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EXHAUST CONNECTING BRANCH FOR TURBINES.

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Fig. 1

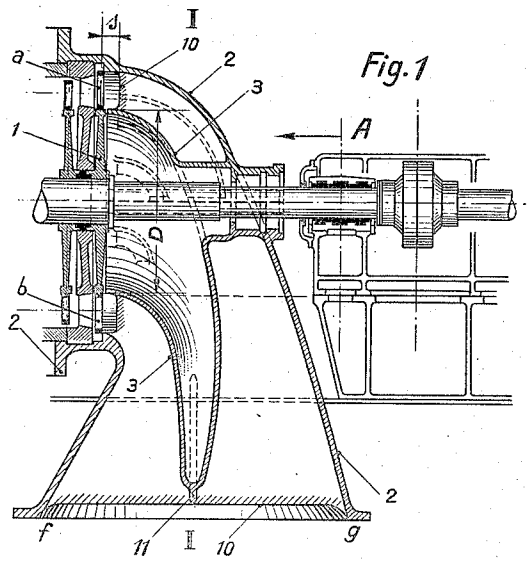
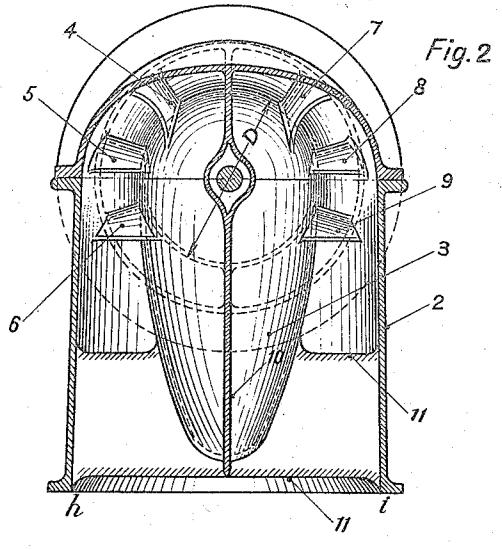


Fig. 2



Witnesses:

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EXHAUST CONNECTING BRANCH FOR TURBINES.

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To all whom it may concern:

Be it known that I, HEINRICH ZOELLY, a citizen of the Republic of Switzerland, residing at Zurich, Switzerland, have invented new and useful Improvements in Exhaust Connecting Branches for Axial-Flow Steam or Gas 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 drawing, and to letters or figures of reference marked thereon, which form a part of this specification.

This invention relates to improvements in exhaust connecting branches for axial flow steam or gas turbines. The exhaust connecting branch is so formed that the working fluid flowing from the outlet of the last rotor wheel toward the outlet opening of the exhaust connecting branch passes, owing to the provision of guide-walls in said branch, through a continuously widening path, whereby the working fluid, whose velocity is continuously decreasing, while its pressure is continuously increasing, is diverted from the axial direction into a direction substantially at right angles to the turbine axis. The guide-walls fitted in the branch may form substantially a horn-shaped body or casing tapered toward the branch outlet and having a curved middle line. Between the wall of the branch and said built-in guide casing there may be provided uniformly curved guide vanes diverting the working fluid from the outlet of the rotor wheel along the nearest possible path toward the branch outlet.

In an exhaust connecting branch provided with such an arrangement the cross section of the diverted middle or center stream of the working fluid, having a relatively high velocity upon its leaving the last rotor wheel, may constantly increase while said stream flows toward the branch outlet. By means of this arrangement the velocity of the working fluid may then decrease and the kinetic energy contained in this stream leaving the last rotor wheel may be transformed into potential energy, whereby sudden changes of direction and therefore eddy currents, with their consequent loss of energy, are avoided as much as possible. In this manner it is possible that the pressure of the working fluid is lower at the point where said fluid flows into the branch than at the point where it leaves this branch. At the same time the working fluid flowing substantially in an axial direction at the point where it leaves the rotor wheel is diverted into a direction substantially at right angles to the turbine axis. The attainment of these aims is possible to a very high degree through the employment of special guide vanes, which, gradually and in a manner avoiding shocks and eddies, divert the working fluid leaving the last rotor wheel by the nearest possible path toward the branch outlet.

The invention may be applied to steam or gas turbines having a horizontal or vertical shaft and having exhaust connecting branches, whose central axis lies in a vertical, horizontal or any other intermediate direction.

One method of carrying the invention into effect is shown by way of example in the accompanying drawing in which:

Figure 1 is a vertical longitudinal section through the exhaust connecting branch of a steam turbine having a horizontal axis and Fig. 2 a cross section on the line I—I of Fig. 1 seen in the direction of the arrow A.

Behind the last rotor wheel 1 of the turbine is arranged the exhaust connecting branch, the casing 2 of which has a horizontally directed inlet and a vertical outlet directed downward. Inside the casing 2 there is fitted the horn-shaped guide casing 3 having, immediately behind the last rotor wheel 1, *i. e.*, at *a—b* (Fig. 1) circular cross section. The outer diameter D of this cross section is somewhat smaller than the diameter of the root circle of the moving blades on the rotor wheel 1. As seen in Fig. 1, the cross section of the guide casing 3 has substantially such a shape, that its middle line conforms to the curved middle line of the exhaust connecting branch 2. Moreover, the cross section of the guide casing is continuously diminishing toward the outlet opening *c—d* of the branch 2. Further, as seen in Fig. 2, the width D of said guide casing 3 decreases gradually toward the outlet opening *h—i* of the branch 2. The entire guide casing has, therefore, substantially the shape of a curved horn, the curved central axis of which deviates only slightly from the curved central axis of the exhaust connecting branch.

In order to divert in the best possible manner the layers of steam flowing out of

the rotor wheel on both sides of the guide casing (as seen in Fig. 2) from their initial direction, which is substantially parallel to the turbine axis, to a direction at right angles to the branch outlet, *i. e.* at right angles to the lines *f*—*g* of Fig. 1 and *h*—*i* of Fig. 2, respectively, guide vanes 4 to 9 are provided between the casing wall of the exhaust connecting branch 2 and the guide casing 3, the meridian lines of these guide vanes coinciding with the path, which it is intended that the working fluid should follow. These guide vanes and the branch may form one casting or the said vanes may be welded to the wall of this branch 2 or to the guide casing or to both these pieces, or they may be connected by means of screws, rivets or the like to the one or the other or to both of the said main pieces. Moreover, middle ribs 10 and 11 may connect the branch casing with the built-in guide casing. The edges of the deflecting walls 4 to 9 and the middle rib 10, which are placed in the path of movement of the working fluid have to be arranged at such a distance (*s* in Fig. 1) from the last rotor wheel, that the working fluid is prevented from impinging directly against these walls.

As in the case of the exhaust connecting branch also the guide casing may be subdivided in the horizontal plane. Its cross section need not form a wholly closed body. Thus, a part of the closed body shown on the drawing may be dispensed with particularly in the upper portion.

What I wish to claim is:

1. An exhaust connecting branch for axial flow steam or gas turbines, comprising a casing open at both ends and guide-walls built-in in said casing, said guide-walls being so formed and so arranged within said casing, that the working fluid flowing from the outlet of the last rotor wheel toward the outlet of the branch passes through a continuously widening path, whereby the said working fluid whose velocity is continuously decreasing while its pressure is continuously increasing, is diverted from the axial direction into a direction substantially at right angles to the axis of the turbine.

2. An exhaust connecting branch for axial flow steam or gas turbines, comprising an outer casing having an inlet opening lying in a plane at right angles to the turbine axis and an outlet opening lying in a plane at right angles to the plane of the inlet opening and a guide casing built-in in said outer casing, said guide casing forming substantially a horn-shaped body tapered to a point toward the branch outlet and having a curved axis.

3. An exhaust connecting branch for axial flow steam or gas turbines, comprising an outer casing having an inlet opening lying in a plane at right angles to the turbine axis and an outlet opening lying in a plane at right angles to the plane of the inlet opening, a guide casing built-in in said outer casing, said guide casing forming substantially a horn-shaped body tapered to a point toward the branch outlet and having a curved axis, and continuously curved guide vanes arranged between the outer casing and the guide casing, whereby the said guide vanes divert the working fluid leaving the rotor wheel along the nearest possible path toward the outlet opening of the branch.

4. An exhaust connecting branch for axial flow steam or gas turbines, comprising an outer casing provided with an inlet and outlet opening for the working fluid and a horn-shaped built-in body in said outer casing and tapered to a point toward the branch outlet and having a curved axis, said body being connected by means of ribs to the outer casing, a continuous space being provided between the outer casing and the built-in body, whereby the annular cross sections of said space continuously increase toward the outlet opening of the branch.

5. An exhaust connecting branch for axial flow steam or gas turbines, comprising an outer casing provided with an inlet and outlet opening for the working fluid, a horn-shaped built-in body in said outer casing and tapered to a point toward the branch outlet and having a curved axis, said body being connected by means of ribs to the outer casing and a continuous space being provided between the outer casing and the built-in body, whereby the annular cross-sections, at right angles to the axis of the built-in body, of said space continuously increase toward the outlet of the branch, and continuously curving guide vanes arranged in said space near the inlet opening of the outer casing, which guide vanes divert the working fluid leaving the rotor wheel, along the nearest possible path toward the outlet opening of the branch.

6. Exhaust connection for axial flow steam and gas turbines, comprising a casing and guide-means therein coöperating with said casing to direct exhaust motive fluid in a continuously expanding path constantly changing in direction from the inlet end to the outlet end of said casing and said paths substantially parallel to the longitudinal middle plane through said casing and means.

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

HEINRICH ZOELLY.

Witnesses:

ERNST FISCHER,

CARL GUBLER.