Sept. 25, 1962 A. R. LUCAS 3,056,000

SNAP ACTING MAGNETIC SWITCH CONSTRUCTION

Filed Oct. 21, 1960

2 Sheets-Sheet 1

Fig. 1

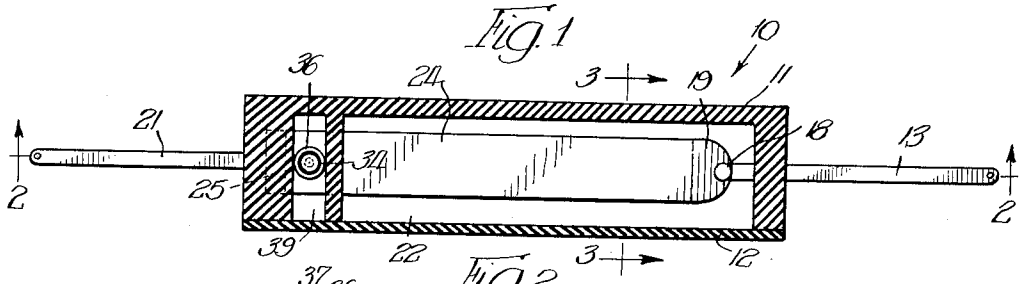


Fig. 2

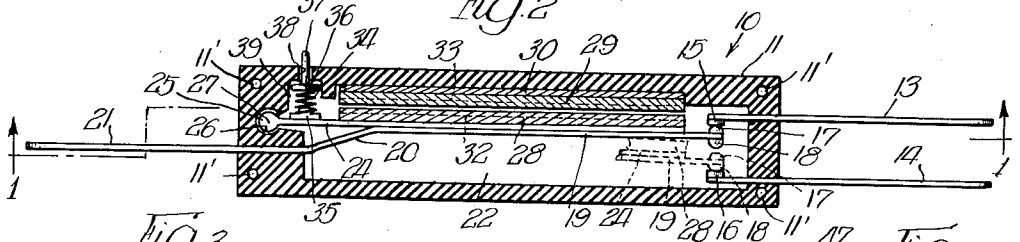


Fig. 3

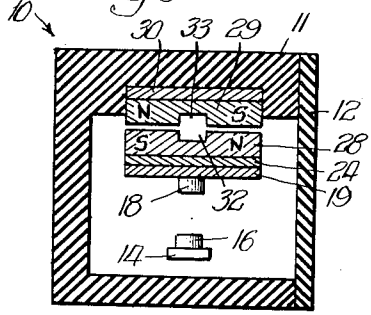


Fig. 5

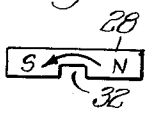


Fig. 7

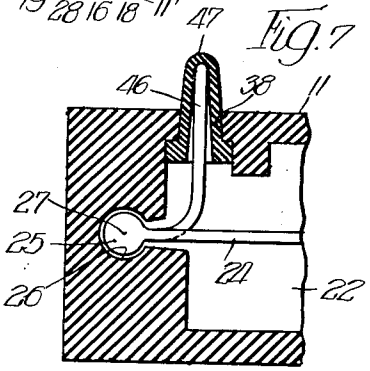


Fig. 4

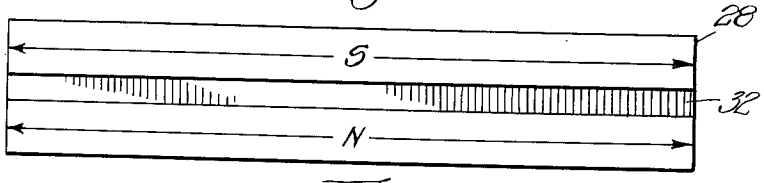
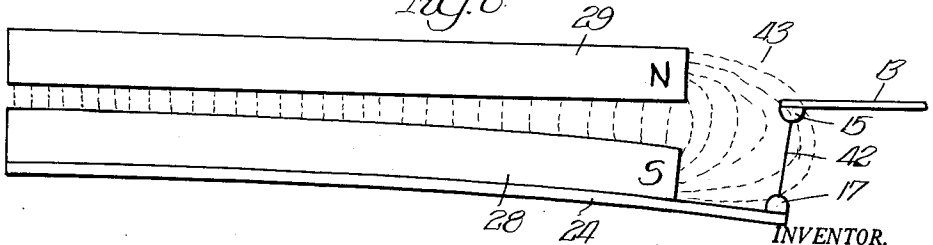


Fig. 6



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SNAP ACTING MAGNETIC SWITCH CONSTRUCTION

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Fig. 8

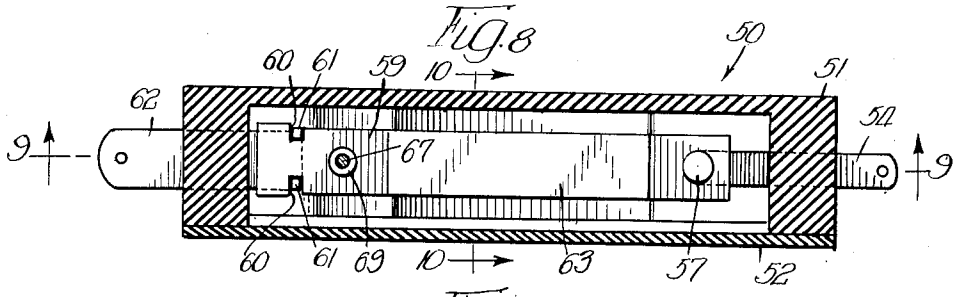


Fig. 9

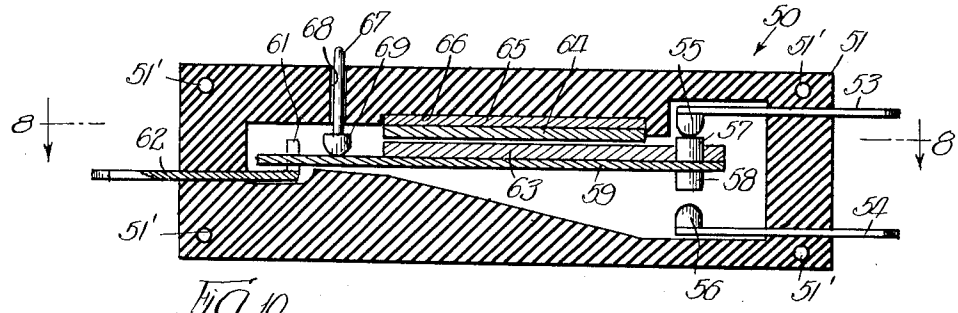


Fig. 10

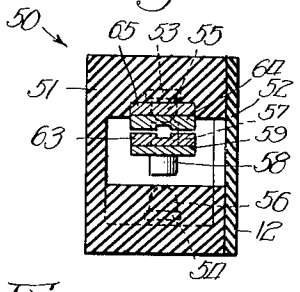


Fig. 11

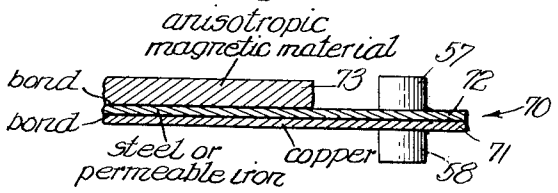


Fig. 12

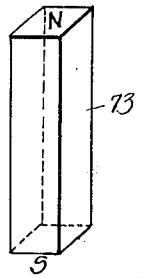


Fig. 13

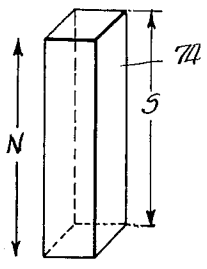


Fig. 14

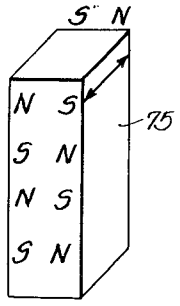


Fig. 15

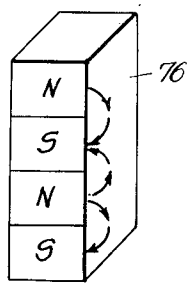


Fig. 16

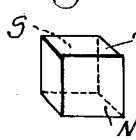


Fig. 17

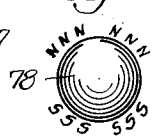


Fig. 18

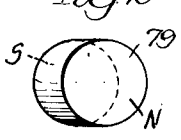


Fig. 19



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3,056,000
SNAP ACTING MAGNETIC SWITCH CONSTRUCTION

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Filed Oct. 21, 1960, Ser. No. 64,116
12 Claims. (Cl. 200—67)

This invention relates, generally, to switches or circuit breakers and it has particular relation to snap acting switches for use on low voltage circuits where the current flow is relatively small. Such switches, including the housings therefore, are relatively small in size and have wide application for controlling the flow of current in circuits operating at voltages of the order of 115–230 volts either alternating or direct current.

Among the objects of this invention are: To provide an improved snap acting switch that is simple and efficient in operation and can be readily and economically manufactured and installed; to employ permanent magnet means in a new and improved manner to provide the snap action; to provide the permanent magnet means in the form of an elongated member having a lengthwise permanently uniformly magnetized planar surface providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity; to employ various polar arrangements for the permanent magnets along the planar surfaces; to employ anisotropic magnetic material and to permanently magnetize the same for the permanent magnet means; to stationarily mount one of two complementary elongated permanent magnets and to movably mount the other for controlling the operation of separable contacts with a snap action on application of a predetermined force to cause such movement; to bond the anisotropic magnetic material to a magnetic shunt; to mount the movable contact on a composite metallic strip formed of good conducting non-magnetic material and of poor conducting magnetic material with the anisotropic magnetic material bonded to the latter which forms a shunt; to apply the operating force by a spring which can be tensioned manually or otherwise to develop such force; to apply the operating force directly to the elongated movable permanent magnet through an operator that is mechanically integral therewith; and to employ the magnetic field that is generated in air on movement apart of the elongated permanent magnets for assisting in extinguishing the arc that is drawn between contacts that are separated as a result of such movement.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

In the drawings:

FIG. 1 is a horizontal sectional view taken along the line 1—1 of FIG. 2 and shows at an enlarged scale a switch in which the present invention is embodied.

FIG. 2 is a vertical sectional view taken generally along the line 2—2 of FIG. 1.

FIG. 3 is a vertical sectional view taken generally along the line 3—3 of FIG. 1.

FIG. 4 is a top plan view of one of the anisotropic magnetic members showing how it is permanently magnetized throughout the entire length of one face and along opposite sides and at opposite polarities.

FIG. 5 is an end view of the magnetic member shown in FIG. 4.

FIG. 6 is a view, somewhat diagrammatic in character, showing how the magnetic field which is generated in air on separation of the anisotropic magnets cooperates with the magnetic field around the current flowing through the arc drawn when the contacts separate for assisting in blowing it out from between the contacts and speeding up the extinguishment thereof.

FIG. 7 is a partial sectional view showing a modified arrangement for operating the movable anisotropic magnet and contact mounted thereon.

FIG. 8 is a horizontal sectional view taken along the line 8—8 of FIG. 9 and shows at an enlarged scale another embodiment of the switch of the present invention.

FIG. 9 is a vertical sectional view taken generally along the line 9—9 of FIG. 8.

FIG. 10 is a vertical sectional view taken generally along the line 10—10 of FIG. 8.

FIG. 11 is a longitudinal sectional view of a contact supporting member made up of a composite backing strip of magnetic and non-magnetic metal having a layer of anisotropic magnetic material bonded to the layer of magnetic material.

FIGS. 12 to 19 show different magnet shapes and patterns of polar arrangements or magnetic fields that can be induced in the anisotropic magnetic material to provide the magnetic members for operating the contacts with a snap action.

Referring now particularly to FIGS. 1, 2 and 3 of the drawings, it will be observed that the reference character 10 designates, generally, a snap acting switch. Here the switch 10 is shown several times full scale, it being understood that it is a miniature type switch capable of being mass produced at relatively low cost. However, this invention can be embodied in large size switches and thus is not limited to miniature types.

The switch 10 includes an elongated case 11 of molded insulating material such as a plastic compound or phenolic condensation product. It is provided with transverse openings 11' for receiving rivets or other fastening means to hold a cover 12 in place. The cover 12 may be formed of the same material as the case 11.

Extending from one end of the case 11 are terminals 13 and 14 to which external conductors can be connected, as by soldering. The terminals 13 and 14 extend through the wall of the case 11 and carry stationary contacts 15 and 16 that are arranged to be engaged, respectively, by movable contacts 17 and 18. The movable contacts 17 and 18 are mounted on the outer end of a conductor or bus 19 which extends lengthwise of the case 11 and has a flexible bus section 20 for connection to a rigid terminal 21 that extends through the opposite end wall of the case 11 for connection to an external conductor by soldering or the like. It will be observed that an elongated cavity 22 is provided within the case 11 and that this cavity is closed off by the cover 12 when it is put in place.

The conductor or bus 19 is secured by bonding or stapling to an elongated metallic operating arm 24 that preferably is formed of magnetic material and has a hub 25 at one end rotatably mounted in an arcuate slot 26 in one wall of the case 11. The hub 25 is arranged to rotate about a transverse axis 27 in the movement of the elongated metallic operating arm 24 and the conductor or bus 19 thereon in moving the contacts 17 and 18 from the position shown by full lines to complete the circuit to the terminal 13 to the position shown by broken lines where the circuit is completed to the terminal 14.

Mounted on and movable with the elongated metallic operating arm 24 is an elongated movable anisotropic magnetic member or armature 28 which has a complementary elongated stationary anisotropic magnetic member 29 that is securely mounted in a wall of the case 11. A magnetic shunt 30 overlies the side of the magnetic member 29 away from the magnetic member 28. It will be observed that the magnetic members 28 and 29 extend throughout the major portion of the length of the case 11 and that they are substantially longer than they are wide. The elongated magnetic members 28 and 29

are formed of anisotropic magnetic material of a ceramic or plastic nature which, as shown in FIGS. 4 and 5, can be permanently magnetized along their sides to have opposite polarities along the entire juxtaposed planar surface areas with no concentration of the magnetic field at any particular point. Centrally located longitudinally extending slots **32** and **33** are provided in the elongated magnetic members **28** and **29**, respectively, to improve the efficiency of the magnetic circuits. As shown in FIG. 3, the arrangement is such that opposite polarities along the sides of the magnetic members 28 and 29 are opposite each other with the result that they are attracted toward each other with a force which is a function of the density of the magnetic fields along the polarized surface areas of the magnetic members **28** and **29**.

It will be understood that the normal positions of the magnetic members **28** and **29** are as shown in FIGS. 2 and 3 where the stationary contact **15** is engaged by the movable contact **17** and the magnetic members **28** and **29** are in juxtaposed position.

Instead of employing a magnetic field pattern as illustrated in FIG. 4 where one side planar surface is entirely of one polarity and the other side planar surface is entirely of opposite polarity, the magnetization can be such as to provide other patterns of magnetic fields which will be described hereinafter. In such case the magnetic members **28** and **29** are magnetized and arranged to place polar areas of opposite polarity opposite each other where it is desired that they be be magnetically attracted toward each other. Where the magnetic members **28** and **29** are to be repelled away from each other, then the arrangement is such that polar areas of like polarity are placed opposite each other.

The magnetic members **28** and **29** are formed of plastic or ceramic materials. They can be manufactured in a wide range of shapes and sizes, depending upon the use to which they are to be put.

For the plastic type of permanent magnet material barium ferrite is suitably sintered, processed and then mixed with a plastic material, such as epoxy resin, polyethylene, styrene or polyvinyl chloride to obtain anisotropic flexibility and machinability. The resulting material then is suitably permanently magnetized to the required strength. The following are typical characteristics of this material:

Durometer "D" hardness	55 flexible.
Residual flux density "BR"	1400 gausses.
Coercive force "HC" (demagnetization force)	1150 oersteds.
Range of coercivity "HC"	1150 to 2600 oersteds.
Resistivity	10^6 ohms per cm.
Specific gravity (density)	3.7.
Maximum energy product (BH max.)	$.402\times10^6$.
Pull strength through .015"	.546# per in.^{2} and .171" thick.

For the ceramic type of permanent magnet material a mixture of barium carbonate and iron oxide is employed. Such a compound can be pressed and sintered to substantially any desired shape. The magnetic characteristics can be controlled through orientation by way of molecular metallurgy. The magnetic material thus formed in the desired shape is permanently magnetized to the desired magnetic field strength. The following are typical characteristics of this material:

Hardness	50–86 Rockwell, very brittle, inflexible.
Residual flux density "BR"	2200 to 3840 gausses.
Coercive force "HC" (demagnetization force)	1825 to 2000 oersteds.
Range of coercivity "HC"	2000 to 4000 oersteds.
Resistivity	10^6 ohms per cm.
Specific gravity (density)	4.7 to 5.0.
Maximum energy product (BH Max.)	1.0×10^6 to 3.5×10^6.
Pull strength through .015"	1.23# per in.^{2} .250" thick.

In order to separate the contact **17** from the contact **15** with a snap action and to cause contact **18** to engage contact **16** with a snap action, a predetermined force is applied to the elongated metallic operating arm **24**. Since a predetermined force is applied and since the magnetic members **28** and **29** are attracted toward each other inversely as the square of the distance therebetween, the application of a predetermined force sufficient to initiate separation thereof and continued application of such force causes them to separate with a snap action and thereby to separate the contact **17** from the contact **15** with a snap action and to cause contact **18** to engage contact **16** with a snap action. The necessary operating force is provided by a coil compression spring **34** which at one end bears against an insulator bearing disc **35** on the elongated metallic operating arm near the pivot axis **27** and at the other against a head **36** that is formed integrally with an operating pin **37** which extends through an opening **38** in the case **11**. A slot **39** in the case **11** provides ample space for receiving the spring **34** and the head **36**.

In operation the application of a force to the operating pin **37** sufficient to compress the spring **34** results in the application of sufficient force to initiate the separation of the movable magnetic member **28** from the stationary magnetic member **29**. The application of this force is continued by the energy stored in the spring **34** and causes the snap action in the manner described.

The release of the operating force by removal of pressure from the operating pin **37** is accompanied by the snap opening of movable contact **18** from stationary contact **16** and the snap closure of movable contact **17** with stationary contact **15**. This is due to the fact that the movable magnetic member or armature **28** is attracted toward the stationary magnetic member **29** by a force varying inversely as the square of the distance therebetween.

As pointed out, the elongated metallic operating arm **24** is formed of magnetic material and underlies the magnetic member **28**. A magnetic shunt **30** overlies the magnetic member **29**. These magnetic members serve to improve the magnetic efficiency of the movable and stationary magnetic members **28** and **29** by providing a low reluctance shunt path of the magnetic poles on the opposite sides.

FIG. 6 shows how the arc current, indicated at **42** between the stationary contact **15** and the movable contact **17**, is affected by the magnetic field **43** which is generated in air between the magnetic members **28** and **29** when they are separated. It will be observed that a portion of the magnetic field **43** reacts with the magnetic field around the arc current **42** which flows when the contact **17** is separated from the contact **15**. As a result of this reaction between the two magnetic fields, the arc thus drawn is moved in one direction or the other depending upon the relative directions of the magnetic fields with the result that the arc is blown out and the circuit is interrupted at a relatively high speed as compared to the speed at which it is interrupted when the arc is drawn entirely external to the magnteic field indicated at **43**.

FIG. 7 shows a modification of the operating means illustrated in FIG. 2 for moving the elongated metallic operating arm **24** and parts associated therewith from one position to the other. It will be observed in FIG. 7 that a rod-like extension **46** is formed integrally with and extends upwardly from the elongated metallic operating arm **24** through the opening **38** in the case **11**. An insulating cap **47** overlies the projecting end of the rod-like extension **46**. In this construction only a single movable member is employed in the switch construction since the

parts that are associated with the elongated metallic operating arm 24 are mechanically integral therewith including the movable contacts 17 and 18.

In FIGS. 8, 9 and 10 there is shown, generally, at 50 a snap acting switch which is somewhat different in construction from the snap acting switch 10 previously described. The snap acting switch 50 is housed in an elongated case 51 of suitable molded plastic insulating material and is provided with transverse openings 51' for receiving holding means such as rivets for securing a cover 52, formed of insulating material, in position. Extending through one end of the elongated case 51 are terminals 53 and 54 to which external connections can be secured as by soldering. At the inner ends of the terminals 53 and 54 stationary contacts 55 and 56 are mounted for contact engagement with movable contacts 57 and 58, respectively. The movable contacts 57 and 58 are mounted on the distal end of an elongated metallic operating arm 59 which not only forms a magnetic shunt but also constitutes an electrical conductor for connection to the movable contacts 57 and 58. At the other end of the operating arm 59 notches 60 are provided for interfitting with and making electrical contact with upstanding fingers 61 of a terminal 62 that extends through the other end of the elongated case 51. It will be understood that an external conductor can be secured, as by soldering, to the projecting end of the terminal 62.

In order to operate the movable contacts 57 and 58 with a snap action an anisotropic magnetic member 63 is bonded or stapled to the upper side of the operating arm 59. For manufacturing purposes the magnetic member 63 can be formed with the operating arm 59 in a flat strip or sheet and cut to the desired length and size. Thus the magnetic member 63 extends to the outer end of the operating arm 59 and the movable contact 57 projects therethrough.

Cooperating with the magnetic member 63 is a complementary anisotropic stationary magnetic member 64 that is suitably bonded or stapled or otherwise secured to a magnetic shunt 65 and the composite arrangement is positioned in a recess 66 in the elongated case 51 and secured therein by adhesive or other means. It will be understood that the magnetic members 63 and 64 can be either of the plastic or ceramic type described hereinbefore having the characteristics which have been outlined. The magnetic members 63 and 64 are permanently magnetized in the desired magnetic pattern and they are related to each other preferably in such manner as to be attracted relatively toward each other or to hold the movable contact 57 in contact engagement with the stationary contact 55.

In order to separate the movable contact 57 from the stationary contact 55 with a snap action and to cause the movable contact 58 to engage the stationary contact 56 with a similar action an operating pin 67, preferably formed of insulating material, is employed. The operating pin 67 extends through an aperture 68 in the upper part of the elongated case 51 and it has a head 69 at its lower end for engaging the upper surface of the operating arm 59 adjacent the pivot mounting thereof on the fingers 61 of the terminal 62. By applying the necessary downward force to the projecting end of the operating pin 67, the magnetic attraction between the magnetic members 63 and 64 is overcome and the operating arm 59 moves with a snap action to open and close the contacts in the manner described. As long as the pressure is maintained against the operating pin 67 sufficient to hold the movable contact 58 in engagement with the stationary contact 56, the circuit here is maintained. On release of the operating pressure from the operating pin 67, the magnetic member 63 is attracted to the magnetic member 64 with a force that varies inversely as the square of the distance therebetween. As the result the contacts are shifted with a snap action.

FIG. 11 shows how the movable contacts 57 and 58 can be mounted for movement with a composite magnetic shunt and electrical conductor 70. It comprises a layer of copper 71 and a layer of steel 72 which are secured together in known form to provide a clad metal composite structure. A magnetic member 73 of anisotropic magnetic material is bonded or stapled or otherwise secured to the composite magnetic shunt and electrical conductor 70 formed by the layers of copper and steel 71 and 72 to provide a unitary construction. It will be understood that the composite magnetic shunt and electrical conductor 70 can be supplied in sheet or roll form with the magnetic material 73 suitably secured thereto. The required width and length of the composite member are cut from such a sheet or roll. Then the contacts 57 and 58 are secured to one end while the other end is provided with notches, such as the notches 60, previously described, for pivotal mounting on a suitable support and also for electrical connection thereto.

FIGS. 12 to 19 show different magnet shapes and patterns in which the anisotropic magnetic material can be permanently magnetized. In FIG. 12 the magnetic member 73, formed either of plastic or ceramic material, as previously described, is relatively longer than it is wide or thick and is permanently magnetized from end to end so that at one end a north pole appears and at the other end a south pole appears.

In FIG. 13 the magnetic member 74, having the shape of the magnetic member 73, is permanently magnetized to provide a north pole along one face and a south pole along the opposite face, these faces being at right angles to the faces of the magnetic member 73 illustrated in FIG. 12.

In FIG. 14 the magnetic member 75 is provided with a plurality of localized magnetic poles in the opposite surfaces as indicated. Here the opposite polarities are provided side by side.

In FIG. 15 the magnetic member 76 has the opposite polarities sequentially arranged in one face. Here, the rear portion of the magnetic member 76 constitutes a magnetic shunt to provide a path between the opposite polarities in the front surface.

FIG. 16 shows a magnetic member 77 of anisotropic magnetic material which has opposite faces that are square and a length which is less than the length of one side of one of the faces. As indicated, the opposite faces are oppositely polarized. Instead of polarizing the opposite square faces, the ends can be oppositely polarized. Moreover, a plurality of poles can be provided along opposite faces of like or opposite polarity. If desired, the configuration of the magnetic member 77 shown in FIG. 16 can be cubic.

FIG. 17 shows a spherically shaped magnet 78 the spherical surface of which can be magnetized individually with the polarities as indicated.

FIG. 18 shows a disc 79 of magnetic material the diameter of which is substantially greater than the length. The opposite circular end faces can be magnetized to opposite polarities, as indicated. Alternatively these end faces can be magnetized individually to provide polar areas of the required polarity.

FIG. 19 shows a magnetic member 80 in the form of a ring and having a diameter substantially greater than the thickness. As indicated, the magnetic member 80 can be polarized in one face with the polarities indicated.

It will be understood that pairs of magnetic members, such as those illustrated in FIGS. 12 to 19, are employed for controlling the opening and closing of contacts with a snap action. Where the arrangement is such that the magnetic members are to attract each other, they are arranged in such manner that opposite poles are opposite each other. Conversely, where it is desired that the magnetic members repel each other, they are arranged with the magnetic poles of like polarity opposite each other.

It will be understood that where a relatively great amount of force is to be exerted magnetically, the com-

plementary magnetic members are employed, one stationary and one movable. In some instances it may be desirable to mount both such magnetic members for relative movement with suitable stop means for limiting the movement of each magnetic member, i.e., the anisotropic members **28** and **29** or **63** and **64**. In those instances where a relatively great magnetic force is not required, only one anisotropic magnetic member can be used in conjunction with a soft iron member which, while readily magnetizable, does not have the capability of a permanent magnet. Such a magnetic material is characterized by having high permeability, low remanence, small coercive force and relatively high resistivity. The soft iron member can be fixed or movable for cooperation with a movable or fixed anisotropic magnetic member as may be desired or both can be movable.

Where it is desired to employ the repulsion action between anisotropic permanent magnets, they can be arranged to cooperate in a first class lever construction with a magnet, such as the magnet **28** or **63**, on one side of a pivot and the movable contact, such as the contacts **17** or **57**, on the opposite side of the pivot. The operating force is applied to one side or the other of the pivot in the required direction to overcome the repulsion between the magnets and operate the contacts with a snap action.

What is claimed as new is:

1. A snap acting magnetic switch comprising, in combination, an elongated magnetic member having lengthwise permanently uniformly magnetized planar surfaces providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, an elongated relatively movable magnetic member having lengthwise permanently uniformly magnetized planar surfaces overlying said planar surfaces on the first mentioned magnetic member and providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to one of said magnetic members, and operating means operatively connected to said one of said magnetic members to apply a predetermined operating force thereto for moving it relative to the other of said magnetic members and operating said contact means with a snap action.

2. A snap acting magnetic switch comprising, in combination, an elongated stationary magnetic member having a lengthwise permanently uniformly magnetized planar surfaces providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, an elongated movable magnetic member having lengthwise permanently uniformly magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to said movable magnetic member, and operating means operatively connected to said movable magnetic member to apply a predetermined operating force thereto for moving it away from said stationary magnetic member and operating said contact means with a snap action.

3. A snap acting magnetic switch comprising, in combination, a magnetic member having permanently magnetized planar surfaces having polar areas of opposite polarity therealong, a relatively movable magnetic member having permanently magnetized planar surfaces overlying said planar surfaces on the first mentioned magnetic member and having polar areas of opposite polarity therealong, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to one of said magnetic members, and operating means operatively connected to said one of said magnetic members to apply a predetermined operating force thereto for moving it relative to the other of said magnetic members and operating said contact means with a snap action.

4. A snap acting magnetic switch comprising, in combination, an elongated magnetic member having lengthwise permanently magnetized planar surfaces having polar areas of opposite polarity along opposite sides with the polarity of each polar area along one side being opposite to the polarity of the corresponding polar area along the other side, an elongated relatively movable magnetic member having lengthwise permanently magnetized planar surfaces overlying said planar surfaces on the first mentioned magnetic member and having polar areas of opposite polarity along opposite sides with the polarity of each polar area along one side being opposite to the polarity of the corresponding polarity along the other side, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to one of said magnetic members, and operating means operatively connected to said one of said magnetic members to apply a predetermined operating force thereto for moving it relative to the other of said stationary magnetic members and operating said contact means with a snap action.

5. A snap acting magnetic switch comprising, in combination, an elongated stationary magnetic member having lengthwise permanently uniformly magnetized planar surfaces providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, an elongated movable magnetic member having lengthwise permanently uniformly magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, there being a longitudinally extending groove in each of said planar surfaces with the groove in said stationary magnetic member registering with the groove in said movable magnetic member, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to said movable magnetic member, and operating means operatively connected to said movable magnetic member to apply a predetermined operating force thereto for moving it away from said stationary magnetic member and operating said contact means with a snap action.

6. A snap acting magnetic switch comprising, in combination, an elongated stationary magnetic member having lengthwise permanently uniformly magnetized planar surfaces providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, an elongated movable magnetic member having lengthwise permanently uniformly magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polar-

ity, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, means pivotally mounting said movable magnetic member at one end, contact means operatively connected to the other end of said movable magnetic member, and operating means operatively connected to said movable magnetic member adjacent its pivot mounting to apply a predetermined operating force thereto for rotating it away from said stationary magnetic member and operating said contact means with a snap action.

7. A snap acting magnetic switch comprising, in combination, an elongated stationary magnetic member having lengthwise permanently uniformly magnetized planar surfaces providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, an elongated movable magnetic member having lengthwise permanently uniformly magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and providing an elongated area along one side of one polarity and another elongated area along the opposite side of opposite polarity, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, means pivotally mounting said movable magnetic member at one end, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to the other end of said movable magnetic member, and operating means operatively connected to said movable magnetic member adjacent its pivot mounting to apply a predetermined operating force thereto for rotating it away from said stationary magnetic member and operating said contact means with a snap action, said operating means including a rigid member movable along a path extending in the plane of movement of said movable magnetic member and a coil compression spring between said rigid member and said movable magnetic member.

8. A snap acting magnetic switch comprising, in combination, an elongated stationary magnetic member having lengthwise permanently magnetized planar surfaces having polar areas of opposite polarity therealong, an elongated movable magnetic member having lengthwise permanently magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and having polar areas of opposite polarity therealong, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, means pivotally mounting said movable magnetic member at one end, a magnetic shunt overlying each elongated magnetic member on the side opposite the respective magnetized planar surfaces, contact means operatively connected to the other end of said movable magnetic member, and operating means operatively connected to said movable magnetic member adjacent its pivot mounting to apply a predetermined operating force thereto for rotating it away from said stationary magnetic member and operating said contact means with a snap action, said operating means including a rigid member movable along a path extending in the plane of movement of said movable magnetic member and a coil compression spring between said rigid member and said movable magnetic member.

9. A snap acting magnetic switch comprising, in combination, an elongated stationary magnetic member having lengthwise permanently magnetized planar surfaces having polar areas of opposite polarity therealong, an elongated movable magnetic member having lengthwise permanently magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and having polar areas of opposite polarity therealong, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, means pivotally mounting said movable magnetic member at one end, contact means operatively connected to the other end of said movable magnetic member, and an operator rigidly connected to said movable magnetic member adjacent its pivot mounting and unitarily movable with said movable magnetic member to which a predetermined force can be applied to operate said contact means with a snap action.

10. A snap acting magnetic switch comprising, in combination, a stationary magnetic member having permanently magnetized planar surfaces having polar areas of opposite polarity therealong, a movable magnetic member having permanently magnetized planar surfaces overlying said planar surfaces on said stationary magnetic member and having polar areas of opposite polarity therealong, the last mentioned polarities being opposite respectively the first mentioned polarities whereby said magnetic members are attracted toward each other, separable contacts at one end of said magnetic members one of which is operatively connected to said movable magnetic member to separate said contacts and draw an arc therebetween on movement of said movable magnetic member away from said stationary magnetic member, the magnetic field at said one end of said magnetic members on movement thereof apart reacting with the current flow through said arc to extinguish the same, and operating means operatively connected to said movable magnetic member to apply a predetermined operating force thereto for moving it away from said stationary magnetic member and separating said contacts with a snap action.

11. A snap acting magnetic switch comprising, in combination, an anisotropic magnetic member having a permanently magnetized planar surface having polar areas of opposite polarity therealong, a magnetic support for said magnetic member along the side thereof opposite said planar surface, a contact support member of electrical conducting non-magnetic material extending along said magnetic support on the side away from said anisotropic magnetic member, a cooperating magnetic member coextensive with and overlying said planar surface, contact means operatively connected to said contact support member, and operating means operatively connected to said contact support member to apply a predetermined force thereto to operate said contact means.

12. As a new article of manufacture, a composite metal member formed by a layer of good electrical conducting non-magnetic material integrally bonded to a layer of magnetic material, and a layer of anisotropic permanent magnet material overlying said layer of magnetic material.

References Cited in the file of this patent

UNITED STATES PATENTS

1,827,102	Penn	Oct. 13, 1931
2,109,953	Bates	Mar. 1, 1938
2,337,001	Ray	Dec. 14, 1943
2,385,887	Shaw	Oct. 2, 1945
2,448,779	Crise	Sept. 7, 1948
2,659,787	Prickett	Nov. 17, 1953