Jan. 20, 1942. H. N. MOORE 2,270,686

IMPELLING DEVICE

Filed Feb. 12, 1936

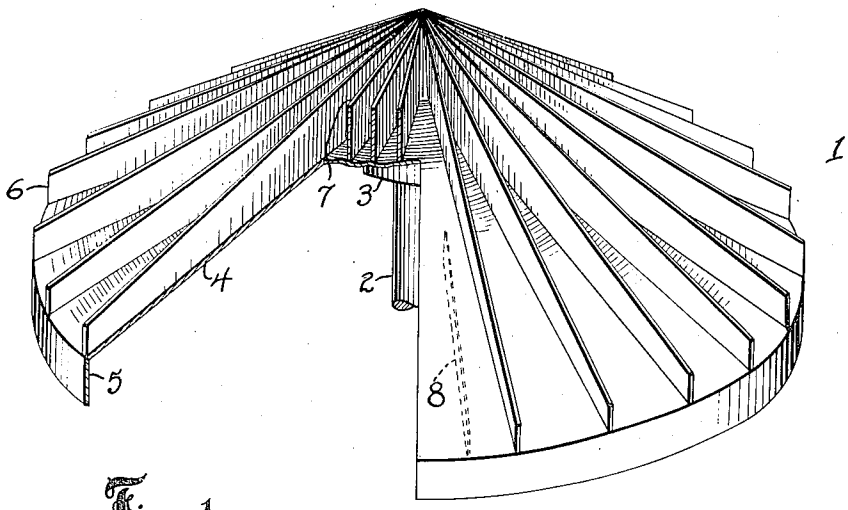


Fig. 1

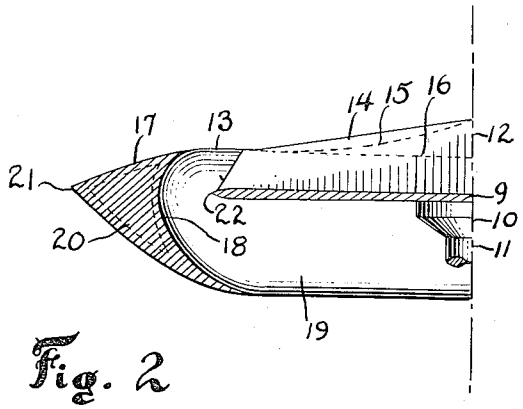


Fig. 2

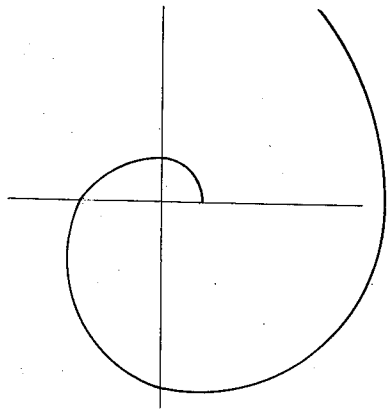


Fig. 3

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IMPELLING DEVICE

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6 Claims. (Cl. 170—135)

The present invention relates to means for producing a resultant force. The operation of the means in fluid media will so dispose the fluid acted upon that a pressure differential is set up between various parts and surfaces of the device. This pressure differential within the medium exerts a resultant force upon the device, and under the action of this resultant force the device can experience motion.

One object of the instant device is to provide a rotary impeller which is to be operated in a fluid medium. Rotation of the impeller causes the fluid to move away from its axis of rotation on one side of the surface of the device. This sets up a pressure differential between the surfaces of the device with its attendant resultant force.

Another object of the device is to set up this force in any direction and in any fluid medium. Specifically, its use to produce a vertical, horizontal or other directional force in air, water, oil or like medium is contemplated.

In air it may be used as a propeller for horizontal force or it may be used as a vertical lift means to replace wings or the like on the present day airplane or as a combination of both. Such vertical lift may be applied to elevators or a force device operated in an oil chamber. This last may be used in place of solenoids or the like for relatively short stroke operative means. This device offers a real advantage over a solenoid where longer strokes are required.

The device will also find a use as an element on certain types of mixing devices where it is desired to keep various fluid mixtures constantly agitated. The device can be operated on a splined shaft, one having a feather key, the impeller moving through the mixture and returned under light spring action when the speed drops off. By this means a speed cycle can move the impeller through a very definite range along the shaft.

Referring to the drawing:

Fig. 1 shows one form of impeller in a sectional perspective view.

Fig. 2 shows a sectional view of another form of impeller.

Fig. 3 shows a general curve, one form of which may be applied to the medium propelling means.

In Fig. 1 numeral 1 indicates the general impeller assembly. Numeral 2 is a drive shaft which may have an enlarged portion 3 where it is attached to the under part of the surface 4 of the device. Surface 4 in this type of device is shown as conical with the apex of the cone at the axial center of the surface. The surface 4 may also take the shape of another curve such as a parabola, hyperbola, etc. where resistance to motion along the axis of rotation becomes an important factor. Around the periphery of the lower edge of surface 4 may be supplied a depending flange 5. Flange 5 serves the double function of strengthening the edge of the surface 4 and serving to confine or prevent the axial movement of the fluid medium on the under side of surface 4. The importance of this last function increases as the surface 4 approaches a plane and operation with the surface 4 as a plane is contemplated. The flange 5 may be made of heavier material than the cone surface and filleted thereto if desired.

Upon the surface are projections or upright fins 6 which may be tapered along their length as shown in the drawing, the wide or higher portion 7 being placed at the axis or apex of the cone. This places the higher portion 7 of the blade 6 at the points experiencing relatively lower speeds. The upper edges of the blades 6 may have the same contour as the surface 4 and be parabolas, hyperbolas, etc. The blades may also be curved in cross section or tilted with respect to the surface.

The projections 6 have the characteristic of being of very low height relative to the area of the surface. The idea being to disturb as small a quantity of medium as possible and still obtain effective pressure differential or a maximum pressure differential. As an example of the importance of this factor a plate nine inches in diameter with radial fins two and ¾ inches high was whirled at about 500 R. P. M., the whole assembly being placed upon a scale with weight added to reduce vibration of the scale dial. No substantial decrease in the dial reading was noted. However when blades one-quarter of an inch high and ones of less heights were used the scale reading decreased substantially upon rotation of the plate, all the other operations of the assembly remaining the same. This invention contemplates the use of fins of relatively low heights, as compared with their lengths, over the greater portion of that length. The height of blades or fins 6 above the surface 4 for most efficient operation may in some cases be less than one-hundredth of an inch. The factor of skin friction must of course be considered.

Intermediate fins such as 8 may be used if desired. This will help prevent the tendency of the medium to pile up against a fin and spill over into the next compartment.

While generally speaking it is desirable to dis-

turb the medium on the under surface of the plate as little as possible other than to employ expedients, one of which will be later described, to build up the pressure there or prevent displacement of the medium, as is one of the functions of the flange 5 and the conical shape of surface or plate 4, reinforcing means may be employed for more strongly fastening the surface 4 and the enlarged portion 3 of shaft 2 together. This may be done by making the surface wall thick throughout and thicker near the portion 3. Again a separate sleeve may be fitted to the inner side of the surface 4 and so distribute the load.

In operation this device is whirled about the axis of shaft 2. Air or other media between the fins or projections 6 is carried around by them. Since this medium experiences no normal force other than the friction of its motion it will not stay on a circular path, but will move outward from the center of rotation. This action produces a double effect. First there is actually less air above the surface 4 than below it which reduces the static pressure head and second, since the air is in motion part of the energy of static pressure is changed to kinetic energy of motion thus reducing the effective static pressure on the upper side of surface 4. This last is true because once steady state conditions are arrived at the air approaching the face of the device moves because a partial vacuum has been formed and it expands as it moves. Again due to the small size of the fins 6 only a relatively small volume of air is disturbed. This has the double effect of greatly decreasing friction losses and decreasing the velocity of approach and therefore the impact velocity of air or other medium upon the surface 4. This is a substantial factor since whether the medium has moved several feet or a few inches, perhaps only a fraction of an inch, will greatly affect the resultant force.

Theoretically all that is necessary to produce this desired effect is only an extremely thin rarefied layer of atmosphere on the upper side of surface 4, i. e., one-sixteenth of an inch thick, or less. This, if maintained, is just as effective as one several feet thick. Such a condition can be obtained by a surface having very low fins ⅛" or $\frac{1}{16}$" or 0.01" high and whirled from 6000 R. P. M. upward. This can be done with a relatively low energy expenditure with such a device. Friction is also reduced by the conical configuration of surface 4. The medium flows from the axis of rotation along the fins 6 a distance substantially equal to the product of the length of a fin and the sine of half the apex angle of the cone. This is of course affected by the variation in the width of the fins 6 as at 7. However it readily appears that such construction greatly reduces the distance the medium travels along the fins 6 and the surface together with the resultant friction.

Fig. 2 is a representation of a modification in which a flat plate 9 mounted on enlarged portion 10 of shaft 11 is used. Fins 12 project from the plate 9. They may be tapered as at 13 and 14. Also their contour may take the shape shown by dotted line 15 and 16. A smooth curved annular ring 17 may be used to guide the air or other fluid to the bottom side of surface 9. The inner curved wall 18 of ring 17 has a varied radius of curvature. The portion of wall 18 below the plate 9 has an increasing radius which will permit the fluid to slow down thus producing a change from a kinetic energy to energy of static pressure. This fluid will tend to increase the pressure below the plate 9 and thus further increase the pressure differential between the two sides of plate 9. The ring 17 has a large opening 19 so that fluid can easily approach the plate 9 and leave it, substantially no back pressure being built up at the periphery of the plate. Annular ring or member 17 has two inherent functions, and may be so constructed that either or both take place. The ring 17 may deflect the radially flowing air downward along the axis of rotation. In this way it itself experiences an upward reaction. Downward is here taken to be in the direction of greater pressure on plate 9 while upward would be in the direction of lesser pressure, i. e. the side mounting the fins 12. On the other hand the ring 17 may guide the medium through a complete 180 degree turn whereby an increased static pressure may be built up on the under surface of plate 9. Turbulence is of course a factor and must be taken into account. The ring 17 may be hollow as at 20 in the interests of lightness and streamlined as at 21. The edge of plate 9 may also be streamlined as at 22 though this may take the form of a bulbous annular ring around the periphery of plate 9 depending upon the pressure distribution at that point. It may also perform the functions of flange 5.

Fig. 3 represents a logarithmic, Archimedes, or other spiral. The fins may take this form so that the medium may flow in a substantially straight line from the axis of rotation and not be carried around too much by the fins. Of course action of the fins on the fluid is necessary.

Where a number of such impellers are used they may be so positioned with respect to the center of gravity of the entire assembly and have such directions of rotation that moment couples are neutralized.

Ring 17 may be of such height as to perform substantially the same function with the impeller of Fig. 1 as with that of Fig. 2.

The compartments or channels between fins 6 may also be thought of as depressions in surface 4.

For best results the fins 6 should be quite close together. This may make it expedient to omit the portions of the fins which are at or near the axis of rotation.

I claim:

1. A propeller designed to operate at high speed in a gas, said propeller comprising a substantially continuous smooth disc mounted for rotation about its center of gravity, a plurality of substantially radial, low, elongate projections on only one surface of the disc, the working faces of said projections being substantially normal to the surface of the disc, the ratio of the height of said projections to the mean diameter of said disc being less than five hundredths, said projections acting on the gas in such manner that the major portion of the effective energy supplied to the propeller is utilized in imparting angular velocity to the gas and causing it to move away from the center of rotation, whereby a pressure differential is maintained between opposite surfaces of the disc.

2. A propeller designed to operate at relatively high speed in a medium, said propeller comprising a single substantially continuous smooth circular plate mounted for rotation about its center of gravity, a plurality of low, elongate projections on only one face of said plate and extending outwardly away from the center of ro-

tation to adjacent the periphery of said plate, the working faces of said projections being substantially normal to said plate, the ratio of the height of said projections to the mean diameter of said plate being less than five hundredths, said projections acting on the medium in such a manner that the major portion of the effective energy supplied to the propeller is utilized in imparting angular velocity to the medium and causing it to move away from the center of rotation, whereby a pressure differential is maintained between opposite faces of said plate, an annular guide surface adjacent the periphery of said plate and arranged to deflect the moving medium from its path normal to the axis of rotation of said plate to a path along said axis in a direction away from the face mounting said projections.

3. A propeller designed to operate at relatively high speed in a medium, said propeller comprising a single substantially continuous smooth surface mounted for rotation at its center of gravity, the minimum distance across said surface being at least one-third the maximum distance thereacross, a plurality of low, elongate projections on only one side of said surface and extending outwardly in all directions away from the center of rotation to adjacent the periphery of said surface, the working faces of said projections being substantially normal to said surface, the ratio of the height of said projections to the mean distance across said plate being less than five hundredths, said projections acting on the medium in such a manner that the major portion of the effective energy supplied to the propeller is utilized in imparting angular velocity to the medium and causing it to move away from the center of rotation, whereby a pressure differential is maintained between opposite faces of said surface.

4. The combination set forth in claim 3, the periphery of said surface presenting a substantially convex curvature throughout, the ratio of the height of said projections to the mean distance across said surface being less than one fiftieth and the center of said surface being elevated with respect to the periphery.

5. The combination set forth in claim 2, said projections comprising fins, an annular flange member extending from adjacent the periphery of the face of said plate opposite the face mounting said fin.

6. The combination set forth in claim 1, guide means associated with the periphery of said disc adapted to direct outwardly flowing gas toward the surface of high pressure.

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