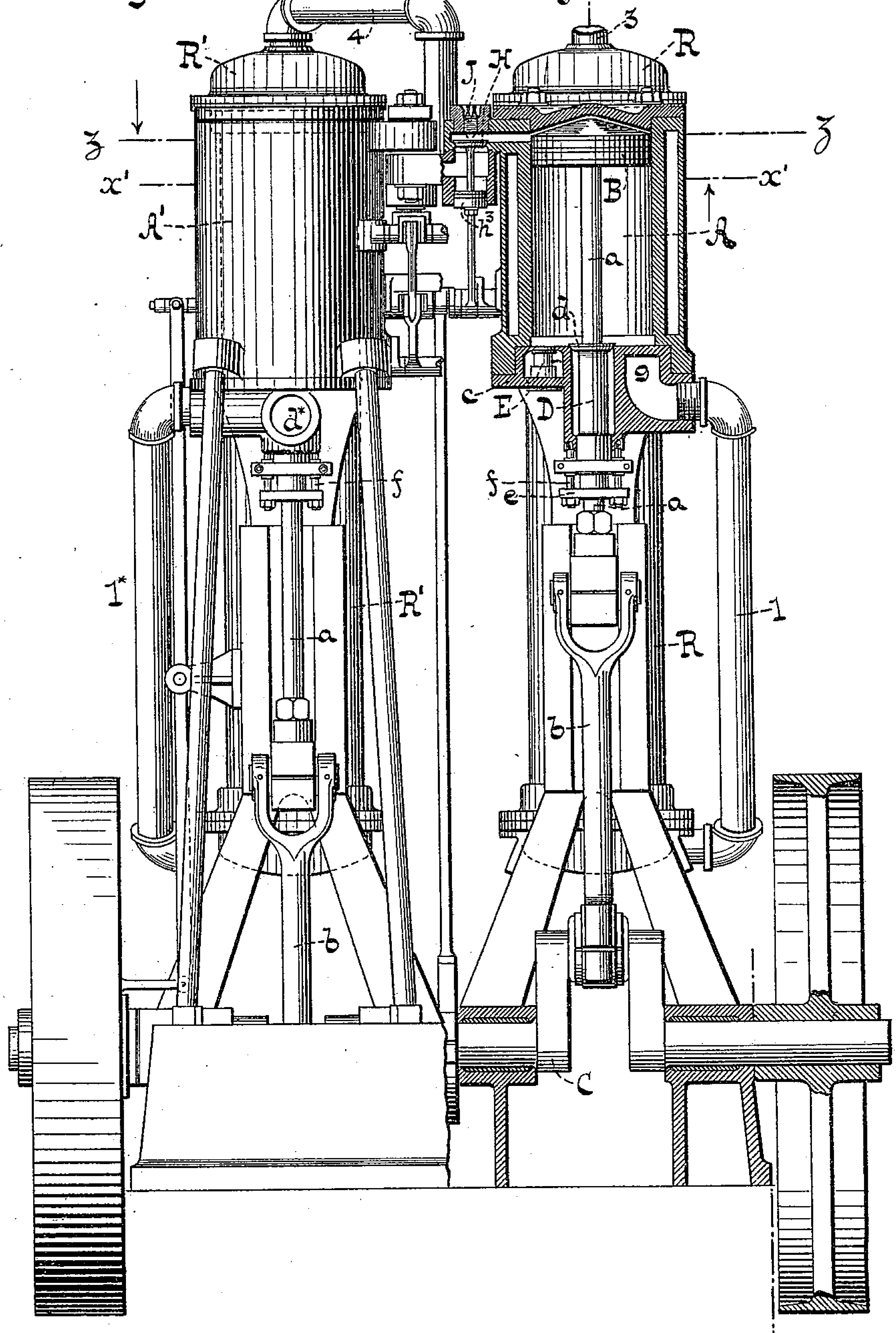
(No Model.) 4 Sheets—Sheet 1.

B. H. COFFEY.

GAS ENGINE.

No. 514,211. Patented Feb. 6, 1894.

Fig. 1.



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(No Model.)

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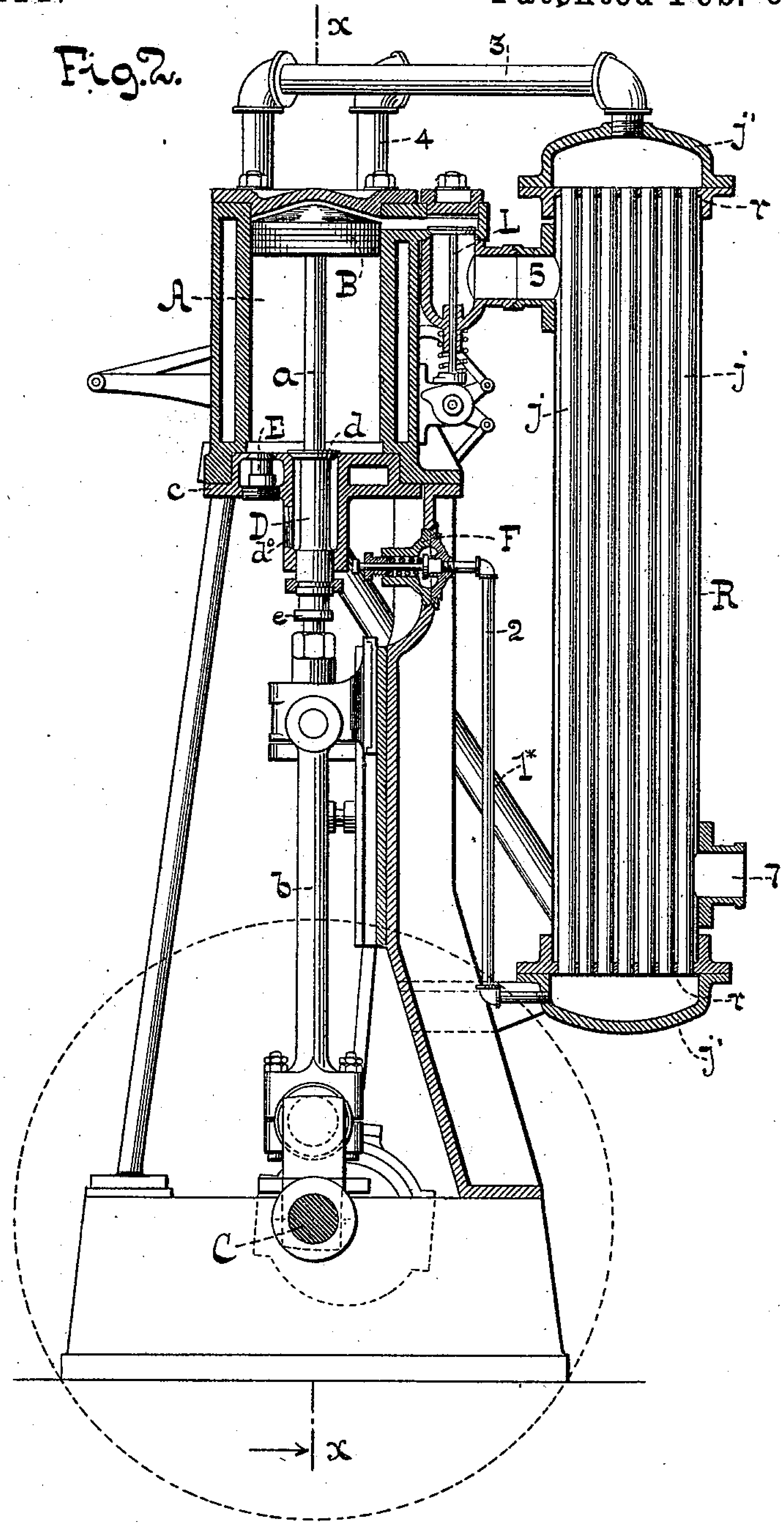
Fig. 2.



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(No Model.)

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Fig. 3.

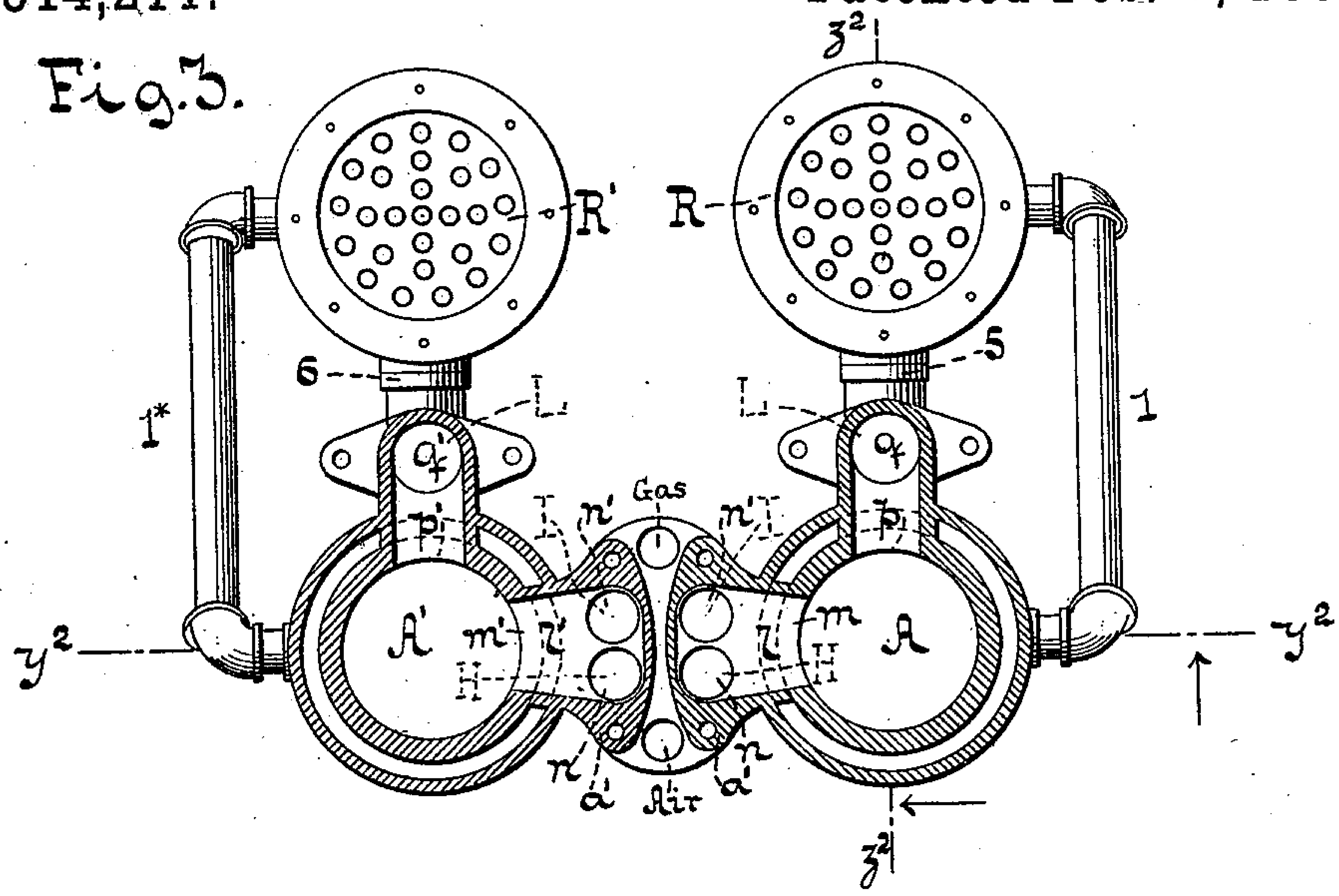


Fig. 4.

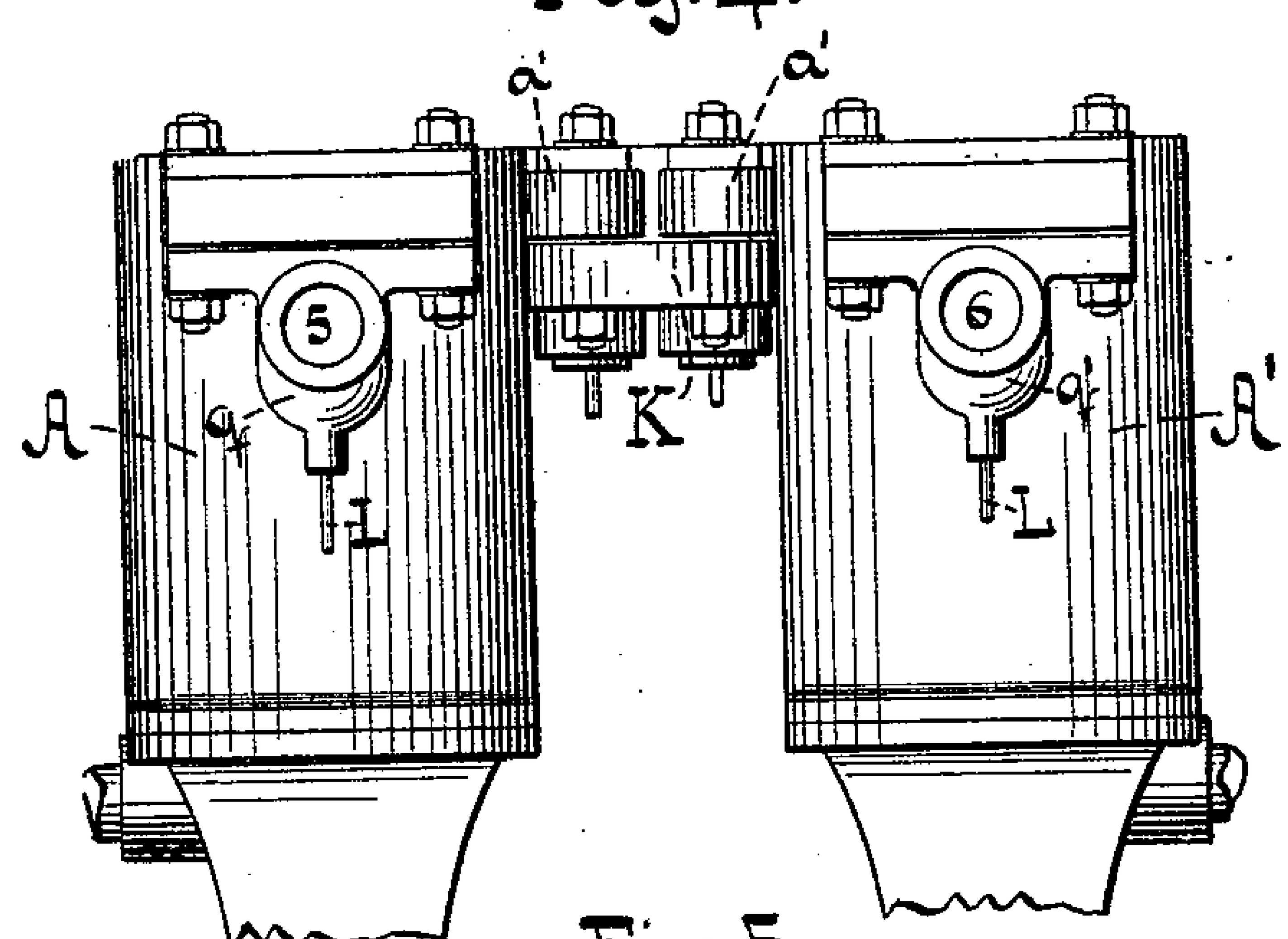


Fig. 5.

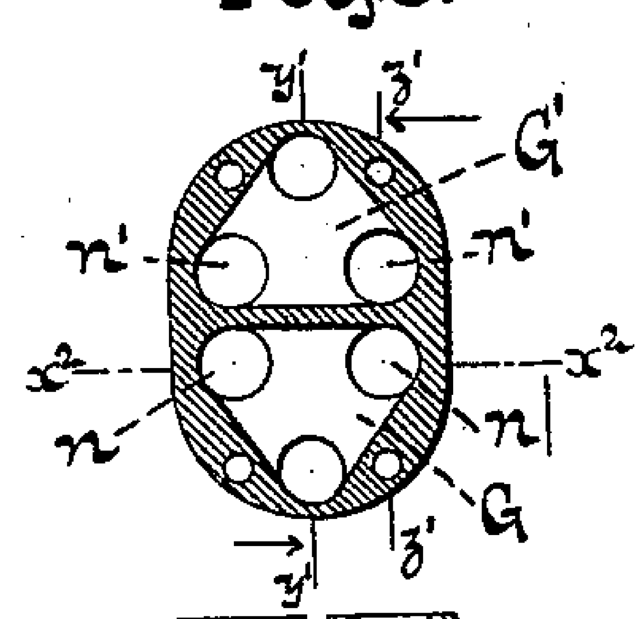


Fig. 6.

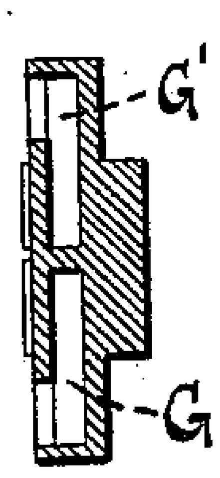
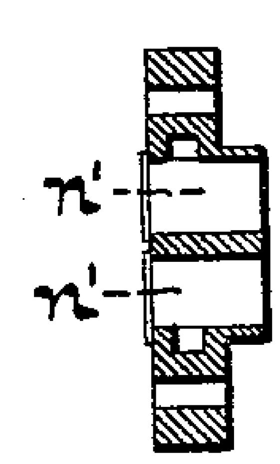


Fig. 7.



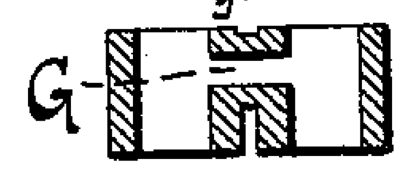


Fig. 8.

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B. H. COFFEY.

GAS ENGINE.

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Fig. 10.

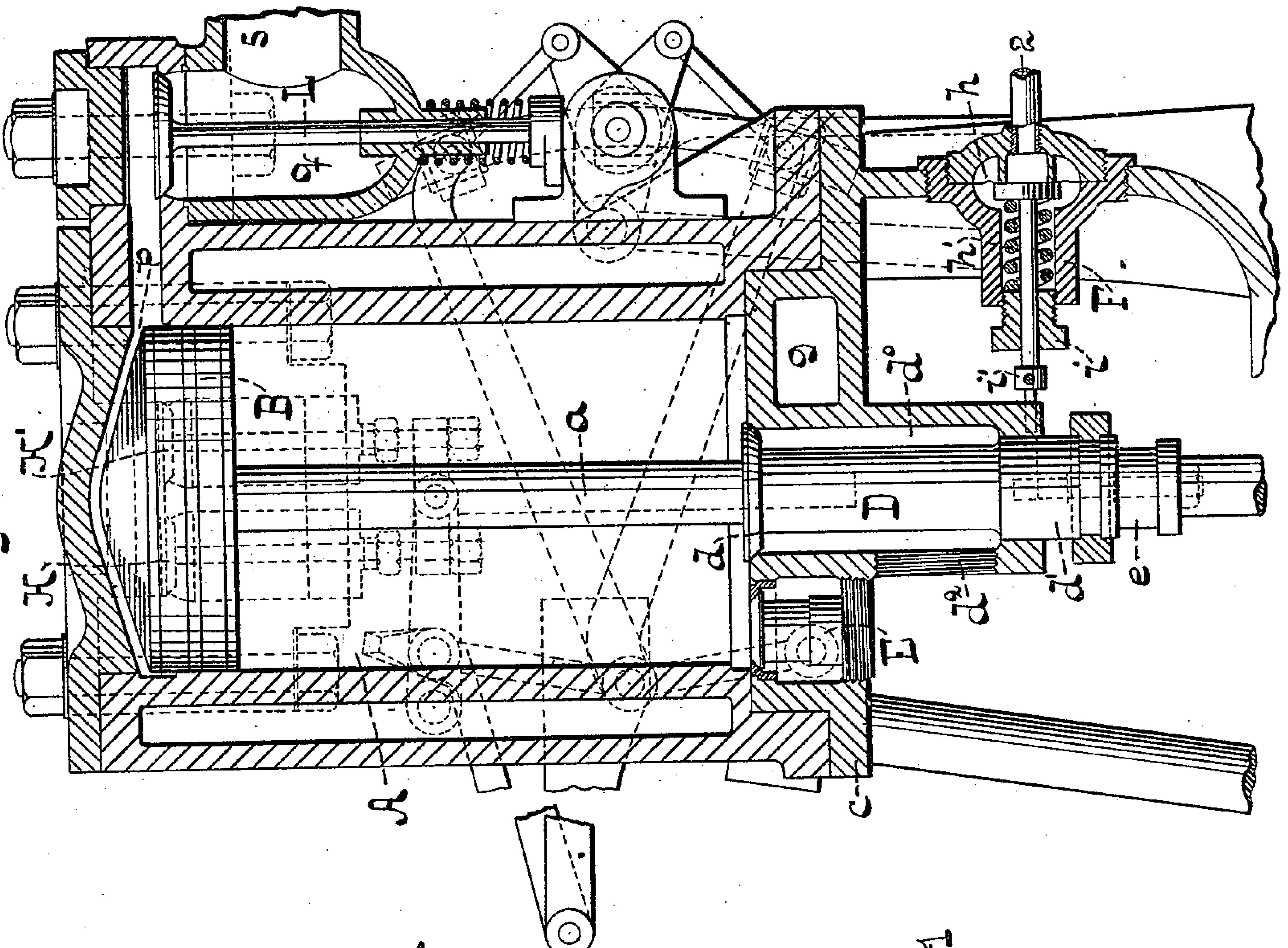


Fig. 9.

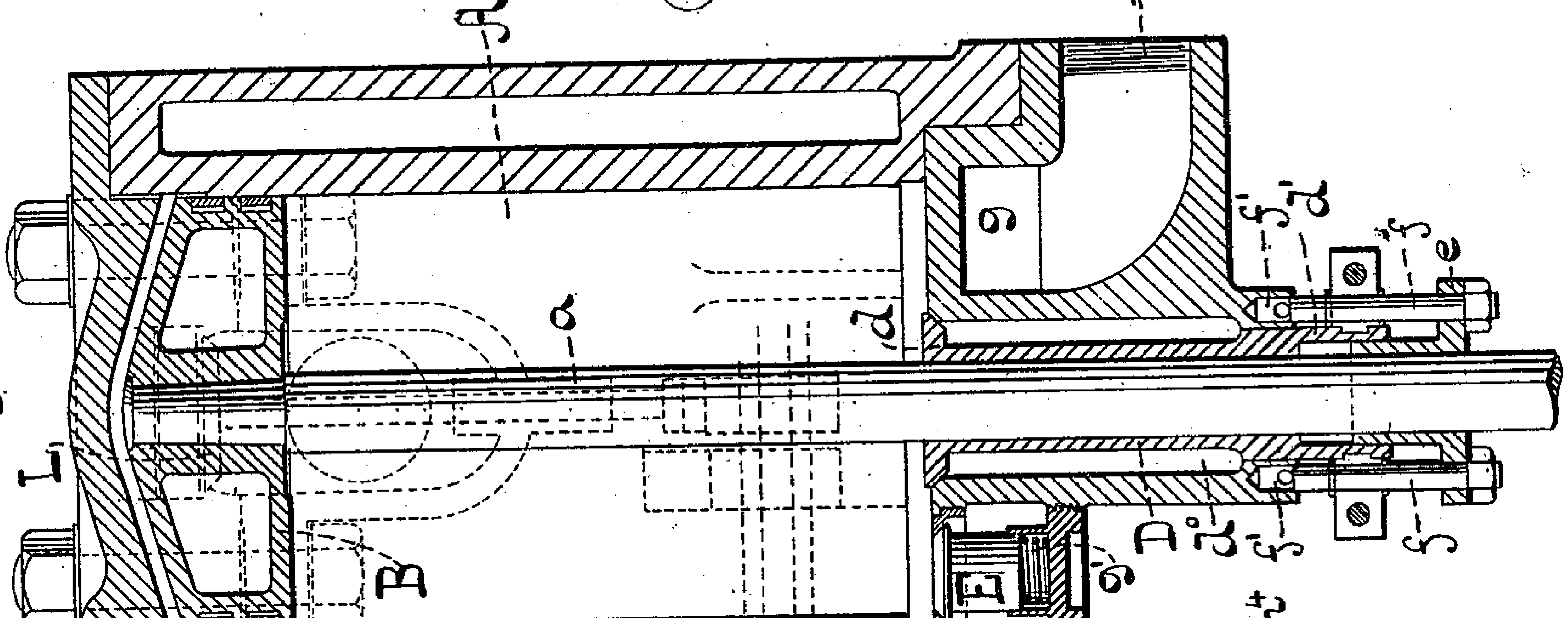
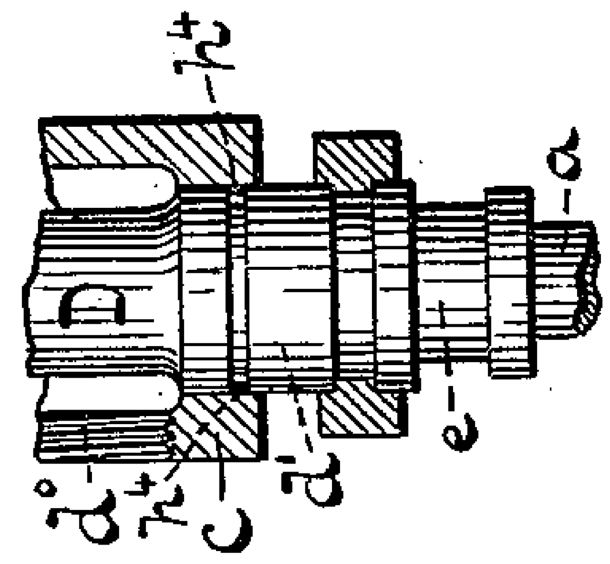


Fig. 11.



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UNITED STATES PATENT OFFICE.

BARTON H. COFFEY, OF NEW YORK, N. Y.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 514,211, dated February 6, 1894.

Application filed November 14, 1892. Serial No. 451,954. (No model.)

To all whom it may concern:

Be it known that I, BARTON H. COFFEY, a citizen of the United States, and a resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention has reference to improvements in the construction of gas engines,—and it consists in certain novel features in the design and operation of the engine as a whole, and in certain improved constructions in the several parts;—said improvements having for their object respectively, to obtain a greater efficiency than has heretofore been attained; to regulate the engine by varying automatically the volume of the explosive charge, without varying its pressure, composition, or its degree of inflammability; to heat the air and gas separately while under pressure; to obtain a substantially constant pressure of air and gas by automatically suspending the action of the motor-pump when the pressure in the reservoirs rises above the limit; to balance and close the admission valves by the pressure in the reservoirs; and finally to adapt the engine for producer gas.

The nature of my said improvements will best be understood as described in connection with the accompanying drawings, in which—

Figure 1 represents a sectional elevation of an engine constructed according to my invention, the section being taken on the line $x\ x$, Fig. 2. Fig. 2 is a vertical section on the line $y\ y$, Fig. 1. Fig. 3 is a horizontal section in the plane $z z$, Fig. 1. Fig. 4 is a rear elevation of the two cylinders and the several valve chests appertaining thereto. Fig. 5 is a section through the air and gas chests on the line $x'\ x'$, Fig. 1. Fig. 6 is a section on the line $y'\ y'$, Fig. 5. Fig. 7 is a section on the line $z'\ z'$, Fig. 5. Fig. 8 is a section in the plane $x^2\ x^2$, Fig. 5. Fig. 9 is a vertical section through one of the cylinders taken on the line $y^2\ y^2$, Fig. 3, said figure being drawn to a larger scale than the preceding figures. Fig. 10 is a similar section taken on the line $z^2\ z^2$, Fig. 3. Fig. 11 is a sectional detail view.

Similar letters and figures indicate corresponding parts throughout the several views of the drawings.

In the present instance I have shown the engine embodying in its design two single acting cylinders combined and co-operating as usual;—A A' designating the two cylinders and B B the pistons connected with the crank shaft C by the piston rods *a* and the connecting rods *b*. I have also shown the engine as being of the vertical type, and shall describe the same as such, but of course it is to be understood that a horizontal engine could be constructed to embody my improvements in a like manner.

The construction and operation of the two cylinders being substantially the same I shall, for the present, confine my description to the cylinder A.

Referring to the drawings, the letter D designates a suction valve placed in the lower head *c* of the cylinder A and permitting the induction of air into the cylinder on the upward stroke of the piston B; the subsequent discharge on the downward stroke taking place through an eduction valve E. The discharged air is conducted by a pipe 1 to a reservoir R, where a pressure of from sixty to eighty pounds is maintained. The construction of this reservoir I will explain more fully hereinafter.

Referring now especially to Figs. 9 and 10, it will be seen that the lower head *c* of the cylinder is cast with a chamber d^0 formed concentric with the piston rod *a*, in which chamber the valve D operates. A lateral opening or orifice d^2 permits the ingress of air into the chamber. At the upper end of the chamber is formed a seat for the disk *d* forming part of the valve. The valve, which is made tubular and surrounds the piston rod, is guided by a suitable boss or collar d' formed at the lower end of the valve and fitted to the bore of said head. A stuffing box *e*, the gland of which surrounds the piston rod and enters the body of the valve prevents leakage between the valve and the piston rod during compression. During the downward stroke of the piston the valve D is carried to, and held against its seat by the friction between the piston rod *a* and the stuffing box *e*, but on the upward stroke the valve is lifted from its seat by friction to admit air to the cylinder; its motion under ordinary circumstances being limited by a detent such as the tappets *f f* moving with the valve and adapted to strike against the cylinder head when the valve is fully lifted. In this instance I have shown the tappets forming a continuation of the bolts employed for drawing up the gland of the stuffing box *e* and entering sockets f' f' in the cylinder head.

The eduction chamber *g* to which the reservoir R is connected by pipe 1, is in the form of an annular passage connected by openings with the cylinder, which openings are controlled by valves E, normally held against their seats by the springs g' and the pressure in the reservoir.

As before stated the motion of the valve D is normally limited by the tappets *f f*; but in case the pressure of the air in the reservoir should exceed the prescribed limit, in view of a reduction in the charge for the engine by a variation in the point of cut off, the action of the motor pump, as I shall hereinafter term this arrangement of cylinder, is practically suspended by automatically holding the valve D closed while such excess of pressure exists.

In Figs. 1 and 10 I have illustrated the device employed, which consists of a casing F containing a diaphragm *h* forming a pressure chamber, with which the reservoir is in communication through a pipe 2. A spring h' is arranged to bear upon the opposite side of the diaphragm, the pressure of which can be regulated by the adjusting screw *i* to bring it to the desired limit. To the diaphragm *h* is secured a forked detent i' the arms of which are arranged in line with the tops of the tappets *f f*, so that when the detent is thrown across the path of the same the valve D cannot be lifted from its seat during the upward stroke of the piston. It will readily be seen that when the pressure of the air in the reservoir exceeds that determined by the spring h', the diaphragm is extended and the valve D is held to its seat,—thereby entirely suspending the pumping action of the motor-pump during as many strokes as may be necessary to cause a reduction of the pressure to the proper limit, whereupon the detent is withdrawn. In this manner I provide for a substantially constant pressure in the reservoir, without the use of a blow off valve, and the consequent loss of energy.

It is evident that the diaphragm may be replaced by a piston, and that in place of holding the valve closed, it may be held open by the action of the pressure regulator, so that the air is simply drawn into the cylinder during the upward stroke of the piston and then forced out through the inlet opening during the downward stroke.

The reservoir R, Fig. 2, in which the compressed air is stored and heated, consists of a cylindrical shell closed at its top and bottom by the tube heads *r*, into which are expanded the ends of the vertical tubes *j*; the spaces above and below the tube sheets being closed by suitable bonnets j'. The air to be heated under pressure passes through the tubes *j*, while the exhaust gases for heating the air pass around said tubes.

As before stated the two cylinders and the parts appertaining thereto, as well as the reservoirs are constructed substantially alike, the only difference being that the cylinder A' has its motor pump inlet opening d^* connected with the gas supply so as to compress and force the gas into the second reservoir R', and consequently a packing h^4 must be introduced between the air inlet valve D and the cylinder head *c* to prevent the entrance of air about the valve. Such a packing I have shown in Fig. 11.

It will be noticed from the above that the air and gas are compressed separately in separate reservoirs, whereby the danger of explosion attending the storage of large volumes of the combustible mixture (air and gas) is avoided. Also that by heating the gases after compressing and while confined, an increase of economy is effected.

I will now proceed to describe the admission valves and their operation. Between the two cylinders A A' (Figs. 3 to 9) are located two chambers G G', one G of which is connected by a pipe 3 with the compressed air reservoir R, while the other G' is connected by a pipe 4 with the compressed gas reservoir R'. Above these chambers are located horizontal passages l l' formed in projections a' cast on the cylinders A A', and leading to the induction ports m m' of the respective cylinders. Each of these passages is connected by vertical openings *n n* with the air chamber G and by openings n' n' with the gas chamber G', so that into each passage l l' air and gas can be introduced. At the upper terminals of the vertical passages are formed seats for upwardly opening puppet valves H H and I I, the valves H operating to admit the air to the passages l l' and the valves I to admit gas to the same simultaneously with the admission of air, from whence they are conducted through the induction ports to the cylinder and exploded at the point of cut off by a suitable igniter as J, which in this instance I have shown as an electric igniter. The valves H H and I I are provided with pistons h^3 (Figs. 1 and 9) of a larger area than the lower faces of the valves which pistons work in suitable bores in the casting of the air and gas chambers G G', so that the air and gas under reservoir pressure act to balance the valves and to close the same against their seats, thus dispensing with the use of springs or weights, and with stuffing boxes. The pistons of course can be replaced by diaphragms. The cylinders are provided with independent exhaust ports p p' from which are led passages q q' controlled by puppet valves L L. The exhaust is conducted by pipes 5 and 6 to the reservoirs R R' and in passing through the space around the tubes *j* heat the air and gas contained in the respective reservoirs. The exhaust after passing through the reservoirs is conducted away at 7.

The valve gear for operating the admission and exhaust valves, may be of any suitable construction, suffice it to say that the gear should be so designed as to open communication between the reservoirs and the cylinders at the dead center; to cut off at variable portions of the stroke, dependent on the action of a suitable governor; and to open the exhaust at the end of the stroke and to hold it open until the end of the return stroke. The particular valve gear herein shown as being best adapted for the purpose, I am about to claim in a separate application.

It will be readily understood from the foregoing description that the method according to which the gases are worked in the engine described consists essentially in separately compressing the air and gas; heating the air and gas while under pressure and in separate reservoirs by the exhaust gases, admitting air and gas simultaneously to the cylinder and in variable amounts determined by the point of cut off, but in constant proportions; exploding the charge at cut off, and expanding to the end of the stroke.

In governing the engine by varying the power of the impulses as described, instead of varying their number, increased steadiness in the running of the engine is obtained, while an increased efficiency results in view of the increased expansion over the Otto cycle.

The engine shown is designed for the consumption of producer gas, and with such gas the volume of air and gas employed for complete combustion is substantially in ratio of one to one, consequently the cylinders are constructed to deliver this proportion of air and gas.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a gas engine, the combination of two motor pump cylinders constructed for the generation of power and the compression of gaseous fluid, two reservoirs for the separate storage of air and gas, and passages connecting the reservoirs with the pump ends of said cylinders separately, and with the motor ends conjointly; the said pump ends of the cylinders being constructed to deliver the gaseous fluids to the reservoirs at a pressure necessitating no additional compression at the motor ends of the cylinders, substantially as described.

2. In a gas engine, the combination of two motor pump cylinders constructed for the generation of power and the compression of gaseous fluid, two reservoirs for the separate storage of air and gas, passages connecting the reservoirs with the pump ends of said cylinders separately and with the motor ends conjointly; the said pump ends of the cylinders being constructed to deliver the gaseous fluids to the reservoirs at a pressure necessitating no additional compression at the motor ends of the cylinders, and connections for leading the exhaust gases through the reservoirs, substantially as described.

3. In a gas engine the combination of two motor pump cylinders for the generation of power and the compression of gaseous fluid; two reservoirs for the separate storage of air and gas, passages connecting the reservoirs with the pump ends of said cylinders separately and with the motor ends of the cylinders conjointly, and pressure regulating devices in connection with the reservoirs, constructed to suspend the action of the pumps for one or more strokes when the pressure exceeds the required limit, substantially as and for the purpose specified.

4. In a gas engine, the combination of a motor pump cylinder, a reservoir for compressed fluid, and a regulating device in connection with the reservoir and adapted to engage with and hold closed the inlet valve of the pump end of the cylinder to suspend the pumping action of the same for one or more strokes when the reservoir pressure exceeds the prescribed limit, substantially as described.

5. The combination with the cylinders of a gas engine, of separate chambers in the valve chests for the reception of air and gas respectively, induction passages leading to the respective cylinders, two openings, one for air and one for gas leading to each of said passages, admission valves closing said openings, and means for lifting two sets of valves alternately to admit air and gas simultaneously to the respective cylinders, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 11th day of November, 1892.

BARTON H. COFFEY.

Witnesses:
KLAS H. TERNSTEDT,
J. J. MALLE.