July 4, 1944. R. E. HARTLINE 2,353,031

FLUID PUMP

Filed April 22, 1942 2 Sheets-Sheet 1

Fig. 1.

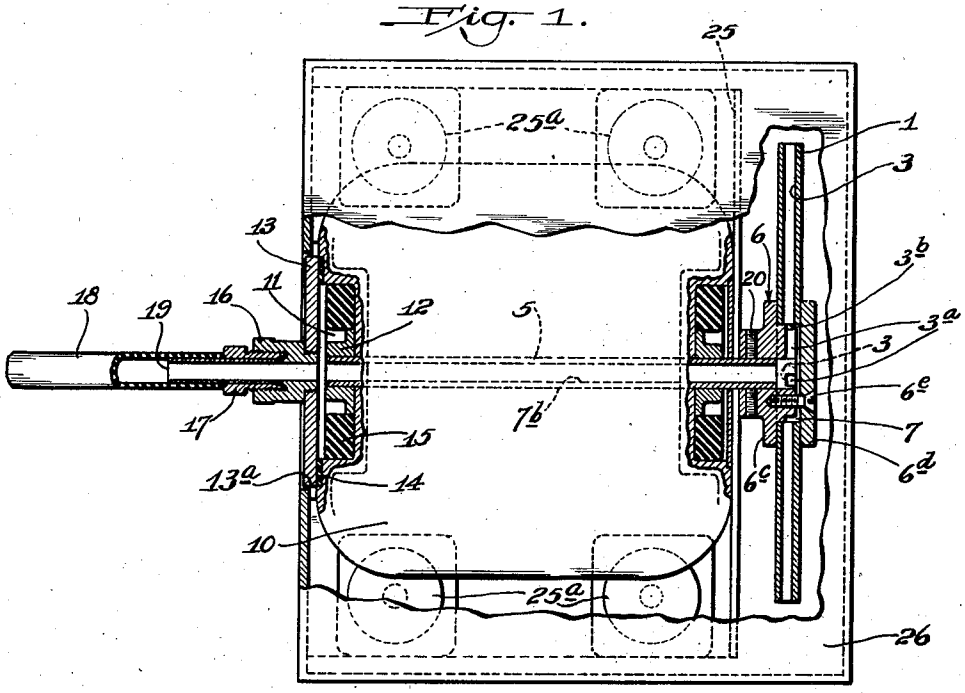


Fig. 2.

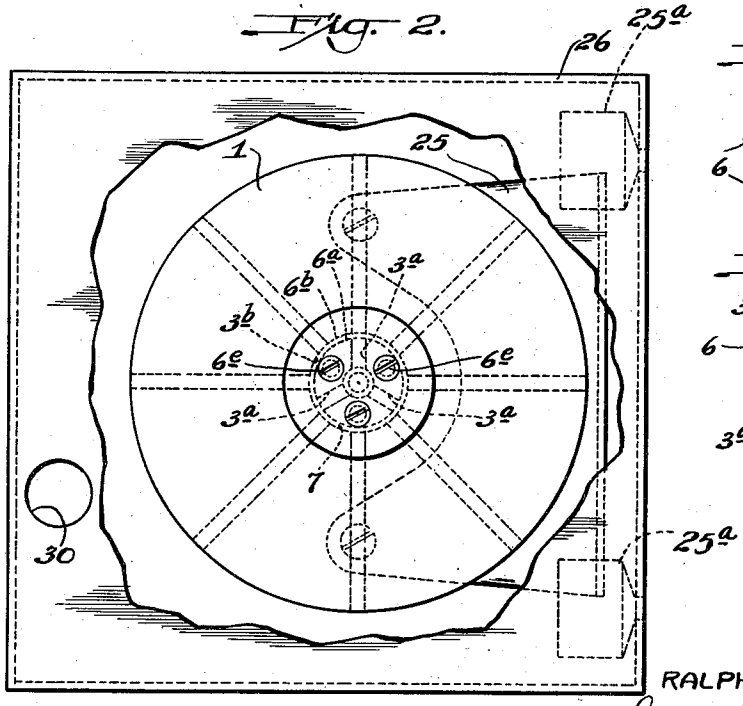


Fig. 6.

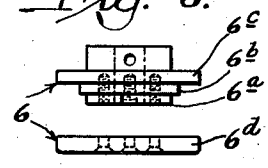
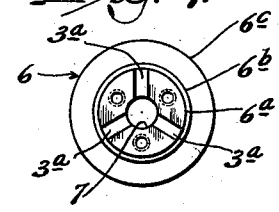


Fig. 7.



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Filed April 22, 1942 2 Sheets-Sheet 2

Fig. 3.

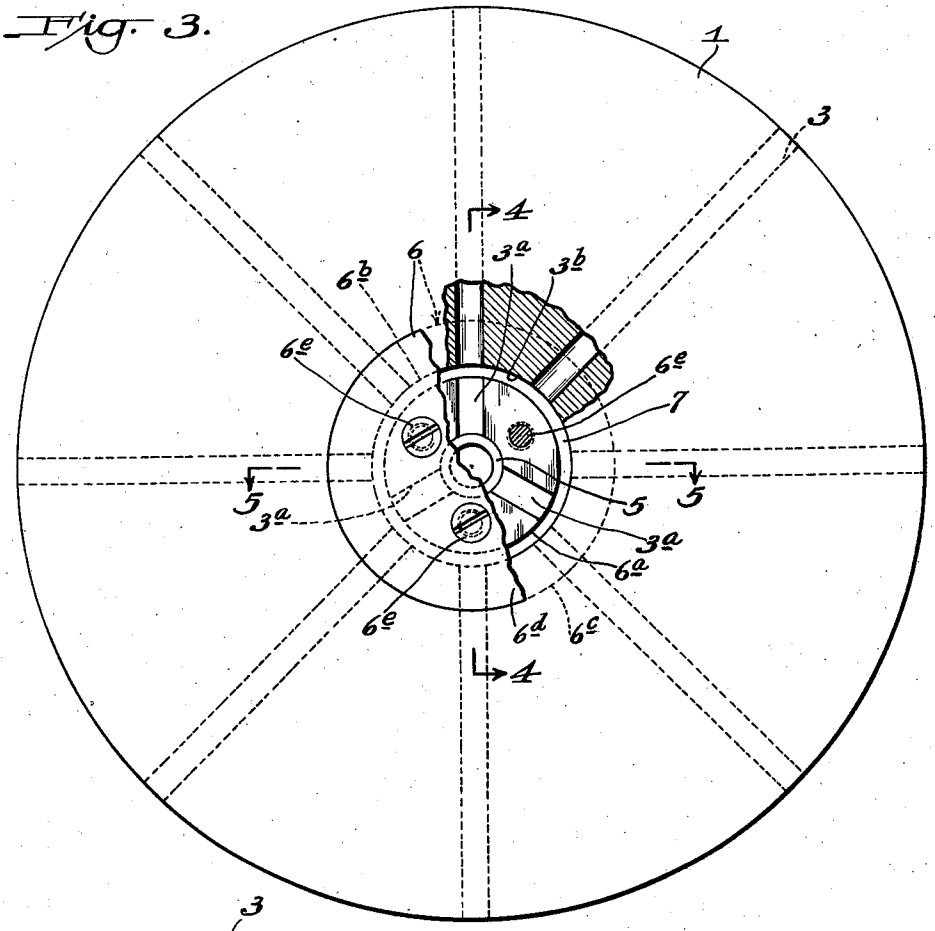


Fig. 4.

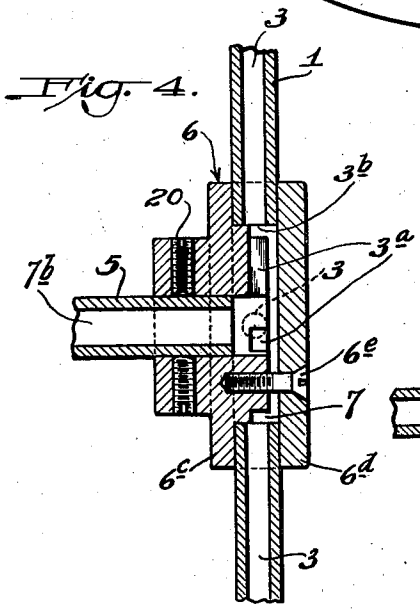
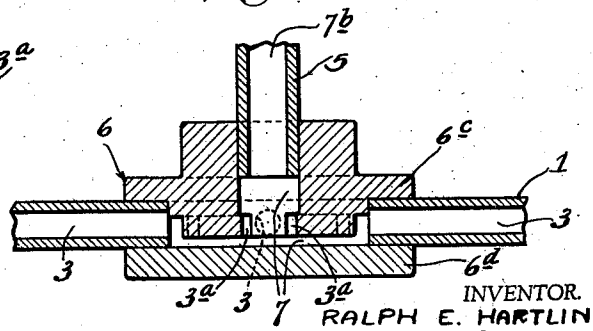


Fig. 5.



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UNITED STATES PATENT OFFICE

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FLUID PUMP

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Application April 22, 1942, Serial No. 439,959

3 Claims. (Cl. 230—117)

This invention relates to a fluid pump and, more particularly, to the type of pump adaptable for use in connection with gas indicating apparatus to move small volumes of air at low pressures and in a continuous manner.

In providing a pump to satisfy the requirements of moving small samples through gas detecting apparatus, it has been difficult in the past to effectively seal the moving parts of a reciprocating or centrifugal pump against the atmosphere to provide the required pressure, and unless expensive and elaborate seals were used, considerable maintenance was involved, making continuous operation difficult.

It is among the objects of this invention to provide a pump of simple construction which overcomes the foregoing objections, which can be readily attached to a driving means, which is of such construction that no enclosure is required for sealing off the pumping unit to produce a difference in pressure and flow of fluid, which is inexpensive in construction and which requires a small amount of power in its operation.

It is a more specific object of this invention to provide a pump having a rotatable impeller which operates as a pump means and which is so constructed that it in itself forms a complete pumping unit for producing the difference in pressure desired and requires merely its connection to a driving means and to a fluid duct to produce a continuous flow such as is adequate for moving a gas sample through a detecting apparatus.

Other objects of this invention will become apparent from a description of a preferred embodiment of my invention.

In the drawings:

Fig. 1 is a plan view partly in section of a preferred embodiment of my invention and illustrates one arrangement of its connection to a motor acting as a driving means for the pump and as a means of connection to a gas sampling line;

Fig. 2 is an end elevational view of the embodiment illustrating in addition the mounting of the driving means to a bracket;

Fig. 3 is another end elevational view partly in section and enlarged to illustrate more clearly the passages formed for connecting the impeller passages or pumping unit to a duct formed in a driving shaft;

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 3;

Fig. 6 is a detailed view of the individual parts making up the shaft attaching member for the impeller in connecting it to a driving shaft; and

Fig. 7 is an end elevational view of the shaft attaching member.

In describing my invention, reference is continually made to its application for moving continuously small samples through a gas detecting apparatus, and it is intended that this operation include moving such volumes as $\frac{1}{10}$ of a cubic foot per minute at a difference in pressure of about 2.4 inches of water. One such application is an alarm apparatus for mine use where the apparatus operates in drawing a sample continuously from a certain atmosphere and is operative to give warning in the event the atmosphere contains an explosive mixture. It is to be understood, however, that applications other than for gas sampling can be made of this invention where these flow and pressure conditions are of advantage and useful.

Invention is predicated on the principle of rotating an impeller containing small radial passages each connected to a central hub chamber which in turn is connected to a fluid duct through which fluid is to be moved. It has been found that rotation of these small radial passages in the atmosphere formed about the body of the impeller produces a suction in the central hub chamber to such an extent that the differential pressure produced is adequate for accomplishing movement of small volumes of gas. In the preferred arrangement, the central hub chamber is attached to a hollow driving shaft which acts as a connecting means to a duct connected in turn to a gas detecting apparatus.

In the embodiment, the impeller 1 is made preferably of some suitable plastic material such as any of the phenolic resins or cellulose derivative materials. The impeller is about ¼" thick and, because of the nature of the material of which it is constructed, is relatively light in weight. It is recognized that the impeller may be made of any other material that is practical for this purpose such, for example, as metal.

Formed in the body of the impeller 1 and extending radially from the periphery to its center are small passages 3 about $\frac{3}{32}$" in diameter and about 1⅞" long. The impeller 1 is mounted on to a hollow driving shaft 5 by using a hub or shaft mounting means 6. This mounting means is made up of two parts 6*a* and 6*d* (see Figs. 6 and 7) and contains extending passages 3*a* which connect the radial passages 3 to a chamber or central passage 7 provided to receive the driving

shaft 5. These passages 3a are formed in the end surface of one part 6a of the shaft mounting means 6 and can be readily formed by merely cutting into the surface. The portion 6a has a hub surface 6b for receiving the impeller body and engaging its inner surface 3b. In addition, a flange 6c extends up on to the side of the impeller and back of the hub and cooperates with the other portion 6d of the shaft mounting means 6. This portion 6d fits onto the opposite surface of the impeller body and is fastened to the first portion 6a by means of screws 6e that pass through the flange or plate portion 6d into threaded openings of the impeller carrying portion 6a. With this arrangement, the assembly of the shaft mounting means 6 is made by inserting portion 6a through the central opening in the impeller body defined by the surface 3b so that the flange 6c abuts the surface of the body and placing the other portion 6d on the opposite side of the body and holding it in place and drawing it tightly against the end surface of the impeller by means of the screws 6e. With this assembly, the radial passages 3 are sealed from the atmosphere except through the passage 7 formed in the portion 6a and a continuing passage 7b provided in the hollow drive shaft 5.

In the embodiment of the invention illustrated, the driving means represented is an electric motor 10 to which the hollow driving shaft 5 is attached. The shaft 5 extends outwardly sufficiently on the driving end to accommodate the fluid pump. On the opposite end of the shaft is a setling chamber supplied for sealing off the bearing 12 for the motor. Ordinarily, a dust plate is placed to enclose the lubricating chamber 11 for the bearing and in the modification made for my application, a plate 13 is fastened to the housing of the motor, which, by means of a washer 14, seals off the chamber 11. Within the chamber a felt washer 15 encircles the bearing and supplies the lubrication for the bearing. When used in connection with my application, this felt washer does not interfere with the small fluid chamber formed at the end of the shaft. A threaded opening in the end sealing plate 13 receives a duct 18 through which fluid is to be moved. If my invention is used with an apparatus for gas detection, this duct is connected to the gas detecting apparatus, not shown, and the invention is operated to move a gas sample continuously through the apparatus.

One suitable means for connecting the duct 18 to the chamber 11 is by a coupling 16 which is threaded directly to the end plate and which has a threaded end for receiving a connection 17. This connection 17 holds and seals off a sleeve 19 which has a flared end that seats against a surface of the connection 17 and the coupling 16. This sleeve extends into the duct 18 a sufficient distance to be held tightly thereto. With this arrangement, no difficulty is encountered in sealing off the moving parts, and in this instance the only moving part is the motor shaft which is ordinarily sealed for lubricating purposes. The important advantage is that no seal is necessary for the pump because it is operative merely by its rotation in the atmosphere, unlike an ordinary centrifugal pump which has a rotating body cooperating with an enclosure to produce a pressure or flow.

In the operation of the pump, the motor supplied should be adequate for rotating the impeller at reasonably high speeds and in the embodiment, it has been found that a rotation of about 5,000 revolutions per minute is adequate for giving the flow conditions specified above. It is to be pointed out that with this improved pump, the pump or whole impeller is readily attached to some form of a driving shaft which need only be bored in some manner so that it can be conveniently connected to a duct supplying a source of fluid. This feature of adaptability along with the advantage of low cost of construction and operation makes the development of importance.

The pump is supplied complete and can be mounted directly on to some form of hollow shaft by means of a key 20 that passes through the shaft mounting means and engages the driving shaft. In the assembly shown, a motor mounting bracket 25 and shock absorber assembly 25a are illustrated diagrammatically for the purpose of completeness and to show how the motor can be attached to a support 26. The support illustrated is an enclosure for the whole apparatus and if tightly sealed about and at its engagement with the plate 13 at 13a and at the absorber connection to the enclosure must be provided with a suitable outlet, indicated at 30, to discharge the fluid moved. If this arrangement is used, a duct is attached to the enclosure for receiving the fluid discharged through the opening and to transport it to some remote location. In this way, the pump can be used for discharging fluid into a duct as well as drawing fluid from a duct.

It is recognized that certain deviations can be made from this specific embodiment of this invention herein described and that other embodiments can be made, and it is intended that the invention include all such modifications and embodiments, although it is to be recognized that the specific embodiment represents a desirable and successful application of the principle involved in my invention and is actually a pump now being used successfully in connection with gas sampling apparatus where a continuous flow of small volume is desired. Variation in size of the structure varies the capacity of the pump. Although emphasis has been placed on an application of my invention to gas sampling apparatus, and other and equally important applications can be made as are obvious to those requiring such apparatus.

While I have described my inventien in accordance with the provisions of the patent statutes and have explained the principle and mode of operation of my invention, and have illustrated and described what I now consider to represent its best embodiment, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as sperifically illustrated and described.

I claim:

1. A centrifugal fluid suction pump comprising a driving means having a drive shaft with a longitudinal passageway, one end of the shaft being connectable to a source of fluid, the other end of the shaft providing a driving means, a plastic impeller member with a hollow central portion and having radial passages extending inwardly from its periphery to the hollow portion, a shaft mounting means attached to the surface defining the hollow central portion of the impeller and having an inner surface for receiving the driving shaft, the shaft mounting means being attached to the end portion of the shaft and extending beyond the shaft to define a connecting chamber for the radial passages and the passageway of the shaft and having a flange extending onto one surface of the impeller body, means formed in the end of the shaft mounting means for fluidly con-

necting the radial passages of the impeller member to the connecting chamber, and an outer sealing plate attached to the opposite surface of the impeller body and attached to the outer surface of the shaft mounting means for sealing off the passage means connecting the radial passages to the passage of the shaft.

2. A centrifugal suction pump comprising a motor having a hollow driving shaft, one end of the shaft being fluidly connected to a source of fluid, the other end of the shaft being connectable to a driven means, a thin plastic impeller body mounted to the end portion of the shaft, radial passages formed in the body and extending from the periphery to an inner surface defining a central hollow section, a shaft mounting means attached to the end portion of the shaft and to the surface of the impeller body defining the central hollow section and operative to drivingly support the impeller body on to the shaft, the shaft mounting means extending beyond the shaft and having passages formed in its outer end fluidly connecting the radial passages of the impeller body to the hollow shaft, the shaft mounting means having a flange extending onto a side surface of the impeller body, a flat plate positioned on to the opposite side of the impeller body and fastened to the end of the shaft mounting means for sealing in cooperation with the flange of the shaft mounting means the impeller body to the shaft and closing to the atmosphere the passage means connecting the radial passages of the impeller body to the hollow shaft.

3. A centrifugal suction pump for gas sampling comprising a circular disc provided with a plurality of radial passages extending from its periphery to its central portion, an electric motor provided with a hollow drive shaft extending therethrough and projecting from an end of the motor, said disc being rigidly mounted on said projecting end of the shaft with the inner ends of said passages in communication with the interior of the shaft, a stationary conduit in communication with the opposite end of the shaft and adapted to be connected to a source of gas, and means sealing the connection between the adjacent ends of the drive shaft and stationary conduit.

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