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ELECTRO-MAGNETIC SWITCH

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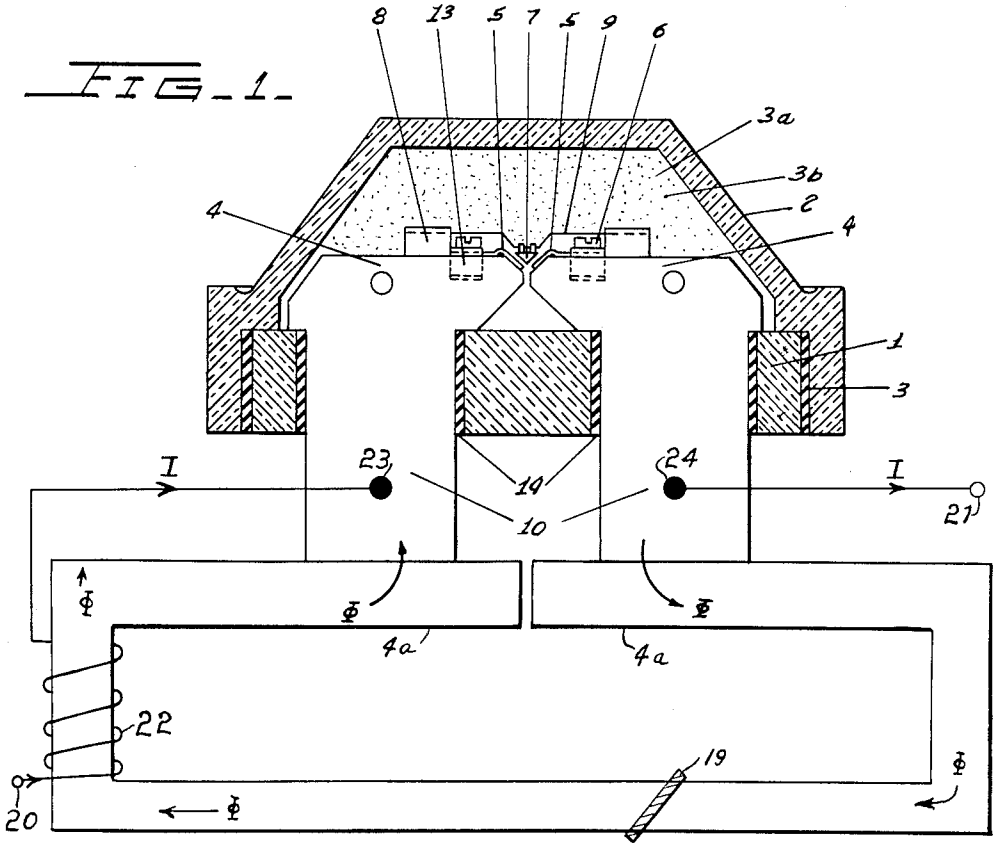
FIG. 1.



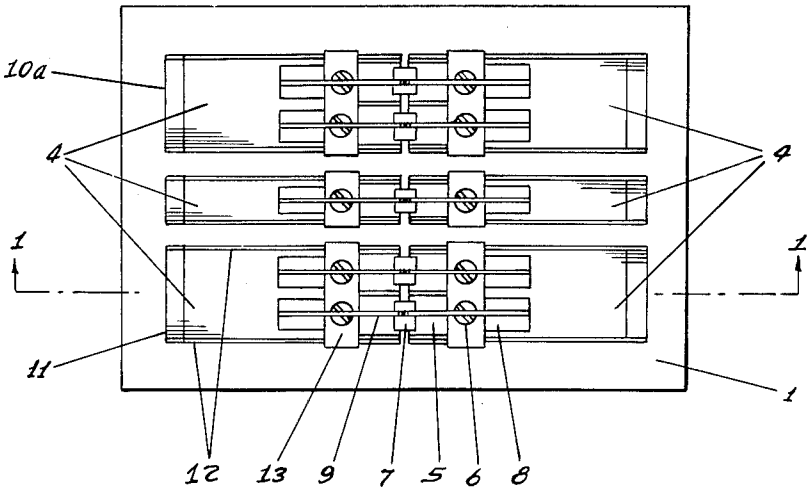


FIG. 2.

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ELECTRO-MAGNETIC SWITCH

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My present invention relates to electrical switches and more particularly it relates to magnetically operated electrical switches in which the armature serves as a movable electrical contact.

The novel electrical switch of my invention can be specifically applied to electromagnetic rectifiers such as the rectifiers disclosed in copending applications Serial No. 257,901 filed April 23, 1951, and Serial No. 249,594 filed October 3, 1951. Electromagnetic rectifiers of the type shown in the above-mentioned applications rectify an A.-C. power source by synchronously connecting the A.-C. source to a D.-C. load when the A.-C. power is of the desired polarity and disconnecting the A.-C. source from the D.-C. load when the A.-C. source polarity reverses. Connection and disconnection of the source and load can be achieved by the switch of my novel invention.

Essentially my invention consists of a plurality of poles, each carrying a stationary electrical contact. An armature is supported between each pair of poles so that when the poles are sufficiently magnetized the armature is pulled toward the stationary electrical contacts secured to the poles and retained there to close the electrical circuit from one contact to the other.

It is seen, therefore, that the poles of my novel switch operate not only as magnetic conductors but also as electric conductors when the armature of the switch has been pulled in position between the stationary electrical contacts by magnetic force produced by flux flowing in the poles.

The poles consist of a stack of air-tightly joined laminations and each stack is inserted also air-tightly in appropriate openings of the switch base. The stacks can consist of punchings made from a good magnetic material. The material used must also be at the same time a good electrical conductor.

Preferably, however, the stacks of the switch consist of a number of punchings from good magnetic material and of punchings from good electrical conducting material. These punchings are secured together to form an air-tight stack. As previously mentioned, these stacks serve not only as magnetic conductors but also as electric conductors. Their cross-sections must be sufficiently large to dissipate the heat produced at the electrical contacts. By providing a stack consisting of a number of good magnetic punchings and good electrically conducting punchings having a large total cross-section, the heat produced at the electrical contacts is easily dissipated.

To increase the current rating of this switch, further cooling can be obtained by the use of a cooling medium flowing in direct contact with the outer surface of the electrical switch. In order to provide this type of cooling, especially if the cooling medium used is a liquid, the contact carrying portion of this switch must be hermetically closed.

This is obtained in my invention by providing my switch with a cover to completely enclose the electrical contact portion of the switch and to provide an air-tight chamber

in cooperation with the base of the switch and appropriate gaskets.

This chamber or inner space can be filled with protecting gas, for example, high pressure nitrogen or hydrogen or it can be evacuated to a relatively high vacuum.

More specifically, cooling can be obtained by a flow of air directed against the switch, or the complete switch structure can be immersed in a moving or stationary liquid like oil or glucolic solution of water.

The main object of my present invention is an electromagnetic switch in which the magnetic poles are at the same time carriers of electric contacts.

Another object of my present invention is the provision of means whereby the entire switch structure is hermetically sealed.

A further object of my present invention is the provision of means whereby the heat generated at the contact points of my novel electro-magnetic switch is easily removed by means of cooling fluids.

These and other objects and advantages of my present invention will become apparent in the following description when taken in connection with the drawings in which:

Figure 1 is a cross-sectional view of the electro-magnetic switch of my invention taken at line 1—1 of Figure 2 and looking in the direction of the arrows.

Figure 2 is a top view of the electro-magnetic switch of Figure 1 of my invention with the cover removed.

Referring now to Figures 1 and 2, the electro-magnetic switch of my invention is completely mounted on a base 1 made of some insulating material, for example, porcelain, glass, quartz, or a similar material.

A cover 2 made of a similar insulating material completely encloses the electro-magnetic switch. A sealing gasket 3 interposed between cover 2 and base 1 makes the enclosure 3A completely hermetic. This enclosure 3A is filled by a protecting gas 3B (for example, nitrogen or hydrogen).

In this enclosure 3A are located the magnetic poles 4 to which are fastened fixed contacts 5 by means of screws 6. Fixed contacts 5 can be engaged by the movable contact 7 here shown in its open position. Movable contact 7 is also the armature of an electro-magnet consisting of poles 4. Movable contact or armature 7 is secured by means of spring 9 to insulator 8 secured to pole 4.

Magnetic structure 4*a* is positioned in such a manner as to magnetically energize poles 4. Energization of magnetic structure 4*a* is accomplished by means of a coil 22 which is energized at the terminals 20 and 21 in a manner well known in the electro-magnetic rectifier art.

It is therefore clear that when armature 7 is in the engaged position with its pair of stationary contacts, a circuit is completed from terminal 20 to terminal 21 through the current carrying connection 23, the current carrying structure 4, armature 7 and the current carrying connection 24. The magnetic structure 4*a* is provided with an air gap, this air gap being electrically insulated by means of insulator 19 to thereby prevent a short circuit of the stationary contacts through the magnetic structure.

The initial establishment of a flux ϕ before contact 7 engages the stationary contacts 5 can be achieved by providing a by-pass circuit across the poles 4 to allow the initiation of a current I in coil 22 independently of the disengaged stationary contacts. By-pass circuits of this type are well known in the art and are clearly described in copending application Serial No. 257,901.

The establishment of the flux ϕ will then act to cause the complementary contact 7 to engage the stationary contacts 5 after overcoming the biasing action of spring 9. Upon engagement of these cooperating contacts, a load current can now flow from terminal 20 through coil 22, pole 4, contact 7, the right hand pole 4, and terminal 21.

The magnetic path ϕ indicated in Figure 1 by dot-dash

lines extends from poles 4 into outer portions 4*a* located outwardly with respect to base 1.

The current path I indicated in Figure 1 also by dot-dash lines extends from poles 4 into outer portions 4*a* located outwardly with respect to base 1.

The current path I indicated in Figure 1 also by dot-dashlines extends along a coil wound around the poles 4 (not shown in the figures). The coil is electrically connected on one side to the pole 4 and on the other to the electrical terminal so that the current I will first flow through the coil and then into the poles 4 when movable or complementary contact 7 engages stationary contacts 5. This engagement occurs when the flux generated by current I and flowing through poles 4 becomes sufficiently strong to overcome the biasing action of spring 9 and pull armature 7 toward stationary contacts 5.

Poles 4 as previously mentioned serve not only as a path for magnetic flux but also as a path for electric current and in my present embodiment they consist of laminations 11 of good magnetic material and laminations 12 of good electric conducting material, for example, silvered copper sheets.

Laminations 11 and 12 are pressed together to form two individual stacks 10 and are each air-tightly joined by means of a silver compound (not shown).

In this embodiment the electrically conducting laminations 12 are placed on the two sides of the magnetic laminations 11. The connection between the electrical conducting laminations 12 and the fixed contact 5 is effected by means of contact bridges 7 which are secured to the poles 4 by means of screws 6 and 13 which also secure fixed contacts 5 to poles 4 on each side of pole 4.

It is easily seen that instead of using stacks 10 consisting of laminations from good magnetic materials and laminations from good electrical conducting material, these individual stacks could be made of laminations which are at the same time of good magnetic material and have good conducting properties.

These stacks 10 are inserted in appropriate openings 10*a* of base 1 and air-tightly sealed in this base 1 by means of a sealing gasket 3. Each stack 10 can also be considered as being the leads through which the electrical current flows. When they are considered as leads for an electrical current, these stacks 10, as is now evident, have a very large cross-section so that the heat generated at the contact points 5 during the operation of the electromagnetic switch is easily dissipated by the stacks 10.

In the foregoing I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. An electro-magnetic switch, said switch comprising a magnetic circuit and an electrical circuit, a portion of said magnetic circuit coinciding with a portion of said electrical circuit, said magnetic circuit comprising pairs of magnetic poles; said poles having a plurality of laminations; said laminations being partly of good conducting material and partly of good magnetic material, said high conductivity laminations being placed outwardly with respect to said magnetic laminations; said electrical circuit comprising pairs of stationary contacts and complementary contacts, a contact bridge extending from a high conductivity lamination to a stationary contact and from there to another high conductivity lamination, said complementary contacts being resiliently mounted on said poles, insulation blocks between said complementary contacts and said poles, each of said complementary contacts completing the circuit between a pair of said stationary contacts at the switch closing time and making the said flux carrying poles also current carrying, a housing comprising a base and a cover, said switch being mounted on said base and being enclosed by said cover, sealing means between said base and said cover; a vacuum within said housing for protecting said contact.

2. An electro-magnetic switch, said switch comprising a magnetic circuit and an electrical circuit, said magnetic and electrical circuits comprising a plurality of laminations, said laminations being of good conducting material and partly of good magnet material, a portion of said magnetic circuit coinciding with a portion of said electrical circuit, said magnetic circuit comprising pairs of magnetic poles, said electrical circuit comprising pairs of stationary contacts and complementary contacts, each pair of said stationary contacts being mounted on a pair of said poles and in current carrying engagement with said poles, each of said complementary contacts being movable into and out of engagement with a pair of said stationary contacts to electrically engage said pair of stationary contacts; a housing comprising a base and a cover, said housing completely enclosing said contact; said base having recesses, said poles occupying said recesses and being fixedly secured to said recesses; sealing means between said cover and said base.

3. An electro-magnetic switch, said switch comprising a magnetic circuit and an electrical circuit, a portion of said magnetic circuit coinciding with a portion of said electrical circuit, said magnetic circuit comprising pairs of magnetic poles; said poles having a plurality of laminations, said laminations being partly of good electrical conducting material and partly of good magnetic material; said good electrical conducting laminations being of silvered copper and outwardly spaced with respect to said magnetic laminations; said electrical circuit comprising pairs of stationary contacts and complementary contacts, a contact bridge extending from a high conductivity lamination to a stationary contact and from there to another high conductivity lamination, said complementary contacts being resiliently mounted on said poles, insulation blocks between said complementary contacts and said poles, each of said complementary contacts completing the circuit between a pair of said stationary contacts at the switch closing time and making the said flux carrying poles also current carrying, a housing comprising a base and a cover, said switch being mounted on said base and being enclosed by said cover, sealing means between said base and said cover; a vacuum within said housing for protecting said contact.

4. An electromagnetic switch, said switch comprising a magnetic circuit and an electrical circuit, a portion of said magnetic circuit coinciding with a portion of said electrical circuit, said magnetic ciruit comprising pairs of magnetic poles; said poles having a plurality of laminations, said laminations being of a material that has both good electrical conductivity and good magnetic properties, said laminations being sealed together in an air-tight packet, said electrical circuit comprising pairs of stationary contacts and complementary contacts, each pair of said stationary contacts being mounted on a pair of said poles and in current carrying engagement with said poles, each of said complementary contacts being movable in to and out of engagement with a pair of said stationary contacts each of said complementary contacts completing the circuit between a pair of said stationary contacts at the switch closing time and making the said flux carrying poles also current carrying, a housing completely enclosing said stationary contacts and said complementary contacts.

5. An electromagnetic switch, said switch comprising a magnetic circuit and an electrical circuit, a portion of said magnetic ciruit coinciding with a portion of said electrical circuit, said magnetic circuit comprising pairs of magnetic poles; said poles having a plurality of laminations; said laminations being partly of good conducting material and partly of good magnetic material, said laminations being sealed together in an air-tight packet, said good conducting laminations being placed outwardly with respect to said magnetic laminations; said electrical

circuit comprising pairs of stationary contacts and complementary contacts, a contact bridge extending from a good conducting lamination to a stationary contact and from there to another good conducting lamination, said complementary contacts being resiliently mounted on said poles for movement into and out of engagement with said pairs of stationary contacts, insulation blocks between said complementary contacts and said poles, each of said complementary contacts completing the circuit between a pair of said stationary contacts at the switch closing time and making the said flux carrying poles also current carrying, a housing comprising a base and a cover, said switch being mounted on said base and being enclosed by said cover, sealing means between said base and said

cover; a vacuum within said housing for protecting said stationary contacts and said complementary contacts.

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