March 4, 1958 W. H. JACKSON 2,825,542

METHOD OF AND APPARATUS FOR DISPERSING FLUIDS IN LIQUIDS

Original Filed July 2, 1949 2 Sheets-Sheet 1

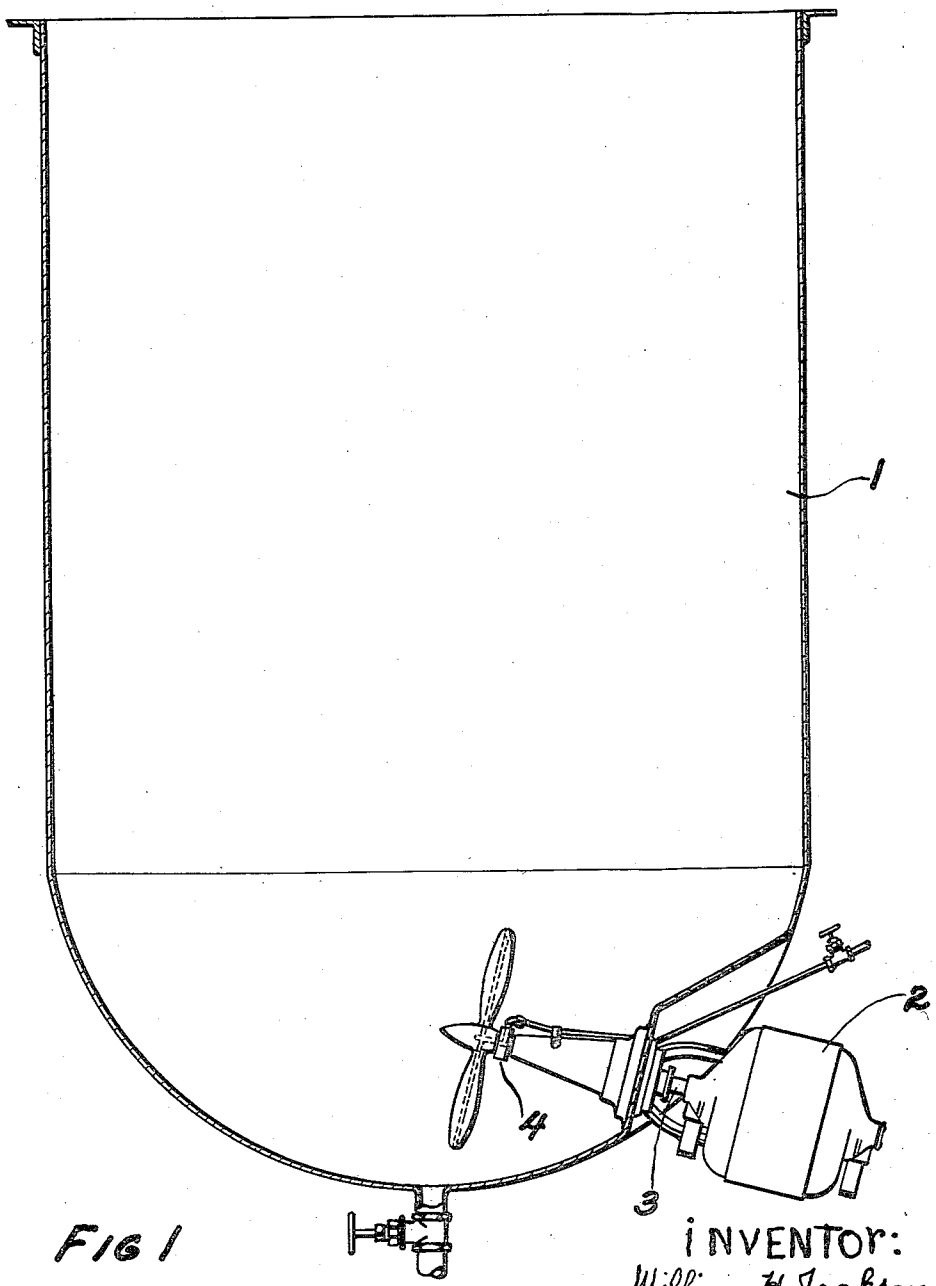


FIG 1

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METHOD OF AND APPARATUS FOR DISPERSING FLUIDS IN LIQUIDS

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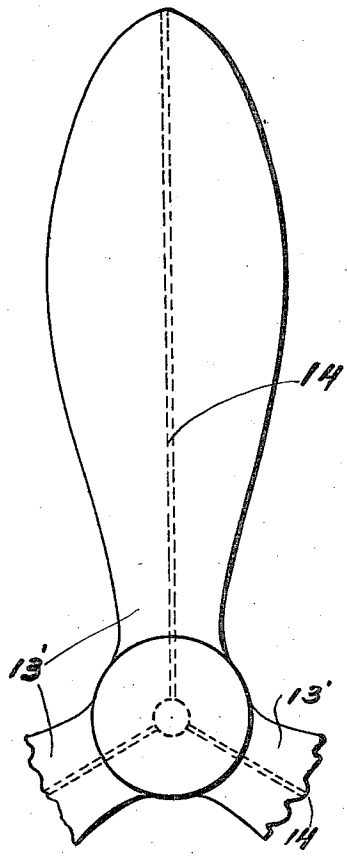


FIG 2.

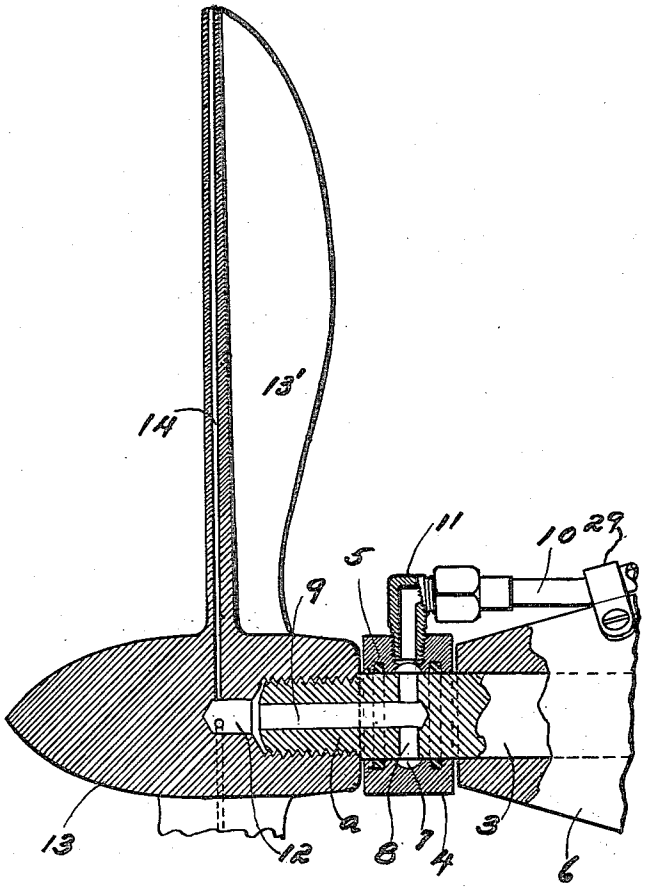


FIG 3

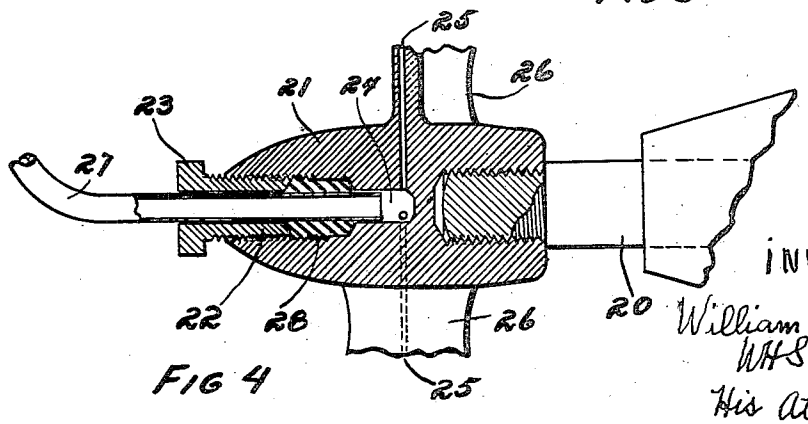


FIG 4

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United States Patent Office 2,825,542 Patented Mar. 4, 1958

2,825,542

METHOD OF AND APPARATUS FOR DISPERSING FLUIDS IN LIQUIDS

William H. Jackson, Gracewood, Ga.

Continuation of application Serial No. 102,855, July 2, 1949. This application February 16, 1956, Serial No. 565,988

4 Claims. (Cl. 261—87)

This invention relates to the dispersion of fluids, either liquid or gas, in liquids and has for its particular objects the provision of a method for the expeditious and efficient mixing or commingling of fluids with liquids and the provision of a simple, cheap and efficient apparatus wherein such method may be performed. Other objects of the invention are hereinafter set forth.

This application is a continuation of my co-pending application Serial No. 102,855, filed July 2, 1949, for Method of and Apparatus for Dispersing Fluids in Liquids.

My investigations have led to the discovery that the remarkably effective dispersion of a gas or liquid in a body of liquid can be accomplished by discharging the medium to be dispersed through the blades of a high speed propeller disposed adjacent the bottom of the body of liquid.

My invention is fully set forth in the following detailed description and accompanying drawings forming a part thereof, in which

Figure 1 is a diagrammatic vertical section, partly in elevation of my improved apparatus for carrying out such effective dispersion of fluids in liquids;

Figure 2 is a fragmentary elevation of the drilled propeller which is employed in such apparatus;

Figure 3 is a fragmentary vertical section, partly in elevation, of the said propeller and the supporting bearing therefor; and

Figure 4 is a fragmentary vertical section, partly in elevation, of a modification wherein the fluid to be dispersed is introduced through the nose of the propeller hub.

Referring to the drawings and the construction shown therein the construction of the tank 1 and the manner of mounting the motor 2 and the propeller shaft 3 is essentially the same as the construction of the corresponding tank and the manner of mounting the corresponding elements in the agitating device disclosed and illustrated in my prior Patent No. 2,042,006 granted May 26, 1936, except that a collar 4, having rubber or like gasket or sealing rings 5, is mounted on the shaft 3 between its bearing 6 thereof and its threaded end *a*. The collar 4 has a semi-circular groove 7 on its interior surface which permanently communicates with the radial bore 8 and the intersecting axial bore 9 drilled in said shaft. The propeller shaft 3 extends, as does the shaft 7 of said patented construction, laterally through the arcuate bottom of the tank 1, at one side thereof, and projects upwardly at an inclination to the horizontal, terminating in proximity to the vertical axis of the tank and adjacent said arcuate bottom thereof. A fluid supply pipe 10, having a fitting 11 on its outer end which is threaded into said collar, serves to supply fluid to the groove 7 that communicates therewith and thence through the bores 8 and 9 to an axial chamber 12 formed in the hub 13 of a propeller element, which is threaded on to the end of the propeller shaft. The blades 13' of the propeller element are each drilled throughout their entire

length to form radial conduits 14 that permanently communicate with the chamber 12 whose walls are intersected by such conduits.

In the modification shown in Fig. 4, the end of the propeller shaft 20 is solid and the propeller hub 21 is threaded directly thereto. The front end or nose of the hub has a chamber 22 formed therein into which a bushing 23 is threaded. The inner end of the chamber 22 communicates with an axial chamber 24 formed in the hub which in turn is in permanent communication with the radial conduits 25 that are drilled in the blades 26 of the propeller element and which conduits are similar to the said conduits 14 of the propeller element shown in Figs. 1-3. A supply pipe 27 which projects through said bushing serves to supply fluid to the chamber 24 while the propeller element is rotating. Suitable packing 28 serves to seal the joints between the pipe 27 and the bushing 23 and between the latter and the hub 21 and thus render the same liquid- and gas-tight. The collar 4 is maintained against rotation on the propeller shaft by means of a hose clamp 29 which serves to rigidly secure the pipe 10 to the bearing member 6.

The propeller which is employed in the above described apparatus is a so-called screw propeller having a substantial pitch and it functions in a dual capacity, serving as the motivating agent to project through the tips of its blades the fluid to be dispersed at very high speed in the form of jets into the main body of liquid in the tank 1 and also serving, due to its pitch which should be sufficient to impart movement of such liquid, to a substantial extent, in a direction substantially in parallelism with the longitudinal axis of the propeller shaft so as to continually sever such jets upon their issuance from the blade tips and thereby constantly present fresh portions of the liquid to be treated to the dispersing action of the propeller jets issuing from the tips of the blades.

The fact that the blades of applicant's screw propeller are stream-lined serves to not only lessen the resistance to the passage of the blades through the main body of liquid and thereby reduce the power expenditure required but also reduces to a minimum the rotational effect imparted to the liquid passing through the rotating propeller, irrespective of its direction of rotation within the liquid. Furthermore, the positioning of orifices of the drilled conduits of the propeller blades at the tips thereof insures of the high speed projection of the fluids therefrom into the relatively slow moving surrounding liquid at right angles to the paths of the currents induced therein by the action of the screw propeller and thereby a maximum of dispersion of the fluids in the main body of liquid is obtainable particularly because the slow motion of the liquid is additive to the relatively greater speed of the projected jets as contrasted with the subtractive effect were tubular arms substituted for its propeller blades as aforesaid. It may be here noted that the kinetic energy available for shear varies directly with the square of the speed and accordingly the said additive effect becomes an important factor. The dispersion effect that is obtained in my improved method can be likened to that which occurs when a locomotive of a train travelling at a high rate of speed is discharging large volumes of smoke from its stack. In such a case, the said stack corresponds to my drilled propeller and the surrounding air to the main body of liquid in tank 1. Due to the relative speed of the surrounding air, the smoke will be cut off at right angles to the axis of its direction of discharge from the stack and will form a stream that will occupy the zone immediately above the roof of one or more of the cars of the train. Now it may be here noted that it is the relative speed of the air with respect to that of the train that is to be taken into account, it being

immaterial, insofar as the dispersion effect obtained whether the air is substantially stationary and the train is moving at a high rate of speed or vice versa. It is submitted that the dispersion effect which I obtain could not be accomplished were tubular arms substituted for my propeller blades that are stream-lined and of substantial pitch, as even though unlimited power were available for rotating such arms, the motivating force to cause portions of the main body of liquid to move, relatively, at high speed across the projection of the axes of such arms would be absent. As a consequence, the main body of liquid would be caused to rapidly flow away from the hub carrying such ducts and in a direction lengthwise to such arms with the result that no appreciable dispersion effect would result.

My invention has wide application, among which applications are the treatment of mineral and vegetable oils with acids and alkalies, the quick dispersion of clarifying agents in city water supplies, the dispersion of carbon dioxide in water for beverage purposes, the dispersion of acid anhydrides in water for the production of commercial grades of acids; and especially for the dispersion of liquids in liquids in the manufacture of emulsions as the outer phase of the emulsion being produced is not unnecessarily broken up and consequently there is no likelihood of a reversal of the phases as might otherwise be the case were the outer phase so disrupted.

My improved apparatus is also adapted to function as a condenser by virtue of the fact that during the high speed rotation of the drilled propellers in a body of precooled condensate of the vapors to be condensed there will be a rapid cooling of the vapors entering the ducts and the consequent condensation thereof due to the excellent heat exchange between the stream-lined propeller blades, if the same are formed of metal, and the precooled liquid in which the same rotate. Such an application of the invention is not specifically claimed herein, the same being reserved for a co-pending application to be subsequently filed.

For effective dispersion of fluids in aqueous liquids, I preferably rotate the propeller at a speed representing a peripheral velocity of the blades thereof at the orifices of the ducts of 1,500-ft. per minute as a minimum and desirably in excess of 3,000-ft. per minute, with a propeller pitch of sufficient amount to impart, as heretofore stated, movement of the liquid within the zone of direct influence of the propeller blades during the rapid rotation thereof in a direction that is essentially parallel with the longitudinal axis of the propeller shaft, so as to continually present fresh portions of the liquid to the dispersing action of the jets isnuing from the propeller blade tips. The propeller speed required for effective dispersion is dependent upon the surface tension of the fluid at the interface between the same and the liquid and also upon the viscosity of the liquid.

Various changes and modifications in the above described apparatus and method may be made without departing from the spirit of the invention as embraced within the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In an apparatus for dispersing fluid in a liquid, the combination with a tank of a propeller shaft rotatably mounted therein, a high-speed screw propeller mounted on the shaft, including a hub member having a chamber

therein and radial, streamlined blades projecting from said hub, said blades having longitudinal internal ducts extending completely therethrough to the tips thereof and communicating with said hub chamber and the tips of said blades lying distant from the lateral sides of the tank and in proximity to its vertical axis; means including a conduit connected to communicate with the chamber in said hub for supplying fluid thereto, so that continuous jets of the fluid will be emitted through said conduit; and means mounted externally of the tank for driving said shaft, the blades of the propeller being of a pitch to impart movement of the liquid within the zone of immediate influence of the propeller blades, during rapid rotation thereof, in a direction essenially in parallelism with the longitudinal axis of said shaft so as to continually present fresh portions of the liquid to the dispersing action of the jets.

2. In an apparatus for dispersing fluid in a liquid the combination comprising a tank, a propeller shaft rotatably mounted therein, a propeller mounted on said shaft, a hub member mounted on said shaft, said propeller having radially streamlined blades projecting from said hub, said blades having longitudinal internal ducts extending completely therethrough to the tips thereof, an aperture in said hub communicating with said ducts, means including a conduit connected to communicate with the aperture in said hub for supplying fluid thereto and means mounted externally of the tank for rapidly driving said shaft, the blades of the propeller being of a pitch to impart movement of the liquid within the zone of immediate influence of the propeller blades during rapid rotation thereof in a direction essentially in parallel with the longitudinal axis of said shaft to contiually present fresh portions of the liquid to the dispersing action of the jets.

3. In an apparatus for dispersing fluid in a liquid in accordance with claim 2 wherein said ducts extend radially through said blades whereby the rotation of said blades will cause a stream of fluid issuing from said duct to be sheared off in small increments at the instant of emergence from said duct, dispersed in said liquid, and moved along therewith.

4. In an apparatus for dispersing fluid in a liquid the combination comprising a tank, a propeller shaft rotatably mounted therein, a propeller mounted on said shaft, said propeller having radially streamlined blades projecting from said shaft and having longitudinal internal ducts extending radially therethrough to the tips thereof, means including a conduit connected to communicate with said ducts for supplying fluid thereto and means mounted externally of the tank for rapidly driving said shaft, the blades of the propeller being of a pitch to impart movement of the liquid within the zone of immediate influence of the propeller blades during rapid rotation thereof in a direction parallel to the longitudinal axis of said shaft to continually present fresh portions of the liquid to the dispersing action of the ducts at the tips of said blades.

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