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METHOD AND APPARATUS FOR PROJECTING UNDERWATER EXPLOSIVE

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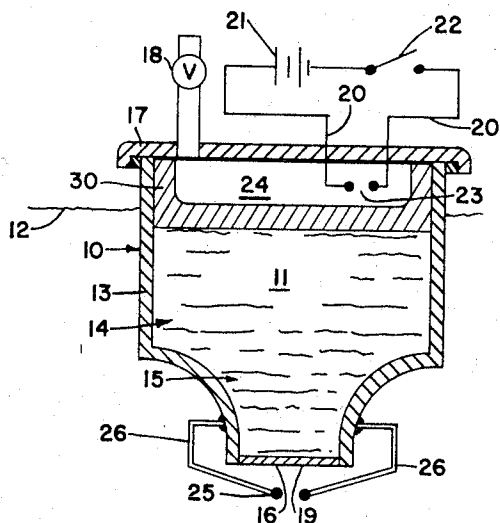


Fig. 1

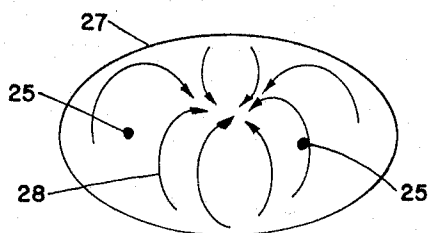


Fig. 3

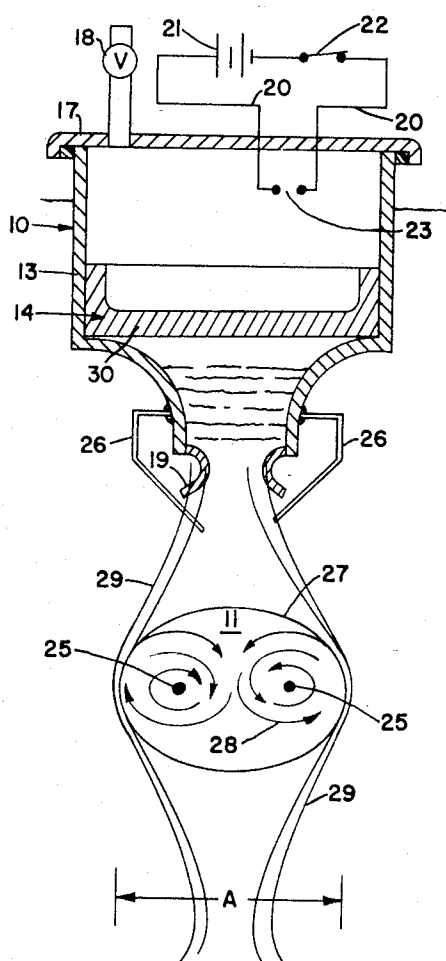


Fig. 2

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METHOD AND APPARATUS FOR PROJECTING UNDERWATER EXPLOSIVE**Calvin A. Gongwer, Glendora, Calif., assignor to Aerojet-General Corporation, El Monte, Calif., a corporation of Ohio****Filed Oct. 11, 1965, Ser. No. 496,251****12 Claims. (Cl. 102—22)**

This invention is a continuation-in-part of my copending application Serial No. 490,769, filed February 28, 1955, now abandoned, for "Method and Apparatus for Projecting Underwater Explosive."

This invention pertains generally to the transmission of an unenclosed body of a first fluid through a second fluid.

A primary object of the invention is to transmit a mass of one fluid through a body of another fluid without using either a container or conduit, and to carry out such transmission without substantial commingling of the two fluids so that the transmitted fluid retains its initial physical and chemical properties substantially unchanged at its final destination.

A further object is to provide an underwater explosive charge by projecting a mass of explosive liquid through a body of water, such as the sea for example, to a remote point at which it is detonated. This type of underwater explosive device is singularly advantageous in that it will dissipate after a short while if not detonated, and thus not continue to exist as a permanent hazard.

A feature of this invention resides in the projection of a mass of a first fluid from a vortex ring generating means through a second fluid, where the vortex ring of the transmitted fluid remains substantially unmixed with the second fluid throughout substantially the entire length of travel.

A still further feature resides in the provision of detonator means for use with the transmitted explosive fluid which is initially disposed in the path of the vortex ring at its point of issue from the vortex generating means so as to be caught up and carried along with the ring.

These and other features of this invention will be fully understood by those skilled in the art from the following detailed description and the accompanying drawings, of which:

FIG. 1 is a cross-sectional elevation of a vortex ring forming means for emitting a mass of fluid according to the present invention;

FIG. 2 is a cross-section of the same vortex forming means immediately after emitting fluid as a vortex ring; and

FIG. 3 is a perspective view of the vortex ring of fluid including detonators therein.

Referring now to the drawings, FIG. 1 shows a vortex forming means 10 for emitting or discharging a mass of an explosive liquid 11 in the form of a vortex into a liquid medium or body of water 12, such as the sea for example. This forming means comprises a container 13 having an upper cylindrical portion 14 and a lower tapered portion 15 ending in a nozzle shaped orifice 16 of reduced cross-section and closed by a frangible cover 19. A drive piston 30 serves as an upper limit for the liquid 11. The top of the container 13 is closed by a cover 17 having an access or valve means 18.

Electrical leads 20 pass through the cover 17 to connect an externally located source of voltage 21 via a switch 22 to a spark gap 23 disposed within a fluid-free area 24 at the upper end of the cylindrical portion 14 above the drive piston 30. The source 21 provides electrical power of sufficient magnitude to generate a spark across a gap 23 when the switch 22 is in its closed position.

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A gaseous charge, such as a vaporized gasoline air mixture, is introduced via the means 18 into the space 24 existing between the piston 30 and the cover 17. Detonation of this charge rapidly moves the piston against the liquid 11 breaking the frangible cover 19 and generating the desired liquid vortex.

Detonator bodies 5, preferably of a lower specific gravity than the explosive liquid 11, and which may be of the proximity or centrifugal types, are detachably held just below and slightly inwardly of the lips of the orifice 16 by supports 26 carried by the forming means 10. The detonators will be picked up and carried along through the liquid 12 by the vortex as will be discussed below.

FIG. 2 illustrates the conditions existing in the system after the explosive liquid 11 has been ejected from the vortex generator. The liquid 11 assumes the shape of a vortex 27, that is, somewhat toroidal in form with the expelled liquid being in rapid rotation as indicated by the arrows 28. The physical nature of a vortex is generally known, and needs no specific exposition here other than illustrations in cross-section of FIG. 2, and in perspective in FIG. 3.

Lines 29 show the relative stagnation of the water around the vortex. This pattern of lines of stagnation will also be similar for other combinations of fluids, either liquids or gases. Dimension A (FIG. 2) is the largest dimension of the vortex perpendicular to the line of travel or transmission and will be referred to here as the vortex diameter. After the ejection of the liquid 11 and the formation of the vortex, the detonators will be found within the toroidal shaped explosive liquid along the cross-sectional axis thereof.

The operation of the device will now be described. The container is first filled to the desired level with the explosive 11. This level is largely determined by the size of the ring desired and the distance which it is to be projected. An explosive gas, such as gasoline and air, is introduced into the space 24 above the liquid 11 while the switch 22 is maintained in the open condition. Then the switch is closed initiating a spark across the gap 23 that explodes the gasoline-air mixture. The resulting expansion exerts a force via the piston onto the liquid 11 rapidly expelling it out of the nozzle orifice forming a liquid vortex that moves along a path through the medium 12 in a direction orthogonally away from the orifice 16. Other means of expelling the explosive liquid can be used, such as a fast acting hydraulic ram piston, for example, as long as the force is applied quickly, otherwise a vortex will not be generated and the explosive liquid would merely be diffused within the liquid 12.

The detonators 25 may be armed in any of several ways, such as centrifugal or proximity arming, and when they finally are set off, this, in turn, serves to detonate the vortex. Should the detonators fail, the explosive liquid will rapidly dissipate upon cessation of the vortex motion thereby eliminating a possible safety hazard.

Tests have shown that a liquid vortex can pass through a surrounding water medium for a distance at least as great as 100 diameters of the vortex. Within this distance, the mobile segment of fluid remains substantially unmixed with the surrounding liquid. The transmission speed depends primarily upon the energy per unit mass imparted to the transmitted fluid, and the diameter thereof is determined by the diameter of the orifice 16. It will therefore be appreciated that in addition to destructive uses, the invention can be beneficial and useful wherever a general means of transmitting one fluid through another is required.

In essence, this is a method for projecting one fluid through another in discrete segments without significant commingling between the two fluids. Although as de-

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scribed herein the accent has been upon the use of liquids, it is felt that the technique is equally applicable to gases.

Also, as described, detonators were used to set off the explosive liquid; however, in certain cases it may be possible to rely on conditions at the destination for detonating the fluid, such as an engine spark, or the like.

It has been found that to achieve the optimum in transmission with the least commingling of the fluids, that the specific gravity of the two fluids should be nearly the same. For instance in the depth charge application described above, nitromethane, with a specific gravity of 1.138 that is quite close to the specific gravity of sea water, provides excellent results.

It is also to be noted that there is no limitation upon the direction of transmission of such a vortex within another medium. The specific representation of a downward transmission was for ease of presentation above.

The invention is not to be limited to the examples given in the description, nor by the illustrations in the drawings, which are given by way of example and not of limitation but only in accordance with the scope of the appended claims.

I claim:

1. A method for transmitting an unenclosed body of an explosive liquid through another liquid to a predetermined remote location for selective detonation, comprising:

arranging a quantity of said explosive liquid within an otherwise closed container having an orifice;
submerging said container in said other liquid; and
subjecting said explosive liquid to an impulsive force within said container whereby said explosive liquid is ejected from said container through said orifice into said other liquid in the form of a vortex ring which moves through said other liquid, said liquids remaining substantially unmixed while said explosive liquid retains its vortex ring configuration.

2. A method according to claim 1, wherein the specific gravities of said liquids are substantially equal.

3. A method according to claim 1, wherein said step of subjecting said explosive liquid to an impulsive force within said container comprises quickly raising the pressure bearing on one surface of said explosive liquid to a value higher than that obtained at the exterior of said container orifice, whereby said explosive liquid is expelled from said container through said orifice in the form of a vortex ring.

4. A method according to claim 1, wherein said step of subjecting said explosive liquid to an impulsive force within said container comprises rapidly expanding a gaseous mixture within said container.

5. A method of transmitting liquid explosive through a liquid medium and detonating the explosive at a predetermined location, comprising the steps of:

confining the liquid explosive in a container having an orifice;

arranging the container with respect to the liquid medium so that the orifice is in open communication with the medium and directed along a path toward the predetermined location;

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directing an impulse of force against the liquid explosive within the container causing the explosive to move through the orifice and form a vortex thereof moving through the liquid medium;

intercepting detonator means disposed within the medium by the vortex of liquid explosive and carrying the same along within the vortex; and

actuating the detonators when the vortex reaches the predetermined location to effect detonation of the explosive liquid.

6. Apparatus for projecting liquid explosive charges through a liquid medium, comprising:

a container having an outlet submerged in the liquid medium;

a body of explosive liquid in said container;

means for rapidly ejecting said explosive liquid from said container through said outlet into the medium to form a moving vortex of the explosive liquid; and
detonating means detachably mounted on said container located generally opposite the outlet, the detonating means being pulled free from the container and drawn into and carried along with the vortex.

7. Apparatus as set forth in claim 6, in addition comprising means for introducing an explosive gaseous mixture into said container and for exploding said mixture thereby rapidly ejecting the body of explosive liquid from the container.

8. Apparatus for transmitting an unenclosed quantity of a first fluid through a second fluid, comprising:

a container;

a movable piston included within the container dividing the container into first and second containing regions;

wall portions of the container defining an orifice that is in communication with the first containing region, the wall portions being so disposed as to submerge the orifice within the second fluid;

a quantity of the first fluid in the first containing region; an explosive charge disposed within the second containing region; and

means for selectively detonating the charge to impulsively drive the piston against the first fluid forcing it through the orifice and along a path through the second fluid in the form of a vortex.

9. Apparatus as in claim 8, in which the first and second fluids are liquids having substantially the same specific gravity.

10. Apparatus as in claim 8, in which the explosive charge consists of a gaseous mixture of gasoline and air.

11. Apparatus as in claim 8, in which there is further provided a frangible cover disposed in sealing arrangement over the orifice.

12. Apparatus as in claim 8, in which the selective detonation means includes means for generating an electric spark within the second containing region.

No references cited.

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