H. A. J. DE BIJLL NACHENIUS.
CENTRIFUGAL PUMP.
APPLICATION FILED AUG. 21, 1917.

1,298,248.

Patented Mar. 25, 1919.
5 SHEETS—SHEET 1.

Fig: 1.

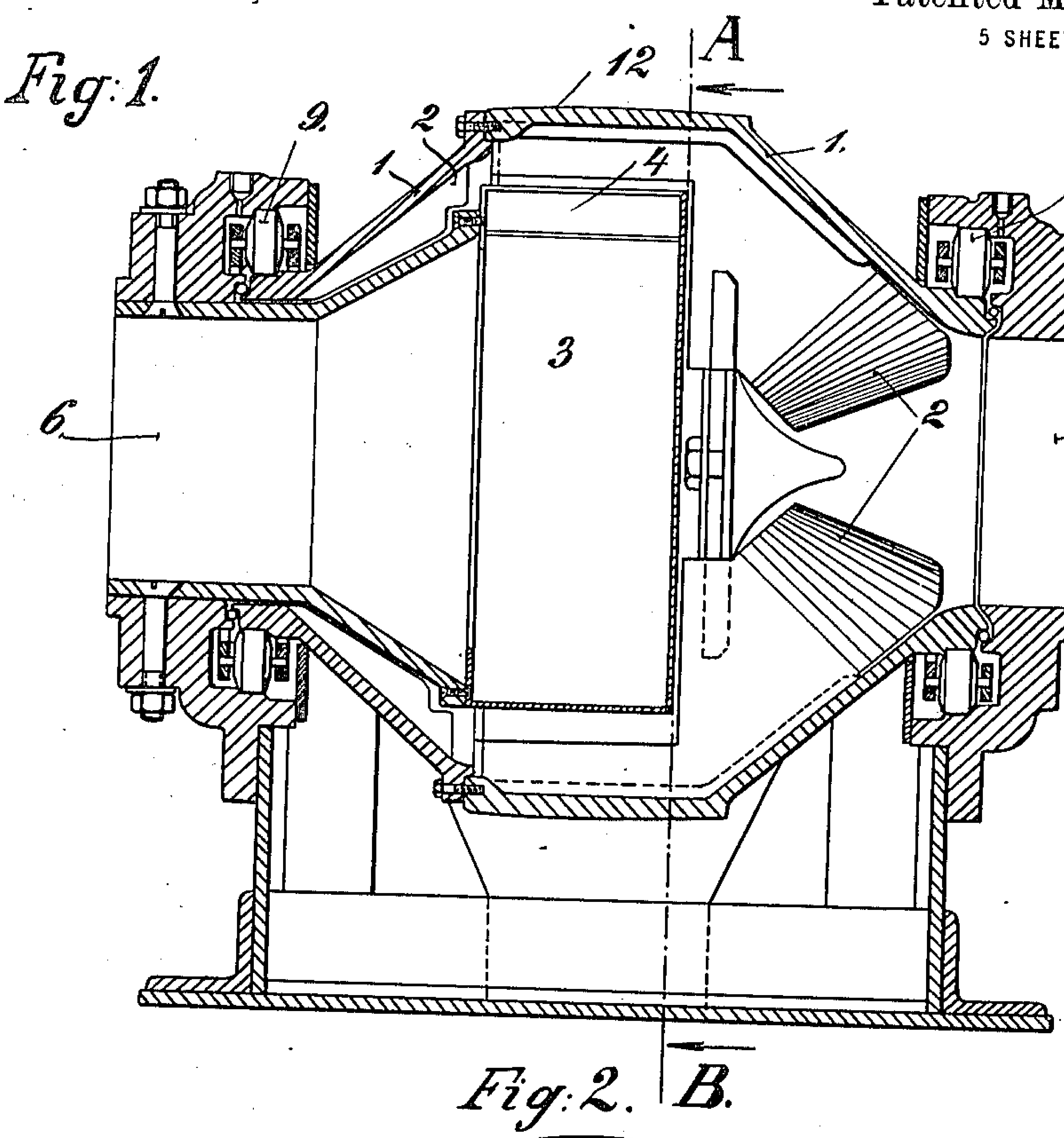

Fig: 2.

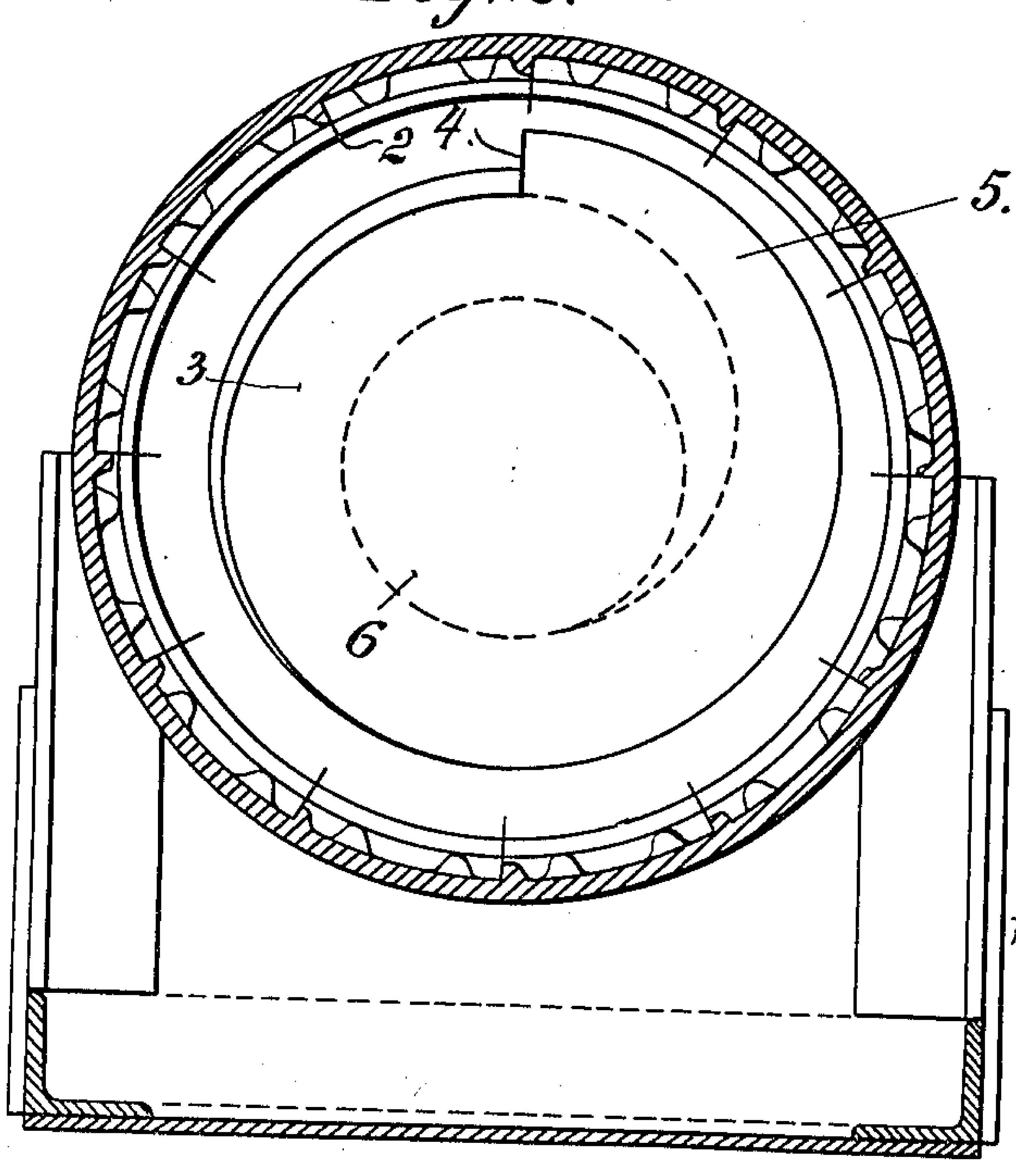

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FIG. 3

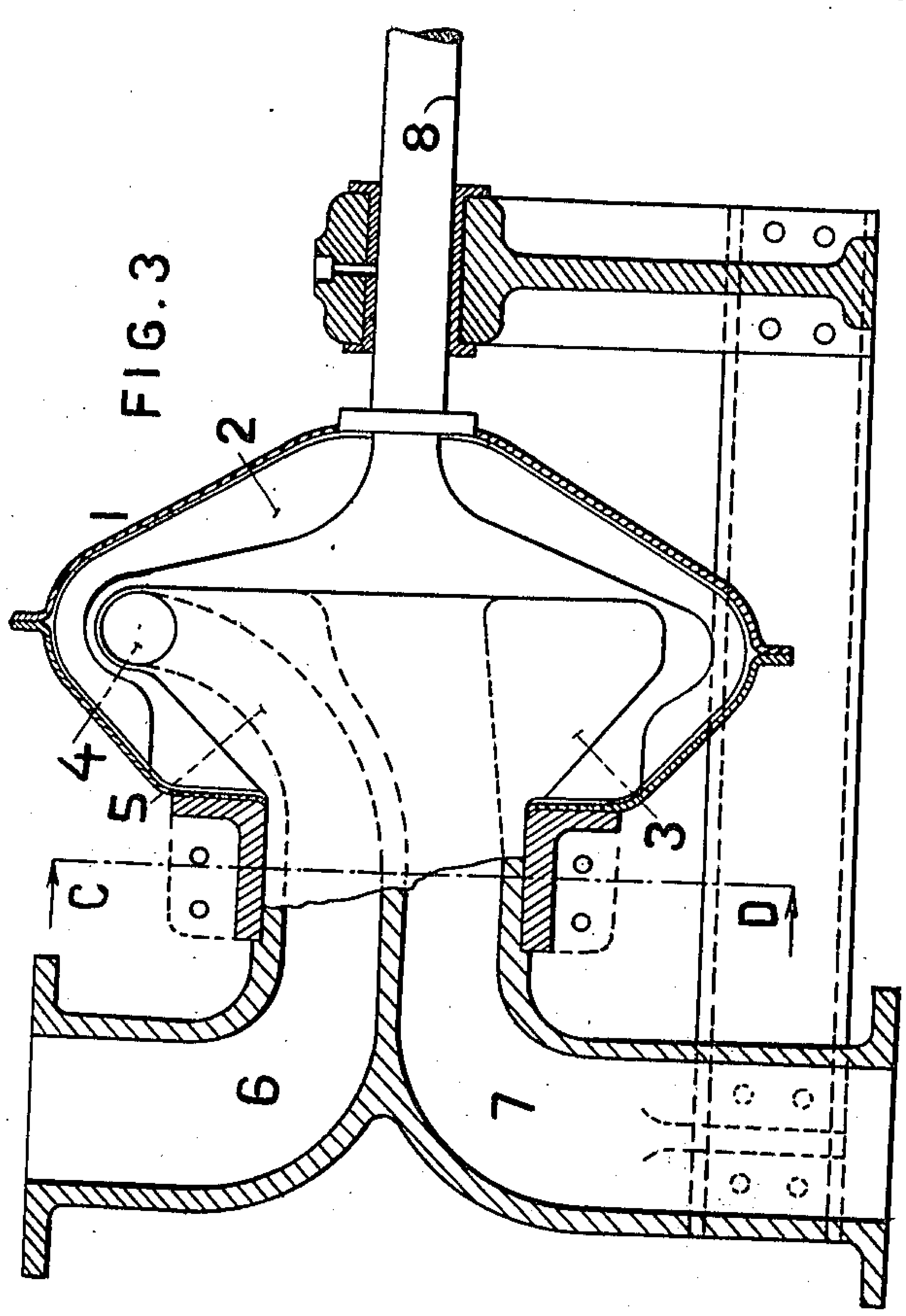

FIG. 4.

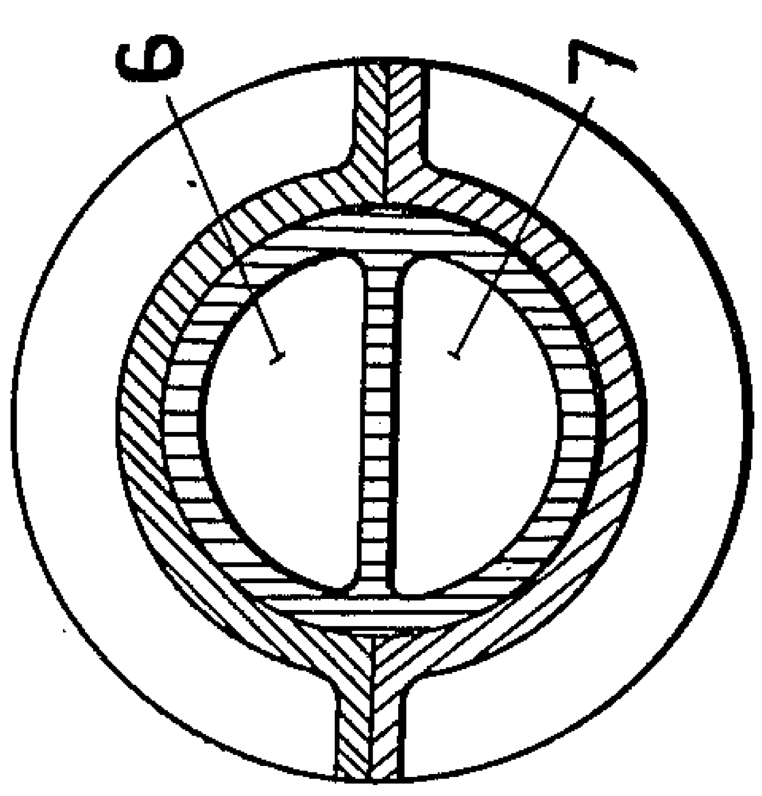

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Fig 6

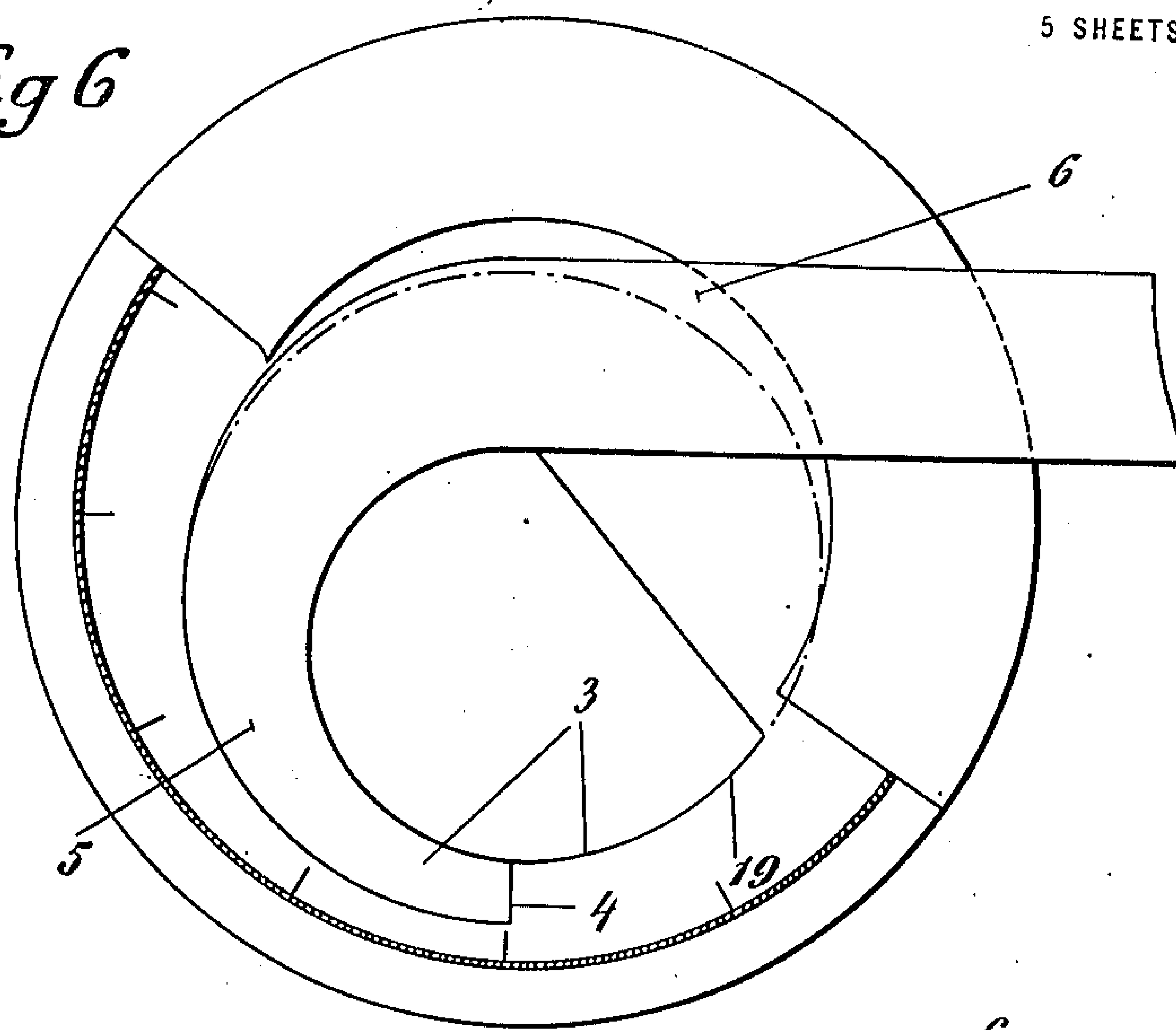
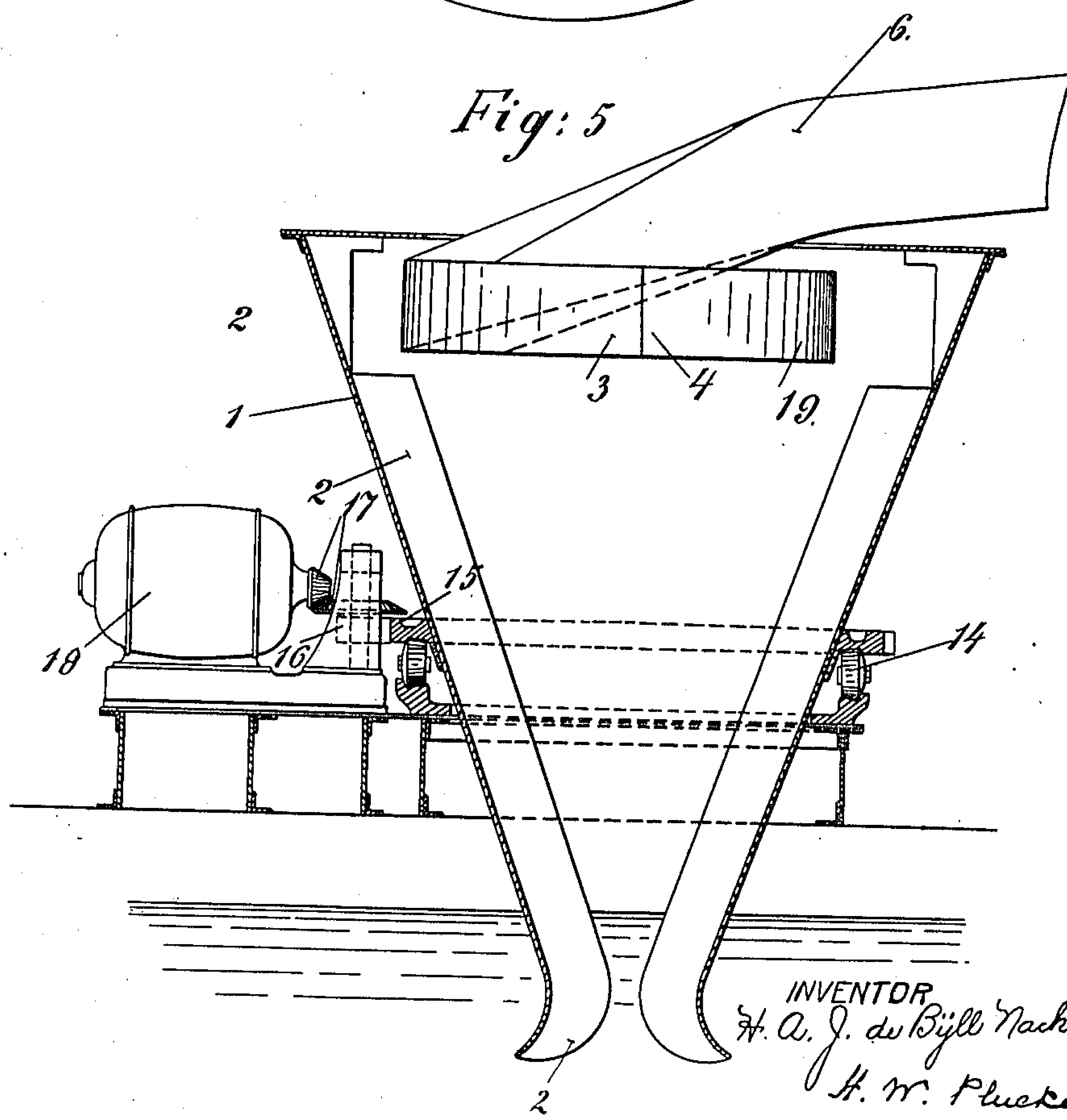


Fig: 5



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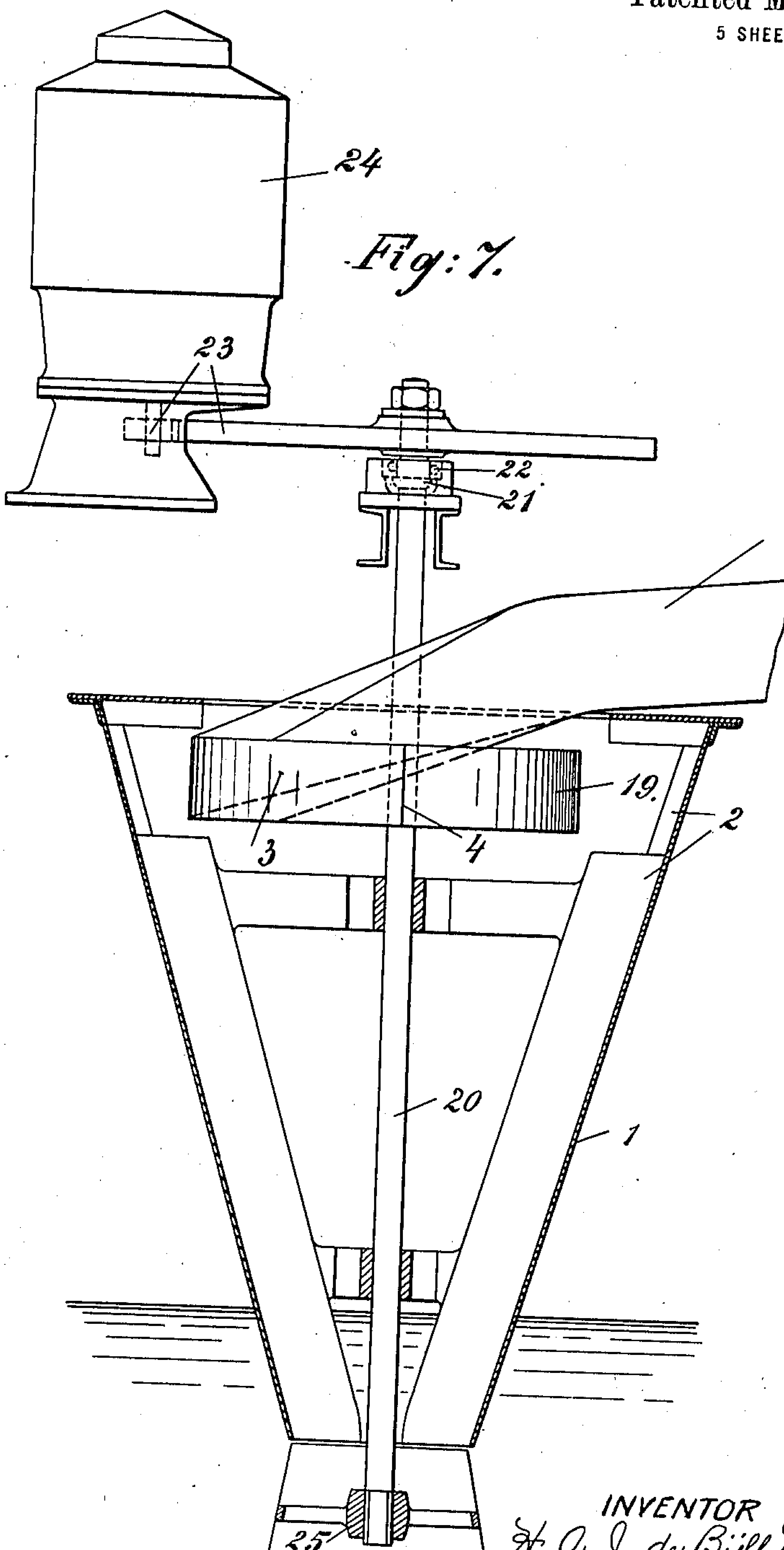

Fig: 7.

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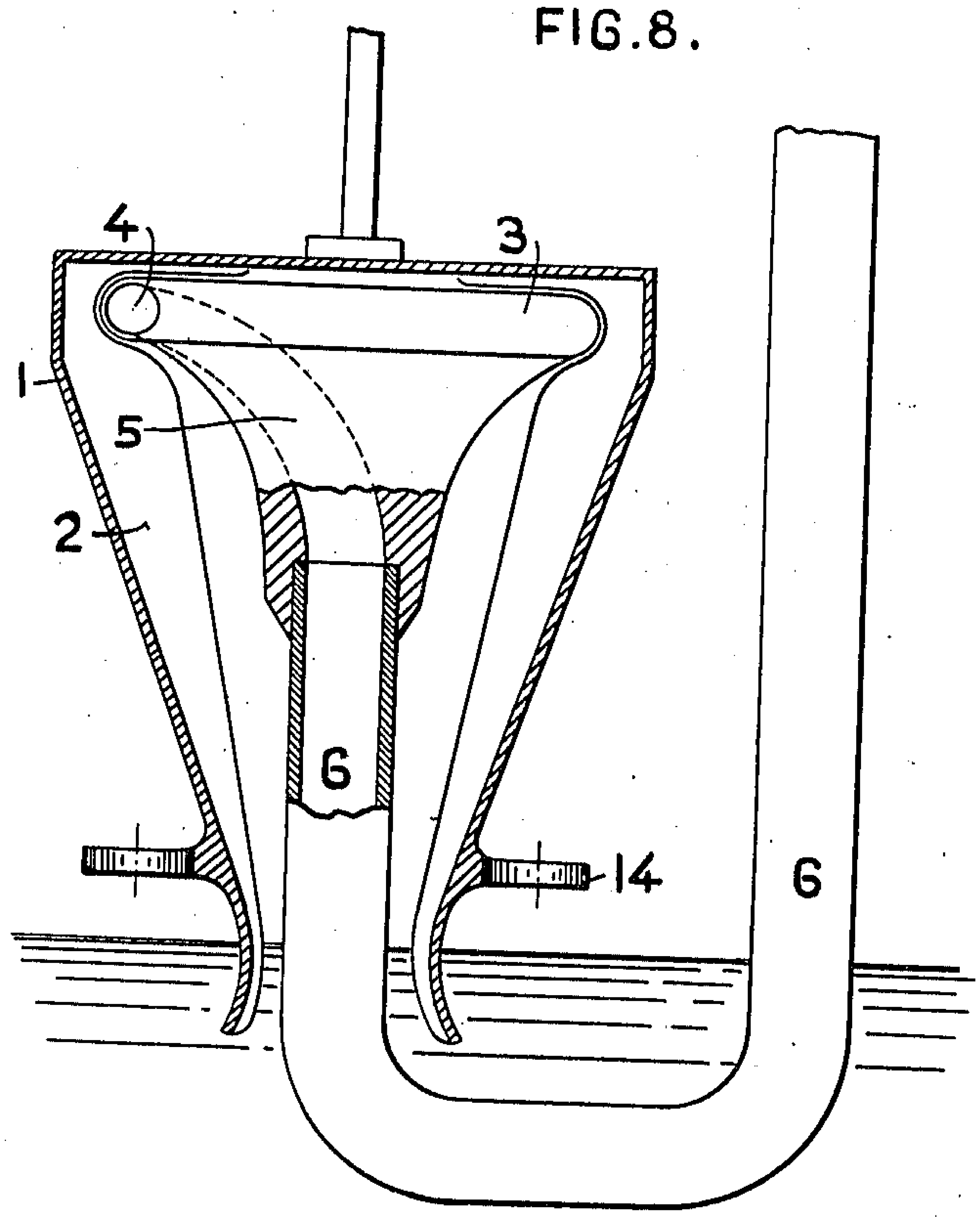
5 SHEETS—SHEET 5.

FIG. 8.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL PUMP.

1,298,248. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed August 21, 1917. Serial No. 187,505.

To all whom it may concern:

Be it known that I, Henri Arnold Johannes de Bijll Nachenius, a subject of the Queen of the Netherlands, and residing at 159 Schotersingel, Haarlem, the Netherlands, have invented certain new and useful Improvements in Centrifugal Pumps, of which the following is a specification.

The present invention relates to improvements in centrifugal pumps having their axes arranged horizontally or vertically, of the kind in which the casing rotates and operates as an impeller, while the delivery branch is stationary.

From the well-known pumps of this kind the pump according to the present invention is distinguished by its peculiar construction, partly from well-known, partly from new details.

This invention has for its object to generally improve the efficiency of pumps of this kind by improving the translation of kinetic energy into pressure and by reducing the losses due to shocks.

Practice has shown that this may be realized in the most perfect way with a pump consisting broadly of a casing rotatable about its axis and operable as an impeller, in combination with a stationary pressure branch and a stationary delivery guide body of particular construction arranged within the pump casing. This guide body is, at its periphery, provided with one or more delivery openings, placed so that the liquid enters these openings in a tangential direction with relation to the periphery of the guide body. Furthermore the guide body has at its circumference, a guide surface or surfaces for the water, leading the latter to the delivery openings under avoidance of losses due to shocks and with the least possible friction. The most suitable shape of guide body is that of the snail shell, in which the periphery is curved evenly along a spiral line. In special cases, particularly in pumps with vertical axes it appears often sufficient to supply in front of each delivery opening a guide wall of a suitable shape to catch the liquid rotating with the casing under avoidance of shocks and to guide said liquid to such delivery openings. This wall, therefore, is not, as is the case with the periphery of a snail shell unbroken; it should be noted, however, that said wall should extend over a sufficient length to catch the liquid without shocks.

I am aware that centrifugal pumps having a rotating casing operating as an impeller, in the interior of which a stationary delivery branch is arranged, the mouth opening of said branch being placed so that the water enters this branch in a tangential direction are known. The branch is trunk shape with the result that water flowing past the mouth opening of this trunk runs against the rear parts of said trunk or flows along the surface of the trunk and causes eddy currents, thus materially raising the hydraulic losses.

I am also aware that a centrifugal pump has been proposed, having a stationary delivery branch and a guide body connected to said branch and arranged within the casing, said delivery branch being provided at its periphery with a number of delivery openings. This delivery body has, however, a circular circumference, the openings being situated in a cylindrical wall and are, therefore, so arranged that the liquid can never enter the openings tangentially in the body. This results to losses which also appear when making use of this kind of delivery body.

Practice has shown that only in a pump with a rotating casing, comprising in combination all the above mentioned features, can an efficiency be obtained equaling that of the usual centrifugal pumps with stationary casing.

The efficency obtained with a pump constructed in accordance with the principle of the invention is in fact at least equal to that of the last mentioned pumps of modern design and it is only after this result has been obtained that the remaining advantages presented by a rotating casing operating as an impeller, can be realized. These advantages are: 1. simple construction, small dimensions and small weight; 2. the velocity of the water along the impeller blades and, as a result thereof, the losses in the rotating casing are very little indeed owing to the large passage; 3. the losses at the discharge of the water from the casing due to the difference in pressure and direction of flow at the front and the back of the blades are eliminated; 4. gap losses are avoided; 5. no axial pressure is acting on the shaft or it may easily be eliminated; 6. pumps constructed in accordance with the principle of the invention are especially adapted for pumping dirty or sandy water, owing to the practical absence of friction and wear a longer duration of life can be guaranteed than with the usual pumps with stationary casing; 7. in certain cases the blades may be omitted entirely.

To this I add the advantages of the pump according to the present invention, consisting in that the delivery body receives the most suitable shape with respect to friction (an even, small, smooth surface or guide walls) while the delivery openings are small in number and arranged so as to allow the liquid to enter said body tangentially thus avoiding all losses due to shocks.

In construction the pump according to the present invention may be so designed that also the mechanical friction losses, for instance at the points where the suction and delivery branches enter into the casing or are connected to same are reduced to a minimum. This object is, for example, attained by arranging the suction and delivery branches at the same side of the rotating casing, while the driving shaft is situated at the opposite entirely inclosed side of the casing. In this construction no special means for rendering the branch connection tight against the suction of air need be provided, while both branches may be combined to constitute a cylinder body at the place where they enter the casing.

A further feature according to the invention which improves the efficency consists in one or a plurality of delivery passages in the guide body of gradually increasing sectional area from the delivery opening or openings at the periphery of the body to the suction branch. By this means the kinetic energy of the liquid at the periphery of the guide body is gradually transformed into pressure.

In combination with the main features of the invention as alluded to above these features materially assist in acquiring considerable improvements in the mechanical efficiency of my pump.

Further features of my pump are explained hereinafter and are illustrated in the accompanying drawings, showing a number of pump constructions.

The pump according to the invention may be arranged with its axis horizontally or vertically to suit local conditions.

Figure 1 is a longitudinal section of a pump with horizontal shaft in which the suction and delivery branches are placed axially.

Fig. 2 shows the same pump in cross section through the line A—B in Fig. 1 viewed in the direction of the arrows.

Fig. 3 shows schematically in longitudinal section a pump in which the suction and delivery branches are situated on one side of the casing, the latter being driven from the opposite side.

Fig. 4 is a cross section of the branch through line C—D in Fig. 3 viewed in the direction of the arrows.

Fig. 5 represents in vertical cross section an embodiment of the invention with vertical axis and having its casing extending below the water level. This embodiment is especially adapted for use in cases where the provision of a shaft within the casing presents difficulties.

Fig. 6 is a plan view of the pump casing and delivery body of the pump according to Fig. 5, in which the top wall is partially cut away.

Fig. 7 illustrates an embodiment of the invention having its shaft arranged vertically and extending through the whole length of the casing.

Fig. 8 illustrates a similar pump in which the delivery branch goes through the suction opening.

Like characters indicate like parts all through the drawings.

The rotating casing 1, constructed of two halves, is of cast iron, sheet steel or any other suitable material. On the inner wall blades 2 are provided, spaced apart over the periphery, said blades being of such a shape as to partially embrace a guide body 3. This guide body 3 is, as said above, constructed so that losses due to friction and shocks are reduced to a minimum and the liquid enters the delivery openings tangentially. The most suitable form is the snail shell form illustrated in Figs. 1 and 2, being provided with one or more mouth openings 4. In the embodiment according to the drawing the body has one single mouth opening, disposed in a direction opposite to the direction of flow of the water. To this opening 4 the guide passage 5 is connected, which through a discharge body 3 leads to the discharge or delivery branch 6, arranged centrally in Figs. 1 and 2. In order to reduce the wear, which is most severe around the opening 4, as much as possible said opening can be formed in an exchangeable hardened steel mouth piece, while the surface of the guide body 3 is rendered as smooth as possible, for instance by enameling said body.

As is plain from the drawing the water is drawn in through the suction branch 7 and is discharged through the delivery branch 6. Owing to the discharge or delivery piping being inclosed from the mouth opening 4, gap losses are eliminated. The discharge passage 5 is funnel shaped from the mouth opening to the delivery branch 6 and of increasing sectional area with the object of gradually transforming the kinetic energy of the water into pressure and reducing the velocity at the periphery of the guide body 3 to the velocity required in the delivery piping. In the pump according to Figs. 1 and 2 no axial pressure is acting on the shaft as long as the tube 7 is of equal size with tube 6. In the embodiment illustrated in Fig. 3, however, such axial pressure is acting. In this case also the suction piping 7 is led through the guide body 3 and the casing 1 therefore has a large opening at one side, being entirely inclosed at the opposite side where it is driven by the shaft 8. Otherwise this embodiment corresponds in principle with that of Figs. 1 and 2.

The casing of the pump shown in Figs. 1 and 2 rotates on roller bearings 9 and 10 through which the discharge and suction water pass. In order to prevent air from being drawn in some packing means is provided at the suction side.

At the delivery side of the pump according to Fig. 1 or at the point where in the pump according to Fig. 3 the combined suction and delivery branches enter the casing means for preventing air from being drawn in is superfluous, because it is here immaterial whether the pressure of the water is greater or less than that of the atmosphere. Even in case the water pressure should be less than the atmosphere and air should tend to enter the casing this air could never reach the periphery of the delivery body 3.

If the pump operates under small suction heights or even receives water under pressure, the pressure of the water within the casing at the periphery of the delivery branch in a pump according to Fig. 1 or at the periphery of the combined suction and pressure branch in a pump according to Fig. 3 would considerably exceed the pressure of the atmosphere and tend to flow off. To avoid this the gap between the branch and the hub of the casing is kept as small as possible and the bore of the hub may be provided with threaded grooves so arranged that any water tending to flow off is constantly screwed back into the casing by the threaded grooves thereby acting as labyrinth packing. The pump may be driven in various ways. In the pump illustrated in Fig. 1 for instance the casing serves as a belt pulley, the belt running on the periphery 12 of the casing 1; the latter, however, may also be driven by an electric motor especially designed for the purpose, the motor being designed to fit on the casing. In the embodiment according to Fig. 3 the shaft 8 may be driven in any suitable well-known manner.

Figs. 5, 6, 7 and 8 represent embodiments of the invention with vertical axes, which pumps are especially adapted for draining-mills. The casing 1 decreases in sectional area in the direction of the bottom and extends below the water level. In this funnel shaped casing also the blades 2 reach below the water level and force the water within the casing upward. The casing according to Fig. 5 is just above the water level fitted out with a toothed brim 15 coöperating with a pinion 16, driven by the electric motor 18 through a bevel gearing 17.

The casing is supported and guided by roller bearings 14. In the pump according to Figs. 5 and 6 the casing is open at the top to allow the delivery branch 6 and the delivery guide body 3 to be placed in position. In this construction of guide body the delivery branch 6 gradually attains the shape of the guide body 3. The snail shell form of body 3 is here abandoned and replaced by a trunk shaped branch. The latter, however, in contrast with well-known trunkshaped delivery branches, is constructed so that the rotating liquid column is caught by a guide wall and under avoidance of shocks guided to the discharge opening, the discharge opening in a well-known manner being so arranged that the liquid enters the body tangentially with respect to the trunk surface. In Fig. 6 this guide wall is indicated by 19. The curvature is so chosen that if the wall were further extended it would end in the outer periphery of the curved portion of the trunk, as is clear by the dot-dash line in Fig. 6.

It is evident that also in this case a snail shell, having a plurality of discharge openings 4 at its periphery might serve the purpose. The advantages presented by these pumps over well-known pumps of this kind are the same as connected with pumps having their axes arranged horizontally. Besides, with respect to the well-known pumps with vertical axes, the efficiency is here increased by the provision of the roller bearing 14 just above the water level by which a smooth and light run is secured. The pump of course can be driven in various ways. The driving means illustrated is adapted in cases, where the arrangement of a shaft in the interior of the casing would present difficulties. If, however, the space allows for this, the casing is preferably suspended from the driving shaft and is either at the bottom end, as in the pumps according to Figs. 5 and 8, guided in roller bearings situated just above the water level or it extends, such as in the pump according to Fig. 7 below the water level where it is carried in a guiacum wood bearing.

The way of driving the pump illustrated in Fig. 7 has the advantage of the better mechanical efficiency. In this case the casing 1 is suspended from the shaft 20 which is carried in ball bearings 21 and guided in ball bearings 22. The shaft is driven by means of a single gearing 23 driven by a vertical electric motor 24. At the lower end the shaft 20 runs in a guiacum wood bearing 25. The delivery branch 6 and the guide body 3 are of the construction of the corresponding parts of the pump according to Figs. 5 and 6.

With high speeds the casing 1 is preferably inclosed at the top as has already been proposed. In the well-known pumps of this construction, however, the delivery branch goes through a packing device in the top wall of the casing resulting in considerable friction losses. In the pump according to the invention, schematically illustrated in Fig. 8, however, the delivery branch 6 is led through the lower mouth opening in the casing and partly through the water underneath its level to the delivery piping above this level. This construction has the advantage over the well-known pump constructions in that in slow speed pumps the casing does not require a vacuum being created in the casing. In this case, however, always some air remaining in the center of the casing, it is advisable in high speed pumps of small capacity to create a vacuum in the casing before starting. In this case the pump operates exactly like a pump according to Figs. 1 and 2, the suction height being at least equal to that of other centrifugal pumps.

The pumps illustrated in Figs. 5, 6, 7 and 8 are especially adapted in cases where the suction height is small, such as in draining mills. The height at which the pump should be placed depends upon the diameter and the number of revolutions of the casing.

Having now described my invention, what I claim and desire to secure by Letters Patent is:—

1. In a centrifugal pump, a casing rotatable on its axis, a stationary delivery branch located within the casing and having an axial outlet opening, a stationary guide body having a tangential inlet opening, and a duct extending from the inlet opening to the outlet opening, the wall of the duct being constructed and arranged to gently change the flow of the fluid from a tangential to an axial direction.

2. In a centrifugal pump, a casing rotating about its axis and operating as an impeller, a stationary delivery guide body situated within said casing, a stationary delivery branch connected to said guide body, said guide body having an inlet opening at the periphery thereof arranged in such a manner that the liquid enters said opening in a tangential direction with relation to said guide body, the guide body having a discharge passage which increases in sectional area from said discharge openings to said delivery branch, the guide surfaces of said guide body being arranged to guide the liquid to said discharge opening under avoidance of shocks and with the least possible friction.

3. In a centrifugal pump, a casing rotatable on its axis, a stationary delivery branch located within the casing and having an axial outlet opening, and a stationary guide body having a tangential inlet opening communicating with the outlet opening, the diameter of the passage from the inlet to the outlet openings being gradually diminished.

4. In a centrifugal pump, the combination with a rotary casing having a fluid inlet and a plurality of fluid impelling blades, of a stationary guide body having a fluid receiving opening and a fluid outlet opening, and having the wall extending between the openings constructed and arranged to guide the fluid from the former to the latter under the minimum shock and the least resistance.

5. In a centrifugal pump, the combination with a rotary casing, having a fluid inlet opening, of a snail shell stationary guide body located therein, said guide body having inlet and outlet openings, and means on the casing for forcing the fluid into the inlet opening.

In witness whereof I have hereunto set my hand.

HENRI ARNOLD JOHANNES DE BIJLL NACHENIUS.