O. LASCHE.

FUEL SUPPLY SYSTEM FOR ENGINES.

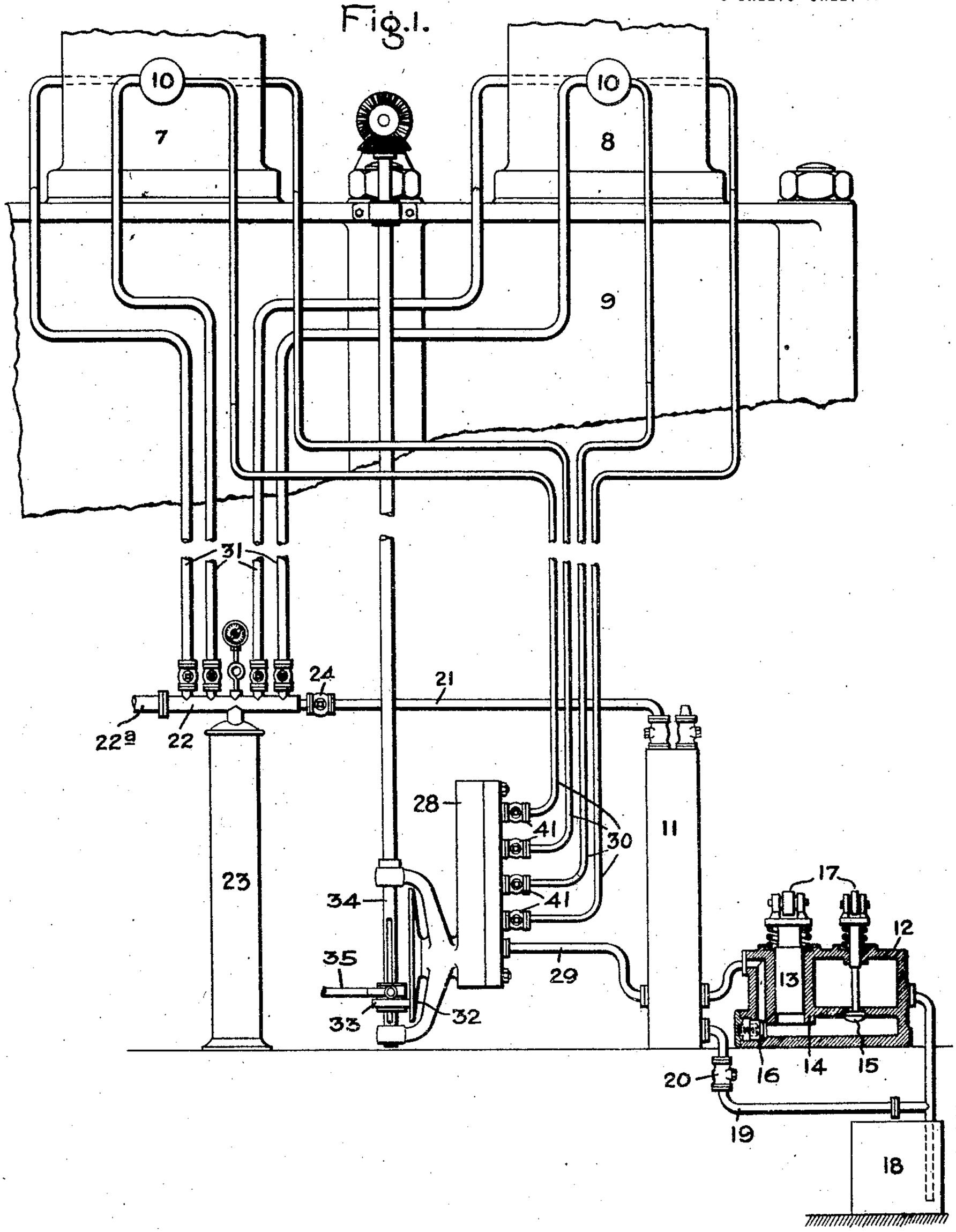
APPLICATION FILED FEB. 10, 1914.

1,154,994.

Patented Sept. 28, 1915.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

Marcus L. Byng

J. Ellis Glen

Inventor:

Oskar Lasche,

by: Albert G. Davis,

His Attorney.

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3 SHEETS—SHEET 2

Fig.2.

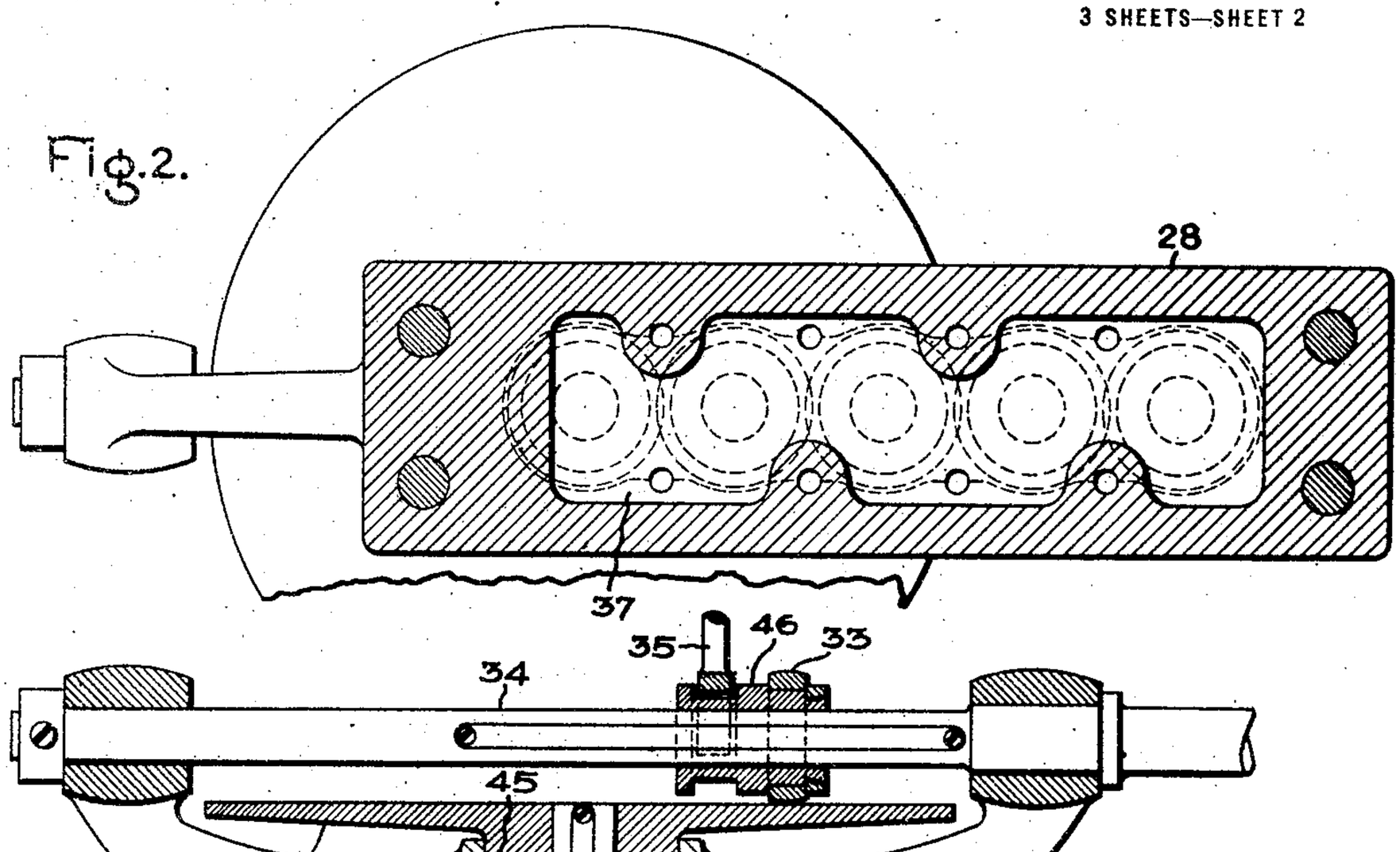

Fig.3.

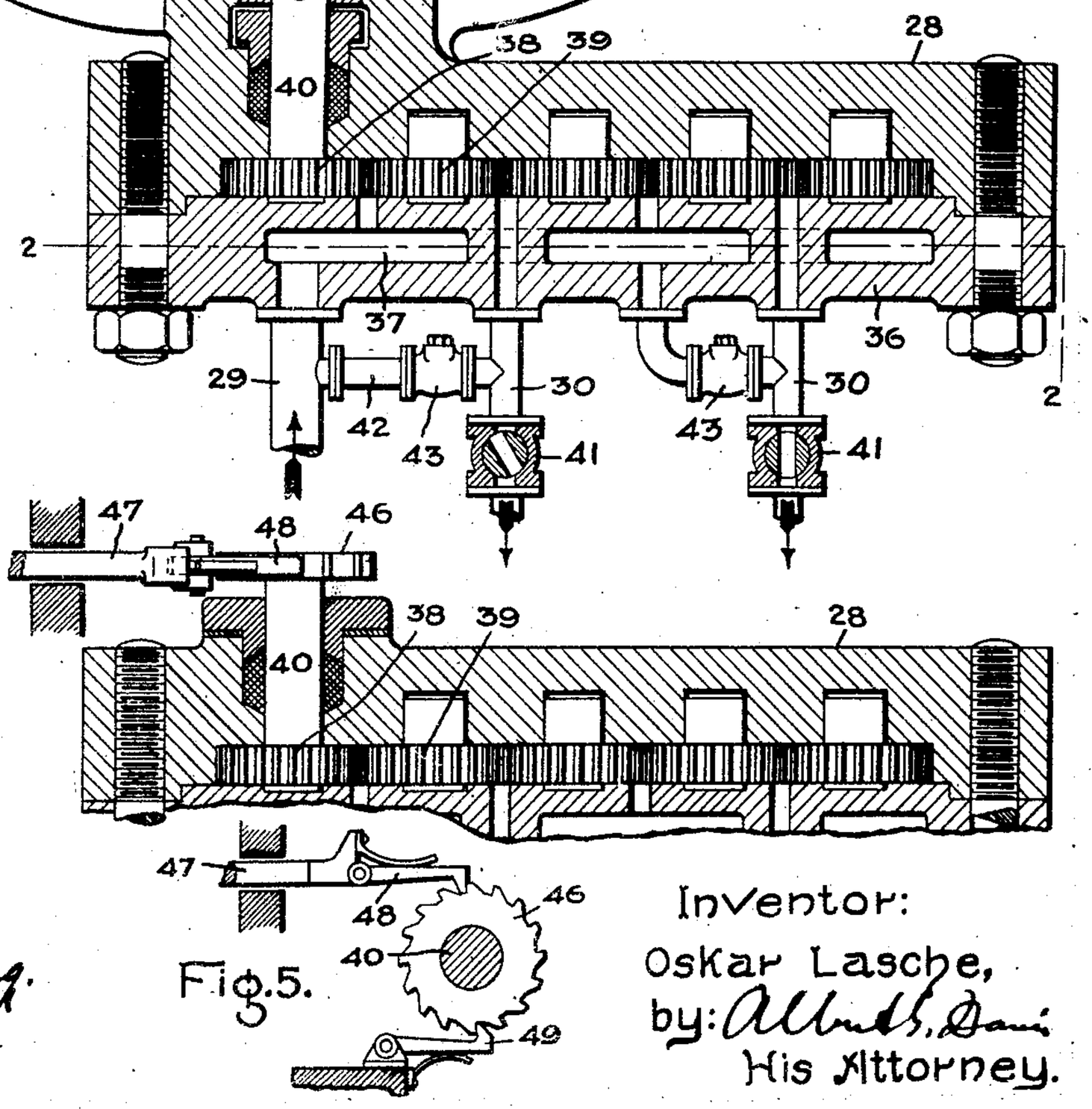

Fig.4.

Fig.5.

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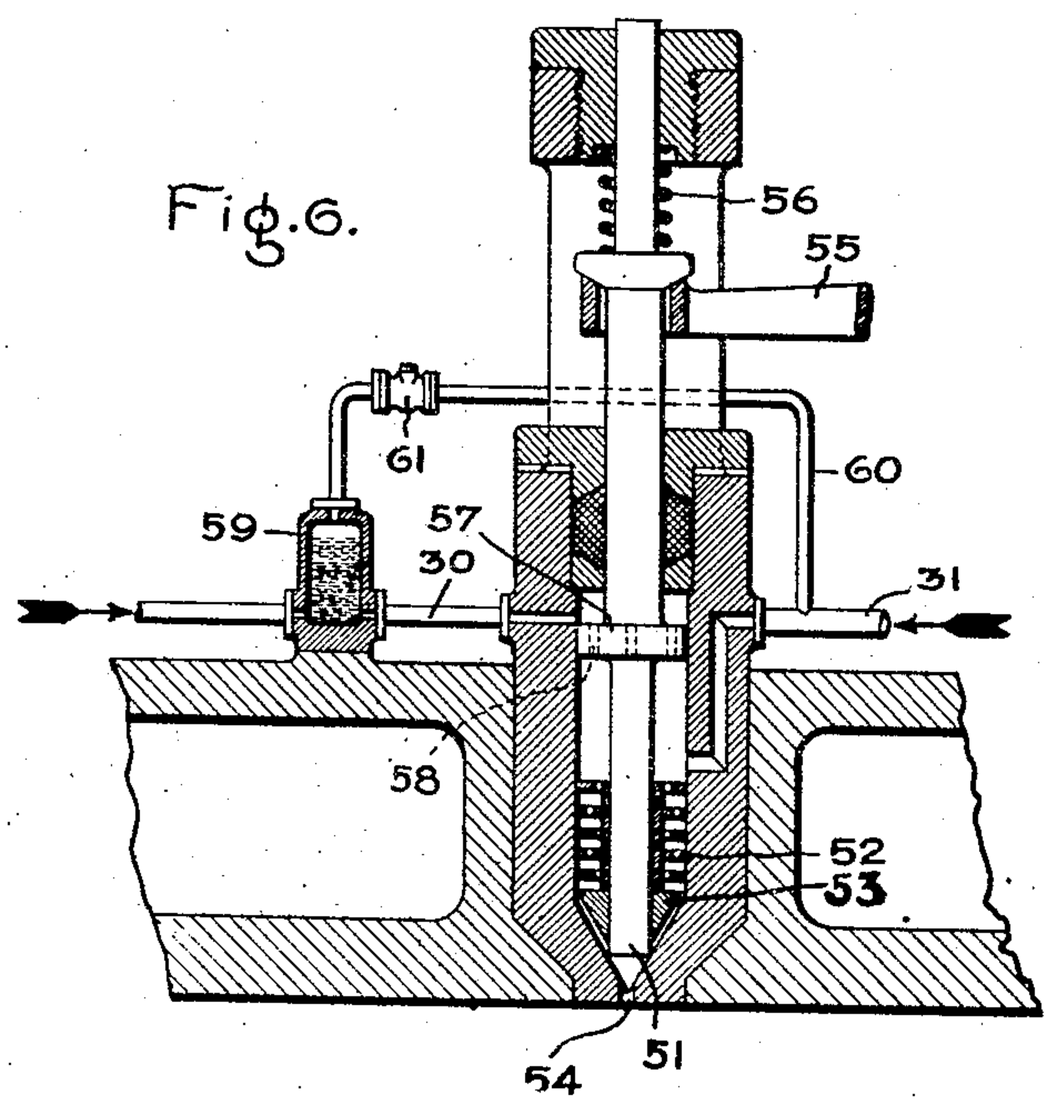
3 SHEETS—SHEET 3.

Fig. 6.



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J. Ellis Glen

Inventor:
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by: Albert G. Davis
His Attorney.

UNITED STATES PATENT OFFICE.

OSKAR LASCHE, OF CHARLOTTENBURG, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

FUEL-SUPPLY SYSTEM FOR ENGINES.

1,154,994. Specification of Letters Patent. Patented Sept. 28, 1915.

Application filed February 10, 1914. Serial No. 817,815.

To all whom it may concern:

Be it known that I, OSKAR LASCHE, a subject of the Emperor of Germany, residing at Charlottenburg, Germany, have invented certain new and useful Improvements in Fuel-Supply Systems for Engines, of which the following is a specification.

At the present time it is the almost universal practice to employ reciprocating plunger pumps to supply liquid fuel to internal combustion engines operating on the high compression cycle. The regulation of these pumps to meet the varying load conditions is generally effected by varying the length of the working stroke of the plunger, or by regulating the action of a by-pass valve which allows a portion of the fuel to flow back to the suction chamber either at the beginning or end of the discharge stroke of the plunger. High speed plunger pumps when called upon to continuously deliver measured and exact quantities of fuel under high pressure are liable to partial or complete failure due to injury to the parts thereof and more especially to such parts as the packings and regulating devices.

My invention aims to avoid the objections above noted. This is accomplished by employing a pressure tank to which an abundant supply of fuel is delivered by any suitable means, such as a pump, the pressure in said tank preferably but not necessarily approximating the final pressure of the fuel entering the combustion chamber. Between the tank and each of the fuel injectors is a rotary gear pump which may increase the pressure somewhat but whose principal function is to act as a measuring device and determine just how much fuel shall be delivered to the injector for each working stroke of the engine. Since the pressure difference between the suction and discharge sides of this pump is small the actual work performed is small and the liability of it and its regulating mechanism getting out of order is reduced to a minimum, and the work required of the speed governor is correspondingly reduced.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 is a somewhat diagrammatic view illustrating the fuel system; Fig. 2 is a sectional view of the gear pump taken on line 2—2 of Fig. 3; Fig. 3 is an axial section of the gear pump; Figs. 4 and 5 are detailed views showing a modification of the means for driving the gear pump, and Fig. 6 is a sectional view of the fuel injector.

In Fig. 1 is shown a portion of an internal combustion engine having two cylinders 7 and 8 which are mounted on the scavenging air receiver 9. Each cylinder is provided with one or more fuel injectors 10. In the present embodiment of my invention each cylinder has two injectors located on opposite sides thereof, the said injectors being of any well-known or suitable construction.

The means for supplying fuel to the injectors will now be described. 11 indicates a tank in which fuel is maintained under pressure. This can be accomplished in a variety of ways. 12 indicates a fuel pump comprising a plunger 13, a cylinder 14, a suction valve 15, and a discharge valve 16. The plunger and suction valves are actuated by levers through rollers 17, said levers being actuated by the engine. On the working stroke of the plunger fuel is delivered to the tank 11. Any excess is returned to the source of supply 18 through the by-pass 19 containing a spring actuated valve 20. The pump 12 should be large enough to continuously deliver to the tank 11 all the fuel that is required for maximum operation of the engine and need not be regulated with exactness because any excess will be returned through the by-pass or through the suction valve as is common practice.

In order to maintain the fuel in the tank under a relatively high pressure in the case of intermittent delivery of the main pump, a pipe 21 is provided that is connected to it and to the manifold 22, the latter being in communication with a source of high pressure air commonly referred to as the blast air. To the manifold is connected a storage tank or blast bottle 23. In the pipe 21 is

a valve 24, by means of which the tank 11 can be cut off from the source of high pressure air.

28 indicates a gear pump in which a pump is provided for each fuel injector. Each pump is of the construction illustrated in Figs. 2 and 3. The pumps all receive fuel from the tank 11 by the pipe 29 and deliver it to the injectors by the pipes 30, a single pipe running to each injector. Compressed air for injecting the fuel is supplied by the pipes 31 that are connected to the manifold and blast bottles, the latter being connected to a suitable compressor by the pipe 22ª. The gear pump is driven by a suitable means, as for example, by disk 32 with which engages a friction roller 33, said roller being splined on the shaft 34, which in turn is driven through suitable gearing from the main shaft of the engine. The position of the friction roller 33 is determined by a speed governor which acts on the roller through the governor arm 35.

Referring to Figs. 2 and 3, the measuring pump 28 comprises a casing and a removable cover 36. In the cover is formed a suction chamber 37 that is in communication with the supply pipe 29. There are as many gear pumps as fuel injectors, each comprises a pair of gears 38 and 39, said gears having suitable spindles. The gears of the various pumps are so arranged that one driving shaft 40 suffices for them all. Fuel is delivered by the individual pumps to the conduits 30. In each conduit is located a throttle valve 41, by means of which the amount of fuel delivered by each pump to its corresponding fuel injector can be varied. As an additional means of regulation a by-pass 42 may be provided which contains a pressure actuated valve 43. When the valve opens, due to excess pressure, fuel is by-passed from the high pressure to the low pressure side of the pump.

The means for driving the pump will now be described; Splined on the shaft 40 is a flat disk 32 which is normally held in engagement with the friction roller 33 by the compression spring 44, there being a ball thrust bearing 45 inserted between the spring and the disk. 34 indicates the driving shaft and splined thereon is a slide collar 46 which carries the friction roller 33. Engaged with the sliding collar is the fork of the governor arm 35. As the roller 33 is moved toward and away from the axis of the shaft 40, the speed of the gear pump will be changed, and in this manner the amount of fuel delivered by each pump to its injector will be correspondingly changed. The pressure in the chamber 37 is preferably substantially the same as that of the blast air employed to inject fuel into the combustion chambers of the engine, and hence the gear pumps will have very little work to perform. Their principal function is to accurately measure the amount of fuel delivered to the injectors for each firing stroke of the engine. Owing to the fact that they have to perform only a very small amount of work, the danger of their failing to operate properly is reduced to a minimum.

Instead of continuously rotating the measuring pumps, the pumps may be operated intermittently at suitable speeds as indicated in Figs. 4 and 5. On the shaft 40 is mounted a ratchet 46 which is reciprocated by any suitably governed means through the rod 47. The end of the rod carries a pawl 48 that is spring pressed into engagement with the teeth on the ratchet 46. A spring pressed detent 49 is employed to prevent backward rotation of the ratchet. Such an arrangement causes the supply of fuel to the engine to be delivered intermittently.

In order to temporarily cut off the source of fuel supply from the injector during certain parts of the working strokes of the engine pistons the arrangement shown in Fig 6 is provided. 51 indicates a needle valve, 52 perforated washers, and 53 a seat for the washers having peripheral passages delivering into outlet 54. The needle valve passes through a suitable stuffing box and is actuated by the lever 55 which is moved by some part of the engine in any suitable or well-known manner. 56 indicates a coiled compression spring that tends to hold the needle valve on its seat. The needle valve is also enlarged to form a slide valve 57, there being passages 58 through it. Compressed air from the blast bottle is admitted by the pipe 31, and fuel is admitted by the pipe 30. In the pipe 30 is a receptacle 59 containing air under relatively high pressure, this air being obtained from the pipe 31 and passes through the pipe 60, the latter containing a non-return valve 61. When the needle and slide valves are in the positions shown fuel from the pipe 30 can be delivered to the upper side of the valve 57 and will flow through the passages 58 on to the upper perforated washer. Just as soon, however, as the needle valve is opened the slide valve 57 covers the port communicating with the pipe 30 and further admission of fuel is cut off. If during the interval that the fuel pipe 30 is closed the measuring pump continues to deliver fuel the air in the receptacle 59 will be compressed by an amount sufficient to admit the fuel to the receptacle and as soon as the valve 57 is opened the said air pressure will coöperate with the pump to force fuel into the injector.

My invention has been described in connection with an engine in which the fuel is

injected by compressed air but it is also applicable to engines in which such air or gaseous medium is omitted. In such a case the pressure within the tank 11 should correspond, or substantially correspond, to the pressure prevailing in the injection device.

My apparatus has the advantage that it can easily be kept in continuous and reliable working condition since the packing of the gear pump causes little difficulty on the one hand and exact regulation of the main pump is avoided on the other hand. Further, since the measuring pump is of the rotary type, the driving mechanism can be made simpler than for a reciprocating pump. Also the regulation of such pumps is a comparatively simple matter.

I have shown what I consider to be the best form of rotary measuring pump, but the invention is not limited to the specific form shown unless so specified in the claims.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. The combination with a high compression internal combustion engine having separate points of fuel injection, of a blast air bottle, a fuel tank, a pipe connecting the tank to the bottle, a plunger pump arranged to deliver fuel to the tank against the pressure of the blast air in amounts sufficient to supply the demands of the engine, a measuring pump for each of said points of injection, said pumps receiving fuel in common from the tank and delivering it independently to said fuel injection points, and means for varying the amount of fuel delivered by each pump to the point of consumption, and means connecting the blast air bottle to each fuel injection point.

2. The combination with a high compression multi-cylinder internal combustion engine having a fuel injector for each cylinder, of a blast air bottle, a tank, a pipe connecting the tank to the bottle, a pump for supplying fuel to the tank against the pressure of the blast air, measuring pumps which receive fuel in common from the pressure tank and deliver it independently to the injectors, means for simultaneously driving the measuring pumps, means for changing the effective delivery of the latter pumps, and means connecting the blast air bottle to the fuel injectors.

3. The combination of a high compression internal combustion engine, an injector for introducing fuel into the combustion chamber thereof, a fuel tank, a tank containing a gas under pressure for forcing fuel through the injector, a connection between the tanks for subjecting the fuel in the first tank to the gas pressure, a pump for supplying fuel to the fuel tank against the gas pressure, a measuring pump that receives fuel under pressure from the fuel tank and delivers it to the injector, and means for varying the amount of fuel delivered by the measuring pump.

4. The combination of a multi-cylinder internal combustion engine, a fuel injector for each cylinder, a tank, a pump for supplying fuel thereto and maintaining a suitable pressure, a measuring device comprising a plurality of geared pumps all of which receive their fuel in common from the tank, each of said pumps delivering a measured quantity of fuel to its corresponding injector, a means common to the pumps for driving them, and means for varying the speed of the pumps to regulate their delivery.

5. The combination of an internal combustion engine, a fuel injector therefor, a tank containing fuel under pressure, a main pump for supplying fuel thereto, a measuring pump which receives high pressure fuel from the tank and delivers it to the injector, driving means for the pumps, and a by-pass on the discharge side of the measuring pump for controlling its effective delivery to the injector.

6. The combination of an internal combustion engine, a fuel injector therefor, a tank containing fuel under pressure, a main pump for supplying fuel thereto, a measuring pump which receives high pressure fuel from the tank and delivers it to the injector, driving means for the pumps, a by-pass on the discharge side of the measuring pump, and a throttle valve located in the discharge conduit of the measuring pump to throttle its delivery to the injector.

7. The combination of an internal combustion engine, a fuel injector therefor, a tank containing fuel under pressure, a main pump for supplying fuel thereto, a measuring pump which receives high pressure fuel from the tank and delivers it to the injector, a friction driving means for the measuring pump which is actuated by the engine, a means for varying the relation between the driving and the driven parts of said pump to change its speed, and a driving means for the main pump.

8. The combination of an internal combustion engine, a fuel tank, a pump for supplying fuel under pressure thereto, a measuring pump driven by the engine which receives its supply under pressure from the tank, a fuel injector comprising a casing,

means for atomizing the fuel, and a needle valve, a conduit admitting high pressure air to the casing, a conduit admitting fuel to the casing, a receiver in the fuel conduit which is subjected to said air pressure, and a valve movable with the needle valve to prevent the passage of fuel from the conduit into the casing when said needle valve is open.

In witness whereof, I have hereunto set my hand this 19th day of January 1914.

OSKAR LASCHE.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.