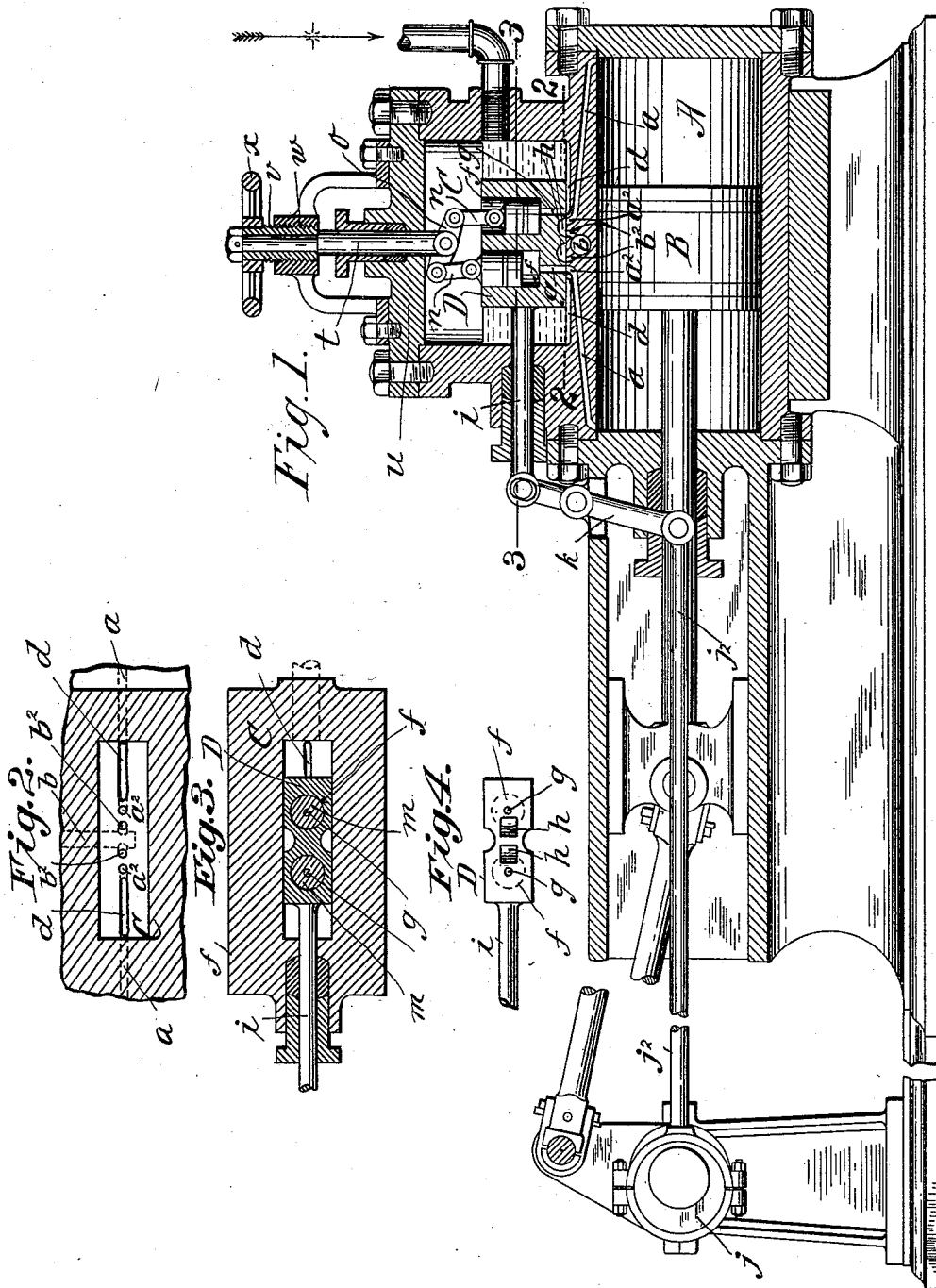


(No Model.)

E. B. BENHAM.
CARBONIC ACID GAS ENGINE.

No. 543,588.

Patented July 30, 1895.



Witnesses:
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UNITED STATES PATENT OFFICE.

ELIJAH B. BENHAM, OF MYSTIC, CONNECTICUT.

CARBONIC-ACID-GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 543,588, dated July 30, 1895.

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To all whom it may concern:

Be it known that I, ELIJAH B. BENHAM, a citizen of the United States, residing at Mystic, in the county of New London and State of Connecticut, have invented new and useful Improvements in Carbonic-Acid-Gas Engines, of which the following is a specification.

This invention relates to carbonic-acid-gas engines of the class in which the carbonic-acid gas is contained in a liquefied form in a chest or chamber above the cylinder and duly admitted through the cylinder-ports to the heated cylinder for expansion therein for driving the cylinder-piston.

15 The invention more particularly pertains to the valve mechanism for admitting the carbonic-acid-gas to the cylinder and for permitting the exhaust, and which, moreover, comprises means for determining and regulating at pleasure the quantity of the gas to be admitted to the cylinder at each operation of the valve mechanism; and the invention consists in arrangements and constructions of parts, all substantially as will hereinafter
25 fully appear and be set forth in the claims.

The engine is illustrated in the accompanying drawings, in which—

Figure 1 is a central vertical longitudinal section thereof. Fig. 2 is a sectional view
30 through the chest or chamber for containing the supply of carbonic-acid-gas, taken horizontally on the level of its bottom, as indicated by the line 2 2, Fig. 1. Fig. 3 is substantially a similar sectional view, but taken
35 on the line 3 3, Fig. 1. Fig. 4 is a plan view of the under side of the valve.

In the drawings, A represents the cylinder within which is driven the piston B, the passages $a a$, for the entrance of the expansive
40 gas into the opposite ends of the cylinder at alternating instants, leading thereto from the comparatively close or contiguous ports $a^3 a^3$, upwardly opening into the chest C above the cylinder in which is the liquefied supply of
45 carbonic-acid gas.

D represents the valve sliding within the chest upon the base thereof. This is a measuring-valve and controls the quantity of the gas admitted to the cylinder from the chest
50 at each reciprocating movement of the valve and also duly permits the exhaust.

b is the lateral exhaust-passage, it having

the separate upwardly-opening ports $b^2 b^3$, both between the cylinder inlet-ports $a^2 a^2$.

The chest has in its bottom two longitudinal channels $d d$, which extend from at or
55 near the end walls of the chest in proximity to the cylinder-ports $a^2 a^2$. (See Figs. 1 and 2.) The valve is of a rectangular form and has two vertical chambers f of cylindrical form
60 opening from its top, they extending only partially to the bottom of the valve and have the axially-extended ports g of contracted diameter leading through the lower part of the valve. The valve also has within its bot-
65 tom the separated recesses $h h$, the pair of which are between the valve-ports $g g$. The slide movement of the valve, which is comparatively slight, is imparted as the engine is running by the connections between the valve-
70 stem i and eccentric j on the crank-shaft, consisting of the eccentric-rod j^2 and the intermediately-pivoted lever k , to the long arm of which the rod is pivoted, while to the short arm thereof is pivotally connected the valve-stem.
75 Within both of said cylindrical openings are plungers or pistons $m m$, having close sliding fits, each being connected at its top to a depending link n . The links have their upper
80 ends pivoted to the extremities of a horizontal lever o , which at its middle is pivotally connected to the lower end of the vertical rod t . This rod extends upwardly through a stuffing-box in the massive cap or cover u of the chest, and has at its upper extremity screw-
85 threads v , which are formed on a sleeve fixed to said rod, but which might be otherwise provided or produced. This screw-threaded part v screw engages in the threaded opening within the central hub of a fixed spider w ,
90 and the rod above the frame has a hand-wheel x or equivalent means for turning it, whereby, through the action of the screw devices, the rod may be raised or lowered, consequently raising and lowering the measur-
95 ing-pistons $m m$.

The rectilinear reciprocatory motion of the valve causes, through the rocking lever and links $o n n$, the alternating reciprocatory movements vertically of the pistons.

The valve D has such a position when at one extreme of its movement that the one end port g will come to communication with the adjacent channel d , so that, as the piston in

the chamber thereabove rises, the portion of the chamber vacated thereby may be filled with the carbonic-acid gas from the chest. At this time, as indicated in the drawings, the right-hand end of the cylinder is exhausting through passage and port a^2 , valve-recess h , and exhaust port and outlet b^2 . The valve, when so in registry, one valve-port g with one channel d and one cylinder-port a^2 with one valve-recess h , which recess establishes communication between cylinder and exhaust, has its other valve-port g in registry with the other cylinder port and passage a^2 , there being now no communication between the left-hand valve-chamber and the left-hand channel d nor between the left-hand valve-recess h and the left-hand exhaust-port b^2 . Of course at every stroke of the cylinder-piston B these relations are reversed.

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

1. A measuring valve for admitting liquefied gas to the cylinder of an engine comprising a piston having a reciprocating movement in a cylinder with a passage communicating therewith for receiving and discharging said liquefied matter, combined with a support for said piston which is adjustable for sustaining said piston at variable distances from the discharge, or lower end of said cylinder, substantially as described.

2. A measuring valve for admitting liquefied gas to the cylinder of an engine having a chamber, and a piston having a reciprocatory movement therein, and a passage for the entrance of the said gaseous matter to the valve chamber which is adapted to alternately register with a cylinder port, and to have open communication with the interior of the chamber within which the acid supply is contained, substantially as described.

3. A valve with a chamber, one side of which is movable, a chest in which it reciprocates, said valve having a passage leading through it to its said chamber, and adapted, as the valve moves to have alternately a communication with the interior of the chest, and with a cylinder port, and means for adjusting the movable side of the valve-chamber for varying the capacity of the chamber, substantially as described.

4. The combination with the cylinder, a chest above the cylinder with passages lead-

ing from adjacent points intermediately of the base of the chamber to opposite end-
portions of the cylinder, and ways or passages in said base open to the interior of the chest which lead to adjacent the cylinder ports, a slide valve movable in said chamber having the two cylindrical openings therein, and passages leading downwardly therefrom to the bottom of the valve, and adapted, as the valve moves, the one to register with the cylinder port, and the other with one of the said base ways, and vice versa, and pistons adjustably movable in said chambers for varying the capacity thereof, substantially as described.

5. The combination with the cylinder, a gas chest above the cylinder with passages leading from adjacent points intermediately of the base of the chamber to opposite end-
portions of the cylinder, and with ways or passages in said base which lead to adjacent the cylinder ports, and two exhaust ports leading from the base of the chest, a slide valve movable in said chamber having the two cylindrical openings therein, and passages leading downwardly therefrom to the bottom of the valve, and adapted, as the valve moves, the one to register with a cylinder port, and the other with one of the said base ways, and vice versa, and having also the recesses, h , h , for alternately connecting cylinder and exhaust ports, and pistons adjustably movable in said valve chambers for varying the capacity thereof, substantially as described.

6. In a carbonic acid gas engine, a valve with two chambers, f , f , and the passages, g , g , and a chest or chamber within which the valve reciprocates, having ports leading therefrom to the cylinder, all so that as the valve moves one of its chambers may have, by its passage, g , communication with a cylinder-port, while the other chamber has communication with the interior of the chest, and vice versa, the pistons, m , m , in said valve chambers, the links connected to the pistons, the lever to which the links are hung, the rod to the lower end of which the lever has its middle pivoted, a fixed part through which the rod has a screw engagement, and means for turning the rod, substantially as and for the purpose set forth.

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Witnesses:

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