No. 735,675.

PATENTED AUG. 4, 1903.

J. L. PILLING & R. J. KRUSE.

MOTOR.

APPLICATION FILED JAN. 19, 1903.

NO MODEL.

3 SHEETS—SHEET 1.

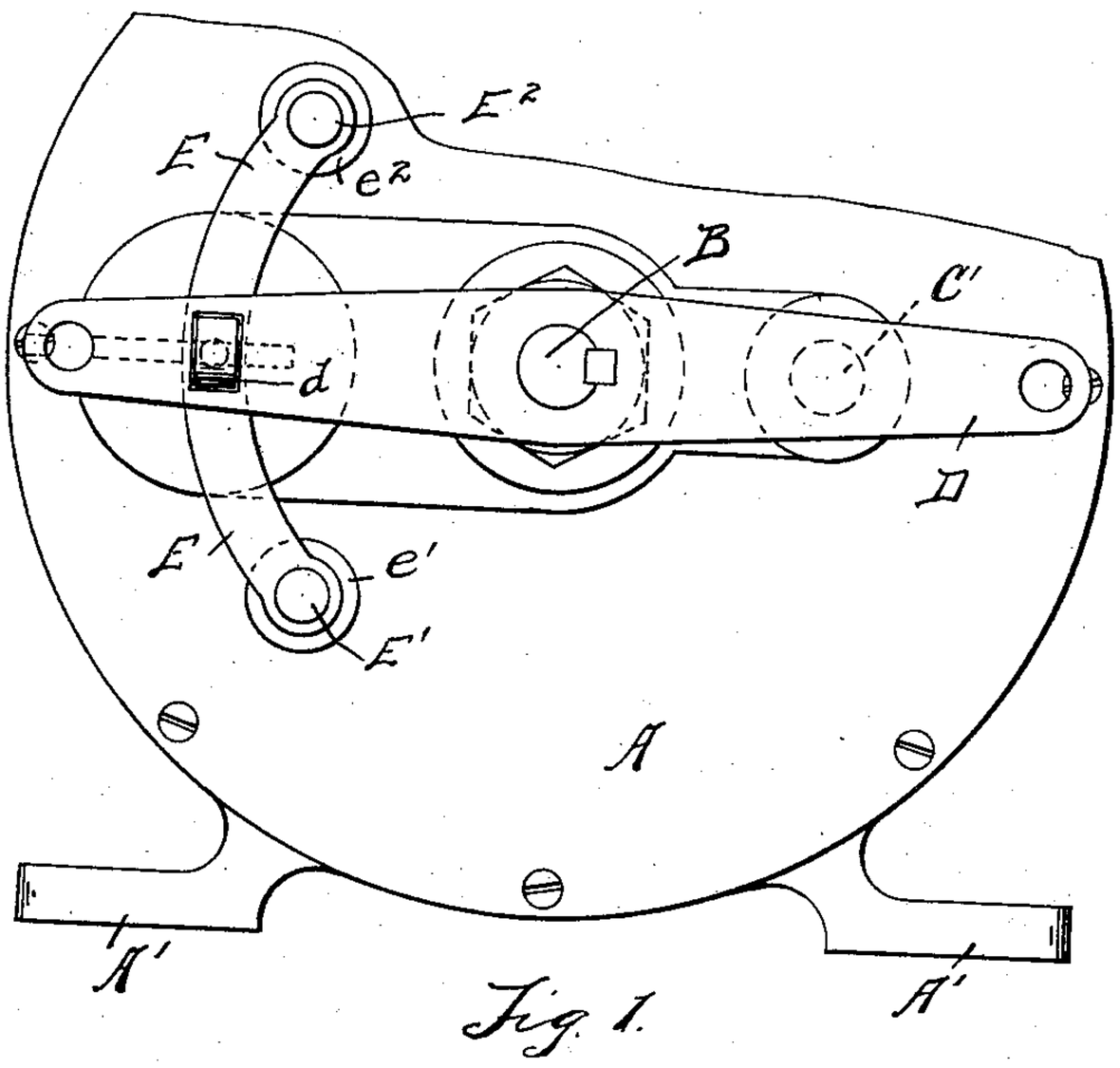

Fig. 1.

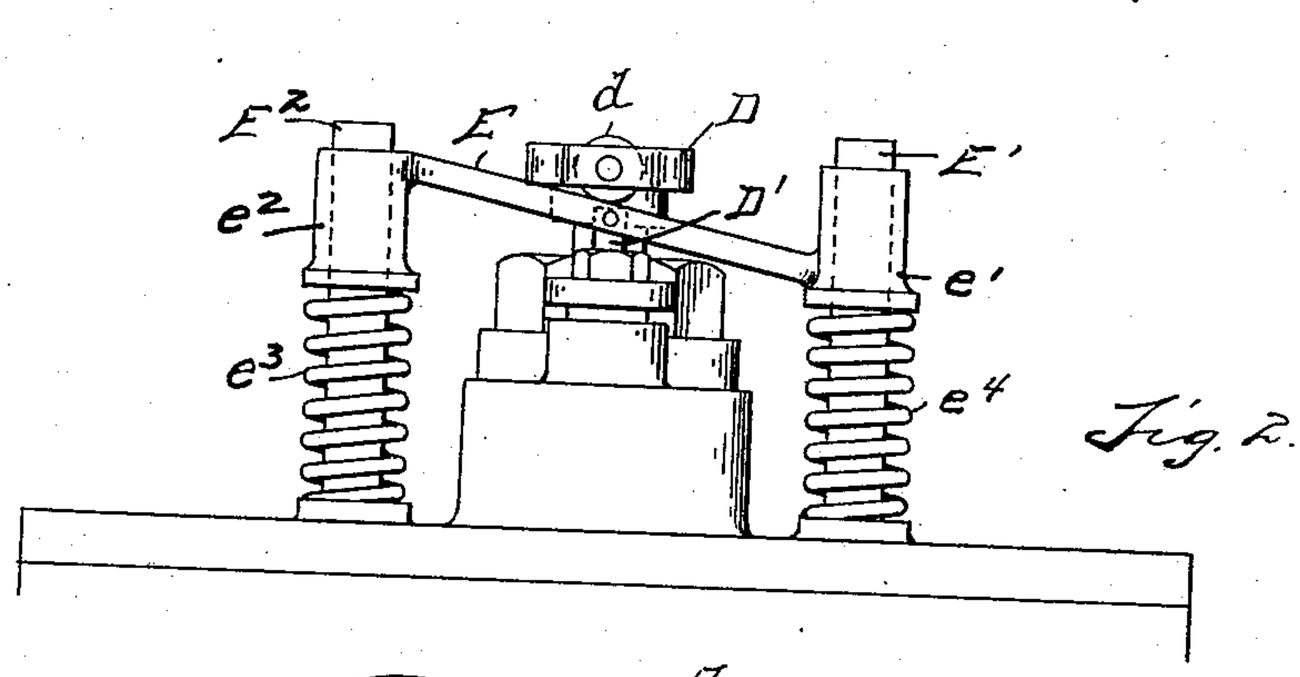

Fig. 2.

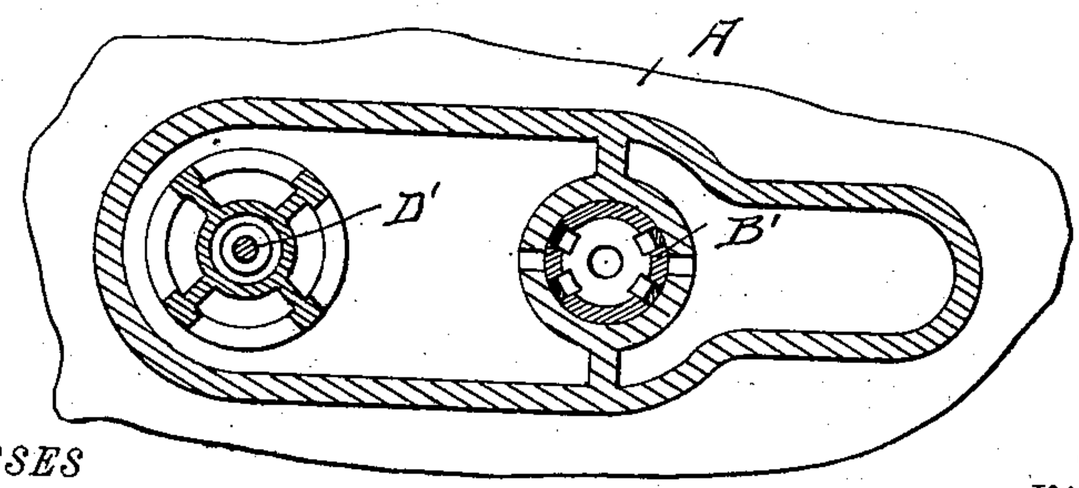

Fig. 9.

WITNESSES

Chas E. Wimer

W. A. Greenburg

INVENTORS

Robert J. Kruse

James L. Pilling

By Parker & Burton

Attorneys.

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3 SHEETS—SHEET 2.

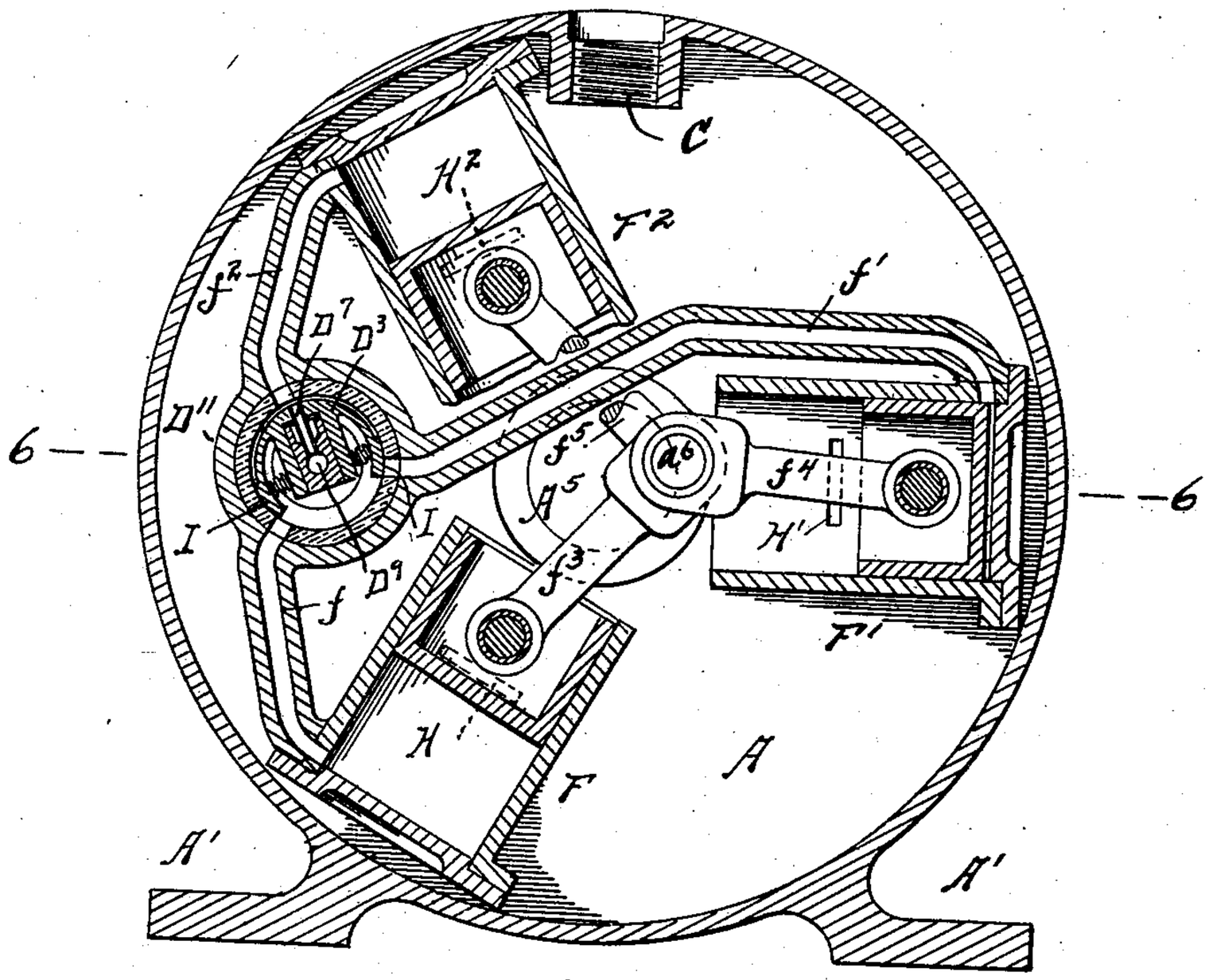

Fig. 3.

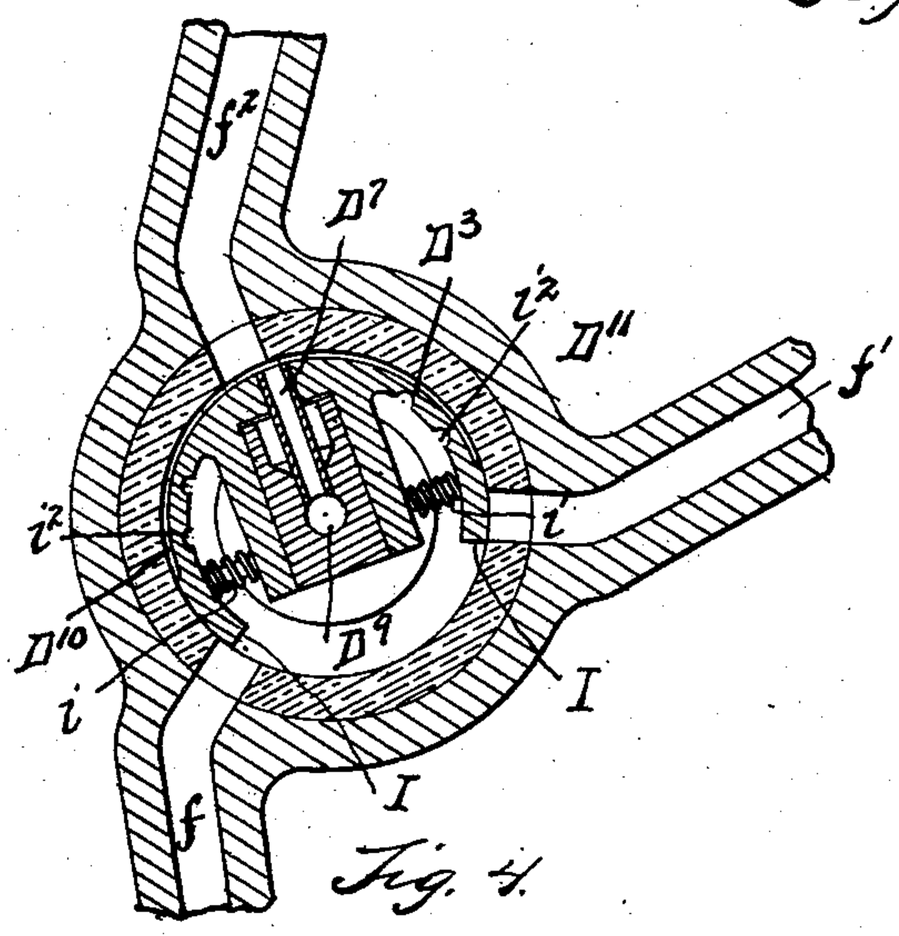

Fig. 4.

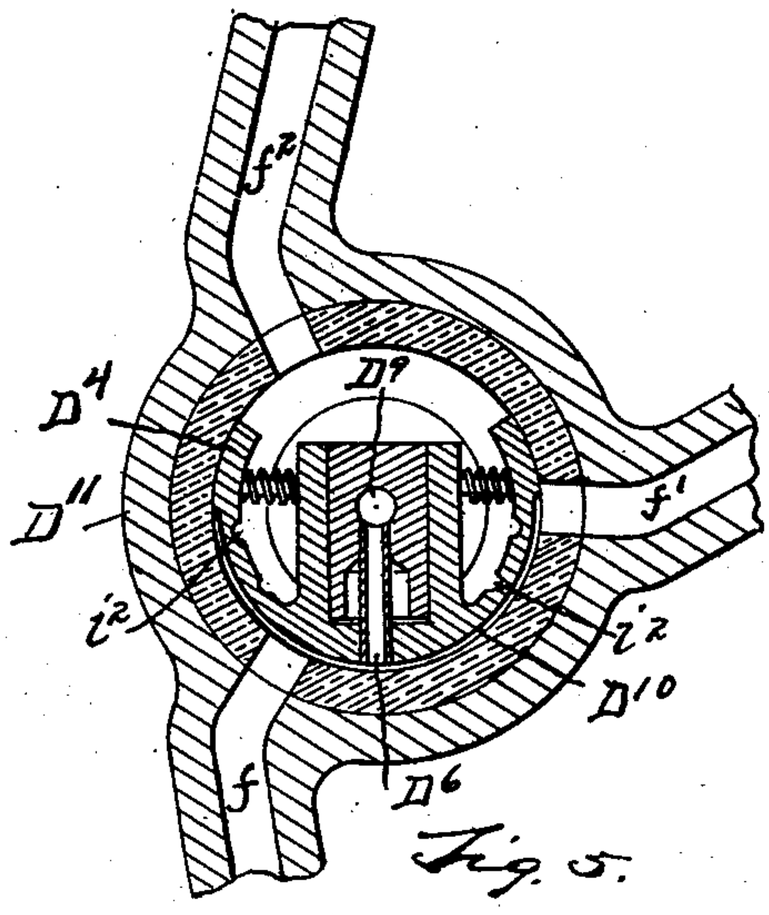

Fig. 5.

WITNESSES

Chas. E. Wiener

W. A. Greenburg.

INVENTORS

Robert J. Kruse

James L. Pilling

By Parker & Burton.

Attorneys.

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3 SHEETS—SHEET 3.

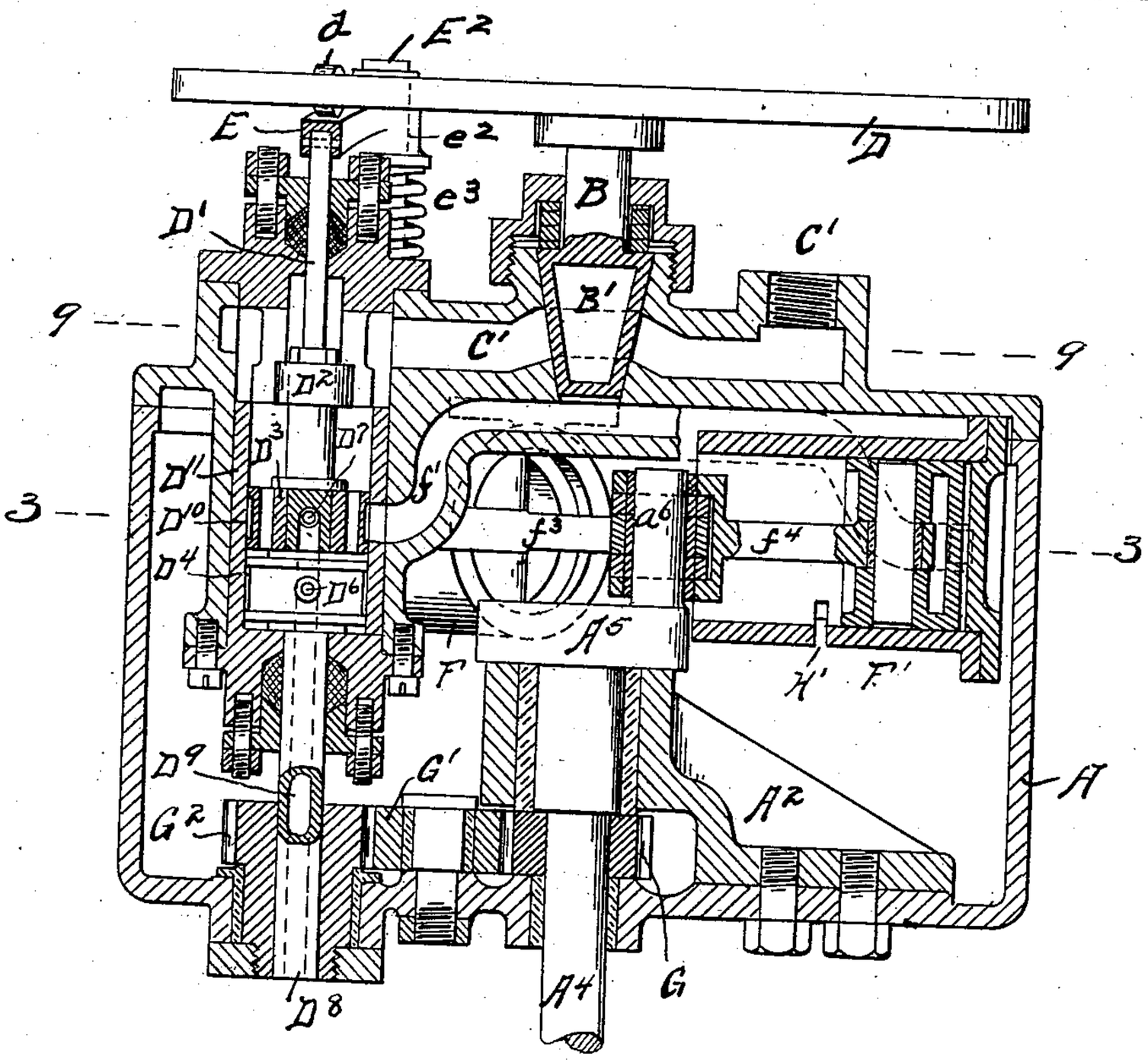

Fig. 6.

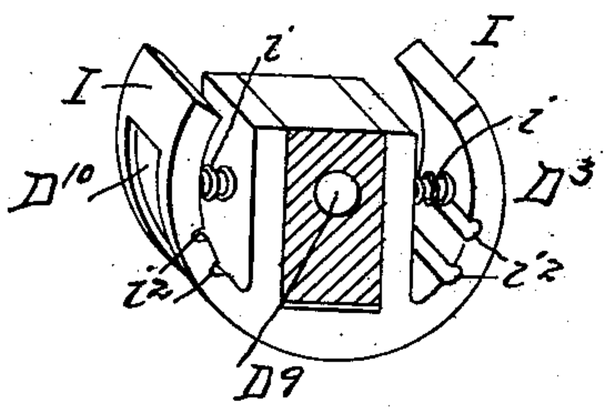

Fig. 7.

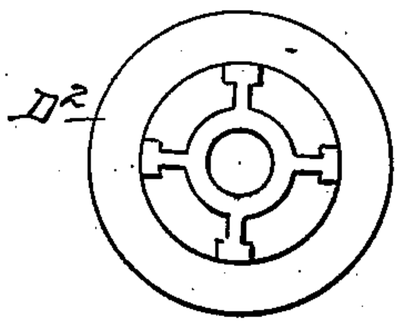

Fig. 8.

WITNESSES

T. S. Massey

Chas. E. Wiener

INVENTORS

Robert J. Kruse

James L. Pilling

By Parker & Burton

Attorneys.

No. 735,675. Patented August 4, 1903.

UNITED STATES PATENT OFFICE.

JAMES L. PILLING AND ROBERT J. KRUSE, OF PORT HURON, MICHIGAN.

MOTOR.

SPECIFICATION forming part of Letters Patent No. 735,675, dated August 4, 1903.

Application filed January 19, 1903. Serial No. 139,693. (No model.)

To all whom it may concern:

Be it known that we, JAMES L. PILLING and ROBERT J. KRUSE, both citizens of the United States, residing at Port Huron, county of St. Clair, State of Michigan, have invented a certain new and useful Improvement in Motors; and we declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

Our invention relates to motors employing elastic fluid; and it consists in the improvements hereinafter described, and pointed out in the claims.

Referring to the accompanying drawings, Figure 1 is a side view of an engine embodying our invention, the upper part being broken away to economize space. Fig. 2 is an elevation of one end of the same looking from the left of Fig. 1. Fig. 3 is a section on the line 3 3 of Fig. 6, except that the port f', which comes back of the plane of section, is shown in full section in the figure. Fig. 4 is a detail sectional view of the rotary valve used in the forward motion of the engine. Fig. 5 is a sectional detail view of the rotary valve used when the engine is reversed. Fig. 6 is a section on the line 6 6 of Fig. 3. Fig. 7 is a perspective view of one of the rotary valves. Fig. 8 is a plan view of a spider used to support the valve-stem. Fig. 9 is a detail view showing a section on the line 9 9 of Fig. 6.

A indicates a casing which is steam tight and within which are contained the cylinders and valve-casings and all the motor parts except the principal lever, which turns the throttle-valve and simultaneously shifts into position one of the steam-controlling valves which direct the steam to the cylinders in a way to produce either direct or reverse motion. The casing is supported on feet A' A'. Within the casing are located three cylinders F F' F^2 of three single-acting engines arranged radially with respect to the center of the cylinder, and the three pistons of the cylinders are pivoted to the single crank-pin a' of the main shaft A^4. The cylinders are located at diverging angles of one hundred and thirty degrees. In the angular space between two of the cylinders F F' is located a cylindrical valve-casing D^{11}, the axis of which is parallel with the axis of the shaft A^4. The casing D^{11} has a communicating pipe f, which leads from it to the closed end of the cylinder F and furnishes a communicating passage between the valve-chamber in the casing D^{11} and the chamber behind the piston in the cylinder F. A similar pipe f' leads from the casing D^{11} to the head of the cylinder F' and furnishes a communicating passage between the valve-chamber within the casing D^{11} and the cylinder-chamber behind the piston in the cylinder F'. A similar pipe f^2 leads from the casing D^{11} to the cylinder F^2 and furnishes a communicating passage between the chamber within the casing D^{11} and the chamber behind the piston in the cylinder F^2. The several pistons in the cylinders F F' F^2 are provided with connecting-rods f^3, f^4, and f^5, which connect with the single crank-pin a^6 on a crank-disk A^5. The shaft from the disk A^5 protrudes through one face of the casing A, and it is strongly supported within the casing by a long bearing on bracket A^2.

Within the valve-casing D^{11} are two rotary valves D^3 and D^4, arranged to be shifted, as will be hereinafter explained. These valves D^3 and D^4 are similar except that they are set the one for direct and the other for reverse action. Both turn in the casing on a single shaft D^8, which is itself hollow for a purpose hereinafter specified.

Into one end of the hollow shaft D^8 is inserted a rod D', that projects through stuffing-boxes through the shell of the casing A, and at its terminus has pivotally connected to it a pressure-cam E, hereinafter more fully explained. The stem D^8 is feathered concentrically to a gear-wheel G^2, and the gear-wheel G^2 is journaled in the shell of the casing A. The gear-wheel meshes with an idler G', journaled on a stud secured to the casing A, and the idler meshes with a driving-wheel G, that is keyed to the shaft A^4. The shaft A^4 and the shaft D^8 turn with equal speed. On the shaft D^8 are the two valves D^3 and D^6 and of these the valve D^3 is provided with passages which register in regular rotation with the passages $f f' f^2$ and with a groove which registers in regular succession with the same passages $f f' f^2$. For example, steam entering through the inlet and passage C' is admitted

to the valve-chamber, and when the valve is in the position shown in Fig. 4 is admitted to the passage *f*, and thence passes to the rear of the piston in the cylinder F. In the position shown in Figs. 3 and 4 the valve is just about to cut off to the passage through the pipe *f* and just about to open the passage through the pipe *f'*. At this time the piston in the cylinder f^2 is making its back stroke. The most of the actuating-steam has escaped from the cylinder through the outlet H^2, but there is a residuum which is at low pressure or at atmospheric pressure, and this residuum is pushed back by the piston through the passage of the pipe f^2 and escapes through the groove D^{10} (seen in Fig. 6) through the passage D^7, which is bored radially into the axial passage D^9 in the stem D^8, and this residual escapes through the end of the stem and to the outer air. The main exhaust which has escaped through the opening H^2 passes into the chamber within the case A and thence through the exhaust-pipe C. (Seen in Fig. 3.) The valve D^3 is arranged for direct rotation and for direct actuation of the pistons. By shifting the valves to bring the valve D^6 into opposition to the various passages through the pipes $f f' f^2$ the engines are reversed, the valves are shifted by the rod D', which does not rotate, but which is held by a collar connection to the hollow shaft D^8, and extends through the casing and is pivoted to a shift-cam E. The shift-cam E is a cross-bar arched concentric with the shaft B and supported by sleeved ends *e'* and e^2 upon posts E' and E^2, that project from the face-plate of the casing A. On the posts between the casing and the sleeves are springs e^3 and e^4, that hold the sleeves toward the outer end of the posts E' and E^2.

There is secured to the protruding end B of the throttle-lever B' a lever D, which reaches over the diagonal cam E and swings in contact with the outer side thereof. The contact is made by a friction-roll *d*, journaled in the lever D. The combined action of the swinging lever and the springs e^3 and e^4 actuate the sleeves *e'* and e^2 and the cross-bar E, which connects them, and this in turn actuates the stem D', which shifts the valves D^3 and D^6. The lever D also actuates the throttle-lever B' simultaneously with the shifting of the valves D^3 and D^6. The throttle B' is arranged to open and close the inlet-passage C'. It is a hollow conical plug having two pairs of opposite openings. (Shown in Fig. 9.) When the lever D is swung to press the cross-bar inward toward the casing A, it forces the rod D' inward and brings the valve D^3 into register with the several passages, and at the same time it opens the throttle B' to give free passage to steam through the passage C'. When the lever is swung in the opposite direction, the springs force the cam-bar E outward, and this carries the rod D' and shifts the valve D^6 into register with the passages; but this valve is timed with respect to the engine to produce a reverse action of the several pistons from that which is produced by admission of steam through the valve D^3. During the time of movement of the valves D^3 and D^6, after D^3 has passed out of register with the passages and before D^6 has arrived in a position of register with the passages, the throttle is in position to prevent the passage of steam through the passages C' entirely.

The valves D^3 and D^4 are each made as a split cylinder and bear with an expansive spring action against the shell in which they rotate, the ends I I of the cylinder bearing against the inner walls, and the spring action is assisted by weakening the walls of the valve somewhat by grooves i^2 and by the use of coiled spring *i*, inserted between the parts I I and the hub of the valve.

What we claim is—

1. The combination of a plurality of cylinders, a plurality of pistons and piston-rods therefor pivoted to a single crank, a valve-casing, a rotary valve provided with a hollow stem therein, means for actuating the valve from the main shaft, passages leading from the valve-casing to the cylinders, a main exhaust from the cylinders and a residual exhaust leading through the valve and through the hollow stem of the valve, substantially as described.

2. In a motor, in combination with an engine, a valve-casing, two valves on a hollow stem and adapted to register with ports leading through the casing to the engine, means for shifting the valves, a main exhaust for the engine leading to the outside thereof, and a residual exhaust leading through the valve and the main-valve stem, substantially as described.

3. In a motor, the combination of an engine valve-casing provided with ports, two cylindrical valves in said casing adapted to register with the ports to produce direct and reverse motion of the engine, means for shifting the valves in the casing, a hollow stem to said valves, and provision for the emission of residual steam from the engine through the valve and through the hollow stem, substantially as described.

4. In a motor, in combination with a plurality of cylinders, a cylindrical valve-casing provided with ports, passages leading from said casing to the several cylinders, a pair of valves, means for shifting the valves to bring either into register with the ports, means actuated by the main shaft for rotating the valves, a hollow shaft for said valves, passages leading through the valve into the hollow shaft, a main exhaust for the engine and a grooved surface to each of said valves arranged to allow the escape of the residual exhaust backward through the passages and through the valve into the hollow stem of said valves, substantially as described.

5. In a motor, in combination with an engine-cylinder, provided with suitable pistons and piston-rod connections, a cylindrical

valve-casing provided with ports, a cylindrical valve, a hollow stem for said valve extending to the outside of said casing, the said valve having a part of its periphery grooved and being adapted to register at its grooved part with a port through said casing and provided with a passage from said groove into the hollow stem, substantially as described.

6. In a motor, the combination of an engine-cylinder, provided with an exhaust-opening arranged to be uncovered by the piston at the end of the out travel of the piston, an inlet-opening, a valve-casing, a passage leading from the valve-casing to the inlet-opening, a rotary valve, means for opening the passage through said valve to the inlet-opening at the beginning of the outstroke of the piston, and for consecutively closing said passage and opening a passage from the inlet through the valve into the hollow stem thereof at the beginning of the instroke of the piston, substantially as described.

7. In a motor, the combination of an engine-cylinder, provided with an opening through the wall thereof arranged to be opened for exhaust purposes by the piston near the end of the outstroke of the piston, a cylindrical valve-casing, a cylindrical valve in said casing, a passage from the valve-casing to the engine-cylinder, a hollow stem to said valve arranged to deliver residual exhaust from the engine, the valve being formed to provide a communication from the main steam-inlet to the cylinder during the period of outstroke of the piston and to provide a passage from the engine-cylinder through the valve and through the hollow stem thereof for a residual exhaust during the period of instroke of said piston, substantially as described.

8. In a motor, in combination with an engine-cylinder, a pair of rotary valves in a cylindrical casing, a stem for said valve shiftable longitudinally thereof, a throttle-valve, a lever connected to the valve-stem, means whereby the valve-stem actuates the rotary valve simultaneously with the throttle-lever, substantially as described.

9. In a motor, in combination with a casing, a plurality of engine-cylinders contained in said casing, a rotary-valve mechanism arranged to control the admission of steam to the engines also contained in said casing, the several engines being provided with exhaust-passages for the main exhaust which lead from the engines into the casing, and means whereby residual exhaust escapes through the controlling-valve to the outside of said casing, substantially as described.

In testimony whereof we sign this specification in the presence of two witnesses.

JAMES L. PILLING.
ROBERT J. KRUSE.

Witnesses:
LOTTA LEE HAYTON,
ELLIOTT J. STODDARD.