D. LARSON.

ALTERNATING CURRENT ELECTROMAGNETIC SWITCH.

APPLICATION FILED NOV. 26, 1907.

1,005,237.

Patented Oct. 10, 1911.

2 SHEETS—SHEET 1.

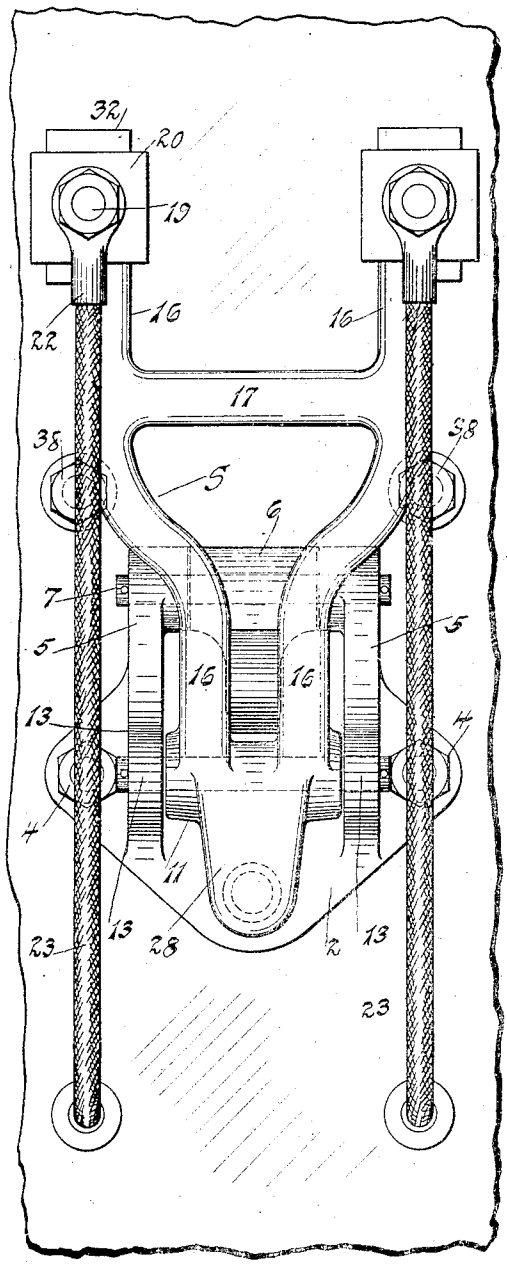


Fig. 1.

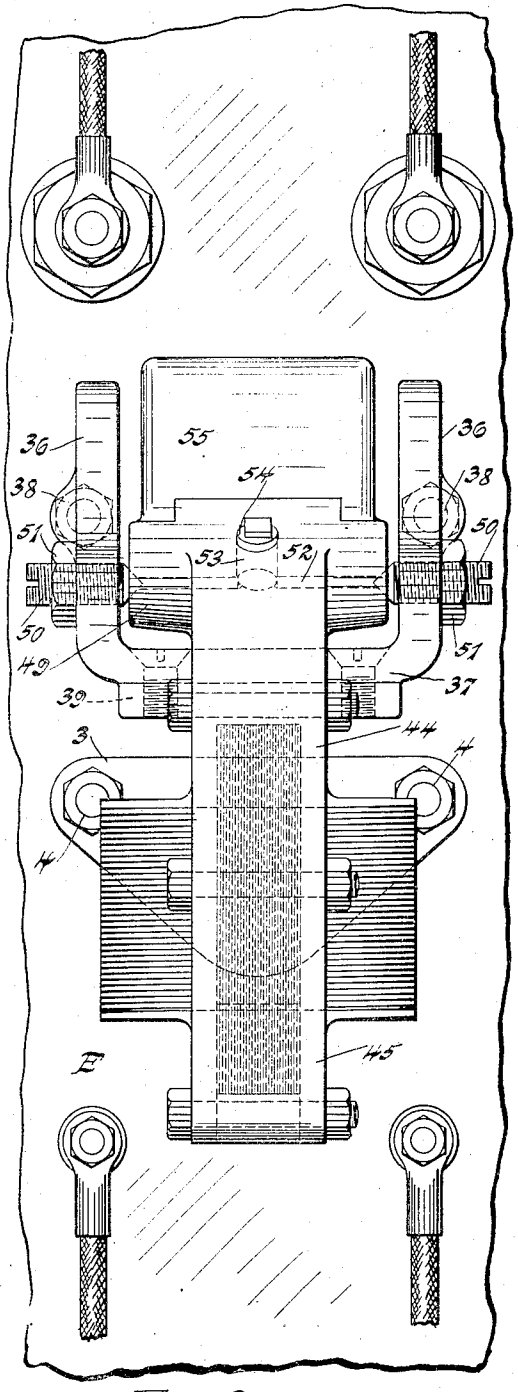


Fig. 2.

Witnesses:

Ernest L. Gale Jr.

James G. Bothell

Inventor

David Larson

By Attorney

C. M. Nissen

D. LARSON.

ALTERNATING CURRENT ELECTROMAGNETIC SWITCH.

APPLICATION FILED NOV. 26, 1907.

1,005,237.

Patented Oct. 10, 1911.

2 SHEETS—SHEET 2.

Fig. 3.

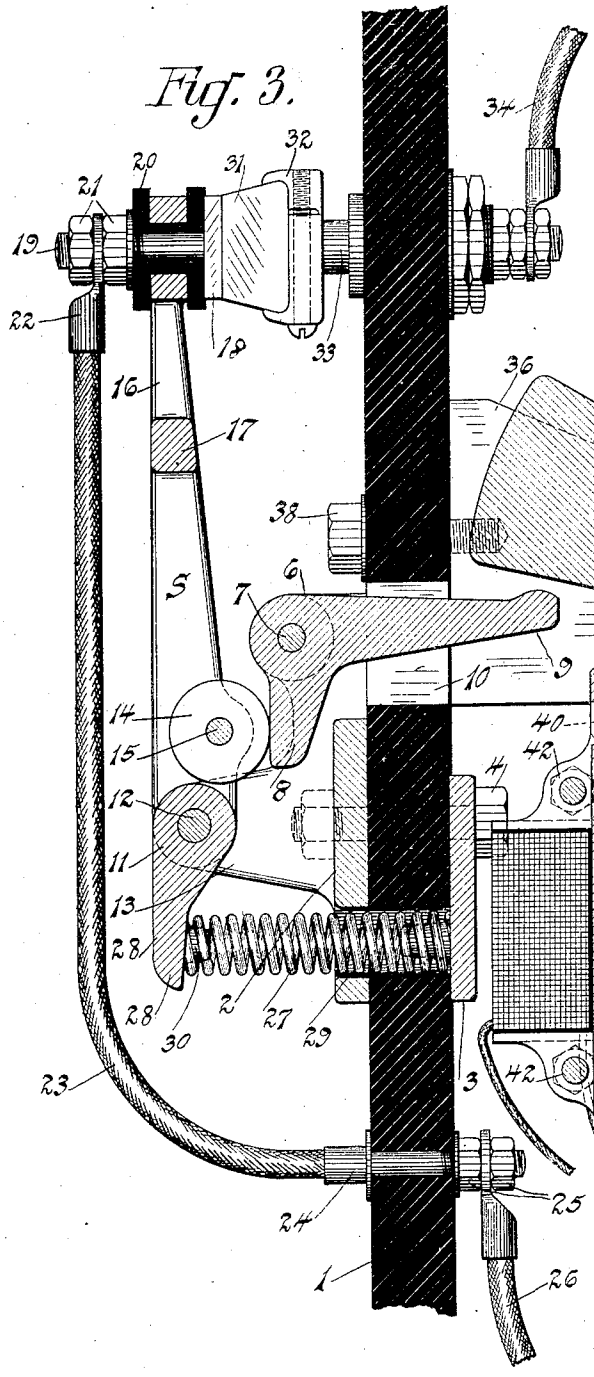
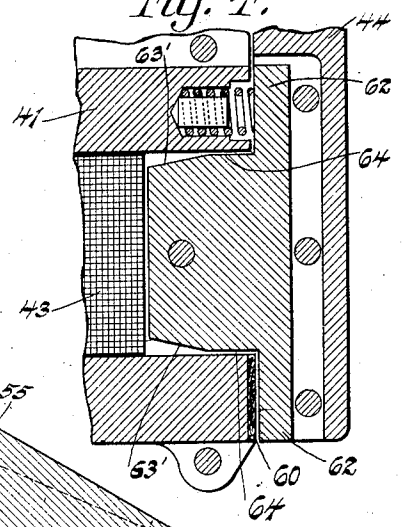
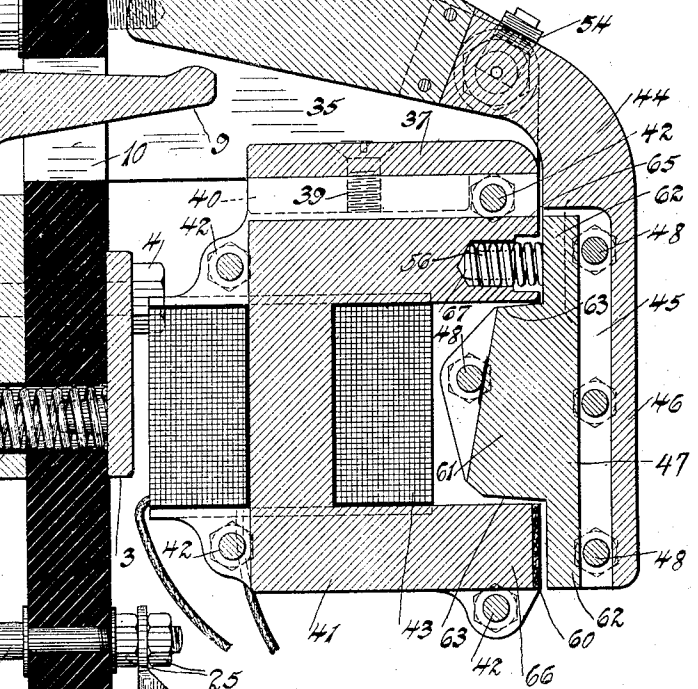


Fig. 4.





Witnesses:

Ernest L. Gale Jr.

James G. Bethell

Inventor

David Larson

By Attorney

C. M. Nissen

UNITED STATES PATENT OFFICE.

DAVID LARSON, OF YONKERS, NEW YORK, ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ALTERNATING-CURRENT ELECTROMAGNETIC SWITCH.

1,005,237. Specification of Letters Patent. Patented Oct. 10, 1911.

Application filed November 26, 1907. Serial No. 403,851.

To all whom it may concern:

Be it known that I, DAVID LARSON, a subject of the King of Sweden, residing at Yonkers, in the county of Westchester and State of New York, have invented a new and useful Improvement in Alternating-Current Electromagnetic Switches, of which the following is a specification.

My invention relates to electromagnetic switches especially adapted for use in connection with alternating electric currents.

One of the objects of the invention is the provision of an improved form of construction of electromagnetic switches.

Other objects of the invention will appear hereinafter, the novel combinations of elements being set forth in the appended claims.

Referring to the drawings, Figure 1 is a front elevation of the switch; Fig. 2 is a rear elevation showing the electromagnet on the opposite side of the switch board; Fig. 3 is a sectional side elevation of the entire device; and Fig. 4 is a detail view of a modified form of armature.

The switch lever and its actuating electromagnet are mounted on opposite sides of a base board 1 made of slate or other suitable insulating material. A bracket 2 and a plate 3 are secured on the front and rear faces, respectively, of the board 1 by means of bolts 4 which pass through the bracket, board and plate. The bracket 2 comprises upwardly extending arms 5 between which is a bell-crank lever 6 pivoted on a shaft 7 extending through the upper ends of the arms 5. The lever 6 comprises a downwardly extending arm 8 and a horizontal arm 9 extending through an opening 10 in the base 1. The switch lever S comprises a hub 11, through which extends a pivot rod 12 extending through the lugs 13 which project outwardly from the arms 5. Integral with the hub 11 are two arms 16 which form the body of the switch lever. These arms are parallel at their lower and upper ends with intermediate portions curved outwardly and upwardly to space the upper ends farther apart. An integral cross piece 17 unites the arms. Mounted on a pivot shaft 15 extending between the arms 16 is a roller 14 in position to engage the arm 8 of the bell-crank lever.

Each arm 16 carries at its upper end an electrical contact 18 which is preferably a flat metal plate formed integral with a stem or bolt 19. The stem 19 extends through the arms 16 and is electrically insulated therefrom by a bushing 20, and clamped in position by the nuts 21 on the threaded end of the stem. Connectors 22 on the upper ends of flexible conductors 23 are clamped between the nuts 21. On the lower ends of the conductors 23 are connectors 24 in the form of binding posts extending through the base 1, and provided with clamping nuts 25 which secure the binding posts in position and also electrically unite therewith the conductors 26.

A coil spring 27 bears at one end against an arm 28 extending downwardly from the hub 11 and extends through an opening 29 in the bracket 2 and base 1, and bears at its opposite end against the plate 3. The spring is held in position by a nose 30 on the arm 28 and a similar nose on the plate 3.

Carbon contacts 31 are held by clamps 32 which have stems 33 extending through the base 1 and forming binding posts to which are electrically connected the conductors 34.

The electromagnet E is mounted at the back of the base board by means of a bracket 35. This bracket comprises flat parallel side members 36 extending outwardly for some distance from the base 1 and an integral flat web 37. The bracket is secured to the base 1 by screw bolts 38 passing through the base and threaded into the side members 36. The electromagnet is suspended from the bracket 35 by screws 39 extending through the horizontal web 37 and threaded into flanges 40 extending laterally from the magnet frame.

The electromagnet E comprises a U-shaped body portion 41 of laminated soft iron, arranged with its pole faces in a substantially vertical plane and away from the base plate. The laminæ forming the body 41 are clamped in position between the side members of the magnet frame by bolts 42. The magnet winding consists of a spool 43 of insulated copper wire.

The armature of the magnet comprises a vertical member 44 preferably of non-magnetic material, formed with parallel sides or plates 45 and a uniting web 46. Soft iron plates or laminæ 47 forming the magnetic portion of the armature are clamped between the sides 45 by bolts 48. The upper end of the member 44 is formed into a hub 49 provided with conical recesses at its ends

which form bearing surfaces for the conical ends of the pivot screws 50. These screws are adjustably mounted in the bracket 35 and are secured in adjusted position by lock nuts 51.

To permit the bearings to be lubricated, a small bore 52 is extended through the hub from one bearing surface to the other, and a screw-threaded opening 52 extends from the surface of the hub down to the central portion of said bore. A threaded plug 54 fits the opening 53. Vaseline or other suitable lubricant is placed in the opening 53 and may be forced through the bore 52 to the bearings if necessary by screwing down the plug 54.

Riveted or otherwise secured to the member 44 is a solid block of metal 55 extending toward the base plate, and forming a weight to actuate the armature and switch lever.

Between the magnet and its armature is placed a stiff helical spring 56 which acts as a buffer to receive the blow of the armature as it swings to attracted position. In this instance I have shown the spring 56 in a recess in the pole 65, and held rigidly to such pole by means of the metal plug 67. Preferably this spring is made of iron or steel and is wedged by the plug 67 into rigid magnetic contact with the pole 65. A portion of the spring projects from the recess so as to be engaged by the end portion 62 of the armature. It will thus be seen that when the armature is in its attracted position the magnetic circuit between the pole 65 and the armature is closed by the spring. The end of the lower pole is covered with a soft material, such as rubber, leather or the like, which serves as a buffer for the lower portion 62 of the armature. When the armature is in its attracted position, however, a small air gap is left between the facing 60 and the portion 62, or between the pole 66 and the face 63. In other words, when the magnet is energized and the armature attracted, the blow due to the momentum of its movement is taken up by the spring 56 and the buffer 60, but when this momentum is overcome and the armature is held stationary by the magnetic pull the lower portion of the armature is held in close proximity but out of contact with the pole 66 or its facing.

The spring 56 is made sufficiently stiff or strong to resist material compression by the armature, but is made of highly resilient and elastic material, preferably hard, highly tempered iron or steel, in order to take up the vibrations of the armature due to alternations of magnetism in the magnet so as to reduce chattering or humming noise to almost a negligible quantity. Such a spring for alternating current magnets is not *per se* my invention, but that of August Sundh, and covered by him in his co-pending application, Serial No. 403,276, filed November 22, 1907, for an improvement in alternating current electro-magnetic switches but I claim as my invention the hard metal plug 67 for securing the spring rigidly in position, and also the particular location of the spring herein shown, which has the structural advantage of making the electromagnetic switch more compact.

When an ordinary straight or flat armature is attracted by an alternating current magnet the flow of current through the magnet windings is at first comparatively large, and the armature attracted so that when it approaches the poles it makes considerable noise when it strikes the magnet poles. After the magnetic circuit is closed the flow of current through the magnet windings is greatly reduced, due to the reluctance of the magnetic circuit being much smaller and the self-induction in the winding much greater. The armature is therefore designed to have an electro-magnetic dash-pot action so that such sudden movements are prevented to avoid the consequent noise, but sufficient pull on the armature being exerted to enable it to accomplish its function. In this instance the armature is designed to have a substantially steady pull throughout the greater portion of its movement and also to permit a strong magnetic flux through the armature when in its initial position. As shown in Fig. 3, the armature comprises an intermediate portion 61 arranged for movement between the poles of the magnet so as to retard the otherwise quick movement of the armature. The end pieces 62 which project in front of the magnet poles are initially a comparatively long distance from the latter, while the faces 63 are adjacent the poles to almost close the air gaps and on which the pull is at first exerted. The end faces 63 of the intermediate portion 61 are slightly inclined to the adjacent surfaces of the magnet so that as the armature moves inwardly the air gaps between the surfaces 63 and the magnet poles are greatly diminished at the same time that the air gaps between the pole faces and the portion 62 are diminished. It has been found by experiment and in practice that this results in a substantially uniform pull on the armature as it moves inwardly, so that the armature arrives at its final attracted position comparatively gently and causes very little noise by striking against the pole faces.

When the parts are in their initial positions the weight 55 is sufficient to actuate the lever 6 and compress the spring 27 to open the electric switch and to hold the armature in its right-hand position as viewed in Fig. 3. It will therefore be seen that when the magnet is first energized the movement of the armature is assisted by the spring

27. The armature may therefore be designed to have an increased pull when the electric switch is closed to lift the weight 55 out of contact with the arm 9, so that no vibrations of the armature will in any event be transmitted to the electric switch contacts. The air gaps between the extensions 62 and the pole faces being much longer than those between the surfaces 63 and the magnet, during the greater portion of the armature's movement most of the magnetic lines of force will cross the latter air gaps and the extension 62 will have little effect. However, as the armature nears its closed position the magnetic flux through the arm 62 will be considerably increased, resulting in a stronger magnetic pull. It is therefore evident that the armature may have a comparatively wide range of movement while its magnetic air gap is very small, and therefore the flow of current through the magnetic windings will be reduced to a minimum throughout the operation of the electromagnetic switch. It will also be observed that this is accomplished without permitting the armature to move so suddenly as to cause an objectionable noise when striking the buffers, and that the armature is held in its attracted position against the strong, highly elastic spring 64 which so efficiently absorbs vibrations as to almost entirely eliminate chattering and humming noises. An additional feature to prevent vibration of the armature at its pivot is the adjustable cone bearing mechanism illustrated particularly in Fig. 2, but this means for mounting the armature is not *per se* my invention.

The lubricating appliance illustrated in Fig. 2 is the invention of August Sundh and covered in his co-pending application above referred to.

In Fig. 4 is shown a modified form of armature in which the central portion movable between the poles has inclined faces 63′ and also straight faces 64 substantially parallel with the adjacent sides of the pole faces when the armature is in its attracted position, but spaced a small distance therefrom. The effect produced by this construction differs somewhat from that in Fig. 3, in that the air gaps between the pole pieces and the inclined faces 63′ are reduced during the inward movement of the armature only during the first part of such movement and remain substantially constant during the latter part thereof, while the air gaps between the pole faces and the armature extensions 62 are diminishing. By this arrangement the electromagnetic dash-pot action is increased, due to the parallel faces 64. It should also be observed that the middle portion of the armature is wider so as to enable the armature to be moved over a longer distance than in Fig. 3. There being also more iron in the magnetic circuit, the flow of current through the magnet winding is still further reduced when the armature reaches its attracted position.

In operation the parts assume the positions shown in Fig. 3 when the magnet is energized. If now the current flow through the magnet winding is interrupted, the armature will be released and the weight 55 will move downwardly against the arm 9 of the bell-crank lever 6, forcing the arm 8 against the roller 14 against the action of the spring 27 to effect the opening of the electric switch, which may be of any type desired, that herein disclosed being merely by way of illustration. When the magnet is again energized the armature will be attracted inwardly gently to lift the weight 55 from connection between the same and the electric switch. The spring 27 exerts a pressure through the switch lever and the bell-crank lever to assist the upward movement of the weight 55 and to close the electric switch and hold the same closed entirely independently of the electromagnet and its armature, so that by no possibility can vibrations from the latter be transmitted to the switch contacts. As before explained, when the armature is moved inwardly, the small blow thereof is absorbed by the buffer 60 and the spring 56 and chattering noises are almost entirely eliminated by the strong, elastic spring 56 and the cone bearing mechanism.

I have disclosed a construction embodying my invention in a practical form, but I do not wish to be limited to this construction exactly, as various changes in the details and arrangements of parts might obviously be made by those skilled in the art without departing from the spirit and scope of the invention.

Having thus fully described the invention, what I claim and desire to have covered by Letters Patent of the United States is:—

1. The combination with a magnet having pole pieces arranged in a vertical plane, of an armature pivoted above the pole pieces and having a depending portion in front of the pole pieces, and a portion extending rearwardly from the pivot and of sufficient weight to swing the armature to initial position when the magnet is deënergized.

2. The combination with a vertical base, of a bracket secured thereto, and an electromagnet beneath the bracket and removably secured thereto with its pole faces in a plane parallel with the base.

3. The combination with a vertical base, of a bracket comprising vertical side members secured to the base and a horizontal uniting web, and an electromagnet secured to the under surface of the web.

4. The combination with a vertical base, of a bracket comprising side members se-

cured to the base and extending outwardly therefrom, a horizontal web uniting the side members, a U-shaped electromagnet secured to the under surface of the web with its poles facing away from said base, and an armature pivoted between said side members near their outer ends and having a weighted portion extending from the pivot toward the base.

5. The combination with an alternating current electromagnet, of an armature having a central portion movable between the pole pieces of the electromagnet and extensions movable to and from the pole faces, said central portion having inclined surfaces and substantially parallel surfaces with respect to said pole pieces, a spring for absorbing vibrations of the armature, and substantially non-chattering cone bearing mechanism to pivotally support the armature.

6. The combination with an electromagnet, of an armature, a spring buffer for the armature, and a hard metal device for holding the base of said spring rigidly in position in one of the poles of the magnet.

7. The combination with an electromagnet, of an armature, a spring buffer for the armature, and a plug of hard metal for holding said spring rigidly in position in a recess in one of the poles of the magnet.

8. The combination with an electromagnet, of an armature therefor, a steel spring in a recess in one of the pole pieces and projecting a short distance from the end surface thereof, and a hard metal plug for riveting or clamping said spring to said pole piece.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

DAVID LARSON.

Witnesses:
CHAS. M. NISSEN,
JAMES G. BETHELL.