C. B. REARICK.

ELASTIC FLUID TURBINE.

APPLICATION FILED FEB. 7, 1910.

1,003,204.

Patented Sept. 12, 1911.

2 SHEETS—SHEET 1.

Fig. 1,

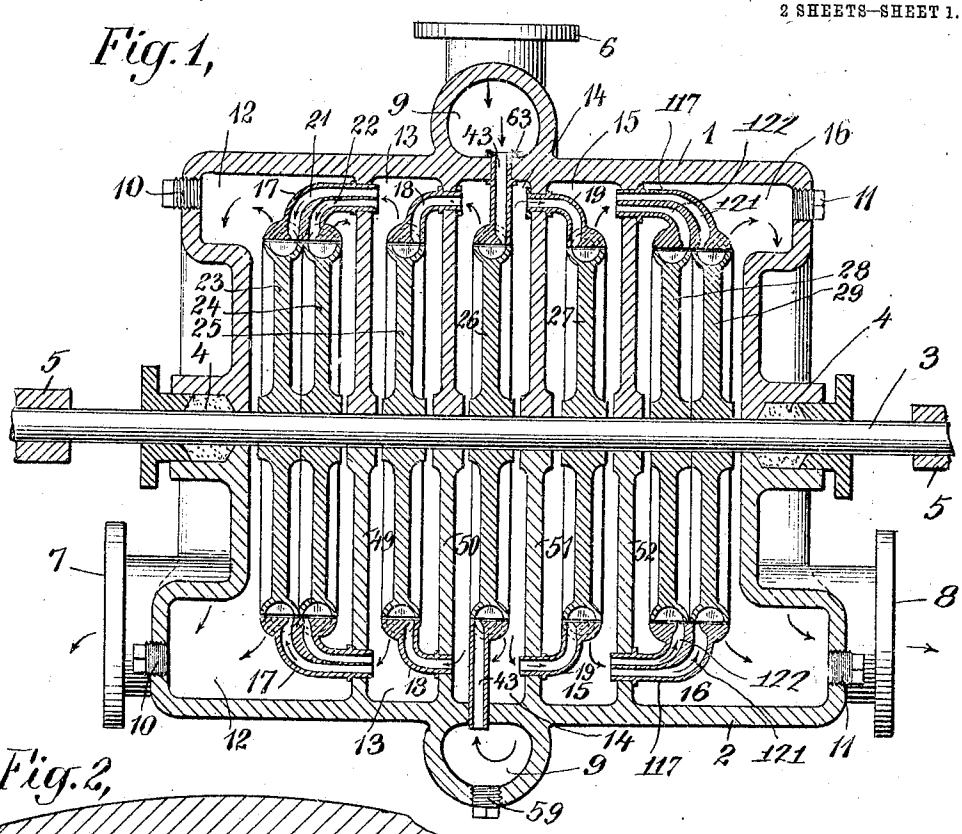


Fig. 2,

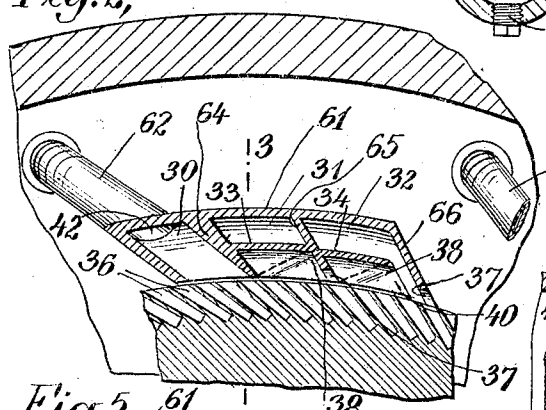


Fig. 4,

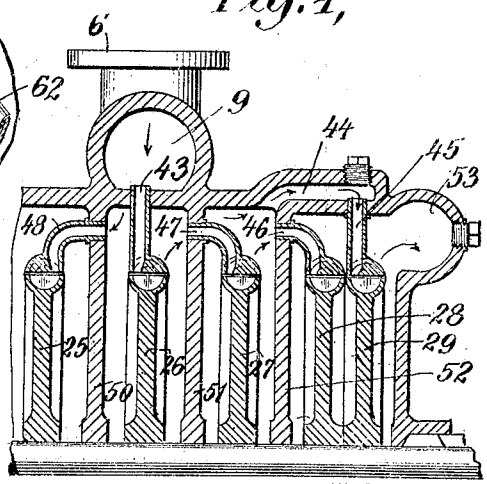


Fig. 5,

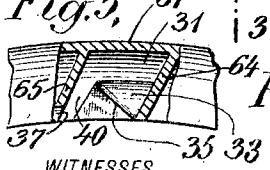
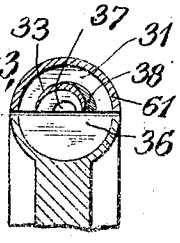


Fig. 3,



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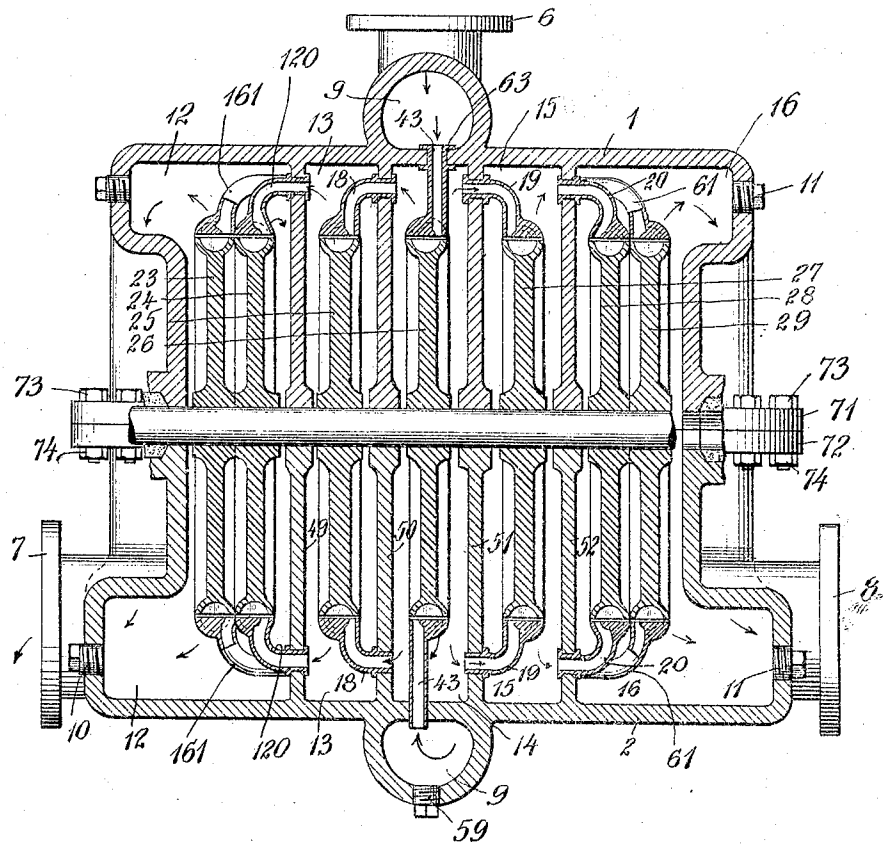
2 SHEETS—SHEET 2.

Fig. 6,



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ELASTIC-FLUID TURBINE.

1,003,204. Specification of Letters Patent. Patented Sept. 12, 1911

Application filed February 7, 1910. Serial No. 542,467.

To all whom it may concern:

Be it known that I, CHARLES BEMIS REARICK, of the city, county, and State of New York, have made a certain new and useful Invention Relating to Elastic-Fluid Turbines, of which the following is a specification, taken in connection with the accompanying drawings, which form part of the same.

This invention relates to elastic fluid turbines and relates especially to steam or other elastic fluid turbine construction of the double flow type in which a duplicate series of secondary chambers are provided on both sides of the primary wheel chamber to receive steam therefrom, the shaft carrying interchangeable bucket wheels running in said chambers, there being a plurality of wheels in each of the lower stage secondary chambers with which nozzle members having special return passages may coöperate.

In the accompanying drawings showing in a somewhat diagrammatic way several illustrative embodiments of this invention, Figure 1 is a vertical longitudinal section. Fig. 2 is an enlarged transverse sectional detail showing the nozzle member construction. Fig. 3 is a cross-section thereof taken substantially along the line 3—3 of Fig. 2. Fig. 4 is a partial longitudinal section showing a modified casing construction; and Fig. 5 is a transverse detail section showing a different return passage arrangement. Fig. 6 is a vertical longitudinal section showing a different construction.

In the illustrative embodiment of this invention, the turbine casing may as indicated be formed as by casting in several longitudinal divided sections 1, 2 which of course may be rigidly but removably secured together in any desired way as by suitable bolts 73 and coöperating nuts 74 securing together suitable integral flanges 71, 72 on the casing sections as indicated in Fig. 6. The casing may be provided with a number of transverse partitions, such as the end partitions and the various intermediate partitions 49, 50, 51 and 52, indicated to form the several chambers 12, 13, 14, 15 and 16 shown in Fig. 1. The primary chamber 14 may as indicated be located adjacent the center of the casing and connected with the annular admission passage 9 and communicating admission pipe 6 through which the steam or other motive fluid may be supplied. On either side of the primary chamber duplicate series of secondary chambers may be arranged so as to receive motive fluid simultaneously from the primary chamber in this double flow construction.

The shaft 3 may be mounted in suitable bearings 5 of any desired construction and pass through suitable stuffing boxes 4 in the end partitions of the casing. The bucketed wheels of any suitable construction may be mounted on this shaft in any desired way and in order to standardize the construction the wheels may all be interchangeable and a plurality of wheels may be mounted in each of the lower stage secondary chambers so as to give the proper increase in wheel capacity therein and allow the first stage wheels to be used at full capacity.

As indicated in Fig. 1 the steam flowing into the different nozzles 43 coöperating with the wheel 26 in the primary chamber 14 passes through the wheel buckets the desired number of times and then is discharged from the primary chamber through the two series of suitable nozzles 18, 19, simultaneously delivering it into the buckets of the wheels 25, 27 in the first of the secondary chambers 13 and 15. Since the steam has expanded considerably by this time this arrangement takes care of a degree of expansion which doubles the steam volume. If this ratio of expansion between the various stages is to be continued each of the succeeding secondary chambers must contain double the wheel capacity of the preceding one and this may be conveniently arranged by having twice as many interchangeable bucketed wheels mounted in each succeeding secondary chamber of the duplicate series. For example, the two turbine wheels 28, 29 are mounted within the secondary chamber 16 so as to receive steam from the preceding secondary chamber 15 through any suitable arrangement of nozzle members. For example, as shown in Fig. 6 the two separate series of nozzle members 20 and 61 may be used in the chamber 16 so as to supply steam from the preceding chamber to the buckets of the two wheels 28 and 29. Similar separate nozzle members 120 and 161 may coöperate with the two low stage wheels 23, 24 in the chamber 12 at the other end of the turbine. It is desirable, to have the bodies of all these nozzle members interchangeable and provided with similar return passages to pass the steam a number

of times through the wheel buckets before it is finally discharged therefrom. This can be arranged by providing the nozzle members 20 with supporting nozzle tubes similar to those of the nozzle members 19 so that when mounted in the partition 52 they properly coöperate with the adjacent wheel 28. The nozzle members 61 may have the same bodies, including the nozzles and return passages, and be provided with longer nozzle tubes so as to project farther from the supporting partition 52 in which they are circumferentially displaced or interposed between the series of nozzle members 20 and by projecting beyond the same support their nozzle members so as to properly coöperate with the outer wheel 29. If desired, however, special nozzle members, such as 17, may be provided in the lower stage secondary chambers so as to simultaneously supply the plurality of wheels as 23, 24 arranged therein. As indicated at the left of Fig. 1, such a nozzle member may have a plurality of fluid passages 21, 22 to simultaneously supply the buckets of the two wheels so that the steam after passing a plurality of times therethrough is finally discharged into the chamber 12, preferably provided with an annular exhaust space communicating with the exhaust pipe 7, the opposite chamber 16 having a similar passage and exhaust pipe 8 as indicated.

Special nozzle members, such as 117, may be provided in the low stage secondary chamber 16 at the right of Fig. 1 to simultaneously supply steam through their multiple fluid passages 121, 122 to the buckets of the two wheels 28, 29. If desired, however, special annular or otherwise arranged supply passages 44 shown in Fig. 4, may be provided to supply the motive fluid to the outer wheels in the lower stage secondary chambers. The steam which has been delivered through the nozzle member 47 and passed through the wheel 27 is delivered into the first secondary chamber 15 and then may simultaneously pass through the nozzle member 46 and wheel 28 and the supply passage 44 and the nozzle member 45 and outer wheel 29 before being discharged into the exhaust space 53. In this way the tubes of the nozzle members 45 may be straight and arranged radially in suitable plugged radial nozzle apertures. It is usually desirable to similarly arrange the nozzle members as 43 in the primary chamber and these supporting nozzle tubes may be firmly held within their nozzle apertures in any desired way as by expanding or otherwise, and if desired special threaded nuts such as 63 may be arranged on suitably threaded extensions of these nozzle tubes to hold them in position. By arranging the nozzle members so as to deliver alternately to both sides of the buckets of the wheel 26 in the primary chamber the longitudinal thrust is completely neutralized in this instance and the duplicate series of secondary chambers and nozzles on each side of this primary chamber have exactly equal and oppositely directed end thrusts so as to entirely eliminate all trouble from this source.

As indicated in Fig. 1, the nozzle apertures may be longitudinally alined by boring them through the various partitions at the desired circumferential interval so that the nozzle members will be properly spaced about the wheel to operate it at the desired capacity. In this way proper alinement of the nozzle tubes and connected nozzle members is insured with respect to the wheels and the holes formed in the outer partitions of the casing may of course be closed with suitable plugs such as 10, 11, similar plugs, such as 59, closing any radial holes made for a similar purpose.

As indicated in Figs. 2 and 3 the nozzle member 61 may comprise the supporting nozzle tube 62 formed if desired integral with the nozzle member and mounted in any desired way in the alined nozzle apertures and supplying the motive fluid through the discharge end 42 of this tube to the suitably shaped nozzle 30 integral if desired with the nozzle member 61 and communicating with the wheel buckets 36 which of course may be formed in any desired way. The nozzle member 61 may be provided with any desired number of return passages so as to pass the motive fluid any number of times through the wheel buckets before it is finally discharged into the chamber. These return passages may be formed by the diaphragms such as 64, 65, 66 in the nozzle member and if desired suitable distributing flanges such as 33, 34 may be arranged projecting from the rear diaphragm to or adjacent the succeeding diaphragm ahead as the wheel rotates so as to form the curved return passages 31, 32, preferably constituting a gradually expanding series, each of which has a greater cross-section than the preceding one. Since there is a tendency for the motive fluid to bank up at the forward sides of these return passages their receiving ends may be relieved at the forward sides so as to accommodate this collection of the fluid and this may be accomplished by inwardly flaring the receiving end of the return passage at its forward side, as indicated in Figs. 2 and 3 by inwardly bending or warping the corresponding portion 38 of the distributing flange 33, or if desired the distributing return passage may be relieved at this point by removing the distributing flange substantially along the line 35 shown in Fig. 5 which is a view taken in the opposite direction from Fig. 2. It is also beneficial in some cases to provide these return passages with open forward sides such as 40 where

the distributing flange 34 is brought adjacent to but not into engagement with the diaphragm 66. It is also usually advantageous to provide these diaphragms with suitable relief apertures such as 37 adjacent the central portions of the faces coöperating with the wheel which also tends to prevent choking.

Having described this invention in connection with a number of illustrative embodiments, forms, proportions, numbers and arrangements of parts, to the details of which disclosure the invention is not of course to be limited, what is claimed as new and what is desired to be secured by Letters Patent is set forth in the appended claims.

1. The elastic fluid turbine, comprising a longitudinally divided casing, provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying interchangeable bucketed wheels running in said chambers, there being a plurality of said wheels in each of the lower stage secondary chambers and nozzle members coöperating with said wheels and having supporting nozzle tubes mounted in longitudinally alined nozzle apertures in said partitions, said nozzle members having interchangeable bodies comprising integral return passages and the nozzle members cooperating with the outer wheels in said lower stage secondary chambers having longer nozzle tubes interposed between those of the nozzle members coöperating with the inner wheels in the same chamber.

2. The elastic fluid turbine, comprising a casing provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying interchangeable bucketed wheels running in said chambers, there being a plurality of said wheels in each of the lower stage secondary chambers and a series of nozzle members having integral return passages coöperating with each of said wheels.

3. The elastic fluid turbine, comprising a longitudinally divided casing provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying interchangeable bucketed wheels running in said chambers, there being a plurality of said wheels in each of the lower stage secondary chambers and a series of nozzle members having integral return passages coöperating with each of said wheels.

4. The elastic fluid turbine, comprising a longitudinally divided casing provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying bucketed wheels running in said chambers, nozzle members coöperating with each of the wheels in said secondary chambers and having supporting nozzle tubes mounted in longitudinally alined nozzle apertures in said partitions and nozzle members coöperating with the wheel in said primary chamber and having supporting nozzle tubes mounted in substantially radial nozzle apertures in said casing.

5. The elastic fluid turbine, comprising a longitudinally divided casing provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying bucketed wheels running in said chambers, nozzle members coöperating with each of the wheels in said secondary chambers and having supporting nozzle tubes mounted in longitudinally alined nozzle apertures in said partitions and nozzle members coöperating with the wheel in said primary chamber.

6. The elastic fluid turbine, comprising a longitudinally divided casing formed with a series of secondary chambers, a shaft carrying interchangeable bucketed wheels running in said chambers, there being a plurality of said wheels in each of the lower stage secondary chambers and a series of nozzle members coöperating with each of the wheels in said secondary chambers and having supporting nozzle tubes mounted in longitudinally alined nozzle apertures in said casing, the nozzle members coöperating with the outer wheels in each of the lower stage secondary chambers having longer supporting tubes interposed between the shorter supporting tubes of the nozzle members coöperating with the inner wheels in the same chamber.

7. The elastic fluid turbine, comprising a casing provided with a chamber, a shaft carrying a plurality of bucketed wheels running in said chamber, nozzle members comprising return passages coöperating with each of said wheels and having supporting nozzle tubes mounted in nozzle apertures in the partition forming the side of said chamber, the nozzle members coöperating with each of the wheels farther from said partition, being provided with longer supporting tubes interposed between the supporting tubes of the nozzle members cooperating with the inner wheel.

8. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber, nozzle members coöperating with said wheel, each of said nozzle members being provided with diaphragms having relief apertures and distributing flanges extending forward from said diaphragms to

form a gradually expanding series of return passages having inwardly open forward sides, the receiving ends of said return passages having inwardly flaring forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

9. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms having relief apertures and distributing flanges extending forward from said diaphragms to form a gradually expanding series of return passages having inwardly open forward sides, the receiving ends of said return passages having relieved forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

10. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms having relief apertures and distributing flanges between said diaphragms to form a series of curved return passages, the receiving ends of said return passages having relieved forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

11. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms and distributing flanges between said diaphragms to form curved return passages, the receiving ends of said return passages being inwardly flared at their forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

12. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and comprising diaphragms and a distributing flange between said diaphragms to form a curved return passage having an inwardly open forward side, the receiving end of said return passage having an inwardly flaring forward side to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

13. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and comprising a return passage provided with a distributing diaphragm, the receiving end of said return passage having a relieved forward side to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

14. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel comprising a curved return passage provided with a distributing flange within the same, the forward side of said distributing flange being inwardly flared at the receiving end of said return passage to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

15. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel having a curved return passage provided with an inwardly flaring forward side at its receiving end and a substantially parallel section at its discharge end to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

16. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms and a distributing flange extending forward from one of said diaphragms adjacent the other to form a curved return passage having an inwardly open forward side, the receiving end of said return passage having an inwardly flaring forward side to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

17. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms having a relief aperture and a distributing flange extending forward from one of said diaphragms to form a curved return passage between them having an inwardly open forward side, the receiving end of said return passage having a relieved forward side to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

18. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms and distributing flanges extending forward from said diaphragms to form a series of curved return passages having inwardly open forward sides, the receiving ends of said return passages having relieved forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

19. The elastic fluid turbine, comprising a chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms having relief apertures and distributing flanges extending between said dia-

phragms to form a series of curved return passages, the receiving ends of said return passages having relieved forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

20. The elastic fluid turbine, comprising a casing provided with partitions to form a primary chamber and a connected series of secondary chambers receiving motive fluid therefrom, a shaft carrying bucketed wheels running in said chambers, there being a plurality of said wheels in one of the lower stage secondary chambers and nozzle members coöperating with said plurality of wheels and having connected nozzle tubes mounted in nozzle apertures in the adjacent partition, said nozzle tubes being provided with a separate nozzle passage leading to each nozzle member.

21. The elastic fluid turbine, comprising a longitudinally divided casing provided with integral partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving fluid therefrom, the shaft carrying bucketed wheels running in said chambers, nozzle members coöperating with each of the wheels in said secondary chambers and having supporting nozzle tubes mounted in longitudinally alined nozzle apertures bored in said partitions from the outer exhaust ends of said casing.

22. The elastic fluid turbine, comprising a longitudinally divided casing provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying bucketed wheels running in said chambers and nozzle members coöperating with said wheels and having supporting nozzle tubes mounted in longitudinally alined nozzle apertures formed in said partitions from the outside low pressure ends of said casing.

23. The elastic fluid turbine, comprising a longitudinally divided casing provided with integral partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying bucketed wheels running in said chambers and nozzle members coöperating with each of said wheels.

24. The elastic fluid turbine, comprising a longitudinally divided chamber, a bucketed wheel running in said chamber and a nozzle member coöperating with said wheel and provided with diaphragms and distributing flanges between said diaphragms to form curved return passages, the receiving ends of said return passages being inwardly flared at their forward sides to distribute the motive fluid received from the wheel buckets before again passing the same therethrough.

25. The elastic fluid turbine, comprising a longitudinally divided casing provided with partitions to form a primary chamber and duplicate series of secondary chambers on both sides of said primary chamber and receiving motive fluid therefrom, a shaft carrying bucketed wheels running in said chambers and nozzle members coöperating with each of said wheels.

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