March 13, 1945. P. M. SALERNI 2,371,588

CENTRIFUGAL PUMP OR THE LIKE

Filed April 4, 1939 2 Sheets-Sheet 1

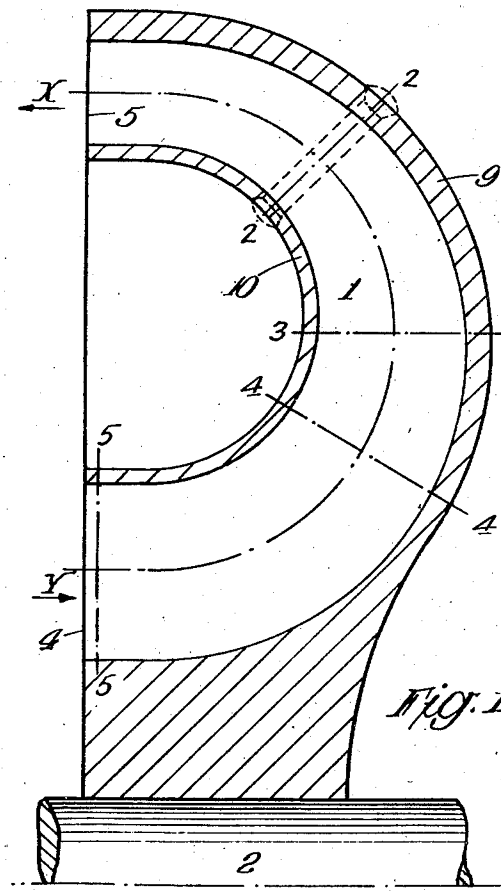


Fig. 1.

Fig. 4.

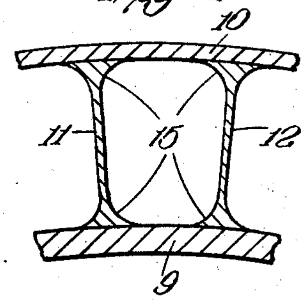


Fig. 5.

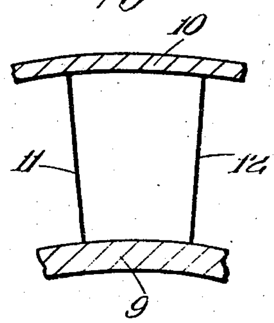


Fig. 2.

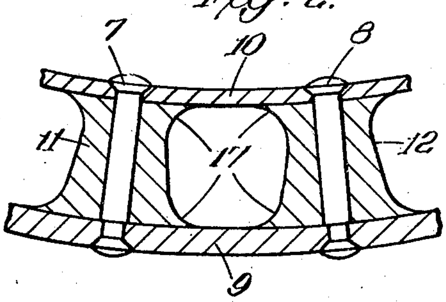
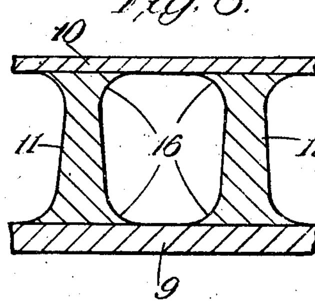


Fig. 3.



INVENTOR:
PIERO MARIANO SALERNI
BY: Haseltine, Lake & Co.
ATTORNEYS

March 13, 1945. P. M. SALERNI 2,371,588

CENTRIFUGAL PUMP OR THE LIKE

Filed April 4, 1939 2 Sheets-Sheet 2

Fig. 6.

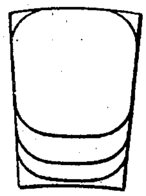


Fig. 7.

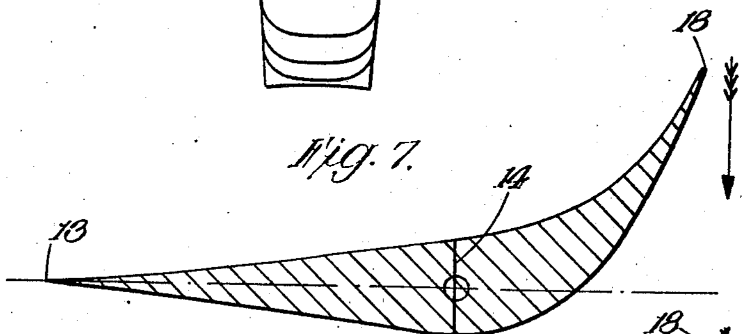


Fig. 8.

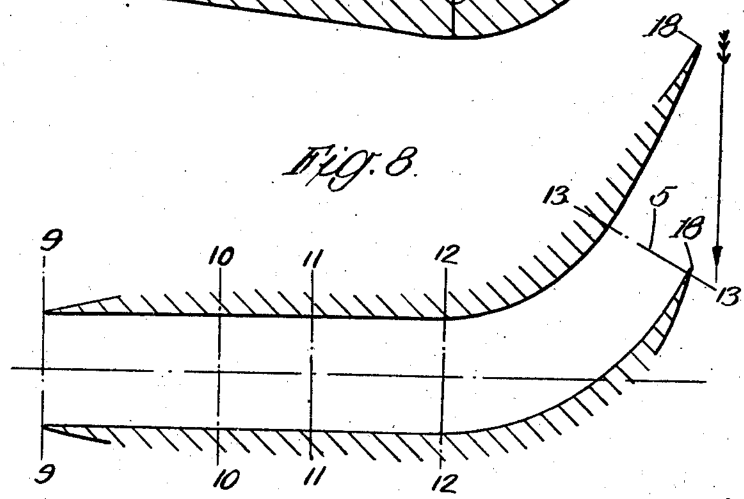


Fig. 9.

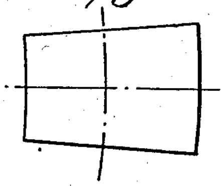


Fig. 10.

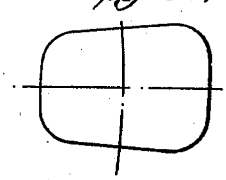


Fig. 11.

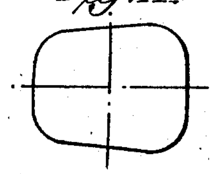


Fig. 12.

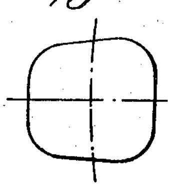


Fig. 13.

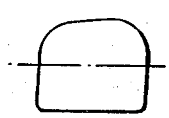
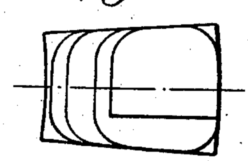


Fig. 14.



INVENTOR:
PIERO MARIANO SALERNI
BY: Haseltine, Lake & Co.
ATTORNEYS

Patented Mar. 13, 1945

2,371,588

UNITED STATES PATENT OFFICE

2,371,588

CENTRIFUGAL PUMP OR THE LIKE

Piero Mariano Salerni, Lillibrooke Manor, England; vested in the Alien Property Custodian

Application April 4, 1939, Serial No. 265,877
In Great Britain April 7, 1938

3 Claims. (Cl. 103—115)

This invention relates to centrifugal pumps, fans, blowers, compressors and the like for liquids or gases and is concerned with the design of the impeller that forms part of such apparatus.

According to this invention the impeller has ducts which, throughout a part near the outlets, have an axial component of direction, are non-divergent and are backwardly curved (i. e. backwards relative to the direction of rotation).

By non-divergent is meant that throughout the part that is so characterised any normal cross section thereof, if superimposed upon any normal cross section thereof which is more remote than itself from the outlet, will not overlap the same either at all or to any substantial extent. Such a construction gives increased efficiency and it is believed that the reason is that eddying and turbulence are thereby diminished.

The degree to which such overlap can be permitted will depend upon the size and capacity of the apparatus and the nature of the fluid to be conveyed, but it must not be so great as to cause material loss of efficiency as compared with a construction wherein there is no such overlap.

Backwards curvature provides a satisfactory method of making the ducts non-divergent throughout a part which has an axial component of direction.

Preferably the ducts are made non-divergent also in a part having a radial component of direction and preceding, i. e. more remote from the outlet than the above-mentioned part. The greater the length of the non-divergent parts the higher will be the efficiency and to obtain the theoretically best result the ducts should be made non-divergent throughout their length.

Preferably the cross sectional area of the non-divergent part or parts of the ducts is progressively reduced towards the outlet. In the case of a tetragonal duct the cross sectional area may be made to decrease by causing both pairs of opposite walls to converge or by causing one pair only to converge. If the fluid to be conveyed has a high viscosity, e. g. as in the case of common engine lubricating oil, if one pair of opposite walls has a convergence of 5°, while the other pair remains parallel, an advantage is obtained. The degree of convergence must not be so great that the ducts become unduly constricted, thereby causing loss of efficiency.

The inlet and outlet of each duct are preferably substantially tetragonal but from the inlet towards the middle portion of the duct the corners are preferably progressively rounded and the duct is preferably made again progressively to approach the tetragonal form towards its outlet.

The ducts can be made non-divergent in a part preceding the backwardly curved part by progressively thickening the vanes of the impeller (i. e. the parts forming the walls separating a duct from the adjoining ducts) in the direction towards the outlet. The vanes can be made integral with the body of the impeller but it is convenient to make them separately and to assemble them upon such body. Preferably the cross sectional area of the duct is simultaneously progressively reduced and preferably this is accomplished by causing the remaining walls of the duct to converge.

It is preferred to form the outlet of each duct in such a manner that the stream issuing from a duct becomes merged gradually with those issuing from the adjoining ducts without objectionable eddying or turbulence. In order to achieve this the thickness of the vanes must be progressively decreased towards the outlet. This can be accomplished, while maintaining non-divergence, by curving the vanes (and therefore the ducts) backwardly to a sufficient extent. Preferably this backwards curvature takes place only in the part of a duct which is near the outlet and has an axial component of direction and preferably in that part the backwards curvature is sufficient to cause the walls constituted by the vanes to converge. Preferably the vanes are radially disposed elsewhere.

The accompanying drawings show a typical embodiment of the invention.

Figure 1 is a section of the impeller.

Figures 2, 3, 4 and 5 are cross sections of a duct on reference lines **2—2**, **3—3**, **4—4**, and **5—5**, respectively of Figure 1.

Figure 6 shows the cross sectional areas of the duct sections of Figures 2, 3, 4 and 5 superimposed.

Figure 7 is a development of a vane on the line X—Y of Figure 1.

Figure 8 is a development of one duct on the line X—Y of Figure 1.

Figures 9, 10, 11, 12, 13 show the cross sectional area of the duct on the lines **9—9**, **10—10**, **11—11**, **12—12** and **13—13** of Figure 8 which correspond to the lines **5—5**, **4—4**, **3—3**, **2—2** and the outlet, respectively, of Figure 1.

Figure 14 shows the cross sectional area of the duct sections of Figures 9, 10, 11, 12 and 13 superimposed.

In Figure 1, **1** is the impeller with which this invention is concerned. **2** is the shaft on which the impeller is mounted. When the impeller 1 is rotated by any prime mover, liquid flows therein by centrifugal action from the inlet 4 thereof to the outlet 5 thereof whence it is discharged.

The front and back walls of the ducts in the impeller are formed by the members 9 and 10 and the side walls are formed by the vanes 11, 12. 7 and 8 are rivets securing these vanes to the members 9, 10.

At the inlet (Figure 5) the vanes are thin and the cross sectional area of the ducts of the impeller is at a maximum.

The thickness of the vanes is thereafter progressively increased as shown in Figures 4, 3 and 2 so as to maintain the walls of the ducts formed by the vanes 11 and 12 non-divergent, notwithstanding that the vanes are extending radially outwards from the axis of rotation. The walls 9 and 10 are progressively brought closer together to reduce the cross sectional area, the height of the vanes being accordingly reduced. Figure 6 shows the successive cross sections of the duct superimposed and it will be seen that the side walls remain the same distance apart while the top and bottom walls are converging. The vanes have been thickened as shown in Figure 7 from the point 13 at the inlet to the point 14 corresponding to the line 2—2 of Figure 1. Throughout this part the duct has a radial component of direction.

Thereafter from the point 14, the vane is turned backwards towards the outlet so that the thickness of the vane may be progressively reduced while the duct remains non-divergent as shown in Figure 8. Throughout this part the duct has an axial component of direction. In the embodiment illustrated, in the latter part of each duct i. e. from the line 12—12 (Figure 8) to the outlet, the sides of the duct constituted by the vanes converge (the backwards turn being sufficient for this purpose) and the walls of the duct formed by the members 9 and 10 are maintained parallel.

The vanes are progressively rounded as shown at 15 (Figure 4), 16 (Figure 3), and 17 (Figure 2) in order that the duct which is tetragonal at the inlet and the outlet may not have sharp corners throughout the greater part of its length. This accounts for the D-shaped cross-section of the outlet shown in Figure 13 on the line 13—13 of Figure 8. One side of the outlet is constituted by a part of a vane which is some distance from the tip and is still somewhat rounded, while the other side is constituted by the tip of a vane which has there ceased to be rounded.

The radius of curvature of the part 9 should not be more than about twice the radius of curvature of the part 10.

This application is a continuation-in-part of application Serial No. 200,136, filed April 5, 1938, now matured into Patent No. 2,293,765, dated Aug. 25, 1942.

What I claim and desire to secure by Letters Patent of the United States is:

1. A rotary impeller comprising annular walls with interior vanes forming a series of ducts through which fluid is impelled from axially inner inlets to peripheral outlets, the vanes and duct walls being curvedly shaped to provide ducts each of which is directed with a substantial axial component at the outlet; the enclosing walls and vanes being of form to define the ducts each of which at every point throughout at least the major part of its length progressively from inlet to outlet has a cross sectional area which is at least as small as at every preceding point; and the inner portion of each vane being disposed in a substantially radial plane while the outer portions of the ducts as they approach their outlets are each curved backwardly from a radial plane to a substantial angular extent to cause adjacent non-diverging ducts to approach and substantially merge for smooth confluence of the angularly issuing streams; whereby the impeller ducts throughout the paths of liquid flow therein are each substantially free of eddy-producing divergence and the liquid travels steadily therethrough and issues from the series of outlets as a high velocity continuous annular stream having axial and whirling components of travel without excessive turbulence.

2. An impeller as in claim 1 and wherein the vanes first flare to secure non-divergence of ducts along their inner portions, but in their outer portions taper to thin edges, as the vanes and ducts curve backwardly to secure non-divergence to the outlets.

3. An impeller comprising vanes between walls or shells to form ducts or passages extending from inlets at one diameter to outlets at a larger diameter, such vanes and ducts having a curved shape which, projected upon a radial plane, terminates in a generally axial direction at the delivery thereby to direct the fluid flow with axial component; the said vanes being first progressively increased in thickness sufficiently to produce duct faces which are non-divergent up to a point near to the outlet, beyond which the vanes are then curved out of the radial planes backwardly relatively to the direction of rotation of the impeller, and are at the same time progressively tapered in thickness towards the outlet ends of the vanes so that the outlets and issuing streams are smoothly merged into an annular stream flowing with axial component, the said walls or shells also forming duct faces which are non-divergent, thus producing a non-divergent duct throughout the duct part wherein the flow of fluid is radial, and the non-divergent formation of the duct being continued to the outlet by reason of the backward curving of the tapering vanes.

PIERO MARIANO SALERNI.