A. L. GALUSHA.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED APR. 13, 1907.

914,566.

Patented Mar. 9, 1909.

3 SHEETS—SHEET 1.

Fig. 1.

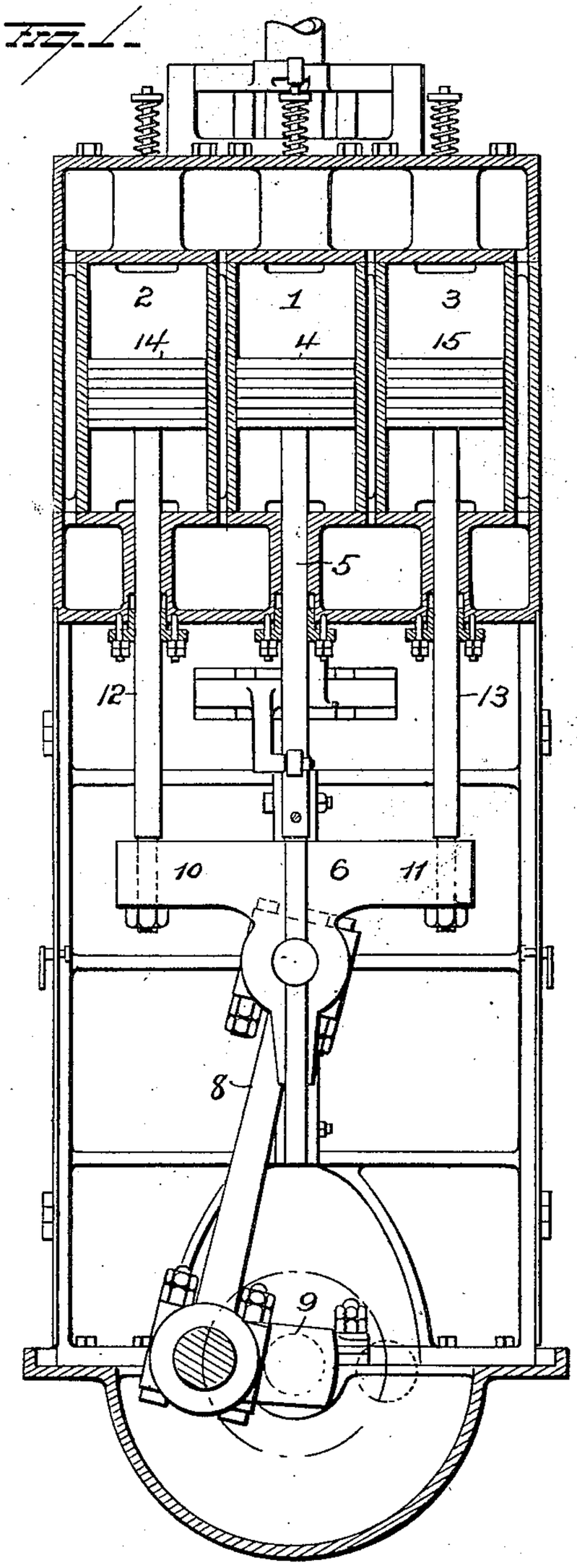
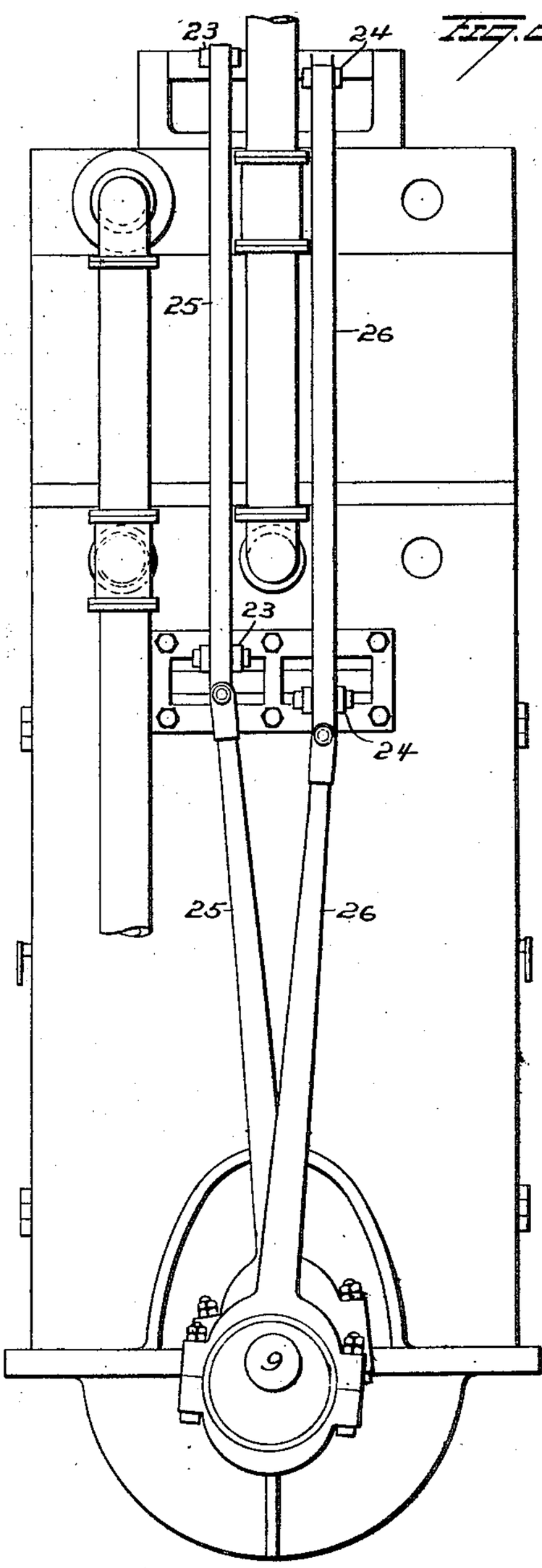


Fig. 2.



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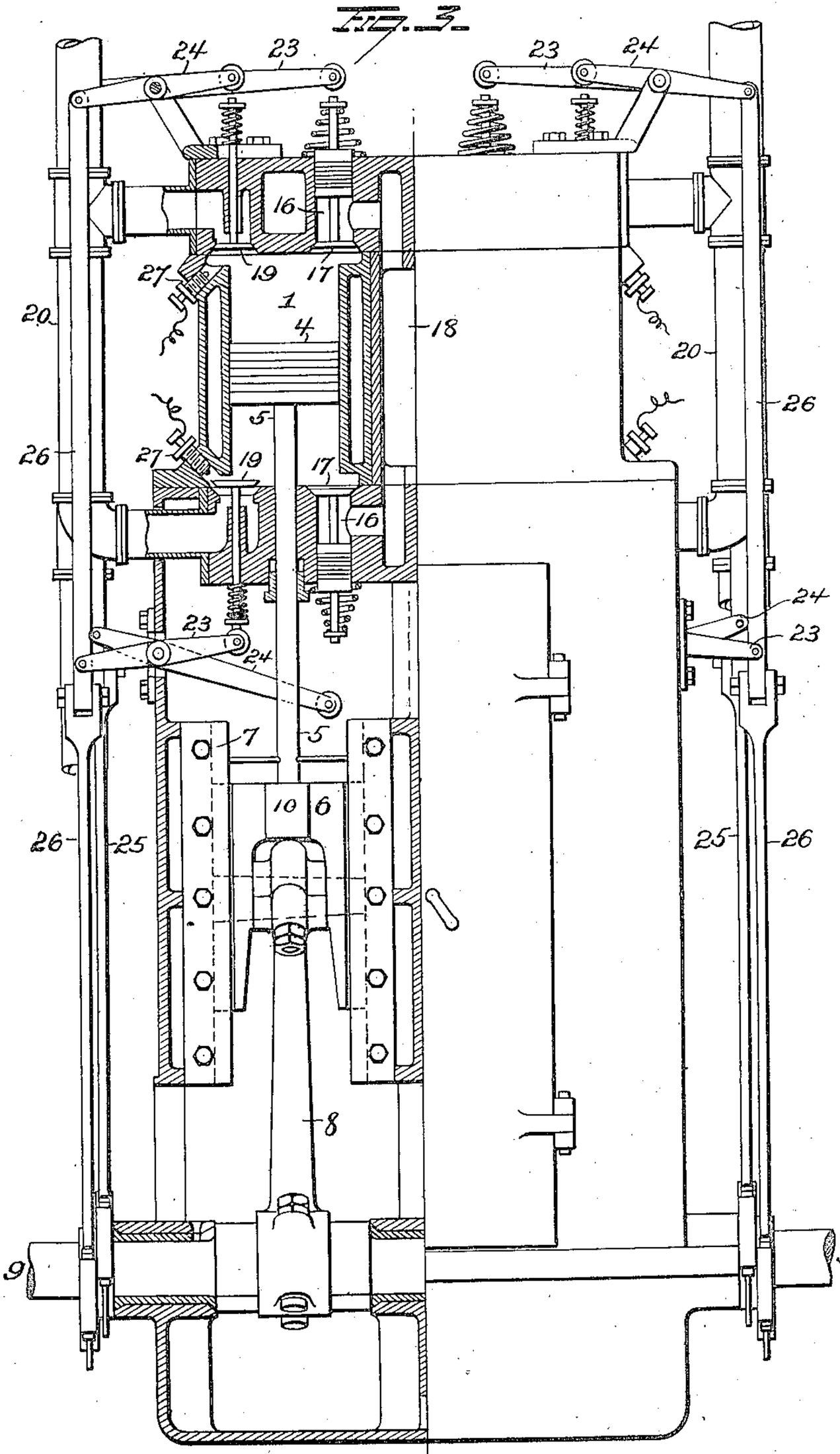
3 SHEETS—SHEET 2.

FIG. 2.



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3 SHEETS—SHEET 3.

Fig. 4.

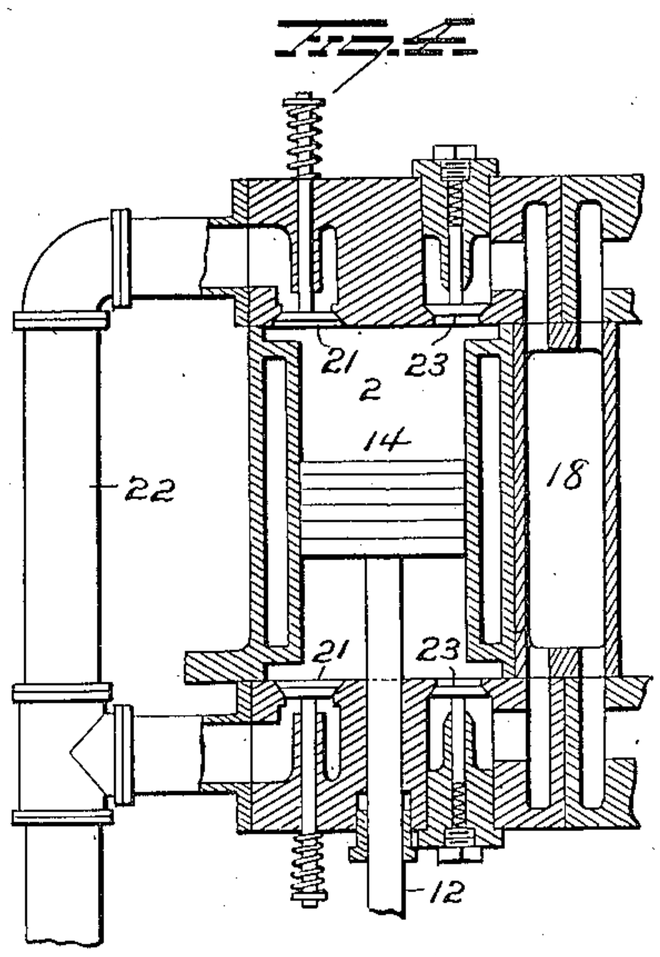
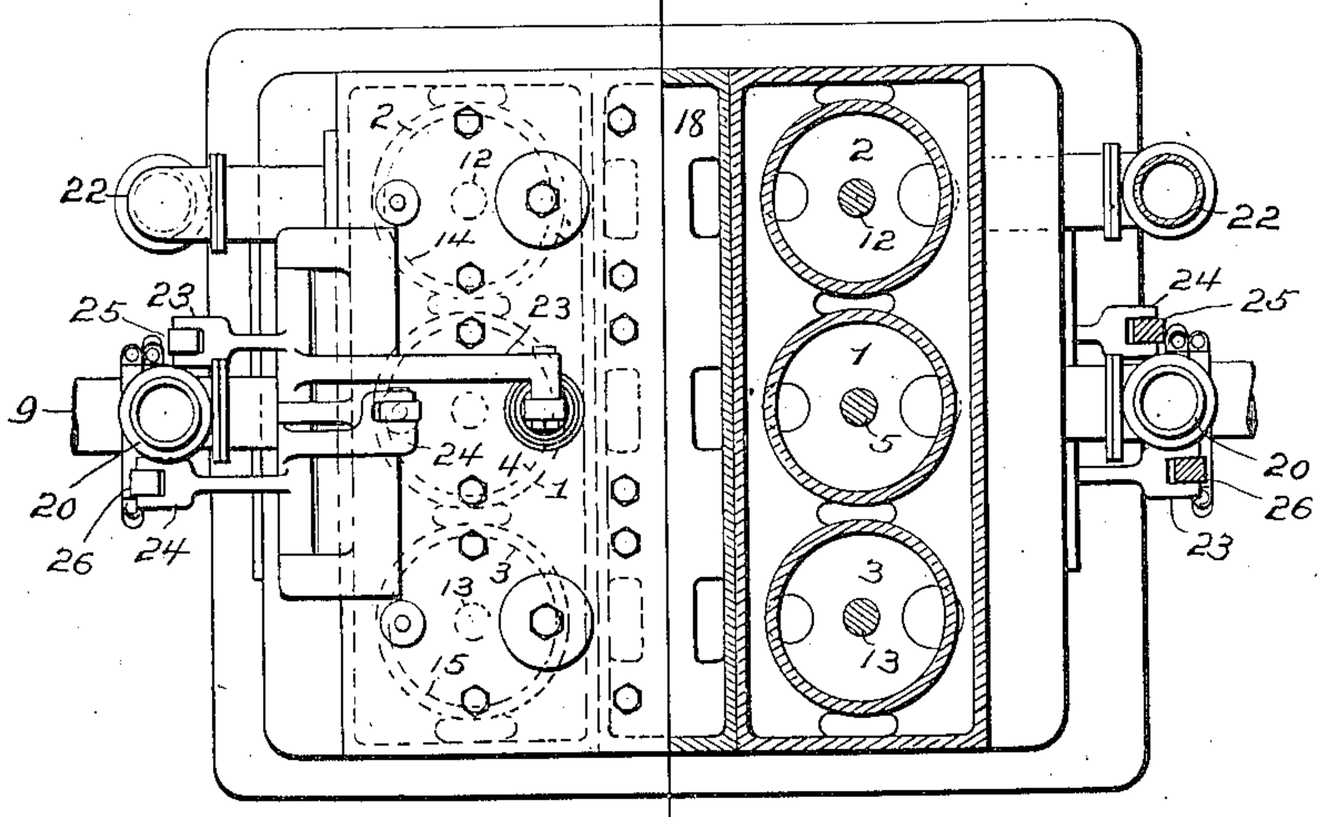


Fig. 5.



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UNITED STATES PATENT OFFICE.

ALBERT LEET GALUSHA, OF DORCHESTER, MASSACHUSETTS.

INTERNAL-COMBUSTION ENGINE.

No. 914,566. Specification of Letters Patent. Patented March 9, 1909.

Application filed April 13, 1907. Serial No. 367,957.

To all whom it may concern:

Be it known that I, ALBERT LEET GALUSHA, of Dorchester, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in internal combustion engines,—one object of the invention being to so construct such an engine, wherein compression is employed, that the firing of the charge will occur other than at the dead center or its immediate vicinity.

A further object is to so construct the engine as to effect complete compression of the charge outside of the combustion cylinder.

A further object is to effect complete and separate compression of the gas and air outside of the combustion cylinder.

A further object is to provide cylinders wherein the gases can be compressed and which shall be so arranged with reference to the combustion chamber as to supply the latter with an explosive charge and cause no load on the bearings by the transfer of work of compression from the combustion cylinder to pump cylinders.

A further object is to so construct an internal combustion engine that two impulses to the working piston within the combustion or motor cylinder to drive the same in opposite directions will be effected every revolution and a single connecting rod or pitman be employed between the working piston and the driven shaft of the engine.

A further object is to provide an internal combustion engine having the total volume of the space within which complete compression takes place, larger than the volume to which the burned gases are finally expanded before leaving the combustion cylinder.

A further object is to provide an engine wherein complete compression of the charge takes place outside of the combustion chamber and to so construct the engine that it can burn, in the motor cylinder, a charge that, at atmospheric pressure would more than completely fill the motor cylinder.

A further object is to construct an internal combustion engine in such manner that a maximum amount of air and gas can be made to enter the combustion or motor cylinder at each stroke of the piston.

With these objects in view the invention consists in certain novel features of construction and combinations of parts as hereinafter set forth and pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical section through one unit of the engine. Fig. 2 is an end elevation. Fig. 3 is a view partly in section and partly in elevation. Fig. 4 is a vertical section through a pump cylinder and a receiver, and Fig. 5 is a view partly in plan and partly in horizontal section showing the three cylinders comprised in one unit.

In the drawings I have illustrated an internal explosive engine comprising two units but as both of these units are precisely the same in construction and operation, a detailed description of one will suffice for the other.

A unit of the engine comprises three cylinders 1, 2, and 3,—the cylinder 1 being the motor or combustion cylinder and the cylinders 2 and 3 being pump cylinders. A working piston 4 is located within the motor cylinder 1 and is connected by a piston rod 5 with a cross-head 6 movable in guides 7, said cross-head being connected by means of a pitman 8 with a crank of a driven shaft 9. The cross-head 6 is provided with lateral projections 10, 11, with which are connected, respectively, piston rods 12 and 13, which are secured at their upper ends to pistons 14, 15, in the pump cylinders 2 and 3.

At each end of the motor cylinder inlet ducts 16 are provided for admitting explosive charges to said cylinder, the ports of said ducts being normally closed by balanced valves 17. The inlet ducts communicate and receive the explosive charge from a compression chamber 18. The motor cylinder is also provided, at each end, with an exhaust valve 19 which controls the escape of burned gases to an exhaust pipe 20.

The pump cylinder 2 is provided at its respective ends with inlet valves 21 for controlling the admission into said cylinder, of gas conveyed from a suitable source of supply by means of a pipe 22. Valves 23 are located at respective ends of the pump cylinder 2 and control the passage of gas from said cylinder to compression cylinder 18.

The pump cylinder 3 is intended for air and the construction and arrangement of valve mechanism is precisely the same as

that above described with reference to gas pump cylinder 2. Fig. 4 of the drawing illustrates the construction and arrangement of the air pump as well as the gas pump, except that with the air pump the pipe 22 is omitted.

Any suitable valve gear may be employed for controlling the operation of the valves 17 and 19 of the motor cylinder, but in the drawing I have shown levers 23 for operating the inlet valve and levers 24 for operating the exhaust valve, said levers being connected by rods or pitmen 25, 26, with cams or cranks on the driven shaft 9.

When the pistons in the several cylinders 1, 2, 3 start downwardly a partial vacuum will be formed in the cylinder 2 (Fig. 4) which will cause the valve 21, at the upper end of the cylinder, to open and gas from pipe 22 to flow into said cylinder. When the pistons shall have reached the lower ends of the cylinders and start to return the spring on the valve 21 will cause said valve to close and the gas within the cylinder will be compressed until the pressure is slightly greater than the pressure in the chamber 18. The difference in pressure causes the valve 23, at the upper end of the cylinder 2, to open and during the remainder of the stroke the gas will be forced past this valve and into the chamber or receiver 18. When the piston in cylinder 2 starts downwardly again, the valve 23 will be closed by the action of its spring. In a similar manner, air will be compressed by the action of the piston in the cylinder 3 and the valves provided for this cylinder and the air thus compressed will enter a chamber or receiver 18 in the same manner as above explained in connection with the compression of gas.

When the piston 4, in the motor cylinder 1, is at the top of said cylinder and starts downwardly, the balanced valve 17 will be opened by the valve gear and a charge of gas and air (preferably mixed just before entering the cylinder) is admitted to the cylinder 1. When the piston 4 has moved a fraction of its downward stroke the valve 17 will be closed, then the charge will be exploded by the action of a suitable sparker 27, great pressure behind the piston being thus created to drive the engine during this stroke. When the piston 4 shall have nearly completed its downward stroke, the exhaust valve 19, at the upper end of the cylinder 1, will be opened by the operation of the valve gear and during the return stroke of the piston the burned gases will be exhausted through the pipe 20. Near the end of the up stroke of the piston 4 the valve 19 will be closed and the cycle of operations just described will be repeated. Exactly the same functions will be performed through the operation of the valves 17 and 19 at the lower end of the cylinder 1.

With an engine constructed as above described, it is apparent that the strains in the piston rods of the two pumps can be made equal to each other and in the opposite direction to the strain in the main piston rod of the engine so that the power of compression is transferred from the motor cylinder to the pump cylinder or cylinders direct, without heavily loading any friction-generating bearings as would be the case if cylinders were each mounted with a separate cross-head, connecting rod and crank.

If desired, city gas can be compressed with one end of one pump and in the particular construction shown in the drawings, air with the other end of that pump and with both ends of the other three pumps, said drawing showing an engine comprising two units each having two pumps. By operating the engine in this manner the explosive mixture would consist of one part of gas and about seven parts of air. With producer gas, one pump for gas and one pump for air will give a mixture of about equal parts of gas and air.

Various slight changes might be made in the details of construction of my invention without departing from the spirit thereof or limiting its scope and hence I do not wish to limit myself to the precise details herein set forth.

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

1. In an explosive gas engine, the combination with a working cylinder and piston, a cross head with which said piston is connected, and a driven shaft with which said cross head is connected, of pumps for separately compressing air and gas outside of the working cylinder, said pumps being equal in size and connected with the cross head at respective sides of the connection of the working piston with the cross head, whereby said pumps will balance each other and relieve the load on the bearings of the moving ports, means for controlling the admission of compressed air and gas into the working cylinder.

2. In an explosive gas engine, the combination with a working cylinder, a working piston therein, and a cross head with which the rod of said piston is connected, of a reservoir, an air pump and a gas pump having valved communication with said reservoir, connections between the cross head of the working piston and the pistons of both pumps, and valve mechanism for controlling the passage of a compressed air and gas from said reservoir to the working cylinder.

3. In an explosive gas engine, the combination with a working cylinder, and a piston therein, of a reservoir having valved communication with both ends of the working cylinder, exhaust valves at both ends of said working cylinder, double acting pumps com-

municating with said reservoir, and connections between the working piston and the pistons of both pumps.

4. An explosive gas engine comprising a combustion cylinder, a piston therein, a cross-head, a rod connecting said piston and cross-head, a gas pump and an air pump, each having its piston rod connected with said cross-head, a receiver communicating with said pumps, and a valve for controlling the passage of compressed fluid from said receiver to the combustion cylinder.

5. An explosive gas engine comprising a combustion cylinder, a piston therein, a rod connected with said piston, a cross-head secured to said rod, a fluid receiver, two cylinders to communicate at their respective ends with said receiver, valves between the respective ends of said cylinders and the receiver, inlet valves at respective ends of said cylinders, a piston in each cylinder, and piston rods connecting both of said pistons with the cross-head, whereby fluid will enter said cylinders and be forced into the receiver at each stroke of the piston.

6. In an internal combustion engine, the combination with a combustion cylinder, a piston therein, a piston rod and a cross-head to which said piston rod is connected, of a gas pump and an air pump having their piston rods connected directly with said cross-head, a compression chamber or receiver communicating with said pumps, means for controlling the passage of air and gas from said receiver to respective ends of the combustion chamber, and means for controlling the exhaust from each end of the combustion cylinder.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

ALBERT LEET GALUSHA.

Witnesses:
WILLIAM P. MEEHAN,
CHARLES H. DONAHUE.