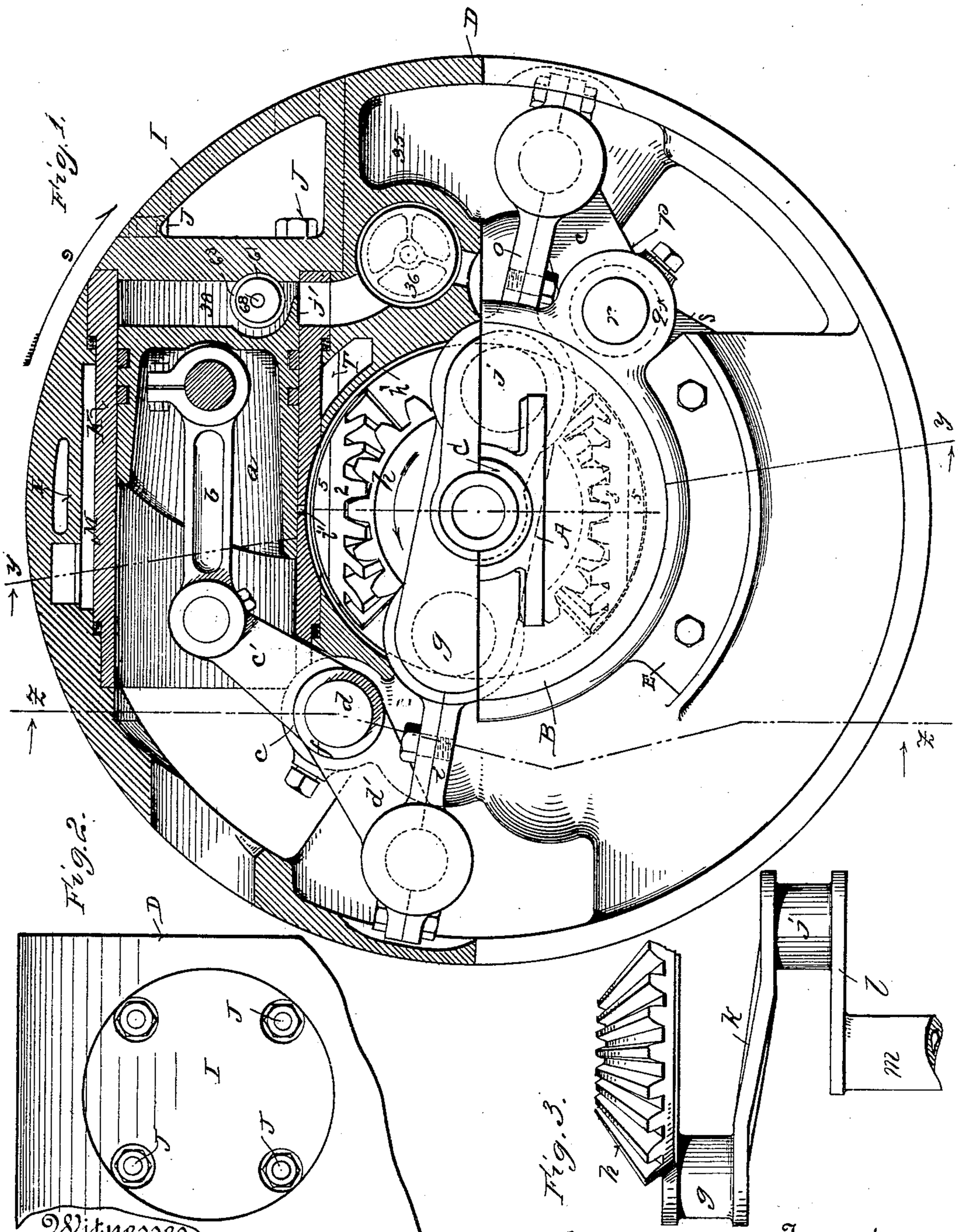
No. 618,157. Patented Jan. 24, 1899.

E. E. WOLF.

GAS ENGINE.

(Application filed June 25, 1897.)

(No Model.) 5 Sheets—Sheet 1.



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(No Model.) 5 Sheets—Sheet 2.

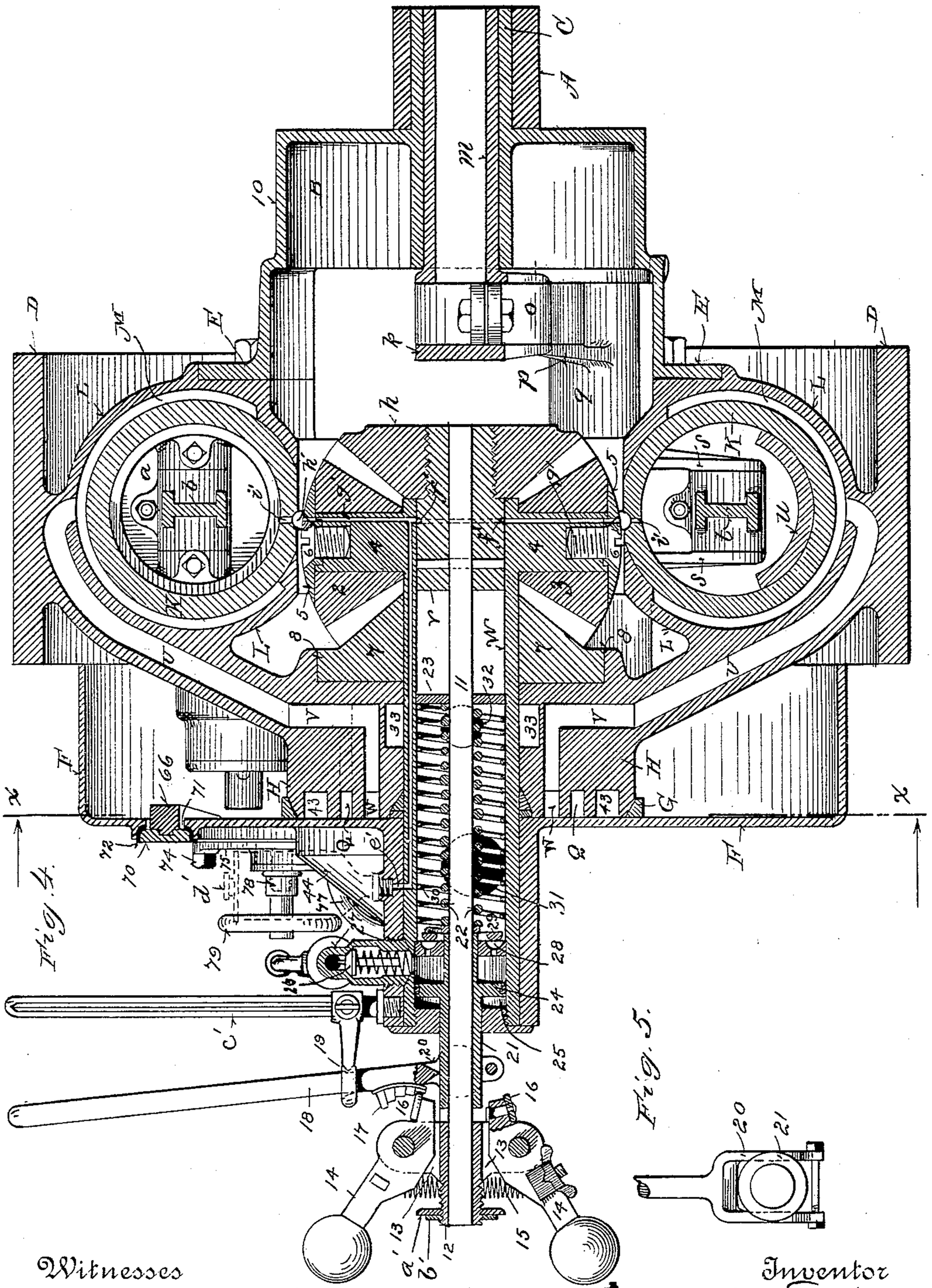

Fig. 4.

Fig. 5.

Witnesses
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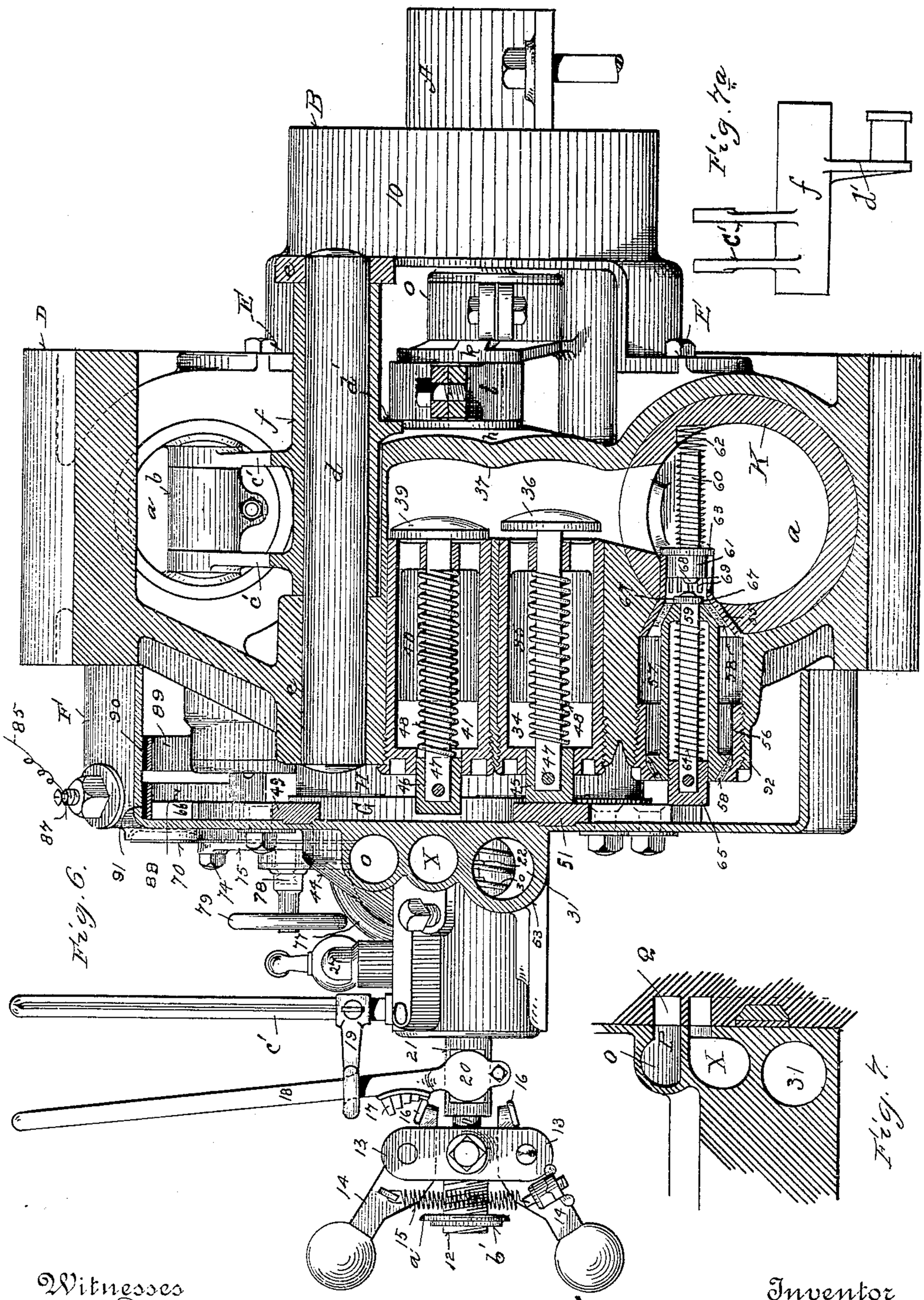

Fig. 6.

Fig. 4.

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(No Model.) 5 Sheets—Sheet 4.

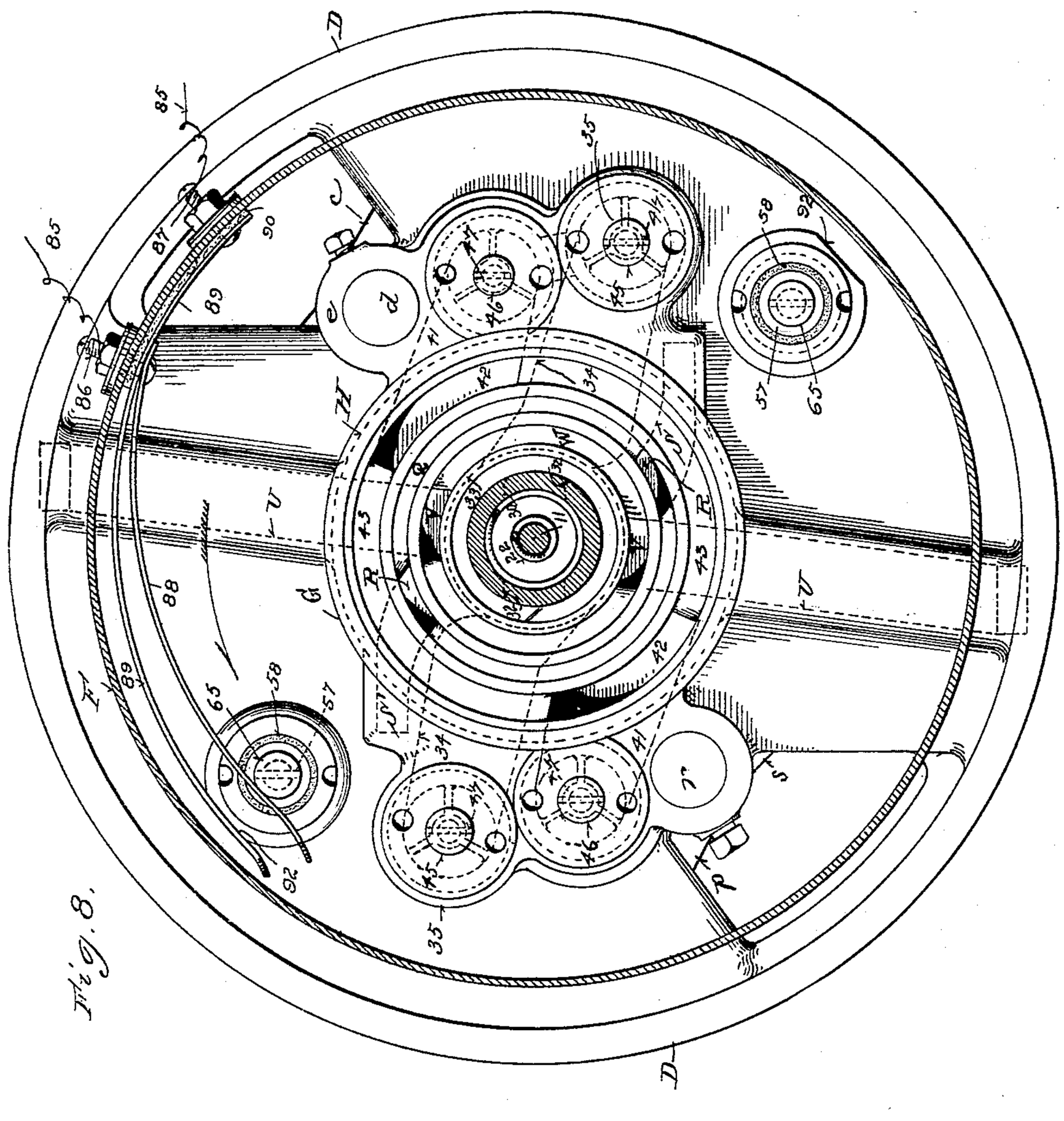

Fig. 8.

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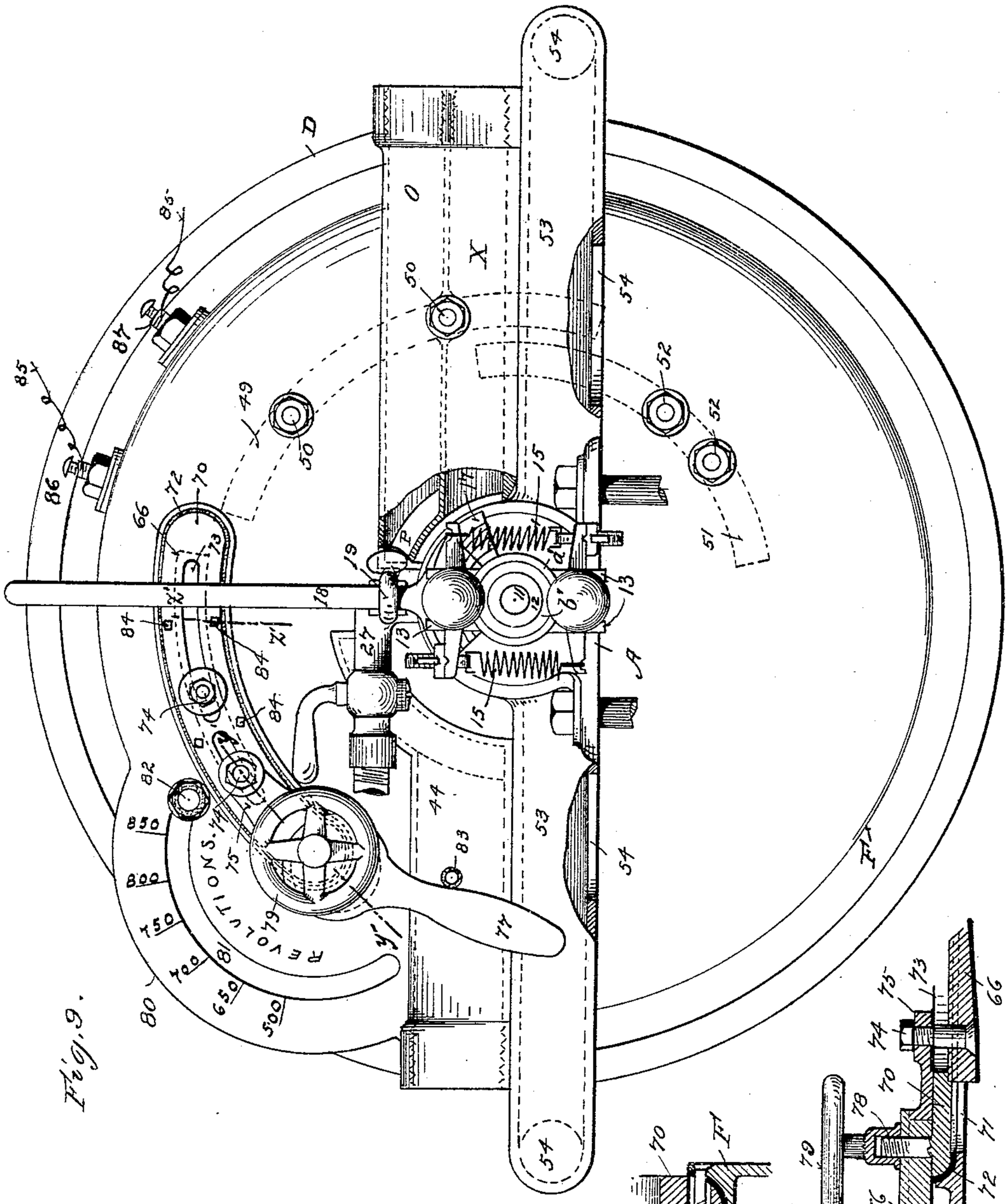
(Application filed June 25, 1897.)

(No Model.) 5 Sheets—Sheet 5.



Witnesses
W. M. McNair,
Jas. C. Dawley.

Inventor
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UNITED STATES PATENT OFFICE.

ELMER E. WOLF, OF SPRINGFIELD, OHIO.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 618,157, dated January 24, 1899.

Application filed June 25, 1897. Serial No. 642,336. (No model.)

To all whom it may concern:

Be it known that I, ELMER E. WOLF, 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 Gas-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain new and useful improvements in rotary gas or gasolene engines.

The essential object of my invention is to take up the power of the cylinder and the power of the piston, both of which assume momentum when the charge is exploded, and to carry the power derived from these two sources to a common driving device or pulley, so that the combined momentum or power of the cylinder and piston, both of which are propelled by the explosive force, is converted into rotary motion and transmitted to this common driving device or pulley for utilization in operating either portable or stationary machinery.

With this end in view the essential features of my invention consist of a wheel carrying one or more cylinders and a piston or pistons for the cylinder or cylinders, combined with a system of gearing and cranks, with suitable intermediate devices, by which the movement of the piston or pistons is transferred to such gearing, by which it is converted into rotary motion and transmitted back into the main wheel, which wheel is also given a rotary impulse by the explosion of the charge as the cylinder is forced in one direction and the piston in the other, and of a driving device or pulley connected with the main wheel and thereby taking up these two rotary forces.

My invention also embraces a number of other features or objects, together with the means for carrying them into practical effect, all of which will be hereinafter more fully described, and particularly pointed out in the claims.

In the accompanying drawings, on which like reference letters and numerals indicate corresponding parts, Figure 1 is a partial vertical sectional view and partial side elevation of my improved engine. Fig. 2 is a detail edge view of a part of the main wheel, showing a removable section which constitutes the piston-head; Fig. 3, an enlarged detail view of the piston-pinion and its cranks; Fig. 4, a transverse vertical sectional view of my improved engine entire, the section being taken on the line *y y* of Fig. 1, looking in the direction of the arrows; Fig. 5, a detail end view of a part of the gasolene-pump devices; Fig. 6, a partial edge view and transverse sectional view of the engine, the section being taken on the line *z z* of Fig. 1, looking in the direction of the arrows; Fig. 7, a detail sectional view of a part of the wheel-hub and of the stationary casing, showing the several ways and passages for water and air; Fig. 7ª, a detail view of the double rocking arms; Fig. 8, a partial side elevation and sectional view of the engine, the section being taken on the line *x x* of Fig. 4, looking in the direction of the arrows; Fig. 9, a side elevation of the engine entire with a few parts broken away to facilitate the illustration; Fig. 10, a detail sectional view on the line *z′ z′* of Fig. 9, showing the manner of insulating and connecting the casing and the plate that carries the igniting-cam; and Fig. 11, a detail sectional view on the line *y′ y′* of Fig. 9, showing the means for adjusting this plate and its cam and the arrangement of the several parts.

The letter A designates a stationary bearing in which is rotatably mounted a wheel B, having a sleeve C, which fits in the bearing and is connected with the main wheel D, as shown at E. Thus this wheel is rotatably supported at one side. The letter F designates a stationary casing having a packing-ring G, in which is rotatably mounted the hub H of the main wheel D. Thus the other side of this wheel is rotatably supported and thus also it will be seen that this wheel may rotate in bearings beyond each side of it. The bearing A and stationary casing F are themselves supported in any manner desired. In this wheel I form or secure one or more cylinders, preferably two. For this purpose I cut out of the rim of the wheel a section I, which I secure by bolts J. I then fit cylinders K in the wheel structure, as more clearly shown in Fig. 1, and as I form the wheel with walls L, which encircle the cylinders, as more clearly shown in Fig. 4, it will be seen that I leave a water space or jacket M, into which

water is fed through an inlet-passage composed of a tube O, formed on the stationary casing F and discharging through a slot P (see Fig. 9) into an annular groove Q, formed in the outer face of the hub H of the main wheel, (see Figs. 4 and 8,) from which the water passes through slots R into passages S, (see Fig. 8,) formed in the wheel structure and discharging into the water-jacket M, as seen at T in Fig. 1. The water flows out of the water-jackets through the passages U, (see Fig. 4,) which extend through the structure and through the hub, as shown at V, and finally open into an annular groove W in the hub, whence the water discharges into tubes X, formed on the stationary casing F. (See Figs. 6 and 9.)

In each of the cylinders is a reciprocating piston *a*, provided with a pitman *b*, the outer end of which is pivoted to a rocking arm or lever *c*, mounted upon a fulcrum-pin *d*, secured in bearings *e*, formed in the wheel structure and in the shell B. (See Figs. 1 and 6.) This arm has a sleeve *f*, so that the portion *c'* of the arm which connects with the pitman *b* and the portion *d'* of the arm extend from the sleeve *f* in such positions as that the portion *c'* will be in the plane of the pitman *b*, while the part *d'* will be in the proper plane to connect with the wrist-pin *g* of the piston-pinion *h* through a pitman *i*. (See Figs. 1, 3, 6, and 7ª.) Thus it will be seen that when the piston *a* moves outward it will impart its motion through these parts to the pinion *h*, which I term the "piston-pinion," because it takes its motion from it, and thus convert a right-line motion of the piston into a rotary motion in the pinion. These parts are clearly shown in Fig. 1 in their relation to one another, and it will be understood that when the piston is making an outward stroke it is also traveling in a circular path with the main wheel, and the result of this is that at the time when the piston begins to move outward the pitman *i* will stand at such an angle to the wrist-pin *g* of the pinion *h* as to thrust such wrist-pin downward or in the direction of the arrow seen in Fig. 1, so that the pinion *h* is made to rotate in that direction. Now I have so far described one cylinder and its piston and the connection between such piston and pinion wrist-pin of the piston-pinion. A like or similar connection between the other piston and this pinion is also included; but for the sake of greater clearness I will refer to these like connections by specific reference-letters. The pinion *h* has also a wrist-pin *j*, these wrist-pins *g* and *j* being connected by a cross-arm *k*, and the wrist-pin *j* having a crank-arm *l*, provided with a hollow spindle *m*, (see Fig. 3,) adapted to be mounted in the sleeve C, as shown in Fig. 4, so as to support this crank structure, for such it is at this end, the other end being supported by the pinion *h* itself. The wrist-pin *j* is connected by a pitman *o* to the double rocking arm *p*, having a sleeve *q*, mounted upon a fulcrum-pin *r*, itself having bearings in the shell B and in the wheel structure just the same as shown and described above with respect to the fulcrum-pin *d*. In Fig. 4 it will be seen that the parts *s* of this second arm *p* connect with the pitman *t* of the other piston, a portion of which piston is seen at *u*, the balance being cut off by reason of the direction of the section, as shown by the line *y y* of Fig. 1. The arrangement is exactly the same, as more fully shown, as to the other piston appearing in the sectional part of Fig. 1. (See also Figs. 4 and 6.) Thus it will be seen that when the pistons make their outward strokes their movement is transmitted to the piston-pinion *h* and that in the transmission it is converted from a right-line movement to a rotary movement and is applied to the pinion *h* upon opposite sides of the center of the crank structure of the pinion and in opposite directions, so that no binding of the parts is experienced, but rather a true and efficient mechanical transmission is performed. Of course it will be also understood that the pitman *o* by reason of the rotary movement of the main wheel will have assumed at the time the motion is being transmitted a similar relation to the wrist-pin *j* as that above described with respect to the pitman *i* and the wrist-pin *g*. Having thus traced the passage of the motion of the pistons into the piston-pinion, I will now show how this motion is carried thence into the main wheel, so as to join with the power that is exerting the rotary influence upon this wheel by reason of the "back action" or "reaction" as it may be termed of the explosions as they act against the cylinder-heads, which are a part of the wheel structure, being formed of the sections I. The piston-pinion *h* being mounted upon a stud-shaft *v*, which rotates in a stationary sleeve *w*, carried by the stationary casing F, it meshes with two pinions 2 and 3, rotatably mounted on studs 4, projecting from this stationary sleeve *w*. Caps 5 and screws 6 serve to keep the pinions 2 and 3 on these studs. These pinions in turn mesh with the gear or pinion 7, secured to the wheel structure, as shown at 8, and rotatably mounted on this stationary sleeve *w*. Hence it will be seen that the rotary motion of the pinion *h* passes first into the pinions 2 and 3 and thence out of them into the pinion or gear 7 and over it into the main wheel D. The direction of rotation of the main wheel is indicated by the arrow 9 in Fig. 1, and it is in this direction that the rotary motion of the pinion *h* is finally transmitted into the main wheel, and so this main wheel gets rotary motion both from the pistons as they move outward and from the cylinder-heads as they recede under the explosive force; but this rotary motion of the wheel D is taken up by the shell B, which is formed into a pulley 10 as one type of means for transmitting this rotary motion to the machinery to be operated—

say the driving-wheel of a motor-cycle—as I contemplate using this engine more particularly for that purpose, though it is applicable to any purpose where power is needed.

I will now refer to the means for introducing gasolene into the engine when gasolene is used; but it will be understood that my engine generally is adapted to be used with gas by applying to it the detailed mechanism necessary to feed the gas to the ports that lead to the cylinders.

A rod 11 is rotated by the pinion *h*, and on this rod is fitted a collar 12, having ears 13, in which are pivoted governor-arms 14, interconnected by springs 15 and each provided with an antifriction-roller 16, adapted to engage with either of the segmental steps 17 on a lever 18, fulcrumed in an arm 19 and bifurcated at its lower end, as seen at 20, to engage with notches in the sides of a hollow piston-rod 21, mounted on the rod 11 and engaged at its inner end by a spring 22, thrusting outwardly on it from a stop 23. When the lever 18 is pushed inward by the governor, as its antifriction-roll 16 passes along one or the other of the steps 17 this whole piston-rod 21 is given an instroke and as the governor leaves these steps this piston is given an outstroke by the spring 22. A piston 24 on the piston-rod 21 works in the part 25 of the stationary sleeve *w*, which forms a pump-barrel, and thus a pump is constituted, which draws the gasolene past a check-valve 26 in a supply-pipe 27 and then forces this gasolene through a valve-seat 28, having a valve 29, seated by a spring 30 in the sleeve *w*. The gasolene passes into this sleeve and mixes with the air entering at the orifice 31, thus constituting this part of the sleeve an air and gasolene barrel, and thence the two together pass out of the orifice 32 in the wheel-hub H and into the annular groove 33, and thence through the passages 34 (see dotted lines in Fig. 8) and into the inlet-valve casing 35, (see Figs. 6 and 8,) and thence past the valves 36 into the chest 37, formed in the wheel structure, as particularly seen in Fig. 6, and from this chest into the explosive-space 38 of the cylinder, as more clearly seen in Fig. 1. This construction is the same for both cylinders. The exhaust products pass also out of the chest 37, past the valve 39, (see Fig. 6,) into the valve-casing 40 and out of the passage 41 to the slot 42 into the annular passage 43, whence it escapes into the tube 44, formed on the casing F. (See Figs. 6, 8, 4, and 9 in the order of this description.)

Referring now to the inlet-valve 36 and the exhaust-valve 39, it will be seen that they have stems and each stem a cap 45 and 46, respectively, held to their respective stems by the pins 47 and that springs 48 seat these valves after they are opened by cams acting upon the caps 45 and 46. These cams are stationary curved plates suitably inclined and attached to the stationary casing F, so that as the valves rotate, with the wheels, past these cams their caps 45 and 46 travel upon these cams at the proper time. The cams are shown particularly in Figs. 6 and 9. The cam for the inlet-valve 36 is shown at 49 and held by bolts 50, and the cam for the exhaust-valve is shown at 51, being held by bolts 52.

The air-orifice 31 above referred to is upon opposite sides of the sleeve *w* and is fed by two tubes 53, formed on the casing F, and these tubes may be open either at their ends or at their sides, as shown at 54.

I will refer now to the electrodes by which the sparking is effected and then to the means for operating the electrodes. From Fig. 1 the position of the electrode is most clearly shown in its relation to the cylinder and in Fig. 6 the construction is best illustrated. Both electrodes are alike, so that a description of one will suffice. A thimble 55 and a thimble 56 are fitted to the wheel structure, and a tubular bearing 57 for the electrode is fitted in these thimbles and insulated from them by insulating material 58. The electrode proper is made of two rods 59 and 60, the rod 59 being slidingly fitted to the tubular bearing 57 and rod 60 having a head 61 slidingly fitted to the thimble 55. A spring 62 keeps the shoulder 63 of one rod seated against the thimble 55 and a spring 64 keeps the other rod projected outward, so that its cap 65 will keep in contact with the cam 66, by which it is operated inward to bring its contact-point 67 against the contact-point 68 of the other rod. This action presses both of the springs. When the cap 65 passes off the cam, both rods return to normal position, and when the shoulder 63 strikes the thimble 55 the rod 60 is arrested, while the rod 59 moves on, and thus the contact-points 67 and 68 are suddenly separated and a spark produced. The thimble 55 is slotted, as shown at 69, to allow the spark and charge to communicate. Referring to the means for operating the electrodes, the same consists of said cam 66, slidingly fitted to a plate 70, (see Figs. 9 and 11,) which is fitted over a slot 71 in the wall of the stationary casing F and insulated from the casing by insulation 72. The plate 70 has a slot 73, in which are fitted bolts 74, projecting from or through the cam 66. To one of the bolts is attached a cam-strap 75, mounted on a cam 76, having a handle 77 and pivoted on a stud 78, projecting from the plate 70 and locked in adjusted positions by a hand-wheel 79, screwed upon a stud 78. A wing 80 projects from the casing F and has a scale and a slot 81, in which is an adjustable stop 82 in the nature of a bolt and nut. The stop 83 limits one movement of the handle 77, while this adjustable stop 82 may be set opposite any of the figures on the scale, which figures represent the number of revolutions the main wheel will make per minute, each piston making two complete revolutions, as ordinarily understood, to each revolution of the main wheel—that is, each piston makes two outstrokes and two instrokes to one revolution

of the main wheel. Now by adjusting the handle 77 to any one of the lines on the scale the cam 66 will be adjusted so as to operate the electrode at the proper time for the best effect for the number of revolutions of the main wheel indicated by the figure adjacent to such line—that is to say, if the engine-governor is so set that the main wheel will make five hundred revolutions per minute the handle 77 will be adjusted to the "500" line. This is done so that the cam 66 will be in position to operate the electrode at the proper time for that speed. It takes about so much time to complete combustion from the time the charge is ignited, and this time is constant irrespective of the speed of the engine. Therefore the faster the engine is going the sooner the electrodes must be operated with respect to the moment when the pistons pass the inner dead-center and begin the power-stroke. If the piston is traveling rapidly, it will reach the extreme inner position sooner than if traveling more slowly, and so in order to spark and complete combustion at the proper time the electrodes must be operated sooner or later, according to the speed of the piston, sooner if the speed is great and later as the speed is less. This I accomplish by adjusting the cam 66 to the given positions indicated by the figures on the scale. Thus the cam is adjusted to such position as that the electrodes will leave it in time for the spark to be produced when the pistons complete or substantially complete the instroke. A series of bolts 84 connect the plates 70 with the casing F.

I will now refer to the conductors for conducting the current to the electrodes. Wires 85 from the generator connect with posts 86 and 87, insulated from but connected to the casing F. To the post 86 is secured a spring-conductor 88, adapted to be touched by the caps 65 of the electrodes as they revolve with the main wheel, the current passing through the rod 59 to the contact-point 67. To the post 87 is secured a spring-conductor 89, there being insulating material 90 and 91 between these spring-conductors and the casing F. This conductor 89 is adapted to be swept against by the surface 92 of the electrodes. The current passes thence through the wheel structure, cylinder, and thimble 55 to the contact-point 68. (See Figs. 6 and 8.)

Referring again to the governor, (see Figs. 4 and 6,) a nut a', held by a jam-nut b', is adjusted to prevent the governor-arms from drawing in more than might be desired, so as to prevent the antifriction-rollers 16 from coming in contact with such of the steps 17 as would give too great a charge of gasolene for the particular conditions under which the engine might be started. The post c' permits the arm 19 to be adjusted to different positions, so as to change the stroke of the piston 24 for each step 17, thus making it a double adjustment—one by the steps and one by the position of the arm 19. It will be seen, too, that the wider the step upon which the rolls 16 press during a part of their revolution the longer the instroke of the piston 24 will be, and hence the greater the amount of gasolene that will be ejected.

As a means of oiling the cylinders I provide a cup d', (shown in dotted lines in Fig. 4,) communicating with an oil-orifice e' in the stationary sleeve w, which orifice terminates in an annular groove f' in the stud-shaft V and thereby delivers oil to the radial orifices g' in the studs 4, which orifices extend through the caps 5 into the annular groove h' in the wheel structure, whence the oil by centrifugal action works through the orifices i' in the cylinder-walls, a lip j' on the piston preventing the orifices i' from becoming uncovered.

Thus it will be seen that aside from the special mechanism shown and described I have incorporated into an engine the principle or mode of operation of carrying to a common pulley or power-transmitting device the combined momentum and force of the piston or pistons and cylinder or cylinders as they receive impulses from the repeated explosions of the charge, such impulses acting in a manner that may be termed "direct" on the pistons and by reaction on the cylinder-heads. This mode of operation, coupled with the other factor that the piston or pistons and cylinder or cylinders are, besides their relative movements, undergoing rotation about a common center and are carried by a body which for convenience I have termed the "main wheel," I regard and believe to be wholly new, and hence wish to be understood as laying broad claim thereto.

While I have referred to the power-transmitting pulley or device and described the same as consisting of the pulley 10, I wish to be understood as including within the term "power-transmitting pulley or device" any part of the main wheel from which the power may be taken to operate outside machinery, and this is the sense in which said term is used in the claims hereto appended.

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

1. In a gas-engine of the character described, the combination with a main wheel, one or more cylinders carried thereby and a power-transmitting pulley or device, of a piston for each cylinder, and intermediate devices consisting of a connection of pitmen, rocking arm and central crank, the latter having its central line in line with the center of said main wheel, and intermediate devices between said crank and the power-transmitting pulley adapted to transmit motion from the former to the latter, substantially as shown and described.

2. In an engine of the character described, the combination with the main wheel, a transmitting pulley or device and one or more cylinders carried by said wheel, of a piston for

each cylinder, a piston-pinion, and rotatable pinions between it and said wheel, and connections between said piston-pinion and the piston or pistons.

3. In an engine of the kind described, the combination with the main wheel, a power-transmitting pulley or device and cylinders carried by said wheel, of pistons in said cylinders, a central gearing consisting of a piston-pinion, a main-wheel pinion, and intermediate pinions, and crank-pitmen, and arm connections between the pistons and piston-pinion adapted to apply the power of the pistons rotatably upon opposite sides of the piston-pinion center.

4. In an engine of the character described, the combination with the main wheel, a transmitting pulley or device secured to it and cylinders carried by it, of reciprocating pistons in said cylinders, a rocking arm and pitmen for each piston, a central piston-pinion having a double crank connected with two of said pitmen, a main-wheel pinion and intermediate pinions connecting it with the piston-pinion for the purpose described.

5. In an engine of the character described, the combination with the main wheel, a power-transmitting pulley or device, cylinders carried by the wheel, a piston for each cylinder, intermediate devices between each piston and the power-transmitting pulley or device, and electrodes, an inlet-valve and an exhaust-valve carried by said wheel, and inlet, exhaust and water inlet and outlet passages in said wheel structure, and a stationary casing having tubes for said passages, cams for said electrodes and valves carried by said wheel, a gasolene-pump communicating with said inlet-passage and a governor connected with said pump, substantially as described.

6. In an engine of the character described, a main wheel one or more cylinders with their pistons carried thereby, charge inlet and exhaust passages, water inlet and outlet passages formed in the wheel structure, a hub and a stationary casing having tubes or conduits for said passages, and a gasolene-pump communicating through the center of said casing and through the hub with the charge-inlet passage.

7. In a gas-engine of the character described, the combination with a stationary casing carrying a sleeve forming in part a pump-barrel and in part an air and gasolene barrel, of a revoluble shaft passing through said sleeve, a governor carried by said shaft, a pump-piston on said shaft, means between the governor and piston to operate the piston in one direction by the action of the governor, and a spring to operate the piston in the other direction, a suitable valve between said barrels, and a gasolene-supply to the pump-barrel.

8. In a pump of the character described, the combination with a stationary casing having a sleeve forming in part a pump-barrel and in part an air and gasolene barrel, a charge-passage leading from the latter barrel to the engine-cylinder, a main wheel carrying said cylinder and having said passages formed in it, of a revoluble shaft passing through said sleeve, a governor operated by said shaft, a piston on said shaft, and a device between the piston and governor for operating the piston, a gasolene-supply leading to the pump-barrel and a suitable valve between said barrels, and a spring to operate the piston in the opposite direction to that by the governor.

9. In an engine of the character described, the combination with a central stationary sleeve, a main wheel revoluble about said sleeve, a shaft revoluble in said sleeve, a charge-passage from said sleeve to cylinder or cylinders in said wheel, an air-orifice and gasolene-supply leading into said sleeve, a valve between them, a piston on said shaft, and a governor on the shaft with means between the governor and piston to actuate the latter.

10. In an engine of the character described, a revoluble shaft, a governor operated thereby, a piston on said shaft, a lever connected to said piston and having steps of various sizes engaged by said governor during a part of its rotation.

11. In an engine of the character described, a revoluble shaft, a governor thereon, means to regulate the approach of the governor-arms, a lever having a movable fulcrum and various-sized steps engageable by the governor according to its speed, and a piston on said shaft connected with said lever.

12. In an engine of the character described, the combination with a stationary casing having a sleeve and an oil-orifice, of a main wheel revoluble about said sleeve and having an annular groove and one or more cylinders communicating with said groove through oil-orifices, the orifices of the sleeve discharging into said groove, whereby the cylinders may be lubricated.

13. In an engine of the character described, the combination with a main wheel having one or more cylinders, and an electrode for each cylinder, of a stationary but adjustable actuating means for said electrode or electrodes, said means being adapted to be adjusted to cause the electrode or electrodes to spark at variable times with respect to the dead-center position of the piston or pistons.

14. In an engine of the character described, the combination with a main wheel carrying one or more cylinders, and an electrode for each cylinder, of a stationary structure, a cam adjustably connected therewith but located in the revolving path of said electrode or electrodes and adapted to be adjusted to disengage from said electrode or electrodes at different times in the circuit of rotation.

15. In an engine of the character described, the combination with a stationary casing, and an insulated plate secured thereto, of a cam

slidably connected with said plate and means mounted on the plate and connected with the cam to adjust the same.

16. In an engine of the character described, the combination with a stationary casing, a plate insulated therefrom, and a scale, of a cam slidingly connected with the plate, an eccentric arm mounted on the plate and connected by a strap with the cam and adapted to be swung to different positions on the scale, for the purpose described.

17. In an engine of the character described, a main wheel carrying one or more cylinders and a piston for each cylinder, and a system of centrally-located gearing consisting of a pinion connected with the piston or pistons, a pinion connected with said wheel and pinions interconnecting said other pinions.

18. In an engine of the character described, the combination with a main wheel having a power-transmitting pulley or device at one side and a hub at the other, of a stationary bearing for said pulley or device and a stationary casing having a flange in contact with said hub, whereby the wheel is revolubly mounted.

19. In a gas-engine of the character described, the combination with stationary spring-conductors, of a revolving wheel structure, and electrodes carried thereby and adapted to revolve past said spring-conductors whereby one of said spring-conductors will make a wiping contact with one of the electrodes and whereby the other of said spring-conductors will make a wiping contact with the wheel structure adjacent to the electrodes.

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

ELMER E. WOLF.

Witnesses:
W. M. McNAIR,
JAS. C. DAWLEY.