

April 21, 1925.

1,534,721

O. LASCHE
CONSTRUCTION OF ELASTIC FLUID TURBINES TO PREVENT BREAKAGE OF
BLADES DUE TO VIBRATIONS
Filed April 28, 1924

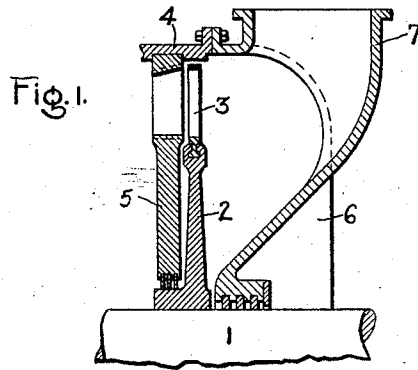


Fig. 2.

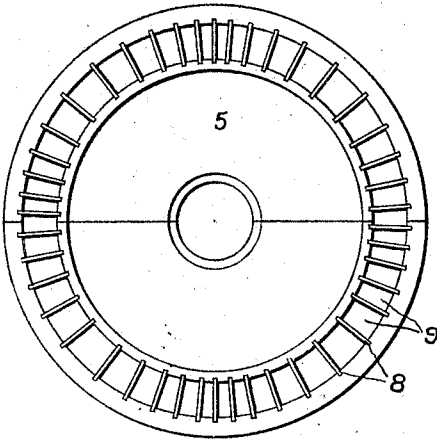


Fig. 4.

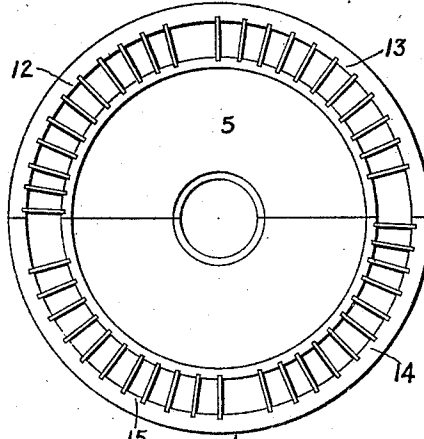
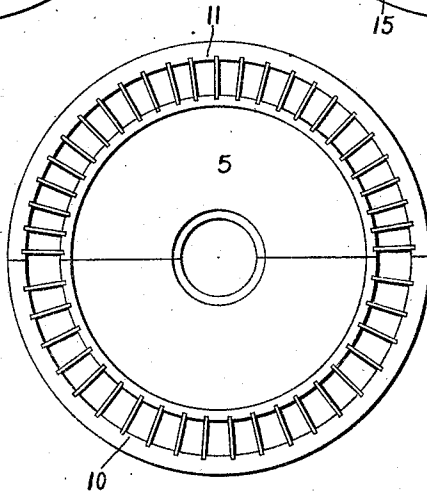


Fig. 3.



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Patented Apr. 21, 1925.

1,534,721

UNITED STATES PATENT OFFICE.

OSKAR LASCHE, DECEASED, LATE OF WESTEND, GERMANY; BY FRITZ LASCHE, ADMINISTRATOR, OF WESTEND, GERMANY, ASSIGNOR TO ALLGEMEINE ELEKTRICITÄTSGESELLSCHAFT, OF BERLIN, GERMANY.

CONSTRUCTION OF ELASTIC-FLUID TURBINES TO PREVENT BREAKAGE OF BLADES DUE TO VIBRATIONS.

Application filed April 28, 1924. Serial No. 709,359.

To all whom it may concern:

Be it known that OSKAR LASCHE, deceased, late a citizen of Germany, and a resident of Westend, Germany, during his lifetime invented certain new and useful Improvements in Construction of Elastic-Fluid Turbines to Prevent Breakage of Blades Due to Vibrations, and that I, FRITZ LASCHE, administrator, according to the German law, of the estate of said Oskar Lasche, do hereby declare, to the best of my knowledge and belief, that the following specification, taken in connection with the accompanying drawing, is a clear, true, and complete description of said improvements.

In a prior application of the aforesaid Oskar Lasche, Serial No. 672,030, filed October 31, 1923, it is pointed out that thorough experiments have shown that the formerly frequently inexplicable breaking of turbine blades or buckets is to be ascribed in certain cases to the development of resonance between the natural frequency of vibrations of the turbine blades of the wheel and the successive shocks received by the blades in rotating in front of the nozzles due to the elastic fluid streams issuing from the nozzles, and that the said Oskar Lasche discovered that when the natural frequency of vibration of the buckets per second is equal to or substantially equal to, or is a whole multiple of or substantially a whole multiple of the product of the number of nozzle partitions multiplied by the number of revolutions per second of the rotor, that this resonance develops and that vibrations of a dangerous character are likely to occur; and it is further pointed out therein that in accordance with said Oskar Lasche's invention, the resonance phenomena is avoided in that the number of nozzles is so chosen, that multiplied by the number of revolutions per second the product is not evenly divisible into a number which represents the natural frequency of vibration per second of the buckets, and in addition falls short of being divisible by at least fifteen per cent and preferably by as much as twenty-five per cent. Or, otherwise expressed, the number of nozzles is so chosen that the natural frequency of vibration per second of the buckets is not an even multiple of the product

of the number of nozzles and the speed of the buckets in revolution per second, and differs from the next whole number by at least fifteen per cent, and preferably by twenty-five per cent.

While the occurrence of such resonance and the accompanying dangerous vibrations of the blades can be safely avoided by the means set forth in such prior application, the said Oskar Lasche found that often it was not convenient in turbine design to choose such a number of nozzles to obtain as the desired relation and the object of his present invention is to provide improved means for accomplishing this same result.

In accordance with the present invention the occurrence of a resonant condition is avoided by so constructing the nozzles that the number of shocks per unit of time to which the blades are subjected by the elastic fluid stream issuing from the nozzle changes during a revolution of the blade wheel so that the blades cannot enter into resonant vibrations. This result may be obtained, for example, by making the nozzle divisions of the diaphragm change either continuously or in groups, and in the latter case preferably in such manner that the respective groups contain numbers of nozzles which numbers do not among themselves form total multiples. To this end it is preferable to choose prime numbers for the division numbers. While it is preferable to use a considerable number of groups of nozzles, one may with advantage use only two groups and in such case the upper half of the diaphragm will contain one number of nozzles and the lower half another number of nozzles. Since diaphragms are ordinarily divided into upper and lower halves, this arrangement is the most desirable from a manufacturing standpoint since it permits each half to have even nozzle divisions. As another means of carrying out the invention, nozzles having the same spacing may be divided into groups which groups are separated from each other by amounts greater than the normal nozzle spacing. By this means there is obtained, also, a different nozzle division around the circumference so that oscillations of the blades produced by the elastic fluid streams issuing from one

group of nozzles is damped by the elastic fluid streams issuing from the next group of nozzles.

In the drawing, Fig. 1 is a radial sectional view of a turbine structure embodying the invention, and Figs. 2, 3 and 4 illustrate different ways of carrying out the invention.

Referring to the drawing, Fig. 1 of which shows diagrammatically and by way of example, the low pressure end of an impulse turbine, 1 indicates a shaft on which is fixed a bucket wheel 2 provided with buckets 3, and 4 indicates a turbine casing which is divided into stages by nozzle diaphragms 5. The last stage wheel of the turbine is shown and it exhausts directly to the exhaust housing 6 from whence the exhaust elastic fluid escapes through conduit 7. The nozzle diaphragm is provided with partitions 8 which define the nozzles or nozzle passages 9.

According to the form of the invention illustrated in Fig. 2 the nozzle partitions 8 are spaced differently around the entire circumference of the diaphragm, thus giving the desired result as already explained. This spacing may be arranged in various ways and with various degrees of change in spacing. In Fig. 2 the spacing is purposely shown exaggerated for purposes of illustration.

In Fig. 3, the two halves of the diaphragm are indicated at 10 and 11, and these halves each have different spacings of the nozzle partitions one-half having one number of nozzle partitions and the other half another number.

In Fig. 4 the nozzle partitions have all the same spacing but are divided into

groups 12, 13, 14 and 15 which groups are spaced apart by amounts different from that of the nozzle partition spacing.

In accordance with the provisions of the Patent Statutes, the principle of operation of the invention has been described, together with the apparatus which is now considered to represent the best embodiment thereof, but it is to be understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What is claimed as new and desired to be secured by Letters Patent of the United States, is:—

1. An elastic fluid turbine having diaphragms provided with nozzles which direct elastic fluid to the turbine buckets, characterized by the fact that the spacing of the nozzle partitions changes around the periphery of the diaphragm.

2. In an elastic fluid turbine, a diaphragm comprising partitions which define nozzle passages, said partitions being unequally spaced from each other.

3. In an elastic fluid turbine, a nozzle diaphragm comprising two parts, the nozzle partitions in one part having a spacing different from that of the nozzle partitions of the other part.

4. A nozzle diaphragm for an elastic fluid turbine, the nozzle partitions of the diaphragm being arranged in groups which are unequally spaced around the periphery of the diaphragm.

In witness whereof, I have hereunto set my hand this 7th day of April 1924.

FRITZ LASCHE,
Administrator of Oskar Lasche, deceased.