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E. WALDRON.

Rotary-Engine.

No. 225,030. Patented Mar. 2, 1880.

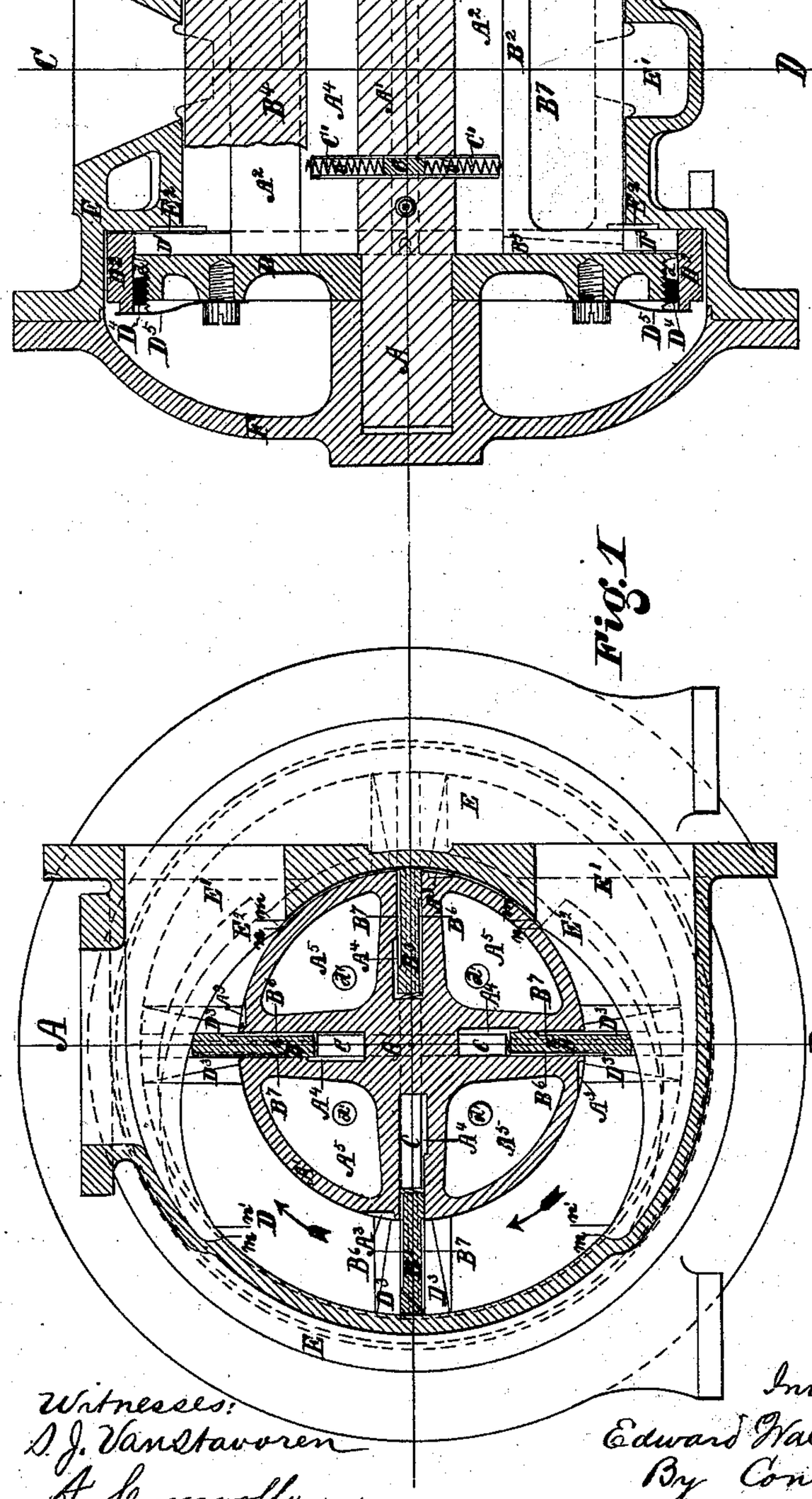

Fig. 2

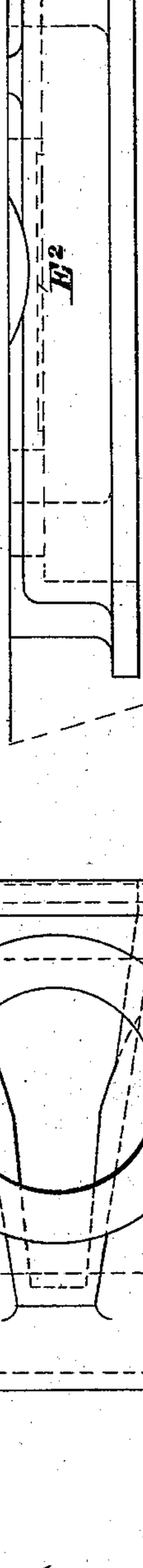

Fig. 3

Fig. 1

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6 Sheets—Sheet 2.

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Rotary-Engine.

No. 225,030. **Patented Mar. 2, 1880.**

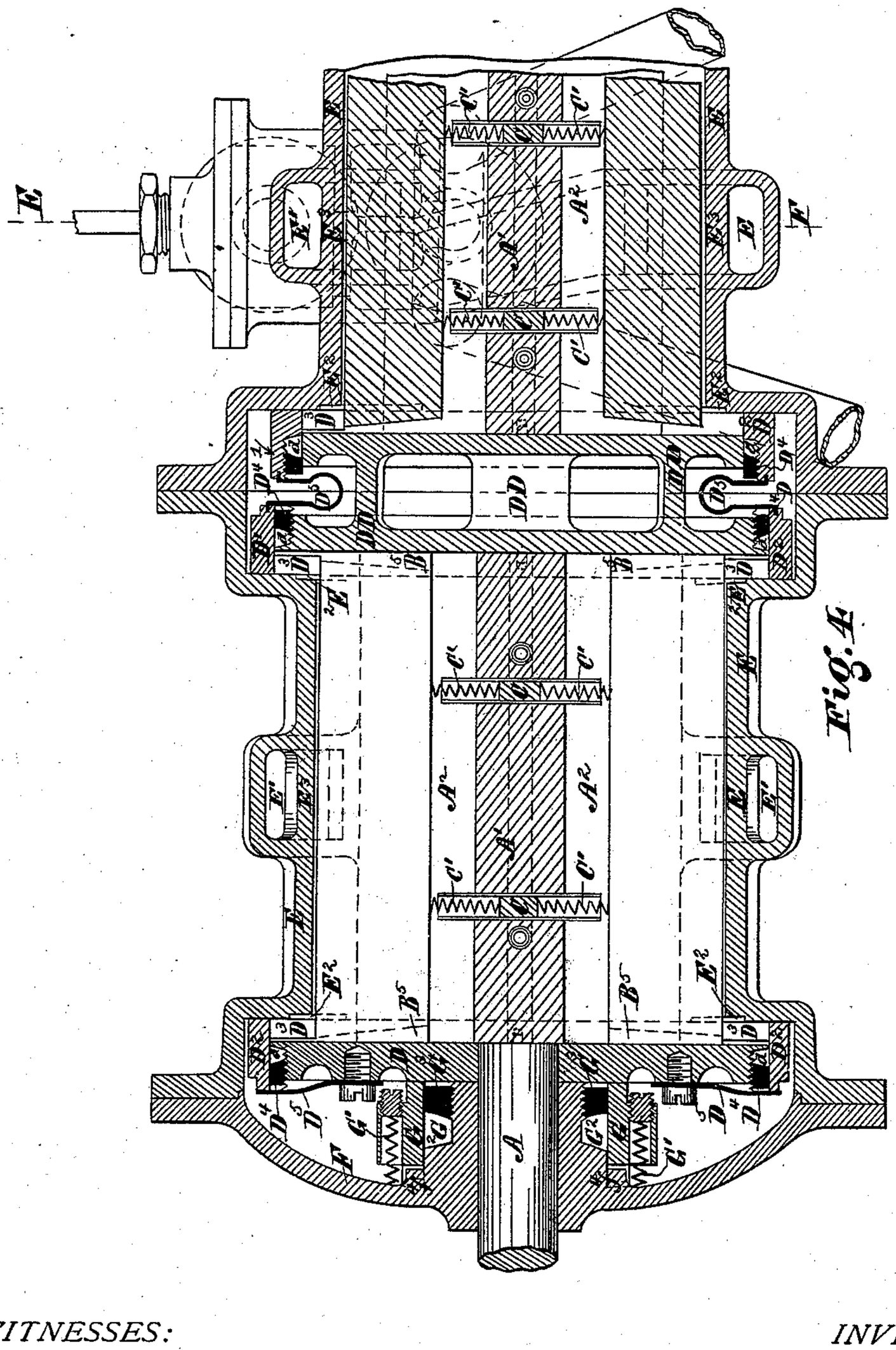

Fig. 4.

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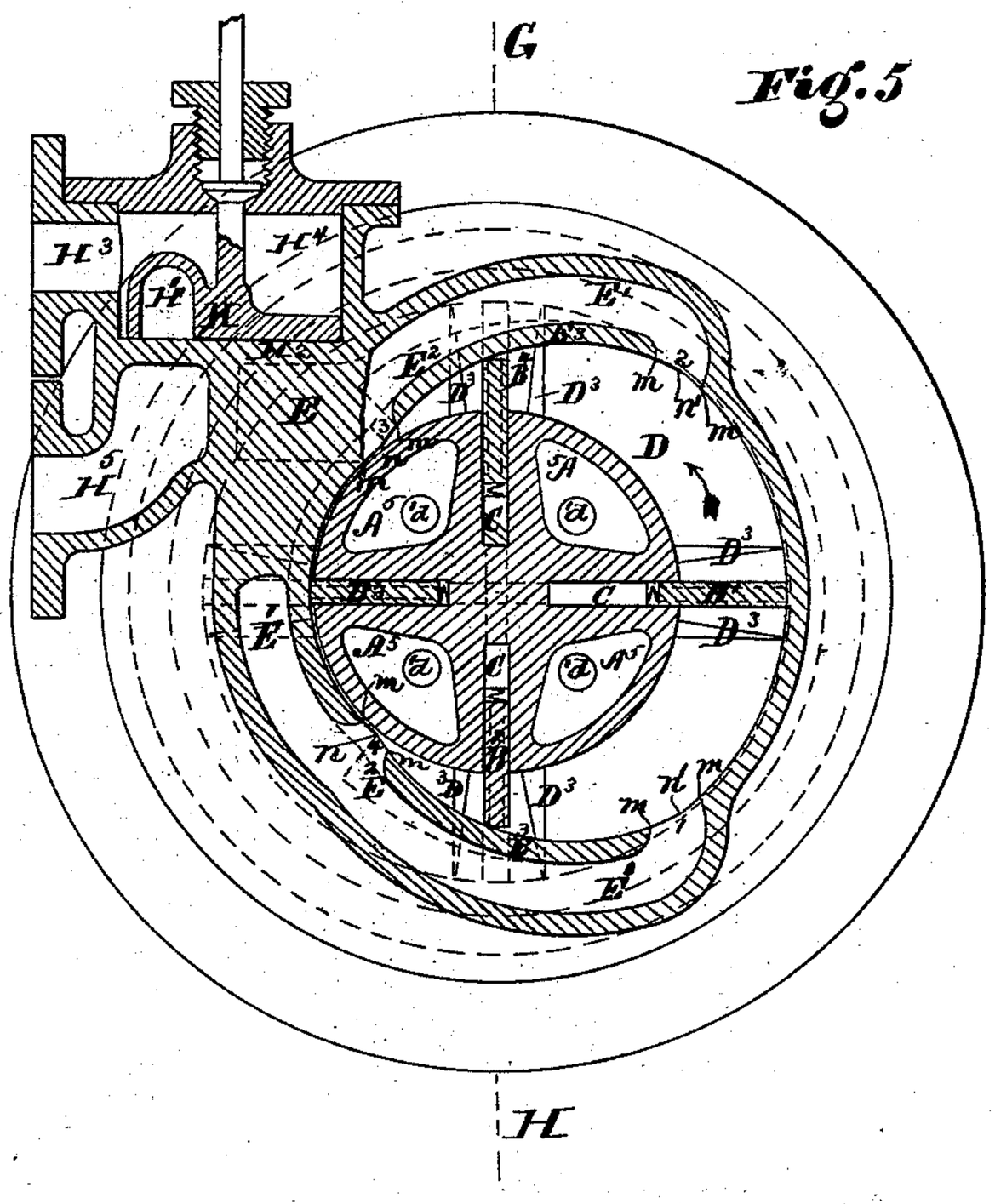
Fig. 5



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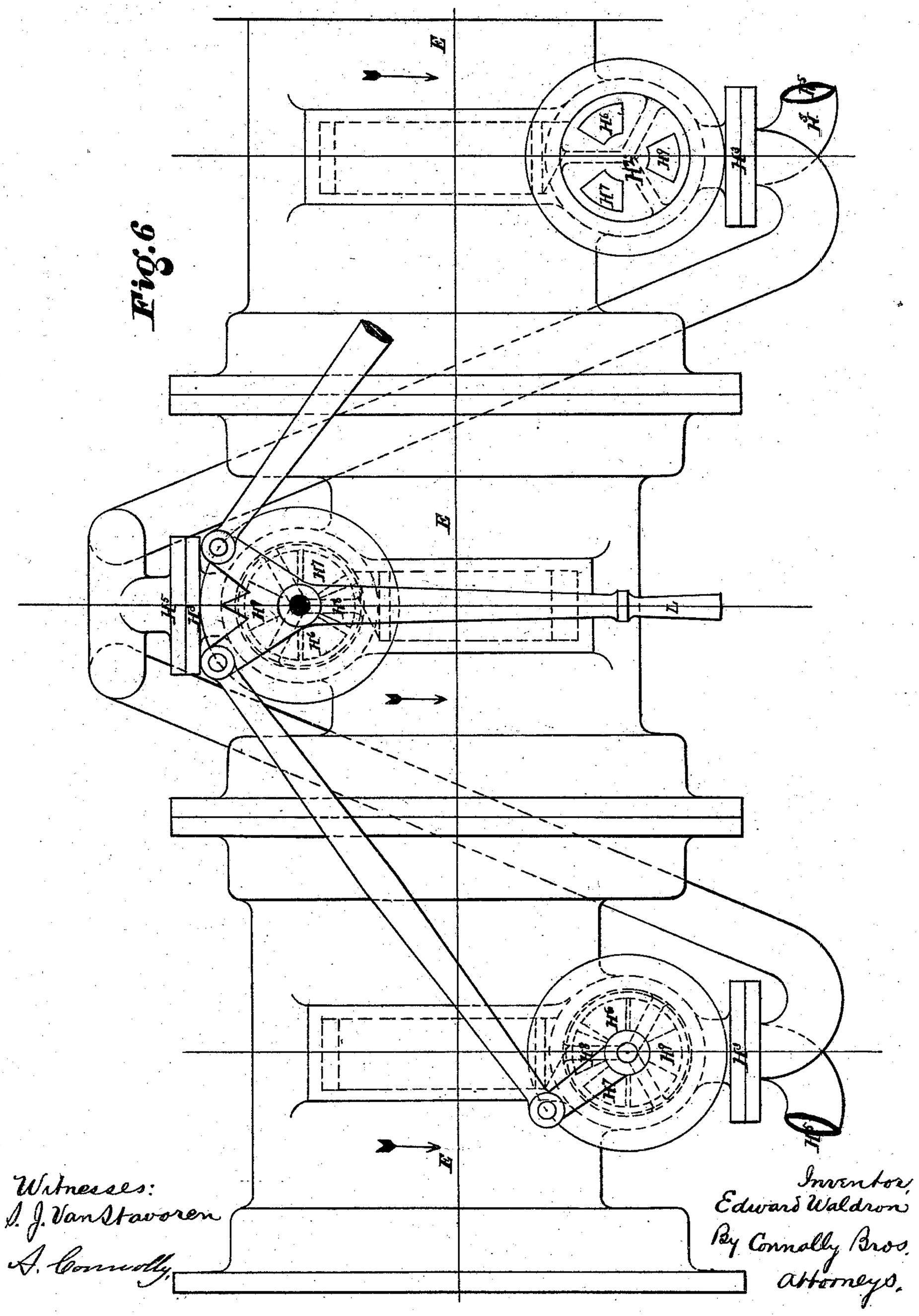

Fig. 6

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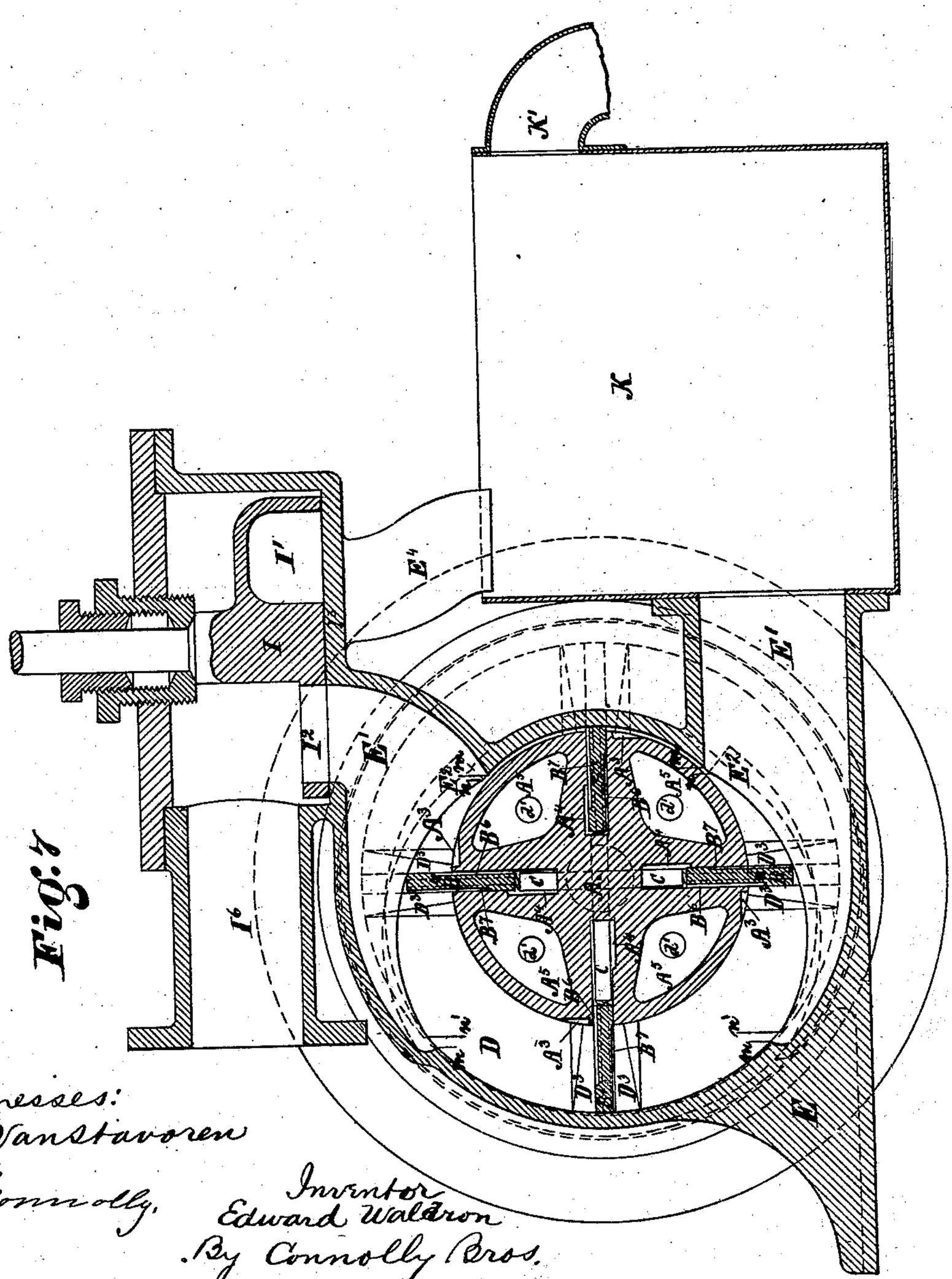

Fig. 7.

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6 Sheets—Sheet 6.

E. WALDRON.

Rotary-Engine.

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Fig: 9.

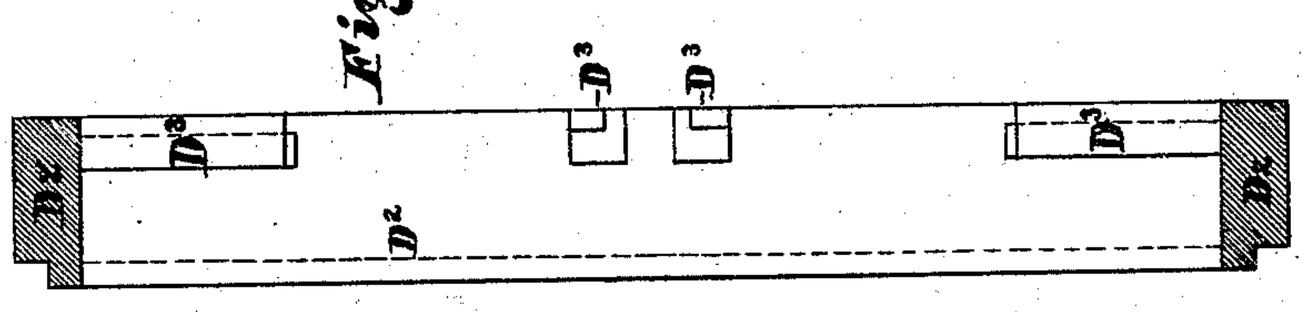
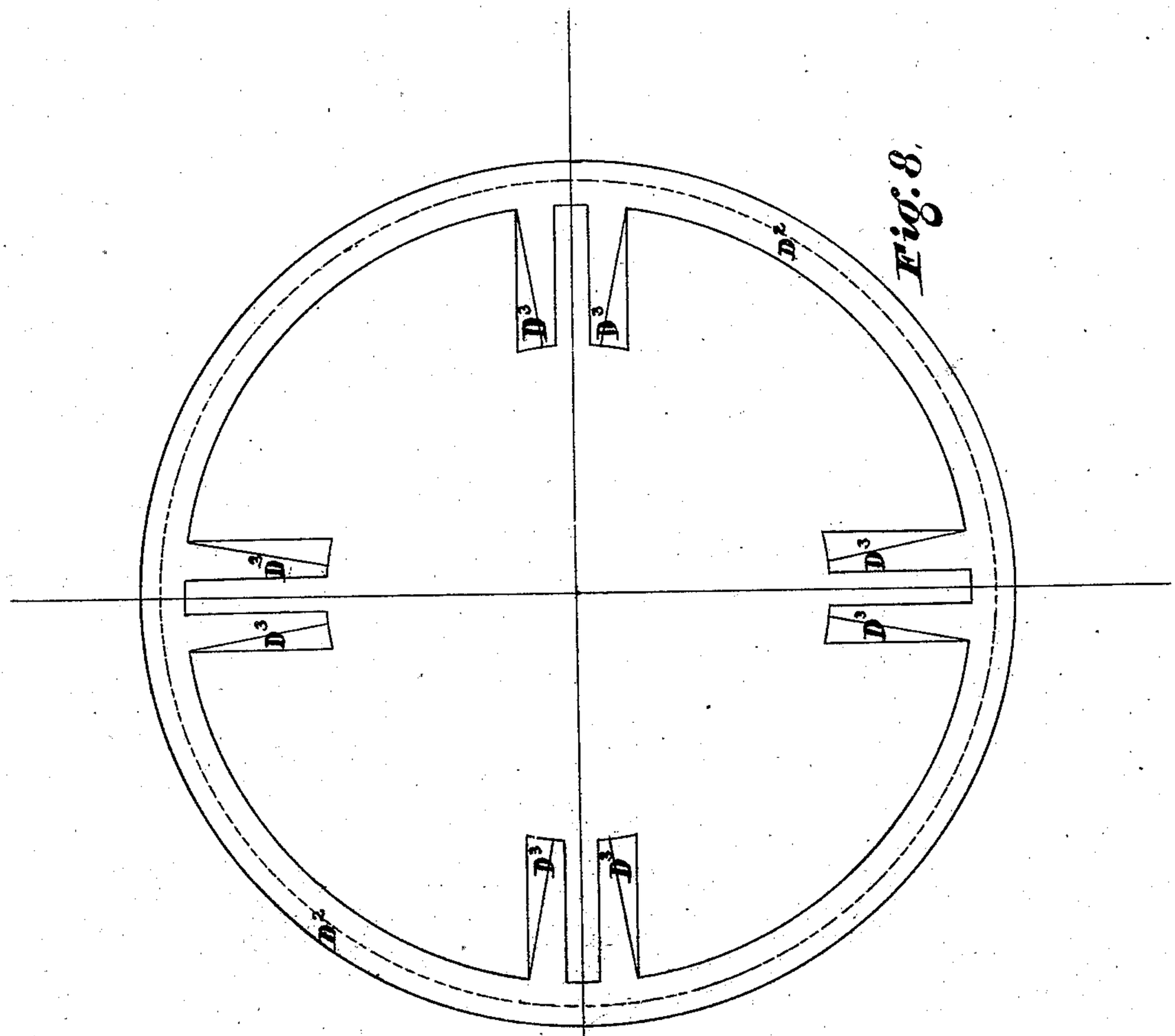


Fig: 8.



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UNITED STATES PATENT OFFICE.

EDWARD WALDRON, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 225,030, dated March 2, 1880.

Application filed September 24, 1879. Patented in England, April 16, 1878.

To all whom it may concern:

Be it known that I, EDWARD WALDRON, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Engines and Pumps; and I do hereby 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 it, reference being had to the accompanying drawings, which form part of this specification, in which—

Figures 1, 2, and 3 show my invention as designed for use as a lift or force pump, or both, for water or other liquid, Fig. 1 being a sectional view on line C D, Fig. 2; Fig. 2, section of same cut on line A B, Fig. 1; and Fig. 3, a plan of the case or cylinder. Figs. 4, 5, and 6 illustrate my invention as a compound balanced engine, Fig. 4 being a sectional view on line G H, Fig. 5; Fig. 5, section of same on line E F, Fig. 4; and Fig. 6, plan showing relative positions of the cases and reversing-valves. Fig. 7 is section showing adaptation as hoisting and lowering machine. Fig. 8 is plan of packing-ring, and Fig. 9 diametrical section of same.

My invention has relation to rotary engines and pumps; and it consists in the improvements hereinafter described and claimed.

In the annexed drawings, A indicates the shafts, and A′ the drums. A^2 are piston or vane races in the drums. A^3, Figs. 1 and 7, are recesses in the drums, and in pumps are for the purpose of enabling the machine to carry around and discharge such dirt or other substance as may pass in with the water or other liquid, but in engines are for the purpose of giving a freer egress to the water in case of priming. A^4, Figs. 1 and 7, are circulation-channels in the piston or vane races in the drums of those machines which are intended to be used for the above-named purposes. B′, B^2, B^3, and B^4 show the pistons or vanes. B^5 (and also B^6 and B^7 in Figs. 1 and 7) are circulation-channels in the pistons or vanes.

All of the above-mentioned circulation-channels are for the purpose of allowing a free circulation of liquids, fluids, or gases in the piston or vane races during the reciprocating movements of the pistons or vanes.

C are cylindrical tubes, solid or plugged in their centers, and having spiral springs C′ inserted into each end of them. D are the drum-caps fitted and firmly secured to the drum; D D, Fig. 4, double drum-caps, by means of which the center and side engines are coupled. D′ in Fig. 2 shows where one of the arms of the packing-ring and a portion of the pistons or vanes B^4 has been left out to illustrate a part of the drum-cap, which is recessed for the reception of one of the arms of the packing-ring, such recesses forming races for so much of the pistons or vanes as travel between the arms of the packing-ring. *d′* are holes or openings in the drum-caps, which (in connection with the tunnels A^5 in Figs. 1, 5, and 7, extending through the drum) are for the purpose of opening communication between the spaces intervening between the drum-caps and the case or cylinder covers, so as to equalize the pressure of the steam, water, or other gas or fluid which may be in said spaces. D^2 are packing-rings, having arms D^3 projecting inwardly. These arms, or those portions of them which are subject to contact with the case or cylinder, taper or diminish toward the center, for the purpose of proportioning their friction-surfaces to the distance to be traveled under friction.

A portion of the periphery of the drum-cap or a portion of the inner periphery of the packing-ring, as shown in Fig. 4 and indicated by the arrow 1, is recessed for the purpose of admitting the soft packing *d*. This packing is compressed by the gland D^4.

D^5 are springs attached to the drum-caps, and which bear on the packing-ring D^2 and keep it and its arms in contact with the case or cylinder E. Where double drum-caps are used springs D^5, Fig. 4, bear from one packing-ring to the other.

E′ are ports in case or cylinder. *m* indicates where the ports begin and end, and *n n′* the extent of the eccentric curves. E^2 indicate the circulation-channels in the cylinder or case. They act in conjunction with the circulation-channels B^5 in the ends of the pistons or vanes, and are for the purpose of admitting

the free ingress and egress of steam, water, or other fluids or gases used to or from the piston or vane races in the drum and drum-caps during the reciprocal movements of the pistons or vanes. E^3, Fig. 5, indicates bearing-surfaces in the ports of the case or cylinder. These bearing-surfaces are for the purpose of preventing an uneven wearing away of those portions of the pistons or vanes which bear against the inner periphery of the case or cylinder.

F indicates the case or cylinder covers. G is a metallic ring or cylinder, fitted to and free to move laterally on that portion of the case or cylinder cover through which the shaft passes. It is kept in contact with the face of the drum-cap by means of the springs G′, and is prevented from revolving by means of tails or lugs which project from it and fit into the recesses f' in the case or cylinder cover. A portion of the case or cylinder cover under this metallic ring is recessed for the purpose of admitting the soft packing G^2, which is compressed by means of the gland G^3. This arrangement is for the purpose of preventing the steam, water, or other fluids or gases which may be occupying the space between the drum-cap and the case or cylinder cover from escaping by way of or coming into contact with the shaft.

H in Fig. 5 is the valve for controlling the admittance and reversing the direction of the steam. H′ is a tunnel in said valve, and H^2 the valve-seat. H^3 is steam-inlet for connecting with steam-pipe, and H^4 steam-chamber. H^5 is exhaust to low-pressure engines from center engine, and waste-pipe from side or low-pressure engines; H^6, Fig. 6, ports in valve-seats connecting with lower port of center engine and upper ports of side engines; H^7, ports in valve-seats connecting with upper port of center engine and lower ports of side engines; H^8, ports in valves; H^9, exhaust-ports in valve-seats.

The valve shown in Fig. 7 is for the purpose of changing the action of the machine from that of a motor to that of a pump. I indicates the valve, and I′ tunnel therein. I^2 is port in valve, and I^3 is valve-seat. I^6 is induction to valve; E^4, return discharge-pipe; K, tank, and K′ overflow. L, Fig. 6, is reversing-valve lever-handle.

As in principle all these machines are alike, no matter for what use they are intended, though in some of the details of construction in some of the parts there is a slight difference, such as larger and graduated ports in the cases or cylinders and larger circulation-channels in the pistons or vanes, and in the drums of such of these machines as are intended to be used as pumps or motors for water or other liquid, and though the machines can also be used as single or compound, and in combination with arrangements intended to increase their range of work, it is obvious that when transmitting power from steam or water or gases or fluids the mode of action in each case will be the same; and it is also evident that, when transmitting power to water, air, or other liquids or fluids, it will operate in a manner alike with all of them. Hence to explain the action of these machines it will be necessary to do so under the following heads: First, as a single engine transmitting power from steam; second, as a lift and force pump for water; third, as a compound balanced engine driven by steam; and, finally, the arrangements used in connection with the engine adapted as a hoisting and lowering machine using water.

First, as a steam-motor, reference being made to Fig. 5 and to center engine, Fig. 6. If the reversing-valve H be turned so as to bring its port H^8 over the port H^6 in the valve-seat, the steam will enter the engine by way of the openings 4 and 1 in the lower port of the case or cylinder, and its effective pressure will be delivered on the vane or piston B′, causing the pistons, together with the drum, drum-caps, and their packing, to revolve in the direction indicated by the arrows. When the piston B′ arrives opposite the opening 2 in the upper port the steam will escape, and thereby relieve the piston of its pressure before it (the piston) strikes the incline, which will drive it toward the center of the drum; but before this escape of steam takes place the piston B^2 has passed the opening 1 in the lower port, and the other pistons follow in like manner. One of the pistons will be always in contact with that portion of the case or cylinder which is nearest to the drum, and so prevent the escape of steam, which would otherwise take place between the drum and the case or cylinder on that side. The packing-rings D^2 and their arms D^3 prevent the escape of steam, which would otherwise take place between the faces of the drum-caps and the faces of the cylinder. The cylindrical tubes and springs move reciprocally with the pistons. By means of the circulation-channels B^5 in the pistons and E^2 in the case or cylinder the steam has free ingress to and egress from the piston-races, so that it cannot impede the pistons in their reciprocal movements. The steam escapes by way of the upper port in the case or cylinder and upwardly through the port H^7 in the valve-seat, and, passing through the tunnel H′, flows down through the exhaust-port H^9, and finally escapes by way of the exhaust H^5. If the valve be reversed so as to bring its port over the port H^7 in the valve-seat, the steam will enter the engine by way of the upper port and cause the machine to revolve in like manner in the opposite direction, the steam escaping from the engine by way of the lower port in the case or cylinder, through the port H^6 in the valve-seat, and through the valve and exhaust port, as before described. Should either of the packing-rings D^2 permit the steam to escape into the space intervening between the drum-cap and the case or cylinder cover on that side, as much of this steam will flow through the pressure-bal-

ance holes *d'* in the drum-caps and through the tunnels A^5, which extend through the drum and pass into the corresponding space on the other side of the machine, as will be necessary to equalize the pressure on the outsides of both drum-caps, and thus prevent the side thrust which would otherwise take place, and the steam will be prevented by the shaft-packing G G' G^2 G^3 *f'* from coming into contact with or escaping by way of the shaft.

Second, as a lift and force pump for water. The machine, being caused to revolve in the direction indicated by the arrows, Fig. 1, expels the air through the upper port and produces a vacuum or partial vacuum in the lower port and its connections. This causes the water to rise and flow into the pump by way of the lower port, when it is caught by the pistons or vanes and forced out through the upper port. During the reciprocal movements of the pistons or vanes the circulation-channels B^5 therein and E^2 in the case or cylinder are in communication; but each piston or vane, when at the end of its stroke toward the center of the drum, has its circulation-channel B^6 closed, so that the water cannot flow around it and escape. Its circulation-channel B^7 is open to or acting in conjunction with the channel A^4 in its race in the drum. As the piston or vane travels outwardly its circulation-channel B^6 opens and the communication between the channels B^7 and A^4 closes, so that when the piston or vane is at the end of its outward stroke the water cannot flow around it and escape on that side.

Third, a compound engine embodying my improvements consists of three engines resting on and true to one pair of shafts. The drum of the center engine is coupled or united with the drums of the side engines by means of double drum-caps. Said double drum-caps are each substantially the same as two single drum-caps joined together by means of webs or arms, or other equivalent connections, and are so constructed for the purpose of coupling the drums of the engines that when one is moved it will carry the other or others with it. The cases or cylinders of the center and side engines are bolted together, and each of the said engines is the same as that already described. The center engine is placed in a position the reverse of the side engines, so that if power be applied on one side of the former it will be on the opposite side of the latter. This is for the purpose of as nearly as possible balancing the weight of the steam on the drums. The center and side engines all turn in the same direction. Where this balance of weight or pressure is not required two engines or machines may be coupled, as above described, and it is obvious that any number may be so coupled. In Fig. 6 the valve-seat only of one of the valves is shown. This is for the purpose of illustrating more clearly the relative positions of the ports in the valve-seat; but, in describing the action in relation to each other of the three engines combined as a compound balanced engine, it will be necessary to consider it as it would be complete in all its details. The steam from the boiler is admitted into the steam-chamber H^4 of the valve of the center engine by way of the inlet H^3. The valve, as shown in the drawings, is shut. If the lever-handle L be moved to the right, it will admit the steam to the center engine by way of the upper port. At the same time the valves of the side engines have been opened to admit the steam by way of their lower ports; but it does not enter yet. The steam will enter on top of the center engine, and, bearing downwardly on the pistons or vanes as they come into position, will turn said engine in the direction indicated by the arrow, Fig. 6, carrying the side engines with it. As the steam escapes from the center engine it will enter the side engines by way of their lower ports, and in its then expanded state, bearing upwardly on the pistons or vanes of both side engines, will expend its force in moving them in the same direction as the center engine. If the lever-handle be moved to the left, the steam will enter the center engine by way of the lower port, and the expanded steam will enter the side engines through their upper ports, and the engine will turn in the opposite direction.

Fourth, as a hoisting and lowering machine using water. Water under pressure or from the main enters on top of the valve through the induction-port I^6, Fig. 7. When the port I^2 in the valve is over that part of the valve-seat marked I^3 the valve is closed and the water cannot enter the machine. If the valve be now turned so that its port is brought in line with a port (not shown in drawings) in the valve-seat, the water will enter the machine by way of its upper port, and, bearing on the piston or vane B', will drive it in the direction of the lower port, from whence it (the water) escapes into the tank K. The other pistons or vanes follow in like manner, and in this way the machine, acting as a water-motor, hoists the load. When it is desired to sustain the load thus elevated in the position to which it has been brought the valve is closed, and the water, having now no outlet by way of said valve, prevents the machine from being driven in the opposite direction by means of the weight or load. To lower the load the valve is moved so as to cause its tunnel, which is in communication with a return-port in the valve-seat, to also overlap and open communication between it and the other or inlet port, also in the valve-seat, and the machine now revolves, and, acting as a pump, draws the water from the tank K, forces it up by way of the said inlet-port through the tunnel in the valve, down through the return-port, and back into the tank by way of the return discharge-pipe E^4.

The speed of the machine can be controlled by means of the valve.

I wish it to be understood that while I de-

scribe certain features of construction applicable to the apparatus as a pump alone—as, for instance, the valve I and its appliances—I do not herein claim such features, but reserve the right to incorporate and claim the same in a separate application.

I have given my invention the title "improvements in rotary engines and pumps;" but I do not wish to be understood as limiting myself to such application, as the improvements are equally applicable to water-meters and other contrivances, so that in details of mechanical construction and arrangement I desire my claims to be construed broadly.

What I claim as my invention is—

1. In a rotary engine or motor, the packing-ring D^2, having arms D^3 projecting inwardly, in combination with the case or cylinder E and drum-caps D, substantially as shown and described.

2. In a rotary engine or motor, the packing-ring D^2, with arms D^3, whose friction-surfaces diminish from the inner periphery of said ring toward its center, whereby said surfaces are proportioned to the distance traveled under friction, in combination with the case or cylinder E and drum-caps D, substantially as shown and set forth.

3. In a rotary engine or motor, the combination of packing-ring D^2, having inwardly-projecting arms D^3, with drum-caps D, having recesses for the reception of the arms, and the case or cylinder E, substantially as shown and set forth.

4. In a rotary engine or motor, the combination of the packing-ring D^2, having inwardly-projecting arms D^3, with the drum A′ and cylinder or case E, said arms being in contact with the surface of said drum, substantially as shown and described.

5. In a rotary engine or motor, the combination, with the case or cylinder E, drum A′, and radially-projecting vanes or pistons B′, of the packing-ring D^2, having arms D^3, which receive said vanes or pistons, and the drum-caps D, substantially as shown and described.

6. In a rotary engine or motor, the double drum-caps D D, in combination with the engine cylinder or case E, substantially as shown and described.

7. In a compound rotary engine or motor, the combination, with a center engine, of side engines having reversed ports, substantially as shown, whereby the initial pressure of the steam or other gas or fluid in said center engine is balanced by being admitted on the opposite sides of said side engines, as described.

8. In a rotary engine or motor, the pistons or vanes B′, having circulation-channels B^5 B^6 B^7, in combination with the drum A and cylinder or case E, substantially as shown and described.

9. In a rotary engine or motor, the case or cylinder E, having circulation-channels E^2, in combination with the circulation-channels B^5, substantially as shown and described.

10. In a rotary engine or motor, the drum-caps D, having balance holes or openings d', in combination with the drum having tunnels A^5, to permit equalization of pressure in the spaces between the drum-caps and the case or cylinder covers, substantially as shown and described.

11. In a rotary engine or motor, the combination, with the case or cylinder E, of the drum A, having circulation-channels A^4, and the vanes or pistons having channels B^7, substantially as and for the purpose set forth.

12. In a rotary engine or motor, the shaft-packing composed of ring G, spring G′, soft packing G^2, gland G^3, and recesses f', constructed and combined substantially as and for the purpose described.

13. In a rotary engine or motor, the drum A′, having recesses A^3, in combination with the case or cylinder E, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 22d day of May, 1879.

EDWARD WALDRON.

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