R. KOSTANJEVIC, J. MATZENIK & F. GESSI.

TURBINE.

APPLICATION FILED APR. 11, 1910.

969,541.

Patented Sept. 6, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

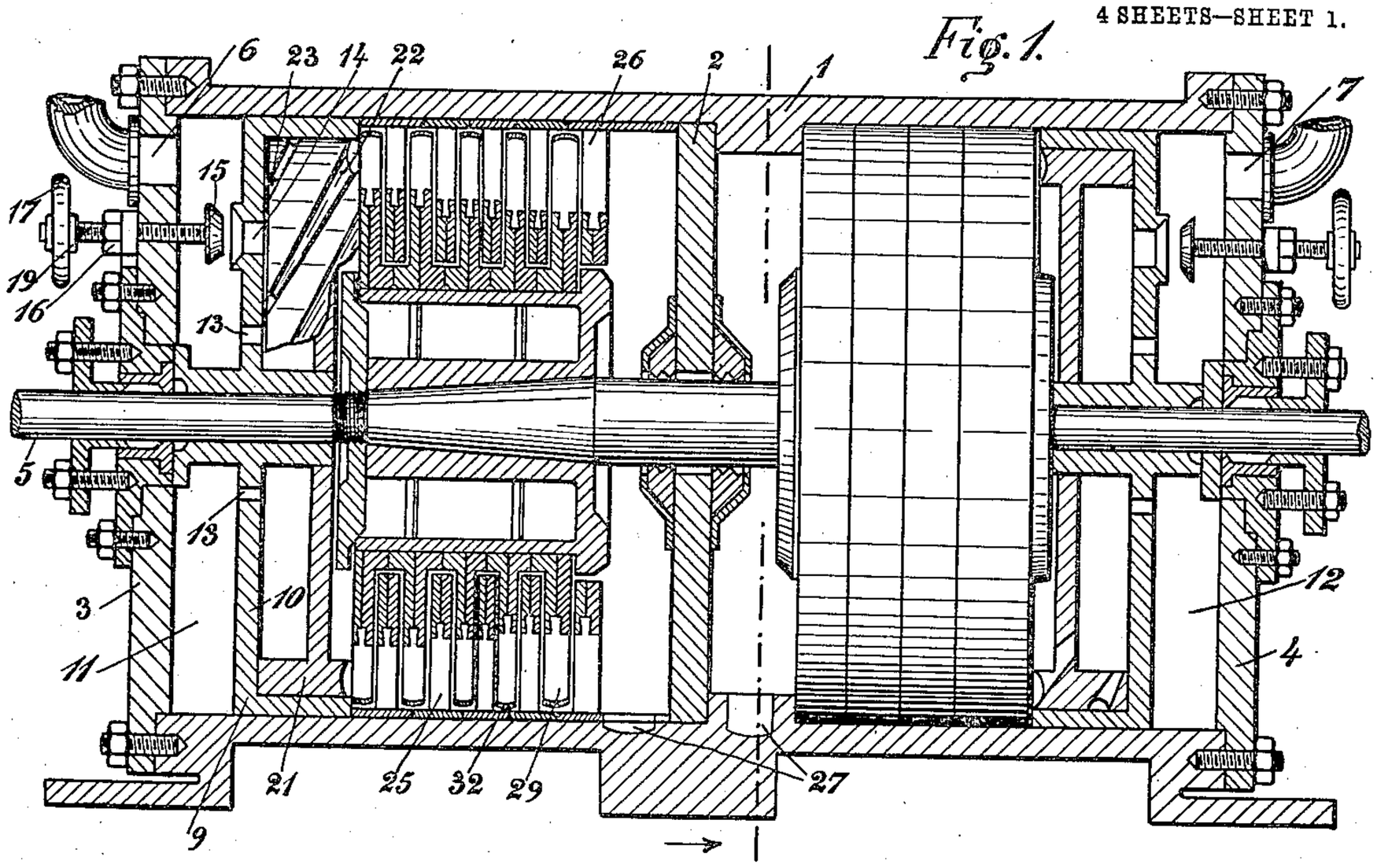


Fig. 2.

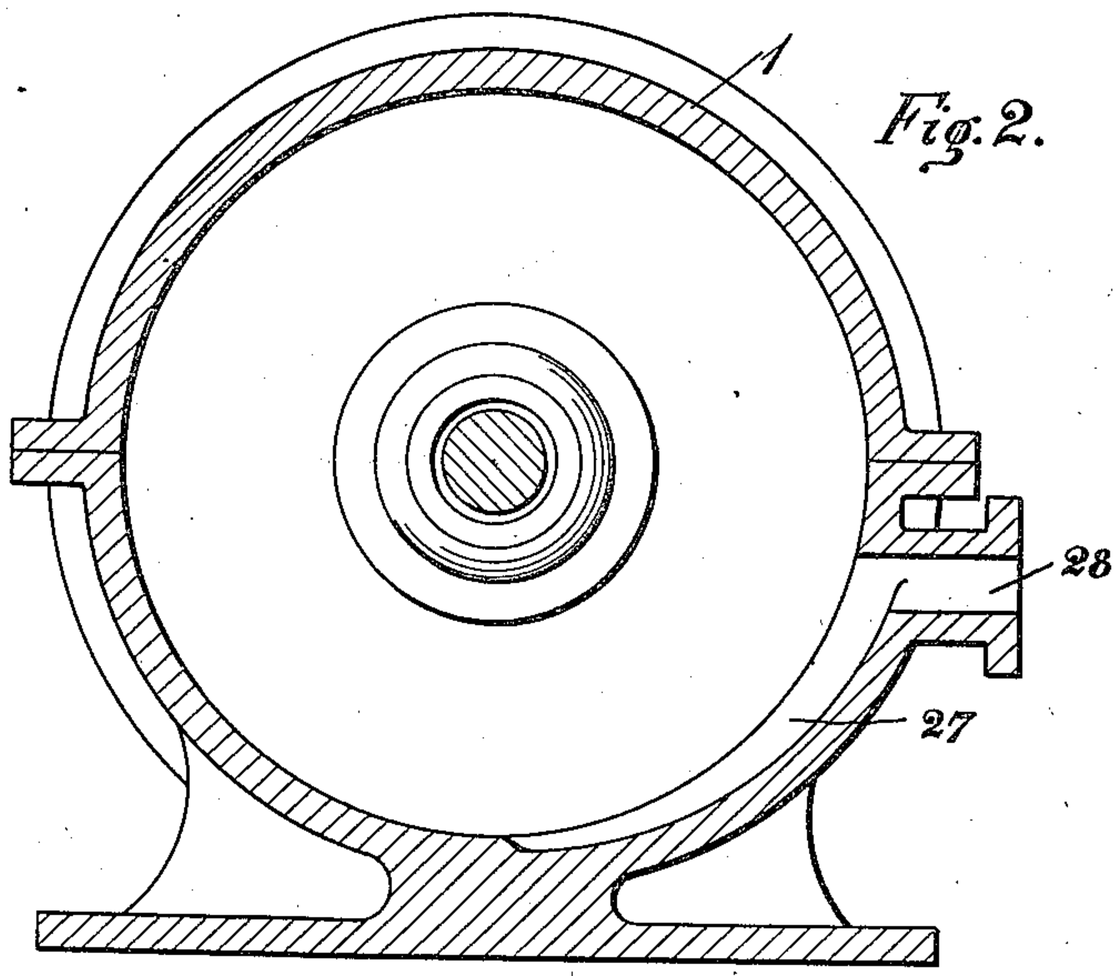
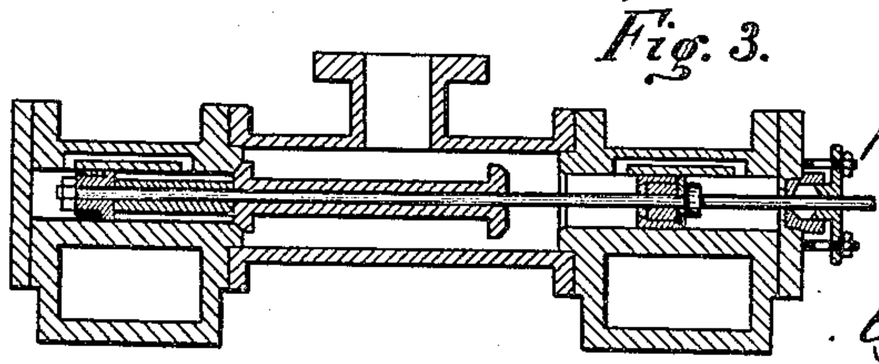


Fig. 3.



Witnesses,
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B. P. Fishburne

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Fig. 4.

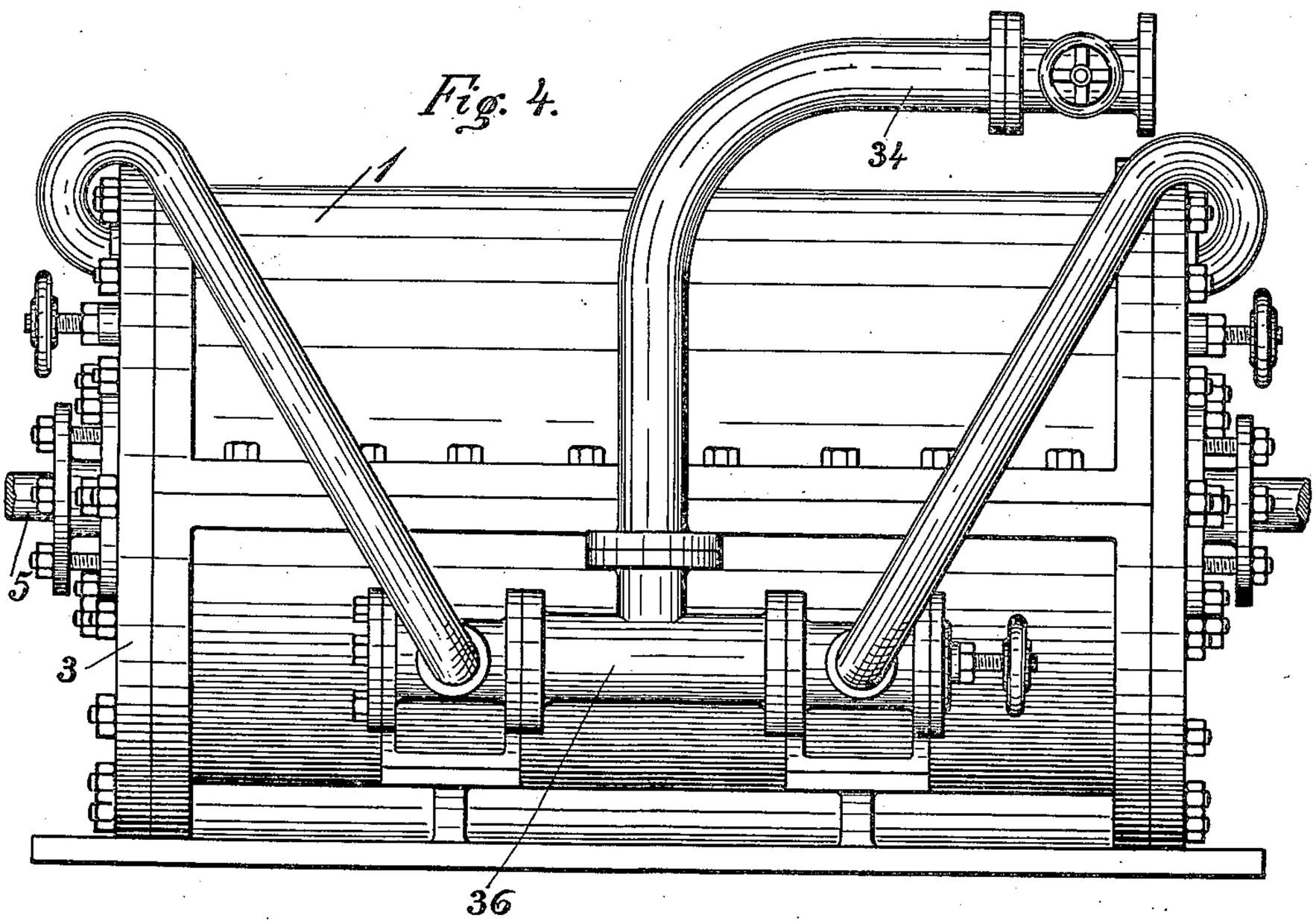
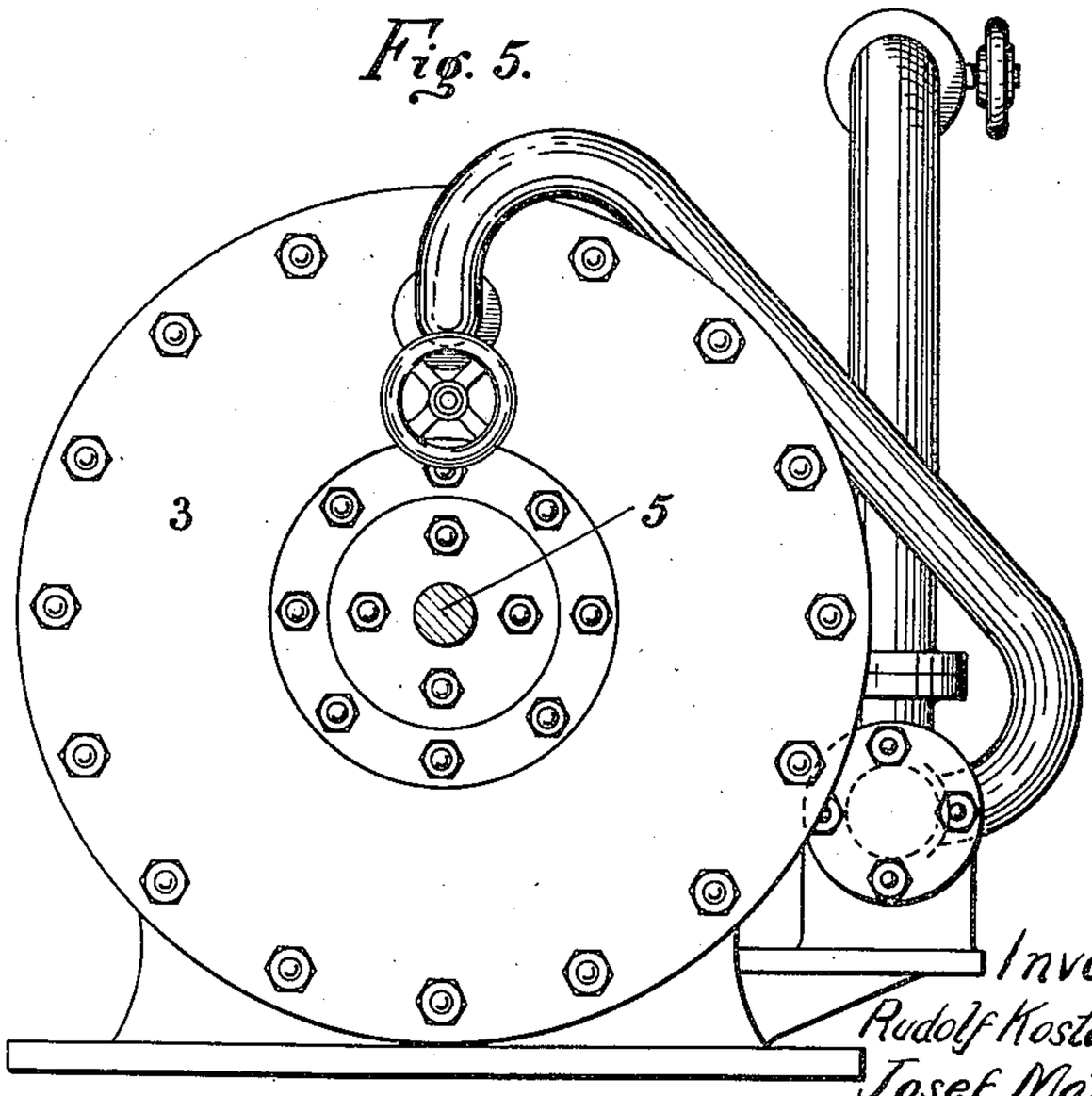


Fig. 5.



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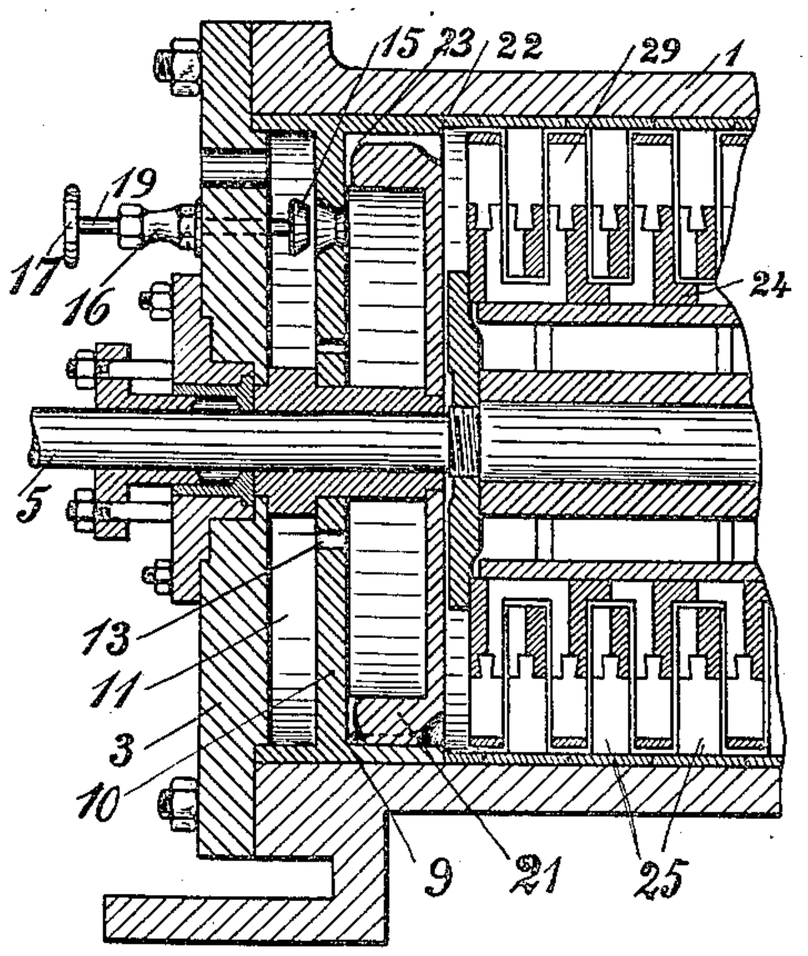

Fig. 6.

Fig. 7.

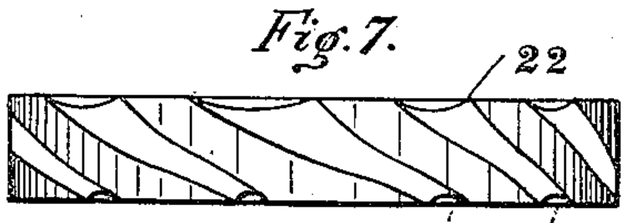

Fig. 8.

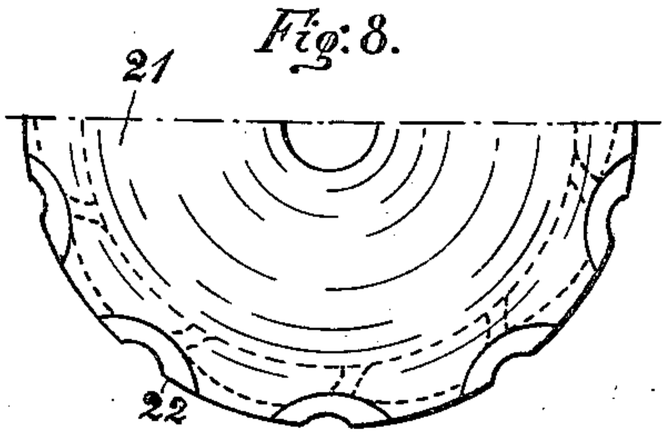

Fig. 9.

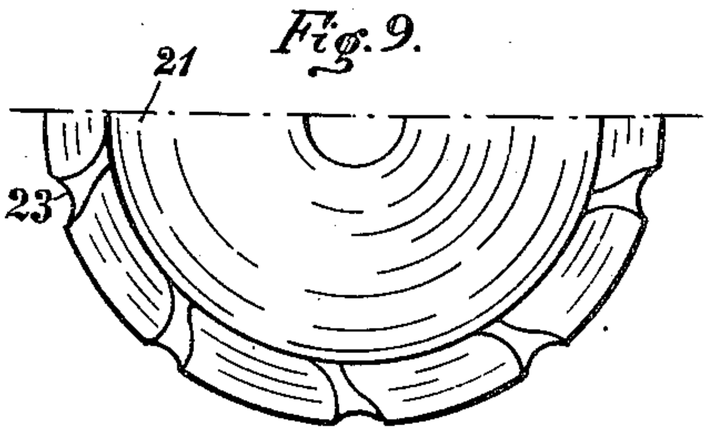

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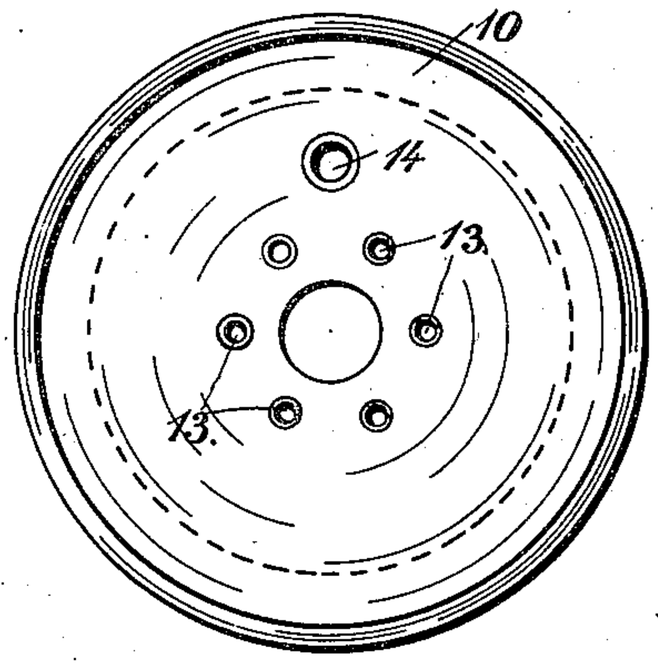
Fig. 10.



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4 SHEETS—SHEET 4.

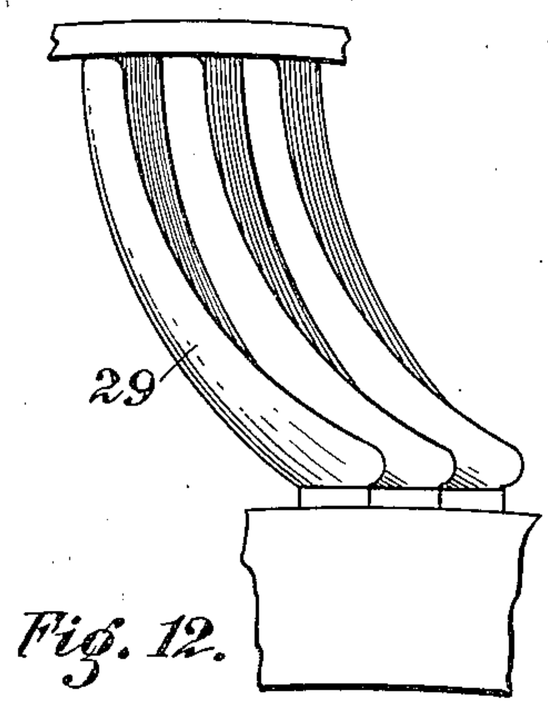

Fig. 12.

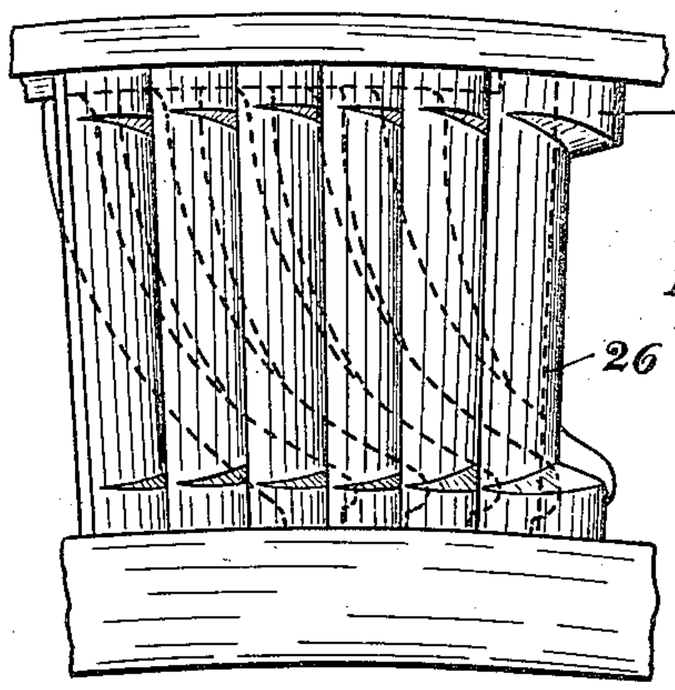

Fig. 15.

Fig. 11.

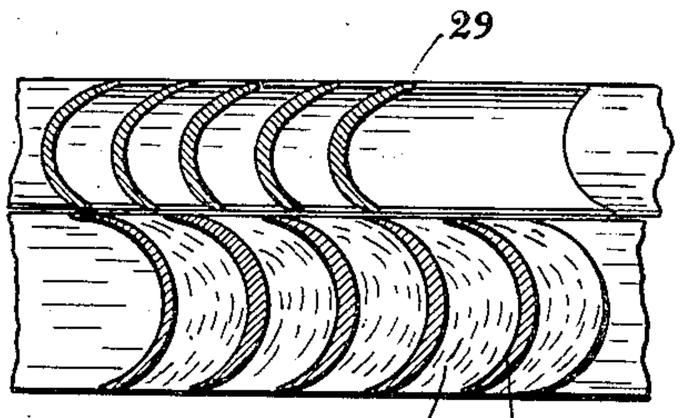

Fig. 16.

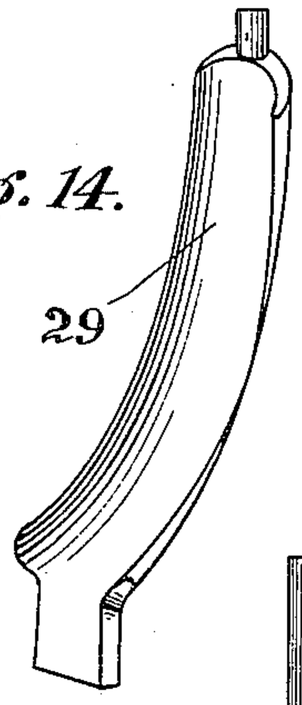

Fig. 14.

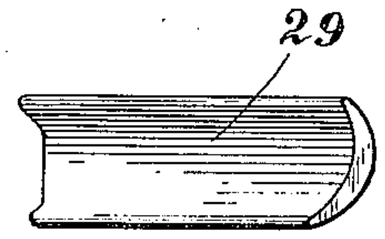

Fig. 13.

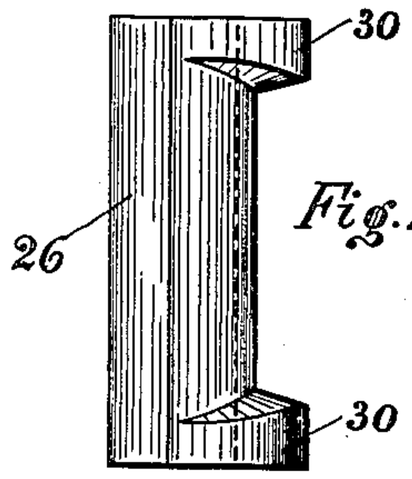

Fig. 17.

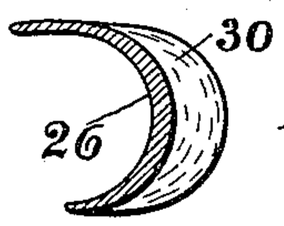

Fig. 18.

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UNITED STATES PATENT OFFICE.

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TURBINE.

969,541. Specification of Letters Patent. Patented Sept. 6, 1910.

Application filed April 11, 1910. Serial No. 554,866.

To all whom it may concern:

Be it known that we, RUDOLF KOSTANJEVIC, engineer, JOSEF MATZENIK, and FELIX GESSI, citizens of Austria, residing at Via Massimiliana 10A, Trieste, Austria-Hungary, have invented certain new useful Improvements in Turbines; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in turbines which are operated by an elastic fluid such for example as steam or the combustion gases of an explosive mixture. And the object of the improvements is to provide a machine in which the size of the operative parts is reduced to a minimum, while the efficiency is not decreased. For this purpose the parts of the engine are so constructed that the jet of the motive fluid is directed against the buckets about the whole circumference of the wheel and over the whole length of each bucket. Thereby the energy of the motive fluid is completely consumed within the engine and the size of the parts of the engine is decreased to a minimum. Obviously by thus consuming the energy in a perfect manner the strain on the elements of the engine is very great. Therefore the buckets are so constructed that jars are avoided almost entirely, for which purpose the motive fluid is caused to move over the buckets along a spiral path, so that it acts merely by reaction. The engine is further constructed in such a way, that it can be reversed, and that the efficiency is the same with the engine running in either direction.

For the purpose of explaining the invention an example embodying the same has been shown in the accompanying drawings in which the same letters of reference have been used in all the views to indicate corresponding parts.

In said drawings—Figure 1, is a vertical longitudinal section of the engine, Fig. 2, is a vertical cross-section of the same, Fig. 3, is a longitudinal section of the controlling apparatus for directing the motive fluid to either side of the turbine, Fig. 4, is a side view of the engine, Fig. 5, is an end view of the same, Fig. 6, is a vertical longitudinal section of the left hand part of the engine, Fig. 7, is a side view of the fluid distributing ring, Fig. 8, is a view of the same seen from the inlet side, Fig. 9, is a view of the same seen from the discharge side, Fig. 10, is a side view of the partition located between the admission chamber and the receiver or distributing chamber, Fig. 11, is a side view of a movable bucket, Fig. 12, is a side view of a plurality of buckets as assembled on their wheel, Fig. 13, is a view of a part of the bucket, Fig. 14, is a view of the bucket seen from the left in Fig. 11, Fig. 15, is a side view of a plurality of stationary vanes as assembled on their common support, Fig. 16, is a circumferential section of stationary and movable vanes, Fig. 17, is a side view of a stationary vane, and Fig. 18, is a cross-section of a stationary vane.

Referring to the example illustrated in the drawings, the turbine consists of a casing 1 of generally cylindrical form which is divided into two separate chambers by a partition 2. Through stuffing boxes provided in the cylinder heads 3 and 4, there extends the shaft 5 of the vaned wheels of the turbine. The said heads are formed with inlet ports 6 and 7 for the motive fluid. Substantially centrally of the cylinder and at both sides of the partition 2 discharge openings for the exhaust fluid are provided. Adjacent to the heads 3 and 4 and at suitable distances from the same cylinders 9, 9 are located within the cylinder 1, and the said cylinders 9, 9 are formed with end plates 10. Between the latter and the cylinder heads 3 and 4 admission chambers 11 and 12 for the motive fluid are provided. The end plate 10 of the cylinder 9 is formed with a plurality of openings 13, 13 through which so much gas or steam is admitted to the wheels as is required under the minimum load of the engine. Apart from the said openings a large aperture 14 is formed in the end plate 10 which can be closed to a greater or less degree by means of a valve 15. The stem 19 of the valve 15 projects to the outside through a stuffing box 16, and at

its free end it is provided with a hand wheel 17. At a suitable part the said stuffing box is internally screw threaded, and the valve stem 19 is provided with corresponding screw threads, whereby the stem can be axially displaced by turning the hand wheel. Thereby the valve 15 is adjusted relatively to its seat provided in the end plate 10 of the cylinder 9, so that the supply of the motive fluid can be regulated according to the load of the engine. Internally the cylinder 9 provides a second chamber which acts as a receiver or distributing chamber for the motive fluid wherein the latter is stored before being admitted to the wheels. For this purpose the hollow of the cylinder is closed against the chamber inclosing the vaned wheels, by means of a ring 21 which at the side adjacent to the vaned wheels is formed with an end plate.

About its circumference the cylinder is formed with spiral grooves 22 which gradually diverge toward the first wheel, and are deepened toward their discharge ends, so that the radial dimension of their discharge ends corresponds substantially to the length of the buckets of the first wheel. In combination with the wall of the cylinder 21 the said grooves 22 provide the jet ports through which the motive fluid is directed against the buckets of the first wheel. The inlet portions to the said grooves 22 communicate with the receiver formed by the cylinder 21 by radial grooves 23, so that communication is established between the receiver and the chamber inclosing the wheels. The apparatus described has the function of distributing the motive fluid in such a way that it is admitted over the entire circumference of the first wheel. To the shaft 5 a plurality of vaned wheels 24 are secured. The construction of the wheels and the manner of mounting the same on the shaft is known in the art and needs no detailed description. Between successive wheels an annular space is provided and within the said space a stationary vaned ring 25 is located. As shown the said ring comprises a plurality of radial vanes 26 which are secured to the inner wall of the cylinder 1. The construction of the said vanes will be described hereinafter. At the rear of the last one of the wheels 24 there is a chamber which is separated from the adjacent section of the engine by the partition 2, and which communicates with the exhaust 28 through a spiral channel 27. The section of the engine which is disposed within the second chamber of the cylinder is constructed in the same way as the section described above, so that the whole engine may be said to be a double engine.

Only one of the sections of the engine can be started at a time, with the exclusion of the other one, the admission ports of the second engine being directed in opposition to those of the first engine. In the same way the buckets of the wheels of the second section are arranged in opposition to those of the first section. The buckets 29 of the wheels 24 have a curved form and a concave inner face, so that the motive fluid admitted thereto would have the tendency to leave the buckets at the points which are opposite to the inlet ports. But each bucket is further twisted with its cavity along a spiral line, so that the fluid which enters the bucket at its outer end is forced to pass along the bucket from the outer end toward the inner end of the same where it is discharged. Thereby any impact is avoided, because during its passage along each bucket from the outer end to the inner end of the same the motive fluid is thrown against walls which are on different sides of the buckets. Thereby the jar which is exerted on the outer end of the bucket is in a large degree balanced by the reaction of the motive fluid at the inner end of the bucket. As the engine is an axial turbine the axial thrust which in machines of ordinary construction acts in one direction is largely balanced, whereby losses in energy are avoided such as are found in axial turbines of ordinary construction, and which decrease the efficiency of such engines.

The stationary vanes are constructed in the form of straight rods having substantially the form of a cylinder segment. The convex side of each of the said vanes is formed with enlarged rims 30 at its outer and inner ends, and the inner faces of the said rims converge toward the discharge side of the bucket. The said enlarged rims have also the function of separating successive vanes from each other, and the portion of the vane which is located between the said enlarged rims and the concave side of the adjacent vane forms the port through which the motive fluid discharged from one bucket is directed against the buckets of the next wheel. By constructing the rims 30 in such a way as to converge with their inner faces toward the following wheel, the motive fluid is slightly compressed before being discharged into the said wheel, whereby it enters the said wheel at an increased speed. As is usual in engines of this class the buckets of the wheels are gradually enlarged toward the exhaust side, because the decrease in the pressure of the fluid during its passage through the turbine must be compensated by increasing the working surfaces of the wheels. For the same reason the length of the ports of the stationary vanes must be successively increased. At their ends the

buckets of the wheels are provided with trunnions whereby they are secured to their support which may be a ring 32 laid around the wheel or the hub on the shaft 5. The said trunnions are so located that the buckets are not disposed radially but at an angle to the radially disposed inlet ports, so that each bucket of the wheel 2 crosses several of the inlet ports. Thereby the motive fluid discharged from each inlet port is supplied at the same time to a plurality of the buckets and on different parts of their length. Thereby the motive fluid is utilized in a most perfect way.

The motive fluid is supplied to the engine through a pipe 34 which through branch pipes is connected with both admission channels of the engine. The said pipe is provided with a fluid controlling device 36 which connects the main pipe either with the left hand side or with the right hand side of the engine. The exhaust openings of the engine are connected with an exhaust pipe 37. The controlling apparatus may be constructed in any known or preferred way, and it needs no detailed description. It may be remarked, that the said controlling device is equipped with self-discharging valves.

If the motive fluid is an explosive gas the mixture of the explosive gas is preferably prepared and explosion effected in a separate chamber, while the gases of high pressure are supplied to the engine. The said explosion chamber may be constructed in any preferred way.

The operation of the engine is as follows: After the controlling apparatus 36 has been set for example in such a way as to connect the left hand side of the engine with the fluid supply, the motive fluid is admitted to the chamber 11 from which it is discharged through the openings 13, 13 provided in the partition 10 into the distributing chamber. From the latter it flows through the spiral channels 22 against the first wheel, so that the engine is slowly started. From the first wheel the motive fluid is discharged into the first set of stationary vanes about the entire circumference of the latter. By simultaneously increasing its pressure the fluid enters the second wheel with an increased speed, and thus the fluid flows gradually through all the wheels and stationary vanes, until it is discharged from the last wheel to the exhaust. As soon as the machines coupled to the engine are thrown into operation the valve 15 is opened by turning the hand wheel 17 in such a direction as to unseat the valve. By means of the said valve the supply of the motive fluid to the receiver of the distributing chamber can be so controlled that only so much of the motive fluid is admitted to the receiver or the distributing chamber as is required in order to maintain the maximum efficiency of the engine under its load.

Claims:

1. In an elastic fluid turbine, the combination with a casing, and a movable vaned wheel, of partitions within said casing providing an admission chamber and a distributing chamber, and a distributing ring located adjacent to said vaned wheel and formed with spiral channels communicating with said distributing chamber and discharging toward the vaned wheel.

2. In an elastic fluid turbine, the combination with movable vaned wheels, of a stationary ring disposed between said wheels, and vanes on said stationary ring, said vanes being formed at their sides with enlarged rims fitting on the adjacent vane and converging with their inner faces toward the discharge side of the vanes.

3. In a machine of the character described, a casing, means to form admission and distributing chambers therein, rotatable vaned wheels disposed within said casing, and distributing rings one for each of said distributing chambers located adjacent to said vaned wheels and formed with spiral ports communicating with said distributing chambers and discharging toward the vaned wheels respectively.

4. In an elastic fluid turbine, the combination with a casing, and a movable vaned wheel, of partitions within said casing providing an admission chamber and a distributing chamber, and a distributing ring located adjacent to said vaned wheel and formed with spiral channels communicating with said distributing chamber and discharging toward the vaned wheel, said admission and distributing chambers communicating with each other through apertures the cross-sections area of which is sufficient to supply the motive fluid required for the minimum load of the turbine, and means to establish further communication sufficient to supply the motive fluid required under heavier loads.

5. In an elastic fluid turbine, the combination with a casing comprising two independent chambers, and movable vaned wheels located one in each of said chambers and mounted on the same shaft, of partitions within each of said chambers providing admission chambers and distributing chambers, and distributing rings one for each of said chambers located adjacent to said vaned wheels and formed with spiral ports communicating with said distributing chambers and discharging toward the vaned wheels respectively, the said channels and the vanes

on said vaned wheels being arranged in opposition to each other in both chambers.

6. In a machine of the character described, a casing, means to divide the same into admission and distributing chambers, a distributing ring disposed within said distributing chamber and provided with channels, and a vaned rotatable wheel disposed within said casing near said distributing ring.

7. In a machine of the character described, a casing having an admission chamber, a distributing ring disposed within said casing, and provided with channels, and a rotatable vaned wheel disposed within said casing near said ring.

In testimony whereof we hereunto affix our signatures in the presence of two witnesses.

RUDOLF KOSTANJEVIC.
JOSEF MATZENIK.
FELIX GESSI.

Witnesses:
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G. H. MECOZZI.