No. 665,917. Patented Jan. 15, 1901.

L. J. LE PONTOIS.

APPARATUS FOR OBTAINING RECIPROCATING MOTION.

(Application filed Apr. 12, 1898.)

(No Model.) 3 Sheets—Sheet 1.

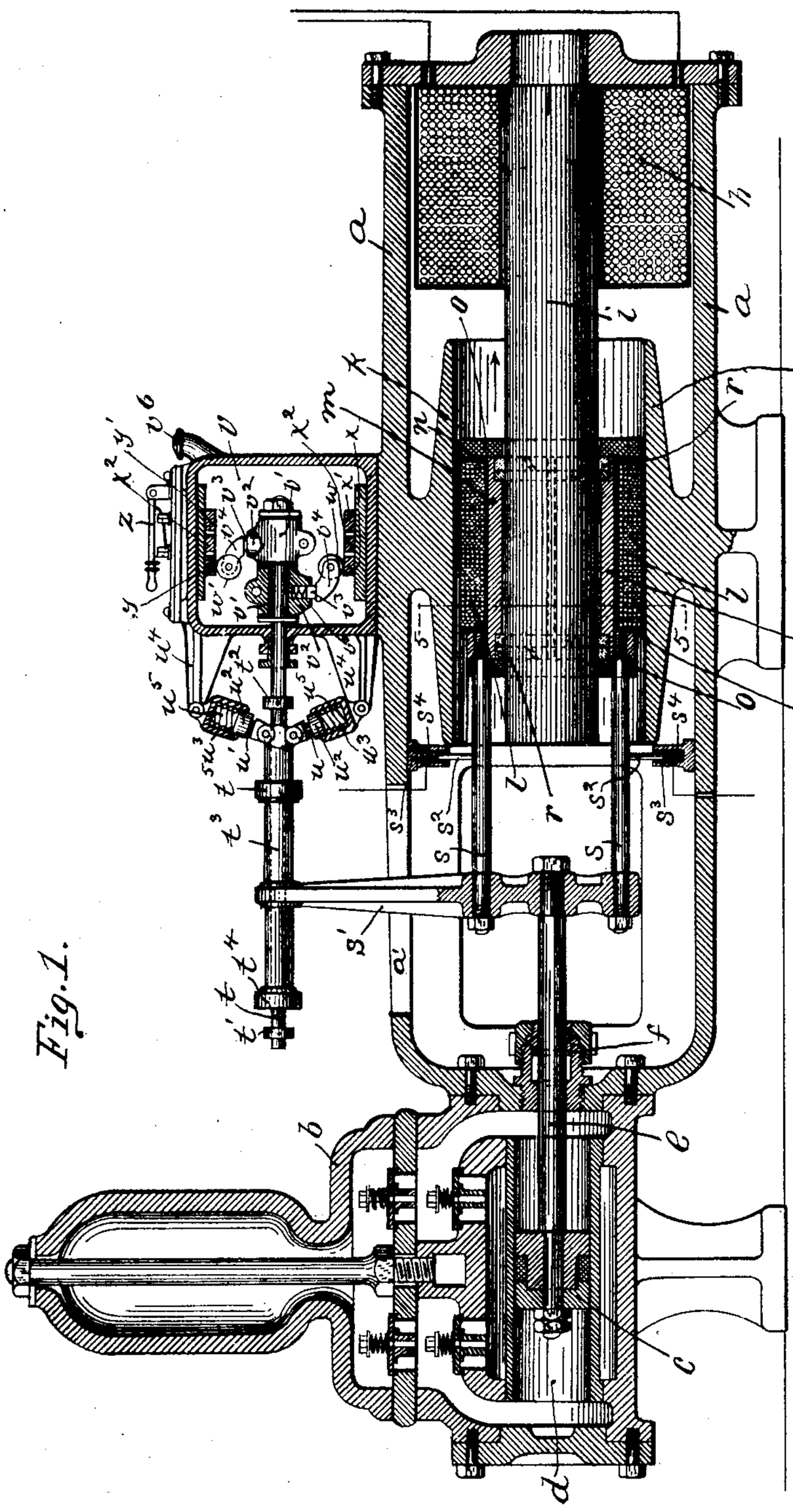


Fig. 1.

WITNESSES:

Walter Samaris
Robt. C. Totten

INVENTOR
Leon J. le Pontois
BY Kay & Totten

ATTORNEYS

No. 665,917. Patented Jan. 15, 1901.

L. J. LE PONTOIS.

APPARATUS FOR OBTAINING RECIPROCATING MOTION.

(Application filed Apr. 12, 1898.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

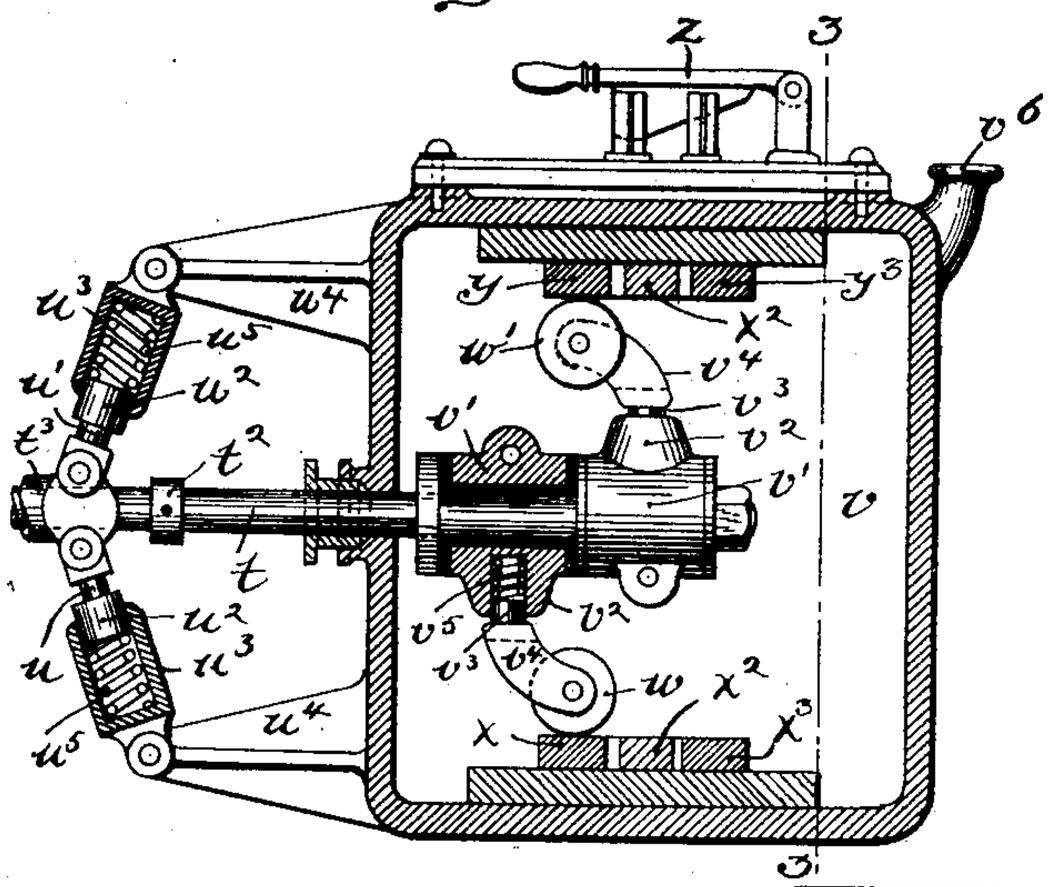


Fig. 3.

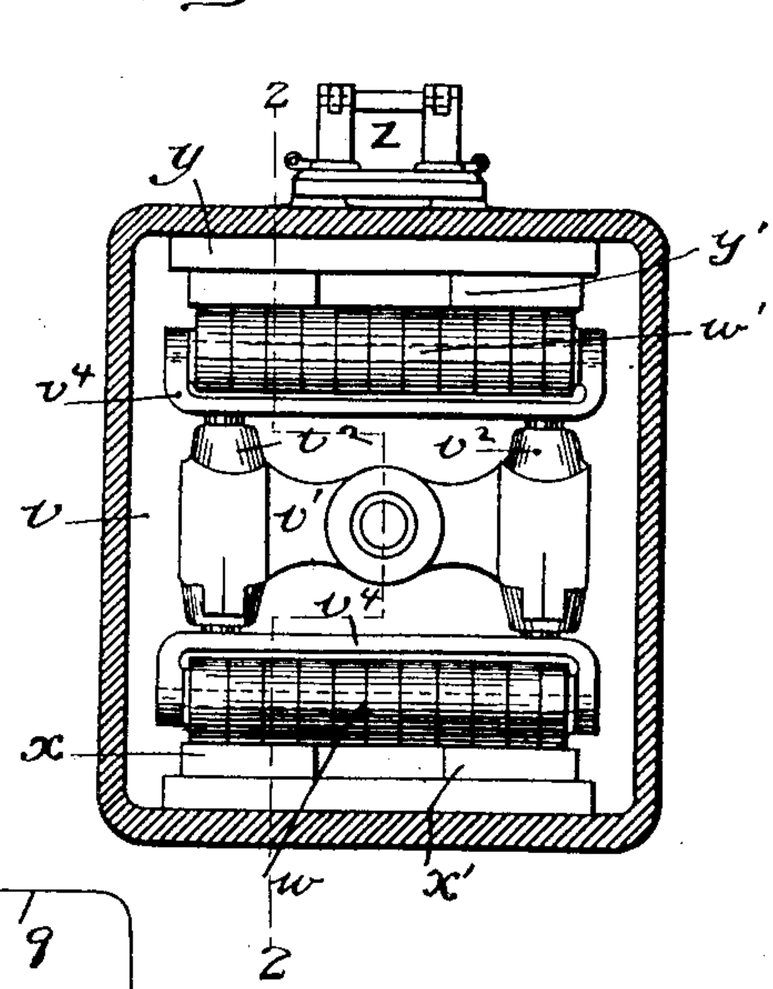


Fig. 4.

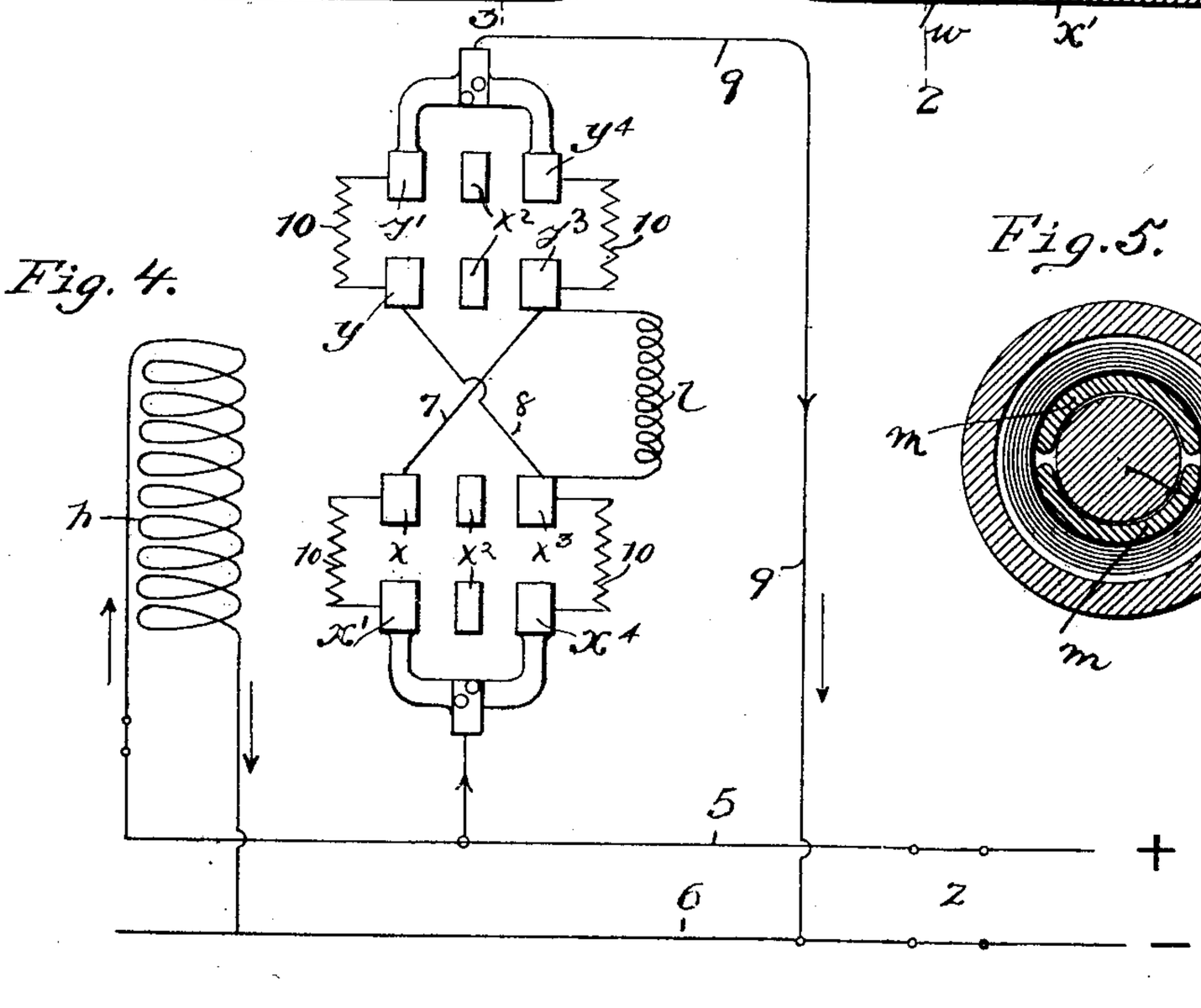


Fig. 5.

WITNESSES:

Walter Famariss
Robt C. Totten

INVENTOR
Leon J. le Pontois
BY Clay & Totten

ATTORNEYS

No. 665,917. Patented Jan. 15, 1901.

L. J. LE PONTOIS.

APPARATUS FOR OBTAINING RECIPROCATING MOTION.

(Application filed Apr. 12, 1898.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 6.

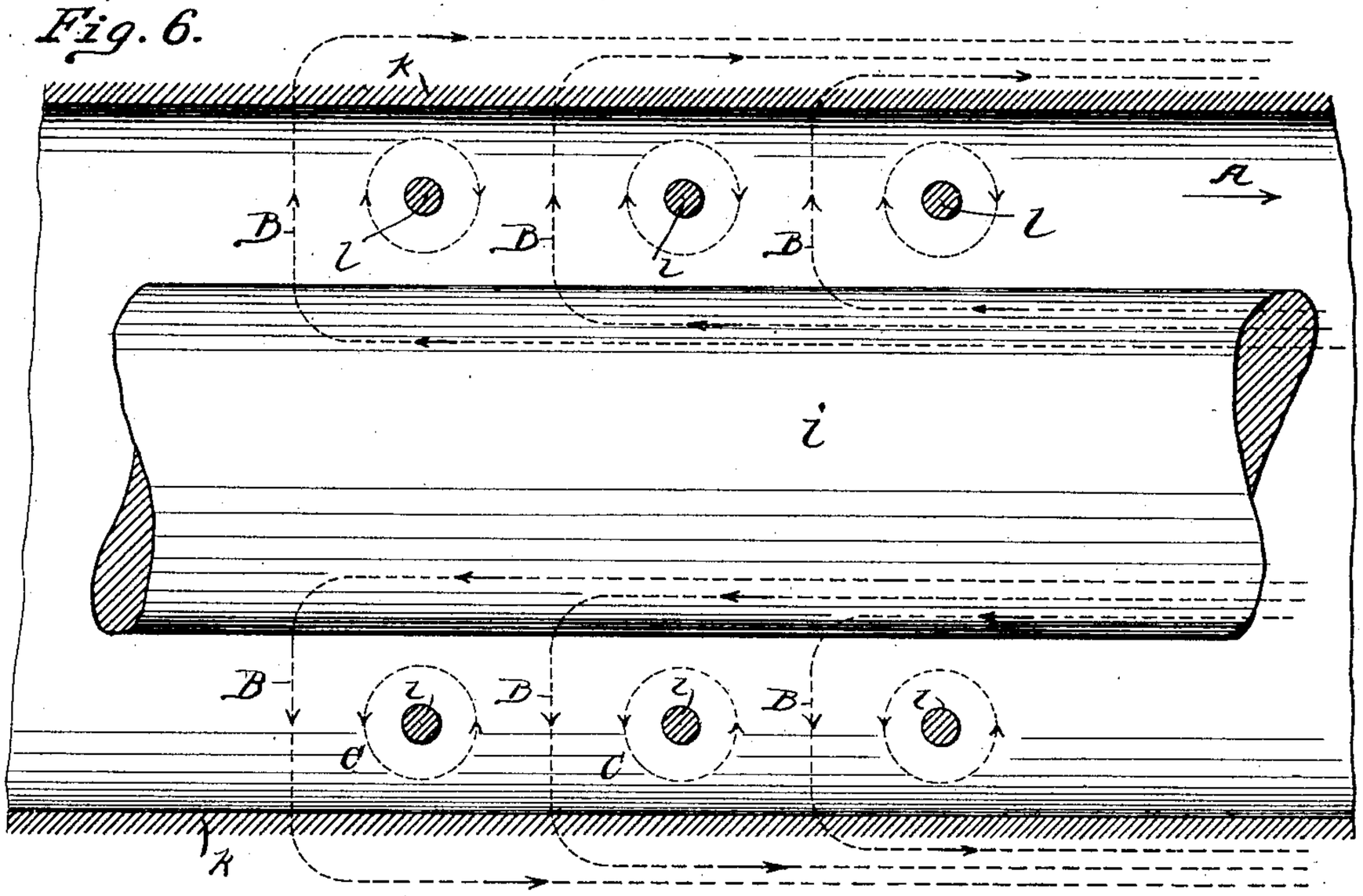
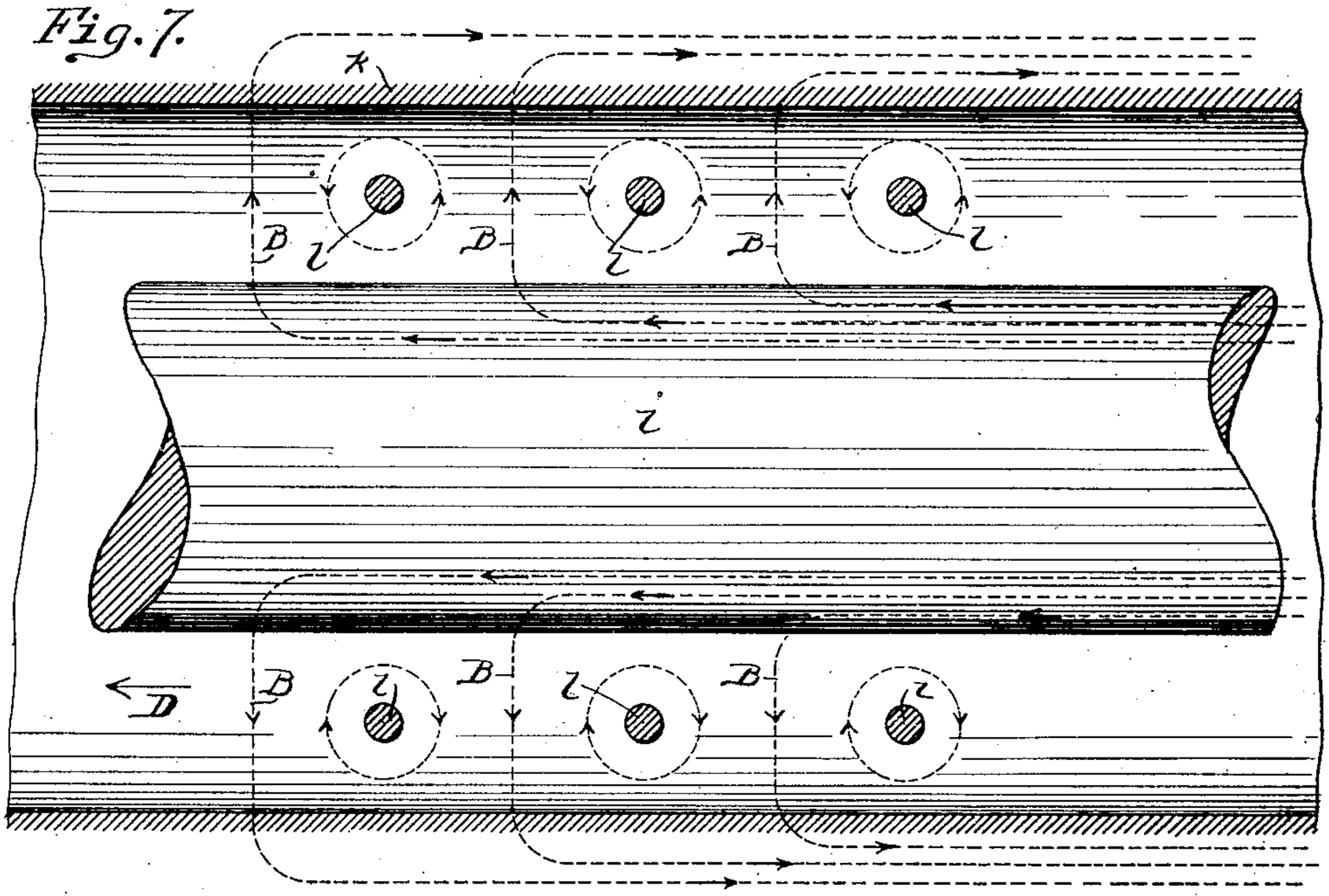


Fig. 7.



Witnesses:

Walter Famariss

Robert C. Totten

Inventor

Leon J. le Pontois

By Kay & Totten

Attorneys

UNITED STATES PATENT OFFICE.

LEON J. LE PONTOIS, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO GUSTAVE A. F. AHLBERG, OF SAME PLACE.

APPARATUS FOR OBTAINING RECIPROCATING MOTION.

SPECIFICATION forming part of Letters Patent No. 665,917, dated January 15, 1901.

Application filed April 12, 1898. Serial No. 677,283. (No model.)

To all whom it may concern:

Be it known that I, LEON J. LE PONTOIS, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for Obtaining Reciprocating Motion; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to apparatus for converting electrical energy into direct reciprocating motion for the purpose of driving pumps, rock-drills, compressors, or other devices to which it may be found applicable.

The invention relates to the general class of motors known as "reciprocating electric motors," but differs from those heretofore employed in the method used in obtaining the reciprocating motion.

The invention consists, generally stated, in causing a conductor or conductors carrying current to be reciprocated in a unipolar magnetic field by the action exerted on the flux surrounding the conductor by the flux of the stationary field, the reciprocating motion of the conductor being obtained by reversing the current passing through the conductor. The invention also consists in suitable apparatus for carrying out the above, all of which will be fully hereinafter set forth and claimed.

To enable others skilled in the art to make and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a longitudinal section of my invention as applied to an ordinary type of pump. Fig. 2 is an enlarged sectional view of the reversing mechanism on the line 2 2, Fig. 3. Fig. 3 is a cross-section through the line 3 3, Fig. 2. Fig. 4 is a diagrammatic view of the switch and its connections and the coils. Fig. 5 is a cross-section on line 5 5, Fig. 1. Figs. 6 and 7 are views showing the disposition of the magnetic fields in relation to the direction of motion.

Like characters of reference indicate like parts in each figure.

In the drawings the letter *a* represents a suitable shell or casing, which is attached to the valve-chamber *b* of a common form of pump, said valve-chamber having the piston *c*, operating in the cylinder *d*, and the piston-rod *e*, extending out through suitable stuffing-box *f*. As the construction of this part of the pump does not have any bearing on my invention, a further description of the same will be unnecessary.

Located within the shell or casing *a* is the stationary unipolar magnetic field-coil *h*, properly insulated in the ordinary manner and connected up to a suitable electric generator. (Not shown.) Within the field-coil *h* is the iron core *i*, said core extending forward into the cylinder *k*, formed within the shell or casing *a*. The stationary magnetic field may be in the form of a permanent magnet, if desired. Surrounding the core *i* within the cylinder *k* is the movable coil *l*, which surrounds the sleeve *m*, the said movable coil being insulated from the sleeve *m* by suitable insulating material *n*. The wires used on the movable coil are preferably of soft iron in order to reduce the reluctance of the magnetic circuit. The sleeve *m* is formed in sections, said sections being connected at their ends by the fibrous or non-metallic rings *o*. These sections do not join each other, but are separated by suitable space, as shown in Fig. 5, so that no eddy-currents can be induced in the sleeve *m*. Rings *r* of suitable insulating material surround the core *i* and separate it from the sleeve *m*, so that a slight space is left between said core and sleeve.

In the above manner it will be observed that the movable coil *l* is free to move back and forth over the core *i*. Rods *s* connect the sleeve *m*, carrying the movable coil *l*, with the standard s', to which the piston-rod *e* is attached. The rods *s* move in contact with the brushes s^2, said brushes being suitably insulated from the sockets s^3 and being forced into contact with said rods by means of the springs s^4. The brushes are connected up by wires to the contacts x^3 y^3, respectively. The rods *s* are insulated properly from the standard s'. This standard s' passes up through a suitable slot or opening a' in the shell or casing *a*, and through the upper end of said standard passes the rod *t*, said rod having the rings t' t^2 thereon. On the rod *t* is the sliding sleeve t^3, provided with collars or rings t^4 t^5. The sleeve t^3 also passes through the opening in the upper end of the standard s'. The up-

per end of said standard s', moving back and forth in the manner hereinafter set forth, comes in contact with the rings t^4 t^5 and moves the sleeve t^3 and afterward the rod t in the manner hereinafter set forth. Pivoted to the sleeve t^3 are the studs u u', having the heads u^2, which fit in the sockets u^3, pivoted to the rigid arms u^4. Springs u^5 are interposed between the heads u^2 and the inner ends of said sockets. The rod t passes through a suitable stuffing-box into the box or chamber v, mounted on the casing a. Secured to the rod t within the box v are the bearings v', suitably insulated from said rod t, said bearings having the seats v^2 therein, adapted to receive the journals v^3 of the frames v^4, in which the rollers w w' are mounted, normally forced outward by springs v^5. One set of rollers w are adapted to move in contact with the contact-pieces x x' x^2 x^3 x^4 in the bottom of the box v, while the set of rollers w' is adapted to move in contact with the contact-pieces y y' x^2 y^3 y^4 at the top of the box v.

Mounted on the box v is a suitable switch z for making and breaking the circuit to the motor. The box v is filled with glycerin or other insulating fluid through the inlet v^6. This glycerin acts to prevent the formation of sparks by introducing an enormous resistance in the breaking of the current.

It is of course to be understood that I do not wish to limit myself in any way to the particular construction illustrated and described, but desire to include within the scope of my invention all other constructions which will produce like results.

The operation of my invention is as follows: In Fig. 1 of the drawings the movable coil l is represented as moving in the direction of the arrow, and the operation will be described with that fact in view. The magnetic flux set up in the stationary magnetic circuit by the field-coil h flows through the core i and passes radially therefrom through the sleeve m across the conductors of the movable field l, exerting a mechanical action or drag on those conductors, which tends to move the movable coil in the direction of the arrow. The mutual action of the magnetic fluxes is clearly represented in Figs. 6 and 7. In Fig. 6, where the movable conductor or conductors are moving in the direction of the arrow A, the magnetic flux set up in the core i and represented by the lines of force B exerts on the fields C, surrounding the movable conductors, a repelling action on one side and an attractive action on the other side. This results in the displacement of the conductors in the direction of arrow A. Fig. 7 is a like representation of this action of the magnetic fluxes after the current in the movable conductors has been reversed. In this case the direction of movement of the movable conductors is reversed, and they travel in direction of arrow D. As the movable coil moves in a field of uniform density, the force exerted by the stationary field on the movable coil is constant at all points of the stroke, this force being the product of both fields. With the movable coil l moving in this direction the rollers w will be in contact with the contact-pieces x and the rollers w' in contact with the contact-pieces y. The movable coil l continues to move in the direction of the arrow until it has reached the full length of its stroke or approximately the end of the cylinder k, whereupon the current will be reversed. This is accomplished in the following manner: As the movable coil moves in the direction stated, the standard s', moving therewith, will come in contact with the ring t^5 and will move the sleeve t^3. As soon as the standard s' strikes the ring t^5 the sleeve t^3 will carry the studs u u' into a vertical position and compress the springs u^5. By a slight further movement of the standard s' the studs will be thrown beyond a vertical line, whereupon the springs u^5 immediately expand and carry the sleeve forward at an increased speed, causing the rollers w w' to quickly break contact with their contact-pieces x x' and y y', and thus break the current. By a still further movement of the sleeve t^3, now in contact with the ring t^2, the rod t continues to move until the rollers w w' pass from the contact-pieces x^2 onto the contact-pieces x^3 x^4 and y^3 y^4. This reverses the current, and as the standard s' moves in the opposite direction the above action is repeated in a reverse order. The passage of the rollers w w' from their contact-blocks x x' and y y' to the contact-blocks x^2 will introduce resistances in the movable coil l, short-circuiting it through those resistances. The movable coil l being thus in closed circuit while it moves in a magnetic field, a current is induced in the movable coil which tends to stop its further movement, and thus assists the reversing action of the current. This also acts to cushion the stroke of the movable coil and prevents wear and tear and undue strain on the machine. By the time, however, that the movable coil has reached the end of its stroke the rollers w w' will be carried onto the contact-pieces x^3 x^4 and y^3 y^4, whereupon the current is reversed and the movable coil moves in the opposite direction in the same manner. In order that it may be clearly understood what is the action of the contact-rollers in this reversing operation, I will refer specially to the diagrammatic view in Fig. 4, which clearly illustrates this action. In that figure the switch z being closed the current passes by the main 5 to the stationary field-coil h, which is constantly in the circuit and never reversed, and back by the main 6. A branch from the main 5 leads to the contacts x' x^4, and when the rollers are in the position shown in Fig. 2 the current passes to the contact x' through the rollers w to the contact x, through the connection 7 to the contact y^3, through the movable coil l to the contact x^3, through the connection 8 to the contact y, and through the rollers w' to the contact y', and returns

through the branch 9 to the main 5, thus completing the circuit. Connecting the several contact-pieces $x\,x'$, $x^3\,x^4$, $y\,y'$, and $y^3\,y^4$ are the non-inductive resistance-coils 10, which tend to minimize the spark when the break is made between the rollers and said contact-pieces. It is evident from the above that when the rollers pass over in contact with the contact-pieces $x^3\,x^4$ and $y^3\,y^4$ the current will be reversed and will pass through the movable coil in an opposite direction.

Owing to the small amount of current passing through the movable coil in comparison with that passing through the field-coil h, the so-called "armature" reaction is reduced to a minimum, and the reversing of the current can take place without any appreciable sparking. Furthermore, notwithstanding the comparatively low speed at which the movable coil must be driven in the case of a pump or like mechanism self current regulation becomes possible owing to the very high strength of the stationary field in comparison with that of the movable coil, enabling the latter to generate counter electromotive force at low speed.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In apparatus for obtaining reciprocating motion, a stationary conductor and a movable conductor acted on by the flux of said stationary conductor, means for reversing the current through one of said conductors and means for momentarily placing said conductor in closed circuit.

2. In apparatus for obtaining reciprocating motion, the combination with a stationary field-magnet, of a movable conductor acted on by the flux of said field, means for reversing the current through said movable conductor, and means for momentarily placing said movable conductor in closed circuit.

3. In apparatus for obtaining reciprocating motion, the combination with a stationary field-magnet, of a movable conductor acted on by the flux of said field, a current-reversing means for said movable conductor, said means being so constructed as to momentarily place said movable conductor in closed circuit during the reversing operation.

4. In apparatus for obtaining reciprocating motion, the combination with a stationary field-magnet, of a movable conductor acted on by the flux of said field, a current-reversing means for said movable conductor, said means being so constructed as to momentarily place said movable conductor in closed circuit through a resistance during the reversing operation.

5. In apparatus for obtaining reciprocating motion, the combination with a stationary field-magnet, of a movable conductor acted on by the flux of said field, current-reversing means for said movable conductor, said means being so constructed as to momentarily place said movable conductor in closed circuit during the reversing operation, and connections between said movable conductor and the current-reversing means for operating the latter.

6. In apparatus for obtaining reciprocating motion, a stationary field-magnet, a movable conductor acted on by the flux of said field, a movable rod having a stop thereon, current-reversing mechanism on said rod, a slidable sleeve on said rod, a spring-toggle carried by said sleeve, and connections between said sleeve and said conductor, substantially as set forth.

In testimony whereof I, the said LEON J. LE PONTOIS, have hereunto set my hand.

LEON J. LE PONTOIS.

Witnesses:
ROBERT C. TOTTEN,
ROBT. D. TOTTEN.