

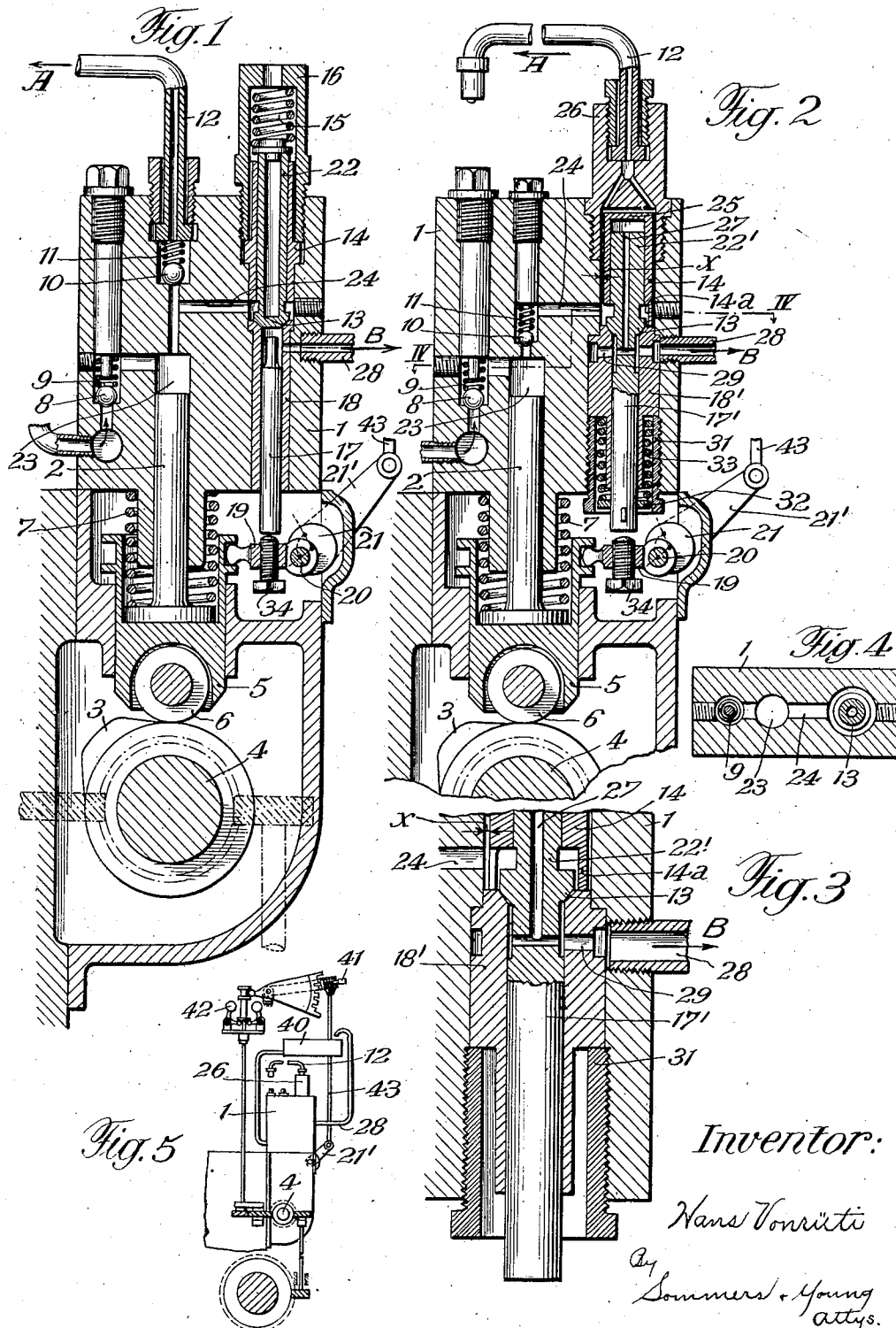
Feb. 21, 1933.

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1,898,916

FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

Filed Oct. 30, 1931



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FUEL PUMP FOR INTERNAL COMBUSTION ENGINES

Application filed October 30, 1931, Serial No. 572,139, and in Switzerland November 12, 1930.

The present invention refers to fuel pumps for internal combustion engines of the fuel injection type and particularly concerns a pressure relief member for such fuel pumps. According to the invention a pressure relief member is provided which, for effecting a sudden pressure relief, is designed for an effective cross-sectional area substantially equal to the area of the pump piston, and embodies pressure balancing means for lessening the effort required for opening the relief member and adapting said member to effect a sudden pressure relief in the pump chamber at the end of the injection period and responsive to but a slight impulse imparted to it by the control means for the same in spite of the considerable effective area of the relief member. The pressure relief member may be provided with a pressure-tight pressure balancing plunger. The invention may for example be so carried into effect that the pressure balancing plunger moves in a freely displaceable cylindrical guide, the space between the plunger and its guide cylinder being connected to a chamber in which a low pressure, preferably atmospheric pressure, is present. Furthermore the relief member may be in the form of a valve and the balancing plunger may be so arranged with regard to the valve seat that the valve is pressed on its seat by the pressure in the pump, so that no valve spring or only a light spring is required. In this manner it is avoided that the control means or the governor respectively is counteracted when opening the valve or maintaining it in its open position by a considerable spring action.

Two constructional examples of the present invention are illustrated in the accompanying drawing in which

Fig. 1 is a vertical section through a first constructional form of the fuel pump according to the invention,

Fig. 2 is a section similar to Fig. 1 of a second constructional form.

Fig. 3 shows a detail of Fig. 2 on a larger scale,

Fig. 4 is a section on the line IV—IV in Fig. 2, and

Fig. 5 is a view showing the fuel pump in

connection with related parts of the internal combustion engine.

Referring now to Fig. 1, the pump body in which the pump piston 2 reciprocates is designated by 1. The piston is moved in the upward direction by means of the cam 3, keyed to the cam shaft 4, of the engine, and the roller 6 mounted in the guide member 5, and it is forced in the downward direction against the cam disk, subsequent to the pressure stroke, by the resetting spring 7. 8 designates the suction valve of the pump, constituted by a ball which is loaded by a spring 9, and 10 is the pressure valve, similarly constructed as a ball loaded by a spring 11. The fuel enters through the suction valve and is admitted to the engine in the direction of the arrow A by a high pressure conduit 12 joining the pressure valve behind the same. The pressure relief valve 13 is movable in a guide 14 and is pressed on its seat by a spring 15 and connected with the oil drainage conduit 28 leading its contents in the direction of the arrow B to the receptacle 40 (Fig. 5), which communicates with the atmosphere. The spring 15 is adapted to exert pressure on the valve 13 by means of a spring casing 16. The valve 13 is actuated by a push-rod 17 arranged below the valve 13 and movable in a guide 18. The actuation of the push-rod 17 is effected by means of a lever 19 which engages with its one end in the guide member 5 and the other end of which is fulcrumed on the pin 20, the latter being eccentrically arranged on a rotatably mounted shaft 21. By rotationally adjusting the shaft 21 by means of a setting lever 41 or the governor 42 respectively (Fig. 5) through the intermediary of a connecting rod 43 and a lever arm 21' connected to the shaft 21, the injection period is so adjusted that the valve 13 with but a small load on the engine is opened earlier than with a greater load, in which case it is opened later.

According to the invention the effective cross-sectional area of the relief valve is approximately the same as that of the pump piston 2 (Fig. 4), so that on lifting the relief valve a sudden pressure relief in the pump chamber occurs, the fuel injection thus being

rapidly interrupted and a sudden pressure drop effected in the fuel injection supply conduit. This is very important for the injection of the fuel. By the mechanism described the fuel injection is effectively and exactly cut off at the desired instant, as the mechanism is adjusted for instance by the governor or manually (Fig. 5). In this way an accurate and rapid action of the fuel injection control means is obtained, so that the engine responds immediately to any impulse from the governor. The fuel consumption becomes low as at the desired moment the fuel injection is abruptly and totally cut off, and dripping is effectively prevented and after-burning is also thereby avoided.

The large size pressure relief member 13 is provided with a pressure-tight pressure balancing plunger 22 having approximately the same diameter as the pressure relief valve 13. By these means the pressure in the space 24, which communicates with the cylinder 23, is prevented from exerting any appreciable effect on the valve 13 in the closing direction. By providing a suitable ratio of the diameter of the pressure balancing plunger 22 to the diameter of the valve 13 this pressure can be reduced to a small amount. Therefore in the arrangement according to the invention a small force applied to the push rod 17 will suffice to open the pressure relief member 13. The area of free passage will be large even when the valve 13 is only slightly lifted, as according to the invention, the diameter of the valve 13 is approximately equal to the diameter of the pump piston 2.

A modified embodiment of the invention as regards the pressure relief valve is illustrated in Figs. 2 and 3. In this case the pressure relief valve 13 is also provided with a pressure-tight pressure balancing plunger 22' and the modification consists in particular in the arrangement that the plunger 22 is displaceable in a top closed cylinder 25. The cylinder 25 is guided only on the pressure balancing plunger 22 of the valve 13, it being housed in the pump body 1 with a circumferential clearance x so as to be freely movable therein and it abuts by means of the parts 14a on the guide bushing 18', so that no mechanical forces are exerted on the plunger 22'. With this embodiment the clearance serves as a pressure space connected with the pump between the pressure valve 10 and the conduit 12 leading to the internal combustion engine in the direction A. The conduit 12 is fixed by the nipple 26. The relief valve is provided with a bore 27 communicating with the conduit 28 for returning the superfluous fuel oil in the direction of the arrow B, conduit 28 in turn communicating with the atmosphere. By this communication atmospheric pressure is provided above the relief valve, the valve thus

being relieved from a possible high pressure load by the aid of the plunger 22'. For operating the valve 13 a push-rod or shaft 17' is arranged below the valve which is movable in the guide 18'. The actuation of the push-rod 17' is effected in the same manner as has been described above with reference to Fig. 1. The guide 18' provided with the passages 29, which connect the valve as well as the upper end of the guide piston 22' through the intermediary of the bore 27 with the fuel drainage conduit 28, is inserted from below and pressed upwardly by the nut 31. To the push-rod 17' a spring cap 32 is fixed, against which a spring 33 abuts so as to urge the rod 17' in the downward direction towards the set screw 34. Also the arrangement illustrated in Fig. 2 shows the feature that only a small closing pressure is exerted on the valve 13 owing to the diameters of the balancing plunger 22' and of the valve 13 being approximately equal. The same advantages as mentioned above with reference to Fig. 1 are obtained also in this case.

A further feature of the invention is that the seat of the pressure relief member 13 is arranged at a lower level and the balancing plungers 22 and 22' respectively at a higher level and the pump pressure admitted between these two parts. This is the case in both of the constructional examples shown in Figs. 1 and 2. This special arrangement permits to press the pressure relief member on its seat during the pressure stroke of the pump by the pressure of the fuel. A further advantage of this arrangement over known devices resides in the fact that in the opened position of the pressure relief member no appreciable force need be exerted by the regulating levers and rods or by the adjusting device respectively on the pressure relief member, as only a feeble closing spring 15, (Fig. 1) or no spring at all (Fig. 2) is required.

I claim:

In a fuel piston pump for internal combustion engines of the fuel injection type, in combination, a pressure relief valve for the pump, the effective diameter of said relief valve for effecting a sudden pressure relief approximating the diameter of the pump piston, control means for actuating the relief valve at the end of the injection period, a pressure balancing plunger connected to the side of the relief valve opposite the valve seat, the diameter of the plunger being substantially equal to the effective diameter of the relief valve, a bushing with a sliding fit around said pressure balancing plunger, said bushing being radially movable in the discharge line and subjected to the discharge pressure on its outer surface, one end of said bushing enclosing the free end of the plunger and the other end having an extension abutting against a part rigidly connected to the

fuel pump casing to prevent discharge pressure from being transmitted to said relief valve, a space between said plunger and the closed end of said bushing, a connection from
5 said space to a low pressure chamber, and means to apply the discharge pressure to said relief valve between its seat and said balancing plunger.

In testimony whereof I have signed my
13 name to this specification.

HANS VONRÜTI.

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