E. F. RAAB.
TURBINE.
APPLICATION FILED JAN. 22, 1907.

935,403.

Patented Sept. 28, 1909.
2 SHEETS—SHEET 1.

Fig. 1.

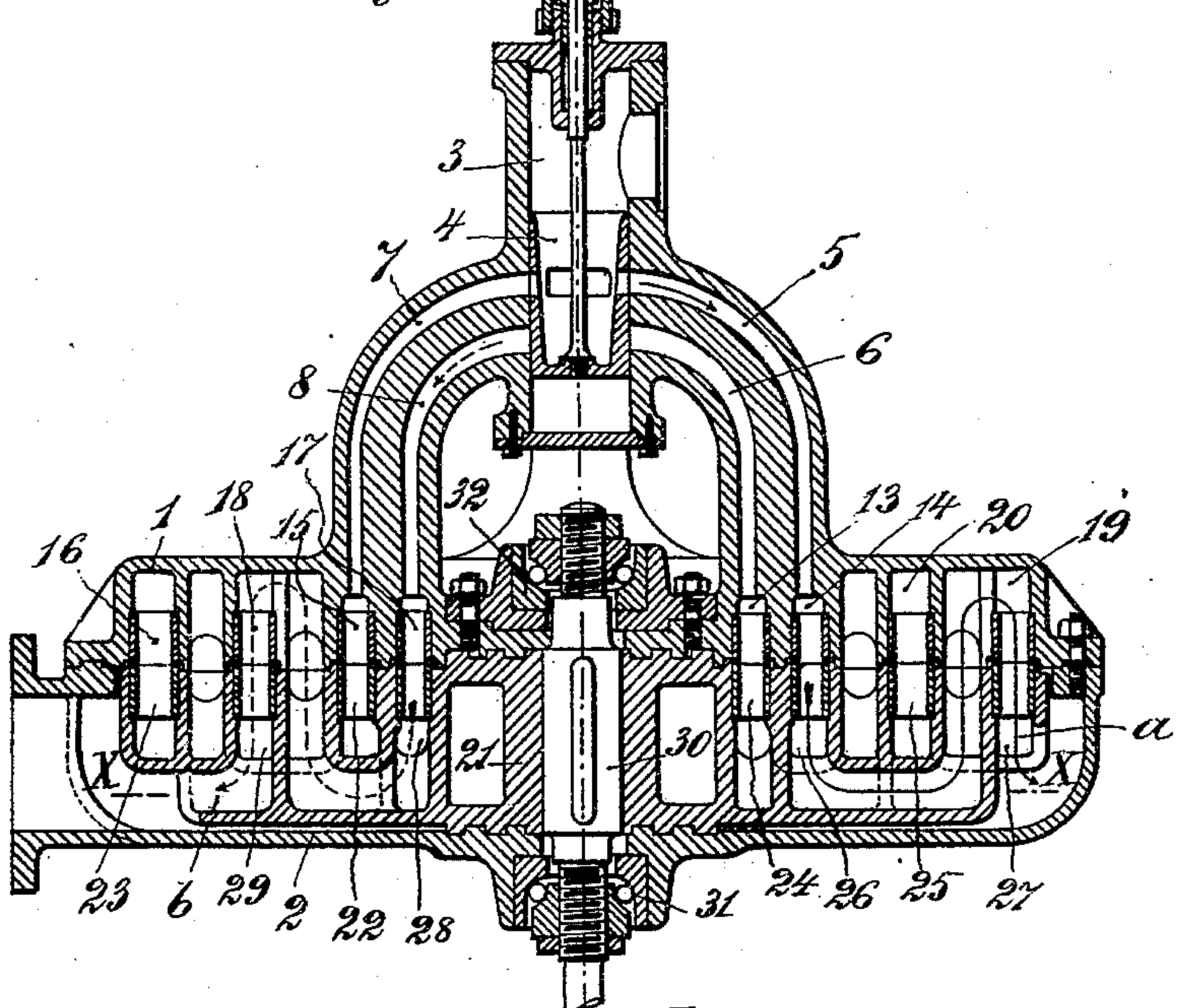
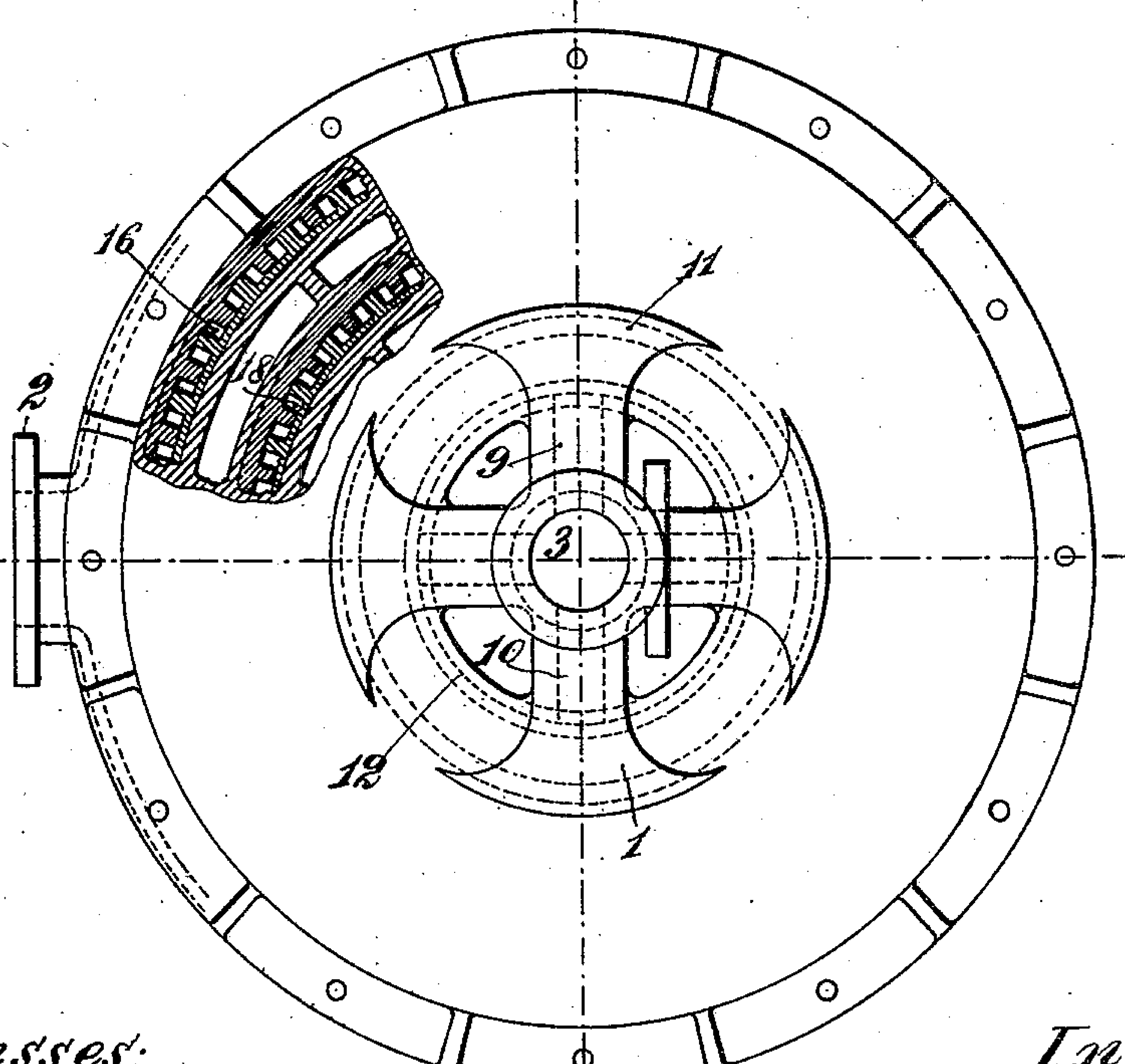


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 4.

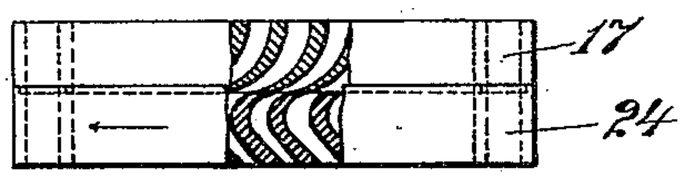


Fig. 5.

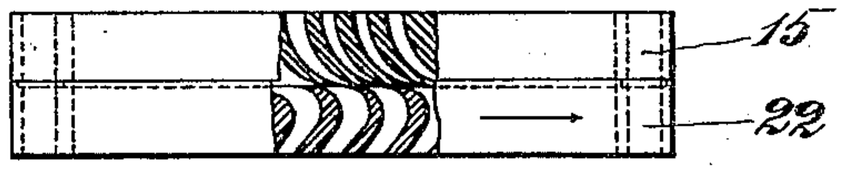
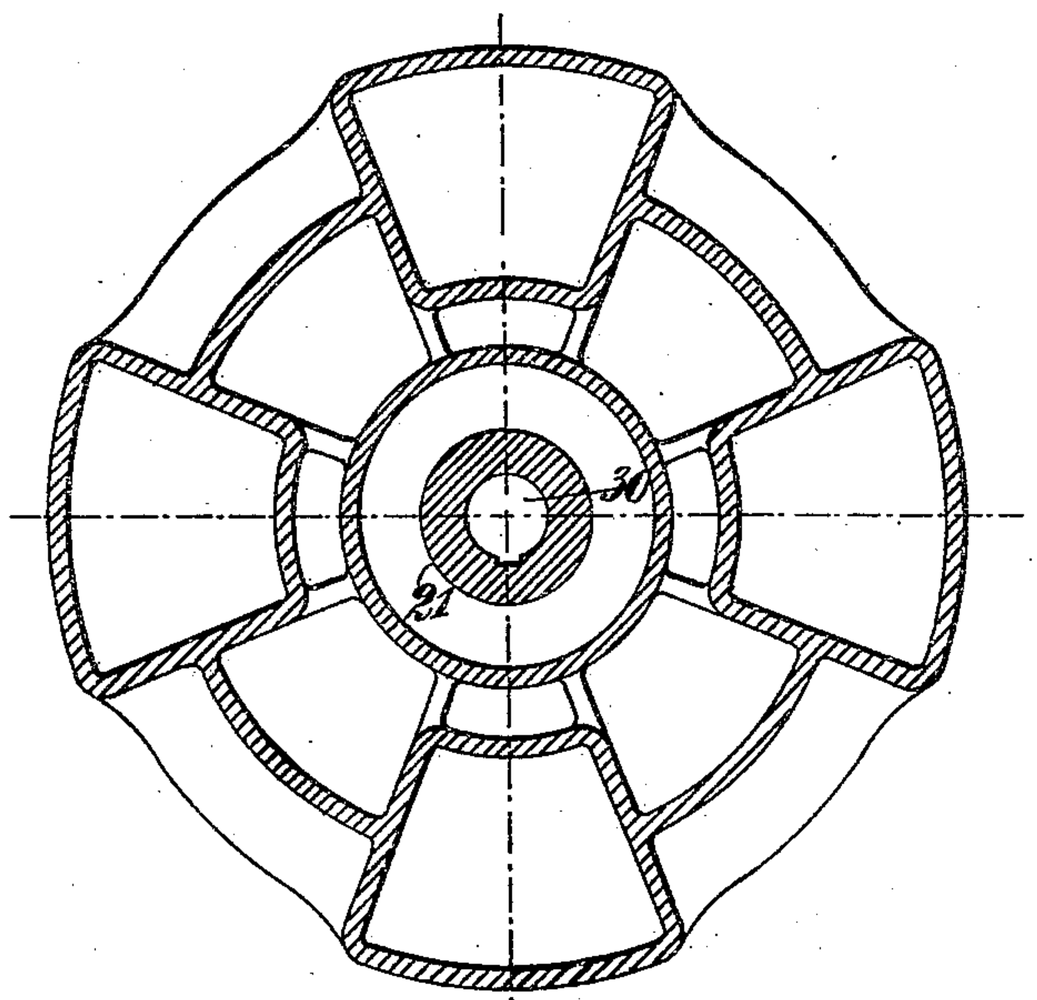


Fig. 3.



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EUGÈNE FÉLICIEN RAAB, OF LEVALLOIS-PERRET, FRANCE.

TURBINE.

935,403. Specification of Letters Patent. Patented Sept. 28, 1909.

Application filed January 22, 1907. Serial No. 353,574.

To all whom it may concern:

Be it known that I, EUGÈNE FÉLICIEN RAAB, a citizen of the French Republic, and a resident of Levallois-Perret, Seine, France, have invented certain Improvements in Fluid-Pressure Turbines, of which the following is a specification.

The object of this invention is to provide an improved turbine driven by steam, compressed air or other elastic fluid.

The invention applies to turbines working with single or multiple expansion, that is to say of the single or multi-stage type, and wherein the fluid circulates parallel to the shaft in directing passages or rings of directing buckets and in the rings of working buckets.

The invention consists in substance in keying or securing on the turbine shaft one or more rotating drums or wheels carrying or each carrying two series or sets of rings of helicoidal buckets said sets being adapted to drive the turbine in opposite directions, the buckets of adjacent rings being disposed alternately, that is to say, set in opposite directions, these rings of buckets being supplied with motive fluid by two series or sets of rings of fixed helicoidal distributing and directing buckets, the buckets of adjacent rings of these latter being likewise oppositely directed. According to the direction in which the turbine is to run, the motive fluid is led to one or other of these sets of fixed rings through a suitable arrangement of passages and partitions in such manner as to drive the shaft forward or backward. The supply of the motive fluid to the one or other of the systems of directing buckets can be controlled by a suitable distributer or device adapted to intercept the flow of the fluid to one of the systems directing buckets while leaving it free to the other and conversely.

In order to illustrate the invention I will describe by way of example and with reference to the accompanying drawings one form of reversible steam turbine constructed in accordance with the invention.

Figure 1 is a longitudinal section on the line of the shaft of the turbine. Fig. 2 is an end elevation showing the steam distributing plate and the annular arrangement of two sets of rings of buckets. Fig. 3 is a cross section of the turbine drum or runner on line X—X. Fig. 4 is a view showing a set of rings of directing and working buckets for reverse running. Fig. 5 is a view showing a set of rings of directing and working buckets for forward running.

In this example of turbine the steam can be admitted through ports or passages in a distributing plate 1 fixed on the exhaust box or casing 2 into two annular expansion chambers 13 and 14 opening respectively on to two rings or sets of fixed buckets 15 and 17 the buckets of these rings being oppositely directed with respect to each other. Two other rings of fixed buckets concentric with the two first mentioned and having their buckets set in corresponding directions to those of the two first named rings are provided.

The distributer plate 1 is formed at the center with a steam admission cylinder 3 in which works a slide valve, piston or the like 4 provided with openings adapted to open and close the proper series of a number of passages 5, 6, 7, 8, 9, 10, 11, 12, in the distributer plate 1 according to the direction in which the turbine is to run. These passages are in direct communication with the annular expansion chambers 13, 14.

The fixed distributer plate 1 is fitted inside with the two sets of rings of fixed directing buckets 15, 16 and 17, 18 these rings being respectively disposed in the concentric annular expansion chambers 14 and 19 and 13, 20.

The rotating member or runner consists of a cylindrical drum 21 fitted with two sets of rings of receiving working buckets, 22—23, these rings being respectively disposed or working in the four chambers 26—27 and 28—29 and the buckets of the respective sets are arranged in opposite directions so that the one set shall serve for forward and the other for backward working. The said central drum 21 is keyed on the turbine shaft 30 mounted in suitable bearings for example the ball bearings 31, 32. The sets of rings of working buckets correspond respectively with the sets of rings of directing buckets and their buckets are properly set for this purpose.

The steam passing through the directing buckets of the distributer plate 1 acts on the working buckets of the drum 21 and impel the turbine shaft 30.

The first set of rings of directing buckets 15, 16 and the corresponding rings of working buckets 22, 23 (Figs. 1, 4 and 5) serve for forward running while the second set of rings of directing buckets 17, 18 and the

corresponding rings of working buckets 24, 25 (Figs. 1, 4 and 5) which are oppositely directed to those of the first pair, serve for backward running.

According as it is desired to drive forward or backward the piston or valve 4 above mentioned will be moved in the admission cylinder 3 so as to admit either into the passages 5, 7, 9 and 11 in the distributer plate 1 for forward working or into the passages 6, 8, 10 and 12 of the distributer plate for backward running; the steam will thus travel as indicated by the full line arrows *a* for forward running and as indicated by the dotted arrows *b* for backward running. With this object the turbine drum 21 and the distributer plate 1 are provided with a suitable arrangement of partitions or the like so that the steam shall only be supplied to the rings of directing and working buckets which are to act for the particular direction of running.

It is to be understood that any suitable number of rings of working and fixed buckets may be employed, provided the buckets of the guiding and working rings for forward working are oppositely set to those of the rings for backward running.

What I claim and desire to secure by Letters Patent is:—

1. A reversible fluid turbine comprising a runner having buckets arranged in two groups, each group comprising a plurality of annular series, one within the other, the buckets of the respective groups being oppositely directed, and the annular series of one group alternating between the annular series of the other group and controllable means for supplying fluid under tension to the buckets of the respective groups, whereby such fluid may be supplied to the buckets of one group to compel movement of the runner in one direction, or to the buckets of the other group to compel reverse movement of said runner.

2. A reversible fluid turbine comprising a runner having buckets arranged in two groups, each group comprising a plurality of annular series, one within the other, the buckets of the respective groups being oppositely directed, and the annular series of one group alternating between the annular series of the other group, a stationary distributing element having directing channels arranged in two groups, each group comprising a plurality of annular series, one within the other, the said series of directing channels being, respectively, arranged alongside of and oppositely directed to the respective groups of buckets of the runner, and being adapted to discharge fluid under tension thereto, and controllable means for supplying such fluid to the respective groups of directing channels, whereby such fluid may be discharged from the channels of one group upon one group of buckets of the runner to compel movement of said runner in one direction, or from the channels of the other group upon the corresponding buckets of the runner to compel reverse movement of said runner.

3. A reversible fluid turbine comprising a runner having buckets arranged in two concentric annular groups, each of which comprises a plurality of annular series of buckets, the annular series of buckets in one group alternating between the annular series of the other group, and the buckets of the respective groups being oppositely directed, buckets of the respective series in each group being of capacities gradually increasing from the innermost to the outermost series, a stationary distributer element having directing passages arranged in two concentric annular groups each comprising a plurality of annular series of passages alongside of and oppositely directed to the buckets of one of the respective groups of the runner, controllable means for supplying fluid under tension to the innermost series of directing passages of the respective groups of the distributer element, and means for supplying the fluid discharged from the buckets of the innermost series of the respective groups of the runner to the outer series of the corresponding groups of directing passages of the distributer element.

4. A reversible fluid turbine comprising a runner having buckets in two groups, each group comprising a plurality of annular series of buckets, the buckets of the several series in each group being of capacities gradually increasing from the innermost to the outermost, the annular series of one group alternating between the annular series of the other group, and the buckets of the respective groups being oppositely directed, and controllable means for supplying fluid under tension to the buckets of the respective groups, whereby such fluid may be supplied to the buckets of one group to compel movement of the runner in one direction, and to the buckets of the other group to compel reverse movement of the runner.

5. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular series of buckets, one within the other, the buckets of the respective groups being oppositely directed, and the annular series of one group alternating between the annular series of the other group, controllable means for supplying fluid under tension to the initial series of buckets in each of said respective groups, and means connected with each group of buckets for directing the fluid passing one series of the buckets comprised in such group to the next adjacent series of buckets in the same group.

6. A reversible fluid turbine having a run-

ner provided with buckets in two groups, each group comprising a plurality of annular series of buckets, one within the other, the buckets of the respective groups being oppositely directed, the annular series of one group alternating between the annular series of the other group, and the buckets of the several series in each group being of capacities gradually increasing from the innermost to the outermost series, controllable means for supplying fluid under tension to the initial series of buckets in each of said respective groups, and means connected with each group of buckets for directing the fluid passing one series of the buckets comprised in such group to the next adjacent series of buckets in the same group.

7. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular series of buckets, one within the other, the buckets of the respective groups being oppositely directed, and the annular series of one group alternating between the annular series of the other group, controllable means for supplying fluid under tension to the initial series of buckets in each of said respective groups, passages produced in the runner and connected with the respective groups of buckets and each adapted to receive fluid passing one series of buckets in one of the respective groups, and means for directing the fluid from each such passage to the next adjacent series of buckets in the corresponding group.

8. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular series of buckets, one within the other, the buckets of the respective groups being oppositely directed, and the buckets of the several series in each group being of capacities gradually increasing from the innermost to the outermost series, controllable means for supplying fluid under tension to the initial series of buckets in each of said respective groups, passages produced in the runner and connected with the respective groups of buckets and each adapted to receive fluid passing one series of buckets in one of the respective groups, and means for directing the fluid from each such passage to the next adjacent series of buckets in the corresponding group.

9. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular series of buckets, one within the other, the buckets of the respective groups being oppositely directed, and the annular series of one group alternating between the annular series of the other group, and the buckets of one series in each group being of greater capacity than another series in the same group, controllable means for supplying fluid under tension to the buckets of least capacity in each group, and means connected with each group of buckets for directing the fluid passing one series of the buckets comprised in such group to a series of buckets of greater capacity in the same group.

10. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular series of buckets, one within the other, the buckets of the respective groups being oppositely directed, and the buckets of one series in each group being of greater capacity than another series in the same group, controllable means for supplying fluid under tension to the buckets of least capacity in each group, passages produced in the runner and connected with the respective groups of buckets and each adapted to receive fluid passing one series of buckets in one of the respective groups, and means for directing the fluid from each such passage to a series of buckets of greater capacity in the same group.

11. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular concentric series of buckets, the buckets of the respective groups being oppositely directed, distributing means comprising directing channels in two groups each comprising a plurality of concentric annular series, the series of directing channels of each group being, respectively, alongside of and oppositely directed to the series of buckets in one of the respective groups of the runner and being adapted to discharge fluid under tension thereto, controllable means for supplying fluid under tension to an initial series in each group of directing channels and means connected with each group of buckets for directing the fluid passing one series of buckets in such group to the directing channels opposite to the next adjacent series of buckets in the same group.

12. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular concentric series of buckets, the buckets of the respective groups being oppositely directed, distributing means comprising directing channels in two groups each comprising a plurality of concentric annular series of channels, the series of directing channels of each of the respective groups being alongside of and oppositely directed to the series of buckets in one of the respective groups of the runner and being adapted to discharge fluid under tension thereto, controllable means for supplying such fluid under tension to an initial series of directing channels of the distributing means, passages produced in the runner and connected with the respective groups of buckets and each adapted to receive fluid passing one series

of buckets in one of the respective groups, and means for supplying the fluid from each such passage to the directing channels opposite to the next adjacent series of buckets in the same group.

13. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular concentric series of buckets, the buckets of the respective groups being oppositely directed, and the buckets of one series in each group being of greater capacity than another series in the same group, distributing means having directing channels in two groups each comprising a plurality of annular series of channels concentric with each other, the series of directing channels in each group of the distributing means being alongside of and oppositely directed to the series of buckets in one of the respective groups of the runner and being adapted to discharge fluid under tension thereto, controllable means for supplying fluid under tension through one series of directing channels in each group to the buckets of least capacity in each group of the runner, and means connected with each group of buckets for directing the fluid passing one series of buckets in such group to the directing channels opposite to a series of buckets of greater capacity in the same group.

14. A reversible fluid turbine having a runner provided with buckets in two groups, each group comprising a plurality of annular concentric series of buckets, the buckets of the respective groups being oppositely directed, and the buckets of one series in each group being of greater capacity than another series in the same group, distributing means having directing channels in two groups each comprising a plurality of concentric series of channels, the series of directing channels in each group of the distributing means being alongside of and oppositely directed to the series of buckets in one of the respective groups of the runner and being adapted to discharge fluid under tension thereto, controllable means for supplying fluid under tension through one series of directing channels in each group to the buckets of least capacity in each group of the runner, passages produced in the runner and connected with the respective groups of buckets and each adapted to receive fluid passing one series of buckets in one of the respective groups, and means for supplying the fluid from each such passage to the directing channels of the distributing means which are opposite to a series of buckets of greater capacity in the same group.

15. A reversible fluid pressure turbine with multiple expansion comprising two drums arranged within each other, one of which carries two series or sets of annular bucket rings, the outer drum carrying the two series or sets of stationary directing bucket rings fixed in said drum and the inner movable drum carrying the two series or sets of receiving bucket rings which are also fixed within the said drum, the said series being set in opposite directions, the pressure fluid being admitted directly by means of a throttle valve into the respective expansion chambers, thus expanding through a series of directing buckets for producing power on one of the series of respective receiving buckets whence it escapes and is directed through the corresponding passages arranged within the movable drum to further expand through a second series of directing buckets corresponding to the first series, and so on, that is, to expand down as necessary to the extreme elasticity of the fluid.

16. A reversible fluid pressure turbine with multiple expansion, comprising two cylinders arranged within each other, each of which carries two series or sets of annular bucket rings, the respective bucket rings being set in opposite directions, a stationary distributer plate carrying at the center a fluid admission slide valve having two separate series of supply ports or passages ending within two series of annular expansion chambers provided within the outer drum and connecting directly with both series of directing buckets, which cause the fluid to expand about their periphery upon both series or sets of receiving buckets of the movable drum, for causing the rotation of the said drum in one direction or the other when the fluid is admitted through the respective admission ports into the other series of corresponding annular expansion chambers.

In witness whereof I have hereunto signed my name this 20th day of December 1906, in the presence of two subscribing witnesses.

EUGÈNE FÉLICIEN RAAB.

Witnesses:
H. C. Coxe,
Gabriel Belliard.