Aug. 21, 1928. 1,681,176

L. DUFOUR

MULTIPLE DIFFUSING NOZZLE

Filed Jan. 6, 1925

Fig. 1.

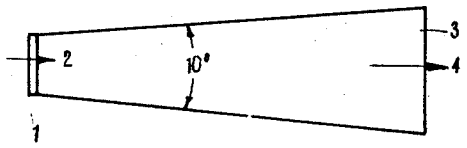


Fig. 2.

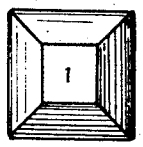


Fig. 3.

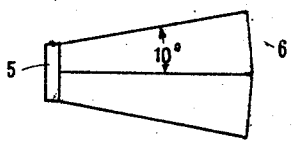


Fig. 4.

Fig. 5.

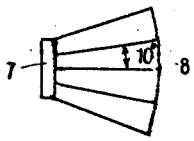


Fig. 6.

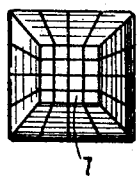


Fig. 7.

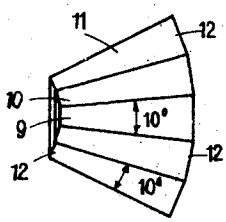


Fig. 8.

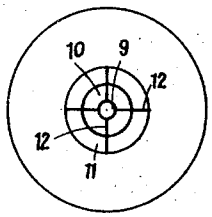


Fig. 9.

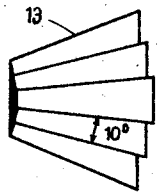


Fig. 10.

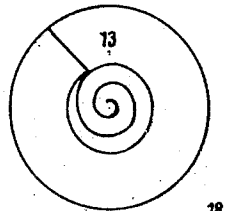


Fig. 11.

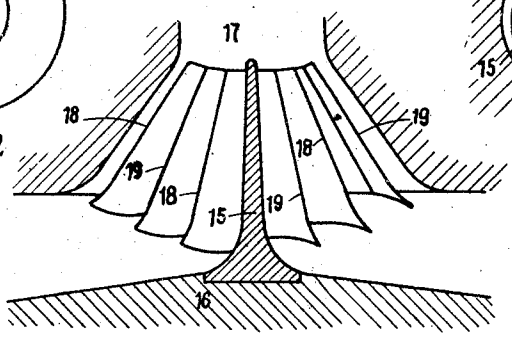
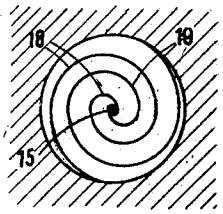


Fig. 12.



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UNITED STATES PATENT OFFICE.

LÉON DUFOUR, OF VERSOIX, SWITZERLAND.

MULTIPLE DIFFUSING NOZZLE.

Application filed January 6, 1925, Serial No. 896, and in Germany January 19, 1924.

The efficiency of diffusing nozzles or diffusers which are intended to convert the velocity of a fluid into pressure and which generally consist of a nozzle continuously widening towards its outlet is only a good one, if the angle formed by two diametrically opposed generatrix sides is not far from about 10°. This angle varies according to the kind of fluid, the velocity and the form of the cross-section of the nozzle. If the taper is too steep the fluid gets detached from the walls of the nozzle and the efficiency will be less.

There are cases where the difference of the velocity at the inlet and outlet of the nozzle which difference is to be converted into pressure is very considerable. Then it is necessary if the angle of 10° is to be observed to employ nozzles of considerable length. This however will be impossible sometimes.

It is the object of the present invention to provide relatively short nozzles even if the sectional area of the outlet differs greatly from that of the inlet and yet to retain the same efficiency as with the best known diffuser nozzles. The diffuser nozzle according to the present invention is combined of several diffusing elements where the walls are arranged so as to produce a good efficiency. The elements are adjoined in such a way that the angle between the diametrically opposed generatrices of the outer walls of the whole diffuser is considerably larger than the usual angle of the best efficiency. It will be easily understood that such a combined diffuser is considerably shorter than one having a single passageway and having the same taper as one single element of a combined diffuser according to the present invention. Of course a comparison can only be made between diffusers having inlets and outlets of equal size.

In the drawings I have shown a number of forms preferred by me.

Figs. 1 and 2 are a longitudinal section and an end elevation of a first form.

Figs. 3 and 4 longitudinal section and end elevation of a second form.

Figs. 5 and 6 longitudinal section and end elevation of a third form,

Figs. 7 and 8 longitudinal section and end elevation of a fourth form.

Figs. 9 and 10 longitudinal section and end elevation of a fifth form, and

Figs. 11 and 12 longitudinal section and a cross section of a sixth form.

In the annexed drawing Figs. 1 and 2 represent a diffuser nozzle of a known form having one single passage way of a quadratic cross-section and walls opening at an angle of 10°.

The fluid enters at 1 at a certain speed and at a certain pressure in the direction of the arrow 2 and is discharged at 3 with a diminished speed but with a greater pressure and in the direction of the arrow 4.

Figs. 3 and 4 represent a diffuser nozzle according to the present invention combined of four such elements as shown in Figs. 1 and 2. Each of these elements has a quadratic cross-section. The combined sectional area of the inlet at 5 is the same as that of the nozzle represented in Figs. 1 and 2 and the whole sectional area of the outlet at 6 is likewise the same as that of the foregoing apparatus. The opening angle of each element is 10° and the efficiency about the same. The total length however is only half of the nozzle shown in Figs. 1 and 2.

The Figs. 5 and 6 represent a diffuser nozzle having sixteen combined elements, each element of quadratic cross-section. The whole inlet area at 7 and the whole outlet area at 8 are equal to the respective cross sections of the nozzles represented in Figs. 1 and 2. The opening angle of each element is 10° and therefore the efficiency nearly the same as in the first nozzle, the length however is one fourth as much.

In the nozzles shown in Figures 3 to 6 the cross section of each element is quadratic, but this is not necessarily so.

As shown in Figs. 7 and 8 the elements could also be arranged around a central one. In these figures a conical element 9 tapered at an angle of 10° is surrounded by two other concentrical elements 10 and 11. Both have annular cross-sections of gradually increasing areas that is to say, the opposite walls in each single element thus formed include angles of about 10° or the angle of divergence in the three truncated cones shown in Figs. 7 and 8 will amount to 10° for the central cone, 30° for the next annular cone and 50° for the outer annular cone. The outer wall of the third element is also the shell of the whole nozzle. The elements are strutted at 12 so as to form one rigid body.

In the Figs. 9 and 10 another form of the nozzle is shown. The outer shell 13 is likewise a conical tube, but the single elements are obtained by winding a thin body for instance a sheet iron into a conical spiral where

the generatrices of opposite sides are including an angle of 10°. The said shell could also be a conical tube into which said spiral is inserted.

In the Figs. 11 and 12 a last example of a combined diffuser nozzle is shown which could be used as a suction pipe of a hydraulic turbine wheel. The central axis of the spiral is a column 15 standing on the floor 16 of the tail-race and extended to the top of spiral at 17. The spiral itself is constituted of two walls 18, 19 beginning at the center where they are joined and ending after several turns into a surrounding circle which is enclosed by an outer shell 20 generally made of concrete. Here also as may be concluded from Fig. 11 the spirals are conical spirals where the generatrices of opposite sides are diverging at an angle of 10°.

This invention allows not only to build diffuser of a smaller size having a good efficiency but also to use diffusers with smaller angles than 10° which will convert velocity of a fluid into pressure with a better efficiency and avoiding the use of relatively long conduits.

Such combined diffusers may be employed in many cases, as for instance for the exhaust of internal combustion engines in order to convert the velocity of the exhaust gases into a vacuum at the inlet of the diffuser and to relieve the cylinder from the residues of combustion and to provide the same with fresh mixture or with scavenging air.

Such combined diffuser nozzles may also be substituted for the suction conduits of a reaction turbine. In this case the velocity of the water at a smaller suction head is much better utilized which sometimes is of great importance.

Having now particularly described my invention, what I claim is:

A multiple diffusing nozzle for converting the velocity of a fluid into pressure and constituted of a compound element having a plurality of passages each defined by uniformly diverging walls, the opposing walls of each passage enclosing angles of substantially 10°, the whole to the effect that the multiple passage nozzle possesses a total outlet aperture considerably larger than that which could be obtained with a single passage nozzle having the same length and the same size of inlet orifice.

In testimony whereof I affix my signature.

LÉON DUFOUR.