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Kurpanek

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[54] **MAGNETO-MOTIVE BISTABLE SWITCHING DEVICES**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 273,940, July 21, 1972, and a continuation-in-part of Ser. Nos. 149,174, June 2, 1971, abandoned, and Ser. No. 273,941, July 21, 1972, which is a continuation-in-part of Ser. No. 149,174, June 2, 1971, and Ser. No. 273,940, July 21, 1972.

[52] **U.S. Cl.** **335/207,** 335/153

[51] **Int. Cl.. H01h 51/28,** H01h 53/06, H01h 36/00

[58] **Field of Search** 335/153, 205, 206, 207

[56] **References Cited**

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[57] **ABSTRACT**

A magneto-motive bistable switch comprising a hermetically sealed contact container having at least one pair of electrical contact points and a free floating ferro-magnetic contactor. An electro-magnetic coil encircles the contact container which is placed within the magnetic flux of two spring loaded permanent magnets. The switch is electrically tripped by a dc trigger pulse thus energizing the coil to thereby magnetically polarize the ferro-magnetic contactor which is thereupon magnetically attracted towards one permanent magnet respectively thus establishing a bridging relationship with at least one pair of electrical contact points. The switch is manually operated by exterior pressure on a switch knob which changes the distance between permanent magnet and contactor which is thereupon attracted to the respective closer permanent magnet thus executing the switching operation. The switch may function as an ac overload circuit breaker when a contactor with a preestablished curie point is used to indicate a sudden power surge. By attaining the curie temperature it loses its ferro-magnetic qualities and thereupon falls off the contact points due to the force of gravitational attraction and breaks the circuit.

The inventive idea postulates a manually and electrically operable ac and dc switch and overload circuit breaker which functions directionally fully independent (except for the ac overload circuit breaker) is absolutely fireproof and operates within a temperature range of 1,000° Centigrade. The switch comprises a hermetically sealed contact container embodying at least one pair of electrical contact points a free floating ferro-magnetic contactor. An electro-magnetic coil encircling the contact container and the contact container are placed together within the magnetic flux of two spring loaded permanent magnets. The switch is electrically tripped by a dc trigger pulse thus energizing the coil that thereby magnetically polarizes the ferro-magnetic contactor which is thereupon magnetically attracted towards one permanent magnet respectively thus establishing a bridging relationship with at least one pair of electrical contact points. The switch is manually operated by exterior pressure on a switch knob thus changing the distance between permanent magnet and contactor which is thereupon attracted to the respective closer permanent magnet thus executing the switching operation. As an ac overload circuit breaker a contactor with preestablished curie point is applied to indicate a sudden power surge by attaining curie temperature thus losing the ferro-magnetic qualities thereupon falling off the contact points due to the force of gravitational attraction thereby breaking circuit. Resetting is either manually or electrically accomplished.

12 Claims, 2 Drawing Figures

FIGURE 1

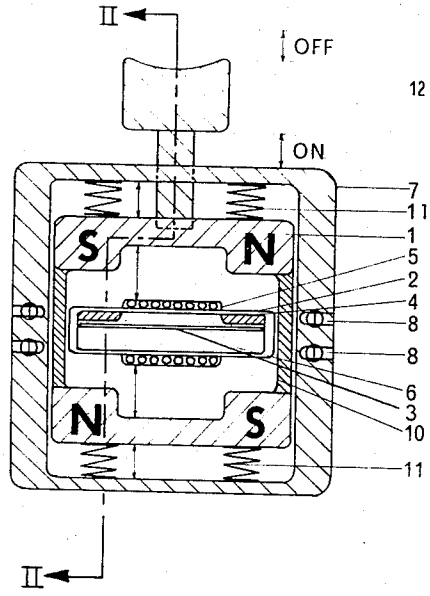
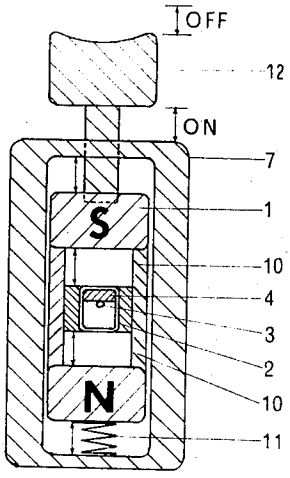


FIGURE 2



MAGNETO-MOTIVE BISTABLE SWITCHING DEVICES

PRIOR APPLICATIONS

This is a continuation-in-part application of U.S. Pat. application Ser. No. 273,940 filed July 21, 1972 which is a continuation-in-part application of U.S. Pat. application Ser. No. 149,174 filed June 2, 1971 now abandoned, and a continuation-in-part application of U.S. Pat. application Ser. No. 273,941 filed July 21, 1972 which is a continuation-in-part of Ser. No. 149,174 filed Jun 2, 1971 and Ser. No. 273,940 filed July 21, 1972.

The inventive idea postulates a manually and electrically operable ac and dc switch and overload circuit breaker which functions directionally fully independent (except for the ac overload circuit breaker) is absolutely fireproof and operates within a temperature range of 1000° centigrade. The switch comprises a hermetically sealed contact container embodying at least one pair of electrical contact points a free floating ferro-magnetic contactor. An electro-magnetic coil encircling the contact container and the contact container are placed together within the magnetic flux of two spring loaded permanent magnets. The switch is electrically tripped by a dc trigger pulse thus energizing the coil that thereby magnetically polarizes the ferro-magnetic contactor which is thereupon magnetically attracted towards one permanent magnet respectively thus establishing a bridging relationship with at least one pair of electrical contact points. The switch is manually operated by exterior pressure on a switch knob thus changing the distance between permanent magnet and contactor which is thereupon attracted to the respective closer permanent magnet thus executing the switching operation. As an ac overload circuit breaker a contactor with preestablished curie point is applied to indicate a sudden power surge by attaining curie temperature thus losing the ferro-magnetic qualities thereupon falling off the contact points due to the force of gravitational attraction thereby breaking circuit. Resetting is either manually or electrically accomplished.

SUMMARY OF THE INVENTION

The object of this invention is the production of a manually and electrically operable magneto-motive bistable switch of simple but effective design easily manufacturable, fireproof and which retaining its switching characteristics without the need of readjustment. This object has been attained in a switch according to the instant invention comprising a hermetically sealed contact container having at least one pair of stationary contact points and one free floating ferromagnetic contactor. The contact container with an electromagnetic coil encircling its mid-section is mounted rigidly inside the switch housing within the magnetic flux of two spring loaded permanent magnets which are spaced apart at a given preselected distance. The permanent magnets have high retentivity such as the cobalt rare-earth type, and face each other so that the poles of one magnet forcing the poles of the other are of opposite magnetic polarity thus forming a fully closed magnetic ring flux field that cannot be demagnetized under a given operating conditions. The switch is electrically tripped by a dc trigger pulse which energizes the electro-magnetic coil, thus changing the magnetic polarity of the free floating ferro-magnetic contactor which is thereupon simultaneously attracted by one permanent magnet and repelled by the other permanent magnet respectively. Hence under the magnetic force of attraction of the permanent magnet the switch executed a bistable switching operation within the contact container by establishing a bridging relationship between at least one pair of electrical contact points of opposite polarity. The coil and the contact points have individual circuits thus permitting the selective switching of relative high dc or ac electrical currents across the contact points with a low voltage dc pulse.

By circuiting coil and contact points in series the switch may function as a very sensitive dc overload circuit breaker. The resetting of the overload circuit breaker is accomplished by either a secondary coil circuit energizing the coil with a current flowing in the opposite direction or manually by applying an exterior manual pressure on the switch knob which is firmly connected to the two spring loaded movable permanent magnets and thereby moving one magnet closer whilst the other magnet is moved further respectively of the rigidly mounted contact container thus bringing the free floating ferro-magnetic contactor into the field of greater magnetic attraction of one magnet thus resulting in a bridging relationship of the previously open contact points by the free floating ferro-magnetic contactor under the increased force of the magnetic attraction of one permanent magnet. The same switch is also applicable as an ac overload circuit breaker by applying a free floating ferro-magnetic contactor with a preestablished curie point such that at a given ac overload said contactor attains curie point temperature thus losing its ferro-magnetic characteristic thereupon falling under the force of gravitational attraction off the contact points thereby breaking the electrical circuit. Coil and contact points are circuited individually therefore resetting is accomplished either manually or electrically after the contactor regains its ferro-magnetic characteristic.

The switch functions except for the ac overload circuit breaker directionally fully independent due to the high force of magnetic attraction produced by the ring flux field of the permanent magnets. The switching capacity of high electrical currents can be improved by the introduction of electrical arc extinguishing media. The switch is absolutely fireproof and functions within a temperature range from − 270°C to approximately +700°C thus having a total temperature range of 1,000°C. Thus a novel multi-functional switch is invented.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cross-sectional view of the bistable switch according to the instant invention.

FIG. 2 shows another cross-sectional view of the bistable switch according to the invention taken along the line II—II of FIG. 1.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The manually and electrically operable magneto-motive bistable switch according to the invention and

as illustrated in FIGS. 1 and 2, comprises two spring loaded 11 permanent magnets 1 mounted so as to be vertically movable within the switch housing 7, and spaced apart by magnetically non-conductive attached spacer bars 10. The magnets are disposed at a given distance between them so that the magnetic poles of one magnet face the poles of the other magnet having opposite magnetic polarity thus forming a fully closed magnetic ring flux field that cannot be demagnetized under a given operating condition. The switch has a hermetically sealed electrically and magnetically non-conductive contact container 2 which has at least one pair of spaced electrical contact points 4 mounted on the end-portions of its interior wall surface. Each contact point 4 and coil terminal 5 is electrically connectable exteriorly of the switch housing 7 by clamp screw terminals such as binding screws to render possible electrical lead connection with the switch. The contact container 2 also has a free floating electrically conductive ferro-magnetic contactor 3 for establishing bridging relationships between electrical contact points 4 disposed within the contact container 2. An electromagnetic coil 5 encircles the mid-section of the contact container. The encircling coil 5 and the contact container 2 are disposed within a switch housing 7 and mounted rigidly parallel between the two permanent magnets 1. The coil 5 responds to an electrical dc trigger pulse and generates a magnetic flux field perpendicular to the air-path of the magnetic ring flux field at the poles of the permanent magnets and thus the coil's flux enters the respective anti-polar permanent magnet and magnetizing one permanent magnet per one selective switching mode therby preventing a degradation of magnetic field strength during frequent switching. The free floating ferro-magnetic contactor 3 responds to the magnetic flux field generated by the electrical dc trigger pulse in the electro-magnetic coil 5 encircling the contact container 2 by being magnetically polarized and thereupon simultaneously repelled by the like poles of one permanent magnet and attracted by the unlike poles of the other permanent magnet respectively. Hence under the magnetic force of attraction of the respective permanent magnet the switch executes bistable switching operations within the contact container 2 by establishing a bridging relationship between at least one pair of electrical contact points 4. The energization of the electro-magnetic coil 5 by an electrical current flowing in the opposite direction reverses the switching operation. This switching operation functions fully directionally independent due to the high force of magnetic attraction of the permanent magnet and remains in the bistable bridging relationship with the contact points 4 until an electric trigger pulse of opposite polarity energizes the electo-magnetic coil 5 thus reversing the switching operation. For the switch to function as a bistable selective switching device, coil 5 and contact points 4 are circuited individually but the switch may also function as a very sensitive dc overload circuit breaker if the coil 5 and contact points 4 are simply connected in series. Thus an increase in electrical current flowing through the coil and the contact points simultaneously increases the magnetic flux of the coil 5 thereby magnetically polarizing the ferro-magnetic contactor 3 which thereupon ceases to be attracted by the holding magnet and is repelled therefrom and attracted by the oppositely poled permanent magnet. For the switch to function as a dc overload breaker to the contact points 4 are spring loaded to permit the ferro-magnetic contactor to move into the magnetic field of attraction of the opposing magnet or a contactor 3 with magnetic retentivity is used. Selective manual switching operations are established by manually applying a pressure on the outside situated switching knob 12 or tumbler switching device which in turn is attracted to the two permanent magnets suspended vertically on springs 11 and thus a temporary displacement of the permanent magnets 1 in the vertical direction with respect to the contact container 2 embodying the ferro-magnetic contactor 3 takes place. The contactor responds to the increase of magnetic attraction of the closest respective magnet thereby executing the bistable seletive switching operation within the contact container 2 by establishing a bridging relationship between at least one pair of electrical ac or dc contact points.

For application of the switch as an ac overload circuit breaker a contactor with preestablished curie point is used such that at a preset ac overload the contactor 3 attains curie point temperature tus losing its ferromagnetic characteristic and falling under the force of gravitational attraction off the contact points to break the electrical circuit. Resetting the ac overload circuit breaker is reestablished manually or electrically. Coil 5 and contact points 4 are circuited individually for the application of ac switching and ac overload circuit breaking for both functions can be carried out simultaneously. When switching high electrical voltage and current an electrical arc extinguishing medium and spherical contactor end-surfaces are used in the construction of the switch.

Thus a novel and multi-functional switch has been designed and no doubt minor modifications will be suggested by those versed in the art. It should therefore be understood that although the present invention has been described by reference to a specific illustrative embodiment there may be modifications thereof as will be evident to one skilled in the art which reasonably and properly come within the scope of What is claimed is:

1. A magneto-motive bistable switch which is operable in two alternative modes, a manual mode and an electrical mode, said switch having a switch housing and comprising:

two permanent magnets disposed within said switch housing and arranged so that the poles of one magnet face the poles of the other at a given fixed distance therebetween to form a fully closed magnetic ring flux field that cannot be demagnetized under a given condition of operation;

spacing means for maintaining said magnest at said given fixed distance, said means comprising at least two magnetically non-conductive spacing bars disposed between said magnets so that an open magnetic working space is formed between said magnets, which space contains two fully closed ring flux fields;

spring means attaching each of said permanent magnets to the inner walls of said switch housing so that said magnets together with said spacer bars are reciprocally movable as a completely interconnected unit within said switch housing;

contact container means disposed in said magnetic working space rigidly parallel between said two magnets, said container means being hermetically

sealed and electrically and magnetically non-conductive and having an exterior and interior wall surface and at least one pair of electrical contact points spaced apart and mounted on the end portions of said interior wall surface of said contact container means so that a straight line projected between said contact points is substantially perpendicular to the reciprocal motion of said interconnected unit, each of said contact points being electrically connectable exteriorly of said contact container means;

manually operable means disposed through said switch housing and connected to said interconnected unit to effect the allowable reciprocal motion thereof;

electro-magnetic coil means encircling said contact container means substantially at its midsection, one pair of contact terminals of said coil means being electrically connectable exteriorly of said switch housing;

electrically conductive free-floating ferro-magnetic contactor means disposed within said contact container means so that in said manual mode said contactor means is magnetically responsive to manually caused reciprocating movements of said interconnected unit by said manually operable means whereby as each of said magnets is alternatively brought in close proximity to said contact container means, said contactor means executes a bistable switching operation within said contact container means to establish a bridging relationship between at least one pair of said contact points, whereas in said electrical mode said contactor means is automatically operatively responsive to a magnetic flux field perpendicular to the air path of said closed ring flux field generated by an electrical dc trigger pulse applied to said coil means, whereby said contactor means executes said bistable switching operation.

2. A switch as defined in claim **1** wherein said at least two permanent magnets are of the colbalt rare-earth type.

3. A switch as defined in claim **1** wherein an arc extinguishing meduim is disposed within said hermetically sealed contact container means.

4. A switch as defined in claim **1** wherein said electrically conductive free floating ferro-magnetic contactor means has an electrically conductive surface coating.

5. A switch as defined in claim **1** wherein said at least one pair of spaced apart electrical contact points are mounted on a spring suspension.

6. A switch as defined in claim **1** wherein said coil means and said contact points have independent electrical circuitry thus rendering possible selective switching modes of said switch.

7. A switch as defined in claim **1** when operating in said electrical mode wherein said coil means and said contact points are connected in series thus rendering possible usage of said switch as a sensitive dc overload breaker said manual mode being employed to reset said selective switching operation after overload, thereafter being removed and allowing said electrical mode to continue.

8. A switch as defined in claim **1** when operating in said electrical mode wherein said free floating ferro-magnetic contactor means has a preselected curie point such that at a given electric alternating current overload said contactor reaches curie point temperature thus losing its ferro-magnetic characteristic and falling off said contact points to break the electrical circuit said manual mode being employed to reset said selective switching operation thereafter being removed and allowing said electrical mode to continue.

9. A magnetic switch as defined in claim **1** when operating in said electrical mode wherein said free floating ferro-magnetic contactor means has a preselected curie point such that at a given electric alternating current overload said contactor means reaches curie point temperature thus losing its ferro-magnetic characteristic and falling off said contact points thereby breaking the electrical circuit and where an electrical dc trigger pulse energizes said electro-magnetic coil means to thereby reset said selective switching operation.

10. A magnetic switch as defined in claim **1** wherein said switch housing is composed of a magnetically and electrically non-conductive material such as plastic.

11. A magnetic switch as defined in claim **1** wherein said hermetically sealed contact container means is composed of a magnetically and electrically non-conductive material such as glass.

12. A magnetic switch as defined in claim **1** wherein said free floating ferro-magnetic contactor means has spherical end-surfaces permitting higher voltage and current switching operations.

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