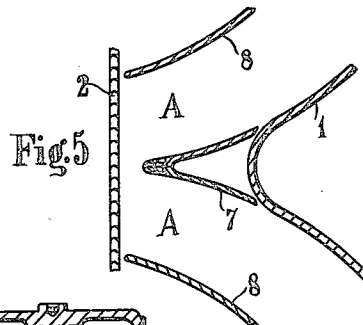
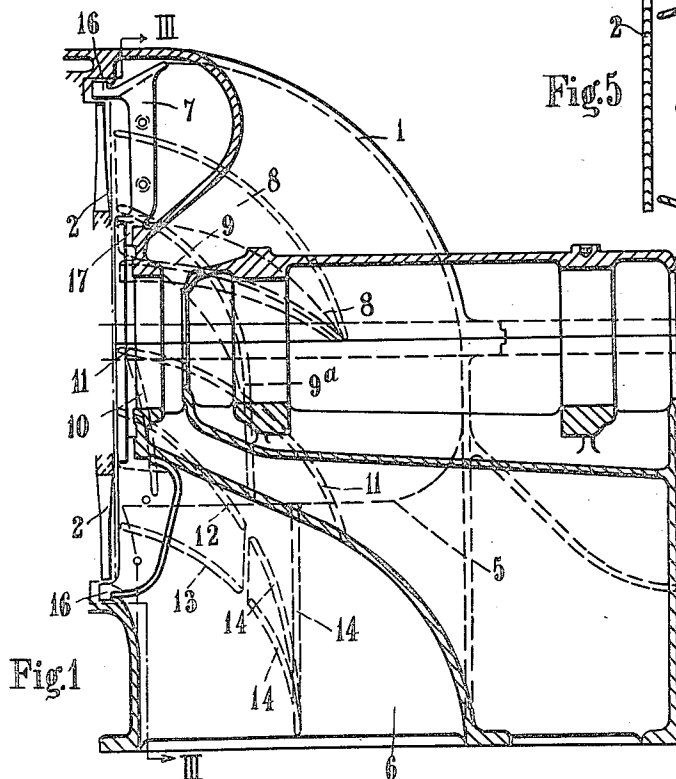
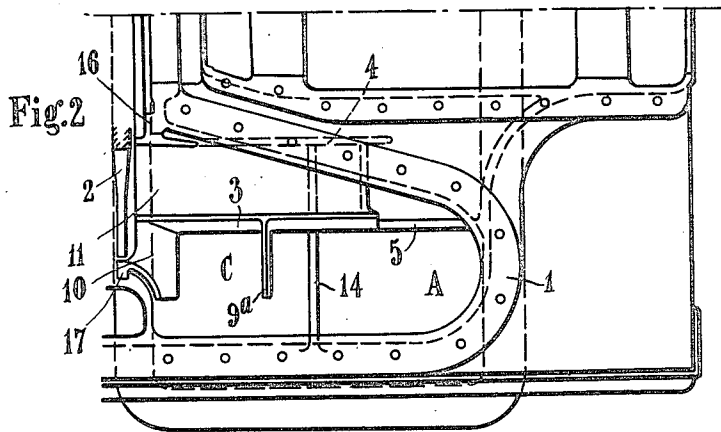


K. BAUMANN.
STEAM TURBINE.
APPLICATION FILED AUG. 24, 1917.

1,320,671.

Patented Nov. 4, 1919.
8 SHEETS—SHEET 1.



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Fig.4

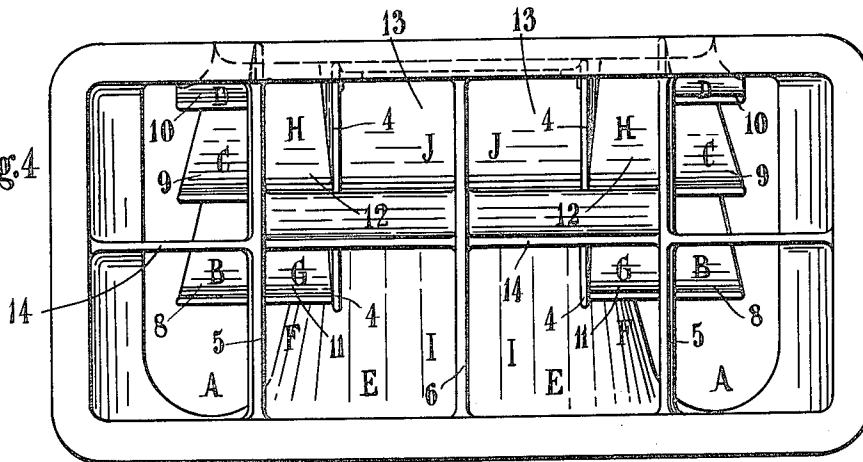
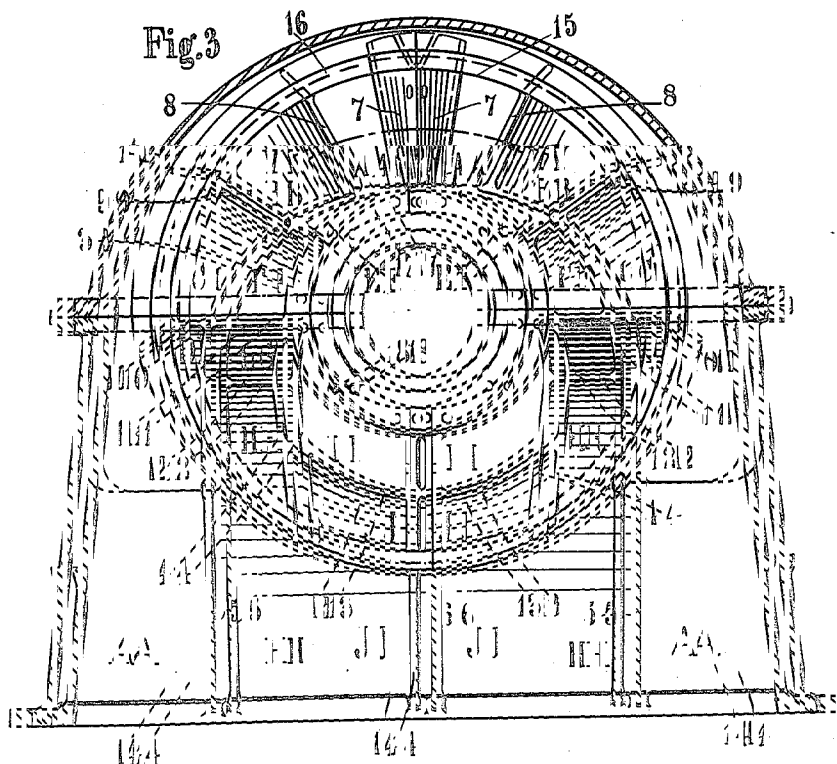


Fig.3



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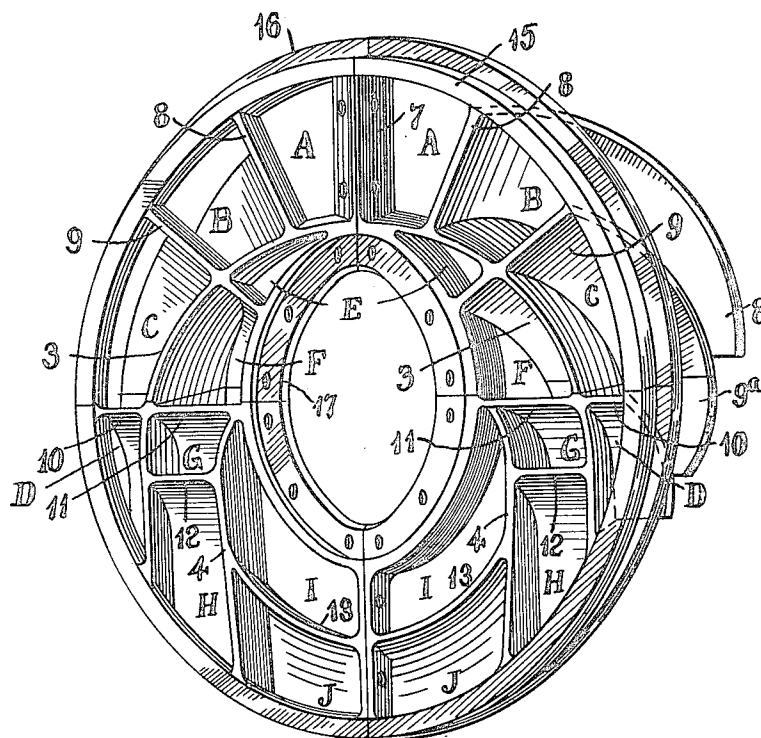
K. Baumann
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Fig 6.



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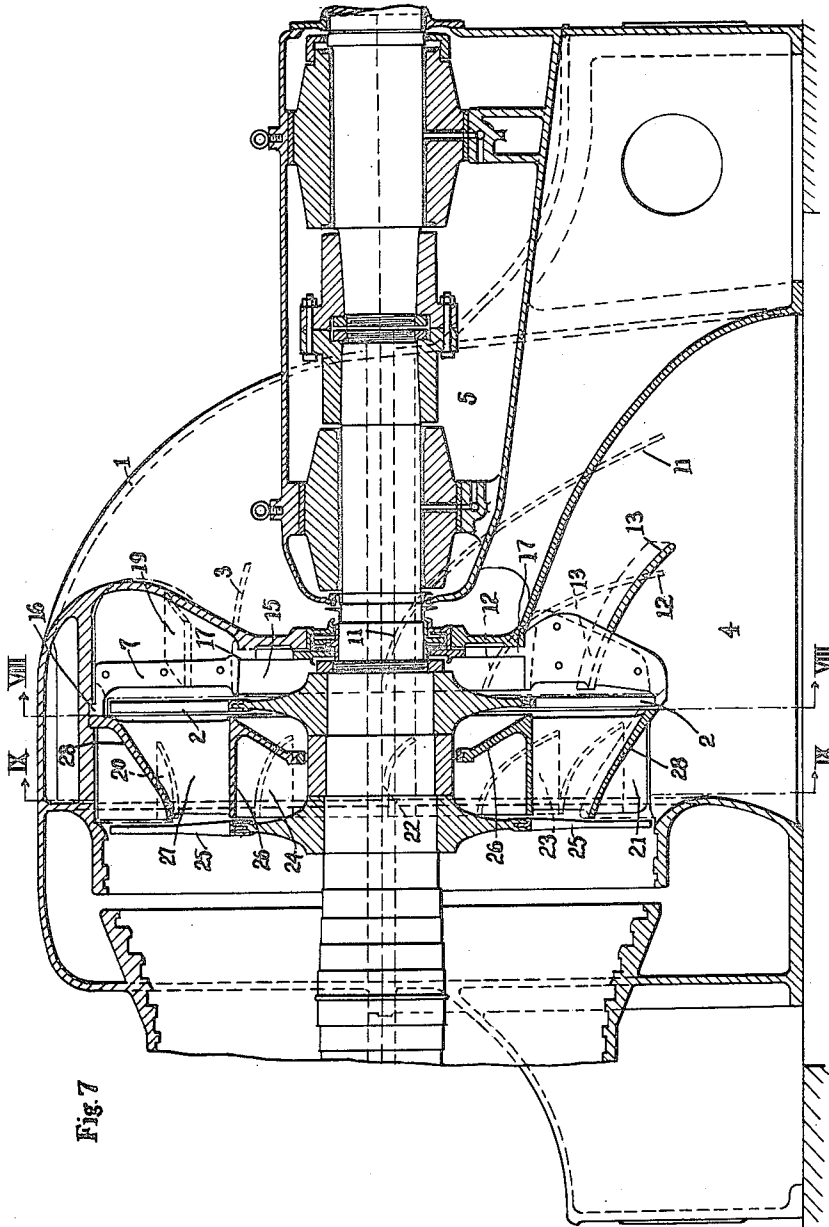


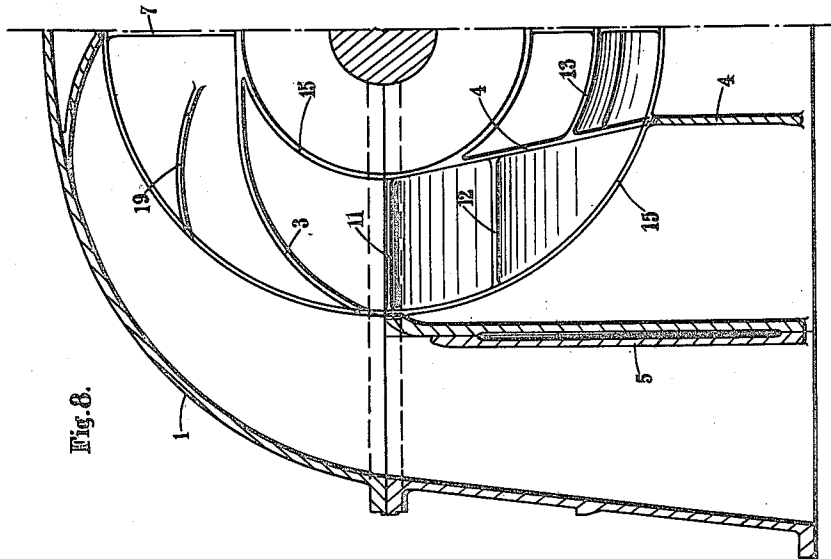
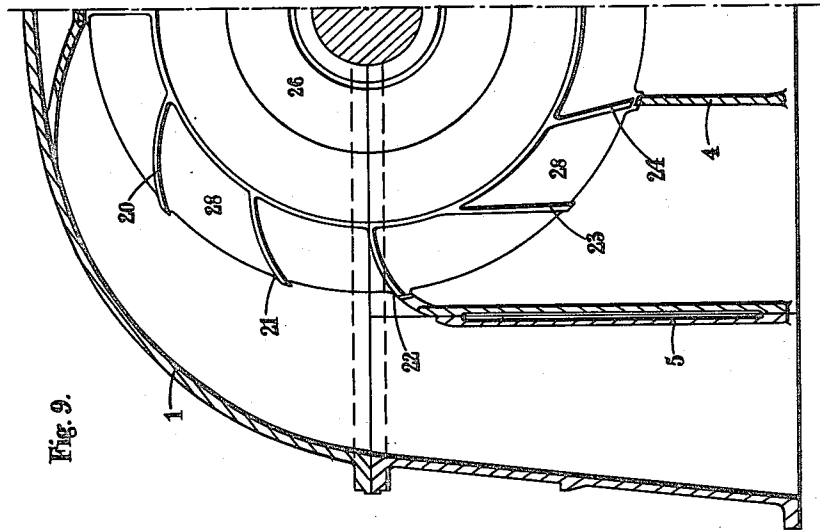
Fig. 7

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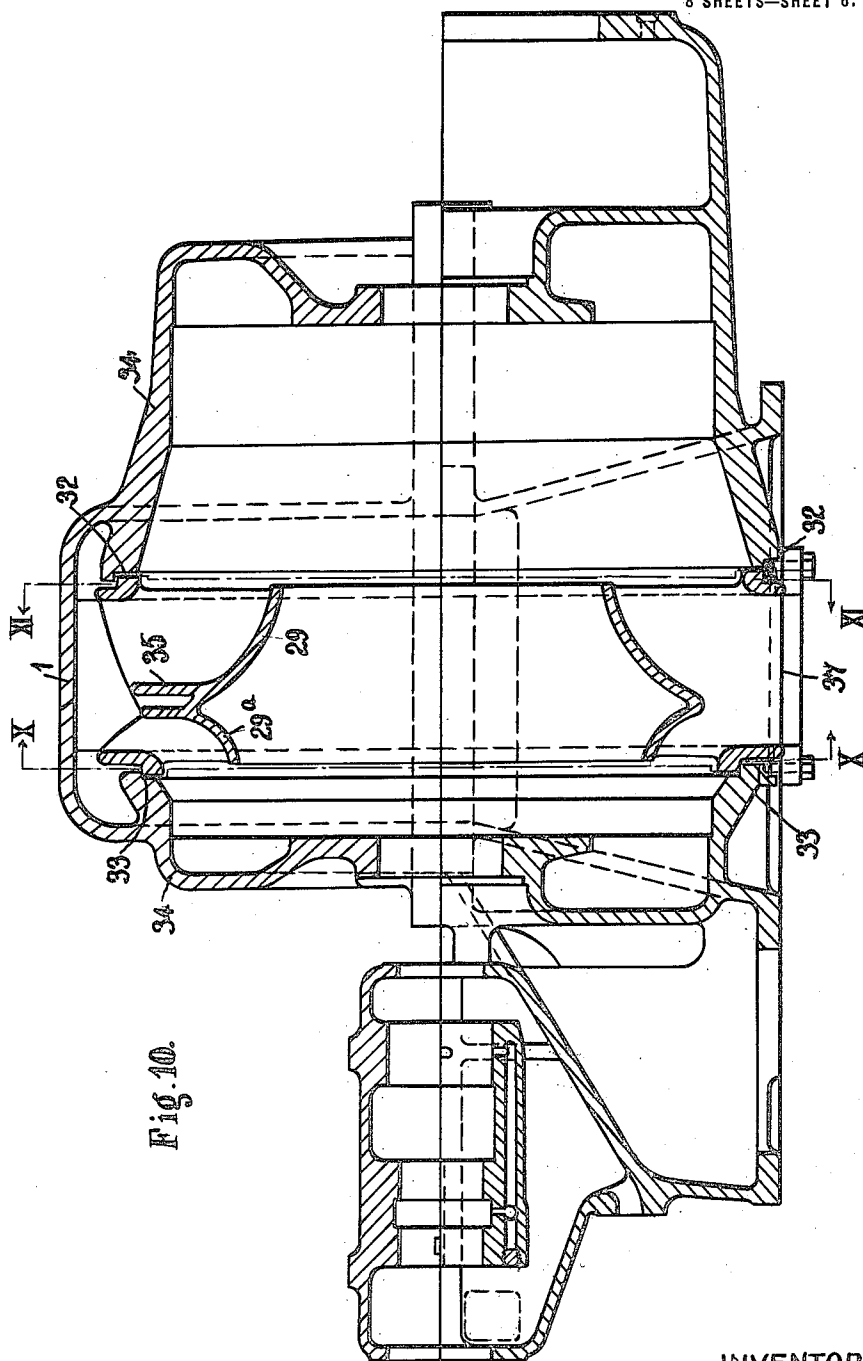
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Fig. 14.

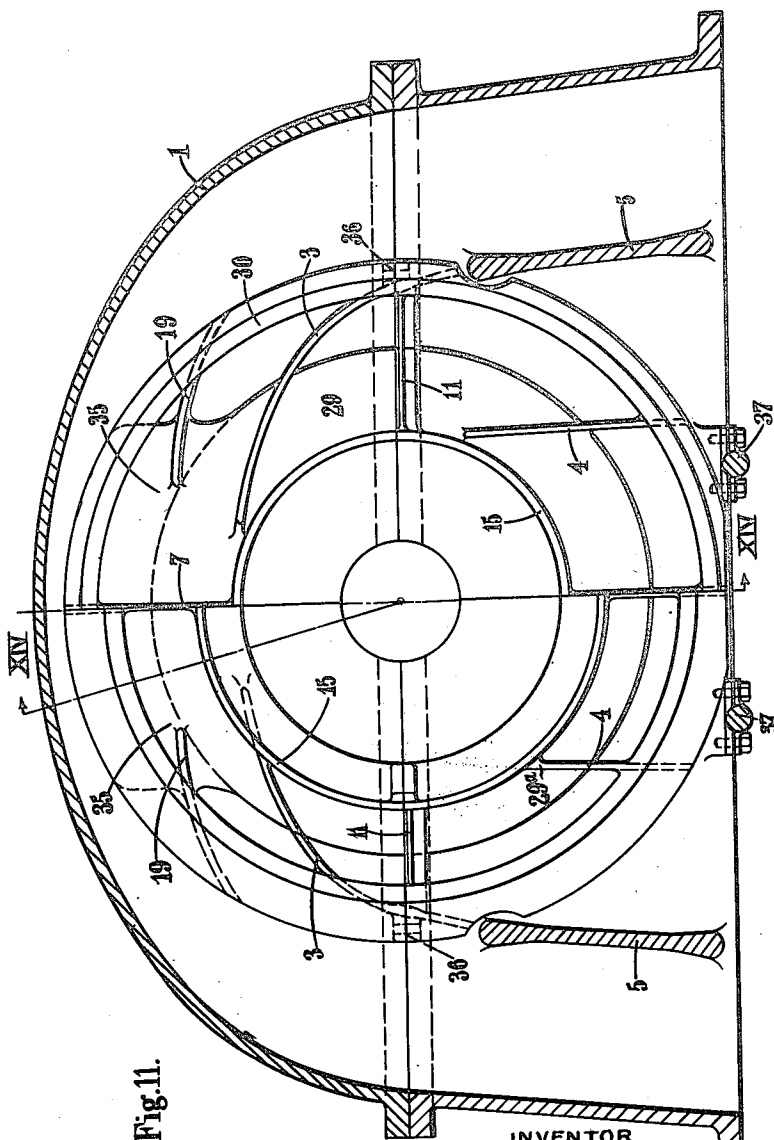
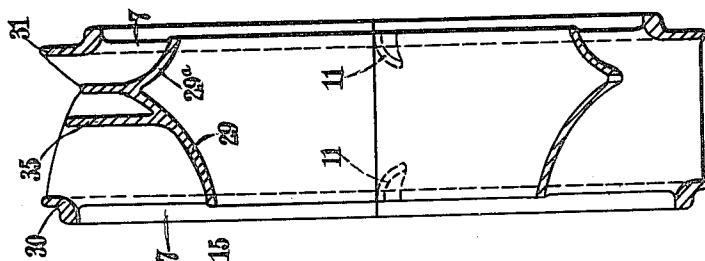


Fig. 11.

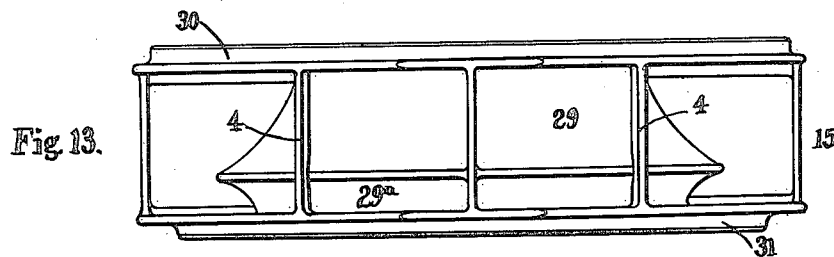
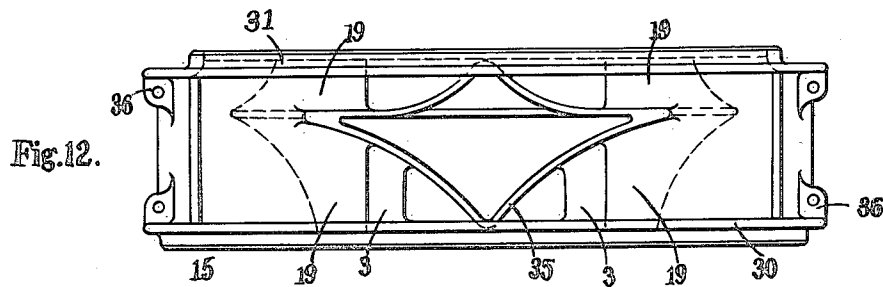
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APPLICATION FILED AUG. 24, 1917.

1,320,671.

Patented Nov. 4, 1919.
8 SHEETS—SHEET 8.



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UNITED STATES PATENT OFFICE.

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STEAM-TURBINE.

1,320,671.

Specification of Letters Patent.

Patented Nov. 4, 1919.

Application filed August 24, 1917. Serial No. 187,963.

To all whom it may concern:

Be it known that I, KARL BAUMANN, a citizen of the Confederation of Switzerland, and a resident of Urmston, in the county of Lancaster, England, have invented a new and useful Improvement in or Relating to Steam-Turbines, of which the following is a specification.

This invention relates to exhaust casings for axial flow steam turbines by means of which the exhaust steam leaving one or more rows of moving blades is conducted to the exhaust outlet of the turbine or to the condenser or condensers.

It has already been proposed to provide the exhaust casing of a turbine with internal guide walls located in planes approximately parallel with the turbine shaft which divide the steam leaving the moving blades into segmental portions and deflect such portions of steam toward the exhaust outlet of the turbine.

The present invention has for its object to provide an improved turbine exhaust casing of compact design, having internal guide walls of the above kind so constructed and arranged that the steam is guided toward the exhaust outlet by easy paths in which short bends or sharp angles or pockets are avoided.

This object is accomplished, according to this invention, by extending the aforesaid internal guide walls across from the outer to the inner circumference of the area from which the steam leaves a ring of moving blades so that the steam is gradually deflected toward the exhaust outlet or outlets.

The internal guide walls or some of them are preferably formed along the whole or a portion of their length to substantially involute curves, the base circle from which said curves are described being preferably of less diameter than the diameter of the outer circumference of the ring of moving exhaust blades across which they extend, and occasionally of less diameter than the inner circumference of said ring. Sometimes the involute curves to which different internal guide walls are formed are described from base circles of different diameter.

In some cases additional guides or division walls are provided which sub-divide the sections into which the annulus representing

the area of a row of moving blades from which the steam passes to the exhaust is divided by said internal guide walls and assist in guiding the steam toward the exhaust outlet. Such additional guides or division walls extend in a direction which over a portion at least of their length is substantially transverse to the turbine axis, and in some cases spring from or intersect one or more internal guide walls, or extend between adjacent guide walls, and where they approach the moving exhaust blades may take various forms. For example, they may be shaped to segments concentric with the turbine shaft or they may terminate in lines approximately normal to the rectilinear or curved portions of the internal guide walls from which they spring or which they intersect or between which they extend.

In order that the invention may be clearly understood it will now be described with reference to the accompanying drawings which show by way of example some exhaust casings for steam turbines constructed in accordance therewith.

In the accompanying drawings, Figure 1 is a central vertical longitudinal section, Fig. 2 a plan view of the lower half, Fig. 3 a cross section on the line III—III of Fig. 1, Fig. 4 a bottom plan view looking upward, and Fig. 5 a fragmentary cross section on the line V—V of Fig. 3, of one form of exhaust casing constructed in accordance with this invention. Fig. 6 is a view in isometrical projection on a somewhat larger scale of certain parts of the construction illustrated in Figs. 1 to 5.

Fig. 7 is a central, vertical, longitudinal section, Fig. 8 a half sectional view on the line VIII—VIII of Fig. 7, Fig. 9 a similar view on the line IX—IX of Fig. 7, illustrating the invention applied to a multiple exhaust turbine of the kind set forth in my application filed October 4, 1916, Serial No. 123,697.

Fig. 10 is a central, vertical, longitudinal section of the cylinders and exhaust casing of a turbine having ahead and astern portions with a centrally located exhaust casing in accordance with this invention, especially suitable for marine propulsion. Fig. 11, as to its left-hand half is a cross section on the line X—X, and as to its right-hand half on the line XI—XI of Fig. 10. Fig. 12 is

a plan view looking from above and Fig. 13 a plan view looking from below, of the frame containing the guides and internal guide walls for the steam shown in Figs. 10 and 11, Fig. 14 being a section of such frame taken on the line XIV—XIV of Fig. 11.

Referring now to Figs. 1 to 6, the exhaust casing is indicated at 1 the central portion of the rear wall being curved outwardly as shown for the purpose of deflecting outwardly the steam leaving the final row of moving blades 2. Internal guide walls 3, 3, 4, 4, occupying planes substantially parallel with the turbine shaft extend across from the outer to the inner circumference of the exhaust area of the moving blades 2. The upper portions of said guide walls 3, 3, 4, 4, are, as shown, formed to substantially involute curves, the base circle from which they are described being smaller in diameter than the inner circumference of the row of moving exhaust blades 2. The internal guide walls 3, 3 are continued down to the exhaust outlet by webs 5, 5, extending across the lower part of the exhaust casing and serving the additional purpose of strengthening said casing so that the turbine may, if desired, be supported from feet located at the ends only of its exhaust casing, in the manner described in my said application.

The exhaust casing may, in addition, advantageously be provided with a central web 6 also extending across the lower portion thereof near the exhaust outlet, which will further strengthen the exhaust casing. At the upper end opposite the exhaust outlet there is provided a V-shaped portion 7 which causes the steam leaving the uppermost moving blades 2 to divide and flow through the two halves of the upper portion of the exhaust casing 1.

In addition to the internal guide walls 3, 3, 4, 4, additional guides or division walls are provided which subdivide the sections into which the exhaust blade area is divided by said internal guide walls and assist in deflecting the steam leaving the moving blades 2 toward the exhaust outlet. The number of such additional division walls employed and their location may be varied considerably, one arrangement which may advantageously be adopted being shown in Figs. 1 to 6, in which division walls 8, 8, 9, 9, in the upper half of the exhaust casing where they approach the moving blades 2, assume a radial direction and from that point curve downward, as shown, toward the exhaust outlet occupying at their lower ends planes transverse to that of the turbine shaft. The curves to which these division walls are formed are, it will be observed, substantially helicoidal in shape. The division walls 8, 8 spring from the internal guide walls 3, 3 and the walls 9, 9 intersect said internal guide walls as shown.

Near the horizontal joint of the lower half of the exhaust casing are further division walls 10, 10, 11, 11 the adjacent inner edges of which unite with the internal guide walls 3, 3. The walls 10, 10 fall away in a sharp curve toward the exhaust outlet as clearly shown in Figs. 1, 2 and 4, while the walls 11, 11 are curved much more gradually so as to deflect the steam flowing above them toward the rear part of the exhaust casing.

The lower half of the exhaust blade area or annulus is also provided with division walls 12, 12, extending, as shown, between the internal guide walls 3, 4, 3, 4 and with division walls 13, 13, extending between the internal guide walls 4, 4. At their upper edges where they approach the exhaust blades 2 the division walls 13, 13 take the form of segments concentric with the turbine shaft and fall away from their upper edges in a curve toward the exhaust outlet such that the steam from the blades 2 flowing below said division walls is guided through that portion of the exhaust casing nearest the high pressure end of the turbine.

Where the turbine and consequently the exhaust casing is of large size, it may conveniently be provided with a transverse web 14, extending approximately centrally across the lower portion of the casing near the outlet. The inner portion of this web 14, which is located between the webs 5, 5, is, near its upper edge, curved inwardly toward the high pressure end of the turbine so as to meet the lower edges of the division walls 12, 12, 13, 13, which are, in this manner, continued down to the exhaust outlet.

The internal guide and division walls above described provide a number of passages through which the steam leaving the exhaust blades 2 flows during its passage to the exhaust outlet and cause such steam to be substantially uniformly distributed throughout the exhaust casing, shocks, whirls, and eddies arising from portions of steam flowing in different directions in the exhaust casing being thereby reduced to a minimum. To enable the drawings to be more easily comprehended the various passages into which the exhaust blade area is divided by the aforesaid internal guide and division walls are indicated in the several figures by corresponding reference letters. As the exhaust casing is bi-laterally symmetrical the same reference letters are used to indicate corresponding passages in either half of the same.

The internal guide and division walls may be mounted in position within the exhaust casing in various ways. For instance, said walls, or some of them, may be cast integral with the exhaust casing. Alternatively, they may be formed separately and attached to and supported from the exhaust casing. A very convenient arrangement, however, is

that illustrated in Figs. 1 to 6, in which the greater part of said guide and division walls are formed in a removable frame 15 having an outer flange 16 and an inner flange 17, the former occupying a groove formed in the exhaust casing, and the latter being secured by bolts passing through the holes 18 into the rear wall of the exhaust casing. Said frame is conveniently made, as shown, in quadrants, the two upper and two lower quadrants being respectively bolted together in a vertical plane as indicated. The manner in which such a frame and the guide and division walls may be constructed will be best understood by an inspection of Fig. 6, which is a view in isometrical projection of such a frame removed from the exhaust casing. Some of the guide and division walls contained in the frame are continued in the lower half of the exhaust casing by webs or walls, such for instance as the webs 5, 6 and 14, while in other cases, as shown for example in Fig. 2, the division walls 9, 9 are continued below the horizontal joint line of the casing by portions 9^a, 9^a in the lower quadrants of the frame.

Referring now to Figs. 7 to 9, the exhaust casing here shown is similar to that described in my said application and the internal guide and division walls provided for conducting away the steam flowing from the final row of moving blades 2, may be substantially similar to those described above with reference to Figs. 1 to 6, although, as will be seen from Figs. 7 and 8, the number and location of the internal guide and division walls vary somewhat from the arrangement shown in the preceding figures. The arrangement of these parts will, however, be readily understood without any detailed description thereof as similar reference numerals are used to indicate corresponding parts. An additional short internal guide wall 19 is provided in this arrangement to assist in deflecting the steam leaving the upper part of the moving blades 2 toward the exhaust outlet.

Internal guide walls 20, 21, 22, 23, 24, for deflecting toward the exhaust outlet portions of the steam leaving the outer portion of the penultimate row of moving blades 25, are formed on the outer circumferential wall 28 of the diaphragm 26 carrying the fixed guide blades 27 through which the steam from the inner portion of the moving blades 25 passes on its way to the final row of moving blades 2. The steam leaving the outer portion of the moving blades 25 is also deflected outwardly as it passes into the exhaust casing by the outer wall 28 of the diaphragm 26.

In Figs. 10 to 14 the frame 15 containing the internal guide walls is somewhat different in construction as in the turbine shown in these figures, the steam may flow in either direction to the centrally located ex-

haust casing 1. The frame 15 in this form of the invention comprises inner portions 29, 29^a, curved outwardly in both directions as shown toward the center, forming trumpet-shaped guides which deflect the steam leaving the last rows of moving blades in the ahead and astern portions of the turbine from an axial into a substantially radial direction of flow, said inner curved portions 29, 29^a, being connected by the guide walls 3, 3, 4, 4, 19, 19, to the outer rings 30, 31 of the frame and are provided with flanges which fit into grooves 32, 33, located respectively in the ahead and astern portions of the turbine cylinder 34. At the upper portion of said frame there is provided a curved guide 35 which acts in a similar manner to the part 7 shown in Figs. 3, 5 and 6 and divides the steam leaving the uppermost moving blades and causes it to flow on opposite sides of the axial vertical plane into the exhaust 37.

In this form of the invention it will be seen that the internal guide walls are arranged very similarly to those shown in Figs. 7 and 8, being indicated by corresponding reference numerals, the frame 15 containing the radial guide walls being conveniently made in two semi-circular portions only, and provided with lugs 36 by which the two portions may be bolted together. It will be observed that in this constructional form of the invention no additional division walls are provided the parts marked 11 in these figures being struts which connect the curved portions 29, 29^a respectively with the outer rings 30, 31 of the frame.

The construction shown in Figs. 10 to 14 is, as hereinbefore stated, particularly adapted for turbines used for marine propulsion, and as the space below the turbine available for the condenser is limited the vertical depth of the exhaust casing is restricted and does not extend below the level of the turbine cylinder. In order that the ahead and astern portions of the latter may be braced together and maintained in proper relative position struts 37 are provided having ears at their ends by means of which they are bolted to the lower inner extremities of the ahead and astern cylinders.

In arranging the guide walls in the exhaust casing the areas inclosed by contiguous guide walls near the exhaust outlet should preferably be proportional to the areas inclosed by said guide walls at the exhaust blades. The guide walls need not necessarily be continued right down to the exhaust outlet but only so far as is necessary to insure the desired direction of flow being imparted to the steam, said guide walls in some cases not extending beyond the outer circumference of the exhaust blade annulus. Generally, however, it will be found desirable, as hereinbefore described,

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