J. BLAEKER.

STEAM TURBINE.

APPLICATION FILED JULY 5, 1910.

997,264.

Patented July 11, 1911.

2 SHEETS—SHEET 1.

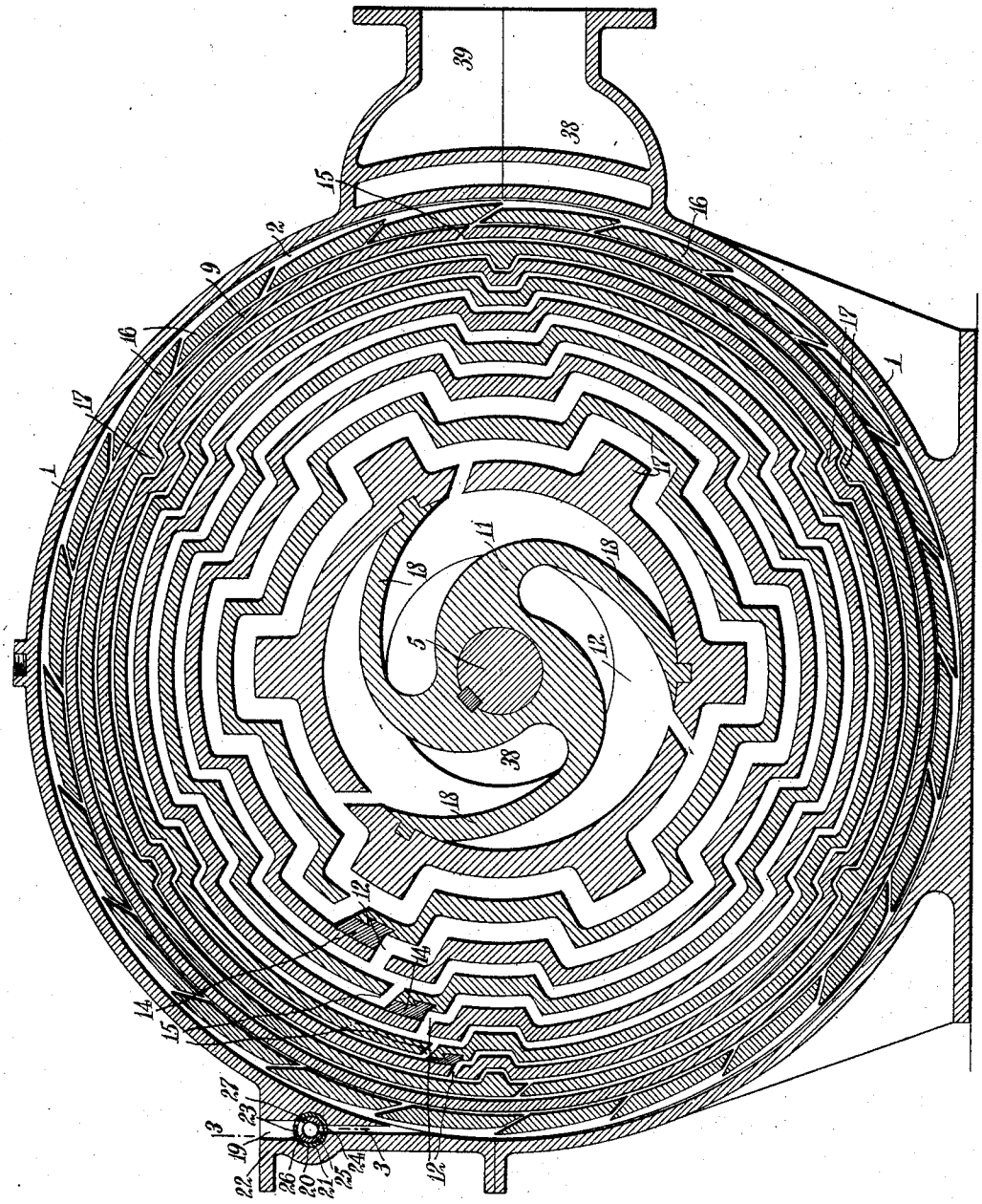

Fig. 1.

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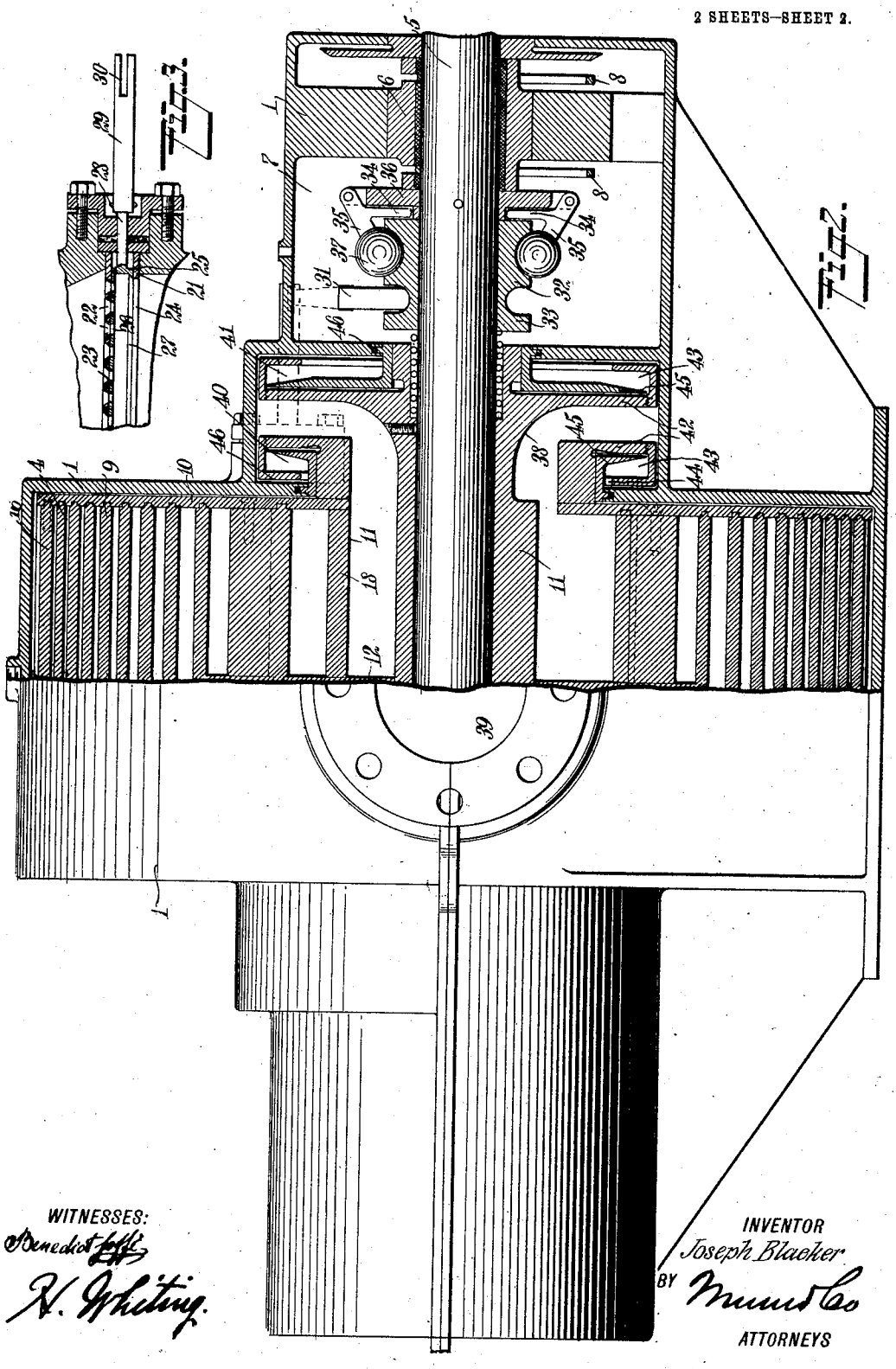

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JOSEPH BLAEKER, OF NEW YORK, N. Y.

STEAM-TURBINE.

997,264. Specification of Letters Patent. Patented July 11, 1911.

Application filed July 5, 1910. Serial No. 570,293.

To all whom it may concern:

Be it known that I, JOSEPH BLAEKER, a subject of the Czar of Russia, and a resident of the city of New York, borough of Brooklyn, in the county of Kings and State of New York, have invented a new and Improved Steam-Turbine, of which the following is a full, clear, and exact description.

This invention relates to a new and improved steam turbine, and is an improvement on my application Serial No. 535,578, filed December 30, 1909.

An object of this invention is to provide a turbine which will be economical in the use of steam, slow in speed, compact in form, strong, durable, and easily operated.

A further object of this invention is to provided a turbine with a rotor, to which the steam is admitted at the periphery and exhausted at the center, said rotor comprising a plurality of stages having gradually-increasing steam passages advancing from the periphery to the center, with abutments increasing in size from the periphery to the center, so that the operating fluid, such as steam, as it decreases in pressure will have an increased abutting surface to impinge on, thereby maintaining the turning moment uniform throughout the rotor.

A further object of this invention is to provide a turbine with one or more hydraulic locks interposed between the stationary and the moving parts, whereby the high-pressure steam is prevented from escaping into the exhaust, and whereby the air is prevented from entering the turbine when it runs condensing.

A still further object of this invention is to provide a rotor with a nozzle for admitting steam to said rotor, and an automatic control of great delicateness for said nozzle.

These and further objects, together with the construction and combination of parts, will be more fully described hereinafter and particularly set forth in the claims.

Reference is to be had to the accompanying drawings forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the views, and in which—

Figure 1 is a vertical transverse section; Fig. 2 is a side view in elevation, partly in longitudinal section along the shaft; and Fig. 3 is a fragmentary detail section on the line 3—3 of Fig. 1.

Referring more particularly to the separate parts of the device, 1 indicates a casing, which is provided with an enlarged cavity 2, in which is adapted to rotate a rotor 4, secured in any well known manner to a shaft 5, which is journaled in suitable bearings 6 in the casing 1. Located in juxtaposition to these bearings 6, there are provided oil chambers 7, which are adapted to oil the bearings, and for this purpose, there are provided dipping rings 8, which carry the oil up to the bearings.

The rotor 4 comprises a plurality of concentric cylinders 9, secured to side plates 10 in any suitable manner, as by means of circular projections, which fit in corresponding grooves in the side plates, and a central spider 11. It will be noted that the side plates are of greater diameter than the intermediate portion of the rotor, so that they will first come in contact with the casing in the event of the Babbitt metal in the bearings 6 wearing out, so that the operator may be warned of this fact, without appreciably damaging the rotor.

If desired, the rotor as a whole may be divided into two parts by an intermediate partition, indicated at 12, so as to balance the end thrust, or this partition may be limited to only the spider 11, and thus have a sufficient balancing force to eliminate the end thrust. It will be noted that the concentric cylinders 9 are spaced apart varying amounts, increasing in size from the periphery toward the center; that is to say, every second cylinder is spaced apart from the next adjacent inner cylinder by an increased distance, so as to form a larger passage therebetween. By this means, a plurality of stages are formed, the passages of which increase in dimensions from the periphery to the center. Each of these stages, however, is divided into other stages, the passages of which are of like dimensions, so that the steam will circulate at least twice in each expanding stage before it is expanded into the next expanding stage. The connection between each expanding stage and the next expanding stage is formed by passages 12, which are preferably arranged radially, and are provided with obstructions 14 at their back sides, so as to prevent the steam, in expanding, from traveling in the reverse direction.

The passages 12 and the obstructions 14 may, if desired, be congregated together on one side of the rotor and the rotor balanced

on the opposite side to take care of this eccentric weight in any suitable manner, as for example, by cutting a circular groove in each end plate at a predetermined distance from the center and inserting in this groove segments of a circular ring, some of which may be made of a heavier metal, so as to counteract the eccentric pull on the rotor; or, the passages 12 and the obstructions 14 may be uniformly distributed in balanced relation about the center of the rotor.

The equal stages in each expanding stage are connected by passages 15, which are preferably inclined in the direction of rotation, so that the steam, in passing from one stage to the other, will not tend to travel in the reverse direction. If any steam should be drawn through again by the injector action, there will be no appreciable loss, inasmuch as it will merely circulate a second time.

It will be noted that the outermost cylinder is divided up into buckets 16, of comparatively little surface, so that the steam which comes at a high velocity will be retarded an inappreciable amount, whereby the rotor will be permitted to rotate at a comparatively slow speed. It will be seen that the next adjacent inner cylinder is perfectly plain, so that it will absorb little or none of the steam energy except that due to the constant changing of the path of the steam. The remaining cylinders, however, are provided with abutments 17, forming a dip and a rise, whereby the steam, in impacting against these abutments, will impart some of its energy to the rotor. It will be noted that these abutments gradually increase in size and surface from the periphery toward the center, so that, as the steam decreases in pressure in passing from one expanding stage to another, it will abut against increasing surfaces, so that the turning moment due to the pressure on the area will be substantially balanced at all points of the rotor. This is further made possible by the abutments 17 being located symmetrically around the rotor. From the last stage of expansion the steam passes to the spider 11, which is provided with curved arms 18, whereby the last energy of the steam is absorbed.

Inasmuch as it is an object of this invention that the rotor should gradually absorb the energy of the steam by having a large number of small impacts, so that the speed of the rotor will be comparatively slow, if it is found that the arrangement as described provides too many abutments, more of the outer cylinders may be made plain, thus enabling the rotor to absorb the energy of the steam in a more gradual manner.

The steam or other motive fluid is admitted to the casing 1 by means of a nozzle similar to that described in my application, above-mentioned, such that it starts with a tubular pipe, the sides of which contract toward each other in one direction and expand from each other in the opposite direction, so as to form a long, narrow slot. This inlet nozzle is indicated at 19 in Fig. 1, and preferably extends tangentially of the casing, so as to act tangentially on the buckets 16.

For the purpose of controlling the flow of steam through the nozzle 19, I provide a valve 20, which consists of a stationary tube 21, having a plurality of openings 22, which let into the boiler side of the nozzle. These openings are arranged in pairs, with a rib 23 extending lengthwise of the tube, so as to form a member against which the steam may react. This tube 21 is also formed at its lower side with a slot 24, which lets into the turbine side of the nozzle 19.

Slidingly mounted in the tube 21, there is provided a concentrically-arranged tube 25, which has openings 26 in its upper side, adapted to be brought in opposition to the openings 22, and of sufficient width to embody the pairs of openings, so that there is no longitudinal bar corresponding to the bar 23, thus there is no back pressure on the moving element. This tube 25 is also provided with a slot 27 on its lower side, which extends in alinement with the slot 24 in the tube 21. It will thus be seen that a short movement of the tube 25 relative to the tube 20 will make a slight change in the alinement of each of the openings 26 with the openings 22, but inasmuch as this slight change is multiplied by the number of openings, the change in the volume of steam admitted will be quite great.

For the purpose of operating this valve automatically, there is provided on the tube 25 a spindle 28, which has an extension 29, bifurcated at 30 to receive a link 31, which extends into the oil chamber 7 and is operated by a governor 32. This governor 32 consists of a shifter 33, which engages the link 31, and is in turn engaged by arms 34 of bell crank levers 35. These bell crank levers are pivoted to a collar 36 on the shaft 5, and are provided at their opposite ends with weights 37, whereby they will be flung outwardly when the shaft rotates at a high speed. It will thus be seen that when the shaft rotates to an extent greater than is desired, the weights 37 will be flung outwardly, thereby shifting the valve, so as to shut off a portion of the steam. If the speed should be reduced to an extent lower than that desired, the valve will automatically be opened by the weights falling toward the center of the shaft. The steam from the nozzle 19, after passing through the various stages of the rotor, passes out through passages 38 to the exhaust 39.

It is to be noted that while the motive fluid, such as steam, is shown as traveling from the periphery toward the center, I may just as well reverse the direction of travel and cause the steam to enter at the center and exhaust at the outer circumference. In such an event the passages and abutments will be smallest at the center and gradually increase to a maximum at the periphery.

For the purpose of preventing the high-pressure steam from forcing its way into the exhaust passages 38, there is provided a hydraulic lock 40, and for the purpose of preventing the exhaust steam from passing into the oil chamber 7, there is provided a hydraulic lock 41. Inasmuch as these hydraulic locks are the same, only one will be described.

The hydraulic lock consists of a fly wheel 42 secured in any well known manner to the rotor, so as to rotate therewith and provided with a peripheral channel 43, which is open at one side at 44, so that the water, with which the casing is provided in any suitable manner, can be scooped up by the fly wheel 42 during its rotation. It will thus be seen that when the fly wheel 42 is rotating at a high speed, it will scoop up a considerable amount of water and hold it throughout its circumference against its periphery, by reason of the viscosity of the liquid and the centrifugal force due to the rotating fly wheel. Secured to each of these fly wheels, there is provided a knife-edge ring 45, which divides the peripheral layer of water in the channel 43 into two parts, one of which is in contact with the high-pressure steam and the other of which is in contact with the low-pressure steam. This ring, which is stationary in the fly wheel, has a tight packing joint formed with the stationary casing 1, by means of a soft metal ring 46, which is interposed between them. It will be seen that the knife-edge ring 45 tapers on the exhaust side, so that the passage is gradually constricted. It will thus be seen that the high-pressure steam not only has to overcome the centrifugal force of the water and force it out of the passage formed between the flat side of the knife-ring and the fly wheel, but also has to compress or endeavor to compress the water between the narrowing sides of the remainder of the channel and the exhaust side of the knife ring. It will thus be seen that practically steam-tight hydraulic locks are provided between the high-pressure steam and the exhaust, and between the exhaust and the oiling chamber.

The operation of the device will be readily understood when taken in connection with the above description. The steam is admitted by the valve 20 into the casing 1 in a long narrow stream, where it strikes the buckets 16 tangentially and imparts a small amount of its energy thereto. From the buckets 16, it passes into the outer passages between the outer cylinders and circulates inwardly, imparting small amounts of its energy to the rotor, and gradually advancing in successive stages from the periphery to the center. In each expanding stage, the steam is expanded through the nozzle passages 12 into the next succeeding larger passage. In passing from the periphery to the center, the steam gradually loses its pressure and comes in contact with abutments which increase in size and area, so that substantially equal torque is applied to the rotor at all points. After passing from the last expanding stage, it passes in contact with the spider 11, which absorbs the remaining energy therein. From the spider, the steam passes out to the exhaust passage 38 to the exhaust 39. The hydraulic lock 40 absolutely prevents the high-pressure steam from seeping or forcing its way into the exhaust, and the hydraulic lock 41 prevents the exhaust steam from forcing its way into the chamber 7.

If for any reason, such as a light load on the shaft 5, the rotor should tend to speed up beyond the desired limit, the governor 32 will automatically control the valve 20, so as to lessen the amount of steam passing therethrough. When the load on the shaft increases, and a larger amount of steam is desired, the weights 37 will be automatically forced toward the shaft 5, so that the valve will be opened the amount necessary to admit steam for the extra load.

While I have shown one embodiment of my invention, I do not wish to be limited to the specific details thereof, but desire to be protected in various changes, modifications and alterations which may come within the scope of the appended claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:—

1. In a turbine, the combination with a casing, of a shaft rotatably supported in said casing, and a rotor connected to said shaft, said rotor comprising a plurality of concentrically-arranged cylinders spaced apart from each other so as to form motive-fluid passages therebetween, the dimensions of said passages increasing in size in successive stages extending from the periphery toward the center.

2. In a turbine, the combination with a casing, of a shaft rotatably supported in said casing, and a rotor connected to said shaft, said rotor comprising a plurality of concentrically-arranged cylinders spaced apart from each other so as to form motive-fluid passages therebetween, the dimensions of said passages increasing in size in successive stages extending from the periphery toward the center, each of said stages com-

prising a plurality of said passages of substantially the same dimensions.

3. In a turbine, the combination with a casing, of a shaft rotatably supported in said casing, and a rotor connected to said shaft, said rotor comprising a plurality of concentrically-arranged cylinders, spaced apart from each other so as to form motive-fluid passages therebetween, said cylinders having projecting abutments thereon forming impact surfaces for the motive fluid to react on, said abutments gradually increasing in size and area from the periphery of the rotor to the center.

4. In a turbine, the combination with a casing, of a shaft rotatably mounted in said casing, and a rotor on said shaft, said rotor comprising side plates, a plurality of buckets secured to said side plates, a plurality of concentrically-arranged cylinders secured to said side plates, and a spider secured to the innermost of said cylinders.

5. In a turbine, the combination with a casing, of a shaft rotatably mounted in said casing, and a rotor on said shaft, said rotor comprising side plates, a plurality of buckets secured to said side plates, a plurality of concentrically-arranged cylinders secured to said side plates, and a spider secured to the innermost of said cylinders, each succeeding cylinder extending from the periphery to the center being spaced apart increasing amounts so as to form successive expanding stages in which the steam expands from a high pressure to a lower pressure at an increased volume.

6. In a turbine, the combination with a casing, of a shaft rotatably mounted in said casing, and a rotor on said shaft, said rotor comprising side plates, a plurality of buckets secured to said side plates, a plurality of concentrically-arranged cylinders secured to said side plates, and a spider secured to the innermost of said cylinders, each succeeding cylinder extending from the periphery to the center being spaced apart increasing amounts so as to form successive expanding stages in which the steam expands from a high pressure to a lower pressure at an increased volume, each of said stages having a passage connecting it with the next succeeding passage.

7. In a turbine, the combination with a casing, of a shaft rotatably mounted in said casing, and a rotor on said shaft, said rotor comprising side plates, a plurality of buckets secured to said side plates, a plurality of concentrically-arranged cylinders secured to said side plates, and a spider secured to the innermost of said cylinders, each succeeding cylinder extending from the periphery to the center being spaced apart increasing amounts so as to form successive expanding stages in which the steam expands from a high pressure to a lower pressure at an increased volume, each of said stages having a passage connecting it with the next succeeding passage, and having obstructions located at the back side of said last-mentioned passage to prevent the motive fluid from traveling in the wrong direction.

8. In a turbine, the combination with a casing, of a shaft rotatably supported in said casing, a rotor connected to said shaft, said rotor having a plurality of concentric passages of step-by-step increasing size so as to form expanding stages, each of said stages comprising a plurality of passages of the same size, and angularly-disposed passages for connecting each passage with the juxtaposed passage.

9. In a turbine, the combination with a casing, of a shaft rotatably supported in said casing, a rotor connected to said shaft, said rotor having a plurality of concentric passages of step-by-step increasing size so as to form expanding stages, each of said stages comprising a plurality of passages of the same size, said stages being connected by radially-disposed passages, and the passages of each stage being interconnected by obliquely-disposed passages.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH BLAEKER.

Witnesses:
H. WHITING,
JOHN P. DAVIS.