

[54] ELECTROMOTOR AND PUMP UNIT

[72] Inventors: Richard Bertsch, Asperg; Paul Fussner, Sindelfingen; Manfred Glaser, Neckarweihingen; Hermann Nusser, Asperg, all of Germany

[73] Assignee: Robert Bosch GmbH, Stuttgart, Germany

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[56]

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Primary Examiner—Robert M. Walker

Attorney—Michael S. Striker

[57]

ABSTRACT

An electromotor and hydraulic pump unit with a sealed housing has a common drive shaft projecting with one end into a balancing pressure chamber in the pump stator. Pressure fluid flows along the shaft into a cavity of the housing in which the electromotor and the other shaft end are located so that the motor is cooled, the shaft bearings in the cavity lubricated by the pressure fluid, and the axial force acting on the bearings is reduced.

9 Claims, 2 Drawing Figures

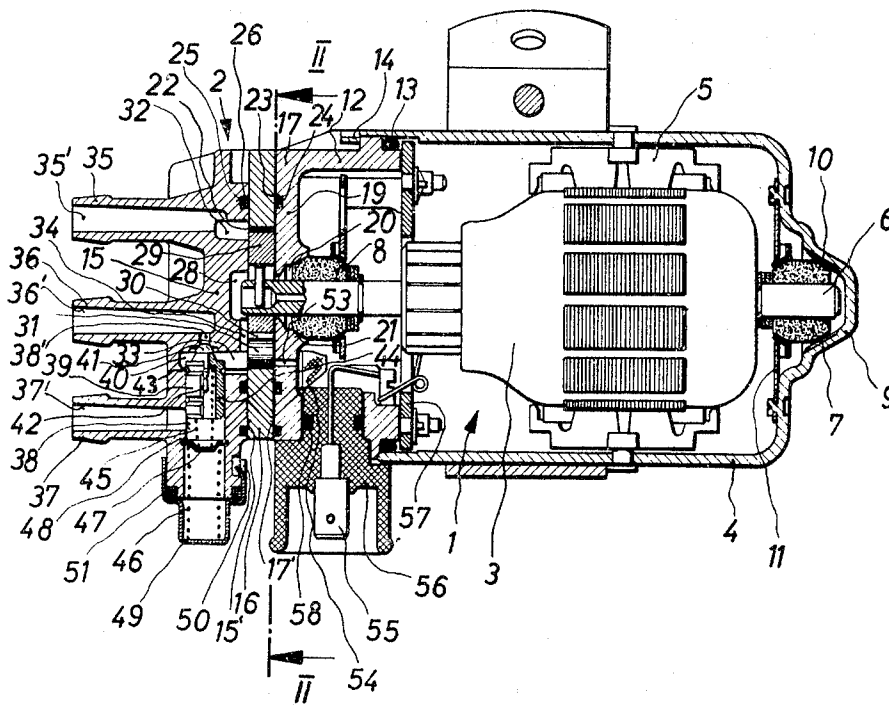


Fig. 1

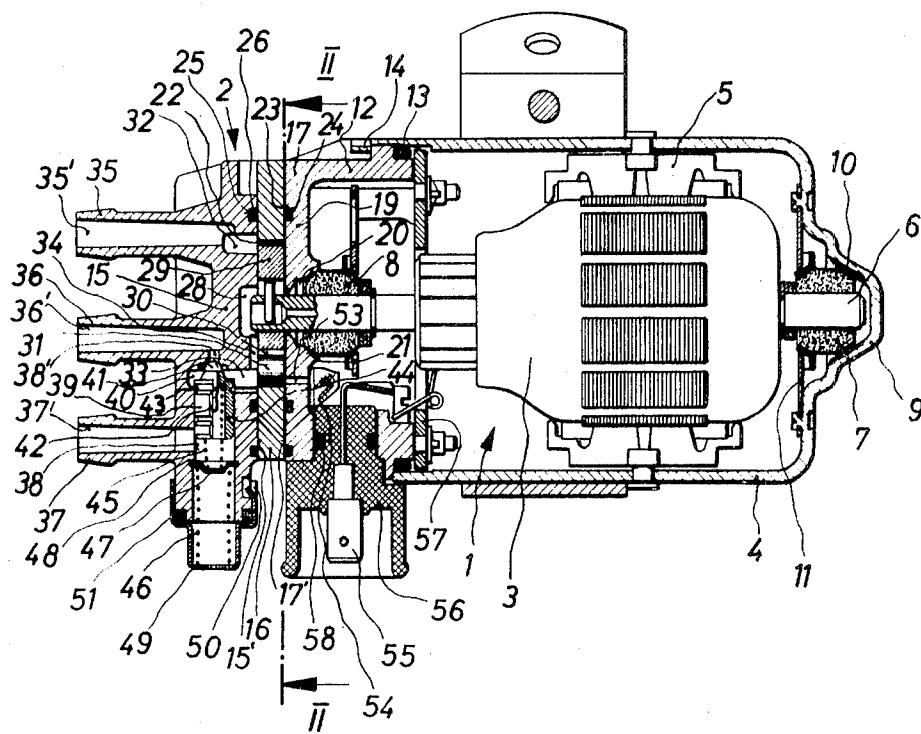
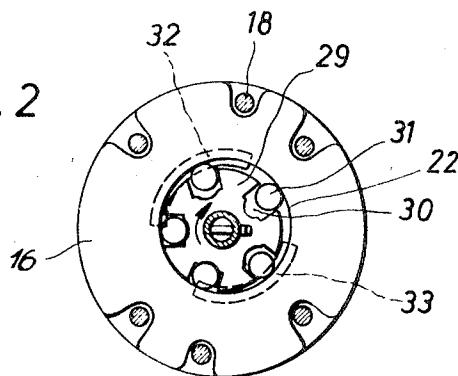


Fig. 2



INVENTOR.

Richard BERTSCH, Paul FÜSSNER

BY Manfred GLASER, Hermann NÜSSER

McGraw-Hill
New York

ELECTROMOTOR AND PUMP UNIT

BACKGROUND OF THE INVENTION

The present invention relates to electromotor and pump units in which the pump and electromotor are mounted in a sealed housing which is substantially filled with a pressure fluid under pressure, and in which the rotor of the electromotor runs in the pressure fluid so that the bearings of the motor shaft are lubricated by the pressure fluid. Motors of this type are particularly used for fuel pumps, and a pump of this type is disclosed in the U.S. Pat. No. 1,493,612.

The apparatus of the prior art has the disadvantage that impurities, such as particles of the collector brushes, enter the fluid which has the disadvantage that impurities and dirt may enter the carburetor to which the fluid is pumped. Particles also float in the cavity of the housing in which the electromotor is located, where they may cause increased friction in the bearings, or even damage to the same, resulting in stopping of the pump. Another disadvantage of the prior art is that the motor shaft, which also carries the pump rotor, is subjected to one-sided axial pressure corresponding to the pressure produced by the pump, so that the bearings are stressed in axial direction.

SUMMARY OF THE INVENTION

It is one object of the invention to provide an electromotor and pump unit in which the motor is cooled by the pressure fluid pumped by the pump, while the bearings of the shaft are lubricated and cooled.

Another object of the invention is to reduce axial forces acting through the shaft on the bearings so that the span of life of the unit is increased.

Another object of the invention is to provide an electromotor and pump unit in which fluid circulated in the cavity of the motor housing, is freed of impurities before again pumped by the pump to a consumer, such as a carburetor.

With these objects in view, the common drive shaft of the motor and pump, has one end located in a balancing pressure chamber communicating with the pressure space of the pump, while the cavity in which the motor and the other shaft end are located communicate also with the pressure space of the pump.

This arrangement results in a hydrostatic relief of the common pump and motor shaft, so that the axial stress of the bearings of the shaft are reduced to a minimum. Furthermore, a part of the pressure fluid is circulated through the cavity of the motor housing to effect cooling and lubricating of the electromotor and its bearing due to hydrodynamic effects. This part of the pressure fluid passes through a filter before again joining the main part of the pump fluid, so that dirt particles and other impurities are filtered out of the pressure fluid which is delivered by the pump to a consumer. Since only part of the pressure fluid circulates through the motor casing, in which it encounters great flow resistance, the total energy losses are low.

An embodiment of the invention comprises an electromotor and a pump including motor and pump rotors, a common drive shaft supporting the rotors, and motor and pump stator means surrounding the rotors, respectively, the pump stator means forming a pressure space having a pressure fluid outlet and a suction space having an inlet, and also forming a balancing chamber communicating with the pressure space; and sealed housing means supporting the motor and pump stator means, and including a motor housing having a cavity, and bearing means in the cavity for supporting the common drive shaft in a position in which one end of the same is located in the balancing chamber while the other end of the same is located in the cavity of the motor housing.

The balancing chamber communicates with the cavity, preferably through a bore in the stator housing through which the shaft passes, so that the cavity is filled with the pressure fluid pumped by the pump. As a result, the motor is cooled, the drive shaft is axially balanced, and the bearing means are lubricated by the pressure fluid.

In a preferred embodiment of the invention, the balancing chamber is connected with a pressure space of the pump by a radial channel, and the cavity in the motor housing is connected by a duct with the central opening in the pump stator in which the pump rotor forms a working space. This duct is covered by filter means so that pressure fluid flowing along the shaft into the cavity and filling the same, can flow out of the cavity through the filter means and duct back to the working chamber of the pump.

In the preferred embodiment of the invention, a biased valve slide connects at the beginning of the operation the pressure space of the pump with the return outlet through a throttling means, and connects, when the pressure increases, the pressure space of the pump with a pressure fluid outlet.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an axial sectional view illustrating an embodiment of the invention; and

FIG. 2 is a fragmentary cross-sectional view taken II—II in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A pot-shaped motor housing 4 forms an inner cavity in which an electromotor 3 having a magnet stator 5 and a drive shaft 6 is located. The motor rotor is fixedly secured to drive shaft 6 which is mounted in bearings 7 and 8. The left end of shaft 6, as viewed in the drawing, carries a pump rotor 29 and has a free end located in a balancing chamber 28. Bearing 7 is disposed in a dished portion of the pot-shaped housing 4 which is made of steel. The inner surface of the dished portion 9 has several grooves 10 located in axial planes through which fluid can flow from the cavity 1 to a space behind the end of shaft 6 on the right side as viewed in the drawing. A disk 11 is secured to the inner surface of housing 4 to hold bearing 7 in place.

The pump stator includes a connector part 15, a stator plate 16, and a support part 17 which are pressed together by bolts 18, see FIG. 2. The end of support part 17 has a cylinder portion secured to the open end of motor housing 4 which is sealed by an annular sealing ring 13. Lugs 14 are bent out of the cylinder wall of motor housing 4 to secure the same to a flange of the cylinder portion 12 of support part 17 of the pump stator means.

The support part 17 has a transverse wall 19 with a central bore 20 through which shaft 6 projects into the balancing chamber 28 in connector part 15. This end portion of shaft 6 carries the pump rotor 29 which is located in an eccentric circular opening 22 in the stator plate 16, see also FIG. 2. Bore 20 has a widened portion formed as a seat 20 for bearing 8 which is also held in place by plate secured to portion 24 of support part 17 of the pump stator means.

Support part 17 and stator plate 16 abut each other with planar surfaces, and are sealed by a sealing O-ring 24 located in a circular groove 23 in surface 17' of support part 17, which is substantially circular and concentric with shaft 6.

Stator plate 16, and connector part 15, abut each other also with planar circular faces. The surface 15' of connector part 15 has a circular groove 25 in which a O-ring 26 is located so that the working space in opening 22 formed by rotor 29 is completely sealed. The balancing pressure space 28 is concentric to shaft 6, and forms a circular depression in surface 15'. Only a very short end portion of shaft 6 on the left side of pump rotor 29 projects into balancing chamber 28.

The pump rotor 29 has a cylindrical rotary member formed with substantially radial slots 30 with part-circular bottom portions, as best seen in FIG. 2. Rollers 31 are respectively

located in the slots and roll during rotation of shaft 6 and member 29 on the wall of the eccentric circular opening 22. The revolving rollers 31 press fluid from the suction chamber 32 into the pressure chamber 33. The roller piston pump 29, 31, 16 operates on the well-known principles of a radial piston pump.

The suction space 32 is arcuate and follows the contour of the circular opening 22. The pressure space 33 has a corresponding shape and is located on the other side of opening 22. Each arcuate space 33 and 32 extends over an angle of substantially 110°.

A channel 34 in the surface 15' of connector part 15 extends in radial direction with respect to the axis of shaft 6, and connects pressure space 33 with the balancing pressure chamber 28. Consequently, the same pressure prevails in balancing chamber 28 as on the pressure side of the pump.

Connector part has a suction means 35 which may be connected with the fuel tank of an automobile, a pressure fluid outlet means 36, which may be connected with the carburetor of a combustion engine, and a return outlet means, which may lead to the fuel tank.

The suction inlet 35' in the suction inlet means 35, communicates with the arcuate suction space 32. The pressure fluid outlet 36' in outlet means 34 communicates through a channel 38' with the pressure space 33. In this region of connector part 15, a blind bore 38 is provided perpendicularly to shaft 6 for guiding a valve slide 39 for sliding movement in a sealed condition. At the bottom of the blind bore 38, an annular chamber communicating with pressure space 33 is provided. Channel 38' is coaxial with the blind valve bore 38, but has a much smaller diameter. The end of channel 38' at the bottom of the blind valve bore 38 is constructed as a seat for a portion 41 at the end of the piston-shaped valve slide 39.

Valve slide 39 has on its outer cylindrical surface a narrow straight throttling channel 42 which connects two annular throttling channels 43, 44 in the valve slide 39 with each other. The distance between the annular throttling channels 43 and 44 is selected so that the annular spaces formed by the same communicate on the one hand with the pressure space 33, and on the other hand with the return outlet 37', when valve slide 39 is in the illustrated throttling position in which portion 41 thereof closes the channel 38'.

Valve slide 39 is biased by two springs 45 and 46 which have different resilience. The softer spring 45 directly abuts slide valve 39 at one end, and the spring plate 47 at the other end, which is urged by a stronger spring 46 against a shoulder 48 in valve bore 38. The other end of spring 46 abuts a closure cap 49 which closes valve bore 38 and is secured to connector part 15 of the pump stator. A sealing ring 51 seals cap 49.

In the region of the working chamber of the pump 29, 16, a duct 53, parallel to shaft 6, is provided in the wall portion 19 of supporting part 17, penetrating the same. The end of duct 53 opening into the cavity 1 formed by motor housing 4 and supporting part 17, is covered by a filter means 54.

The electromotor 3 is connected by suitable insulated conductors to a multiple plug 55 which is mounted on an insulating body 56. A contact plate 57 is secured to the flange 12 of support plate 17, and carries slide contacts, not shown. A sealing ring 58 in the insulating body 56 seals the cavity 1.

The roller piston pump 29, 16 operates in a well-known manner when electromotor 3 is started. Pressure fluid is pumped from pressure space 33 through channel 34 into the balancing chamber 28 from where the pressure fluid, for example fuel, flows along shaft 6 through bore 20 into the cavity 1. The volume may be 4 liter per hour. When at least the major part of cavity 1 is filled with a pressure fluid, which also enters during this filling operation through the duct 53 and filter 54, a rinsing circulation is obtained. Cold fluid flows from the pump through opening 20 along shaft 6 and bearing 8 so that heat produced by friction is conveyed by the fluid. Due to the fact that the viscosity of the fluid is higher at a low temperature, the fluid entering bearing 8 forms a good lubricating film in the same. In cavity 1 in the stator housing 4, the fluid

flows around the motor rotor which is also cooled, and then lubricates the bearing 7, flowing through grooves 10 behind the end faces of bearing 7 and shaft 6.

Due to the rotation of the rotor of electromotor 3, an outwardly directed flow of fluid takes place in cavity 1, as has been found by tests, so that the now slightly warmed fluid flows through filter means 54 and duct 53 back to the working space in stator plate 16. Since during the operation of the pump, the greater part of the fluid pumped by the same has flowed from pressure space 33 and channel 38' into pressure fluid outlet 36', as will be explained hereinafter, the fluid returns from cavity 1 through duct 53 and combines in the working space of the pump with the other pumped fluid, which causes no harm to the carburetor since the fluid has been cleaned by filter 54 before entering the working space of the pump.

At the beginning of the rotation of the pump by the motor 3, valve slide 39 is in the position shown in FIG. 1. At the beginning of the pumping operation, at first only air or gases may be pumped which flow from the pressure space 33 through the annular throttling channel 43, and throttling channel 42 to the annular throttling channel 44 which communicates with the return outlet 37' so that the gases or the air are returned to the fuel tank.

When the pump begins to pump liquid, for example gasoline, the throttling effect of channels 40 and 42 is so great that the pressure increases in chamber 40 and valve slide 39 is moved against the action of spring 45 so that portion 41 of valve slide 39 opens channel 38' and the pressure chamber 33 communicates with the pressure fluid outlet 36'.

At the same time, throttling channel 43 and throttling channel 42 are closed.

When the pressure in the pressure chamber 33 further increases up to a permissible maximum, the valve slide 39 is moved against the force of spring 46 so far in valve bore 38 that the pumped fuel can directly flow into the return outlet 37' so that the pressure is relieved.

At the end of the pumping operation when electromotor 3 stops, valve slide 39 is returned to its initial illustrated position by the action of the springs 45 and 46. Portion 41 of valve slide 39 closes again channel 38' so that the connection between the pump and the tank of the automobile is interrupted.

Instead of the roller piston pump, any other pump construction may be used, and the slide valve may be omitted or differently constructed.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of electromotor and pump units differing from the types described above.

While the invention has been illustrated and described as embodied in an electromotor and pump unit in which part of the pumped fluid is circulated in a housing of the electromotor, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

We claim:

1. Electromotor and pump unit comprising an electromotor and a pump including motor and pump rotors, a common drive shaft supporting said rotors, an motor and pump stator means surrounding said rotors, respectively, said pump stator means forming a pressure space having a pressure fluid outlet

and a suction space having an inlet, and also forming a balancing chamber communicating with said pressure space, said pump stator means including a support part mounted on said housing means, a connector part having said inlet and outlet, and a stator plate between said support part and said connector part and being formed with a central opening in which said pump rotor is located, said connector part having a surface in sealing contact with one side of said stator plate and being formed with said pressure space and said balancing chamber which communicate with said central opening for receiving pressure fluid, said support part being formed with a bore through which said drive shaft projects into said balancing chamber with the end of an end portion carrying said pump rotor in said central opening; and sealed housing means supporting said motor and pump stator means, and including a motor housing forming with said pump stator means a cavity, and bearing means in said cavity for supporting said common drive shaft in a position in which said end of the same is located in said balancing chamber while the other end of the same is located in said cavity of said motor housing so that pressure fluid from said pressure space flows through said balancing chamber and said bore along said drive shaft into said cavity so that said cavity is filled with the pressure fluid pumped by said pump whereby said electromotor is cooled, said drive shaft is axially balanced, and said bearing means are lubricated by said pressure fluid.

2. A unit as claimed in claim 1 wherein said balancing chamber in said connector part is concentric with said one end portion of said drive shaft; and wherein said connector part has a channel which extends in radial direction between said balancing chamber and said pressure space.

3. A unit as claimed in claim 1 wherein said support part is formed with a duct penetrating the same and having one end opening into said central opening and another end opening into said cavity; and comprising filter means for filtering impurities out of fluid flowing through said duct so that pressure fluid entering said cavity through said bore in said support part along said drive shaft flows through said filter means and said duct out of said cavity.

4. A unit as claimed in claim 3 wherein said pump rotor includes a rotary member secured to said drive shaft and formed with peripheral chambers, and rollers in said chambers; wherein said central opening has a circular inner surface eccentric to the axis of said drive shaft and engaged by said rollers so that working spaces are formed between said pump rotor and said circular inner surface communicating with said pressure and suction spaces in said connector part; wherein said duct has said one open end communicating with said working spaces and the other open end thereof communicating with said cavity; and wherein said filter means are located in said cavity covering said other open end of said duct.

5. Electromotor and pump unit comprising an electromotor

and a pump including motor and pump rotor, a common drive shaft supporting said rotors, and motor and pump stator means surrounding said rotors, respectively, said pump stator means forming a pressure space having a pressure fluid outlet and a suction space having an inlet, and also forming a balancing chamber communicating with said pressure space, said pump stator means including a return outlet; valve means spring-biased to a throttling position connecting said pressure space with said return outlet, and being responsive to increased pressure in said pressure space to move to an operative position connecting said pressure space with said pressure fluid outlet; and sealed housing means supporting said motor and pump stator means, and including a motor housing forming with said pump stator means a cavity, and bearing means in said cavity for supporting said common drive shaft in a position in which one end of the same is located in said balancing chamber while the other end of the same is located in said cavity of said motor housing, said balancing chamber communicating with said cavity so that said cavity is filled with the pressure fluid pumped by said pump whereby said electromotor is cooled, said drive shaft is axially balanced, and said bearing means are lubricated by said pressure fluid.

6. A unit as claimed in claim 5 wherein said pump stator means is formed with a valve bore; wherein said valve means include a valve slide movable in said valve bore, and two springs having different resilience abutting each other, one of said springs abutting said pump stator means and the other spring abutting said one spring and said valve slide.

7. A unit as claimed in claim 6 wherein the weaker spring is said other spring, and the harder spring is said one spring; including a spring plate between said springs; and a cap closing said valve bore, said one harder spring abutting said cap and thereby said pump stator means.

8. A unit as claimed in claim 5 wherein said pump stator means is formed with a channel connecting said pressure space with said pressure fluid outlet; and wherein said valve means has a valve portion closing said channel in said throttling position and opening the same in said operative position; and wherein said valve means has throttling means for connecting said pressure space with said return outlet in said throttling position.

9. A unit as claimed in claim 8 wherein said pump stator means is formed with a valve bore; wherein said valve means include a valve slide having said valve portion and said throttling means, said throttling means including a straight throttling channel extending in axial direction of said valve slide and two annular throttling channels extending around said valve slide and connected by said straight throttling channel, one of said annular throttling channels communicating with said return outlet, and the other annular throttling channel communicating in said throttling position with said pressure space.

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