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METHOD FOR CONSTRUCTION OF HYDRAULIC TURBINE SPIRAL CASES

Filed Sept. 18, 1963 5 Sheets-Sheet 1

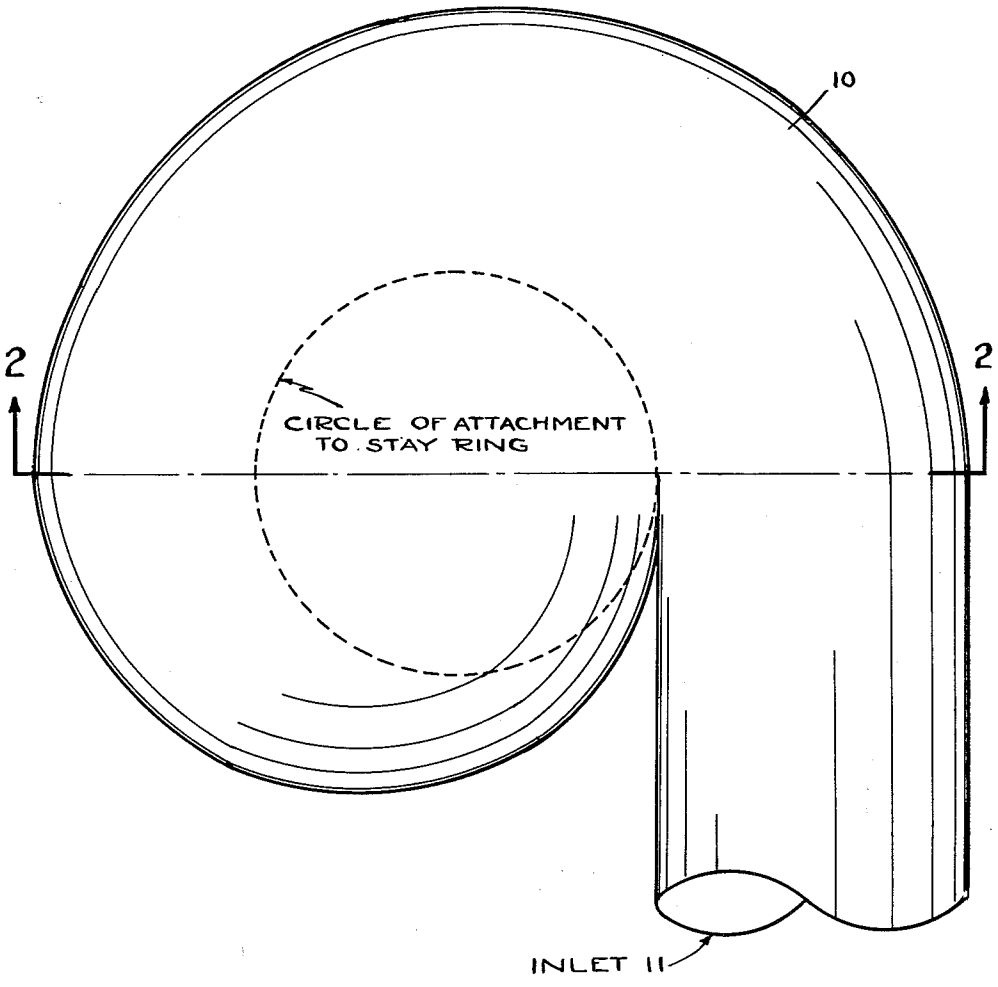


Fig. 1.

INVENTORS.
VICTOR G.M. CHATFIELD
JACQUES A. DESBAILLETS
ROBERT A. NEWEY
BY Raymond A. Paquin
ATTORNEY.

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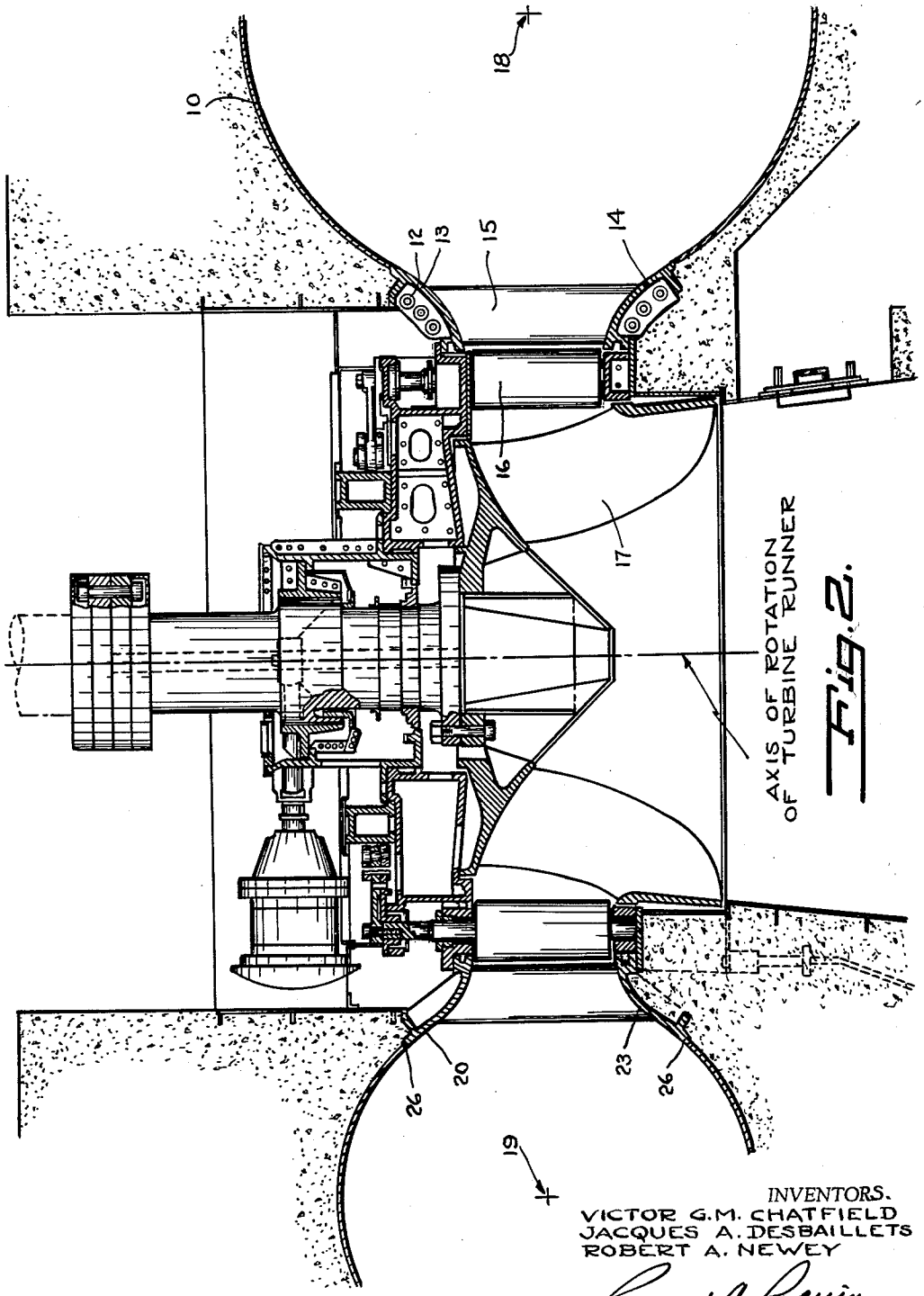


Fig. 2

INVENTORS.
VICTOR G.M. CHATFIELD
JACQUES A. DESBAILLETS
ROBERT A. NEWEY

BY Raymond A. Paquin
ATTORNEY.

June 1, 1965 V. G. M. CHATFIELD ET AL 3,186,685

METHOD FOR CONSTRUCTION OF HYDRAULIC TURBINE SPIRAL CASES

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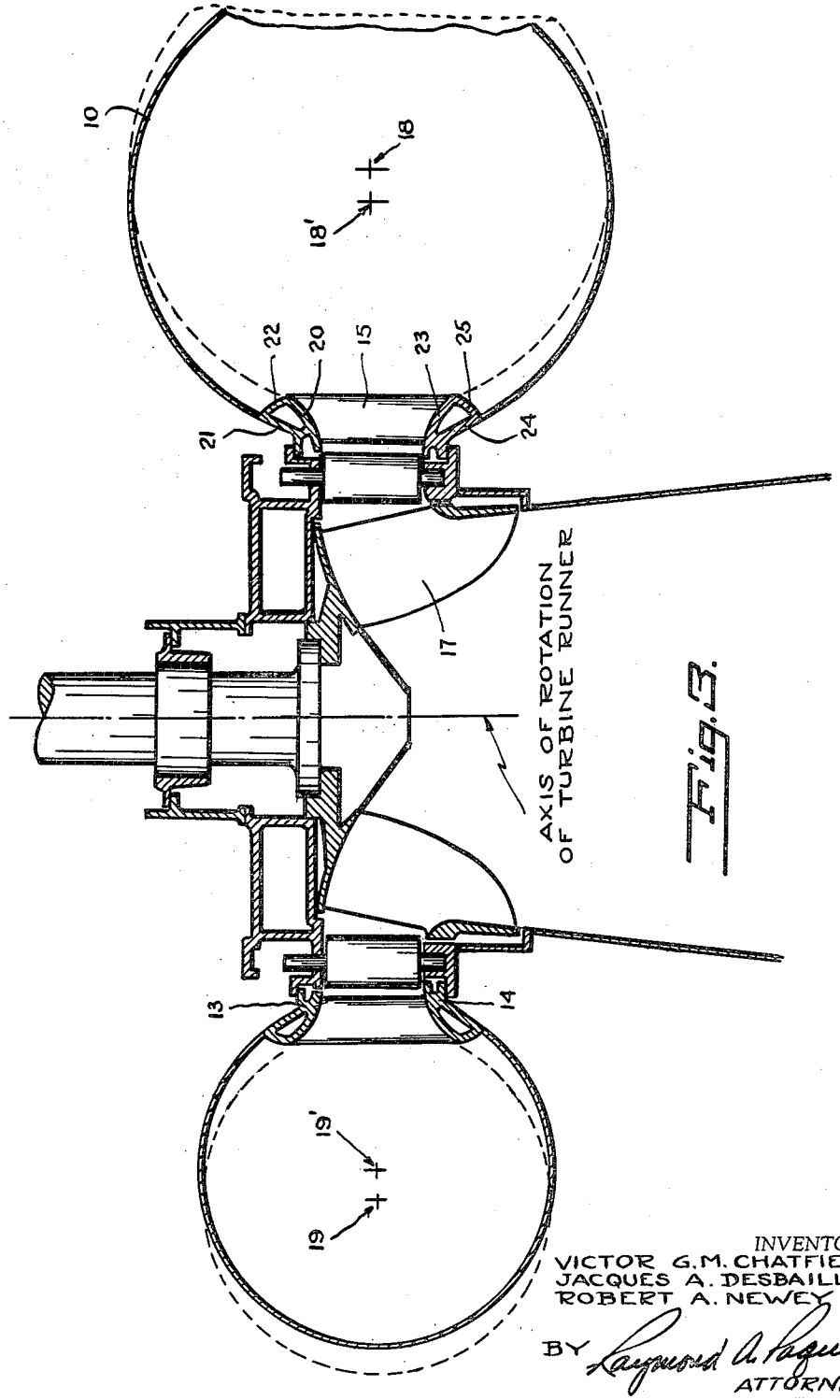


Fig. 3.

INVENTORS.
VICTOR G.M. CHATFIELD
JACQUES A. DESBAILLETS
ROBERT A. NEWEY

BY Laymond A. Paquin
ATTORNEY.

June 1, 1965 V. G. M. CHATFIELD ET AL 3,186,685

METHOD FOR CONSTRUCTION OF HYDRAULIC TURBINE SPIRAL CASES

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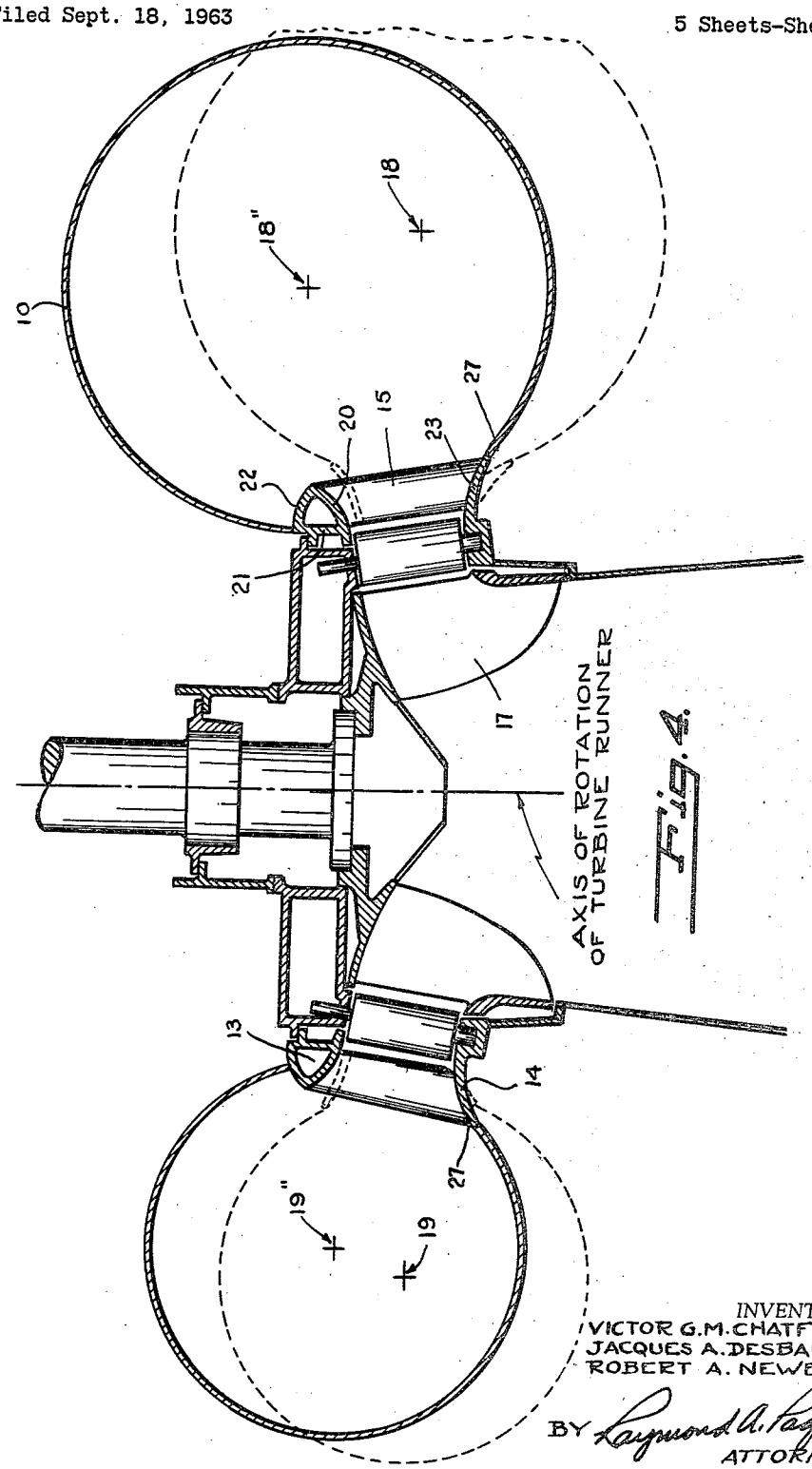


Fig. 4.

INVENTORS.
VICTOR G.M. CHATFIELD
JACQUES A. DESBAILLETS
ROBERT A. NEWEY
BY Raymond A. Paquin
ATTORNEY.

June 1, 1965 V. G. M. CHATFIELD ET AL 3,186,685

METHOD FOR CONSTRUCTION OF HYDRAULIC TURBINE SPIRAL CASES

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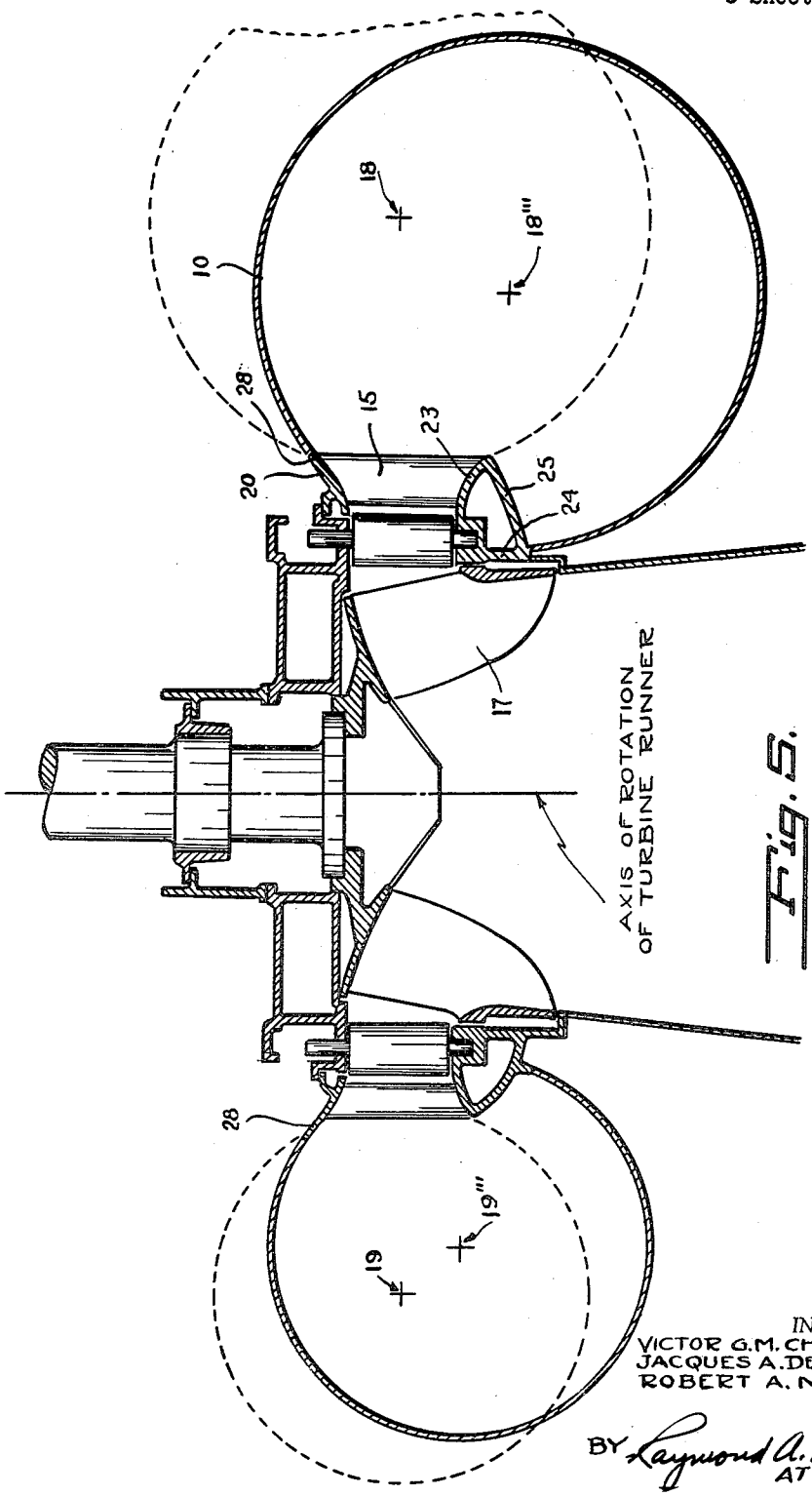


Fig. 5.

INVENTORS.
VICTOR G.M. CHATFIELD
JACQUES A. DESBAILLETS
ROBERT A. NEWEY

BY Raymond A. Paquin
ATTORNEY.

United States Patent Office

3,186,685
Patented June 1, 1965



3,186,685

# METHOD FOR CONSTRUCTION OF HYDRAULIC TURBINE SPIRAL CASES

Victor G. M. Chatfield, Lachine, Quebec, Jacques A. Desbaillets, Montreal, Quebec, and Robert A. Newey, Pointe Claire, Quebec, Canada, assignors to Dominion Engineering Works Limited

Filed Sept. 18, 1963, Ser. No. 309,729
4 Claims. (Cl. 253—26)

This invention relates to hydraulic machines or the like and has particular reference to the provision of new and improved spiral casings for hydraulic machines which are of reduced overall dimensions and improved hydraulic efficiency.

In the operation of conventional hydraulic machines, other than those of the impulse type, water from the spiral casing passes, first, through the stay ring, and then through the wicket gates, which wicket gates and stay ring collectively comprise the distributor, before acting on the turbine runner.

In general, said spiral casing is in the form of a volute. The cross-sectional area at any given section thereof is determined by the amount of water required to flow past that section and the water velocity which it is possible to attain in the casing consistent with a low hydraulic friction loss. Furthermore, the sections of said casing are normally made circular, to utilize to the best advantage the plate that forms the walls.

Conventionally, the median plane of said casing is coincidental with the median plane of the distributor. The radial sections of said casing are of circular form generally tangential to the flared lips of the stay ring.

Conventionally, also, the bore of said stay ring is set to clear the wicket gates and the plate steel volute casing is attached to the outer diameter of said stay ring.

Thus, as the overall dimension of the volute casing, measured substantially at right angles to the penstock and in the median plane, determines the minimum possible spacing between turbine units in a multi-unit power house, this conventional manner of attaching the casing to the outer diameter of the stay ring often results in an undesirably large power house. Furthermore, said attachment method also results in the construction and use of a volute casing requiring an undesirably large amount of material in its construction resulting in unnecessary high cost. Furthermore, the large plate area produces an excessive wetted area resulting in high hydraulic friction.

It is an object of the present invention to provide new and improved volute casings for hydraulic machines which are of reduced overall dimensions.

Another object of the invention is to provide new and improved volute casings for hydraulic machines of the type set forth which are particularly adapted for use in multi-unit power houses where utilization of available space is at a premium such as to permit a closer spacing of said volute casings in said power house.

Another object of the invention is to provide new and and improved volute casings of the type set forth in which the casings are manufactured of a relatively smaller amount of material and are of reduced pitch.

Another object of the invention is to provide new and improved volute casings of the type set forth which are of increased hydraulic efficiency.

Another object is to provide new and improved volute casings of the type set forth which are especially adapted for the reduction of frictional losses.

Other objects and advantages of the invention will be apparent from the foregoing description taken in connection with the accompanying drawings. It will be understood that changes may be made in the details



of construction and arrangement of parts shown and described as the preferred form of the invention has been given by way of illustration only.

Referring to the drawings:

FIG. 1 is an exterior plan view of a conventional spiral or volute casing;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1 looking in the direction of the arrows showing the details of said casing and details of a typical hydraulic turbine or pump-turbine of the Francis type.

FIG. 3 is a sectional schematic view of a typical hydraulic machine of the Francis type incorporating one execution of the invention;

FIG. 4 is a view similar to that of FIG. 3 but showing an alternative execution of the invention; and

FIG. 5 is a view similar to that of FIG. 3 but showing a further execution of the invention.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout. FIG. 1 illustrates a conventional volute casing 10 in plan view.

As shown by FIG. 2, casing 10 is attached to the periphery 26 of stay ring 12, which is comprised of upper shroud 13, lower shroud 14, and a plurality of stay vanes 15. In the operation of the machine, water enters casing 10 through the inlet 11 under pressure and flows around said volute casing. The water is directed by stay vanes 15 to wicket gates 16 and thence to runner 17.

In FIG. 2, the center of casing 10 adjacent or close to the inlet penstock 11 (not shown) is shown as 18; and the center of the casing diametrically opposite 18 is shown as 19.

The present invention reduces the distance between said centers 18 and 19 and permits a closer spacing of units in a multi-unit power house, reduces the physical size of the volute, the amount of material required to construct it, and by requiring that the water follows a shorter path, reduces hydraulic losses.

The present invention, further, reduces the pitch of casing 10 and is characterized by the attachment of the casing 10 to stay ring 12 at a point remote from the fluid guiding surface 20 of stay ring 12, said stay ring being reinforced at this point by a structure substantially triangular in cross-section. Said foredescribed construction may be utilized on both the top shroud 13 and bottom shroud 14 of stay ring 12, or on the top shroud 13 of said stay ring only, or on the bottom shroud 14 of said stay ring only, as will be shown.

With regard to FIG. 3 of the drawings, such illustrates the invention applied to both the top shroud 13 and bottom shroud 14 of stay ring 12. The upper shroud 13 of said stay ring, as shown, comprises fluid guide 20, rib 21 to which rib, casing 10 is attached, and reinforcing member 22 which joins the extremities of said fluid guide and rib and completes a triangle therewith.

The lower shroud 14 of said stay ring 12 is similarly comprised of fluid guide 23, rib 24 to which casing 10 is attached, and reinforcing member 25 which completes the triangle.

Fluid guides 20 and 23 are converging in the radially-inwards direction, such as to effect a transition between the relatively large area of casing 10 and the relatively smaller area of the distributor passage through wicket gates 16.

The center of the inlet section of the casing, which in the conventional construction shown in FIGS. 1 and 2 located at 18, is, due to the construction of the present invention, moved inwardly to 18'. Each section around the volute is constructed in a similar manner such that, for example, center 19 of the section diametrically op-

posite becomes 19', thereby substantially reducing the overall diameter of the volute.

With regard to the form of the invention shown in FIG. 4 of the drawings, such illustrates the invention as applied to the top shroud 13 only of stay ring 12.

Upper shroud 13 of stay ring 12 is constructed, as before, of fluid guide 20, rib 21, and reinforcing member 22. The lower shroud 14 of said stay ring comprises fluid guide 23 only.

Casing 10 is attached to periphery 27 of fluid guide 23 such that there is no abrupt change of direction at this point thus eliminating the need for reinforcement afforded by rib 24 and reinforcing member 25. The center of the inlet section of casing 10 is now located at 18", which is at a lesser radius from the vertical center-line of the machine than 18. Similarly, 19 is now located at 19".

With regard to FIG. 5 of the drawings, such illustrates the invention as applied to the bottom shroud 14 only of stay ring 12. Lower shroud 14 is constructed as described in FIG. 3 and comprises the fluid guide 23, the ribs 24, and reinforcing member 25. The upper shroud 13 is comprised of the fluid guide 20 only.

Casing 10 is attached to the periphery 28 of fluid guide 20 such that there is no abrupt change of direction at the joint, thus eliminating the need for the reinforcement afforded by rib 21 and reinforcing member 22.

The center 18 of the inlet section of the casing 10 is now located at 18''' which is at a lesser radius from the the vertical center-line of the machine than 18. Similarly 19 is now located at 19'''.

From the foregoing it will be seen that we have provided new and improved means for accomplishing all of the objects and advantages of the invention.

We claim:

1. In a hydraulic machine, a volute casing having a wall of arcuate outline in cross-section terminating in a pair of spaced annular edges defining an annular opening at the inside of the volute, a volute lip on said wall at one edge thereof projecting into said casing a minimum distance at the minimum cross-section of the casing and increasing progressively in projection as said cross-section increases, in cross-section said lip appearing in outline in the general shape of a triangle having its base a portion of said casing wall and its two sides curved outwardly from the base and meeting in a curved apex, an annular stay ring located in said annular opening in the casing, said annular edges of the casing being united with said stay ring adjacent the peripheral edges



thereof, and said stay ring having a plurality of spaced vanes projecting therefrom into the casing to said apex and extending from said lip to the casing wall adjacent the other edge thereof, said casing, lip, stay ring, and vanes being united so as to constitute integral mechanical structure.

2. In a hydraulic machine, a volute casing having a wall of arcuate outline in cross-section terminating in a pair of spaced annular edges defining an annular opening at the inside of the volute, a volute lip on said wall at each edge thereof projecting into said casing a minimum distance at the minimum cross-section of the casing and increasing progressively in projection as said cross-section increases, in cross-section each one of said lips appearing in outline in the general shape of a triangle having its base a portion of said casing wall and its two sides curved outwardly from the base and meeting in a curved apex, an annular stay ring located in said annular opening in the casing, said annular edges of the casing being united with said stay ring adjacent the peripheral edges thereof, and said stay ring having a plurality of spaced vanes projecting therefrom into the casing to said apexes and extending from one lip to the other lip, said casing, lips, stay ring, and vanes being united so as to constitute integral mechanical structure.

3. The hydraulic machine defined in claim 1 wherein said lip is hollow and the side thereof forming the base of the triangle is divided circumferentially into a plurality of spaced ribs.

4. The hydraulic machine defined in claim 2 wherein each one of said lips is hollow and the side thereof forming the base of the triangle is divided circumferentially into a plurality of spaced ribs.


**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 1,171,926 | 2/16 | Carpenter | 230—116 |
| 1,462,890 | 7/23 | Taylor | 253—120 |
| 2,165,448 | 7/39 | Browne | 230—116 |
| 2,296,701 | 9/42 | Butler et al. | 230—116 |
| 2,406,388 | 8/46 | Larrecq | 230—116 |
| 2,994,348 | 8/61 | Cape | 253—26 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 1,141,182 | 3/57 | France. |


KARL J. ALBRECHT, *Primary Examiner.*

HENRY F. RADUAZO, *Examiner.*