No. 883,935. PATENTED APR. 7, 1908.

J. H. CHAMP.

MOTOR.

APPLICATION FILED JULY 1, 1899. RENEWED NOV. 7, 1907.

4 SHEETS—SHEET 1.

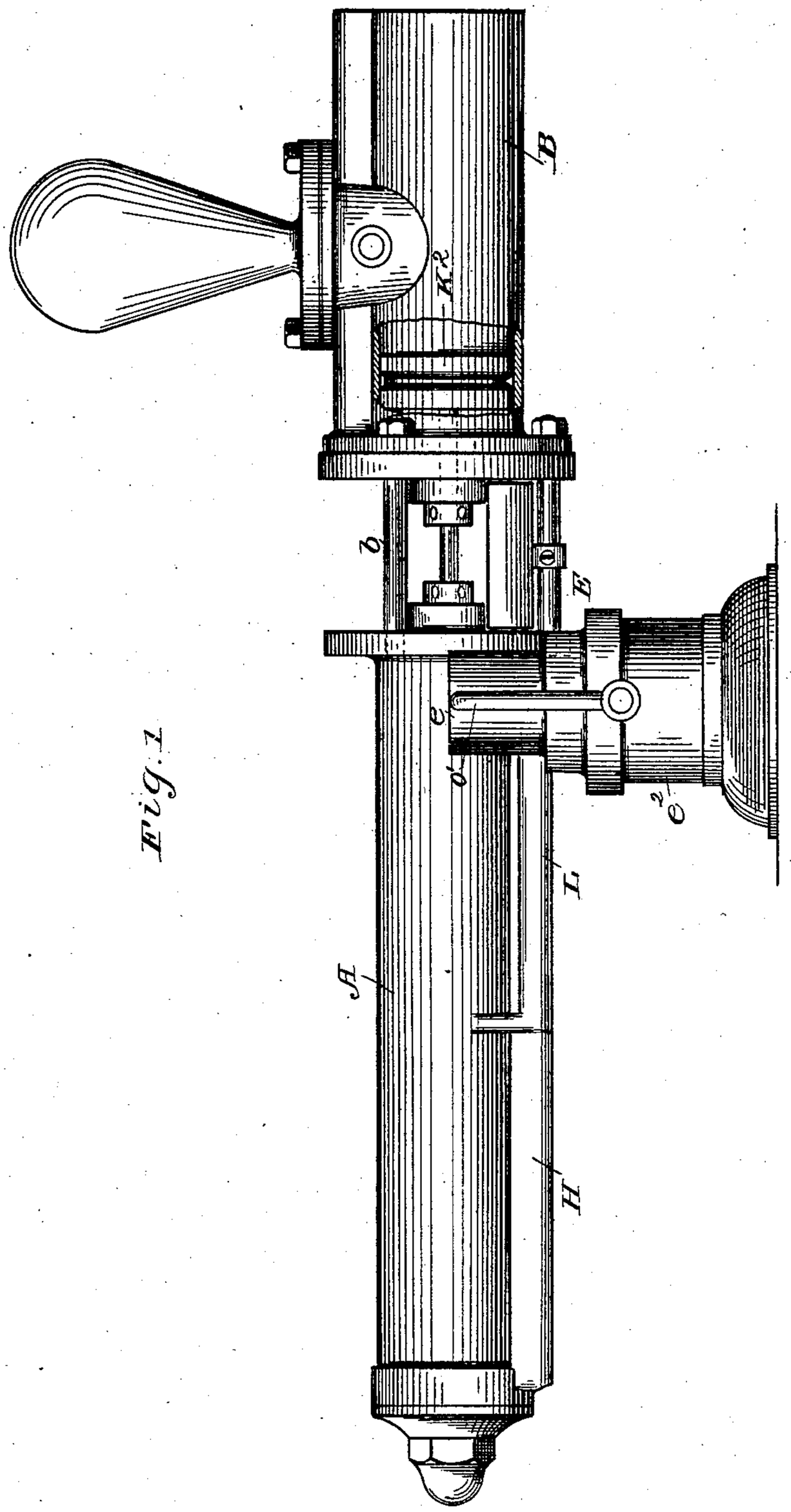

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 2

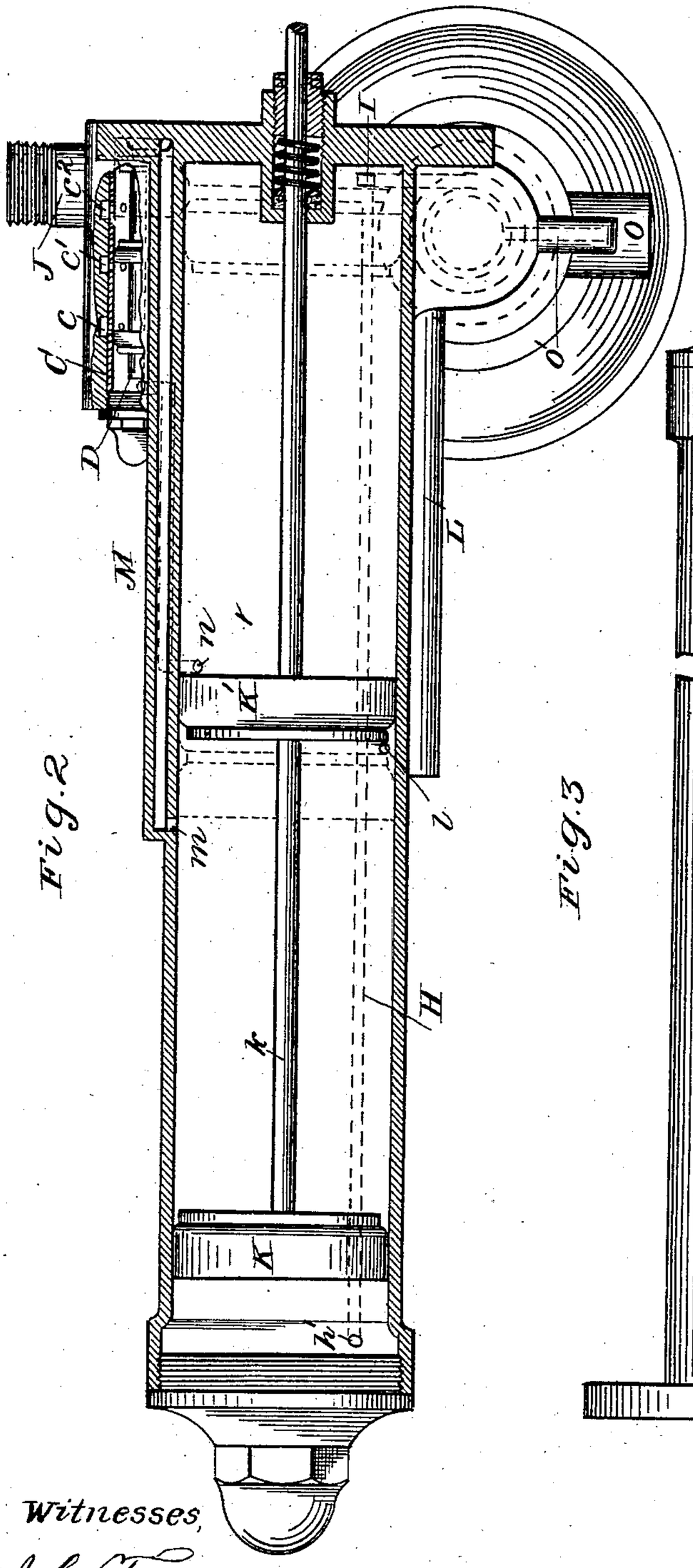
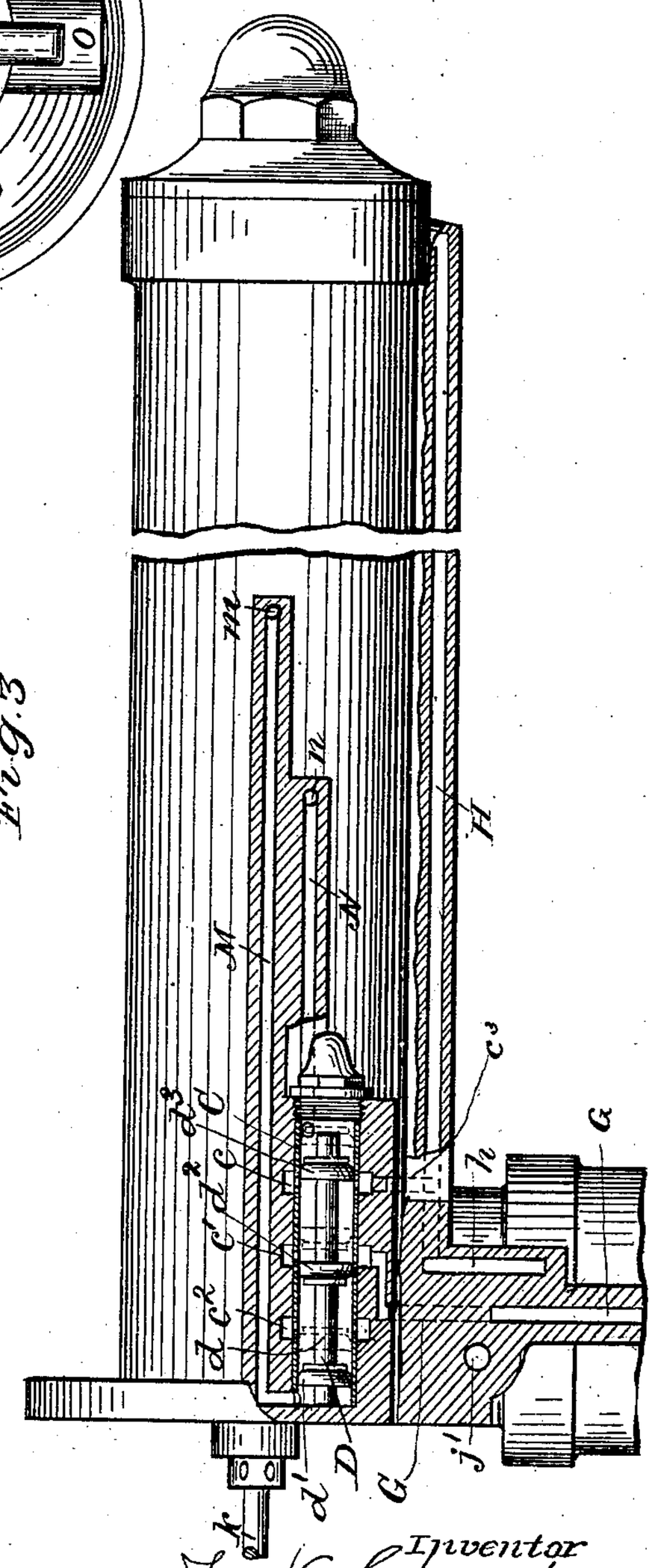


Fig. 3



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4 SHEETS—SHEET 3.

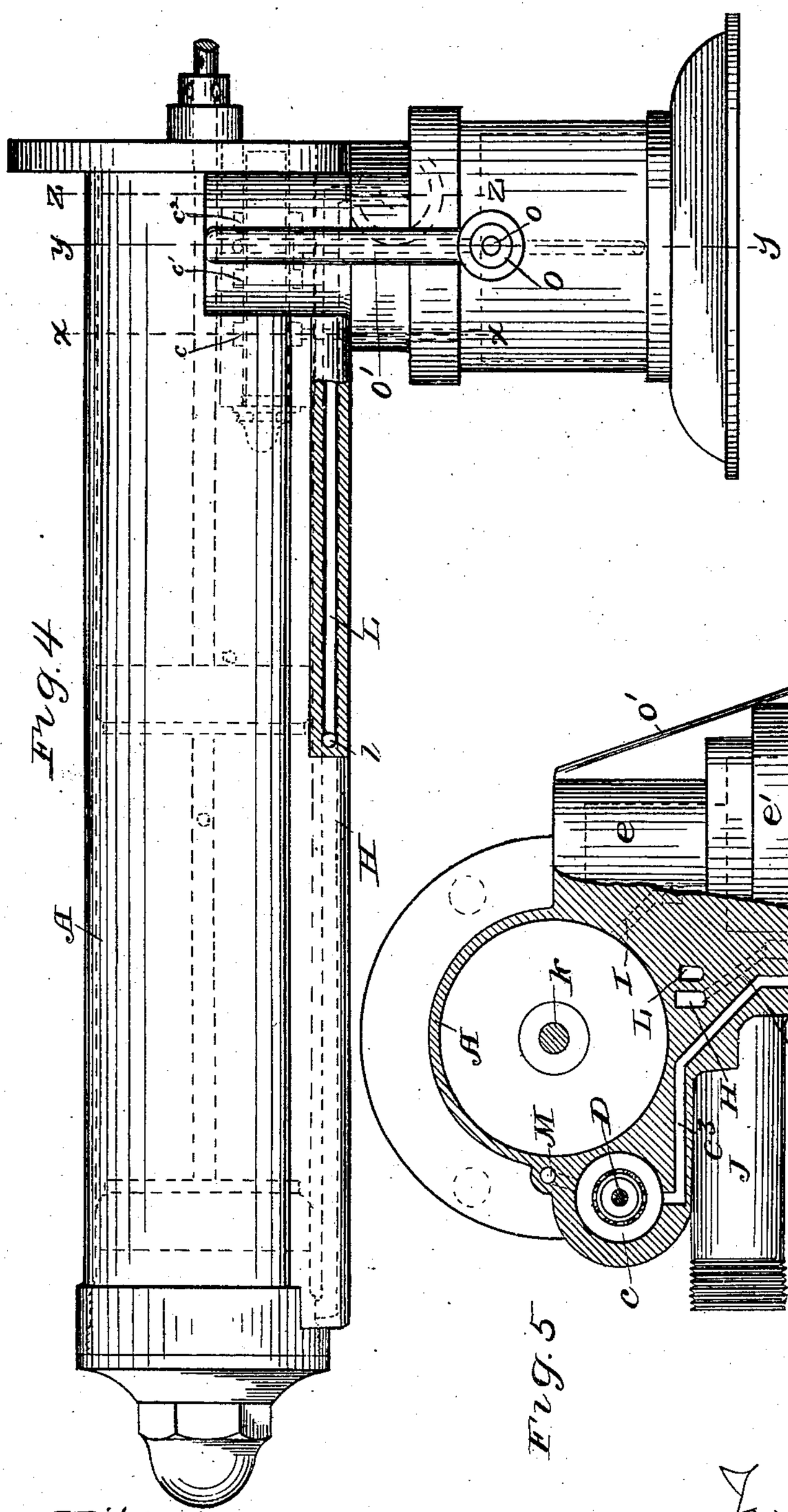

Fig. 4.

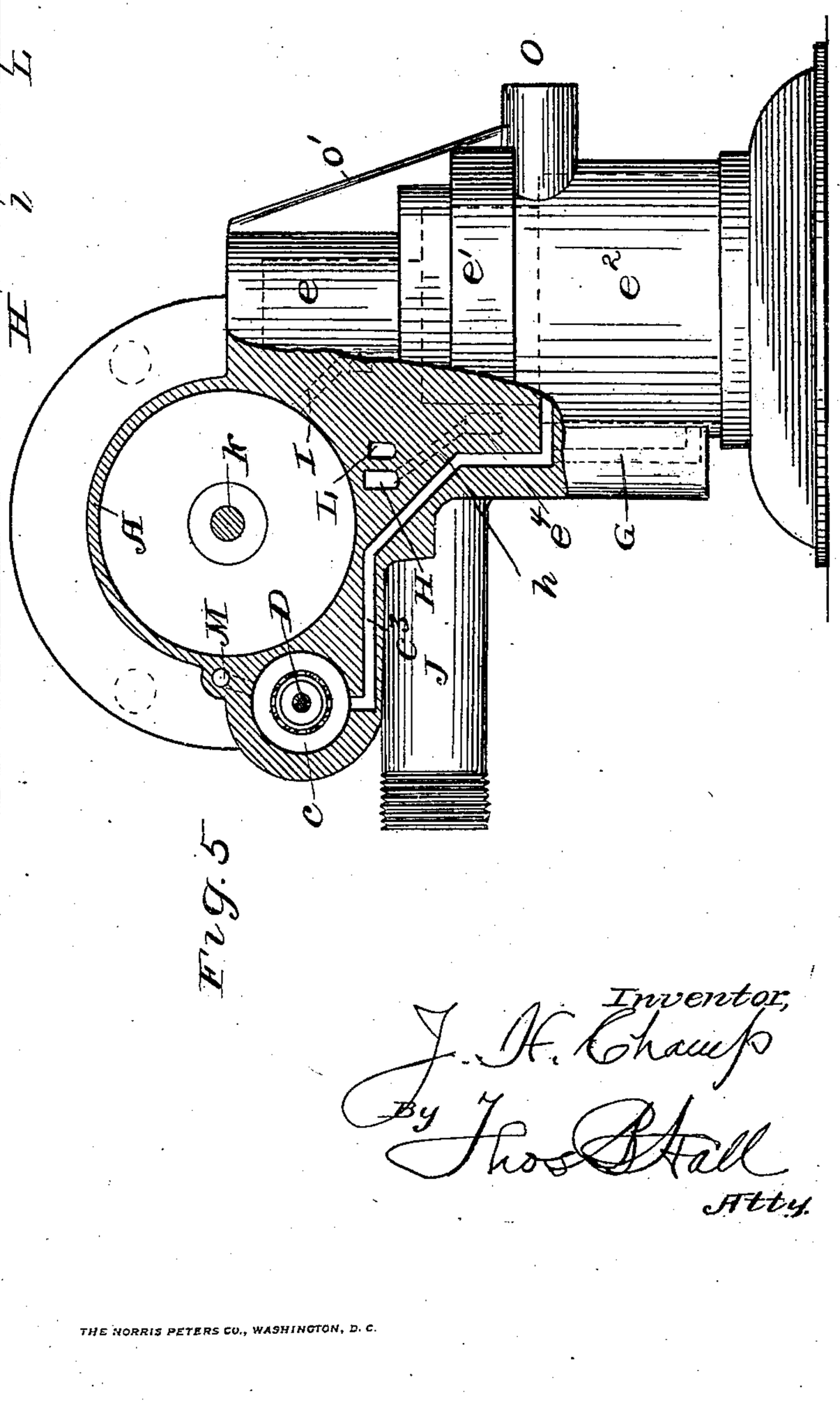

Fig. 5.

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4 SHEETS—SHEET 4.

Fig. 7

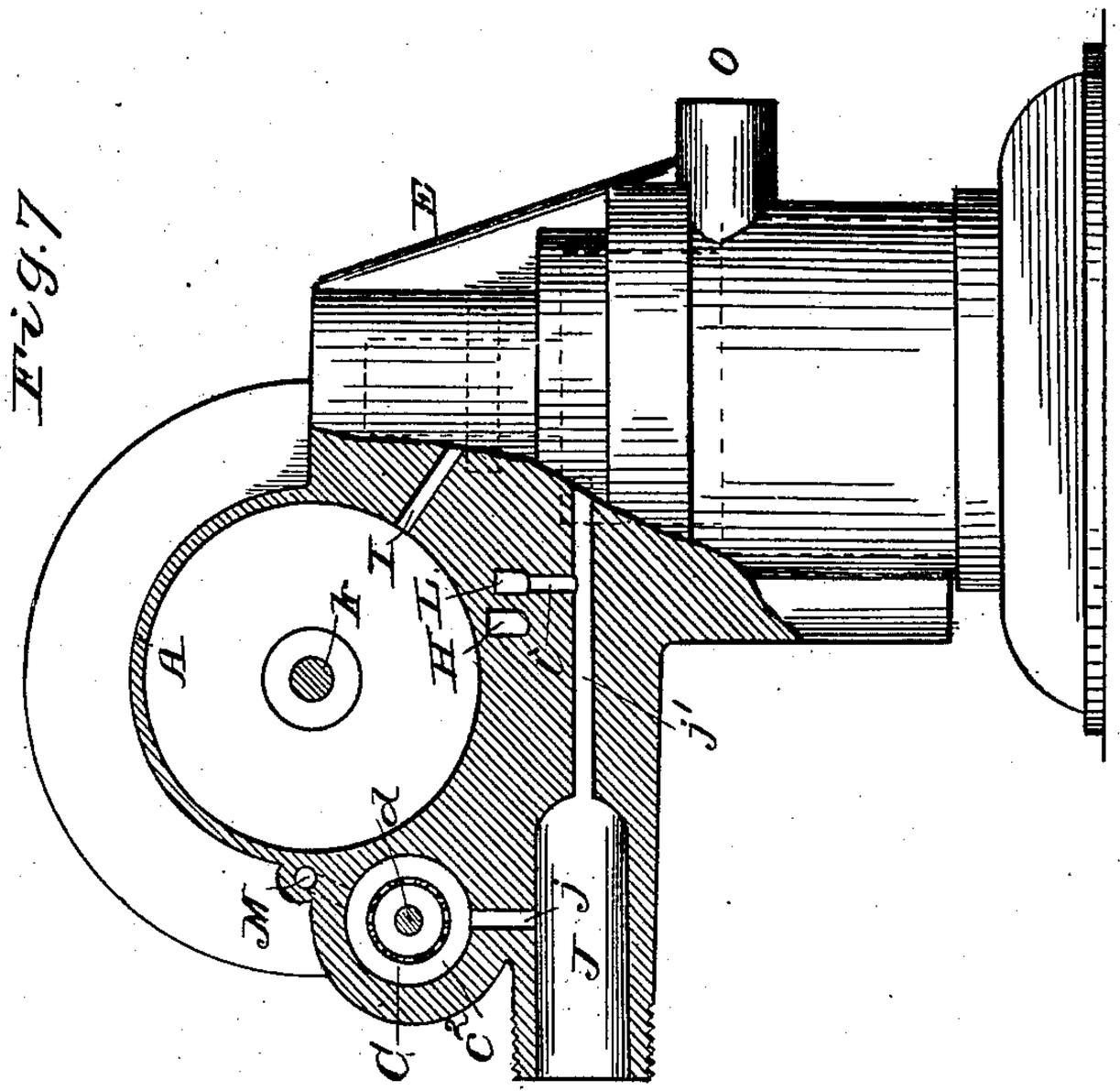
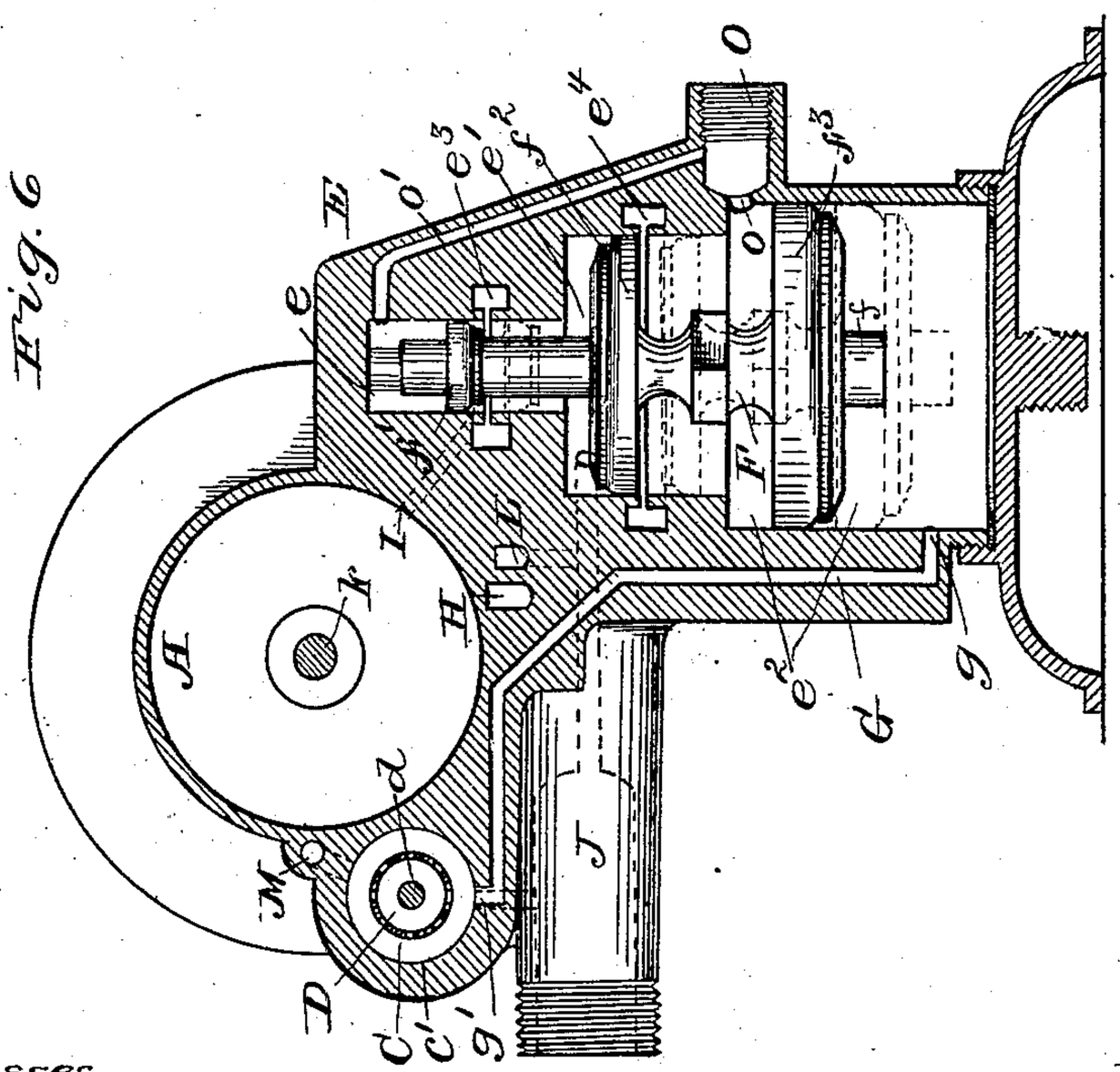


Fig. 6



Witnesses,

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UNITED STATES PATENT OFFICE.

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MOTOR.

No. 883,935. Specification of Letters Patent. Patented April 7, 1908.

Application filed July 1, 1899, Serial No. 722,521. Renewed November 7, 1907. Serial No. 401,161.

To all whom it may concern:

Be it known that I, JOSEPH H. CHAMP, a citizen of the United States, resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Motors, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle so as to distinguish it from other inventions.

The object of the invention is to provide an improved motor.

The invention consists of the means hereinafter described, and particularly pointed out in the claims.

The annexed drawings and the following description set forth in detail, certain mechanism embodying the invention; such disclosed means constituting but one of various mechanical forms in which the principle of the invention may be used.

Figure 1 is a side elevation of a double acting hydraulic air compressor. Fig. 2 is a longitudinal horizontal section of the water cylinder, the top of the primary valve chamber being broken away, and showing the primary valve in top plan. Fig. 3 is a side elevation of the water cylinder opposite to the side shown in Fig. 1; the primary valve chamber and certain other mechanism being shown in longitudinal vertical section. Fig. 4 is a side elevation of the water cylinder and the main valve mechanism casing; certain mechanism being shown in dotted lines, and other mechanism being in longitudinal vertical section. Fig. 5 is a vertical transverse section of the water cylinder, on line x—x of Fig. 4; the casing of the main valve mechanism being partly in section and partly in side elevation. Fig. 6 is a vertical transverse section of the water cylinder, on line y—y of Fig. 4, with the main valve mechanism casing in similar section. Fig. 7 is a transverse vertical section of the water cylinder, on line z—z of Fig. 4, with the main valve mechanism casing partly in section and partly in side elevation.

The double acting hydraulic air compressor is provided with a water cylinder A, and with an air cylinder B. On the outlet side of the water motor, a primary valve chamber C is located, at the end of the latter next to the air cylinder. Primary valve piston mechanism D reciprocates longitudinally in such valve chamber, and has rigidly secured on its piston rod d, the two end pistons d' d^3 and the intermediate piston valve d^2. Three annular channels c, c', c^2 surround the valve chamber, and connect therewith at various points. On the inlet side of the water motor, the casing E of the main valve mechanism is located; the spaces within such casing including differential cylindrical sections located in vertical line with each other; the upper cylindrical section e being of the smallest relative diameter; the middle cylindrical section e' being of the next larger diameter; the bottom cylindrical section e^2 being of the largest diameter. Upper cylindrical section e has annular channel e^3 surrounding it, and connecting therewith at various points. Middle cylindrical section e' has annular channel e^4 surrounding it, and connecting therewith at various points.

Main valve mechanism F consists of rod f having rigidly secured thereto three members, namely: piston valve f' secured to the upper portion of rod f, and working in cylindrical section e; piston valve f^2 secured to the middle portion of rod f, and working in cylindrical section e'; piston f^3 secured to the lower portion of rod f, and working in cylindrical section e^2. A passage G has its lower portion in constant free communication with the lower portion of piston cylindrical section e^2, by connection g which is always below the piston f^3 of the main valve mechanism, the upper portion g' of such passage G connecting with annular channel c'. One end of a passage H has a depending branch h connecting with annular channel e^4; the outer end of such passage H has connection h' with the interior of the outer end of the water cylinder. A passage I has its lower extremity connecting with annular channel e^3; the upper portion of such passage connecting directly with the interior of the inner end of the water cylinder. Annular channel c of the primary valve chamber connects by passage c^3 with the top of piston cylindrical section e^2 (Fig. 5). Annular channel c^2 of the primary valve chamber connects with outlet J, by intermediate passage j (Fig. 7). One end of passage L, formed in the lower

longitudinal portion of the water cylinder shell, has connection *l* with the interior of the water cylinder; its other end connects with vertical passage *l'*, which latter empties by way of passage *j'* into outlet J; said connection *l* is located, near the middle of the length of the water cylinder, relatively to the two pistons K and K' on piston rod *k* so that such connection *l* is always between such two pistons. The function of said passage L is to pass to the outlet J such volume of the motive fluid as is discharged from the two ends of chamber C into cylinder A through the connection *m n* immediately hereinafter described. One end of passage M has connection *m* with the interior of the water cylinder, at a point further from the air cylinder than is connection *l;* the opposite end of passage M communicates with the end of the primary valve chamber C nearer to the air cylinder. One end of passage N has connection *n* with the interior of the water cylinder, at a point nearer the air cylinder than is connection *l;* the opposite end of passage N communicates with the end of the primary valve chamber C further from the air cylinder. The inlet O is formed in the side of the casing of the main valve mechanism, on the opposite side of the motor from outlet J; it connects by passage *o* with the upper portion of the piston chamber e^2; it also connects by angular passage *o'* with the upper portion of top valve chamber *e*. The air compressing cylinder has working therein a piston K^2, rigidly secured on piston rod *k;* such rod having longitudinal reciprocating movement in suitable fluid tight packings respectively of the water cylinder and the air cylinder. Such two cylinders are joined together by bolts *b*.

The operation of the foregoing described mechanism is as follows; assuming the main valve mechanism to be in uppermost position, as shown in Fig. 6. The pressure water passes from inlet O to the outer end of the water cylinder,—by way of passage *o*, piston cylindrical section e^2, valve cylindrical section *e'*, annular channel e^4, passage *h*, passage H. Thereupon such pressure water forces piston K towards the air cylinder, so that pistons K and K' have positions as shown in dotted lines of Fig. 2; thereby establishing pressure water communication with the end of the primary valve chamber nearer the air cylinder,—by way of passage M. The primary valve D is thereupon moved to its furthest possible position from the air cylinder, as shown in dotted lines in Fig. 3; annular channels *c'* and c^2 are thus thrown into communication by the intermediate portion of the valve chamber C; permitting the water beneath piston f^3 in piston cylindrical section e^2, to pass to outlet J,—by way of connection *g*, passage G, passage *g'*, annular channel *c'*, a part of primary valve chamber C, annular channel c^2, passage *j*. Main valve mechanism thereupon drops into position shown in dotted lines of Fig. 6; piston valve f^2 shutting off the flow of pressure water from valve cylindrical section *e'* to annular channel e^4. Pressure water then passes from inlet O, to the inner end of the water cylinder,—by way of passage *o'* into the top of top valve cylindrical section *e*, thence through annular channel e^3 and passage I. Piston K' therefore moves away from the air cylinder, so that the two pistons K and K' assume positions shown in full lines in Fig. 2. Then, the pressure water within the water cylinder passes, through opening *n*, and passage N, to the end of the primary valve chamber C further from the air cylinder. The primary valve D therefore moves to position nearest to the air cylinder, as shown in full lines in Fig. 3. Annular channels *c* and *c'* are thus thrown into communication; the pressure water against upper face of piston f^3 thereby passing to bear against the lower face of piston f^3 (Fig. 6),—by way of passage c^3, annular channel *c*, part of valve chamber C, annular channel *c'*, passage *g'*, passage G, connection *g*. Water then passes to outlet J from the inner end of the water cylinder,—by way of passage I, annular channel e^3, top valve cylindrical section *e*, valve cylindrical section *e'*, passage *j*.

While I have herein described the invention as applied to compressing air, it is plain that the same may be applied to forcing or lifting water, or in analogous operation on other suitable fluid. So too, any suitable fluid may be employed as the actuating fluid, instead of water, in cylinder A.

I, therefore, particularly point out and distinctly claim as my invention:—

1. The combination of pistons K K' on rod *k* in cylinder A having clear space between such pistons; primary valve cylinder C having three channels *c c' c²* connecting therewith at different sections of its length; primary valve mechanism D comprising rod *d* having two opposite end pistons *d' d³* and central piston valve d^2; main valve mechanism casing E having three differential cylindrical sections *e e' e²* located in vertical line, channel e^3 connecting with upper cylindrical section *e*, channel e^4 connecting with middle cylindrical section *e';* main valve mechanism F comprising rod *f* having two differential piston valves *f' f²* and piston f^3; passage G connecting channel *c'* with cylindrical section e^2 at *g* always below piston f^3; passage H connecting one end of cylinder A with channel e^4; passage I connecting the other end of cylinder A with channel e^3; passage c^3 connecting channel *c* with cylindrical section e^2 at a point always above piston f^3;

passage j connecting channel c^2 with outlet J; passage j' connecting outlet J with cylindrical section e'; passage L connecting cylinder A with outlet J; passages M and N respectively connecting opposite ends of cylinder C with cylinder A; inlet O connected with cylindrical sections e e^2 respectively by passages o o', substantially as set forth.

2. The combination of pistons K K′ on rod k in cylinder A having a clear space between such two pistons; primary valve cylinder C having channels c c' c^2 respectively communicating therewith at different sections of its length; primary valve mechanism D consisting of rod d having opposite end pistons d' d^3 and intermediate piston valve d^2; passages M N respectively connecting opposite ends of cylinder C with cylinder A respectively at m n; passage L connecting with cylinder A at a central point l always between pistons K K′ and in a diametrical section of cylinder A between said connections m n; main valve mechanism casing E having differential cylindrical sections e e' e^2, such section e communicating with channel e^3, such section e' communicating with channel e^4; main valve mechanism F consisting of rod f having piston valves f' f^2 and piston f^3; inlet O connecting with the upper portions of said sections e e^2; outlet J communicating with passage L, chamber e' and channel c^2; passage H connecting one end of cylinder A with channel e^4, passage I connecting the other end of cylinder A with channel e^3; passage G connecting channel c' with said section e^2 at a point always to one side of piston f^3; passage c^3 connecting channel c with section e^2 at a point always to the remaining side of piston f^3, substantially as set forth.

3. The combination of pistons K K′ on rod k in cylinder A having a clear space between such two pistons; primary valve mechanism cylinder C having channels c c' c^2 and containing rod d having opposite end pistons d' d^3 and intermediate piston valve d^2; main valve mechanism cylinder E having the three differential cylindrical sections e e' e^2; main valve mechanism F comprising rod f having piston valve f' at its upper portion working in said section e, and having piston valve f^2 at its middle portion working in said section e', and having piston f^3 at its lower portion working in said section e^2; passage G having its lower portion in constant free communication with the lower portion of said piston section e^2,—the upper portion of said passage G having connection g' with annular channel c'; passage H having dependent branch h connecting with annular channel e^4,—the outer end of such passage H, having connection h' with one end of cylinder A; passage I having its lower extremity connecting with annular channel e^3,—the upper portion of such passage I connecting with the other end of cylinder A; passage c^3 connecting said channel c withthe top of said section e^2; passage j connecting channel c^2 with outlet J; passage L having one end l connecting with cylinder A and having its other end l' connecting by passage j' into outlet J; said connection l being located near the middle of cylinder A at a point always between pistons K K′; passage M having one end connecting with cylinder A at point m, and having its opposite end communicating with one end of cylinder C; passage N having one end connecting with cylinder A at point n, and having its opposite end communicating with the other end of cylinder C; inlet O connected by passage o with the upper portion of section e^2, and connected by passage o' with the upper portion of section e, substantially as set forth.

4. The combination of power pistons K K′ secured on piston rod k at a distance apart in power cylinder A within which such two pistons together reciprocate with a clear space between them; primary valve cylinder C having the three annular channels c c' c^2 surrounding it and connecting with it at different cross sections of its length; primary valve mechanism D consisting of piston rod d having the central piston valve d^2 and the two opposite end pistons d' d^3; main valve mechanism casing E having the three differential cylindrical sections e e' e^2 located in vertical axial line with each other, the upper section e being of the smallest relative diameter, the middle section e' being of the next largest diameter, the bottom section e^2 being of the largest diameter; said upper section e having the annular channel e^3 surrounding it and connecting therewith, said middle section e' having the annular channel e^4 surrounding it and connecting therewith; main valve mechanism F consisting of rod f having at its upper portion piston valve f' working in said section e, and having at its middle portion piston valve f^2 working in said section e' and having at its lower portion piston f^3 working in said section e^2; passage G having its lower portion in constant free communication with the lower portion of said piston section e^2 by connection g which is always below said piston f^3,—such passage G having its upper portion g' connecting with said annular channel c'; passage H having depending branch h connecting with said annular channel e^4, and having its outer portion h' connecting with one end of cylinder A; passage I having its lower extremity connecting with annular channel e^3, and having its upper portion connecting with the other end of cylinder A; passage c^3 connecting said annular channel c with the top of said piston section e^2; passage j connecting said annular channel c^2 with outlet J; passage L having connection l with cylinder A and also connecting with passage l' which latter empties

through passage j' into outlet J; passage M having connection m with cylinder A and communicating with one end of cylinder C; passage N having connection n with cylinder A and communicating with the other end of cylinder C; inlet O connected by passage o with the upper portion of section e^2, and connecting by passage o' with the upper portion of section e, substantially as set forth.

Signed by me, this 27th day of June, 1899.

JOSEPH H. CHAMP.

Attested by—

THOS. B. HALL,

D. T. DAVIES.