

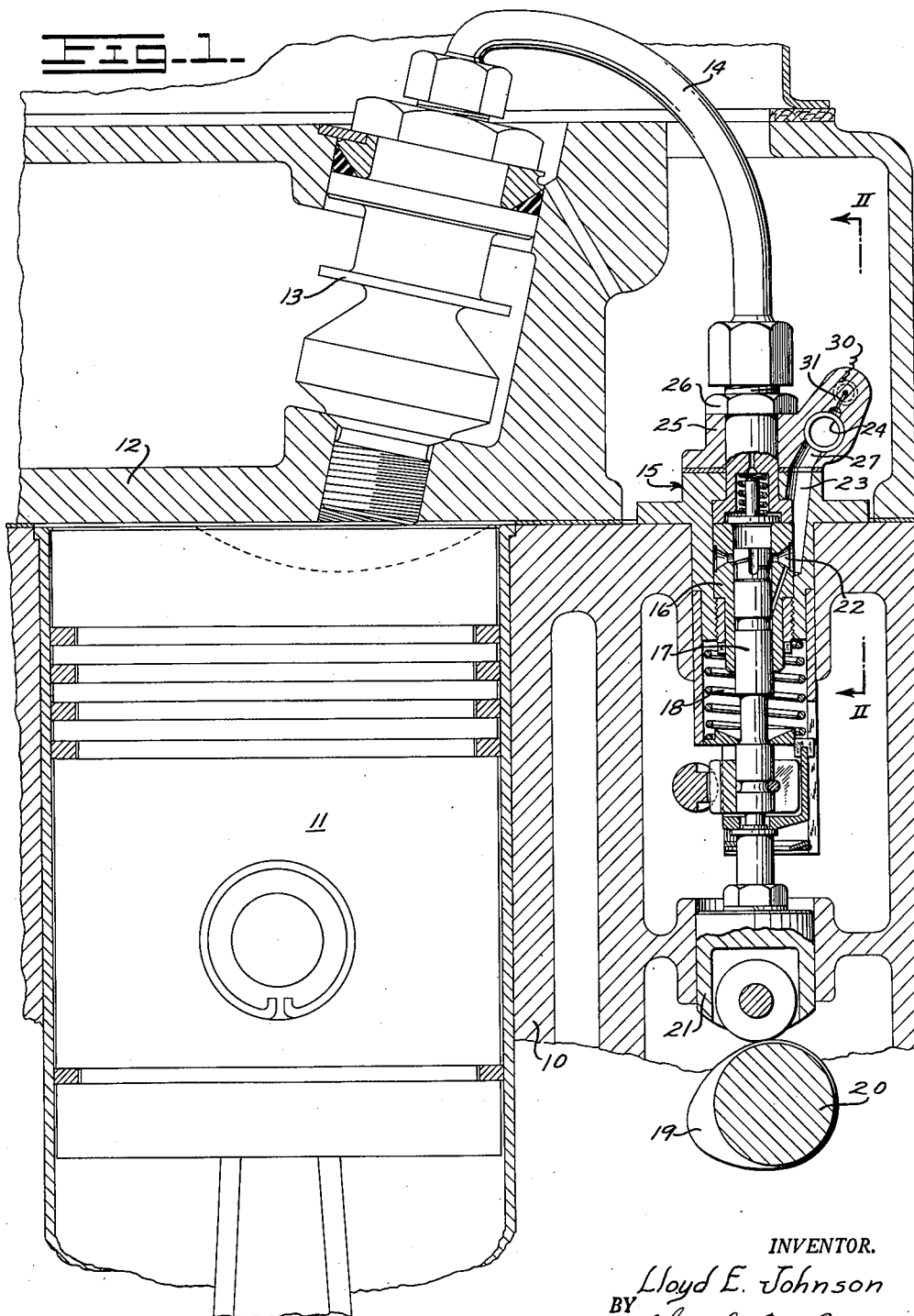
July 15, 1952

L. E. JOHNSON
FUEL INJECTION SYSTEM

2,603,159

Filed Oct. 23, 1947

2 SHEETS—SHEET 1



INVENTOR.
Lloyd E. Johnson
BY Charles M. Fryer
ATTORNEY.

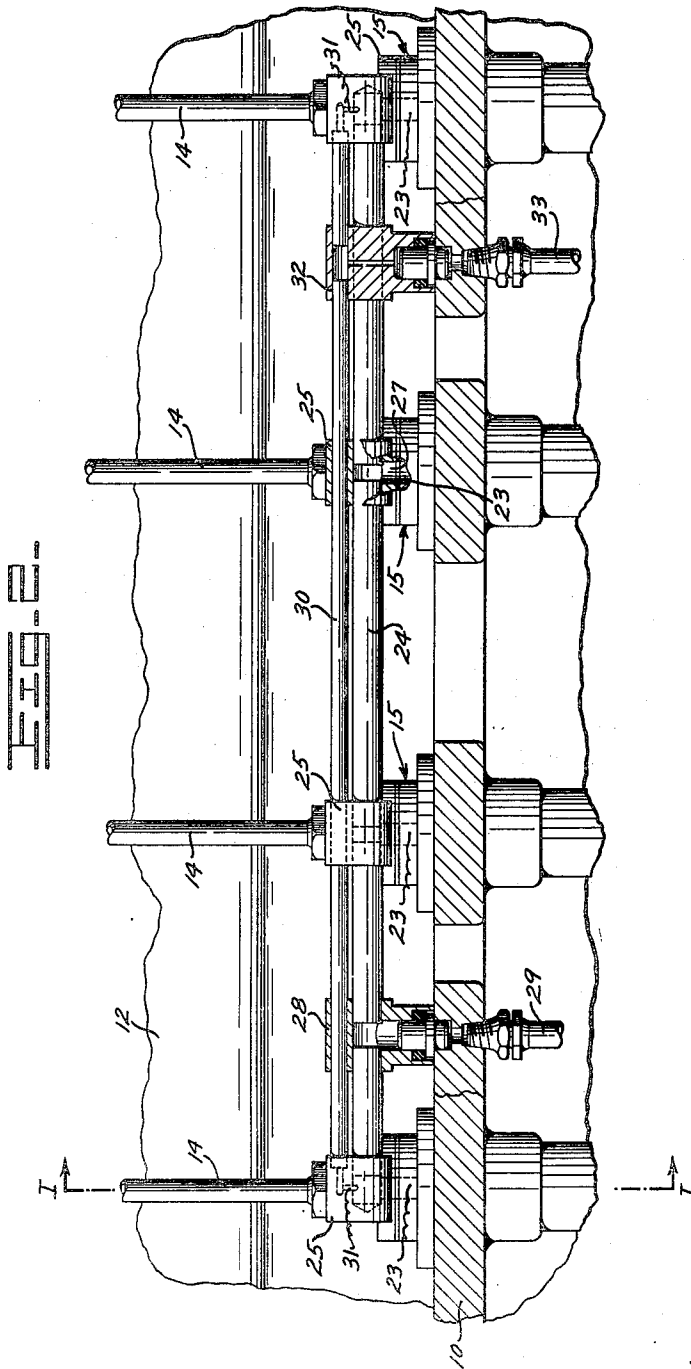
July 15, 1952

L. E. JOHNSON
FUEL INJECTION SYSTEM

2,603,159

Filed Oct. 23, 1947

2 SHEETS—SHEET 2



INVENTOR.

BY *Lloyd E. Johnson*
Charles M. Fryer
ATTORNEY.

UNITED STATES PATENT OFFICE

2,603,159

FUEL INJECTION SYSTEM

Lloyd E. Johnson, Peoria, Ill., assignor to Caterpillar Tractor Co., San Leandro, Calif., a corporation of California

Application October 23, 1947, Serial No. 781,605

5 Claims. (Cl. 103—41)

1

This invention relates to fuel injection systems and particularly to that portion of a fuel injection system by means of which fuel is directed to injection pumps and any air entrained with the fuel is vented or returned to the source of fuel supply.

It is conventional practice in injecting fuel to internal combustion engines to employ a set of pumps corresponding in number to the number of cylinders in the engine. Fuel is supplied to these pumps from the fuel tank by a low pressure transfer pump and the fuel injection pumps are operated by cam action in the order and timing desired. Because of the high pressure and small volume operation of the injection pumps, any gas or air included with the fuel delivered to them will interfere with their proper functioning and failure of fuel delivery to the engine cylinder results. One method of eliminating air from the injection pumps is to provide a vent valve in association with each pump so that upon the presence of air in any pump the valve may be temporarily opened. This method requires the attention of an operator. It is costly because of the necessity of the vent valves and it is undesirable when the injection pumps are exposed in an inaccessible position or obstructed by other engine parts.

The present invention provides means for automatically and continuously relieving or venting air from fuel supplied to injection pumps and is disclosed herein in association with an engine having pumps located in close proximity to the engine cylinders and, therefore, spaced apart from each other a considerable distance. It will appear from an understanding of the present disclosure, however, that the invention is equally adaptable to injection systems wherein the pumps are all contained in a compact group and connected with the several cylinders of the engine by longer conduits.

It is an object of this invention to provide a fuel injection system for engines having means to continuously vent air from the system just before it reaches the injection pumps. Another object is to provide an arrangement for venting air or gas from such a system that will operate regardless of variations in the position of the engine such as might be caused by a vehicle carrying the engine traveling up or down grade. Still further and more specific objects and advantages of the invention are made apparent in the following specification wherein a preferred form of the invention is described in detail by reference to the accompanying drawings.

2

In the drawings:

Fig. 1 is a vertical section taken transversely through a portion of an engine equipped with a fuel injection system embodying the present invention and taken on the plane indicated by the line I—I in Fig. 1; and

Fig. 2 is a fragmentary section taken on the line II—II of Fig. 1.

In Fig. 1 a portion of a conventional internal combustion engine of the compression ignition type is illustrated as comprising a cylinder block 10 having cylinders within which pistons 11 are reciprocally mounted in the conventional manner. A cylinder head casting 12 overlies the block and contains a fuel injection nozzle 13 for each of the cylinders in the block. A conduit 14 connects this nozzle with a fuel injection pump generally indicated at 15. The pump herein shown is of the reciprocating plunger type having a cylinder 16 in which a plunger 17 is disposed. A spring 18 normally retracts the plunger and a cam 19 on a cam shaft 20 acts through a cam follower 21 to advance the plunger in opposition to the action of the spring 18. Fuel oil is supplied to the interior of the cylinder 16 upon retraction of the plunger through an inlet port 22. The port 22 communicates with a bore 23 in the pump housing. A pump assembly 15 is provided for each cylinder of the engine and the pump assemblies are preferably arranged in alignment, as illustrated in Fig. 2.

According to the present invention, fuel oil is distributed to the several pumps through a common manifold 24. To support this manifold each of the pumps is provided with a fitting 25 secured in place thereon as by a nut 26. Each of the fittings 25 has a bore for the reception of the manifold pipe 24 and this pipe is preferably, as shown in Fig. 2, formed in separate sections with sufficient space between the ends of the sections to permit the flow of oil from the interior of the manifold downwardly through a bore 27, which, as shown in Fig. 1, communicates with the bore 23 in the pump housing. Fuel oil is introduced to the manifold 24 through a fitting 28, which fitting communicates with a conduit 29 leading to a fuel transfer pump (not shown). The fuel transfer pump, operating at a relatively low pressure, withdraws fuel from a fuel tank or reservoir (not shown) and directs it into the manifold so that a constant supply of fuel is always present therein to meet the requirements of the several fuel injection pumps associated with the manifold.

Just above the fuel manifold 24 and prefer-

ably also supported by and passing through the fittings 25 is a vent manifold 30. The vent manifold 30 communicates with the fuel manifold 24 only at its opposite ends and through restricted orifices 31 formed in the endmost fittings 25. The vent manifold 30 also communicates as through a fitting 32 shown in Fig. 2 with a return line 33 preferably leading to the fuel tank or other source of supply from which the fuel is withdrawn by the transfer pump. The orifices 31, which communicate between the extreme ends of the fuel manifold and the ends of the vent manifold 30, insure a constant return of a limited amount of fuel-oil to the source of supply. These orifices are preferably restricted or small in diameter so that the quantity of fuel returned is very limited and an excess or unnecessary burden is not placed upon the fuel transfer pump. These orifices are, however, sufficiently large to insure return to the source of supply of any air that might be included in the fuel delivered by the fuel transfer pump to the fuel oil manifold 24.

Because the vent manifold 30 is disposed above the fuel manifold 24, any air delivered to the fuel manifold by the transfer pump will naturally find its way into the vent manifold. The reason for placing the orifices 31 adjacent the opposite ends of the fuel manifold is to insure that air which occupies the uppermost position in the manifold will always be able to escape into the vent manifold regardless of whether the engine is tilted forwardly or rearwardly, as would occur if a vehicle in which the engine was carried were traveling up or down grade. The capacity of the fuel transfer pump is sufficient to fulfill the requirements of all of the fuel injection pumps on the engine and to provide sufficient extra fuel to insure a constant return through the vent manifold back to the source of supply. Consequently, the fuel injection pumps which withdraw oil from the lower portion of the fuel manifold 24 will never receive any of the air which occupies the upper portion of said manifold and is delivered back with the excess oil to the source of supply.

The fuel oil manifold 24, herein shown as separate pieces of pipe entering the fittings 25 and the fitting 28, is preferably brazed or otherwise securely sealed at its several points of connection with these fittings, though it may, of course, be a single pipe with bored openings communicating with the bored passages in the fittings. The invention as herein disclosed is applied to an engine wherein the fuel injection pumps are spaced according to the spacing of cylinders in the engine and are in alignment with each other. It is apparent, however, that the manifold pipes may be curved for adaptation to other arrangements of fuel injection pumps or may be considerably shorter where all of the pumps are contained in a group within a single fuel injection housing.

With the present invention the necessity of

vent or bleed-off valves associated with each of the pumps is eliminated and a continuous venting of air from the fuel injection system is automatically accomplished.

I claim:

1. In a fuel injection system for an engine which comprises a plurality of fuel injection pumps, a fuel manifold disposed above said pumps and communicating with each of them, a vent manifold disposed above the fuel manifold, restricted orifices connecting the top of the fuel manifold with the vent manifold, means for directing fuel from a source to the fuel manifold, and means connecting the vent manifold with said source.

2. In a fuel injection system for an engine comprising a plurality of aligned fuel pumps, a fuel manifold disposed above and connecting the intakes of said pumps, a vent manifold parallel to and above the fuel manifold, vent openings connecting said manifolds adjacent their extreme ends, and means for exhausting fluid from the vent manifold.

3. In a fuel injection system for an engine comprising a plurality of injection pumps to which fuel is supplied from a source, a fuel supply manifold disposed above said pumps, means for directing fuel downwardly from said manifold to each of said pumps, and vent opening in the upper portion of said manifold.

4. In a fuel injection system for an engine comprising a plurality of injection pumps to which fuel is supplied from a source, a fuel supply manifold disposed above said pumps, means for directing fuel downwardly from said manifold to each of said pumps, vent openings in the upper portion of said manifold, and means communicating between said vent openings and said fuel source.

5. In a fuel injection system for an engine comprising a plurality of injection pumps to which fuel is supplied from a source, a fuel supply manifold disposed above said pumps, means for directing fuel downwardly from said manifold to each of said pumps, restricted vent openings in the upper portion of said manifold, and means communicating between said vent openings and said fuel source.

LLOYD E. JOHNSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,096,711	Fielden	Oct. 26, 1937
2,185,144	Edwards	Dec. 23, 1939
2,192,387	Schlaupitz	Mar. 5, 1940
2,357,870	Beeh	Sept. 12, 1944
2,412,316	Campbell	Dec. 10, 1946
2,414,261	Kalitinsky	Jan. 14, 1947
2,426,319	Meitzler	Aug. 26, 1947
2,458,377	Hennings	Jan. 4, 1949