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R. A. MITCHELL & L. L. LEWIS.

GAS ENGINE STARTER.

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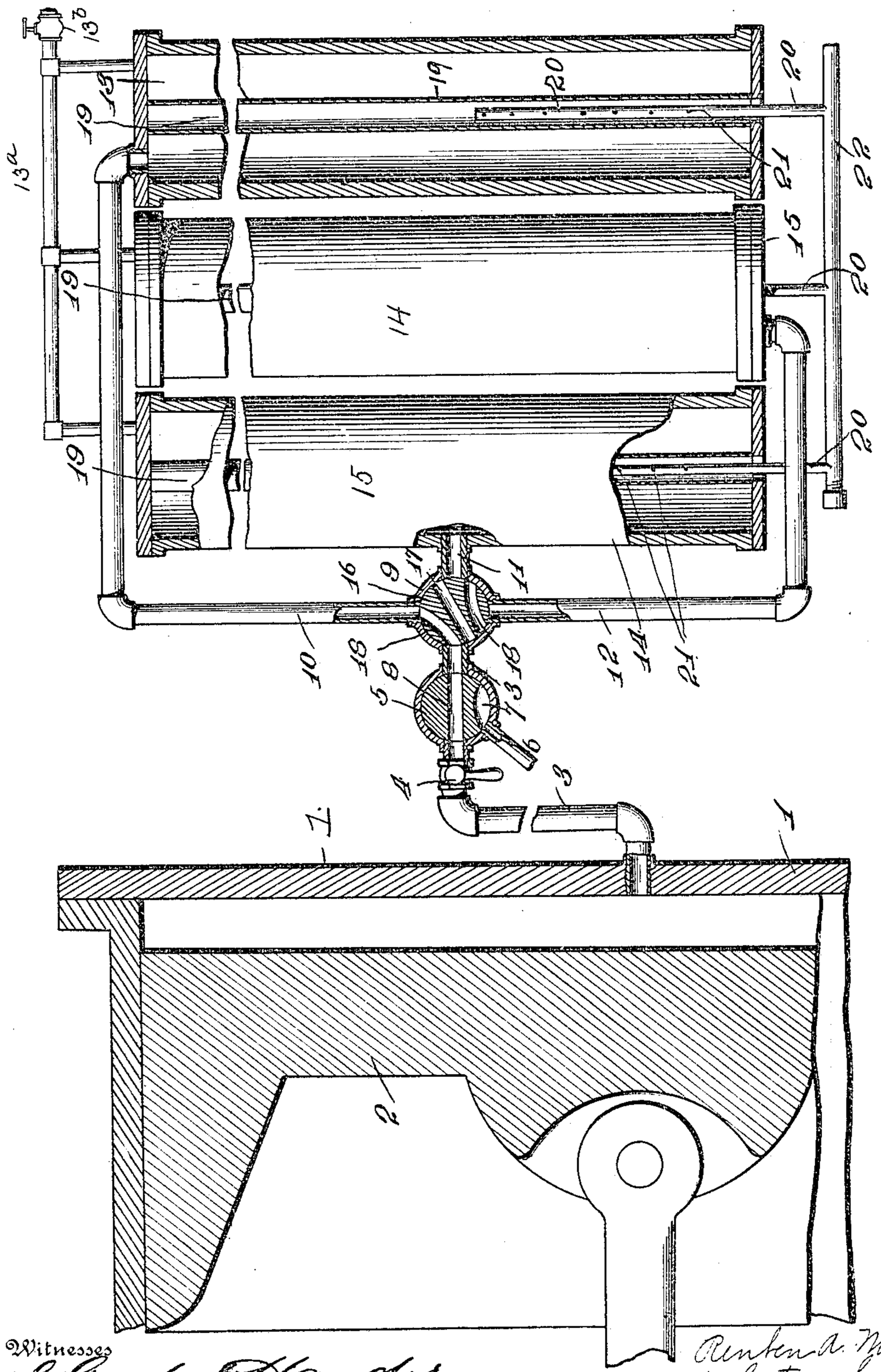

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UNITED STATES PATENT OFFICE.

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GAS-ENGINE STARTER.

SPECIFICATION forming part of Letters Patent No. 787,341, dated April 11, 1905.

Application filed October 29, 1903. Serial No. 179,075.

To all whom it may concern:

Be it known that we, REUBEN A. MITCHELL and LESTER L. LEWIS, citizens of the United States, residing at Oil City, in the county of Venango and State of Pennsylvania, have invented certain new and useful Improvements in Gas-Engine Starters; and we 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.

This invention relates to improvements in gas-engine-starting apparatus, and particularly to means for controlling the admission of pressure from a source of supply to an engine-cylinder.

The object in view is the provision of means for supplying a number of successive charges to a gas-engine cylinder controlled by a single valve.

With this and further objects in view the invention consists in certain novel constructions, combinations, and arrangements of parts, as will be hereinafter fully described and claimed.

In the accompanying drawing the figure represents a longitudinal vertical central section through a mechanism embodying the features of the present invention, parts being illustrated in elevation.

In the present art it is common to start a gas-engine by extrinsic mechanical power, and it has been proposed to impart the initial stroke to the piston of a gas-engine by supplying an expansive charge to the piston-head; but in practice we find that a single stroke of the piston is sometimes insufficient for securing the desired compression of the explosive charge for producing a perfect explosion, and by the present improved apparatus we contemplate introducing a series of successive charges of expansible fluid to a gas-engine cylinder for insuring the successful starting of the piston thereof; and in carrying out the invention we employ elements such as are illustrated in the embodiment delineated in the accompanying drawing, in which 1 indicates any suitable gas-engine cylinder provided with a piston 2. A tube 3 discharges into the explosion end of the cylinder 1, and an ordinary hand-operated plug-valve 4 is interposed in the length of tube 3 for controlling the admission of pressure therethrough. An exhaust-valve 5 is also interposed in the length of the tube 3, and the casing of said valve is provided with an exhaust-port 6, adapted to be thrown into communication with the bore of pipe 3 by means of the passage 7, formed in said valve 5, and such communication being established when the valve is rotated to the position indicated in dotted lines. A central passage 8 is formed in valve 5 for normally establishing communication between the sections of pipe 3. The section of pipe 3 beyond the valve 5 communicates with the valve-casing 9, which casing is also in communication with tubes 10, 11, and 12, communicating with receptacles or tanks 13, 14, and 15, respectively. A valve 16 is rotatably mounted within the casing 9 and is provided with a central straight passage 17 and side passages 18 18, whereby the pipes 10, 11, and 12 may be successively thrown into communication with pipe 3 by rotation of the valve 16.

The receptacles or tanks 13, 14, and 15 in practice are supplied with air or other gas under pressure and are provided with suitable heating means of any preferred type. We have illustrated as a means for rapidly heating the said receptacles a central tube 19 in each of the tanks extending longitudinally thereof and surrounding a gas-supply pipe 20, apertured, as at 21, and leading to a common gas-supply pipe 22.

In operation after the tanks 13, 14, and 15 have been charged with a supply of compressed air—say under a pressure of one hundred pounds—the cut-off valve 13^b in feed-pipe 13^a is closed, thereby sealing said tanks 13 14 15, after which the gas is turned on through pipe 22, and the gas discharged through the burners formed of pipes 20 is ignited for heating the tubes 19 and the air within the surrounding receptacles. The heat may be regulated as desired; but we prefer to raise the temperature of the contained atmosphere sufficiently for increasing the

pressure approximately seven times, whereby a charge passing from one of the tanks into the cylinder 1 will be effective in throwing the piston 2. When the desired pressure is secured within the tanks 13, 14, and 15, the valves 5 and 9 being in the position indicated in the drawing, the valve 4 is opened and the air within the tank 13, expanding, passes out through tube 10, upper passage 18, and tube 3 into the cylinder 1, throwing the piston 2, and as soon as the said piston reaches the limit of its receding movement the valve 5 is moved to the position indicated in dotted lines, whereupon the charge within the cylinder 1 is exhausted and the piston 2 permitted to return to its former position. As soon as the piston 2 has reached the limit of its return stroke the valve 5 is rotated to its former position, as indicated in full lines in the drawing, and the valve 9 is rotated for bringing the passage 17 into register with pipes 11 and 3, and a second charge is thus admitted to the cylinder 1, which throws the piston, as above described, and the charge may be exhausted in a similar manner to the exhausting of the first charge, whereupon the valve 9 is rotated for bringing the lower passage 18 in position for establishing communication between pipes 3 and 12, and a third charge thus admitted to the cylinder 1.

With the high degree of pressure which we secure with our tanks it may not be necessary each time the engine is started to utilize all of the charges, and, in fact, a single charge may be sufficient for successfully starting the gas-engine; but with the arrangement of the elements disclosed it will be seen that a failure to start the engine is hardly possible.

It is obvious that when a charge has been shot from one of the tanks 13 14 15 to the engine-cylinder the pressure in such tank is substantially exhausted, owing to the relatively small size of said tanks compared with the capacity of the engine-cylinder. The device illustrated in the drawing is meant to be operative in such manner that only a single shot or charge of compressed and heated air from a tank may be available. We do not intend that a tank as either of the three illustrated in the drawing may be used for a succession of charges or shots to the engine-cylinder without recharging and reheating the compressed air in the tank, but prefer that the tanks be charged after each shot, so that full advantage may be given by reason of the great increase in pressure owing to the rise of temperature of the compressed air in the tank.

It will be seen by reference to the drawing that we have provided means for heating the atmosphere within the tanks 13, 14, and 15, and such heating means is so arranged as to readily produce an excessively high temperature or superheated condition of the contained compressed air, whereby the said air will have its pressure multiplied to a maximum degree. The burners 20 are so arranged within the respective tanks 13, 14, and 15 that the heat produced thereby is diffused approximately evenly throughout the respective tanks, and the contained air has all of its parts substantially simultaneously heated, whereby a maximum amount of pressure may be obtained in a minimum time. The heated compressed air is admitted to the explosive-engine cylinder, as above set forth, and while we have illustrated and described the employment of a plurality of tanks we find that by the superheating of the air sufficient pressure may be obtained for imparting sufficient force to the piston in the cylinder for effectually starting the engine by a single discharge from one of the tanks.

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

1. In a gas-engine starter, the combination with a gas-engine, of a plurality of tanks, a tube communicating with said gas-engine, an exhaust-valve interposed in said tube, tubing extending from said tanks and communicating with said tube, and a valve controlling communication between said tubing and the first-mentioned tube.

2. In a gas-engine starter, the combination with a gas-engine, of a plurality of tanks, a valve-casing, tubes extending from said tanks to said casing, a pipe leading from said casing to said engine, and means within said valve-casing for successively establishing communication between said tubes and pipe.

3. In a gas-engine starter, the combination with a gas-engine, of a plurality of tanks, a pipe communicating with said engine, tubing establishing communication between said tanks and pipe, a multiple-passage valve controlling communication between said tubing and pipe, and exhaust mechanism interposed in the length of said pipe.

4. In a gas-engine starter, the combination with a gas-engine, of a compressed-air tank, means of communication between said tank and engine, a pipe extending longitudinally through the interior of said tank, and an apertured gas-supply pipe extending into said pipe.

5. In a gas-engine starter, the combination with a gas-engine, a plurality of tanks, a tube communicating with said gas-engine, a tube extending from each of said tanks and communicating with said first-mentioned tube, and a valve controlling said communication formed with a plurality of passages adapted to be brought into line with the first-mentioned tube and with the respective last-mentioned tube.

6. In a gas-engine starter, the combination with a gas-engine, of a plurality of sources of pressure-supply, a valve-casing, a pipe leading from each of said sources and

communicating with said valve-casing, a valve within said casing formed with a number of passages equal to the number of said tubes, and a pipe extending from said casing to said cylinder.

7. In a gas-engine starter, the combination with a gas-engine, of a plurality of sources of pressure-supply, a coupling, a conduit leading from each of said sources of pressure-supply to said coupling, a conduit extending from said coupling to said cylinder, and means within said coupling for establishing communication between said last-mentioned conduit and said first-mentioned conduits successively.

8. In a gas-engine starter, the combination with a gas-engine, of a plurality of compressed-air-storage tanks, heating means therefor, a coupling, a conduit leading from each of said tanks and communicating with said coupling, a pipe leading from said coupling to said cylinder, and a valve in said coupling formed with a plurality of passages designed to register successively with said conduits for establishing communication between said pipe and the conduits.

9. In an explosive-engine starter, the combination with an explosive-engine, of a compressed-air reservoir in communication with said engine, and means for heating the air within said reservoir.

10. In an explosive-engine starter, the combination with an explosive-engine, of a compressed-air reservoir, means of communication between said reservoir and engine, means for heating the air within said reservoir, and means for controlling the discharge of heated air from said reservoir to said engine.

11. In an explosive-engine starter, the combination with an explosive-engine, of a compressed-air reservoir of less containing capacity than that of the cylinder of said engine, means for heating the air within said reservoir, and means for admitting the heated air from said reservoir to said engine.

12. In an explosive-engine starter, the combination with an explosive-engine, of a compressed-air-supply reservoir, means for heating the supply of air within said reservoir, and means for introducing the same into the cylinder of said engine for imparting the initial stroke to the piston of said engine.

13. In an explosive-engine starter, the combination with an explosive-engine, of means for introducing heated, compressed air into said engine for imparting the initial stroke to the piston thereof.

14. In an explosive-engine starter, the combination with an explosive-engine, of a reservoir for containing compressed air, means for raising the temperature of said compressed air to a superheated condition for multiplying the pressure thereof, and means for introducing such superheated air to the cylinder of said explosive-engine for imparting the initial stroke to the piston thereof.

15. In an explosive-engine starter, the combination with an explosive-engine, of a relatively small compressed-air tank, means for superheating the compressed air therein, and means for introducing the charge of superheated, compressed air into the cylinder of said engine for imparting the initial movement to the piston therein.

16. In an explosive-engine starter, the combination with an explosive-engine, of a compressed-air tank, means for heating all parts of the contained air substantially simultaneously for raising the same to a superheated condition, and means for introducing said superheated, compressed air into the cylinder of said engine for imparting the initial stroke to the piston within said cylinder.

17. In an explosive-engine starter, the combination with an explosive-engine, of a compressed-air reservoir, a heating apparatus for raising the temperature of the air within said reservoir, the combustion of the heating means being supported by oxygen supplied from outside said reservoir, and means for establishing communication between said reservoir and engine.

In testimony whereof we hereunto affix our signatures in presence of two witnesses.

REUBEN A. MITCHELL.
LESTER L. LEWIS.

Witnesses:
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