(No Model.)

5 Sheets—Sheet 1.

H. H. HENNEGIN.

GAS ENGINE.

No. 545,502. Patented Sept. 3, 1895.

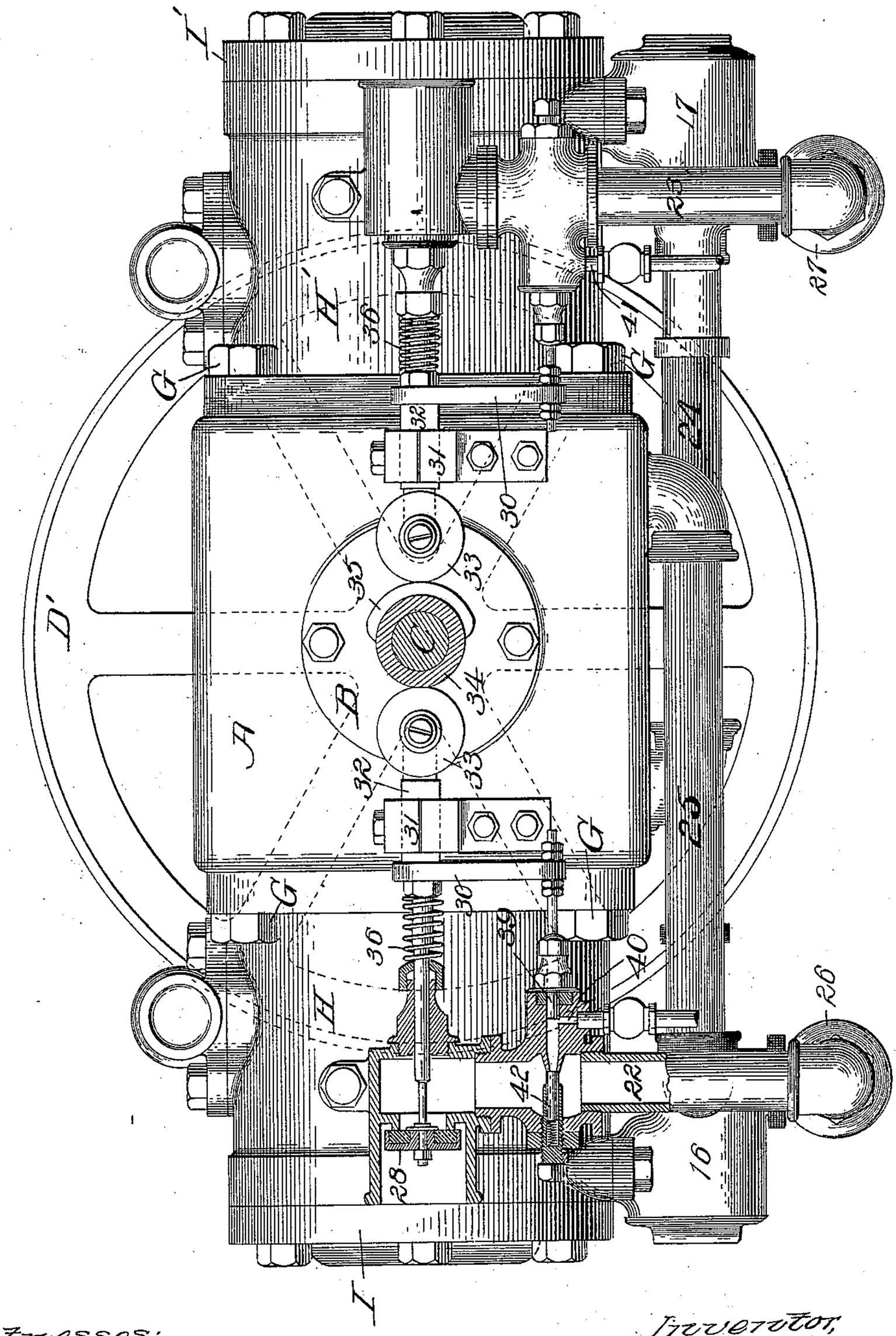

Fig. 1.

Witnesses:
F. P. Cornwall
Hugh K. Fragner.

Inventor,
Herbert H. Hennegin
by Paul Bakewell
his atty

(No Model.)

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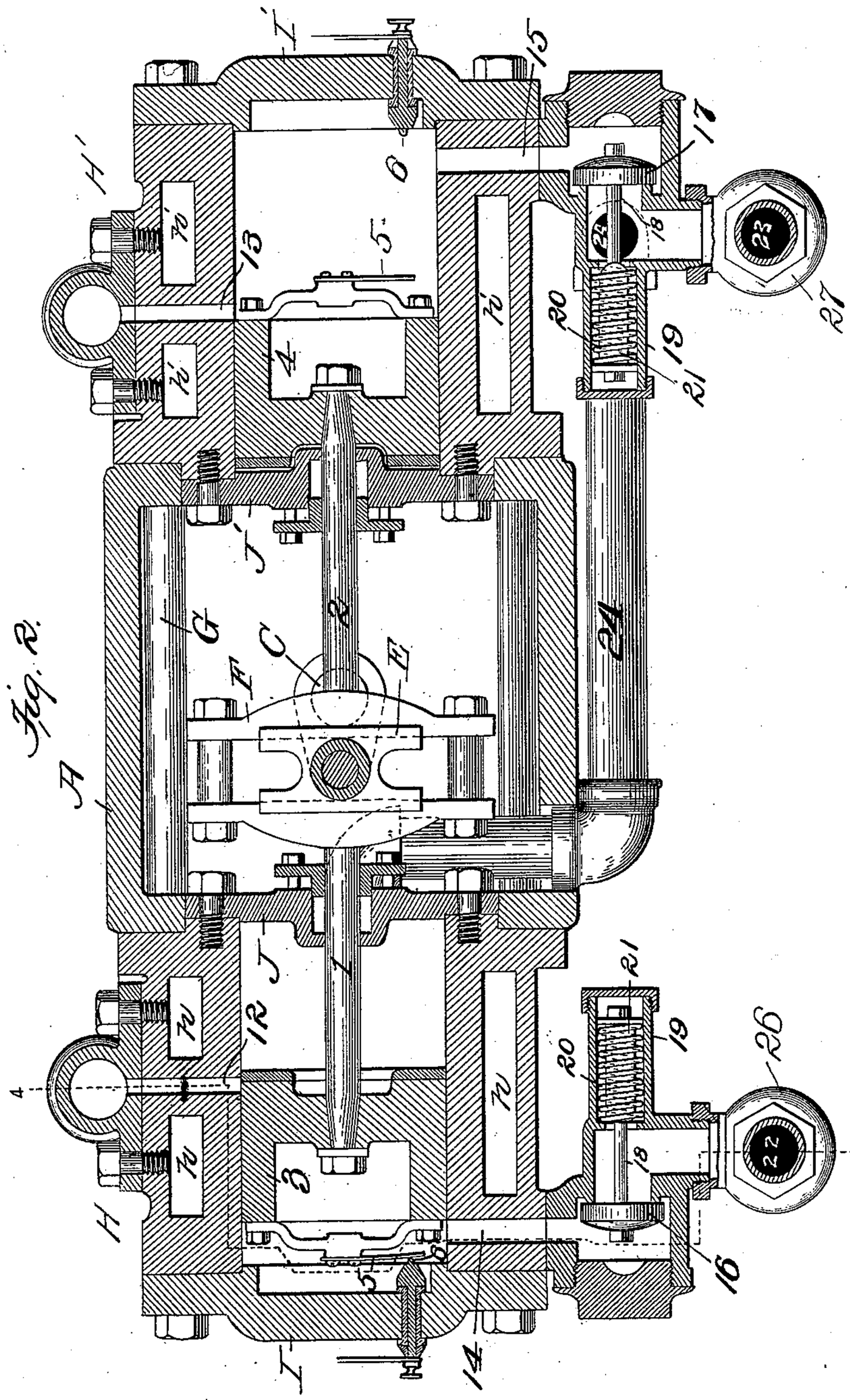
H. H. HENNEGIN.

GAS ENGINE.

No. 545,502. Patented Sept. 3, 1895.



Witnesses:
F. R. Cornwall.
Hugh N. Wagner

Inventor,
Herbert H. Hennegin
by Paul Bakewell
his atty.

(No Model.)

5 Sheets—Sheet 3.

H. H. HENNEGIN.

GAS ENGINE.

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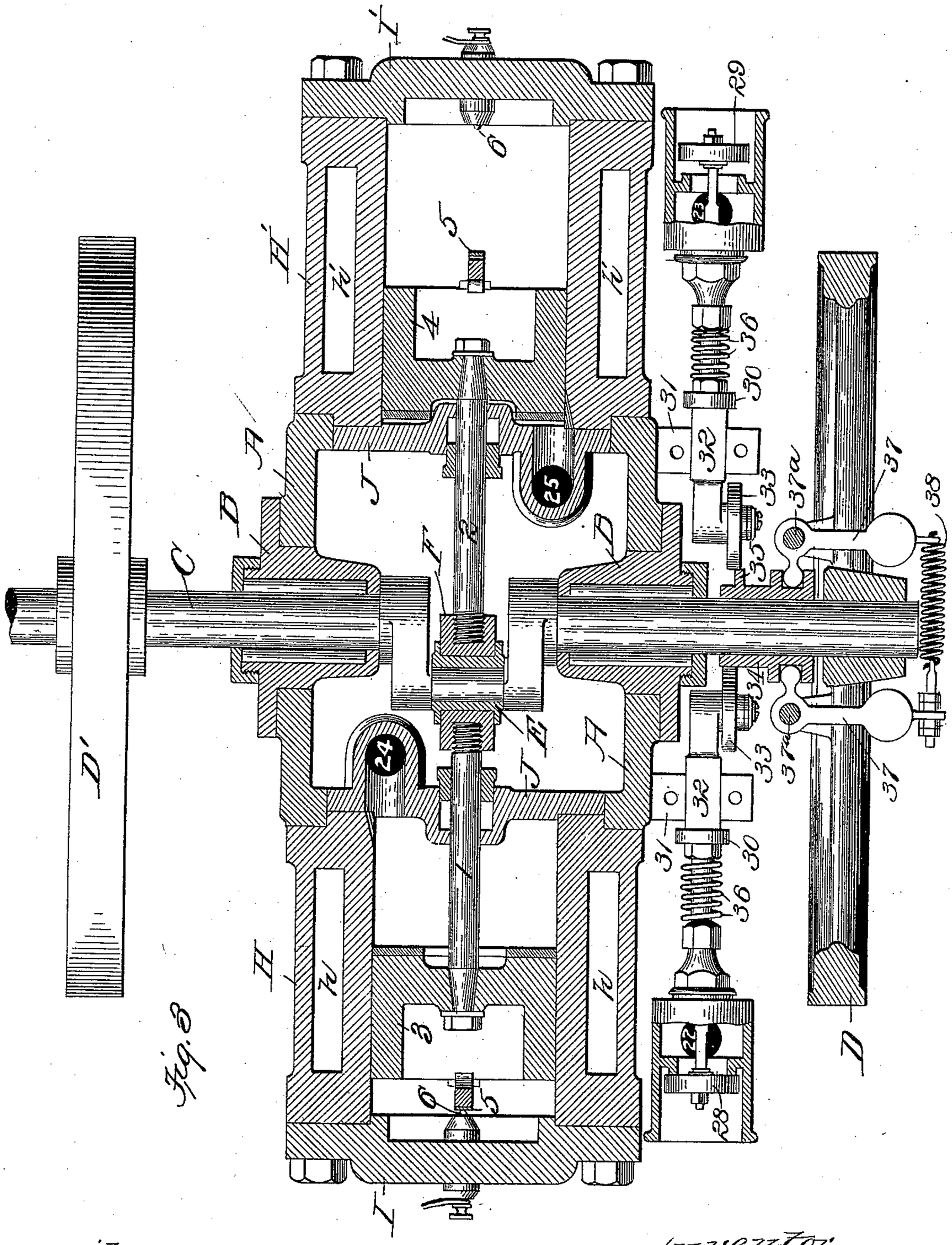


Fig. 3

Witnesses
F. R. Cornwall
Hugh K. Wagner.

Inventor
Herbert H. Hennegin
by Paul Bakewell
his atty.

(No Model.) 5 Sheets—Sheet 4.

H. H. HENNEGIN.

GAS ENGINE.

No. 545,502. Patented Sept. 3, 1895.

Fig. 5.

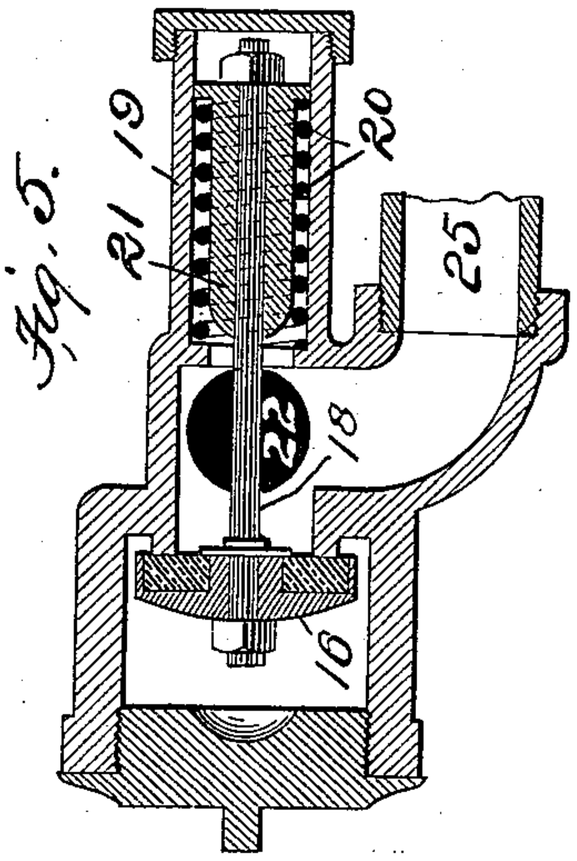
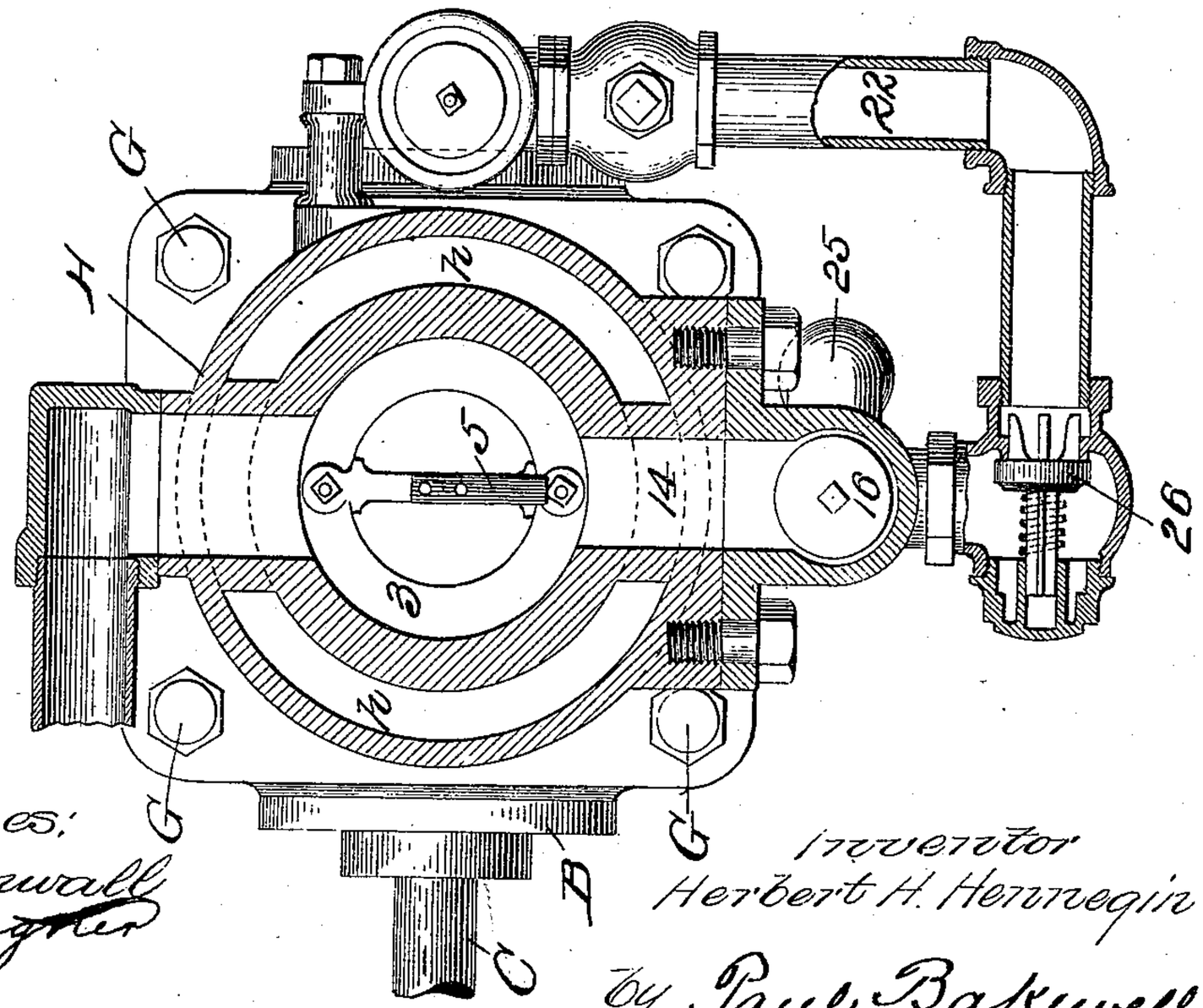


Fig. 4.



Witnesses:
F. R. Cornwall
Hugh K. Spagler

Inventor
Herbert H. Hennegin
by Paul Bakewell
his atty

(No Model.) 5 Sheets—Sheet 5.

H. H. HENNEGIN.

GAS ENGINE.

No. 545,502. Patented Sept. 3, 1895.

Fig. 6

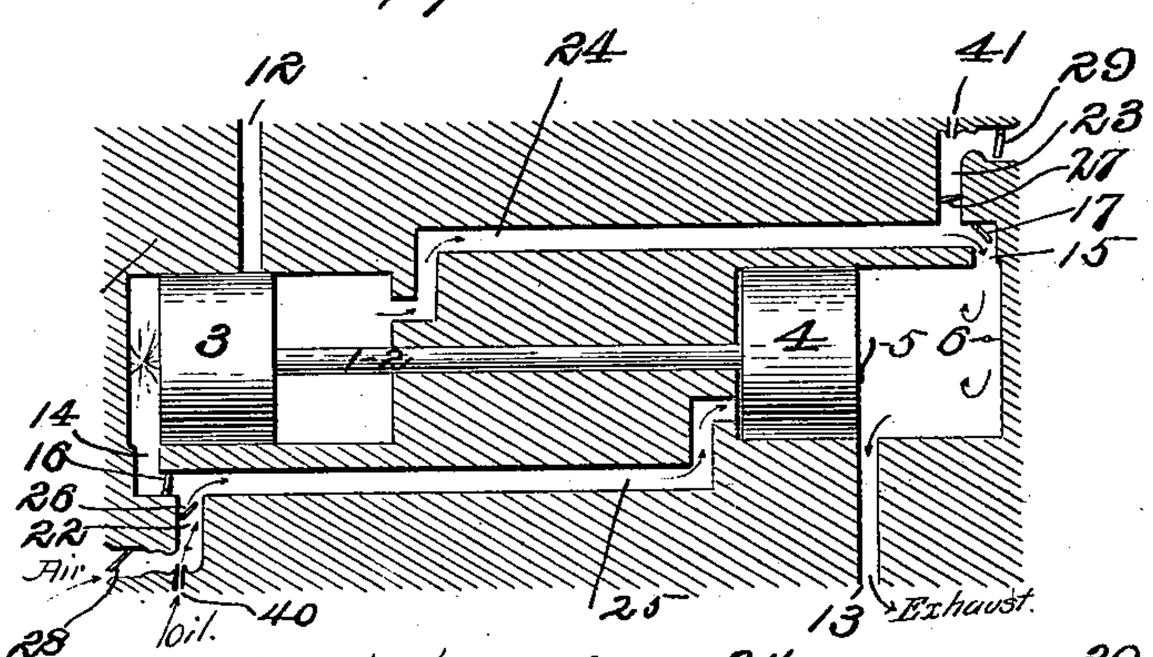


Fig. 7

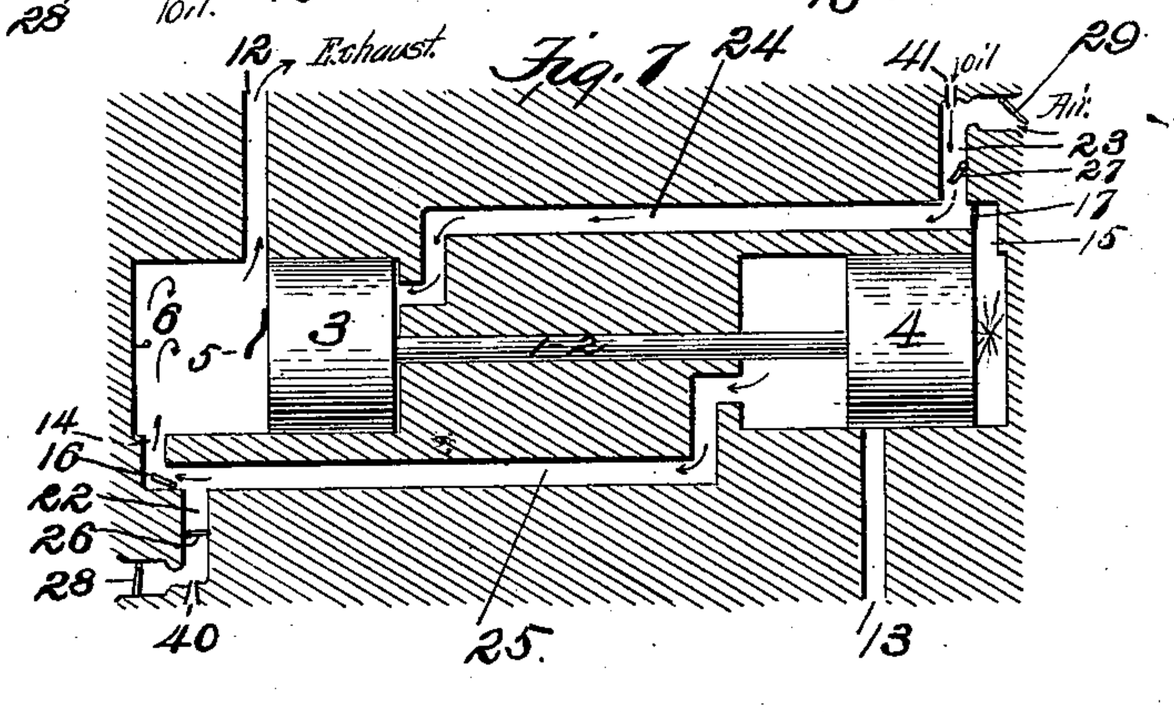
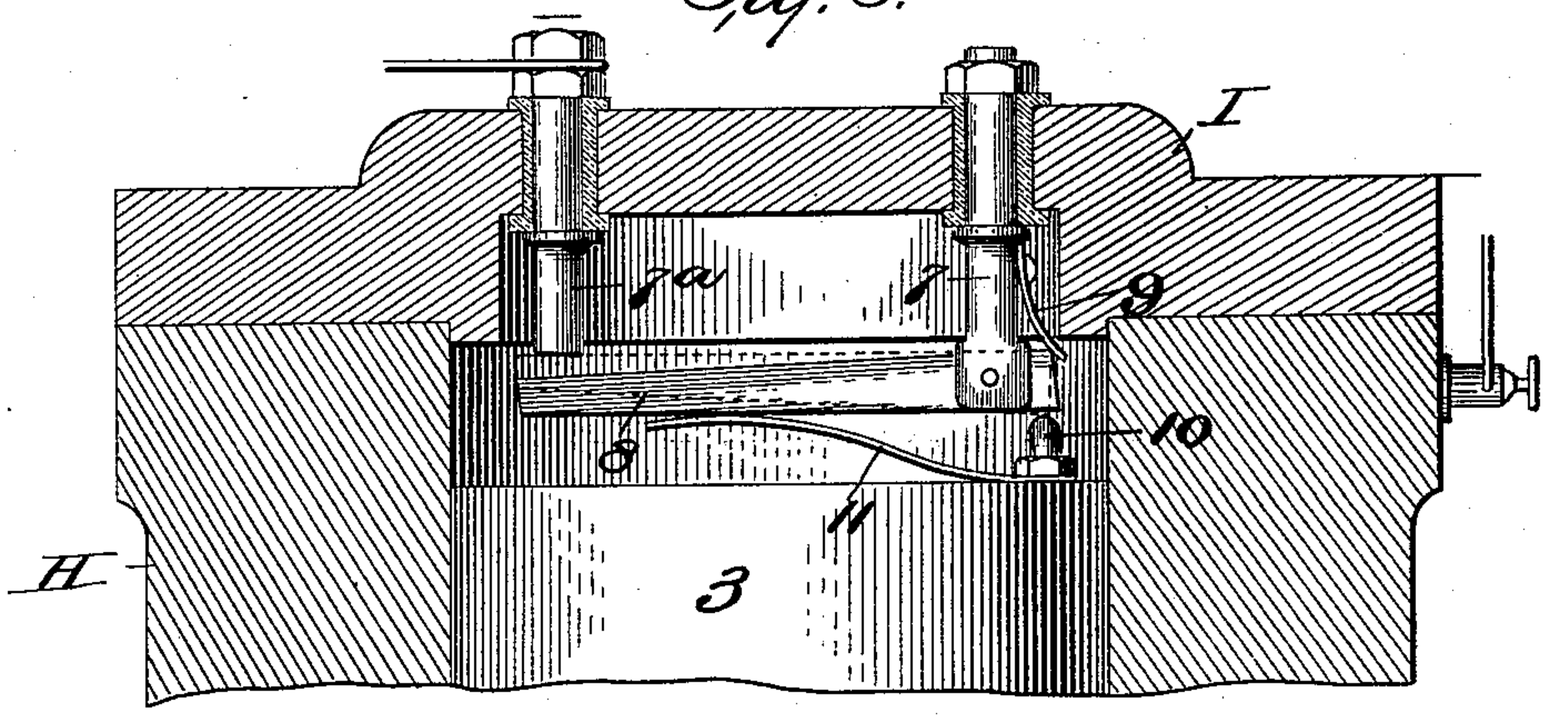


Fig. 8.



Witnesses:
F. P. Cornwall
Hugh K. Wagner.

Inventor
Herbert H. Hennegin
by Paul Bakewell
his atty.

UNITED STATES PATENT OFFICE.

HERBERT H. HENNEGIN, OF ST. LOUIS, MISSOURI.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 545,502, dated September 3, 1895.

Application filed February 11, 1895. Serial No. 537,988. (No model.)

To all whom it may concern:

Be it known that I, HERBERT H. HENNEGIN, a citizen of the United States, residing at the city of St. Louis, State of Missouri, have invented a certain new and useful Improvement in Gas-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, wherein—

Figure 1 is a side elevational view, the near fly-wheel being removed. Fig. 2 is a longitudinal vertical sectional view. Fig. 3 is a longitudinal horizontal sectional view. Fig. 4 is a cross-sectional view on line 4 4, Fig. 2. Fig. 5 is a detail view of the valve which controls the admission of air and gas into the outer ends of the cylinders. Fig. 6 is a diagrammatic view illustrating the position of the valves when the pistons are making their stroke to the right. Fig. 7 is a similar view illustrating the positions of the valves when the pistons are making their stroke to the left. Fig. 8 is a detail view of a form of igniter.

This invention relates to a new and useful improvement in gas-engines, the objects being to construct an engine of the class described which will be simple, cheap, compact, light in weight, and powerful. To attain these objects I construct a double cylinder-engine the pistons of which are connected to a common rod. These pistons in their movement mix the air and gas and force it in advance of the opposing piston, where it is exploded. There are two explosions at each revolution, and suitable means are provided for admitting air and gas at the proper time to the mixing-chambers.

My invention consists in the principles of operation and the construction involved in utilizing said principles to accomplish the purposes above set forth.

In the drawings, A indicates a central box or housing in the sides of which are received boxes B, forming roller-bearings for shaft C, which extends out on each side and has mounted thereon fly-wheels D and D′, the one balancing the other. A crank-pin is formed on the shaft within the housing, and has a bearing in a sliding block E, which is mounted in a cross-head F, to which the piston-rods 1 and 2 are secured. Secured to the ends of the housings by bolts G, which pass therethrough, are cylinders H and H′, which are preferably formed with spaces *h* and *h′* for the circulation of water.

I and I′ are the heads on the outer ends of the cylinders, and J and J′ are heads on the inner ends of the cylinders, respectively, which latter heads are preferably separate from the housing.

3 and 4 are piston-heads on the rods 1 and 2, which heads are provided with means for igniting the compressed air and gases therebetween and the heads I and I′ at their outstroke. This means is illustrated in Figs. 1, 2, 3, and 4 as a spring 5 mounted on the pistons which contacts with a projection 6 in the path of its travel. At the beginning of its instroke the spring 5 leaves the point 6 and forms an electric arc, which ignites the air and gases, and the expansion thereof forces the piston inwardly. Contact 6 is insulated from the heads I and I′, and forms one terminal of a circuit. Any part of the engine-casings forms the other terminal, and the circuit is completed only when one of the springs 5 contacts with their respective points 6.

In Fig. 8 I have illustrated another form of igniter, which I prefer to use in some instances. This igniter consists of posts 7 and 7ª, mounted in the heads I and I′ and insulated therefrom. In the end of post 7 I pivot an arm 8, which is impelled by a spring 9 to normally rest upon the end of post 7ª. These posts and arm form one terminal of a circuit, the wire being led from post 7ª. The casing in this, as in the other form of igniter, forms the other terminal. A projection 10 is provided upon the piston-heads, which include in its path the short end of arm 8. A spring 11 extends beyond said projection and includes in its path the long end of arm 8. When the piston is on its instroke, the spring 11 first comes in contact with arm 8, completing the circuit. Then the projection 10 strikes the short end of the arm and immediately the long end of the arm leaves post 7ª, forming the arc, which remains until the projection leaves the arm. The advantages of this construction over the other are: that there is little waste current; the arc is formed shortly before the piston completes its stroke and remains until the piston has started on its in-

stroke, thus giving a longer time for ignition, and the spring is removed from the arc and its resiliency is not destroyed.

12 and 13 are exhaust-ports, which lead from the cylinders exhausting the spent air and gases when the pistons are forced inwardly, said exhausts being closed when the piston is on or at the limit of its outstroke.

Leading from the outer ends of the cylinders are inlet-ports 14 and 15, which are controlled by valves 16 and 17. These valves are spring-seated and are provided with stems 18, (see Fig. 5,) which extend into a pocket 19. A spring 20 surrounds this stem and exerts a tendency to normally seat the valve. To occupy space so that the pressure of the fluid passing through this valve will not be greatly influenced, I arrange on the stem and within the spring a thick sleeve 21, which almost entirely fills said pocket, except for the space required for proper operation of the spring. On the opposite side of these valves 16 and 17 are formed spaces, into which lead pipes 22 and 23 and 24 and 25. The passages through pipes 22 and 23 are controlled by inwardly-opening check-valves 26 and 27, said pipes extending beyond said check-valves and being absolutely controlled by the air-intake valves 28 and 29. The stems of these air-intake valves pass through their respective casings inwardly and are connected to cross-heads 30, which are mounted in suitable bearings 31, bolted to the housing A through the medium of squared shanks 32. On the inner ends of these shanks are mounted rollers 33, which ride upon a sleeve 34, slidingly keyed to the shaft C. This sleeve is provided with a radially-increased projection 35, which in the ordinary operation of the engine is in the path of the rollers, and operates the air-intake valves to unseat them to admit air at the proper time, and when the pistons are in proper positions to receive it. Springs 36 are arranged to normally hold the rollers against the sleeve 34. Sleeve 34 is provided with an [illegible] groove in its outer end [illegible] lar projections [illegible]

[illegible] engine exceed that [illegible] was set through the adjustability of the governor-spring, the governor-arms 36 by centrifugal force will overcome the resistance of the spring and the right-angular projections on the arms will slide the sleeve along the shaft C, removing the radial projection 35 thereon from the path of the rollers. When this occurs, the air-intake valves are not operated, and air not being admitted to the inner end of either cylinder will tend to retard the speed by the creation of a partial vacuum or rarefying the air. As soon as the centrifugal force of the governor-arms relaxes and is overcome by the tension of the spring, the projecting face 35 is forced under the rollers and the air-intake valves are again operated.

Connected to the cross-heads 30 and moving therewith are plungers 39, which normally rest to one side of gas-inlets 40 and 41, which lead into a chamber in which the plungers operate. Pressure causes the gas to constantly fill these chambers, and when the cross-heads are actuated the plungers move outwardly, closing the gas-inlets and forcing the gas before them against a yielding plug 42, which closes the gas-opening in pipes 22 and 23. In this manner the fluid, in whatever form it might be, is forced into pipe 22 or 23 only when its respective air-intake valve is unseated. This results in a great saving of fuel and prevents the accumulation of fuel in these pipes, as the supply can be so regulated by the adjustable connections of the plungers to the cross-heads that only enough gas to support a charge is admitted at one time. It will be understood that the connection between the plungers and cross-heads can be so arranged that the cross-heads will have a play on the plungers in each direction before actuation.

Pipes 24 and 25 lead from the inner ends of the cylinders to points between the valves 16 and 17 and 26 and 27.

The operation is as follows: We will assume that the pistons are just commencing a stroke to the right, referring more particularly to Fig. 6. The spent air and gases in front of piston-head 4 have been exhausted through 13, and this port is soon closed, being covered at an early stage by the advance movement of the piston. The explosion behind piston 3 will close valve 16, and the air (and gases) in front of said piston will be forced through pipe 24 (check-valve 27 being closed) past valve 17 and in front of advancing piston 4. In this manner the whole charge in front of piston 3 is compressed in [illegible] In this connection it might [illegible]t, in order to give more space [illegible]sion, the outer ends of both [illegible]sed. The raised portion 35 [illegible] left-hand roller, and air-in- [illegible] raised from its seat, while [illegible]nger forces a charge of gas into pipe 22. Piston 4, which we may consider a "dead" piston, draws, by suction, the air and gas through pipe 22, past check-valve 26, through pipe 25 and into the piston-chamber behind piston 4. In passing through these different courses the air and gas becomes intimately mixed. The compressed air and gas in front of piston 4 is now ignited, it now becoming a "live" piston, and the operation of the parts is reversed—that is, the spent air and gases in front of piston 3, now dead, are exhausted through port 12. (See Fig. 7.) Valve 17 closes to prevent escape of expanding air and gases behind piston 4. The air and gases which were drawn in behind piston 4 in its outward movement are now forced in front of the same, back through pipe 25,

(valve 26 and intake-valve 28 being closed,) past valve 16, and in front of outgoing piston 3, where they are compressed. The raised portion 35 now operates the right-hand roller and air-intake valve 29 is raised from its seat, while the plunger forces a charge of gas into pipe 23. Piston 3 draws, by suction, the air and gas through pipe 23, past check-valve 27, through pipe 24, and into the piston-chamber behind piston 3. In this manner the cycle of operations is repeated. It will be noted that both pistons 3 and 4 approach closely to the heads J and J′, in order to leave as little air and gas therebetween as possible.

I am aware that many minor changes in the construction and arrangement of the parts of my device can be made. Therefore I do not wish to be understood as limiting myself to the exact arrangement or construction of the parts as herein shown and described.

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

1. In a gas engine, the combination with two cylinders arranged in line with each other, of pistons operating in said cylinders, which pistons are connected to a common rod, a cross-head arranged in the rod, a slide-block arranged in the cross-head, pipes which lead from the inner ends of the cylinders to the outer ends of the opposite cylinders, check-valves which control the openings of said pipes into the outer ends of the cylinders, branch pipes which lead from the first mentioned pipes, inwardly opening check-valves arranged in the branch pipes, air-intake valves in the outer ends of the branch pipes, pumps for forcing the oil into the branch pipes, the pumps and the air intake valves of each cylinder being operated together means for operating the pumps and air intake valves, and a governor mounted on the engine shaft for controlling said means; substantially as described.

2. In a gas engine, the combination with the shaft, of a cam sleeve slidingly arranged thereon, a governor for said sleeve, rollers which bear against the cam surface of said sleeve, non-circular rods in which said rollers are mounted, air intake valves arranged on the ends of the rods, pump plungers which are adjustably connected to the rods, and springs for forcing the rollers against the cam-surface, whereby when one air intake valve is open and the pump is forcing the oil in front thereof, the other air intake valve is seated and its connected pump is receiving a charge to be forced in front of its air-intake valve when the latter is unseated substantially as described.

3. In a gas engine, the combination with two cylinders arranged in line with each other, pistons operating in said cylinders, said pistons being connected to a common rod and said pistons also controlling the cylinder exhaust ports, valved connections between the ends of the cylinders whereby the pistons compress the air and gases for each other, an electric terminal on the pistons, an electric terminal on each of the cylinder heads with which the piston terminals alternately contact to form an arc to ignite the compressed charges, air intake valves and gas pumps which are operated from the shaft of the engine, and a governor for controlling said valves and pumps; substantially as described.

4. In a gas engine, the combination with the cylinder, and its piston, forming one terminal of an electric circuit, of posts mounted in the cylinder head and insulated therefrom, an arm pivoted in one of the posts and resting upon the other, said posts and pivoted arm forming the other terminal of an electric circuit, the wire being connected to the post upon which the arm rests, and means on the moving piston to complete the circuit through the arm, and, raising it, form an arc between its end and the post upon which it rested, substantially as described.

5. In a gas engine, the combination with the cylinder and its piston forming one terminal of an electric circuit, of posts mounted in the cylinder head and insulated therefrom, an arm pivoted in one of the posts and resting upon the other, said posts and arm forming the other terminal of an electric circuit, the wire being connected to the post upon which the arm rests, a spring on the piston for contacting with the arm to complete the circuit, and a projection on the piston for contacting with the arm to raise its end from the post upon which it rested, to form an arc, substantially as described.

6. In a gas engine, the combination with a check-valve, of an open pocket for receiving the stem, a spring in the pocket, which surrounds the stem and exerts a tendency to seat the valve, the diameter of said stem being increased or provided with a sleeve which entirely fills the space within the coils of the spring, substantially as described.

7. In a gas engine, the combination with the casing and the driving shaft, of a cam surface arranged on the driving shaft, a squared shank mounted in bearing on the casing, a roller mounted on the shank, a valve stem projecting from the cross head, an air intake valve on said stem, a plunger adjustably mounted on the cross-head, a gas opening arranged in advance of the travel of said plunger, and a yielding plug for confining the gas in front of the plunger, which plug is unseated to permit the escape of the gas when the plunger is actuated, substantially as described.

8. In a gas engine, the combination with two cylinders arranged in line with each other, of pistons within said cylinders which are connected to a common rod, a cross-head arranged in the rod, a sliding block arranged in the cross-head, valved connections between

the ends of the cylinders, and a governed sleeve which controls the air intake valves and gas pumps; substantially as described.

9. In a gas engine, the combination with two cylinders arranged in line with each other, pistons operating in said cylinders which control their own exhaust, valved connections between the ends of the cylinders whereby the pistons compress the air and gases in advance of each other, means for exploding the compressed charges, connections between the ends of the cylinders, and means located on the shaft for controlling the air intake valves and gas pumps; substantially as described.

In testimony whereof I hereunto affix my signature, in presence of two witnesses, this 2d day of February, 1895.

HERBERT H. HENNEGIN.

Witnesses:
F. R. CORNWALL,
HUGH K. WAGNER.