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COMBINED FLUID MIXER AND PUMP

Filed April 24, 1939

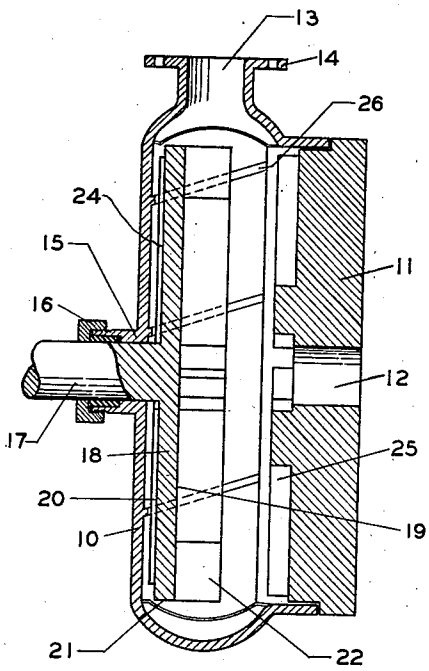


FIG. 1

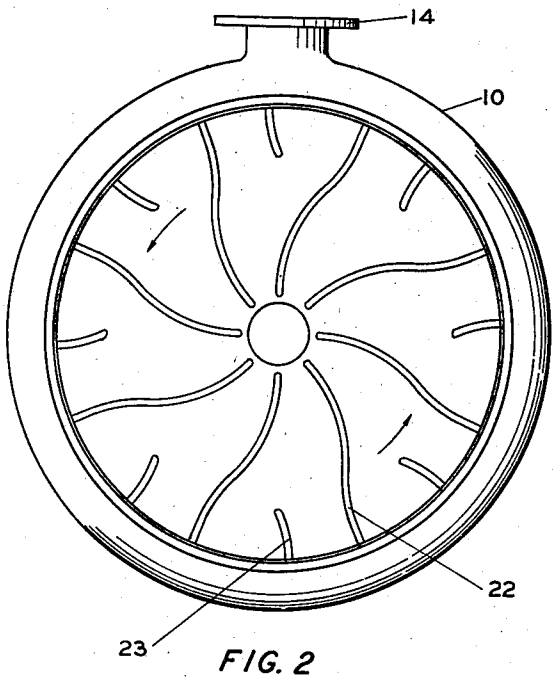


FIG. 2

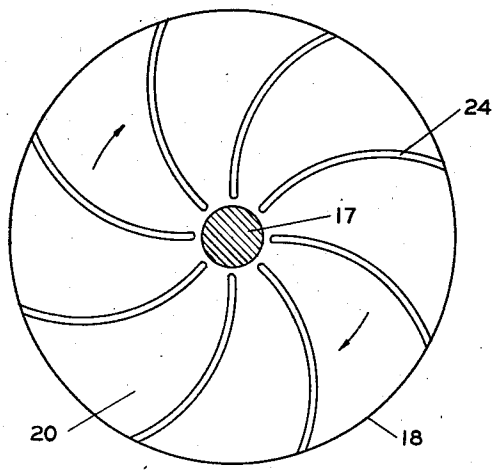


FIG. 3

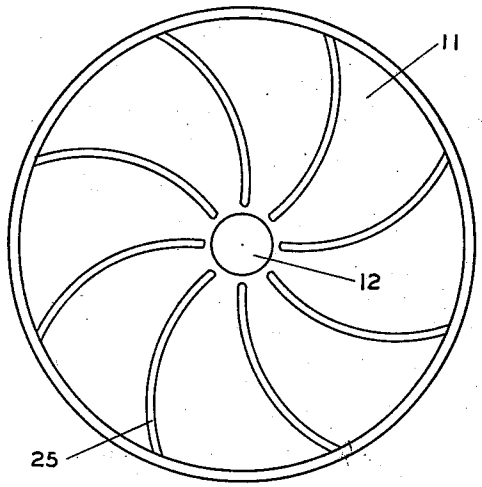


FIG. 4

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COMBINED FLUID MIXER AND PUMP

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5 Claims. (Cl. 259—96)

This invention relates to centrifugal pumps and in its more specific aspects to centrifugal pumps which are adapted to thoroughly mix and pump a composition of two or more fluids.

In certain industries, as for example, in the petroleum industry, it is often essential that a plurality of different fluids be properly combined preparatory to being transmitted or conducted under pressure to the next step in a treating process. There are many instances in which two solutions, while more or less miscible, normally react slowly to produce the desired mixture. It is common knowledge that the speed of reaction of a plurality of fluids may generally be accelerated by vigorous agitation which causes more intimate contact between the component parts. Heretofore, it has usually been the practice to combine and pump the fluids by one of the following methods: (I) The different fluids are placed in a suitable receptacle wherein they are stirred and agitated to produce complete mixing and then passed to a pump which transmits the mixture under pressure to the next step in the process. This procedure is not economical as it requires separate mixing apparatus in addition to the necessary pumping equipment. (II) A combined stream of the fluids is passed through a centrifugal pump and a portion of the mixture is by-passed back to the pump inlet and recirculated through the pump. This system only partially solves the problem, however, as it falls short of providing complete mixing in many cases. While it is true that we can thus increase the degree of intermixture, the full and complete mixing required in particular instances cannot be properly obtained in the manner indicated. (III) Two or more centrifugal pumps may be placed in series and a stream of the fluids transmitted through each successive pump. It has been found that any improvement in the degree of mixing effected by this method is not warranted by the initial cost of the additional equipment and the cost of operating and maintaining the same.

The practice of my present invention obviates the difficulties experienced in the past and provides single pumping means which is adapted to thoroughly mix the fluids introduced therein and then transmit the resultant mixture under pressure. My invention is basically a centrifugal pump in which the casing, suction head and impeller are constructed and arranged to induce extreme turbulence in fluids admitted thereto in order to foster and effect complete association of the constituent materials. In the conventional type of centrifugal pump the flow of fluids therethrough is substantially streamlined and smooth. My invention, on the other hand, contemplates breaking up this smooth flow and creating counterflows and eddies within the pump casing and thereby promoting the necessary agitation to effect proper mixture. This is accomplished by providing on the face of the impeller a series of vanes which are in the nature of compound curves in shape, as distinguished from the usual vane design on conventional centrifugal pump impellers. Auxiliary shorter blades are position near the outer periphery of the impeller and are designed to break up the fluid flow, tending to return a portion of the fluid back to the central opening in the pump casing. Additional vanes or fins are made integral with the casing and on the inner face of the suction head. Furthermore, the liquid contact surfaces within the pump are all pitted and roughened. By means of the various vanes referred to above and by roughening the contact surfaces, maximum turbulence and excellent mixing will result as will be more fully described hereinafter. As a result of the mixing process which takes place, the efficiency of my invention as a pump is necessarily reduced. However, it should be remembered that this invention serves both as a mixer and a pump, and that any loss in mechanical efficiency is more than compensated for by the completeness of the mixing operation.

It is the primary object of this invention to provide unitary means for thoroughly mixing and pumping a composition of different fluids.

Another object of this invention is to provide a combined centrifugal pump and mixer which is adapted to readily and completely mix two or more fluids in a relatively short period of time and transmit the mixture under pressure.

The present invention has for a further object the provision of combined mixing and pumping means which is simple, compact and sturdy in design; and inexpensive to manufacture, operate and maintain.

These as well as additional objects and advantages will be apparent to those skilled in the art by reference to the following detailed description and annexed drawing which respectively describes and illustrates a preferred embodiment of the invention, and wherein

Figure 1 is a vertical cross section view through the axes of rotation of the impeller, showing the essential elements of the invention in assembly;

Figure 2 is a front elevation view of the impeller positioned within the housing;

Figure 3 is a rear elevation view of the impeller; and

Figure 4 is an elevation view of the inner end of the suction head.

Referring to the drawing, I have denoted therein a centrifugal pump housing which consists of a casing 10 and a removable closure plate or suction head 11 having a fluid inlet passageway 12. While the pump housing illustrated in the drawing is substantially circular, it is to be understood that an involute or other known type of pump housing may be employed with equal success in the practice of my invention. The casing is provided with a fluid discharge outlet 13 which has an integral flange 14 for connection to the usual discharge conduit, not shown. At the back end of the casing is a simple form of journal housing 15 and a packing unit 16 for respectively supporting and making an adequate seal with shaft 17 of a circular rotary impeller 18 which is disposed in the housing so that its front face 19, rear face 20 and periphery 21 are all in spaced relation with the interior of the housing. A plurality of compound or reverse curved vanes 22 on the front face of the impeller will, upon rotation of the impeller direct a stream of fluid admitted into the pump housing toward the periphery 21. A second series of shorter curved vanes 23 will, by virtue of their position, tend to intercept a portion of the fluid and redirect it toward the inner end of these vanes so as to oppose what might otherwise be termed normal flow. The rear face of the impeller is also provided with a series of curved vanes 24. As will be noted by an inspection of Figure 1, vanes 24 project a lesser distance from the rear face of the impeller than vanes 23 project beyond the corresponding face. Furthermore, vanes 24 are arranged to thrust peripheral fluid toward the drive shaft in the space at the back end of the housing, thus fostering proper mixing and preventing the suction of air through packing unit 16. In addition to the various impeller vanes described above, my invention contemplates the utilization of a set of stationary vanes 25 on the inner surface of the suction head plate. Like short vanes 23 and vanes 24, the vanes on the suction head plate are employed to induce fluid agitation. Reference numeral 26 denotes a plurality of spaced directional ridges or baffles intermediate the periphery of the impeller and the casing. Instead of providing smooth surfaces on the front face of the impeller and on the vanes located thereon, as is usually done to insure smooth and unhindered flow, I prefer to intentionally leave all surfaces inside the housing in a rough unfinished condition. Numerous countercurrents and eddies are thus created when fluid is passed through the pump, thereby increasing the fluid turbulence and agitation.

In the operation of my invention a continuous stream of the fluid or fluids to be mixed is admitted into the housing through inlet passageway 12. The fluid impinges against the center of the front face of the impeller which is rotating at the desired speed in the direction indicated by the arrow in the drawing. Vanes 22 pick up the fluid; hurtle it in an outward direction beyond the periphery of the impeller; and thence through outlet 13. A portion of the fluid is thrust against the short curved vanes 23 which, by virtue of their orientation, divert this fluid inwardly toward the axis of rotation, creating countercurrents and a swirling action which results in agitation. The portion of the fluid which is not returned to the center of the housing is impelled into the space between the periphery of the impeller and the casing where baffles 26 tend to hinder flow. These baffles are tilted slightly toward the suction head plate; and, in addition to promoting turbulence, they will direct some of the fluid to the suction head plate. Stationary vanes 25 on the suction head plate pick up this fluid and direct it toward the axis of the pump to aid in the mixing operation. When the fluid reaches the inner ends of the suction head vanes 25, it will be noted that its direction of flow is opposite to the direction of rotation of the impeller. At this point the returned fluid comes in contact with new fluid entering the housing, and, due to the velocity of the circulating fluid, the new fluid is agitated to an appreciable extent even before it reaches the face of the impeller. As was pointed out earlier in this specification, numerous countercurrents and eddies are set up in the fluid because of the roughened condition of the impeller and housing surfaces; and added counterflow is provided by employing vanes 24 on the rear face of the impeller.

From the foregoing it is believed that the construction, operation and advantages of my present invention will be readily comprehended by persons skilled in the art. It is to be understood that the form of this invention, herewith shown and described, is to be taken as a preferred example of the same and that various changes in size, shape and arrangement of parts may be resorted to without departing from the spirit of this invention, and further that the theories of operation set out, although believed to be accurate, are not to be considered as the sole basis of the operativeness of this device, but that this device does operate successfully whether or not upon the principles described herein, this invention to be limited only by the appended claims.

I claim:

1. A combined fluid mixer and centrifugal pump comprising a pump housing, a rotary impeller mounted in the housing and having its front face, rear face and periphery in spaced relation with the interior of the housing, an impeller shaft rigidly connected to the rear face of the impeller, a fluid inlet in the housing opposite the front face of the impeller, a fluid outlet in the housing, a plurality of curved vanes on the front face of the impeller for directing a stream of fluid admitted into the housing toward the periphery of the impeller, a second plurality of shorter curved vanes on the front face of the impeller for urging a portion of the fluid impinging thereon in a direction opposing flow, and a plurality of baffles intermediate the periphery of the impeller and the housing for inducing fluid turbulence.

2. A combined fluid mixer and centrifugal pump comprising a pump housing, a rotary impeller mounted in the housing and having its front face, rear face and periphery in spaced relation with the interior of the housing, an impeller shaft rigidly connected to the rear face of the impeller, a fluid inlet in the housing opposite the front face of the impeller, a fluid outlet in the housing, a plurality of curved vanes on the front face of the impeller for directing a stream of fluid admitted into the housing toward the periphery of the impeller, a plurality of

curved stationary vanes on the interior of the housing opposite the front face of the impeller, the curvature of said stationary vanes being such as to tend to oppose fluid flow through the housing, and a plurality of baffles intermediate the periphery of the impeller and the housing for inducing fluid turbulence.

3. A combined fluid mixer and centrifugal pump comprising a pump housing, a rotary impeller mounted in the housing and having its front face, rear face and periphery in spaced relation with the interior of the housing, an impeller shaft rigidly connected to the rear face of the impeller, a fluid inlet in the housing opposite the front face of the impeller, a fluid outlet in the housing, a plurality of curved vanes on the front face of the impeller for directing a stream of fluid admitted into the housing toward the periphery of the impeller, a second plurality of shorter curved vanes on the front face of the impeller for urging a portion of the fluid impinging thereon in a direction opposing flow, a plurality of curved stationary vanes on the interior of the housing opposite the front face of the impeller, the stationary vanes tending to direct fluid toward the axis of the impeller shaft, and a plurality of baffles intermediate the periphery of the impeller and the housing.

4. A combined fluid mixer and centrifugal pump comprising a pump housing, a rotary impeller mounted in the housing and having its front face, rear face and periphery in spaced relation with the interior of the housing, an impeller shaft rigidly connected to the rear face of the impeller, a fluid inlet in the housing opposite the front face of the impeller, a fluid outlet in the housing, a plurality of curved vanes on the front face of the impeller for directing a stream of fluid admitted into the housing toward the periphery of the impeller, each of said vanes extending from a point approximate the axis of the impeller to the periphery thereof, a second plurality of substantially shorter curved vanes on the front face of the impeller for urging a portion of the fluid impinging thereon in a direction opposing flow, the outer end of each of said shorter vanes terminating at the periphery of the impeller, and a plurality of stationary curved vanes on the interior of the housing opposite the front face of the impeller.

5. A combined fluid mixer and centrifugal pump comprising a pump housing, a substantially circular rotary impeller mounted in the housing and having its front face, rear face and periphery in spaced relation to the interior of the housing, a fluid inlet in the housing for admitting fluid into the space between the front face of the impeller and the interior of the housing, a fluid outlet in the housing, a plurality of curved vanes on the front face of the impeller for directing a stream of fluid admitted into the housing toward the periphery of the impeller, each of said vanes extending from a point approximate the axis of the impeller to the periphery thereof, a second plurality of substantially shorter curved vanes on the front face of the impeller for urging a portion of the fluid impinging thereon in a direction opposing flow, the outer end of each of said shorter vanes terminating at the periphery of the impeller, a plurality of curved vanes on the rear face of the impeller, a plurality of stationary curved vanes on the interior of the housing opposite the front face of the impeller, the curvature of said stationary vanes being such as to induce fluid flow toward the axis of the impeller, and a plurality of baffles intermediate the periphery of the impeller and the housing for promoting fluid turbulence.

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