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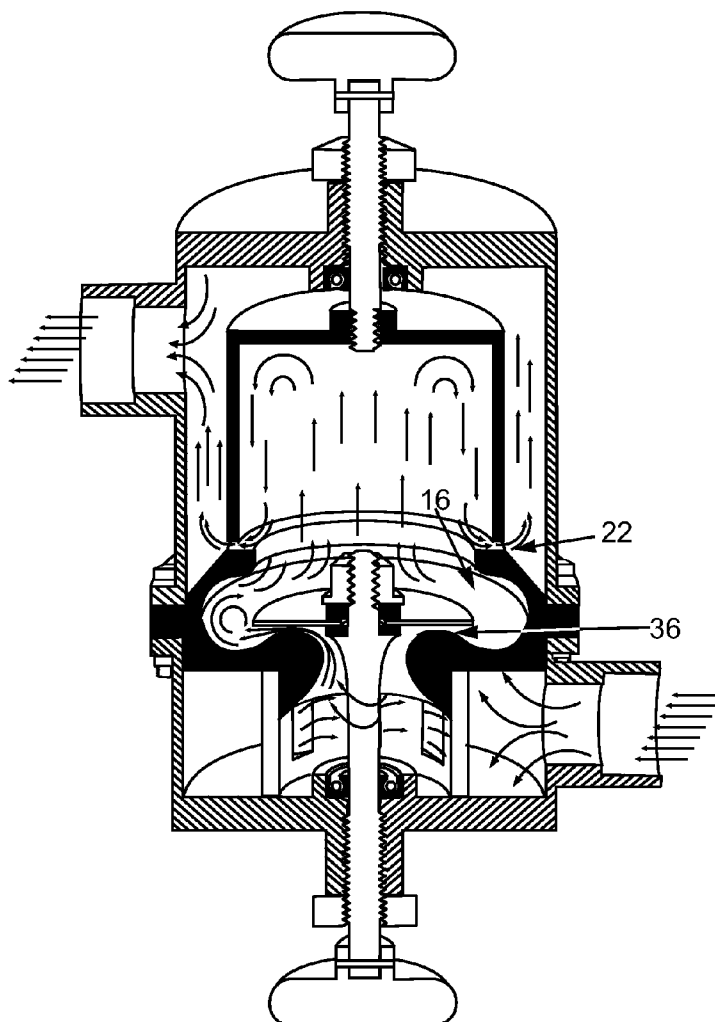
(19) **United States**(12) **Patent Application Publication**
ECHART(10) **Pub. No.: US 2016/0054031 A1**(43) **Pub. Date: Feb. 25, 2016**(54) **HYDRODYNAMIC AND HYDROSONIC
CAVITATION GENERATOR****Publication Classification**(71) Applicant: **Rubem Ioel Dotte ECHART**, Porto Alegre (BR)(51) **Int. Cl.**
F24J 3/00 (2006.01)(72) Inventor: **Rubem Ioel Dotte ECHART**, Porto Alegre (BR)(52) **U.S. Cl.**
CPC **F24J 3/003** (2013.01)(21) Appl. No.: **14/759,189**(57) **ABSTRACT**(22) PCT Filed: **Jan. 2, 2013**(86) PCT No.: **PCT/BR2013/000001**

§ 371 (c)(1),

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The present invention describes a method and apparatus to use the kinetic energy available in a liquid flow to produce hydrodynamic cavitation, which, in turn, drives the hydrosonic cavitation simultaneously with sufficient efficiency and capacity to transfer the entire energy of the flow to the liquid as heat and/or another cavitation effect, thus producing physical and chemicals reactions at the molecular and atomic level.



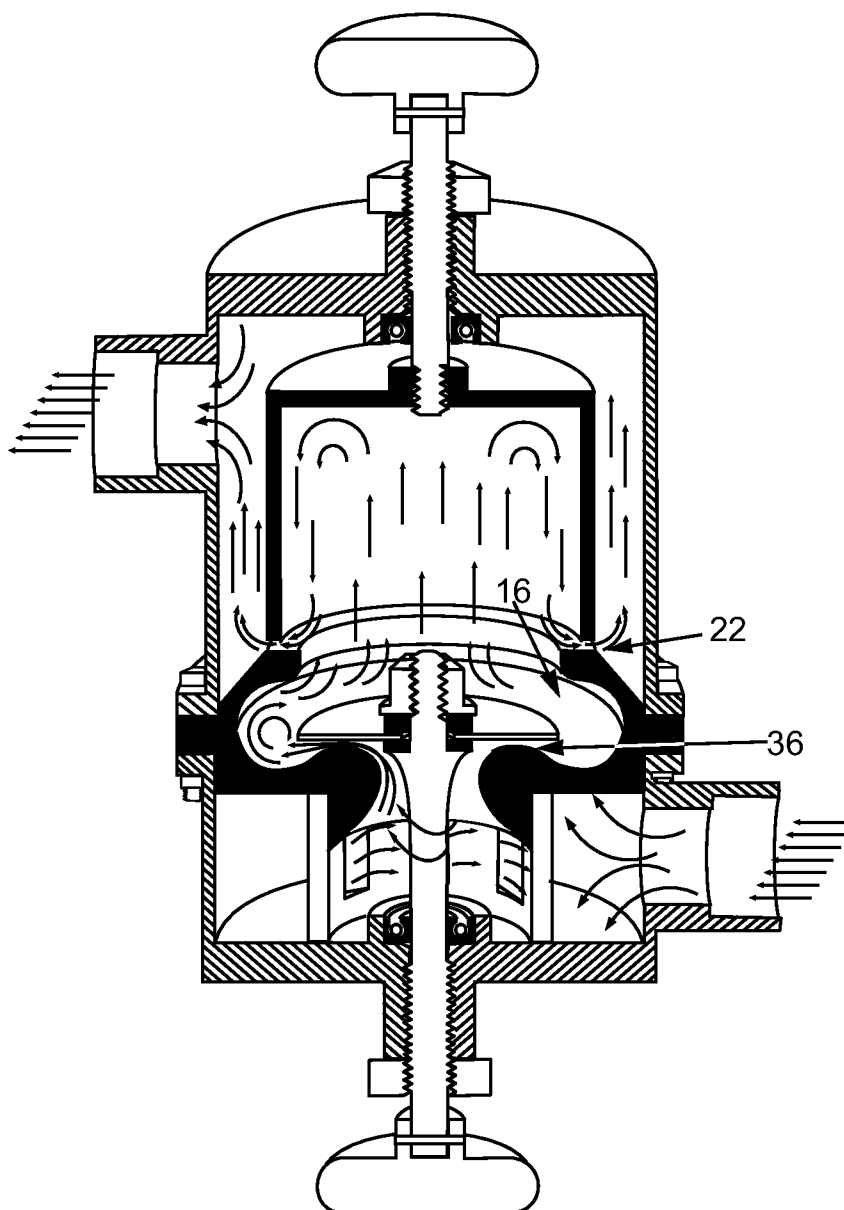


FIG. 1

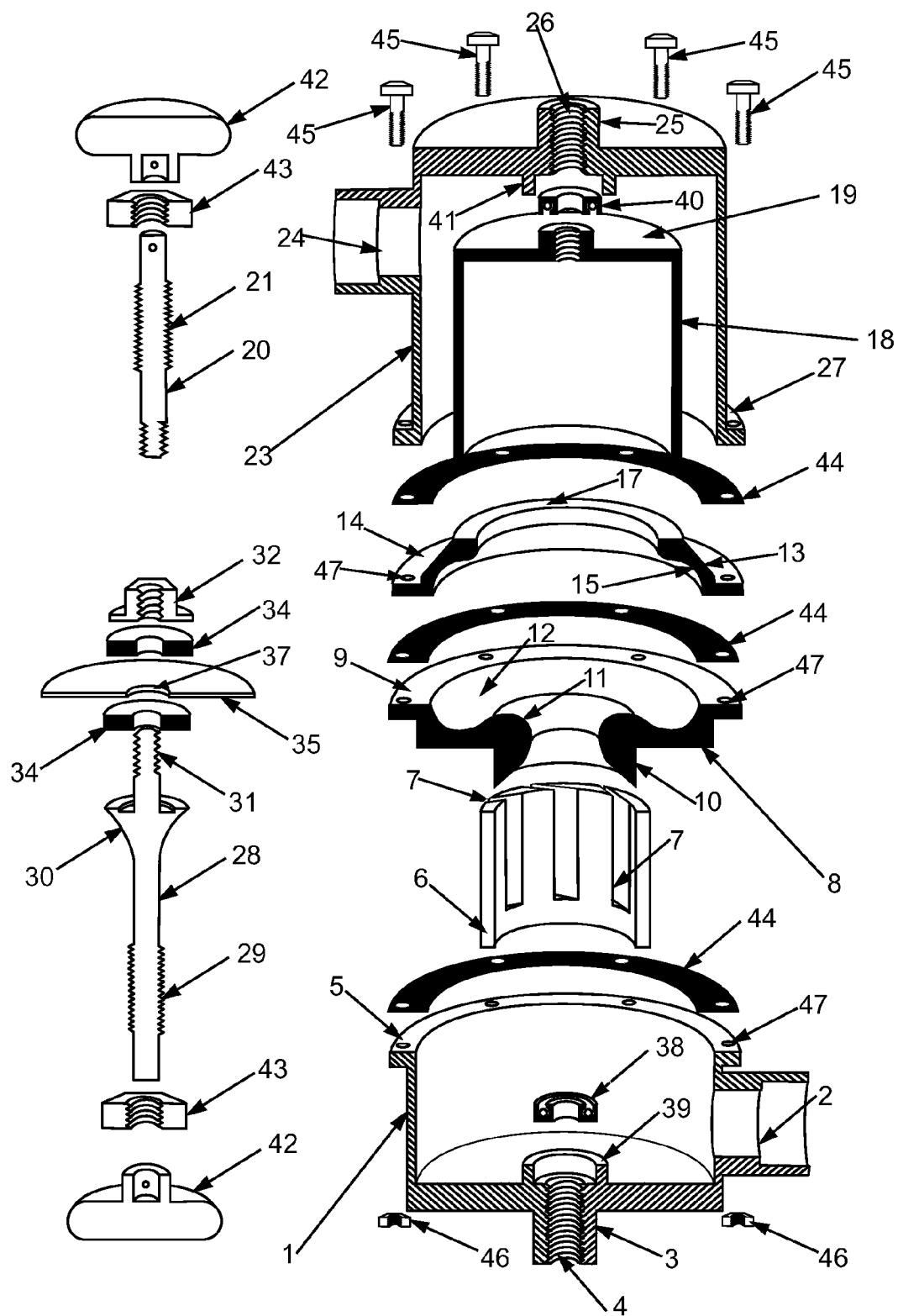


FIG. 2

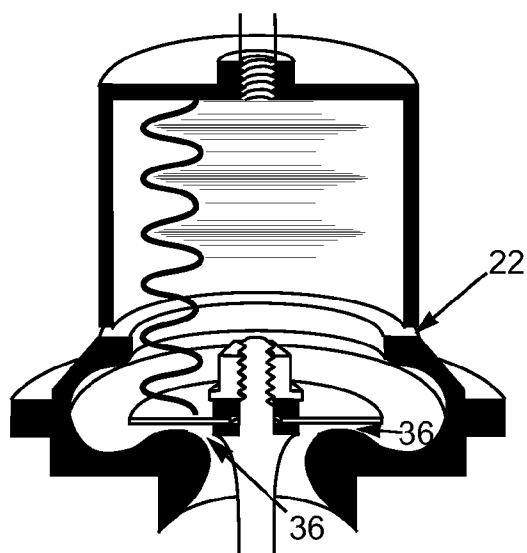


FIG. 3

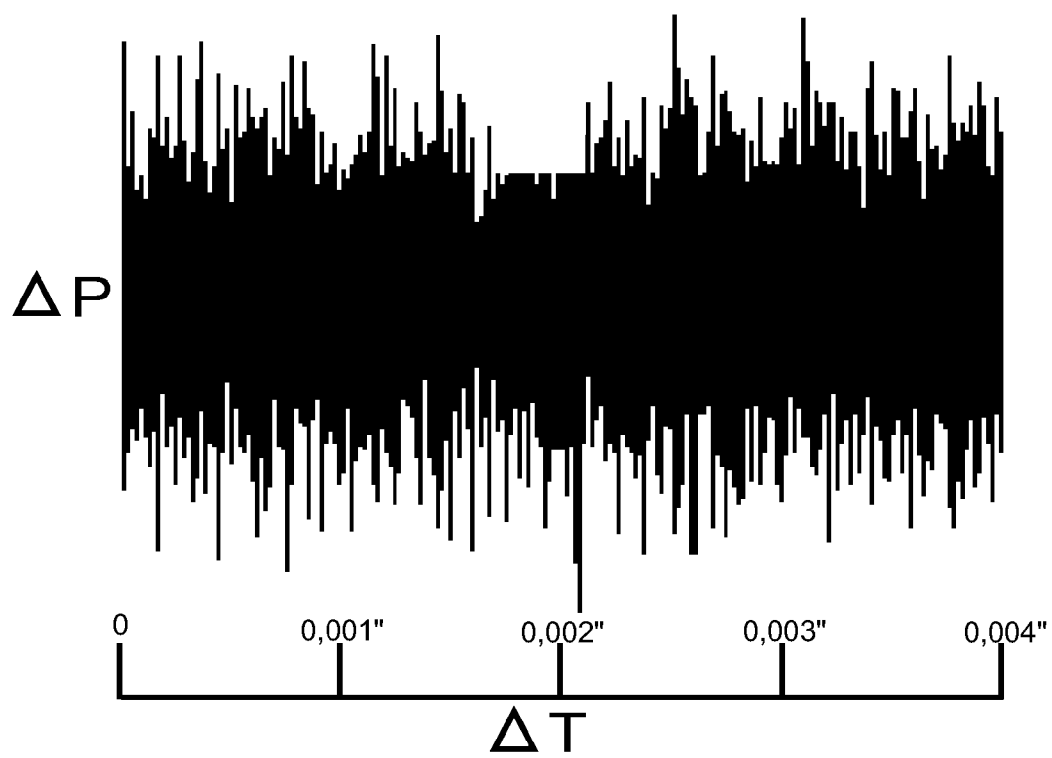
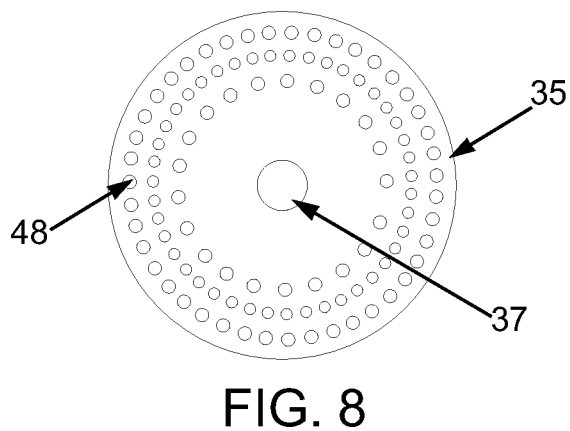
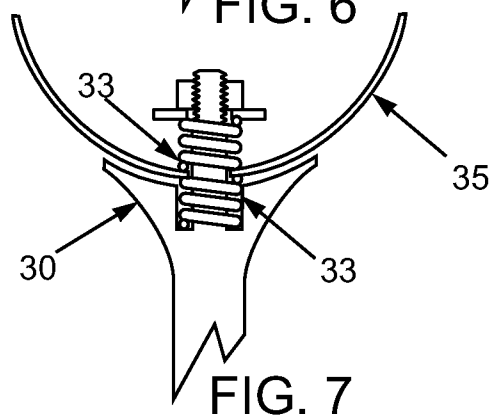
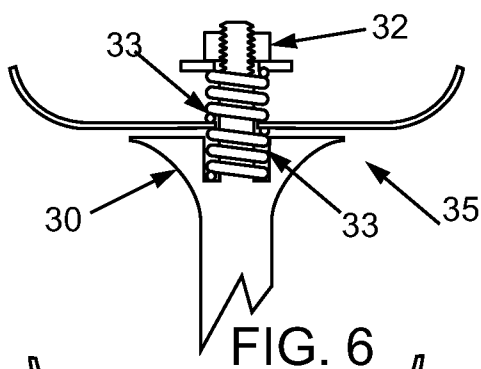
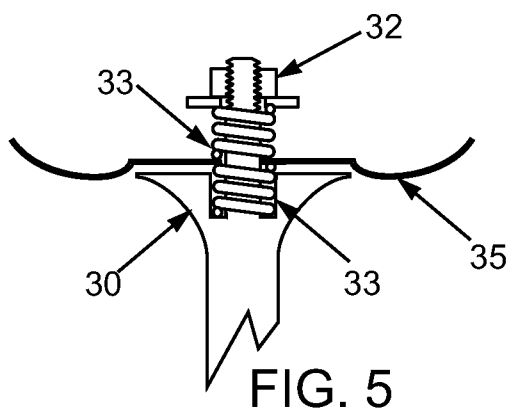


FIG. 4



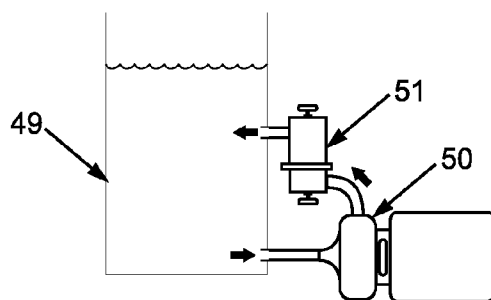


FIG. 9

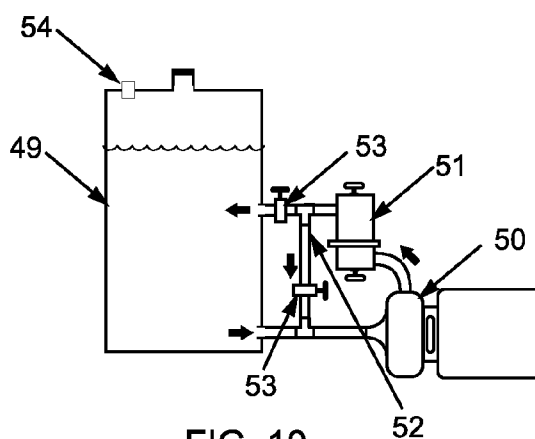


FIG. 10

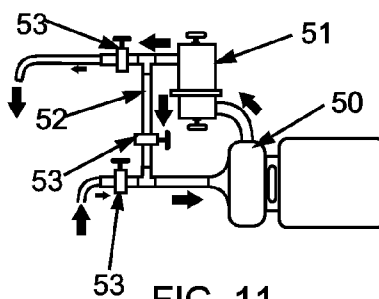


FIG. 11

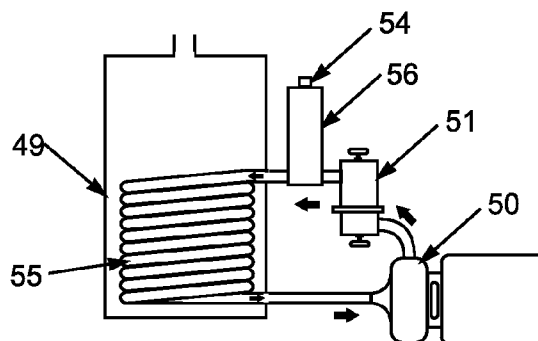


FIG. 12

HYDRODYNAMIC AND HYDROSONIC CAVITATION GENERATOR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to the formation and collapse of bubbles in hydrodynamic and hydrosonic cavitation phenomena so that the high pressures and temperatures are achieved in these bubbles collapse can be used for heating and/or to trigger and/or enhances physico-chemical transformations in liquid medium.

[0003] 2. Description of the Related Art

[0004] The phenomenon said cavitation that occurs in liquid medium is the formations, growth and collapse of gaseous and vapor bubbles due to the reduction of surrounding pressure below the vapor pressure of the liquid at working temperature. The most widely used techniques to do that are: the generation of sound or pressure waves in the liquid using a piezoelectric transducer, said hydrosonic cavitation, and by reducing the surrounding pressure by the acceleration of a liquid flow through a Venturi tube or a orifice plate, said hydrodynamic cavitation.

[0005] Hydrosonics method produces cavitation by generating sound or pressure waves in the liquid medium, so that vapor bubbles are created and growing during the low pressure phases of these waves and are collapsed in the high pressure cycle of the same; these waves can be driving by mechanical means or, mainly, by electrical pulses from a electronic circuit whose energy is transmitted to the static liquid contained in reservoirs through electromagnetic or piezoelectric transducers that can provide an energy transferring near to 85% of the employed sound energy; the efficiency is increased still more when it is running in resonant mode in a small volume reservoir and in ultrasonic frequencies so that the waves are reflected by the reservoir walls and can reach the entire volume of the liquid; each microbubble imploding emits a new shock wave, forming a chain of cavitation in a static liquid this way forming spherical microbubbles, which increases the strength of implosions. These configurations are widely used to objects cleaning, in the chemical and food industry and in the pharmaceutical and laboratory practice. Its efficiency decreases when applied to larger volumes or in moving fluids.

[0006] Hydrodynamic cavitation is the physical phenomenon produced in a liquid flow obtained by rapid acceleration of the liquid in a Venturi tube, sharp edges or narrow holes, so that, according to the Bernoulli principle, occurs a drastic pressure fall that reduces the same below the vapor pressure of the liquid medium, so that vapor microbubbles are created and shortly thereafter they implodes when the speed decreases and pressure rises in the Venturi tube output. The hydrodynamic cavitation yield is a little lower than obtained in hydrosonic cavitation because the fast moving fluid disperses randomly the reflection of pressure waves emitted by microbubbles implosions. Therefore, the advantages of hydrosonic cavitation disappear when used in dynamic flows where hydrodynamic cavitation offers most practical and efficient results. This method is used for treating relatively large volumes of liquid as in water treatment and heating, in some specific processes in the food and chemical industry, due its effectiveness and efficiency compared to other methods to do the same.

[0007] There are several patents describing both hydrosonic and hydrodynamic cavitation apparatus for vari-

ous purposes. Hydrosonic cavitation devices using piezoelectric transducers are limited to small static volumes of liquids; another hydrosonic apparatus of reasonable efficiency that can process larger volumes of liquid when powered by electric motor is disclosed in U.S. Pat. No. 5,188,090 as a cylindrical rotor with several peripheral holes which rotates within a concentric housing being supported by bearings and sealed by mechanical seals; It is difficult to build, expensive and needs a pump to force liquid to pass through said housing; both the vibration produced by shock waves as the uneven erosion of the rotor caused by cavitation causes premature damages and incapacitation of rotor, bearings and mechanical seals. Such are also the U.S. Pat. Nos. 5,957,122; 6,595,759; 7,089,886; 6,910,448; and 6,976,486, all with similar rotors endowed with cavities; there are still a device described in U.S. Pat. No. 7,767,159 where the rotor interacts with a concentric stator, both equipped with peripheral holes that is capable, when rotates, to cut and to allow the passage of pressurized fluid at high frequencies given by product of the holes number multiplied by the number of rotations, generating sound waves pulses upstream and downstream in liquid flow, which are, actually, sequences of low amplitude water hammers; this device has the same problems attributed to the U.S. Pat. No. 5,188,090. The Brazilian patent application titled "cavitation and shock waves generator", produces similar effect but at lower frequency and greater amplitude pulses and need only be driven by a pressurized liquid stream; it is mainly intended to micro-organisms mechanical destruction; Also well known are devices capable of generating hydrodynamic cavitation by forced passage of fluid through plates with small holes; they produces low yield and are susceptible to plugging and erosion by cavitation. There are even systems that use liquid vortices, whose central low pressure generates the microbubbles and the high periphery pressure causes they collapse, that we can see in Russian patent RU 2015715 and in the Brazilian patent application titled "Hydrodynamic Cavitation Generator Device". The Russian patent is a simple version of Hilsh-Rankine vortex tube on enlarged scale and, like this, has modest energy efficiency; the Brazilian application is restricted to liquids free of solid particles and need a filter to avoid clogging like most hydrodynamic cavitation generators; another example is the application publication US 20070189114 of fairly complex construction.

[0008] All forms of cavitation above referred aims heating liquids, especially water, or physical and chemical transformations as the homogenization, the emulsion, the gas dissolution, the degassing and the decanting of solid particles, the enhancement of catalysts and the acceleration of chemical reactions such as esterification and transesterification, particularly in biodiesel production processes; purification and sterilization of liquids, especially water, destroying micro-organisms such as microalgae, bacteria, viruses and fungi, both mechanically, through the impact of shock waves, which cause cell disruption and cavitation induced inside living cells, as by oxidation, provided by reactive radicals such as hydroxyl and hydrogen peroxide, which are produced during the cavitation processes. There are several claims that these devices release more heat than the corresponding energy they consume.

[0009] When referring to heating liquids generally we rely only on heating processes based on the fossil fuels, biofuels and on the electric heaters, all with proven energy conversion efficiency slightly above or below 90%. Also are widely known processes and devices for heating water and other

liquids that use solar or thermonuclear energy. There are still widely used devices that allows for some power saving capturing thermal energy contained in the atmosphere: the condensation heaters that burn gas or liquid fuel which typically obtained average yield of 114%, incorporating an average of 18% by vapor condensation contained in the atmospheric air, which are used, still now, only in colder latitudes;

[0010] Another well-known process, widely used in swimming pools are the “heat pumps”, which are, actually, heat exchanger devices with reverse cooling circuit (Carnot cycle), so that they can absorb the heat energy of the air transferring it to water or other liquid means; manufacturers claim a COP (coefficient of performance) about 250% or more in relation to consumed energy for these devices. The advantage disappear in that the air temperature decreases and/or temperature of the liquid increases, until achieving economically disadvantageous values; as thermal energy production generally exceed the consumed energy, the adopted reference unit is the COP—coefficient of performance—a ratio of total heat produced by consumed energy.

SUMMARY OF THE INVENTION

[0011] The present invention discloses a method and apparatus which can heat, directly or via a heat exchanger, water or others liquids and even the environment with a thermodynamic efficiency of COP (coefficient of performance) greater than 2, or more than 200% regarding the power supplied to the input device; furthermore it can perform the other actions assigned to the liquid cavitation phenomena and described above with the same efficiency, and, especially, not conditioned to environmental temperature and air relative humidity, being able to reach temperatures above 150° C. when working in closed and pressurized circuit to prevent the change to the vapor phase in the working fluid.

[0012] The present cavitation generator does not go against the energy conservation law: it only retrieves the kinetic energy of a liquid flow as friction heat and sum the amount of the well known energies produced in a cavitation process by dissociation and ionization of molecules of steam while microbubbles implosion inside the liquid volume; furthermore, it also incorporates the energy emitted by chemical micro reactions as the micro combustion that occurs at microbubbles implosion being triggered by pressures above 1000 BAR and temperatures greater than 5.000° K. This generator can be powered by any liquid flow sustaining a heat production proportional to pressure of working liquid. It can be pressurized by virtually any type of pump, moved by combustion or electric motors and, directly, by a wind device and even by manual operation, in special cases, such as for emergency water purifiers.

[0013] The present invention can also be used to prevent formation of mineral deposits and encrustations in pipes, water tanks, boilers and other hydraulic facilities; it can also be used efficiently to processing liquid foods, enzyme deactivation and protein harvesting. This invention obtains the results above mentioned, according to the testing of prototypes, due to its capacity to generate hydrosonic cavitation within a resonance chamber where a laminar flow moves slowly; powered only by a turbulent flow of hydrodynamic cavitation, so that triggering the generation of large amplitude waves, that produces pressure fluctuations in the laminar flow 4 times, approximately, more efficiently than those generated by piezoelectric transducers. This hydrodynamic cavitation generator produces high density microbubbles clouds due to

its ability to fractionate the liquid flow radially dispersing it in a very thin layer of high speed, whose thickness can be regulated externally, according to the pressure and flow characteristics, the density and the viscosity of the liquid. A thin disk limits the radial thickness of the venturi where the liquid is accelerated so that, when the liquid speed is increased, the pressure decreases (in accordance with the Bernoulli principle), and said thin disk is pushed backward forcibly by the greater pressure of the downstream flow; with decreasing of slot passage, the upstream pressure instantaneously increases and push said disk to its initial position; the disk is holding by elastic elements with a limited course, so that allows a vibratory movement can be established; the disk acceleration is proportional to pressure of flow and the disk area and, inversely proportional to the mass thereof. As the forces acting on the disk easily reach tens of kilograms-force to the small mass of the disk, the acceleration module is quite significant, establishing frequencies that will depend on the compression constant of the elastic elements, so that allows easily and precise adjusting. The vibratory motion of said disk defines a fluctuation of speed and pressure which the liquid flows through the gap so that produces also oscillations in pressure upstream and downstream of said disk, as pressure waves; simultaneously hydrodynamic cavitation is generated in the slot passage, where a smaller number of larger diameter microbubbles are produced at higher flow speed, and, a larger amount of microbubbles with smaller diameter is generated at lower speed thereof. The amplitude of disk movement can vary from a few thousandths of a millimeter to over 1 mm; its frequency depend on the density, the viscosity and the pressure of working liquid, the pressure imparted to the elastic elements and disk mass and can be adjusted from the audible range until hundreds of kHz. The vibrating motion of said disk allows the use of very narrow slots without causing clogging and without needing fine filters that induce energy waste by load loss, so that can produces a greater cloud of cavitation microbubbles without occurrence of “vena contracta”, common phenomenon that occurs in the “plate of orifices” cavitation devices; in addition, the amount of energy that would be dissipated as vibration and noise is harnessed as useful energy by conversion of vibration in a resonant pressure waves field within a cylindrical chamber, said resonance chamber, wherein a laminar flow of liquid moves slowly; these waves produce high pressure fluctuation, so that said resonating chamber behaves as a ultrasound system, where a cloud of quasi-spherical microbubbles is created at low-pressure phase and collapses at the high pressure peak of every wave; both the vibration frequency and the exposure time of liquid flow to pressure waves are externally adjustable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The following description associated to the appended drawings disclose, in a non-limited manner, the parts, the preferred embodiment and operation of the present invention.

[0015] FIG. 1 shows a cross-sectional assembling of this cavitation generator and, the path of liquid inside the apparatus by arrows means;

[0016] FIG. 2 shows an exploded view of a longitudinal section of the present cavitation generator.

[0017] FIG. 3 shows the arrangement and the course of pressure waves within said resonance chamber.

[0018] FIG. 4 is an actual graphic spectrum of pressure waves, as they are emitted by present cavitation generator and recorded by means of a pressure sensor.

[0019] FIGS. 5, 6, 7 and 8 show constructive variations of said diaphragm;

[0020] FIG. 9 illustrates the configuration of a hydraulic circuit that uses this cavitation generator associated to an open tank specially to use as water heater and purifier;

[0021] FIG. 10 shows a bypass mounted on the cavitation generator's hydraulic circuit for liquid heating control;

[0022] FIG. 11 shows a schematic drawing of the hydraulic circuit for passage's heating of liquids.

[0023] FIG. 12 shows a schematic drawing of the hydraulic circuit provided with a heat exchanger.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0024] The present cavitation generator comprises:

[0025] a chamber pot-shaped, preferably cylindrical, said high pressure chamber (1) which is endowed with said feeding tube (2) suitable for connecting the chamber (1) to a pipe; said high pressure chamber (1) is endowed, on its bottom, with a support (3) with a center hole provided with internal screw thread (4) both being coincident with the axis of the chamber (1), which has, at its open end or edge, a flange (5) or other fastening means for to attach it, firmly and sealing, at the whole remainder of the apparatus body; a cylindrical tube that is positioned within said high pressure chamber (1), said vortex tube (6), provided with side openings (7) whose axes are aligned tangentially to the tube (6) circumference;

[0026] one piece said annular divider (8) with discoid shape preferably and shaped flange edges (9), suitable for tightly seal connecting to the flange (5) of said high-pressure chamber (1); said annular divider (7) being provided with a central cylindrical tube-like protrusion at one side, with a circular opening in a convergent inner profile (10) suitable to connecting of a fluid-tight manner to said vortex tube (6), and on the opposite face, another semicircular cross-sectional bulge (11), positioned around of the circular opening (10), to compose a half portion of an radial and annular venturi tube, whose external edges cross-section forms a circular concentric recess (12).

[0027] one piece, said semi toroidal annular disc (13) with generally circular shape and flange edges (14), suitable to seal tightly connecting to the flange (9) of said annular divider (8) and having a concentric annular depression (15), so that, when attached to said annular divider (8) forms a cross-section toroidal cavity endowed, facing to the center, a circular opening (16); on the opposite face, there are a circular protrusion with rectangular cross-section (17);

[0028] a cylindrical pot-shaped chamber, said resonance chamber (18), with a closed end (19) that is attached to the extremity of said flow regulating rod (20), whose free internal end is endowed of a screw (21); the open edge of this resonance chamber (18) is concentrically positioned at a small distance from said circular protrusion of rectangular cross-section (17) of said semitoroidal annular disc (13), forming a circular slot (22) so that, be approached or spaced from said rectangular protrusion (17) decreases or increases the area of said circular slot (22);

[0029] a pot-shaped chamber, said collecting chamber (23), which is endowed of discharge tube (24) suitable for connecting the chamber to a hydraulic circuit pipe; said collecting chamber (23) is endowed of a support (25) having a bore with

internal thread (26) on the bottom center where work the external thread (21) of said flow regulation rod (20) that holds said resonance chamber (18) and may move it axially; at the open end edge of said collecting chamber (23) has a flange (27) or other fastening means designed to attach it seal and firmly to the flange (14) or other fastening means of said semi-toroidal annular disc (13).

[0030] a cylindrical rod able to be turned by a handling wheel (), said pressure regulating rod (28) provided with a screw portion (29) so that it can screwed into the nut () located in said central bore (4) located at the bottom of said high pressure chamber (1); the opposite end of said rod is endowed with a conical lug, said flow diffuser (30) whose flat base supports a screw (31) with a nut (32) or other means of fastening (33) that are able to support springs and/or other elastic means such as elastomer discs (34) between which said working diaphragm (35).

[0031] a thin disc, said diaphragm (35) having a diameter equal to or larger than the diameter of said semicircular cross section bulge (11), which is positioned concentrically and close to the latter, so as to form a circular narrow slot (36) with venturi-shaped cross-section; said diaphragm (35) is provided with a central hole (37) in which fits the screw of said flow divider (28) of said pressure regulating rod (28) and which is limited on both sides by springs (32), elastomer discs (33) or other elastic means, that are retained by a nut (32) that can adjust the pressure of these elastic means against the base of said flow divider (30), so that said diaphragm (35) may establish a resonant vibratory motion; said pressure regulating rod (28) can adjust, thus, the pressure of the entire assembly and, therefore, the vibration frequency of said diaphragm (35);

[0032] a liquid retainer (38) or other seal member positioned around said pressure regulating rod (28) fitted in a housing (39) on the bottom of said high pressure chamber (1) to preventing leakages;

[0033] a liquid retainer (40) or other sealing member positioned around said flow regulation rod (20) fitted in housing (41) on the bottom of said collecting chamber (23) to preventing leakages;

[0034] two manipulating wheels (42) or other manual facilitators means fixed on the outer edges of the pressure regulating rod (28) and of the flow regulation rod (20), (4;26) whose screw portions (21, 29) also receives nuts (43) to hold these rods in selected positions.

[0035] gaskets (44) are used to prevent leakage, which are interspersed between the flanges of said high pressure chamber (1), said annular divider (8), said semi toroidal disc (13) and said collecting chamber, which are strongly attached by sets of screws (45) and nuts (46) distributed in the holes (47) on the flanges which are coincident with each other.

[0036] Said diaphragm (35) is a thin disk so that its mass is reduced sufficiently to allow to achieves high frequencies, but at the same time it should withstand relatively significant deforming forces; to allowing ultrasonic frequencies operation, it must be built on sturdy and inox materials; FIGS. 5, 6 and 7 shows constructive variations that add resistance's shape and, at the same time, generates waveforms that increase the nodal intersections between the primary fronts and the reflected ones at the bottom of said resonance chamber; FIG. 8 shows a disc with several small holes (48), an artifice to be used to decrease the mass of said diaphragms and, at the same time, to produce additional cavitation.

[0037] The operation of present hydrodynamic and hyper-sonic cavitation generator starts when water or other working liquid is introduced into said high pressure chamber, where it is immediately directed to the interior of said vortex tube through the lateral openings tangentially directed, undergoing angular acceleration and assuming spiral movement around the said pressure regulating rod; on reaching said flow diffuser the liquid is directed radially outward, passing through the venturi like narrow slot, where it undergoes strong acceleration and and thus, a drastically reducing of pressure; this high depression produces a lot of vapor bubbles and causes said diaphragm to be pushed against the bulge of said annular divider, abruptly decreasing flow passage area of said slot, but without closing it completely due to an instantaneous pressure increasing at upstream; the flow speed and the depression further rises due to upstream pressure growth, but, the increasing pressure exceeds all the others owing to inertial force like a partial water-hammer, until a reversing point when said diaphragm is violently pushed in opposite direction; as said diaphragm is restrained on both sides by elastic members, a resonant oscillatory motion is established in accordance with: $f = (P \cdot A \cdot t) / (I \cdot m)$, where f is the frequency, P , the flow pressure, A , the area of the diaphragm, t the time, I , the diaphragm free course and m , the mass thereof;

[0038] The vibratory movement is transmitted to the volume of liquid, downstream of said diaphragm, in waves form with the net power defined by: $I = (P \times Q) / (A \times k)$, where I is the power in W/cm^2 , P is the pressure in kgf/cm^2 , Q the rate of the flow in liters per minute, A is the diaphragm area and k , the constant ($=0.6$); on this basis it easily reaches ultrasonic frequencies.

the liquid oscillating pressure in the flow passage at the narrowest point of the annular venturi is always lower than the point of vapor of the liquid, due the fluctuation of speed, which produces a dense cloud of diverse sized cavitation microbubbles; as the flow is driven radially within the narrow opening of the venturi, its velocity falls exponentially and, the opposite, occurs with the pressure, which causes the collapse of microbubbles in a very short time; said toroidal cavity around the circular slot edges creates an internal toroidal vortex, whose peripheral centrifugal pressure collapses all microbubbles and creates a protective barrier which prevents erosion of the chamber inner walls; from there, the flow is directed into said resonance chamber (1), whose diameter is substantially greater than the inlet pipe, forcing the fluid to moves in slowly in a laminar flow, so that it remains overtime exposed to pressure wave column generated by said diaphragm liquid speed within said resonance chamber produces a Doppler effect on the pressure waves field so that, even in a resonant mode, the waves that move away from said diaphragm have a longer length than the reflected ones, mainly in relation to the moving liquid volume, this way producing also a great variety of microbubbles sizes; the liquid path leads it into said collecting chamber, where the liquid absorbs the sound and vibrations produced by said resonance chamber walls and then, is forced out through said outlet tube. The microbubbles generated by waves means, both infrasound as ultrasound, are generally spherical and implode with the energy: $E = 4/3 \cdot \pi \cdot R^3 \cdot P$ where R is the radius of the microbubbles and P , the peak pressure of the pressure waves.

[0039] For water heating in vessels (FIG. 9) as swimming pools and spas and even domestic boilers (49), which operate at lower than 50° C. temperature, the liquid is drawn from the tank (49) by pump (50), injected directly into the present

generator (51) and returned to the tank (49); this configuration can also be adopted for sterilization of liquids, acceleration of chemical reactions, emulsification, biodiesel production and others processes that needs the effects of intense cavitation. For said passage heating usage, it is necessary a “bypass” (52) system and control valves (53) to regulating the amount of liquid that must be reprocessed and that one which is can released at a desired temperature according to the power of the installed pump (FIG. 10); the present generator also can produces heat for boilers, in addition to water’s point of vapor at ambient pressure, since the liquid phase is maintained by a pressurized system, which, as shown in FIG. 11, need a safety valve (54). For heating other liquids as foods, chemicals or, for environmental heating, a heat exchanger (55) must be associated with as shown in FIG. 12; this circuit must have a gas bleeder (56) endowed with a safety valve (54), necessarily.

1. A hydrodynamic and hydrosonic cavitation generator characterized by being able to utilizes the energy available in a fluid flowing through a pipe to generate hydrodynamic cavitation and hydrosonic cavitation simultaneously.

2. A hydrodynamic and hydrosonic cavitation generator characterized by being able to transform kinetic and/or potential energy of a liquid flow into heat energy by transferring this heat to the liquid in equal proportion and amount of the mechanical energy of the fluid, expressed by the product of the flow rate by the pressure thereof increased by the thermal energy released by the physico-chemical transformations caused by cavitation effects, in this way, the total amount of resulting heat energy exceeds the amount of mechanical energy provided by that the liquid flow.

3. A hydrodynamic and hydrosonic cavitation generator as referred in the previous claims, wherein the hydrodynamic cavitation is produced by forcing a liquid flow radially, from the center outwards through a radial Venturi tube shaped slot in which one of the halves is a thin disk, said diaphragm, so that, when the liquid pressure falls due to its acceleration, the diaphragm is pulled inside, closing the slot partially, which causes an immediately increasing of upstream pressure that drives said diaphragm outwards, establishing, this way, a vibratory motion and generating pressure waves in the downstream liquid volume.

4. A hydrodynamic and hydrosonic cavitation generator as referred in the previous claims wherein said diaphragm can be shaped, but not limited, as a thin disc with curved edges forming a semitoroidal cross-section.

5. A hydrodynamic and hydrosonic cavitation generator as referred in the previous claims wherein said diaphragm can be shaped, but not limited, as a thin disc with curved edges forming a semicircular cross-section.

6. A hydrodynamic and hydrosonic cavitation generator as referred in the previous claims wherein said diaphragm can be shaped, but not limited, as a thin disk with semi spherical cross-section profile.

7. A hydrodynamic and hydrosonic cavitation generator as referred in the previous claims wherein said diaphragm can be shaped, but not limited, as a thin disk with multiple small holes.

8. A hydrodynamic and hydrosonic cavitation generator as referred in claim 3 wherein a rod said pressure regulator is disposed in concentric position and normal to the plane of said annular semi toroidal disk member, which supports at one end said springs or elastic elements that support said diaphragm, being able to move longitudinally thereby caus-

ing increase or decrease of the gap of said slot and the pressure of said diaphragm over the bulge of said annular divider.

9. A hydrodynamic and hydrosonic cavitation generator as referred in claim 3 wherein a cup shaped chamber, said resonating chamber is mounted with the open end focused to said diaphragm whose bottom serves as means for reflecting pressure waves generated by this diaphragm and whose the open edges form a circular slot between said resonating chamber and a member said rectangular cross-section bulge which is part of an another one said semi toroidal annular cavity disk which surrounds said diaphragm.

10. A hydrodynamic and hydrosonic cavitation generator as referred in claims 5 and 6 wherein said resonance chamber can be moved longitudinally to regulate the opening of said circular slot.

11. A hydrodynamic and hydrosonic cavitation generator as referred in previous claims wherein a cylindrical member, said collector chamber, provided with means for draining the working fluid, that surrounds said resonating chamber to maintain, around this, a volume of liquid intended to absorb the sound waves emanating from the walls of said resonating chamber.

12. A hydrodynamic and hydrosonic cavitation generator as referred in the previous claims wherein the adjustment of the working pressure allow control the variation of the frequency of the pressure waves produced in the liquid medium passing through its interior, from infrasound to ultrasound frequency, so that these pressure waves can produces hydrosonic cavitation.

13. A hydrodynamic and hydrosonic cavitation generator as referred by the previous claims, characterized to enable to be driven by a flow of pressurized fluid powered by any energy source such as pumps driven by any type of motor, gravity force, direct wind or hydro turbines power or even, for animals or manpower.

14. A hydrodynamic and hydrosonic cavitation generator as referred in the preceding claims wherein the cavitation occurs with sufficient intensity to trigger exothermic chemical reactions between, at least one fuel and, at least one oxidant, dissolved in the working liquid flow due to the rapid

partially vaporizing of reagents at the time of micro bubbles growth and its ignition when they collapse due to the high pressures and temperatures achieved, being the thermal energy generated and the resulting byproducts transmitted into the liquid.

15. A hydrodynamic and hydrosonic cavitation generator as referred in the preceding claims, wherein the destructive action of the cavitation is prevented by isolating the inner walls by means of a vortex barrier that is generated within said toroidal cavity formed by the union of said annular divider with said semi toroidal annular disc.

16. A hydrodynamic and hydrosonic cavitation generator as referred in claims 1 and 2, that is able to perform the mixing, homogenization and emulsification of one or more liquids of different or equal physical and chemical characteristics and the dissolution of gas in a liquid as well as liquids degassing.

17. A hydrodynamic and hydrosonic cavitation generator as referred in claims 1 and 2 which is able to destroy microorganisms as microalgae, bacteria, fungi and viruses in water through the mechanical disruption of their cell membranes and due to the oxidation caused by radicals reactants produced by cavitation.

18. A hydrodynamic and hydrosonic cavitation generator as referred in the preceding claims, that is able to break the hydrogen bonds between the water molecules, separate and fragment clusters of water molecules and recombine them, dissociate water molecules and recombine its elements as radicals such as hydroxyl and hydrogen peroxide.

19. A hydrodynamic and hydrosonic cavitation generator as referred in the preceding claims characterized by allowing to be manufactured with any type or metal alloys and/or even in plastics material also by molding injection, 3D printing or similar process and/or machining process.

20. A hydrodynamic and Hydrosonic Cavitation Generator as referred in the preceding claims wherein is allowed to be dimensioned and scaled it in a wide range of sizes, liquid processing capacity and heating power.

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