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VOLUMETRIC DIAPHRAGM PUMPS FOR GASOLINE INJECTION

Filed Oct. 11, 1955

2 Sheets-Sheet 1

FIG. 2.

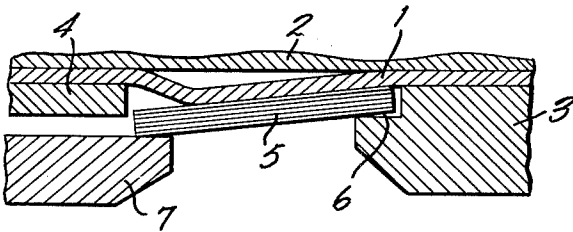
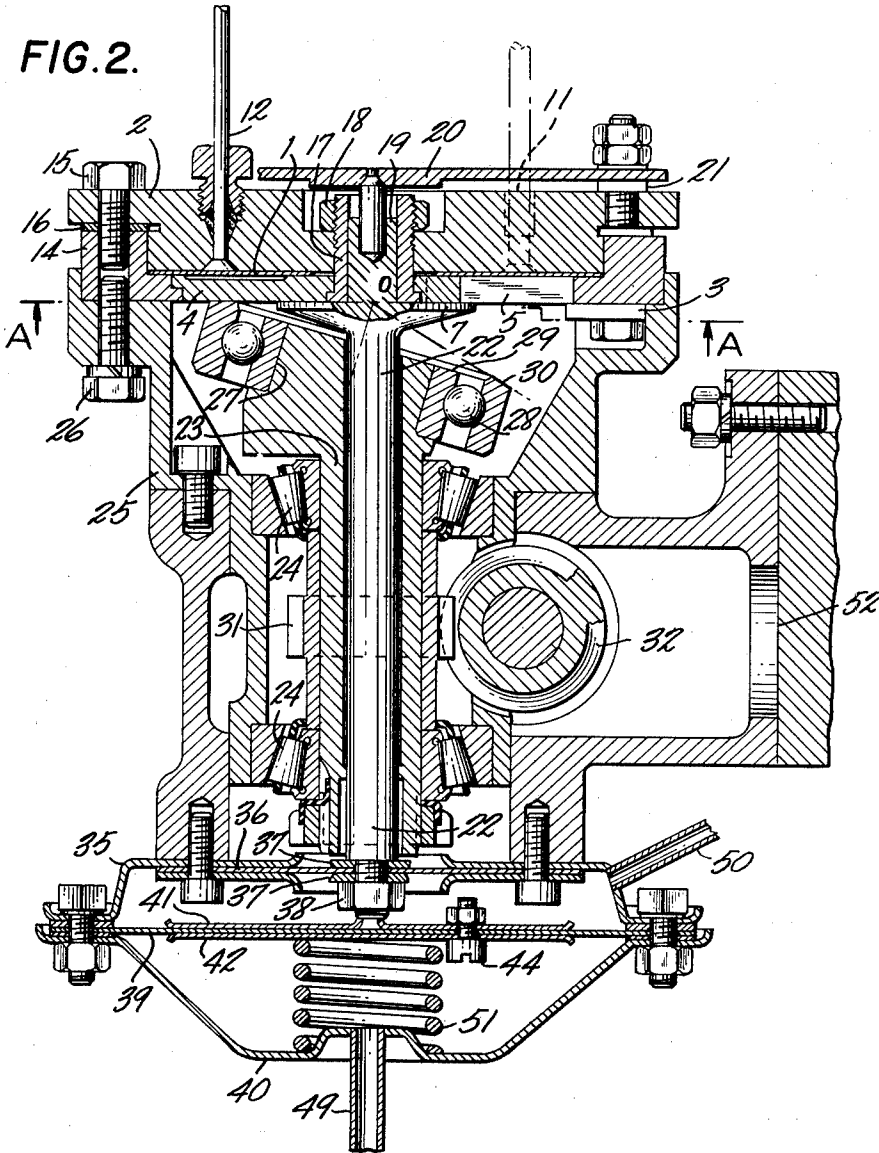


FIG. 1.

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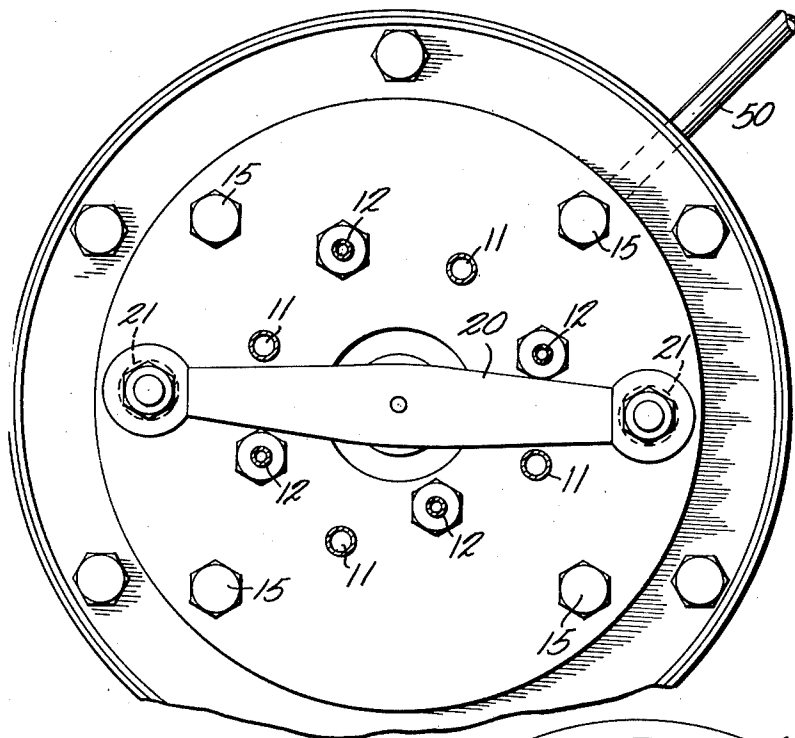


FIG. 4.

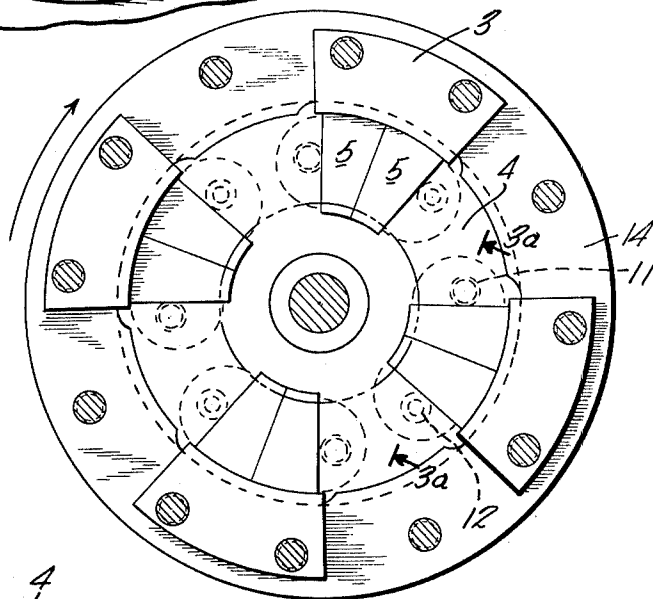


FIG. 3.

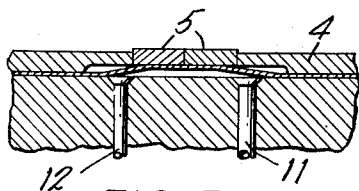


FIG. 3a.

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VOLUMETRIC DIAPHRAGM PUMPS FOR GASOLINE INJECTION

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1 Claim. (Cl. 103—38)

The invention relates to an improvement to volumetric pumps wherein the delivery of the fluid is effected by the successive actuation of a certain number of pressure members resting against a flexible wall.

It is the object of this improvement to render the operation thereof more reliable and less sensitive to variations in temperature, to increase its robustness, its simplicity of manufacture and its simplicity of use.

The known pumps having a deformable chamber are based on the following principle: a chamber, which may be circular for example, is formed by a plane surface or face into which lead suction and delivery pipes, said face being covered with a flexible wall or diaphragm. Pressure members, which are actuated successively in such a manner as to exert pressures on the deformable diaphragm, are situated around the circumference of the diaphragm. The variations in volume of the chamber between the diaphragm and the face effect the suction and delivery of the fluid.

According to a known method of constructing these pumps, the action of the pressure members is not exerted vertically in relation to the diaphragm, but with a rocking movement. The pressure members are arranged in a circle, and their outward-facing ends are seated in such a manner that their rocking movements can take place about a fulcrum situated in the seating. The opposite ends of the pressure members all rest on a movable circular member, the distance of which from the diaphragm can be regulated in the pump shaft. It will readily be understood that any regulation of the distance of the moving member in relation to the face will cause variation in the volume of fluid drawn in and delivered for each alternating movement effected by a pressure member.

The delivery is obtained by the successive application of the pressure members to the diaphragm by means of a set of rollers which roll over said pressure members.

One feature of the present invention is to replace the set of rollers, the axis of which is generally parallel to the plane of the pressure members, by a single rolling bearing, the axis of which forms a relatively large angle with the plane of the pressure members, the surface of said rolling bearing resting on the pressure members being chamfered, and the apex of a cone drawn through the chamfered surfaces lying in the centre of the circle of the pressure members in such a manner that said chamfered surface rolls, without sliding, over the said plane.

A further feature of the invention consists in mounting the aforesaid movable delivery-regulating support in such a manner that the only spring behind the actual body of the pump is the one the flexibility of which determines the position of said support, and in shifting the member sensitive to the regulating parameter to the other end of the pump by extending the stem of the support through the driving shaft of the rolling bearing, said parameter being the negative pressure obtaining in the

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engine manifold in the event of use as a petrol-injection pump.

A gasoline injection pump according to the invention, for a 4-cylinder engine, will now be described by way of non-limiting example, with reference to the accompanying drawings.

Figure 1 is a section showing the principle of the known diaphragm pump;

Figure 2 shows a longitudinal section through the pump according to the invention;

Figure 3 shows a section in plan along AA';

Figure 3a is a detail section along III—III;

Figure 4 is an end view showing the position of the limiting spring.

Referring to the drawing, Figure 1 illustrates diagrammatically the principle of this pump: a flexible diaphragm 1 is mounted between a face 2 and an annular member 3 surrounding a central member 4. Pressure members 5 are arranged radially between the annular member 3 and a support 7, the distance of which from the face is variable; by means of a roller, not illustrated, the pressure members are successively applied against the face in such a manner as to cause suction and delivery effects between the face and the diaphragm, said space being suitably connected to gasoline inlet and delivery pipes.

Referring to the device illustrated in Figures 2 and 3, it will be seen that the pump body 2 is provided with four inlet pipes such as 11 and four delivery outlets such as 12. The diaphragm 1 is applied against its face, in known manner, by an external ring 14 and bolts 15. Washers 16 enable the diaphragm to be given a well-defined, limited tightness. The ring 14, as well as the sleeve 17 and the nut 18, likewise grip against the diaphragm a plate 4 in the form of a four-armed star leaving four openings in each of which is a set of two pressure members 5, which are substantially trapezoidal in shape and of the same thickness as the plate.

In Figures 1 and 2, the plane AA' is the outer plane of the pressure members when they are applied against the diaphragm.

The outer supports for the pressure members consist of the members 3. There are four supports such as 3, one for each set of pressure members. They are fixed in such a manner that the various pivoting motions of the sets of two pressure members can be selected separately. All the pressure members bear on the movable support 7 in the centre. It is the position of this support which regulates, in known manner, the lifting of the pressure members and hence the delivery. This support has an extension 19 mounted for sliding in a sleeve 17 and the end of which receives the thrust of the leaf spring 20. This leaf spring is supported at its two ends on adjustable supports such as 21, screwed into the body 2.

The shaft of the movable support 7 is continued on the other side by a stem 22, the mounting of the other end of which will be described later. This stem 22 passes through the main shaft 23 of the pump. This shaft is mounted in a conventional manner between two taper roller bearings 24 in a housing 25, fixed to the engine at 52. The pump body assembly, and particularly the ring 14, is fixed concentrically on this housing 25 by the bolts 26. The shaft 23 has a seating 27 which is not parallel with the axis of the shaft 23 and on which a ball bearing 28 is mounted with a tight fit. The inner ring of this ball bearing is relieved at 29 to avoid contact with the support 7. Its outer ring is chamfered at 30 and the apex of a cone drawn through the chamfered surface is at the point O which is in the plane AA', the centre of the pump-body assembly; nat-

urally, the axis of the cone is also the axis of the seating 27. Movement is imparted to said shaft 23 by a helical pinion 31 which is driven by a perpendicular pinion 32.

At the other end of the housing 25 is a casing 35 which is fixed on the one hand to the housing 25 and which receives in the centre an impervious diaphragm 36 through which passes the end of the stem 22, sealing being effected by gripping the diaphragm between two washers 37 by means of the nut 38.

A main metering diaphragm 39 separates the casing 35 from an outer casing 40. This diaphragm has in the centre an inner plate 41 which rests against the end 23 of the stem 22 and an outer plate 42 of the same diameter. These two plates are pressed together through the diaphragm by means of bolts 44. These bolts serve to centre a highly flexible spring 51. This spring 51 therefore urges the assembly of the plates 41—42 against the stem 22 in opposition to the regulating spring 20 at the other end of the pump.

The outer casing 40 is generally brought into communication with the atmosphere through the central conduit 49, but provision is made for the possibility of this pipe 49 being brought into communication with the neck of a venturi situated in the inlet manifold for the engine fuel mixture to which the present pump is applied, upstream of the air-regulating throttle. On the other hand, the casing 35, which is entirely enclosed on all sides, either by fixed walls or by diaphragms, is brought into communication through the pipe 50 with the inlet manifold of the engine, downstream of the throttle, that is to say in a zone where there is absolute pressure on the engine valves.

The pump may equally well be mounted horizontally or vertically.

The spring 20 is a leaf spring of simple shape, the flexibility of which may be determined simply by its thickness.

Operation is as follows:

When the pump is mounted, the spring 51 urges the plates 41 and 42 against the stem 22 of the movable support in such a manner that said support 7 aligns the pressure members in the plane AA'; the leaf-spring 20, regulated by the supports 21, is put under tension in such a manner that it first compensates the effort of the spring 51, then permits the support 7 to be raised by a suitable amount to obtain the gasoline delivery corresponding to the full load on the engine. The pump is connected up in the following manner: the pipes 11 are in communication with a conventional feed pump which supplies a delivery pressure of the order of one atmosphere. The delivery pipes 12 are brought into communication with the engine injectors. The pipe 50 is connected to the inlet manifold downstream of the throttle; the pipe 49 may be connected either to a venturi, or directly to the inlet manifold upstream of the throttle.

As soon as the engine is started, a negative pressure is formed in the manifold downstream of the throttle. This negative pressure is exerted inside the casing 35 and particularly on the surface of the diaphragm 39 and of the plate 41. A considerable effort is therefore added to the effort of the spring 51 and increases the flexion of the spring 20, which determines a new position for the support 7 causing a reduced lift of the pressure members, thus preparing for the gasoline delivery to be less than the delivery at full load.

The feed pump, which begins to operate, delivers gasoline under the diaphragm at 11, under the aforesaid slight pressure, thus moving the pressure members 5 until they come into contact with the support 7.

The rotational movement of the engine is transmitted by means of the pinions 32 and 31 to the shaft 23 and the bearing 28 begins to rotate on the plane AA'.

When the corresponding generating line of the cone 30 passes over a set of pressure members, the first pressure member begins by cutting the communication with the inlet pipe and the second pressure member drives the gasoline into the pipe 12 under the pressure determined by the setting of the injector. When the accelerator is depressed and the throttle opens progressively, the negative pressure in the pipe 50 diminishes, the force which was added to the spring 51 diminishes likewise, and the spring 20 restores the support 7 to a position which allows the pressure member greater clearance; when the throttle is fully open, there is no longer any effort added to the spring 51 and the support 7 resumes the initial position corresponding to delivery under full load. When the engine is not only under full load but also at full speed, that is to say when it is developing the whole of its power, the speed of the air in the inlet pipe causes a slight negative pressure in the pipe 49, and hence a slight effort which opposes the spring 51, tending to raise still further the support 7 and to increase slightly the delivery at full load.

It will be noted that the mounting of the bearing 28 instead of the pump rollers is an improvement on the known arrangement, considerably reduces the unit pressure between the bearing and the pressure member, and eliminates the necessity of aligning the various rollers very exactly; moreover, the forces transmitted through the parts follow a short path, since the distance between the plane AA' and the first supporting bearing 24 is slight.

If it is noted at the same time that all the various members through which the forces are transmitted are preferably constructed of ferrous metals, and that the equalization of the temperatures of the various members is easily obtained since moving oil bathes them all, it will be seen that the variations in temperature cannot involve variations in the pressure of the bearing 28 on the pressure members. Since the bearing 28 is amply dimensioned, its wear is practically negligible and its pressure on the pressure members does not vary.

Moreover, it will be noted that the distance between the support 7 and the spring 20 is short. Since all the members of the pump are assumed to be made of ferrous metals, this distance cannot vary much as a function of the temperature so that the precision of the regulation of the spring 20 is retained. On the other hand, the distance between the support 7 and the diaphragm 39 is fairly great. Expansions of the stem 22 can therefore displace slightly the diaphragm 39 and the support for the spring 51; but this is of no importance because the spring 51 is very highly flexible and the corresponding change of effort will be negligible.

The device which has just been described is intended to be used for a four cylinder engine; it is naturally possible, without going outside the scope of the invention, to provide similar devices for engines comprising any number of cylinders, the number of pressure members varying accordingly.

I claim:

A volumetric diaphragm pump comprising a flexible wall, a plurality of pressure members lying in a plane and resting against the wall about the axis of the pump, and means for actuating said pressure members in succession to effect delivery of fluid, said last-named means comprising a single bearing roller rotatable about an axis which is oblique with respect to said axis of the pump and forms an acute angle with said last-named axis with said two axes intersecting in said plane of the pressure members, and a support carrying said bearing roller and rotatable about said axis of the pump, said bearing roller having a tapered surface engageable with said pressure members which lies on the surface of a cone having an axis coinciding with the axis of said bearing roller, the cone having an obtuse apex angle at the intersection of said axes and said bearing roller being mounted in said

support for rotation about its axis to bring it into selective contact with said pressure members, a lifting support for the pressure members to vary the delivery of the pump, a first extension of said support passing through the flexible wall against which the pressure members rest and a regulating spring biased against said extension, and a second extension opposite said first extension, a diaphragm connected to the end of said second extension, and a second spring biasing said extension in the direction of said regulating spring, said diaphragm defining two chambers one of which is adapted to communicate with the atmosphere and the other with a source of different pneumatic pressure.

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