

[54] **ADDITIVE DIFFUSOR**
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 [22] Filed: **Aug. 14, 1972**
 [21] Appl. No.: **280,675**

[52] U.S. Cl. **259/10, 137/53, 137/604, 259/3, 259/97, 415/91, 415/115, 416/90**
 [51] Int. Cl. **B01f 5/12, B01f 7/06**
 [58] Field of Search **416/90, 231; 415/91, 115; 259/3, 7, 8, 9, 10, 16, 22, 23, 24, 25, 26, 97; 137/53, 602, 604**

[56] **References Cited**
UNITED STATES PATENTS
 3,689,173 9/1972 Morton 416/90 X

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[57] **ABSTRACT**
 Apparatus for treating flow media wherein an additive diffusor is provided in a flow passageway of an axial flow device to effect homogeneous mixing of the flow media and an additive.

6 Claims, 3 Drawing Figures

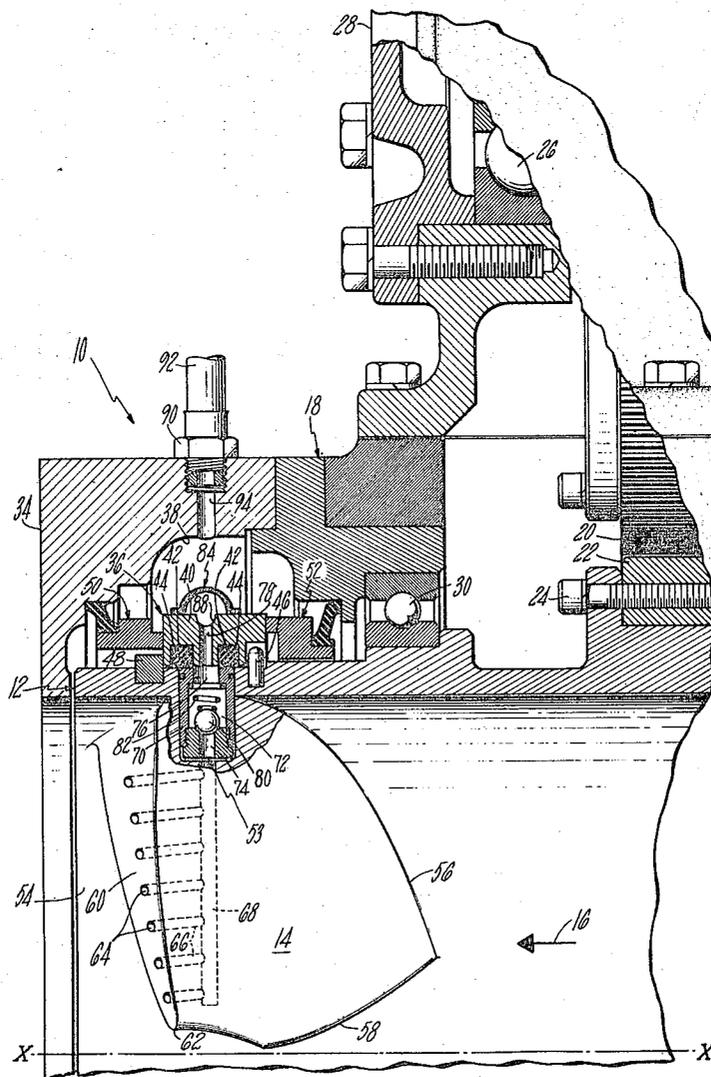
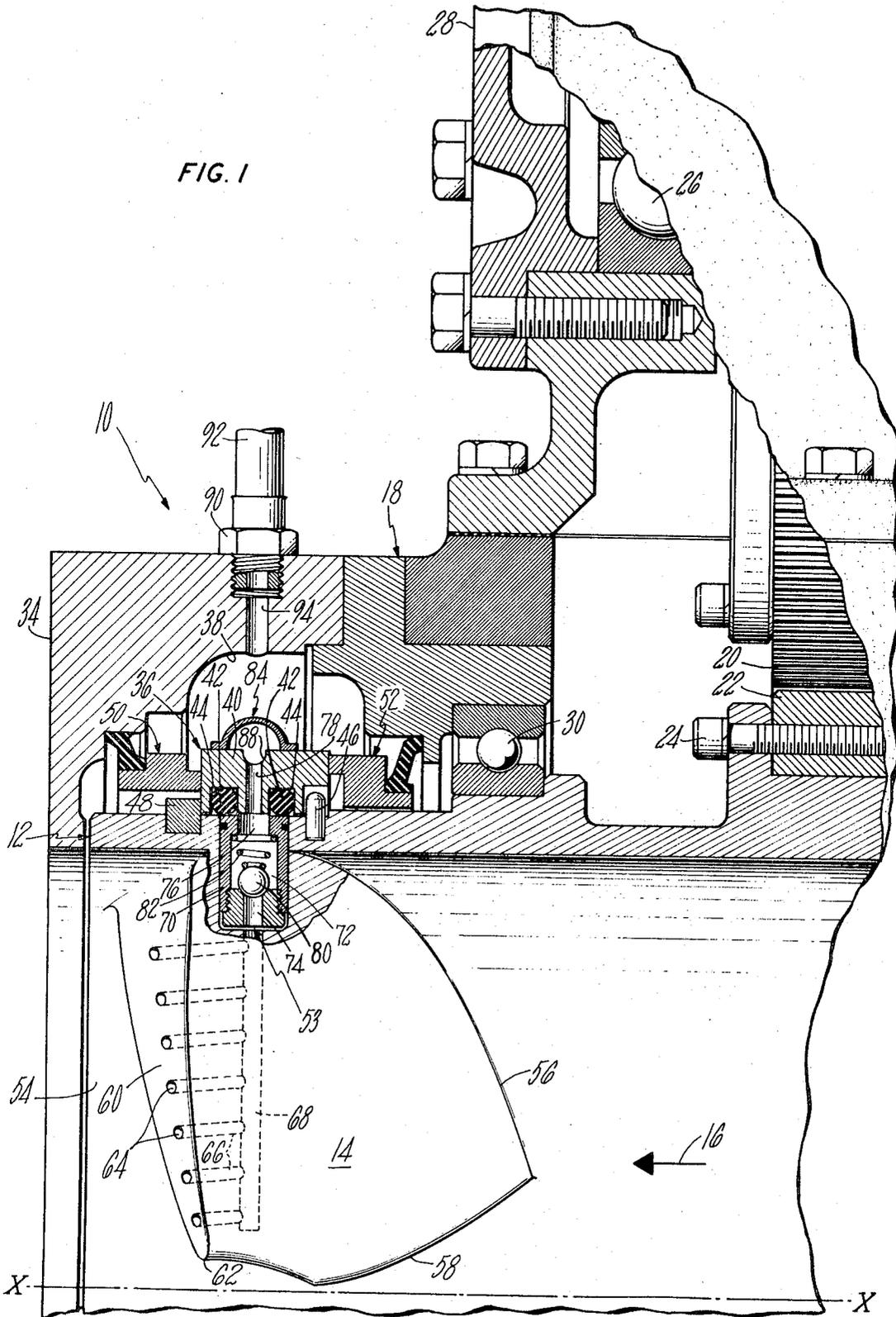
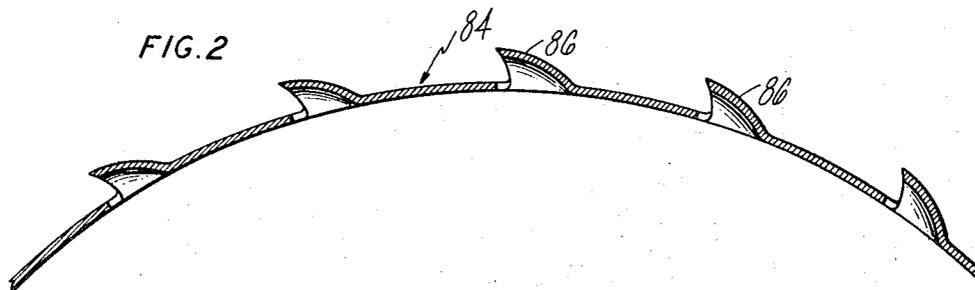
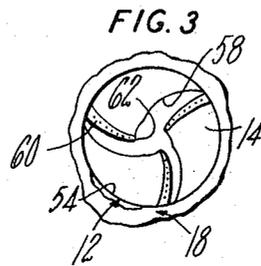


FIG. 1





ADDITIVE DIFFUSOR

This invention generally relates to an apparatus for material handling and particularly concerns an apparatus for homogeneously mixing large volumes of different material.

A primary object of this invention is to provide a new and improved additive diffusor particularly suited for use with flow propulsion units of an axial flow type.

Another object of this invention is to provide such an additive diffusor capable of continuously supplying a selected additive to a material being propelled through a flow passageway to effect efficient mixing of the additive and the propelled material in a highly diffused homogeneous mixture.

A further object of this invention is to provide such an additive diffusor which may be used for a variety of different applications and is particularly suited for continuously dispersing an additive into a flow passageway in association with equipment having increased throughput capabilities for high volume processes.

Still another object of this invention is to provide a new and improved additive diffusor of the type described capable of meeting stringent performance requirements under strenuous conditions with few service problems.

Other objects will be in part obvious and in part pointed out in more detail hereinafter.

A better understanding of the objects, advantages, features, properties and relationships of the invention will be obtained from the following detailed description and accompanying drawings which set forth an illustrative embodiment and is indicative of the way in which the principle of this invention is employed.

In the drawings:

FIG. 1 is a side view, partly broken away and partly in section, of an axial flow unit incorporating an additive diffusor of this invention;

FIG. 2 is a side view, partly broken away and partly in section, showing an additive collection ring which is externally mounted on a rotor of the axial flow unit of FIG. 1; and

FIG. 3 is an axial end view showing a blade profile projection of the axial flow unit of FIG. 1.

Referring to the drawings in detail wherein a preferred embodiment of this invention is shown for illustrative purposes, a pump 10 is shown which is an axial flow unit and may be either a single stage or multiple stage unit having a cylindrical rotor 12 in each stage of the unit such as fragmentarily illustrated in half-section in FIG. 1. Impeller blades such as shown at 14 in FIG. 1 provide propulsion for material in a flow passageway of the rotor 12 in the direction of arrow 16 from an inlet end of the unit, not shown, to an outlet end of the unit at the left-hand side of rotor 12 in FIG. 1. In FIG. 3, three equally spaced helical impeller blades 14 are shown providing an axially unobstructed flow passageway through the rotor 12 although it is to be understood that this invention is not limited to such specific impeller arrangement. The rotor 12 is shown mounted for rotation within a cylindrical chamber formed within a housing generally designated 18. Units of this general type are normally powered and require a suitable power source such as a motor, not shown, for rotating an input shaft, not shown, drivingly connected to a drive gear 20 shown in mesh with a driven ring gear 22 secured by bolts such as at 24 to an outside wall of the

rotor 12. As fully described in my copending U.S. Pat. application Ser. No. 236,433 filed Mar. 20, 1972, entitled "Improved Mechanical Seal," and assigned to the assignee of this invention, housing 18 provides mountings for drive shaft bearings 26 within housing gear casing 28 and also for bearings such as at 30 supporting the rotor 12 for rotation about a rotational axis generally designated X—X. The above referenced patent application also describes the particular housing and rotor construction shown in FIG. 1, and the subject matter of that application is incorporated herein by reference.

It should be noted that annular end mounting flanges such as 34 are suitably secured by a machine bolt, not shown, to each axial end of the housing 18 to maintain a seal assembly such as at 36 in operative association with the rotor 12 within enlarged annular chambers as at 38 which will be understood to circumferentially extend around the axial end portions of rotor 12. The illustrated left-hand axial end of rotor 12 is provided with a seal mating ring 40 shown secured on the left-hand end portion of rotor 12 (FIG. 1), and a pair of O-ring seals 42, 42 will be understood to extend continuously around the outer periphery of rotor 12 with a desired radial interference-fit to provide a fluid-tight seal, with each O-ring seal 42, 42 being received within recessed grooves 44, 44 in seal mating ring 40. Seal mating ring 40 is drivingly connected to the rotor by removable retaining pins such as shown at 46, and pins 46 cooperate with a retaining ring 48 to releasably secure the seal assembly 36 in position on the rotor 12. Undesired passage of oil, water, and other contaminants into chamber 38 is controlled by a pair of ring seal subassemblies 50, 52 secured to housing 18 and presenting oppositely facing radial surfaces for sealing engagement with an adjacent side of seal mating ring 40.

To effectively provide a controlled homogeneous mixing process for various combinations of fluids or fluid and solid mixtures in an apparatus particularly suited for continuous high volume operation, an additive diffusor 53 is provided for dispersing a selected additive in controlled proportions relative to the flow media passing through the rotor 12. This invention may be employed in different ways, e.g., in dispersing solid particulate matter into a sludge of flowable material passing through rotor 12, or in mixing different fluids such as a gaseous additive to be homogeneously mixed together with a liquid media in the passageway of rotor 12. While the preferred embodiment provides an additive diffusor 53 for each of the impeller blades 14, it will be understood that the described apparatus is for illustrative purposes, and for such purposes of explanation, it will be sufficient to describe only one additive diffusor 53 which is shown for blade 14 as illustrated in FIG. 1.

In the specifically illustrated embodiment of this invention, rotor impeller blade 14 (FIG. 1) extends from an inside rotor wall 54 (along line 56) to provide a free edge 58 on blade 14 disposed radially inwardly of wall 54 such that blade 14, when rotated, acts as a screw propeller to propel flow media through the rotor 12. Blade 14 is preferably helical in shape and includes a trailing downstream edge 60 which is directed radially outwardly from an apex 62 of the blade 14 toward inside rotor wall 54.

This blunt downstream trailing edge 60 of impeller blade 14 provides for a low pressure area in the region of the flow passageway immediately adjacent the edge 60 at a predetermined rotor speed and, in accordance with another aspect of this invention, a plurality of dispersion outlets are shown such as at 64 formed in the downstream trailing edge surface of the impeller blade. Each dispersion outlet 64 is connected by an individual passageway 66 to a common internal manifold 68 formed inside blade 14 which leads toward its root portion where the blade 14 merges with the inside wall 56 of rotor 12. At the root of the blade 14, a valve body 70 is shown defining a valve chamber 72. Chamber 72 communicates with manifold 68 through an outlet port 74 and connects to the chamber 38 of housing 18 via an inlet port 76 in valve body 70 and a communicating opening 78 in the seal mating ring 40.

By such construction, chamber 38 may conveniently serve as an additive accumulator chamber for supplying various selected additives to the flow passageway of rotor 12. For controlling additive flow through the above described passage means between chamber 38 and the outlets 64, suitable control means is provided which is responsive to the effect of centrifugal force upon rotor rotation permitting the passage of additive flow during rotor operation. While other specific control means may be used such as a centrifugal switch or a control switch responsive to changes in speed or pressure, in the illustrated embodiment, a ball check valve member 80 is received in the valve chamber 72 and is biased by a spring 82 radially inwardly against a valve seat surrounding outlet port 74 and into its illustrated normally closed flow control position.

Servicing the additive diffusors for each impeller blade 14 is a common additive collection ring 84 secured by any suitable means, not shown, to circumferentially extend about the seal mating ring 40. Upon rotation of rotor 12, additive within the accumulator chamber 38 will be collected from chamber 38 by raised vanes 86 (best seen in FIG. 2) formed on collection ring 84 with openings facing in the direction of rotation. The vanes 86 positively direct the additive into a common accumulator groove 88, which will be understood to circumferentially extend around the outer periphery of the seal mating ring 40, and through each of the plurality of openings such as illustrated at 78 in the seal mating ring 40 and into each valve chamber 72 of the impeller blades 14. If desired, a suitable coupling 90 to a supply conduit 92 may be secured to the housing 18 for supplying additive (through a connecting passage therein such as at 94) into the accumulator chamber 38. The illustrated arrangement obviously may be varied and tailored to different types of additives being supplied, depending on whether the additive is a gas, liquid or solid and the nature of the solid additive if such is being used in the application of this invention.

By virtue of the above described structure, the low pressure region behind each impeller blade 14 provides a suction force at a predetermined rotational speed of the rotor as flow media passes over opposite sides of the blades 14, and centrifugal force developed by rotor rotation causes the ball check valve member 80 to automatically move radially outwardly under the effect of the centrifugal force to overcome the biasing force of its spring 82 to permit additive in chamber 38 to be collected and positively directed by the additive collection

ring 84 into the common manifold 68 and through the connecting individual passages 66 to each of the dispersion outlets 64.

By such construction, uniform distribution of additive through each ball check valve of the respective impeller blades 14 and into their manifold 68 is provided to permit the additive to be forced out the dispersion outlets 64 under suction force and dispersed into the flow passageway in the rotor in a fan-like continuous sweeping action, providing a very effective spiralling turbulent mixing of the additive with the flow media. As the rotor 12 slows down at shut-off the effect of the lower pressure region downstream of the blade 14 is reduced to minimize the pressure differential between the chamber 38 and the dispersion outlets, and the centrifugal force is diminished whereby the spring 82 automatically returns its ball check valve member 80 into normally closed flow control position. Any undesired accumulation of flow media within the accumulator chamber 38 is effectively prevented to protect the integrity of the additive composition in addition to protecting the seal area about the outer periphery of the rotor.

An additive diffusor constructed in accordance with this invention will be seen to be usable in a variety of different applications for effectively mixing of flow media and an additive into a highly diffused homogeneous state. The disclosed construction not only provides for such mixing in an efficient fashion but is suited to be incorporated in the impeller blades in a particularly compact design for direct dispersion across the flow path of the media to be treated. Moreover, the additive diffusor is quick and easy to maintain for extended reliable performance under demanding conditions.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. In a generally cylindrical rotor having a flow passageway therethrough and an impeller blade mounted on and projecting generally radially inwardly from an inside wall of the rotor which is supported on a generally cylindrical housing for rotation about an axis of rotation of the rotor, an additive diffusor comprising a dispersion outlet carried by the impeller blade, an additive supply source, passage means in the rotor communicating the dispersion outlet with the additive supply source for dispersion of an additive into the flow passageway, and an additive control in the passage means for controlling additive flow, the additive control being movable between a first position normally blocking additive flow and a second position permitting additive flow through the passage means, the additive control being movable from said first position into said second position responsive to rotor rotation.

2. The diffusor of claim 1 wherein an accumulator chamber is formed in the housing in circumferentially extending relation about the rotor for communication with the passage means, and wherein an additive collection ring is received within the accumulator chamber and mounted on the rotor for rotation therewith, the additive collection ring having openings formed therein in communication with the additive control in the passage means and radially outwardly directed vanes integrally formed on the ring in overlying relation to the openings in the additive collection ring and fac-

ing in the direction of rotor rotation for collecting and guiding additive from the accumulator chamber through said openings to the additive control during rotor rotation.

3. The diffuser of claim 1 wherein the impeller blade includes a downstream trailing edge projecting radially inwardly from the inside wall of the rotor, the downstream trailing edge of the blade being of sufficient thickness to create a relatively low pressure region in the passageway of the rotor in downstream adjacent relation to the trailing edge of the blade upon rotor rotation, and wherein the dispersion outlet is located in said downstream trailing edge of the blade to provide a suction force facilitating additive diffusion into the rotor flow passageway upon rotor rotation.

4. The diffuser of claim 1 wherein the rotor includes a plurality of impeller blades each mounted on and projecting radially inwardly from the inside wall of the rotor, the blades being of substantially identical construction and spaced apart on the rotor in a helical, generally symmetrical arrangement about its major longitudinal axis, and wherein each of the blades includes a plurality of dispersion outlets communicating with a common manifold formed in the blade which common

manifold serves as a part of said passage means for additive dispersion in a fan-like continuous sweeping action in the flow passageway upon rotation of the rotor.

5. The diffuser of claim 1 wherein an accumulator chamber is formed in the housing in surrounding relation to the rotor for communication with the passage means, and additive collection means is mounted on the rotor for rotation therewith, the additive collection means being rotatable within the accumulator chamber for directing additive from the accumulator chamber to the additive control in the passage means during rotor rotation.

6. The diffuser of claim 1 wherein the passage means includes a valve chamber and inlet and outlet ports to the valve chamber formed in the rotor adjacent a root of the impeller blade, the inlet port being in communication with the additive supply source, wherein a valve seat surrounds the outlet port, the outlet port communicating with the dispersion outlet, and wherein the additive control includes a ball check valve biased in a generally radial direction extending inwardly toward a rotational axis of the rotor and toward a normally closed first position in engagement with said valve seat.

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