

F. J. KIMBALL.
FUEL PUMP FOR INTERNAL COMBUSTION ENGINES.
APPLICATION FILED JUNE 25, 1912.

1,099,449.

Patented June 9, 1914.

2 SHEETS—SHEET 1.

Fig. 1

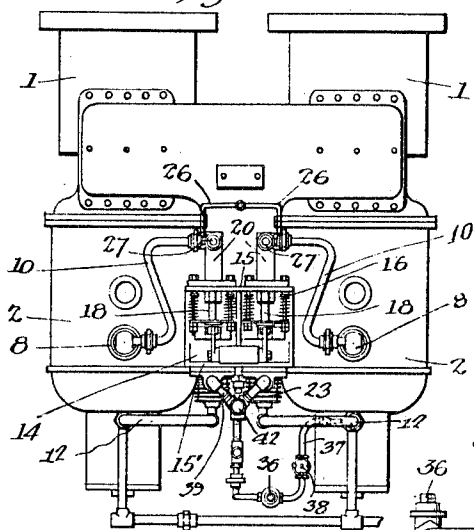


Fig. 4.

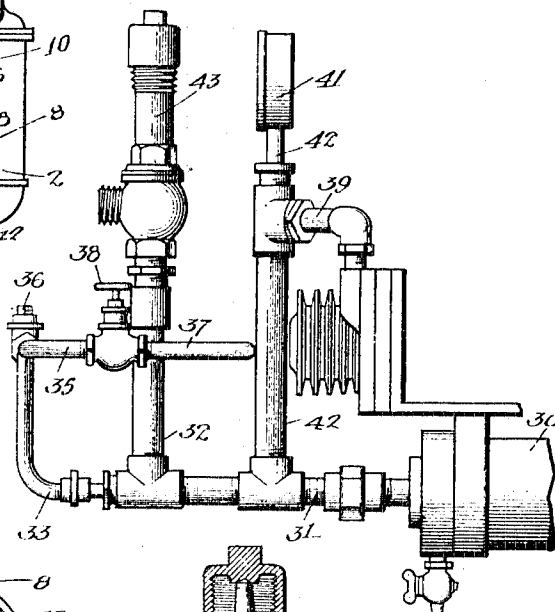


Fig. 2

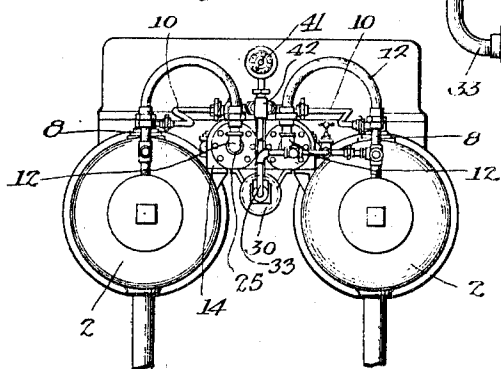


Fig. 5

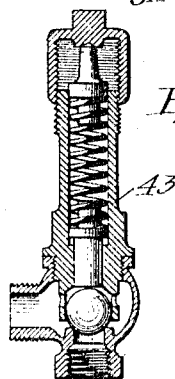
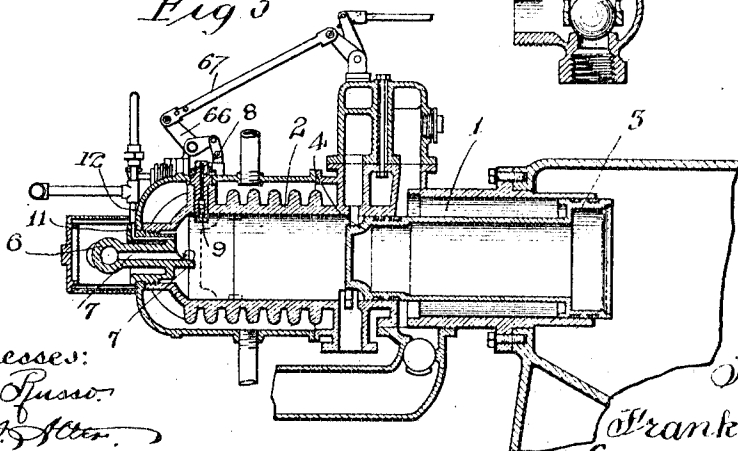


Fig. 3



Witnesses:
Gully Russo
Geo. D. Allen

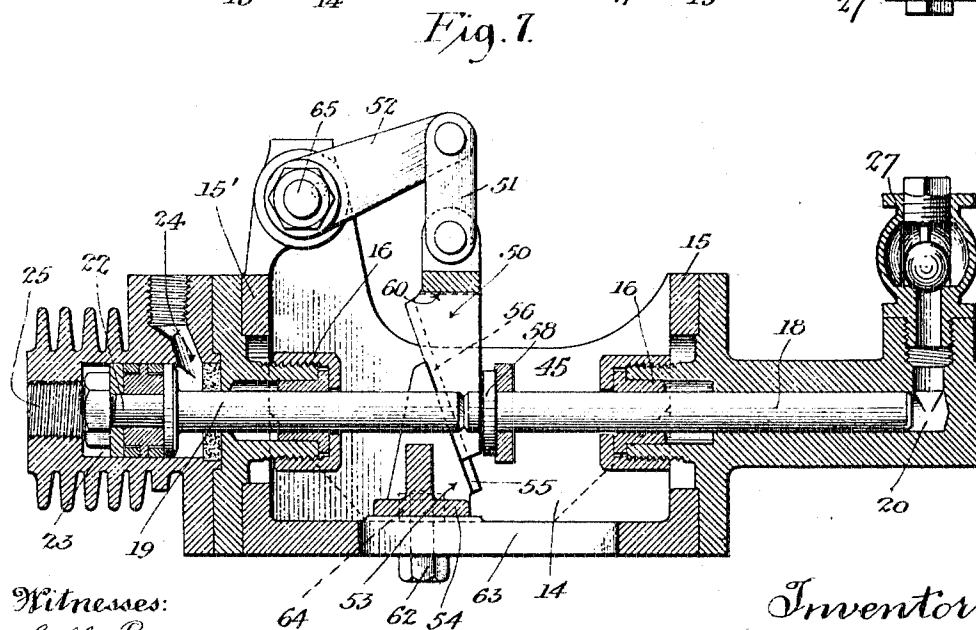
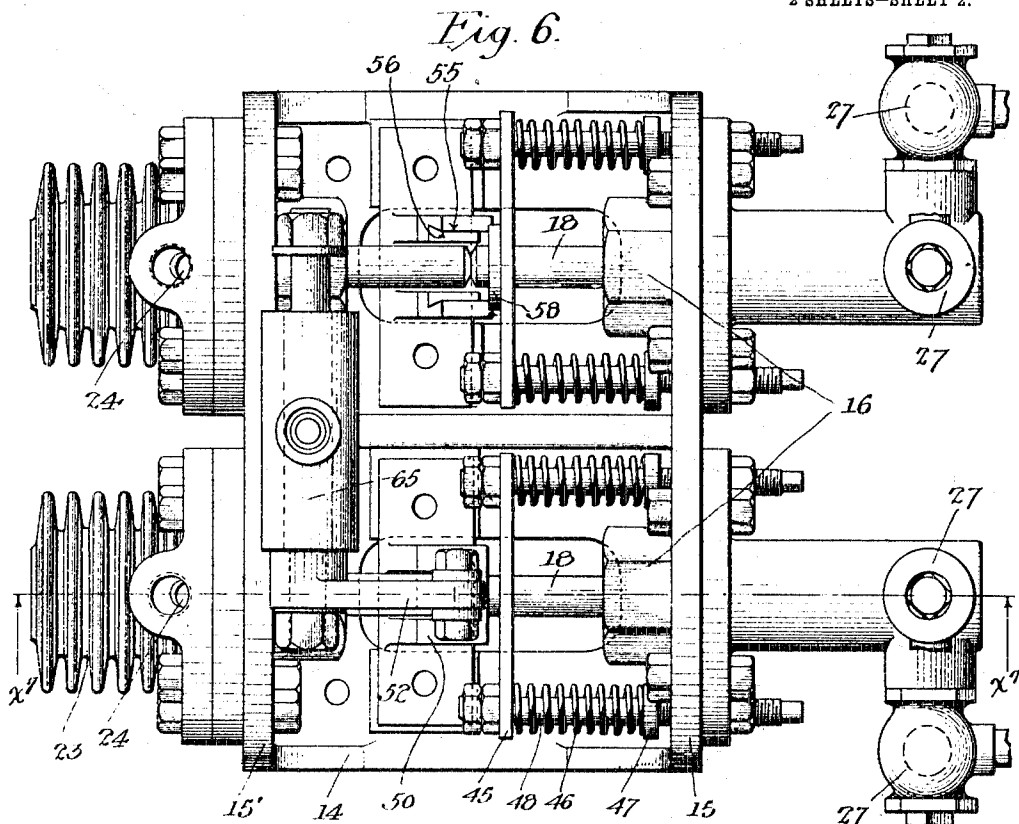
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Witnesses:
Sully Russo
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UNITED STATES PATENT OFFICE.

FRANK J. KIMBALL, OF LOS ANGELES, CALIFORNIA.

FUEL-PUMP FOR INTERNAL-COMBUSTION ENGINES.

1,099,449.

Specification of Letters Patent.

Patented June 9, 1914.

Application filed June 25, 1912. Serial No. 705,873.

To all whom it may concern:

Be it known that I, FRANK J. KIMBALL, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Fuel-Pump for Internal-Combustion Engines, of which the following is a specification.

The main object of the present invention is to provide means for pumping oil or other fuel into the cylinders of an internal combustion engine without the use of any mechanical connection to the crank shaft.

A further object of the invention is to provide a fuel pump in which the pressure produced by the pump increases correspondingly with the pressure in the cylinder, so that there will always be sufficient pressure to force the fuel into the cylinder.

A further object of the invention is to provide means for controlling the period during which the fuel is admitted both as to time of beginning and the length of such period.

Other objects of the invention will appear hereinafter.

The accompanying drawings illustrate an embodiment of the invention, and referring thereto: Figure 1 is a plan of an internal combustion engine provided with my improved pipe. Fig. 2 is an end elevation thereof. Fig. 3 is a longitudinal section of said engine. Fig. 4 is a side elevation of the connections for the pump. Fig. 5 is a vertical section of a relief valve used in the device. Fig. 6 is a plan of the pump and operating devices therefor. Fig. 7 is a longitudinal section on line $x'-x'$, Fig. 6.

The internal combustion engine to which my invention applies may be of any suitable type, the engine here shown being a two cycle engine of the differential piston type, and comprising for each cylinder, large and small cylinder portions 1 and 2 with a piston having large and small piston portions 3 and 4, adapted to work in said cylinder portions and connected in the usual manner to the shafts of the engine. Ignition means is provided in each cylinder consisting, for example, of a hot-ball 6 communicating through passage 7 with the interior of the smaller diameter cylinder portion 2. Suitable ports are also provided for controlling the admission and exhaust of air to the respective cylinder portions, the same not be-

ing herein described in detail, as they form no part of the present invention.

According to the present invention, the fuel, preferably oil, is injected into a cylinder by a pump operated by pressure of gases from the engine cylinder. The fuel is supplied to the engine cylinder through a nozzle 8 fitted in the wall of the cylinder and having a duct 9 which opens at its lower end into the combustion chamber or cylinder in position to discharge the oil on top of a lip 7' at the inner end of the hot-ball passage 7. The upper end of said duct 9 in the nozzle communicates through pipe 10 with the outer end of the oil pump cylinder. A passage 11 is formed in the head of the cylinder portion 2, communicating through pipe 12 and suitable connections as hereinafter set forth, with the fluid pressure cylinder for operating the oil pump.

An oil pump may be provided for each cylinder and it is sufficient to describe the construction, connections and operations of one pump. The pump is mounted on a frame 14 secured to the engine frame, said frame having two vertically extending head plates 15 and 15' provided with stuffing boxes 16 in which slide respectively, a pump piston rod 18 and a fluid pressure operated rod 19, said rods abutting and being in alinement. The pump piston rod 18 works in an oil pump cylinder 20, secured to the vertical plate 15 and having an outlet 21 at one end communicating with the pipe 10 aforesaid. An oil supply pipe 26 is connected through check valves 27 with the pump cylinders 20. The fluid pressure operated piston rod 19 is provided at its outer end with a piston 22 working in a cylinder 23, secured to the other vertical plate 15'. Said cylinder 23 is provided with a lateral port 24 opening into the space between the piston and the inner end of the cylinder, for communicating fluid pressure to said space, tending to hold the piston in outermost position, and said cylinder is further provided with a port 25 in its outer end for receiving fluid pressure to drive the piston inwardly, said port communicating with pipe 12 aforesaid, which is in constant connection with the interior of the corresponding cylinder of the internal combustion engine. Piston 22 is larger than the pump piston rod 18, so that pressure from the engine cylinder operating on piston 22, operates the

pump piston rod to inject fuel into the said cylinder.

A receiver or storage tank 30 communicates through pipe 31 to a pipe 42 connected with branch pipes 39 leading to the lateral ports 24 aforesaid, in cylinder 23, and said pipe 31 also communicates through pipe 33, check valve 36, pipe 35, manual valve 38 and pipe 37 with the pipe 12 aforesaid, which is in communication with the interior of a cylinder of the internal combustion engine, the same storage tank 30 serving for control of all the pumps. A pressure gage 41 may be connected through pipe 42 to the supply pipe 39 for said storage tank to indicate pressure therein, and a relief or safety valve 43 is provided, connected by a pipe 32 to said pipe 31 for the storage tank to allow escape of air when the same reaches a definite pressure, said relief valve being adjustable to enable it to be set to hold the pressure at any desired amount. This safety valve with the adjacent portion of the pipe 32 is broken away in Fig. 2 to show more clearly the parts behind the same.

The oil pump piston rod 18 is spring operated in opposition to the pressure operated piston, being, for example, provided with a cross-bar 45, engaged by springs 46 which extend between said cross-bar and nuts 47 on bolts 48, said bolts screwing through the vertical plate 15 aforesaid, so that by adjustment of said nuts the pressure of the springs 46 on the oil pump piston rod may be adjusted. Means are provided for limiting the movement of the oil pump piston rod 18 under the action of said springs, said means being controlled by a governor responsive to the speed of the engine and consisting, for example, of wedge 50 pivotally mounted by link 51 on an arm 52 and mounted to slide on a bearing block 53 mounted on frame 54, said bearing block having an inclined dovetail track 55 for receiving a correspondingly formed rib 56 on said wedge and the opposite face of said wedge being vertical and adapted to engage a collar 58 on the oil pump piston rod 18. Said wedge is slotted as at 60 for passage of the two piston rods. The bearing block 53 is slidable longitudinally on the frame 14 and may be adjusted in any position thereon by means of a bolt 62 extending through a slot 63 in said frame and provided with a nut 64 for clamping the said block in position. Arm 52 is mounted on a shaft 65 carrying arm 66 which is connected by rod 67 to any suitable governor device, not shown, whereby the position of said arm 52 and of the wedge 50 carried thereby, may be varied in accordance with the speed of the engine.

The operation is as follows: Assuming that the engine has been in operation and that a supply of compressed air has been

forced into the storage tank or reservoir 30, the pressure of such air is communicated through pipes 31 and 39 and port 24 to the cylinder 23 on the inner side of the piston 22, tending to force said piston outwardly and thereby withdraw the piston rod 19 from the pump piston rod 18, the pump piston rod being caused by the springs 46 to follow up this movement until it is arrested by engagement with the wedge 50. This position of the wedge thus determines the length of stroke of the pump piston rod and the amount of oil injected at each stroke. During each compression stroke in the internal combustion engine cylinder, the pressure of the compressed gases is exerted, through the pipe 12, on the outer end of the piston 22 and when this pressure becomes sufficient to overcome the constant pressure on the inner face of the piston, the piston will be forced inwardly, and engaging the pump piston rod, will force the pump piston outwardly in its cylinder, injecting oil through the pipe 10 into the internal combustion engine cylinder. As such oil is delivered or supplied onto the lip of the hot-ball passage, combustion takes place and the temperature and pressure within the combustion cylinder rapidly increases, but this pressure is immediately communicated through pipe 12 to the outer face of the piston 22 so that no matter what may be the pressure in the combustion chamber, the difference in areas of the pistons 22 and 18 will insure sufficient pressure on the oil to force it into the combustion chamber. When the pressure in the combustion chamber is relieved during the clearing stroke, the piston 22 is restored to normal position by the operation of the constant pressure on the other face thereof, communicated through port 24 and pipes 39, 42 and 31 from the storage reservoir 30 and this movement is followed up by the pump piston 18, causing oil to be drawn in from the supply pipe 26; check valve 27 opening in this movement, and closing during the injecting operation.

The timing of admission of fuel to the cylinder is effected by varying the pressure in the receiver 30 by suitable adjustment of the relief valve 43 therefor. For example, by increasing the pressure in the receiver 30. The pressure tending to hold the piston 22 outwardly is increased and the time at which this pressure is overbalanced by the communication of pressure to the outer side of the piston from the engine cylinder is correspondingly delayed. The admission of fuel into the cylinder can be timed in this manner so as to admit the fuel for a period of 30° to 60° before the engine piston finishes its compression stroke and the ejection of fuel can be continued until the engine piston has traveled 30° to 100° on its impulse stroke. The regulation of speed of

the engine is effected by raising and lowering the wedge 50, for example, by means of the governor.

What I claim is:

5 1. In combination with a combustion cylinder, of an internal combustion engine, a pump cylinder, a piston working therein, fuel supply means communicating with said pump cylinder, said pump cylinder having
10 an outlet communicating with the said combustion cylinder, means acting on said piston to move the same so as to draw fuel into the said pump cylinder, fluid pressure operated means acting on said piston to
15 move the same to force fuel from said pump cylinder into the combustion cylinder, and comprising a piston, a cylinder in which said piston works, said cylinder communicating at one side of said piston with the combustion cylinder to receive compressed elastic
20 fluid therefrom for operation of said piston during the compression stroke of the internal combustion engine, and means for supplying elastic fluid at a definite pressure at the other side of said piston in the fluid pressure operated cylinder.

2. In combination with a combustion cylinder of an internal combustion engine, a pump cylinder, a piston working therein,
30 fuel supply means communicating with said pump cylinder, said pump cylinder having an outlet communicating with the said combustion cylinder, means acting on said piston to move the same so as to draw fuel into
35 the said pump cylinder, fluid pressure operated means acting on said piston to move the same to force fuel from said pump cylinder into the combustion cylinder, and comprising a piston, a cylinder in which said
40 piston works, said cylinder communicating at one side of said piston with the combustion cylinder to receive compressed elastic fluid therefrom for operation of said piston during the compression stroke in said combustion cylinder, means for supplying elastic
45 fluid at a definite pressure at the other side of said piston in the fluid pressure operated cylinder to elastically resist the movement of said piston, and means for variably
50 regulating the pressure of said supply of elastic fluid at said other side of the piston.

3. In combination with a combustion cylinder of an internal combustion engine, a pump cylinder, a piston working therein,
55 fuel supply means communicating with said pump cylinder, said pump cylinder having an outlet communicating with the said combustion

cylinder, means acting on said piston to move the same so as to draw fuel into the said pump cylinder, fluid pressure operated means acting on said piston to move
60 the same to force fuel from said pump cylinder into the combustion cylinder, and comprising a piston, a cylinder in which said piston works, said cylinder communicating at one side of said piston with the combustion cylinder to receive compressed elastic
65 fluid therefrom for operation of said piston during the compression stroke in said combustion cylinder, a storage tank communicating with the combustion cylinder to receive compressed gases therefrom, and provided with a relief valve for variably controlling the pressure in said tank, and means
70 for establishing communication from said storage tank to said fluid pressure operated means.

4. In combination with a combustion cylinder of an internal combustion engine, a pump cylinder, a piston working therein,
80 fuel supply means communicating with said pump cylinder, said pump cylinder having an outlet communicating with the said combustion cylinder, means acting on said piston to move the same so as to draw fuel into
85 the said pump cylinder, fluid pressure operated means acting on said piston to move the same to force fuel from said pump cylinder into the combustion cylinder, and comprising a piston, a cylinder in which said
90 piston works, said cylinder communicating at one side of said piston with the combustion cylinder to receive compressed elastic fluid therefrom for operation of said piston during the compression stroke in said combustion cylinder, said oil pump piston and
95 fluid pressure operated piston being independently movable, spring means operating on said oil pump piston for moving the same in a direction to draw fuel into the cylinder
100 for said piston, a wedge mounted to move longitudinally with relation to the movement of the pistons, means on said pistons for engaging said wedge, and means for adjusting the said wedge transversely to the
105 movement of the pistons to control the stroke of the fuel pump piston.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 15th day of June, 1912.

FRANK J. KIMBALL.

In presence of—

ARTHUR P. KNIGHT,
MARY E. BLASDEL.