No. 861,763. PATENTED JULY 30, 1907.

L. PASCHALL.

EXPLOSIVE ENGINE.

APPLICATION FILED APR. 8, 1905.

5 SHEETS—SHEET 1.

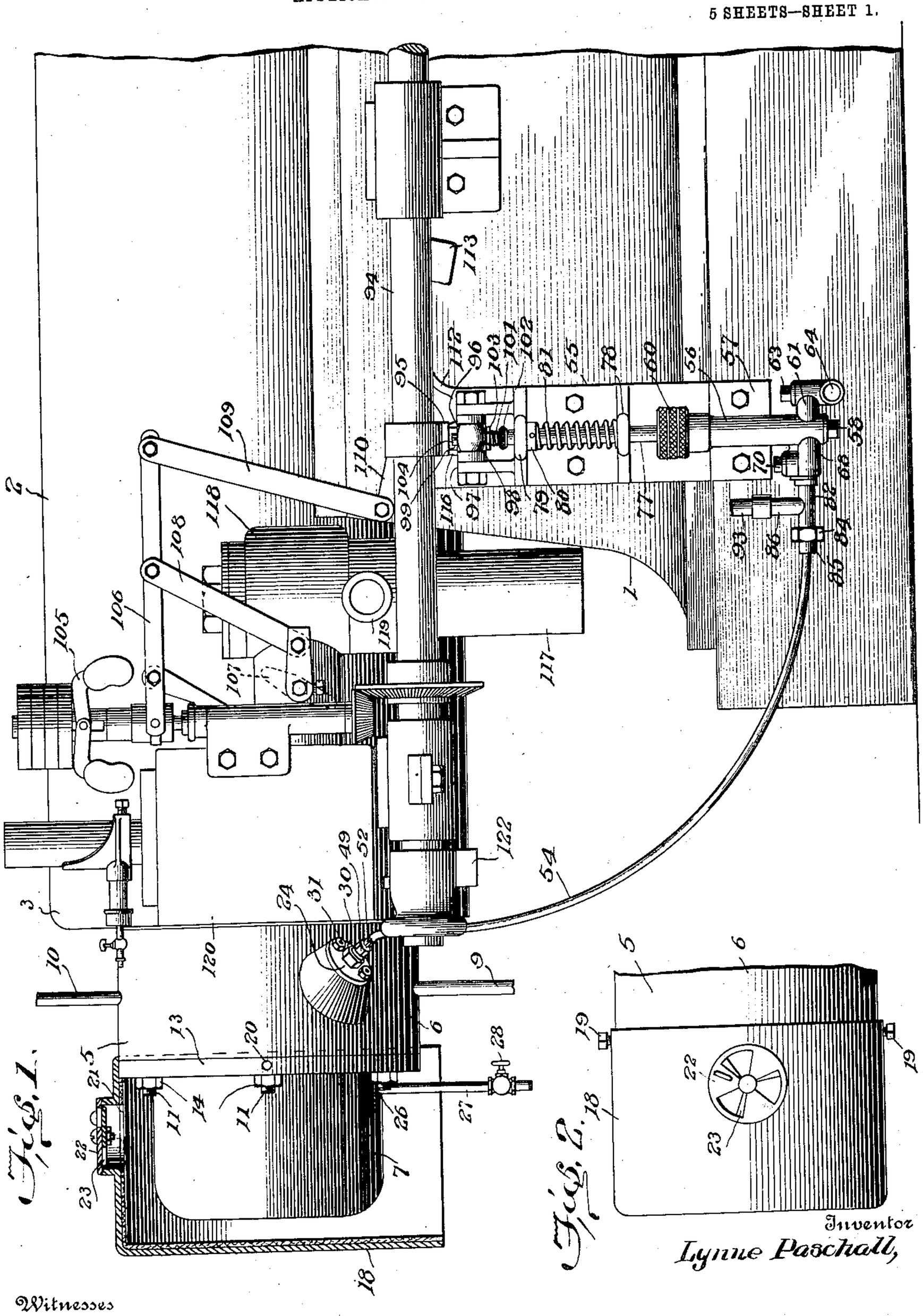

Fig. 1.

Fig. 2.

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Lynne Paschall,

Witnesses

G. Howard Walmsley.

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By H. A. Faulkner.

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5 SHEETS—SHEET 2.

Fig. 3.

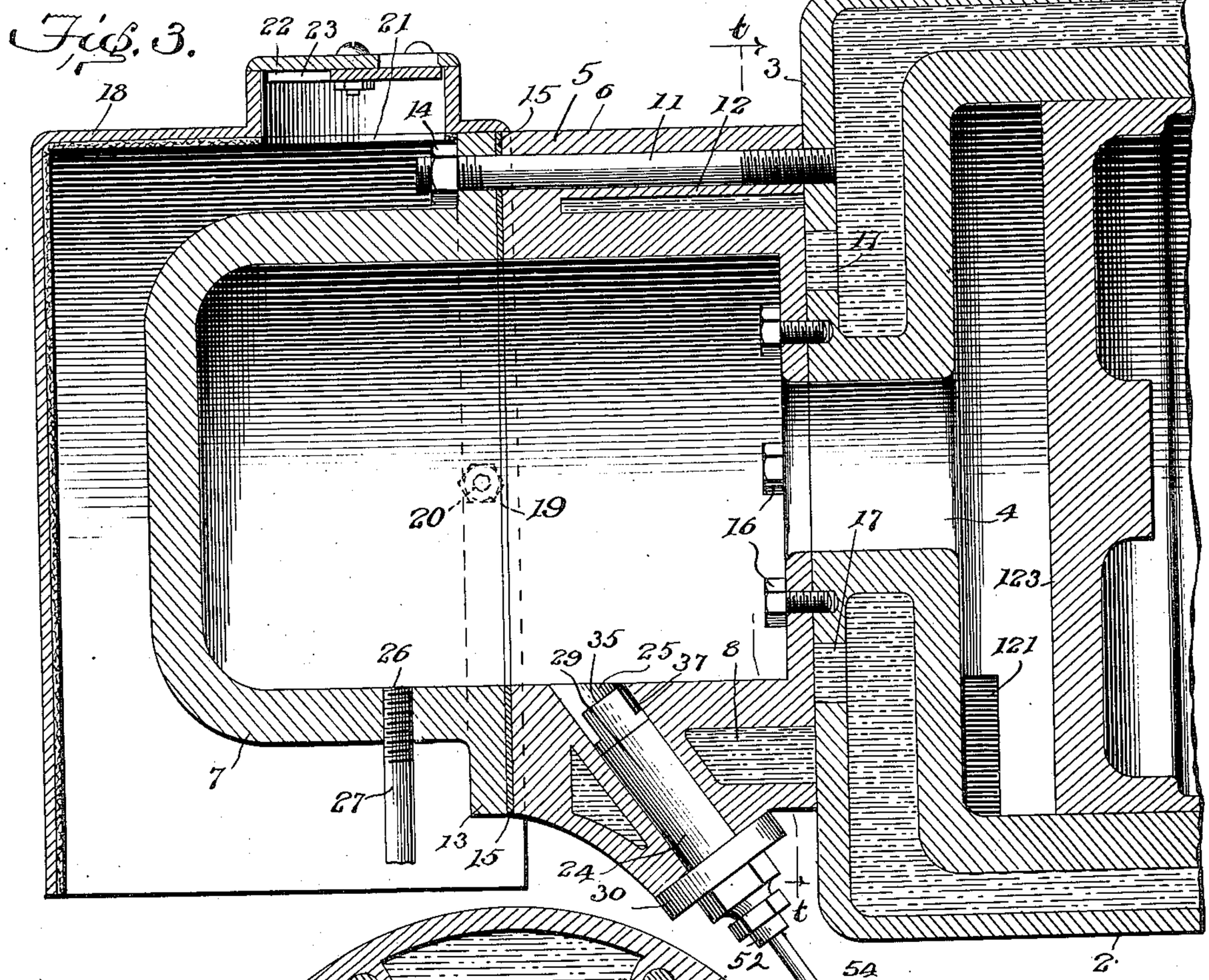
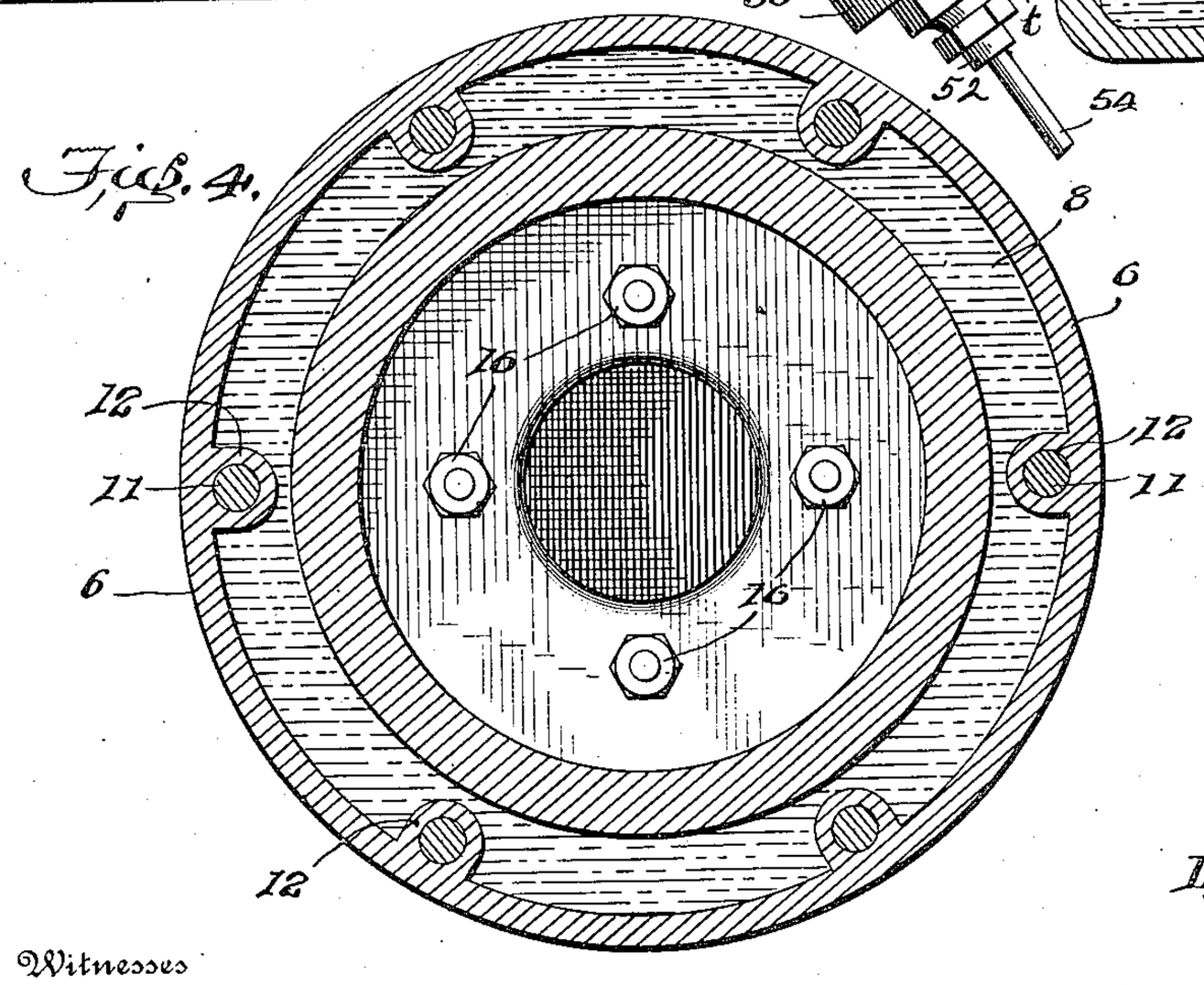


Fig. 4.



Witnesses

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Forced oil supply.

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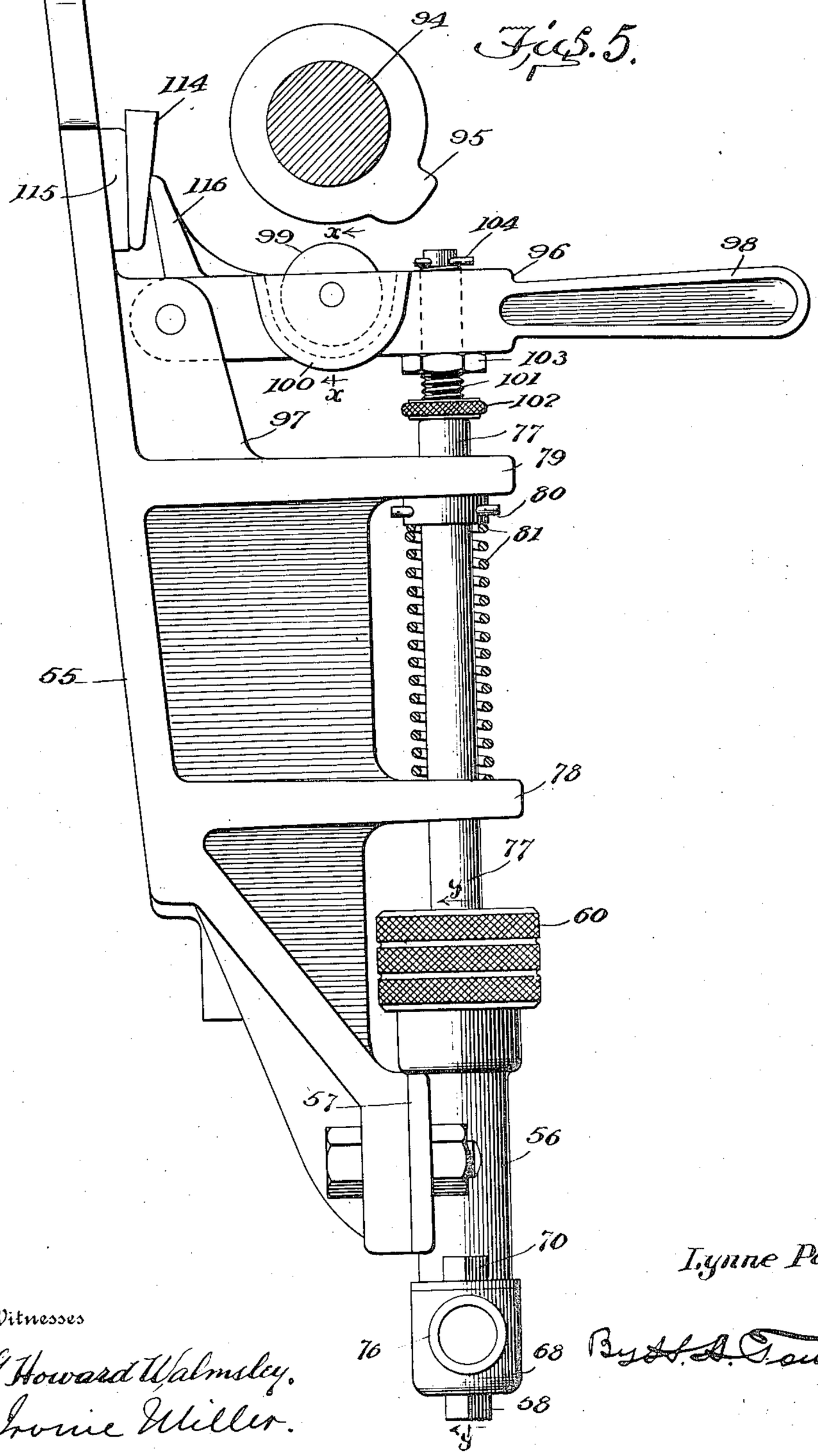
5 SHEETS—SHEET 3.

Fig. 5.



Witnesses

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5 SHEETS—SHEET 4.

Fig. 6.

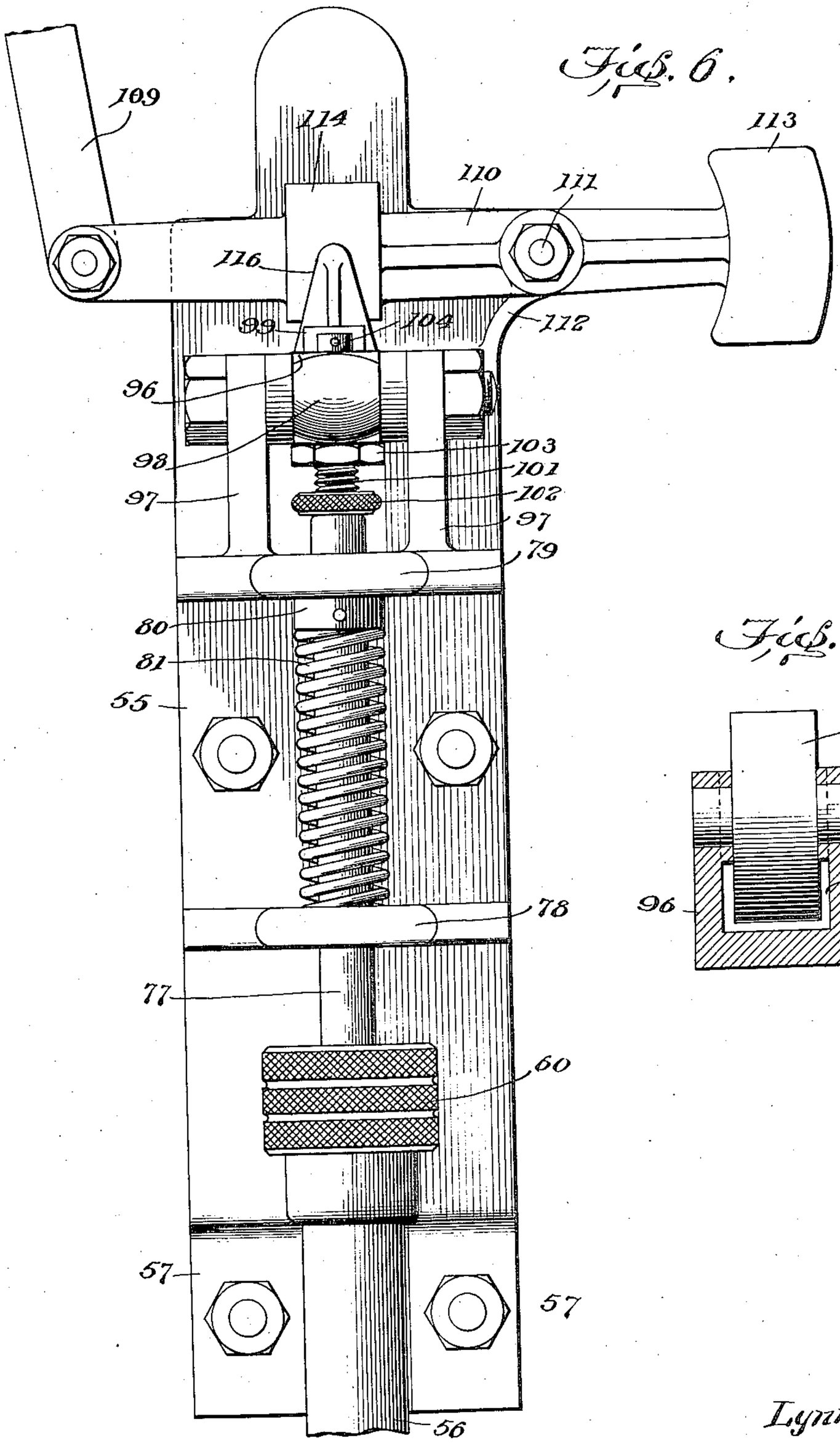

Fig. 7.

Witnesses

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5 SHEETS—SHEET 5.

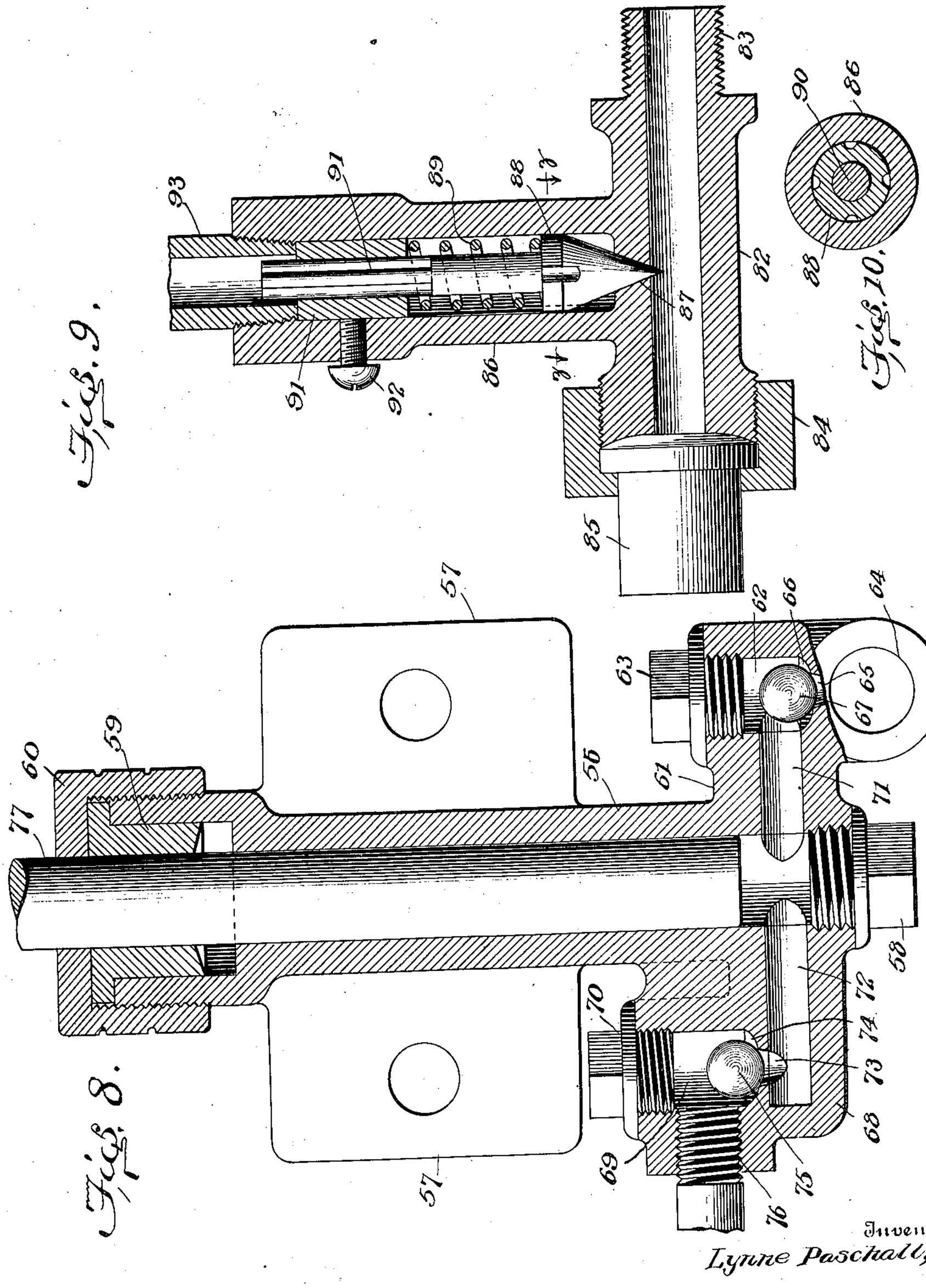

Fig. 8.

Fig. 9.

Fig. 10.

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UNITED STATES PATENT OFFICE.

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EXPLOSIVE-ENGINE.

No. 861,763. Specification of Letters Patent. Patented July 30, 1907.

Application filed April 8, 1905. Serial No. 254,437.

To all whom it may concern:

Be it known that I, LYNNE PASCHALL, a citizen of the United States, residing at Springfield, in the county of Clark and State of Ohio, have invented certain new and useful Improvements in Explosive-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to explosive engines, and has for its object to provide an engine of the explosive type in which crude oil can be used, either alone or in connection with gas, as a fuel. More specifically, the invention relates to that class of oil engines in which the oil is sprayed into a retort connected with the cylinder by a contracted passageway, the heat of the retort acting to ignite the explosive mixture when compressed. The invention consists in certain novel features which I will now proceed to describe and will then particularly point out in the claims.

In the accompanying drawings, Figure 1 is a side elevation of a structure embodying my invention in one form, the hood being shown in central vertical section; Fig. 2 is a detail plan view of the hood and a portion of the retort to which it is applied; Fig. 3 is a central vertical section, taken longitudinally through the retort, hood and cylinder end, the plane of section being diverted diagonally through the lower portion of the inner section of the retort so as to show the sprayer; Fig. 4 is a transverse sectional view through the inner section of the retort, taken on the line *t t* of Fig. 3 and looking in the direction of the arrows; Fig. 5 is a side elevation of the pump and its associated mechanism and supporting bracket, the cam shaft being shown in section; Fig. 6 is a front elevation of the same, with the cam shaft omitted; Fig. 7 is an enlarged detail sectional view, taken on the line *x x* of Fig. 9 and looking in the direction of the arrows; Fig. 8 is a front elevation of the pump, detached, the body thereof being in section upon the line *y y* of Fig. 9 and looking in the direction of the arrows; Fig. 9 is a sectional view of the oil relief or safety device, the plane of section corresponding to that of Fig. 8; and Fig. 10 is a detail sectional view, taken on the line *z z* of Fig. 9 and looking in the direction of the arrows.

In the said drawings, I have shown my improvements as applied to a well known type of explosive engine, operating on the four-cycle principle, the same comprising a base 1 on which is mounted a cylinder 2, water-jacketed in the usual manner. The cylinder head 3 is provided with an aperture or passage 4 of relatively small diameter, whereby the interior of the cylinder is placed in constantly open communication with the interior of the retort 5. The retort is constructed of two sections, 6 and 7, of which the section 6, lying immediately adjacent to the cylinder head, is provided with an internal space 8 to receive the water which forms a water-jacket therefor, the same being supplied by an inlet pipe 9 and carried off by an outlet pipe 10. The outermost section 7 of the retort is not water-jacketed, and is secured to section 6 by means of stud bolts 11. These bolts have their inner ends threaded into the cylinder head 3, and extend out through sleeves 12 in the retort section 6, and through a flange 13 on the section 7, beyond which flange they project, their projecting ends being threaded to receive nuts 14, by means of which the two sections of the retort are clamped to each other and to the cylinder head. A gasket 15 is preferably interposed between the meeting faces of the sections 6 and 7. The section 6 is additionally secured to the cylinder head by means of screw bolts 16, which hold it tightly in position against the cylinder head when the nuts 14 are loosened, thereby preventing any escape of water from the water-jacket space of the cylinder head through the core openings 17 formed therein.

The water-jacketing of the inner section of the retort serves to keep down its temperature and prevent premature firing of the charge. The outer section 7 is heated to a relatively high temperature, so as to effect the ignition of the charge when the mixture in said outer portion has received the proper quantity of air during compression. To maintain the temperature of the outer section 7, the same is inclosed in a hood 18, which is open at the bottom and closed at the sides and top, one side being closed by the body of the retort, over which the hood fits. In practice, the open side of the hood fits over the flange 13, and is secured in position by set-screws 19, passing through the hood on each side thereof and engaging recesses 20 in the flange. This hood serves to retain the heat of the section 7 and prevent its cooling by radiation to too low a temperature. Provision is also made, however, for preventing overheating of the outer section of the retort, by means of an opening in the top of the hood, controlled by a damper, so that, by opening said damper more or less, a greater or less quantity of air may be permitted to pass up through the hood and thus reduce the temperature to the desired extent. The opening is indicated at 21, and is provided with the usual fixed slotted plate 22, upon which is pivoted a correspondingly slotted plate 23, which may be so turned as to cause its apertures to register more or less with those of the fixed plate 22. This dampered aperture is also of utility in connection with the starting of the engine, which is effected by heating the outer end of the retort by means of a suitable lamp or torch. By opening the damper, the retort may be readily heated by placing the torch below it without removing the hood, since the draft passage thus formed avoids the necessity of such re-

moval. When removal of the hood is necessary, however, it is readily effected by simply loosening the two set screws 19. Similarly, access may be readily had to the interior of the retort when necessary either for the inspection or cleaning out of the same, by removing the nuts 14 and slipping the section 7 off of the stud bolts 11.

The oil is injected into the retort through a sprayer, by means of which the oil is delivered into the interior of the retort in the form of a fine spray, so as to be more readily vaporized by the heat thereof. The sprayer is indicated as a whole by the reference numeral 24, and it is inserted in a sleeve-like recess 25, formed to receive the same in the water-jacketed portion of the retort, so that the sprayer is surrounded by the water-jacket of the retort and overheating of the sprayer and the oil therein is prevented. The sprayer is arranged in an inclined position relatively to the longitudinal axis of the retort, being so placed that its discharge is directed toward and into the outer section 7 of the retort, and preferably toward the top thereof, which is the hottest part. By reason of this arrangement, while the sprayer is cooled by the water-jacket of one section of the retort, the spray of oil is delivered into the other or hottest section in such a way as to be more promptly vaporized.

The retort is provided in its under side with an opening 26, preferably formed through the outer section 7 of the retort, from which opening a pipe 27 extends downward, said pipe being provided with a valve 28. This provides a means for draining the interior of the retort in case of any accumulation of unconsumed residuum therein, as well as a means for determining whether such residuum exists.

Referring now to the sprayer, it is, as hereinbefore stated, inserted in a recess 25 formed to receive it in the jacketed portion of the retort. Said recess is preferably circular in cross section, and the sprayer has a correspondingly shaped cylindrical body 29 to fit said recess, and a flanged head 30, to receive the screw bolts 31 by means of which it is secured in position. The removal of these screw bolts permits the entire sprayer to be readily withdrawn from its recess for inspection or repair.

A suitable sleeve or nipple 52 is secured to the outer end of the vaporizer 24 in any suitable manner, and to this sleeve 52 there is brazed, or otherwise connected, the discharge end of a pipe or conduit 54, preferably of brass, connected at its other end to the oil pump.

As already stated, oil is supplied to the sprayer by a pump, and said pump and its associated mechanisms are mounted upon a bracket 55, secured to the base 1 at one side thereof. 56 indicates the barrel or cylinder of the pump, which is provided with lateral flanges 57, by means of which it is bolted to the face of the bracket 55 at the lower end thereof. The bore of the pump cylinder preferably extends entirely through the same, being closed at its lower end by a screw plug 58, while the upper end is provided with a stuffing box, the gland 59 of which has a cover 60 which is threaded onto the upper end of the pump cylinder. At the lower end of said cylinder there is provided on one side a lateral extension 61, in which is formed the inlet valve chamber 62, closed at the top by a screw plug 63 having the full width of the chamber. A connection 64 to the oil supply communicates with the inlet 62 through a passage 65 provided with a valve seat 66 to receive a ball valve 67. On the other side of its lower end the pump cylinder is provided with an extension 68, having an outlet valve chamber 69, closed at its top by a screw plug 70 of the full width of the chamber. An inlet port 71 extends from the valve chamber 62 to the lower end of the pump cylinder, and an outlet port 72 extends from the lower end of the pump to the outlet valve chamber 69, communicating therewith by a passage 73, having a valve seat 74 to receive the ball valve 75. The outlet valve chamber 69 communicates with the supply pipe 54 through a threaded opening 76 in the manner hereinafter described. The pump plunger consists of a cylindrical rod or bar 77, of equal diameter throughout its length, fitting the interior of the cylinder and extending up through and beyond the stuffing box to a point where its upper end is in operative relations with its actuating mechanism. This upward extension of the pump plunger passes through and is guided by separated lugs 78 and 79 on the bracket 55. Below the upper lug 79 the plunger is provided with a collar 80 secured thereon, and a spring 81 is coiled around the plunger between said collar and the lower guiding lug 78, said spring holding the plunger normally at its upward limit of motion, which is determined by the collar 80. The lug 78 is located at a distance above the body of the pump sufficient to permit the cover 60 of the stuffing box to be unscrewed and lifted up so as to give access to the box for repacking it when necessary without requiring the removal of either cylinder or plunger.

It will be seen that the pump just described is simple and inexpensive in construction and readily accessible as to all of its parts for inspection, cleaning or repairs.

Provision is made to prevent injury to the oil supply pipe or conduit 54 and sprayer, in case of accidental stoppage or obstruction of those parts, by means of a release or safety valve connected to the pump and operating to divert the oil from the pipe 54 and return it to the source of supply in case the oil delivered from the pump meets more than a predetermined resistance. This relief device comprises a tube 82, threaded at one end, as indicated at 83, to enter the outlet aperture 76 of the pump, its other end being externally threaded to receive the sleeve nut 84 of a flange union, the sleeve 85 of which is brazed or otherwise connected to the receiving end of the pipe 54. Connected to the tube 82 at right angles therewith is a second tube 86, communicating with the passage through the tube 82 by means of a needle or tapering valve-seat 87. A correspondingly tapering or needle valve 88 is mounted in the tube 86, being held to its seat by a spring 89, coiled around its stem 90 and bearing at its lower end against the back of the valve 88, while its upper end bears against a bushing 91, which is vertically adjustable in the tube 86. I have shown the bushing as being adapted to be secured in position after adjustment by a set screw 92. The valve stem 90, where it passes through the bushing, which guides it, is flattened or otherwise so formed as to permit the passage of the oil. A pipe 93 is connected to the upper end of the tube 86 and leads back to the oil tank or other source of supply. It will be seen that the spring 89 may be adjusted, by means of the bushing 91, so as to hold the valve 88 to its seat against the normal pressure of the oil deliv-

ered by the pump, the adjustment of said spring being such that when a predetermined pressure is exceeded, the oil will be diverted through the relief valve and pipe 93 back to the tank, thus preventing injury to the pipe 54 or sprayer.

The amount of oil delivered to the retort is automatically controlled by means of a governor through mechanism which varies the length of stroke of the pump plunger to conform to the conditions to be met. The engine is provided with the usual side or cam shaft 94, driven from the engine shaft and operating the valves and governor in any suitable way. Upon the shaft 94 there is secured a cam 95, which operates the pump plunger through the medium of an intervening lever 96. This lever is pivoted at its inner end between lugs 97 on the bracket 55 above the lug 79, and extends thence outward in the path of the cam 95 and above the upper end of the plunger 77, its outer end terminating in a handle portion 98, by means of which it may be operated by hand in starting the engine. The lever 96 is provided with an antifriction roller 99 with which the cam 95 engages, said antifriction roller being mounted to rotate in a recess 100, formed in the body of the lever and adapted to be filled with oil, so that the antifriction roller runs in an oil bath. Above the plunger 77 the lever 96 is provided with a tappet 101, preferably in the form of a screw extending up through a threaded aperture in the lever and provided with a milled head 102, by means of which it may be readily adjusted by hand, and having a lock nut 103 to secure it in position after adjustment. This tappet bears upon the upper end of the plunger 77, and depresses said plunger against the action of the spring 81 when the lever 96 is depressed by reason of the contact of the cam 95 with the roller 99. It will be seen that the stroke of the pump may be primarily adjusted by means of the tappet 101, which will project the roller 99 more or less into the path of the cam 95, and thus give the pump a longer or a shorter stroke. This adjustment may be readily effected while the engine is in operation, the lever 96 being depressed out of the path of the cam, if necessary, by grasping its handle portion 98. The tappet 101 is provided with a pin 104, passing through its upper end above the lever 96 and serving to prevent the tappet from moving down far enough, accidentally or otherwise, to strike the lug 79 and thereby cause breakage.

The primary adjustment of the stroke of the pump through the tappet 101 serves to regulate the supply of oil to meet the general conditions under which the engine is operating. The special conditions, such as variations of load, etc., are provided for by the governor control hereinbefore referred to. The governor, indicated as a whole by the reference numeral 105, is driven from the shaft 94 by the gearing shown, and is connected to one end of a lever 106, which, in the present instance, is shown as controlling a throttle valve 107 by means of a link 108. This throttle valve controls the supply of air to the engine, and also the supply of the mixed air and gas when gas is used, either wholly or in part, as a fuel. To the end of the lever 106 opposite that to which the governor is connected there is pivoted one end of a link 109, the other end of which link is pivoted to one end of a lever 110, which lever is pivoted between its ends, at 111, to a lug 112 extending laterally from the bracket 55. The other end of the lever 110 is provided with a counterweight 113, to balance the governor connections. The lever 110 is provided with a wedge-shaped portion or inclined face 114, which moves between a suitable abutment 115 on the bracket 55 and an arm or lug 116 on the lever 96. When the parts are running under normal load, the lever 110 is raised to a position such that the wedge 114 is out of the path of the projection 116, and the lever 96 is free to rise to the highest point to which the spring 81 is permitted by the collar 80 to lift it, said highest point being determined, as hereinafter stated, by the position of the tappet 101. This gives the maximum pump stroke determined by the primary adjustment, and supplies the predetermined maximum of fuel to the engine. In case of an increase in speed, due to decrease in load or other causes, the governor will move the lever 110 downward, bringing the wedge 114 downward to a greater or less extent between the abutment 115 and projection 116, and limiting to a corresponding extent the upward motion of the lever 96, correspondingly decreasing the length of stroke of the pump and the supply of oil to the retort. By reason of this construction, the speed of the engine can be automatically governed with great nicety, the inclined face of the wedge-like portion of the lever 110 positively regulating with great exactness the length of stroke of the pump plunger, and increasing or decreasing the same, under the control of the governor, to meet existing conditions.

The general operation of the engine requires no description here, since the operation of the several mechanisms has been fully described in considering their detail constructions. In practice, it has been found that the engine operates successfully with crude petroleum alone as a fuel, and also in connection with gas employed along with the oil. The engine shown receives air into the cylinder through an air inlet pipe 117, whence it passes through a mixer 118, and is there mixed with gas supplied through an inlet pipe 119, in case gas is used. The supply of air, or air and gas, is controlled from the governor, as already stated, by the throttle valve 107, located between the mixer 118 and the inlet valve chamber 120, which latter contains the inlet valve and communicates with the interior of the cylinder through an inlet port 121. The engine is, of course, provided with the usual exhaust valve, operated from the shaft 94 by means of a cam 122. The parts are preferably so timed that the cam 95 depresses the lever 96 at the beginning of the charging stroke of the engine piston 123, so that the oil is sprayed into the retort and vaporized at the earliest possible moment, the vapor being subsequently compressed and mixed with sufficient air to cause the explosion at the end of the next or compression stroke, in the manner usual in engines of this class.

I do not wish to be understood as limiting myself strictly to the precise details of construction hereinbefore described and shown in the accompanying drawings, as it is obvious that these details may be varied without departing from the principle of my invention.

I make no claim in the present application to these features of the construction hereinbefore described relating to the spraying or vaporizing and ingiting devices and the construction of the retort.

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

1. In an explosive engine of the character described, the combination, with a retort, a sprayer discharging into the same, an oil pump and an oil supply pipe connecting the pump and sprayer, of an oil release device comprising a tube forming a part of the oil supply pipe and provided with a needle valve opening, and a second tube with which said opening communicates, a needle valve arranged in said second tube, a spring acting to close said needle valve, and adjusting means carried by said second tube within the same to form an abutment for said spring and movable longitudinally thereof to regulate the tension of said spring said adjusting means comprising an adjustable bushing mounted within the tube and forming an abutment for the spring and a guide for the valve stem, substantially as described.

2. In an explosive engine of the character described, the combination, with a retort, a sprayer discharging into the same, and an oil pump for supplying the sprayer, provided with a spring-lifted plunger, of a lever engaging said plunger to depress the same against the spring, a cam driven by the engine and engaging the lever to depress the same, a governor, and a controlling lever actuated by said governor and provided with means for limiting the motion of the pump actuating lever into the path of the cam, substantially as described.

3. In an explosive engine of the character described, the combination, with a retort, a sprayer discharging into the same, and an oil pump for supplying the sprayer provided with a spring-lifted plunger, of a lever engaging said plunger to depress the same against the spring, a cam driven by the engine and engaging the lever to depress the same, a governor, and a controlling lever actuated by said governor and provided with means for limiting the motion of the pump actuating lever into the path of the cam, said means comprising an inclined surface upon the controlling lever and a projection upon the pump actuating lever, into the path of which said inclined surface is moved by the governor, substantially as described.

4. In an explosive engine of the character described, the combination, with a retort, a sprayer discharging into the same, and an oil pump for supplying the sprayer, provided with a spring-lifted plunger, of a lever engaging said plunger to depress the same against the spring, a cam driven by the engine and engaging the lever to depress the same, a governor, and a controlling lever actuated by said governor and provided with means for limiting the motion of the pump actuating lever into the path of the cam, said means comprising a projection on the pump actuating lever, a fixed abutment, and a wedge on the controlling lever movable into the path of said projection between it and the abutment, substantially as described.

5. In an explosive engine of the character described, the combination, with a retort, a sprayer discharging into the same, and an oil pump for supplying the sprayer, provided with a spring-lifted plunger, of a lever engaging said plunger to depress the same against the spring, an antifriction roller mounted in said lever, and a cam driven by the engine and adapted to engage said antifriction roller to depress the lever, said lever being provided with a recess forming an oil bath in which said antifriction roller is mounted, substantially as described.

6. In an explosive engine of the character described, the combination, with a retort, a sprayer discharging into the same, and an oil pump for supplying the sprayer, provided with a spring-lifted plunger and having a stuffing box at its upper end provided with a detachable cover through which the plunger passes, of a bracket on which said pump is mounted, said bracket having two lugs through which the plunger passes, the lower lug located at a distance above the pump sufficient to permit the stuffing box cap to be raised to give access to the stuffing box, the plunger being provided with a collar below the upper lug, and a spring coiled around the plunger and bearing against said collar and the lower lug, substantially as described.

7. In an explosive engine of the character described, a cylinder having an air inlet and a throttle valve controlling the same, a retort communicating with said cylinder through a contracted passage, a sprayer discharging into said retort, an oil pump supplying said sprayer and provided with a spring-lifted plunger, a lever engaging said plunger to depress the same against the spring, a shaft driven by the engine and provided with a cam to engage the lever to depress the same, a governor driven by said shaft, a governing lever actuated by the governor and connected to the throttle valve to control the same, and a controlling lever connected to the governing lever so as to be actuated thereby and provided with means for controlling the extent of engagement of the pump actuating lever and cam, substantially as described.

In testimony whereof, I affix my signature in presence of two witnesses.

LYNNE PASCHALL.

Witnesses:
E. O. HAGAN,
IRVINE MILLER.