A. E. GUY.

CENTRIFUGAL PUMP.

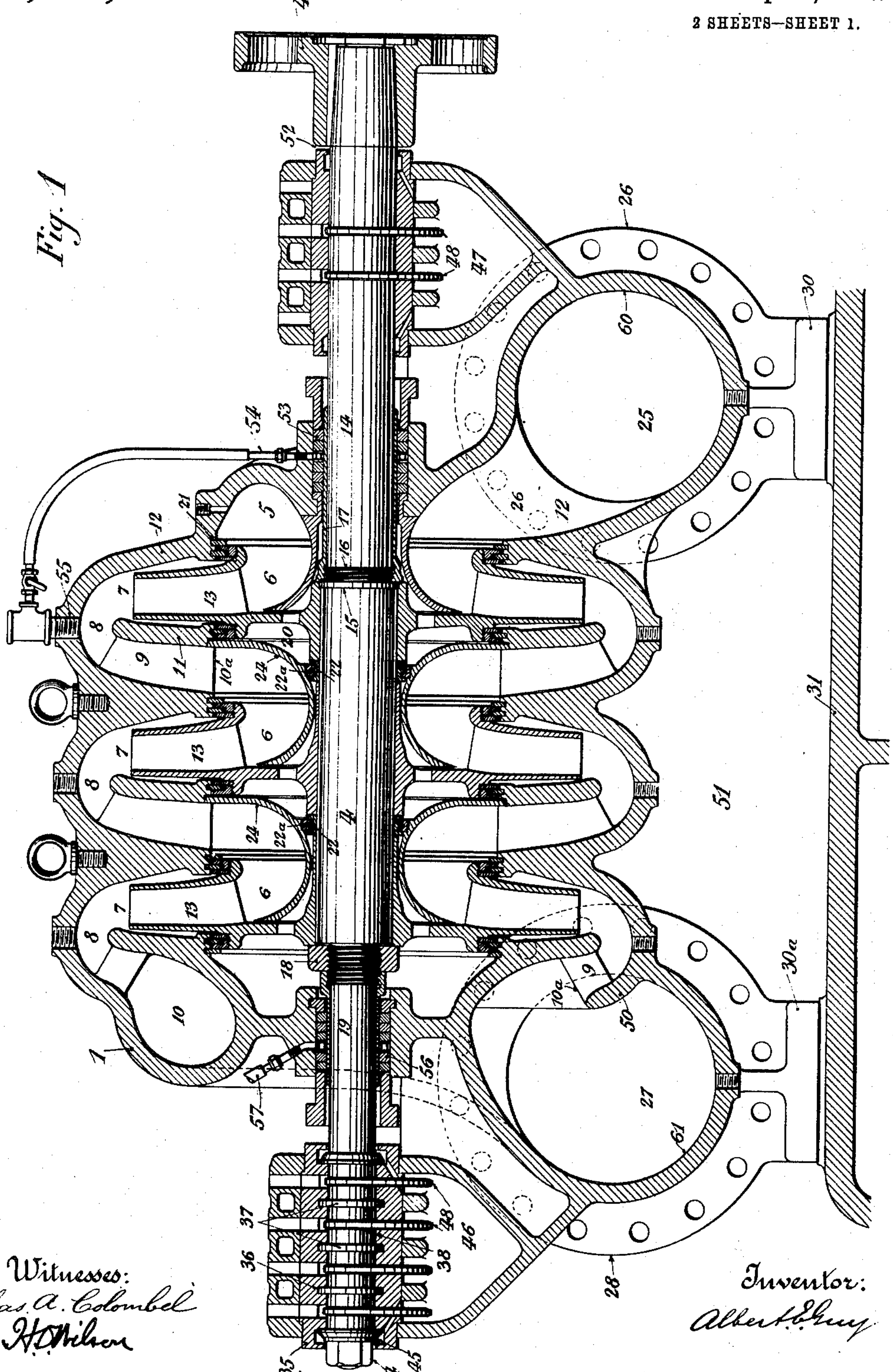
APPLICATION FILED MAR. 11, 1912.

1,037,244.

Patented Sept. 3, 1912.

2 SHEETS—SHEET 1.

Fig. 1



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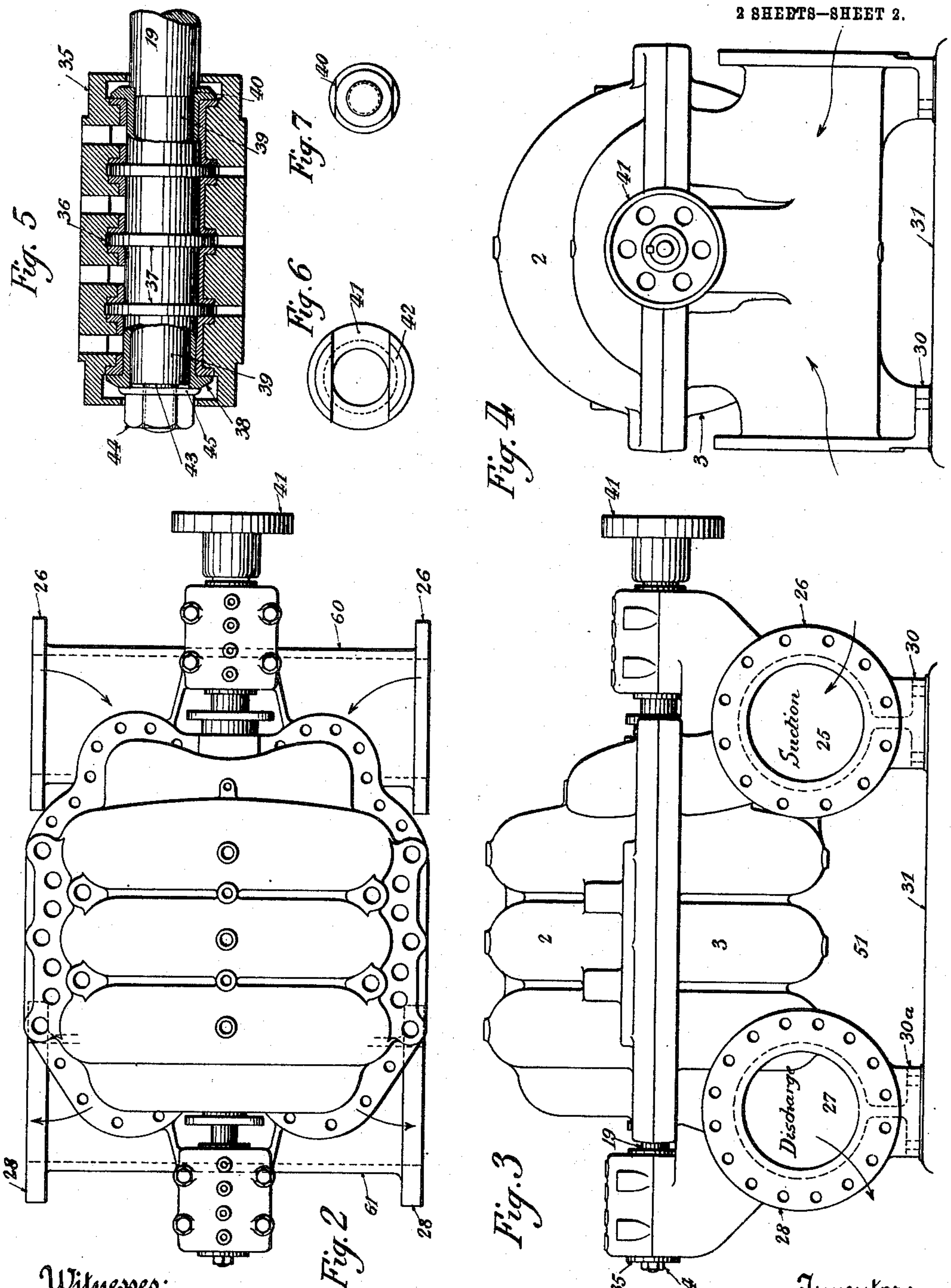

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UNITED STATES PATENT OFFICE.

ALBERT E. GUY, OF TRENTON, NEW JERSEY.

CENTRIFUGAL PUMP.

1,037,244. Specification of Letters Patent. Patented Sept. 3, 1912.

Application filed March 11, 1912. Serial No. 682,968.

To all whom it may concern:

Be it known that I, ALBERT E. GUY, a resident of Trenton, in the county of Mercer and State of New Jersey, have invented a new and useful Improvement in Centrifugal Pumps, of which the following is a specification.

This invention relates to centrifugal pumps, and particularly to that type of pump in which the pump casing is made in two or more separable parts joined on a plane parallel to the axis of the driving shaft and passing therethrough.

The objects of the invention are to provide an improved construction and arrangement of the casing for a pump of the character described; to provide an improved pump which may be accommodated to different existing arrangements of systems or conduits with greater facility than pumps of those types now in use; and to provide a construction which minimizes strains and stresses in the driving shaft and connected parts during operation of the pump.

A further object of the invention is to provide a construction of pump in which a more effective packing may be obtained.

Further objects of the invention are in part obvious and will in part appear hereinafter.

In the drawings Figure 1 represents a longitudinal cross section through a centrifugal pump constructed according to my invention; Fig. 2 is a plan view of the same; Fig. 3 is a side view of the same; Fig. 4 is an end view of the pump shown in Fig. 3, as the same appears from the right; Fig. 5 is a cross sectional view through a thrust bearing on the line 5—5, Fig. 1; Fig. 6 is an end view of the thrust bearing sleeve, from the right in Fig. 5; and Fig. 7 is an end view from the left of that portion of the driving shaft shown in Fig. 5.

The pump illustrated in the drawings is formed with a body 1, comprising two parts, 2 and 3, joined together on a plane passing through the axis of the rotatable driving shaft 4, as illustrated in Fig. 3. The part 3 is intended to be suitably secured to the base, bed plate or foundation and is ordinarily termed the casing. The part 2 is termed a cover and is removable from the casing to expose the inner parts of pump for inspection or repair. Shaft 4 extends longitudinally through the body and carries upon it the rotating parts of the pump. The body 1, as illustrated, is provided with chambers on its interior through which the liquid passes during the course of operation of the pump. The pump body has on the suction side, a main intake chamber 5, an inlet chamber 6, then an impeller chamber 7, followed by a return bend 8, entering into the return passage 9. In said return passage 9 are ribs or vanes 10ª, the purpose of which is to guide the liquid centripetally into the inlet bend leading to the second impeller. With this type of pump to each impeller, except that adjacent to the discharge side, there is an impeller chamber, a return bend and a return passage provided with guide vanes, and the combination of these parts constitutes one stage of the pump. The return bend of the last stage leads the liquid centripetally into a discharge chamber 10. Hence although Fig. 1 illustrates the application of my invention to a three-stage pump, it is to be understood that said invention may be applied to a pump having one or any number of stages. The invention may also be applied to single stage pumps of the multi-stage type.

Each impeller chamber 7 is formed between walls 11 and 12 and in each impeller chamber is located an impeller 13 mounted to rotate with the shaft 4. As shown, three impellers 13 are mounted upon the central portion of shaft 4, which may be of the same diameter as the main end portion 14 of the shaft, but preferably is slightly greater in diameter to provide a collar 15 having an end shoulder, and a screw threaded portion 16 on the shaft to receive a protecting sleeve 17 therefor, which is threaded onto the threaded portion 16 of the shaft. The central portion and the main end portion 14 of the shaft are made of full diameter to provide maximum rigidity and minimum deflection or sagging thereof, and at the same time to guard against the bad effects of critical speed of the shaft. The size of those portions of the shaft referred to will always be selected to obtain the results stated. The impellers 13 are spaced apart along the shaft and are clamped between collar 15 and a nut or collar 18 threaded onto the other reduced end 19 of the shaft.

To minimize leakage from each impeller chamber 7 to a balancing chamber 20 on one side and the inlet chamber 5 on the other side, suitable tightening or running joints 21 are formed between the impellers and the walls 11 and 12 of the body. These preferably embody separate or separately renewable annular flanges mounted in the bore of the body and separate or separately renewable annular flanges intermeshing therewith and secured to the impellers, and specifically of the type illustrated and described in my companion application, Serial No. 682,967, filed concurrently herewith. Similarly, to minimize leakage between each balancing chamber and the inlet chamber of the next stage of the pump, running joints are also formed therebetween, comprising multi-flange rings 22 clamped between successive impellers and intermeshing with multi-flange rings 22ª secured to the shells 24, each of which forms a wall of an interstage inlet chamber 6. The form and arrangement of these joints form no part of the present invention and further description thereof is unnecessary.

It is found difficult in practice, with the ordinary types of centrifugal pumps to connect any given type of pump to all existing arrangements of conduits for which pumps are desired, by reason of the fact that the inlet and discharge conduits in different existing systems or installations lead to the pump location from different directions. To obviate the necessity of building special pumps for different systems or installations, or of multiplying the number of types of pumps to be carried in stock, the present pump is so constructed as to be adapted for connection at a plurality of points to a suction conduit or conduits, and similarly, for connection at a plurality of points to a discharge conduit or conduits. As shown, one end of the casing 3 is formed to provide an intake passage 25 which extends transversely thereof or in a direction normal to the shaft 4. At its middle portion, the intake passage 25 is connected to the intake chamber 5 by a passage 26, which extends upwardly along wall 12 of the body and branches out around the shaft 4 and merges into the intake chamber 5. That portion of the casing forming the intake passage 25, is substantially cylindrical and is in the form of a duct or pipe 60 having suitable means at each end, as a flange 26, adapted for connection to a conduit of the system. At the other end of the pump, the discharge chamber 10 leads into a discharge passage 27 which is also in the casing 3 and similar in arrangement to the intake passage 25 and extends transversely to the casing. The liquid flowing through the return bend 8 of the last stage of the pump and into discharge chamber 10 and discharge passage 27 is led centripetally along a wall 50 of the return passage 9 in which are provided radial vanes 10ª. Return passage 9 flares inwardly and thus causes the velocity of the liquid to be gradually reduced so that it flows quietly through the discharge chamber 10 and circumferentially around the discharge chamber 10 and into the discharge passage 27, thus preventing disturbance of the stream of liquid, which might occur if the liquid issuing from the final stage of the pump impinged normally onto the stream flowing through discharge passage 27. That portion of the casing forming the discharge passage 27 is formed at each end with suitable means; as for example, flanges 28, adapted for connection to a discharge conduit of the system.

It will be observed that the ducts or pipes 60 and 61 forming intake passage 25 and discharge passage 27 form transverse beams, as it were, rigidly connected to the casing 3 and well adapted for supporting the weight of the pump and its contents. Also, as stated, the conduits of the system are connected to the beams 60 and 61, which are a permanent part of the fixed casing, the position of which need never be disturbed for inspection or repair. This can be accomplished by the simple removal of the cover. There is, therefore, no danger of affecting the alinement of the pump, which might occur if the connections to the conduits were required to be disturbed. Moreover, by referring to Fig. 1, it will be seen that the beams 60 and 61 are spaced apart from each other and that a clear space 51 is left between them under the main portion of body 1. Between the beams 60 and 61, the body and its contained parts are symmetrical in transverse section, there being no rigid connection of the casing 3, between the beams 60 and 61, to the support upon or to which the pump is connected.

In a pump of this character, the pressure in the body resulting from the action of the impellers, is often considerable and causes some expansion and, consequently, change in dimensions, of the body itself. This, of course, is comparatively slight but it is often sufficient, in the ordinary type of pump with a rigid base running the full length of the body, to cause unequal expansion of the body above and below the shaft 4, and results in flexure of the shaft 4 and wear in the running joints. These objectionable features are avoided by the present construction. Preferably, a suitable foot 30 is provided at each end of the duct 60 forming intake passage 25 and a similar foot 30ª at each end of the duct 61 forming discharge passage 27, these being arranged to rest upon a suitable support or base 31. In practice one pair of feet, such as the feet 30ª are firmly and rigidly secured to support 31, as by being bolted thereto. The other feet 30 are also secured to support 31, but in any convenient manner to permit slight play or longitudinal movement of the feet 30 with reference to the feet 30ª. A slight clearance 52 is also provided between the end of the body 1 and the driving connection 41 on the end of shaft 4. By reason of the construction stated, the body 1 of the pump may expand slightly along the shaft 4 when the pressure in the body is sufficient to cause such a result. Such expansion is permitted by the relatively loose connection of the pairs of feet, as above described, and clearance 52 and will be equal on all sides of shaft 4, as is obvious. Liability to distortion of the shaft is thus materially diminished.

At the discharge end of the pump, a suitable thrust bearing is formed between the shaft 4 and the body 1. In the form shown, this comprises a hollow bearing member 35 secured to the body and having a bore provided with annular grooves 36 in which rotate annular flanges or collars 37 formed on a sleeve 38 mounted on a reduced end 39 of end portion 19 of shaft 4. To secure the sleeve 38 to rotate with shaft 4, the portion 19 of the shaft is flattened on opposite sides adjacent to the portion 39, as indicated at 40 in Fig. 7. Opposite portions of the end of the sleeve 38 are cut away, as at 41, to leave projecting side members 42 embracing and fitting the flattened portion 40 of the shaft, as indicated in Fig. 5. At its extreme end, the shaft 4 is further reduced as at 43, and the sleeve 38 is of such length as to project slightly over the reduced portion 43 of the shaft. To hold sleeve 38 firmly in position, a nut 44 is threaded on the end of the shaft and is tightened against a washer 45 interposed between the same and the sleeve 38. The thrust bearing described positively insures rotation of the sleeve 38 and, since the nut 44 rotates therewith, vibration is the only element which can cause loosening of the parts. This may be prevented by any of the well known means for such purpose, such as by slight deformation of the threads between the nut and the shaft at the end of the latter.

The thrust bearing described is not claimed herein but will form the subject matter of a separate application.

Beneath the thrust bearing, the casing 3 is formed with a chamber 46 for holding oil or other lubricating material. A similar chamber 47 is formed in the casing at the other end of the body, and oiling rings 48 are placed about the shaft to carry to and distribute the oil or other lubricant upon its surface.

In centrifugal pumps of the present type, it is usual to rotate the shaft for driving the impeller from a source of power connected at the discharge end of the pump. This requires the shaft to be strongest at the discharge end of the pump where the drive is received, and consequently, practically of full diameter at that end. Difficulties in packing the pump increase with the diameter of the driving shaft and in the case mentioned, where the shaft is of large diameter at the discharge end of the pump, and where the pressure in the body is always the greatest, these difficulties are correspondingly increased. In the present construction, the shaft 4 is of full diameter, and the driving connection 41 is provided, at the intake end of the pump. The packing at the discharge end of the pump is, therefore, upon the reduced portion of the shaft and may be made more effective.

As shown, the packing 53 at the intake end of the pump is mounted between the protecting sleeve 17 and the body and is intended to prevent entrance of air from the atmosphere into the first inlet passage 6, in which, in the case of a suction pump, the pressure is below atmosphere. It is found in practice that air tends to leak through the packing and break the partial vacuum in the passage 6 and then through the suction line, which consequently causes the water to drop out of the suction line and break the column of liquid. Such a condition is dangerous and may result in destruction of or great damage to the pump. Furthermore, if air enters the pump and is unequally distributed therethrough the balance of the shaft is disturbed, and as the shaft often rotates at 3,000 revolutions per minute the bad effects resulting therefrom are magnified or exaggerated. To prevent the entrance of air through packing 53, I therefore, provide a suitable liquid seal 54 for the packing through which liquid may enter and, if the pressure in chamber 6 is low, be drawn into the chamber through the passage between the shell 13 and protecting sleeve 17. Water seal 54 may be connected to any suitable source of supply. For example, if the pump is operating upon acidulous water or other liquid which might have a bad effect upon the material of the packing, it is desirable to connect water seal 54 to a source of supply of pure water. Under normal conditions, however, when the pump is operating upon harmless liquid, the water seal 54 may be connected to the cover 2 and consist of a small tube leading from an opening 55, tapped through the wall of the cover, and to the packing 53. The packing 56 at the other end of the shaft 4 may be provided with a similar liquid seal 57, if desired.

With a pump constructed according to my invention, a single design of pump will accommodate itself to a considerable number of systems or conduits. It may be installed with the shaft upon a horizontal axis and the inlet and outlet conduits of the system connected to the flanges 26 and 28 on the same side or on opposite sides of shaft 4 or, if preferred, conduits may be connected to each end of intake passage 25 and to each end of discharge passage 27. Similarly, if the pump is installed with its shaft 4 in a vertical position, the inlet and outlet conduits may be both on the same side of the shaft, on opposite sides of the shaft, or on both sides of the shaft. It will be understood, however, that in case the pump is placed with its shaft 4 in a vertical position some slight modifications thereof are required, as, for example, in the arrangements for lubricating the bearings.

What I claim is:

1. A centrifugal pump having a body and a driving shaft rotatable therein, said body being formed of a casing and a cover joined on a plane passing through the axis of the shaft and being also formed with an inlet chamber, an impeller chamber and a discharge chamber, an impeller carried by said shaft and rotating in said impeller chamber, said casing being also formed at one end with an intake passage for said inlet chamber and at the other end with a discharge passage for said discharge chamber, one of said passages extending in a direction transverse to said shaft and arranged at each end for connection to the conduits of a system and for securement to a support.

2. A centrifugal pump having a body and a driving shaft rotatable therein, said body being formed of a casing and a cover joined on a plane passing through the axis of the shaft and being also formed with an inlet chamber, an impeller chamber and a discharge chamber, an impeller carried by said shaft and rotating in said impeller chamber, said casing being also formed at one end with an intake passage for said inlet chamber and at the other end with a discharge passage for said discharge chamber, each of said passages extending in a direction transverse to said shaft, and each being arranged at each end for connection to the conduits of a system and for securement to a support.

3. A centrifugal pump having a body and a shaft rotatable therein, said body being formed with an inlet chamber, an impeller chamber, a discharge chamber and a discharge passage, an impeller carried by said shaft and rotating in said impeller chamber, said body being formed with an inturned wall between said impeller chamber and discharge passage leading the liquid smoothly into the discharge chamber and discharge passage.

4. A centrifugal pump having a body formed with an inlet chamber, an impeller chamber and a discharge chamber, a shaft rotatable in said body and carrying an impeller in said impeller chamber, said body being also arranged at one end with a transverse duct forming an intake passage for said inlet chamber and at the other end with a duct forming a discharge passage for said discharge chamber, said transverse duct forming a transverse beam for supporting said body at the intake end and being provided with supporting means adapted for connection to a support, and means for supporting said casing at the discharge end.

5. A centrifugal pump having a body formed with an inlet chamber, an impeller chamber and a discharge chamber, a shaft rotatable in said body and carrying an impeller in said chamber, said body being also arranged at one end with a transverse duct forming a discharge passage for said discharge chamber and at the other end with a duct forming an intake passage for said inlet chamber, said transverse duct forming a transverse beam for supporting said body at the discharge end and being provided with supporting means adapted for connection to a support, and means for supporting said casing at the intake end.

6. A centrifugal pump having a body formed with an inlet chamber, an impeller chamber and a discharge chamber, a shaft rotatable in said body and carrying an impeller in said impeller chamber, said body being also arranged at each end with a transverse duct, one forming an intake passage for said inlet chamber, and the other forming a discharge passage for said discharge chamber, said ducts forming transverse beams for supporting said body and being provided with supporting means adapted for connection to a support.

7. A centrifugal pump having a body formed with an inlet chamber, an impeller chamber, and a discharge chamber, a shaft rotatable in said body and carrying an impeller in said impeller chamber, said body being also arranged at each end with a transverse duct, one forming an intake passage for said inlet chamber, and the other forming a discharge passage for said discharge chamber, said ducts forming transverse beams for supporting said body and being provided with supporting means adapted for connection to a support, said body being also formed to provide a free space between said beams and being of symmetrical cross section therebetween.

8. A centrifugal pump comprising a body formed with an inlet chamber at one end, a discharge chamber at the other end and an impeller chamber therebetween, a shaft rotatable in said body and carrying an impeller rotating in said impeller chamber, said shaft being of full size at the inlet end of the casing and reduced at the discharge end, and packings between the body and the full sized and reduced portions of the shaft, respectively.

9. A centrifugal pump comprising a body formed with an inlet chamber at one end, a discharge chamber at the other end and an

impeller chamber therebetween, a shaft rotatable in said body and carrying an impeller rotating in said impeller chamber, said shaft being of full size at the inlet end of the body and twice reduced at the discharge end, packings between the body and the full sized and first reduced portions of the shaft, respectively, a renewable sleeve on the second reduced portion of the shaft and rotatable therewith, a bearing member in the body in which said sleeve rotates, and interengaging parts on said sleeve and member forming a thrust bearing for said shaft.

In testimony whereof, I have hereunto set my hand.

ALBERT E. GUY.

Witnesses:
F. W. WINTER,
ELBERT L. HYDE.