

TURBINE.

APPLICATION FILED JAN. 2, 1914. RENEWED JAN. 8, 1916.

1,243,476.

Patented Oct. 16, 1917.
3 SHEETS—SHEET 1.

3 SHEETS—SHEET 1.

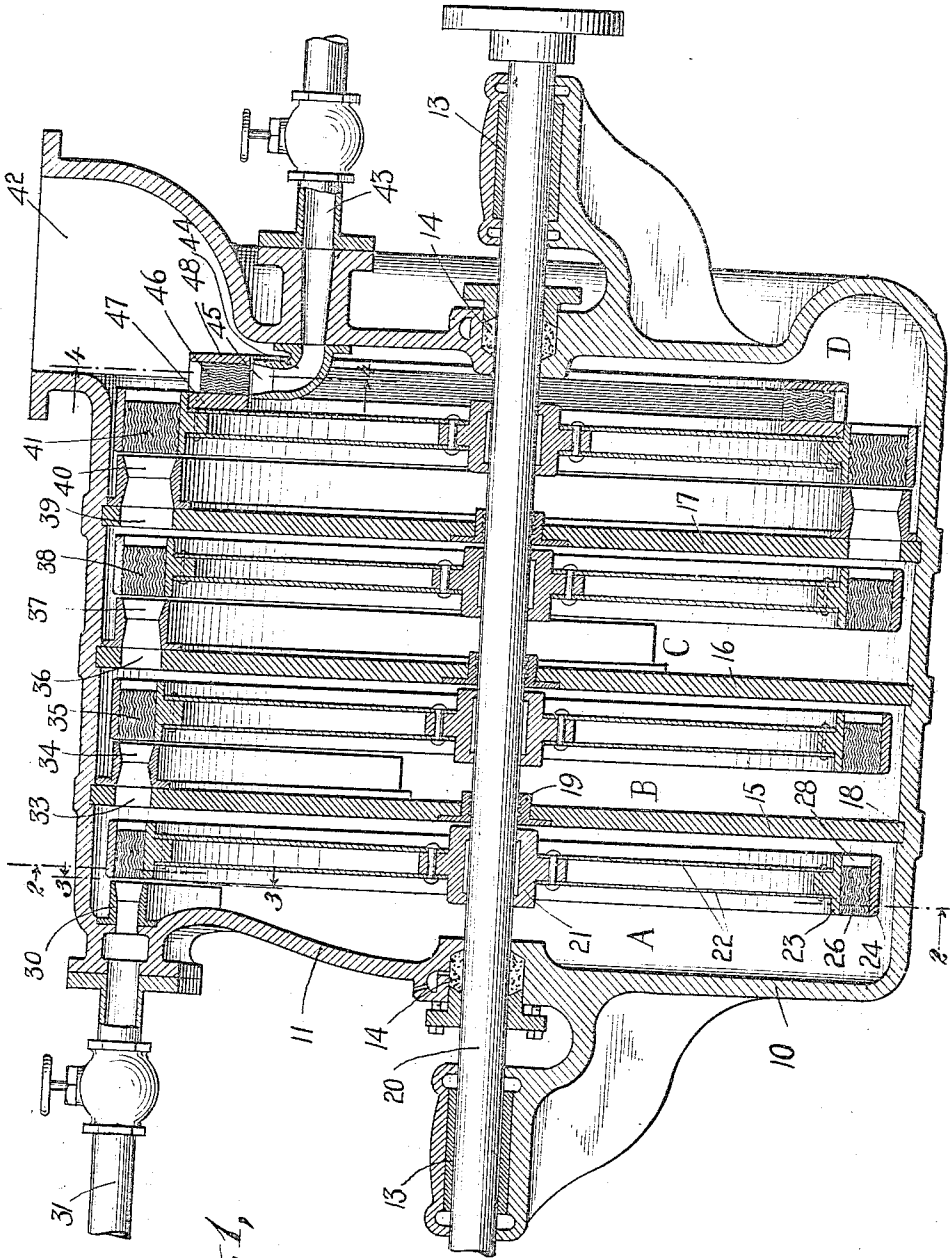


Fig. 1.

WITNESSES

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3 SHEETS—SHEET 2.

Fig. 3,

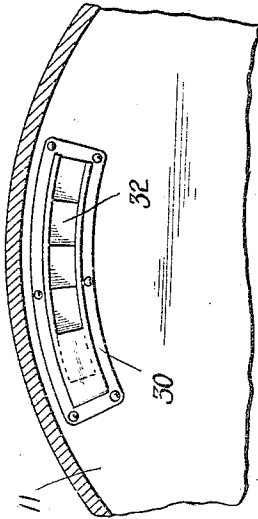


Fig. 4,

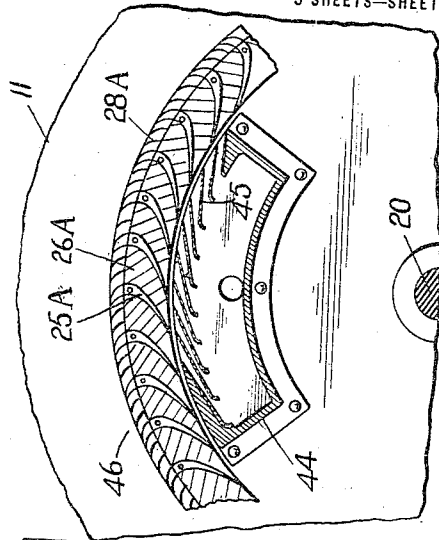
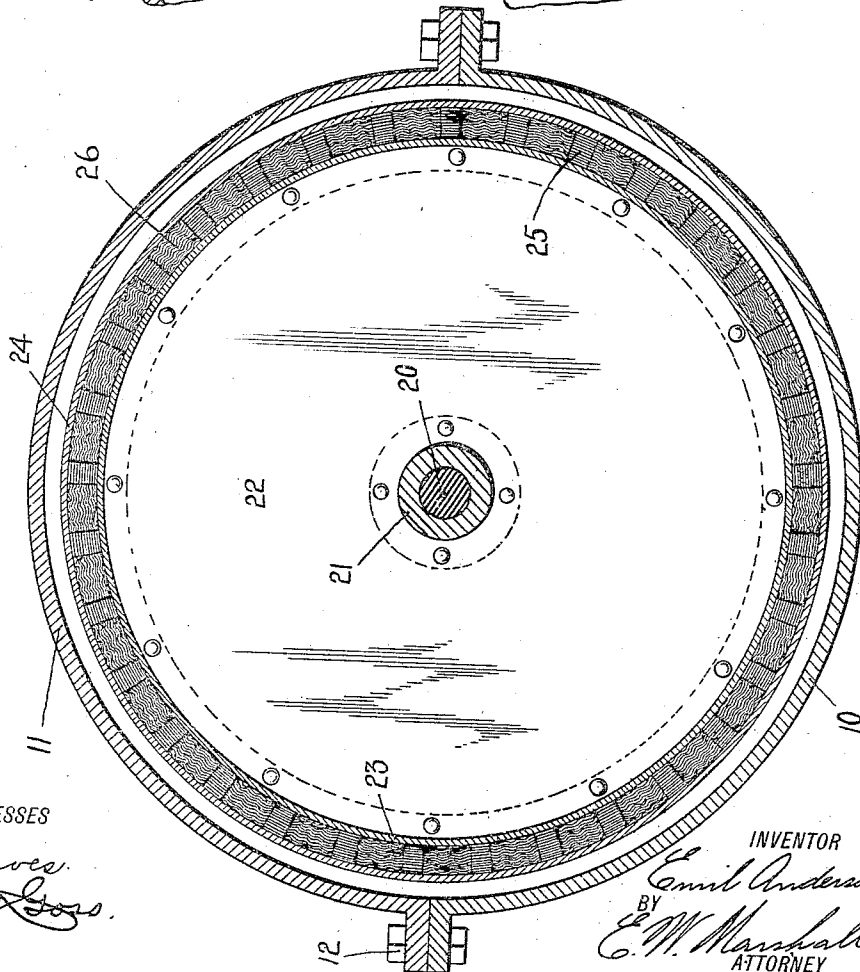


Fig. 2.



WITNESSES

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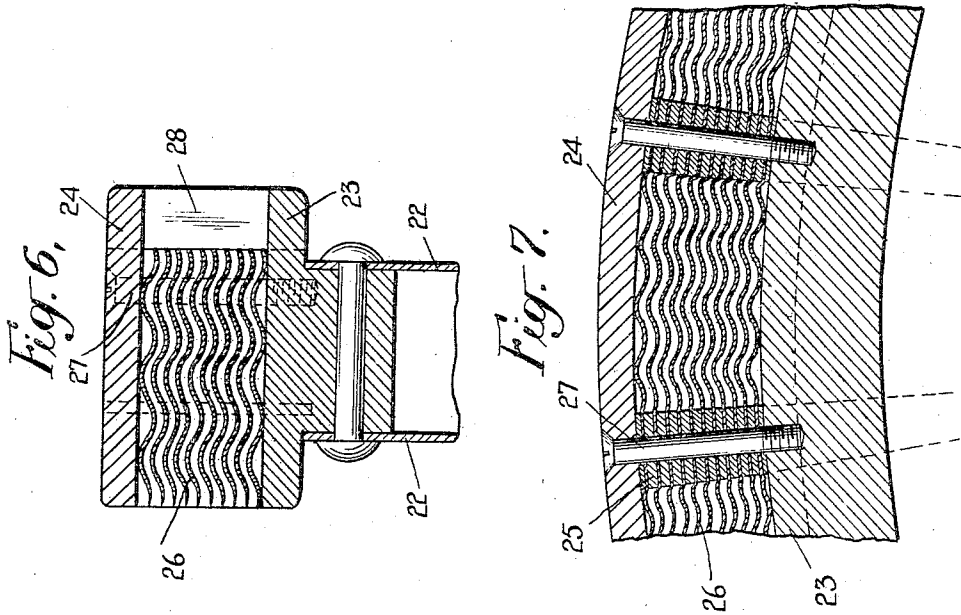
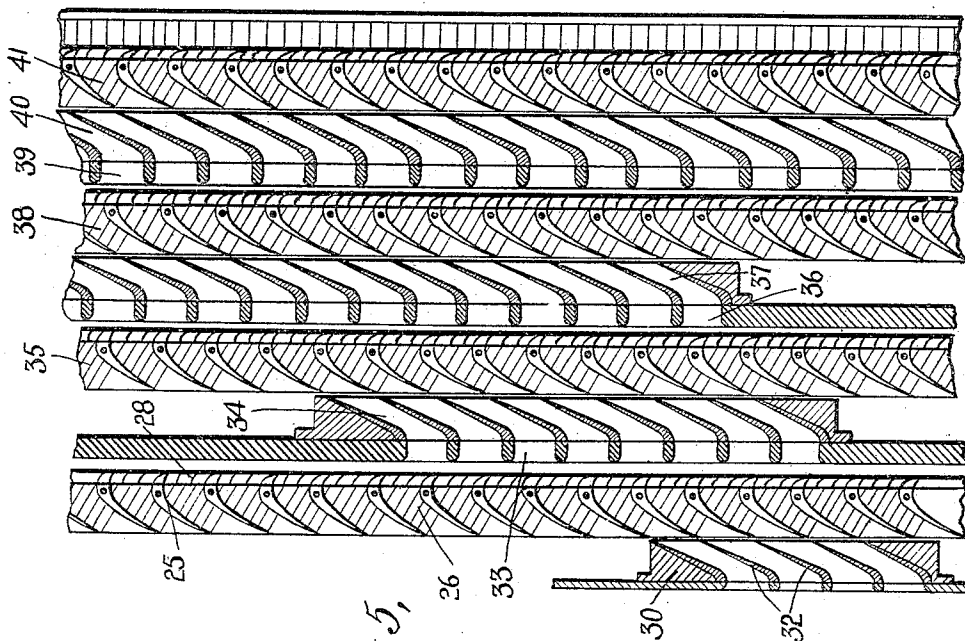
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3 SHEETS—SHEET 3.



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Fig. 5,

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UNITED STATES PATENT OFFICE.

EMIL ANDERSON, OF NEW YORK, N. Y., ASSIGNOR TO THE UNIVERSAL TURBINE COMPANY, OF NEWARK, NEW JERSEY, A CORPORATION OF NEW JERSEY.

TURBINE.

1,243,476.

Specification of Letters Patent.

Patented Oct. 16, 1917.

Application filed January 2, 1914, Serial No. 809,840. Renewed January 8, 1916. Serial No. 71,136.

To all whom it may concern:

Be it known that I, EMIL ANDERSON, a citizen of the United States of America, and a resident of New York, county and State of New York, have invented certain new and useful Improvements in Turbine-Engines, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to turbines and its object is to provide a simple and efficient apparatus of this character. More especially it relates to improvements in that type of turbine which is disclosed in my copending application for Patent Serial No. 724,516 which was filed October 8, 1912, and to improvements in the construction and arrangement of parts of such apparatus as is disclosed in said application.

I will describe my invention in the following specification, and then point out the novel features thereof in appended claims.

Referring to the drawings:

Figure 1 is a sectional side elevation of one form of turbine which embodies the present invention.

Fig. 2 is a sectional end elevation of the same apparatus, the section being taken on the line 2—2 of Fig. 1.

Fig. 3 is an end elevation of one of the nozzle blocks, this view being that of a section taken on the line 3—3 of Fig. 1.

Another of the nozzle blocks and portions of the rotor and other parts are shown in Fig. 4, which is a sectional end elevation taken on the line 4—4 of Fig. 1.

Fig. 5 is a developed sectional plan view on a larger scale of parts of the nozzles and rotor rings, of the same apparatus as that shown in the preceding figures.

Certain details of construction are illustrated on a still larger scale in Figs. 6 and 7 of which Fig. 6 is a sectional side elevation of a portion of one of the rotor rings and Fig. 7 is a sectional end elevation of a similar part of the apparatus.

Like characters of reference designate corresponding parts in all the figures.

The turbine comprises, and its parts are supported by, an annular casing, the lower part of which is designated by the numeral 10 and the upper part of which is designated by the numeral 11. These parts are

fastened together by some suitable means such, for example, as bolts 12. The lower part of the casing is constructed to form supports 13—13 for the rotor shaft 20, and stuffing boxes 14—14 are provided where the shaft passes through the casing.

The inside of the casing is divided into chambers by circular transverse walls 15—16 and 17, each of which fits into a groove such as 18 in the inner surfaces of the parts of the casing and each of which is provided with either a packed bearing or a stuffing box such as 19, where the rotor shaft passes through it.

Affixed to the rotor shaft within the first chamber is a hub 21, to an outwardly extending annular rib of which are riveted two circular disks 22. 23 is a metallic ring or wheel rim which fits over the outer peripheries of the disks and which is provided with an inwardly extending annular rib to which the disks are riveted. 24 is an outer rim, flange or shrouding ring.

According to the present invention the annular space between the ring 23 and flange 24 is divided into a plurality of transverse compartments by means of spacing blocks 25 which lie obliquely to the axis of the shaft and are preferably curved as shown in Fig. 5 to together form impulse vanes. The proximate sides of adjacent sets of spacing blocks thus form the walls of these compartments. The compartments are further subdivided by thin bands or friction drive plates 26 which are held apart by the spacing blocks 25 and are substantially parallel with the rim flange 24. These plates are preferably corrugated as shown in the drawings and their corrugations are relatively fixed so that between them are formed narrow wavy or zig-zag passages for the motive fluid with the waves substantially normal to the path of flow of the fluid.

As a preferred construction these subdividing plates are constructed of a continuous strip of metal with the corrugations stamped therein and with smooth portions left between adjacent sets of corrugations for the reception of the spacing blocks. Such a strip is then spirally wound around the ring 23 with a set of spacing blocks 25 between each of its layers, until a desired

thickness is obtained, and then the rim 24 fitted over it. The parts thus assembled may be fastened together by some suitable means, such, for example, as by screws 27 passing through the rim 24, the spacing blocks 25, each layer of the strip 26, and into the ring 23.

It is to be noted that although the spacing blocks 25 run through the rotor ring thus formed, the band 26 is narrower than the ring 23 and rim 24. It is placed with one of its edges in alinement with the edges of the ring and rim so that between its other edge and the edges of the ring and rim is a space. In this space are placed deflector vanes or impulse blades 28 which may be held conveniently in slits in the edges of the rim and ring and locked in place by swaging the edges of the rim and ring at the cuts after such blades are put in position.

Affixed to the casing is a nozzle block 30 to which motive fluid is led through a valve controlled supply pipe 31. In this block are nozzle blades 32 which form a plurality of expansion nozzles in alinement with the first rotor ring, the construction and arrangement of which has been described specifically.

As the parts already described form an operative structure, I will now describe the operation of the apparatus. The motive fluid discharged from the expansion nozzles, enters the motor ring at an angle oblique to the plane of its rotation and passes across and through the space between the ring 23 and the rim 24 through which it is more or less guided by the spacing blocks 25, those of each set of these blocks being in alinement with each other.

Each of the compartments between adjacent sets of spacing blocks is divided by the corrugated plates 26 into a plurality of unrestricted wavy paths and the motive fluid as it passes through them is deflected up and down, at each deflection giving up a part of its velocity and imparting an impulse to the rotor. There are no negative reactions even at the edge of the rotor from which the fluid is discharged as here the curved ends of the spacing blocks and the deflector vanes 28 turn the direction of the discharge flow of the fluid and thereby an additional driving impulse is obtained.

It is to be noted that in the specific apparatus illustrated in the drawings the motive fluid is discharged into the first chamber A within the casing. From thence it passes through a series of apertures 33 in the wall 15 and through a plurality of expansion nozzles 34 into a second rotor ring 35 which is of similar construction to that of the first rotor ring which has been specifically described. As the deflector vanes

or impulse blades 28 turn the motive fluid back away from the direction of rotation, the blades between adjacent nozzles 34 are so disposed as to substantially reverse the direction of flow of the motive fluid so as to direct it into the second rotor ring in substantially the direction of rotation. This second rotor ring is also mounted upon the shaft 20 but is in the second chamber B and the annular space for the flow of fluid is wider to provide for expansion of the motive fluid. For this same reason the nozzles 34 are wider than those of the first set, and there are more of them.

The effect of the fluid in passing through this second rotor ring is similar to that upon the first ring and a further driving effect upon the shaft 20 is obtained.

The motive fluid is discharged from the second rotor ring into the chamber B from whence it passes through apertures 36 in wall 16 and through expansion nozzles 37 into and through a third rotor ring 38 where a further driving effect is obtained. The apertures 36 are larger than the apertures 33 and there are more of them. Likewise the nozzles 37 are wider and more numerous than the nozzles 34, and the working passages of the rotor ring are larger than those of the rotor ring 35.

Consequently the passages are proportioned to provide for the increased volume of the expanded motive fluid.

From this third rotor ring the fluid is discharged into the chamber C from which it passes through apertures 39 in wall 17 and through expansion nozzles 40 into and through a fourth rotor ring 41 which is still wider than the others. In this case there are continuous rings of apertures 39 and of nozzles 40. From this fourth rotor ring the motive fluid is discharged into the enlarged chamber D within the casing from which it escapes into the air or into condensers through the exhaust outlet 42.

At this end of the casing is another valve controlled supply pipe 43 through which motive fluid may be introduced into a nozzle block 44 and outwardly through expansion nozzles 45 into and through a rotor ring 46. In this case however, the nozzles direct the flow of the motive fluid outward at an angle to the radii and the spacing blocks 25A are held between two flat annular rings 47-48 with the wavy paths formed by annular corrugated disks 26A. Deflector vanes 28A are also provided which are set into and affixed to the rings 47 and 48.

The operation in this rotor ring is similar to that in the others except the flow of the motive fluid is outward whereas in the others it follows more or less helical paths at a substantially equal distance from the axis of the shaft 20 and with an axial progression.

The driving impulse obtained in the rotor ring 46 may be added to those obtained in the other rotor rings, so that this rotor ring may be used as an auxiliary to the others to obtain added power when desired. But the nozzles 45 and the fluid passages in rotor ring 46 may be so disposed as to cause a rotation of the shaft 20 in the opposite direction to that imparted to it by the other rotor rings. In such a case the apparatus may be reversed by shutting off the supply of motive fluid through the pipe 31 and admitting it through pipe 43.

The particular turbine shown herein is one designed for marine use in which the end thrust produced by the motive fluid opposes that of the driven propeller shaft. It is obvious that where it is desirable to have no end thrust, the parts may be so designed that the motive fluid may be introduced at the ends of the casing and discharged in the middle, or may be introduced in the middle and discharged at the ends of the casing. This is common practice and so well understood by those skilled in this art that this application is not encumbered with specific illustrations and descriptions of such structures which clearly come within the terms of the appended claims.

What I claim is:

1. A turbine engine rotor comprising substantially cylindrical superimposed corrugated bands and a plurality of spacing blocks between said bands.

2. A turbine engine rotor comprising substantially cylindrical superimposed corrugated bands and a plurality of spacing blocks between said bands at intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of open-ended compartments.

3. A turbine engine rotor comprising substantially cylindrical superimposed bands and a plurality of spacing blocks between the bands at equal intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of transverse open-ended compartments and said bands being corrugated between the blocks to divide each of said compartments into a plurality of wavy motive fluid passages.

4. A turbine engine rotor comprising substantially cylindrical superimposed bands and a plurality of curved spacing blocks between the bands at equal intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of transverse open-ended compartments oblique to the axis of the bands and said bands being corrugated between the blades to divide each of said compartments into a plurality of wavy motive fluid passages with the waves thereof substantially

normal to the flow of motive fluid through the compartments.

5. A turbine engine rotor comprising superimposed corrugated bands, a plurality of spacing blocks between said bands, and a plurality of deflector vanes.

6. A turbine engine rotor comprising superimposed corrugated bands, a plurality of spacing blocks between said bands at intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of open-ended compartments, and a plurality of deflector vanes across one end of said compartments.

7. A turbine engine rotor comprising superimposed bands, a plurality of spacing blocks between the bands at equal intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of transverse open-ended compartments and said bands being corrugated between the blocks to divide each of said compartments into a plurality of wavy motive fluid passages, and a transverse deflector vane across one end of said compartments between each adjacent groups of spacing blocks.

8. A turbine engine rotor comprising superimposed bands, a plurality of curved spacing blocks between the bands at equal intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of transverse open-ended compartments oblique to the axis of the rotor and said bands being corrugated between the blocks to divide each of said compartments into a plurality of wavy motive fluid passages with the waves thereof substantially normal to the flow of motive fluid through the compartments, said blocks projecting beyond one edge of said bands, and a plurality of transverse deflector vanes across one end of each said compartments between the projecting part of each adjacent group of spacing blocks.

9. A turbine engine rotor comprising a metallic band wound spirally and spacing blocks between adjacent layers thereof.

10. A turbine engine rotor comprising a metallic band wound spirally and spacing blocks between adjacent layers thereof at equal intervals, said blocks being arranged in alining groups dividing the spaces between the layers of said band into a plurality of open-ended compartments.

11. A turbine engine rotor comprising a metallic band wound spirally and spacing blocks between adjacent layers thereof, said band being corrugated between said blocks.

12. A turbine engine rotor comprising a metallic band wound spirally and spacing blocks between adjacent layers thereof at equal intervals, said blocks being arranged in alining groups dividing the spaces be-

tween the layers of said band into a plurality of open-ended compartments, said band being corrugated between said blocks, to form unrestricted wavy passages within the compartments between adjacent layers of the band.

13. A turbine engine rotor comprising a metallic band wound spirally and curved spacing blocks between adjacent layers of the band, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of open-ended compartments and the bands being corrugated between the blocks to divide each of said compartments into a plurality of wavy motive fluid passages with the waves thereof substantially normal to the flow of motive fluid through the compartments.

14. A turbine engine rotor comprising a metallic band wound spirally, a plurality of curved spacing blocks between adjacent layers thereof at equal intervals, said blocks being arranged in alining groups dividing the spaces between the layers of the band into a plurality of axially open compartments diagonal to the axis of the rotor and the parts of said band between the blocks being corrugated to divide each of the compartments into a plurality of unrestricted wavy motive fluid passages with the waves thereof substantially normal to the flow of motive fluid.

15. A turbine engine rotor comprising a metallic band wound spirally, a plurality of curved spacing blocks between adjacent layers thereof at equal intervals, said blocks being arranged in alining groups dividing the spaces between the layers of the band into a plurality of axially open compartments diagonal to the axis of the rotor and the parts of said band between the blocks being corrugated to divide each of the compartments into a plurality of unrestricted wavy motive fluid passages with the waves thereof substantially normal to the flow of motive fluid, said blocks projecting beyond one edge of the band, and a plurality of deflector vanes between the projecting part of each adjacent set of spacing blocks running transversely across the layers of said band.

16. A turbine rotor comprising spaced members having wavy surfaces forming between them an axially open zigzag passage with the waves diagonal to the axis of the rotor.

17. A turbine engine rotor comprising a plurality of spaced members having wavy surfaces forming between them axially open unrestricted zigzag passages with the waves diagonal to the axis of the rotor.

18. A turbine engine rotor comprising spaced members having wavy surfaces, each symmetrically disposed in relation to the axis of the rotor, forming between them an

axially open annular zigzag passage with the waves diagonal to the axis of the rotor.

19. A turbine engine rotor comprising spaced members having wavy surfaces forming between them an axially open zigzag passage, and means for dividing said passage into a plurality of compartments diagonal to the axis of the rotor, the waves of said passage being substantially normal to the flow of motive fluid through said compartments.

20. A turbine engine rotor comprising members forming between them an axially open motive fluid passage and spacing blocks between said members diagonal to the axis of the rotor, the parts of said members between the blocks being corrugated.

21. A turbine engine rotor comprising members forming between them a plurality of motive fluid passages, and curved spacing blocks between said members at equal intervals diagonal to the axis of the rotor, dividing said passages into a plurality of axially open compartments, the parts of said members between the blocks being corrugated with the corrugations substantially normal to the flow of motive fluid through the compartments.

22. A turbine engine having a rotor comprising spaced members having wavy surfaces forming between them an axially open zigzag passage with the waves diagonal to the axis of the rotor, and a nozzle at the side of the rotor disposed at substantially right angles to said waves.

23. A turbine engine having a shaft, a plurality of rotor rings mounted thereon, each comprising a plurality of spaced members having wavy surfaces forming between them axially open unrestricted zigzag passages with the waves diagonal to said shaft, and a diagonally disposed nozzle at the side of each rotor ring.

24. A turbine engine having a shaft, a plurality of rotor rings mounted thereon, each comprising a plurality of spaced members having wavy surfaces forming between them axially open unrestricted zigzag passages with the waves diagonal to said shaft, a diagonally disposed nozzle at the side of each rotor ring, means for introducing motive fluid through said nozzles and rotor rings successively.

25. A turbine engine having a shaft, a casing divided into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members having wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, a nozzle at the side of the first rotor ring for passing motive fluid into and through the first rotor

ring into the first chamber, and another nozzle for passing the motive fluid from said first chamber into and through another rotor ring into the next chamber.

5 26. A turbine engine having a shaft, a casing, a partition wall therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members hav-
10 ing wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, a nozzle at
15 the side of the first rotor ring disposed at an angle thereto for passing motive fluid into and through said first rotor ring into said first chamber, a port in the partition wall, a nozzle connected therewith disposed
20 at a similar angle to the second rotor ring, said second rotor ring and its nozzle being of greater capacity than the first rotor ring and its nozzle.

27. A turbine engine having a shaft, a casing, partition walls therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members hav-
25 ing wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, nozzles at one side of each of said rotor rings, and
30 ports in the partition walls communicating with the nozzles, said rotor rings and their respective nozzles being of successively increasing capacities.

28. A turbine engine having a shaft, a casing, partition walls therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members hav-
40 ing wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, a set of nozzles at one side of each of said rotor rings, and
45 ports in the partition walls communicating with the nozzles, said rotor rings being of successively increasing capacities, and the number and size of the nozzles in each set being successively greater.

55 29. A turbine engine having a shaft, a casing, a partition wall therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members hav-
60 ing wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, nozzles at the

sides of said rotor rings disposed at an angle thereto, means for passing motive fluid successively through said nozzles and rotor rings, an auxiliary rotor ring also mounted upon the shaft in one of said chambers, a nozzle therefor, and a valve-controlled supply pipe connected with the last named
70 nozzle.

30. A turbine engine having a shaft, a casing, a partition wall therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members hav-
75 ing wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, nozzles at the sides of said rotor rings disposed at an angle thereto, a valve-controlled supply pipe whereby motive fluid may be passed suc-
80 cessively through said nozzles and rotor rings, an auxiliary rotor ring also mounted upon the shaft in one of said chambers, a nozzle therefor, and a valve-controlled supply pipe connected with the last named nozzle, said auxiliary rotor ring and its nozzle
85 being arranged to impart to the shaft a reverse rotation.

31. A turbine engine having a shaft, a casing, a partition wall therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members having wavy surfaces each symmetrically disposed in relation to the axis of the rotor, forming between them an axially open annular zigzag passage with the waves diagonal to the axis of the rotor, nozzles at the sides of said rotor rings disposed at an angle thereto, a valve-controlled supply pipe whereby motive fluid may be passed successively through said nozzles and rotor rings, an auxiliary rotor ring also mounted upon the shaft in one of said chambers, said auxiliary rotor ring being constructed to form an annular space and having means for transversely dividing said space into a plurality of radially open ended compartments having opposed wavy walls forming zigzag passages between said dividing means, an outward flow nozzle affixed to the casing within the auxiliary rotor ring and its nozzle being arranged to impart to the shaft a reverse rotation.

32. In elastic fluid turbines, a nozzle member having nozzles, a cooperating turbine wheel having a wheel rim, a shrouding ring supported in connection with said wheel rim to form an annular passage extending across the wheel, a series of thin friction drive plates arranged in spaced relation in said passage, a series of curved impulse vanes interposed between adjacent friction drive
120
125

plates to provide a series of narrow channels for the motive fluid, and a series of impulse blades beyond the discharge ends of said friction drive plates to be acted on by the motive fluid discharged by the friction drive members.

33. In elastic fluid turbines, a turbine wheel having an annular passage extending across the wheel, a series of thin annular friction drive members arranged in spaced relation in said passage, to provide a series of narrow channels for the motive fluid as the motive fluid moves across the wheel.

34. In elastic fluid turbines, a turbine wheel having an annular passage extending across the wheel, a series of thin annular friction drive members arranged in spaced relation in said passage, to provide a series of narrow channels for the motive fluid as the motive fluid moves across the wheel, and a series of impulse blades arranged on said wheel to be acted on by the motive fluid discharged from said channels.

35. In elastic fluid turbines a plurality of turbine wheels each having an annular passage extending across the wheel, a series of thin friction drive members arranged in spaced relation in said passage to provide a series of narrow channels for the motive fluid, and stationary reversing blades between adjacent wheels.

36. In elastic fluid turbines, a plurality of turbine wheels each having an annular passage extending across the wheel, a series of thin friction drive members arranged in spaced relation in said passage to provide a series of narrow channels for the motive fluid and a series of impulse blades arranged on said wheel to be acted on by the motive fluid discharged from said channels, and stationary reversing blades between adjacent wheels.

37. A turbine engine rotor comprising substantially cylindrical superimposed bands and a plurality of spacing blocks between said bands at intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of open-ended compartments.

38. A turbine engine rotor comprising superimposed bands, a plurality of spacing blocks between said bands at intervals, said blocks being arranged in alining groups dividing the spaces between the bands into

a plurality of open-ended compartments, and a plurality of deflector vanes across one end of said compartments.

39. A turbine engine rotor comprising superimposed bands, a plurality of curved spacing blocks between the bands at equal intervals, said blocks being arranged in alining groups dividing the spaces between the bands into a plurality of transverse open-ended compartments oblique to the axis of the rotor, said blocks projecting beyond one edge of said bands, and a plurality of transverse deflector vanes across one end of each said compartments between the projecting part of each adjacent group of spacing blocks.

40. A turbine engine having a shaft, a casing divided into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced chambers each symmetrically disposed in relation to the axis of the rotor, forming between them axially open annular passages, a nozzle at the side of the first rotor ring for passing motive fluid into and through the first rotor ring into the first chamber, and another nozzle for passing the motive fluid from said first chamber into and through another rotor ring into the next chamber.

41. A turbine engine having a shaft, a casing, a partition wall therein dividing the casing into chambers, a rotor ring mounted upon the shaft in each chamber, each of said rotor rings comprising spaced members each symmetrically disposed in relation to the axis of the rotor, forming between them axially open annular passages, a nozzle at the side of the first rotor ring disposed at an angle thereto for passing motive fluid into and through said first rotor ring into said first chamber, a port in the partition wall, a nozzle connected therewith disposed at a similar angle to the second rotor ring, said second rotor ring and its nozzle being of greater capacity than the first rotor ring and its nozzle.

In witness whereof, I have hereunto set my hand in the presence of two subscribing witnesses, this 30th day of December, 1913.

EMIL ANDERSON.

Witnesses:

ERNEST W. MARSHALL,
J. C. SCHOEN.