A. C. VAUCLAIN.

STEAM TURBINE.

APPLICATION FILED DEC. 13, 1912.

1,070,309.

Patented Aug. 12, 1913.

4 SHEETS—SHEET 1.

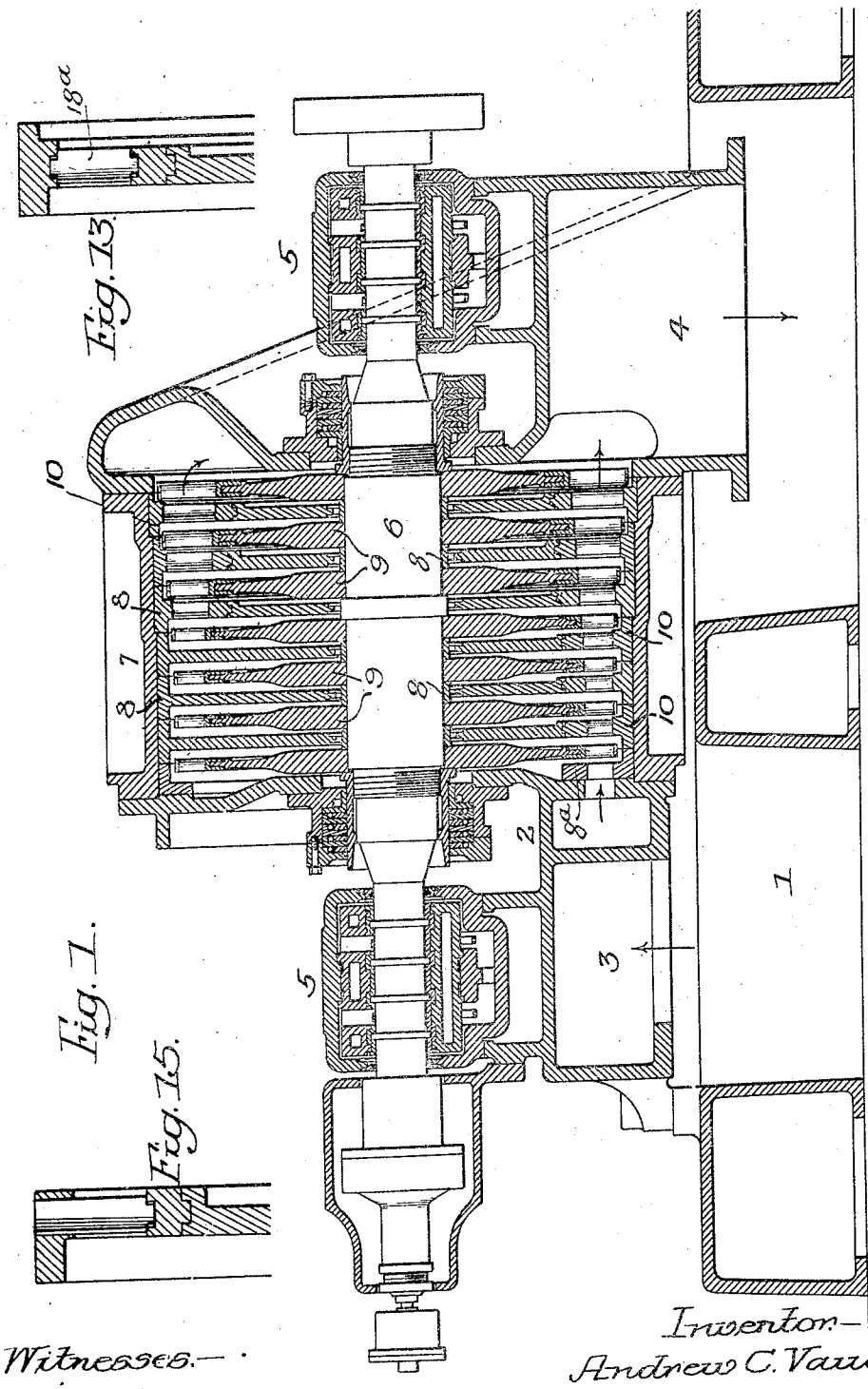


Fig. 13.

Fig. 1.

Fig. 15.

Witnesses.—
Wills A. Simmons.
Charles H. York

Inventor—
Andrew C. Vauclain
by his Attorneys—
Howson & Howson

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4 SHEETS—SHEET 2.

Fig. 2.

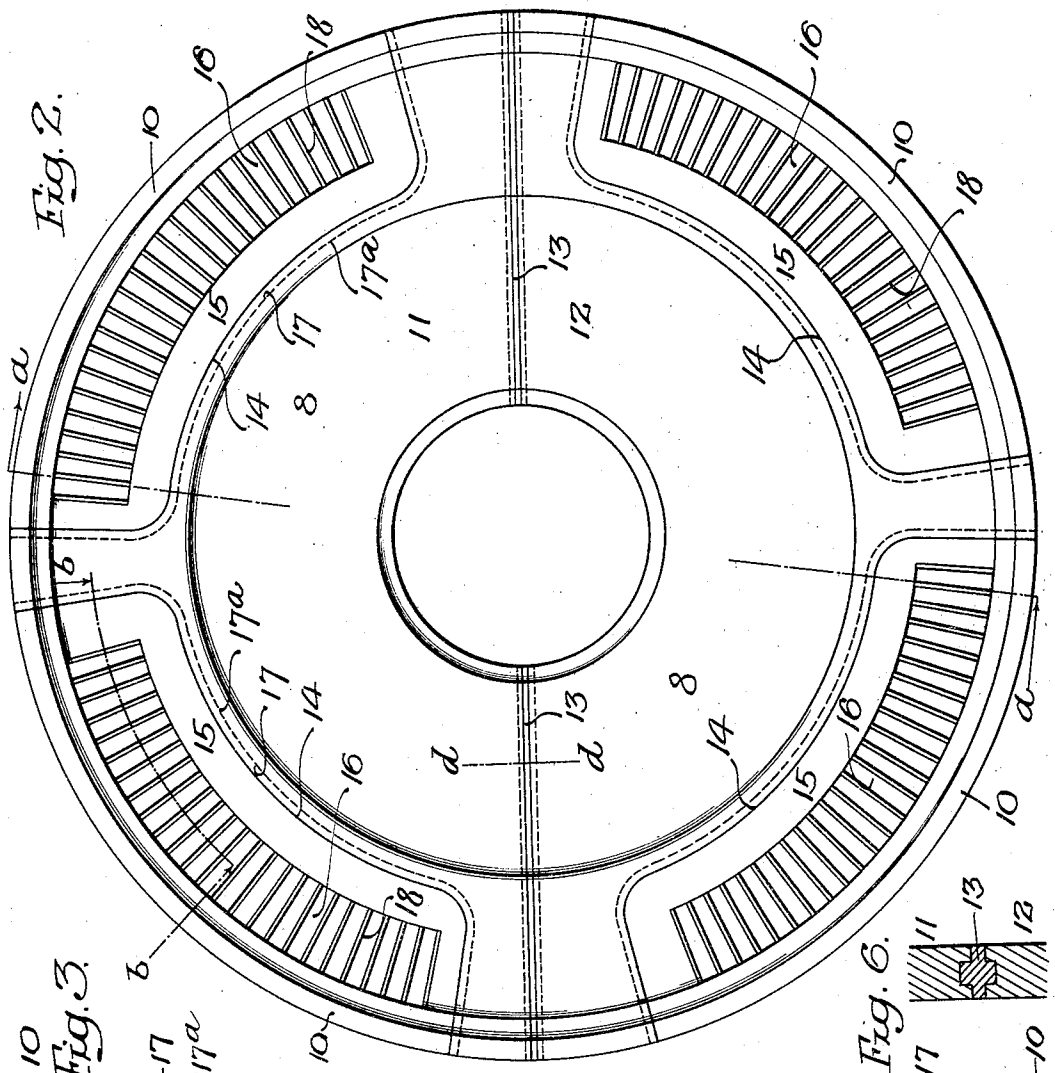


Fig. 3.
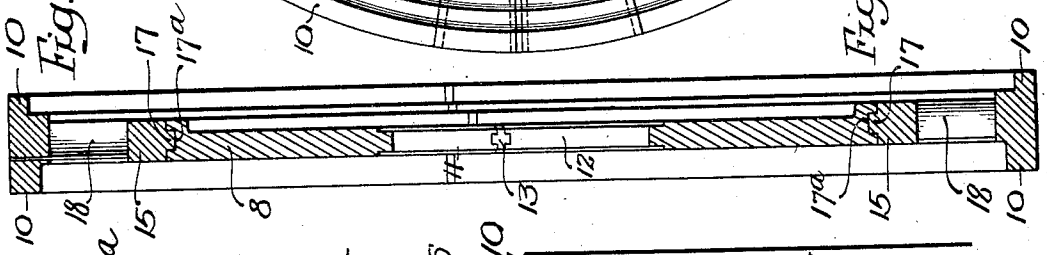


Fig. 4.

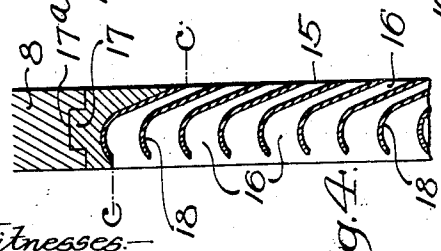


Fig. 5.

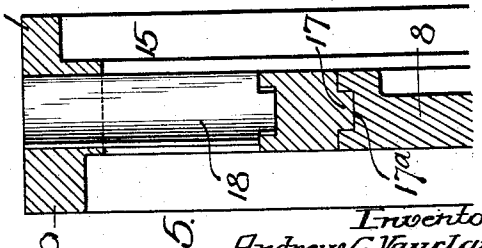


Fig. 6.

Witnesses.—
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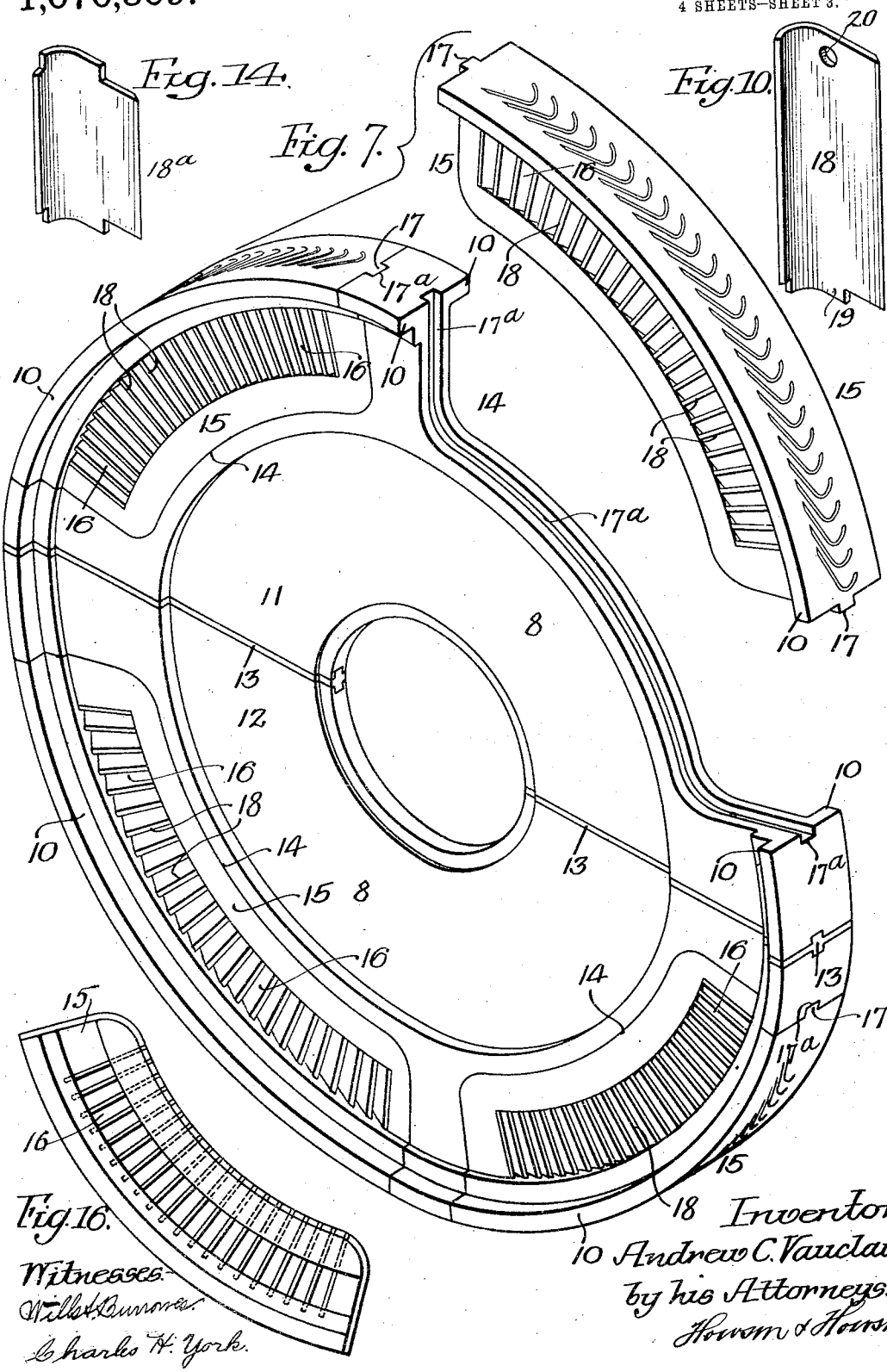
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4 SHEETS—SHEET 3.



Witnesses:
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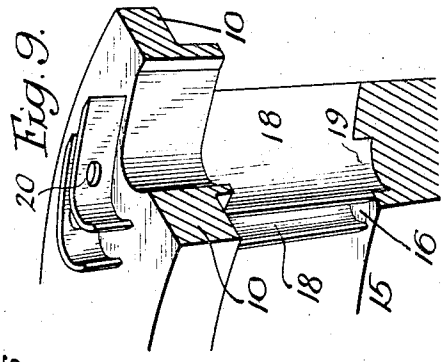
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4 SHEETS—SHEET 4.



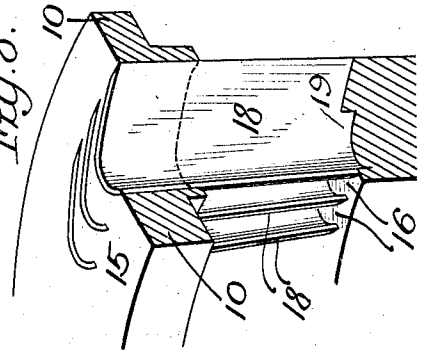




Fig. 12.

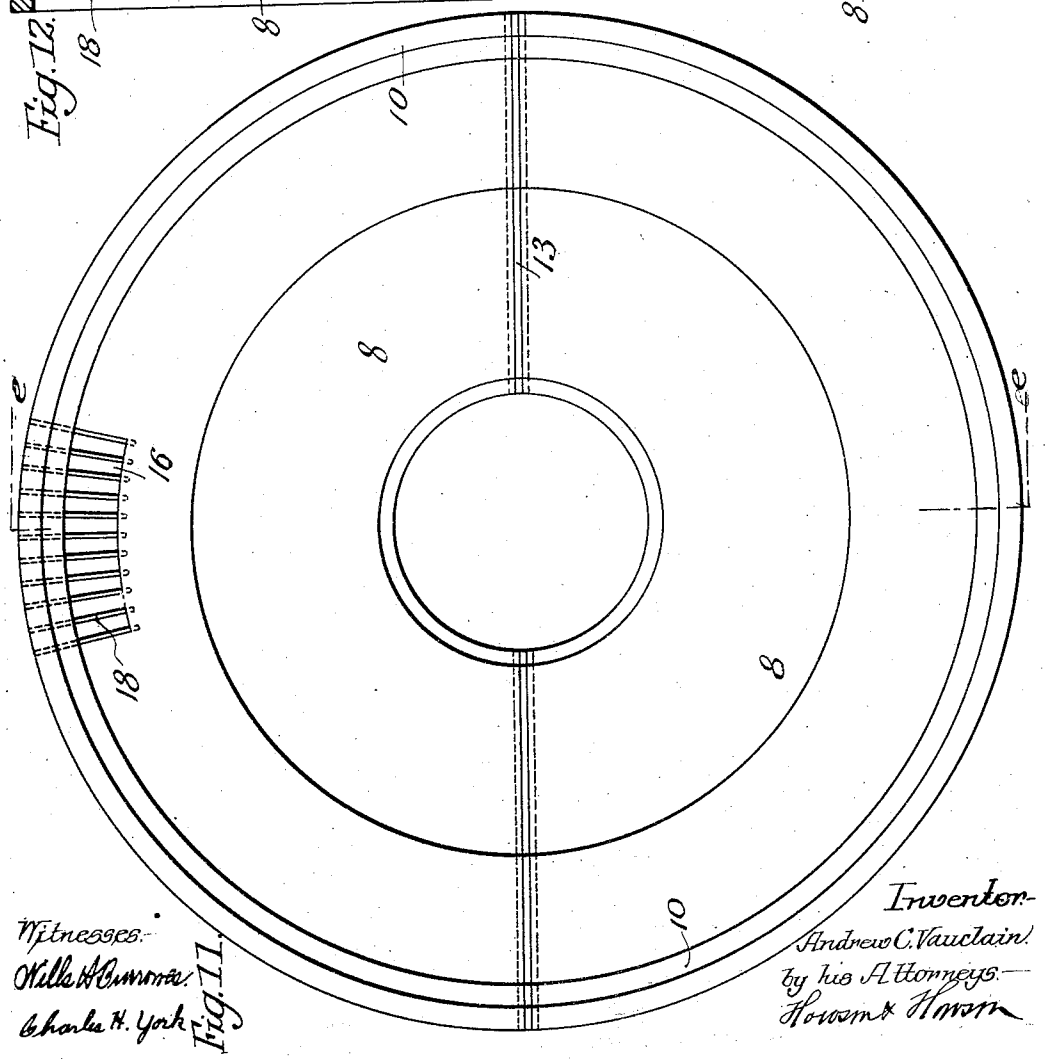


Fig. 11.

Witnesses:
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Charles H. York.

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UNITED STATES PATENT OFFICE.

ANDREW C. VAUCLAIN, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO SOUTHWARK FOUNDRY & MACHINE CO., OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

STEAM-TURBINE.

1,070,309. Specification of Letters Patent. Patented Aug. 12, 1913.

Application filed December 13, 1912. Serial No. 736,567.

To all whom it may concern:

Be it known that I, ANDREW C. VAUCLAIN, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Steam-Turbines, of which the following is a specification.

The object of my invention is to improve the construction of the diaphragms of steam turbines so as to dispense with all parts which are liable to become loose and consequently cause damage to the working elements.

My invention further relates to certain details of construction which will be fully described hereinafter, reference being had to the accompanying drawings, in which:—

Figure 1, is a longitudinal sectional view of a steam turbine illustrating my invention; Fig. 2, is an enlarged face view of one of the diaphragms; Fig. 3, is a sectional view on the line *a—a*, Fig. 2; Fig. 4, is a sectional view on the line *b—b*, Fig. 2; Fig. 5, is a sectional view on the line *c—c*, Fig. 4; Fig. 6, is a sectional view on the line *d—d*, Fig. 2; Fig. 7, is a perspective view of a diaphragm with one of the sections removed; Fig. 8, is a sectional perspective view on the line *c—c*, Fig. 4; Fig. 9, is a sectional perspective view on the same line as Fig. 8, showing the blades after the casting is made and before finishing; Fig. 10, is a detached perspective view of one of the blades; Fig. 11, is a face view of a diaphragm showing the blades located in the diaphragm and not in a segment; Fig. 12, is a section on the line *e—e*, Fig. 11; Fig. 13, is a sectional view showing a blade cast permanently in the diaphragm; Fig. 14, is a perspective view of the blade shown in Fig. 13; Fig. 15, is a sectional view illustrating a modification; and Fig. 16, is a view showing a modification of the segment.

Referring to the drawings, 1 is the base on which the turbine structure is mounted.

2 is the casing containing the steam inlet and exhaust passages 3 and 4 and mounted on this casing are the bearings 5 for the turbine shaft 6. These bearings can be made in any manner without departing from the essential features of my invention. The cylinder 7 of the casing contains the diaphragms 8 and the rotors 9. These rotors are secured to the shaft and may be made in any suitable manner as my invention relates particularly to the diaphragms which form the compartments in which the rotors travel. These diaphragms have flanges 10 at each side, in the present instance, and one flange abuts another; thus spacing the several diaphragms a given distance apart. The flanges of the diaphragms may be on one side only, if found desirable.

The cylinder is preferably bored in steps, as shown in Fig. 1, and the diaphragms are placed in the cylinder and are secured therein in any suitable manner. The cylinder, in some types of turbines, may be of an even diameter throughout. Each diaphragm has passages therein for the steam and the rotors have blades against which the steam impinges as it escapes through the passages; causing the rotors and the shaft to revolve. The passages in the diaphragms are of less area at the inlet end than at the exhaust end of the turbine. This is common in turbines where a series of rotors are used.

Referring particularly to Figs. 2 to 10 inclusive, the diaphragm 8 is made in two parts 11 and 12. The meeting edge of each of these parts is grooved to receive a rib on a connecting strip 13, Fig. 6, which may be attached to one of said parts. The diaphragm is turned complete while in one piece and is then cut in half, as indicated in Fig. 2. The cutting tool displaces a given amount of metal which is equal to the thickness of the strip 13 so that when the strip is in position the diaphragm is of the same size that it was before the cutting. Each diaphragm is notched at the periphery as indicated at 14, Fig. 7, and a segment 15 is inserted in the notch. The tongue 17 on the segment fits a groove 17^a in the recessed portion of the diaphragm 8 and is held therein by the cylinder 7, when the diaphragm is in place therein. In each segment is a steam passage 16 and while I have indicated in Figs. 2 and 7 a diaphragm having four segmental sections, the first diaphragm will have a single section of limited area. The last diaphragm at the exhaust end will have the four segments and the openings in these four segments will be substantially the full length of the segments as well as the full width thereof.

In the segment 15 are partitions 18 which extend across the passage 16 and form nozzles. These partitions are made, in the present instance, as illustrated in Figs. 8, 9, and 10, and have a curved and a straight portion which form the nozzles for the passage of the steam through the diaphragm when they are all assembled, as shown in the drawings. The partitions 18 are made of sheet metal, in the present instance, bent into shape and cast in the segments 15, Fig. 9. The ends of these partitions, which extend into the castings; are preferably coated with black lead, or other suitable material, so that the castings will not adhere to the metal of the partitions. Thus, while the partitions are rigidly held in position as regards lateral movement, they can expand and contract longitudinally in the casting. I preferably make these partitions 18 removable and shape them as illustrated in Fig. 10. One end of each partition is reduced to form a tongue 19 and the other end is perforated at 20, by reducing the inner ends of the partitions. I connect the metal of the casting between each partition at the edges of the blades, thus strengthening the casting. After the casting is made, the partitions are withdrawn by inserting a tool in the opening 20 of each partition, after which the side walls of a passage 16 are machined smooth. The ends of the tongues are cut off to an amount equal to the metal removed from one side of the passage 16, after which the partitions are again inserted in the segment. When the partitions have been fitted in place, the projecting end is removed, as in Fig. 8. These partitions are held in position in the segments by the cylinder or casing when the diaphragms are placed in position.

While I prefer to make the partitions of such a length that they extend through the outer wall of the segments, in some instances, they may extend only a short distance into each wall, as in Fig. 13, which makes them permanent with the casting and not removable.

Where the blades are permanently seated in the castings, both ends may be reduced, but where the partition extends through the wall, as in Fig. 5, then the width at this wall cannot be reduced.

While I have shown the steam passages in the segments which are mounted in the diaphragm, in some instances the diaphragm may be cast with the steam passages therein, as in Figs. 11 and 12. In this case the blades are inserted in the mold for the diaphragm as they would be inserted in the mold for the segments. I may also make the segment 8^a, which is usually bolted onto the casing and has the first steam passage therein, Fig. 1, in the same manner as the segments which are inserted in the diaphragm. I may also make the partitions 18 formed of the bent plates of less width than the diaphragm or segment, as in Fig. 15, to reinforce that portion of the metal of the diaphragm or segment located between the partitions and the flange may be on one side only, as shown.

While I have shown a rib on the segment adapted to a groove in the diaphragm, a rib may be formed on the diaphragm adapted to a groove in the segment, and, in some instances, the joint between the segment and the diaphragm may be made plain, if found desirable.

While I prefer to make the diaphragm in a single casting and to cut it in half, machining the abutting edges, in some instances, the segments may be cast in two equal parts and the abutting edges finished; the sections being secured together by bolts or other fastenings or held in place by the casing.

In Fig. 16, I have shown a modification of the segments in which the partitions extend through the inner wall and only extend into the outer wall for a short distance; the partitions being held in place by the diaphragm in this instance.

It will be seen from the above construction that a very substantial diaphragm for steam turbines is made. Also that there are no loose parts which are liable to become detached while the turbine is in motion. The diaphragm can be substantially made and, as the partitions are cast into the diaphragm or a segment during the process of manufacture (being properly spaced prior to casting) their location is assured so that they cannot be displaced after once in position.

In the construction illustrated in the drawings if, for any reason, one of the partitions should be injured; that partition can be quickly removed and another inserted; making it possible to keep in stock partitions of the proper length and shape to fit the several diaphragms.

By making the diaphragm with recesses and providing segmental sections adapted to the recesses, the sections can be readily handled during the process of manufacture and when it is necessary to assemble the parts in the cylinder, this can be quickly accomplished.

I claim:

1. The combination in a steam turbine, of a casing; a diaphragm therein having a steam passage; with partitions extending across the said passage and removable longitudinally from the diaphragm.

2. The combination in a steam turbine, of a casing; a diaphragm therein having a steam passage, with partitions of greater length than the width of the passage; and having their ends located in the diaphragm but not attached thereto.

3. The combination of a diaphragm for steam turbines, recessed at the periphery; a segment mounted in the recess and having a

steam passage therein; bent plates spaced apart and extending across the steam passage and having their ends projecting into the walls of the segment; the portions of the partitions extending into the casting being free of the casting so as to allow the parts to expand or contract independently.

4. In a steam turbine, a diaphragm having steam passages therein and having partitions separating the steam passages; the portions of the partitions extending into the casting being held firmly therein against lateral movement, but free to move longitudinally to a limited extent.

5. The combination in a turbine engine, of a diaphragm having a steam passage therein; partitions extending across the passage; said partitions being made of sheet metal and extending through the outer wall and removable from the diaphragm.

6. The combination in a turbine engine, of a diaphragm; a segment mounted in the diaphragm and having a steam passage therein; partitions extending across the passage and through one wall thereof and removable therefrom.

7. The combination in a steam turbine, of a diaphragm having steam passages therein; partitions separating the steam passages; said partitions radiating from a common center and extending into the walls of the recess forming the steam passages and extending through the outer wall and removable from the casting so that, after the casting is made with the partitions in place, the partitions can be removed and the walls of the steam passages machined and the partitions reinserted.

8. The combination in a steam turbine, of a diaphragm having a steam passage therein; a series of partitions extending across the steam passage and embedded in the diaphragm; one end of the partitions extending through the wall of the diaphragm, the other end being reduced in width so as to form a tongue.

9. A partition for the diaphragm of a turbine engine, consisting of a sheet metal plate bent transversely and having a tongue at one end and perforated at the opposite end.

10. The combination in a steam turbine, of a two-part diaphragm, each part having a groove at the meeting face; with a filling strip mounted between the two parts and having tongues adapted to the grooves.

11. The combination in a steam turbine, of a cylinder; a series of diaphragms, having lateral flanges at the periphery, located in the cylinder so that one flange abuts another; a shaft, with rotors mounted thereon, between the diaphragms; blades on the rotors; steam passages in the diaphragms; and partitions therein dividing the steam passages and held in place by the cylinder.

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

ANDREW C. VAUCLAIN.

Witnesses:
WM. E. SHUPE,
WM. A. BARR.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."