

April 21, 1936.

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2,037,894

FUEL PUMP

Filed July 17, 1933

2 Sheets-Sheet 1

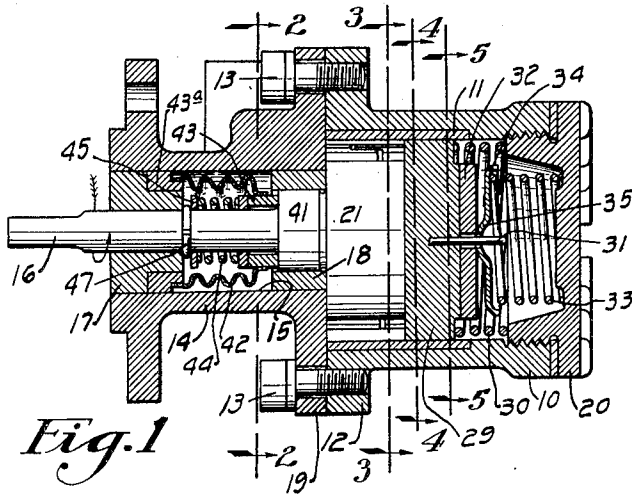


Fig. 1

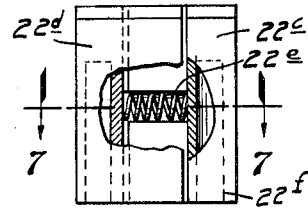


Fig. 6

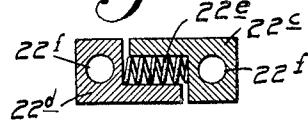


Fig. 7

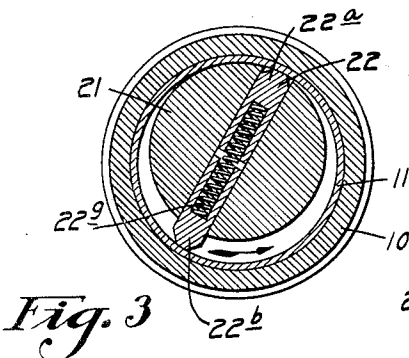


Fig. 3

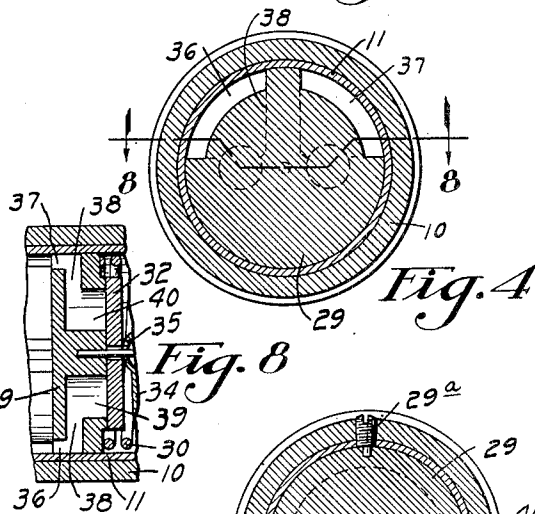


Fig. 4

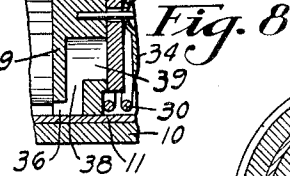


Fig. 8

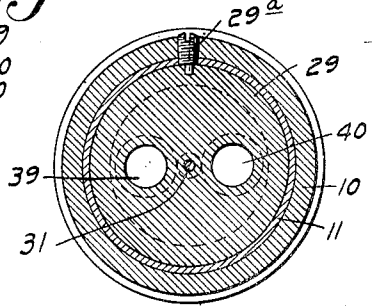


Fig. 5

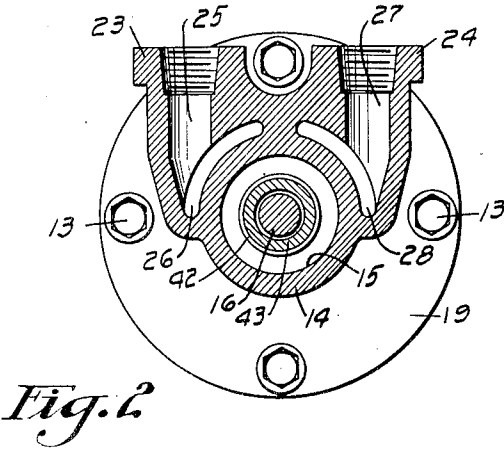


Fig. 2

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2 Sheets-Sheet 2

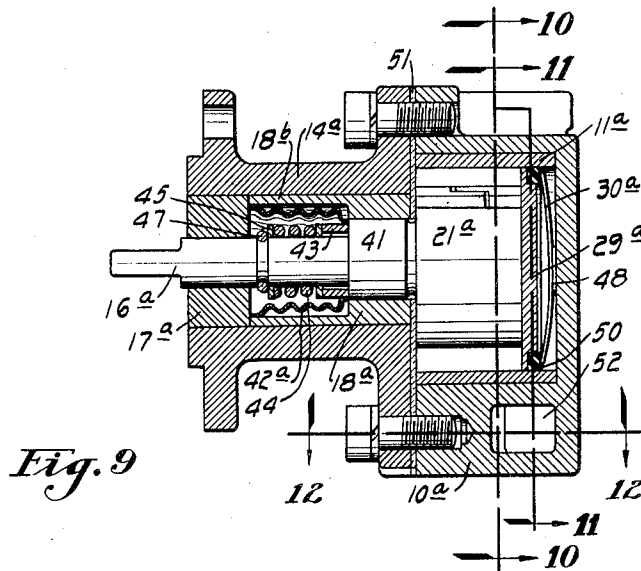


Fig. 9

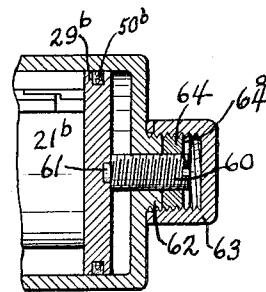


Fig. 13

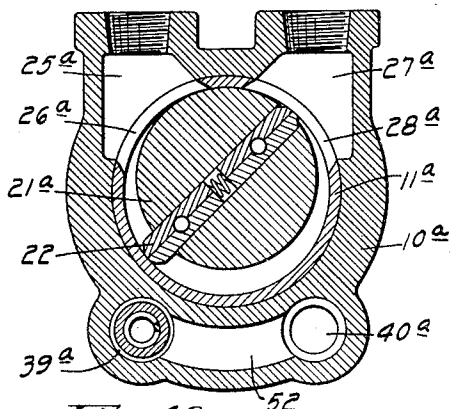


Fig. 10

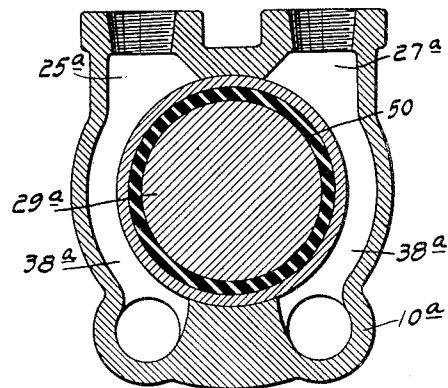


Fig. 11

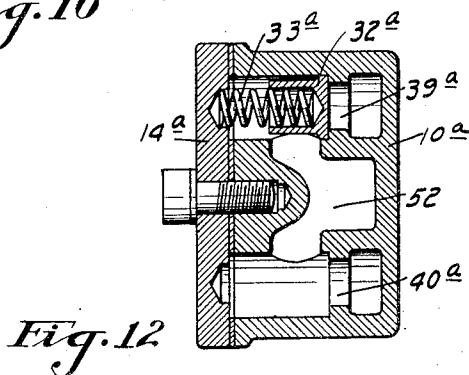


Fig. 12

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UNITED STATES PATENT OFFICE

2,037,894

FUEL PUMP

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Application July 17, 1933, Serial No. 680,797

4 Claims. (Cl. 103—136)

This invention relates to pumps and has for its principal object to provide a new and improved construction for a pump, which while admirably adapted for use as a fuel pump for internal combustion engines, may be employed in many other relations, as for example, for use with oil burners, fuel transfer systems, insecticide sprayers, and in fact for use generally wherever liquids may be pumped.

Another object is to provide a pump of the type described of simple, compact and sturdy construction that can be manufactured at a relatively low cost by the use of common and simple machining operations and having a minimum number of parts, and in which the design and arrangements of the parts is such that part manufacturing and assembling operations are markedly simplified so that variations from the manufacturing sizes or dimensions which may occur in the machining of the parts will not affect the efficiency of the pump in operation, thus obviating the necessity for a high degree of accuracy in the machining and manufacture of parts and, as a result, enabling marked savings in manufacture to be effected.

The above and other objects will appear more fully from the following more detailed description and by reference to the accompanying drawings forming a part hereof wherein I have shown by way of illustration a satisfactory constructional example embodying the principles of the invention.

As shown in the drawings, Fig. 1 is a central longitudinal section through a pump embodying the present invention.

Figs. 2, 3, 4 and 5 are sections on the line 2—2, 3—3, 4—4 and 5—5 respectively of Fig. 1.

Fig. 6 is an enlarged detail partially in elevation and partly in section through one of the impeller vanes.

Fig. 7 is a section of line 7—7 of Fig. 6.

Fig. 8 is a section on the line 8—8 of Fig. 4.

Fig. 9 is a view similar to Fig. 1 of a modified construction, and

Figs. 10, 11 and 12 are sections on the lines 10—10, 11—11 and 12—12 of Fig. 9, and

Fig. 13 is a fragmentary central longitudinal section similar to Figs. 1 and 9 of a further modification of a portion of the structure.

As shown in Figs. 1 to 8 inclusive, the pump comprises a main casing 10, having a cylindrical bore. In that portion of the bore of the casing 10, which defines the working chamber of the pump, is inserted a bushing 11. One end of the casing 10, is provided with a peripheral, laterally

extending flange 12, provided with suitably spaced, screw threaded apertures into which are adapted to be screwed the bolts 13. The bolts 13 serve to connect to the casing 10, a member 14 preferably made as a casting and which is provided with a bore 15 through which passes the impeller driving shaft 16, suitable bearing members 17 and 18 being interposed between the bore 15 and the shaft 16. The member 14 is also provided with a lateral flange 19 through which the bolts 13 pass and which is clamped in contacting engagement with the flange 12. It will be noted that the apertures provided in the flange 19 for the bolts 13 are slightly larger in diameter than the bolts for a purpose presently to be set forth.

The end of the casing 10 opposite to the flange 12 is internally screw threaded for the reception of a head or closure plate 20. Mounted within the working chamber of the casing 10 and suitably connected in driving relationship with the shaft 16 is a rotor 21. As will be noted by referring to Figs. 1 and 3, the rotor 21 is located eccentrically within the working chamber of the pump, and, as shown most clearly in Fig. 3, said rotor is provided with a diametrically extending slot in which is slidably received an impeller vane denoted generally by the reference character 22.

In order to insure effective sealing engagement between the vane 22 and the surfaces of the pump with which said vane is engaged, said vane preferably comprises a pair of similar composite sections 22a and 22b. Each of these sections is of similar construction, and, as shown best in Figs. 6 and 7, comprises a pair of members 22c and 22d which, adjacent to their side edges, are nearly the same dimension as the diametrical slot within the rotor so as to engage with said slot with a neat sliding fit. The central portion of each of the members 22c and 22d is reduced in thickness so as to permit of the members 22c and 22d to engage each other in overlapping relationship, as clearly shown in Fig. 7. Approximately midway between their inner and outer ends, the members 22c and 22d are each provided with a semi-cylindrical recess, which, when the parts are assembled together, forms a bore or chamber for the reception of a small spring 22e. The spring 22e, as will be seen from an inspection of Figs. 6 and 7, has its ends in abutting relationship with the sections 22c and 22d and serves to hold said sections with a yielding pressure against the side faces of the working chamber of the pump. The thickened outer side portion of each member 22c and 22d is provided with a bore or recess 22f for the reception of the spring 22g, 55

there being a pair of these springs, and said springs serving to hold the outer edge of each vane 22a and 22b with a yielding pressure against the inner cylindrical wall of the bushing 11 and providing an effective sealing between the vane and the working surfaces of the pump chamber across which the vane is swept by the rotation of the rotor.

In the form of the invention shown in Figs. 1 to 8 the member 14 has formed integral therewith a pair of internally screw threaded hollow bosses 23 and 24 which serve as the inlet and outlet of the pump according to the direction of rotation of the rotor 21. For clarity of description it will be assumed that the rotor rotates in the direction of the small arrow shown in Fig. 3. Under these circumstances the boss 23 will be the inlet and the boss 24 the outlet for the pump. The boss 23 is in communication with a conduit 25 which terminates in an arcuate shaped port 26, and the boss 24 is in communication with a similar conduit 27 and port 28; the ports 26 and 28 being in communication with the working chamber in which the rotor 21 is mounted.

Interposed between the head 20 and the side face of the rotor 21, is a valve plate 29, presently to be more fully described, and which is held with a yielding pressure against the side face of the rotor 21, by means of a spring 30, the ends of which spring abut against the valve plate 29 and the inner end of the head 20, thus serving to hold the plate with a yielding sealing contact against the side face of the rotor. Secured within the plate 29 and located approximately at the center thereof, is a guide pin 31, upon which is loosely mounted a valve 32, said pin passing through a central aperture in the valve 32. A valve spring 33 has one end thereof in abutting engagement with a cap which is adjustable by means of a thread on pin 31 together with a nut and lock nut, and has its other end in engagement with a spring retainer 34 provided at its center with a curved projection 35. The projection 35 is also provided with a central aperture through which the guide pin 31 passes and said projection engages with the side wall of the valve 32. From the above it will be seen that the spring 32 serves through the intermediary of the cap 34 to hold the valve 32 in contacting sealing engagement with the valve plate 29.

The valve plate 29, as will be seen from an examination of Figs. 1 and 4 of the drawings, is provided with a pair of conduits which at the face of the valve plate adjacent to the working chamber of the pump terminate in a pair of arc shaped conduits 36 and 37; these arc shaped conduits communicate each through a similar radial conduit section 38 provided in the valve plate and terminate in the cylindrical ports 39, 40 respectively. Any suitable means may be provided to prevent rotation of said valve plate and as shown such means comprises one or more pins 29a threaded into the wall of the casing 10 and projecting inwardly thereof into suitable recesses or apertures provided in said plate 29.

The impeller shaft 16 is provided at its inner end with an enlarged head 41 which is journaled within the bearing 18. An effective sealing of the impeller shaft 16 is secured by a packing means of the syphon type comprising a flexible diaphragm 42 having secured to its inner end a collar 43 which is engaged loosely over the shaft 16. To the other end of the diaphragm 42 is secured a second collar 43a seated between the reduced inner end of the bearing 17 and the bore 15 of

the member 14. The collar 43 is forced with a yielding pressure against the side face of the enlarged head 41 of the shaft 16 by means of a spring 44, one end of said spring abutting against the outer side face of the collar 43 and the other end of the spring abutting against the washer 45 which encircles the shaft 16 and is held against movement outwardly of the shaft by means of a split ring 47 seated within an annular groove formed in said shaft.

The manner in which the device operates is as follows:

Let it be assumed that rotation is imparted to the impeller shaft 16 in a counterclockwise direction as indicated by the arrow in Fig. 3 and that the bosses 23, 24 are connected respectively to a supply of the fluid to be pumped and the point where the fluid is to be delivered. As the vane 22 sweeps past the arcuate port 26, suction will be induced in said port and within the working chamber of the pump between the vane and the upper edge of the rotor at the point where the latter contacts with the inner wall of the bushing 11. Fluid will be sucked into the working chamber of the pump in the left hand side thereof, Fig. 3, and behind the vane 22, the fluid filling the crescent shaped working chamber and following up the movement of the vane. As the diametrically opposite end of the vane then sweeps past the port 26 it will cut off the crescent shaped chamber in front of its leading edge from the suction line and will impel or force the fluid which has filled said chamber and cause said fluid to be ejected through the port 28, the conduit 27 and outlet 24, the above operation being characteristic of pumps of this particular type.

Should pressure of the fluid being delivered by the pump tend to increase beyond a certain maximum amount as determined by the strength of the spring 33, a certain portion of the fluid will be by-passed, this being accomplished as follows: It will be noted that the port 37 of the valve plate 29 is located in alignment with the outlet port 28 and will be subjected to the same pressure as the fluid forced through said outlet. The port 37, its respective conduit 38 and cylindrical port 40, will therefore, be filled with fluid under the same pressure as the fluid within the outlet of the pump. Should this pressure become greater at any time than the pressure exerted by the spring 33, the valve 32 will be lifted off its seat, thus permitting communication to be established between the ports 39 and 40 and a portion of the fluid will then be by-passed through ports 37, 40, 39 and 36 directly from the pressure side to the suction side of the pump.

It will be noted that, as the aperture in the valve 32 is somewhat larger than the guide pin 31 upon which it is mounted, and as the pressure of the spring 33 is exerted upon the valve 32 through the central projection 35 of the spring retainer 34, the valve 32 will be permitted to cant in its opening movement in response to the pressure exerted only at one side thereof.

The valve plate 29 will be held with a yielding pressure against the inner side face of the rotor 21 and will also hold the rotor with a yielding pressure against the inner face of the bearing 18 thereby insuring an effective side sealing of the rotor. As a further precaution against leakage around the sides of the rotor the two part construction of the vane sections 22a and 22b has been resorted to; the springs 22c of each vane section forcing the vane sections lat-

erally against the side walls of the working chamber.

It will be noted that no end thrust is placed upon the rotor shaft by the spring 44 because this spring is confined between the head 41 and the split ring 47, both of which parts are in effect a part of the impeller shaft, or at least have no capacity for movement longitudinally of such shaft.

The sylphon packing construction effectively prevents any leakage about the impeller shaft. The construction of the bearing 17 permits the sylphon packing means to be assembled and slipped longitudinally over the end of the shaft, after which said bearing is inserted into the bore 15.

By making the holes through which the bolts 13 pass somewhat larger in diameter than the said bolts, it is possible to adjust the member 14 relatively to the casing 10 so as to secure the requisite wiping contact between the rotor and the bushing 11. The two part construction of the pump casing furnished by the members 10 and 14 permit the pump to be manufactured by very simple machining operations and the adjustment just referred to enables the pump to be set to operate most effectively even though there be variations in dimensions as the result of errors in the machining operations.

During the rotation of the pump, the vane sections 22a and 22b will be forced radially of the rotor with a yielding pressure and held in contacting engagement with the inner face of the bushing 11 by means of the springs 22g, thereby, insuring an effective operation of said vanes.

In the modified form shown in Figs. 9 to 12 the construction has been still further simplified and improved not only to reduce manufacturing costs and machining operations but also to increase considerably the operating efficiency of the pump. As shown in Figs. 9 to 12 the inlet and outlet conduits 25a and 27a of the pump are provided in the main casing member 10a. The member 10a is provided with a bushing 11a which is cut away as clearly shown in Fig. 10 to provide the ports 26a, 28a, corresponding in function to the ports 26, 28. The casing member 10a defines a working chamber for the rotor 21a provided with a composite vane 22 constructed as shown in Figs. 1 to 8 inclusive. It will be noted, however, that instead of the by-pass conduit and valve arrangement of Figs. 1 to 8, the member 10a is provided with conduits 38a which communicate directly with the inlet and outlet conduits 25a, 27a and with the ports 39a and 40a and instead of the large valve 32 connected by the arcuate conduit 52 extending across the bottom of the casing member 10a serving both ports, the port 39a only is provided with a valve 32a normally held by the spring 33a against its seat.

In Figs. 9 to 12, the rotor 21a is urged yieldingly towards the inner face of the casing member 14a by a diaphragm type of spring 30a which at its outer periphery engages with an annular gasket member 50 seated in a recess formed at the perimeter of a plate 29a. The diaphragm spring 30a is curved or bowed and engages at its central part with the inner wall of the casing 10a, the said inner wall being provided with any suitable non-circular projection 48 which engages within a similarly shaped aperture provided at the center of the diaphragm spring 30a. As will be readily understood the spring 30a

serves to hold the plate 29a in yielding frictional engagement with the inner face of the rotor 21a also to hold the gasket ring 50 in position, and by its engagement with the projection 48 and the gasket ring 50 prevents rotation of the plate 29a.

In addition to holding the plate 29a against the inner face of the rotor 21 the pressure of the diaphragm spring 30a also acts to hold the outer face of the rotor against an insulating and wear resisting gasket 51 secured between the opposed faces of the casing members 10a and a flanged bearing member 14a in which is located the bearings and packing for the rotor shaft 16a.

The construction of the bearings and sylphon packing shown in Figs. 9 to 12 differs somewhat from the corresponding parts of Figs. 1 to 8 in that the bearing 17a is of one piece construction, part 43a having been eliminated, and the sylphon packing is secured directly to an annular extension 18b of bearing 18a which extension surrounds and houses the sylphon packing. The construction of the ring 43, spring 44, washer 45 and spring retaining ring 47 is the same as in Figs. 1 to 8.

It will be noted from the foregoing that the pump shown in Figs. 9 to 12 is of simpler construction than that shown in Figs. 1 to 8. The main casing member is much more compact and its machining involves only the simplest of machine tool operations, all of which are performed from one side only. Likewise the modified by-pass and valve arrangement are much simpler in construction and possess the advantage of having the relief or by-pass valve 32a located on the lower side of the pump housing so as to always be kept moistened with fuel thus preventing valve failure or leakage due to the valve becoming dry. The number of parts required for the main shaft bearing and sylphon packing have also been reduced.

The use of an insulating gasket between the casing members 10a and 14a not only insures more effective sealing between these members but prevents heat transference to the main pump casing 10a from the casing member 14a, which in many installations may be connected to the internal combustion engine or to a part which may be in heat conducting relationship therewith.

While the pump of Figs. 1 to 8 may be operated after assembly with equal efficiency in either direction the modified pump of Figs. 9 to 12 can only operate in one direction or the other in accordance with the location of the valve 32a, on one side or the other of the casing.

As will be readily understood the operation of the modified pump is the same as described in connection with Figs. 1 to 8 except the by-pass conduit 38a which connects directly with the pressure port 40a is not provided with any valve, pressure developed in such conduit therefore passes across the arcuate conduit 52, which connects the ports 39a—40a, to the port 39a and when the pressure exceeds a predetermined maximum the valve 32a will be lifted from its seat against the pressure of the spring 33a thus to permit the fluid to be by-passed from the pressure to the suction side of the working chamber of the pump.

If it is desired to use the pump for high pressures which would be great enough to force the end plates 29 or 29a back against the action of the springs 30 or 30a respectively and thus destroy the side sealing effect produced by such plates

and springs, the structure shown in Fig. 13 may be employed. As shown in Fig. 13, an end plate 29b provided with an annular packing 50b is held against end face of the rotor 21b by a thrust bolt 60 having a reduced end 61 of non-circular cross section which engages within a similarly shaped recess at the center of the plate 29b. The bolt 60 is screw threaded into a bore extending through the end wall of the casing 10b and a central boss 62 integral therewith. The external periphery of the boss 62 is threaded for engagement thereby of a cup-shaped closure cap 63. In order to hold the bolt 60 against rotation a lock nut 64 engages over the end of the bolt 60 and with the face of the boss, said nut preferably also being screw threaded on its periphery for engagement by the thread of the cap 63. Slots 64a are provided in the outer side face of the nut 64 to facilitate its adjustment. After the main pump parts are assembled the bolt 60 is adjusted to hold the end plate 29b against the rotor 21b with just sufficient pressure to secure end sealing but not to bind the parts against rotation. The lock nut 64 is then adjusted and the cap 63 screwed home. By reason of the engagement of the lock nut and cap with the bolt 60, the latter will be held against rotation and it in turn will prevent rotation of the end plate 29b because of the engagement of its non-circular reduced end 61 with the central recess of the plate 29b.

Although the pump is designed primarily for use as a fuel pump for internal combustion engines, the principles of construction are not limited to this specific use it being understood that the pump may be constructed for use in any relation that may be desired. By constructing the pump as herein disclosed and using a rotary pump instead of a reciprocating one it becomes possible to drive the pump by any rotating part of an internal combustion engine, for example, by connecting it with a fan drive, the drive for the oil pump, or generator, or any other readily accessible, externally located, rotating part of any standard internal combustion engine. While I have described a satisfactory constructional example of a pump embodying the principles of my invention it will be understood that the invention is not limited to the specific constructional details herein described and illustrated in the drawings, but that many changes, variations and modifications may be resorted to without departing from this invention.

I claim:

1. A rotary pump particularly adapted for use as an internal combustion engine fuel pump comprising, a two part casing divided perpendicularly to the axis of rotation of said pump, one of said casing parts having a bore which defines the working chamber of said pump and having an integral end wall for closing one end of said bore, a rotor with expansible radially extending vanes mounted in said working chamber, a driving shaft secured to said rotor, and projecting outwardly from the other end of said bore and through the other part of said casing for connection to said engine, said other part of said casing forming a closure for said working chamber, an end plate between said rotor and end wall, a heat insulating and wear resisting packing secured between said casing parts to prevent heat transfer from said engine to the working chamber of said

pump, and means between said end wall and end plate for holding said end plate in yielding frictional engagement with one side face of said rotor and the other side face of said rotor in similar engagement with said packing.

2. A rotary pump of the type wherein a rotor is mounted within a working chamber defined by the casing of said pump characterized by an end plate mounted within said chamber and in contacting sealing engagement with one end face of said rotor, means for holding said end plate with a predetermined pressure against said rotor comprising an adjustable screw-threaded member located in axial alignment with said rotor, means to lock said member against rotation, comprising a lock nut screw-threaded on said member and a sealing closure cap in screw-threaded engagement with said lock nut and said casing.

3. In a rotary pump a two part casing divided perpendicularly to the axis of rotation of said pump, one of said casing parts defining the working chamber of said pump, a rotor mounted within said working chamber having a driving shaft projecting through the other of said casing parts and said other of said casing parts being provided with the entire bearing surface for radially supporting said rotor and shaft and having a laterally extending flange for connection to said first named casing part, said first named casing part being provided with a pair of conduits communicating with said working chamber and each of said conduits having an extension projecting below said working chamber, a transverse by-pass conduit extending across said first named casing part below said chamber, a pair of by-pass ports connecting said transverse conduit with said pair of conduits, a valve member adapted to be interchangeably associated with either of said by-pass ports and a spring for normally holding said valve in sealing contact with one of said ports, one end of said spring abutting against said valve member and the other end of said spring abutting against the said lateral flange of said other casing part.

4. A rotary pump, particularly adapted for use as an internal combustion engine fuel pump comprising a two part casing divided perpendicularly to the axis of rotation of said pump, one of said casing parts having a bore which defines the working chamber of said pump and having an integral end wall for closing one end of said bore, a rotor with expansible radially extending vanes mounted in said working chamber, a driving shaft secured to said rotor, and projecting outwardly from the other end of said bore and through the other part of said casing for connection to said engine, said other part of said casing forming a closure for said working chamber, an end plate between said rotor and end wall, a heat insulating and wear resisting packing secured between said casing parts to prevent heat transfer from said engine to the working chamber of said pump, and means between said end wall and end plate for holding said end plate with a predetermined pressure in frictional engagement with one side face of said rotor and the other side face of said rotor in similar engagement with said packing.

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