J. P. COLEMAN.

ELECTROMAGNETIC APPARATUS.

APPLICATION FILED NOV. 2, 1910.

984,748. Patented Feb. 21, 1911.

3 SHEETS—SHEET 1.

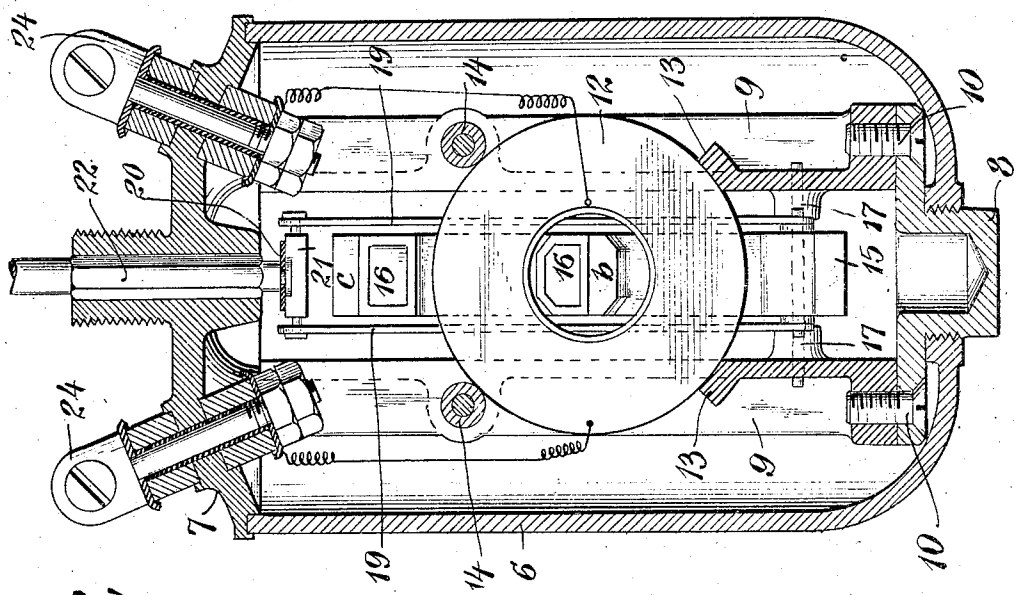

Fig. 2,

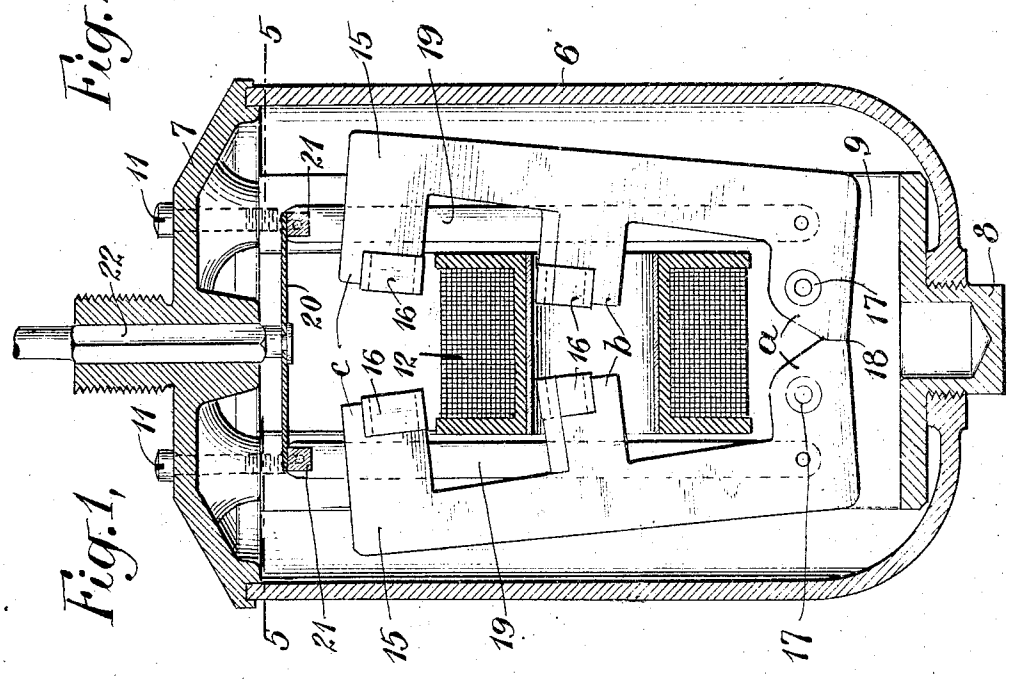

Fig. 1,

WITNESSES:

M. S. Kirkland

A. L. Venable

INVENTOR

John P. Coleman

BY

Geo. E. Crume

His ATTORNEY

J. P. COLEMAN.

ELECTROMAGNETIC APPARATUS.

APPLICATION FILED NOV. 2, 1910.

984,748. Patented Feb. 21, 1911.

3 SHEETS—SHEET 2.

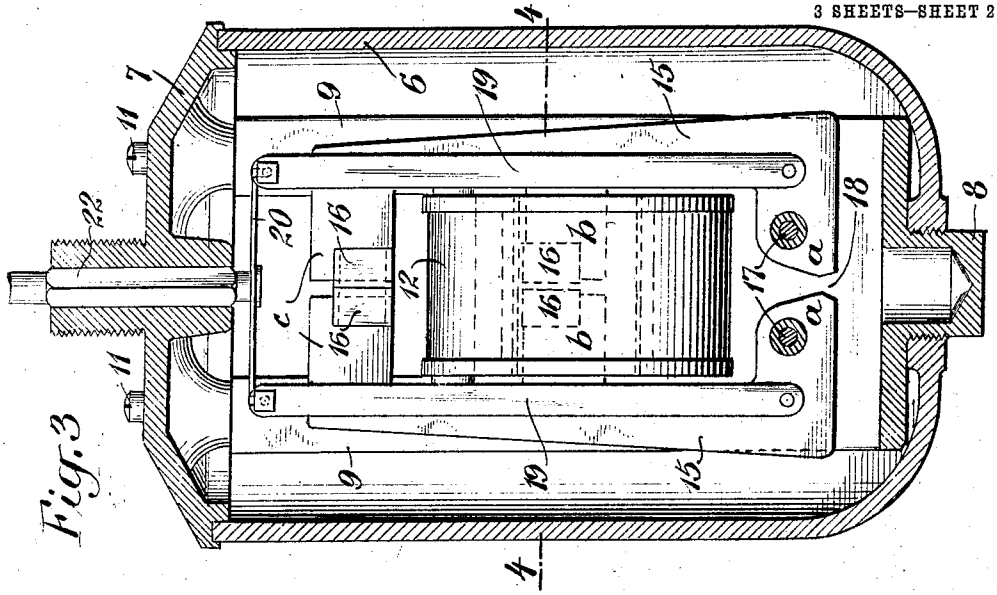

Fig. 3

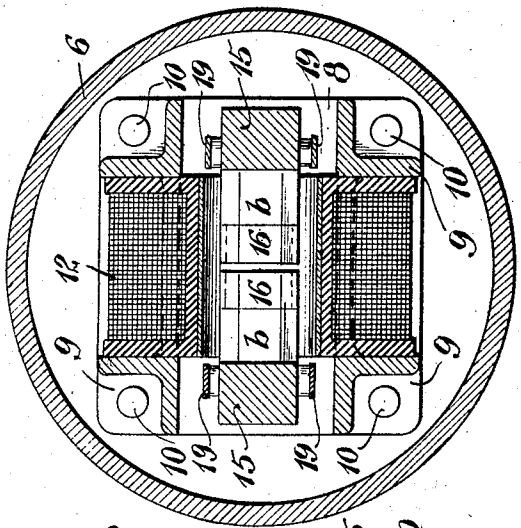

Fig. 4,

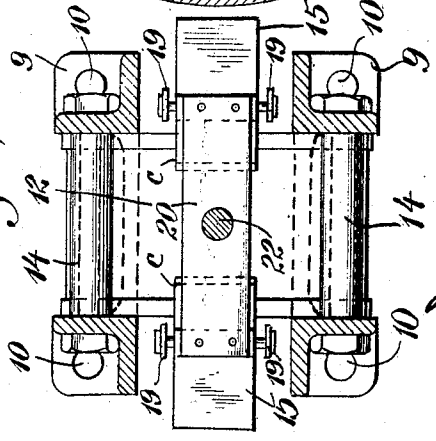

Fig. 5,

WITNESSES:

M. S. Kirkland

A. L. Voncill

INVENTOR

John P. Coleman

BY

Geo. E. Crum

His ATTORNEY

J. P. COLEMAN.
ELECTROMAGNETIC APPARATUS.
APPLICATION FILED NOV. 2, 1910.

984,748. Patented Feb. 21, 1911.

3 SHEETS—SHEET 3.

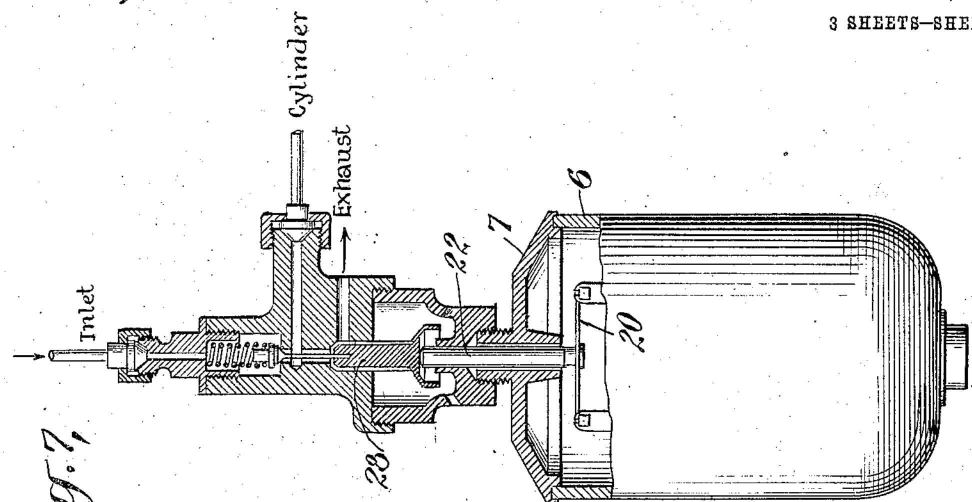

Fig. 7.

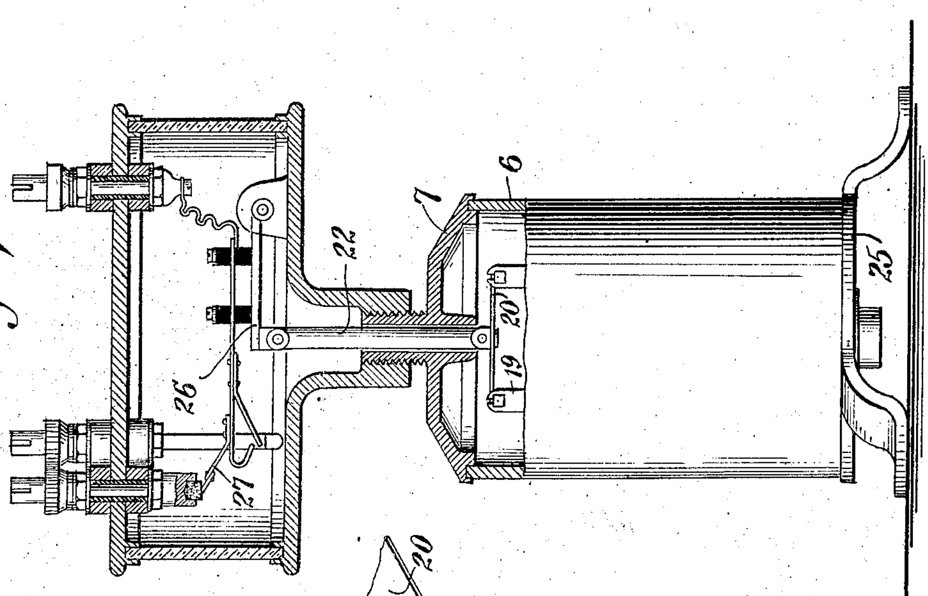

Fig. 6.

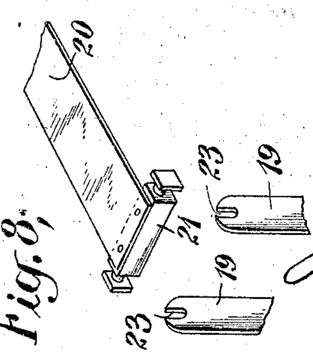

Fig. 8.

WITNESSES:
M. S. Kirkland
A. L. Verrill

INVENTOR
John P. Coleman
BY
Geo. E. Crane
His ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN P. COLEMAN, OF NEW YORK, N. Y., ASSIGNOR TO THE UNION SWITCH & SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ELECTROMAGNETIC APPARATUS.

984,748. Specification of Letters Patent. Patented Feb. 21, 1911.

Application filed November 2, 1910. Serial No. 590,314.

To all whom it may concern:

Be it known that I, JOHN P. COLEMAN, a citizen of the United States, and a resident of the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Electromagnetic Apparatus, of which the following is a specification.

My invention relates to electro-magnetic apparatus of the type adapted to be operated by alternating current, and particularly to apparatus of this character adapted to control such devices as a pin-valve for pneumatic apparatus, the armature or movable member of a relay device, or similar mechanism.

An object of my invention is the provision of apparatus of this character which will operate with a minimum amount of chattering, and with a maximum amount of holding power for a given consumption of energy.

I will describe one form of apparatus embodying my invention, and then point out the novel features thereof in claims.

In the accompanying drawings, Figure 1 is a view showing in side elevation, partly sectioned, one form of electro-magnetic apparatus embodying my invention. Fig. 2 is a view showing in end elevation, partly sectioned, the apparatus shown in Fig. 1. Fig. 3 is a view similar to Fig. 1, but showing the parts of the apparatus in their closed or energized positions. Fig. 4 is a sectional view on the line 4—4 of Fig. 3, and Fig. 5 is a sectional view on the line 5—5 of Fig. 1. Fig. 6 is a view showing an application of an electro-magnetic apparatus embodying my invention to the operation of the armature or movable contacts of an electric relay. Fig. 7 is a view showing the application of such an apparatus to the operation of a pin-valve for pneumatic apparatus. Fig. 8 is a view showing in detail certain mechanical features of the apparatus shown in the preceding views.

Similar reference characters refer to similar parts throughout the several views.

Referring now to the first five figures of the drawings, the numeral 6 designates an inclosing cover of aluminum, glass or other suitable material. 7 represents the upper end of a frame formed by its union with bottom plate 8 and the uprights 9. On the lower end of the frame is a stud 8, for securing the cover 6. The two supporting brackets 9, 9, are held in place by means of screws 10 which pass through the base plate portion 8 of the frame. These brackets extend upward to the top-plate 7, to which they are secured by means of screws 11, as shown in Fig. 1. Mounted between the two brackets 9, 9, is a solenoid coil 12. This coil is supported, as shown in Fig. 2, on shoulders 13 formed by slightly flaring out the upper edges of the webbed portions of the brackets 9, 9; and the coil is further held securely in place by means of bolts 14 passing between the two uprights of the supporting frame of the upper portions of the brackets 9, 9, as shown in Figs. 2 and 5. 15, 15, designate two armatures which are mounted to have relative movements. One armature may be stationary and the other pivotally mounted to have movement relatively to the stationary one, or both may be pivoted. As here shown both are pivotally mounted between the two brackets 9, 9. The armatures are preferably of soft iron and laminated. Each of these armatures in the form herein shown, comprises an upright body portion and three horizontally disposed arms, the latter being designated in the drawings as *a*, *b* and *c*. Of these arms, the arms *a* serve as supports for the pivot pins 17, while the arms *b* and *c* perform the functions of pole-pieces, and for this purpose are each provided with a "shading-band" or short-circuiting coil 16 comprising a band of copper or other good electrical conductor passing around approximately one-half of the area of the face of each of these pole-pieces. Th arrangement is clearly shown in Figs. 1 and 2. The object of these shading bands is to prevent as far as possible the total deënergization of the pole-pieces during the periods of reversals of the alternating current. The shading-bands preferably extend outward a small distance from the faces of the pole-pieces as shown, for the purpose of preventing the actual contact of the iron of the two armatures when the latter are in their energized or closed positions.

The armatures are so arranged that the pole-pieces *b* enter the hole of the solenoid coil 12, while the pole-pieces *c* pass above the coil 12 and meet at a greater radius from the point of pivoting 17. The upper edges of pole-pieces *b* are beveled as also the shading-bands 16 on these pole-pieces, as shown in Figs. 1 and 2, for the purpose of

avoiding interference with the interior surface of the coil 12. It will be noted in Figs. 1 and 3 that the adjacent ends of the legs or bearings *a* are so shaped that when the armatures are "closed" or drawn together until their pole-pieces *b* and *c* are in contact respectively, as shown in Fig. 3, there is an opening or air-gap between the ends of the bearings *a* at the point 18. When, however, the armatures are permitted to fall apart by rotation on their pivots, this air-gap 18 becomes smaller until the bearings *a* come into contact at that point, and the armatures are then held in the positions shown in Fig. 1.

Having thus described the essential elements of the electro-magnetic apparatus embodying my invention, I will explain the operation of this apparatus, and will then describe a means of adapting it to the performance of work.

As hereinbefore explained, the armatures are so shaped in the portions adjacent to their pivots as to normally form a closed magnetic circuit at the point 18, and to effect an opening of the circuit at that point when the armatures have assumed their closed or energized positions as shown in Fig. 1. When an electric current is passed through the coil 12 a magnetic flux is developed through the center pole-pieces *b* and the pivoted arms *a* of the armatures. Under the influence of this flux the armatures are drawn together, opening the magnetic circuit at the point 18 and bringing the pole-pieces *b* and *c* into close relation respectively. The effect of this closing together of the armatures is to establish a magnetic circuit of relatively low reluctance through the center and upper pole-pieces *b* and *c*, at the same time making the reluctance relatively high in the path originally taken by the flux through the center pole-pieces *b* and the bearings *a*. Consequently the preponderance of magnetic flux will take the upper path, and this path being at a large radius from the point of support of the armatures, a greater holding power or torque is obtained than is possible when the magnetic flux is caused to flow always in the same path. Likewise there is a relatively small tendency to "chatter" for a given amount of energy in the coil 12.

Referring again to the first five figures, I will describe a means for utilizing the movements of the electro-magnetic apparatus hereinbefore described, for the performance of work.

The numerals 19 designate four vertical links pivotally secured to the armatures 9, 9 as shown particularly in Figs. 1 and 2. Mounted at the upper ends of these links is a flat flexible plate 20 of thin bronze or other suitable flexible material, to the center of which is secured a rod 22 through which motion is transmitted to any device which is to be operated by the electro-magnetic apparatus. By means of this flexible plate 20, excessive pressure is avoided on the device to be operated, and some range is provided for wear in the latter and in the connections without readjustment of the parts. The flexible plate 20 is preferably connected with the vertical links 19 in a manner similar to that shown in detail in Fig. 8. Referring to this view it will be seen that vertical slots 23 are cut into the upper ends of the links 19, and that blocks 21 of cold rolled steel or other suitable material turned down near each end to fit the slots 23, are riveted to the plate 20 at or near the ends of the plate. The plate 20 may therefore easily be removed from the links 19 by raising it, in case of necessity, to disassemble the apparatus.

Referring to Fig. 2, I have here shown two terminal posts 24 fitted to the cover portion 7 of the inclosing case, by means of which electrical connections may be led to the solenoid coil 12.

Referring now to Fig. 6, I have here shown an application of an apparatus embodying my invention to the operation of the armature or movable contacts of an electric relay device. 6 designates as before the inclosing case which, for this particular application, is preferably provided with a supporting base 25. The operating rod 22 is for this application pivotally secured to the flexible plate 20, and again pivotally secured at its upper end to a pivoted armature 26 carrying contact fingers 27. The arrangement of the contacts, contact fingers, terminal posts, etc., of a relay device of this type is too familiar to require further description.

Referring now to Fig. 7, I have here shown the application of an apparatus embodying my invention to a "pin-valve" device for pneumatic apparatus. 28 designates a pin-valve, which is shown as being raised by means of the rod 22 for the admission of air or other fluid from the inlet to the cylinder or other place in which the fluid is desired. When the upward pressure on the rod 22 exerted by the electro-magnetic apparatus below is released, the valve 28 is moved downward by gravity and by fluid pressure to close the connection between the inlet and the cylinder, and to open the connection between the cylinder and the exhaust.

Having thus described my invention, what I claim is:

1. An electro-magnetic apparatus having in combination, an energizing coil, two armatures pivotally mounted to have relative movements and adapted to be excited by said coil and having two paths for magnetic flux, one of said paths being at a small radius from the pivotal points and having

the lower reluctance of the two paths when the armatures are open, and the other path being at a large radius from the pivotal points and having the lower reluctance of the two paths when the armatures are closed.

2. An electro-magnetic apparatus comprising an energizing coil, two armatures pivotally mounted to have relative movement, and two paths for magnetic flux through said armatures, one of said paths being at a small radius from the pivotal points and adapted to be energized when the armatures are open, the other of said paths being at a large radius from the pivotal points and adapted to be energized when the armatures are closed.

3. An electro-magnetic apparatus comprising an energizing coil, and two armatures pivotally mounted to have relative movement provided with arms adapted to form two magnetic paths through said armatures at different radii from the pivotal points for magnetic flux induced by said coil, the path at the smaller radius having the lower reluctance of the two when the armatures are in their open or deënergized positions, and the path at the greater radius having the lower reluctance of the two when the armatures are in their closed or energized positions.

4. An electro-magnetic device comprising an energizing coil, and two pivotally mounted armatures, said armatures being adapted to provide two paths for magnetic flux at different radii from the pivotal points, the path at the smaller radius being energized to move the armatures to their closed positions, and the path at the larger radius being energized to hold the armatures in their closed positions.

5. An electro-magnetic apparatus having in combination, an energizing coil, two pivotally mounted armatures each having two pole-pieces, the pole-pieces of one armature being opposite the corresponding pole-pieces of the other armature, said armatures having two paths for magnetic flux, one path being through the parts adjacent the pivotal points and one set of pole-pieces, said path having the lower reluctance of the two paths when the armatures are open, the other path being through the two sets of pole-pieces and having the lower reluctance of the two paths when the armatures are closed.

6. An electro-magnetic apparatus comprising an energizing coil, two pivotally mounted armatures, projecting arms carried by said armatures adapted to provide two paths through said armatures at different radii from the pivotal points for the magnetic flux induced by the coil, the path at the smaller radius being energized to move the armatures to their closed position, and an air gap in the said path opened by the closing of the armatures whereby the preponderance of flux is transferred to the path at the greater radius for holding the armatures in their closed positions.

In testimony whereof, I have signed this specification in the presence of two subscribed witnesses.

JOHN P. COLEMAN.

Witnesses:
C. C. WHITE,
JAMES CHALMERS, Jr.