J. D. IHLDER.

ELECTROMAGNETIC SWITCH.

APPLICATION FILED OCT. 11, 1907.

936,724.

Patented Oct. 12, 1909.

3 SHEETS—SHEET 1.

Fig. 1.

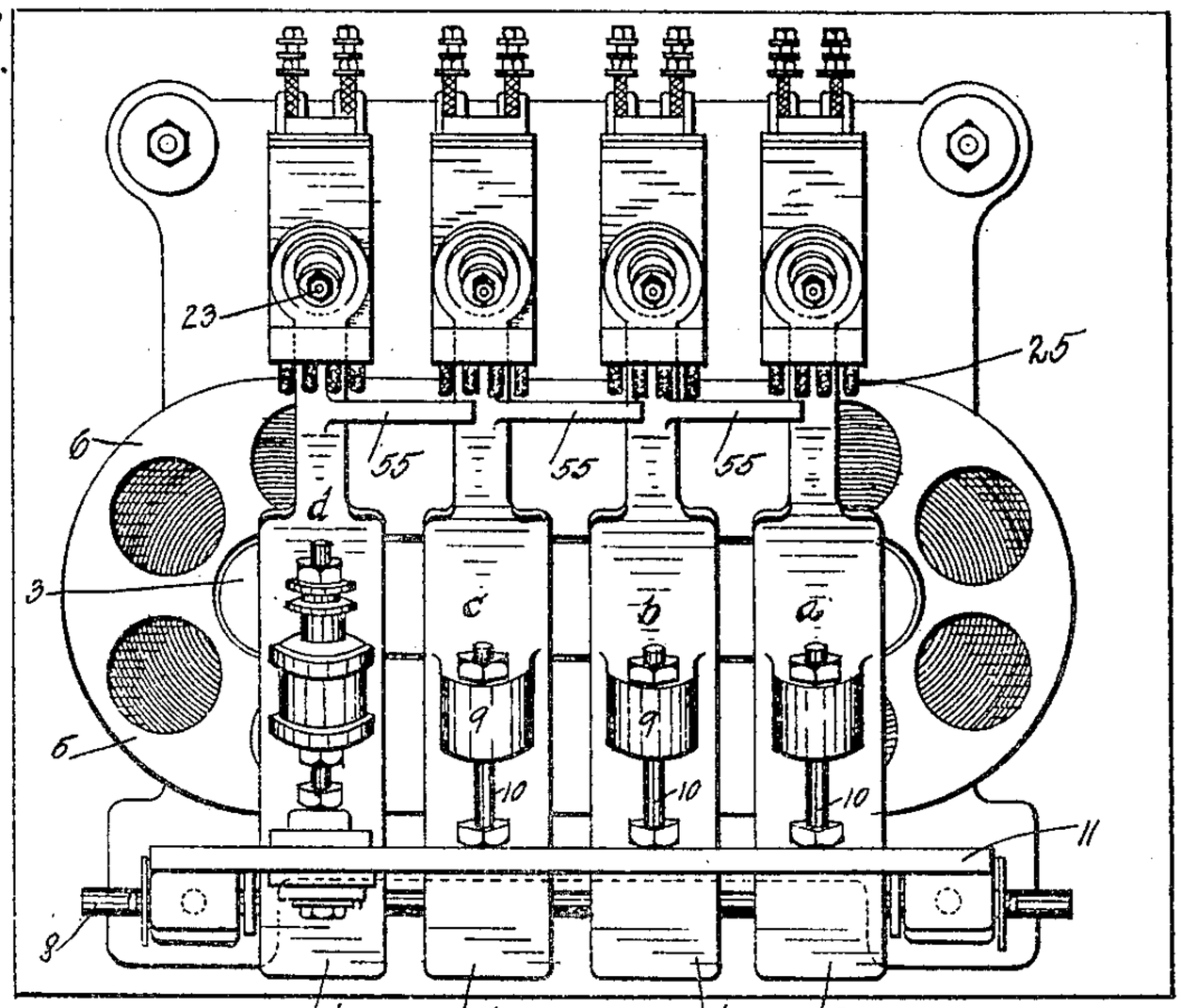
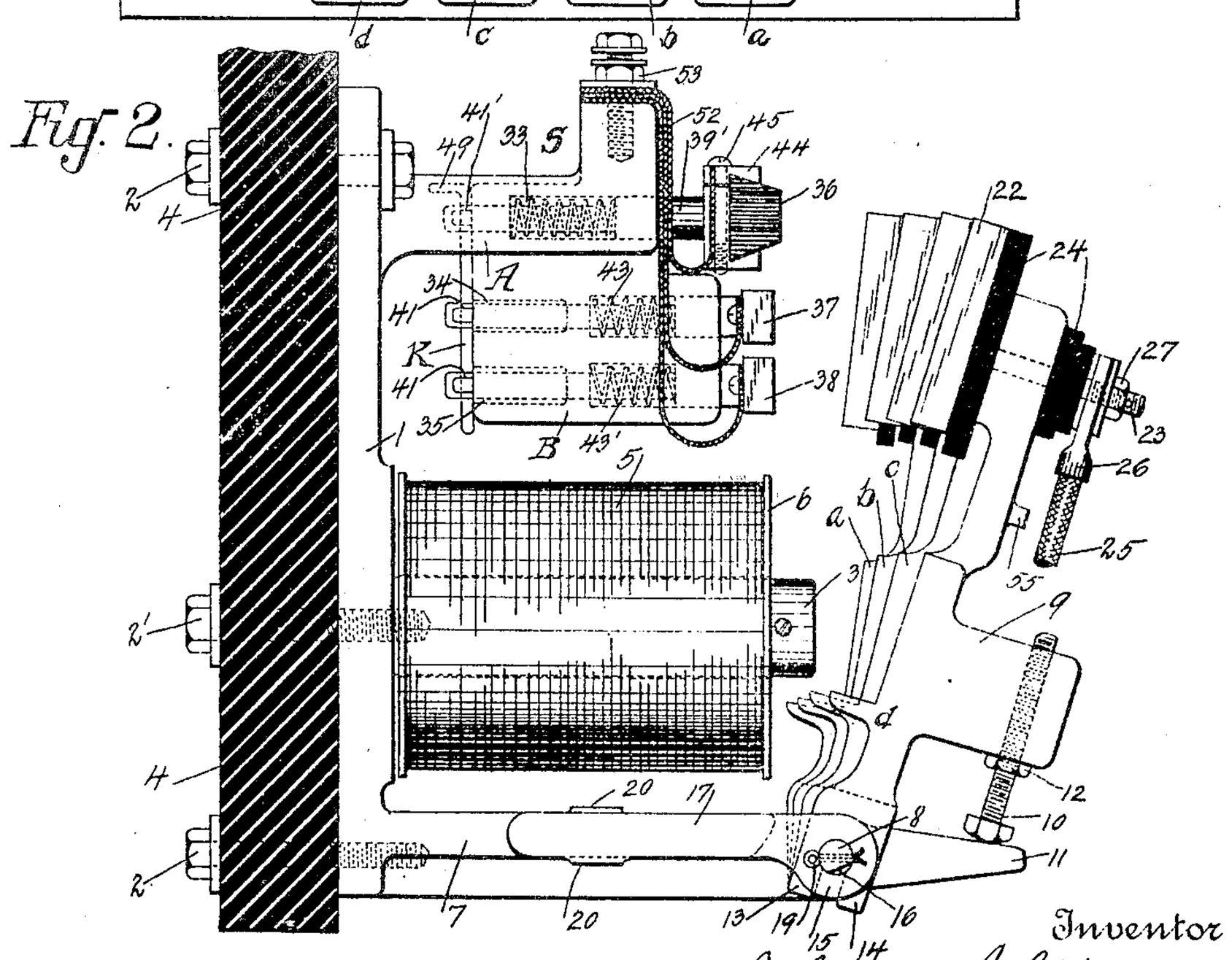


Fig. 2.



Witnesses:

Ernest L. Gale. Jr.

James G. Bethell

Inventor

John D. Ihlder

By C. M. Nissen Attorney

J. D. IHLDER.

ELECTROMAGNETIC SWITCH.

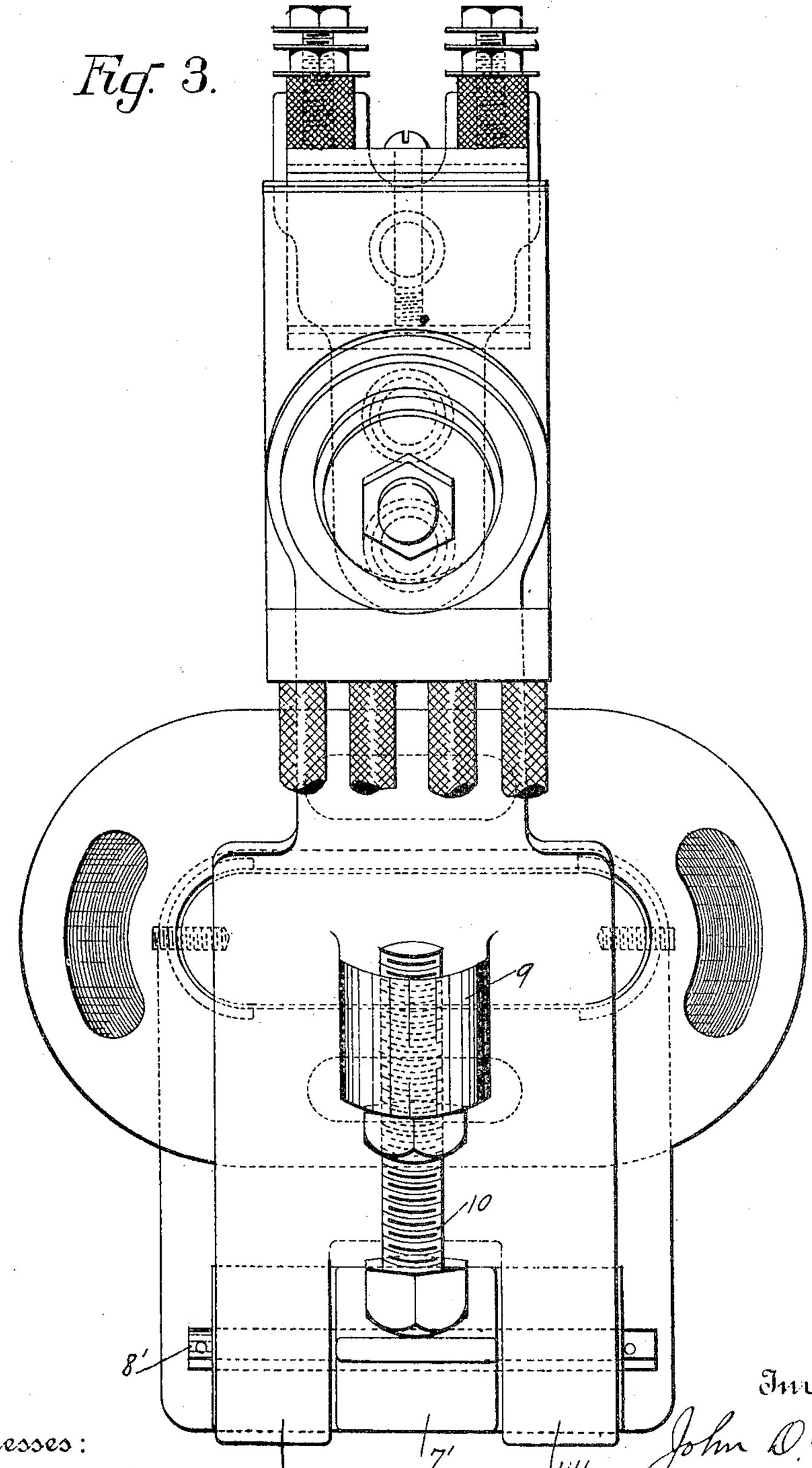
APPLICATION FILED OCT. 11, 1907.

936,724.

Patented Oct. 12, 1909.

3 SHEETS—SHEET 2.

Fig. 3.



Witnesses:

Ernest L. Gale. Jr.

James G. Bothell

Inventor

John D. Ihlder

By C. M. Nissen Attorney

J. D. IHLDER.

ELECTROMAGNETIC SWITCH.

APPLICATION FILED OCT. 11, 1907.

936,724.

Patented Oct. 12, 1909.

3 SHEETS—SHEET 3.

Fig. 4.

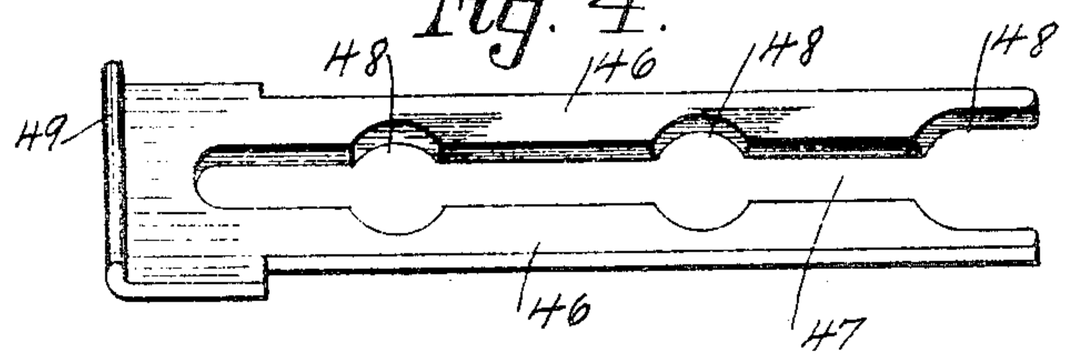


Fig. 5.

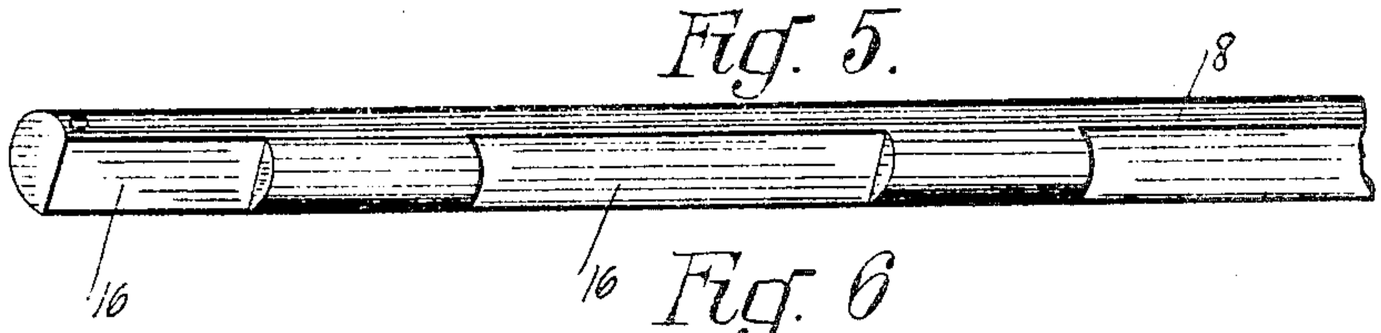


Fig. 6

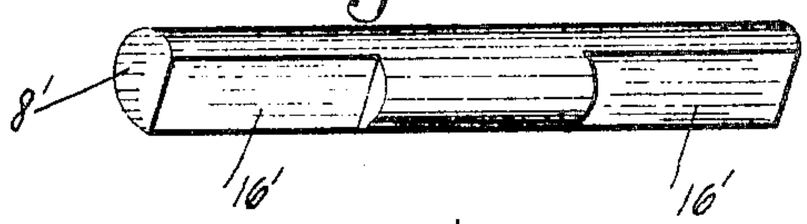


Fig. 7.

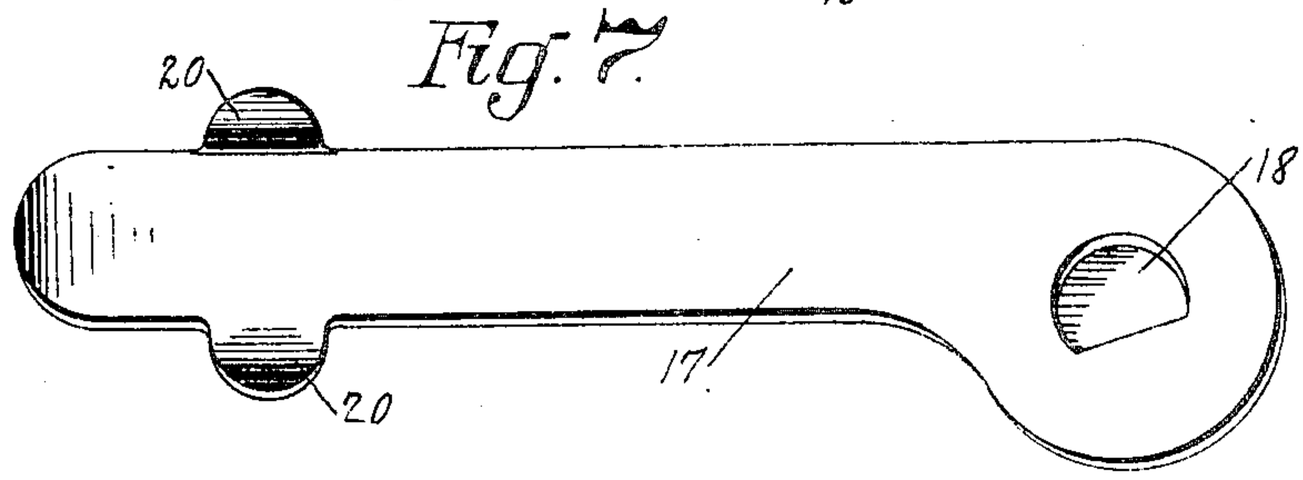


Fig. 8.

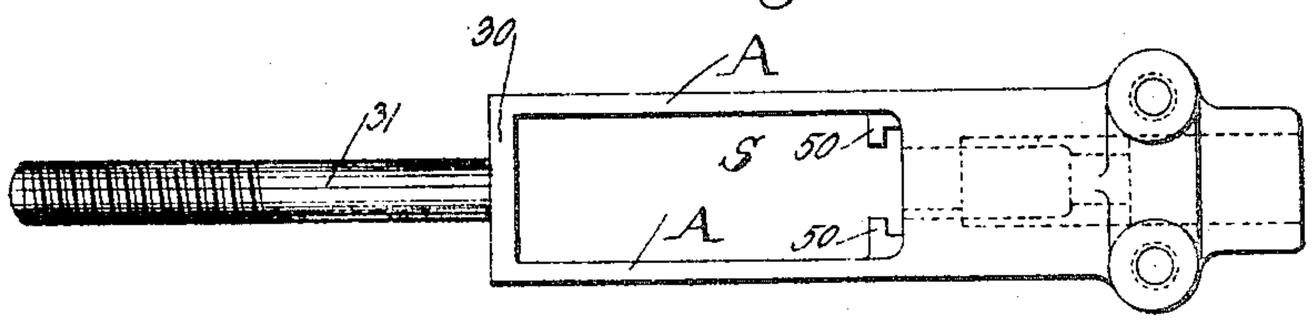
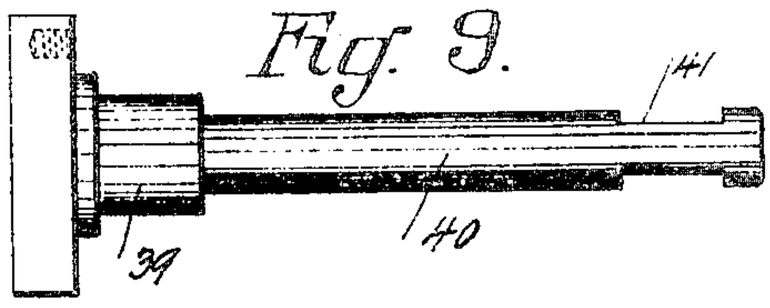


Fig. 9.



Witnesses:

Ernest L. Gale. Jr.

James G. Bethell

Inventor

John D. Ihlder

By C. M. Nissen Attorney

UNITED STATES PATENT OFFICE.

JOHN D. IHLDER, OF NEW YORK, N. Y., ASSIGNOR TO OTIS ELEVATOR COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTROMAGNETIC SWITCH.

936,724. Specification of Letters Patent. Patented Oct. 12, 1909.

Application filed October 11, 1907. Serial No. 396,980.

To all whom it may concern:

Be it known that I, JOHN D. IHLDER, residing in New York, in the county of New York and State of New York, have invented a new and useful Improvement in Electromagnetic Switches, of which the following is a specification.

My invention relates to electro-magnetic switch mechanism, and certain features of the invention are especially adapted to mechanism of this kind in which a plurality of switch arms are operated successively by an electro-magnet or magnets to close a series of electric circuits. Switches of this character are used for various purposes, a well known example of such use being found in accelerating magnets for electric motors, in which an electro-magnet operates a plurality of switches successively to gradually short-circuit the starting resistance of the motor. In multiple magnet switches of this kind the operation of the switch arms in their proper order is obtained in various ways, as, for example, by adjusting their armatures to different distances from the magnet when in open position, or by weighting the arms to different degrees. But no special means is provided to insure that the switch arms shall open in the reverse order.

One of the objects of the present invention is to provide positive means for insuring the closing of the switch arms in the proper order, and also to prevent them from being opened out of their proper order. In the case of an accelerating magnet it is necessary that the switch arms be operated in their proper order to obtain a gradual cutting out and in of the starting resistance, and to avoid the arcing which occurs when the switches are opened out of order.

A further object of the invention is to provide improved means to permit the switch arms and also the stationary contact-carrying arms to be readily removed and replaced.

With this object in view, an important feature of the invention resides in means for pivotally and removably supporting the switch arms.

Another feature of the invention resides in the means for locking the stationary contact-carrying arms in position.

Other objects of the invention will appear more fully hereinafter, and the novel combinations of elements will be pointed out in the claims.

Referring to the drawings, Figure 1 is a front elevation of a multiple switch electromagnet to which my invention is applied; Fig. 2 is a side elevation of the same; Fig. 3 is a front elevation of a single switch electromagnet; Fig. 4 is a detail view of the locking pin for the stationary contact arms; Figs. 5 and 6 are views of the pivot bolts for the switch arms of the multiple switch and single switch magnets, respectively; Fig. 7 shows a locking arm for the pivot bolt; Fig. 8 is a plan view of a support in which the stationary contacts are mounted; and Fig. 9 is a view of one of said contacts.

Figs. 1 and 2 show a multiple switch electro-magnet in which a plurality of switch arms are operated by a single magnet. The magnet frame comprises a vertical bracket 1 of magnetic material secured to a vertical base or support 4 by means of bolts 2. A horizontally disposed magnet core 3 is also secured to the face of the bracket 1 by means of the bolts 2′ which pass through the support 4 and bracket 1 and into the magnet core, the openings in the bracket and core being screw-threaded to receive the threaded ends of the bolts. The magnet winding consists of a single coil 5 wound in the usual way on a spool 6, elongated to fit the core 3. Arms 7 integral with and extending horizontally forward from the bracket 1 are provided at their forward ends with circular openings to receive a rod 8 on which are pivoted the switch arms *a*, *b*, *c*, *d*. These switch arms are made of magnetic material and extend upwardly in front of the magnet core 3 in position to be operated thereby. Each switch arm has an integral lug 9 formed thereon which is provided with a threaded opening to receive an adjustable screw bolt 10. The heads of the bolts rest on a horizontal bar 11 when the switch arms are open and limit the outward movement of the arms. The stop bolts 10 are locked in their adjusted positions by lock nuts 12. These stops 10 are adjusted so that each switch arm, commencing with the arm *a*, is somewhat nearer its armature than the next arm to the left. As

a result of this arrangement when the magnet is energized by a gradually increasing current in the winding 5, the switch arm *a* will be first moved, and then the arms *b*, *c* and *d* in regular order.

The particular means for pivotally and removably mounting the switch arms forms an important feature of this invention and is as follows. The lower end of each switch arm is widened and bifurcated to form two arms 13, 14 with a slot 15 between them. This slot is narrower than the diameter of the bearing rod 8 except at its upper end where it is enlarged and curved to an arc of a circle, and forms a bearing surface to receive the rod 8. The rod 8 (see Fig. 5) is circular in cross-section except the portions of its length which form bearings for the switch arms. These portions each have a segment cut away to form a flat surface 16 which reduces the diameter of the rod to somewhat less than the width of the slot 15. With this construction, all that is necessary to be done in removing a switch arm is to turn the rod 7 to bring the flat surface 16 in line with the slot 15, when the switch arm may be lifted right off. When the bearing rod 8 is turned to extend the flat surface 16 across the slot 15 the switch arm is locked against removal.

The bearing shaft 8 is locked in position by means of a lock arm 17 (Fig. 7). This lock arm which is made of spring brass or other resilient material, is provided at one end with a segmental opening 18 to fit on the end of the shaft 8 which projects slightly beyond the arm 7. The lock arm is secured in position on the shaft by a cotter pin 19. Near its outer end the lock arm is formed with lugs 20 bent inwardly at right angles to the body of the arm. These lugs are adapted to straddle the arm 7 of the magnet frame, and lock the bearing shaft 8 with its flat surfaces 16 extending across the slots 15. When it is desired to remove a switch arm from its bearing rod 8, the free end of the lock arm 17 is sprung out to release the lugs 20 and then turned down, rotating the shaft 8 until the flat faces 16 are in line with the slots 15 when any switch arm can be removed by simply lifting it off the rod 8. This construction provides for the quick removal of any switch arm without removing the rod which carries it, and without the removal of split or cotter pins or other devices as heretofore in use. This construction by means of which the arms are quickly interchangeable is useful where a single switch arm is used, but especially so where a number of arms are mounted on a single rod.

Each switch arm carries at its upper end a contact 22 made of copper or other metal and having a rod or stem 23 extending through the switch arm. The contact 22 and its stem 23 are insulated from the switch arm by bushings 24 of insulating material. Flexible conductors 25 are electrically connected to the contact 22 by means of a connector 26 mounted on the stem 23. The parts are clamped in position by a nut 27 on the threaded end of the stem 23.

The stationary contacts are mounted in supports S secured to the base 4. Each of these supports S comprises a pair of parallel arms A (Fig. 8) extending forward from the base 4, and a vertically arranged solid body portion B formed in one piece with the arms A and extending below said arms. The inner ends of the arms A are united by a transverse member 30 which abuts against the base 4. A rod or stem 31 extends from the part 30 through the base 4 and is screw-threaded to receive a clamping nut. The body portion B has three openings 33, 34, 35 extending therethrough, in which are yieldingly mounted the stationary contacts 36, 37, 38, arranged in vertical alinement in position to be engaged by the contact 22 on the switch arm. The middle and lower contacts are preferably made of copper and each formed with a stem consisting of short section 39 (Fig. 9) of large diameter and a longer section 40 of smaller diameter. The section 40 which is preferably circular in cross-section has segments cut away near its outer end to form a neck 41. The openings 34, 35 each comprises a section in which slides the enlarged end of the contact stem, and a smaller section to receive the part 40 of the contact stem. Coil springs 43 43′ are placed in the openings 41 behind the enlarged sections 39 of the contact stems. The upper contact 36 which is made of carbon and extends farther forward than the others in order to take up the arcing when the switch is opened, is held in a clamp 44 consisting of upper and lower members united by a screw bolt 45. The clamp 44 has a stem similar to those of the copper contacts except that the enlarged portion 39′ and the neck 41′ are longer to permit a greater range of movement of the carbon contact, the enlarged portion of the opening 33 also being made deeper for this purpose.

The contacts are secured against removal from the support S by a key K (Fig. 4). This key which is preferably made of sheet brass or other sheet metal, has a portion cut away to form a longitudinal slot 47 between parallel arms 46. The slot 47 is formed with arc-shaped enlargements 48 at distances corresponding to the distances between the contact stems. The end of the key is bent at right angles to the body to form a handle 49. The key is slidably held in the support S by lugs 50 formed on the body portion B and arranged opposite the contact stems. When in locking position the arms 46 of the key straddle the necks

41 of the contact stems with the enlarged portions 48 of the key slot below their respective contact stems. The slot 47 is just wide enough to permit a free longitudinal movement of the contact stems limited in extent by the length of the necks 41. When it is desired to remove a contact, the key is raised far enough to bring the enlarged portions 48 of the slot opposite the contact stems, when any contact may be removed. Or, the key may be lifted entirely out of the holder if desired. The key K not only locks the contacts against removal, but forms a stop to limit their movement in both directions. Flexible conductors 52 extend from each contact to binding posts 53, insuring good electrical connection between the contacts and their support S.

To insure the opening and closing of the switch-arms in their proper order, the arms *b*, *c* and *d* are provided with lateral extensions 55 which project into the path of the arms *a*, *b*, *c*, respectively. These projections may be either rigid and cast integral with the switch arm, or in the form of a spring. When the switch arms are closed, each projection 55 bears against the adjacent arm, so that each arm is held in attracted position by those to the right of it, leaving only the arm *d* free. When the arm *d* opens it frees the arm *c*, which may then open and free the arm *b*, and so on throughout the series, so that no arm can open out of its turn. In closing the arms, the reverse order takes place, as the arms *b*, *c* and *d* are each held open until the arms *a*, *b*, and *c*, respectively have closed. The same results could be obtained with other arrangements of the stops 55. Various other arrangements might be adopted to secure the same result.

If the projections 55 are in the form of springs they may each be under a moderate tension when the switch arms are closed. Each projection 55 will then tend to open its switch arm a certain distance before the succeeding arm is free to open. For example, the spring projection 55 on the arm *d* will exert a yielding pressure on the arm *c*. This pressure will react to open the arm *d* somewhat earlier and quicker than it would open otherwise, and at the same time yieldingly hold the arm *c* closed until the arm *d* has opened far enough to remove the spring 25 from the arm *c*. The switch arms therefore will not be opened so nearly simultaneously as when rigid projections are used.

Fig. 3 shows a modification in which my improved form of pivotal connection for the switch arms is applied to an electro-magnet having a single switch arm. The pivot bolt 8′ (see Fig. 6) has a central circular bearing portion journaled in the arm 7′ of the magnet frame, and end portions with flattened surfaces 16′ to form bearings for the bearing portions 14′ of the switch arm. The construction and operation is similar to that described in connection with the multiple switch magnet.

Although I have shown and described my invention as applied to an accelerating magnet in which a plurality of switch arms are operated by a single magnet, it is obvious that it might also be applied to a construction in which each switch arm is operated by a separate magnet. The invention is applied to any series of parallel switch arms that are designed to be operated successively, whether by a single magnet or separate magnets or whether used to control a motor starting resistance, or for some other purpose. Further, I wish not to be limited to details of construction and arrangement of parts shown, as various changes in these might be made without departing from the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. In an electro-magnetic switch mechanism, the combination with an electro-magnet, switch arms, and stationary contacts, of a combined lock and pivot shaft for the switch arms, and a locking key for the stationary contacts substantially as described.

2. In an electro-magnetic switch mechanism, the combination with an electro-magnet, switch arms, and stationary contacts, of a combined lock and pivot shaft for the switch arms, a locking key for the stationary contacts, and means for preventing the operation of the switch arms out of a predetermined order.

3. In an electro-magnetic switch mechanism, the combination with a magnet, of a pivot shaft rotatably mounted on the magnet frame, a plurality of switch arms mounted on the shaft and removable therefrom when the shaft is rotated to certain positions, contacts carried by the switch arms, stationary contacts carried by the magnet frame, a key for locking the stationary contacts against removal, and means for preventing the operation of the switch arms out of a predetermined order.

4. In an electro-magnetic switch mechanism, the combination with a magnet and a plurality of switch arms, of a shaft on which said arms are mounted, a plurality of stationary contacts, a locking key therefor, said shaft and key being movable into positions to either lock or release the switch arms and stationary contacts, respectively, and means for preventing the operation of said arms out of a predetermined order.

5. In an electro-magnetic switch mechanism, the combination with a magnet, of a pivot shaft, a plurality of switch arms pivoted on the shaft and removable therefrom in a direction perpendicular to the shaft when the shaft and arms are in certain relative positions, but locked against removal

when in other positions, means for limiting the pivotal movement of the arms, means for securing the shaft in position to lock the arms against removal throughout their range of pivotal movement, and means for preventing the operation of the arms out of a predetermined order when thus locked.

6. In an electro-magnetic switch mechanism, the combination with a magnet, a plurality of pivoted switch arms, and a plurality of stationary contacts, of means for locking the stationary contacts against removal, means for locking the switch arms against removal, and means for locking the switch arms against operation out of a predetermined order.

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

JOHN D. IHLDER.

Witnesses:
C. BLINN,
T. W. A. GOLDY.