(No Model.)

G. M. WARD.

GAS MOTOR.

No. 311,214. Patented Jan. 27, 1885.

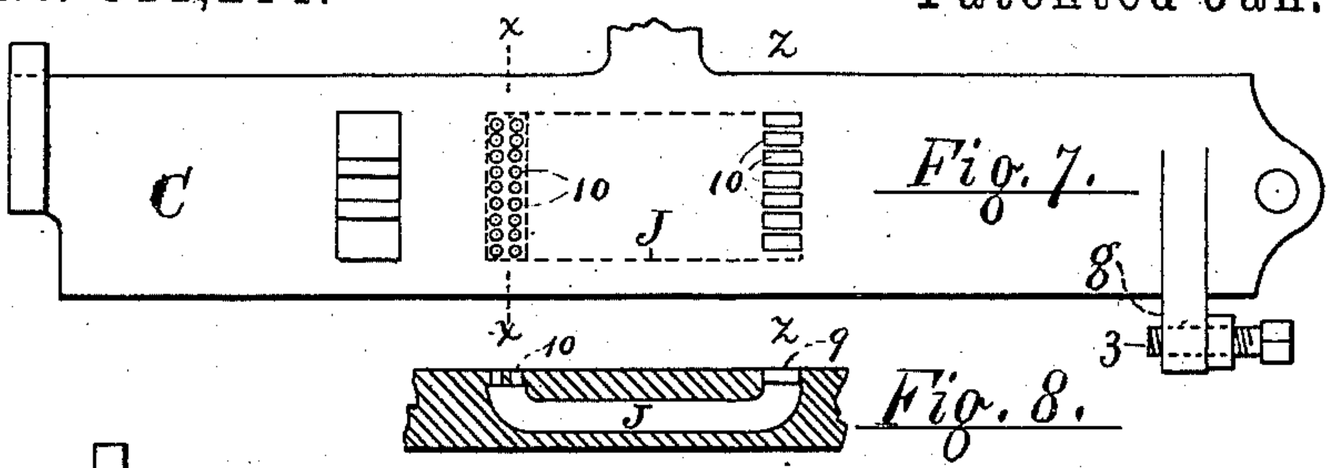


Fig. 7.

Fig. 8.

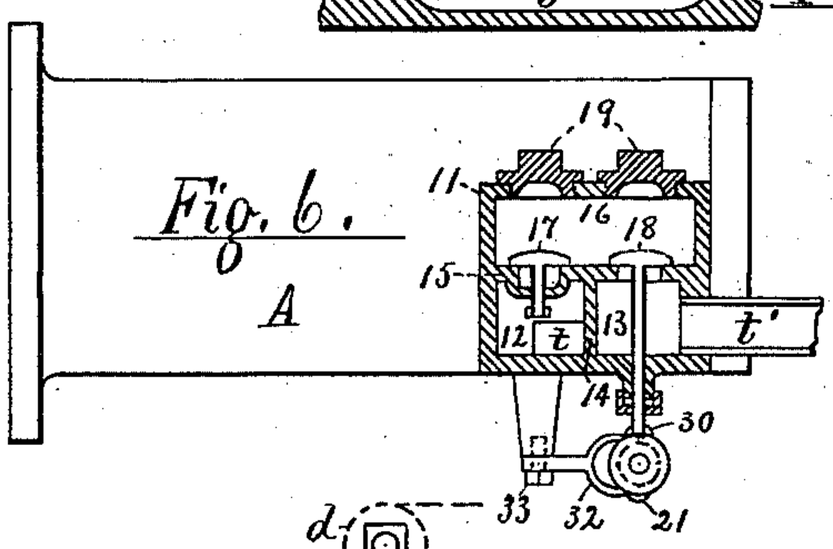


Fig. 6.

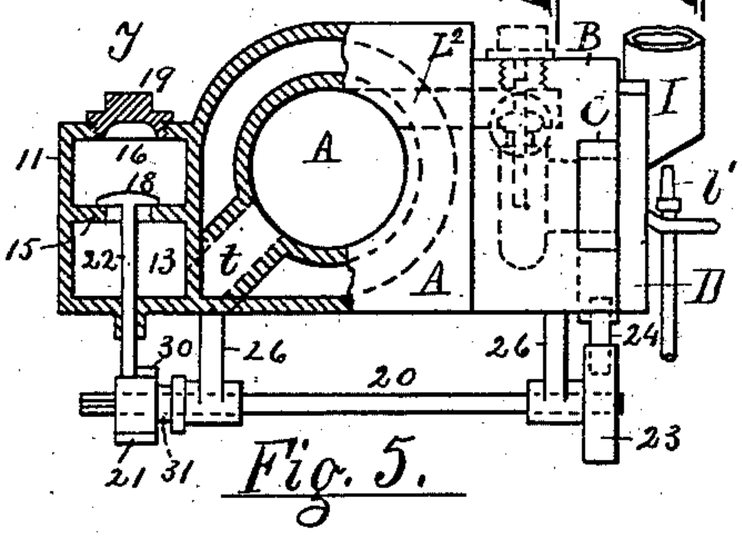


Fig. 5.

Fig. 10.

Fig. 9.

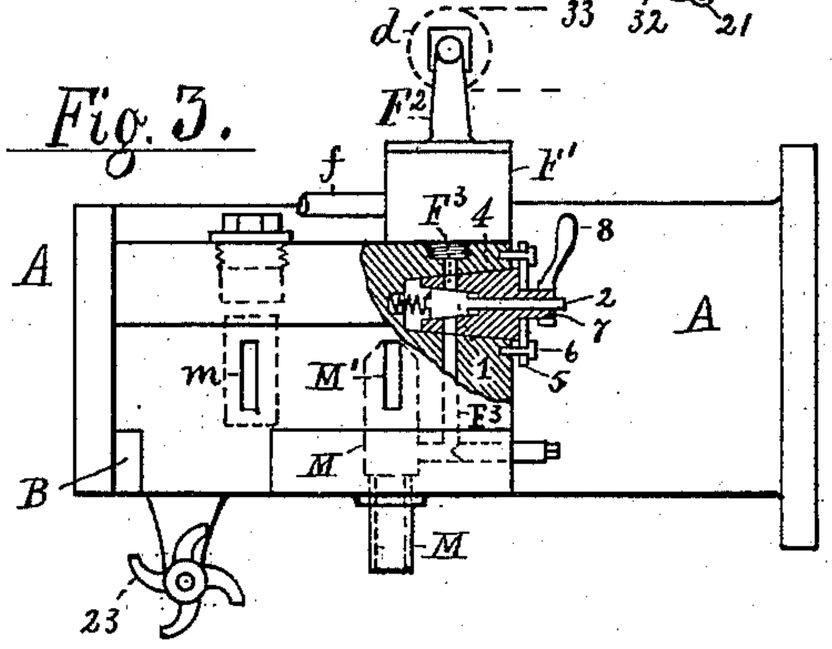


Fig. 3.

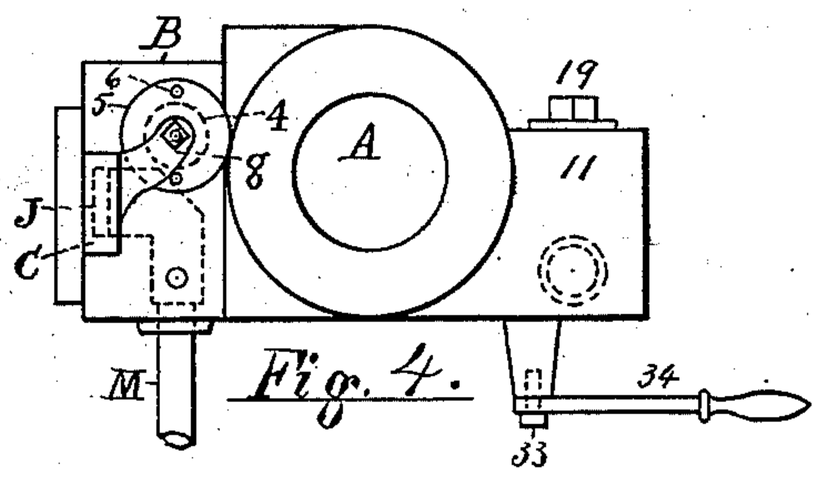


Fig. 4.

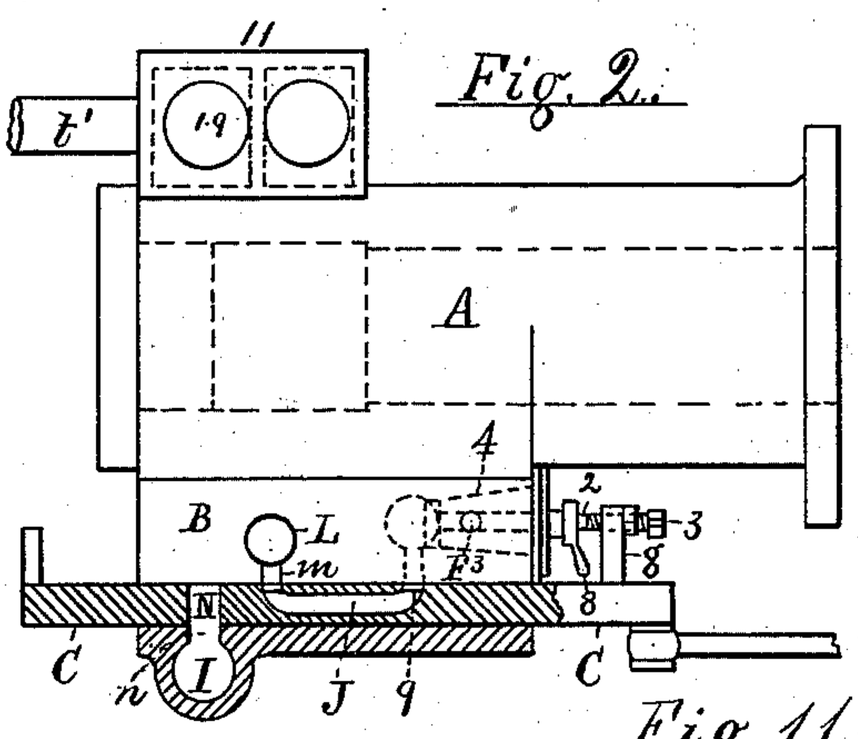


Fig. 2.

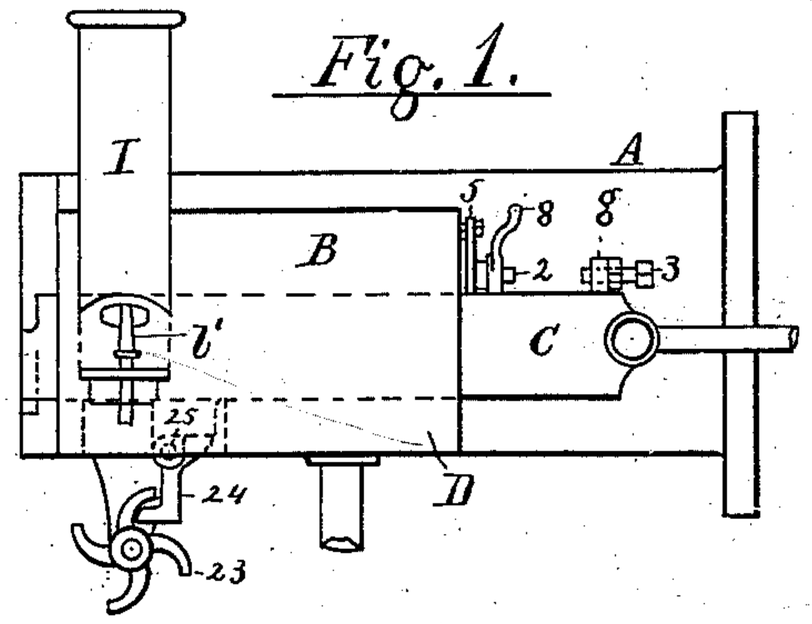
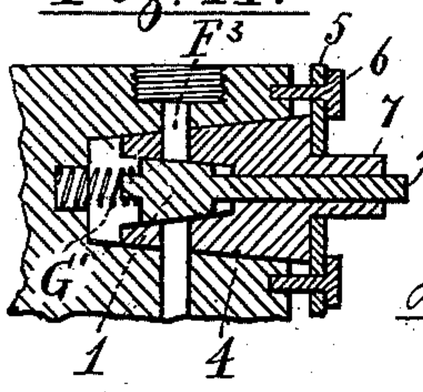


Fig. 1.

Fig. 11.



Attest.

L. Lee.

H. J. Sheberath.

Inventor.

Geo. M. Ward per

Thos. S. Crane, Atty.

UNITED STATES PATENT OFFICE.

GEORGE M. WARD, OF NEWARK, NEW JERSEY.

GAS-MOTOR.

SPECIFICATION forming part of Letters Patent No. 311,214, dated January 27, 1885.

Application filed April 25, 1884. (No model.)

To all whom it may concern:

Be it known that I, GEORGE M. WARD, a citizen of the United States, residing in Newark, Essex county, New Jersey, have invented certain new and useful Improvements in Gas-Motors, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to certain improvements in the valve-gearing and valves of the gas-motor patented to J. A. Senell and myself, September 18, 1883, as No. 285,169; but the same may be combined and used with engines of different construction.

The improvements consist, first, in an improved construction for the gas-valve employed for admitting a regulated supply of gas to the cylinder and gas-slide; secondly, in an improved construction for the passages to or from the gas-slide, whereby the gas and air are more thoroughly mixed in their passage to the cylinder; and, thirdly, in an improved means of constructing the exhaust-valve, and of operating it by means of a rotating ratchet-shaft and a pawl attached to the gas-slide.

The object of the first improvement is to prevent leakage from the gas-valve and to regulate the supply with more certainty; of the second, to mix the gases perfectly before ignition or combustion, and of the third to provide a double check-valve in the exhaust-passages, and to simplify the valve mechanism by dispensing with all the connections from the exhaust-valve to the engine crank-shaft.

In the drawings I have shown only the engine-cylinder and its various attachments, the other parts of the engine consisting merely in the frame, crank-shaft, piston, and connections from the crank-shaft to the piston and to the slide—such as are used in all gas-engines—and as are fully shown in the said Patent No. 285,169; and for convenience of reference to the said patent I have marked all the similar parts herein with the same reference-letters, and applied figures for reference to the novel parts of my present construction.

Figure 1 is a side view of the cylinder and slide-cover. Fig. 2 is a plan of the entire cylinder. Fig. 3 is a side view of the cylinder and seat for slide, the seat being sectioned at that part around the inlet gas-valve. Fig. 4 is a view of the inner end of the cylinder. Fig. 5 is a view of the outer end of the cylinder with the exhaust-valve chest, and part of the cylinder in section at the center of the rear exhaust-valve. Fig. 6 is a side view of the cylinder and valve-chest, the latter being shown in section through the centers of the exhaust-valves. Fig. 7 is a view of the inner side of the gas-slide enlarged. Fig. 8 is a section of the slide adjacent to the port J. Fig. 9 is a section of the slide on line *z z* in Fig. 8. Fig. 10 is a similar section on line *x x* in Fig. 8, and Fig. 11 is a sectional view of the double conical gas-valve and its seat enlarged.

A is the cylinder; B, a seat on the right-hand side of the same to receive the gas-valve, gas-slide C, governor F^2, and inlet-valve chamber L.

D is a cover holding the slide to the seat B, and carrying a flame-chimney, I, lighting-passage *n*, and gas-burner *l'*.

F' is the governor-valve case; F^2, the column and bearing for the driving-shaft of the governor, the spindle and balls of the governor not being shown, although the pulley *d* is indicated by dotted lines.

F^3 is the duct from the governor to the regular gas-feeding valve of the engine, which valve is actuated once for each stroke by a lug, *g*, upon the inner side of the slide, the gas being supplied to the governor by the pipe *f*.

M is an air-inlet located in the seat B underneath the gas-valve 1, and communicating with the port J in the slide C, as in the Patent No. 285,169, by a port, M', in the face of the seat B.

L is an inlet-valve chamber formed in the seat B, (which latter thus serves as a valve-chest,) and communicating with the double-mouthed port J in the slide by a passage, *m*, a valve, L', opening upward in said chamber, and conducting the charge of mixed air and gas into the chamber or bore A' by a tangential port, L^2. The slide is provided with the internal port, J, having two mouths opening coincidently at a given time into the port M' and passage *m*, and has a lighting-pocket, N, formed in such relation to the lighting-passage *n* that it coincides with the latter when the ports in J connect the valve-chamber L with the gas and air supply to furnish the cylinder

with its requisite charge. The slide being then shifted to the right by any suitable means, after the engine has compressed the charge in the usual manner, the light in the pocket N ignites the charge in the chamber L, and thus fires the cylinder-charge. As this chamber contains but a small quantity of the mixed gases, its contents are not certain to explode unless the same have been very thoroughly mixed in their passage to the chamber through the port J. The port in the slide is therefore provided with gratings of the kind hereinafter described, and the presence of an excess of air in the chamber is prevented, and an explosion of the charge in the valve-chamber is insured.

To effect a suitable movement of the slide, it is preferably geared, as shown in the Patent No. 285,169, so as to reciprocate but once for two complete revolutions of the crank-shaft or double strokes of the operative piston, thus allowing the cylinder to discharge its exhaust, draw in a mixed charge, and to compress it before the same is fired by the light in the pocket N.

My present improvement in the gas-inlet consists in making a taper seat across the gas-duct F^3, and placing therein a taper plug or gas-valve, 1, provided with a spindle, 2, projecting outside of the seat, to move it longitudinally, and with a spring to keep it normally closed. A lug, *g*, is formed on the slide C, and is preferably provided with a set-screw, 3, by which the spindle 2 is pressed at each stroke of the slide, and the gas-valve opened just as the port J opens a communication with the port M′ and passage *m*. The reverse movement of the slide permits the valve to close when the lug *g* is withdrawn, and the spring G′ then holds it pressed into its conical seat during the explosion and discharge of the charge. The conical seat is shown formed inside a conical shut-off plug, 4, having the gas-duct F^3 carried through it transversely, so that the rotation of this plug will close the gas-duct and prevent leakage from the valve 1 when the engine is not in use. To effect such rotation, the plug 4 is held into a tapering seat (in the main seat B) by a gland, 5, and bolt 6, Fig. 11, and is constructed with a hollow shank, 7, provided with a handle, 8, the spindle of the valve 1 passing through the hollow shank and projecting in the path of the lug *g*, as described above.

My improvement in the gas-slide consists in the insertion of bridges in the mouths of the port J, through which the charge is led to the cylinder, these bridges having inclined apertures in them to mix up the air and gas before they enter the cylinder.

In the enlarged views of the slide shown in Figs. 7 to 10 the bridges are shown at 9 and the perforations through them at 10, the perforations consisting in slits in one bridge and in round holes in the other.

In Fig. 10 the perforations are shown inclined all toward the bottom of the slide, thus discharging the gases upward as they pass from the port J into the duct *m* and chamber L, if such chamber be used; but the section in Fig. 9, which represents the end of the port which receives the air and gas, has perforations inclined in both directions, so as to mix the gases thoroughly inside the port J while passing through it. By this construction the stream of air and gas is subdivided in these little passages, and when reunited is thoroughly mingled by the movement of the inclined jets against the walls of the ports.

I am aware that air and gas have been introduced into the end of a cylinder in small streams to mix the same, and that a tangential port has been used for the same purpose. My invention differs from these both in the application of "inclined apertures" to a grating or bridge inserted in a narrow passage, and in their use before the small valve-chamber L. The gases are thus deflected sidewise against the walls of the narrow passage, and are effectually mingled, though confined in such a narrow space. I therefore disclaim the mere division of the gases into streams or jets, except in the manner described.

My improvement in the exhaust-valve mechanism consists, first, in applying two valves to the exhaust-passage *t* in such manner that one of them will be self-closing, to resist the suction of the operative piston when drawing in a charge, and the other will be self-closing in the opposite direction when the charge is compressed, both valves being seated by their weight alone, and all springs upon them being thus dispensed with. The arrangement is shown in Figs. 5 and 6, wherein 11 is a valve-chest having its lower part divided into two chambers, 12 and 13, by a plate, 14, and valve-seats 15. Its upper part is in one chamber, 16, which connects with the chambers 12 and 13 by apertures, over which are seated a check-valve, 17, and a discharge-valve, 18. Screw-caps 19 are inserted in the top of the chest 11 to admit the valves, and a cam-shaft, 20, and cam 21 are supported beneath the cylinder in bearings 26, to operate the discharge-valve 18. The check-valve is merely guided in its place by a short stem, not projected beyond the chamber 12; but the valve 18 has a stem, 22, projected through the bottom of the chest 11, and resting upon the cam 21, which is rotated intermittently by the shaft 20 when the latter is operated by the slide C. The cam-shaft is provided at the end beneath the slide with a ratchet-wheel, 23, having four teeth, and a pawl, 24, is pivoted to the slide at 25 in such manner as to push the wheel around one-quarter of a revolution for each stroke of the slide. The principal cam-face is concentric, except at one spot, where the figure 21 is applied in Figs. 5 and 6, and at a single point at the opposite side (marked 30) in the same figures. The projection 21 extends all the way across the face of the cam, which is shown more than double the width of the stem 22; but the projection 30 extends but half-way across, so as to be moved in or out of line

with the stem, as may be desired. The cam is fitted movably on the shaft, but made to turn with it in the manner common with sliding couplings, and a groove, 31, is formed in the hub of the cam to fit a shifter, 32, which is pivoted adjacent to the cam at 33, and is provided with a handle, 34, to shift the cam longitudinally on the shaft 20, and thus apply the cam-tooth 30 to the valve-stem 22 when desired. By thus applying it the exhaust-valve 18 may be opened during the early part of the compression-stroke, in the manner effected in my former patent, No. 285,169, by a recessed disk, *u'*, and the operator may thus be able to turn the fly-wheel of the engine around with less resistance from the compression when first starting the engine. To accomplish this, the handle 34 is operated to shift the cam, with the tooth 30, in line with the valve-stem 22, and let the cam remain in that position merely until the engine is started and has acquired momentum enough to effect the full compression with the exhaust closed.

From the above description it will be seen that my construction enables me to shut off the gas-duct F^3 when the engine is not running, to dispense with spring to close the exhaust-valve when drawing in the charge, and to dispense with the mechanism heretofore used to communicate the motion from the main crank-shaft to the exhaust-valve.

The pawl to operate the ratchet-wheel 23 may be constructed in any manner to push the wheel when moving in only one direction, and the set-screw 3 is not used when the valve-spindle 2 is made the right length.

I therefore claim my improvement as follows:

1. The combination, with the gas-supply duct F^3, of the taper plug 1, inserted across the duct F^3, and provided with the spring G' and spindle 2, and the slide C, provided with lug *g*, arranged and operated to open the gas-duct, all substantially as and for the purpose set forth.

2. The combination, with the taper shut-off plug 4, seated across the gas-duct, and provided with duct F^3, as described, of the taper plug 1, seated inside the shut-off plug, and provided with spring G' and spindle 2, and adapted to move endwise to open the duct F^3, as and for the purpose set forth.

3. The combination, with the slide C and its internal port, J, for conducting the air and gas to the valve-chamber L, of the gratings having inclined perforations for dividing and remixing the gases, substantially in the manner shown and described.

4. The combination, with the slide C and the exhaust-valve 18, of the shaft 20, cam 21, ratchet-wheel 23, and pawl 24, attached to the slide, substantially as and for the purpose set forth.

5. The combination, with the ratchet-shaft 20, intermittently rotated by the pawl 24, of the cam constructed with opposite teeth 21 and 30, and means, substantially as described, for shifting it longitudinally, as and for the purpose set forth.

6. The combination, with the cylinder A and its exhaust-passage, of the check-valve 17 and the exhaust-valve 18, arranged substantially as described, and the means for opening the exhaust-valve intermittently, the whole arranged and operated substantially as and for the purpose set forth.

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

GEORGE M. WARD.

Witnesses:
THOS. S. CRANE,
I. B. WARD.