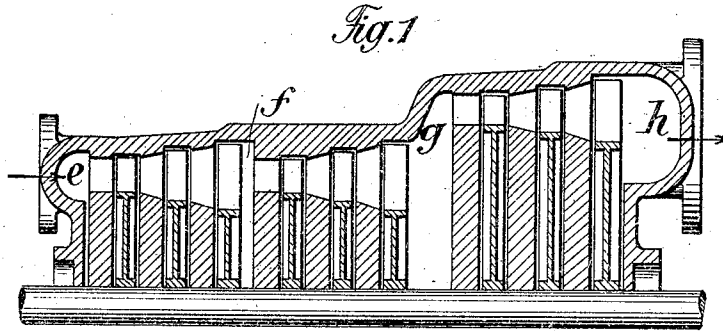
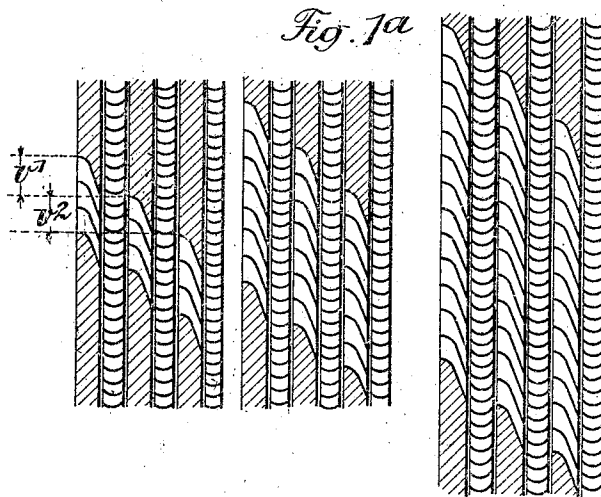
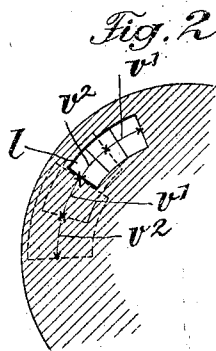
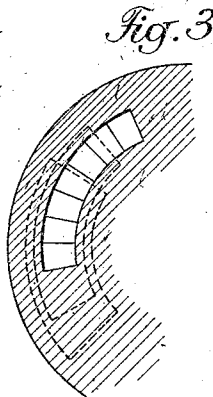
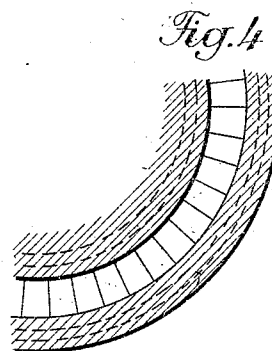


No. 889,019.

PATENTED MAY 26, 1908.

J. KARRER.
MULTIPLE STAGE TURBINE.
APPLICATION FILED JULY 12, 1908.

2 SHEETS—SHEET



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2 SHEETS—SHEET 2.

Fig. 5

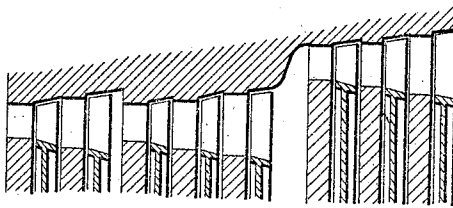


Fig. 6

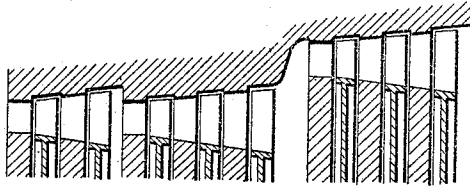
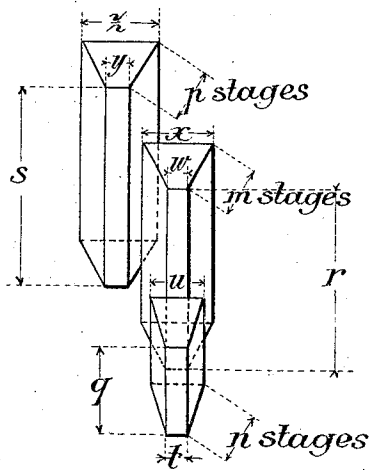


Fig. 7



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MULTIPLE-STAGE TURBINE.

No. 889,019.

Specification of Letters Patent.

Patented May 26, 1908.

Application filed July 12, 1906. Serial No. 325,865.

To all whom it may concern:

Be it known that I, JOSEF KARRER, a citizen of the Republic of Switzerland, residing at Zurich, Switzerland, have invented certain new and useful Improvements in Multiple-Stage Turbines Operated by Impact upon Portions of the Circumference; 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 or figures of reference marked thereon, which form a part of this specification.

This invention relates to a turbine for steam or other gaseous propelling fluid operated by impact upon portions of the circumference of its moving wheels or blade rings, and more particularly to such turbines on the impulse principle, in which the consecutive rings of fixed and moving blades constitute what is called "pressure stages".

The object of the invention is to more completely utilize in turbines of the said class the velocity of the propelling fluid emerging from the passages between the blades of the moving ring or wheel of one pressure stage in the succeeding stage.

In turbines of this class that have hitherto been known, the said velocity is in a great measure lost on account of sudden changes in the cross sectional area of the flow of the propelling fluid through the consecutive stages of the turbine.

According to this invention the consecutive fixed and moving passages between the blades are made so as to avoid such sudden changes in the cross sectional area of the flow of the fluid and the losses caused by them. This is obtained by making the peripheral extension of the cross sectional area of flow the same through all the consecutive stages of a similar diameter, the radial extension of the cross sectional area, however, increasing without any sudden step or jump, this increase being distributed at pleasure over the succeeding pressure stages and over the succeeding blade rings of the stages. If the number of stages is large, this radial increase can be stopped on reaching a certain limit with a certain stage, and may be commenced again, the peripheral extension thereby being increased an appropriate amount at once and then remain the same through a number of

stages until the radial extension reaches again a limit. This latter case is the usual one, and may be described as a repetition of groups of stages, each group having the same peripheral extension of cross sectional area of flow or impact, every succeeding group, however, a larger one than the preceding group until a limit of peripheral extension, usually the entire circumference, is reached, whereby within each group of stages the radial extension of the cross sectional area increases from an initial value at the inlet to the first stage of the group, up to a final value at the outlet from the last stage of the group. In this usual case the utilization of velocity of the propelling fluid emerging from the moving blades of a stage is obtained only within the groups of stages, while between the groups, where a sudden increase in peripheral extension and a sudden contraction in radial extension of the cross sectional area of flow takes place, this velocity as far as the means according to this invention are concerned, is almost completely lost. The number of groups, however, being seldom more than three or four, and the number of stages being as large as ten to twenty and more, this loss occurs in few places of the turbine only.

The accompanying drawings show diagrammatically, by way of example in a general way, how the invention is used in a turbine having nine pressure stages, these pressure stages being united to three groups and these groups not having necessarily the same diameter.

Figure 1 is a section through the axis of a turbine of this general description. Fig. 1^a a section along the circumference of the blade rings. Figs. 2, 3 and 4 show the fixed guide passages of the three groups of pressure stages, seen in the direction from the high pressure to the low pressure end of the turbine. Figs. 5 and 6 are sections showing modifications and Fig. 7 is a diagrammatic illustration.

In this construction as an example, the first two groups of fixed and moving blades have the same diameter at the point of impact, while the third group is not of the same diameter at its point of impact as the first two.

The steam enters the inlet chamber *c* and expands in the fixed guide passages of the first pressure stage group, the increase of

cross section corresponding to the expansion taking place by the increase of its breadth or radial extension only. The peripheral extension or length of the impact of the group is constant, as shown in Fig. 2. In this figure the front view of the impact area of the first pressure stage is shown in full lines, and the area of the succeeding pressure stages is shown in dotted lines, in a way to demonstrate that the peripheral length of the impact is constant and its radial extension increasing. v^1 and v^2 indicate the amount of angular displacement of the impacts relatively to each other; these displacements result from the blade arrangement as shown in Fig. 1^a, which is a section of a portion of the turbine on the plane of impact developed.

The exhaust chamber *f* of the first pressure stage group is at the same time the inlet chamber of the succeeding group which commences with a smaller breadth of guide passage but the length of which subject to impact is greater than in the first group and remains constant within the same group, see Fig. 3. In this figure the impact area of the first pressure stage of the second group is shown in full lines and demonstrates the increased peripheral length of the impact within this group compared with that of the first group. The impact areas of the succeeding pressure stages of this group are shown in dotted lines, in such a way as to demonstrate the constancy of the peripheral length and the increasing radial extension of the impact within this group.

The exhaust chamber *g* (Fig. 1) of the second group is the inlet chamber of the next group. The impact length within this group is also constant, as shown in Fig. 4, which shows the impact areas of the last group of pressure stages; that of the first stage of the group in full lines, and that of the succeeding pressure stages of the group in dotted lines, in analogy to Figs. 1 and 2. The steam thus traverses all the pressure stages, or, (if there is more than one group), all the groups, and enters the exhaust chamber of the turbine at *h*.

In the construction shown in Fig. 1 the breadth of the guide passages within each group increases without any sudden step or jump. The breadth of the guide passages is greater at the exit of the last stage of the group than at the entrance to the first stage of the group. Each of the moving passages presents a constant breadth of blade from its inlet to its outlet, corresponding to the breadth of the fixed expansion guide passages which precede and succeed. The only difference of the construction shown in Fig. 5 from that shown in Fig. 1 is that the radial increase is not carried out in the expansion guide passages 1, (see Figs. 2 to 4) alone, but in the moving blade passages, which thereby provide a gradual transition from one guide

passage to the next. Also in this case the peripheral length of the impact remains constant within each group and the increase of the cross section of the fluid passages or impact area takes place only in a radial direction, the same as in Fig. 1.

In Fig. 6 the radial increase is distributed over the passages of the fixed and those of the moving blade. The peripheral extension or length of the cross sectional area of flow takes place only by radial increase of the fluid passages, without a sudden step occurring at any point, the same as in Figs. 1 and 5.

Among the constructions according to Figs. 1, 5 and 6, that according to Fig. 1 is the most convenient one, because it is easiest with the fixed blade passages to provide for the increase of radial extension of the guide passage. In this case this radial extension of the fixed blade passages of any stage corresponds to the expansion of the motive fluid that is to take place in that stage.

Fig. 7 is a diagrammatic representation of the expansion process within the turbine according to this invention. The succeeding groups of pressure stages are represented by prisms of constant length, *q*, *r*, *s*, comprising *m*, *n*, *p*, pressure stages. The increase of the breadth or radial extension of the impact area and the cross section of flow are represented by the breadth of the prisms, this increase being seen from the difference of the initial breadths *t*, *w*, *y*, and the final breadths *u*, *x*, *z*, respectively.

It is evident that the peripheral length of the cross sectional area of impact of any stage or any group of stages may be subdivided at pleasure, the constancy of peripheral length then being performed by the constant peripheral length of such sub-divisions.

It is also evident that the radial increase need not be symmetric as is the case in the accompanying drawings. The increase may take place in a more or less one-sided way, either outward or inward.

It is also evident that the loss of velocity of the emerging propelling fluid at the end of each group of stages may be lowered by the adoption of means, like the addition of a velocity stage to the last pressure stage of the group, or by otherwise lessening the velocity of the fluid emerging from the last moving wheel of a group.

I claim

1. In a multi-stage, elastic fluid pressure turbine, the combination with the moving blade rings, of a succession of pressure stages of similar diameter, fixed expansion guide passages acting upon a portion of the periphery of the moving blade rings, the peripheral extent of said action being the same for each pressure stage and increasing in size radially to accommodate the expansion in the successive stages.

2. In a multi-stage elastic fluid pressure turbine, the combination with the moving blade wheels of a succession of pressure stages of similar diameter, fixed expansion guide passages acting upon a portion of the periphery of their respective wheels, the peripheral extent of said action being substantially the same in each stage and said expansion guide passages increasing in size radially to accommodate the increase in expansion, the blades of the wheels increasing in length or radial extent in accordance with the increase of radial extent of the expansion guide passages to which they appertain.

3. In a multi-stage elastic fluid pressure turbine, the combination with the moving blade wheels having blades increasing in radial extent from the higher to the lower stages, of a succession of pressure stages of similar diameter, expansion guide passages acting upon a portion of the periphery of the wheels to the same peripheral extent in all the stages and increasing in radial dimension from the higher to the lower stages.

4. In a multi-stage elastic fluid pressure turbine, the combination with the moving blade wheels having blades increasing in radial extent in the successive stages, of a succession of pressure stages of similar diameter, expansion guide passages acting upon a portion of the periphery of the wheels, the peripheral extent of said expansion guide

passages being the same in all the stages and increasing in radial extent in each of the successive stages, and the expansion guide passages for each stage increasing in size in a radial direction from their inlet to their outlet.

5. In a multi-stage elastic-fluid pressure turbine, being divided into groups of pressure stages which pressure stages have a similar diameter within their respective group, moving blade wheels in each group whose blades increase radially from the highest to the lowest stage of each group, expansion guide passages arranged in sets for each wheel, the peripheral extent of which is the same throughout a group but increases in radial extent in accordance with the sizes of the moving blades; the peripheral extent of the sets of the expansion guide passages of the groups increasing from the higher to the lower groups, the radial extent of the expansion guide passages of the first stage of each succeeding group being considerably less than that of the last stage of the preceding group.

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

JOSEF KARRER.

Witnesses:

A. LIEBERKNECHT,
E. C. REDINGER.