No. 710,311. Patented Sept. 30, 1902.

P. V. AVRIL.

ELECTROMAGNETIC DEVICE FOR CONTROLLING THE ROTATION OF SHAFTS.

(Application filed Apr. 29, 1901.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

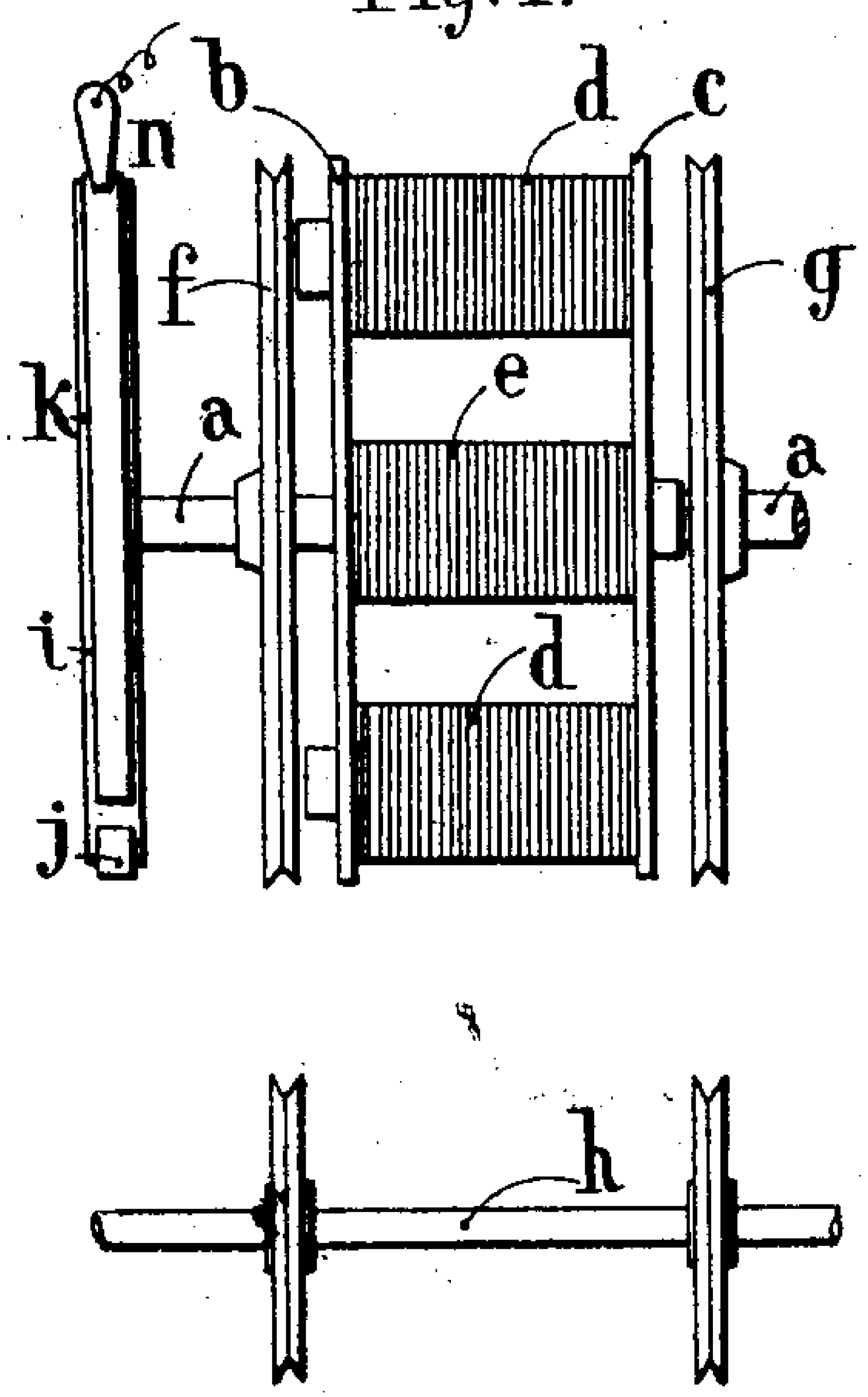
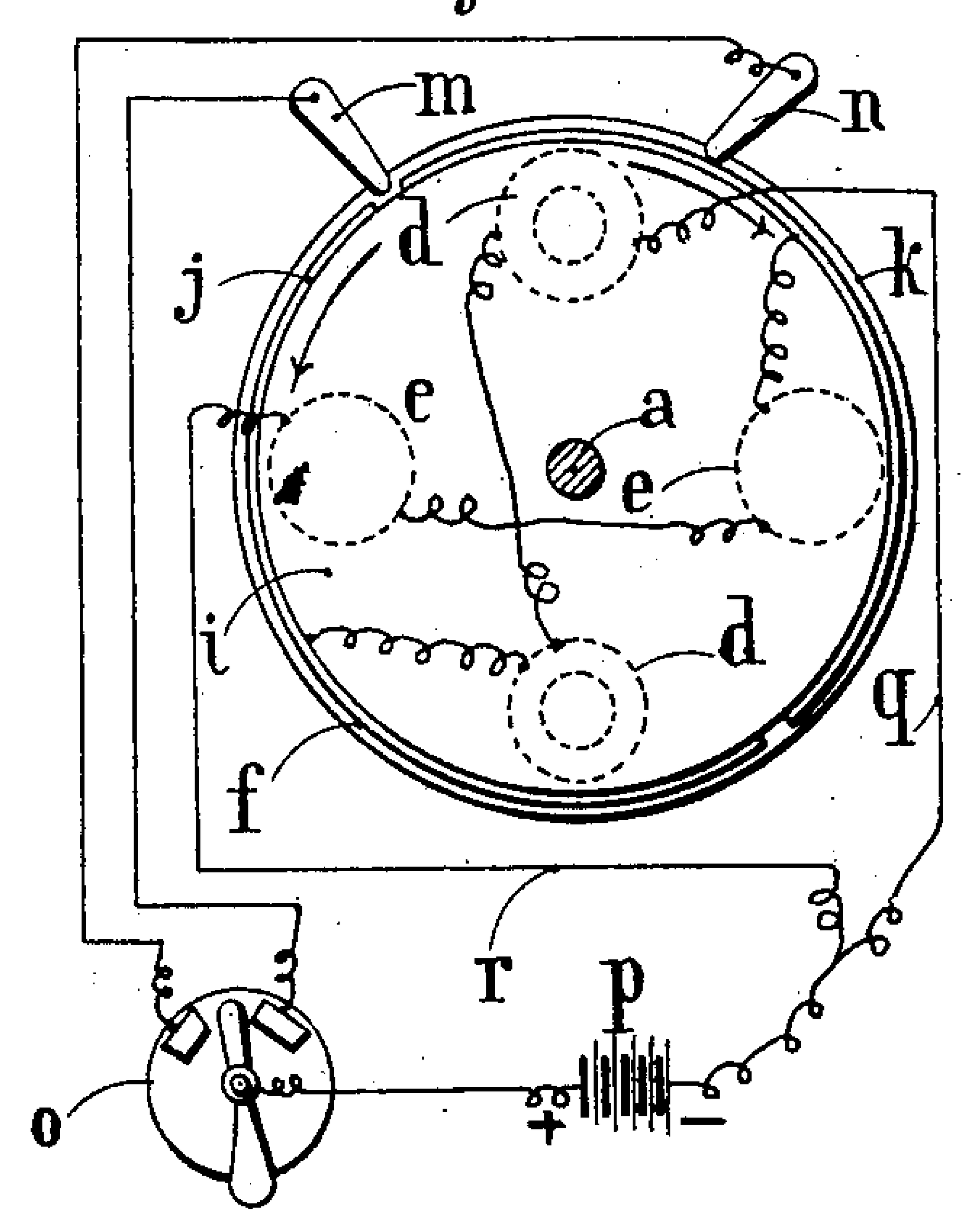


Fig. 2.



Witnesses:
C. D. Kesler
N. Louis Bogan

Inventor
Paul V. Avril
By James L. Norris.
Atty

No. 710,311. Patented Sept. 30, 1902.

P. V. AVRIL.

ELECTROMAGNETIC DEVICE FOR CONTROLLING THE ROTATION OF SHAFTS.

(Application filed Apr. 29, 1901.)

(No Model.)

3 Sheets—Sheet 2

Fig.3.

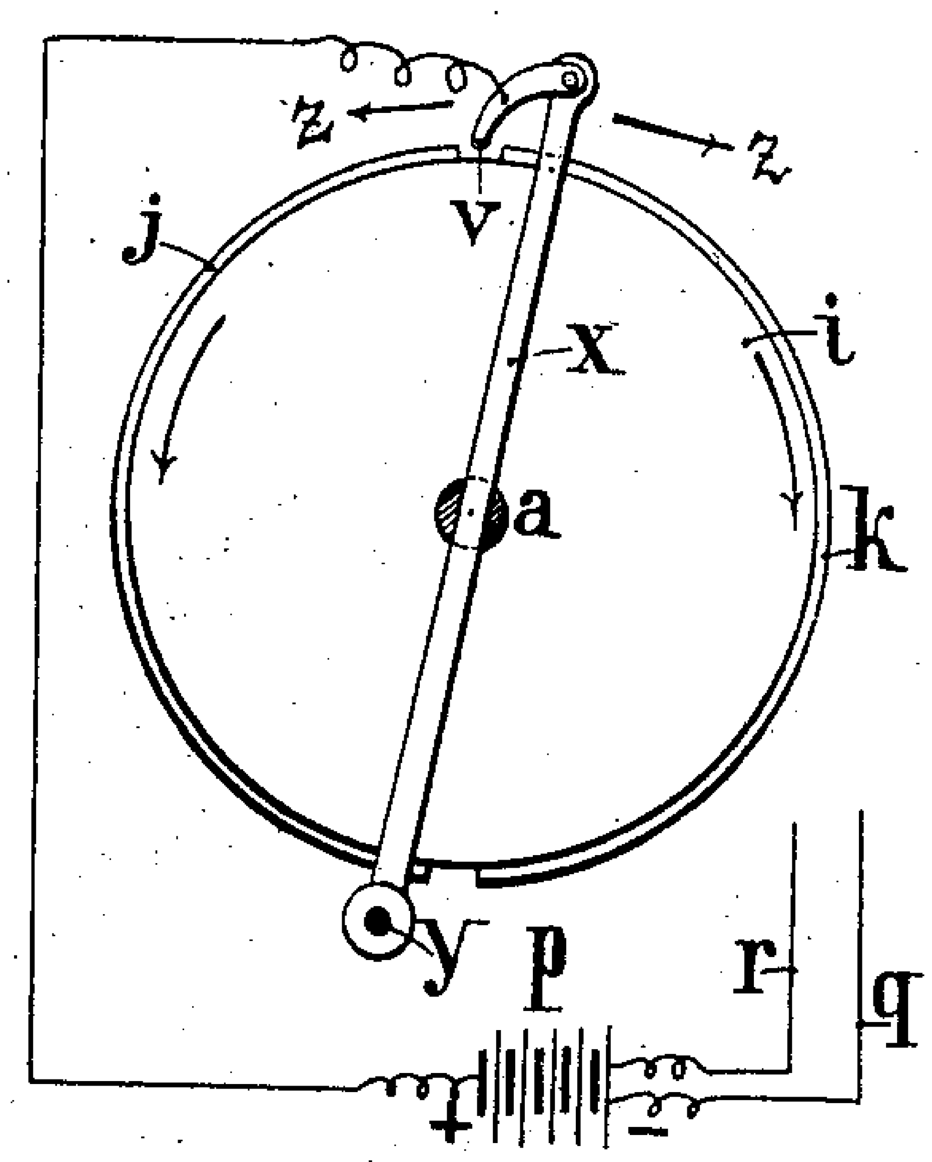


Fig.6.

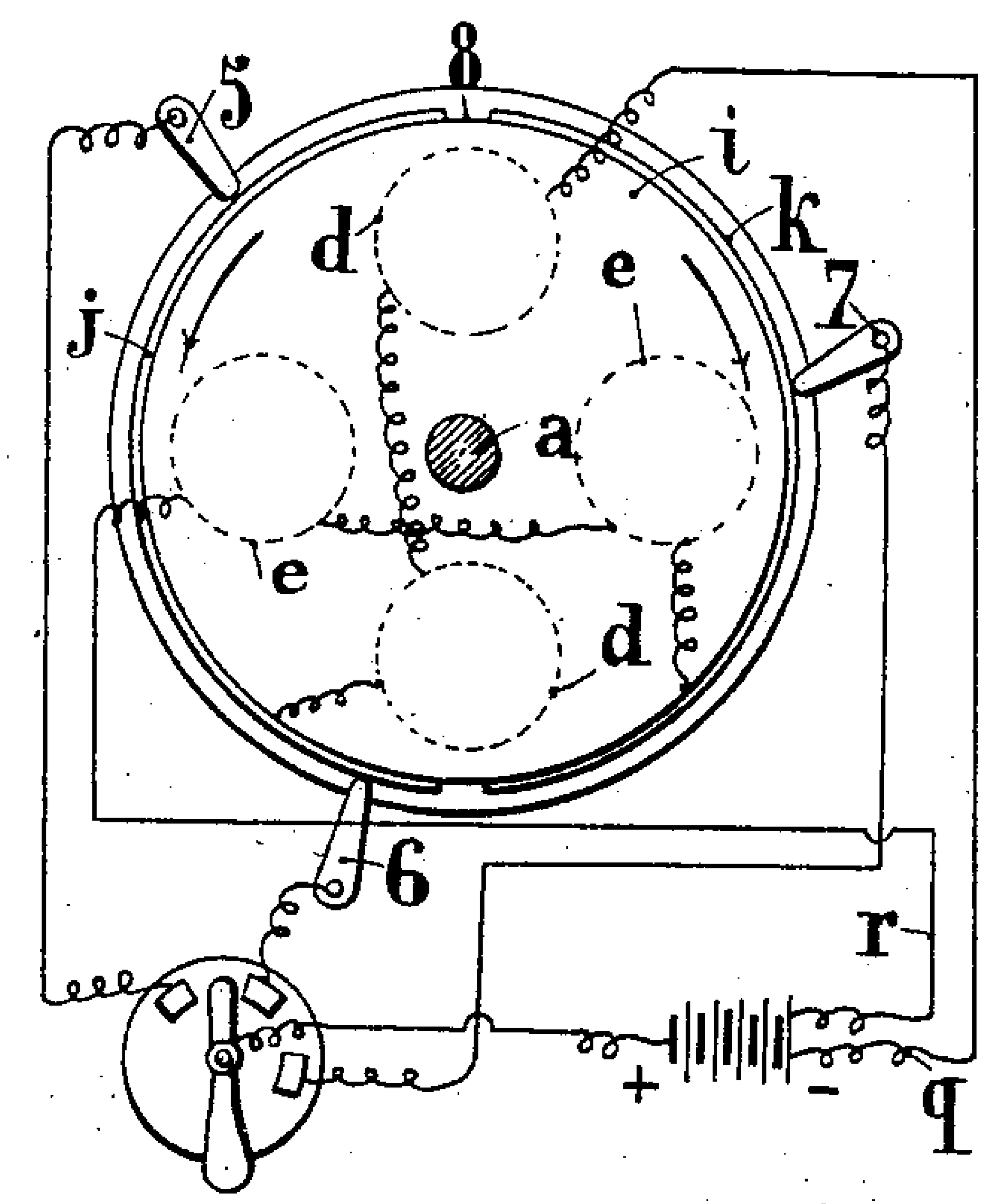


Fig.4.

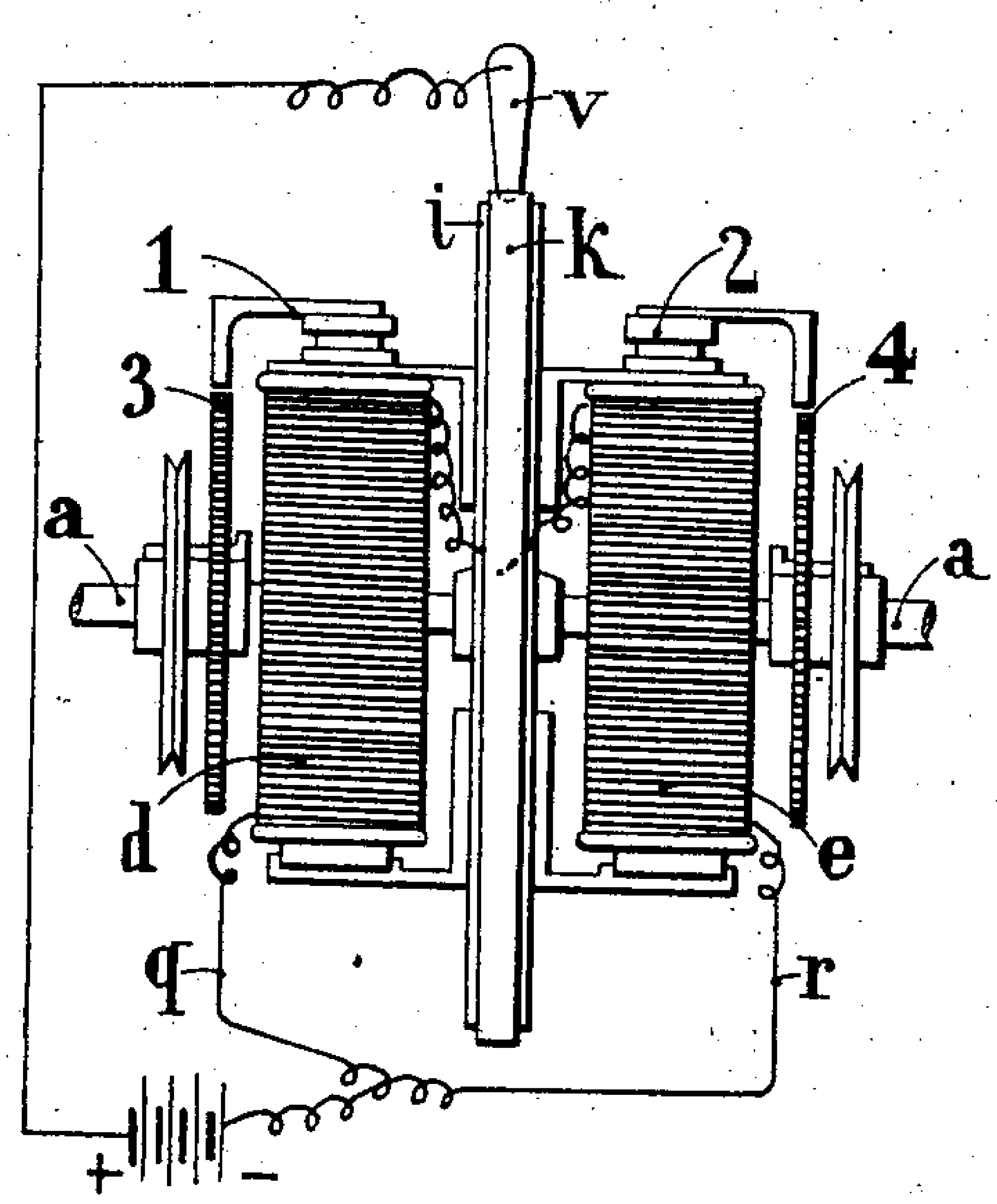
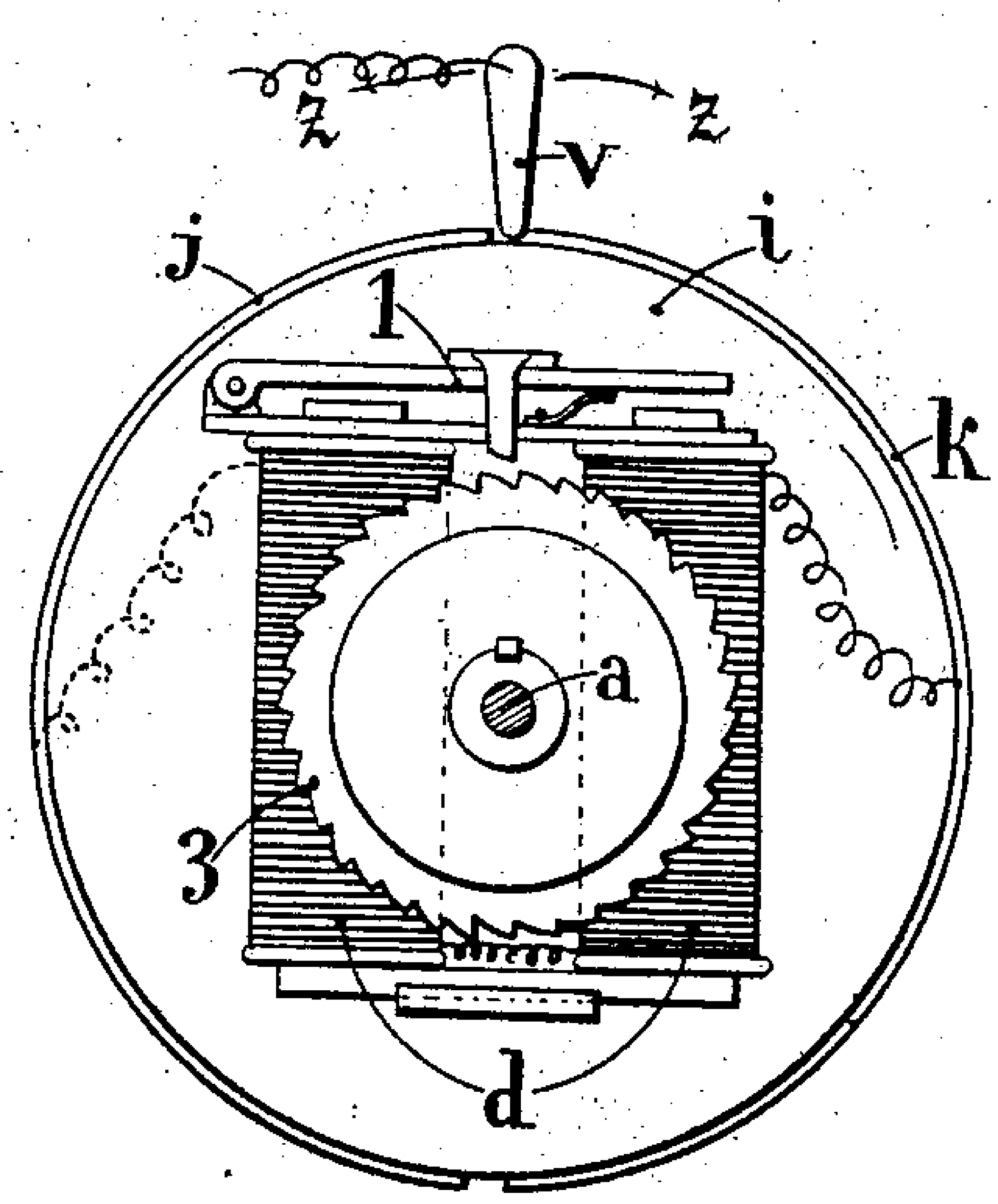


Fig.5.



Witnesses:
C. D. Kesler
N. Louis Bogan

Inventor
Paul V. Avril
By James L. Norris.
Atty

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 710,311.

Patented Sept. 30, 1902.

P. V. AVRIL.

ELECTROMAGNETIC DEVICE FOR CONTROLLING THE ROTATION OF SHAFTS.

(Application filed Apr. 29, 1901.)

(No Model.)

3 Sheets—Sheet 3.

Fig. 7.

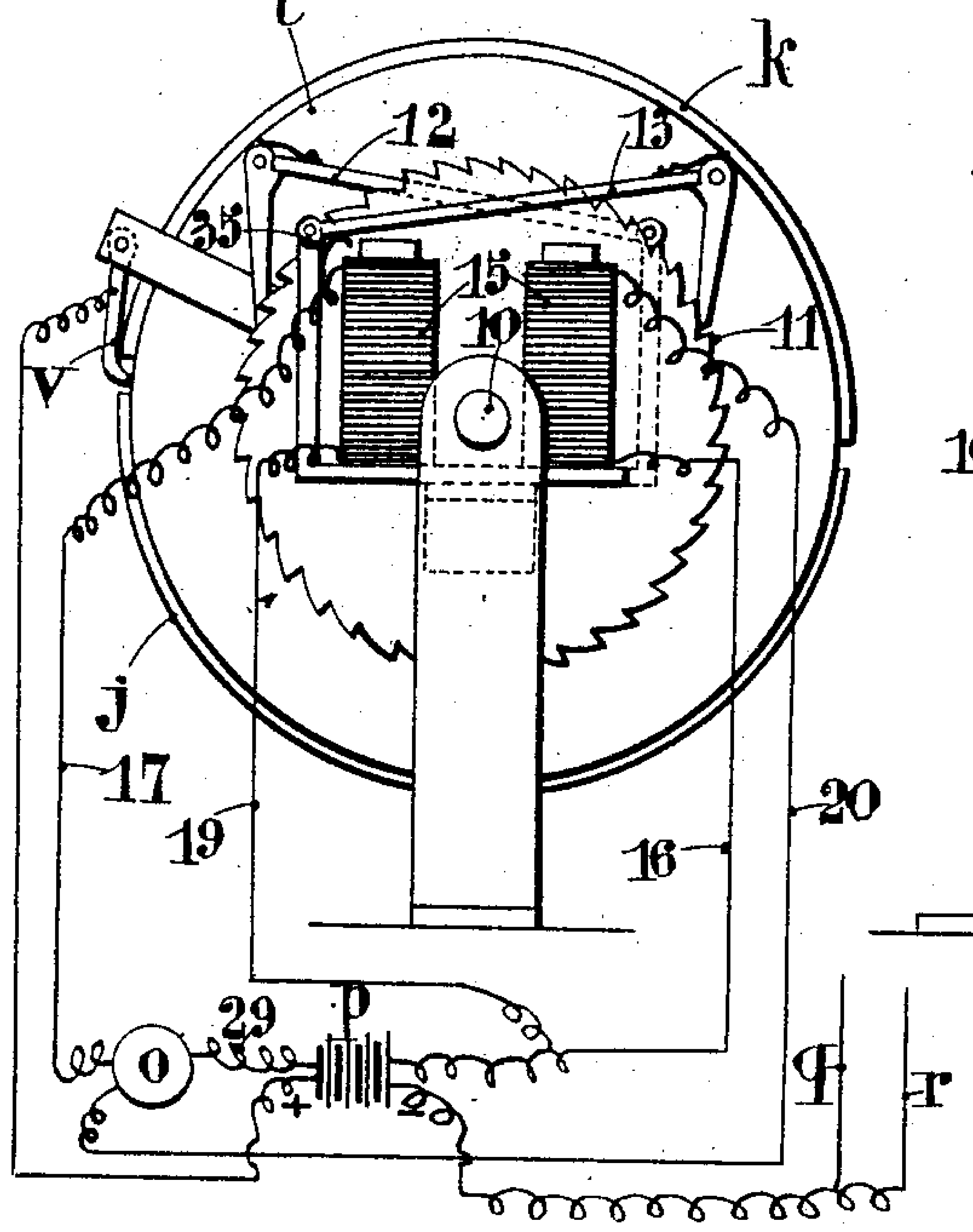


Fig. 8.

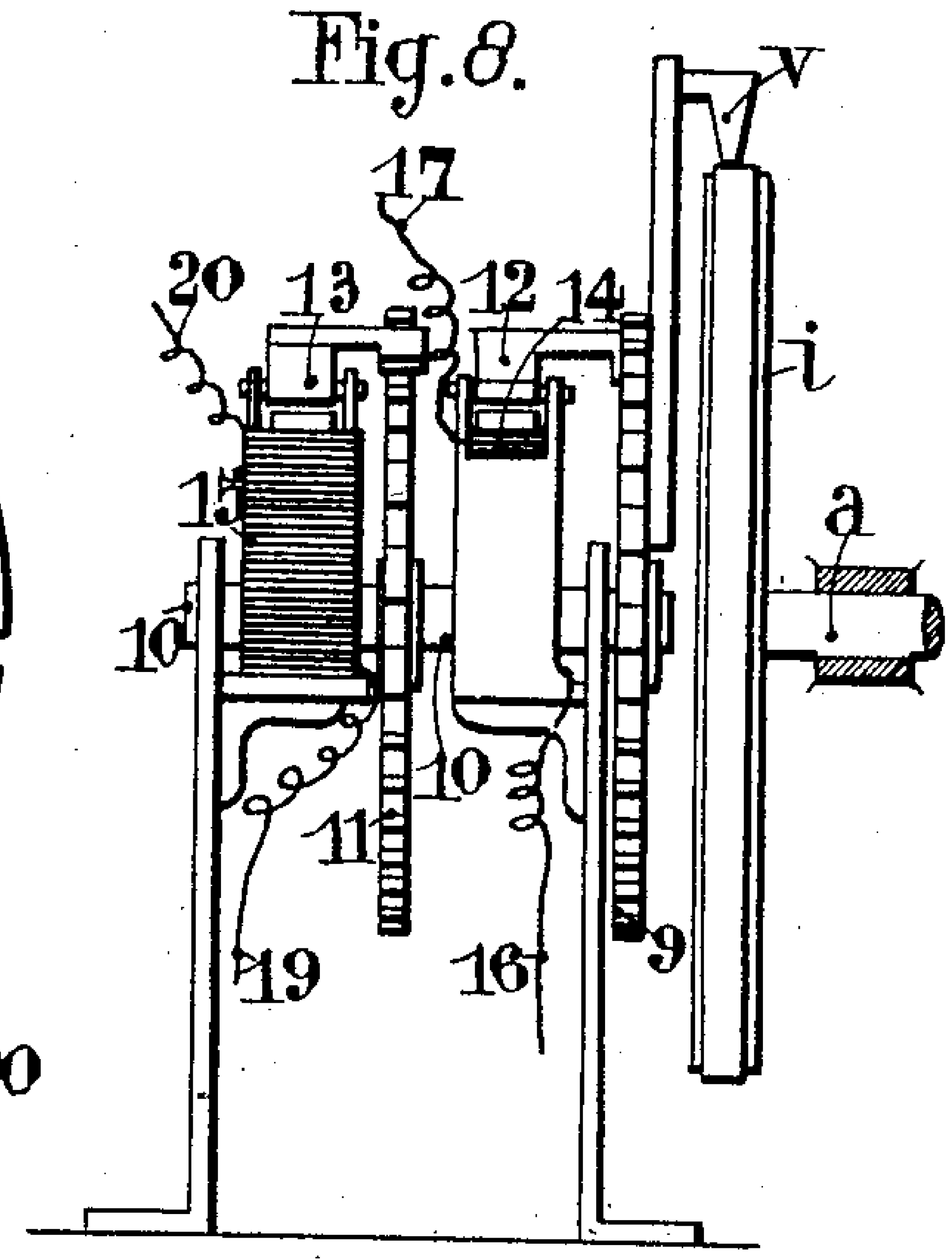


Fig. 9.

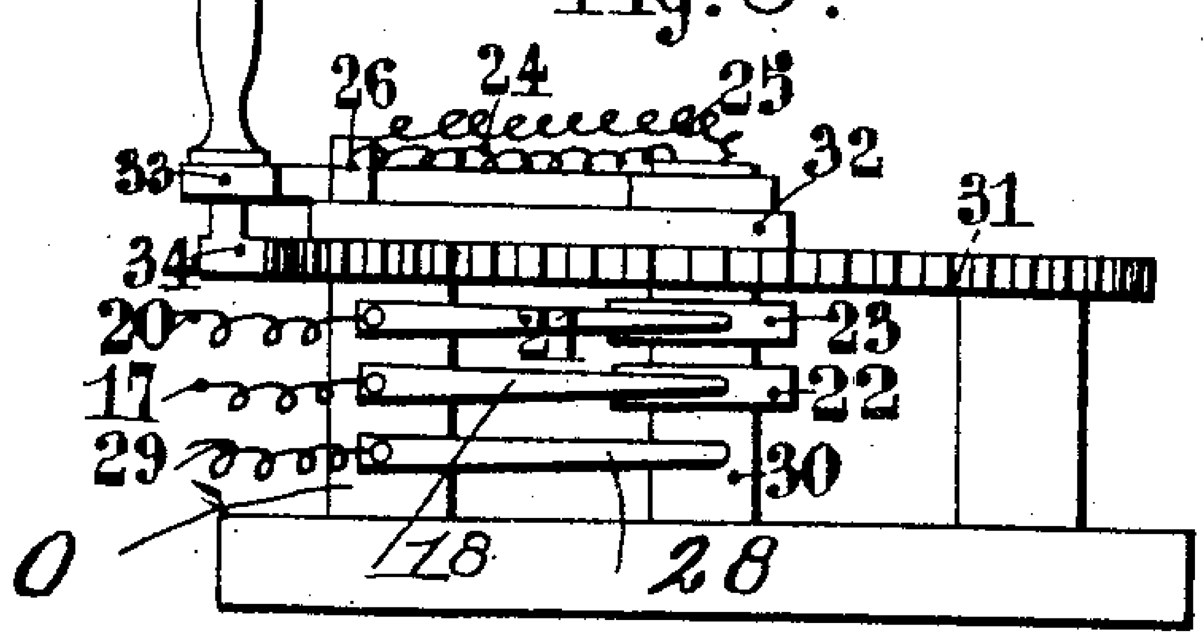


Fig. 11.

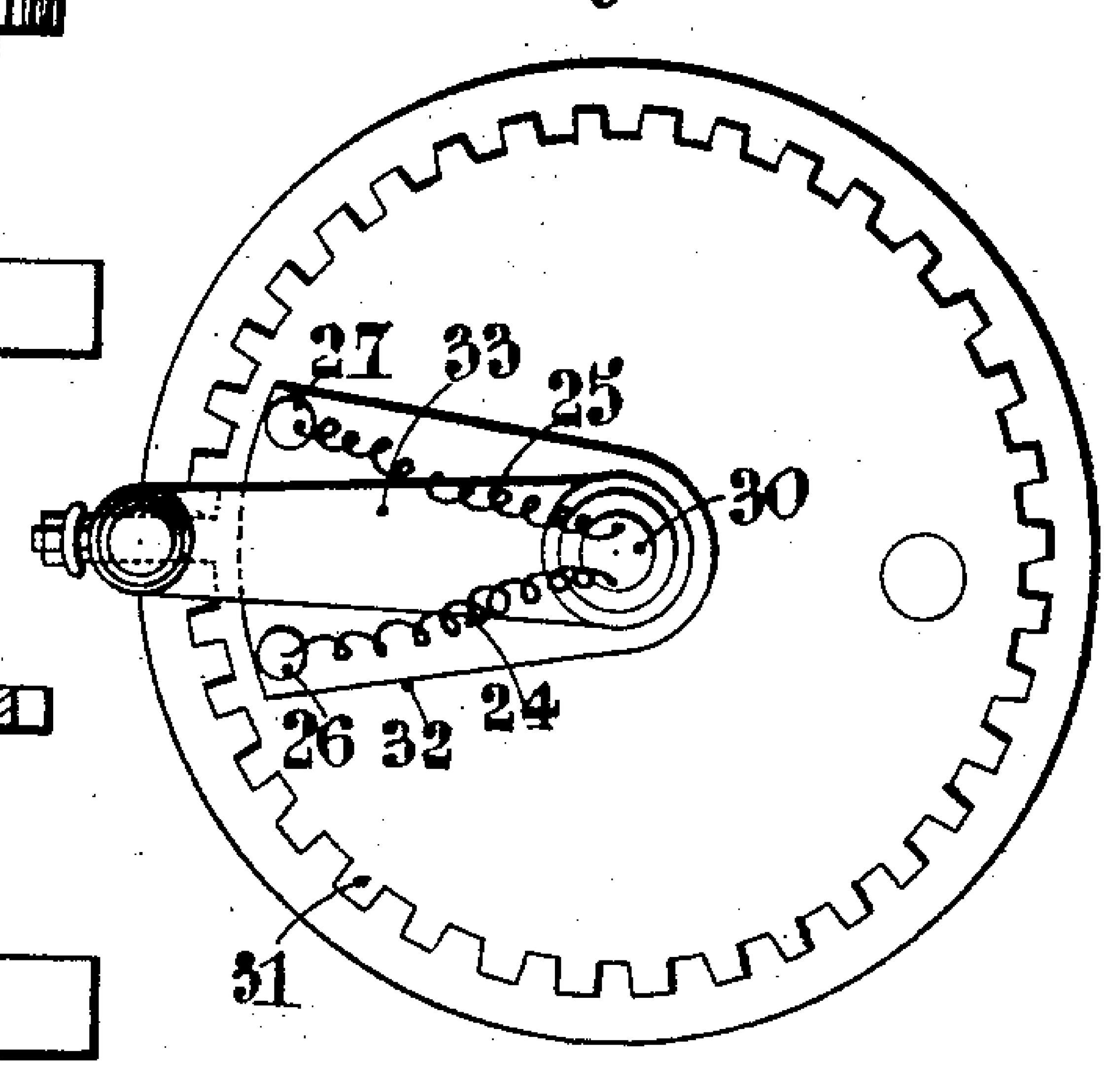
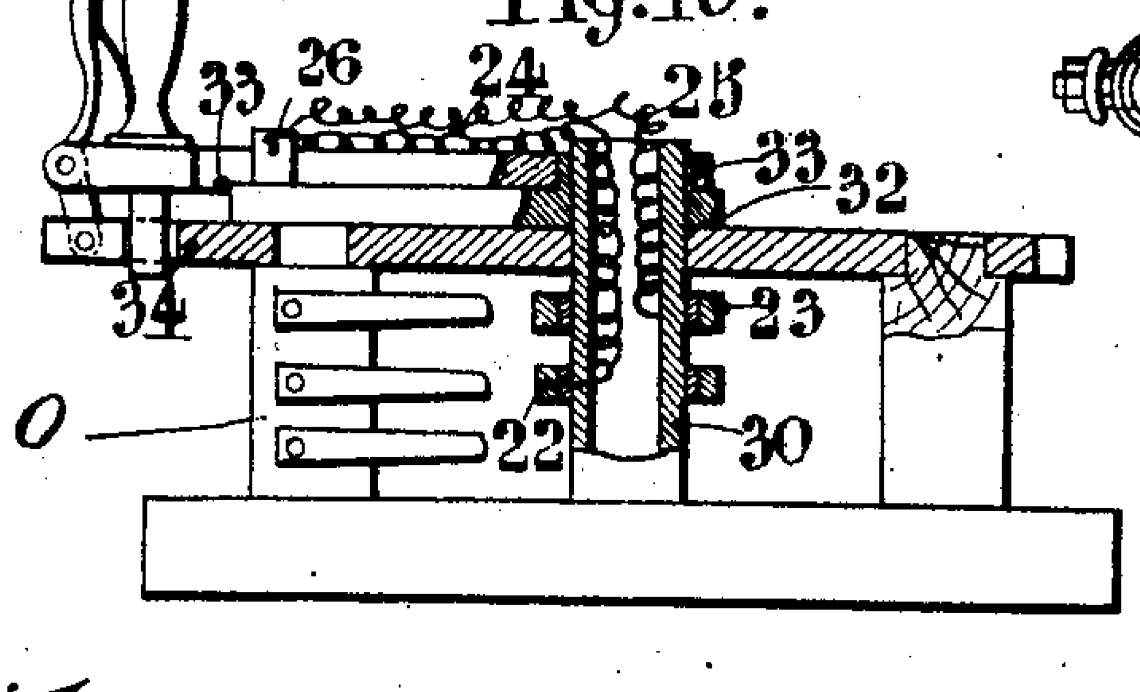


Fig. 10.



Witnesses:
C. D. Kesler
N. Louis Bogan

Inventor
Paul V. Avril
By James L. Norris.
Atty

UNITED STATES PATENT OFFICE.

PAUL VICTOR AVRIL, OF PARIS, FRANCE, ASSIGNOR TO HIMSELF AND LA SOCIÉTÉ MARINIER, NAVOIT ET JEANSON, OF PARIS, FRANCE.

ELECTROMAGNETIC DEVICE FOR CONTROLLING THE ROTATION OF SHAFTS.

SPECIFICATION forming part of Letters Patent No. 710,311, dated September 30, 1902.

Application filed April 29, 1901. Serial No. 58,054. (No model.)

To all whom it may concern:

Be it known that I, PAUL VICTOR AVRIL, engineer, a citizen of the French Republic, residing at Paris, France, (and having post-office address 55 Quai des Grands-Augustins, in the said city of Paris,) have invented certain new and useful Improvements in Electromagnetic Devices for Controlling the Rotation of Shafts, of which the following is a specification.

This invention relates to electromagnetic devices by means of which a shaft may be rotated in either direction and the direction of rotation readily reversed.

The nature of this invention will be better defined and more clearly understood by the following description with reference to the annexed drawings, which illustrate several constructions and application of the said electromagnetic controlling device.

Figures 1 and 2 denote front and side elevations, respectively, of my improved device. Fig. 3 is an elevation of the contact for imparting to the shaft alternate rotations of a very slight extent. Figs. 4 and 5 are front and side elevations, respectively, of a modified form of my device. Fig. 6 is an elevation of a modified form of contacts for obtaining rotation of the shaft in one direction. Figs. 7 and 8 are side and front elevations of the device for imparting annular displacements to the shaft. Figs. 9, 10, and 11 are a side elevation, a sectional detail, and a plan, respectively, of the current-controlling device used in connection with the construction shown in Figs. 8 and 9.

A shaft *a*, Figs. 1 and 2, mounted in suitable bearings, has keyed on it two disks of magnetizable metal *b* and *c*, carrying between them two groups of electromagnets *d e*. The cores of one group *d* of these magnets project beyond disk *b*, while the cores of the other group *e* project beyond the other disk *c*. These cores are magnetically insulated from the disks *b* or *c*, beyond which they extend and constitute two horseshoe-magnets. Each set of electromagnets is included in a separate circuit, both circuits capable of being connected to one and the same source of electricity.

In front of the poles of each group of electromagnets are arranged armature-disks *f* and *g*, mounted loosely on the shaft *a*. Each armature-disk may consist of a pulley, a spur-wheel, or the like for transmitting motion, as shown in Figs. 1 and 2, where the armature-disks *f g* are represented as grooved pulleys. These armature-disks or pulleys, which may or may not be of the same diameter, are rotated in opposite directions direct from any suitable prime mover or by a counter-shaft. (Not shown.) In Fig. 1 a secondary shaft *h* is shown, carrying two grooved pulleys adapted to be connected to the said armature-disks by means of belts, these latter not shown.

On the shaft *a* is a disk *i*, of insulating material, on the periphery of which are two strips of conducting metal *j* and *k*, insulated from each other and upon which is adapted to bear two stationary contacts *m* and *n*, connected to contact-pieces or a switch *o*, the arm of which switch is connected to one pole of a source of electricity *p*, while the other pole is connected, by means of conductors *q* and *r*, to the two groups of electromagnets *d e*, to which are also connected the two strips of metal *j k* on the disk of insulating material. All the electrical connections are diagrammatically shown in Fig. 2.

If one of the electric circuits be closed by means of the switch *o*, the corresponding electromagnet attracts its armature, and the shaft *a*, on which it is mounted, will be caused to rotate in one direction. Let us suppose that circuit being kept closed through one of the strips *j* or *k*, the shaft *a* rotates in the direction indicated by the arrows, and let us close the circuit on the stationary contact *n*—that is to say, on the strip *k*.

The shaft *a* is withdrawn until the point of separation of the strips *j* and *k*, which is below the contact *m*, is coming under the contact *n*. If in consequence of the momentum acquired the shaft *a* keeps on rotating, the other strip *j* comes in contact with the other stationary contact *n* and the circuit through the first strip *k* is broken and completed through the other strip *j*. The shaft *a* will be rotated in the opposite direction; but as the strip j leaves immediately the stationary contact n this reverse motion is very limited and the shaft a is brought to rest. If then the circuit through the first stationary contact m be closed, the shaft a is rotated until the gap separating the strips j and k comes again in contact with the fixed contact m. The partial rotation of the shaft a is thus limited according to the distance between the stationary contacts m and n.

The switch o may be replaced by any other suitable device moved by hand or automatically for supplying current alternately to one or the other of the stationary contacts m or n.

The switch o and the two stationary contacts m n may be replaced by single movable contact, Fig. 3, pivotally attached to an arm x, pivoted on the axis y. In the position of rest the extremity v of the arm x engages with the gap between the two contact-strips j and k on the disks, but touches neither of them. When the arm x is caused by suitable means to oscillate in one or the other direction of the arrow z, the movable contact v comes into contact with one or other of the strips j and k, thereby closing the circuit of the corresponding electromagnet. The shaft a is thus rotated until the oscillating arm x is brought back to its position of rest. As soon as the contact v is brought in contact with the other strip the shaft a is rotated in the opposite direction.

In the modification, Figs. 4 and 5, the groups of electromagnets d and e are fixed to the disk of insulating material i, which is keyed on the shaft a, and the armatures 1 and 2 of the magnets constitute pawls, which when the electromagnets are energized engage, respectively, with ratchet-wheels 3 and 4, mounted loosely on the shaft a and which revolve in opposite directions. The oscillating contact v, hereinbefore described, may be used in connection with this arrangement of Fig. 3.

By providing three stationary contacts, as shown in Fig. 6, rotation may be imparted to the shaft a in one direction.

By closing the circuit on the contact 5, for example, the set of electromagnets d d will be excited, and, as explained with reference to Figs. 2 and 3, the shaft a and the disk which carries the contact-strips j and k are caused to rotate as long as the electromagnets are excited—say as long as the switch closes the circuit on the contact 5. When the gap 8 between the strips j and k comes under the contact 5, the mechanism is stopped. If the contact be closed on 6, the same set of electromagnets d is excited, (because the strip j is in contact with 6 and d,) and the rotation goes on in the same direction until the gap 8 comes under the said contact 6. If now the contact be closed on 7, the same set of electromagnets d remains excited, (because the strip j is in contact with 7 and d,) and the rotation of the shaft goes on in the same direction until the gap 8 comes under the contact 7 and the mechanism is stopped. By reversing the direction of the switch—say by closing the contact on 6—the second set of electromagnets is excited and the shaft will turn in the reversed direction, and so on until the gap 8 is returned under the contact 5, which occurs when the switch has been replaced on the first contact.

To cause the shaft to rotate in the opposite direction, it is only necessary in case of Fig. 6 to close and open the circuits through the stationary contacts in the reverse order.

Figs. 7 to 11 illustrate means for controlling the movable contact v, (referred to in Figs. 3, 4, and 5,) by which a desired angular displacement can be imparted to the shaft a.

Instead of the contact pivoted to the arm, as hereinbefore described, the contact v is pivotally attached to a ratchet-wheel 9, Figs. 7 and 8, keyed on a shaft 10 or spindle arranged coaxially with the shaft to be rotated and carrying a second ratchet-wheel 11, the teeth of which are arranged in the opposite direction to that of the teeth of the ratchet-wheel 9. These two ratchet-wheels may be driven in opposite direction through the medium of driving-pawls 12 and 13, forming the armatures of two electromagnets 14 15, mounted on a fixed support. The electromagnet 14 is connected by a wire 16 to a source of electricity p and by another wire 17 to a rubbing contact-piece 18, Fig. 9, of a current-controlling device o, Figs. 9, 10, and 11. The other electromagnet 15 is connected by a wire 19 to the source of electricity p and by another wire 20 to a rubbing contact 21, Fig. 9. The rubbing contact-pieces 18 and 21 bear on two insulated rings 22 23, to which are attached the two wires 24 and 25, connected to the terminals 26 and 27, respectively. A third rubbing contact-piece 28, connected by a wire 29 to the source of electricity p, bears on an arbor 30, carrying a toothed disk 31, having the same number of teeth as in each of the ratchet-wheels 9 and 11. An arm 32, of insulating material, capable of being rotated on the said arbor 30 by means of a handle 33, carries the terminals 26 27.

The handle 33 is insulated from the arbor 30 and carries a contact-piece 34, which moves in front of the periphery of the toothed disk 31. Let us suppose the handle 33 is brought in contact with the terminal 27 and while in this position the contact 34 on the handle bears on a tooth on the disk 31. In this case the current flows through the wire 29 to the rubbing contact 28, then through the arbor 30 and toothed disk 31, whence it flows through the contact 34 on the arm of insulating material and handle 33 to the terminal 27, then through the wire 25 to the ring 23 and through the rubbing contact-piece 21 and wire 20 to one of the electromagnets 15, Figs. 7 and 8, and finally back to the source of electricity through the wire 19. The armature 13 being attracted moves the ratchet-wheel 11 in connection therewith one tooth and remains in engagement until the handle 33 is moved so as to bring the contact 34 opposite a space in the periphery of the toothed disk 31. The armature 13 is then brought back to its first position by a spring 35. If the rotation of the handle is continued in that direction in which this handle remains in contact with the terminal 27, the circuit will be alternately closed and broken through the electromagnet 15 and the ratchet-wheel 11 will be moved a tooth each time. The spindle 10, on which the ratchet-wheel 9 is mounted, takes part in this motion, as well as the movable contact *b*, attached to the said ratchet-wheel 9; but this contact could be keyed directly on the spindle 10. To cause the arbor 10 to rotate in the opposite direction, it is only necessary to turn the handle 33 in the direction to make contact with the order-terminal 26.

Each time one of the ratchet-wheels 9 and 11 is moved one tooth the movable contact *v* comes in contact with either one or the other of strips *j* or *k*. The rotation of the shaft *a*, arranged coaxial with the spindle carrying the ratchet-wheels, takes place in one direction or the other through the medium of one of the electromagnetic mechanisms illustrated in Figs. 1 to 5. The extent of rotation of the said shaft *a* is equal to that imparted to the spindle 10 and is effected through the medium of armatures 12 and 13, actuating the ratchet-wheels 9 and 11. By suitably manipulating the controlling device *o* any required extent of rotation can be imparted to the spindle 10 and to the coaxially-arranged shaft *a*.

Having now particularly described and ascertained the nature of my invention and in what manner the same may be carried into effect, I declare that what I claim is—

1. The combination with a shaft adapted to be be operatively connected to a prime mover, and an electromagnetic device carried by the shaft and adapted when energized to connect the shaft with the prime mover to cause the operation of said shaft, of a disk mounted upon said shaft, contact-strips carried thereby, means engaging the said strips for making and breaking an electrical circuit for energizing and deënergizing said magnetic device to control the movement of the said shaft, and electrical connections between said means, magnetic device and source of electrical energy.

2. The combination with a shaft adapted to be operatively connected to a prime mover, and an electromagnetic device carried by the shaft and adapted when energized to connect the shaft with the prime mover to cause the operation of said shaft, of a disk mounted upon said shaft, contact-strips carried thereby, a movable contact engaging the said strips for making and breaking an electrical circuit for energizing and deënergizing said magnetic device to control the movement of the said shaft, and electrical connections between said movable contact, magnetic device and a source of electrical energy.

3. The combination with a shaft adapted to be operatively connected to a prime mover, of an electrical magnetic device carried by the shaft and adapted when energized to connect the shaft with the prime mover to cause its operation, a disk mounted upon said shaft, contact-strips secured to the periphery of said disk a suitable distance apart, means engaging the said strips for making and breaking an electrical circuit for energizing and deënergizing said magnetic device to control the movement of said shaft, and electrical connections between said means, magnetic device and a source of electrical energy.

4. The combination with a shaft adapted to be operatively connected to a prime mover, of an electromagnetic device supported by said shaft and comprising in its construction a disk loosely mounted upon the shaft, said disk suitably connected to a prime mover and forming the armature of the magnetic device, a disk fixed to said shaft, contact-strips carried thereby, means engaging with said strips for making and breaking an electrical circuit for energizing and deënergizing said magnetic device to control the movement of said shaft and to connect said shaft with the said prime mover to cause the operation of the shaft, and electrical connections between said means, magnetic device and a source of electrical energy.

5. The combination with a shaft adapted to be operatively connected to a prime mover, of an electromagnetic device supported by said shaft and comprising in its construction a disk loosely mounted upon the shaft, said disk suitably connected to a prime mover and forming the armature of the magnetic device, a disk fixed to said shaft, contact-strips carried thereby, a movable contact engaging with said strips for making and breaking an electrical circuit for energizing and deënergizing said magnetic device to control the movement of said shaft and to connect said shaft with the said prime mover to cause the operation of the shaft, and electrical connections between said movable contact, magnetic device and a source of electrical energy.

6. The combination with a shaft adapted to be operatively connected to a prime mover, of an electromagnetic device supported by said shaft and comprising in its construction a disk loosely mounted upon the shaft, said disk suitably connected to a prime mover and forming the armature of the magnetic device, a disk fixed to said shaft, contact-strips secured to the periphery of said disk a suitable distance apart, means engaging with said strips for making and breaking an electrical

circuit for energizing and deënergizing said magnetic device to control the movement of said shaft and to connect said shaft with the said prime mover to cause the operation of the shaft, and electrical connections between said means, magnetic device and a source of electrical energy.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

PAUL VICTOR AVRIL.

Witnesses:
EDWARD P. MACLEAN,
EMILE KLOTZ.