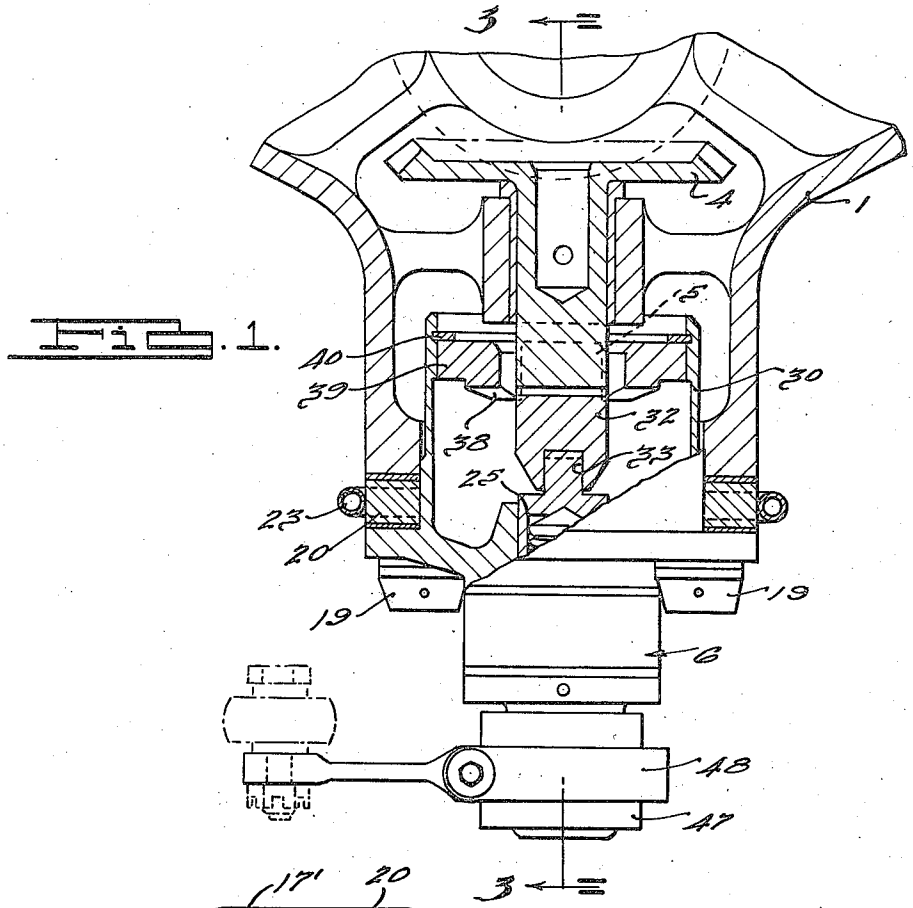
Aug. 6, 1946. B. G. PARSONS 2,405,163

FUEL INJECTOR

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Fig. 1.



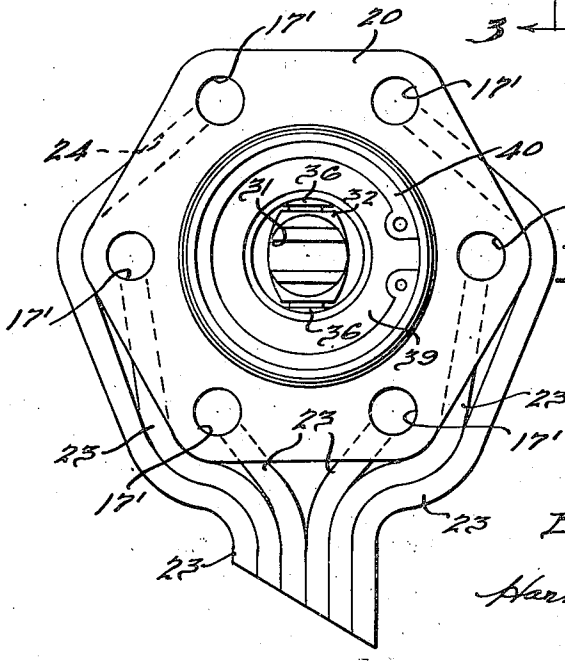


Fig. 2.

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FUEL INJECTOR

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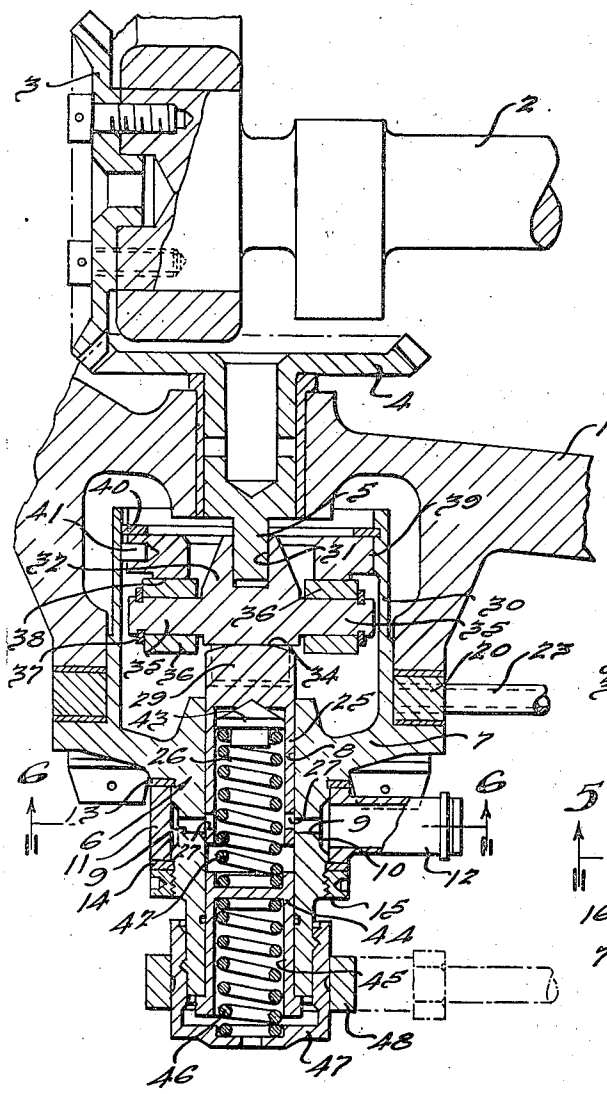


Fig. 3.

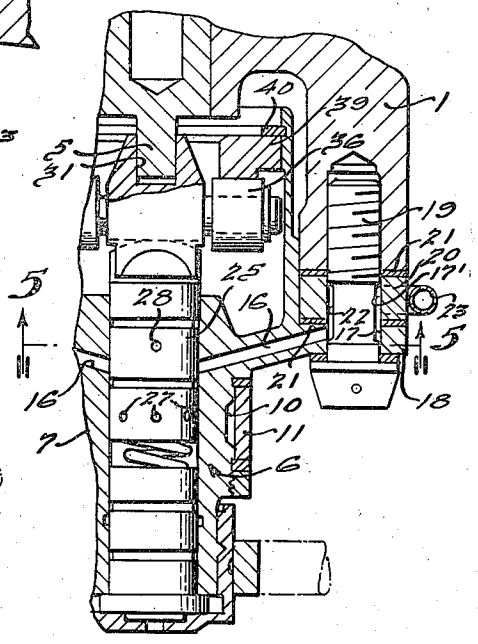


Fig. 4.

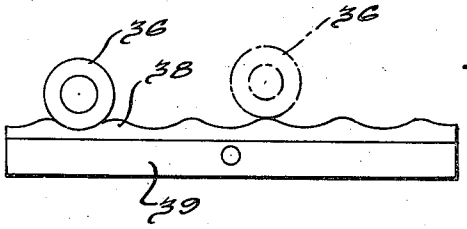


Fig. 11.

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FUEL INJECTOR

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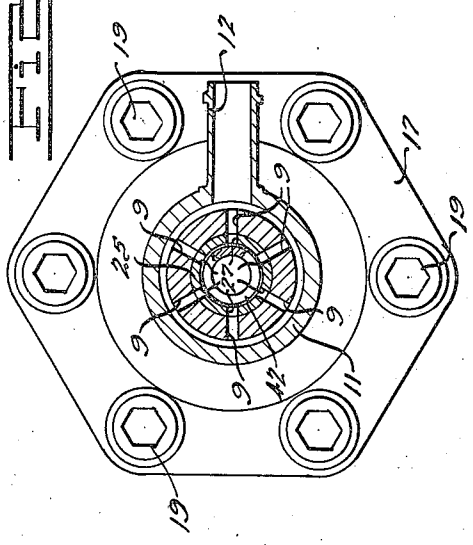


Fig. 6.

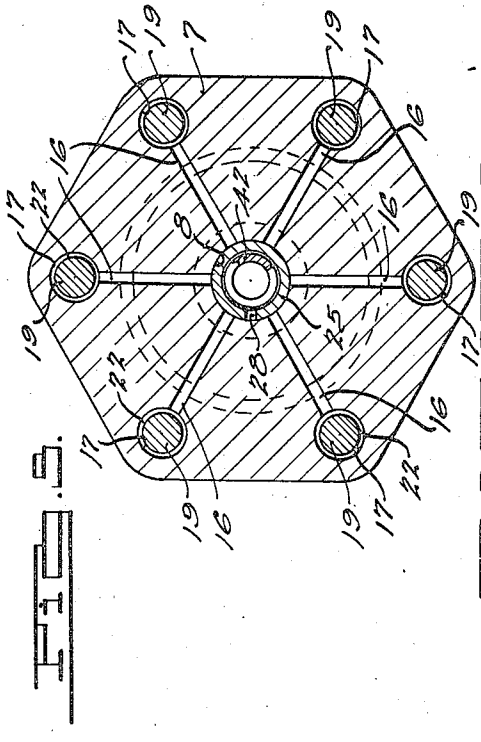


Fig. 9.

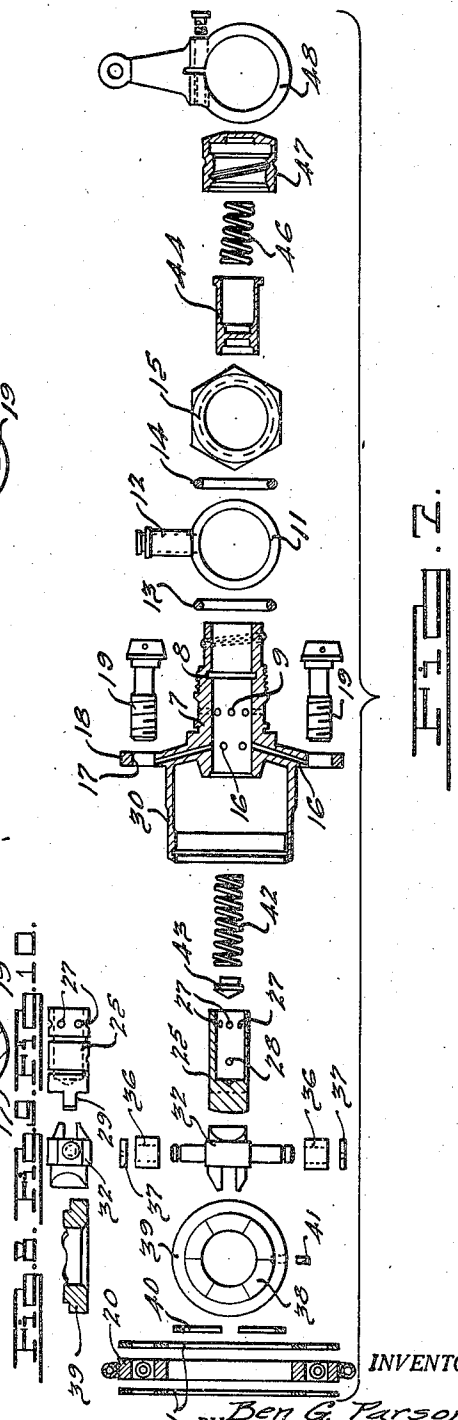


Fig. 7.

Fig. 10.

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Patented Aug. 6, 1946 2,405,163

UNITED STATES PATENT OFFICE

2,405,163

FUEL INJECTOR

Ben G. Parsons, Grosse Pointe, Mich., assignor to Fuel Charger Corporation, Detroit, Mich., a corporation of Michigan

Application December 14, 1944, Serial No. 568,177

11 Claims. (Cl. 103—2)

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The present invention relates to improvements in liquid pumping devices and particularly to fuel injectors for use with internal combustion engines.

The primary object of the present invention is to provide improvements in devices of the type mentioned whereby a single plunger is employed to accurately meter and distribute liquid fuel, such as gasoline, to a multiplicity of internal combustion engine cylinders, thereby effecting considerable economy.

Other objects of the invention will become apparent from the specification, the drawings relating thereto, and from the claims hereinafter set forth.

In the drawings, in which like numerals are used to designate like parts in the several views throughout:

Fig. 1 is a vertical cross-sectional view, with parts in elevation, of a fuel injector embodying features of the present invention and showing such injector mounted on the crankcase of an internal combustion engine;

Fig. 2 is a top plan view of the injector shown in Fig. 1 and with such injector removed from attachment to the crankcase;

Fig. 3 is a vertical cross-sectional view of the structure shown in Fig. 1 taken substantially along the line 3—3 of Fig. 1 and with the plunger at the beginning of the delivery stroke;

Fig. 4 is a partial cross-sectional view similar to Fig. 3, but taken at a right angle thereto and showing the parts in a different operating position;

Fig. 5 is a cross-sectional view taken substantially along the line 5—5 of Fig. 4;

Fig. 6 is a cross-sectional view taken along the line 6—6 of Fig. 3;

Fig. 7 is an exploded view of the parts making up the injector assembly;

Fig. 8 is a cross-sectional view of the cam ring;

Fig. 9 is a side elevational view of the drive shaft;

Fig. 10 is a side elevational view of the pumping plunger; and

Fig. 11 is an inverted, developed, elevational view of the cam ring showing one of the rollers in its association therewith.

The present invention relates to improvement over the structure disclosed and claimed in the copending application of Ben G. Parsons Serial No. 561,958, filed November 4, 1944.

In general, the injector of the present invention employs a single cylinder for distributing liquid fuel, such as gasoline, to a multiplicity of internal

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combustion engine cylinders. In the particular embodiment illustrated the pump is designed to distribute to six cylinders, by way of example. It will be obvious that it could be constructed to deliver to more or less cylinders. For a six-cylinder engine only one of the injectors of the present invention would be needed; and for a four-cylinder engine one designed to deliver to four cylinders would be needed and would have four delivery ports with corresponding changes in the delivery ratio and cam design. Also, it is contemplated that for twelve- or eighteen-cylinder engines, a corresponding multiple of the injectors of the present invention could be employed, the number depending upon whether the particular injector was designed for six or four delivery ports.

The injector of the present invention is illustrated as being mounted on a crankcase 1 of an internal combustion engine. It is driven from the engine cam shaft 2 which is mounted within the crankcase in the usual way. A beveled gear 3 is fixed to one end of the cam shaft 2 for rotation therewith and meshes with another beveled gear 4 which is rotatably mounted within the crankcase 1. The shaft of the beveled gear 4 has a depending transverse tongue 5 which is connected to the injector and serves to operate the injector in a manner that will be more apparent from the following description.

The fuel injector is generally indicated at 6 and comprises a plunger housing 7 formed with a central axial bore 8 therethrough. The housing 7 has formed therein a plurality of radially extending and equally spaced inlet bores or ports 9 which open into the bore 8. An annular, external recess or groove 10 is formed around the housing 7 and communicates with the outer ends of passageways 9. There are six of such bores 9 in the embodiment illustrated.

An inlet tube-fitting 11 embraces the casing 7 around the recess 10 to form an annular inlet chamber therebetween. The fitting 10 has a tubular projection 12 thereon to which a flexible tube or conduit may be connected. The conduit (not shown) leads to the source of fuel supply.

The fitting 11 is mounted on the housing 7 and has rubber sealing rings 13 and 14 disposed on opposite sides thereof, the ring 13 abutting against a shoulder formed on the casing 7 and the ring 14 being disposed between the adjacent faces of the fitting 11 and the fitting nut 15. The nut 15 is threaded onto a threaded portion formed on the exterior surface of the casing 7.

A plurality of equally spaced discharge passageways or bores 16 are also formed in the housing 7, the inner ends of which open into the bore 8. Such openings are in a plane axially spaced from the plane of the inlet passageways 9. The opposite ends of the passageways 16 communicate with axially extending openings 17 formed in a radially projecting flange 18 of the housing 7. There are six of the discharge passageways 16 in the embodiment illustrated, one for each of the engine cylinders. Such passageways are rotatably spaced between the inlet passageways 9. This relationship is best seen from a comparison of Figs. 5 and 6.

The injector assembly 6 is mounted to the crankcase 1 by means of mounting bolts 19 which are passed through the openings 17. A distributor ring or tube ring 20 is disposed between the flange 18 and the adjacent face of the crankcase 1. Sealing gaskets 21 are disposed between the facing surfaces of the ring 20 and the crankcase 1 and flange 18. The mounting bolts 19 pass through openings 17' formed in the cam ring 20 and have reduced portions 22 which form with such openings 17' and the openings 17 an annular chamber into which the corresponding passageways 16 open and communicate.

Distributor tubes or conduits 23, there being one for each cylinder, are fixedly mounted on the ring 20. Bores or passageways 24 are formed in the ring 20, there being one for each of the openings 17' and for each of the conduits 23. Each conduit 23 communicates with one of the bores 24 and in turn communicates with the chamber formed between the reduced portion 22 and the openings 17' and 17 through ring 20 and flange 18 respectively. The opposite ends of the tubes 23 are each connected to an injector nozzle (not shown). The nozzles are associated with the engine cylinders, as will be understood by those skilled in this art, and may be of the type disclosed in the copending application of Ben G. Parsons Serial No. 546,352, filed July 24, 1944.

The hollow delivery plunger 25 is rotatably and reciprocally disposed within the bore 8 and has an opening through one end thereof which is in open communication with the bore 8. The space within the hollow plunger 25 is indicated at 26. The plunger 25 is formed with a plurality of equally spaced inlet openings 27 formed through the wall thereof adjacent the open end. There are six of such openings 27 in the embodiment illustrated, one corresponding to each of the inlet passageways 9 and having the same equal spacing. The plunger 25 is also formed with a single delivery opening 28 through the wall thereof which is axially spaced from the ports 27 and which is aligned with one of the ports 27, as shown in Fig. 4. The port 28 is adapted to register with ports 16 in succession in a manner that will become more apparent from the following description.

The plunger 25 is rotated and reciprocated within the bore 8 to effect delivery of the fuel through the delivery passageways 16 in succession. The closed end of the plunger 25 has a transversely extending tongue 29 projecting upwardly therefrom. The plunger and tongue project beyond the bore 8 within an enlarged space formed by an integral annular portion 30 of the casing 7. The tongue 5, on the shaft of the beveled gear 4, also projects downwardly within the space within wall 30 and is received within a groove 31 formed in a drive shaft or drive member 32. The member 32 has another groove 33 formed in the opposite end thereof which receives therein the tongue 29. A driving connection is thus established between the shaft of the gear 4 and the plunger 25 so that the plunger 25 is rotated with gear 4. The upper end of tongue 29 is formed on a radius as indicated at 34, so that alignment of the plunger 25 within bore 8 is not disturbed upon rotation of member 32.

Member 32 has a pair of diametrically opposed stub axles 35 formed thereon which serve to mount rollers 36. The rollers 36 are retained on the stub axles by means of snap rings 37. The rollers 36 are constantly held against the cam surface 38 of a cam ring 39. The cam surface 38 is designed to effect proper reciprocation of the plunger 25 upon rotation thereof, in the present instance being designed with six crests and troughs. The cam ring 39 is mounted within the wall portion 30 and is held against axial displacement by means of a snap ring 40 against which it bears and which is received within the annular, internal groove formed in the casing portion 30. It is located in its proper rotative position by means of a locating pin 41 which is properly located and fixed to the portion 30 and which is received within an opening formed in the cam ring 39.

It will thus be seen that upon rotation of the gear 4, which is timed with the cam shaft 2, the plunger 25 is caused to rotate and reciprocate. Reciprocation of the member 32 with respect to the shaft beveled gear 34 is permitted, due to the tongue and groove connection therebetween. When the rollers 36 are on the crests of the cam 38, the plunger is at the beginning of the inlet or suction stroke and the six inlet openings 9 are overlapped with the inlet openings 27 in the plunger to provide inlet communication into the interior space 26 within the plunger. At this time there is no communication between the distributor port 28 and any of the passageways 16. When the rollers 36 are on the troughs of the cam 38, the plunger 25 is at the end of the intake stroke and the beginning of the delivery stroke. Further rotation of the plunger brings the opening 28 into communication with one of the passageways 16. At this time the passageways 9 are closed off. There are thus six cycles of reciprocation of the plunger for each rotation thereof, so that for one rotation of the plunger the port 28 is brought into communication with all of the passageways 16, in succession.

A coil spring 42 is disposed within the hollow plunger 25 with one end bearing against a centering button 43 which in turn seats within the end of space 26. The opposite end of the spring 42 is received within a seat formed within an adjustable control piston 44. The control piston 44 is slidably received within the open end of bore 8 and is formed with an axial recess 45 on the opposite side of the separate wall between it and the spring 42. Another coil spring 46 is disposed within the recess 45 abutting against the adjacent face of the separating wall with the opposite end of the spring abutting against an end cap or control nut 47. The nut 47 is threadably connected to the end of the casing 7 and has a control lever 48 fixed thereto. By adjusting the rotative position of the cap 47 with the lever 48, the tension on spring 46 is varied so that the relative axial position of piston 44 with respect to plunger 25 may be adjusted.

This, in effect, varies the amount of fuel contained within space 26 so that the amount of fuel delivered due to the reciprocation of the plunger 25 may be adjustably varied. The lever 48 may be adjustably fixed in the proper position around the cap 47 so that it may be suitably located to adapt it to its particular installation.

The system employed with the injector of the present invention is what is termed a "dead end" system; that is, there is no flow return or spill back in the system. This is accomplished by having more inlet openings on the suction than on the delivery, when only one is open. This makes it possible to dispense with the use of a transfer pump.

In the operation of the device above described, fuel is constantly supplied through tube 12 so that there is a constant supply of fuel within space 10 and within the inlet openings 9. With the plunger 25 in such a rotative position that the rollers 36 are on the crests of the cam 38, the plunger is at the beginning of its intake stroke; and as the rollers 36 move toward the troughs of the cams, the plunger 25 moves upwardly with the openings 27 overlapping and communicating with inlet openings 9. Fuel is thus drawn into the space 26. When the rollers 36 reach the troughs in the cam 38, the plunger is at the end of the intake stroke and at the beginning of the delivery stroke. Further rotation of the plunger 25 causes the rollers to move to the crests of the cam, and at the beginning of such movement communication between openings 27 and 9 is cut off, and opening 28 communicates with one of the passageways 16 delivering fuel to the particular cylinder associated with that passageway through its particular conduit 23. There are six troughs and crests on the cam 38 so that for each rotation of the piston 25 the delivery port 28 is brought into communication with all of the passageways 16 in succession. When the rollers 36 are at the troughs of the cam, only one distributor opening 16 is in communication with the space 26 through the opening 28, and all of the inlet openings 9 are closed. When the rollers 36 are at the crests of the cam, all six inlet openings 9 are in communication with the space 26 through openings 27. A uniform charge of fuel is thus delivered through the port 28 to the delivery ports 16 in succession as the piston 25 rotates and reciprocates. The stroke of the piston 25 is constant; but the effective stroke thereof, that is, the amount of confined fuel delivered through the delivery ports, may be adjustably varied by adjusting the piston 44, as above described.

What is claimed is:

1. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means in said plunger communicating the interior of said plunger with said inlet ports, means in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

2. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of equally and circumferentially spaced fuel inlet ports through said casing communicating with said bore, means providing a plurality of equally and circumferentially spaced delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means in said plunger communicating the interior of said plunger with said inlet ports, means in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

3. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways in said plunger communicating the interior of said plunger with said inlet ports, means providing an outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

4. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways corresponding to the number of said inlet ports in said plunger communicating the interior of said plunger with said inlet ports, means providing an outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

5. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways corresponding to the number of said inlet ports in said plunger communicating the interior of said plunger with said inlet ports, means providing an outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

6. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of equally and circumferentially spaced fuel inlet ports through said casing communicating with said bore, means providing a plurality of equally and circumferentially spaced delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways corresponding to the number of said inlet ports in said plunger communicating the interior of

said plunger with said inlet ports, means providing an outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

7. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways in said plunger communicating the interior of said plunger with said inlet ports, means providing a single outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

8. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways in said plunger communicating the interior of said plunger with said inlet ports, means providing an outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, said outlet passageway being axially spaced from said inlet passageway a distance greater than the axial spacing between said inlet and said outlet ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

9. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports through said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of inlet passageways in said plunger communicating the interior of said plunger with said

inlet ports, means providing a single outlet passageway in said plunger communicating the interior of said plunger with said delivery ports, said outlet passageway being axially spaced from said inlet passageway a distance greater than the axial spacing between said inlet and said outlet ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession.

10. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports in said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet and communicating with said bore, a hollow delivery plunger disposed within said bore, means in said plunger communicating the interior of said plunger with said inlet ports, means in said plunger communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession, said last named means comprising a rotatable member operatively connected to said plunger, and cam means operably connected to said rotatable member to effect axial movement of said member and said plunger upon rotation thereof.

11. In a fuel pump having a casing, a longitudinal bore within said casing, means providing a plurality of fuel inlet ports in said casing communicating with said bore, means providing a plurality of delivery ports through said casing axially spaced from said inlet ports and communicating with said bore, a hollow delivery plunger disposed within said bore, means providing a plurality of fuel inlet passageways in said plunger communicating the interior of said plunger with said inlet ports, means providing an outlet passageway in said plunger axially spaced from said inlet passageways and communicating the interior of said plunger with said delivery ports, and means to reciprocate and rotate said plunger to effect delivery of fuel through said delivery ports in succession, said last named means comprising a rotatable member operatively connected to said plunger, and cam means operably connected to said rotatable member to effect axial movement of said member and said plunger upon rotation thereof.

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