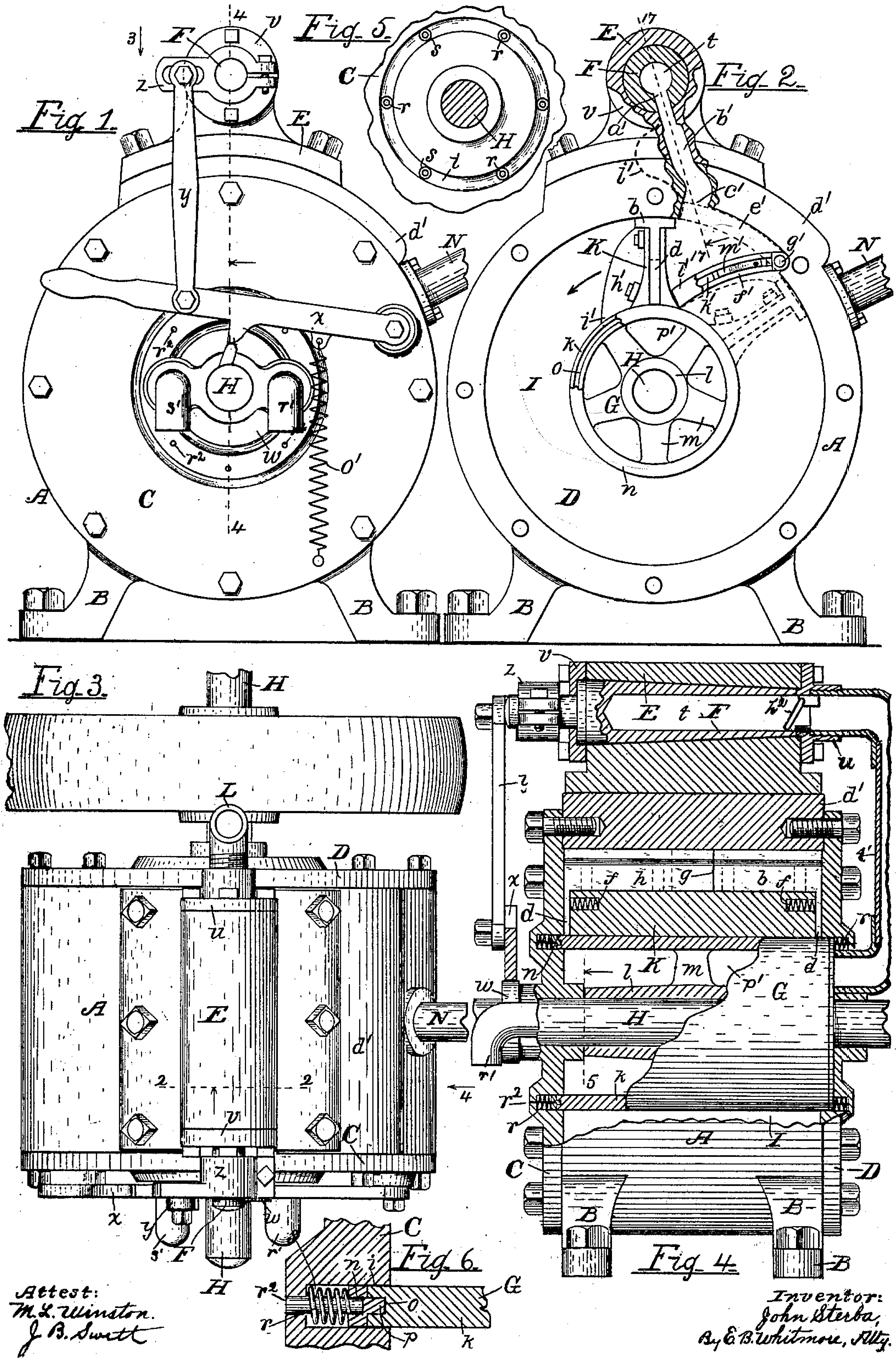
No. 672,432. Patented Apr. 16, 1901.

J. STERBA.

ROTARY EXPLOSIVE ENGINE.

(Application filed Dec. 28, 1898.)

(No Model.) 3 Sheets—Sheet 1.



Attest:
M. L. Winston.
J. B. Swett

Inventor:
John Sterba,
By E. B. Whitmore, Atty.

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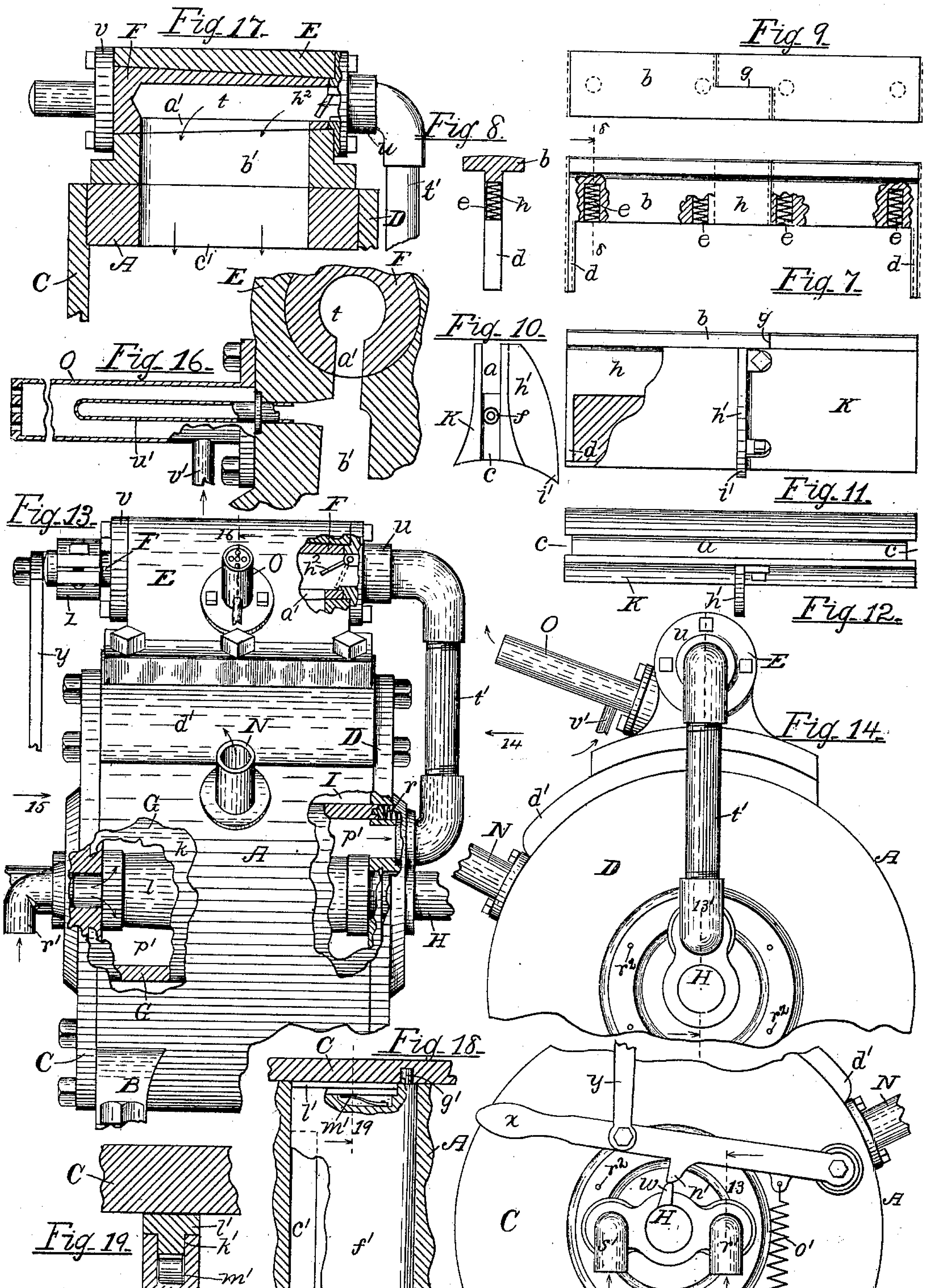

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Fig. 20.

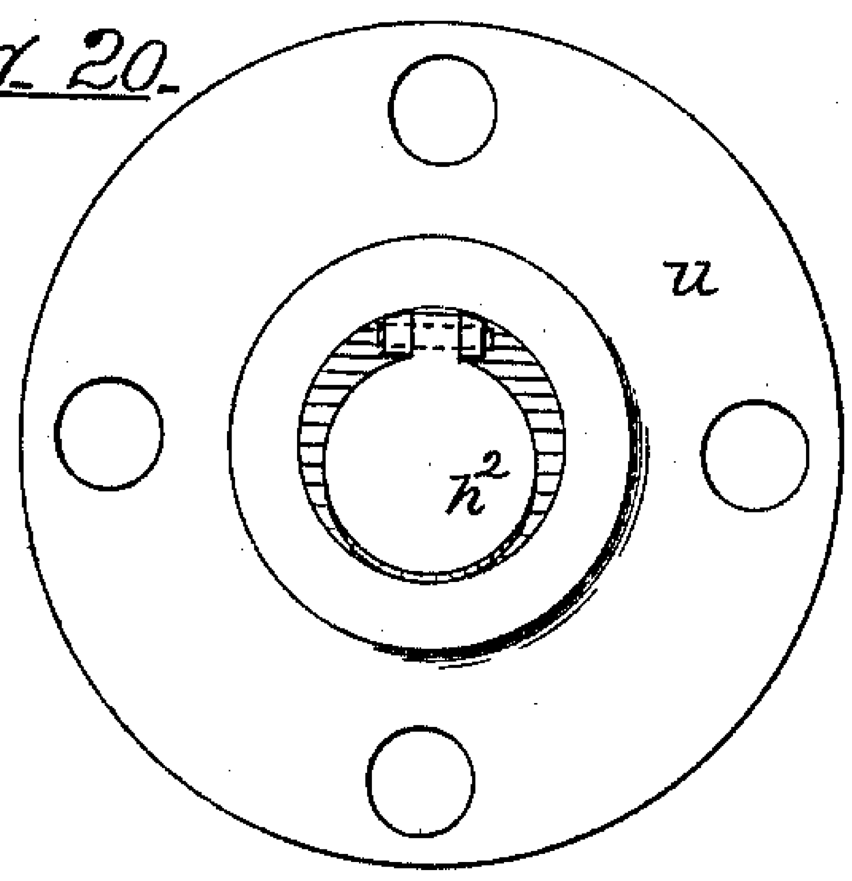


Fig. 22.

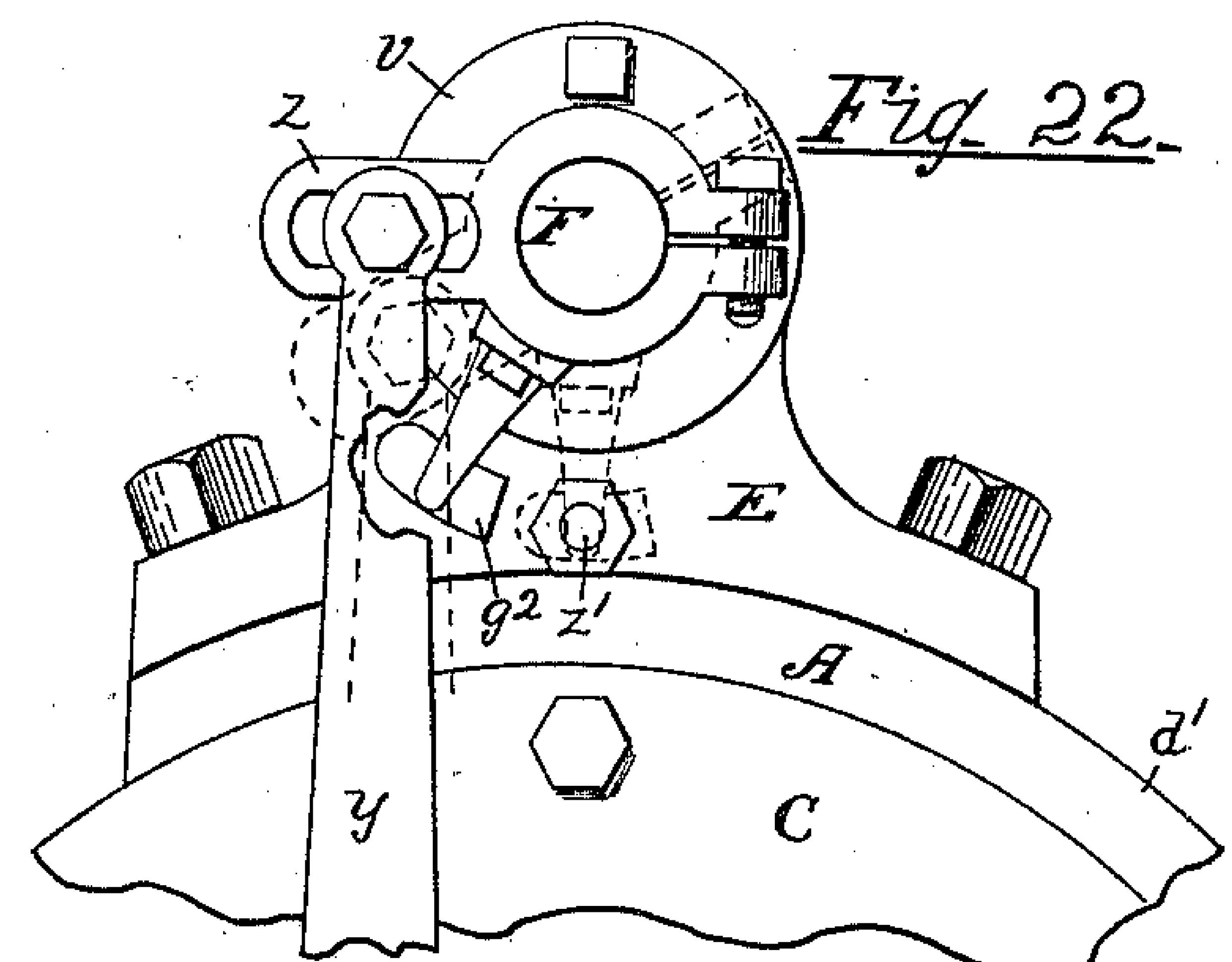
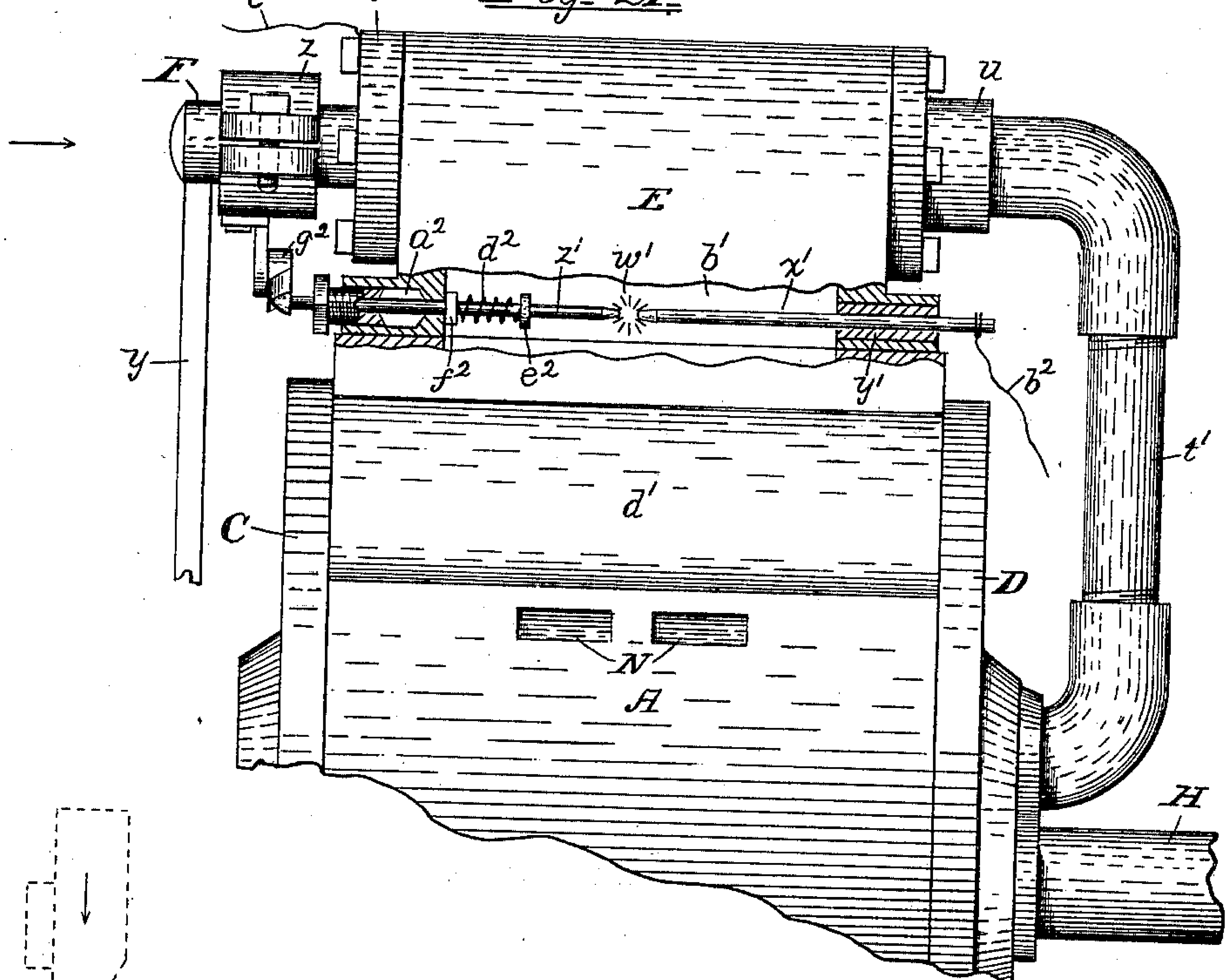


Fig. 21.



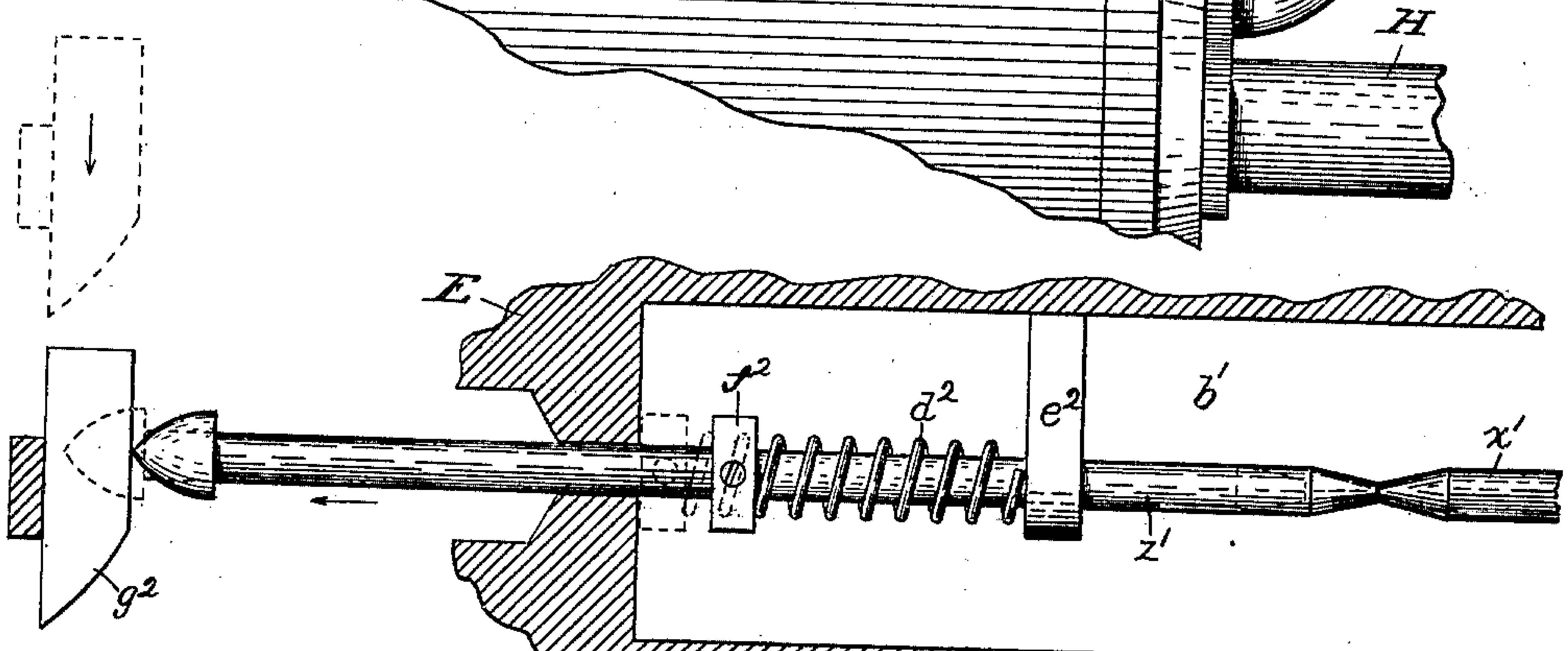


Fig. 23.

Attest:
M. L. Winston.
J. B. Swett.

Inventor:
John Sterba,
By E. B. Whitmore,
Atty.

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UNITED STATES PATENT OFFICE.

JOHN STERBA, OF ROCHESTER, NEW YORK.

ROTARY EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 672,432, dated April 16, 1901.

Application filed September 28, 1898. Serial No. 692,117. (No model.)

To all whom it may concern:

Be it known that I, JOHN STERBA, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented a new and useful Improvement in Rotary Gas-Engines, which improvement is fully set forth in the following specification and shown in the accompanying drawings.

My invention is a rotary engine designed to be driven by some expandible vapor or gas, as gasolene-vapor and air mixed, or other suitable gas or vapor adapted, when confined in a chamber, to exert a pressure upon moving parts.

The objects of this invention are simplicity of construction, durability as to wear, continuous packing, &c., the invention being hereinafter fully described, and more particularly pointed out in the claim.

Referring to the drawings, Figure 1 is a front elevation of the device. Fig. 2 is a similar elevation with the front head removed to show the interior, parts being transversely sectioned as on the dotted line 2 2 in Fig. 3 and other parts shown in two positions by full and dotted lines. Fig. 3 is a plan of the engine. Fig. 4 is a side elevation, seen as indicated by arrow 4 in Fig. 3, mainly in central longitudinal section on the dotted line 4 4 in Fig. 1. Fig. 5 is a view of a part of the inner face of a cylinder-head, indicated by arrow in Fig. 4, the main shaft being transversely sectioned on the dotted line 5 in said figure. Fig. 6 is a section of a packing-ring and associated parts. Fig. 7 is a side elevation of the divided piston-packing, partly in longitudinal section, parts being shown in two positions by full and dotted lines. Fig. 8 is a transverse section of the packing on the dotted line 8 8 in Fig. 7. Fig. 9 shows the outer surface of the piston-packing and the lap-joint between the parts. Fig. 10 is an end view of the piston. Fig. 11 is a side elevation of the piston, partly broken away. Fig. 12 is an outer edge view of the piston. Fig. 13 is a side elevation of the engine, parts being broken away and centrally sectioned on the dotted line 13′ in Fig. 14, a part at the left being vertically sectioned on the dotted line 13 in Fig. 15. Fig. 14 is a rear elevation of parts, seen as indicated by arrow 14 in Fig. 13. Fig. 15 is a front elevation of parts, seen as indicated by arrow 15 in Fig. 13. Fig. 16 is a transverse section of parts on the dotted line 16 in Fig. 13. Fig. 17 is a longitudinal section of parts on the dotted line 17 17 in Fig. 2, showing the opening into the cylinder. Fig. 18 is an elevation of the inner face of the gate-valve closed and associated parts, parts being broken away and longitudinally sectioned along the axis and in the plane of the valve. Fig. 19 is a longitudinal section of a part of the gate-valve and associated parts, taken on the dotted line 19 in Fig. 18. Fig. 20 is a face view of the check-valve in the rocking valve. Fig. 21 is a side elevation of the upper parts of the device, partly broken out to show the electrodes. Fig. 22 is a front elevation of the upper parts, seen as indicated by arrow in Fig. 21, parts being shown in two positions by full and dotted lines. Fig. 23 is a skeleton figure, better showing the method of operating the movable electrode.

Figs. 6 to 12, inclusive, Figs. 16, 18, and 19, and Figs. 20 to 23, inclusive, are drawn to various scales larger than those of the other figures.

Referring to the drawings, A, Figs. 1 to 4, is the main cylinder or body of the engine, resting upon legs B, C D being, respectively, the front and the back heads of the cylinder. The cylinder is surmounted by a valve-case E, holding a hollow tapered rocking valve F parallel with the cylinder.

G is a smaller cylinder within and concentric with the cylinder A, there being an annular space I between the cylinders, in which the fluid acts to drive the engine.

H is the main shaft of the engine, rigid with the inner cylinder, the axes of the two cylinders and the shaft being common, the shaft piercing the heads C D, in which it has bearings.

The cylinder G is provided at one side with a piston K, Figs. 2, 11, and 12, working in the space I. The piston is formed at its outer edge with a longitudinal groove *a*, in which is inserted a divided packing-piece *b*, Figs. 7 to 9, which bears at its outer convex surface snugly against the inner concave surface of the cylinder A, so as to be tight. The piston is also formed with radial grooves *c c* at its ends, in which to receive extended parts *d d* of the packing-piece *b*. Radial springs *e*, resting in chambers in the packing-piece in position to bear against the piston at the bottom of the groove a, serve to crowd the packing-piece out against the surface of the cylinder. Other longitudinal springs $f f$, Figs. 4 and 10, pressing against the parts $d d$ of the packing-piece, serve to extend the latter to press its ends against the inner faces of the respective heads C D to form tight joints therewith. The division g, Fig. 9, of the packing-piece is not along a transverse plane, but along three planes, two transverse and the other longitudinal, which permits the divided parts to lap upon each other. By this means the joint between these parts remains tight even though the parts are extended longitudinally by said springs $f f$, which springs rest in cavities in the piston. These springs e and f always keep the packing of the piston tight without further attention until the packing is worn out. The vertical web h of the packing-piece b, fitting and filling the groove a in the piston, prevents the leak of vapor between those parts. By these means the piston is rendered tight in the space I.

The inner cylinder G is formed with a circular shell k, Figs. 2, 4, and 13, open at its ends, and a hub l and arms m, the hub being rigid with the shaft H. The heads C D, which serve as heads for both cylinders A and G, are formed with internal annular grooves $i i$, Figs. 5 and 6, opposite the ends of the shell k, in which said ends project, as shown. Packing-rings $n n$ are provided for the ends of the shell k, which also occupy said grooves $i i$. The ends of the shell are formed with grooves $o o$ and the rings with tongues $p p$ to enter the respective grooves—that is to say, the joint between a ring and the cylinder G is not a single plane, but made up of five bearing-surfaces, three plain and two curved. This form serves to prevent leakage between the space I in the main cylinder and the space p' in the cylinder G. Springs r, resting in chambers s formed at the bottoms of the grooves $i i$, bear against the respective rings to hold them snugly against the ends of the cylinder G, as shown. Stay or holding pins r^2, Figs. 1 and 6, rigid in the heads C D, enter the rings n and prevent their turning with the cylinder G. These pins are preferably passed through the springs r, as shown, fitting freely in the rings.

The valve F is formed with a central longitudinal cavity t, Figs. 2 and 4, with which a pipe L communicates at the end. A head u, secured at the end of the valve-case E, serves to receive the pipe and also to bear against the small end of the valve, as shown. A counterbored head v, secured at the opposite end of the valve-case, receives the projecting end of the valve and prevents end play of the latter. The valve is rocked or turned in the valve-case by means of a cam w, Figs. 1 and 4, rigid with the shaft H, and an intermediate lever x, connecting-bar y, and arm z, the latter being rigid with the valve. The valve is formed with a longitudinal opening a', Figs. 2, 16, and 17, which communicates with a passage or chamber b', connecting the interior of the valve-chamber with the interior of the main cylinder at c', Figs. 2 and 18. The shell of the cylinder is thickened at d' and formed with a longitudinal cavity or chamber e', in which to receive a curved abutment f'. This abutment when closed (shown by dotted position in Fig. 2) covers the opening c', its inner concave surface corresponding with and forming a continuous part of the concave surface of the cylinder. During the revolutions of the piston K its outer curved surface bears against and passes the closed abutment the same as any other part of the cylinder, the abutment being held shut by said piston while passing. This abutment is constructed to turn on trunnions $g' g'$ in the heads C D, parallel with the cylinder A, so as to swing from gravity into the space I. After the piston in making the revolutions passes the abutment the latter falls from gravity into the space I to the position shown by full lines in Fig. 2, its outer free edge then resting against the surface of the inner cylinder G. In this position it divides the space I and constitutes a tight closer or abutment, serving to prevent the fluid under pressure from passing below or back of it into the space I. The dropping of the abutment opens communication for the fluid between the chamber b' and the space I in the rear of the piston, so as to carry the latter, with the shaft H, around. This piston is provided in front with a plate or pilot h', Figs. 2, 11, and 12, which serves as a lifter or actuator for the abutment. When the piston arrives at the rear of the abutment, as shown by dotted position in Fig. 2, the pilot encounters the abutment and swings it upward toward its closed position, it being finally completely closed and temporarily held shut by the direct action of the packing-piece b. The front or contact edge of the pilot is curved or made cam-shaped, so that it will first encounter the abutment near its outer edge, thus starting it slowly; but the form of the pilot is such that as it advances the point of contact with the abutment moves rapidly toward the axis of the latter, thus accelerating the motion of the abutment as it approaches its closed position, and this acceleration of the abutment's motion toward its seat is further increased from the fact that as said point of contact moves along the face of the pilot away from the center of motion of the pilot—the axis of the shaft H—it has a greater circular velocity. This is an essential feature of the invention, as the speed of the engine is usually high and the valve starts easiest if first encountered at its free edge. The advance or projecting point i' of the pilot has the lowest rate of motion of any part of the pilot and encounters the abutment with the least resistance, so that the resulting shock or jar is at the minimum.

To render the abutment f' fluid-tight, it is formed with grooves k' at its ends, Figs. 2, 18, and 19, and provided with curved packing-plates l', formed with tongues to fit the grooves. Springs m' are provided in cavities in the abutment in position to bear against the packing-plates to crowd them outward against the cylinder-heads C D.

N, Figs. 1, 13, and 21, is an ordinary exhaust communicating with the space I for the escape of spent fluid therefrom. This exhaust-opening is relatively placed so that the spent fluid is allowed to escape about the time the abutment f' is closed, as above stated.

The cam w acts against a projecting point n' of the lever x to open the rocking valve F, the circular length of this cam being arranged to have the valve F close when the piston is at any given point in its revolution, the fluid working expansively during the remainder of the revolution. The positions of the cam and associated parts shown in Fig. 1 correspond with the positions of the cylinder G and associated parts shown in Fig. 2, the valve F being just opened to allow an inflow of the fluid. When the cam has passed the point n', a spring o' acts to pull the lever x downward and close the valve F.

The air and gasolene-gas combined employed to drive the engine are mingled in the space p' in the inner cylinder G, the gas entering through a pipe r', Figs. 13 and 15, and the air entering through a similar pipe s'. The air and gasolene-vapor are forced into the cylinder G by means of ordinary pumps or other well-known means, and the mixed fluid passes out at the opposite end of the cylinder through a pipe t' into the valve F, filling the chamber b' and the space I between the piston and the abutment f', as appears in Fig. 2. This mixed gas is ignited in the combustion-chamber b' by some simple and well-known means—as, for instance, an electric spark w', Fig. 21, or a hot tube u', Fig. 16. When the latter is employed, it is inserted at some convenient point in the valve-case communicating with the chamber b' and heated by a flame in the inclosing tube in the usual manner, the heating-jet entering through the side tube v'. In this case a self-acting gravity check-valve h^2, Figs. 13 and 20, is employed in the rocking valve F to close the inflow-passage into the rocking valve and prevent the flame from passing back into the pipe t'. If a spark is used, it may be produced by means of a stationary platinum wire x', reaching into the chamber b' and insulated at y', and an opposing movable wire z', passing through a stuffing-box a^2. Conducting-wires b^2 and c^2 connect the wires x' and z' with a battery, the connection with the wire z' being through some convenient part of the machine. A spring d^2 on the wire z', Fig. 23, acting between a fixed stud e^2 and a ring f^2, rigid with the wire z', serves to hold the latter normally apart from the wire x', as appears in Fig. 21. A cam g^2, operated by the arm z, moves the wire z' longitudinally to produce a spark after the rocking valve F is closed.

For opening the valve F when gasolene is used the cam w is shortened up to a mere tooth, as appears in Fig. 15, which causes the valve to open and instantly close again. Also when gasolene is used some ordinary means of cooling the cylinder is employed—such, for instance, as currents of cold water flowing over or around the cylinder.

The valve-case E, Fig. 2, is placed practically opposite the valve-chamber e', with the combustion-chamber b' connecting them. The form of this chamber b' or the direction it takes is not essential, except that the opening c' is purposely made opposite the part of the abutment near its free edge. (See Fig. 18.) When the engine is designed to be used with steam, the chamber or passage b' is made comparatively narrow or just sufficiently large in cross-section to afford a ready flow into the main cylinder A; but when gasolene is designed to be used the chamber is broadened, as indicated by heavy dotted line i' in Fig. 2, so as to contain a larger volume of the vapor.

What I claim as my invention is—

A rotary engine having two concentric hollow cylinders one within the other, a piston rigid with the inner cylinder and working in the space between the two cylinders, a valve-case secured to the convex surface of the outer cylinder, a hollow valve in the valve-case and a passage or chamber connecting the interior of the valve-case and the space within the outer cylinder, the valve having an opening communicating with said passage or chamber, a pipe connecting the space within the inner cylinder with the space in the valve and pipes communicating from without into the space within the inner cylinder, as set forth.

In witness whereof I have hereunto set my hand, this 23d day of September, 1898, in the presence of two subscribing witnesses.

JOHN STERBA.

Witnesses:
E. B. WHITMORE,
M. L. WINSTON.