Sept. 6, 1960 J. P. CASASSA 2,951,447

IMPELLER PUMPS WITH MAGNETIC DRIVES

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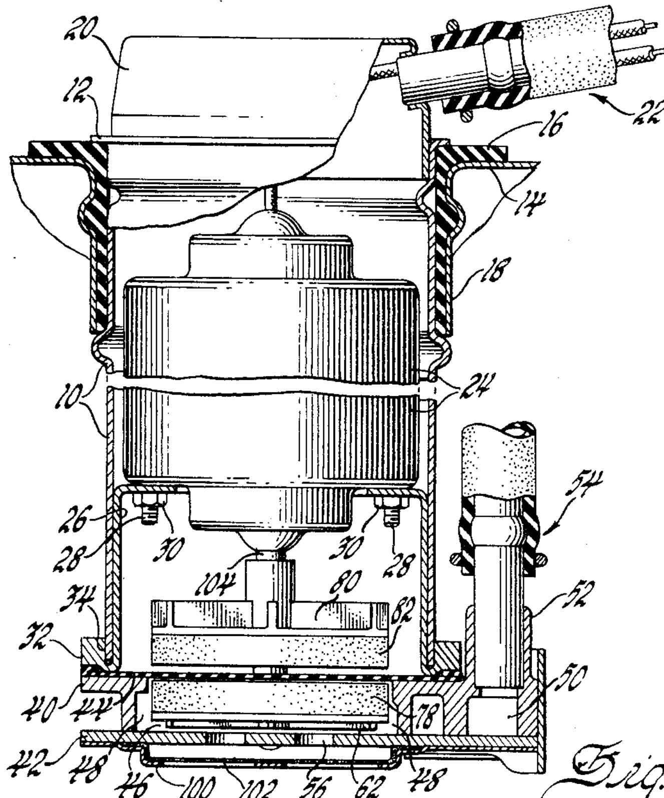


Fig. 1

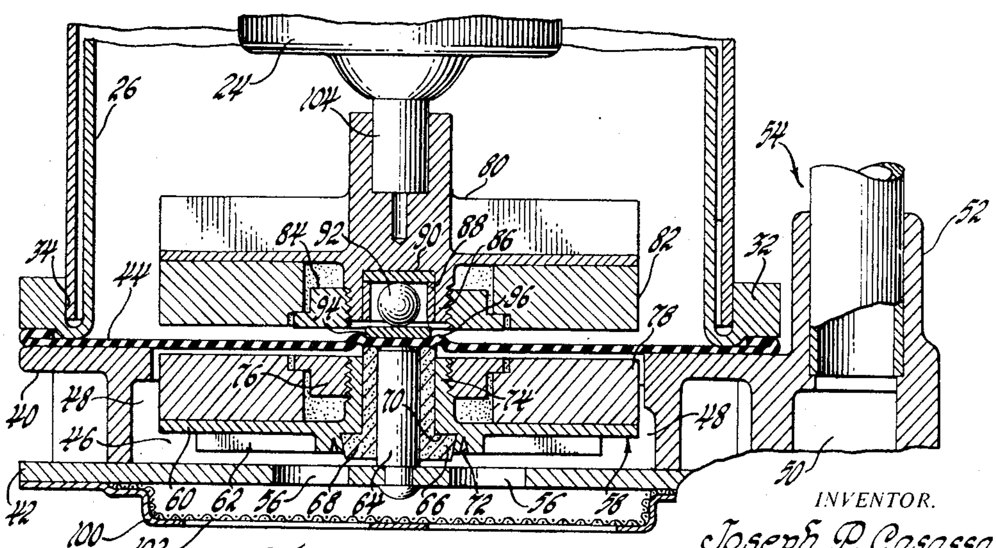


Fig. 2

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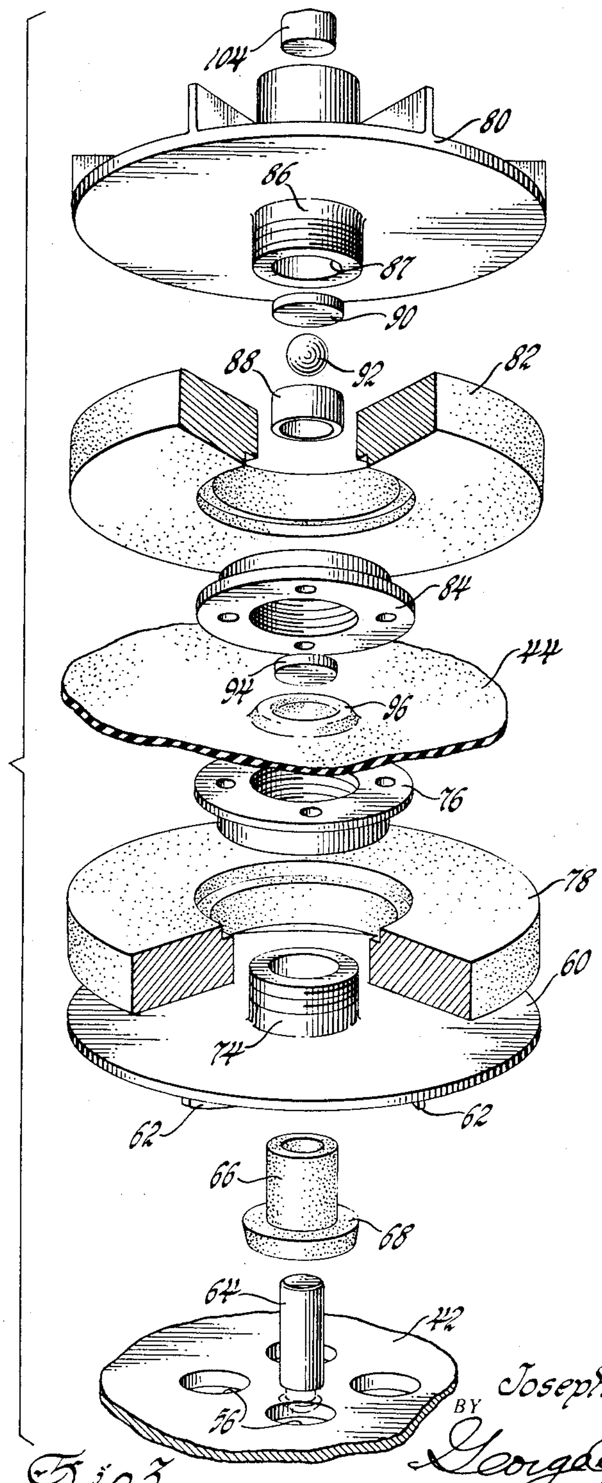


Fig. 3

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2,951,447

Patented Sept. 6, 1960



2,951,447

# IMPELLER PUMPS WITH MAGNETIC DRIVES

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Filed July 31, 1958, Ser. No. 752,323

6 Claims. (Cl. 103—87)

This invention relates to pumps and more particularly to pumps of the impeller type for handling limited or varying quantities of fluid such as engine fuel.

Impeller type fuel pumps have been installed heretofore in engine fuel tanks with the pump intakes immediately above the bottoms of the tanks. Annular magnets have also been employed in transmitting a driving torque from a power source to a given pump impeller. Details of construction for a pump of this type are disclosed in the United States application for Letters Patent, Serial No. 703,142, filed December 16, 1957, in the name of Robert L. Carter.

The pump disclosed in the patent application above referred to performs excellently with a minimum of resistance to the flow of fluid through the pump inlet. It has become desirable, however, to simplify the pump structure, reduce its cost without impairing the performance characteristics, and to minimize vibratory and sound effects.

An object of the present invention is to provide an improved impeller type pump of simple construction and low cost.

A feature of the invention is a pump impeller having a magnetic drive effective through an impermeable nonmagnetic diaphragm, the impeller being rotatable on a pivot pin and preferably with the aid of a bushing of low friction material such as graphite acting as a step bearing.

The above and other important features of the invention will now be described in detail in the specification and then pointed out more particularly in the appended claims.

In the drawings:

Fig. 1 is a sectional view of a motor drive and a pump in which the present invention is embodied, the rotative elements of the pump being shown in full;

Fig. 2 is an enlarged view of the pump illustrated in Fig. 1, the rotative elements being sectioned to show their interior construction and relative location while the pump is not operating; and

Fig. 3 is an exploded view of parts of the impeller and pump drive shown in Figs. 1 and 2, sections being cut away better to disclose the relationship of the parts.

As in the patent application above referred to, the pump shown in the present drawings employs annular permanent magnets as driving and driven members. Each magnet could take some other form, but annular rings with sections of alternating polarity arranged about the pump axis are preferred. As in the patent application, the pump is adapted to be suspended from the top wall of a fuel tank with the pump intake being located immediately above the tank bottom.

The present invention is particularly concerned with the mounting of the pump impeller but it should be understood that a pump drive casing **10** is flanged as at **12** for dependence within a fuel tank **14**. A rubber insulator and sealing element **16** is interposed between the casing



**10** and a depending flange **18** formed on the tank. A cap **20** is fixed to the top of the casing **10** and receives electrical conduit means **22** for operating a motor **24**. An inverted cup **26** is nested within the bottom of the casing **10** to hold the motor **24** by means of bolts **28** and nuts **30**. The cup **26** bears a rim **32** recessed at **34** to receive the bottom edge of the casing **10** and form a liquid tight seal.

The pump casing comprises a main casting **40** and a bottom wall or plate **42** which cooperate with a brass or nonmagnetic diaphragm **44** in defining a pumping chamber **46**. The casting **40** is formed with a spirally expanding recess **48** extending partially around the chamber **46** to a tangential outlet passage **50** formed in a side portion of the casting **40** and closed by an extended portion of the plate **42**. A neck **52** is made integral with the casting **40** upwardly to communicate with fuel discharge conduit means generally indicated at **54**.

The bottom plate **42** bears several inlet apertures **56** located near the center of an impeller generally indicated at **58**. The latter is composed of an aluminum vane portion **60**, the curved and radially extending vanes **62** of which are located on the underside of the impeller **58** and the inlet openings **56** are directed toward the inner ends of the vanes. A pivot pin **64** has one end fixed to the plate **42** as clearly shown in Fig. 2, and the upper end of the pin abuts the central portion of the diaphragm **44**. Surrounding the pin and rotatable with respect thereto is a bushing **66** of hardened graphite or equivalent non-frictional material which will serve as a bearing and be unaffected by the fuel to be handled by the pump. The annular upper end of the bushing **66** is so formed as to present a smooth surface to the diaphragm **44** as these two parts come into frictional engagement to some extent as will further appear. The lower end of the bushing **66** is formed with an outstanding flange **68** which is received in an annular recess **70** formed in the underside of the plate **60**. It will be noted that the bushing is of such length that it does not span the complete distance between the diaphragm **44** and the plate **42** as does the pin **64**, but leaves a slight clearance. The pump or vane portion **60** is fixed tightly to the bushing **66** by swaging as indicated at **72**. The vane portion **60** has a threaded hub **74** to which is joined a threaded disc **76**. The latter serves as a lock nut holding an annular permanent magnet **78** against the vane plate **60** as a rigid part of the impeller **58**. It will be understood that the impeller **58** with its bushing **66** freely rotates within the pumping chamber **46** on the pivot pin **64**.

Enclosed within the inverted cup **26** is a hub member **80** on the underside of which is carried a driving permanent magnet **82** similar to the magnet **78**. This magnet **82** is held to the hub driving member **80** by means of a lock ring **84** which is similar to the lock ring **76**. A threaded hub **86** holds the lock ring and is recessed at **87** to accommodate a hardened steel annular ring **88** and a hardened steel step bearing plate **90**. Within the ring **88** and adapted to orbit therein because of the clearance provided is located a steel ball **92**. This ball rests upon a hardened steel plate **94** which is retained on the center portion of the diaphragm **44** by an annular ridge **96** formed on the latter.

An open retainer frame **100** is fixed to the bottom side of the pump plate **42** and maintains a screen **102** in position for clarifying fuel passing to the openings **56**. Conventional bolts, not shown, are utilized to hold the retainer frame **100** and the pump parts as well as the diaphragm **44** to the flange **32** as will be understood.

The motor **24** is provided with a depending drive shaft **104** tightly received in the hub of the member **80**.

The driving and driven magnets **82** and **78** are each in the form of a ring with sections of alternating polarity arranged about the ring axis, as heretofore stated. The magnetic material of at least the magnet **78** should obviously be such as to be unaffected by the fluid to be handled by the pump or the heat conditions with which the pump must contend. A magnet of this type is discolsed in the British Patent 758,962, published October 10, 1956, and mentioned in the United States application heretofore referred to. The magnet **82** is sealed within the motor support casing and, therefore, is not in contact with the fuel being pumped.

Assuming that the apparatus disclosed is suspended in a fuel tank with the bottom plate **42** of the pump near the bottom of the fuel supply tank and the current is supplied to the motor **24**, it will be seen that the motor shaft **104** will rotate the driver magnet **82**. The motor armature as well as the driving plate **80** and the magnet **82** will be supported by the ball **92** which in turn is supported by the hardened plate **94**, the diaphragm **44** and the pin **64**.

With the rotation of the driver magnet **82**, the magnet **78** will be caused to rotate with it by virtue of the magnetic attraction set up between the two magnets. The latter should be of sufficient magnetic strength to attract each other so that the work load given to the pump will not cause the magnets to fall out of phase. With a rotation of the magnet **78**, the vanes **62** will produce an outward discharge of fluid through the passage **50** and the conduit means **54** as will be understood, the fluid entering the pump from the tank by way of the screen **102** and the inlet openings **56**. With the operation of the impeller **58** in the pumping of fluid, the pressure of the latter on the underside of the impeller will decrease and the bushing **66** will bear down against the top side of the plate **42**. The bottom end of the bushing, therefore, acts as a step bearing and the upper end of the bushing will clear the diaphragm **44** when the pump is in operation.

Upon shutting off the current to the motor **24**, the fluid pressure on the underside of the impeller **58** will increase as the flow of fluid ceases and the mutual attraction of the two magnets **78** and **82** will then be effective to cause the impeller to assume its raised position as depicted in Fig. 2; i.e., the upper end of the bushing **66** will come into contact with the underside of the diaphragm **44**.

With the simplified construction as above described, it will be seen that the inlet passages for the fluid by way of the openings **56** are clear and not obstructed and that large bearing surfaces are provided for rugged support of the impeller **58**. It will also be noted that the support of the central portion of the diaphragm **44** is firm and that drumming or vibratory noises are, therefore, not to be encountered under heavy service.

I claim:

1. A pump including a casing, an impermeable diaphragm of nonmagnetic material cooperating with said casing in defining a pumping chamber, a first permanent magnet arranged outside said chamber on one side of said diaphragm and adapted to be power rotated, an impeller in said pumping chamber opposite said first magnet and including a second permanent magnet facing said diaphragm, radially extending vanes on said impeller, said casing having an inlet near the center of said impeller and directed toward said vanes, an outlet in said casing leading from the periphery of said pumping chamber and impeller, a pivot pin fixed to said casing, a bushing of low friction material rigidly fixed to said impeller and rotatable with the latter on and with respect to said pivot pin, and said bushing being adapted to contact said diaphragm and said casing.

2. A pump including a casing, an impermeable diaphragm of nonmagnetic material cooperating with said casing in defining a pumping chamber, magnetic drive means including a magnet rotatable in a plane parallel with said diaphragm and outside said chamber, a pump impeller in said chamber within the magnetic field of said magnet and including radial vanes, said casing having an inlet directed toward the inner end of one of said vanes and an outlet directed from the periphery of said chamber, a nonrotatable pivot pin having one end contacting the pumping chamber side of said diaphragm and its length extending from said diaphragm to said casing, and said impeller being rotatable on said pivot pin.

3. A pump including a casing having a bottom wall with an inlet opening, an impermeable nonmagnetic diaphragm cooperating with said casing in defining a pumping chamber, said wall partially defining a discharge passage leading from said chamber, a pump impeller with radial vanes mounted in said chamber, said vanes extending in a plane adjacent to said wall, a nonrotatable pivot pin extending between said bottom wall and diaphragm and abutting the latter, said impeller being rotatable on said pivot pin, and magnetic drive means arranged to rotate said impeller by magnetic flux effective through said diaphragm.

4. A pump such as set forth in claim 3, the magnetic drive means including a driver magnet and an orbiting ball step bearing resting on the diaphragm.

5. A pump including a casing adapted to be immersed in fluid and including a nonmagnetic, impermeable diaphragm and a bottom wall, said diaphragm and wall being parallel to determine a pumping chamber between them, an inlet and an outlet in said casing and communicating with said chamber, a nonrotatable pivot pin extending upwardly from said wall to and in contact with said diaphragm, a pump impeller journaled directly on said pin, and magnetic drive means associated with said pump to transfer torque to said impeller by magnetic flux effective through said diaphragm.

6. A pump including a casing, an impeller, and a pivot pin as set forth in claim 5, and said impeller including a bushing journaled on said pivot pin, said bushing being of non-friction material such as graphite and being adapted to act as a step bearing.

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