

Feb. 13, 1940.

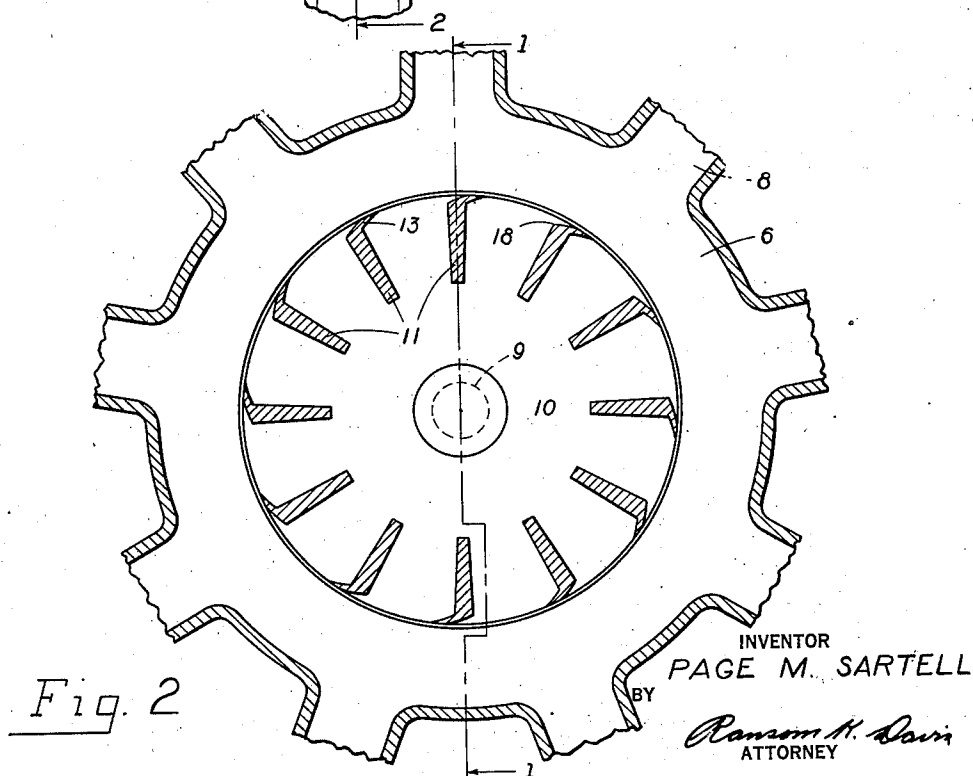
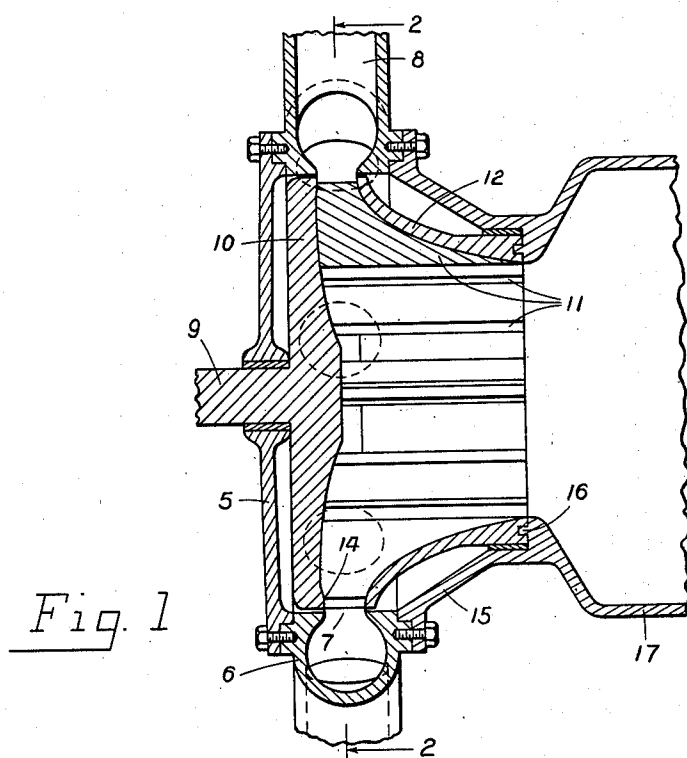
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2,190,245

PUMP FOR COMPRESSIBLE FLUIDS

Filed March 2, 1938

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

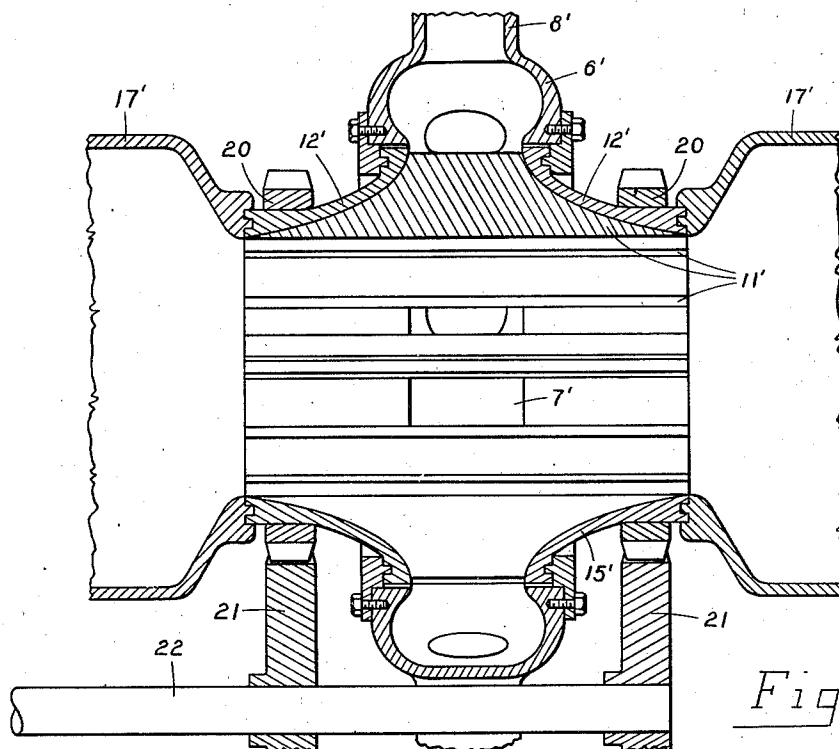


Fig. 4

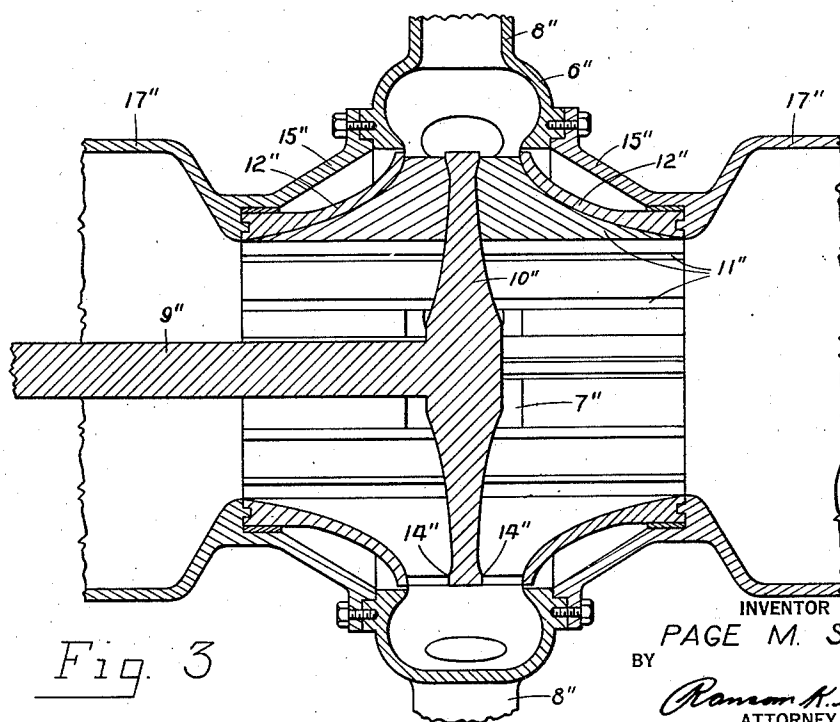


Fig. 3

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PUMP FOR COMPRESSIBLE FLUIDS

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15 Claims. (Cl. 230—127)

This invention relates to a pump for transferring compressible fluids, such as vapors or gases, either for removing the fluids from a confined space or for delivering the fluid under compression. While the drawings and description are, for purpose of illustration, particularly directed to the latter type of duty and more specifically to a supercharger, it is to be understood this is for descriptive purposes only and not by way of limitation.

Among the several objects of this invention are:

To provide a pump of the type mentioned so constructed as to prevent turbulences in the fluid passing therethrough;

To provide a pump of high efficiency due to the absence of energy consuming eddies;

To develop a method of transferring compressible fluids whereby the velocities of flow are controlled and a maximum pressure of output is secured for a given input of energy;

To apply Bernoulli's theorem to prevent energy losses;

To provide a pump having parts so designed and related that back-flow of fluid at the intake orifice is avoided;

To eliminate turbulences in the fluid in the impeller by preventing contact of the fluid with a stationary housing wall;

To eliminate stationary blades around the periphery of the impeller.

Other objects will become apparent to those skilled in this art from a perusal of the specification in conjunction with the accompanying drawings wherein;

Fig. 1 is an axial section of one embodiment of the invention on line 1—1, Fig. 2;

Fig. 2 is a transverse section on the line 2—2, Fig. 1;

Figs. 3 and 4 are axial sections of two forms of my invention employing double impellers.

Previous types of superchargers have had three inherent types of turbulence in the air passing therethrough. The first is at the intake orifice where the air is set into rotation somewhat in the form of a ring with more or less circular cross-section on any radius, which builds up a pressure that causes some of the air to flow outwardly from the intake orifice to the zone of lower pressure immediately exteriorly thereof, thus reducing the effective area of the intake orifice. The second type of turbulence results from some of the air particles between the impeller blades being dragged over the stationary impeller housing wall whereby such particles are

given a helical movement through the space between the impeller blades. The third type of turbulence occurs at the periphery where the air particles are released from the impeller with high tangential velocity. The last named type of turbulence has led to the use of fixed radial vanes around the impeller to neutralize, insofar as possible, this tangential velocity and constrain the particles to move radially, but the use of such fixed vanes results in increased size, weight, and cost. The present invention overcomes all three types of eddies by the construction and mode of operation hereinafter set forth.

Figs. 1 and 2 depict an embodiment of my invention whereby the above mentioned objects are attained. The propeller housing comprises a side portion 5 that may be more or less in the form of a disc or very flat cone and has about its periphery a diffuser chamber 6 substantially in the form of a hollow torus in the inner periphery of which is a continuous annular opening 7 and from which the compressed fluid is led to the points of use through outlets 8. Rotatably mounted in the side portion 5 is a shaft 9 fixed to drive plate 10 that carries impeller blades 11. The edges of blades 11 away from drive plate 10 have a curvature determined in a manner hereinafter to be explained and which is, roughly speaking, parabolic, and fixed to these edges of the blades 11 is a shroud 12 whereof the inner surface has the contour defined by the said concave edges of the blades. The tips 13 of blades 11 are turned backwardly opposite to the direction of rotation of the impeller when in operation and are opposed and in close juxtaposition to the annular opening 7 in chamber 6, the width of the tips 13 being substantially the same as the effective width of the opening 7.

Upon the face of drive plate 10 to which the blades 11 are attached is a peripheral laterally extending rib 14 that constricts the width of the passage from the space between the impeller blades into chamber 6. The end of the impeller remote from drive plate 10 is rotatably supported by a wall member 15 extending laterally and radially inwardly from the chamber 6, an annular rib 16 on wall portion 15 being disposed in a cooperating groove in shroud 12 to prevent passage of fluid between the impeller and the wall portion 15 adjacent the intake orifice. The wall portion 15 may be expanded radially outwardly to form a substantially cylindrical inlet chamber 17, although this is not done unless the conditions for a particular application of the device render it desirable to utilize Bernoulli's principle

to speed up the flow of fluid into the impeller, as to increase the volume of fluid handled.

I have found that better results are had if the movement of fluid through the impeller is the result of increasing the pressure upon the fluid as it progresses from intake to discharge rather than relying upon the velocity of the air particles produced by the action of centrifugal force thereon. By means of pressure formulas familiar to those skilled in this art, I compute the pressure which, for the various radial distances of the air particles passing through the impeller, at the designed number of R. P. M., are necessary to give the required quantity of fluid at the discharge pressure desired, and having ascertained what these pressures should be, the curvature of the inner surface of shroud 12 is so defined that there will be produced in the stream of fluid the volume corresponding to the desired pressure, according to well known relations between the pressures and volumes of bodies of compressible fluid. It is of course understood that thermal effects must also be considered in the computations. It so works out that the movement of a particle of air entering the impeller at any point on a circle so defined that half the volume of ingoing fluid passes through such circle and the other half passes outside such circle, is substantially a parabola.

In superchargers of the prior art the edges of the impeller blades lie at practically a right angle to the direction of movement of air particles entering the impeller, which gives rise to initial rotation of the particles in a substantially toric volume with resultant back pressures and inefficiencies at the intake orifice. With my construction, however, the radially inner edges of the blades 11 define a cylinder having substantially the same diameter as the intake orifice and the incoming particles of air are set into rotation in a cylindrical form, thus eliminating the intake eddies. As the particles of air continue their movement they take on a radial component of velocity that moves them away from the axis of rotation and such movement is constrained to follow paths determined by the inner surface of the shroud 12 whereby the cross-sectional area of the moving airstream is reduced to effect the desired increase in pressure at each point in the path and it is this increase in pressure that builds up the velocity with which the fluid particles are discharged from the impeller. In addition to effecting the pressure above mentioned, the shroud 12 prevents contact of any portion of the air stream with a stationary wall and thus eliminates the inter-blade turbulence found in other devices for this purpose.

When the air particles have reached a position on the circle defined by the base 18 of blade tips 13, their velocity is purely radial and if released into the diffuser chamber at this point the well known impeller tip turbulences would arise. To prevent this the tips 13 of the blades 11 are bent backwardly at such an angle that, for the designed discharge velocities, there will be imparted to the fluid particles a component of velocity that neutralizes the tangential velocity they would have if released at the point 18 and gives a resultant velocity that is purely radial. That is, the rib 14 constricts the passage through which the discharge occurs and according to Bernoulli's principle the velocity of the particles is increased but owing to the backward slope of the blade tips the fluid particles are allowed

to lag and the vector sum of this lag combined with the normal tendency to tangential velocity with respect to the impeller is zero and the particles have a pure radial velocity.

Fig. 4 depicts an embodiment of my invention wherein are duplicate intake chambers 17' on opposite sides of the axial center line of the impeller whereby the fluid is fed in from both sides. The blades 11' are mounted in shroudings 12' rotatably supported by the intake chambers 17', the driving of the impeller being effected through gears 20 mounted on shrouds 12 and meshed with drive pinions 21 secured to drive shaft 22. The curvature of the shrouds 12' is developed in exactly the same manner as has been above set forth.

Fig. 3 illustrates a form of double intake impeller that differs from Fig. 4, however, in that a drive plate 10'' is disposed on the longitudinal center line of the impeller and the blades 11'' 20 are secured thereto.

In Figs. 4 and 3 parts corresponding to elements in Figs. 1 and 2 are given the same reference numbers as in Figs. 1 and 2 but are distinguished by superscripts prime and double prime, respectively.

According to the provisions of the patent statutes I have set forth the principle and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A rotary impeller type pump for compressible fluids, comprising a housing having a side portion, a chamber in the form of a hollow torus mounted on the periphery of said side portion, said chamber having a continuous annular opening formed in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice and then expanding radially outwardly into a cylindrical inlet chamber; an impeller rotatably mounted in said housing, said impeller having a driving plate adjacent said side portion, said plate having a laterally extending annular rib at the periphery of its inward face, blades fixed to the inward face of said plate and extending radially inwardly from the periphery thereof with their radially inner edges defining a cylinder having a diameter substantially equal to that of said intake orifice, the edges of said blades away from said disk being substantially parabolically concave, and a shroud on said concave edges having an inner surface conforming to the surface defined by the concavities of said edges, the radially outer tips of said blades being turned backwardly opposite the direction of rotation of said impeller and being adjacent and opposed to the opening in the first mentioned chamber; and means to prevent passage of fluid between said impeller and said housing adjacent said intake orifice.

2. A rotary impeller type pump for compressible fluids, comprising a housing having a side portion, a chamber in the form of a hollow torus mounted on the periphery of said side portion, said chamber having a continuous annular opening formed in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice; an impeller rotatably mounted in

said housing, said impeller having a driving plate adjacent said side portion, said plate having a laterally extending annular rib at the periphery of its inward face, blades fixed to the inward face of said plate and extending radially inwardly from the periphery thereof with their radially inner edges defining a cylinder having a diameter substantially equal to that of said intake orifice, the edges of said blades away from said disk being substantially parabolically concave, and a shroud on said concave edges having an inner surface conforming to the surface defined by the concavities of said edges, the radially outer tips of said blades being turned backwardly opposite the direction of rotation of said impeller and being adjacent and opposed to the opening in the said chamber; and means to prevent passage of fluid between said impeller and said housing adjacent said intake orifice.

3. A rotary impeller type pump for compressible fluids, comprising a housing having a side portion, a chamber in the form of a hollow tore mounted on the periphery of said side portion, said chamber having a continuous annular opening formed in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice and then expanding radially outwardly into a cylindrical inlet chamber; an impeller rotatably mounted in said housing, said impeller having a driving plate adjacent said side portion, said plate having a laterally extending annular rib at the periphery of its inward face, blades fixed to the inward face of said plate and extending radially inwardly from the periphery thereof with their radially inner edges defining a cylinder having a diameter substantially equal to that of said intake orifice, means rotatable with said blades to separate the air in said impeller from said wall portion and to impress upon said air a substantially parabolic flow, the radially outer tips of said blades being turned backwardly opposite the direction of rotation of said impeller and being adjacent and opposed to the opening in said first mentioned chamber; and means to prevent passage of fluid between said impeller and said housing adjacent said intake orifice.

4. A rotary impeller type pump for compressible fluids, comprising a housing having a side portion, a chamber in the form of a hollow tore mounted on the periphery of said side portion, said chamber having a continuous annular opening formed in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice, and an impeller rotatably mounted in said housing, said impeller having a driving plate adjacent said side portion, said plate having a laterally extending annular rib at the periphery of its inward face, blades fixed to the inward face of said plate and extending radially inwardly from the periphery thereof with their radially inner edges defining a cylinder having a diameter substantially equal to that of said intake orifice, the edges of said blades away from said disk being substantially parabolically concave, and a shroud on said concave edges having an inner surface conforming to the surface defined by the concavities of said edges, the radially outer tips of said blades being turned backwardly opposite the direction of rotation of said impeller and being adjacent and opposed to the opening in the said chamber.

5. A rotary impeller type pump for compressible fluids, comprising a housing having a side portion,

a chamber in the form of a hollow tore mounted on the periphery of said side portion, said chamber having a continuous annular opening formed in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice, and an impeller rotatably mounted in said housing, said impeller having a driving plate adjacent said side portion, said plate having a laterally extending annular rib at the periphery of its inward face, blades fixed to the inward face of said plate and extending radially inwardly from the periphery thereof with their radially inner edges defining a cylinder having a diameter substantially equal to that of said intake orifice, means rotatable with said blades to separate the air in said impeller from said wall portion and to impress upon said air a substantially parabolic flow, the radially outer tips of said blades being turned backwardly opposite the direction of rotation of said impeller and being adjacent and opposed to the opening in said chamber; and means to prevent passage of fluid between said impeller and said housing adjacent said intake orifice.

6. A rotary impeller type pump for compressible fluids, comprising a housing having a side portion, a chamber in the form of a hollow tore mounted on the periphery of said side portion, said chamber having a continuous annular opening formed in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice; and an impeller rotatably mounted in said housing, said impeller having a driving plate adjacent said side portion, said plate having a laterally extending annular rib at the periphery of its inward face, blades fixed to the inward face of said plate and extending radially inwardly from the periphery thereof with their radially inner edges defining a cylinder having a diameter substantially equal to that of said intake orifice, means rotatable with said blades to separate the air in said impeller from said wall portion and to impress upon said air a substantially parabolic flow, the radially outer tips of said blades being turned backwardly opposite the direction of rotation of said impeller and being adjacent and opposed to the opening in said chamber.

7. A pump for compressible fluids, comprising a housing having a circular side portion, a diffuser chamber on the periphery of said portion, said chamber having a continuous annular opening in its inner periphery, and a wall portion extending from said chamber laterally away from said side and radially inwardly to define an intake orifice and then expanding radially outwardly into a cylindrical inlet chamber; an impeller rotatably mounted in said housing, said impeller including side members whereof one has a peripheral annular rib extending toward the other side member and said other side member has an inner surface contour to impress a substantially parabolic flow upon air passing thereover from said orifice, radially extending blades between and in continuous contact with each of said side members, the radially inner edges of said blades defining a cylinder having the diameter of said orifice and the radially outer tips of said blades being backwardly turned opposite the direction of rotation of said impeller and being disposed opposite and adjacent to said opening in the diffuser chamber; and means to prevent passage of fluid between said impeller and said housing adjacent said orifice.

8. A pump for compressible fluids, comprising a housing having a circular side portion, a diffuser chamber on the periphery of said portion, said chamber having a continuous annular opening in its inner periphery, and a wall portion extending from said chamber laterally away from said side; an impeller rotatably mounted in said housing, said impeller including side members whereof one has a peripheral annular rib extending toward the other side member and said other side member has an inner surface contour to impress a substantially parabolic flow upon air passing thereover from said orifice, radially extending blades between and in continuous contact with each of said side members, the radially inner edges of said blades defining a cylinder having the diameter of said orifice and the radially outer tips of said blades being backwardly turned opposite the direction of rotation of said impeller and being disposed opposite and adjacent to said opening in the diffuser chamber; and means to prevent passage of fluid between said impeller and said housing adjacent said orifice.

9. A pump for compressible fluids, comprising a housing having a circular side portion, a diffuser chamber on the periphery of said portion, said chamber having a continuous annular opening in its inner periphery, and a wall portion extending from said chamber laterally away from said side; and an impeller rotatably mounted in said housing, said impeller including side members whereof one has a peripheral annular rib extending toward the other side member and said other side member has an inner surface contour to impress a substantially parabolic flow upon air passing thereover from said orifice, radially extending blades between and in continuous contact with each of said side members, the radially inner edges of said blades defining a cylinder having the diameter of said orifice and the radially outer tips of said blades being backwardly turned opposite the direction of rotation of said impeller and being disposed opposite and adjacent to said opening in the diffuser chamber.

10. A pump for compressible fluids, comprising a housing having a circular side portion, a diffuser chamber on the periphery of said portion, said chamber having a continuous annular opening in its inner periphery, and a wall portion extending from said chamber laterally away from said side; and an impeller rotatably mounted in said housing, said impeller including side members whereof one has an inner surface contour to impress a substantially parabolic flow upon air passing thereover from said orifice, radially extending blades between and in continuous contact with each of said side members, the radially inner edges of said blades defining a cylinder having the diameter of said orifice and the radially outer tips of said blades being backwardly turned opposite the direction of rotation of said impeller and being disposed opposite and adjacent to said opening in the diffuser chamber.

11. A pump for compressible fluids comprising a housing, a rotatable impeller in said housing,

said impeller having radial plates and a shroud shaped to set fluid particles that have just entered said impeller into substantially cylindrical rotation, then change the motion of said particles into one that is substantially parabolic, and still further change the motion of said particles to discharge said particles with substantially pure radial velocity, and means to cause said particles to move into said impeller with substantially rectilinear movement parallel to the axis of said impeller.

12. A pump for compressible fluids comprising a housing, a rotatable impeller in said housing, said impeller having radial plates and a shroud shaped to set fluid particles that have just entered said impeller into substantially cylindrical rotation, then change the motion of said particles into one that is substantially parabolic, and still further change the motion of said particles to discharge said particles with substantially pure radial velocity.

13. A pump for compressible fluids, comprising a housing and an impeller rotatably mounted in said housing, said impeller including side members whereof one has a peripheral annular rib extending toward the other side member and said other side member has an inner surface contour to impress a substantially parabolic flow upon air passing thereover from said orifice, radially extending blades between and in continuous contact with each of said side members, the radially inner edges of said blades defining a cylinder having the diameter of said orifice and the radially outer tips of said blades being backwardly turned opposite the direction of rotation of said impeller and being disposed adjacent to the periphery of said housing.

14. A pump for compressible fluids, comprising a housing and an impeller rotatably mounted in said housing, said impeller including side members whereof one has an inner surface contour to impress a substantially parabolic flow upon air passing thereover from said orifice, radially extending blades between and in continuous contact with each of said side members, the radially inner edges of said blades defining a cylinder having the diameter of said orifice and the radially outer tips of said blades being backwardly turned opposite the direction of rotation of said impeller and being disposed adjacent to the periphery of said housing.

15. A pump for compressible fluids, comprising an impeller having a substantially radially extending side member, radially disposed plates extending laterally from said member, the lateral edges of said plates remote from said member having a substantially parabolic, concave curvature, the radially inner edges of said plates defining a cylinder, and a shroud conforming to the parabolic curvature of said remote edges of said plates, the radially outer tips of said plates being sharply deflected backwardly in a direction opposite the direction of rotation of said impeller.