C. B. REARICK.

ELASTIC FLUID TURBINE.

APPLICATION FILED NOV. 18, 1909.

1,003,203.

Patented Sept. 12, 1911.

2 SHEETS—SHEET 1.

Fig.1,

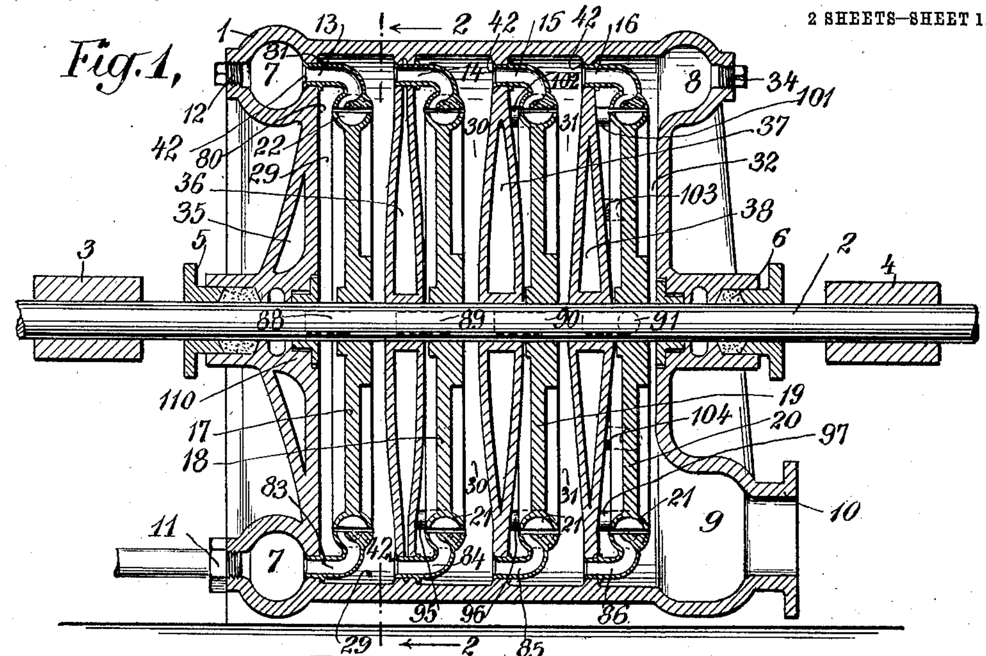


Fig.2,

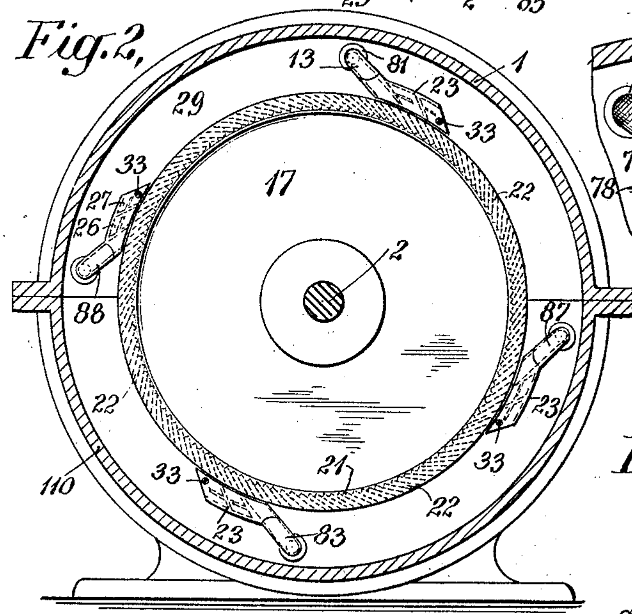


Fig.3,

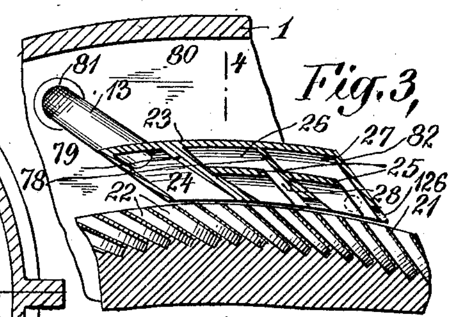


Fig.4,

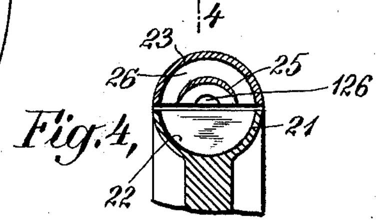
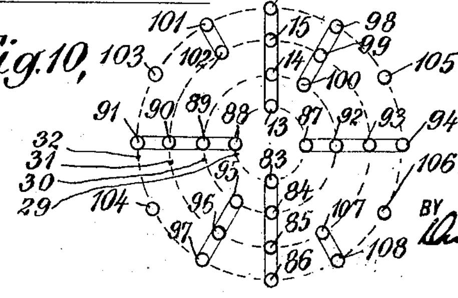


Fig.10,



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2 SHEETS—SHEET 2.

Fig. 6,

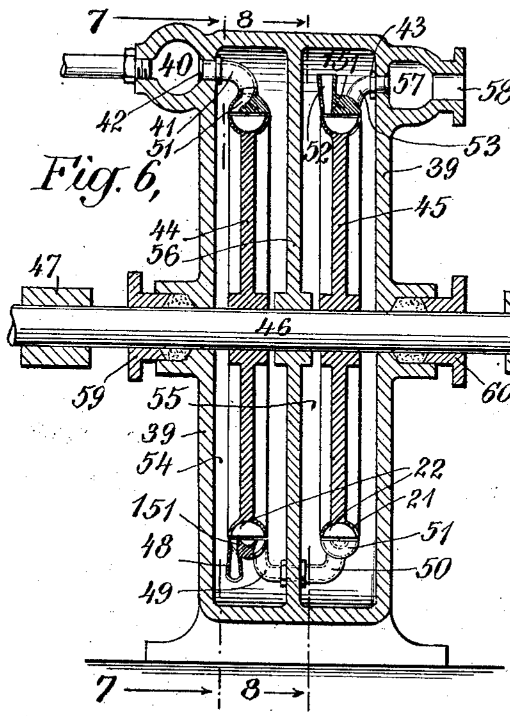


Fig. 7,

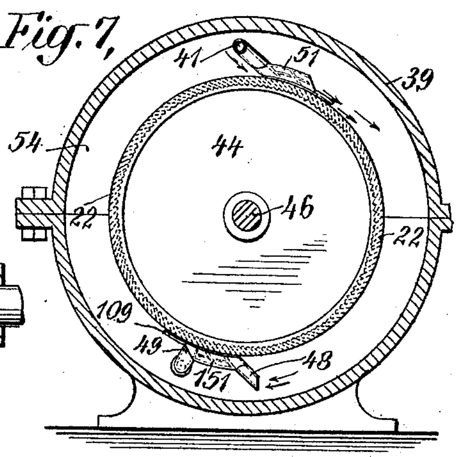


Fig. 8,

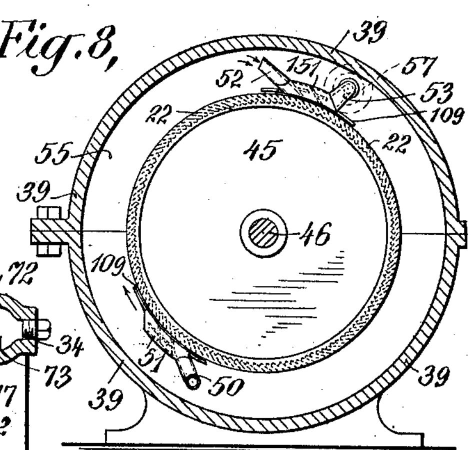


Fig. 9,

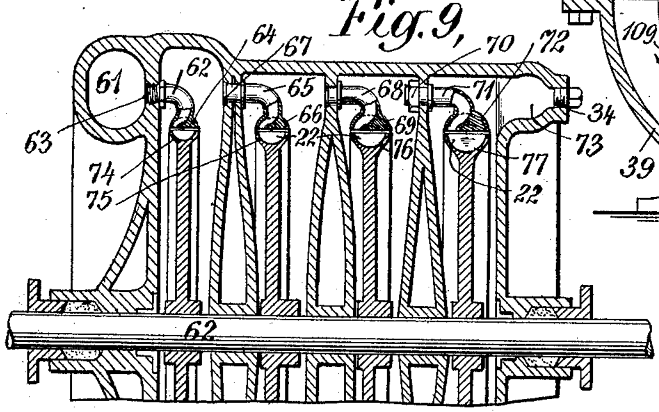
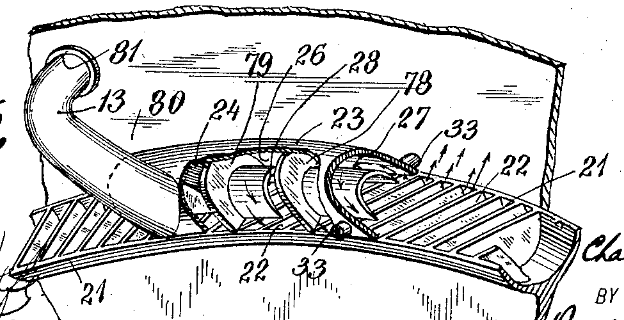


Fig. 5,



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ELASTIC-FLUID TURBINE.

1,003,203. Specification of Letters Patent. Patented Sept. 12, 1911.

Application filed November 13, 1909. Serial No. 528,837.

To all whom it may concern:

Be it known that I, CHARLES BEMIS REARICK, a citizen of the United States, and resident of the city, county, and State of New York, have invented 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 in which assembly is facilitated by the use of detachable nozzle members mounted in alined nozzle apertures in the casing.

In the accompanying drawings showing in a somewhat diagrammatic manner several illustrative embodiments of this invention, Figure 1 is a vertical longitudinal section. Fig. 2 is a transverse section substantially along line 2—2 of Fig. 1. Fig. 3 is an enlarged transverse section showing a nozzle member. Fig. 4 is a corresponding cross-section along the line 4—4 of Fig. 3. Fig. 5 is a perspective view corresponding to Fig. 3. Fig. 6 is a longitudinal section showing a different form of turbine. Figs. 7 and 8 are transverse sections thereof along the lines 7—7 and 8—8 of Fig. 6. Fig. 9 is a partial longitudinal section showing another modified construction; and Fig. 10 is a diagram indicating the arrangement of nozzle members.

In the illustrative embodiment of this invention shown in Figs. 1 to 5 of the drawings, the turbine casing may be formed as by casting in several longitudinal sections, such as 1, 110, which may of course be removably secured together in any desired way. The casing may of course be provided with a number of transverse partitions to form the various chambers 29, 30, 31 and 32, for example, and these partitions are preferably formed with a heat insulating air space which as in the case of the air space 36 may extend throughout the entire area of the partition, which is more desirable, between the first stage chambers where the steam temperatures are higher. If desired, however, these air spaces, such as 37, 38, need not extend out to the periphery of the partition at least between the lower stages. It is of course understood that the sides of these partitions may be given a convex form or a flat or conical contour, as in the case of the walls around the air space 38, and if desired a similar air space 35 may be formed in the end partition of the casing adjacent the first stage. Any desired form of bearings may be used to support the shaft 2 of the turbine and the bearings 3, 4 are merely indicated diagrammatically. Suitable stuffing glands, such as 5, 6, may be used around the shaft at the ends of the casing in connection, if desired, with bushings coöperating with the inner faces of the end partitions. The wheel sections 17, 18, 19 and 20 which may be rigidly secured upon the shaft 2 in any desired way, may have any desired construction and be formed with buckets in any desired way, a solid construction being indicated in which the buckets 22 are separated by the integral bucket partitions 21 (see Figs. 2 and 3), although it is of course understood that any other construction or form of wheel may be used in connection with corresponding nozzle members.

The nozzle members are preferably detachably mounted in the casing so as to coöperate with the wheels and this may be effected by forming nozzle members, such as 23, in which the nozzle tube 13 coöperates with the adjacent partition so as to receive the impelling fluid from the annular admission port 7 and supply pipe 11. The nozzle tube 13 also largely supports the nozzle member which as indicated may comprise a primary nozzle and coöperating return passages guiding the impelling fluid the desired number of times through the wheel buckets before it is released into the chamber. A convenient form of nozzle member is indicated in Figs. 3, 4 and 5 in which the nozzle tube 13 communicates with the nozzle chamber 24, preferably leading the steam simultaneously into a number of the wheel buckets 22 from which it is discharged at the other side of the wheel into a return passage 26 between the nozzle diaphragms 78, 79, so as to be brought around to the inlet side of the wheel and pass a second time through the coöperating buckets 22 after which if desired it may enter the return passage 27 within the end diaphragm 82 and be similarly guided for a third pass through the wheel buckets. Each return passage is of course arranged with respect to the wheel bucket so as to secure the desired advance along the wheel and deliver the steam into buckets ahead of those from which it has issued at the end of the previous pass, and it seems desirable in order to guide the impelling fluid and promote its uniform distribution to provide suitable distributing flanges, such as 25, secured to the rear diaphragms and extending adjacent to the forward diaphragms of the return passages. These distributing flange may as indicated in Figs. 3, 4 and 5 be smoothly curved so as to give a substantially uniform cross-section to the return passage and promote the uniform distribution of the steam therein at the time it is delivered from the return passage into the wheel buckets without danger of choking or otherwise impeding the steam flow. If desired also suitable semi-circular or other relief openings 126 may be formed in one or more of the diaphragms so as to allow the escape of any accumulation of dead or comparatively slow moving steam naturally present in the space within the guard flanges 25 inside the high velocity steam whirl. If desired, suitable guard flanges, such as 109, shown in Fig. 8, may be formed on the nozzle members to prevent leakage along the line of the buckets, although such flanges are not in all cases necessary. The nozzle members may be secured in any desired way in the nozzle aperture in the casing as by flanging out the free end 42 of the nozzle tube so as to draw its flange 81 against the partition 80, or if desired, a threaded end 63 may be formed on one of these nozzle tubes 62 as indicated in Fig. 9 or a suitable tightening nut 70 may have a threaded engagement with the projecting end of the nozzle tube 71 shown in Fig. 9 which is a more desirable form of connection for most purposes. Suitable retainers 33 (see Figs. 2 to 5) may also be provided adjacent the ends of the nozzle members and these retainers of any form, such as the pins 33 by their engagement with the adjacent partitions rigidly hold the nozzle members in proper coöperation with the wheels so as to maintain the desired clearance with respect thereto.

If desired, the nozzle members of a turbine may be made of the same size and the desired expansion from one stage to another may be secured by increasing the number of nozzles in the various stages. This arrangement is shown in Figs. 1 to 4 and an illustrative nozzle diagram is indicated in Fig. 10 in which four nozzles are provided for the first stage and six, eight and twelve for the succeeding three stages. By using such an arrangement the nozzle members may be mounted by boring alined nozzle apertures through the casing, these apertures extending through as many partitions as necessary to secure the proper number of nozzles in each stage and then the nozzle members may be readily and removably mounted in these apertures so that accurate alinement with respect to the wheels is readily secured. For example, the series of nozzle apertures for the nozzles 13, 14, 15 and 16 may be readily bored through the various casings shown in Fig. 1 by the use of proper jigs so as to accurately position them and then after mounting these nozzle members in the partitions in any desired way, the apertures formed in the end partitions may be closed as by the plugs 12, 34. In this arrangement four such series of nozzle apertures could be formed in the casing spaced apart at 90 degrees as indicated in Fig. 10 and the corresponding nozzle members mounted to coöperate with the different wheels which are diagrammatically indicated by the different sized dotted circles, the inner circle representing the first stage wheel and the outer circle the fourth stage or low pressure wheel. To provide the two additional nozzles for the second stage wheel two sets of nozzle apertures may be bored from the low pressure side of the casing through all the partitions except the last, producing apertures in which the nozzle members 95, 96 and 97, 98, 99, 100, are mounted, as indicated in Fig. 10, thus providing the two additional nozzle members 95 and 100 for the second stage wheel which would thus have six nozzle members. Other alined nozzle apertures may be bored through the proper casings at the desired intervals so as to provide the nozzle members 102 and 107, for instance, for the third stage wheel as well as the nozzle members 101 and 108 for the low pressure wheel which may also have the additional nozzle members 103, 104, 105 and 106 mounted in apertures which in such cases would merely extend through the outer partition and the dividing partition within on both sides of the low pressure chamber 32. It is of course understood that the high pressure steam supplied to the annular admission passage 7 feeds the various nozzle members coöperating with the first stage or high pressure wheel 17 by passing through the nozzle tubes, such as 13, 83. This steam after passing through the wheel buckets is discharged into this first stage chamber 29 and then on passing through the nozzle tubes such as 14, 83 is expanded and acquires velocity to impel the second stage wheel 18 as it passes through its buckets. Finally the steam from the fourth stage chamber 32 is received in the annular expanded exhaust passage 8, 9 and is discharged from the exhaust pipe 10 to the condenser, if desired. While this complete interchangeability of all the nozzle members in a turbine is desirable for many reasons, such as minimizing the number of differently constructed parts required, many of these advantages may be secured by mounting different sized nozzle members in the same or different sized nozzle apertures so as to coöperate with the different wheels, as is indicated in Fig. 9. In this case, the wheels 74, 75, 76 and 77 mounted on the turbine shaft 62 are shown as provided with buckets 22 which progressively increase in width and capacity from the high pressure to the low pressure end of the turbine. The nozzle members 64, 66, 69 and 72 correspondingly increase in width and capacity so as to properly coöperate with the wheel buckets, and it is of course understood that all the nozzle members coöperating with any one wheel would be of the same size so as to be completely interchangeable. By boring this alined series of nozzle apertures through the different casing partitions from the low pressure side these nozzle members may all be readily mounted in position by securing their nozzle tubes 62, 65, 68 and 71 in the corresponding casings so that the nozzle tube 62 and corresponding nozzle member 64 receives steam from the annularly arranged admission passage 61 while the annular exhaust passage 73 receives the steam from the low pressure chamber and discharges the same through a suitable exhaust pipe, after closing the apertures in this end partition in alinement with the nozzle apertures in the other partitions. The increase in size of the various nozzle members may be made sufficient to secure the desired expansion without increasing the number of nozzle members used with the wheels of the different stages, although of course the nozzle members may increase both in size and in number from one stage to another, if desired. It is also understood that detachable nozzle members may be used with one stage turbines having only a single wheel and many advantages, such as interchangeability and ease of assembly may be secured with such constructions.

While of course the return passages may be formed of expanding cross-section so as to secure an expansion of the steam or other impelling fluid between the various passes in a single nozzle member these return passages may be uniform throughout the nozzle members, as indicated in Figs. 1 to 5, and this minimizes leakage losses between the wheels and nozzle members. In some cases return nozzle members may be mounted on the same wheel to receive the steam discharged from the wheel buckets into the chamber and after expansion if desired conduct the steam or other impelling fluid several more times through the wheel buckets before discharging it into the chamber of the succeeding stage. For this purpose, suitable return nozzle members 151 may be employed, as indicated in Figs. 6 to 8, and it is of course understood that any desired number of nozzles and return nozzles may be mounted in connection with any wheel. The nozzles 51 may be formed and mounted as previously described and the return nozzles 151 may be provided with the admission passages 48 receiving the steam from the chamber and terminating in suitable nozzles, directing the steam into the desired number of buckets 22 and after it has been guided by suitable return passages through these buckets to the desired extent it may be discharged through the return nozzle tube 49 communicating with the connected nozzle tube 50 of the nozzle member 51 of the next stage. The turbine is indicated in Fig. 6 as having its two wheels 4, 45 mounted upon the shaft 46 having the bearings 47 and glands 59, 60 in the casing which is shown as having the solid end partitions 39 and intermediate partition 56 between the chambers 54, 55 of the two stages, although it is understood that suitable air spaces may be formed in these partitions if desired. The steam under these circumstances passes from the admission port 40 through the nozzle tube 41 of the nozzle member 51 and after being discharged into the chamber 54 enters the admission passage 48 of the return nozzle member and then as described after passing through this nozzle member 151 and the connected nozzle member 51 of the next stage the steam is discharged into this low pressure chamber 55, then after passing into the admission passage 52 of the secondary return nozzle 151 and through the wheel buckets to the desired extent the steam is discharged through the return nozzle tube 53 into the exhaust passage 57, 58.

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 having partitions provided with air spaces to form chambers for the various stages, a shaft carrying bucketed wheels running in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes, return passages angularly arranged with respect to the wheel buckets and provided with distributing flanges extending from the rear diaphragms of each return passage adjacent the front diaphragms thereof, and return nozzle members comprising nozzle tubes, admission apertures and return passages, said nozzle tubes being removably mounted in alined nozzle apertures bored through a number of said partitions, the additional nozzle members for the lower stage wheels being mounted in nozzle apertures bored through the partitions from the low pressure side of the casing.

2. The elastic fluid turbine comprising a longitudinally divided casing having partitions to form chambers for the various stages, a shaft carrying bucketed wheels running in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes, return passages angularly arranged with respect to the wheel buckets and provided with distributing flanges extending from the rear diaphragms of the return passages adjacent the front diaphragms thereof, said nozzle tubes being removably mounted in alined nozzle apertures bored through a number of said partitions, the additional nozzle members for the lower stage wheels being mounted in nozzle apertures bored through the partitions from the low pressure side of the casing.

3. The elastic fluid turbine comprising a longitudinally divided casing having partitions to form chambers for various stages, a shaft carrying bucketed wheels running in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes and return passages angularly arranged with respect to the wheel buckets, said nozzle tubes being removably mounted in alined nozzle apertures bored through said partitions and retainers to hold said nozzle members firmly in alinement with respect to said wheels.

4. The elastic fluid turbine comprising a divided casing having partitions to form chambers for the various stages, a shaft carrying wheels running in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes, said nozzle tubes being removably mounted in alined nozzle apertures formed in said partitions and being held firmly in coöperation with said wheels by retainers.

5. The elastic fluid turbine comprising a divided casing formed with a chamber, a shaft carrying a bucketed wheel running in said chamber, nozzle members coöperating with said wheels and comprising nozzle tubes, and return passages angularly arranged with respect to the wheel buckets and provided with distributing flanges extending from the rear diaphragms of the return passages adjacent the front diaphragms thereof, said nozzle tubes being mounted in nozzle apertures formed in said casing.

6. The elastic fluid turbine comprising a divided casing having partitions to form chambers, bucketed wheels to run in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes and return passages, said nozzle members being removably mounted by fastening means coöperating with alined apertures bored through a number of said partitions.

7. The elastic fluid turbine comprising a divided casing formed with a chamber, a wheel running in said chamber and nozzle members coöperating with said wheel and comprising nozzle tubes and return passages, said nozzle tubes being mounted in apertures formed in said casing.

8. The elastic fluid turbine comprising a casing formed with a chamber, a turbine wheel running in said chamber and nozzle members coöperating with said wheel and comprising nozzle tubes and return passages, said nozzle tubes being mounted in apertures in said casing.

9. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber and a nozzle member provided with diaphragms forming a return passage angularly arranged with respect to the wheel buckets and formed with an external guard flange and with a distributing flange extending from the rear diaphragm of said return passage adjacent the forward diaphragm to direct fluid a number of times through the wheel buckets before discharging the same into said chamber.

10. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber and a nozzle member provided with diaphragms forming a return passage angularly arranged with respect to the wheel buckets and formed with a guard flange and with distributing flanges extending from the rear diaphragms of said return passage adjacent the forward diaphragms to direct fluid a number of times through the wheel buckets before discharging the same from said nozzle member.

11. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber and a nozzle member provided with diaphragms forming a return passage angularly arranged with respect to the wheel buckets and formed with a distributing flange extending from the rear diaphragm of said return passage adjacent the forward diaphragm to direct fluid a number of times through the wheel buckets before discharging the same into said chamber.

12. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber and a nozzle member provided with diaphragms forming a return passage angularly arranged with respect to said wheel buckets and provided with a distributing flange substantially parallel to the outer portion of said return passage, there being a relief aperture formed in said nozzle member communicating with the space within said distributing flange to allow fluid to escape therefrom into the wheel chamber.

13. The elastic fluid turbine comprising a casing formed with a chamber, a bucketed

wheel mounted in said chamber, a plurality of nozzle members coöperating with said wheel and comprising nozzle tubes and return passages, said nozzle members being removably mounted in said casing and retainers holding said nozzle members in alinement with said wheel.

14. The elastic fluid turbine comprising a divided casing formed with a chamber, a bucketed wheel mounted in said chamber, a plurality of nozzle members coöperating with said wheel and comprising nozzle tubes and return passages, said nozzle tubes being removably mounted in alined nozzle apertures in said casing.

15. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber and a nozzle member provided with diaphragms and with a distributing flange between said diaphragms forming a curved return passage angularly arranged with respect to said wheel buckets, there being a relief aperture formed in one of said diaphragms communicating with the space within said distributing flange to allow fluid to escape therefrom.

16. The elastic fluid turbine comprising a divided casing having partitions to form chambers, bucketed wheels to run in said chambers and nozzle members coöperating with said wheels and comprising nozzle tubes and return passages said nozzle tubes being removably mounted in alined nozzle apertures formed in said partitions and a number of said nozzle members for each wheel being interchangeable.

17. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber and a nozzle member provided with diaphragms and with distributing flanges between said diaphragms forming a plurality of curved return passages angularly arranged with respect to said wheel buckets and having inwardly opening forward sides, there being relief apertures formed in said diaphragms communicating with the space within said distributing flanges to allow fluid to escape therefrom.

18. The elastic fluid turbine comprising a divided casing having partitions to form chambers, bucketed wheels to run in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes and return passages and return nozzle members comprising nozzle tubes, admission apertures and return passages, said nozzle tubes being mounted in alined nozzle apertures formed in said partitions and said nozzle members being held firmly in coöperative relation with said wheels.

19. The elastic fluid turbine comprising a casing formed with a chamber, a wheel to run in said chamber, a nozzle member coöperating with said wheel and comprising a nozzle tube and return passage and a return nozzle member coöperating with said wheel and comprising a nozzle tube, admission aperture and return passage, said nozzle tubes being mounted in apertures formed in said casing and said nozzle members being held in coöperative relation to said wheels.

20. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber and a nozzle member provided with diaphragms and with distributing flanges between said diaphragms forming a plurality of curved return passages having inwardly opening forward sides, there being relief apertures formed in said diaphragms communicating with the space within said distributing flanges to allow equalization of fluid pressure through said relief apertures.

21. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber, a nozzle and a coöperating return member provided with diaphragms and with a distributing flange between said diaphragms forming a curved return passage angularly arranged with respect to said wheel buckets, there being a relief aperture formed in one of said diaphragms communicating with the space within said distributing flange to allow equalization of fluid pressure through said relief apertures.

22. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber, a nozzle and a coöperating return member provided with diaphragms and with distributing flanges between said diaphragms forming a plurality of curved return passages angularly arranged with respect to said wheel buckets and having substantially open forward sides opening inward, there being relief apertures formed in said diaphragms communicating with the space within said distributing flanges to allow equalization of fluid pressure through said relief apertures.

23. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber, a nozzle and a return member provided with diaphragms and with distributing flanges between said diaphragms forming a plurality of curved return passages having substantially open forward sides opening inward, there being relief apertures formed in said diaphragms communicating with the space within said distributing flanges to allow equalization of fluid pressure through said relief apertures.

24. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber, a nozzle and a return member provided with

diaphragms and with a distributing flange between said diaphragms forming a curved return passage having a substantially open forward side to receive the fluid discharged from said wheel buckets and pass the same a second time therethrough.

25. The elastic fluid turbine comprising a chamber, a bucketed wheel running in said chamber, a nozzle and a coöperating return member coöperating with said wheel and provided with diaphragms and distributing flanges between said diaphragms to form curved return passages having substantially open forward sides and relief apertures formed in said diaphragms adjacent said wheel.

26. The elastic fluid turbine comprising a chamber, a bucketed wheel running in said chamber, a nozzle and a coöperating return member coöperating with said wheel and comprising diaphragms and a distributing flange between said diaphragms to form a curved return passage and a relief aperture formed in said diaphragm within said distributing flange and adjacent said wheel.

27. The elastic fluid turbine comprising a chamber, a bucketed wheel running in said chamber, a nozzle and a coöperating member coöperating with said wheel and provided with diaphragms and a distributing flange extending forward from one of said diaphragms to form a curved return passage between them having a substantially open forward side and a relief aperture formed in one of said diaphragms within said distributing flange.

28. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber, a nozzle and a coöperating return member provided with a rearwardly extending guard flange adjacent said wheel and with diaphragms and with a distributing flange between said diaphragms forming a curved return passage having a substantially open forward side to receive the fluid discharged from said wheel buckets and pass the same a second time therethrough.

29. The elastic fluid turbine comprising a chamber, a bucketed wheel running in said chamber, a nozzle and a coöperating return member coöperating with said wheel and provided with a rearwardly extending flange adjacent said wheel and with diaphragms and distributing flanges between said diaphragms to form curved return passages having inwardly open forward sides and relief apertures formed in said diaphragms adjacent said wheel.

30. The elastic fluid turbine comprising a chamber, a bucketed wheel running in said chamber, a nozzle and a coöperating return member coöperating with said wheel and a rearwardly extending guard flange adjacent said wheel and with diaphragms to form a curved return passage and a relief aperture formed in said diaphragm adjacent said wheel.

31. The elastic fluid turbine comprising a chamber, a bucketed wheel running in said chamber, a nozzle and a coöperating return member coöperating with said wheel and provided with a rearwardly extending guard flange adjacent said wheel and with diaphragms to form curved return passages and a relief aperture formed in one of said diaphragms adjacent the wheel.

32. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted within said chamber and a nozzle member provided with a coöperating nozzle tube supporting said nozzle member and with diaphragms forming a curved return passage to receive fluid discharged from the wheel buckets and return the same for another passage through the wheel buckets before discharging the same into said chamber.

33. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber and a nozzle member provided with an integral supporting nozzle tube with a guard flange extending along the wheel buckets and with diaphragms forming a curved return passage to receive the fluid discharged from the wheel buckets and return the same for another passage through the wheel buckets before discharging the same into said chamber.

34. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber, a nozzle and a coöperating return member provided with a guard flange extending rearwardly along the wheel buckets and with a curved return passage to receive the fluid discharged from the wheel buckets and return the same for another passage through the wheel buckets before discharging the same into said chamber.

35. The elastic fluid turbine comprising a longitudinally divided casing formed of a plurality of members provided with integral partitions to form chambers, a shaft carrying bucketed wheels to run in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes, said nozzle tubes being removably mounted in alined nozzle apertures bored through a number of said integral partitions from the low pressure side of the casing and a number of said nozzle members for each wheel being interchangeable.

36. The elastic fluid turbine comprising a longitudinally divided casing made up of a plurality of members each provided with a number of integral partitions to form chambers, a shaft carrying bucketed wheels to run in said chambers, nozzle members coöperating with said wheels and comprising

nozzle tubes, said nozzle tubes being removably mounted in alined nozzle apertures bored through a number of said integral partitions from the side of said casing.

37. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber, a nozzle and a coöperating nozzle member provided with diaphragms forming a return passage angularly arranged with respect to the wheel buckets and formed with an external guard flange extending rearwardly adjacent said wheel buckets and with a distributing flange extending from the rear diaphragm of said return passage adjacent the forward diaphragm to direct fluid a number of times through the wheel buckets before discharging the same into said chamber.

38. The elastic fluid turbine comprising a casing formed with a wheel chamber, a bucketed wheel mounted in said chamber, a nozzle and a coöperating nozzle member provided with diaphragms forming a return passage angularly arranged with respect to the wheel buckets and formed with a guard flange extending rearwardly adjacent said wheel buckets and with distributing flanges extending from the rear diaphragms of said return passage adjacent the forward diaphragms to direct fluid a number of times through the wheel buckets before discharging the same from said nozzle member.

39. The elastic fluid turbine comprising a longitudinally divided casing formed of a plurality of members provided with integral partitions to form chambers, a shaft carrying bucketed wheels to run in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes, said nozzle tubes being removably mounted in alined nozzle apertures bored through a number of said integral partitions, said partitions being formed with heat insulating air spaces between the various wheel stages and a number of said nozzle members for each wheel being interchangeable.

40. The elastic fluid turbine comprising a longitudinally divided casing made up of a plurality of members each provided with a number of integral partitions to form chambers, a shaft carrying bucketed wheels to run in said chambers, nozzle members coöperating with said wheels and comprising nozzle tubes, said nozzle tubes being removably mounted in alined nozzle apertures bored through a number of said integral partitions, said partitions being formed with heat insulating air spaces between various wheel stages.

41. The elastic fluid turbine comprising a casing provided with a wheel chamber, a wheel mounted within said chamber and provided on its periphery with an annular series of inclined substantially semi-circular lapping buckets, nozzle members coöperating with said wheel to deliver fluid into the buckets thereof and return nozzle members provided with curved return passages and with admission apertures and coöperating with said wheels to receive fluid from said chambers and discharge the same therefrom after passing said fluid a plurality of times through the buckets of said wheels.

42. The elastic fluid turbine comprising a casing formed with a wheel chamber, a wheel mounted within said chamber and provided on its periphery with an annular series of inclined substantially semi-circular lapping buckets, a nozzle member cooperating with said wheel and a return nozzle member provided with a return passage and with an admission passage and with a guard flange coöperating with said wheel, to receive fluid from said chamber and pass the same through the wheel buckets before discharging said fluid from said chamber.

CHARLES BEMIS REARICK.

Witnesses:
HARRY L. DUNCAN,
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