A. SIMON.

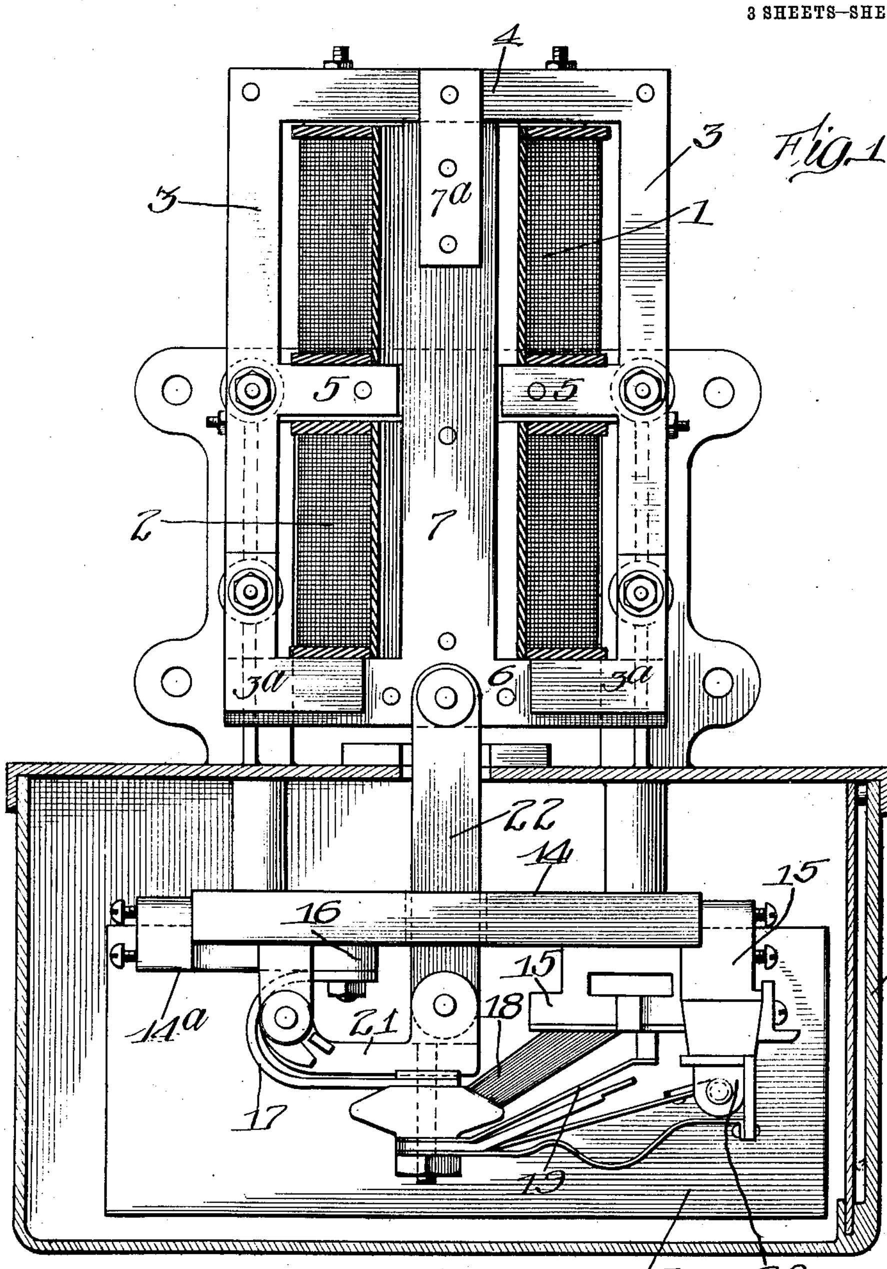
ALTERNATING CURRENT SWITCH.

APPLICATION FILED FEB. 21, 1907.

1,006,504.

Patented Oct. 24, 1911.

3 SHEETS—SHEET 1.



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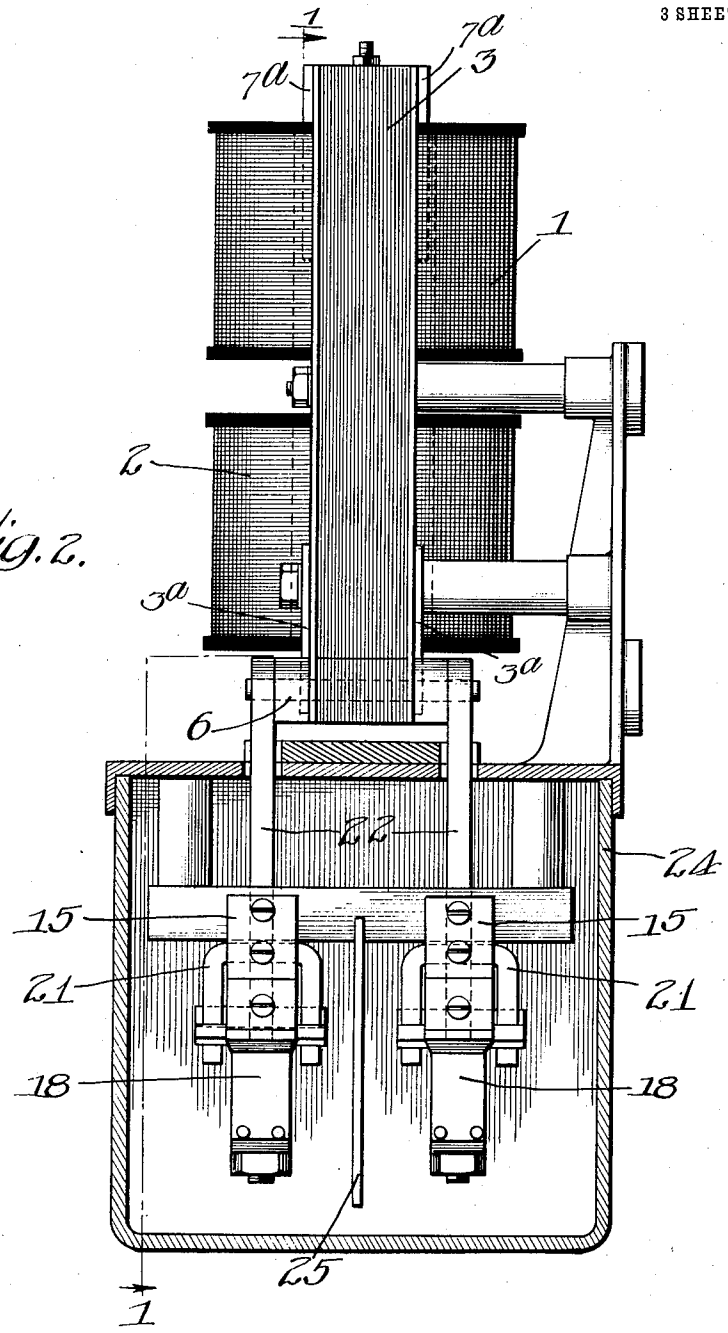

Fig. 2.

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3 SHEETS—SHEET 3.

FIG. 3.

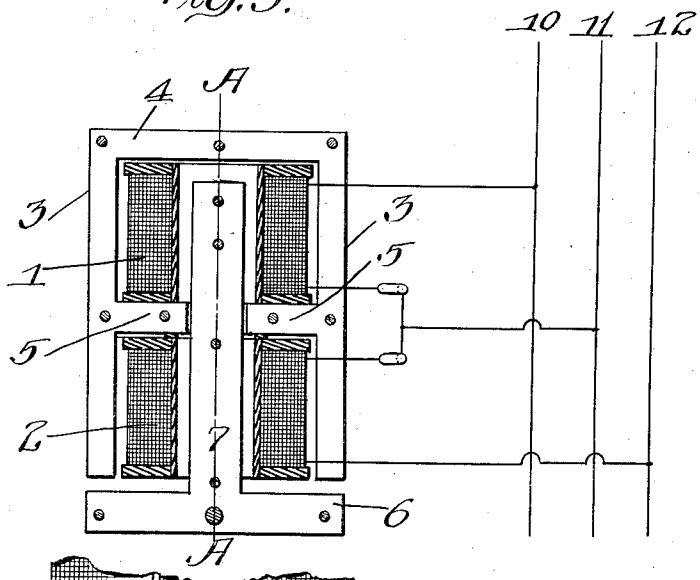
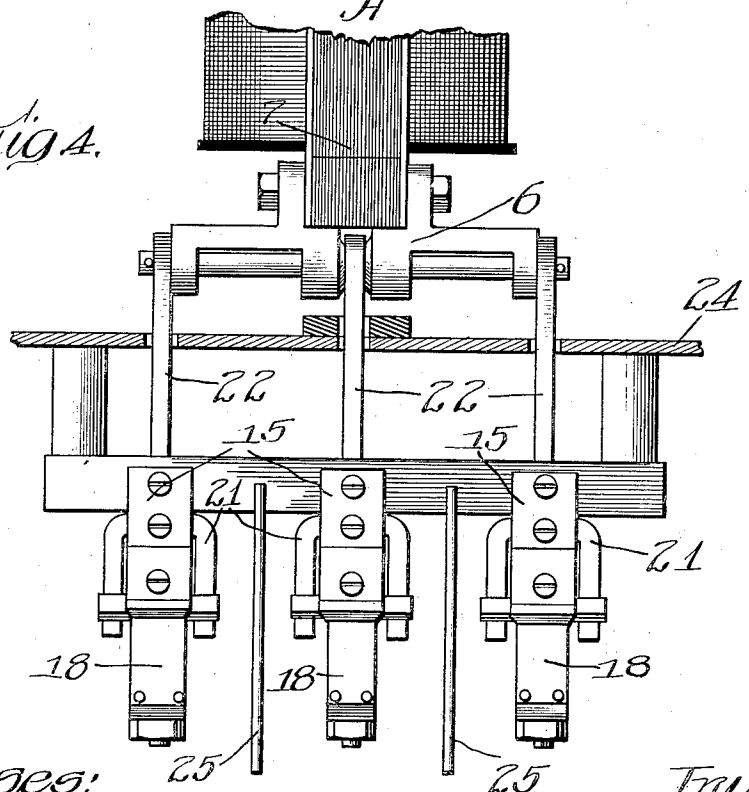


FIG. 4.



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UNITED STATES PATENT OFFICE.

ARTHUR SIMON, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MANUFACTURING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

ALTERNATING-CURRENT SWITCH.

1,006,504. Specification of Letters Patent. Patented Oct. 24, 1911.

Application filed February 21, 1907. Serial No. 358,666.

To all whom it may concern:

Be it known that I, ARTHUR SIMON, subject of the Emperor of Germany, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Alternating-Current Switches, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in electrical switches or contactors.

It has for its object the production of a magnetically operated switch which is especially adapted for use on alternating current circuits.

The particular type of alternating current magnet that I employ in my switch is set forth in my application for United States Letters Patent, filed October 8th, 1906, Serial No. 338,005.

The magnet that I employ in the preferred form of my invention is provided with a magnet frame and armature with which are associated a plurality of windings that produce magnetic fluxes of different phase. The magnetic frame and armature conjointly form circuits or paths for the magnetic fluxes, one for each flux. When the magnet frame and armature are apart, an air gap is introduced into the magnetic circuit of each phase, thereby causing each flux to make an effective pull upon the armature. The circuits for the fluxes and the air gaps in said circuits are arranged symmetrically to a common axis. The magnetic fluxes are, therefore, distributed symmetrically about said axis, thereby causing the center of pull of the magnet to remain stationary. The magnetic circuits of the fluxes are in the same plane, and, consequently, the position of the resultant flux does not shift. The instantaneous minimum resultant pull of the fluxes is made sufficient to seal the magnet firmly. The result of all these things is that a magnet is produced, the armature of which will not vibrate nor chatter in any way.

According to the preferred embodiment of my invention, I provide a magnet frame and an armature having the characteristics that are above set forth. I preferably provide the magnet frame with two coils which are arranged in substantially axial alinement. I cause these coils to produce magnetic fluxes of different phase. Obviously such result may be accomplished in various ways. I may connect the said coils to different phases of a polyphase alternating current circuit or I may connect the same with a single phase alternating current circuit and provide means for either retarding or advancing the flux of the current in one of the coils. Of course my invention comprehends any way of making the coils produce magnetic fluxes of different phase.

I employ the alternating current magnet to operate suitable switch contacts. The contacts may be connected to the armature of the magnet in various ways to accomplish the ends that I seek.

For the purpose of more particularly setting forth the nature of my invention, I shall describe specifically certain switches that I have designed to embody my invention. These switches are illustrated in the accompanying drawings, in which—

Figure 1 is a sectional elevation of one form of switch, said section being taken on line 1—1 of Fig. 2, Fig. 2 is a side elevation with certain parts shown in section, Fig. 3 is a detail view showing more particularly the magnet and one way of connecting the coils in circuit, and Fig. 4 illustrates another form of section in which there are three sets of switch contacts.

The magnet or solenoid that I use in the switch shown in the drawing will now be particularly described. It is provided with two coils or windings 1 and 2 which are arranged in substantially axial alinement. These coils are energized by alternating current and produce magnetic fluxes of different phase. The frame in which these coils are mounted is preferably laminated and is formed with side pieces 3, a top piece 4, and a central cross-piece 5. Below the lower extremities of the side pieces 3 is arranged an armature 6. The structure of the magnet frame and the armature may be varied according to the circumstances. The armature is provided with an upward extension or plunger 7 which extends upwardly to the top piece 4, passing through an opening in the cross-piece 5. The coils surround the plunger. There is just sufficient clearance between the plunger and cross-piece to al-

low the plunger to rise and fall freely. The coil 1 is surrounded by the upper portions of the side pieces 3, the top piece 4, and the cross-piece 5, while the coil 2 is surrounded by the lower portions of the side pieces 3, the cross-piece 5 and the armature 6. The plunger 7 carries guide pieces 7^a which engage the top piece 4, and the side pieces 3 carry similar guide pieces 3^a which engage the armature 6.

The magnet frame and the armature form two circuits for the magnetic fluxes, one for each coil. When the armature is separated from the magnet frame, as shown in Fig. 3, an air gap is imposed in the magnetic circuit of each coil, the air gap in the magnetic circuit of the coil 1 being disposed between the top of the plunger 7 and the top piece 4, while the air gap in the magnetic circuit of the coil 2 is disposed between the lower extremities of the side pieces 3 and the armature 6.

When the magnet E is sealed, that is, when the armature is attracted to the magnet frame, the air gaps are closed or eliminated, the armature being in engagement with the lower extremities of the side pieces and the top of the plunger in engagement with the top piece 4. The paths or circuits for the fluxes are arranged symmetrically to a common axis. Likewise the air gaps are arranged symmetrically to the same axis. The centers of pull of the fluxes are accordingly kept in alinement, or, more broadly speaking, the fluxes are distributed symmetrically about a common axis, and, consequently, the center of pull of the resultant flux remains stationary, or in one position. The magnetic circuits are arranged in the same plane, and, consequently, the position of the resultant flux will not shift as would be the case if said circuits were arranged in different planes. The resultant instantaneous minimum pull of the fluxes is made sufficient to keep the armature firmly against the magnet frame. These things produce a magnet which will not chatter nor vibrate, as would be the case if the center of pull of the resultant fluxes changed during the cycles of the fluxes or the plane of the resultant flux shifted.

The circuit for the flux of the coil 1 may be assumed to extend through the upper portion of the plunger 7, thence dividedly through the top piece 4, down the upper portion of the side pieces 3, and through the cross piece 5 back to said plunger. Likewise, the circuit for the flux of the coil 2 may be assumed to extend through the lower portion of the plunger 7, thence dividedly through the cross-piece 5, down the lower portion of the side pieces 3 to the armature 6, and thence back to said plunger.

It will thus be seen that circuits or paths are provided which will distribute the fluxes symmetrically to a common center line or axis A A, Fig. 3, thereby causing the center of pull of the resultant flux to remain stationary.

The manner in which the coils 1 and 2 may be connected in a three phase circuit is illustrated in Fig. 3. The circuit is provided with mains 10, 11, and 12, one terminal of the coil 1 being connected to the main 10, and one terminal of the coil 2 being connected to the main 12, while the other terminal of each coil is connected to the main 11. The coils are thus energized by currents of different phase, and, consequently, produce magnetic fluxes of different phase. The magnet is so designed that the minimum value of the resultant pull of the several fluxes is above zero, and is sufficient to keep the said magnet firmly sealed. It will be understood that the coils may be connected in circuit in various ways, and that various means may be employed to cause said coils to produce magnetic fluxes of different phase.

The switch contacts will now be described. Figs. 1 and 2 show the switch having two sets of contacts. The base 14, which is suitably mounted with the magnet frame, carries two sets of contacts each of which comprises stationary contacts 15 and movable contacts hereinafter described. Mounted near one end of the base is a binding post or terminal 14^a which has an extension 16 to which are secured flexible conductors 17. Movable contacts, namely a main contact or laminated brush 18, an auxiliary contact 19, and an arching contact 20, are connected to each flexible conductor. The movable contacts are mounted upon a pivoted arm 21, said arm being pivoted to a suitable bracket depending from the base 14. Each arm 21 is suitably connected to the armature 6 by means of an insulating link 22, which passes through the base 14, and is suitably pivoted to said arm and said armature.

The switch contacts are inclosed in a suitable casing 24 within which is arranged a partition placed between the two sets of contacts. The casing contains oil, in which the switch contacts are immersed. Of course, any other suitable fluid may be used instead of oil and, as hereinafter used, the term "oil" comprehends all substitutes therefor. The partition prevents the current from jumping from one set of contacts to the other, and the oil decreases the arc between the movable and stationary contacts. The auxiliary contact is adapted to engage a suitable part of the stationary contact 15 and the arcing contact is adapted to engage a carbon block carried by said stationary contact. When the switch is opened, the movable contacts, namely, the main contact, the auxiliary contact and the arcing contact, leave their corresponding stationary

contacts in the order in which they are named. The auxiliary contact serves to lessen the arc that occurs between the main contact and the stationary contact, and the carbon contact takes the arc that occurs upon finally breaking the circuit.

The parts that have been described are preferably all assembled into a unitary structure.

In the switch that I have described, the post or terminal 14^a forms one switch terminal and the stationary contacts 15 two other switch terminals. The movable contacts are adapted to connect the two stationary contacts 15 to the terminal 14^a. The switch contacts that I have described are designed particularly for use on an alternating current circuit having three mains, the binding post 14^a being connected to one main, one of the stationary contacts 15 to the second main and the other of said stationary contacts to the third main. It will be understood, however, that the switch contacts may be designed to be connected in circuit in various ways, and, moreover, that various changes may be introduced into the switch to meet the conditions under which it is to be used.

Fig. 4 illustrates a switch in which three sets of contacts are employed, instead of two, as in the switch previously described. The general structure of the switch, however, is substantially the same. The contacts of each set are constructed and mounted in the same way as those previously described. The reference numerals that have heretofore been used to designate certain parts of the switch are applied to corresponding parts in Fig. 4. It will, of course, be understood that the number of sets of contacts that are used depends upon circumstances. The switch may have only one set of contacts or several sets, according to whether it is to control simply one circuit or several circuits.

Figs. 1, 2, and 4 show the movable contacts in engagement with the stationary contacts, the magnet being sealed as would be the condition when the coils 1 and 2 are energized. When the coils 1 and 2 are deënergized, the armature is separated from the magnet frame as shown in Fig. 3, under which condition the movable contacts are separated from the stationary contacts and the switch is open. In order to close the switch, current is sent through the coils 1 and 2 to energize the same. These coils attract the armature 6 and accordingly the armature 6 and the upward extension 7 are brought into engagement with the side pieces and the top respectively of the magnet plane. As the armature ascends upon being attracted by the magnetic fluxes, it pulls up the link 22 which in turn raises the free end of the arm 21, thereby bringing the movable contacts 18, 19, and 20 into engagement with their corresponding stationary contacts 15, thus closing the switch.

The fact has been previously brought out that the armature of the magnet will be held firmly to the magnet frame, and accordingly not chatter. The switch will, therefore, be firmly sealed, thereby making good contact.

It will be understood that I am aware that various changes may be introduced into the structure that I have shown and described as my invention is susceptible of assuming various forms. The claims appended hereto are therefore intended to cover the various structures that may be designed embodying my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States is:

1. The combination with a switch contact, of an alternating current magnet for operating the same having a plurality of coils arranged in substantially axial alinement, said coils being adapted to produce magnetic fluxes of different phase, and a magnet frame and movable armature forming suitable paths for the magnetic fluxes of said magnets and said coils being adapted to magnetically attract said movable armature.

2. In an electric switch, the combination with a contact, of an alternating current magnet for operating the same having a plurality of coils adapted to produce fluxes of different phase and arranged in substantially axial alinement, and a magnet frame and movable armature of magnetic material forming paths for said fluxes, one for each flux, said armature and said frame being so formed as to distribute said fluxes symmetrically about a common axis and in substantially the same plane.

3. In an electric switch, the combination with a switch contact, of an alternating current magnet having a movable armature of magnetic material connected to said switch contact, said magnet being adapted to produce magnetic fluxes of different phase, and a magnet frame for distributing said fluxes symmetrically about a common axis in substantially the same plane to cause said magnet to magnetically attract and hold said armature.

4. In an electric switch, the combination with a movable contact, of an alternating current magnet for operating the same said magnet producing magnetic fluxes of different phase, a magnet frame and movable armature for said magnet forming paths for and distributing said fluxes symmetrically about a common axis and in substantially the same plane, the points of contact between said armature and said frame being disposed symmetrically about said axis.

5. In an electric switch, the combination with a contact, of an alternating current

magnet for operating the same, said magnet being adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming paths for the fluxes of said magnet and constructed to distribute said fluxes symmetrically about a common axis, and in substantially the same plane, said armature having a cross piece adapted to be separated from said magnet frame at points substantially equidistant from said axis to introduce air gaps in the magnetic circuits of said magnet.

6. In an electric switch, the combination with a switch element of an alternating current magnet for operating the same having a plurality of coils for producing magnetic fluxes of different phase and provided with a frame and movable armature of magnetic material forming circuits or paths for said fluxes, one for each flux, said paths being arranged symmetrically about a common axis in substantially the same plane, and said magnet having, when deënergized, suitable air gaps arranged symmetrically about said axis, whereby symmetrical pulls are exerted by said fluxes between said frame and armature.

7. In an electric switch, in combination, a supporting base, a magnet frame secured thereto, an alternating current magnet mounted within said frame and adapted to produce magnetic fluxes of different phase, a movable armature for said magnet formed of magnetic material, switch contacts mounted on said base, a link connecting said armature to one of said contacts, said magnet frame and said armature forming magnetic paths for distributing the magnetic fluxes produced by said magnet symmetrically about a common axis to cause said magnet to magnetically attract and hold said armature.

8. In an electric switch, in combination, a supporting base, a magnet frame secured thereto, an alternating current magnet mounted within said frame and adapted to produce magnetic fluxes of different phase, a movable armature for said magnet formed of magnetic material, switch contacts mounted on said base, a link connecting said armature to one of said contacts, and a casing containing oil in which said contacts are immersed, said magnet frame and said armature forming magnetic paths for distributing the magnetic fluxes produced by said magnet symmetrically about a common axis to cause said magnet to magnetically attract and hold said armature.

9. In an electric switch, in combination, an alternating current magnet having means for producing magnetic fluxes of different phase and disposing said fluxes symmetrically about a common axis and in substantially the same plane, a plurality of sets of contacts, and means connecting one contact of each set to the armature of said magnet.

10. In an electric switch, in combination, an alternating current magnet having means for producing magnetic fluxes of different phase and disposing said fluxes symmetrically about a common axis and in substantially the same plane, a base, a plurality of sets of switch contacts mounted on said base, links connecting one contact of each set to the armature of said magnet, and a casing containing oil in which said contacts are immersed.

11. In an electric switch, in combination, two coils adapted to produce magnetic fluxes of different phase, and arranged in substantially axial alinement, a magnet frame and armature forming two paths or circuits for said fluxes, one for each flux, said armature having an extension extending through both coils and forming parts of said paths, and a switch element connected to said armature.

12. In an electric switch, in combination, two coils adapted to produce magnetic fluxes of different phase and arranged in substantially axial alinement, a magnet frame and armature forming two paths or circuits for said fluxes, one for each flux, said armature having an extension extending through both coils and forming parts of said paths, and a plurality of switch elements connected to said armature.

13. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a switch element operatively connected with said armature.

14. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a plurality of switch contacts operatively connected with said armature.

15. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in com-

bination with a base, a plurality of sets of contacts mounted upon said base, and links operatively connecting one contact of each set to said armature.

16. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a base, a plurality of sets of contacts, each including a movable contact and mounted upon said base, and links operatively connecting each movable contact to said armature.

17. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a set of switch contacts each including movable and stationary contacts, each movable contact being operatively connected to said armature, and a casing adapted to contain oil in which said switch contacts are immersed.

18. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a plurality of sets of contacts, each including a movable and a stationary contact, means operatively connecting the movable contacts to said armature, and a casing surrounding said sets of contacts containing oil.

19. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a plurality of sets of contacts, each including a movable and a stationary contact, means connecting the movable contacts to said armature, a casing surrounding said sets of contacts adapted to contain oil, and a partition arranged between the sets of contacts.

20. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a base, switch contacts mounted thereon, one a stationary contact, a link connecting the movable contact to said armature, and a casing containing oil, in which said switch contacts are immersed.

21. An alternating current magnet having two coils adapted to produce magnetic fluxes of different phase, a magnet frame and armature forming two paths, one for each flux, said frame being provided with two side pieces, a top piece and a central cross piece, and said armature being arranged below said side pieces and having an upward extension passing through both coils, in combination with a base, a plurality of sets of switch contacts, each including a movable and a stationary contact, links connecting the movable contacts to said armature, a casing surrounding said sets of contacts, and containing oil, and a partition between the sets of contacts.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

ARTHUR SIMON.

Witnesses:
R. E. LUDWICK,
R. C. FENNER.