T. TURNBULL, Jr.

MEANS FOR FEEDING FLUID FUEL.

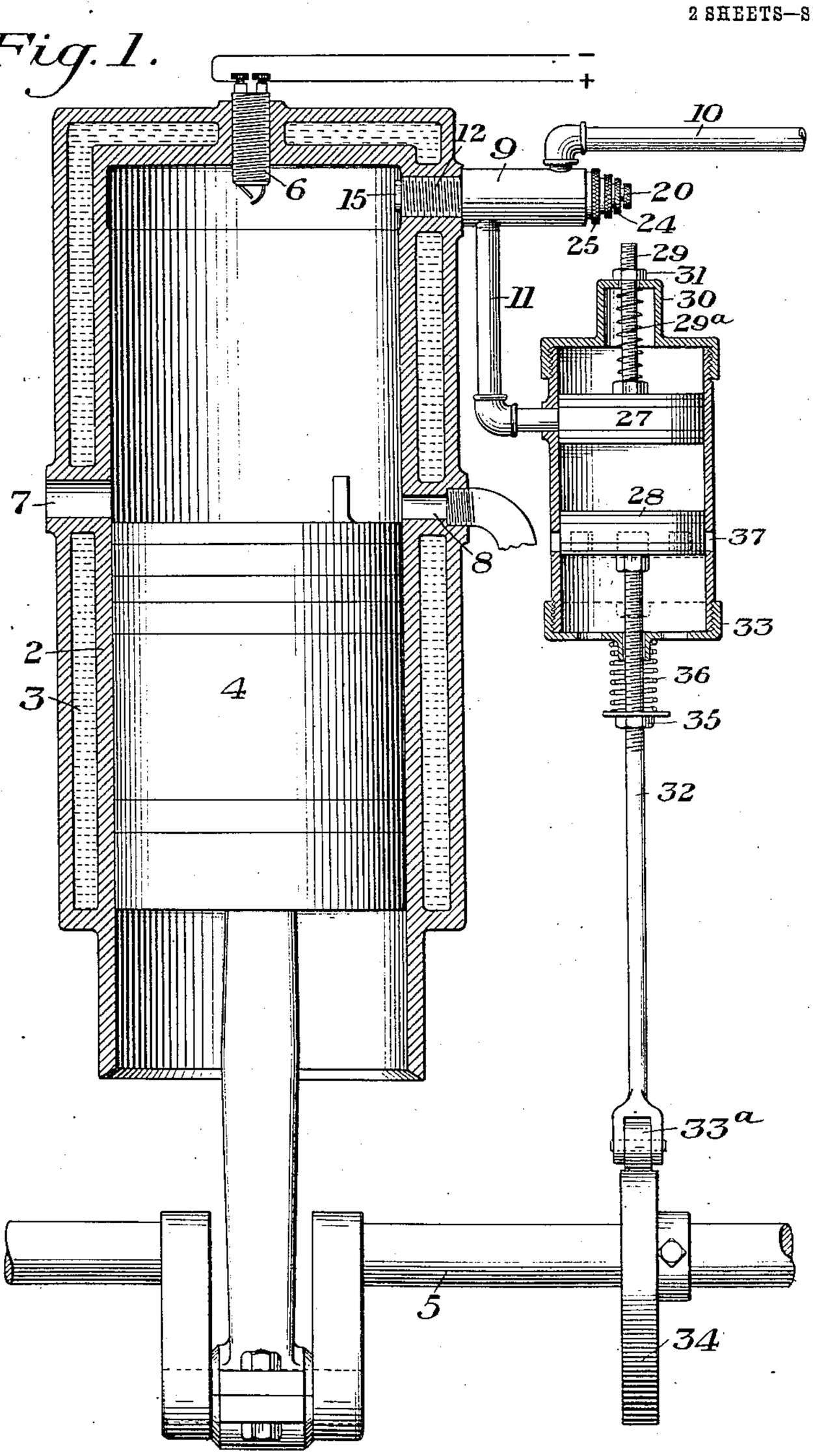
APPLICATION FILED JAN. 29, 1910.

960,057.

Patented May 31, 1910.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

R. A. Balderson.

Walter Famariss

INVENTOR

Thos. Turnbull, Jr.

by Bakewell, Byrnes & Parmelee,

his Attys

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2 SHEETS—SHEET 2.

Fig. 2.

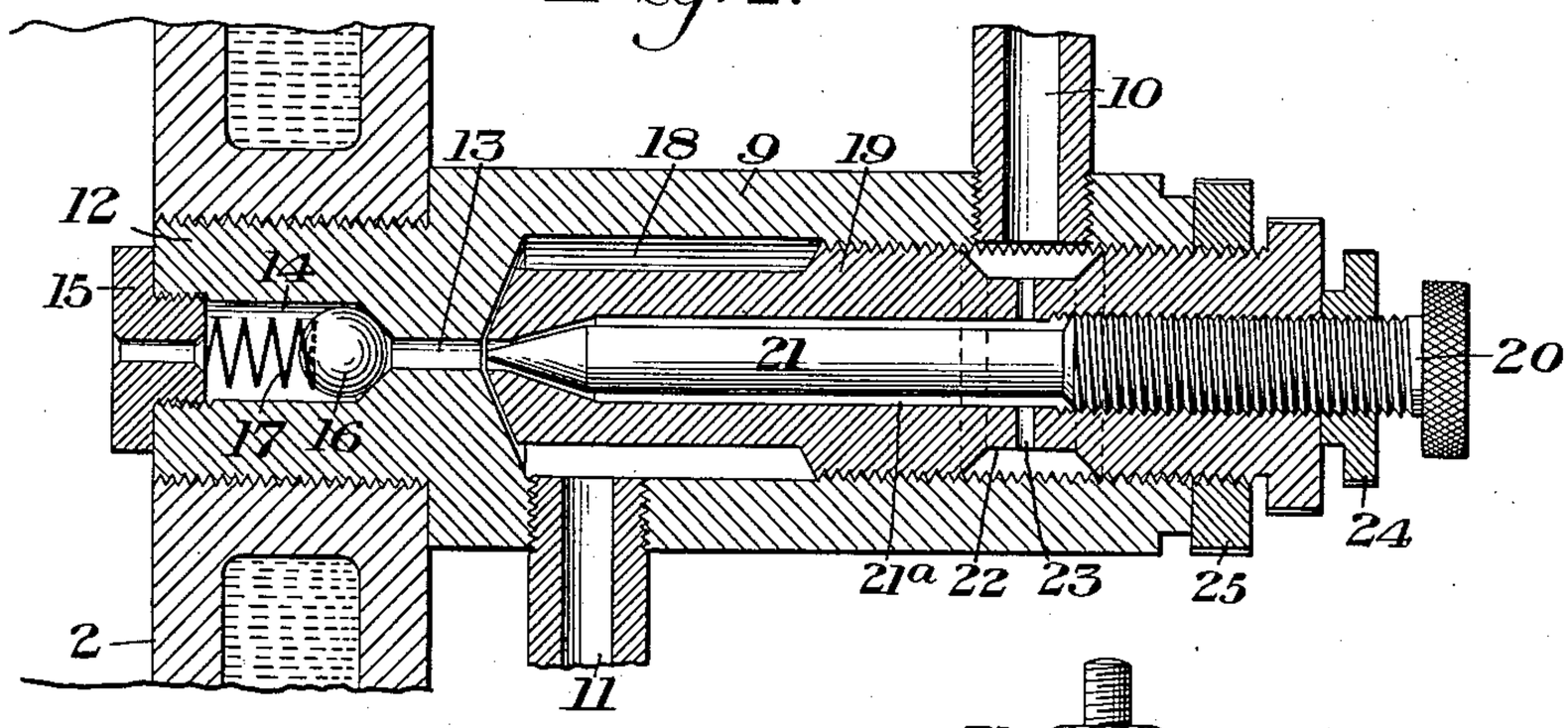


Fig. 3.

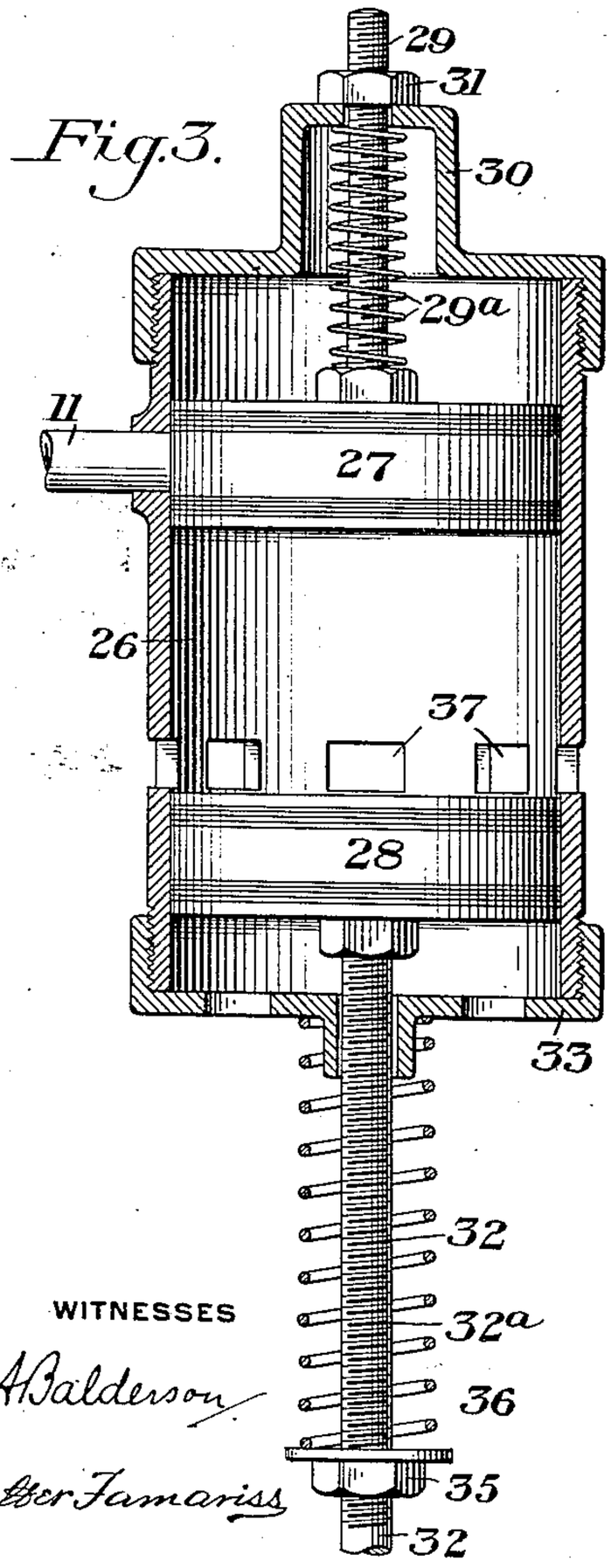
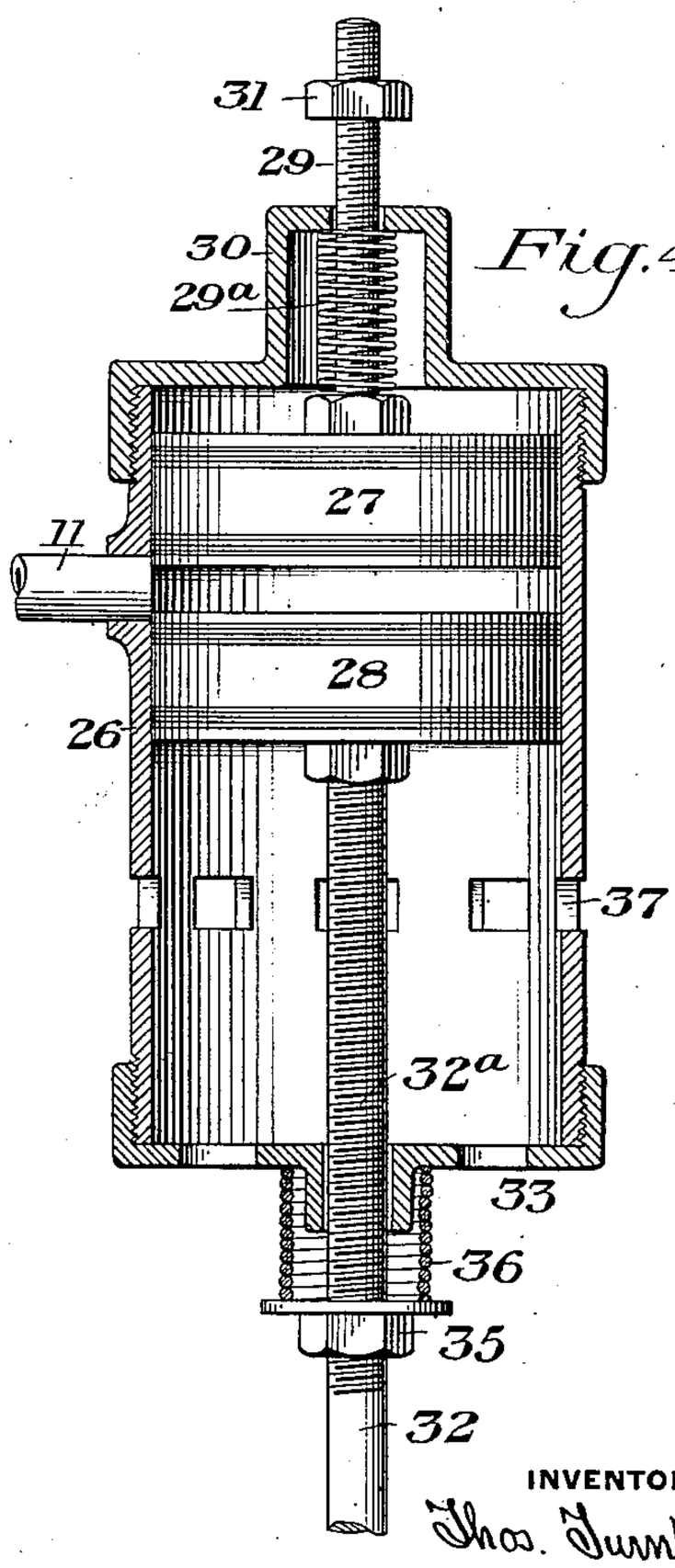


Fig. 4.



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UNITED STATES PATENT OFFICE.

THOMAS TURNBULL, JR., OF PITTSBURG, PENNSYLVANIA.

MEANS FOR FEEDING FLUID FUEL.

960,057. Specification of Letters Patent. **Patented May 31, 1910.**

Application filed January 29, 1910. Serial No. 540,822.

To all whom it may concern:

Be it known that I, THOMAS TURNBULL, Jr., of Pittsburg, Allegheny county, Pennsylvania, have invented a new and useful Means for Feeding Fluid Fuel, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional view showing a portion of a two-cycle gas engine having my improved fuel feeding means applied thereto; Fig. 2 is a sectional view of the fuel injector; and Figs. 3 and 4 are sectional views of the pump for supplying the air to the injector, the two views showing the compressor piston of the pump at opposite limits of its stroke.

My invention has relation to means for feeding fluid fuel, and is particularly designed to provide fuel-feeding means for use with explosive engines.

The object of my invention is to provide an improved device of this character by means of which fuel in regulated quantities and at proper intervals may be injected into the combustion chamber of the engine, the motive power for injecting the fluid into such chamber being derived from a pump operated by the engine.

The precise nature of my invention will be best understood by reference to the accompanying drawings, in which I have shown the preferred embodiment thereof, and which will now be described, it being premised, however, that various changes may be made in the details of construction and arrangement of the several parts, by those skilled in the art, without departing from the spirit and scope of my invention as defined in the appended claims.

In these drawings, the numeral 2 designates the cylinder of a gas engine of the two-cycle type; 3 the usual water jacket therefor, 4 the engine piston, 5 the crank shaft, and 6 the sparker or igniter.

7 designates the exhaust openings, and 8 an air admission, which is arranged opposite the exhaust opening 7 and into which air enters under compression from the crank case chamber as is usual in two-cycle engines.

9 designates the outer shell or casing of a fuel injector having a fuel admission pipe 10 and an air admission pipe 11. This shell is provided with a screw-threaded extension 12 at one end, which is screwed into the cylinder wall, and through which extends the discharge port 13, said port being enlarged at 14.

15 is a fuel discharge plug, which is threaded into the end of the enlarged portion 14 of the discharge port.

16 is a ball valve, seated within the enlarged portion 14 of the port and normally holding the port 13 closed, by means of a spring 17 to prevent back-flashing.

The shell 9 is provided with an interior chamber 18, into which is screwed a plug 19. The plug is also formed with a chamber or passage to receive a needle valve 20 threaded therein, the inner end portion of the needle valve being of less diameter than the diameter of the chamber or passage in the plug, as indicated at 21. The plug 19 has an annular groove 22 opposite the inner end of the fuel feed pipe 10, and the bottom of this groove communicates with the interior space 21^a of the plug by means of a plurality of ports 23. The needle valve controls the discharge of fuel from the space 21^a into the port 13, and can be set so as to regulate the quantity of discharge, being held in the desired adjustment by means of a lock or jam nut 24. The inner end portion of the plug 20 is of reduced diameter, providing an air space into which the air pipe 11 discharges. The plug 19 can be screwed in or out so as to control the amount of air which will be discharged from the chamber 18 into the port 13 with the fuel, being held in the desired adjustment by means of a lock or jam nut 25.

The air supply pipe 11 is connected at its other end to a cylinder 26 having therein a piston valve 27 which controls the outlet from the cylinder to the pipe 11, and also having therein a piston 28. The piston valve 27 has a stem 29 which extends outwardly through the head 30 of the cylinder 26, where it is secured by a nut 31, or by other suitable means. A spring 29^a is seated around said stem between the valve and the inner wall of the head 30. The piston 28 has a rod 32 projecting through the opposite head 33 of the cylinder 26, and carries at its outer end a roller 33^a, which engages a cam 34 on the crank shaft 5. The piston rod 32 is provided with a threaded portion 32^a carrying a nut 35 exteriorly of the cylinder, a spring 36 being seated around the rod between this nut and the outer side of the cyl-

inder head 33. The cam 34 actuates the piston 28 on its compression stroke and the spring 36 returns the piston after the completion of its compression stroke.

The cylinder 26 is provided with air inlet ports or openings 37, which are arranged to be uncovered by the piston 28 on its return stroke and to be closed by said piston at an early point in its compression stroke.

The operation is as follows:—The cam 34 is so set that the piston 28 will commence its compression stroke a short time before the engine piston 4 has completed its power stroke. The continued forward movement of the piston 28 effects a compression of air within the cylinder 26, admitted through the ports or openings 37, until a degree of compression is reached sufficient to overcome the pressure on the piston valve 27 exerted by the spring 32, and which pressure can be regulated to the desired extent by means of the nut 31. The piston valve 27 is then moved backwardly to expose the entrance to the air supply pipe 11, and the compressed air in the cylinder 26 is discharged through said pipe into the chamber 18 of the injector. The fluid fuel, such as gasolene, which enters the injector through the pipe 10 fills the groove or depression 22 and flows through the ports 23 into the chamber 21ª, in which the needle valve is placed. The pressure discharged into the chamber 18 through the pipe 11 meets the fuel discharged past the needle valve, and blows said fuel through port 13 and plug 15 into the engine cylinder, the pressure of the air being sufficient to unseat the ball valve 16. This operation will be repeated on each alternate stroke of the engine piston 4.

As before stated, by adjusting the needle valve and the plug 19, the relative quantities of gas and fuel admitted at each operation may be regulated, as may be desired. Any excessive pressure between the piston 28 and the piston valve 27 caused by the admission of a less volume of air into the engine cylinder with the fuel than the volume which is compressed between the piston 28 and the piston valve 27, is taken care of by the further backward movement of the piston valve against the action of its spring 29ª.

It will be readily understood that my invention is equally applicable to four cycle engines, by causing the piston rod 32 to be actuated from a half speed shaft instead of directly from the main shaft of the engine. In fact, the cylinder 26 may be variously arranged, and its piston may be actuated by any desired timed connection with a moving part of the engine, the arrangement shown in the drawing being intended simply to illustrate a simple arrangement for actuating the air compressing piston.

Various fuels require different degrees of compression in the engine cylinder, and hence should be supplied to the cylinder at different pressure and at different times in the compression stroke. This can be readily and accurately regulated by adjusting the tension of the spring 29ª to thereby vary the degree of compression in the cylinder 26 which will be reached before the piston valve 27 will be moved to uncover the entrance to the pipe 11. It is obvious that the greater the tension given the spring 29ª, the greater will be the compression effected in the cylinder 26, and the later will the charge be injected into the engine cylinder. Therefore the fuel charge can be injected into the engine cylinder at any point in the compression stroke of the engine piston. The volume of air which enters the engine cylinder will, of course remain constant with all adjustments of the spring 29ª.

The engine can be provided with governing mechanism of any usual or desired character. Various changes may also be made in the construction and arrangement of the injector parts without departing from my invention.

The apparatus described forms a reliable and efficient means for feeding fuel to explosive engines, or for other purposes.

It will be noted that the air compressor is of a simple and efficient type, no valves being required, except the piston valve 27, the piston 28 acting itself as a valve to control the admission to the compressor cylinder.

What I claim is:—

1. In apparatus of the character described, an injector comprising a casing or shell having a chamber therein provided with a discharge port leading from its inner end, a valve seating backwardly to close said port, a plug adjustably seated within the chamber of the shell or casing, an air supply pipe communicating with said chamber, a fuel discharge in said plug, an adjustable valve for controlling said passage, the plug having fuel ports communicating with a fuel supply, and means for periodically admitting a volume of compressed air to said chamber; substantially as described.

2. In apparatus of the character described, a fluid fuel injector comprising a plug or casing having a chamber therein, and a port leading from the inner end of said chamber, said port having a backwardly seating valve, an air supply pipe communicating with said chamber, means for periodically admitting a volume of compressed air through said pipe, a plug adjustably seated in said chamber and having a reduced inner end portion acting as a valve for the discharge port, said plug also having an annular groove or depression therein communicating with a fuel supply, with ports leading from said depression into

an interior chamber in the plug, and a needle valve adjustably seated in said plug and controlling the outlet from said chamber, the outlet from said chamber being in line with the said discharge port; substantially as described.

3. Means for feeding fluid fuel, comprising an injector having a fuel supply, and an air supply, an air compressing cylinder to which the air supply is connected, and means for periodically delivering a volume of compressed air from said cylinder into the air supply, and thence into the injector, together with means for varying the pressure of said air; substantially as described.

4. In an explosive engine, a fuel feeding injector having a fuel supply and an air supply, an air compressing cylinder to which the air supply is connected, and means for periodically delivering a volume of compressed air from said cylinder into the air supply and thence into the injector, together with means for varying the pressure of the air and its time of delivery relatively to the beginning of the compression stroke of the engine piston, without changing the volume of the air; substantially as described.

In testimony whereof, I have hereunto set my hand.

THOMAS TURNBULL, Jr.

Witnesses:
Geo. H. Parmelee,
H. M. Corwin.