No. 725,700. PATENTED APR. 21, 1903.

E. W. GRAEF.

HYDROCARBON OIL OR GAS ENGINE.

APPLICATION FILED DEC. 13, 1901.

NO MODEL.

Fig. 1.

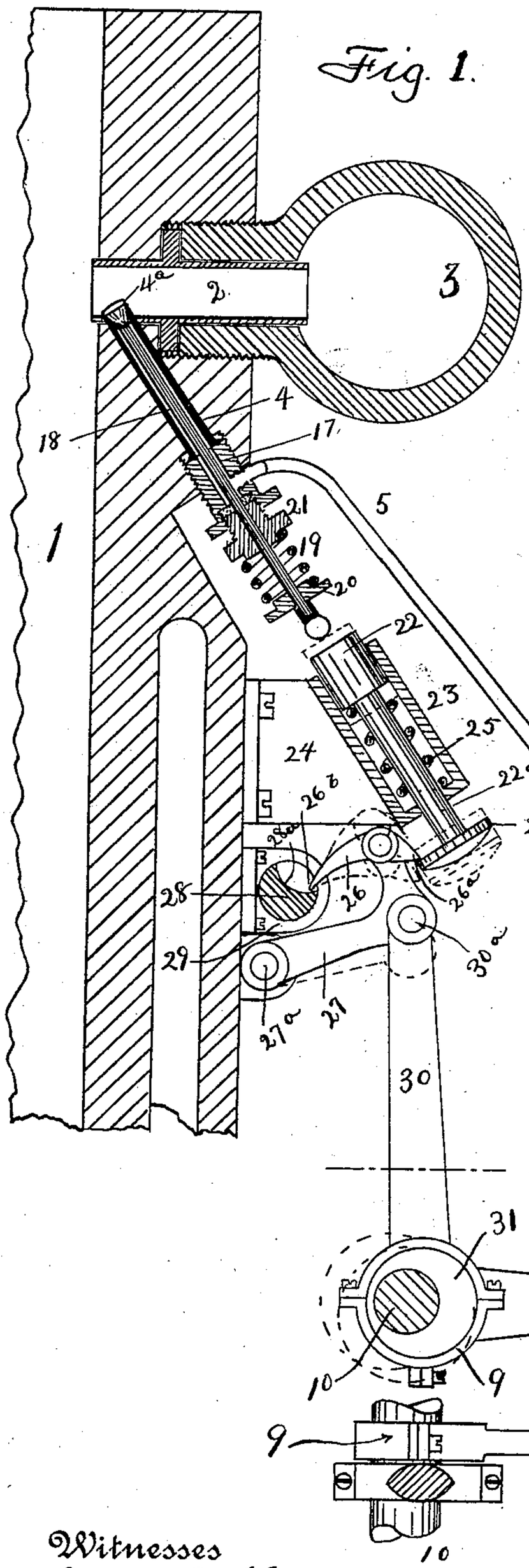
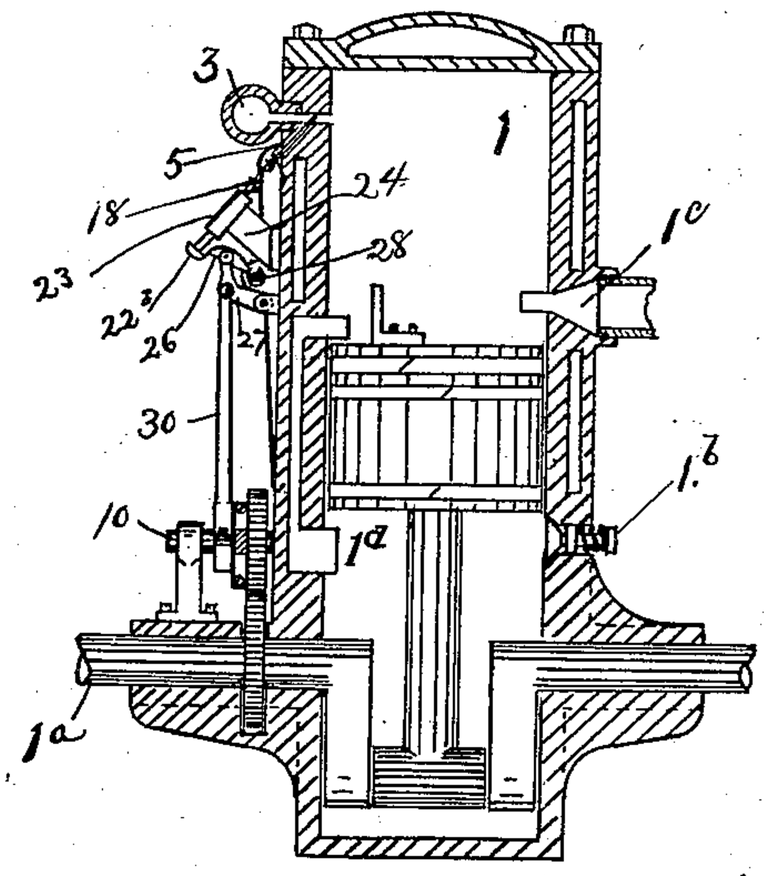


Fig. 2.

Fig. 3.



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HYDROCARBON OIL OR GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 725,700, dated April 21, 1903.

Application filed December 13, 1901. Serial No. 85,740. (No model.)

To all whom it may concern:

Be it known that I, ERNEST W. GRAEF, a citizen of the United States, and a resident of New York city, borough of Brooklyn, State of New York, have invented certain new and useful Improvements in Hydrocarbon Oil or Gas Engines, of which the following is a specification.

My invention relates to improved means for injecting liquid or gaseous fuel into the cylinder or explosion-space of a hydrocarbon oil or gas engine or motor.

In carrying out my invention I provide a fuel-chamber in connection with the cylinder or explosion-space of an engine or motor and means to maintain fuel in said chamber under pressure, together with a valve and devices to control its operation to permit the sudden injection into said cylinder or explosion-space of the desired amount of such fuel under pressure.

The invention also contemplates the novel details of improvement that will be more fully hereinafter set forth, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming part hereof, wherein—

Figure 1 is a sectional view of a portion of the cylinder of an engine or motor to which my improvements are applied. Fig. 2 is a detail of part thereof, and Fig. 3 is a central section of an engine shown equipped with my improvements.

Similar numerals of reference indicate corresponding parts in the several views.

In the accompanying drawings the numeral 1 indicates a cylinder or the explosion-space of an engine or motor, which may be of suitable construction, and 2 is a tube leading thereto and shown connected with a "hot tube" 3 for igniting a charge of combustible, although other well-known means for igniting a charge may be used, if desired.

4 is a tube from which fuel is to be ejected, and it is shown located in the wall of the cylinder and communicating, as by a pipe 5, with the chamber 6^a of a pump-casing 6, the piston 7 of said pump being shown connected by a link 8 with an eccentric 9, carried by a shaft 1^a, as shown; but said pump and piston may be otherwise arranged and operated, if desired. The inlet channel or port 6^b of the pump-casing 6 is to be connected with a supply of hydrocarbon oil—such as kerosene, gasolene, or petroleum—and 11 12 are valves on opposite sides of the piston channel or barrel 7^a for controlling the passage of fluid to the pressure-chamber 6^a. The pressure-chamber 6^a is also shown connected by a by-pass or channel 6^c with the intake-channel of the pump, being shown leading to the channel 6^b, and the channel 6^c is controlled by a valve 13, which prevents the passage of fluid from channel 6^b directly into the by-pass 6^c, but permits the passage of the fluid from the latter to the former. The valve 13 is shown controlled by a spring 14, located in a socket 15 in the pump-casing and held in place by an adjustable cap or the like 16, whereby the pressure of the spring upon valve 13 may be regulated as required.

From the foregoing it will be understood that if the pressure of the fluid in chamber 6^a increases beyond the resistance of spring 14 such pressure will be relieved by the opening of valve 13 and permitting the fluid to pass back into the supply or intake channel 6^b. Thus the amount of pressure in chamber 6^a can be regulated and controlled by the spring 14, and the excess fluid from said chamber is not lost, the pump being able to keep up a greater supply of fuel in chamber 6^a than the cylinder demands.

I have provided means for quickly opening and closing the outlet of tube 4 into the cylinder or explosion-space, and for this purpose the tube 4 is shown connected with a nipple or plug 17, secured in the wall 1, and the pipe 5 communicates with the bores in said nipple and tube. At the outer end of said tube is a valve 4^a, adapted to open toward the interior of the cylinder and provided with a stem 18, passing through said bores, the valve 4^a being normally maintained closed by a spring 19, shown coiled around stem 18 and bearing at one end against a stop 20 on said stem and at the other end against a bushing 21, which is shown adjustably connected with nipple or plug 17 by screw-threads. A tight joint may be made around the stem by suitable pack-

ing, and the stem is permitted to reciprocate. The tension of spring 19 may be adjusted by means of the bushing 21. The pressure of spring 19 should be such as to maintain valve 4^a normally upon its seat against the pressure of fuel from chamber 6^a, and the pressure of spring 19 should be relatively greater than the pressure of spring 14 against valve 13, whereby as valve 13 and spring 14 prevent undue pressure from arising in chamber 6^a the valve 4^a will not be inadvertently opened by pressure from said chamber. I have provided devices to open and close valve 4^a quickly, which devices are shown in the nature of a hammer and trigger controlled, primarily, by the operation of the engine or motor, and for this purpose I have shown a plunger 22, having a guide 23, carried by the cylinder 1, as by a support 24, secured thereto, the stem 22^a of said plunger having a head 22^b at its outer end, a spring 25 being shown coiled around said stem and bearing at one end against the plunger and at the other end against the guide 23, and thereby serving to normally hold the plunger near or against stem 18, Fig. 1; but the normal tension of spring 25 is less than the normal tension of spring 19. The plunger 22 is drawn back and released intermittently to act upon the stem 18 in the nature of a hammer, and for this purpose I have shown a rocker or trigger 26, pivotally supported by a lever 27, which in turn is pivotally supported by cylinder 1, as at 27^a, one end 26^a of the rocker or trigger being adapted to act upon head 22^b and the other end 26^b having a fulcrum, as upon a member 28, shown rotatively supported in a bearing or bracket 29 on cylinder 1. For the purpose of regulating or altering the movement of the end 26^a of the rocker or trigger 26 relatively to head 22^b the member 28 is shown provided with a depression 28^a, curved inwardly or concave, forming a seat for the end 26^b of the rocker or trigger 26, Fig. 1. By adjusting member 28 more or less in a circular direction the fulcrum of the end 26^b of the rocker or trigger can be adjusted relatively to head 22^b to cause the end 26^a to act upon said head sooner or later, whereby the opening of the valve 4^a may be timed. For operating the rocker or trigger 26 I have shown a link or arm 30, pivotally connected with lever 27, as at 30^a, and operated by an eccentric 31 on shaft 10, (see Fig. 2;) but other means may be provided for operating the rocker 26, if desired.

In Fig. 3 I have shown my improvements as applied to a two-cycle engine or motor, in which 1^b is the air-inlet valve and 1^c the exhaust-outlet, 1^d being the port controlled by the piston, all in well-known manner; but my improvements may be applied to other types of engine or motor, as the well-known four-cycle engine.

In the operation of my improvements the pump maintains the desired pressure of fuel in chamber 6^a, and the rocker or trigger 26 being moved outwardly at the proper time pulls the plunger 22, compressing spring 25, and then releases the plunger, which moves toward the stem 18, striking the same suddenly, like a blow from a hammer, with a force sufficient to overcome the resistance of spring 19 and open valve 4^a suddenly, and the plunger immediately moves back, thereby permitting spring 19 to quickly close the valve 4^a. While the valve 4^a is open an amount of fuel is projected under pressure into the explosion-space or cylinder proportioned to the pressure in chamber 6^a and the amount of movement of valve 4^a plus the time the valve is open. By adjusting the member 28 relatively to the end 26^b of the rocker or trigger 26 the time at which the fuel is injected into the explosion-space or cylinder may be regulated, and the quantity of fuel injected can also thus be regulated, and thereby the speed of the motor can be controlled.

By means of my improvements kerosene-oil may be utilized as fuel and may be injected into the explosion-space or cylinder in liquid form, and as the liquid fuel is injected into the explosion-space or cylinder while under pressure it will pass from valve 4^a somewhat in the form of a spray, to be readily mixed with air to form an explosive mixture. By the arrangements shown the fuel is not drawn into the explosion-space or cylinder primarily by the suction action of the piston, but is positively injected in definite form at any desired part of the stroke of the piston.

My invention is not limited to the details of construction shown and described, as they may be varied without departing from the spirit thereof.

Having now described my invention, what I claim is—

1. The combination of a cylinder, a piston, a shaft connected therewith, an injection-valve, a pump having a pressure-chamber in communication therewith, means for causing the pump to maintain a constant pressure of fuel in said chamber, tripping means to suddenly open said valve, and devices interposed between the tripping means and the shaft to operate the former by the latter, said devices comprising means to regulate the amount of opening of the valve, substantially as described.

2. The combination of a cylinder, a piston, a shaft connected therewith, an injection-valve, means to operate the same, a pump having a pressure-chamber in communication with said valve and having a channel connecting said pressure-chamber with the intake-channel that communicates with the fuel-supply, means to permit excess fuel from said chamber to pass back into the supply while preventing the fuel from passing to said chamber in a reverse direction, tripping means to suddenly open said valve, and devices interposed between the tripping means and the shaft to operate the former by the

latter, said devices comprising means to regulate the amount of opening of the valve, substantially as described.

3. The combination of a cylinder, a piston, a shaft connected therewith, an injection-valve, means to operate the same, a pump having a pressure-chamber in communication with said valve and having a channel connecting said pressure-chamber with the intake-channel that communicates with the fuel-supply, a valve to control said channel and arranged to permit fuel to pass only from the pressure-chamber through said channel to the intake-channel, a spring for said valve, means to adjust the pressure of said spring upon the valve, whereby a predetermined pressure may be maintained in said chamber and excess fuel therefrom may pass back to the intake-channel, tripping means to suddenly open said valve, and devices interposed between the tripping means and the shaft to operate the former by the latter, said devices comprising means to regulate the amount of opening of the valve, substantially as described.

4. The combination of a cylinder, a piston, a shaft connected therewith, an injection-valve, a pump having a pressure-chamber in communication therewith, means to hold said valve normally closed, a plunger or hammer to act suddenly upon said valve, and devices connected with said shaft to retract and trip said plunger or hammer, comprising means to regulate the velocity of the plunger or hammer whereby the passage for fuel is controlled, substantially as described.

5. The combination of a cylinder, a valve, a pump having a pressure-chamber in communication therewith, means to maintain the valve normally closed, a plunger or hammer adapted to act suddenly upon the valve to open the same, a rocker or trigger to control said plunger or hammer, and means for giving said rocker or trigger more or less movement in connection with the plunger or hammer, substantially as described.

6. The combination of a cylinder, a valve, a pump having a pressure-chamber in communication therewith, means to maintain the valve normally closed, a plunger or hammer adapted to act suddenly upon the valve to open the same, a rocker or trigger to control said plunger or hammer, means for operating said rocker or trigger, and means for adjusting the fulcrum of said rocker or trigger relatively to the plunger or hammer, substantially as described.

7. The combination of a cylinder, a valve, a pump having a pressure-chamber in communication therewith, means to maintain the valve normally closed, a plunger or hammer adapted to act suddenly upon the valve to open the same, a rocker or trigger to control said plunger or hammer, means for operating said rocker or trigger, and a member rotatively supported and having a depression curved inwardly forming a seat or fulcrum for the rocker or trigger, substantially as described.

8. The combination of a cylinder, an injection-valve, means to maintain a supply of fuel to be controlled by said valve, means to maintain said valve closed, a plunger or hammer adapted to suddenly open said valve, a rocker or trigger adapted to operate said plunger or hammer, a rocking arm carrying said rocker or trigger, means for operating said arm, a fulcrum for said rocker or trigger independent of the plunger or hammer, and means for adjusting the position of said fulcrum relatively to the plunger or hammer, substantially as described.

9. The combination of a cylinder, an injection-valve, means to maintain a supply of fuel to be controlled by said valve, a stem connected with said valve, a spring acting with said stem to hold the valve closed, a plunger or hammer having a spring to throw the same with a sudden impact and open said valve, and means for intermittently withdrawing and releasing the plunger or hammer, comprising devices to give the plunger or hammer more or less movement against its spring, substantially as described.

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