

J. H. KUGLER.
STEAM TURBINE.
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2 SHEETS—SHEET 1.

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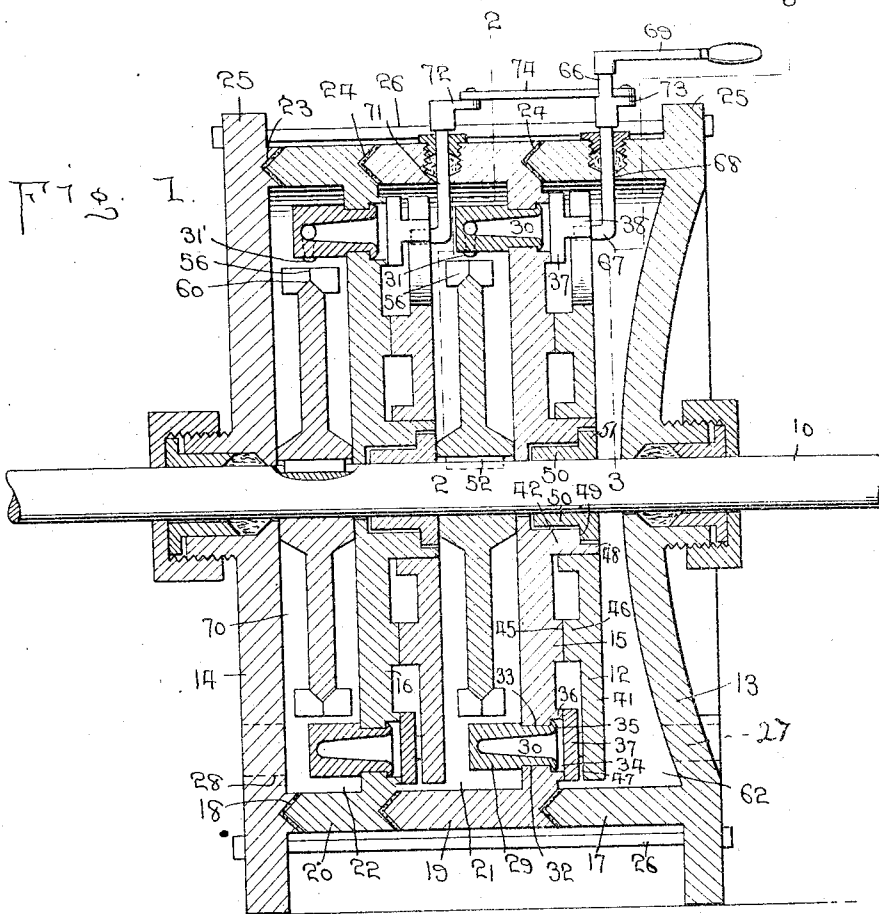
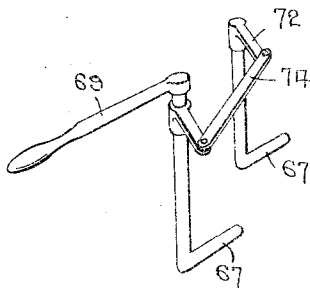


Fig. 7



Witnesses

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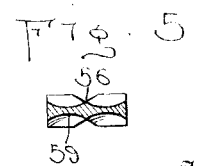
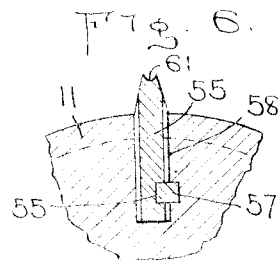
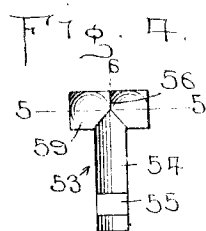
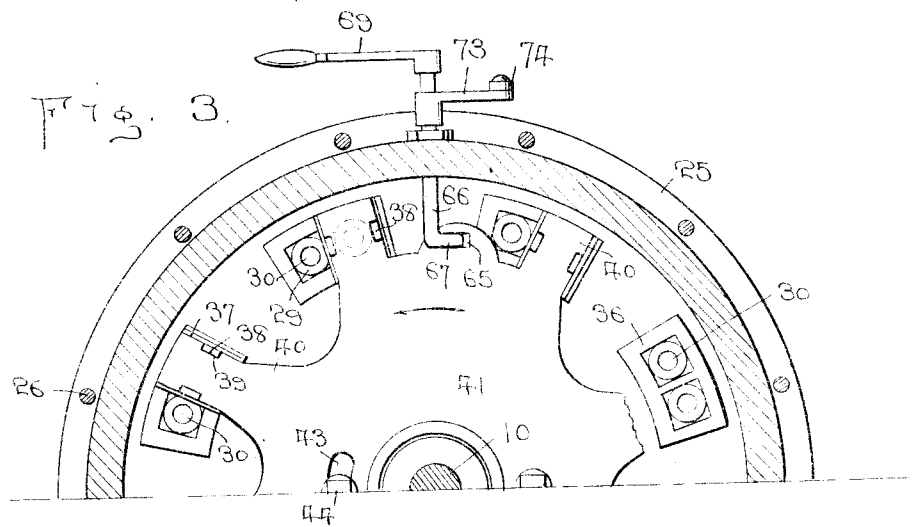
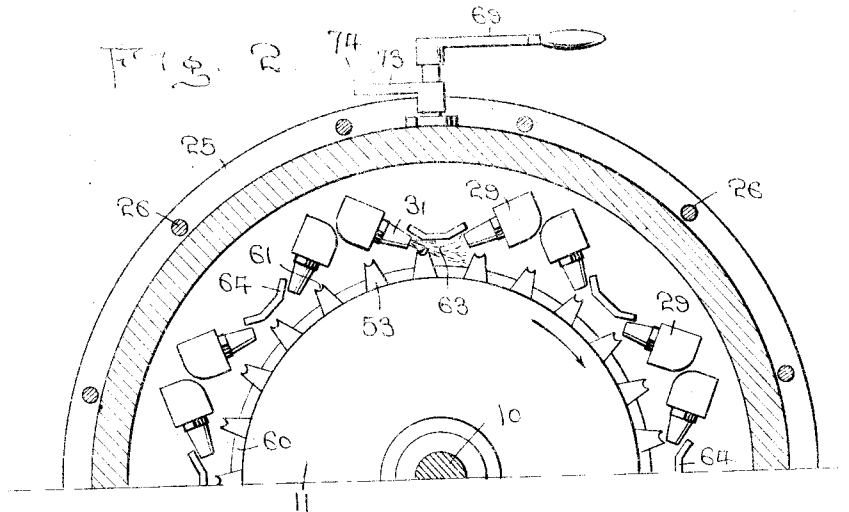
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2 SHEETS—SHEET 2.

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STEAM-TURBINE.

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To all whom it may concern:

Be it known that I, JOHN H. KUGLER, a citizen of the United States, residing at Fairfield, in the county of Adams and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Turbines; and I 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 turbines, and it more particularly relates to steam turbines.

An object of the invention is to provide a steam turbine, the motion of which may be quickly and easily reversed.

Another object of the invention is to provide a turbine of this character having interchangeable parts, whereby a complete machine may be added to or taken from, according to the particular requirements, demands or circumstances, without affecting the general principles and operations of the turbine.

A further object of the invention is to provide an improved slide valve mechanism, and means associated therewith for operating all of the slide valves in unison.

A still further object is to provide a number of turbine sections, adapted to be integrally united, and having means associated therewith for reversing the direction of all of the steam jets in all of the turbine sections in unison.

A still further object is to provide a series of turbine sections, each section of which is dependent upon an element of another section for rendering it complete.

A still further object is to provide an improved rotor paddle which is especially adapted for application to a reversible turbine of this character.

A still further object is to construct a turbine which is comparatively simple of construction, compact and powerful.

A still further object is to provide a turbine of maximum efficiency, consistent with minimum expense for production and maintenance.

Other objects and advantages may be recited hereinafter and in the claims.

In the accompanying drawings which form a part of this application, Figure 1 is a sectional view through one section of my improved turbine, the section being taken

substantially as indicated by line 1—1 of Fig. 2. Fig. 2 is a detail side elevation view of the upper part of my turbine, the division being made on line 2—2 of Fig. 1. Fig. 3 is a sectional view of the upper half of my improved turbine, the section being taken on line 3—3 of Fig. 1. Fig. 4 is a side elevation view of my improved rotor paddle or propeller blade. Fig. 5 is a vertical sectional view on line 5—5 of Fig. 4. Fig. 6 is a sectional view on line 6—6 of Fig. 4, and, Fig. 7 is a detail perspective view of the reversing lever and its adjuncts.

Referring to the drawings in which similar reference characters designate corresponding parts throughout the several views, and more particularly to Fig. 1, it may be seen that each complete turbine section essentially consists of a rotary shaft 10, a rotor 11 keyed to the shaft, a valve disk 12, and a casing; the latter comprising casing heads 13 and 14 and an annularly flanged partition 15. The casing heads 13 and 14 are provided with annular flanges 17 and 18 respectively, the annular flange of the partition being designated 19. In Fig. 1, however, I have shown a two-section turbine, and in changing from a one-section turbine to a two-section turbine, it has been necessary to provide a supplemental partition 16, having an annular flange 20. This supplemental partition is inserted between the primary partition 19 and the casing heads 14, and in this relation and position, the supplemental partition substitutes the casing head 14, in rendering complete the primary nozzle chamber or rotor chamber 21; a similar or secondary rotor chamber 22 being inclosed by the head 14 and the partition 16. It will be seen, therefore, that when two or more turbine sections are thus united, each section is dependent upon an element of the other section to render it complete.

The partitions 19 and 20 and the annular flange 18 are preferably provided with V-shaped grooves 23, which are provided with any suitable packing material 24, the several annular flanges being shaped to correspond with the shape of the grooves, and being seated therein, on the packing 24. By this means, the different sections and elements thereof may be accurately and quickly fitted together by an unskilled person. The heads 13 and 14 are provided with radial flanges 25 which are apertured, at intervals, for the

reception of connecting and retaining bolts 26, which hold all of the elements of the casing or of the united casings together. The head 13 is provided with a primary steam inlet 27, the head 14 being provided with an outlet or final exhaust 28.

The partition 15 is provided with a series of apertured or ported nozzle supports 29, the steam ports 30 of which communicate with nozzles 31, the latter being oppositely disposed, or pointing in opposite directions, as shown in Fig. 2. The nozzle carriers are provided with substantially cylindrical shanks or barrels 32 which are fitted into cylindrical openings 33 through the partition 15, the openings 33 communicating with rectangular apertures 34 into which the ends of the barrels 32 are expanded or swaged, as shown at 35.

The invention is not limited by the means described and shown for securing the nozzle carriers to the partition 15, as obviously, other means may be employed, without departure from the spirit and scope of the invention.

The partition 15 is provided with a series of valve seats 36, a corresponding series of movable valve members 37 being slidably seated on said valve seats and being adapted to alternately cover and uncover the alternate ports 30, as best illustrated in Fig. 3. Each valve member 37 is provided with a pair of parallel guide arms 38 which are adapted to slide within a corresponding pair of guide notches 39, formed in the opposite edges of each radial arm 40, which extends from a valve-actuating disk 41.

The partition 15 is provided with a centrally apertured cylindrical boss 42, on which the valve-actuating disk 41 is rotatably seated, said disk being provided with arcuate slots 43; bolts 44 extending through the slots 43 and having screw threaded engagement with the partition 15. The partition 15 and the disk 41 are provided with corresponding annular ribs 45 and 46 respectively, the latter being slidably seated upon the former, thereby providing a true bearing for the disk 41, so that the latter will at no time bind upon the valve members 37, a clearance space 47 being provided between each valve member and the valve actuating disk, so that steam may enter between said valve members and disk and hold said valve members firmly seated upon the valve seats 36, without exerting any pressure whatever upon the valve disk 41.

The boss 42 is provided with an annular flange 48, a shoulder 49 being provided at the junction of the annular flange with the boss, a sleeve 50 is snugly fitted over the shaft 10 and extends into the aperture of the boss 42, a clearance being allowed between said sleeve and said boss. The sleeve 50 is provided with a peripheral and radial

flange 51 which is inclosed by the flange 48, being closely fitted against the shoulder 49, so as to form a steam-tight joint, a clearance being provided between the flanges 48 and 49. The shaft or axle 10 may be carried by suitable bearings (not shown), and as the shaft rotates, the sleeve 50 would be free to rotate therewith if it were not for the frictional contact of the flange 51 and the shoulder 49; but, on account of steam pressure against the flanged sleeve 50, the same is held tightly against the shoulder 49 while the shaft 10 rotates therein. In case of any eccentric movement of the shaft 10, the sleeve 50 moves therewith while the flange 51 has slight sliding movement upon the surface of the shoulder 49. By this arrangement, I have provided for any slight inaccuracy in fitting the several elements around the shaft 10, without causing any of them to bind thereon, a clearance being provided between each of the several heads and partitions.

The rotor 11 is keyed or otherwise, properly secured to the shaft 10, as indicated at 52. Each rotor is provided with a series of rotor blades or paddles 53, projecting radially from its periphery, said blades being arranged in such relation to the nozzles 31, that steam from the latter strikes the blades centrally, thereby causing the rotor to rotate and carry the shaft 10 therewith. The rotor blades are preferably of the form illustrated in Fig. 4, having a shank 54, provided with a key seat 55, into which is fitted a key 57, which secures the shank within one of the sockets 58, which are provided in the rotor 11. The head or paddle of the rotor blade is formed with a central rib or ridge 56 and with concaved portions 59 on the opposite sides of the ridge. The rotor is also provided with a central and peripheral ridge 60. The top of the blade is provided with a groove 61 at right angles to the plane in which the rotor travels, said groove being preferably arcuate or concaved.

In operation, the steam enters the valve chamber 62, under heavy pressure, and passes thence through the steam ports 30 and the nozzles 31, striking the centrally and radially disposed ridge 56 and also striking within the groove 61. The jet of steam is divided by the ridge, and passing into the concaved portions 59, is deflected outwardly and downwardly, the ridge 60 coacting with the ridge 56 and with the concaved portions for deflecting the steam out of the way of the rotor blades, thereby eliminating or minimizing the back pressure of steam upon the blades 53. At the same time, a portion of the steam is deflected upwardly by the grooves 61, as indicated at 63.

Each valve seat is provided with a pair

of nozzle supports 29, the nozzles of which point in opposite directions, and between each pair of nozzle supports is secured a deflector plate 64, which guides or deflects the outwardly directed jet 63, so as to aux-

5 iliate the action of the grooves 61, for preventing back pressure of the steam on the rotor blades.

As illustrated in Fig. 3, the valve carrying arms 40 are properly spaced for holding the valve closures or slide valves 37 over each alternate nozzle support, so as to close the port 30 thereof, the other alternate ports being open. It will also be obvious that while the nozzles which point in clockwise direction are covered, the other nozzles, which point in contra-clockwise direction are uncovered, so that steam may pass there-through. It will be obvious, from an inspection of Fig. 2, that the rotor is moving in clockwise direction, the clockwise-pointing nozzles being open.

In order to change the direction of rotation, it will be necessary to shift or rotate the valve disk 11 in the direction of the arrow (see Fig. 3), so as to uncover the ports which are shown covered in Fig. 3 and to cover the other or alternate ports, and it will be obvious that steam will cease to flow in the clockwise direction, shown in Fig. 2, and will flow through the oppositely pointed nozzles, thereby striking the blades 63 on their opposite sides, and thus causing the rotor to move in contra-clockwise direction.

In order to shift the valve actuating disk, I have provided the same with an aperture 65, and I provide a valve shifter comprising a shaft 66 and shifter arm 67, extending at right angles therefrom and engaging with the aperture 65. An aperture 68 being provided through the flange 17, and any suitable form of steam packing being provided within the aperture and surrounding the shaft 66. A hand lever 69 is secured on the upper end of the shaft 66, and it is obvious that when the handle 69 is oscillated, the arm 67 is also oscillated, carrying the valve actuating disk therewith; and, by moving the lever 69 a sufficient distance, the valve carrying arms are caused to open and close respectively the alternate ports 30.

While I have practically confined the description to the right hand or primary turbine section, it is to be understood that this description practically applies to the left hand section thereof and to sections which may be subsequently added, with the following exceptions, viz:

60 It will be noted that the nozzle supports and nozzles of the left hand section (see Fig. 1) are larger than those in the right hand section, the rotor blades also being larger. This relation being for the purpose of reducing the steam pressure in each suc-

ceeding valve section, and for utilizing the reduced steam pressure to the maximum extent. This reduction of pressure is made quite obvious by considering the right hand nozzles 31 as the inlets and the left hand nozzles 31' as the outlets which are larger than inlets.

In summing up this construction, in which the several turbine sections are thus united, it may be stated that such a turbine consists of a primary valve chamber 62, a rotor chamber 70 and an intermediate chamber containing slide valves, a valve-actuating disk, a rotor, and nozzles, disposed within the peripheral flange 19.

In order to shift the left hand actuating disk simultaneously with the right hand disk, I have provided a secondary shifting member 71, an arm 72 being secured on the upper end of said shifting member and pivotally connected with a similar arm 73, on the member 66, through the medium of a link 74; and it is obvious, that if other turbine sections were added, other members 71 could be similarly connected, so that all of the valve-actuating disks could be operated in unison, by means of the hand lever 69.

It is obvious that I have provided a steam turbine which is fully capable of attaining the foregoing objects and in a thoroughly practical and efficient manner.

I do not limit my invention to the exact details of construction, combination and arrangement of parts as herewith described and illustrated, but my invention may only be limited by a reasonable interpretation of the following claims.

What I claim is:

1. In a steam turbine, a valve chamber having an inlet opening, a nozzle-containing chamber having a rotor therein, a partition between the valve chamber and the nozzle-containing chamber, said partition having a series of ports communicating with the nozzles and with the valve chamber, said partition having a cylindrical boss, a valve actuating disk rotatably seated on said boss and carrying a series of slide valves for alternately covering and uncovering said ports, and means for shifting the valve-actuating disk.

2. In a steam turbine, a valve chamber having a steam inlet opening, a nozzle-containing chamber containing a rotor in operative relation to the nozzles, a partition separating the valve chamber and the nozzle-containing chamber, said partition having ports communicating with the nozzles and with the valve chamber, a valve-actuating disk movably seated in the valve chamber and having radial arms, and slide valves movably secured to the arms and adapted to be held by steam pressure over certain of said ports, and means for shifting the

valve actuating member from over said ports so as to cover other of said ports.

3. In a steam turbine, a casing, a rotor in the casing, a steam chamber, a partition
5 between the rotor and the steam chamber, steam ports communicating with the steam chamber and adapted to convey steam into operative relation to the rotor, a cylindrical boss on the partition, a valve disk
10 rotatably mounted on the cylindrical boss, and slide valves carried by the valve disk over the ports and adapted to be held against the surface surrounding the ports by means of steam pressure.
- 15 4. In a steam turbine, a rotor chamber, a steam chamber, a partition separating said rotor chamber and said steam chamber, steam ports through the partition, an axle extending through the partition and carrying
20 a rotor within the rotor chamber in operative relation to the steam ports, a hollow boss formed on the partition, a shouldered sleeve surrounding the axle within the hollow boss, a valve-carrying member rotatably
25 seated on the periphery of the hollow boss, and means for moving the valve-carrying

member for alternately opening and closing the ports.

5. In a steam turbine, a casing consisting of a number of annularly flanged sections, 30 certain of said sections being formed with annular grooves and with annular ridges on the annular flanges, said annular ridges and annular grooves being approximately right angled in cross section and adapted to be
35 fitted to the adjacent similarly formed sections and thereby to assure the perfect concentric relation of the several sections.

6. In a steam turbine, a rotor chamber, a rotor rotatably mounted in the rotor cham- 40 ber, a series of steam nozzles in the rotor chamber, and a series of deflector plates adjacent to the respective nozzles and lying approximately at right angles to the intersecting radial lines of the rotor. 45

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

JOHN H. KUGLER.

Witnesses:

WALTER KUGLER,
J. E. ZIMMERMAN.