(No Model.)

6 Sheets—Sheet 1.

E. H. GAZE.

GAS ENGINE.

No. 437,776. Patented Oct. 7, 1890.

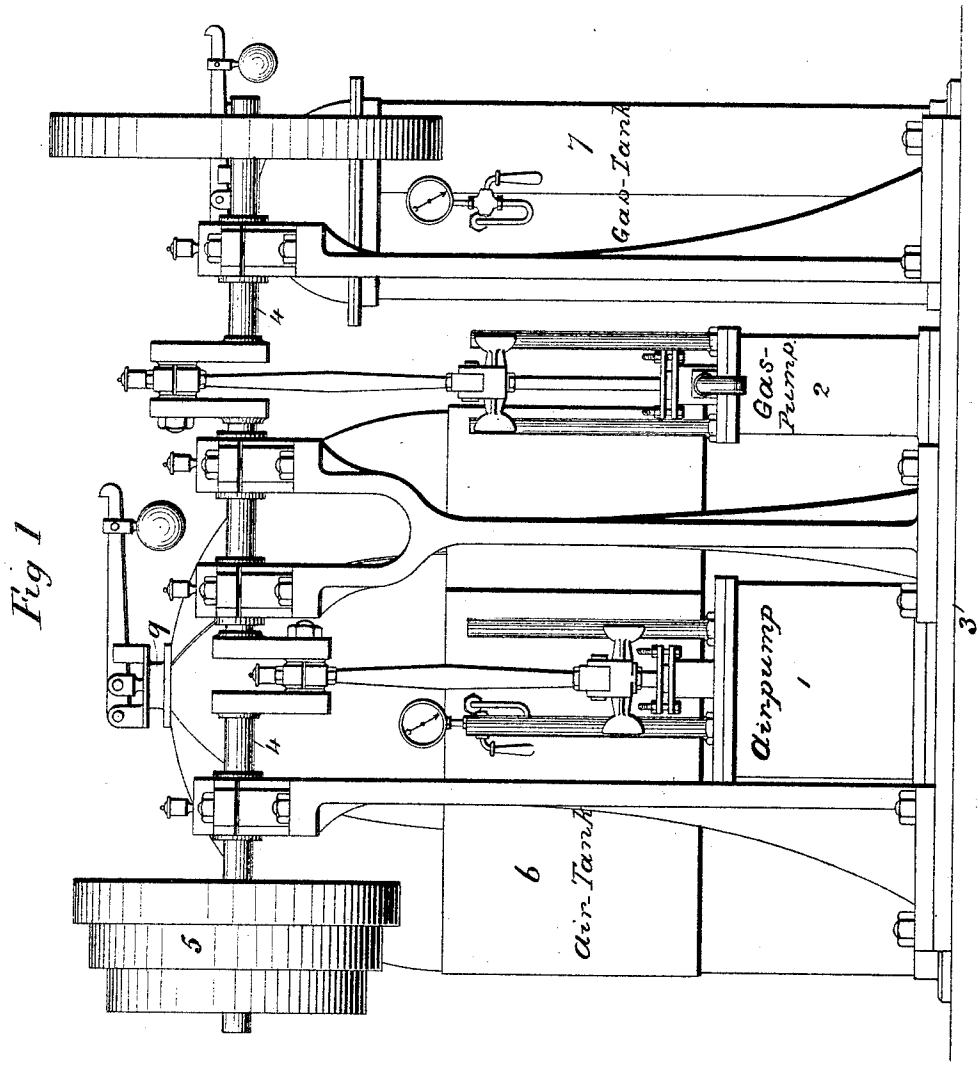

Fig 1

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(No Model.) 6 Sheets—Sheet 2.

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GAS ENGINE.

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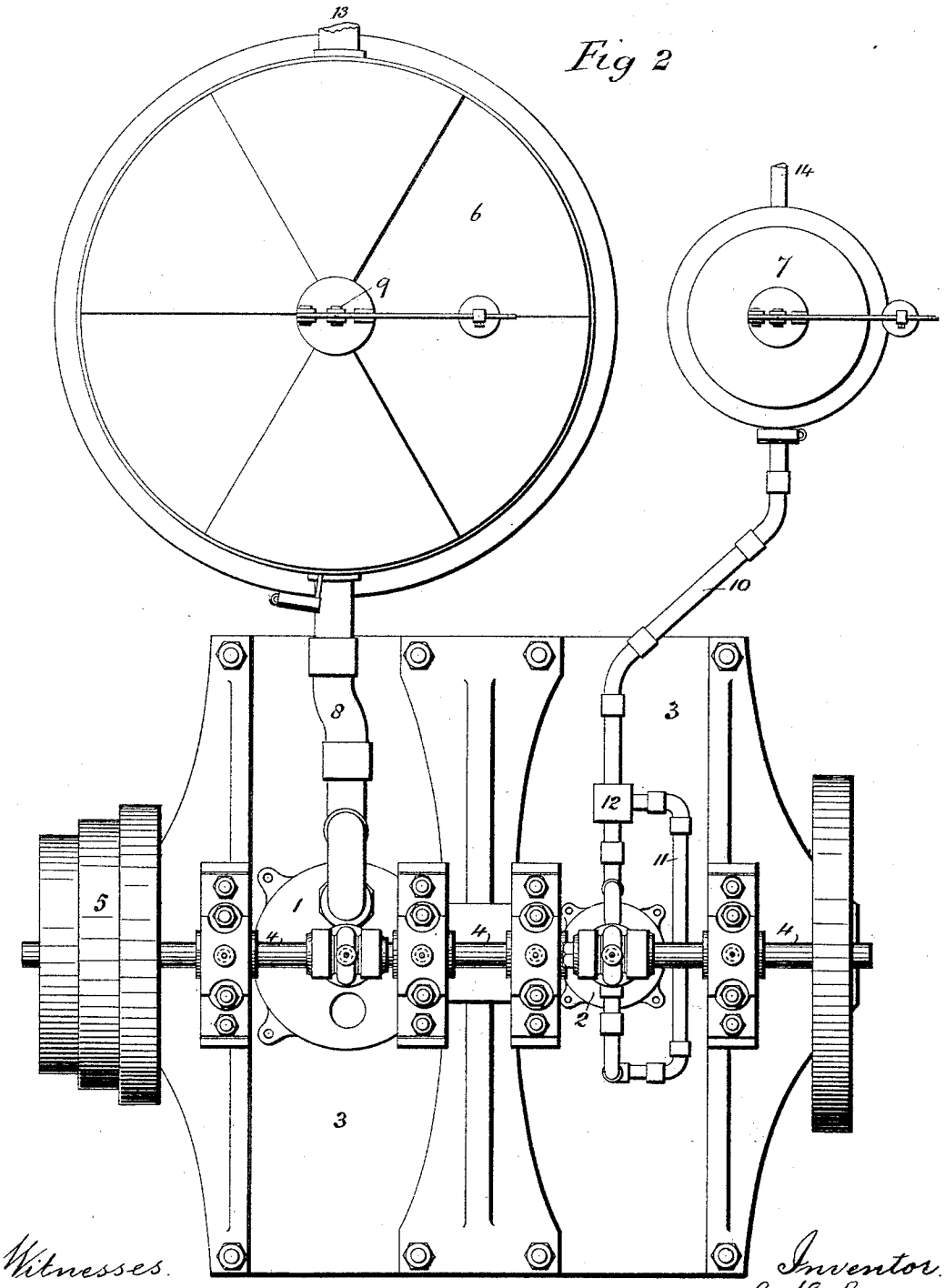
Fig 2



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(No Model.) 6 Sheets—Sheet 3.

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GAS ENGINE.

No. 437,776. Patented Oct. 7, 1890.

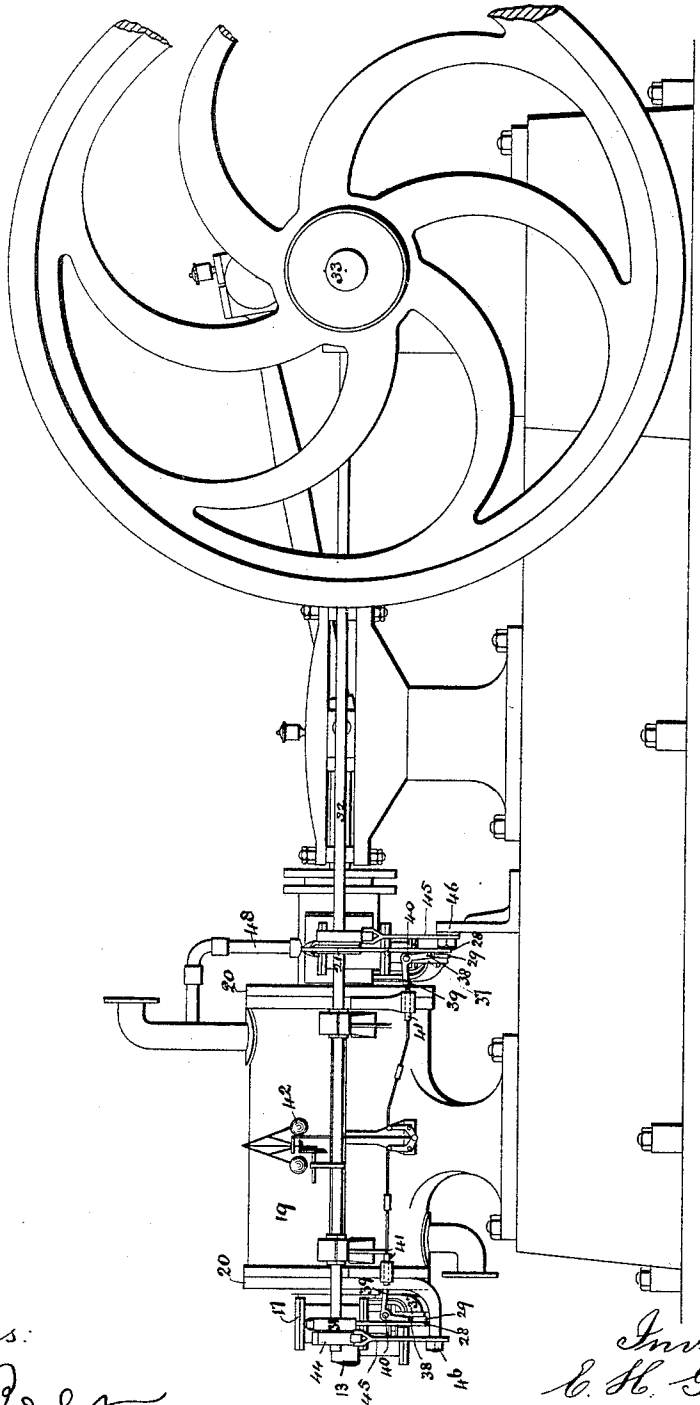

Fig 3

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(No Model.) 6 Sheets—Sheet 4.

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GAS ENGINE.

No. 437,776. Patented Oct. 7, 1890.

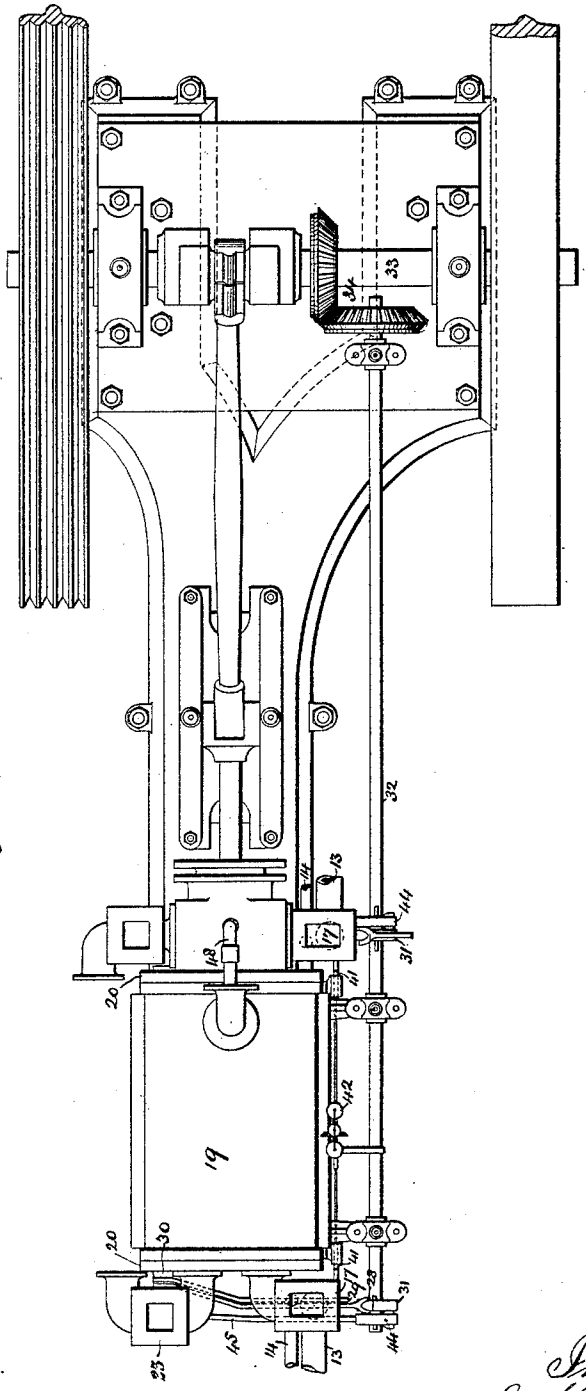

Fig 4

Witnesses:
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(No Model.) 6 Sheets—Sheet 5.

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GAS ENGINE.

No. 437,776. Patented Oct. 7, 1890.

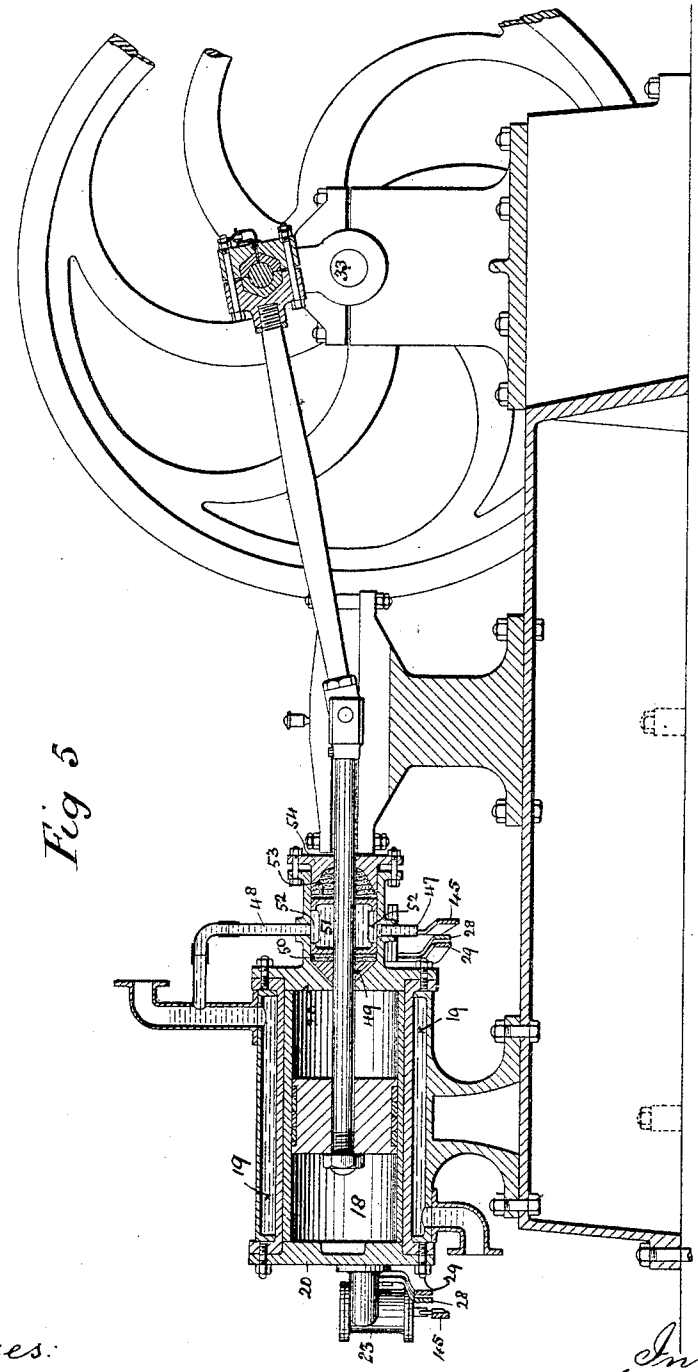

Fig 5

Witnesses:
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(No Model.) 6 Sheets—Sheet 6.

E. H. GAZE.

GAS ENGINE.

No. 437,776. Patented Oct. 7, 1890.

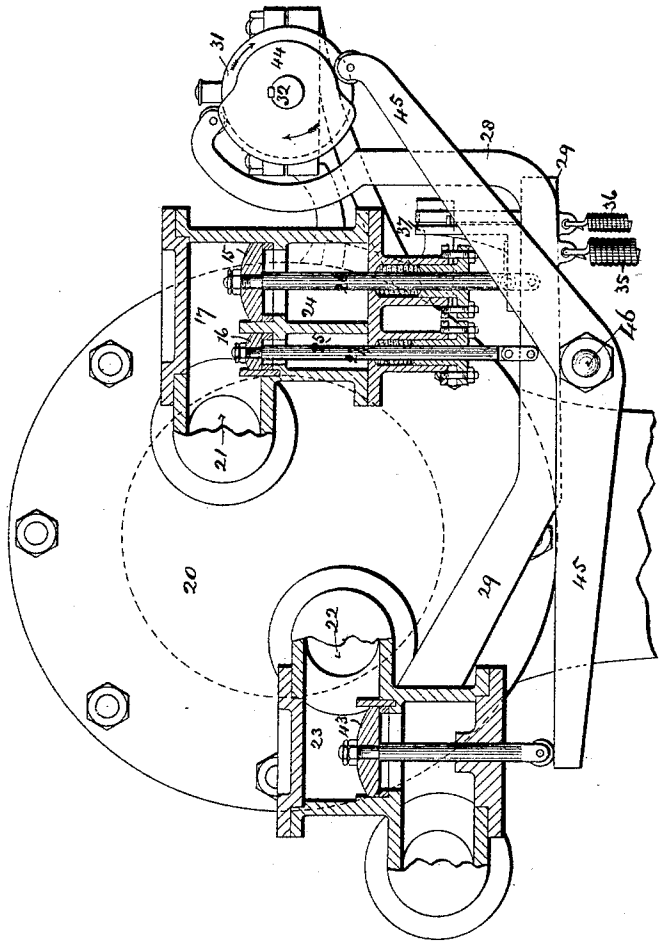

Fig 6

Witnesses:
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UNITED STATES PATENT OFFICE.

ERNEST HENRY GAZE, OF LONDON, ENGLAND.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 437,776, dated October 7, 1890.

Application filed March 4, 1890. Serial No. 342,554. (No model.) Patented in England March 14, 1888, No. 3,964, and April 23, 1888, No. 6,036; in France March 7, 1889, No. 196,531, and in Belgium June 3, 1889, No. 86,490.

To all whom it may concern:

Be it known that I, ERNEST HENRY GAZE, a subject of the Queen of Great Britain and Ireland, residing at Walterton Road, London, England, have invented new and useful Improvements in Gas-Engines, (for which I have obtained Letters Patent in Great Britain, No. 3,964, dated March 14, 1888, and No. 6,036, dated April 23, 1888; in France, No. 196,531, dated March 7, 1889, and in Belgium, No. 86,490, dated June 3, 1889,) of which the following is a specification.

My invention for improvements in gas-engines consists in the construction of an engine provided with apparatus to systematically and separately compress and store air and gas to supply the motor-cylinder of gas-engines with compressed charges of air and gas at a sufficient pressure to give an initial impulse and motion to the motor-piston at and during the admission of the ordinary working-charges and previous to their being exploded. The said charges need no compressing or recompressing in the motor-cylinder, so that the pressure and force of the working-charges are previous to their explosion available to start or assist in starting the engine by propelling the motor-piston to the point of cut-off. When the supply of air and gas is shut off, the then mixed charges of air and gas are exploded in the motor-cylinder in the usual manner by an ordinary heat tube ignitor. No compressing or recompressing having to be effected in the motor-cylinder, the engine may be arranged as a double-acting engine to receive in every stroke an initial impulse from its ordinary working-charges at and during their admittance to the motor-cylinder, followed by a second impulse in the same stroke resulting from the force of the explosion of the said charges, while simultaneously exhausting on the other side of the piston to that which receives an impulse or impulses in every stroke; or the engine may be arranged as a single-acting engine to receive during each outstroke an initial impulse from the working-charges at and during their admittance to the motor-cylinder, followed by a second impulse in the same stroke from the force of the explosion and to exhaust during each return-stroke. The speed of the pumps charging the compression-storage reservoirs may be altered and varied to the speed of the engine in order to vary the pressure of the stored air and gas in the reservoirs, and consequently the pressure of the charges during their initial propulsion of the motor-piston of the engine and the force of the after-resulting explosion. By this construction the power of the engine can be adjusted to the load and the governing reduced and regularity of turning obtained. The compressing apparatus may be driven by the engine actuated by it or by a separate engine, and one or more engines may obtain their working-charges from the same compressing and storing apparatus. The reservoirs are made sufficiently large to maintain the pressure steady during withdrawals of power by the engine or engines.

In the accompanying six sheets of drawings the engine is shown with the necessary chest, valves, and mechanical arrangements at the front end of the cylinder for a double-acting engine; but it will be obvious that if these are omitted at the front end of the other cylinder and the front cover of the cylinder removed the result is a single-acting engine.

Figure 1 is a part elevation of an apparatus suitable for compressing and storing the air and gas constructed according to my invention, and Fig. 2 is a plan of the same. Fig. 3 is a side elevation of a single-cylinder double-acting compression gas-engine, taking power from one or two impulses in every stroke and exhausting simultaneously on the other side of the piston, constructed according to my invention; and Fig. 4 is a plan. Fig. 5 is a longitudinal section; and Fig. 6 is a transverse section, through the valve-chest on the outside end of the cylinder, showing the cams and levers of the same.

The air-pump 1 and gas-pump 2 are arranged on a bed-plate 3, and are driven from a crank-shaft 4, itself driven by a belt working on the cone-pulley 5 from the gas-engine or actuated from a separate engine. The air and gas pumps are water-jacketed to reduce the elevation of temperature of the air and gas due to the compression, and consequently the power required to compress them. The air and gas are pumped, respectively, into the

reservoirs 6 and 7, which are maintained at the same pressure. By means of the cone-pulleys 5 the speed of the pumps can be adjusted to regulate the supply to the reservoirs 6 and 7, according to the consumption of the engine or engines, and also to vary the initial pressure on admittance to the cylinders, and consequently the force of the resulting explosions to suit the load on the engine. The air-pump 1 is connected by the pipe 8 directly to the air-reservoir 6, provided with an escape-valve 9, which limits the pressure in the reservoir. The gas-pump 2 is connected by a pipe 10 to the gas-reservoir 7. A pipe 11 communicates with a pipe 10 through a return-valve 12, so adjusted that when the pressure in the gas-reservoir 7 exceeds a predetermined amount the gas from the pump 2 passes through the return-valve 12 into the pipe 11 and thence back to the gas-supply. The air and gas reservoirs 6 and 7 communicate with the engine or engines to be driven by the separate outlet-pipes 13 and 14. The proportions of air and gas admitted to the cylinder are adjusted by screw-down valves on the air and gas pipes 13 and 14 close to the admission-chests of the engine.

In a gas-engine constructed according to my invention the air and gas in the reservoirs 6 and 7 are admitted simultaneously through the separate supply-pipes 13 and 14 and separate valves 15 and 16 to the valve-chests 17 and thence to the cylinder 18 of the engine. The then mixed air and gas by their pressure cause the initial propulsion of the engine in every working-stroke, and are afterward exploded without further compression or recompression in the manner usual in gas-engines to increase their pressure.

It will be evident that an engine constructed according to my invention requires no supplementary starting arrangement, nor to be started by manual force, as at present, and that no clearance-spaces are required for compressing or recompressing at the ends of the cylinder.

The motor-cylinder 18, in which the piston is caused to travel from end to end, is surrounded by the water-jacket 19, and is closed at its ends by covers 20. In each cover are ports 21 and 22, communicating with the interior of the cylinder and with admission and exhaust chests 17 and 23, respectively, in the former of which are the two puppet-valves 15 and 16, communicating, respectively, with the air and gas reservoirs through the outer chests 24 and 25. The spindles 26 and 27 of the said valves pass through stuffing-boxes and are connected by links to the levers 28 and 29, hinged at 30 and working on the cam 31 on the cam-shaft 32, driven from the crank-shaft 33 of the engine through the bevel-wheels 34. The levers 28 and 29 and the valves 15 and 16 are held down, when the lever 28 is not raised by the cam 31, by means of springs 35 and 36 or by weights. By these means the air and gas under pressure from the reservoirs are prevented from forcing the valves 15 and 16 off their seats when the pressure in the cylinder is reduced. The valves also receive the force of the explosions while resting on their seats. On the end of the lever 29 is a bracket 37, carrying a bell-crank or trigger lever 38 39, free to oscillate to a limited extent about its axis 40, so that in its normal position its arm 38 hangs over the lever 28 in such a manner that on the lever 28 being elevated the lever 29 is elevated also, and thus both valves 15 and 16 are opened simultaneously. When, however, the speed of the engine exceeds the predetermined rate, the sliding bolt 41 is caused by the governor 42 to slide forward into the path of motion of the arm 39 of the trigger-lever and arrest its downward motion, thereby causing it to turn on its axis and carry its arm 38 clear of the lever 28. It will be clearly seen that by these means the next elevation of the lever 28 actuates the air-valve only, the lever 29 remaining quiescent, so that air only is admitted to the cylinder and expanded by the heat from the walls of the cylinder remaining from previous explosions. The exhaust-valve 43 is actuated by the cam 44, acting through the lever 45, fulcrumed at 46, as clearly shown.

The piston-rod stuffing-box is constructed as follows: Pipes 47 and 48 convey water to and from the stuffing-box, a conical metal disk 49 being placed at the cylinder end, then some rope or other engine-packing 50, then a metal box or chamber 51, which may be constructed in halves, just fitting the inside of the stuffing-box, but not touching the piston-rod, and having slots or holes 52 to permit of the free circulation of the water onto and around the piston-rod, and also to the packing, and then another ring of packing 53, and, lastly, the gland 54 is screwed down, holding all tight. The charges are exploded at any desired part of the stroke after the cut-off is effected by means of a hole in the cylinder at the required part. The hole is in communication with an iron tube, the projecting end of which is inclosed in another tube and heated by an atmospheric gas-burner.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination, with a gas-engine and separate reservoirs for holding its supply of gas and air, of an air-pump and a gas-pump for maintaining an equal pressure in each reservoir, said pumps being driven by a crank-shaft common to both, and means, such as cone-pulleys, for coupling the said crank-shaft to the gas-engine, whereby the speed of the pumps may be simultaneously changed and adjusted to vary the initial pressure of the gas and air in the reservoirs to the requirements of the gas-engine, substantially as set forth.

2. In a gas-engine, the combination, with the air-supply valve and the gas-supply valve, of a pivoted lever for opening the air-valve

and a revoluble cam for operating said lever, a second pivoted lever for operating the gas-valve, trip mechanism normally coupling the said levers, whereby both valves are simultaneously operated by the said cam, and a sliding stop controlled by the speed-governor for said trip mechanism to strike against, thereby disengaging the gas-valve lever when the speed of the engine becomes too great, substantially as set forth.

3. In a gas-engine, the combination, with the air-supply valve and the gas-supply valve, of a pivoted lever for opening the air-valve and a revoluble cam for operating said lever, a second pivoted lever for operating the gas-valve, a bell-crank lever pivotally supported by one lever and engaging with the other lever, whereby both levers are operated simultaneously by the said cam, and a sliding stop controlled by the speed-governor for the horizontal arm of said bell-crank lever to strike against, thereby temporarily disengaging the gas-lever when the speed of the engine becomes too great, substantially as set forth.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ERNEST HENRY GAZE.

Witnesses:
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