No. 877,484.

PATENTED JAN. 28, 1908.

E. W. BROOKS.

CENTRIFUGAL PUMP.

APPLICATION FILED JUNE 14, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

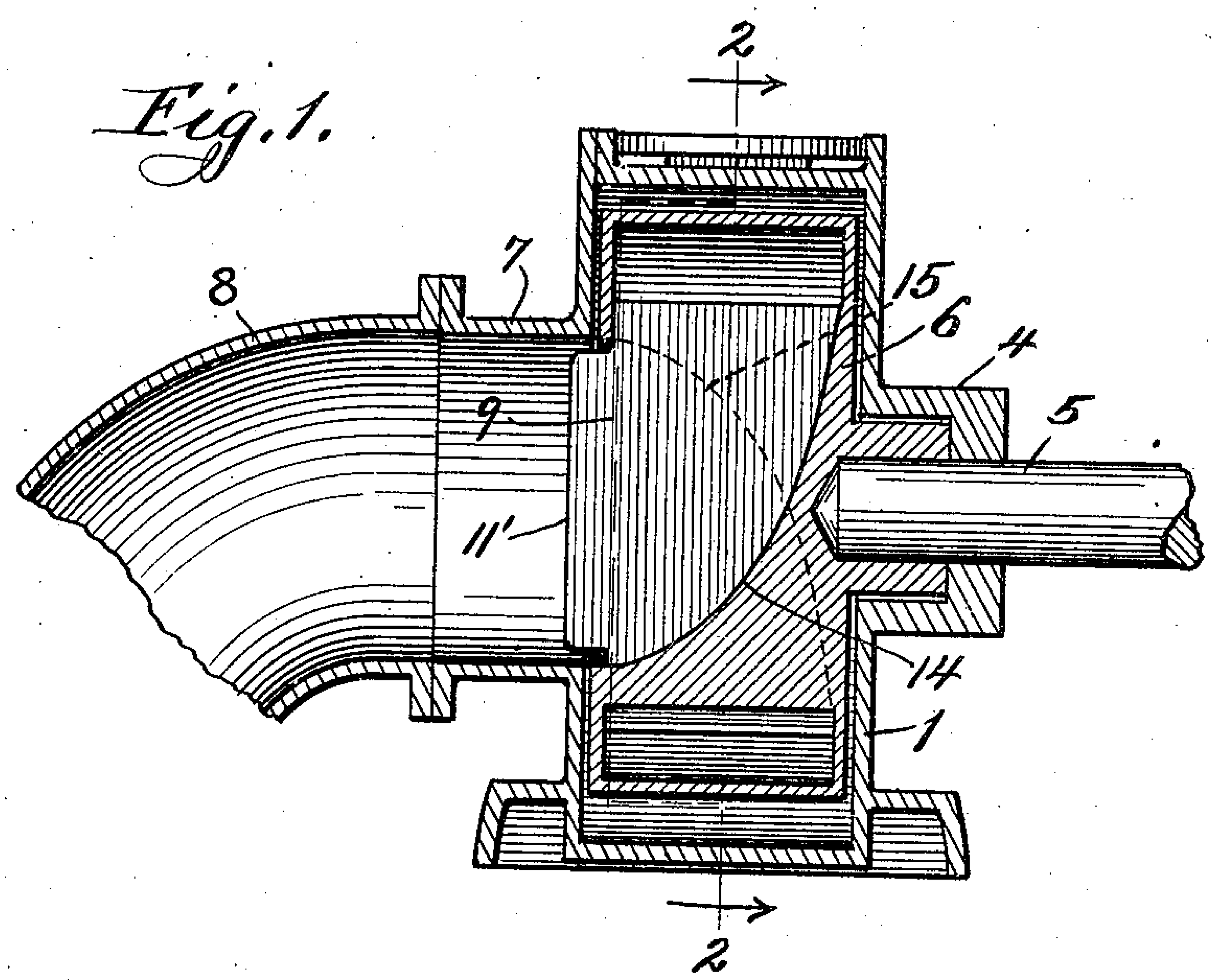
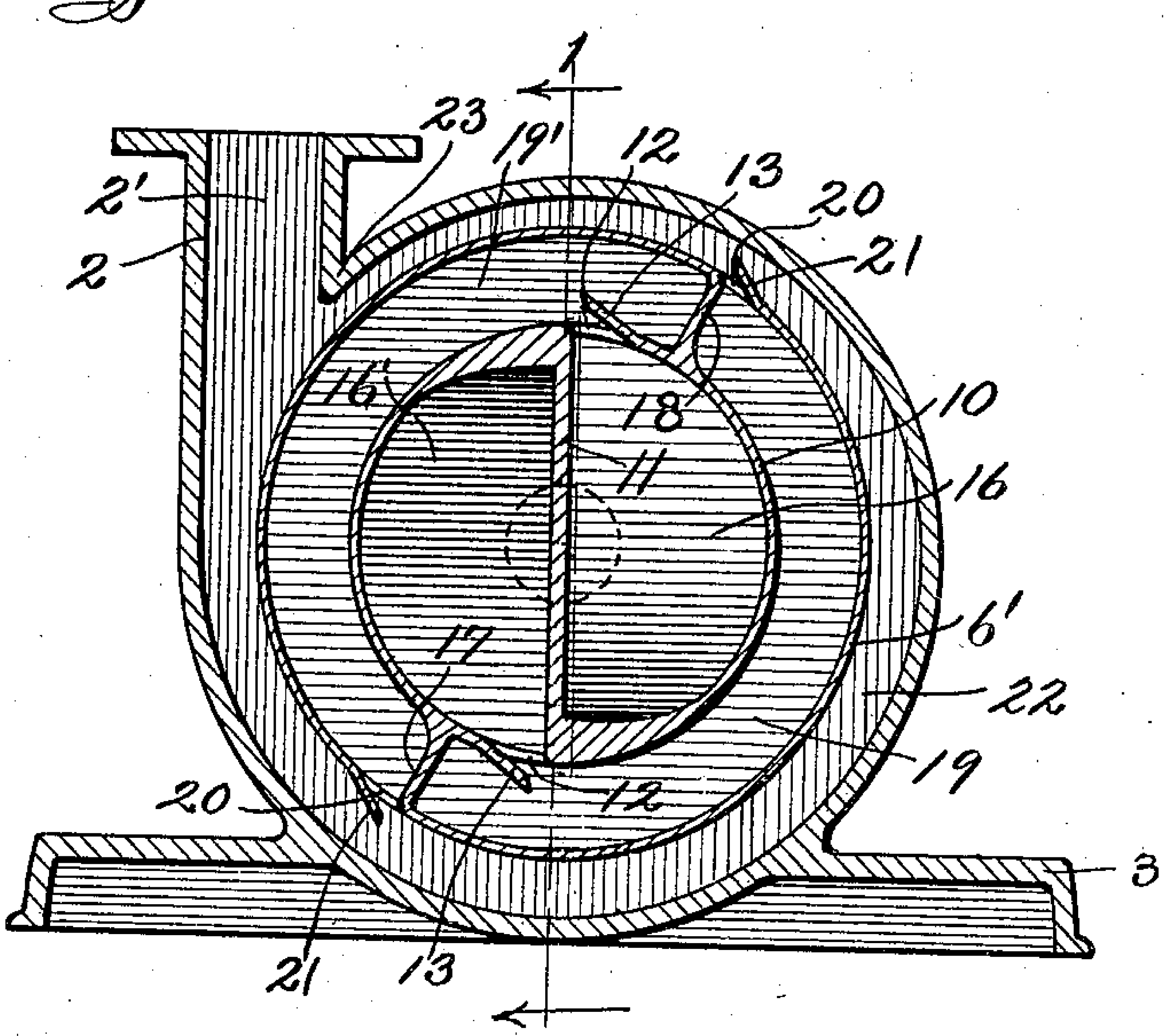


Fig. 2.



Witnesses:

R. J. Jacker

Emilie Rose.

Inventor:

Everett W. Brooks,

By Albert N. Graves,

Att'y.

THE NORRIS PETERS CO., WASHINGTON, D. C.

No. 877,484. PATENTED JAN. 28, 1908.

E. W. BROOKS.

CENTRIFUGAL PUMP.

APPLICATION FILED JUNE 14, 1906.

2 SHEETS—SHEET 2.

Fig. 3.

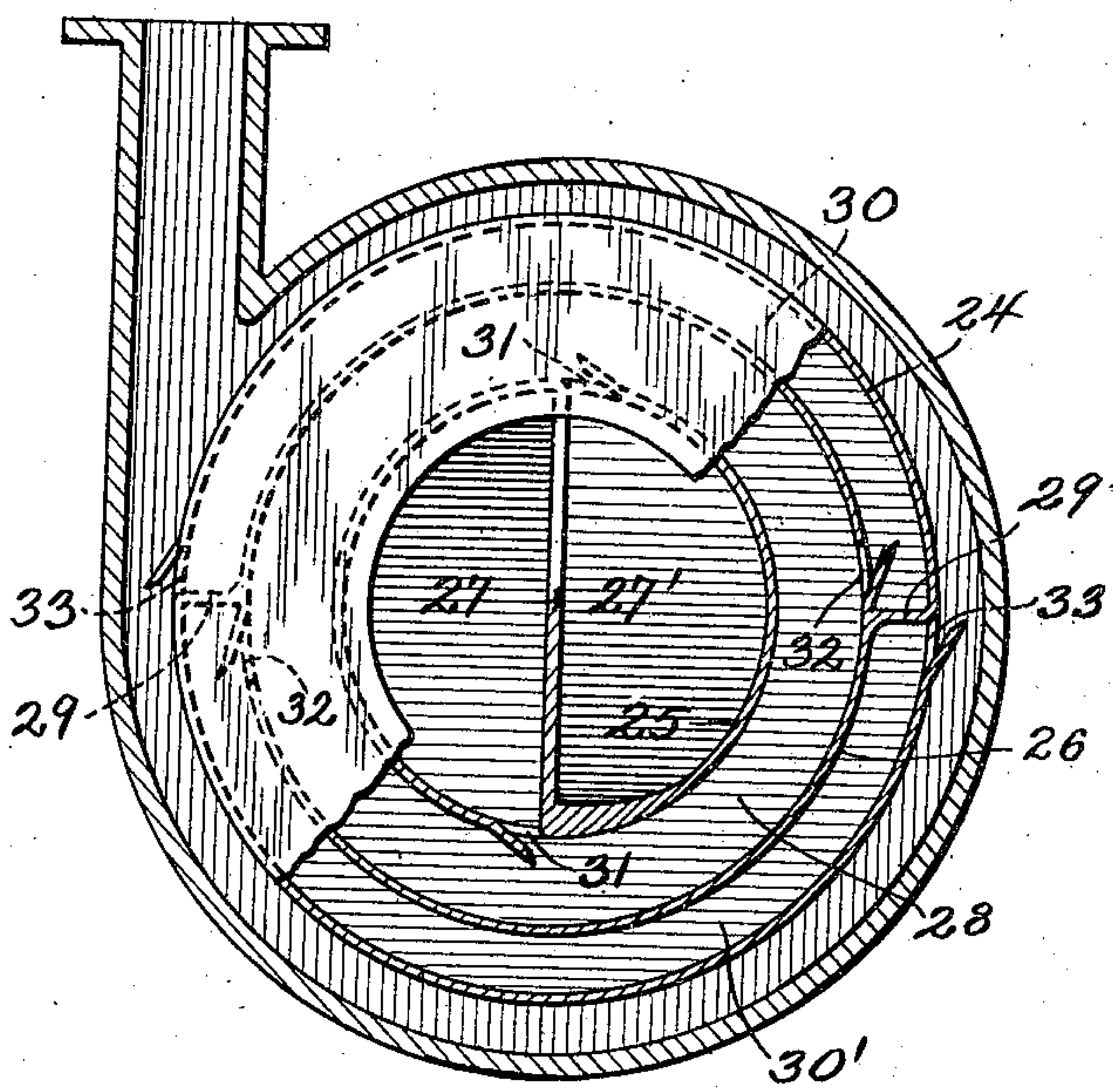
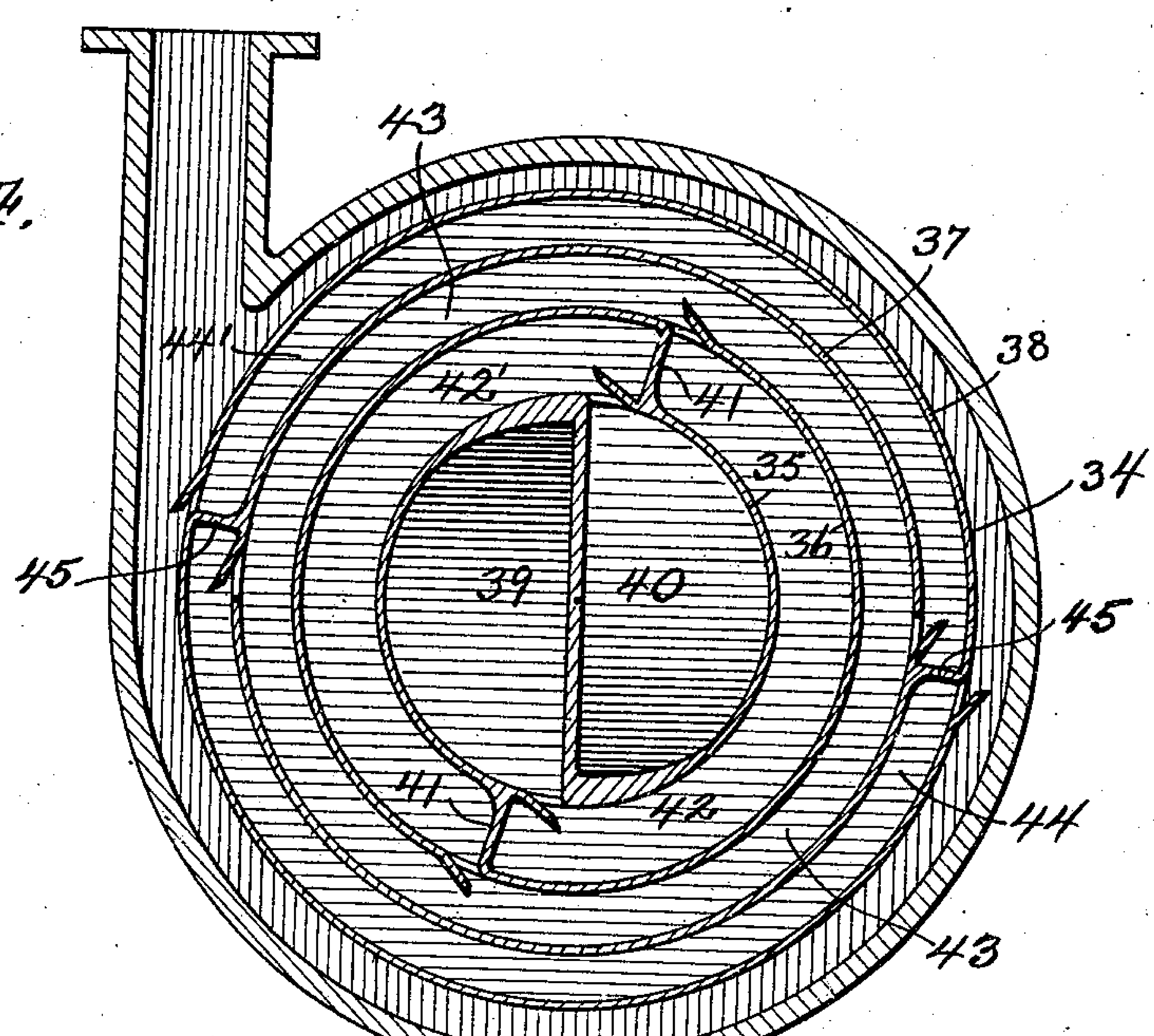


Fig. 4.



Witnesses:

R. J. Jacker

Emilie Rose

Inventor:

Everett W. Brooks

By Albert W. Graves

Atty.

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EVERETT W. BROOKS, OF CHICAGO, ILLINOIS.

CENTRIFUGAL PUMP.

No. 877,484. Specification of Letters Patent. Patented Jan. 28, 1908.

Application filed June 14, 1906. Serial No. 321,604.

To all whom it may concern:

Be it known that I, Everett W. Brooks, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

This invention relates to improvements in centrifugal pumps, and refers more specifically to a multi-stage pump, *i. e.* a pump in which the liquid is passed through a succession of chambers wherein it is successively subjected to the action of impelling blades or members.

The salient object of the present invention is to secure the same general results as are secured in compound centrifugal pumps, viz: to produce a pump capable of delivering liquid at a high pressure or against a high head, and to accomplish this by a simplified and improved construction.

Other objects of the invention are to provide a construction having greater efficiency; to provide a construction which is more compact than a compound pump; and in general to provide an improved pump of the character referred to.

The invention consists in the matters hereinafter described and more particularly pointed out in the appended claims.

The invention will be readily understood from the following description, reference being had to the accompanying drawings, in which—

Figure 1 shows in axial sectional view one embodiment of the invention; Fig. 2 is a sectional view of the pump shown in Fig. 1 taken on line 2—2 of Fig. 1 and looking in the direction of the arrows, and Figs. 3 and 4 are views similar to Fig. 2 of modified construction.

Compound centrifugal pumps, as most usually constructed, embody a plurality of independent casings or chambers arranged side by side with a main shaft extending through the series and an impeller mounted upon the main shaft in each chamber. The delivery passage of the first unit delivers from the peripheral portion of the chamber to the axial portion of the succeeding chamber, and so on successively through the series. With this arrangement it is obvious that the speed of revolution of the several impellers is the same, and since the impellers act successively on the same body of liquid it follows that the amount of acceleration is successively less and less through the several succeeding chambers or stages of the pump. Moreover the liquid tends by centrifugal action to flow radially outward at all times, whereas in a pump constructed as described it is deflected radially inward as it is delivered from each chamber to the succeeding one and is thus compelled to flow in a direction the exact opposite from that in which it tends to flow. Still further, the stream of liquid delivered at the periphery of any given chamber is compelled to flow radially inward through passages which are necessarily moving at a lower rate of speed than the liquid itself because near the axis of rotation, and hence it follows that there is a retarding friction in these passages.

A pump embodying my present invention is designed with a view of obviating these conditions and imparting the necessary flowing head or pressure to the liquid by augmenting its onflow through a series of stages without introducing a retarding effect during its flow from one stage to a succeeding one. The manner in which this is accomplished will be apparent from the following description of constructions embodying the invention.

Referring to Figs. 1 and 2, 1 designates as a whole a suitable stationary casing which is internally of approximately cylindric form and provided at its periphery (at its upper side in the present instance) with a tubular extension 2 constituting the delivery pipe. The casing is desirably provided at its lower side with a base 3 whereby it may be mounted and held in stationary position. At one side, the casing is provided with an axial hollow hub-like extension 4 through which is arranged to extend, and within which is journaled, the main shaft 5 carrying upon its inner end the piston or impeller 6. At its opposite side the casing is provided with a tubular axial extension 7 adapted to be connected with a suitable supply pipe 8, through which the liquid enters the pump axially.

The impeller 6 consists of a hollow cylindric shell, the main body of which is of an axial length slightly less than the internal axial length of the pump chamber, provided with an axial inlet opening 9 which registers with the opening of the inlet extension of the casing, and divided internally into a plurality of chambers, as will now be described. In the pump shown in Figs. 1 and 2, the interior of the impeller is divided by a single cylindric partition 10 concentric with the axis of rotation of the impeller and of such diameter that the cylindric space within the impeller outside of this partition 10 is of somewhat less capacity than the space inclosed by it. The inner cylindric chamber thus formed is subdivided by a transverse radially disposed partition 11 which forms in effect a pair of radial impeller blades. Coincident with the points where the front faces of the impeller blades (considered with reference to the direction of rotation) merge into the cylindric partition member 10, are formed narrow axially elongated ports 12 leading into the annular outer chamber of the impeller, and these ports are overhung by deflecting lips 13 which extend approximately tangential to the wall 10, of which they form in effect extensions.

The end walls 14 and 15 of the two central chambers 16 and 16′ of the impeller, which are opposed to the inlet end thereof, are shaped to conform approximately to the shape which the two streams of liquid passing through these chambers will assume; these end walls being each, to this end, curved and inclined from the corner or angle where the rear face of the impelling blade or partition 11 meets the cylindric wall 10 at the inlet end of the impeller to the diagonally opposite angle at the end of the throat opening remote from the inlet side of the impeller, as shown clearly in Fig. 1.

The annular space of the impeller formed between the partition member 10 and the outer cylindric wall 6′ of the impeller is subdivided by means of radial partitions or impeller members 17 and 18 arranged in diametrically opposite relation, and from the two outer chambers 19 and 19′ thus formed lead elongated slot-like ports 20, located just in advance of the impeller members 17 and 18, respectively, and overhung by deflecting lips 21 constructed and arranged generally like the lips 13. The internal diameter of the casing is sufficiently larger than the external diameter of the impeller to provide an annular discharge space 23 having a combined capacity preferably somewhat less than the capacity of the two chambers 19 and 19′ of the impeller. Desirably, and as shown herein, the axis of the impeller is located slightly eccentric from the center of the cylindric outer casing; the arrangement being such that the annular passage 22 is of gradually increasing capacity from the angle 23 where the outlet extension 2 merges into the casing, around the exterior of the impeller to the ejector outlet 2′. The partition or vane member 11 is provided with an extension 11′ which projects into the inlet passage of the pump casing, as seen clearly in Fig. 1.

The operation of the pump constructed as described is obvious but may be briefly stated as follows: The cylindric stream of liquid entering through the supply pipe is divided by the extension 11′, the respective halves thereof entering the two primary chambers 16 of the impeller. While passing through these chambers the liquid is carried around bodily with the impeller, thus acquiring centrifugal force and eventually escaping out through the ports 12 into the secondary chambers 19 and 19′. In this connection it is to be noted that the ports 12 are made of such restricted area that they are at all times efficiently sealed by the outflow of the liquid therethrough; the size of the ports being modified to correspond to the rate of speed at which the pump is to be driven and the head against which it is to pump. The liquid is obviously transferred from the primary chamber 16 to the secondary chambers 19 and 19′ of the impeller without retardation so far as its rotation bodily is concerned, and arriving in these latter chambers it is here, as in the primary chambers, subjected to the centrifugal action imparted thereto by the rotation of the impeller. That is to say, the partitions or impeller vanes 17 and 18 insure the continuous bodily rotation of the body of liquid within the impeller. Nevertheless the liquid after passing through the ports 12 must flow a considerable distance around the interior of the chambers 19 and 19′, respectively, before it reaches and passes through the ports 20 leading to the discharge space 22 within the casing. This retention of the liquid within the impeller enables a relatively large amount of centrifugal force or energy to be imparted to the liquid while passing through this second stage of the pump, and the amount of this force is augmented by reason of the fact that the peripheral speed of the outer chambers is obviously materially higher than the peripheral speed of the inner chambers. The result of the construction is that the liquid is delivered from the pump chamber at a higher pressure than would be the case were an impeller used of the same diameter without the subdividing annular partition 10 for the reason that because of the retardation of flow incident to the liquid passing through the series of ports, and through the tortuous course which it must pursue, the impeller may be rotated at a relatively higher speed without overspeeding the pump, with its incident disadvantages.

In Figs. 3 and 4 the principle disclosed in Figs. 1 and 2 is still further developed.

In Fig. 3, the impeller, designated as a whole 24, is internally subdivided by two cylindric partition members 25 and 26; the innermost space is subdivided into two chambers 27 and 27′ substantially as in Figs. 1 and 2; the space immediately outside of these chambers forms an annular chamber

28 without partitioning vanes, and the outermost annular space is divided by vanes 29 and 29′ into two chambers 30 and 30′. Ports 31, 31, 32, 32 and 33, 33 afford communication between the several chambers and the discharge space within the outer casing; these ports being arranged generally as in the previously described construction.

In operation the liquid from the primary chambers 27, 27′, is delivered into the annular chamber 28 wherein, while neither retarded nor accelerated by the presence of vanes, it is nevertheless carried around bodily with the impeller and at the same time progresses through this annular chamber and out through the ports 32. It is the function of this annular chamber unprovided with vanes to retard the flow of the liquid through the impeller as a whole in so far as it accomplishes this function passively, *i. e.*, without presenting any obstruction to the flow of the liquid, and which would, of course, mean loss of power. By reason of the fact that the liquid is thus retained in the impeller during the longer period required for it to pass through the chamber 28, a larger amount of centrifugal force may be imparted to the liquid before it issues through the ports 32 into the succeeding and final stage of this piston. In the two chambers 30 and 30′ it is again positively carried around with the piston by the impelling action of the blades or partitions 29, 29′, and finally issues into the discharge chamber through the ports 33. In this embodiment of the pump a higher pressure may be induced than in that shown in Fig. 1, for the reason that the flow of the liquid through the impeller is more effectively retarded and the discharge ports more effectively maintained sealed.

In the embodiment shown in Fig. 4, the piston designated as a whole 34 comprises, as in the former constructions, a plurality of concentric partitions, designated 35, 36, 37 and 38, respectively; the central space being subdivided by a diametrically disposed vane member into two primary chambers 39 and 40 substantially as in the last described construction. The next concentric space is subdivided by vanes 41 into two chambers 42 and 42′, which in turn discharge into an annular chamber 43 unprovided with vanes and corresponding to the chamber 28 of the pump shown in Fig. 3. Chamber 43 discharges into the outermost annular space of the piston, which is divided into two chambers 44 and 44′ by means of partition vanes 45.

The operation of this pump is obviously closely analogous to that of the pump shown in Fig. 3; the only difference being that an additional stage is added to the piston or impeller.

From the foregoing it will be understood that the invention is not specific in its character, but on the contrary susceptible of embodiment in constructions differing in details.

I claim as my invention:

1. In a compound-piston centrifugal pump, the combination of a suitable main casing and a compound piston journaled to rotate therein, said piston being internally sub-divided to form alternate chamber-passages the flow-direction through each of which is substantially non-radial, and port passages the flow-direction through which is radial, said port passages being arranged to afford communication between successive chamber passages and between the latter and the discharge space outside the piston and within the casing, one or more radially extending impelling walls in the primary chamber or chambers and suitable radially extending impelling walls in one or more of the succeeding chambers.

2. In a compound-piston centrifugal pump, the combination of a suitable main casing and a compound piston journaled to rotate therein, said piston consisting of a hollow shell-like member internally sub-divided to form alternate chamber passages the flow-direction through each of which is substantially non-radial and port passages the flow-direction through which is radial, said port passages being of restricted size and arranged to afford communication between the discharge and receiving ends of successive chamber passages and between the latter and the discharge space outside the piston and within the casing, one or more radially extending impelling walls in the primary chamber or chambers and suitable radially extending impelling walls in one or more of the succeeding chambers.

3. In a compound-piston centrifugal pump, the combination of a suitable main casing, a hollow shell-like piston journaled to rotate in said casing, one or more annular partition members arranged concentric with the axis of rotation of the piston and dividing the latter into a central primary chamber space and one or more annular radially outer chamber spaces, one or more impelling blades within said primary chamber, one or more radially extending impelling walls subdividing one or more of said annular chambers, and means for rotating said piston, said piston being provided with an axially disposed or approximately axially disposed inlet, with one or more restricted ports leading from the primary chamber space to the circumferential chamber space, and with one or more restricted ports leading from the outer chamber space or spaces through the shell of the piston to the discharge space within the main casing, said latter discharge ports being circumferentially offset relatively to the ports affording communication between said

chambers, whereby the liquid is compelled to traverse in a non-radial direction a substantial portion of the circumferential length of the outer chamber space before escaping from the latter.

4. In a compound-piston centrifugal pump, the combination of a suitable main casing having a main chamber approximately circular interiorly, a main shaft journaled to extend axially into said casing, a compound piston mounted upon said main shaft within said casing, said piston consisting of a hollow shell-like structure sub-divided by radial and circumferentially extending partitions into a plurality of axially disposed primary ore receiving chambers, and a plurality of radially outer, concentrically disposed annular or parti-annular chambers, said primary chambers being each provided with one or more restricted peripheral ports leading into the corresponding radially outer chamber, and said latter chambers in turn provided with one or more restricted peripherally disposed discharge ports, located circumferentially-remote from the ports through which the liquid enters them.

5. In a compound piston centrifugal pump, the combination of a suitable main casing having a main chamber provided with a peripheral discharge outlet and an axially disposed inlet, a main shaft journaled to extend into said casing in alinement with said inlet, a compound piston mounted upon said main shaft within said casing, said piston consisting of a generally cylindric hollow shell-like structure interiorly subdivided by one or more partitions concentric with the axis thereof, and by one or more radially extending partitions, into a plurality of axially disposed primary or receiving chambers and a plurality of radially outer concentrically disposed chambers, said primary chambers being each provided with an axially elongated slot-like peripheral port leading into a corresponding radially outer chamber, and said outer chambers being each in turn provided with a restricted peripherally disposed discharge port.

6. In a compound piston centrifugal pump, the combination of a suitable main casing, a piston journaled to rotate therein, said piston consisting of a hollow shell-like structure subdivided into one or more primary axially disposed receiving chambers, and a continuous unobstructed annular chamber surrounding said primary chamber or chambers, and an impelling blade arranged to extend within said primary chamber or chambers, said primary chamber or chambers being provided with peripherally disposed restricted outlets and said annular chamber being also provided with one or more restricted peripheral outlets.

7. In a compound piston centrifugal pump, the combination of a suitable main casing forming a main chamber, a main shaft journaled to extend into said casing, a compound piston mounted upon said main shaft within said casing, said piston consisting of a hollow shell-like structure subdivided internally by a plurality of annular, concentrically disposed, spaced apart partitions, one or more radial partitions subdividing the interior of the central space of said piston into a plurality of primary receiving chambers, other radial partitions subdividing one or more of the outer annular spaces of said piston into a plurality of outer chambers, one of the annular spaces between the outermost chambers of the piston and the central chambers thereof being circumferentially continuous and unobstructed, and said piston being provided with restricted ports leading through the peripheral walls of the several chambers.

8. In a compound piston centrifugal pump, the combination of a suitable main casing forming a main chamber, a main shaft journaled to extend into said casing, a compound piston mounted upon said main shaft within said casing, said piston consisting of a hollow shell-like structure subdivided internally by a plurality of annular, concentrically disposed, spaced apart partitions, one or more radial partitions subdividing the interior of the central space of said piston into a plurality of primary receiving chambers, other radial partitions subdividing one or more of the outer annular spaces of said piston into a plurality of outer chambers, one of the annular spaces between the outermost chambers of the piston and the central chambers thereof being circumferentially continuous and unobstructed, each of the chambers of said piston being provided with an inlet opening and with a restricted peripheral outlet opening or port, the inlet opening and the outlet opening of each of the said chambers except the primary chambers being circumferentially offset, whereby the liquid is compelled to progress throughout the greater part of the circumferential length of each of said chambers in its passage therethrough.

EVERETT W. BROOKS.

Witnesses:

ALBERT H. GRAVES,

EMILIE ROSE.