No. 772,353. PATENTED OCT. 18, 1904.

J. T. HALSEY.

MULTIPLE CYLINDER EXPANSION FLUID ENGINE.

APPLICATION FILED FEB. 13, 1900. RENEWED MAR. 17, 1904.

NO MODEL. 8 SHEETS—SHEET 1.

FIG. 1.

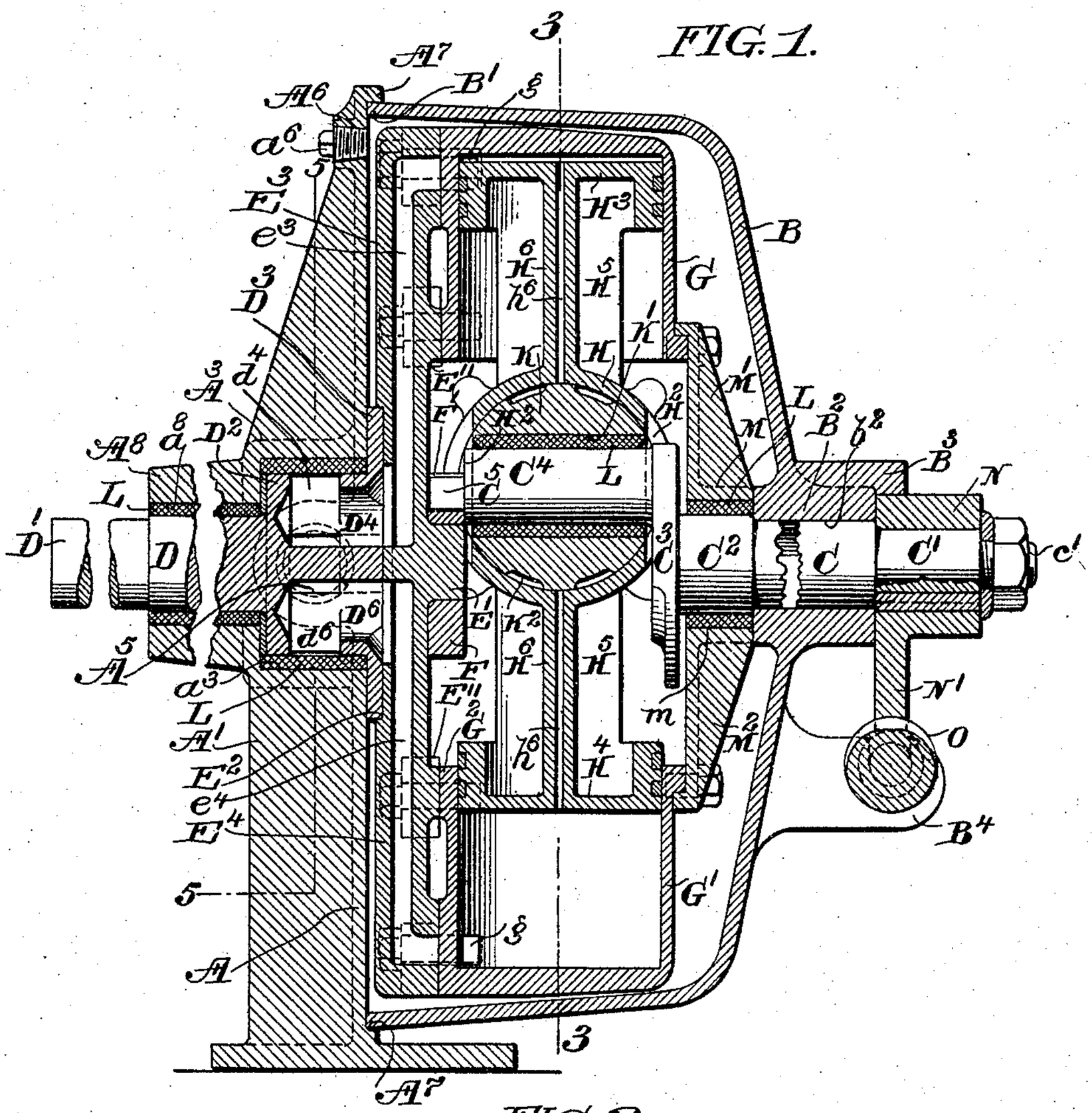
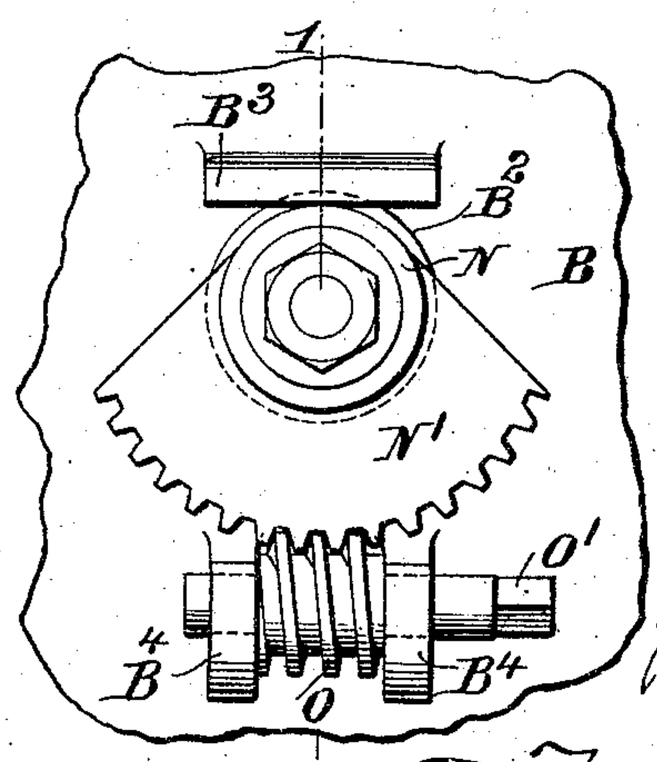


FIG. 2.



Witnesses:
Henry Drury
D. Howarth

Inventor:
James T. Halsey
by his atty
James T. Chambers

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NO MODEL. 8 SHEETS—SHEET 2.

FIG. 3.

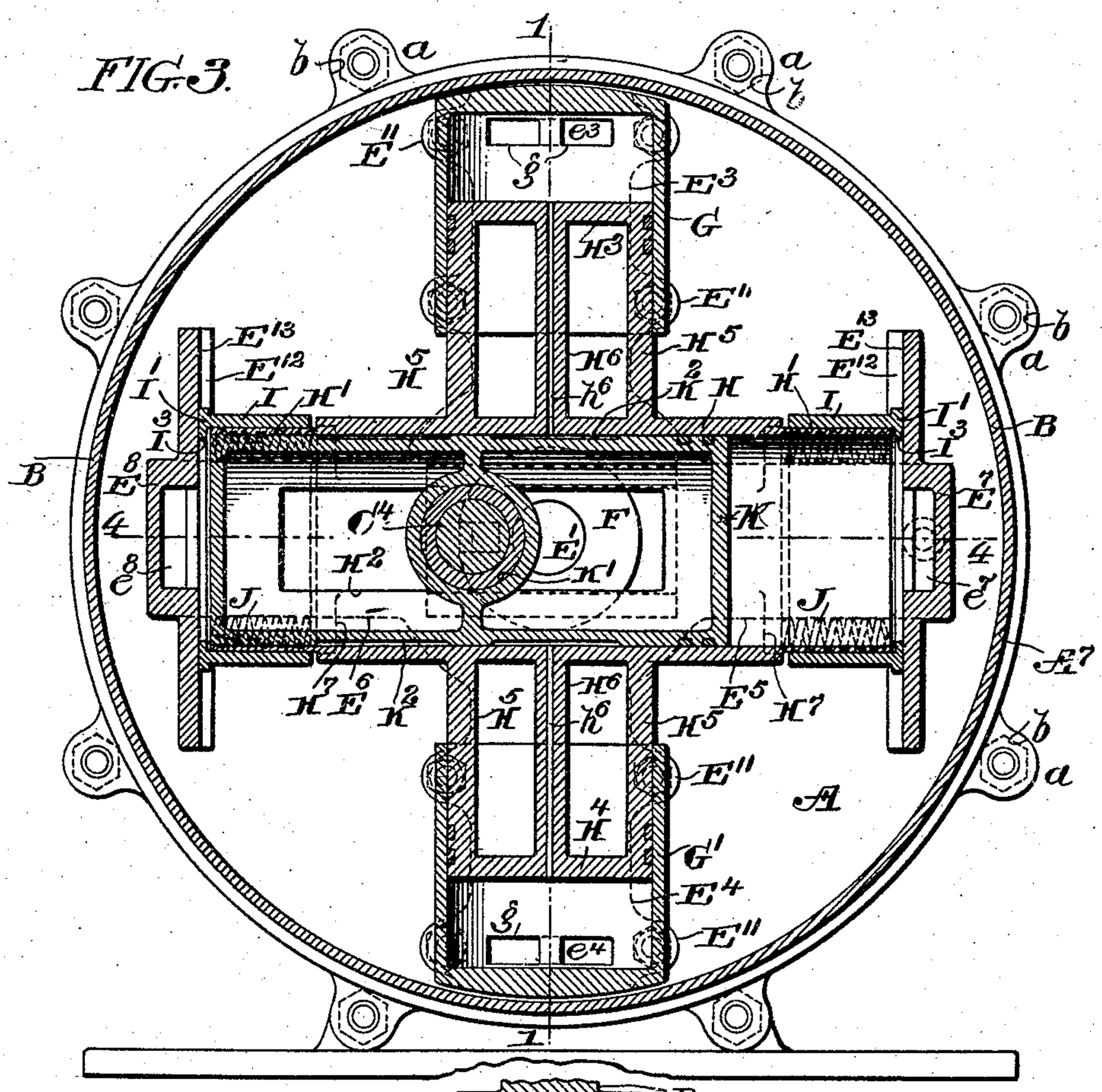
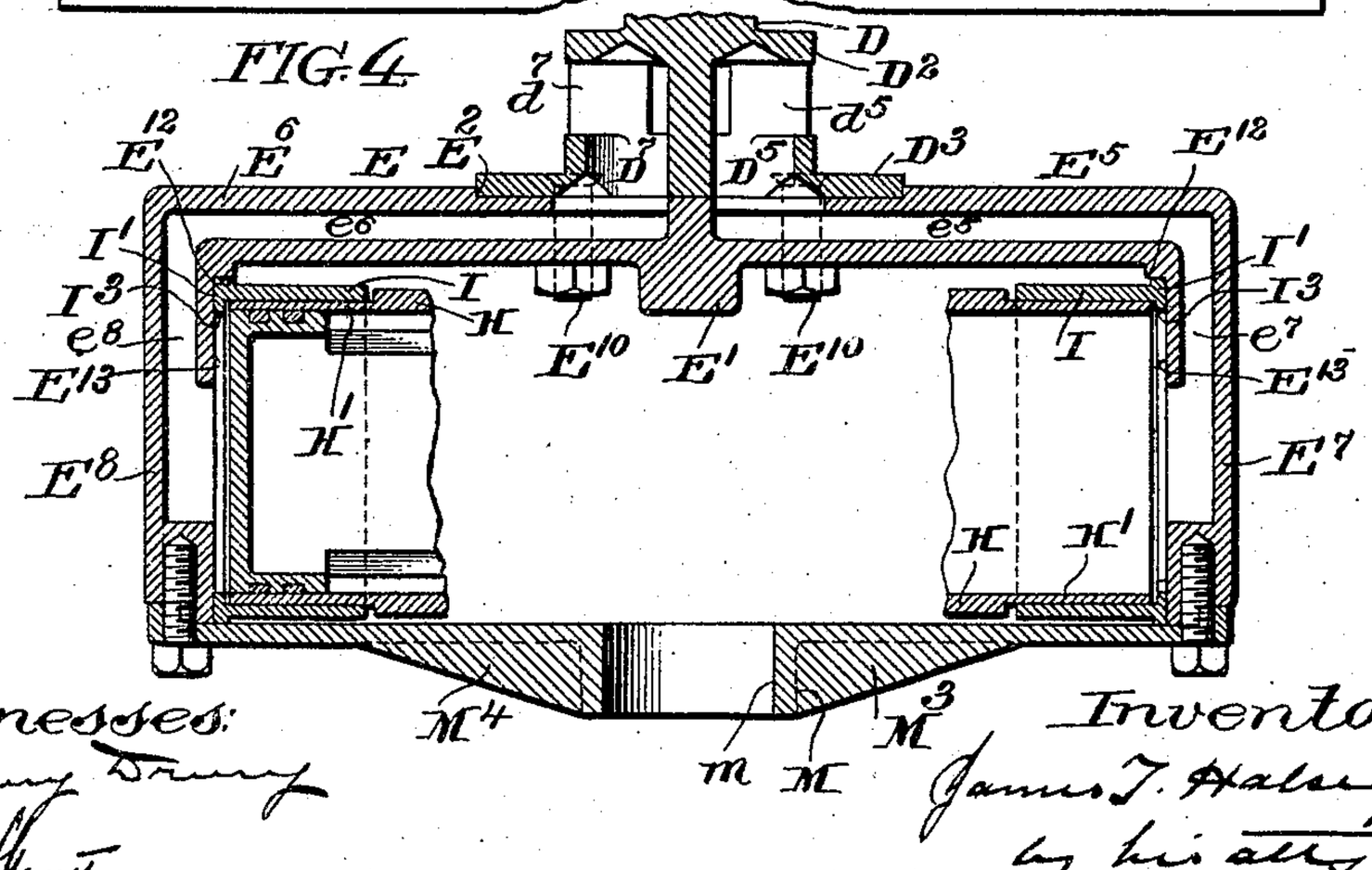


FIG. 4.



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NO MODEL. 8 SHEETS—SHEET 3.

FIG. 5.

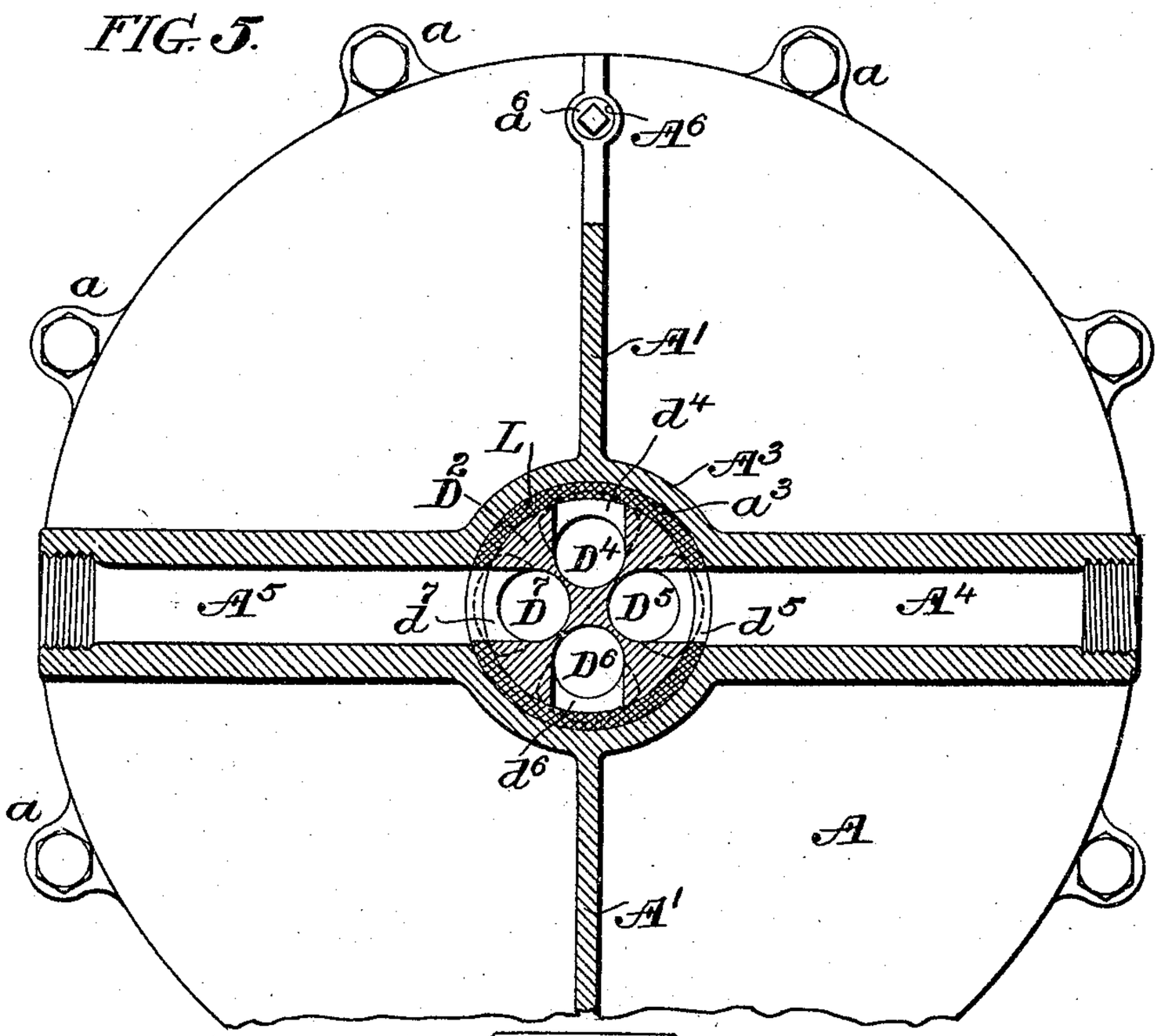
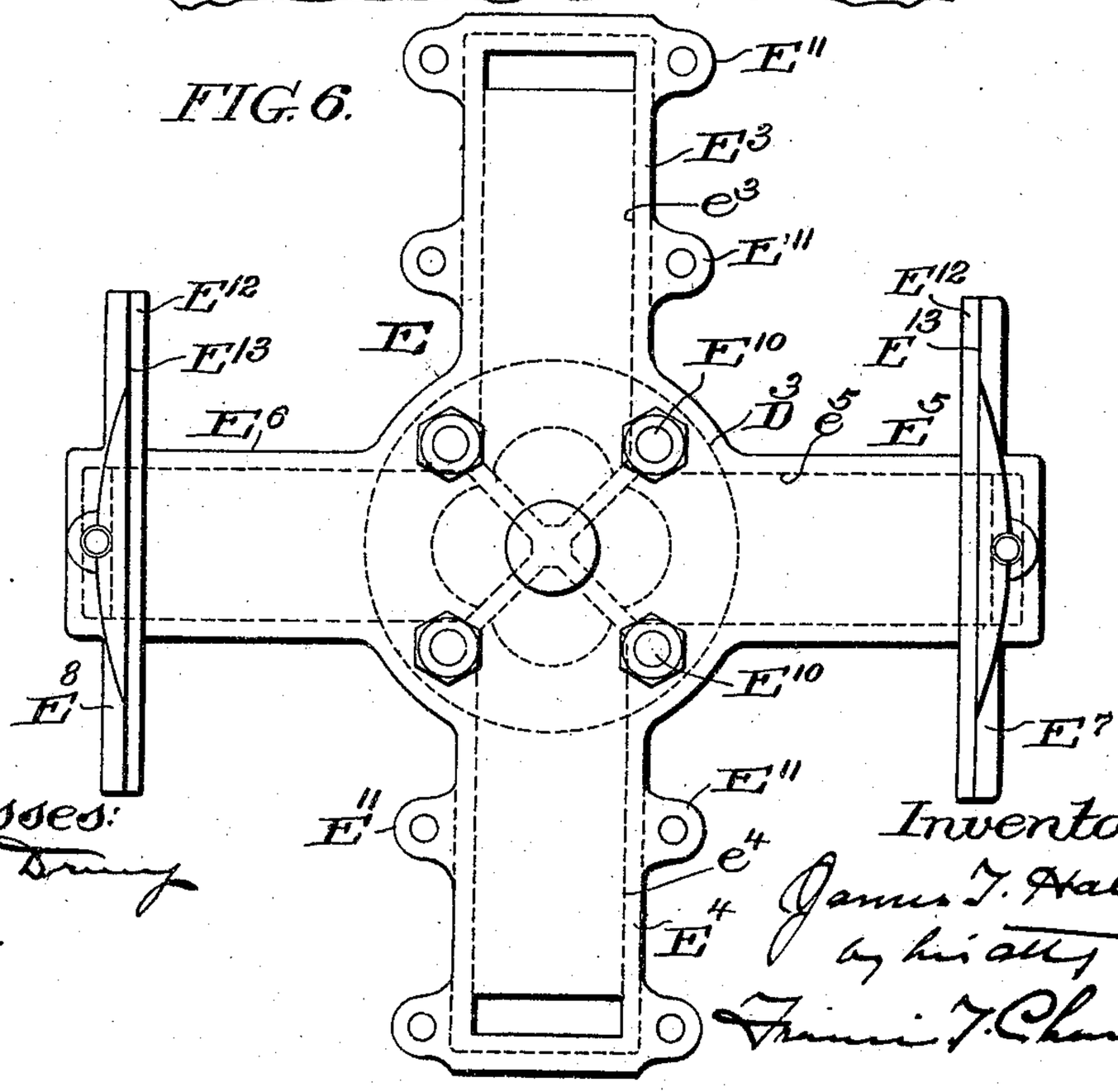


FIG. 6.



Witnesses:
Henry Orrig
H. Stewart

Inventor:
James T. Halsey
by his atty.
Francis J. Chamberlain

PHOTO-LITHOGRAPHED BY SACKETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

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NO MODEL. 8 SHEETS—SHEET 4.

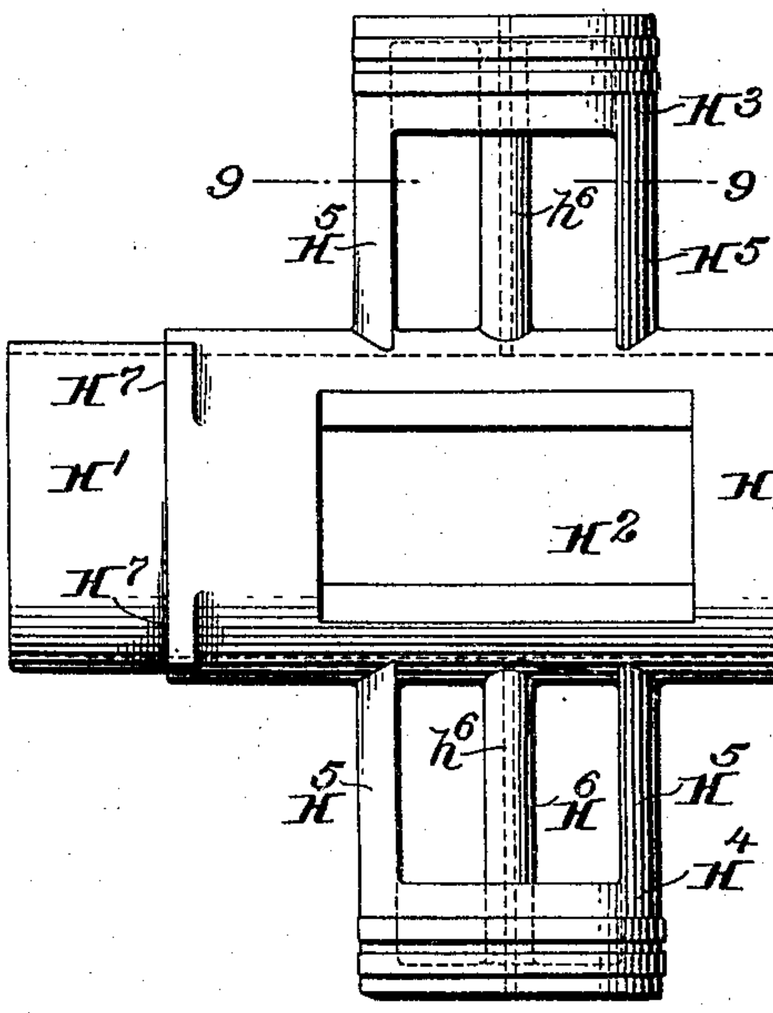


FIG. 7.

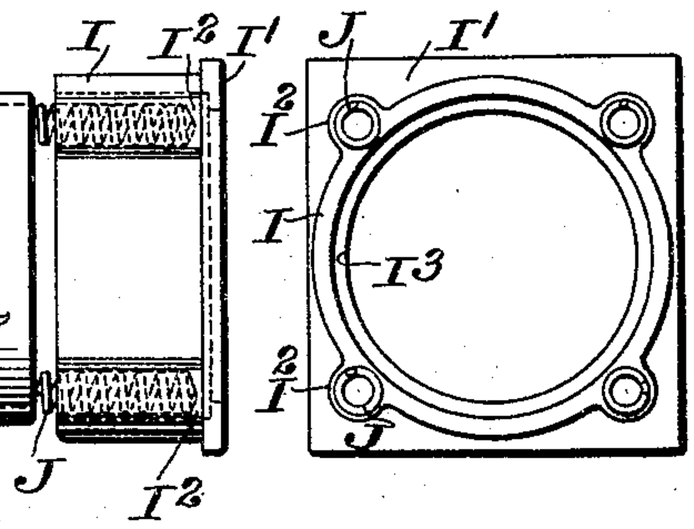


FIG. 8.

FIG. 9.

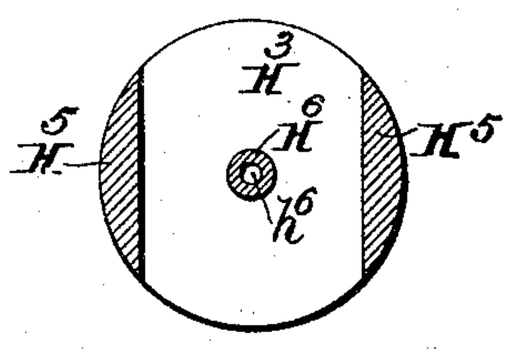


FIG. 10.

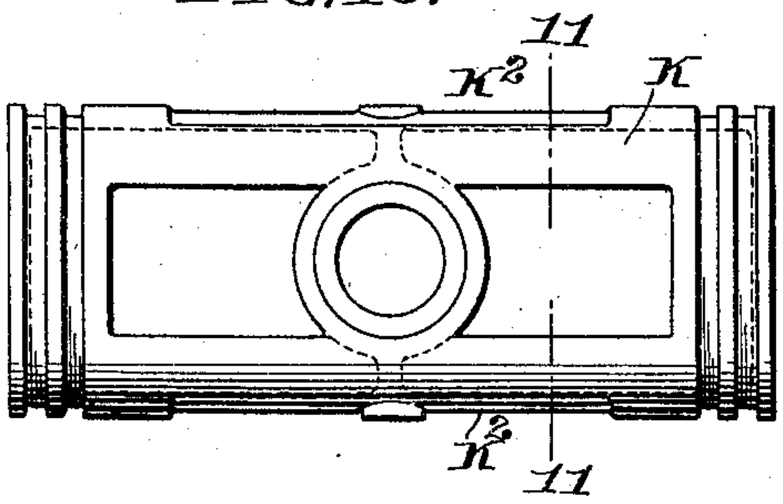


FIG. 11.

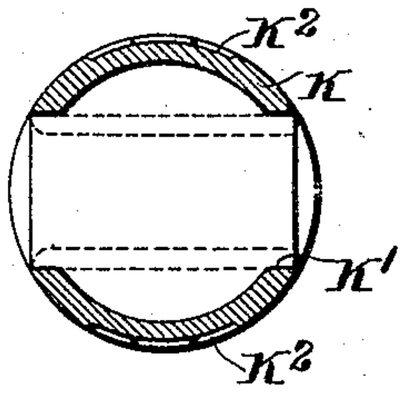


FIG. 12.

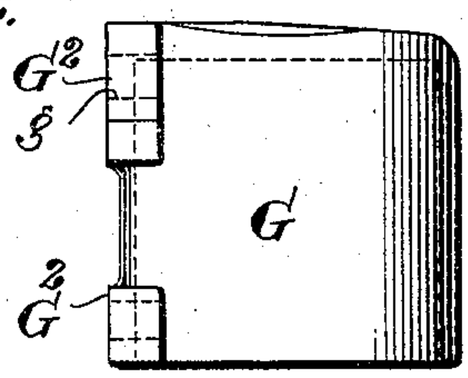
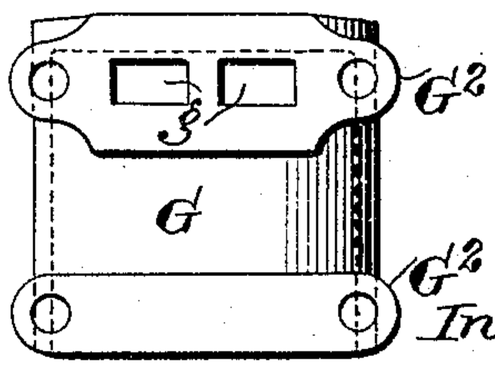


FIG. 13.



Witnesses:
Henry Dewey
H. Hewett

Inventor:
James T. Halsey
by his atty.
Francis J. Chambers

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NO MODEL. 8 SHEETS—SHEET 5.

FIG. 14.

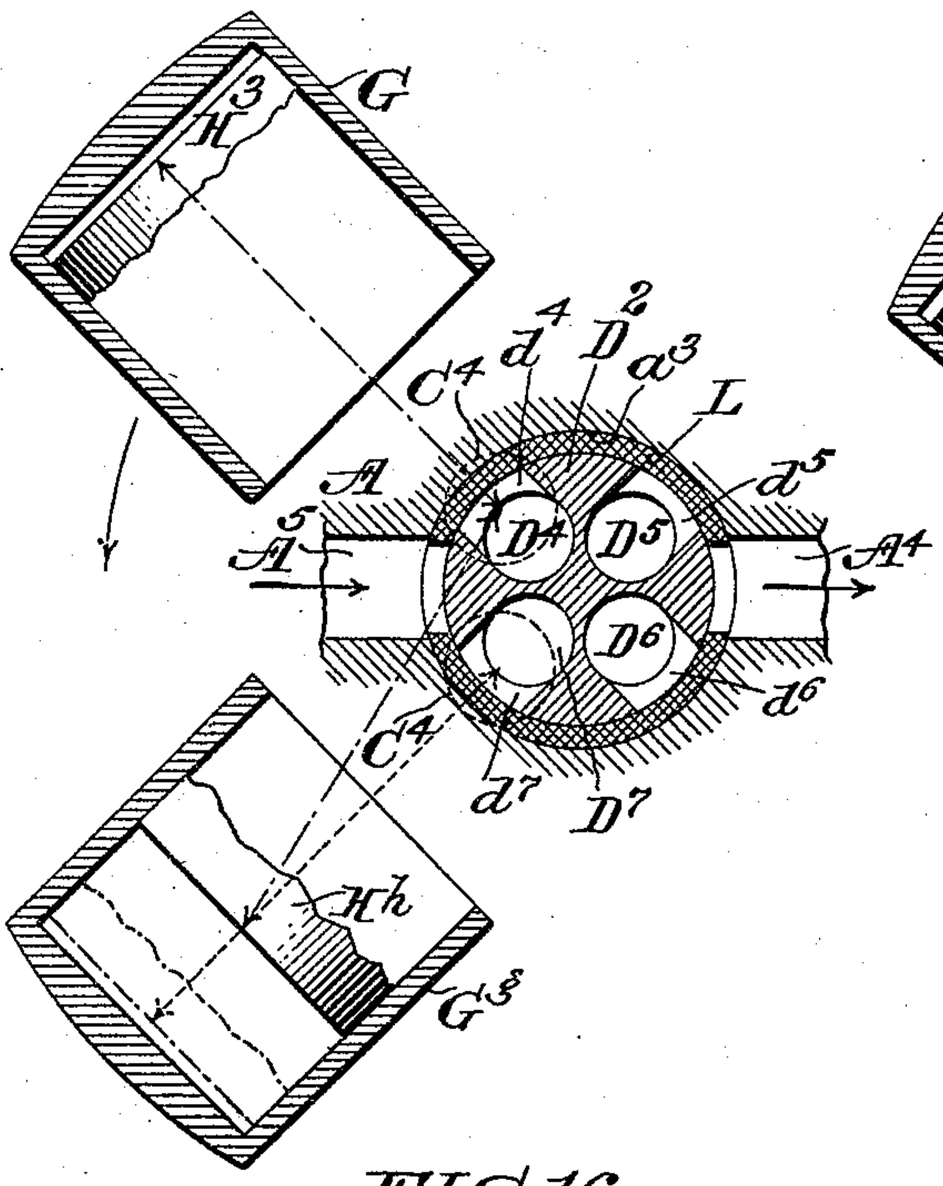


FIG. 15.

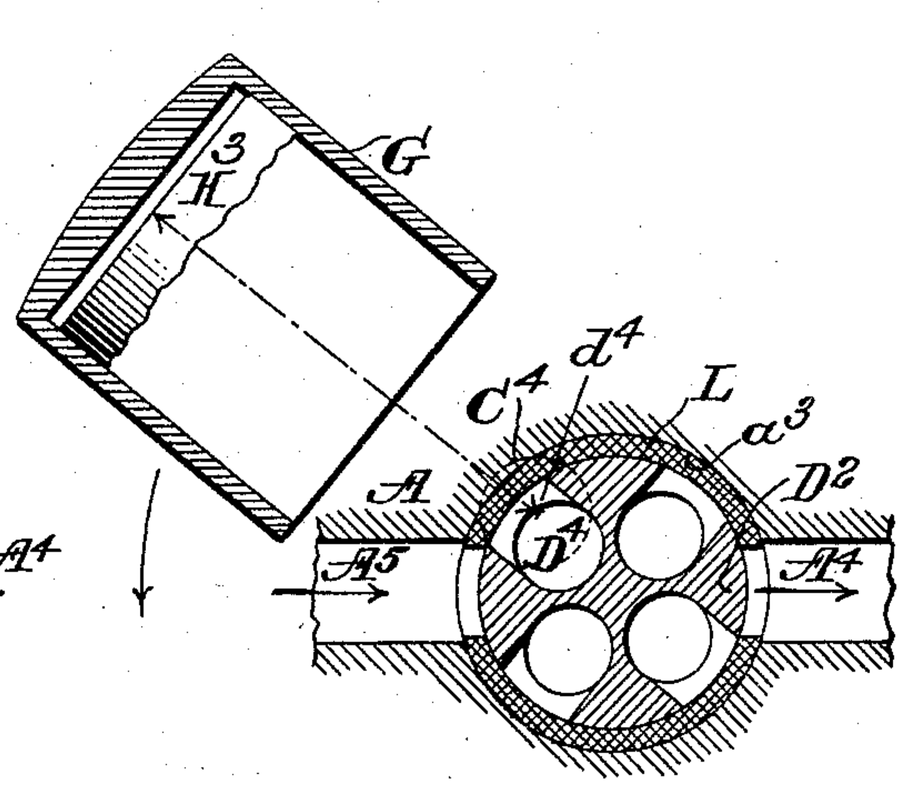
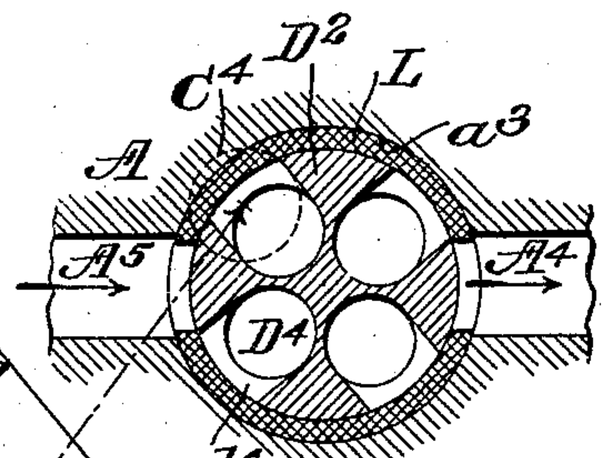


FIG. 16.

FIG. 17.



Witnesses:
Henry Drury
H. Swoape

Inventor:
James T. Halsey
by his atty.
Francis T. Chambers

No. 772,353. PATENTED OCT. 18, 1904.

J. T. HALSEY.

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NO MODEL. 8 SHEETS—SHEET 6.

FIG. 18.

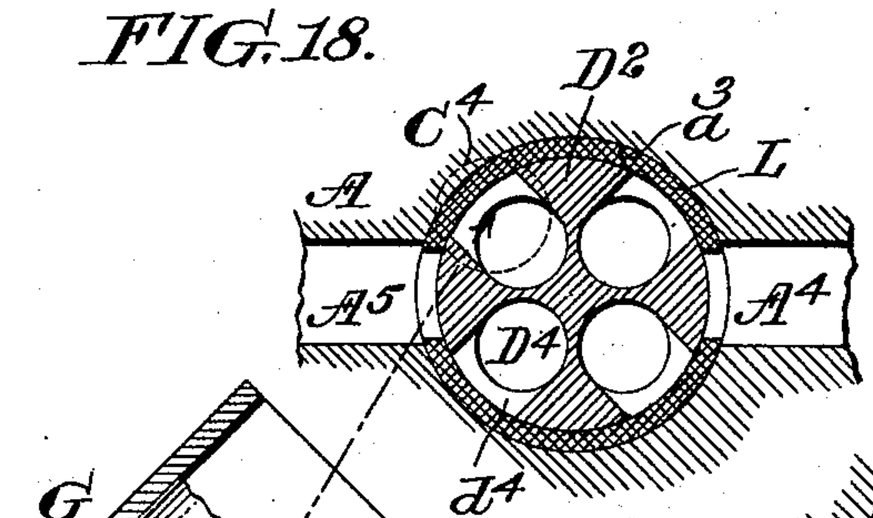


FIG. 19.

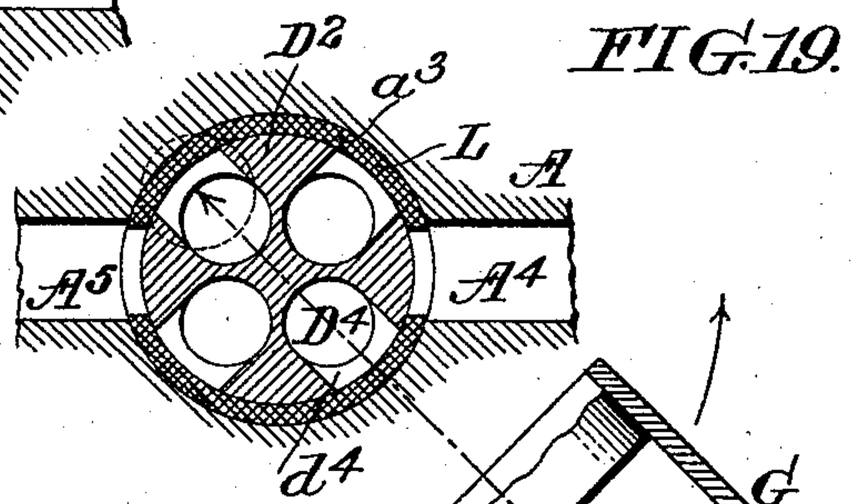


FIG. 20.

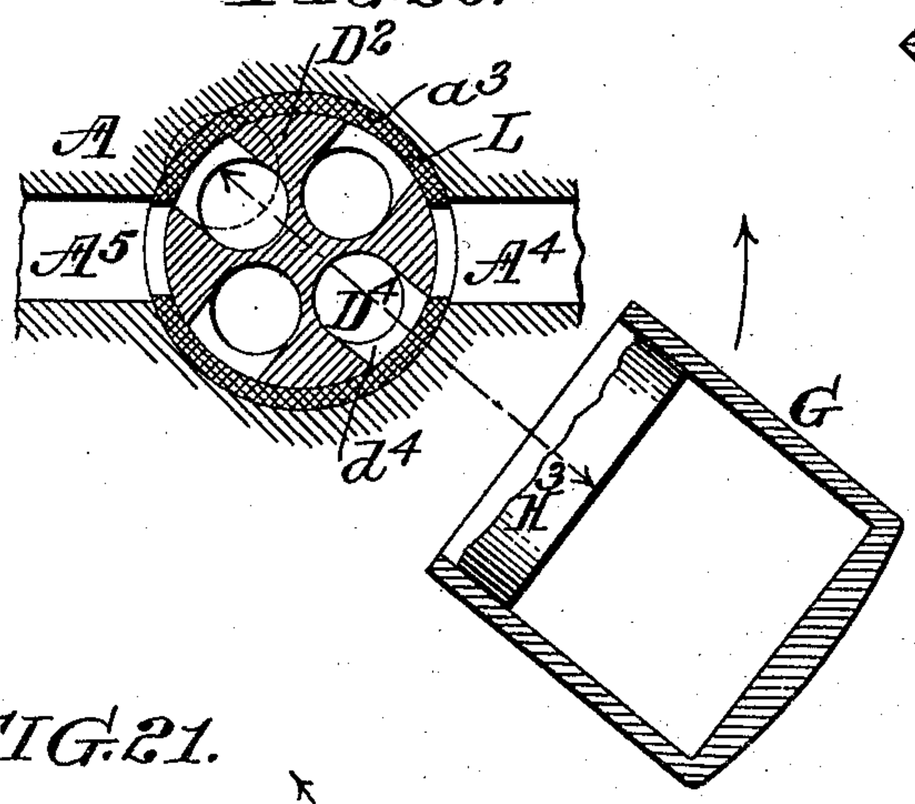


FIG. 21.

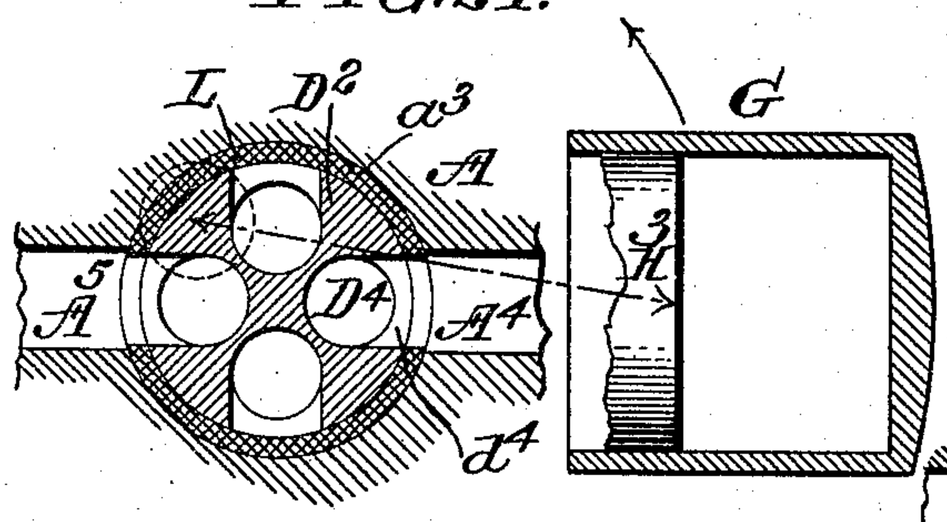
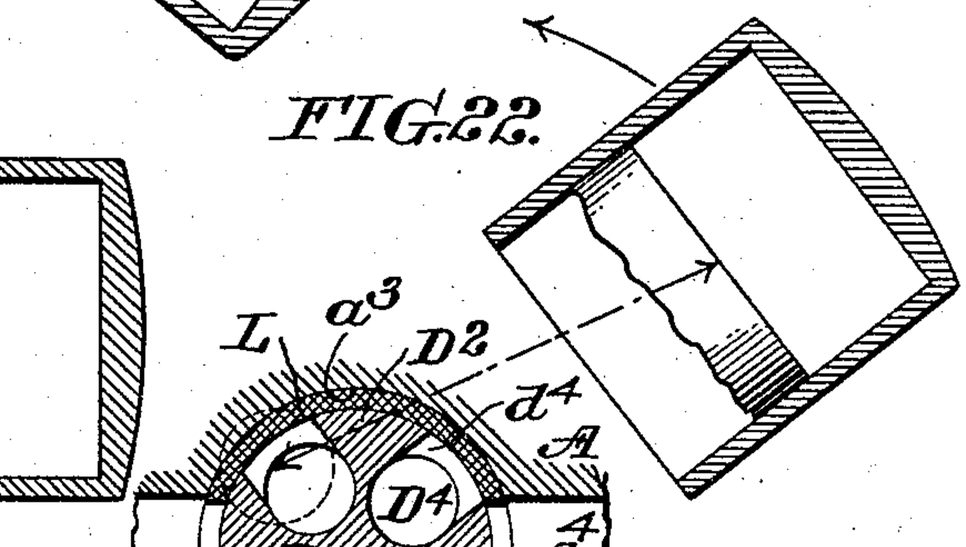


FIG. 22.



Witnesses:
Henry Drury
H. Stewart

Inventor:
James T. Halsey
by his atty
James T. Chambers

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NO MODEL. 8 SHEETS—SHEET 7.

FIG. 23.

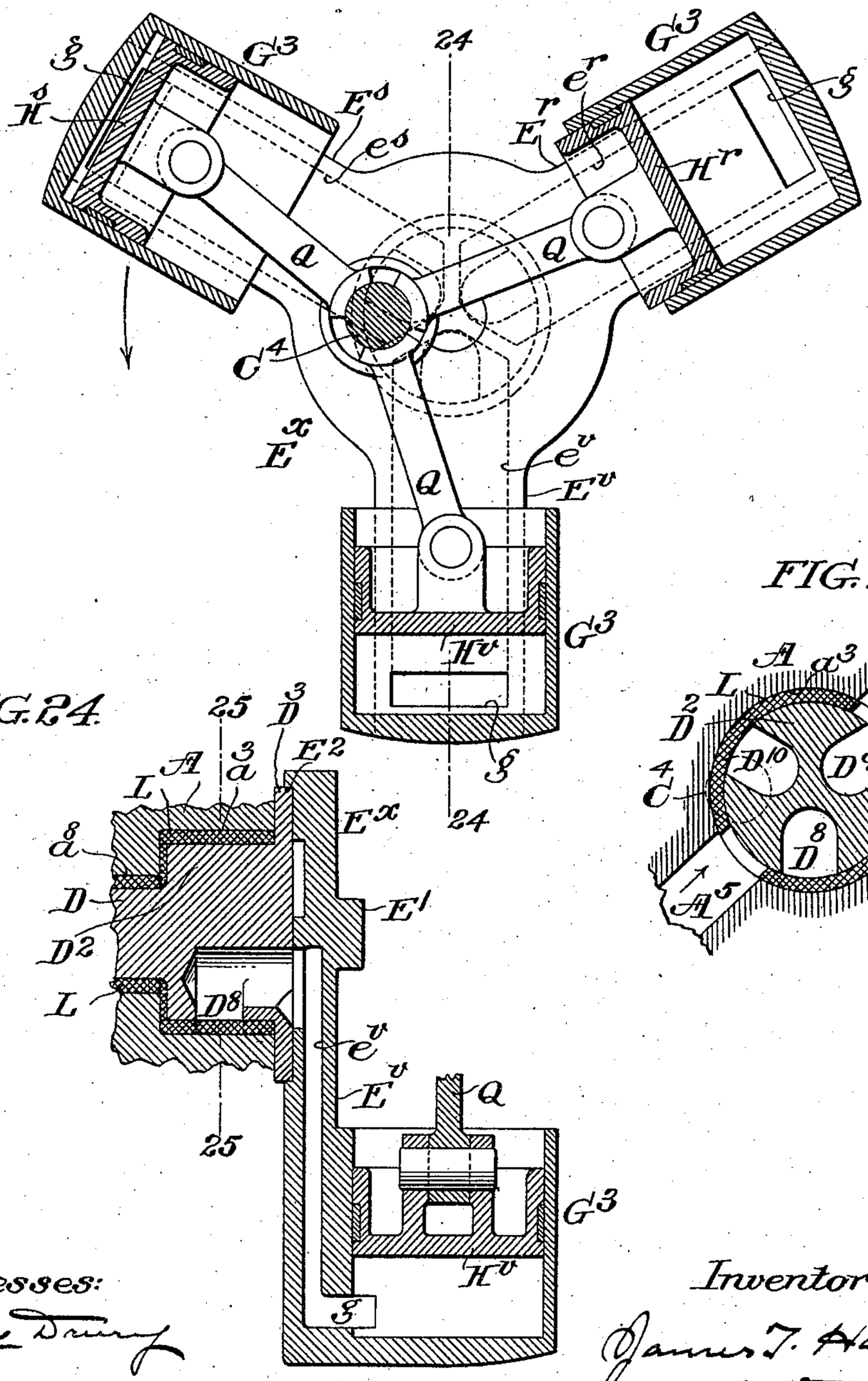

FIG. 25.

FIG. 24.

Witnesses:
Henry Drury
D. Stewart

Inventor:
James T. Halsey
by his atty.
Francis J. Chambers

No. 772,353. PATENTED OCT. 18, 1904.

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NO MODEL. 8 SHEETS—SHEET 8.

FIG. 26.

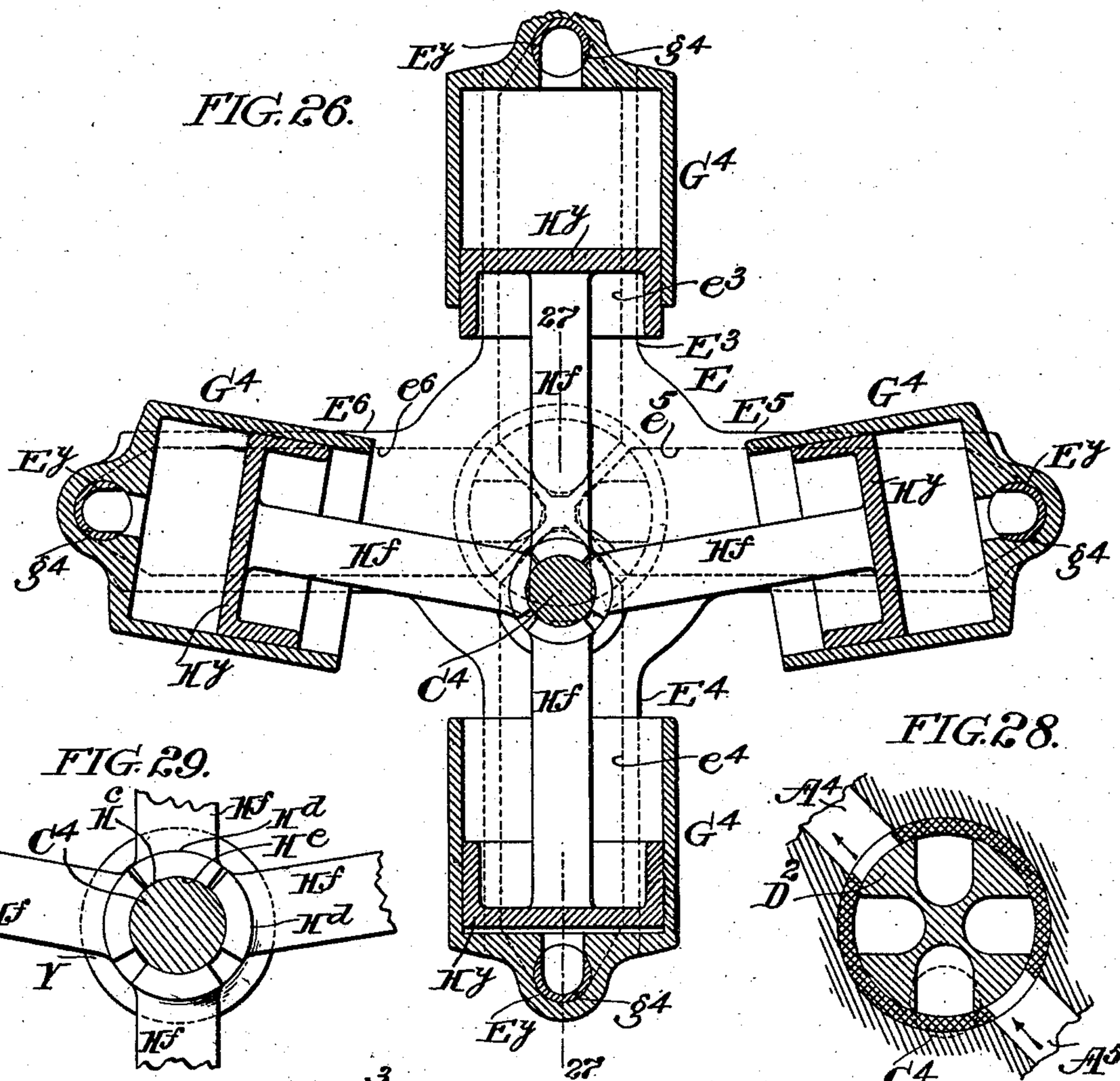
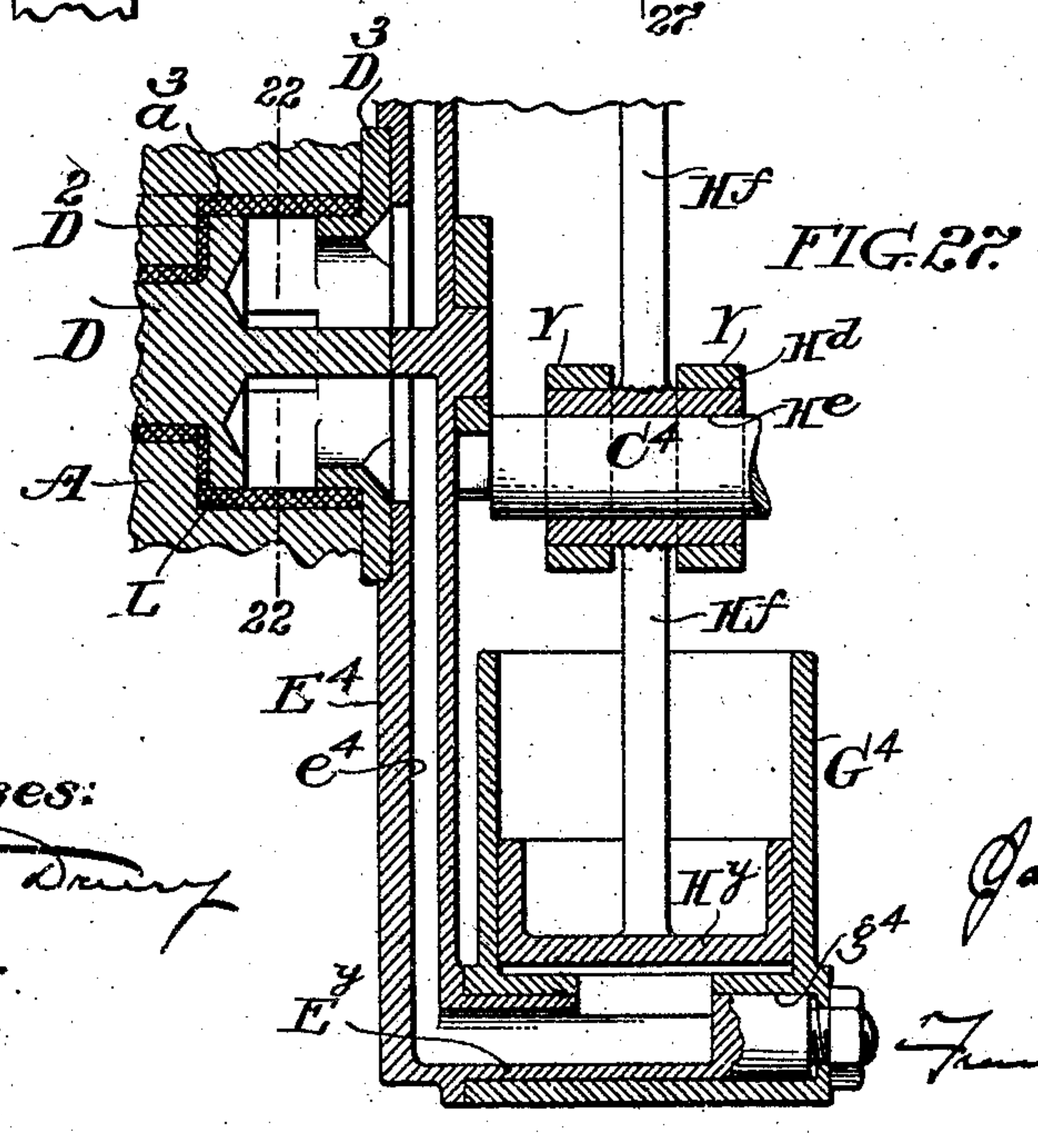


FIG. 29.

FIG. 28.

FIG. 27.



Witnesses:

Henry Drury

H. Hewett

Inventor:

James T. Halsey

by his Atty.

Francis T. Chamberlain

No. 772,353. Patented October 18, 1904.

UNITED STATES PATENT OFFICE.

JAMES T. HALSEY, OF PHILADELPHIA, PENNSYLVANIA.

MULTIPLE-CYLINDER EXPANSION FLUID-ENGINE.

SPECIFICATION forming part of Letters Patent No. 772,353, dated October 18, 1904.

Application filed February 13, 1900. Renewed March 17, 1904. Serial No. 198,657. (No model.)

To all whom it may concern:

Be it known that I, JAMES T. HALSEY, a citizen of the United States of America, residing in the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Multiple-Cylinder Expansion Fluid-Engines, of which the following is a true and exact description, reference being had to the accompanying drawings, which form a part thereof.

My invention relates to multiple-cylinder expansion fluid-engines, and has for its object to provide an engine of this character and compactness of form and one at the same time which is durable and in which the engine can be reversed or the cut-off varied by novel and simple mechanism.

The leading feature of my novel construction consists in the combination, with the main shaft, of a series of cylinders revolving with the shaft and each provided with a port arranged to register alternately with the admission and exhaust connections and a relatively fixed pin eccentric to the shaft and to which the pistons working in the cylinder are coupled. The eccentric-pin is provided with the means for adjusting it so as to reverse the engine or to regulate the cut-off of the expansible fluid admitted to the cylinders, as will be made clearly apparent, and the ports leading from the cylinders are preferably connected with the ports formed in a rotating plug concentric with the shaft, said ports opening in the sides of the plug and registering with the steam admission and exhaust conduits opening through the bearings of the plug.

Reference being now had to the drawings in which my invention is illustrated, Figure 1 is a vertical cross-section through an engine provided with my improvements, taken as on the line 1 1 of Fig. 3, but with the eccentric-pin C^4 rotated upward through an angle of ninety degrees. Fig. 2 is a face view of the eccentric-pin-adjusting device. Fig. 3 is a vertical section taken on the line 3 3 of Fig. 1, but with the eccentric-pin C^4 rotated downward toward the left to an angle of ninety degrees. Fig. 4 is a cross-section on the line 4 4 of Fig. 3. Fig. 5 is a section on the line 5 5 of Fig. 1. Fig. 6 is a face view of the frame in which the ports are formed and which connects the cylinders of the engine with the valve-plug. Fig. 7 is a face view of the transverse cylinder and of the two plunger-pistons extending out from its sides. Fig. 8 is an end view of one of the transverse cylinder-heads. Fig. 9 is a cross-section on the line 9 9 of Fig. 7. Fig. 10 is a face view of the piston moving in the transverse cylinder. Fig. 11 is a cross-section on the line 11 11 of Fig. 10. Fig. 12 is a side elevation of one of the open-ended cylinders G. Fig. 13 is a face view of said cylinder. Figs. 14 to 22, inclusive, are diagrammatic views illustrating the admission and exhaust of steam to the cylinders during the operation of the engine. Fig. 23 is a plan view illustrating a modification of the engine shown in the previous figures. Fig. 24 is a cross-sectional view on the line 24 24 of Fig. 23. Fig. 25 is a cross-sectional view on the line 25 25 of Fig. 24. Fig. 26 is a plan, partly sectional, view of another modification of my invention; Fig. 27, a cross-section on the line 27 27 of Fig. 26; Fig. 28, a cross-section on the line 28 28 of Fig. 27; and Fig. 29 is a view illustrating a convenient connection between the eccentric-pin and connecting-rods in the constructions illustrated in Figs. 23 to 28, inclusive.

A, Figs. 1, 3, and 5, indicates the framing of the engine, preferably formed with bracing-webs, as indicated at A′, and with a cylindrical bearing A^3, formed in its center, into which lead admission and exhaust ports, as indicated at A^5 A^4.

A^6 is an oil-hole near the top of the frame A, normally closed by a screw-plug a^6.

A^7 is a peripheral rim adapted to receive the casing B, as shown in Fig. 1.

A^8 is a prolongation of the frame serving as a shaft-bearing.

a a, &c., are lugs on the edge of the frame, with which lugs *b* of the casing B register, bolts serving to secure the frame and casing together.

The casing B has its edge B′ formed to fit against the framing A immediately inside of the flange A^7. It is also formed with a central boss B^2, in which are formed bearings b^2 for the stud-shaft C, B^3 indicating an out-

wardly-projecting flange serving as a stop, and B^4 B^4 indicating outwardly-projecting arms serving as bearings. The stud-shaft C is formed with an outward extension C′, to which by means of a feather on the clamping-nut *b′* the hub N of the segment-rim N′ is secured. On the inner end of the stud-shaft C it is formed, as shown, into a bearing C^2, at the end of which is a disk C^3, from one edge of which projects the pin C^4, having at its inner end the squared extension C^5.

D′ is the main shaft of the engine, having a portion D resting in the bearing A^8 of the casing and having formed to or secured to its inner end the valve-plug D^2, from the inner face of which extends the annular flange D^3 and through the inner face of which are formed the ports D^4 D^5 D^6 D^7, opening outward through the sides of the plug, as indicated at d^4 d^5 d^6 d^7, said openings being in a plane which will lead them to register with the admission and exhaust ports A^5 and A^4 as the plug revolves.

E is a frame (best shown in Fig. 6) formed at its center with a cylindrical boss E′ on one side and a recess, as indicated at E^2, which fits over the flange D^3 of the plug, to which flange the frame E is secured, as by means of the bolts E^{10}. (Shown in Fig. 6.) The frame E is formed for the engine shown in the earlier figures of the drawings with four arms, (indicated at E^3 E^4 E^5 E^6,) ports e^3, e^4, e^5, and e^6 extending through said arms and communicating with the ports D^4 D^5, &c., in the plug D^2. The two arms E^5 E^6 of the frame are also formed with lateral extensions E^7 and E^8 at their ends, (see Fig. 4,) through which the ports e^5 e^6 are continued, as indicated at e^7 and e^8. The lateral extensions E^7 and E^8 are formed with guideways E^{12} E^{12} at their inner ends and with parallel opposite faces E^{13} E^{13}, and the other two arms, E^3 and E^4, are formed, as shown, with laterally-extending lugs E^{11}.

F is a ring turning on the cylindrical boss E′ (see Fig. 1) and having a squared slot F′, in which rests squared pin C^5 of the pin C^4.

G and G′ are oppositely-disposed open-ended cylinders secured to the arms E^3 and E^4, as by means of lugs G^2, registering with the lugs E^{11} and having ports, as indicated at *g*, which register with the ports e^3 and e^4.

H is a transversely-extending cylinder having its ends H′ H′ cylindrically finished to receive the heads I I. The opposite sides of the cylinder H are cut away, as indicated at H^2 H^2, to give passage to the pin C^4, and between these cut-away portions the plunger-pistons H^3 and H^4 extend from the sides of the cylinder H, as best shown in Fig. 7, the pistons being coupled to the cylinder through the arms H^5 and also through the central tubular connection, (indicated at H^6,) the perforation of which is indicated at h^6.

H^7 H^7, &c., indicate shoulders to support the springs J J, &c.

It will be understood that the pistons H^3 and H^4 work in the cylinders G and G′, as shown, for instance, in Figs. 1 and 3.

I I are the movable heads of the cylinder H, each fitting over the finished portion H′ and having its outer face I′ finished so as to rest against the face E^{13}, with a squared edge in contact with the guideway E^{12}, I^2 I^2, &c., indicating bearings for the springs J, and I^3 is the opening through the head I, which is made so large as to always maintain an opening into the end of the cylinder from the ports e^7 or e^8. The function of the springs J is to press the heads I outward, maintaining contact with the lateral extensions E^7 and E^8.

K is the piston working in the cylinder H. It is formed with a transverse cylindrical opening K′, in which fits the pin C^4, and with recesses (indicated at K^2 K^2) of or equal to the cross-section of the cylinders G or G′, with which this recess is in communication through the ports h^6, so that when the steam, for instance, is admitted to the cylinder G it will press upon the piston H^3 and with practically the same force will also exert pressure in the recess K^2, tending to push the piston K away from the wall of the cylinder H with the same force that the cylinder is pressed toward it by the action of the piston H^3. This is of value because it greatly diminishes friction.

L L, &c., indicate bushings in the various bearings.

M (best shown in Figs. 1 and 4) is a frame having a central cylindrical bearing *m*, which fits and turns freely on the bushing of the bearing C^2. This frame is also preferably provided with strengthening-flanges, as indicated at M′, M^2, M^3, and M^4, and at the ends of its braced arms is secured either to the cylinders G and G′, as shown in Fig. 1, or to the ends of the extensions E^7 and E^8, as shown in Fig. 4.

The boss N already mentioned is firmly secured to the stud-shaft extension C′, (see Figs. 1 and 2,) and has extending from it the toothed segment N′, which is engaged by a worm O, supported in bearings in the arms B^4 B^4, the shaft of the worm having a squared extension O′, by which it can be rotated. It will be obvious that the position of the pin C^4 will be shifted by turning the worm, the possible extent of the shifting being regulated by the stop-flange C^3.

Before describing the operation of the engine I will refer to the modified forms shown, and first to the construction shown in Figs. 23 to 25, inclusive. In this construction the plug D^2 instead of having four ports is provided with three, as D^8 D^9 D^{10}, and the frame rotating with the plug (here indicated) at $E^\times$ has three arms, (indicated at E^r E^s E^v,) the ports in the arms being indicated at e^r e^s e^v. Three open-ended cylinders (indicated at G^3 G^3) are secured to the arms of the frame, and the three pistons H^r, H^s, and H^v are coupled

to the eccentric-pin C^4 by connecting-rods Q Q, &c.

In the other modifications illustrated in Figs. 26 to 29, inclusive, the frame E has four arms, as in the first-described construction; but each of these arms is provided with an outwardly-extending pin E^y, through which the port is continued, and upon each of these pins is pivoted the outer end of a cylinder G^4, g^4 indicating the pivotal connections. In this construction the pistons H^y are coupled with the eccentric-pins C^4 by piston-rod extensions H^5 H^5, &c., extending rigidly from the pistons, the rotation of the frame and cylinders causing each cylinder to rock on its pivoted connection.

In Fig. 29 I have indicated a convenient coupling for either the connecting-rods Q of Fig. 23 or the piston-rod extensions H^f of Fig. 26 with the pin C^4. The ends of the arms, as H^f, are segmentally finished, as at H^e, to fit against the pin C^4. These segmentally-finished ends are laterally extended, as indicated at h^q, and rings, as Y, fit over them, which hold them in place on the pin C^4. This is a practicable construction, especially as the action of the pistons against the pin C^4 is always a thrusting action.

It will readily be understood that the pin C^4 being stationary the action of steam admitted to the cylinders of the engine successively will be to rotate the whole system of cylinders, with their frames and connections, around the eccentric-pin, the action being exactly inverted from the ordinary action of a multiple series of cylinders acting upon a rotatable crank-pin.

In the diagrammatic series of drawings, Figs. 14 to 22, inclusive, the entire cycle of movements is fully illustrated with reference to one of the cylinders, that indicated at G, and in Fig. 14 I have also indicated at c^4 the position to which the pin C^4 is thrust when it is desired to reverse the action of the engine, showing at G g and H h the position of the cylinder and piston with reference to the eccentric-pin in its different positions. It will also be obvious that by shifting the eccentric-pin the amount of steam admitted to any cylinder while its ports are in connection with the steam-supply can be varied with exactly the same effect as is usually produced by varying the cut-off of the valve.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an expansible-fluid engine, a frame A having a bearing A^3 formed therein and a passage or bearing for a shaft a^8 forming a continuation thereof, said frame having also admission and exhaust passages for steam opening through the face of bearing A^3, in combination with a valve-plug D^2 working in bearing A^3 and having a series of ports formed therein to register alternately with the admission and exhaust ports, a cylinder-supporting frame secured to and moving with the valve-plug and having steam-passages connected with the ports in the plug, a series of cylinders connected with the frame and the steam-passages therein, a fixed crank-pin set eccentric to the valve-plug and series of cylinders, pistons in the cylinders connected to said crank-pin as described, and a casing B forming with the frame A a tight casing for the moving parts of the engine and a support for the crank-pin.

2. In an expansible-fluid engine, a frame A having a bearing A^3 formed therein and a passage or bearing for a shaft a^8 forming a continuation thereof, said frame having also admission and exhaust passages for steam opening through the face of bearing A^3, in combination with a casing B secured to said frame and forming with it a tight casing inclosing the moving parts, said casing having a bearing b^2 concentric with the bearing A^3, a valve-plug D^2 working in bearing A^3 and having a series of ports formed therein to register alternately with the admission and exhaust ports, a cylinder-supporting frame secured to and moving with the valve-plug and having steam-passages connected with the ports in the plug, a series of cylinders connected with the frame and the steam-passages therein, a shaft C supported in bearing b^2 and adjustably supporting a crank-pin C^4 and pistons working in the cylinders and connected as described to the crank-pin.

3. In an expansible-fluid engine, a frame A having a bearing A^3 formed therein and a passage or bearing for a shaft a^8 forming a continuation thereof, said frame having also admission and exhaust passages for steam opening through the face of bearing A^3, in combination with a casing B secured to said frame and having a bearing b^2 concentric with the bearing A^3, a valve-plug D^2 working in bearing A^3 and having a series of ports formed therein to register alternately with the admission and exhaust ports, a cylinder-supporting frame secured to and moving with the valve-plug and having steam-passages connected with the ports in the plug, a series of cylinders connected with the frame and the steam-passages therein, a shaft C supported in bearing b^2 and adjustably supporting a crank-pin C^4, a toothed segment r' secured to shaft C and a worm O in engagement with this segment for adjusting the angle of the shaft and crank and pistons working in the cylinders and connected as described to the crank-pin.

4. In an expansible-fluid engine, a frame A having a bearing A^3 formed therein and a passage or bearing for a shaft a^8 forming a continuation thereof, said frame having also admission and exhaust passages for steam opening through the face of bearing A^3 in combination with a casing B secured to said frame

and having a bearing b^2 concentric with the bearing A^3, a valve-plug D^2 working in bearing A^3 and having a series of ports formed therein to register alternately with the admission and exhaust ports, a cylinder-supporting frame secured to and moving with the valve-plug and having steam-passages connected with the ports in the plug and a central bearing-boss E′, a series of cylinders connected with the frame and the steam-passages therein, a shaft C supported in bearing b^2 and adjustably supporting a crank-pin C^4, a ring F journaled on boss E′ and supporting an end C^5 of the crank-pin, pistons working in the cylinders and connected as described to the crank-pin and a frame M secured to the outer sides of the cylinders and having a bearing on shaft C.

5. An expansible-fluid engine having a shaft, as D, in combination with two cylinders, as G G′, set opposite to each other and secured to the shaft, pistons, as H^3 H^4, working in said cylinder, a transversely-extending cylinder, as H, secured to said pistons and formed with a lateral slot, as H^2, a double-acting piston, as K, working in cylinder H and formed with a pin-bearing K′ adapted to register with slot H^2, a fixed pin C^4 extending through slot H^2 into the bearing K′, a series of ports, as e^3, e^4, e^5, e^6 revolving with the shaft and cylinders and leading into cylinders G G′ and the ends of cylinder H, and cut-off mechanism for admitting and exhausting fluid to and from said ports and cylinders.

6. An expansible-fluid engine having a shaft, as D, in combination with two cylinders, as G G′, set opposite to each other and secured to the shaft, pistons, as H^3 H^4, working in said cylinder, a transversely-extending cylinder, as H, secured to said piston and formed with a lateral slot, as H^2, a double-acting piston, as K, working in cylinder H and formed with a pin-bearing K′ adapted to register with slot H^2, an adjustable but not rotatable pin C^4 extending through slot H^2 into the bearing K′, a series of ports, as e^3, e^4, e^5, e^6, revolving with the shaft and cylinders and leading into cylinders G G′ and the ends of cylinder H, and cut-off mechanism for admitting and exhausting fluid to and from said ports and cylinders.

7. An expansible-fluid engine having a shaft, as D, in combination with two cylinders, as G G′, set opposite to each other and secured to the shaft, piston, as H^3 H^4, working in said cylinders, a transversely-extending cylinder, as H, secured to said pistons and formed with a lateral slot, as H^2, a double-acting piston, as K, working in cylinder H and formed with a pin-bearing K′ adapted to register with slot H^2, a stud-shaft C supported in bearings opposite to the shaft D, a crank-pin C^4 attached to said shaft and extending through slot H^2 into bearing K′, means for turning shaft C to adjust the position of pin C^4, a brace M having a bearing on shaft C and secured to the cylinders G G′, a series of ports e^3, e^4, &c., revolving with the shaft and leading into the cylinders and cut-off mechanism for regulating the admission and exhaust of fluid.

8. An expansible-fluid engine having in combination a shaft D having four ports formed through it, a bearing a^3 for the portion of the shaft in which the ports are formed, said bearing having admission and exhaust ports A^5 A^4 formed in it, a frame E secured to the end of the shaft and having formed in it ports e^3 e^4 e^5 e^6 connecting with the ports in the shaft, two cylinders G G′ secured opposite to each other to the frame E and into which ports, as e^3 e^4, open, a transverse double-acting cylinder H laterally movable in the frame E and into the ends of which the ports e^5 e^6 open, said cylinder having one or more longitudinal slots H^2 on its sides, pistons H^3 H^4 working in the cylinders G G′ and secured to cylinder H, a stud-shaft C having a crank-pin C^4 extending through slot H^2, a frame M secured to cylinders G G′ and frame E as described and journaled on shaft C and a piston K working in cylinder H and having a bearing formed through it for pin C^4.

JAMES T. HALSEY.

Witnesses:
CHAS. F. MYERS,
D. STEWART.