No. 776,770. PATENTED DEC. 6, 1904.

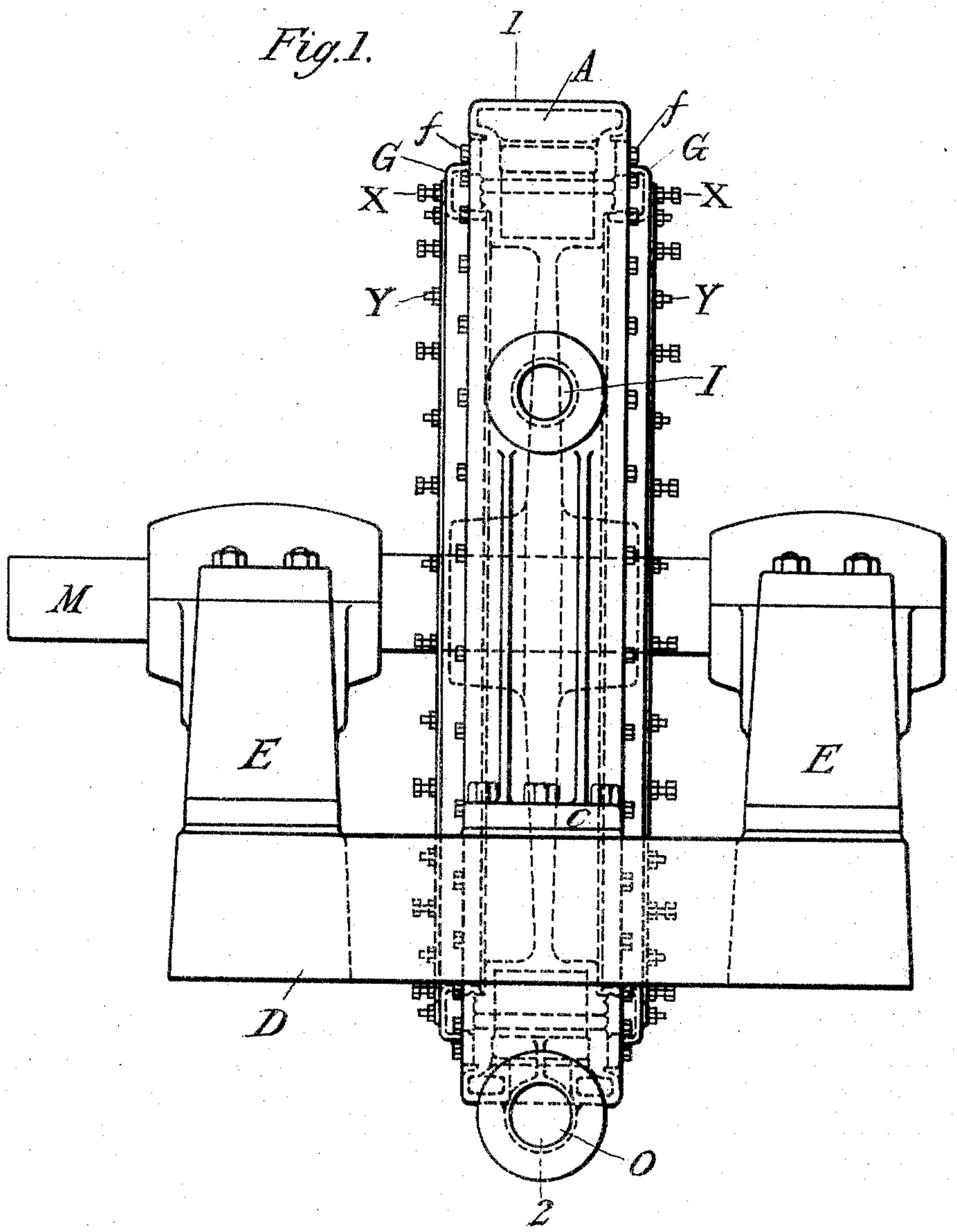
E. WÖLNER.

STEAM TURBINE.

APPLICATION FILED MAY 12, 1904.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.



Witnesses

Arthur Stanbach.

Harold G. Creighton

Inventor

Eugen Wölner.

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NO MODEL. 3 SHEETS—SHEET 2.

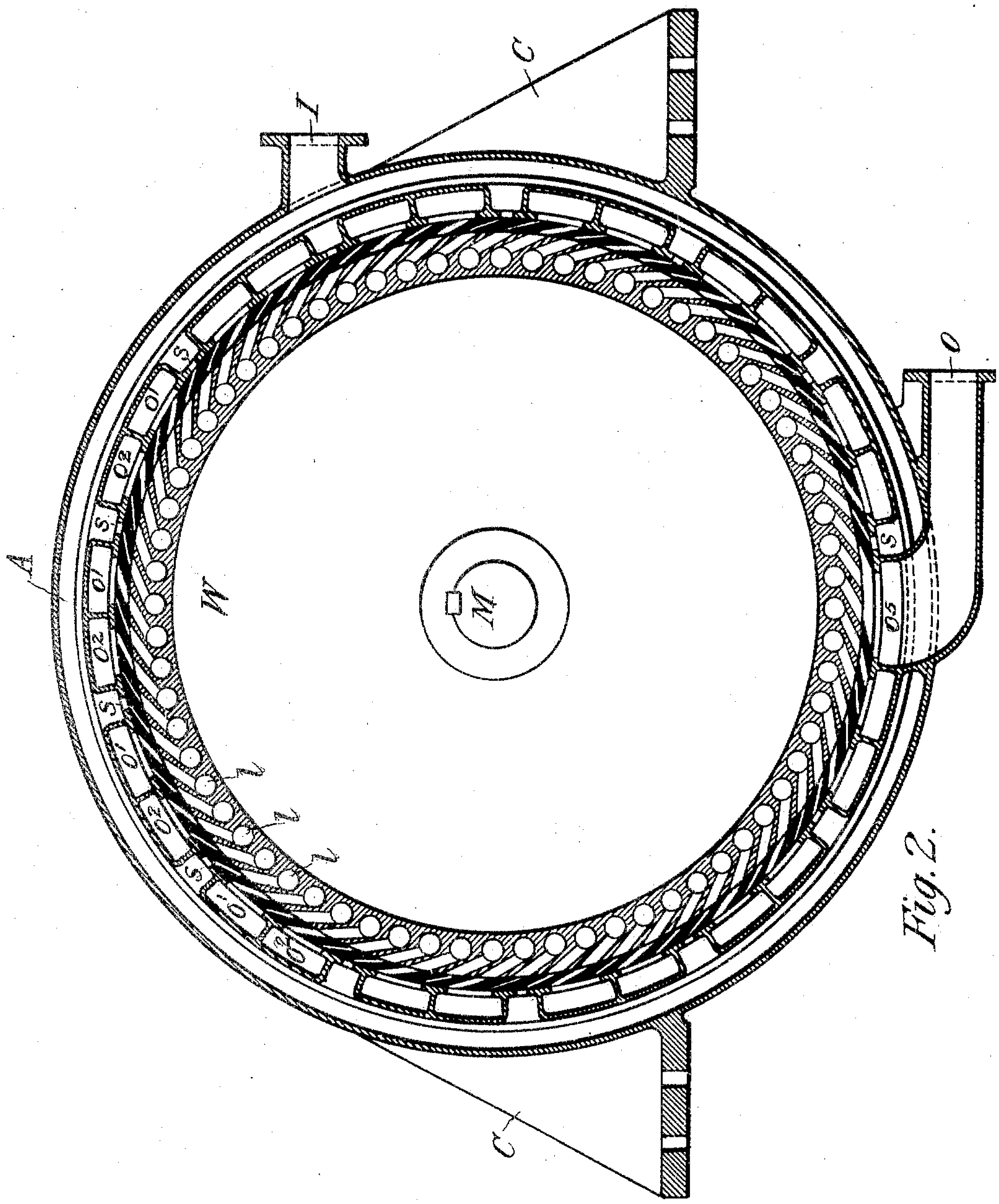

Fig. 2.

Witnesses

Arthur Stambach.

Harold G. Creighton

Inventor

Eugen Wölner.

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NO MODEL. 3 SHEETS—SHEET 3.

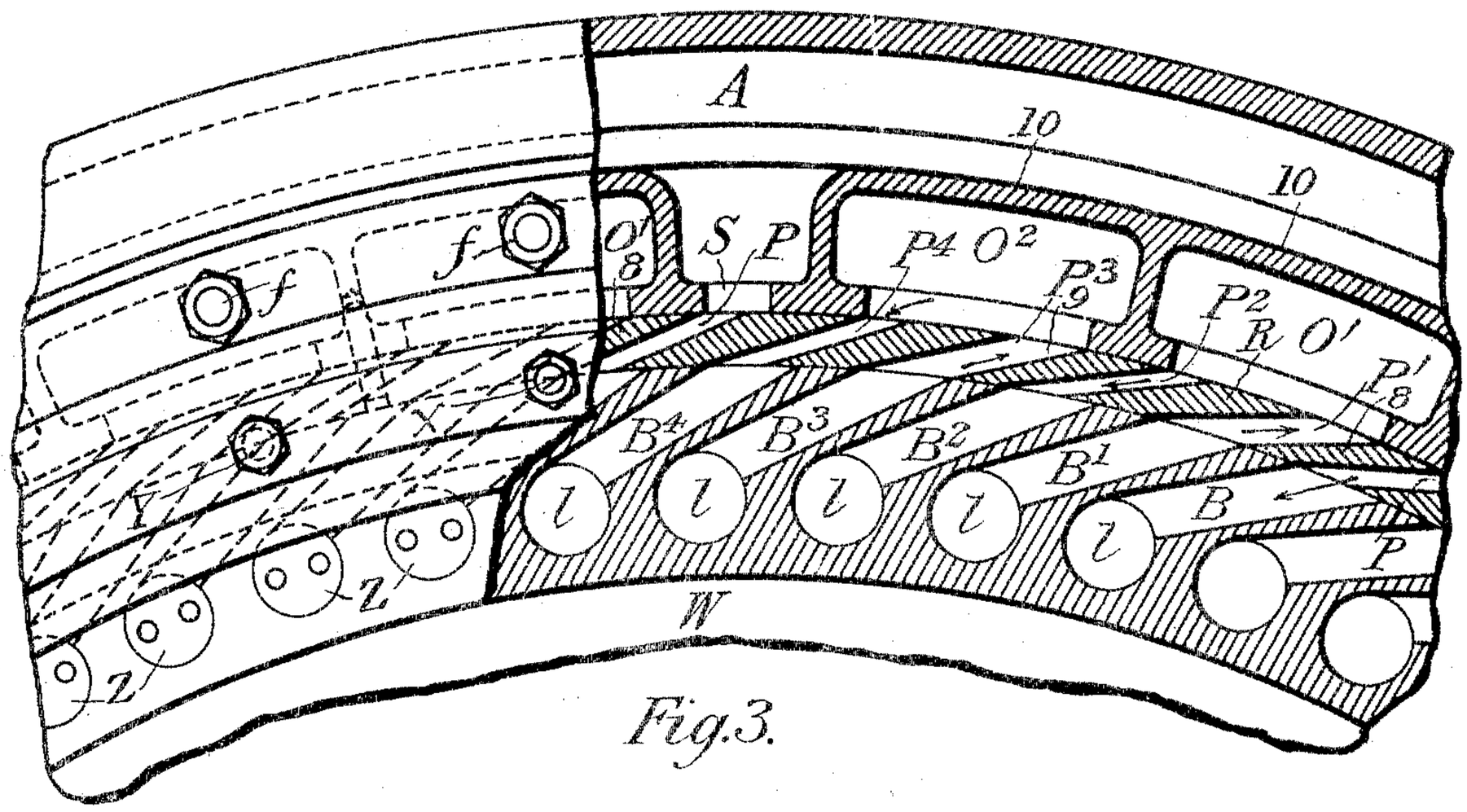

Fig. 3.

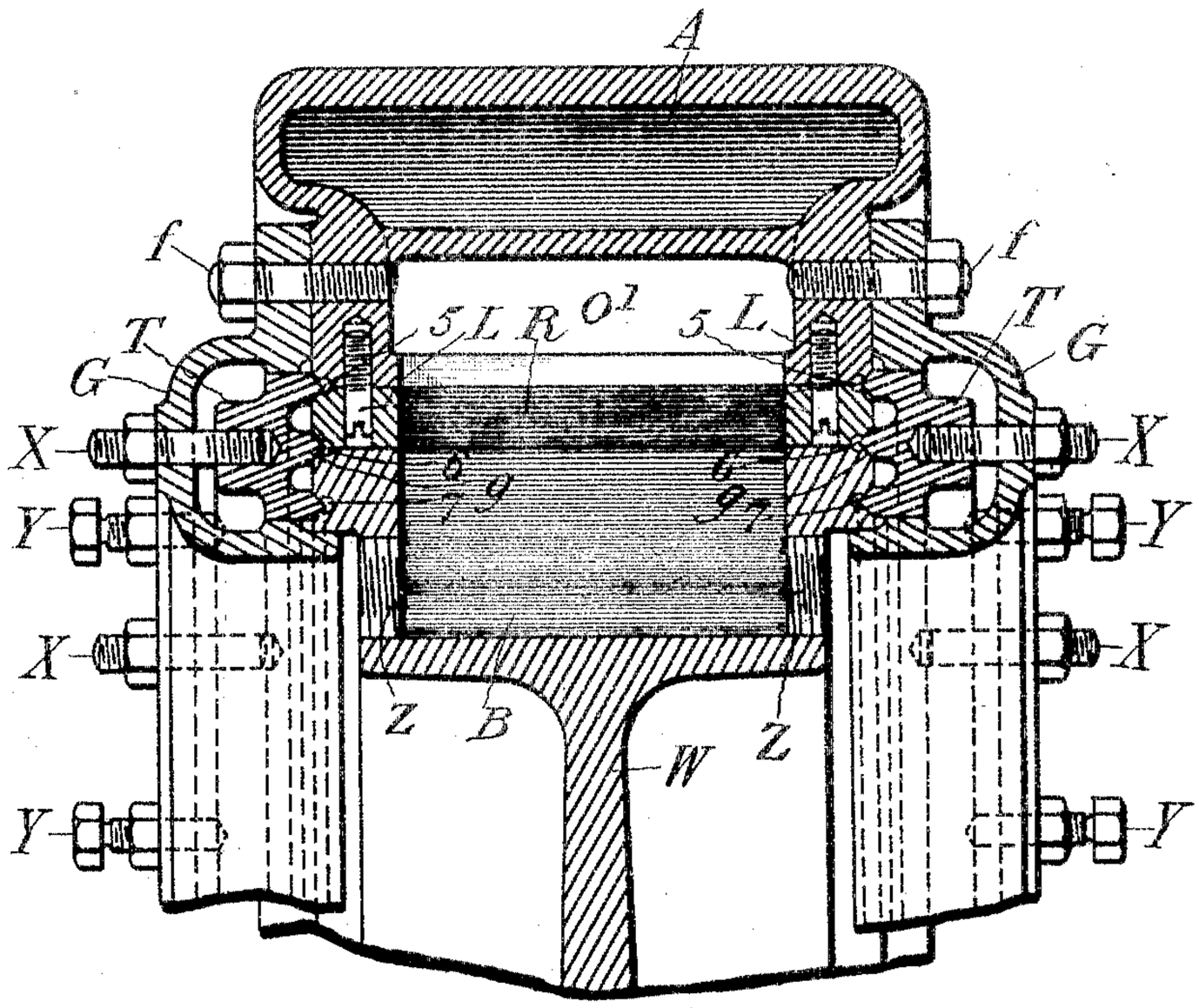

Fig. 4.

Inventor
Eugen Wölner

Witnesses
Arthur Stambach.
Harold G. Creighton

No. 776,770. Patented December 6, 1904.

UNITED STATES PATENT OFFICE.

EUGEN WÖLNER, OF PITTSBURG, PENNSYLVANIA.

STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 776,770, dated December 6, 1904.

Application filed May 12, 1904. Serial No. 207,628. (No model.)

To all whom it may concern:

Be it known that I, EUGEN WÖLNER, a citizen of the United States, residing at Pittsburg, county of Allegheny, 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, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

The object of my invention is to construct a steam-turbine for transmitting power in which the steam is effectively applied and more than once utilized on the same wheel before being exhausted, and a further object being to so construct the parts that leakage and waste of the steam is prevented. These objects I attain in the manner hereinafter described, reference being had to the accompanying drawings, in which like parts are similarly designated.

Figure 1 is a general elevation of the exterior of the turbine and shaft with the bearings shown mounted on a bed-plate of ordinary construction. Fig. 2 is a vertical longitudinal section through the steam-casing, the steam-port ring, and the turbine-wheel on the line 1 2 of Fig. 1. Fig. 3 is a similar view, on a larger scale, of a part of the outer steam-casing and the turbine-wheel; and Fig. 4 is a cross-section through the steam-casing, the hollow guides and the packing-rings, the steam-port ring, and the rim of the turbine-wheel and its bucket.

I will now describe the detailed construction of my steam-turbine.

My invention consists of an outer circular casing A, cast or otherwise, which constitutes the steam-chamber, the steam-port ring R, fixed to the turbine, the turbine-wheel W, the packing-rings T, and the hollow packing-ring guides G. The steam-casing A is provided with a steam-inlet or union I and with supply-ports S, preferably but not necessarily arranged symmetrically around the wheel and auxiliary chambers O′ and O² intermediate the high-pressure ports arranged around the periphery of the wheel, and with an exhaust-passage or union O, and also provided with brackets C, by which it is secured to the bed-plate D. The annular steam-chamber A surrounds the auxiliary chambers, and thereby tends to maintain their temperature uniform, being only separated from the auxiliary chambers by the walls 10 of the latter. The steam-port ring R is provided with obliquely-lying live-steam-supply ports P, leading the steam to the buckets B of the turbine-wheel W directly from the steam-chamber A, and also with obliquely-lying ports P′ and P³ for the purpose of guiding the steam into the chambers O′ and O², located around the turbine-wheel in the steam-casing A, and with obliquely-lying ports P² and P⁴ to lead the steam again from the chambers O′ and O² into the buckets of the turbine-wheel W. It will be observed that the inlet-ports P and ports P² and P⁴ are comparatively narrow and those P′ and P³ are comparatively wide, while those parts 8 and 9 of the ring between P and P′ and between P² and P³ are narrower than a bucket. The steam-port ring R is held in its place within the steam-casing A by the headless pin-screws L, Fig. 3.

The steam-turbine wheel W is keyed on the shaft M, that rotates in the bearings E, and is provided around its rim with buckets of a rectangular shape having bottoms *l* of cylindrical form and larger than at the face of the rim, as shown in Figs. 2, 3, and 4, lettered B B′ B² B³ B⁴. The said buckets in the wheel may be formed by cores in the mold when cast and finished with a milling-tool and the bottoms bored out from side to side and with the ends threaded. They are closed up by headless screw-plugs Z, as shown in Figs. 3 and 4. The buckets in the said rim of the wheel W lie at an angle to the obliquely-lying ports in the steam-port ring R in a direction most advantageous to cause the steam to reach the bottom of the buckets with the fullest efficiency of driving power. The packing-rings T are provided with wedge-shaped flanges *g* for the purpose of forming male parts to the V-shaped grooves 5, 6, and 7 on the sides of the steam-casing A and at the joint between the steam-port ring R and rim of the turbine

wheel W to insure steam-tight joints of the said parts. To obtain adjustment of the packing-rings T, they are provided with lock-nuts and cone-pointed set-screws tapped into the guides G. The screws are screwed up against the back of the packing-rings T to cause the required tightness, and to maintain the position of the packing-rings in the guides G they are provided with the stud-bolts X, and by screwing up the nuts on the said bolts the packing-rings are rigidly fixed in the desired position, as shown in Fig. 4. The guides G, which are hollow annuli, are securely bolted to the steam-casing A by the stud-bolts and nuts *f*, and within which are located the packing-rings T, with perfect-fitting surfaces in contact with the said guides, and also with the rim of the turbine-wheel W by means of a flange *g* engaging a groove will still further insure against any escape of steam from between the parts.

I have shown three grooves 5, 6, and 7, Fig. 4, the upper one between the steam-casing A and steam-port ring R, the center one between the inner periphery of the steam-port ring R and the turbine-wheel W, and the third at the side of the turbine-wheel just beyond the bottom of the buckets, as shown in Fig. 4.

The wheel is operated by the steam entering at the inlet-union I and filling the outer circular casing A and passing through the supply-port openings S to the inlet-ports P in the steam-port ring R, where it enters the nearest bucket in the wheel W—say bucket B, as shown in Fig. 3— and with the full pressure of the steam on the bottom *l* causes the wheel to revolve with its shaft in the bearings E. Full live-steam pressure will remain on bucket B until the rear edge of the bucket B has passed the forward edge of the rib 8 in ring R, just before which time there will be momentarily a free passage from P through the bucket-port P′ into O′. When the bucket has reached the position B′, steam has fully exhausted into O′. The bucket then moves to the position B^2 to be further driven, the steam-pressure on O′ having now been augmented by a fresh supply of superheated steam from P, as above described. The bucket is then driven toward the position B^3; but in doing so there is momentarily a free passage from O′ P^2, through the bucket, passage P^3 to O^2, thus augmenting the steam-pressure in O^2 to drive the bucket that is located below the passage P^4. The bucket then passes under another live-steam port P, and the operation is repeated until the buckets in the wheel arrive at the exhaust-port O^5 in ring R, whence the steam goes by union O to another and second wheel and then to a condenser or into the open air. The steam is thus practically triple-expanded, and after such triple expansion its pressure is augmented by superheated live steam, this operation being accomplished a number of times in one revolution, there being several sets of expansion-chambers O′ O^2 between a number of peripheral ports S.

It is obvious that by increasing the width of the ribs 8 and 9 I may use the steam by triple expanding without augmenting the intermediate-pressure steam in O′ by high-pressure steam and without augmenting the low-pressure steam in O^2 by intermediate-pressure steam. In order to reverse the turbine, there is a reversing-turbine on the same shaft, as is customary.

It will be noticed in the drawings that the casing with the turbine-wheel are placed in a vertical position and the driving-shaft in a horizontal position; but the turbine-wheel can just as well be operated in a horizontal position with the driving-shaft in a vertical one.

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

1. In a steam-turbine, a hollow steam-casing constituting the steam-supply chamber, having a steam-inlet, steam-supply ports, intermediate steam-chambers having passages for the steam to the induction-ports without interfering with the supply-ports, and an escape-passage for the exhaust-steam, and circular **V**-shaped grooves to receive packing-rings to form steam-tight joints, substantially as described.

2. The combination, in a steam-turbine, of a steam-port ring closely fitting within a steam-casing and held in position by pin-screws, having obliquely-lying induction and eduction ports and having on the sides grooves to receive packing-rings to form jointly with the steam-casing and the turbine-wheel steam-tight joints, substantially as described.

3. The combination, in a steam-turbine, a turbine-wheel having a number of cavities therein of rectangular form at the periphery and having cylindrical-formed bottoms with their ends at the sides of the wheel and closed, and being in an angular direction to the radius of the wheel, and having on the sides of the rim **V**-shaped grooves to receive packing-rings to form jointly with the steam-port ring and the steam-casing steam-tight joints, substantially as described.

4. In a steam-turbine, the combination of circular hollow rings secured by bolts and nuts, to the steam-casing and forming guides for adjustable circular packing-rings having minor rings with wedge-shaped edges to form male parts to fit into **V**-shaped grooves on the sides of the wheel-rim, a steam-port ring, a steam-casing, and adjusting-screws and set-screws to set the packing-ring to secure steam-tight joints, substantially as described.

5. In a steam-turbine, expansion-chambers arranged in sets, each chamber having an inlet and an outlet passage, a high-pressure steam-inlet between adjacent sets of chambers, and a turbine-wheel having peripheral buckets coöperating with said passages, where-

by alternate buckets will be acted upon by steam at different stages of expansion, substantially as described.

6. In a steam-turbine, the combination with a turbine-wheel having a single line of buckets; of expansion-chambers arranged in sets, each expansion-chamber having an inlet and an outlet port and high-pressure inlet-ports between the sets of chambers, the buckets of said wheel coöperating with said ports to radially supply steam to the buckets and expand the steam in stages, the expanded steam acting upon alternate buckets, substantially as described.

7. In a steam-turbine, the combination with a turbine-wheel having peripheral buckets; of intermediate and low pressure steam-chambers and a high-pressure steam-chamber surrounding them and having a high-pressure steam-port between each pair of chambers, and ports leading to and from each low and intermediate steam-pressure chamber, substantially as described.

8. In a steam-turbine, an annular steam-chamber, a steam-port ring secured thereto, grooves formed at their junction, a turbine-wheel coöperating with the ring and having lateral grooves as well as grooves formed between the ring and wheel, a packing-ring having three flanges secured at each side of the turbine, each flange entering a groove, substantially as described.

9. In a steam-turbine, the combination with a turbine-wheel having buckets, means to triple expand the steam and augment each of the two last stages of expansion by steam from the preceding stage and to cause the steam to act at each stage of expansion upon the turbine-wheel, substantially as described.

10. In a steam-turbine, the combination with a turbine-wheel having buckets, means to triple expand the steam and augment each of the two last stages of expansion by steam from the preceding stage and means to cause the augmented steam at each stage to act upon each bucket successively, substantially as described.

11. In a steam-turbine, the combination with a turbine-wheel, of a steam-chamber having supply-ports and auxiliary chambers arranged in sets of two, each chamber having an inlet and exhaust port, said ports coöperating with the wheel to expand steam at intermediate pressure in one of the chambers and then in the other at low pressure, said steam acting on alternate buckets of the wheel at each stage of the expansion, substantially as described.

12. In a steam-turbine, the combination with a turbine-wheel, of a steam-chamber, auxiliary chambers arranged in sets of two, high-pressure steam-ports between the sets of auxiliary chambers, inlet and outlet ports differing in area in each of the auxiliary chambers, said ports coöperating with the wheel and chambers to triple expand the steam and cause it to act on the wheel at each stage of the expansion, substantially as described.

13. In a steam-turbine, the combination with a turbine, a turbine-wheel having buckets, a steam-casing having a high-pressure chamber, and auxiliary chambers arranged in sets of two therein and around the periphery of the wheel, a port-ring between the wheel and casing having high-pressure steam-ports, and ports to admit steam to and exhaust it from each of the auxiliary chambers, the distance between a high-pressure inlet-port and the next adjacent port being less than the width of a bucket, and the distance between the exhaust-port of one of the auxiliary chambers to the inlet-port of the adjacent auxiliary chamber also being less than the width of a bucket, substantially as described.

14. In a steam-turbine, the combination with a turbine-wheel having buckets, of an annular high-pressure steam-chamber, auxiliary chambers arranged in sets of two surrounded by the high-pressure chamber, a port-ring coöperating with the chambers and buckets to triple expand the steam and cause it to act at each stage of the expansion on the wheel, and annular guides at each side of the steam-chamber, and a flanged packing-ring in said guides coöperating with grooves at the joint between the ports, substantially as described.

15. In a steam-turbine, the combination with a turbine-wheel having rectangular buckets each terminating in a cylinder, of a screw-plug in each end of the cylinder portion of each bucket, substantially as described.

16. In a steam-turbine, the combination with a turbine-wheel having rectangular buckets each having a cylindrical bottom, of a screw-plug to close each end of the bottom, a steam-chamber around the periphery of the wheel, a hollow annular guide secured to each side of the chamber and a flanged packing-ring in each guide adjustable to and from the wheel, substantially as described.

17. In a steam-turbine, a turbine-wheel having rectangular buckets, each terminating in a cylindrical portion, and means to close each end of said cylindrical portion, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

EUGEN WÖLNER.

Witnesses:
ARTHUR STAMBACH,
HAROLD G. CREIGHTON.