

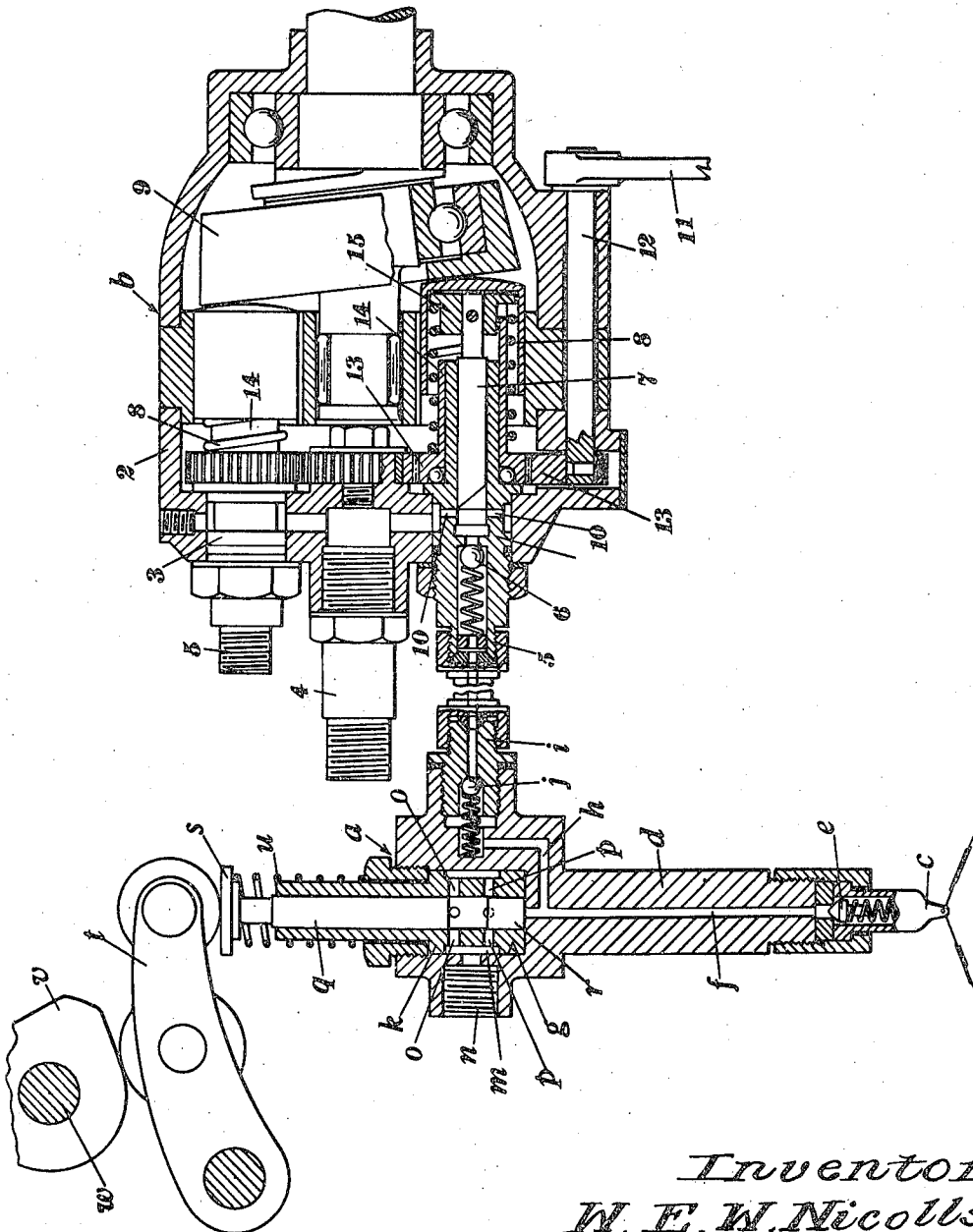
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FUEL PUMP

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FUEL PUMP

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This invention relates to systems for supplying liquid fuel in small measured quantities to the cylinder or cylinders of an internal combustion engine, and of the kind having in combination an injection pump adapted for connection to an injection nozzle, or a plurality of such pumps and a variable delivery metering pump adapted to supply the liquid fuel to the injection pump or pumps in variable quantities, the sole function of the injection pump or each of them being to discharge through the nozzle the fuel received from the metering pump.

The object of the invention is to provide an improved form of injection pump for use in a system of the kind specified above.

The accompanying drawing is a sectional elevation of a liquid fuel injection pump system embodying an injection pump in accordance with the invention.

The liquid fuel system shown in the drawing comprises an injection pump *a* or a plurality of such pumps, and a variable-delivery metering pump *b* adapted to supply liquid fuel to the injection pump or pumps, the sole function of the injection pump or each such pump being to discharge through an associated nozzle *c* the fuel received from the metering pump.

In constructing the injection pump *a*, or each such pump, I employ a cylindrical body part *d* adapted to be inserted in and secured to one end of the cylinder or one of the cylinders of an internal combustion engine. At its inner end the body part *d* has secured to it the injection nozzle *c* which may be of any desired form, the interior of the nozzle being fitted with a spring loaded non-return valve *e*. Along the axis of the body part *d* is formed a passage *f* which extends between the nozzle *c* and a cylindrical chamber *g* formed in the outer end of the body part. At a position adjacent to the chamber *g* the passage *f* communicates through a branch passage *h* with a fuel inlet pipe connection *i*, the latter being detachably secured to the body part *d*, and being controlled by a non-return valve *j*. In the chamber *g* is secured a pump barrel *k* which extends from the outer end of the body part *d*, the inner end of the bore of the barrel being open to the axial passage *f* in the body part. Also around an intermediate part of the exterior of the barrel *k* is formed (either in the barrel or in the body part *d*) an annular gallery *m* which communicates at one side with a lateral pipe connection *n* through which lubricating oil or other convenient auxiliary liquid can be supplied. Also in the portion of the barrel *k* surrounded by the gallery *m*

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are formed two sets of ports leading to the bore of the barrel, one set of these ports (herein termed the upper set) being indicated by *o*, and the other set (herein termed the lower set) being indicated by *p*.

The barrel *k* contains two coaxial plungers *q*, *r*. The plunger *q*, which forms the actuating member of the pump, is a long one and it extends from about the position of the upper set of ports *o* to beyond the outer end of the barrel *k*. The outer end of this plunger *q* is provided with a head *s* on which acts a rocker arm *t* for moving the plunger inwards and a spring *u* for moving the plunger outwards. The arm *t* is actuated by a cam *v*, and the latter is carried on a cross shaft *w* which (when the engine to be supplied with liquid fuel is a multi-cylinder engine) is common to all the engine cylinders and is provided with the cams required for actuating all the injection pumps. The other plunger *r*, which forms the fuel injecting member of the pump, is a relatively short one and consists of a cylindrical piece freely slidable in the bore of the barrel *k*. This plunger *r* is situated in the portion of the barrel bore between the lower set of ports *p* and the entrance to the passage *f* leading to the nozzle *c*.

The fuel inlet pipe connection *i* of the injection pump *a*, or of each such pump, is connected by a pipe or pipes to the variable-delivery metering pump *b*. This pump *b* may be of any convenient type such as is ordinarily used for supplying liquid fuel to an engine, and its delivery is variable in response to the speed and/or load of the engine, or the requirements of the attendant. It is not essential, however, that the metering pump *b* shall be capable of operating at the normal high pressures, as its sole duty is to feed the injection pump or pumps as *a*. In the example shown the metering pump *b* is of the multiple-delivery swash plate type, and comprises a hollow casing 2 in which a plurality of ported pump cylinders 3 are mounted around a common inlet pipe connection 4, and are provided at their outer ends with outlet pipe connections 5 controlled by non-return valves as 6. Slidable within and extending from the inner ends of the pump cylinders 3 are plungers as 7 which are also rotatable about their longitudinal axes. The plungers 7 are slidable in one direction by springs 8 and in the opposite direction by a rotatable swash plate 9, the latter being adapted to be driven by the engine. Movements of the plungers 7 by the spring 8 cause fuel from the inlet connection 4 to be drawn into the pump cylinders 3 through

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ports 10 in the cylinder walls, and movements of the plungers by the swash plate 9 serve to discharge fuel from the cylinders through the outlet connections 5. The inner ends of the plungers 7 are made so that the output of the pump 6 can be varied in the usual manner by rotational movements of the plungers about their longitudinal axes. Such rotational movements may be imparted to the plungers 7 either by hand or automatically from a lever 11 on a spindle 12, the latter being connected by toothed gearing 13 to sleeves 14 which surround the cylinders 3 and engage notched collars as 15 on the inner ends of the plungers.

It will be understood that each of the outlet pipe connections 5 of the metering pump 6 is connected to the inlet pipe connection 1 of an injection pump 4 as above described.

The injection pump 4 or each such pump operates in the following manner. Lubricating oil or other auxiliary liquid is supplied through the pipe connection 2 to the gallery 3 and the space between the adjacent ends of the plungers 4, 5 at a moderate pressure. When a charge is received from the metering pump 6 the effect of this charge is to push the injection plunger 7 upwards to an extent dependent on the volume of the charge, a corresponding quantity of the auxiliary liquid being displaced by this movement from the barrel bore through the ports 8, 9, both sets of which are initially uncovered by the plungers 4, 5. In this action the injection plunger 7 moves sufficiently to close the lower ports 9. Later the actuating plunger 4 is moved inwards by its cam 6 causing a further displacement of the intervening liquid and closing the upper ports 8. Continued movement of the actuating plunger 4 causes movement of the injection plunger 7 through the medium of the entrapped auxiliary liquid and thereby effects the injection through the nozzle 10 of the quantity of fuel received from the metering pump 6, the injection ceasing when the lower ports 9 are uncovered. After injection the actuating plunger 4 returns under the action of its spring 11, and auxiliary liquid flows back into the space between the plungers 4, 5 in readiness for the next cycle of operations.

In the example shown the upper ports 8 are of circular cross section, but this is not essential as these ports may have any other suitable cross sectional shape.

By means of injection pumps constructed and operating as above described, I am able to attain the desired results in a very simple and satisfactory manner.

The invention is not, however, limited to the example above described as subordinate details may be varied to suit requirements. Thus, the positions of the nozzle and outlet pipe connection of the injection pump or each such pump may be interchanged.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A liquid fuel pump having in combination a body, an inlet through which measured quantities of liquid fuel can be supplied under pressure to the inner end of a bore in the body, an actuating

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plunger slidable in the bore and extending through its outer end, a second plunger arranged coaxially with the actuating plunger in the inner end of the bore so that the second plunger is movable relatively to the actuating plunger by and to an extent dependent on the quantity of liquid fuel supplied to the inner end of the bore, the adjacent ends of the two plungers being spaced apart, ports which communicate under the control of the plungers with the space between the adjacent ends of the plungers, and through which an auxiliary liquid under pressure can flow into and out of the said space, an outlet through which liquid fuel supplied to the inner end of the bore can be discharged by movement imparted to the second plunger from the actuating plunger through the medium of the auxiliary liquid between the adjacent ends of the plungers, and means for imparting reciprocatory movements to the actuating plunger.

2. A liquid fuel pump having in combination a cylindrical body part, a chamber in the body part, a barrel secured in and extending from one end of the chamber, an inlet through which measured quantities of liquid fuel can be supplied under pressure to the inner end of the barrel bore, an actuating plunger slidable in the barrel bore and extending through its outer end, a second plunger arranged coaxially with the actuating plunger in the inner end of the barrel bore so that the second plunger is movable relatively to the actuating plunger by and to an extent dependent on the quantity of liquid fuel supplied to the inner end of the barrel bore, the adjacent ends of the two plungers being spaced apart, a gallery surrounding the barrel and having an inlet through which an auxiliary liquid under pressure can be supplied to the gallery, ports formed in the barrel at positions near the adjacent ends of the plungers, and serving under the control of the plungers to allow flow of the auxiliary liquid between the gallery and the space separating the adjacent ends of the plungers, an outlet passage which communicates with the inlet passage, and through which liquid fuel supplied to the inner end of the barrel bore can be discharged by movement imparted to the second plunger from the actuating plunger through the medium of the auxiliary liquid between the adjacent ends of the plungers, and means for imparting reciprocatory movements to the actuating plunger.

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