No. 816,109. PATENTED MAR. 27, 1906.

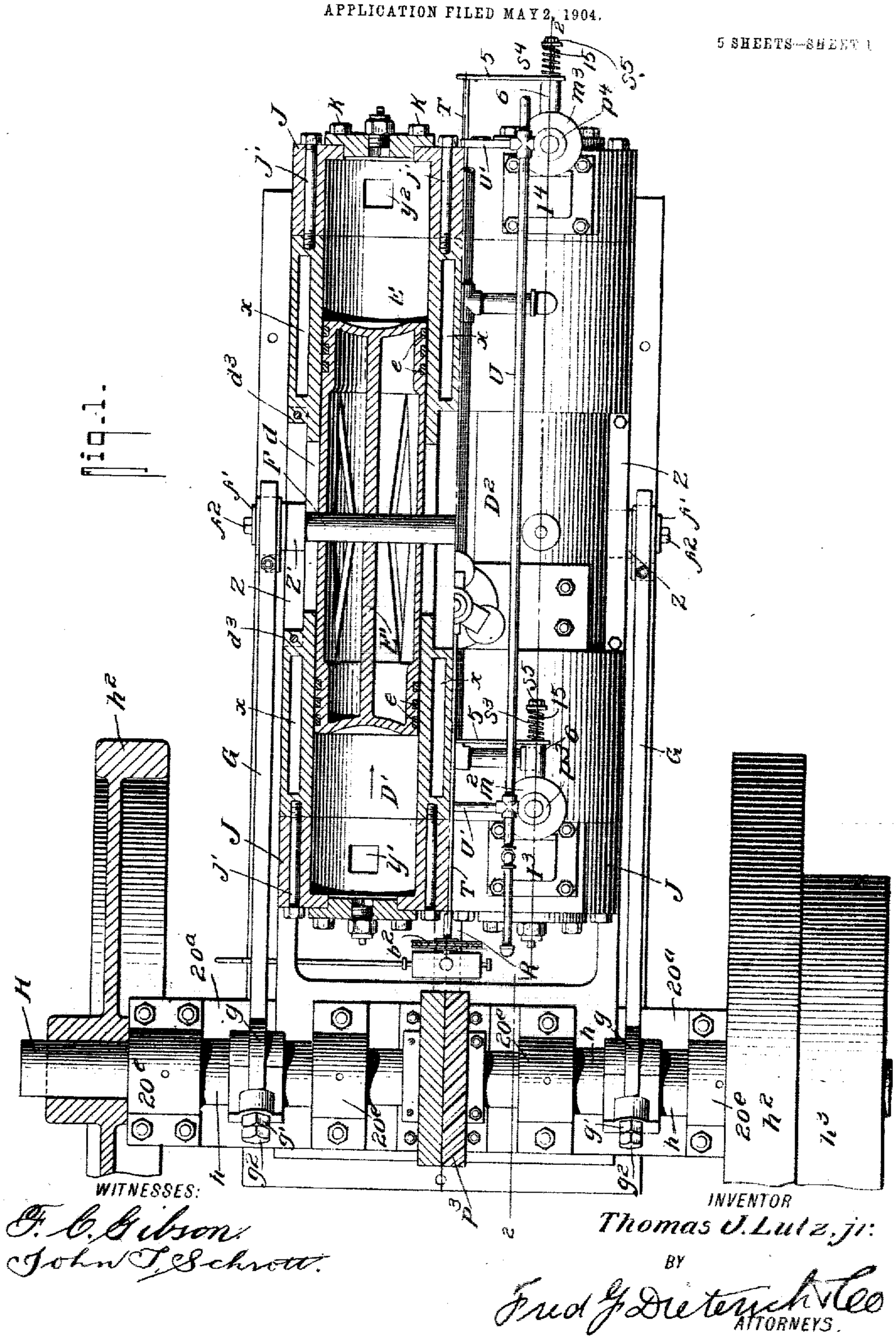
T. J. LUTZ, JR.

EXPLOSIVE ENGINE.

APPLICATION FILED MAY 2, 1904.

5 SHEETS—SHEET 1.

Fig. 1.



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John T. Schrott.

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ATTORNEYS.

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5 SHEETS--SHEET 2.

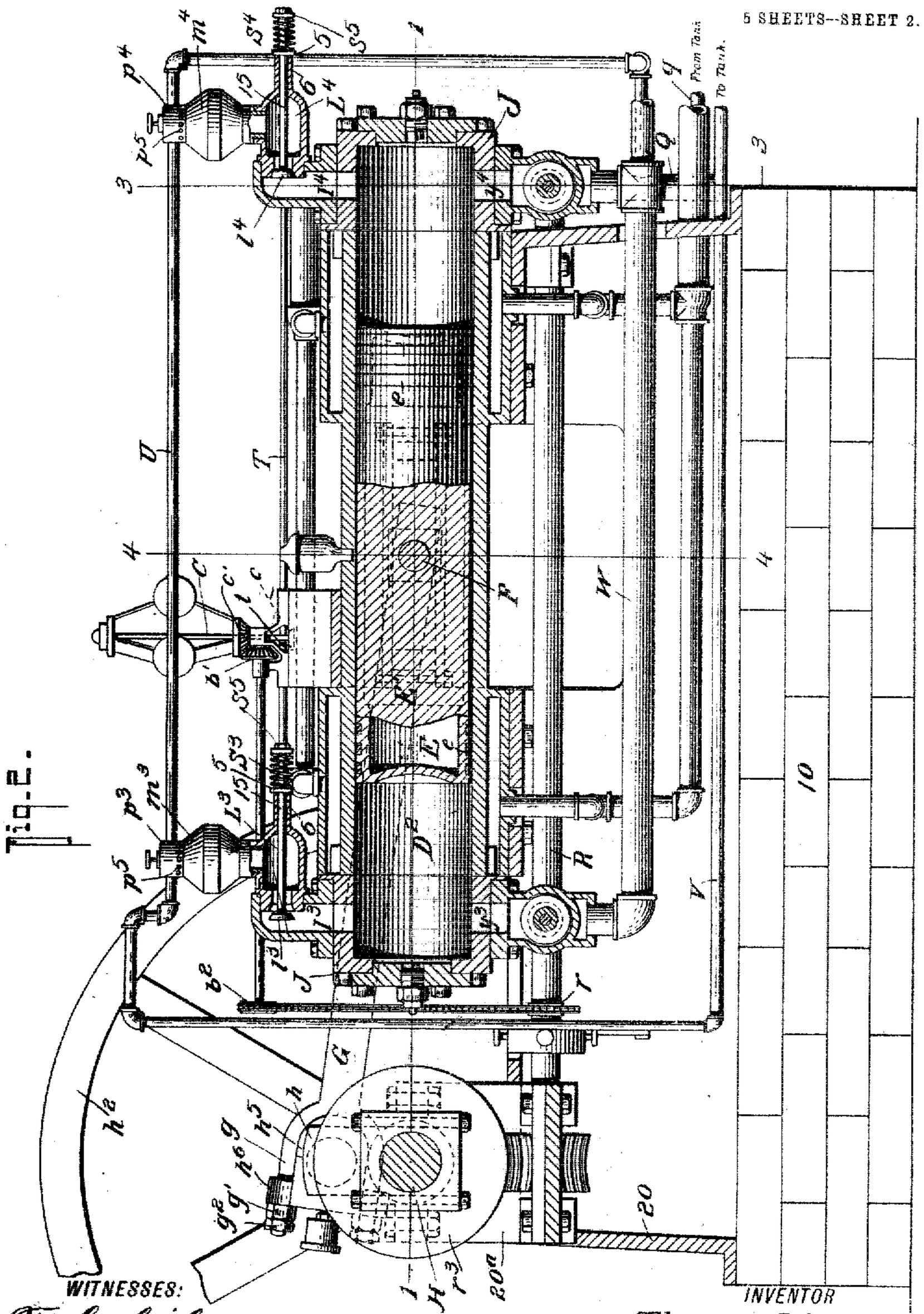

Fig. 2.

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5 SHEETS—SHEET 3.

Fig. 3.

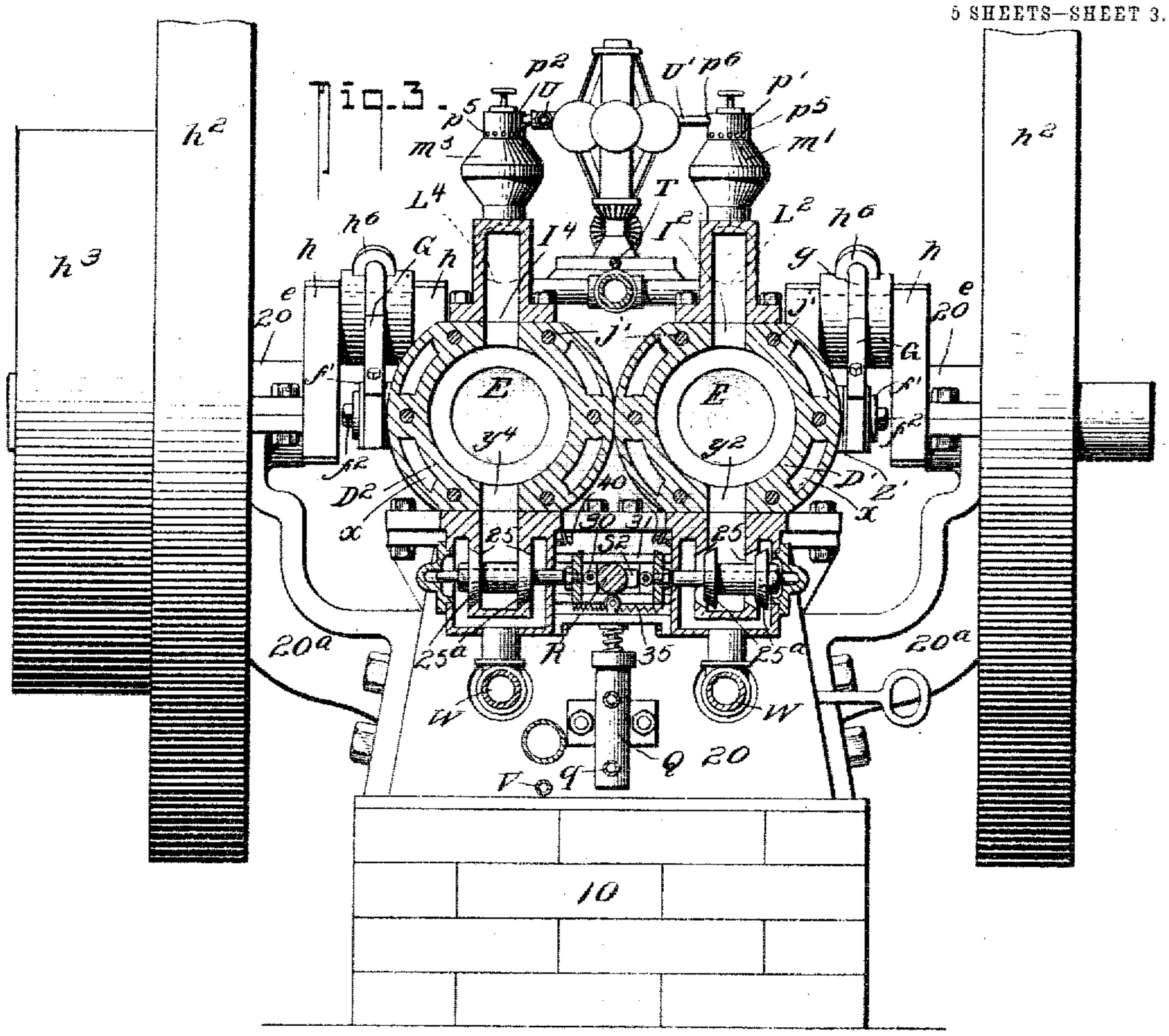


Fig. 5.

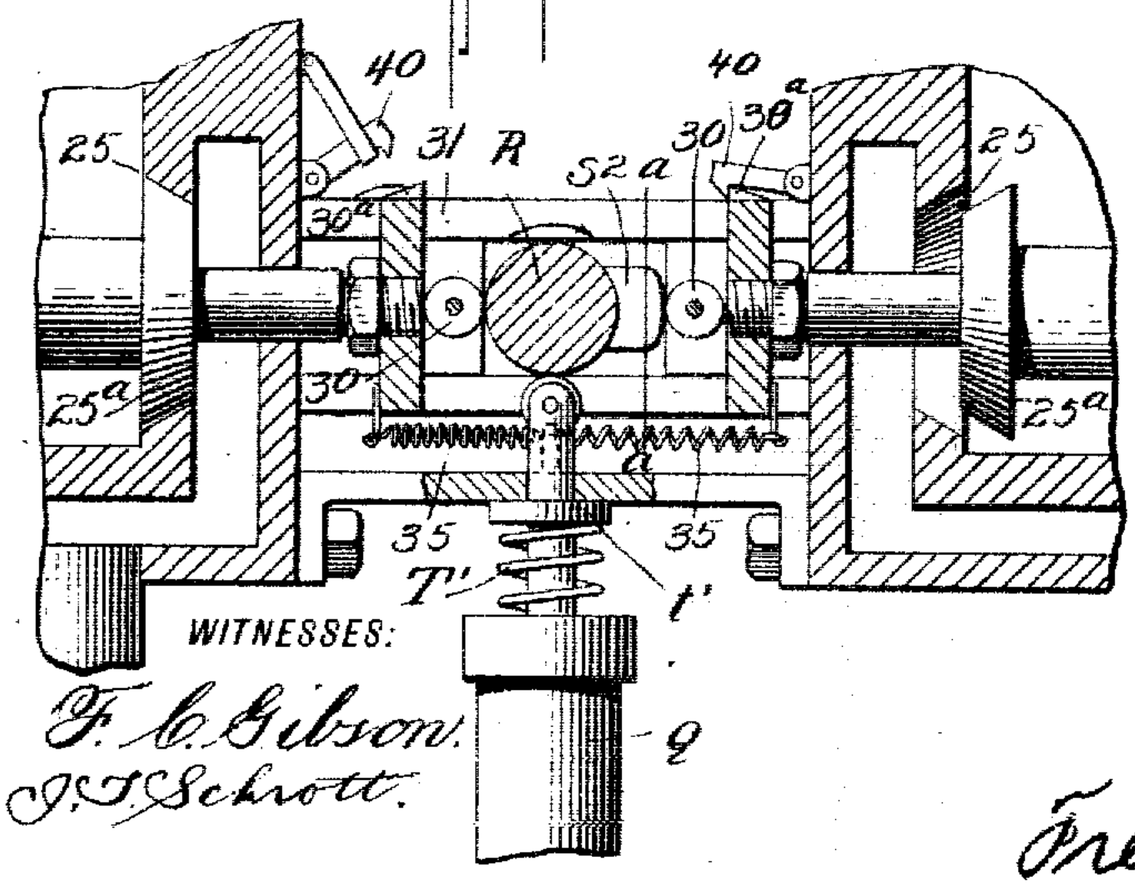
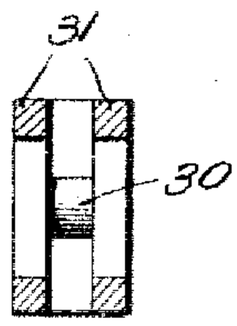


Fig. 5.a



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5 SHEETS—SHEET 4.

Fig. 4.

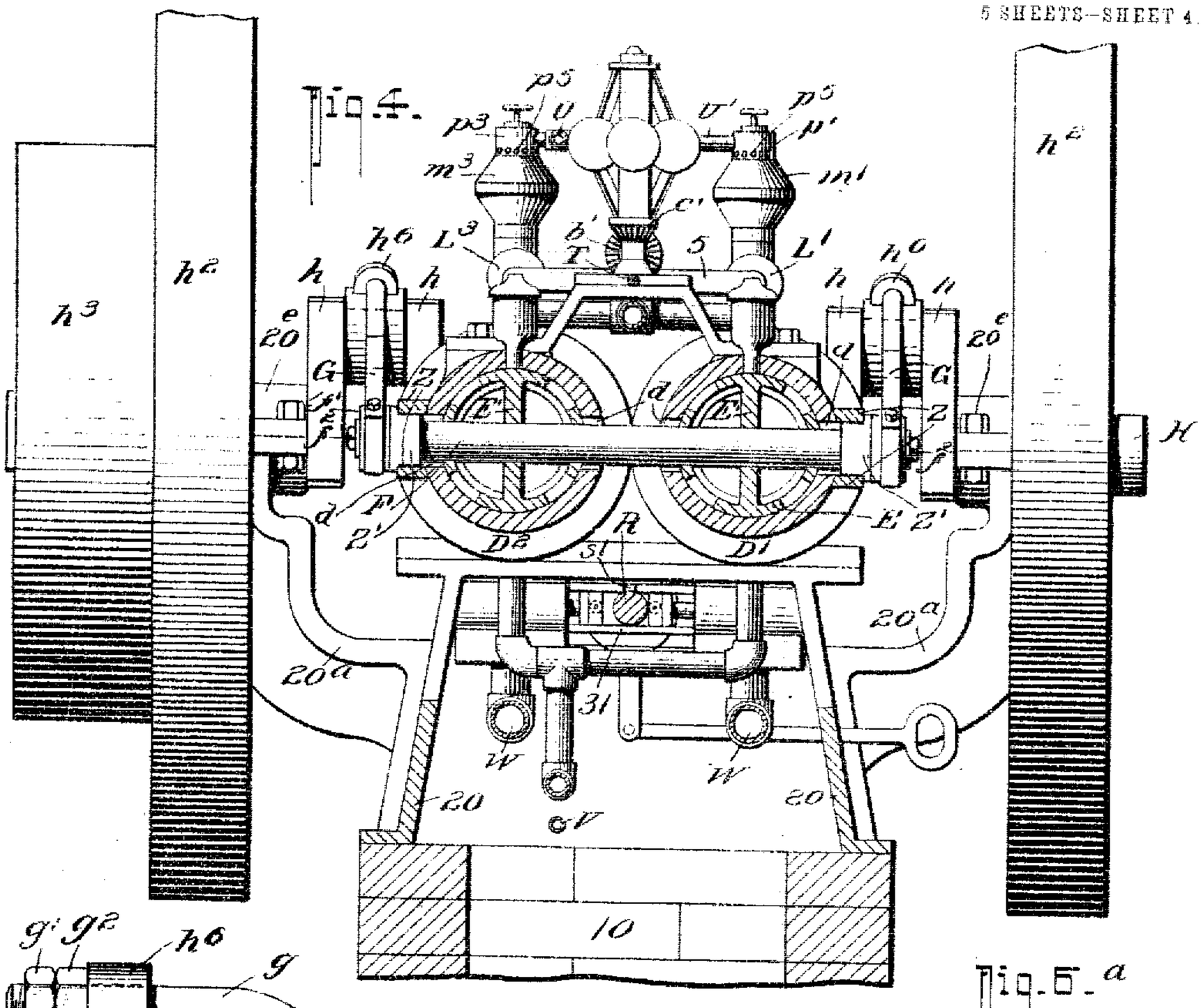
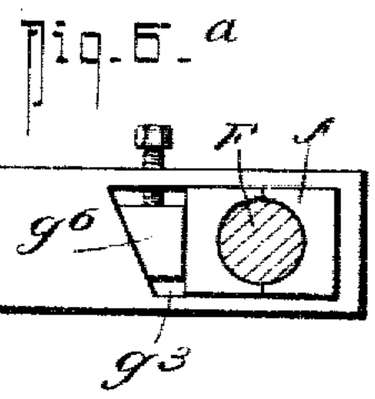


Fig. 5.



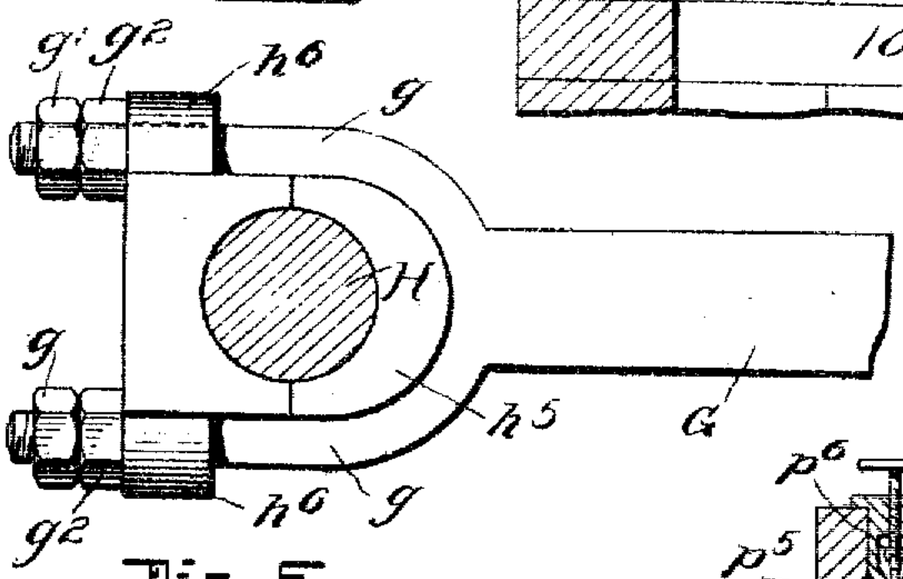


Fig. 6.

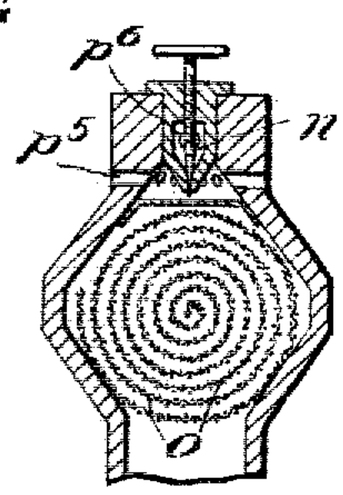


Fig. 7.

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5 SHEETS—SHEET 5.

Fig. 8.

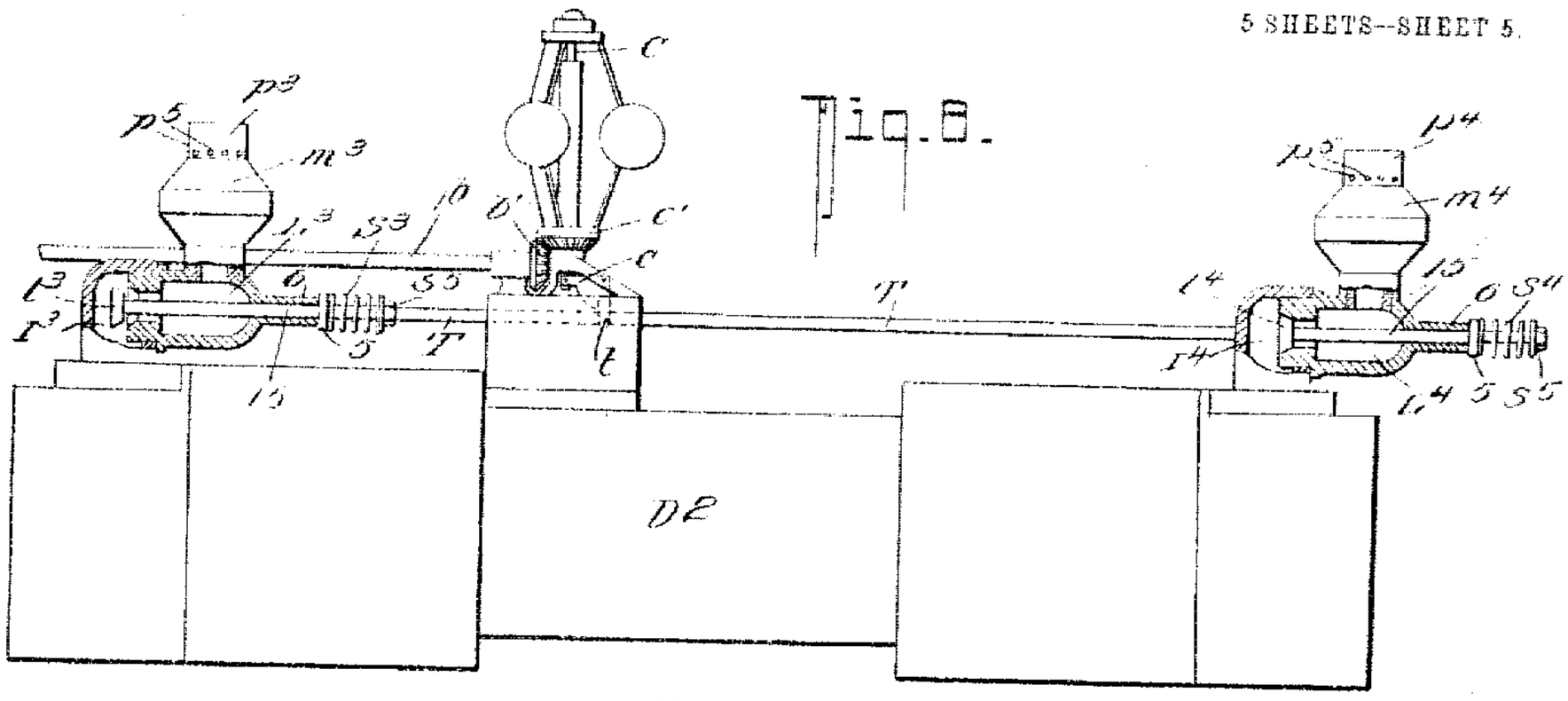


Fig. 9.

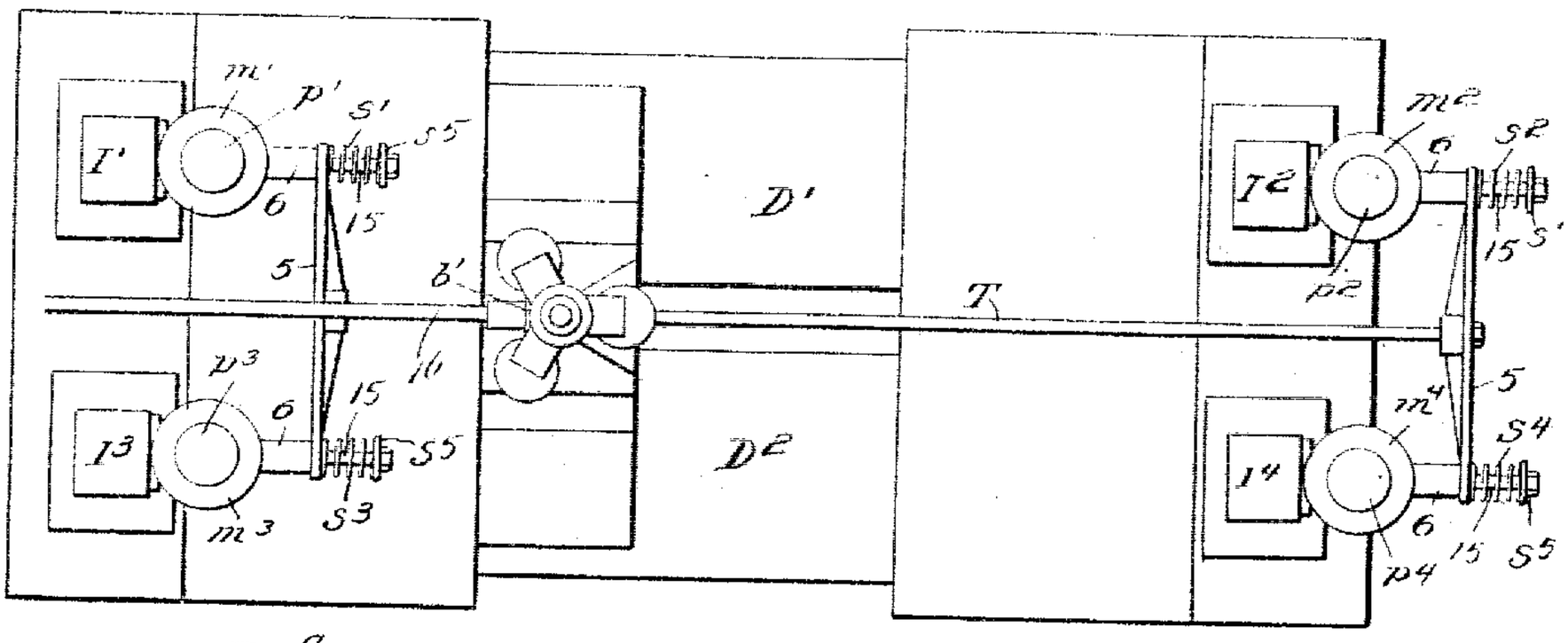


Fig. 11.

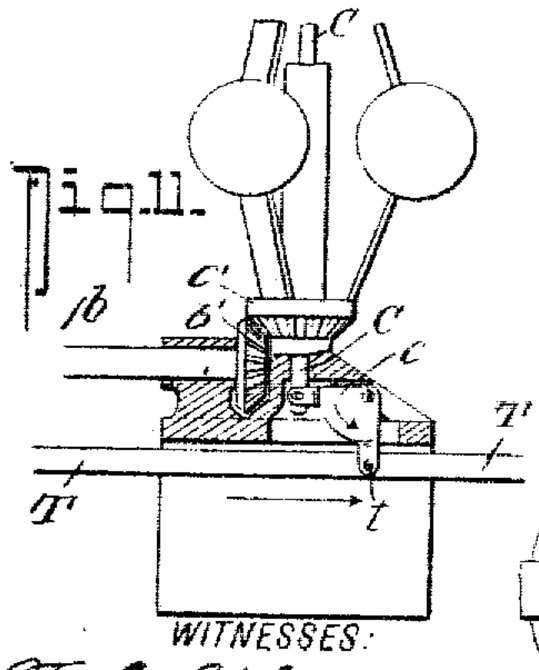
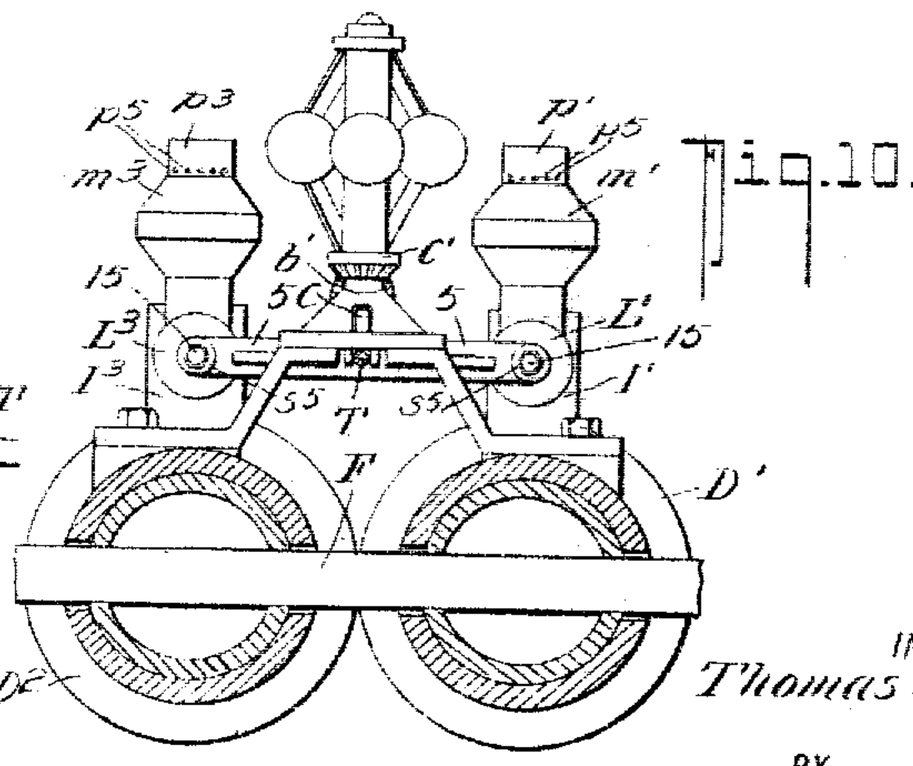


Fig. 10.



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UNITED STATES PATENT OFFICE.

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EXPLOSIVE-ENGINE.

No. 816,109. Specification of Letters Patent. Patented March 27, 1906.

Application filed May 2, 1904. Serial No. 205,874.

To all whom it may concern:

Bé it known that I, THOMAS J. LUTZ, Jr., residing at Mansfield, in the county of Richland and State of Ohio, have invented a new and Improved Explosive-Engine, of which the following is a specification.

This invention relates generally to that class of engines operable under the explosive action of a working agent composed of a mixture of gas, gasolene, and air injected into the engine-cylinder, and primarily my invention seeks to provide an engine of the character stated of a simple, economical, and stable construction, of a high efficiency, and capable of being readily adapted for the various uses for which explosive-engines are now commonly employed.

In its generic nature my invention comprehends an improved construction and cooperative arrangement of a pair of cylinders parallelly disposed and a single shifting rod common to the pistons in both of the cylinders, carbureting or mixing means, and a working-agent pump mechanism.

Another and essential feature of my invention lies in an improved arrangement and construction of exhausting-valve mechanisms, means for actuating the same intermittently and alternately, and detent devices that coöperate with the said valve mechanisms adapted to provide for such adjustments of the several exhaust-valve mechanisms, whereby to change the engine from a one-cycle to a two-cycle or to a four-cycle engine.

In its more subordinate features my invention embodies a special arrangement of carbureters or working-agent-mixing devices, shifting-valve devices for controlling the feed of the working agent to the cylinders, and a cooperating governor mechanism for controlling the action of the valves that regulate the working-agent feed; and the said invention further consists in certain details of construction and peculiar combination of parts, all of which will be hereinafter explained in detail, pointed out in the appended claims, and illustrated in the accompanying drawings, in which—

Figure 1 is a combined top plan and horizontal section of my improved engine, the section being taken practically on the line 1 1 of Fig. 2. Fig. 1ª is a detail section on the line *a a* on Fig. 1. Fig. 2 is a vertical longitudinal section of the same on the line 2 2 of Fig. 1. Fig. 3 is a transverse section of the same on the line 3 3 of Fig. 2. Fig. 4 is a similar view on the line 4-4 of Fig. 2. Fig. 5 is a detail view which illustrates the double-exhaust-valve devices, the gasolene-pump, and the shaft with the cam devices that controls the said exhaust devices. Fig. 5ª is a detail view of slide-block and frame. Fig. 6 is a detail view showing the manner of connecting one end of the rod G with the crank-shaft H. Fig. 6ª is a similar view illustrating the mode of connecting said rod G with the transversely-disposed piston-rod F. Fig. 7 is a detail section of the carbureter or mixing device. Fig. 8 is a diagrammatic side view, parts being in section, of my engine, illustrating the governor-controlled means for regulating the spring tension against the suction-valves hereinafter referred to. Fig. 9 is a plan view of the same. Fig. 10 is a cross-section thereof, and Fig. 11 is a detail section of the cam device for shifting the rod T and its connection with the governor.

In carrying out my invention the engine mechanism is mounted upon a stable foundation 10, upon which the engine body or frame 20 is supported and made fast in any approved and suitable manner. The engine frame or body 20 is in the nature of a hollow casting of a suitable length and width, upon which is mounted a pair of cylinders D' D², disposed in parallel longitudinal planes and in transverse alinement. At the front end the engine-frame has bolted or otherwise made fast thereon vertical standards 20ª, provided with bearing-boxes 20ᵉ to receive the crank-shaft H, the cranks *h h* of which are disposed at right angles to the crank-shaft—that is, parallel to each other on same line of crank-shaft—the reason for which will presently appear. At both ends the shaft H has the usual balance-wheels h^2 h^2, and at one end it has the usual belt-pulley h^3, as shown.

Within each end of the cylinders D' D² operate an elongated piston, the opposite heads of which are concaved and are provided with the usual packing-rings *e e*, and each of the pistons E is cored out to leave a solid rib E', that extends the full length of the pistons through the center and to provide a hollow space at the side of the said rib. Each cylin-

der at diametrically opposite sides and centrally thereof has openings *d d*, and the several openings or ways *d* of the two cylinders are in the same transverse alinement to permit of a reciprocable movement therein of the single piston-rod F, that passes through the said open spaces or ways *d* and through the pistons E, as clearly shown in Figs. 1 and 4, by reference to which it will be also seen that upon both ends of the rod F is fixedly held a cross-head or slide-block z', that rides upon the horizontal guides or slideways Z, which in my construction are bolted to lugs d^3 on the cylinders D′ D^2, and the aforesaid pistons E each are of such length that at no part of their stroke do the ends thereof pass back sufficiently to uncover the open ways 2. The rod F is coupled to the shaft H through the medium of a pair of connecting-rods G G, the front ends of which are forged out into a U shape to provide for conveniently slipping therein one-half of the shaft-bearings h^5, and the other half of said bearings are formed with apertured lugs h^6, through which the bifurcated ends *g g* of the rods G pass and which are made secure by the lock and jam nuts g' g^2, as clearly shown. At the rear or back end each rod has an opening g^3, which is cut square at three sides, the top, the bottom, and the back end, while that end of the opening toward the crank-shaft is cut at an angle of approximately sixty-five degrees. The bearings *f*, that receive the ends of the rod F, are slipped into openings g^3 and are held fast by wedge-blocks g^6, with which engage the angled sides of the openings *g*, and the said bearings *f* are held fast by the adjusting-screw, as shown in Fig. 6^a, and the back ends of the rods G are also held in place by the cap-plates f' and the cap-bolts f^2, substantially as shown.

Each cylinder D′ D^2 has a working-agent inlet and an exhaust for the exploded mixture in one end, and the said inlets and outlets for the cylinder D′ are designated I′ I^2 and Y′ and Y^2, while the similar inlets and outlets for the cylinder D^2 are designated I^3 I^4 and Y^3 Y^4, respectively, and each of the several inlets I′ I^2 I^3 I^4 communicate with the coöperating inlet-chambers L′ L^2 L^3 L^4, (best shown in Fig. 2,) from which it will be also seen that each inlet-chamber is fed from carbureters or mixing devices m' m^2 m^3 m^4, the peculiar construction of which will be presently explained, and each pair of inlet-chambers L′ L^2 L^3 L^4 have their working-agent opening to the cylinder-heads controlled by a valve, the several valves being designated l' l^2 l^3 l^4, the said valve being normally closed by the action of the springs S′, S^2, S^3, and S^4 and arranged to open under a vacuum created in the ends of the cylinders with which they connect. The several mixing devices or carbureters before mentioned are each constructed and operate alike, and each consists of the double truncated casing that discharges into the inlet-chambers L′ L^2 L^3 L^4, that communicate through the valved openings with the cylinder-heads, as shown, and the said casings m', m^2, m^3, and m^4 terminate in dome portions p', p^2, p^3, and p^4, that have air-inlets p^5 at a point below the gasolene-intakes p^6, (shown on Fig. 7,) which are fed from the laterals U′ of the gasolene-feed pipe U, that extends down to the pump Q, presently again referred to. (See Fig. 2.) The gasolene is admitted to the mixer-casings through needle-valves *n* and percolates through a filling O, of copper-wire gauze, of any suitable mixing device, and the said mixer devices are so arranged that the piston suction draws the air through the inlets p^5, and after mixing with the gasolene the resultant working agent is drawn into the cylinder back of the piston. The several intake and outlet chambers on each cylinder are mounted upon the end heads J of the said cylinders D′ D^2, which heads are bolted to the said cylinders by long bolt-studs j', as clearly shown in Fig. 1.

Each of the valves l', l^2, l^3, and l^4 has a longitudinal stem 15, and the outer ends of said stems 15 project and receive the springs s', s^2, s^3, and s^4, which are disposed between the nut-washers s^5 and the outer ends of the tubular extensions 6 of the several chambers L′, L^2, L^3, and L^4, and the two valves at each end of the cylinders are connected by a transverse bridge-piece 5, against which presses the inner ends of the valve-closing springs, as shown.

By referring now more particularly to Figs. 8, 9, 10, and 11 of the drawings it will be noticed the two bridge-pieces 5 5 are connected to the opposite ends of a shifting rod T, having a projected stud member *t*, that coacts with a member *c*, that connects with the member C of the governor mechanism, the connections between the member *c*, the governor devices, and the rod T being such that when the engine runs at a higher speed than it ought to the governor-balls in expanding will push the member C down, and thereby cause the part *c* to move in the direction indicated, and thereby move the bridge-pieces 5 5 against the springs *s s* on the stems 15 of the suction-valves, and thus give them more or less tension, whereby to not permit the inlet-valves to open to their full extent, but enough to take in a small charge of working mixture, enough to make a light impulse, and so on until the speed of the engine decreases to the desired degree, when the tension of the springs *s s* adjusts the resistance on the suction-valves in such manner as to maintain a substantially uniform feed to the explosion-compartments. On the members C of the governor devices is mounted a bevel-gear c',

that meshes with a bevel-gear b', which carries a chain-wheel b^2, coupled with a chain-wheel r on the pump-actuating shaft R. The shaft R extends lengthwise of the engine at a point below and centrally between the two cylinders D' D^2, and the said shaft R at the front end carries a worm-gear, which meshes with a worm-wheel r^3, mounted upon the shaft H, from which it received motion. Each cylinder-head has a valved outlet for the burned mixture, and the several outlets (designated Y' Y^2 Y^3 Y^4) are disposed under the inlets at the top of the cylinder-heads, and each outlet opens into an exhausting-chamber through two escape-ports 25 25 in the same transverse plane, as best shown in Fig. 3, and the several sets of escape-ports are controlled by a pair of valves 25^a, mounted upon a single stem, longitudinally reciprocable and adapted to be automatically moved to a closing position. The exhaust-chambers into which the several ports 25 discharge carry off the exhaust into the exhaust-pipes W W. (Shown in Figs. 2 and 3.) The manner in which the said valves 25^a are automatically shifted to their open position and returned to their closed position is best illustrated in Fig. 3, from which it will be seen that the shaft R has a cam s^2, adapted to engage with the oppositely-disposed slide-blocks 30, mounted in a guide-frame 31, through which the shaft R passes, and to the said blocks 30 are secured the ends of the stems that carry the valves 25^a for the exhausts Y^2 and Y^4, the several parts—that is, the shaft with its cam s^2, the sliding blocks 30, and the valve-stems, together with the guide-frame 30—being so cooperatively arranged that, assuming the shaft R to be turned in the direction indicated by the arrow on Fig. 5, when the cam s^2 is in the position shown, will have moved the head-block 30, with the stem carrying the valves 25^a for the exhausts Y^2, outwardly to its limit to open the said valves 25^a, as shown, thereby providing for the discharge of the exhaust from the cylinder D' to the pipe W, and at the same time the valves 25^a for the exhaust Y^2 will be in a position to allow of the springs 35 to close off the cylinder D' from the corresponding exhaust-offtake W, it being understood that in the continued rotation of the shaft R the cam s^2 engages with the opposite blocks 30, and thereby shifts the valves 25^a at that side so as to open the exhaust Y^4, which closed, by means of spring 35, valve 25^a on cylinder D' and D^2. The head-blocks 30 are drawn in a direction opposite to that to which they are moved by the cams s^2 by the spring connection 35, as shown, and each of the head-blocks has upwardly-projecting members 30^a to coöperate with gravity-latches 40. The purpose of the several latches 40 is to lock either one of the cross-heads 30 from moving automatically outward under spring tension and to thereby maintain any one or more of the exhausts permanently open and to hold either of the slide-blocks 30 in a position so as to be not engaged by their respective cams s^2 on the shaft R. By thus arranging the exhaust-valves and providing the means for shifting the same to their open and closed position and providing a means for holding the said valves locked to their open position and in a condition not to be actuated by the cams s^2 on the shaft R it follows that any one or more of the said exhausts can be held open, the purpose of which will be presently more fully explained. The front end of the shaft R is similarly equipped with a cam S' (shown in Fig. 4) for coacting with the valves that control the exhausts Y' Y^3, the operation of which is precisely similar to that explained and shown for the valves Y^2 Y^4. The cam s^2 on the rear end of the shaft R is also utilized for operating the gasolene-pump, which will be understood by again referring to Fig. 3, from which it will be seen that the pump Q is disposed directly under the shaft R and in vertical alinement with the movement of the cam s^2, and the said pump has its plunger or piston-head projected upward by means of a spring T', disposed about the projected end of the pump-piston and between the head of the pump and a stud-piece t', and the outer end of the plunger or piston-head has a roller-bearing t^2, (see Fig. 5,) that engages the shaft R and is arranged to be engaged by the cam s^2 on said shaft R, and the said roller, with the plunger, has a limited vertical movement through the guide-block 30, as shown, engaged by the cam s^2 as it passes out of engagement with the stem of the valves of one of the exhausts and over to engage with the stem of the valves for the other exhausts, thus discharging, as it were, an ejection of the gasolene at each complete rotation of the shaft R. The gasolene is ejected from the pump through the feed-pipe U to the several mixers or carbureters, and the overflow from the carbureters passes through an offtake-pipe V back to the gasolene-tank, as shown. q represents the feed-pipe to the pump from the gasolene-tank.

By providing the valve devices for the exhausts and the actuating means therefor, as described, the several exhaust-valves for one cylinder operate automatically with respect to the double exhaust-valves in the exhausting end of the other cylinder, and the double exhaust-valves for the two cylinders at each end thereof are also arranged to operate alternately to two revolutions of crank-shaft H and to one of shaft R, which is arrived at by the pitch of the gear which transmits the motion to the cam-shaft R.

So far as described it will be readily apparent that when all the exhaust-valves are open

an explosion occurs alternately at each end of the two cylinders in unison, and when one or more of the exhaust-valves 25 are hooked up the vacuum created by pistons in the cylinders at the end where the valve or valves 25 are hooked up will draw air through the double exhaust-valve and force it out through the said double exhaust-valve again. Should, for example, the two pistons operating in parallel be traveling in the direction indicated by the arrow in Fig. 1, the charge is ignited at L′, while a new charge is drawn in through the inlet-chamber L^3 at the same time the burned mixture is discharging through the exhaust Y^2. At the reverse movement of the pistons E′ E^2 the charge is ignited in chamber L^4, while a new charge is being drawn in through chamber L^2 and a charge is compressing at the end L^3 in cylinder D^2 and the burned charge at the end of the cylinder D′ in line with the end L^3 of cylinder D^2 is exhausting through outlet Y′.

In my invention I prefer to utilize electric sparking means for exploding. In the drawings, J designates the sparking means, that are fitted into the ends of the cylinders D′ D^2 by suitable cap-bolts *k*. 23 24 designate the spark-plugs, which are held in the heads J. When it is desired to convert my engine from a single-cycle engine—that is, an explosion at each complete reciprocating movement of the two pistons E—it is only necessary to lock the exhaust-valves Y^2 Y^4 to their open position by a proper adjustment of the latches, which are clearly shown in Figs. 3 and 9. When the valves are thus adjusted, the suction action of the pistons freely draws in air through the exhaust-ports Y^2 Y^4 as the said pistons travel forward to compress the charge last taken in at the front of the pistons, and the air thus drawn in is again forced out through the ports Y^2 Y^4 as the pistons return and finish a complete reciprocal or single cycle of motion, it being apparent that under the conditions just mentioned the pistons after the charge in front of them has been compressed and exploded will have to make another complete cycle of movement to first force out the burned mixture at the front end and then draw in a new charge and return again to compress the said new charge.

To convert my construction of engine into a four-cycle engine—that is, to effect the operations necessary to the result, to wit, drawing in a charge, retreating under the explosive action, and expelling the burned mixture, requiring each a movement of the pistons thereof so that two complete reciprocations in each direction are necessary to complete the cycle of movement required—it is only necessary to open either of the exhausts Y^3 Y′ in addition to keeping open the exhausts Y^2 Y^4 by adjusting the valves that coöperate with the exhaust-ports Y^3 Y^4 to keep either of the said ports also open. Assuming the exhaust-port Y^3 to be opened to coöperate with the opened exhausts Y^2 Y^4, the working charge would be then drawn in, compressed, and exploded at the front end of the cylinder D^2 only, as at no time, by reason of the free outlets from the ends Y^3 Y^4 in the cylinder D′ and the opened outlet Y^2 in the cylinder D^2, would there be a charge taken in at the said ends of the cylinders D′ D^2.

A very important advantage gained by my construction of engine is that by reason of the double-valve arrangement—that is, two sets of valves on one stem and two separate discharges in the exhausts from the cylinders the said construction and arrangement of parts reduces back pressure on the pistons to the minimum, and thereby effects a maximum amount of power. Another and important advantage gained by arranging the exhausts in the manner shown and described, and particularly the means provided for locking the valves to the positions shown, is that when my engine is utilized for automobiles power can be momentarily increased or diminished, as the conditions may make desirable, by simply adjusting the latch device for the exhaust-valves. Any adjustment in practice may be effected by any suitable shifting-lever devices operable from the motor-vehicle seat.

When my invention is utilized as an automobile-motor, I prefer to use a float feed for the working agent instead of the special form of carbureters or mixers hereinafter referred to, and illustrated in the drawings.

X designates the water-pipe that feeds water through the water-space *x*, which surrounds the cylinder and the heads, as shown.

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

1. An explosive-engine of the character described which comprises a pair of parallelly-arranged working cylinders, an automatically-actuating working-agent feed, and an exhaust opposite each working-agent feed that form a coöperative part of each of the working cylinders, a crank-shaft-actuated means for moving the working-cylinder pistons in unison, a pair of valves for each exhaust, a crank-shaft-actuated means for alternately shifting the pairs of valves in unison, one to an open and the other to a closed position, and means for feeding the working agent to the cylinders at predetermined times, as set forth.

2. In a machine of the character described, in combination with the cylinders; the pistons; the crank-shaft, the valved intake and valved exhausts arranged substantially as shown; of a working-agent feed for each end of each cylinder, a valve for each of said feeds, a spring that positively forces each of said

feed-controlling valves to closed position, a longitudinally-shiftable bar having a cross connection at each end that joins the valve-actuating springs at each end, a governor coupled with the crank-shaft which includes a shiftable member and a cam-lever connection that couples the governor-actuated shiftable member with the shifting rod that controls the valve-springs.

3. In an engine of the character described, the combination with a pair of parallelly-disposed cylinders, each having an automatically-actuated inlet-valve and an exhaust-valve in each end, a spring for each inlet-valve for forcing said valves to their closing position, a bridge member for each pair of inlet-valve stems that engage the springs, a shifting bar that connects both bridge members, the governor mechanism which includes the vertically-movable rod C and the connection *c* that joins the shifting rod T and the rod C, all being arranged substantially as shown and for the purposes described.

4. In an explosive-engine of the character described, the combination of a pair of working cylinders, each having an automatically-controlled working-agent inlet and an exhaust opposing the inlets, a valve for each exhaust normally closed by spring tension, means actuated by the crank-shaft for alternately engaging said exhaust-valves and moving them to their open position, said means including a slide-block for each valve and a detent for each slide-block adapted to be moved into engagement with the said blocks to hold them back out of position to be engaged by the crank-shaft when the valves are adjusted to an open position, as specified.

5. An explosive-engine of the character described, which comprises a pair of parallelly-disposed working cylinders, each having an automatically-actuating working-agent feed and an exhaust opposite each working-agent feed; means for coupling the pistons of the two cylinders with the engine crank-shaft to work them in unison; a valve for each exhaust; an actuating device for each transverse pair of exhaust-controlling valves adapted to alternately shift the pairs of valves in unison, one to an open, and the other to a closed position, and a working-agent feed-pump actuated by one of the devices that actuate one pair of exhaust-controlling valves.

6. In an explosive-engine of the character described, the combination with the pair of working cylinders, the pistons therefor, the crank-shaft, said cylinders having a working-agent feed-inlet at each end, an automatically-actuated valve in each end of each cylinder having an exhausting-port, and the working-agent feed; of a valve for each exhaust-port, a device actuated by the crank-shaft for shifting each transverse pair of exhaust-valves to open one as the other closes, said valve-shifting devices including a rotary shaft having cams adapted to engage the valve-stems and the plunger or piston-head of the pump, as set forth.

7. In an explosive-engine, having a pair of parallel working cylinders, each of which is provided with an automatically-controlled working-agent inlet in each end, a piston for each cylinder coupled together and actuated in unison by the crank-shaft; of an exhaust for each end of each cylinder, each exhaust having a controlling-valve, the valves that oppose each other at each end being in transverse alinement, a means for intermittently shifting each of the pairs of valves to their open positions and a spring-actuated device for each valve for moving it positively to its closed position and its stem in position to be engaged by the aforesaid shifting means.

8. In an explosive-engine of the character described, the combination with a pair of working cylinders each of which has an automatically-controlled working-agent inlet, and an automatically-closed outlet in each end, a working-agent feed connected with the inlets, valves for the exhaust, means for shifting the said valves operated from the engine crank-shaft to intermittently and alternately actuate the several exhaust-valves to move them to an open position, means for positively holding one or more of the said exhaust-outlet-controlling valves to their open position, as set forth.

9. In a gas-engine of the character described, the combination with the working cylinders, the automatically-controlled working-agent inlets, one in each end of each of the cylinders, the crank-shaft, the pistons, the exhaust-outlets in each end of the cylinders, means for coupling the pistons to move in unison from the crank-shaft, a carbureter or mixer connected with each working-agent inlet, a gasolene-pump that connects with all of the carbureters or mixers; of valves for controlling the exhausts, means for automatically shifting said valves to close off the exhausts and a means for first moving the said valves to their open position and then actuating the gasolene-pump, said means comprising a shaft driven from the crank-shaft and a cam upon the said shaft adapted to engage the pump-piston and the exhaust-controlling valves, substantially in the manner shown and described

10. In an explosive-engine of the character described, in combination with the two working cylinders each having a valved working-agent inlet at each end and an exhaust opposing each inlet, and means for actuating both pistons in unison from the crank-shaft; of a valve for each exhaust, the pairs of valves at each end being in transverse alinement and each having a cross-head on its projecting stem, a guide for each pair of cross-heads, a

spring connected to each cross-head for pulling the said head outward to close the valves; a detent for holding the cross-head to its rearmost position with the valve open, and the shaft R geared with the crank-shaft and having cams S^2 for engaging the cross-heads on the exhaust-controlling valve-stems, all being arranged substantially as shown and described.

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Witnesses:
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GEORGE KESSLER