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SUPERSONIC AGITATION

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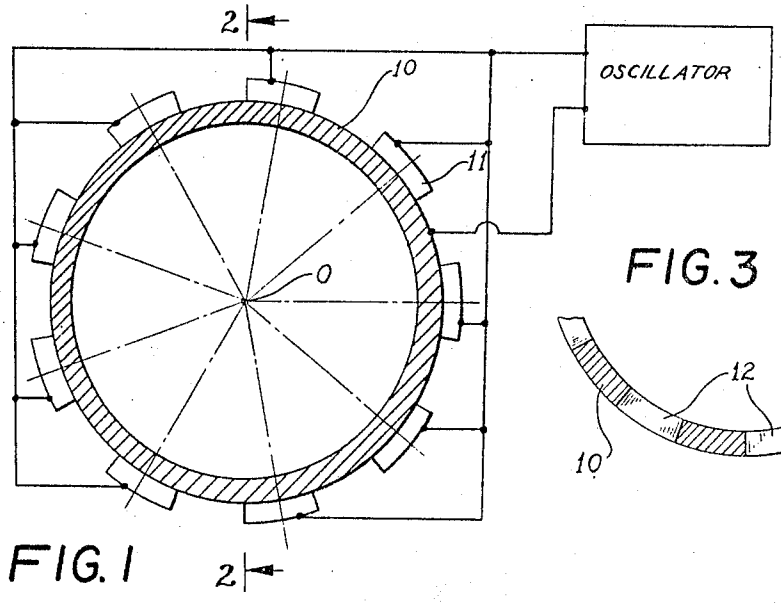

FIG. 1

FIG. 3

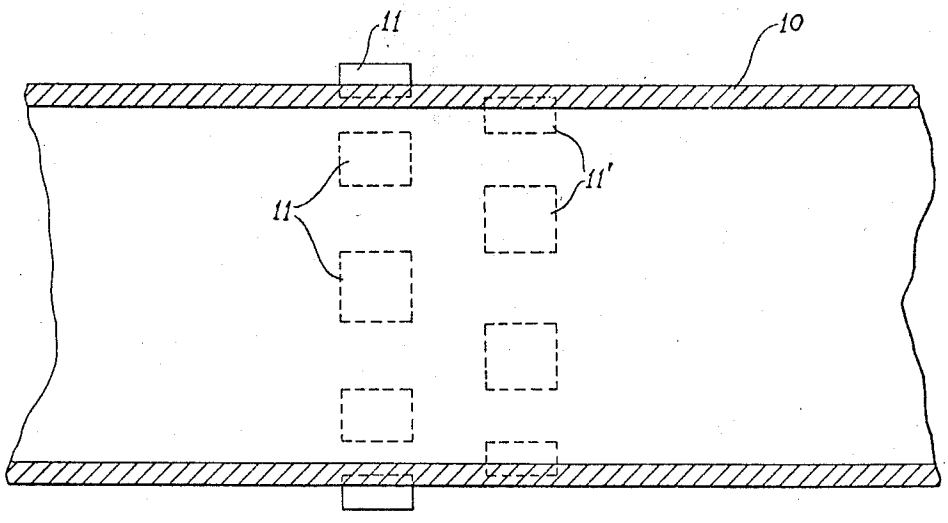

FIG. 2

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SUPERSONIC AGITATION

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8 Claims. (Cl. 259—1)

1

This invention relates to the supersonic agitation of materials, particularly liquids. Such agitation has been employed heretofore and it has been determined that very desirable changes can be effected within various mediums provided sufficient supersonic power can be developed. As heretofore employed, only sufficient power has been developed to indicate that very desirable changes could be effected within such mediums, but it has heretofore been impossible to concentrate enough power to determine the full value of such agitation. The indications, as gathered from work previously accomplished in this field, are that among the very desirable changes and results which could be effected, if sufficient power could be developed, are the following: destroy bacteria in order to obtain enzymes; more effective sterilization, mixing ordinarily immiscible compounds; treat metals in their molten state to change crystal structure; homogenize liquids more rapidly and in larger quantities.

It is, therefore, one of the principal objects of this invention to provide a method and means for generating sufficient supersonic power to accomplish the above and other purposes, and in general to provide more supersonic power than has heretofore been obtained by similar means.

It is a further object of this invention to provide a method and means for treating continuously flowing fluids with powerful supersonic energy.

It is another object of this invention to provide a method and means not only for delivering a high degree of supersonic power into a fluid, but also to insure that all portions of the fluid will be subject to the high power supersonic treatment.

It is still another object of this invention to provide a method and means for imparting supersonic energy to a fluid through the walls of a container and to insure maximum transfer of energy from the supersonic vibrator through the walls of the container and into the fluid within the container.

Further objects and advantages of this invention will become apparent in the following detailed description thereof.

In the accompanying drawings,

Fig. 1 is a transverse vertical section through an elongated fluid conductor showing one form of my invention applied thereto.

Fig. 2 is a longitudinal vertical section through the Fig. 1 device taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 1 showing a portion of the container with a modified form of my invention applied thereto.

Referring to the drawings, I have shown this invention as applied to a container such as a pipe 10 having a circular cross section although it will be apparent that certain of the features of this invention are applicable to containers

2

having other sections. Furthermore, I have shown this invention as applied to the case where fluid is adapted to flow continuously through the pipe 10 and be treated with supersonic energy as it flows, although it will be obvious that the principles of the invention will in large part apply also to the case where fluid is stationary within the confines of the container.

As shown, fluid is flowing through pipe 10 and the problem consists in delivering the maximum amount of supersonic energy to all parts of the fluid during its flow through the pipe, and to deliver such energy in sufficient quantity to effect the desirable results outlined in the introduction hereto and which supersonic agitation thus far has only indicated as possible without fully achieving these end results.

For this purpose I mount on the surface of pipe 10 a plurality of electroacoustic transducers 11 having their inner surfaces ground to fit closely the surface of pipe 10 so that intimate contact between the inner vibrating surfaces of transducers 11 and the outer surface of pipe 10 can be achieved. The center of curvature of quartz crystals 11 is therefore the same center O as that of the pipe 10 and the energy delivered by such crystals will be concentrated substantially in the region of center O. The transducers 11 are preferably quartz crystals which may be oscillated in the usual manner from any suitable source of high frequency oscillations.

By the above arrangement it will be seen that the entire energy of the plurality of crystals positioned around the periphery of pipe 10 will be concentrated in the region of the central axis O of the pipe and the liquid in this region will receive the maximum concentrated supersonic energy. The violent agitation of the fluid in this region will set up turbulence so that continuously changing streams of fluid will flow inwardly from the outer region of the interior of the pipe toward the region of the central axis and thus substantially all of the liquid will be subject to the concentrated high intensity supersonic power.

In order to insure that all of the liquid will be subject to the intense power of the region of the central axis O, a plurality of concentric rings of crystals such as 11 and 11' may be provided longitudinally displaced along the pipe to increase the turbulence and thus insure the passage of all of the liquid through the region of concentrated supersonic power at one or more periods during its passage through the pipe. As many longitudinally displaced bands of crystals may be provided as are found necessary to effect the desired results.

The arrangements shown and described in connection with Figs. 1 and 2 will result in concentrating in the region of the central axis O

such power as the quartz crystals can transmit through the wall of pipe 10. To insure that the maximum amount of energy generated by the crystals passes through the wall of pipe 10, the following relationships should be established:

(1) The product of the density multiplied by the velocity of the supersonic vibrations in the material should be equal to that of the crystal.

(2) The wall of pipe 10 should be tuned to the frequency of vibration of the crystal, i. e., the wall should be ¼ of a wave length in thickness. By Formula 1, the maximum transfer of energy is obtained from the standpoint of the material of the container wall; by Formula 2, the maximum transfer of energy is obtained from the standpoint of the dimensions of the container.

In a modified form of the invention as shown in Fig. 3, the crystals 12 may be set into the wall of pipe 10 in place of the material of the wall. In this form of invention the precautions set forth in Formulas 1 and 2 above are unnecessary because the energy does not have to traverse the wall of pipe 10 but is transmitted directly to the liquid within the pipe.

Having described my invention what I claim and desire to secure by Letters Patent is:

1. An apparatus for the supersonic agitation of fluids in a container, comprising a plurality of electro-acoustic transducers positioned substantially in a plane and adapted to pass supersonic beams through the fluid, means for simultaneously energizing all of said transducers, the transducers being positioned to concentrate the beams substantially at a point within the container.

2. An apparatus for the supersonic agitation of fluids flowing in a pipe in the direction of the longitudinal axis thereof, comprising a plurality of electro-acoustic transducers positioned substantially in a plane and adapted to pass supersonic beams through the fluid, means for simultaneously energizing all of said transducers, the transducers being positioned to concentrate the beams substantially at a point in the longitudinal axis of the pipe.

3. An apparatus for the supersonic agitation of fluids flowing in a pipe in the direction of the longitudinal axis thereof, comprising a plurality of electro-acoustic transducers positioned substantially in a plurality of parallel planes displaced along the longitudinal axis of the pipe and adapted to pass supersonic beams through the fluid, means for simultaneously energizing all of said transducers, the transducers being positioned to concentrate the beams substantially in the longitudinal axis of the pipe.

4. An apparatus for the supersonic agitation of fluids flowing in a pipe in the direction of the longitudinal axis thereof, comprising a plurality of electro-acoustic transducers positioned substantially in a plurality of parallel planes displaced along the longitudinal axis of the pipe and adapted to pass supersonic beams through the fluid, the transducers in one plane being angularly displaced with respect to the transducers in the adjacent plane, means for simultaneously energizing all of said transducers, the transducers being positioned to concentrate the beams substantially in the longitudinal axis of the pipe.

5. An apparatus for the supersonic agitation of fluids in a container, comprising a plurality of electro-acoustic transducers positioned substantially in a plane and adapted to pass supersonic beams through the fluid, the transducers being positioned to concentrate the beams substantially at a point within the container, means for simultaneously energizing all of said transducers, the transducers extending through the wall of the container.

6. An apparatus for the supersonic agitation of fluids in a container, comprising a plurality of electro-acoustic transducers positioned substantially in a plane and adapted to pass supersonic beams through the fluid, the transducers being positioned to concentrate the beams substantially at a point within the container, means for simultaneously energizing all of said transducers, the transducers consisting of piezo-electric crystals in engagement with the outer surface of the container wall, each crystal and the container wall bearing the following relationship: the product of the density multiplied by the velocity of the supersonic vibrations in the wall equals that of the crystal.

7. An apparatus for the supersonic agitation of fluids in a container, comprising a plurality of electro-acoustic transducers positioned substantially in a plane and adapted to pass supersonic beams through the fluid, the transducers being positioned to concentrate the beam substantially at a point within the container, means for simultaneously energizing all of said transducers, the transducers consisting of piezo-electric crystals in engagement with the outer surface of the container wall, each crystal of the container wall bearing the following relationship: the wall of the container is of a thickness equal to one-quarter wave length of the vibrations generated by the crystal.

8. An apparatus for the supersonic agitation of fluids in a container, comprising a plurality of electro-acoustic transducers positioned substantially in a plane and adapted to pass supersonic beams through the fluid, the transducers being positioned to concentrate the beams substantially at a point within the container, means for simultaneously energizing all of said transducers, the transducers consisting of piezo-electric crystals in engagement with the outer surface of the container wall, each crystal and the container bearing the following relationships: the product of the density multiplied by the velocity of the supersonic vibrations in the wall equals that of the crystal, and the wall of the container is of a thickness equal to one-quarter wave length of the vibrations generated by the crystal.

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