in which said winding is center-tapped and diodes are connected in series with said winding at each end terminal thereof to provide a full-wave rectifier combination.

7. The combination as claimed in claim 1, in which pairs of oppositely poled diodes are connected to each end of said winding in a full-wave bridge rectifier configuration.

8. The combination as claimed in claim 4, in which means are provided for supplying a small steady bias current to said control winding.

* * * * *