UNIDENTIFIED SUBMERGED OBJECT.

(ANOMALOUS PHENOMENA IN THE OCEAN.)

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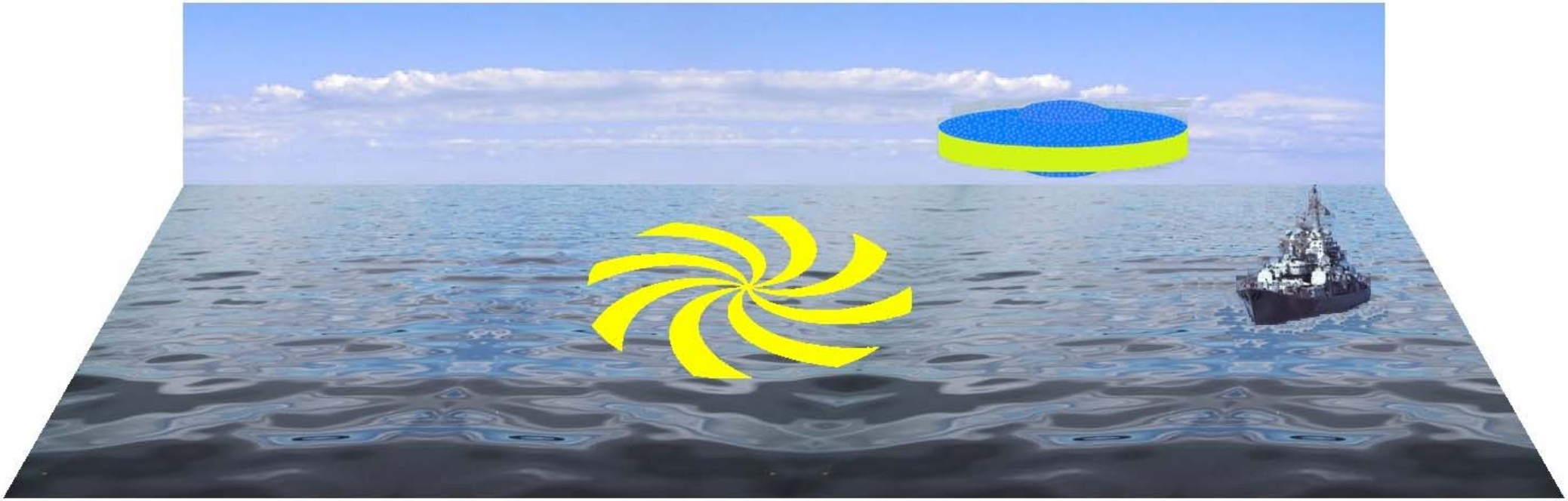


INTRODUCTION.

Since time immemorial known anomalous phenomena (**AP**) in the waters of the ocean that remain unexplained even today {**1, 2, 3**}.
At log-book of ship recorded cases meeting of ships with anomalous phenomena in the ocean, such as:
pop-up (and / or hang-up over the water) glowing balls;
moving light spots, circles and luminous rotating "wheels";
beating from the depth and moving in the water "searchlights" and "pillars of light";
objects of unknown origin, which flying out of the water and which plunging into the water;
unidentified underwater objects (**UUO**), moving at speeds far exceeding the rate of the most advanced submarines;
underwater objects, having a short time on sinking (on the depth not available for submarines) and having a short time on emergence to the surface;
UUO, which are creating mechanical effect on equipment and marine vessels on the ocean surface and in its depths;
massive underwater objects of unknown origin, remotely affecting the operation of equipment;"
acoustic and radio eradiation of unknown origin, which are coming from the depths of the ocean;
unidentified flying objects (**UFO**), which appear in the areas of concentration of naval forces {**4, 5, 6**}.
Abnormal phenomena in the sea is unpredictable.
Abnormal phenomena in the form of unidentified submerged objects (**USO**) relatively are elusive and are invulnerable, even with using against them all arsenals anti-submarine warfare.
The naval forces of several countries were carrying out to search for and prosecute unidentified underwater objects.
But these objects successfully evaded from actions anti-submarine forces and, apparently, remained intact in the application the anti-submarine weapons against them.

January-February 1960. In the gulf **Nuevo** (depth less than **174** m) the Argentine navy ships bombed, found on the thirty-meter depth unidentified underwater object (**USO**), which, from the readings of instruments, has been classified as a "**submarine**".

At the same time was caused by a group of anti-submarine ships and planes, that attacked on an unidentified underwater object using homing torpedoes and depth charges, and at the same time was established the minefields, using which outlets from bay were closed down.

From the side ocean, front of the line minefields, took up positions nine anti-submarine ships and one aircraft carrier (**Fig. 1**).

Fig. 1. Nuevo gulf, Argentina, 1960.
Naval ships, aircraft and minefields against an unidentified underwater object (USO).

After many days (**24** days) of intensive bombing, an unidentified underwater object floated to the surface.
Naval ships shot at him artillery fire.
Under artillery fire, an unidentified underwater object had gone into the depth of water and disappeared from view of all Argentine instruments of surveillance {**7, 8**}.

11 - 27 November, 1972. Norwegian ships discovered in **Sognefjord** (length - **205** km., maximum depth of **1308** meters) an unidentified underwater object (**USO**).
In conjunction with the ships of **NATO**'s Atlantic Fleet the Norwegians pursued and attacked an unidentified underwater object by depth charges, and was taken steps to block object in the fjord.
During the pursuit of the object, electronic equipment on Norwegian ships was broken.
All actions, to capture or destroy the object, were without the results.
Unidentified underwater object disappeared from the fjord {**9, 10, 11, 12**}.

A large number of observations of unidentified underwater objects has revealed that the velocity and the depth of objects significantly outperformed such for the most advanced undersea vessels of man:
1964. The Atlantic Ocean. "**Bermuda Triangle**". The **U.S. Navy** conducted a regular naval exercises anti-submarine forces . Area of naval exercises is controlled by the **AUTEC** ("**US Navy's Atlantic Undersea Test and Evaluation Center**"), which have systems of remote underwater tracking with acoustic beacons on the Bahamas and near island of Andros.

In the maneuvers participated military ships and **SRV** (scientific research vessels). Suddenly, by sonar was detected at depth unusual underwater ship. A large number of apparatus gave an accurate picture: the powerful pulsations came from a depth of **8100** m, the speed of the object was **120** knots (**220** km / h).
About the location of high-speed object on depth, which for submarines unreachable, had the confirmation from two anti-submarine groups, separated by hundreds of miles.
Tracking an object continued a few days. ... {**4**}.

Fig. 2. One of photographs of UFOs, who flew out of the water in the area of island South George, 1979. {**4**}

Furthermore, unidentified underwater objects moves freely from the water into the air and vice versa.

1979. At South Atlantic. Region near island South Georgia.
Witnesseth intelligence chief of Flotilla the Northern Fleet (**USSR**), captain first rank **Berezhnoj V.E**: In secret service were reports about sightings of **UFO** , about different orbs, about glowing objects, which moving over the sea and over the ships, and which dramatically are changing the direction of movement, instantly appear and disappear instantly. And it was happening over ships at sea and over the sea surface and over onshore facilities.
So, in **1979** near the island of South George, fishermen for a long time have seen object, that took off from underwater and hovered at an altitude of several hundred meters. The object was photographed (**Fig. 2**). Despite the wind, the object did not change its location and a few hours was hanging at the same place.
And after immediately disappeared. {**4**}.

From ancient times, sailors, who had visited the tropical seas of **Southeast Asia**, are reported of the giant glowing wheels ("**Lightwheels**"), rotating into the sea with a large (**10** to **100** rev / min) speed:
July 16, 1864, South China Sea, Gulf of Siam, a watcher, with the clipper "**Vestnik**", **Timofeev** night, at the entrance to the gulf, the saw ahead on the horizon two bright, pulsing light spots.
Timofeev sent a ship between the light spots.
This were glowing and rotating in opposite directions the wheels in the form of curved rays of twelve-meter thick, which on half were coming out of the water.
Rotation speed-about **10** revolutions per minute.
The wheels have been without a rim and have been diameter of **460** meters.
When they were behind the stern, in front and the left was seen one more glowing, rotating wheel, but only smaller diameter.
The total observation time of about **20** minutes {**4**}.

Figured glow in the form of giant luminous, rotating wheels (without rim) occurs at the surface ("**Marine Lightwheels**"), under the water surface ("**Submarine Lightwheels**") and above the surface of water.
European sailors called Figured glow on the sea - "**the devil's carousel**".
In the East, Figured glow on the sea, called - " **the wheels of the Buddha**".
About of Figured glow on the sea **I. T. Sanderson** writes that the so-called "**wheels**" of fire at reality does not the wheels, better they have been would named "**the sun with rays**" {**13**} .

Analysing of the reports about the glowing wheels on the sea, **Corliss** notes that the spokes of the wheels may be straight or curved, or the spokes of the wheels may be in «**S**»-shaped .
The direction of rotation of spokes around the axis of the wheel can be either against or in a clockwise direction. In the same wheel the direction of rotation of the spokes can be changed to the opposite.
In some cases, direction of rotation of the spokes in the outer part of the wheel oppositely to the direction of rotation of the spokes in the inside part of the wheel.

Sometimes observers, while looking at the glowing wheel in the sea, differ in assessing the direction of rotation of the spokes of the wheel {**1, 14**}.
Spokes of the wheels may have a length of several meters to several kilometers and a width of meter to several tens of meters.
The nature of the Figured glow in the sea, in the form of a giant rotating, glowing wheel (no rim), is still unsolved.

No info about, that the Figured glow of the sea managed to reproduce in the laboratory.
On the nature of the glowing wheel of the sea there are various hypotheses, which assume that the Figured glow on the sea is caused by activities of tiny marine organisms {**15-30**}.

But none of these hypotheses have failed the test by the facts.
For example, some time was a popular hypothesis german oceanographer **K. Kalle** {**19, 31**}.
K. Kalle analyzed the message in the logs of ships about the Figured glow on the sea at during passage of ships at **Aden** and the **Persian** bays, at the gulf of **Martaban** (Moutama), at **Malacca strait**, at the gulfs near of **Thailand**.
K. Kalle suggested, that the Figured glow of the sea creates bioluminescence of tiny marine organisms.
K. Kalle thinks that tiny marine organisms start glow when appears the motions in the aquatic environment caused by superpositions of two waves (incident and reflected).
Incident and reflected waves are produced, according to **K. Kalle**, in shallow sea areas during shifts and shifting of soil layer on seas bottom {**32**}.
Accordingly the hypothesis **K. Kalle**, it follows that for every glowing wheel in the sea should be in the sea second glowing wheel, symmetrically located with respect to first wheel, that is, second wheel is a mirror image of the first wheel (mirrored twin) {**32**}.
Hypothesis of **K. Kalle** powerless to explain the existence in a sea of single the wheels (without mirrored twin).
Unable to explain a hypothesis of **K. Kalle** the rotation wheel (spokes) and a gradual distortion (from straight to curvilinear) radial spokes contours , which initially have been the straight.

Moreover, at water samples , that were taken by researchers of the vessel "**Vladimir Vorobiev**," after as researchers were seeing "**the devil's carousel**", was showed the absence of the luminous microorganisms:

October 12, 1969. **Bengal gulf**.
The crew of the research vessel "**Vladimir Vorobiev**" with 23.30 for a half hour watching the unusual light phenomenon: around the ship counterclockwise is rotating bright white spot with a diameter of **300-400** meters.
Soon the "**spot**" was divided into eight rotating curved rays, resembling turbine blades.
By Fathometer were recorded of a value depth of around **170** m at the location of vessel "**Vladimir Vorobiev**" and the presence some object at a depth of **20** meters.
After a while the glow faded, the diameter "**wheel**" reduced to **80-100** meters, and shortly phenomenon has ceased.
During investigation of water for the presence of glowing plankton was not found the presence of glowing plankton.
The investigation revealed that immediately prior to the advent of the glow on the ship out of order electric generator of the trawl's winch, and, with the advent of the light rays, sailors awoke to a sense of fear.
During the manifestation of the phenomenon of crew members felt the pressure on the eardrum and ear of they, according to the head of the expedition of **Edward Petrenko**, "**were close to panic**" {**4**}.

Anomalous phenomena in the sea is so unusual that there the belief that modern physics is unable to explain these phenomena {**4**}.

THE GAS MICROBUBBLES.

The water in the seas and inland waters microscopically unhomogeneous and always contain micro-inclusions in the form of gas-filled microbubbles (**Fig. 3**).
The aqueous medium surrounds the gas-filled microbubbles (the gas microbubbles).
Accumulations of the gas microbubbles creates in the seas and inland waters of the peculiar stably existing field of microbubbles.
The seismic shift of the bottom of the reservoir, fluctuations in atmospheric pressure over the surface of water and other natural and manmade phenomenas are cause fluctuations in the aquatic environment.
Fluctuations in the aquatic environment are acted on the gas microbubbles.
Wave's action of the aquatic environment creates a different movement of the gas microbubble, in which the gas microbubble :
may pulsate linearly with respect to its equilibrium radius ($\mathbf{r_0}$);
can fluctuate non-linearly;
can increase up to a maximum radius and shrink until collapse;
can oscillate relative to the initial position and / or translationally move relative to the aquatic environment (translational effect);
can deformed and can be split up ;
can interact with other gas microbubbles are forming with them stable mobile clusters from a multitude of gas microbubbles.
Aquatic environment, which oscillating with frequency ω, is creating a wave's influence on the gas microbubble, forcing the gas microbubble pulsate relative to the equilibrium radius ($\mathbf{r_0}$) with the forced frequency of pulsation ω.

The resonant frequency of the pulsations of the gas microbubble ω_r {**33**} it is fundemental characteristic of a gas microbubble, what is pulsated with a frequency ω in an aqueous environment relatively to its equilibrium radius ($\mathbf{r_0}$).

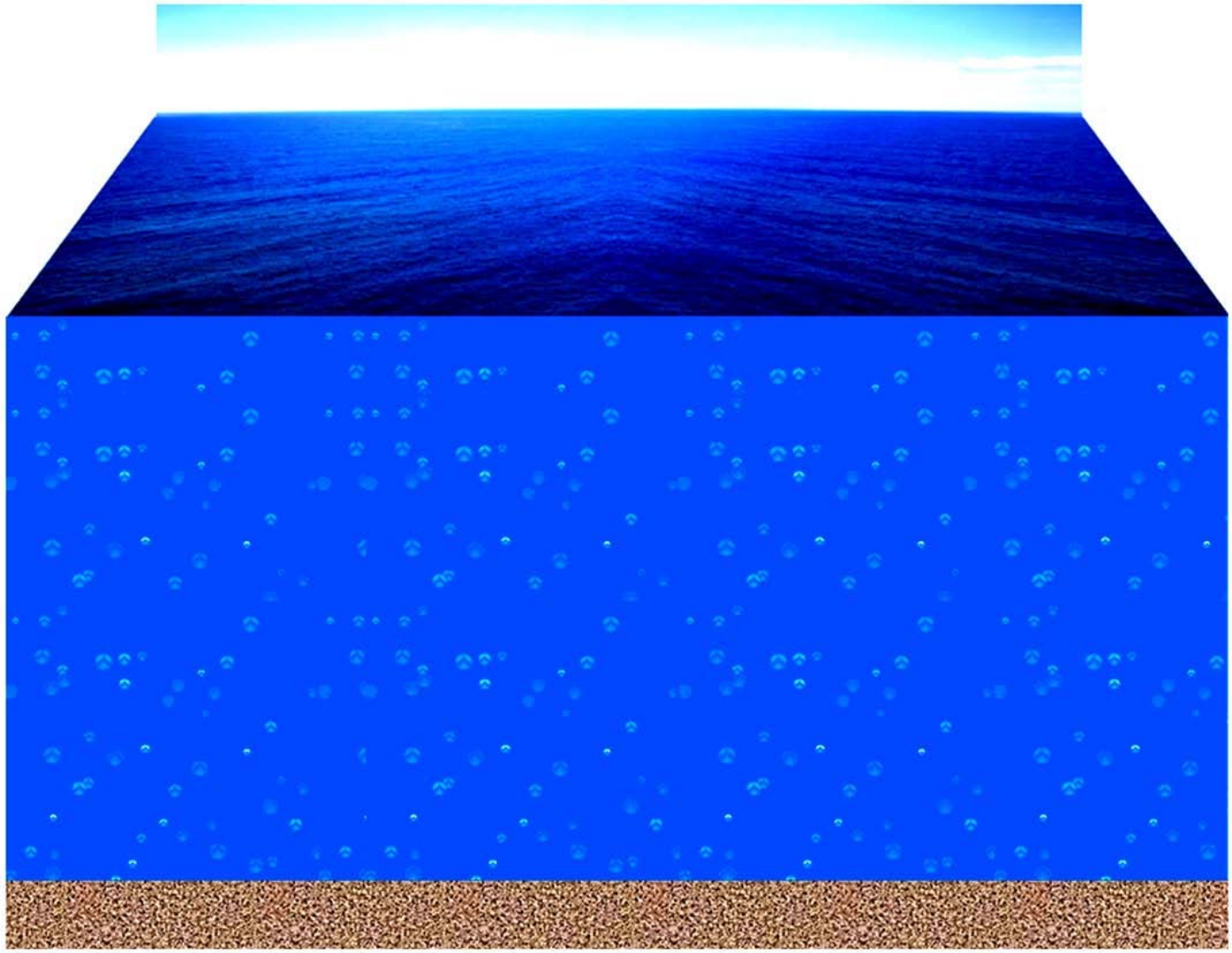


Fig. 3. Vertical section of water environment the sea, which contains of the gas microbubbles.

In the event beginning pulsations of a gas microbubble with a resonance frequency ω_r (resonance of the bubble) the amplitude of the pulsationsof the gas microbubble increases till a maximum value.
Of ambient water environment, into the cavity of a gas microbubble, which pulsate with the forced frequency of pulsation ω, diffuses (one-sided diffusion) gas dissolved in water {**34, 35**}.
One-way diffusion of gas into the cavity the gas microbubble , which are pulsated in an aqueous environment, increases the equilibrium radius of the microbubble {**34**} and, in accordance with the formula **M.Minnaert** {**33, 35, 36**}, reduces the magnitude of the resonant frequency of the pulsations ω_r microbubble.
Gas bubbles, pulsing with the forced frequency $\omega < \omega_r$, is called "**till resonance**".
Gas bubbles, pulsing with the forced frequency $\omega > \omega_r$, is called "**after resonance**".
One-way diffusion of gas into the cavity of a "**till resonance**" gas microbubble ($\omega_r>\omega$), which is pulsating with the frequency of forced oscillations ω, increases the equilibrium radius of the microbubble.
In the "**till resonance**"gas microbubbles ($\omega_r>\omega$) increase the equilibrium radius is accompanied by a decrease in the resonant frequency of pulsation ω_r, characterizing microbubble.

With increasing amplitude of the wave's actions the aquatic environment on the "**till resonance**" gas microbubbles ($\omega_r>\omega$) are increased the rate of growth of the equilibrium's radius ($\mathbf{r_0}$) and the rate of decrease of the resonance frequency of pulsations ω_r of the gas microbubble.
The decrease of the resonance frequency ω_r of the "**till resonance**" gas microbubbles continues up to a coincidence value of the resonance frequency with the value of frequency forced oscillation ω.
Increase up to the maximum amplitude of the pulsations gas microbubble, which occurs when is coincidence value ω_r of the resonance frequency with the value of frequency forced oscillation ω, provoke collapsing of gas microbubble.
During collapsing of gas microbubble, radius such gas microbubble, rapidly decreases up to the minimum possible.

During collapsing of gas microbubble, the gas pressure in the cavity of such gas microbubble is growing rapidly.
Cavity in gas microbubble, during collapsing gas microbubble, are deformed and are splited (splits up) on a few more smallest microbubbles with radii minimally possible sizes.
Collapsing the pulsating gas microbubbles produces effects such as **sonoluminescence**, the destruction (**cavitation**) of solid surfaces, the radiation **pressure waves**, **chemical reactions**, **local electrization** of the gas microbubbles {**37**}.
These effects characterizes a phenomenon which are called a **acoustic cavitation** {**34**}.
Acoustic cavitation is able to transform a low energy density of wave action of aquatic environment in a high energy density in and around of the collapsing gas microbubble.
When wave action aqueous environment, the pulsating "**till resonance**" gas microbubbles are stocking kinetic energy wave action {**33**}.
During the collapse of a gas microbubble a stored energy is expended on the excitation of sonoluminescence, on the local electrization of microbubbles, on the emission of shock waves.
Sonoluminescence it is the glow up the water, caused by the emission of light from the collapsing gas microbubble.
During multibubble sonoluminescence, light into the water radiates set, consisting of the collapsing the gas microbubbles.
The frequency and amplitude of the wave's actions the aquatic environment influences the flow of sonoluminescence {**37**}.
Sonoluminescence in liquids discovered during actions wave with the various frequencies: with high (**300-1500** kHz), with medium (**1 - 100** kHz) and with low (**7 - 800** Hz), including the infrasound (**7 -16** Hz) {**37**}.
During periodic oscillations of the water environment in the water basin may spread the traveling waves and may occur standing waves .
Source, which creates plane traveling or standing waves in water environment, can have the form of flat geometric figures.
Hereinafter, assume that, the flat (**Fig. 4**) standing and traveling waves creates the sources, that have flat circular shape.
In a standing wave: "**till resonance**" gas microbubbles ($\omega_r>\omega$) are shifting into knots of speed oscillation aquatic environment; "**after resonance**" gas microbubbles ($\omega_r<\omega$) are shifting into the antinodes of speed oscillation aquatic environment {**35, 38**} (**Fig. 5**).

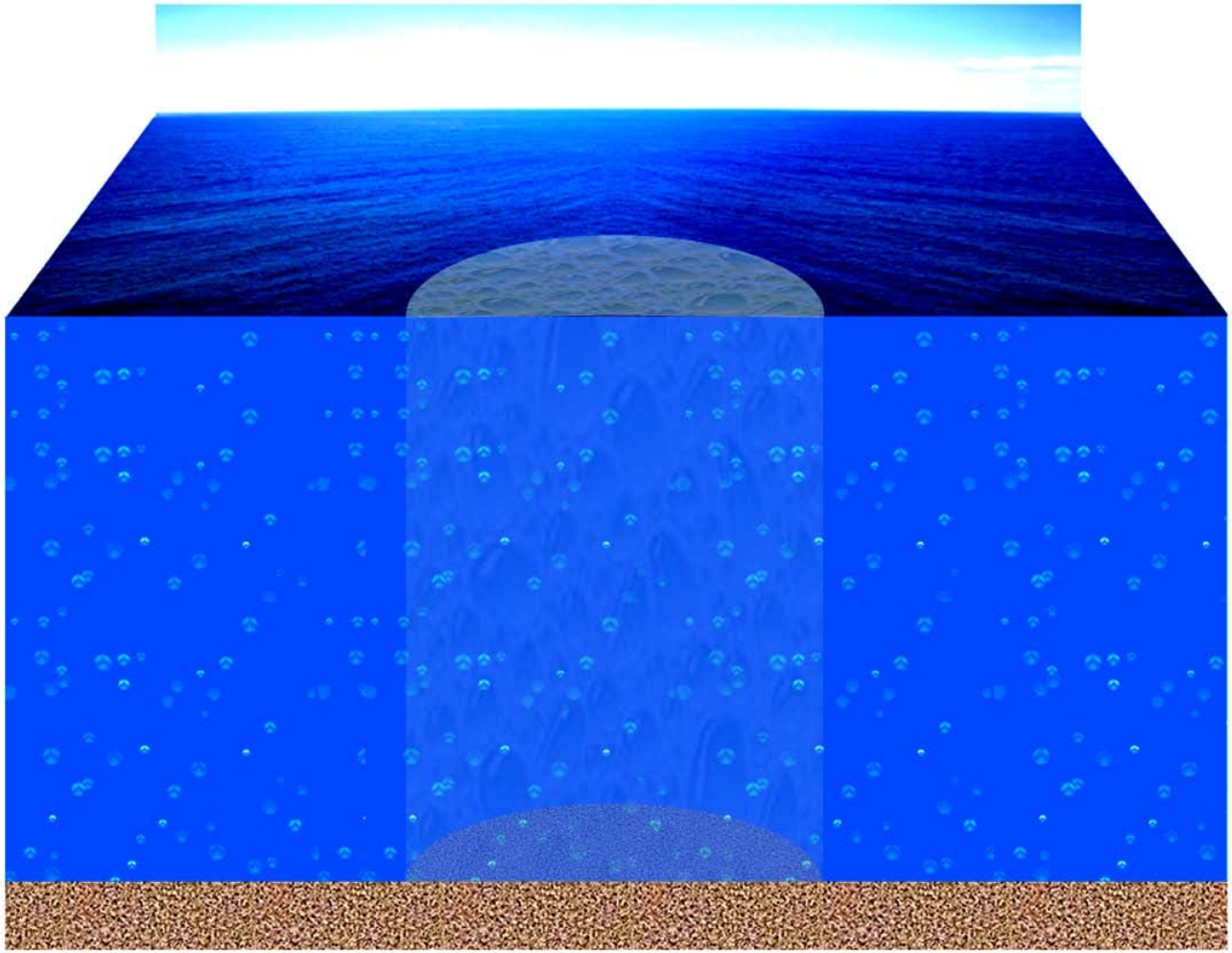


Fig.4. A plane wave in an aqueous medium, created by a circular source.
(The vertical section of the water column.)

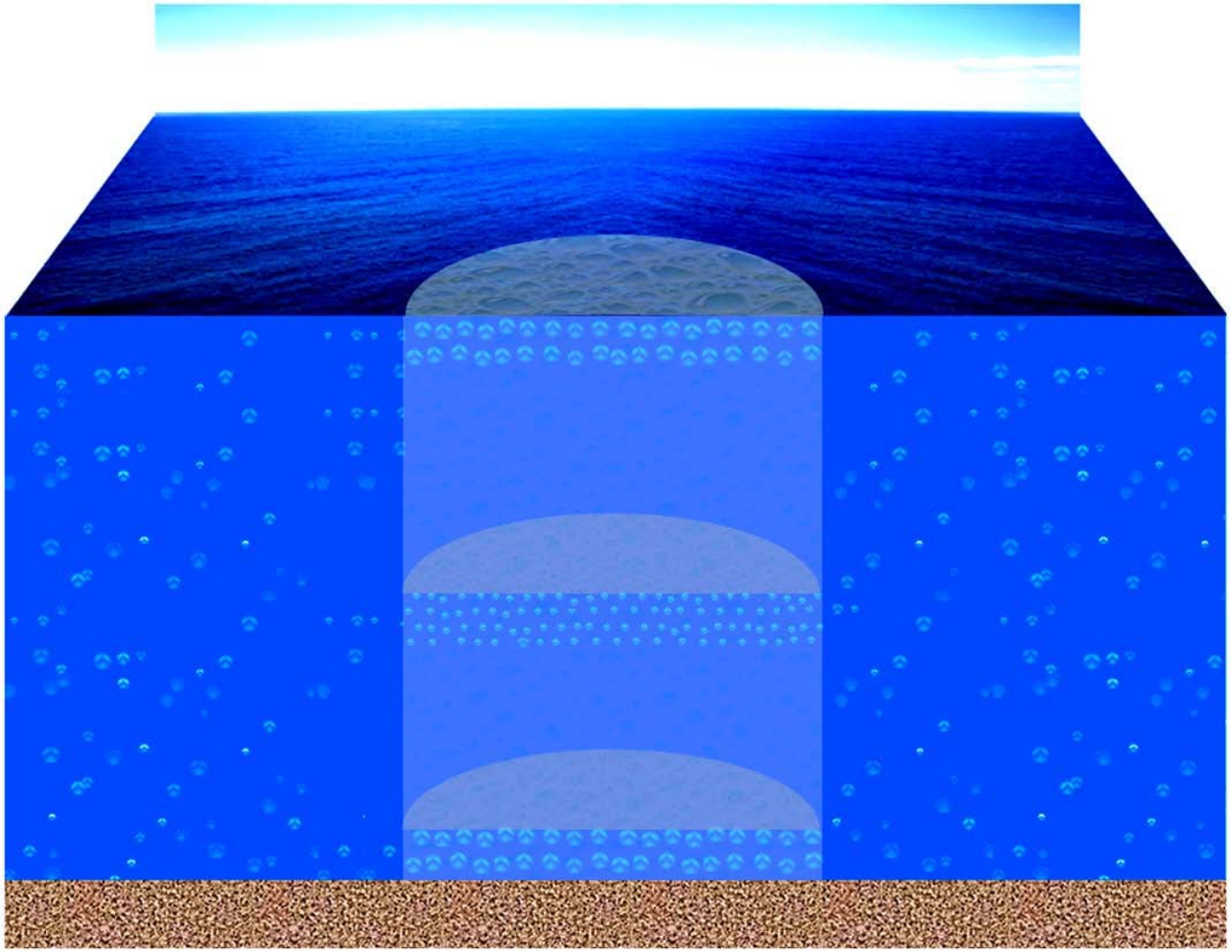


Fig.5. Cluster "till resonance" gas microbubbles near knot of speed oscillation aquatic environment of a standing wave between the surface and the bottom of the sea.
Two clusters "after resonance" gas microbubbles near the antinodes of speed oscillation aquatic environment of a standing wave. One at the bottom and other on the sea surface.
(The vertical section of the water column.)

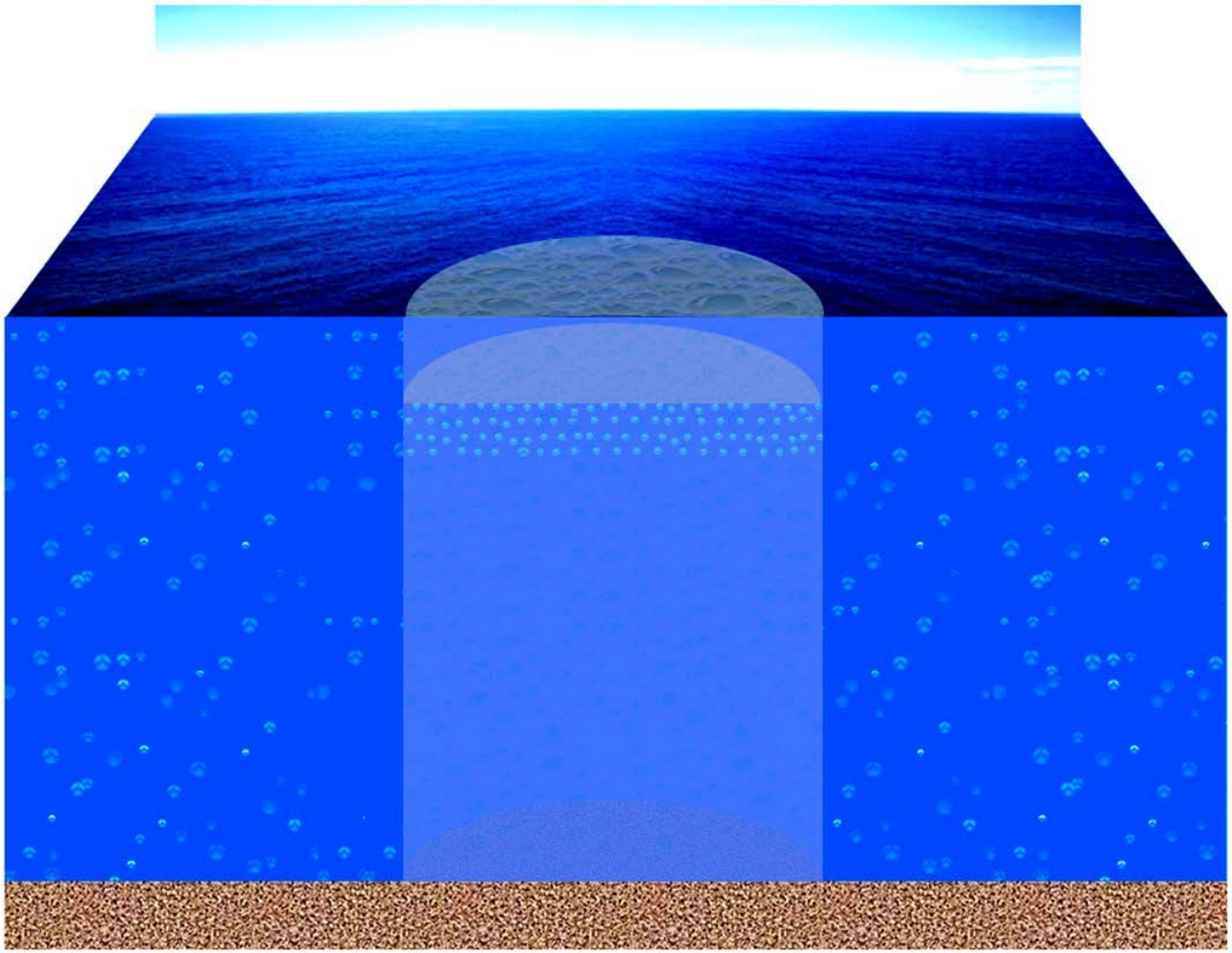


Fig 6. Cluster of gas microbubbles near the sea surface in a traveling wave created by seismic displacements of the bottom of the sea.
(The vertical section of the water column.)

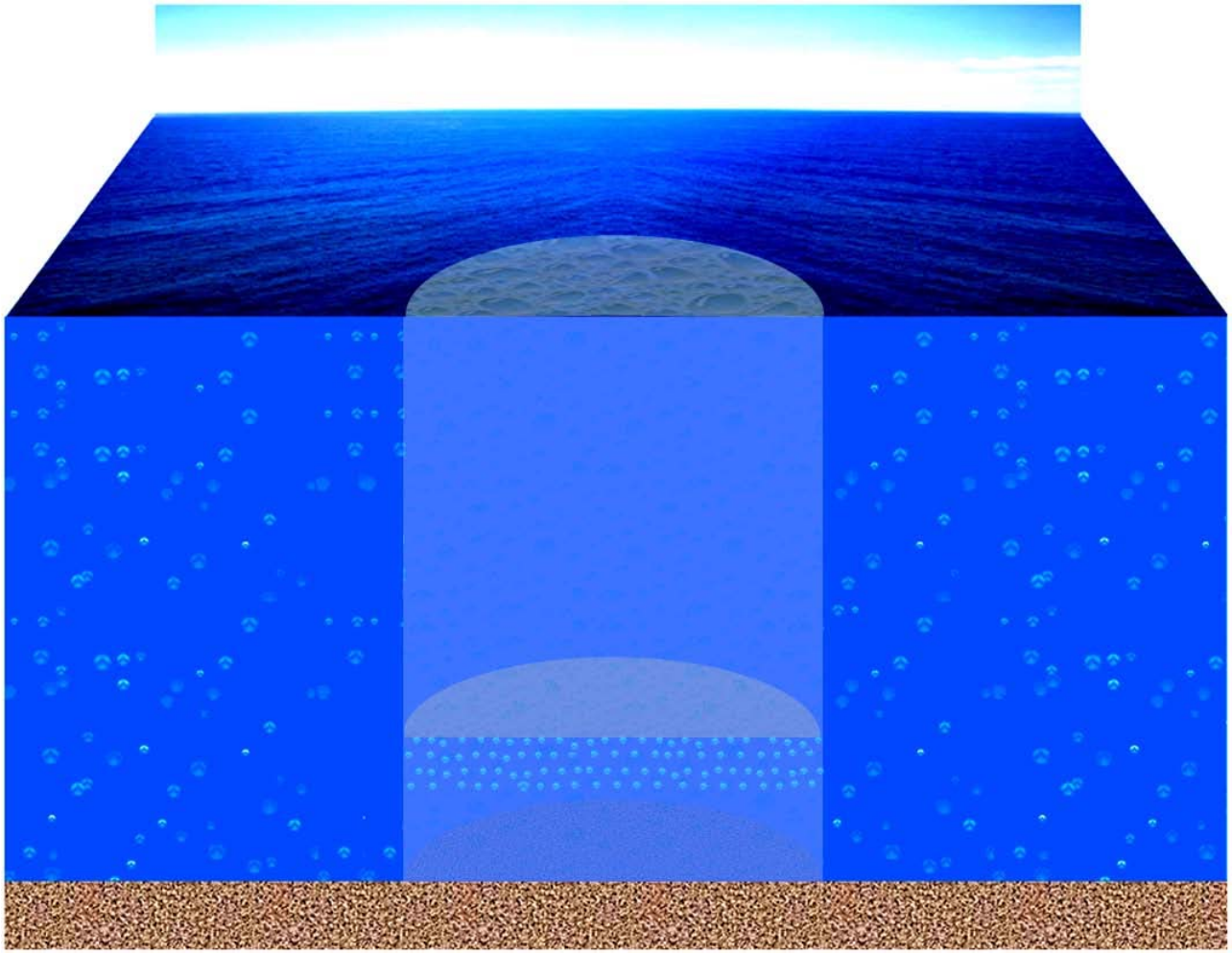


Fig.7. Cluster of gas microbubbles near the bottom of the sea in a traveling wave, created by actions atmospheric phenomenons at the sea surface.
(The vertical section of the water column.)

In a traveling wave the vibration's force is directed away from the source of vibrations.
Therefore, in a traveling wave the gas microbubbles are accumulated in the opposite direction against the source of the oscillations (**Fig. 6, 7.**).
Depending on the ratio of the directions and magnitudes of the **vibrational** force and the buoyant **archimedean** force, the vector of averaged vertical displacements of gas bubbles in a traveling wave can be directed up or down.
In addition, ability, the pulsating gas microbubbles into the aquatic environment, to move in direction towards a solid boundary (the ship's hull or sea floor) and away from the horizontal free boundaries (sea surface, the interface between water layers of different density) affects on moving of the pulsating gas microbubbles into the aquatic environment {**39**}.
In the aquatic environment, during periodical exposure of a standing or traveling waves, moving (pulsating, oscillating, translatory moving, and others) in the aquatic environment the **gas microbubbles are mutually attracted and repelled**.
In a standing or traveling wave, are arising interactions of the pulsating gas microbubbles.
Such interactions of the pulsating gas microbubbles governed the forces of mutual attraction (**Bjerknes** forces {**39**}) and repulsion ({**40**}, etc.) of the between pulsating gas microbubbles.
The forces of attraction and repulsion, arising from the periodical exposure of standing waves or traveling waves on the gas microbubbles, are creating in an aquatic environment a stable correlation between the gas microbubbles.
Value of attitude of the forces attraction at the forces repulsion , that act (in a vibrating aquatic environment) on pulsating gas microbubbles, varies with the distance between the microbubbles.
Decrease distance between the pulsating gas bubbles increases the exposure of repulsive forces in comparison with the forces of attraction.
With Increasing distance between the pulsating gas bubbles decreases the exposure of repulsive forces in comparison with the forces of attraction.
In a standing or traveling waves an actions of the forces of repulsion and attraction between the moving gas microbubbles in an aquatic environment creates quasi-elastic interconnection between the gas microbubbles.

QUASI-ELASTIC BODY IN AN OSCILLATING AQUATIC ENVIRONMENT.

In an oscillating aquatic environment, multitude moving (pulsating, oscillating, moving steadily, and others) quasi-elastic interconnected gas microbubbles creates a stable structured system with the properties of quasi-elastic body, which be able to move (pulsate, oscillate, move steadily, etc.) relatively of the environment.
Hereinafter, stable, structured system formed by a multitude of quasi-elastic interrelated gas microbubbles, we will name "quasi-elastic body".
Gas microbubbles endows with a quasi-elastic body ability to transform a low energy density of wave action of aquatic environment in a high energy density inwardly and near the body.
Gas microbubbles endows with a quasi-elastic body ability to move (at a wave's action and action the buoyant **archimedean** force) in the direction of
to the solid boundary (the hull of the ship or the sea floor) and to move away from the horizontal free boundary;
move in vertical and horizontal directions .
Gas microbubbles endows with a quasi-elastic body ability to produce such effects, as light emission, destruction (**cavitation**) solid surfaces, the emission of shock waves, chemical reactions, and electrization.
The deformation of the quasi-elastic body is proportional to bigness the applied force to the body.
For small deformations ($\mathbf{u_{ik}<<1}$) in the quasi-elastic body the stress tensor σ_{ik} ik is a linear function of the strain tensor $\mathbf{u_{ik}}$:

$$\sigma_{ik} = K\cdot u_{ll}\cdot\delta_{ik} + 2\cdot\mu\cdot[\, u_{ik} - (1/3)\cdot\delta_{ik}\cdot u_{ll}],$$

where **K** and μ are respectively the bulk modulus and shear modulus, δ_{ik} is the unitary tensor.

In the quasi-elastic body equilibrium equations in cylindrical coordinates **r**,φ,**z** have the form:

$$(\partial\sigma_{rr}/\partial r) +(1/r)\cdot(\partial\sigma_{r\varphi}/\partial\varphi)+(\partial\sigma_{rz}/\partial z)+ (\sigma_{rr} - \sigma_{\varphi\varphi})/r+\rho\cdot F_r=0;$$
$$(\partial\sigma_{r\varphi}/\partial r) +(1/r)\cdot(\partial\sigma_{\varphi\varphi}/\partial\varphi)+(\partial\sigma_{\varphi z}/\partial z)+ (2\cdot\sigma_{r\varphi})/r+\rho\cdot F_\varphi=0;$$
$$(\partial\sigma_{rz}/\partial r) +(1/r)\cdot(\partial\sigma_{\varphi z}/\partial\varphi)+(\partial\sigma_{zz}/\partial z)+ \sigma_{rz}/r+\rho\cdot F_z=0;$$

where ρ - density of quasi-elastic body;

F_r , F_φ , F_z , respectively, components (along axis **r**, φ, **z**) of the force acting on unit mass of the quasi-elastic body.

In the quasi-elastic body the stress tensors $\sigma_{r\varphi}$, $\sigma_{\varphi z}$ (in cylindrical coordinates **r**,φ,**z**) have the form:

$$\sigma_{\varphi z}= \mu\cdot[(1/r)\cdot(\partial u_z/\partial\varphi)+ (\partial u_\varphi/\partial z)] ;$$
$$\sigma_{r\varphi}= \mu\cdot[(\partial u_\varphi/\partial r)- (u_\varphi/r)+ (1/r)\cdot(\partial u_r/\partial\varphi)] .$$

Strain tensor u_{ik} (in cylindrical coordinates **r**,φ,**z**) has the form:

$$u_{rr} = (\partial u_r/\partial r) ;$$
$$u_{\varphi\varphi}= (1/r)\cdot(\partial u_\varphi/\partial\varphi)+ (u_r/r) ;$$
$$u_{zz}=(\partial u_z/\partial z) ;$$
$$2\cdot u_{\varphi z}= (1/r)\cdot(\partial u_z/\partial\varphi)+ (\partial u_\varphi/\partial z) ;$$
$$2\cdot u_{rz}= (\partial u_r/\partial z)+ (\partial u_z/\partial r) ;$$
$$2\cdot u_{r\varphi}= (\partial u_\varphi/\partial r)- (u_\varphi/r)+ (1/r)\cdot(\partial u_r/\partial\varphi) ,$$

where u_r , u_φ , u_z , respectively, the components (along axis **r**, φ, **z**) of the strain vector (displacement) of quasi-elastic body.

In what follows we consider the quasi-elastic deformation of the body at zero value of φ -th component ($F_\varphi=0$) of the force vector acting on a unit of body mass.

THIN CIRCULAR QUASI-ELASTIC PLATE IN AN OSCILLATING AQUATIC ENVIRONMENT.

In plane standing the waves or in plane traveling the waves in the aquatic environment may to arise a thin circular quasi-elastic plate, consisting of interconnected pulsating gas microbubbles.

A thin circular quasi-elastic plate it is a variant of cylindrical quasi-elastic body (**Fig.17a.**), which has a thickness **h** substantially less as compared with the size body (**R; 2π·R**) in the other two directions.

The impact of the oscillating (with frequency ω) the aquatic environment on a thin circular quasi-elastic plate gives rise to forced oscillations (deformation) of the plate with a frequency (ω) vibrations of the water environment.

In a plane traveling wave or in a plane standing wave arise forced transversal vibrations of thin circular plate with the frequency of oscillation (ω) of forcing force.

In during the periodic forced transverse vibrations of thin circular plate, wich is synchronous with oscillations of the water environment, periodically increases and decreases the hydrostatic pressure acting on the surface of a gas microbubble.

Synchronous with the vibrations of the water environment a periodical change the hydrostatic pressure around the gas microbubbles increases the number of collapsing gas microbubbles and accelerates them collapsing (in the phase of pressure increase) .

Sonoluminescence multitude collapse gas microbubbles in of quasi-elastic body creates a light emission from thin circular oscillating quasi-elastic plate.

Increased frequency and / or amplitude of the forced transverse vibrations of a thin quasi-elastic plate increases the flow of light emission from plate.

The thickness of a thin circular quasi-elastic plate increases continuously by joining the pulsating gas microbubbles toward plate. The pulsating gas microbubbles moves to the plate from the oscillating aquatic environment.

Joining toward a thin circular quasi-elastic plate of the multitude of pulsating gas microbubbles increases the number of collapsing gas microbubbles onto plate and thereby increases the flow of light emission from plate.

In addition, increasing the thickness of a thin circular quasi-elastic plate , during accession to plate the multitude of pulsating gas microbubbles, alters the natural frequencies of the plate up to coincidence one of them with frequency forced force (ω).

When coincidence the natural frequency of a thin plate with the frequency of the forced force arise the phenomenon of resonance of the plate in the presence of resistance aquatic environment.

When resonance plate (in the presence of resistance to the aquatic environment) is increased the vibration amplitude of the plate.

When resonance, there may arise transverse vibrations of thin circular quasi-elastic plate with the formation of nodal lines (with zero-amplitude oscillations) in the form of **n** nodal diameters (**Fig.8a.**), or in the form of **m** nodal circles (**Fig.8 б.**), or in the form of combining **m** nodal circumference with **n** nodal diameters (**Fig.8 в.**) {**41**}.

In the case of mode shapes with n nodal diameters, every circumference on the surface of a thin circular quasi-elastic plate (concentric relatively the axis of symmetry of the plate , the circle radius **r**, where $\mathbf{r^* \leq r \leq R}$) divided into **2·n** equal parts (**n= 0; 1; 2;3;…**).

In the case of mode vibrations with **n** nodal diameters, two mentioned neighboring parts of concentric circumference on the surface of a thin circular quasi-elastic plate fluctuate in opposite phases.

The amplitude of the oscillations of the points of nodal diameters, which divide the circle into equal parts, is equal to zero.

At the time arising of the resonant vibrations of the plate, in the mode nodal diameters, a nodal line (a nodal diameter) coincides with segment of straight line connecting center of symmetry of plate with couple the points, which situated on the outer borderline of thin circular quasi-elastic plate.

Over time, from the time arising of the resonant vibrations of the plate, the nodal diameter, which originally had the shape a segment of a straight line, is capable to be transformed in a curvilinear segment.

In the case of vibration thin circular quasi-elastic plate with modes **m** nodal circumference (**m = 0; 1; 2;3;…**), the nodal lines are created from **m** concentric , relatively to the center of symmetry plate, circumferences (**r** -the circumference radius, where

$\mathbf{r^* \leq r \leq R}$) on the surface the plate.

The oscillation amplitude nodal circumference is equal to zero.

а) б) в)

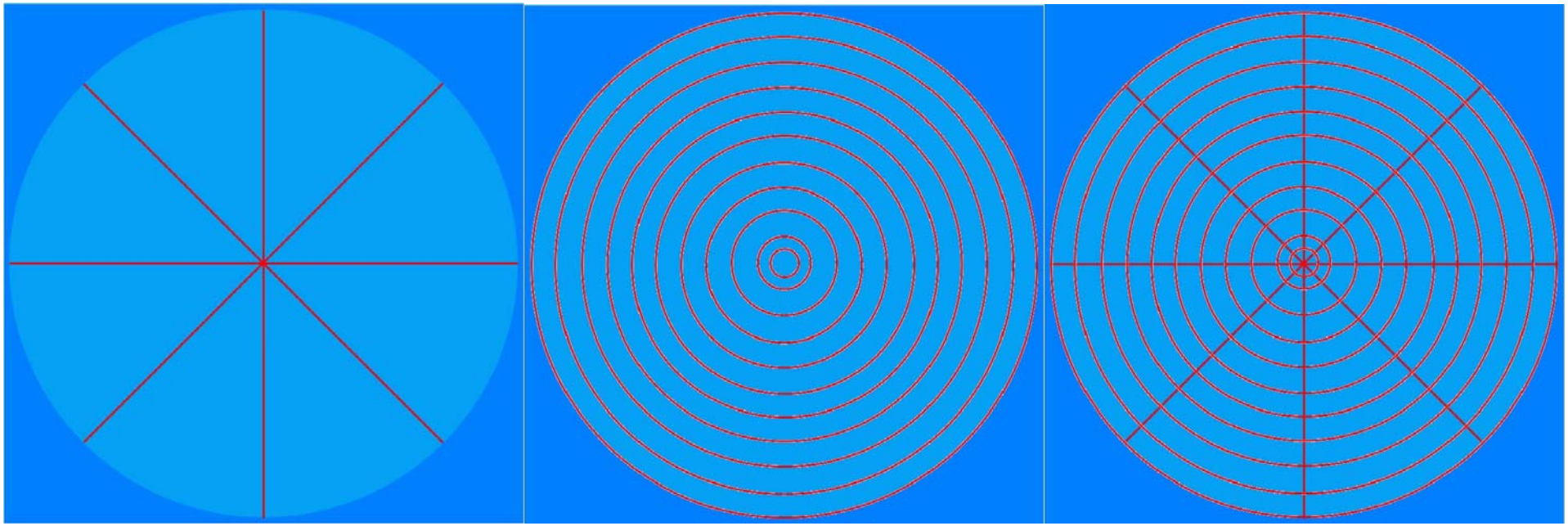
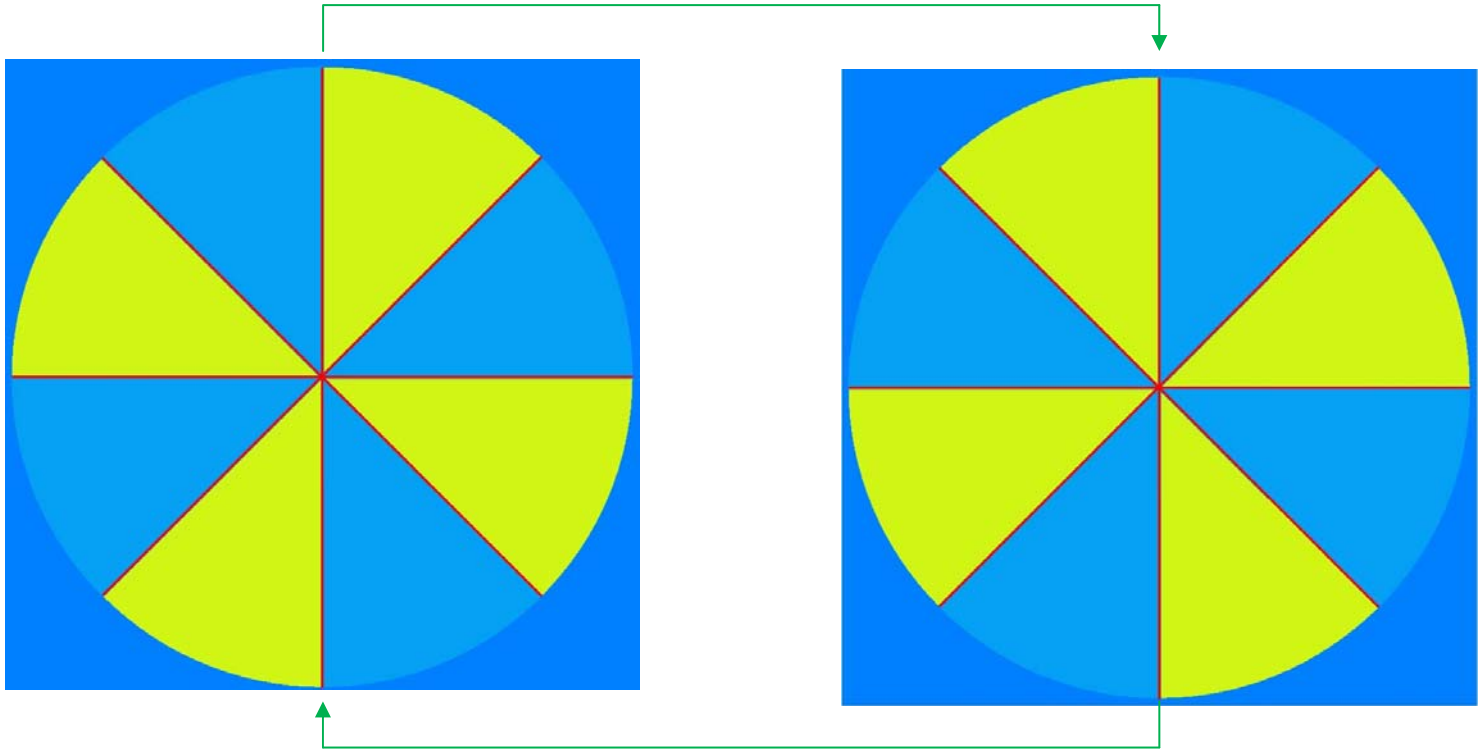


Fig.8. Nodal's (they not vibrating) lines (red color),which are arising during resonant transversal vibrations of a thin circular plate:
а) - four nodal diameter;
б)- eleven nodal circumferences;
в)- a combination of eleven nodal circumferences and of four nodal diameters .

At resonance on the surface a vibrating circular quasi-elastic plate, which has a **m** nodal circumferences, each from a nodal circumference, which situated inside a surface of the plate, separates of two adjacent rings of plate, which vibrate in opposite phases.
At resonance , in the case modes of vibration of quasi-elastic circular plate with **m** nodal circumference (**m>0**) and **n** nodal diameters (**n >0**), a pair of segments adjacent nodal circumference intersecting with a pair of neighboring nodes diameter divides the surface of plate on **2·n·m** rectangular plot, of which every two adjacent oscillate in opposite phases.
At resonance, the vibration amplitude of nodal circumference and nodal diameters equal to zero.
At resonance, the two neighboring plot a thin circular quasi-elastic plate vibrates in opposite phases.
Vibrations of two adjacent sections of the thin circular quasi-elastic plate in opposite phases are accompanied by a periodic change of the compression of gas microbubbles on their expansion in one plot with while simultaneously changing the expansion of gas microbubbles on their compression on the neighboring plot .
During of resonance , on the plot of "**compression**" of thin circular quasi-elastic plate vertical displacement amplitude of the quasi-elastic plate material is directed toward of the bottom of the sea.
During of resonance, gas microbubbles, on the plot of "**compression**" of thin circular quasi-elastic plate, are compressed up to collapsing a some amount from such microbubbles.
During of resonance, on the plot "**expansion**" of a thin circular quasi-elastic plate, vertical displacement amplitude of the quasi-elastic material plate is directed toward the surface sea.
During of resonance, the gas microbubbles in plate expands on the plot of "**extensions**" in the thin circular quasi-elastic plate.
On the plot "compression" of the thin circular quasi-elastic plate a significant number of the set of gas microbubbles (which are compressed on this plot) collapses and creates a the flow of light emission from this plot of plate .
Increasing the amplitude of oscillations of a thin quasi-elastic plate facilitates increasing number of collapsing gas microbubbles at the plot of "**compression**" and, thus, increases the light emission of plot of "**compression**" of the plate.
During the expansion of gas microbubbles on the plot "**expansion**" of the thin quasi-elastic plate are increased the number of expanding gas microbubbles and decreases down to zero the number of collapsing gas microbubbles.



а) б)

Fig. 9. Periodic changes, from а) to б) and back, of bending deformations plots of a thin circular plate during resonant transverse vibrations of the plate. Nodal lines (they not vibrating) are marked in red. Plots of "compression" plates are marked in yellow. Plots "expansion" of the plate are marked in blue.

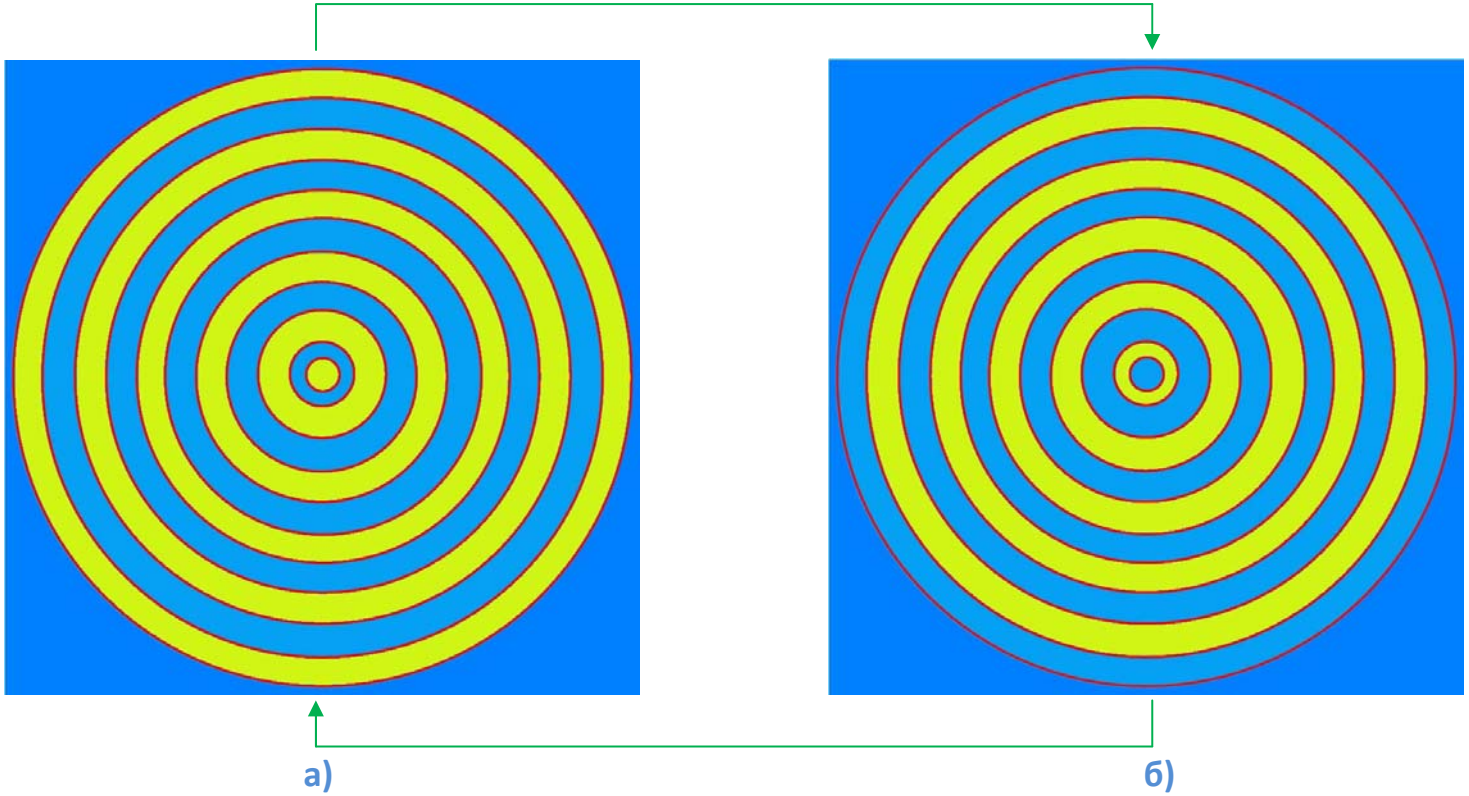
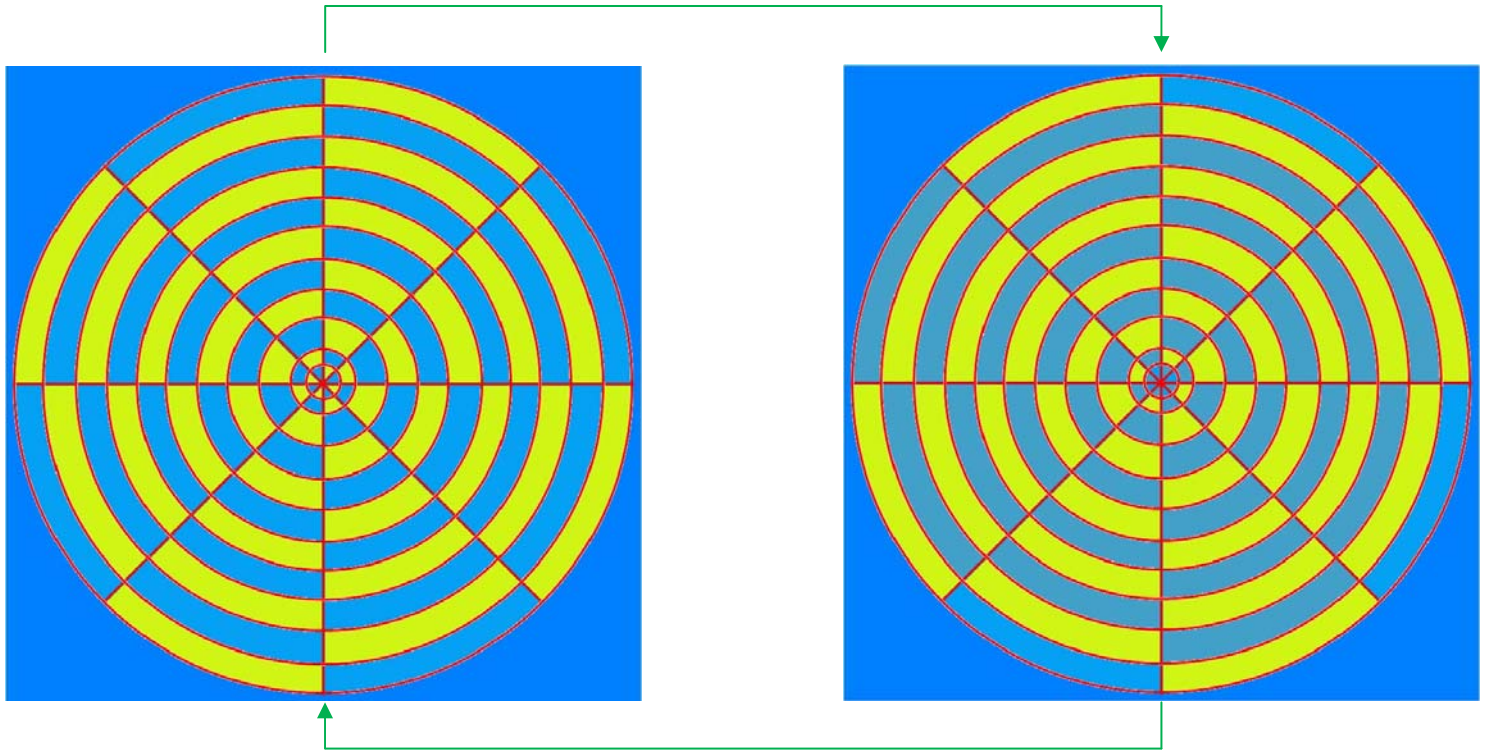


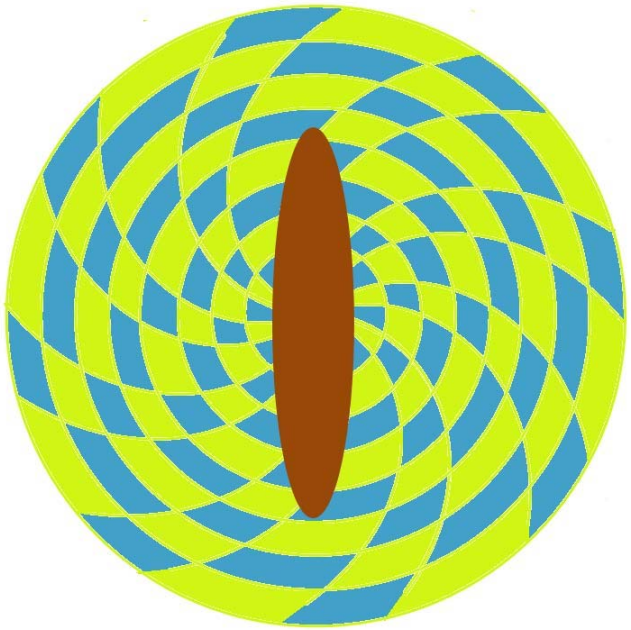
Fig. 10. Periodic changes, from а) to б) and back, of bending deformations plots of a thin circular plate during resonant transverse vibrations of the plate. Nodal lines (they not vibrating) are marked in red. Plots of "compression" plates are marked in yellow. Plots "expansion" of the plate are marked in blue.

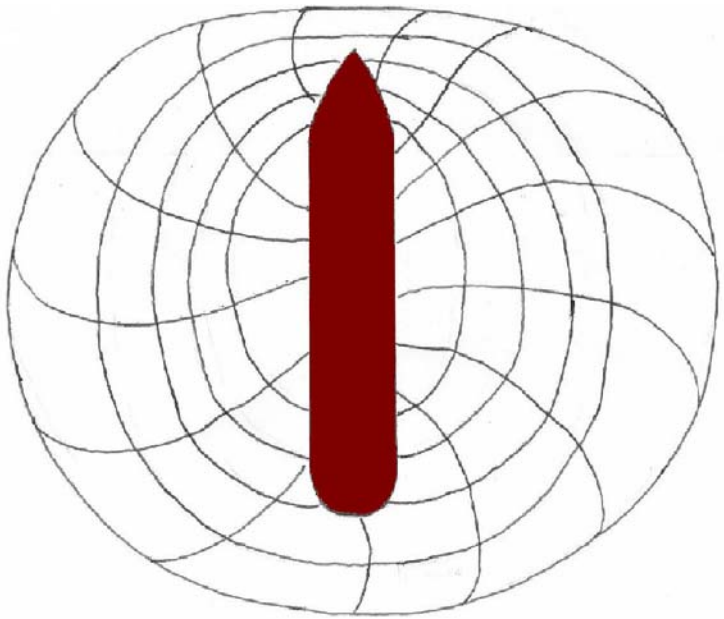


а) б)

Fig. 11. Periodic changes, from а) to б) and back,
of bending deformations of rectangular plots a thin circular plate
during resonant transverse vibrations of the plate.
Nodal lines (they not vibrating) are marked in red.
Plots of "compression" plates are marked in yellow.
Plots "expansion" of the plate between the red lines are marked blue.

During expanding the gas microbubbles do not create a light emission.
Increasing the amplitude of oscillations of a thin quasi-elastic plate facilitates reducing number of collapsing gas microbubbles at the plot "**expansion**" of plate and, thus, reduces down to zero light emission from the plot "**expansion**" of the plate.
Therefore, during resonant vibrations of a thin quasi-elastic plate there is a significant difference between light emission of plots of "**compression**" compared with the light emission of plots of "**expansion**" of the plate.
During the periodic change of phases of the resonant vibrations of a thin circular quasi-elastic plates, each plot of the plate alternately transforms from state the plots of "compression" into state of the plots of "**extensions**" and vice versa (**Fig.9;10;11.**).
Therefore, during the resonant vibrations of a thin circular quasi-elastic plate, opposite phases of the ("**compression**", "**expansion**") vibrations plots of the plate correspond to the opposite site of light phenomena: the absence of the light emission from this plots and the light emission from this plots.
The periodic switching of the light emission from one plots to the adjacent plots (**Fig.9.**) during the resonant transverse vibrations of thin circular quasi-elastic plates, which are realized out in the shape of the formation of nodal diameters, the crew of the ship is visually perceives as a rotation spokes around the axis of the wheel. A rotation spokes could be directed against a clockwise direction the so-and in a clockwise direction.Opinions of crew members, which contemporaneously are looking at periodical a switching of the light emission between plots of the "**compression**" and between plots of the "**expansion**", could differ in assessing the direction of rotation of the spokes of wheel (**Video 1**).
During of the resonant transverse vibrations of thin circular quasi-elastic plates, which are realised out in the shape of the formation of nodal circumferences, the periodic switching of the light emission from one plots to the adjacent plots (**Fig. 10.**) crew the ship are perceived visually as propagation of light waves in the sea (**Video 2**).
The periodic switching of the light emission from one plot (with four corners) on a nearby plot (with four corners) (**Fig. 11.**), (during the resonant transverse vibrations of thin circular quasi-elastic plates in the form , which combines the nodal diameters and the nodal circumferences) the crew of the ship is visually perceived as moving light spots (with four corners) on the sea (**Video 3**).
In **Fig.12.** is shown a variant of such light spots (with four corners) on the sea (**Fig. 12. a**)and a sketch of the phenomenon of figure the glow on the sea, that the crew «**Dione**» watched (**Fig. 12. б**) in 1978 {**15, 42, 43**}.





а) б)

Figure 12. а) Light spots (with four corners) that can occur in resonant transverse vibrations of thin circular quasi-elastic plates, which consists of a pulsating gas microbubbles; б) sketch of the phenomenon of figure-glow of the sea, which was watched in the Persian Gulf in 1978, the members of crew of the ship «Dione».

(A ship is marked with a brown color, the spots of light - yellowish green color)

WARPING THE NODES DIAMETERS AT ROTATION THIN CIRCULAR QUASI-ELASTIC PLATES .

In cylindrical quasi-elastic body (a thin quasihomogeneous circular plate) ($0 \leq \mathbf{r} \leq \mathbf{R}$; $0 \leq \mathbf{z} \leq \mathbf{h}$), by symmetry, the components $\mathbf{u_r}$, $\mathbf{u}_\varphi$, $\mathbf{u_z}$ vector strain (displacement) of quasi-elastic body are constant along a horizontal circumference that concentric with respect to the center of symmetry the plate.

Therefore we can write:

$(\partial \mathbf{u}_\varphi / \partial \varphi) = \mathbf{0};$

$(\partial \mathbf{u_z} / \partial \varphi) = \mathbf{0};$

$(\partial \mathbf{u_r} / \partial \varphi) = \mathbf{0}.$

At execution, on the outer surfaces of the horizontal (**z=0; z= h**) thin quasihomogeneous circular plate , the conditions $(\partial \mathbf{u}_\varphi / \partial \mathbf{z})\big|_{z=0} = (\partial \mathbf{u}_\varphi / \partial \mathbf{z})\big|_{z=h}$, because of the subtleties of the plate, it is possible to accept that along a thickness of the plate function $(\partial \mathbf{u}_\varphi / \partial \mathbf{z})$ remains constant, i.e. $(\partial \mathbf{u}_\varphi / \partial \mathbf{z}) = \mathbf{const}$.

With that said, we can write:

$\mathbf{u_{r\varphi} = (1/2) \cdot [(\partial u_\varphi / \partial r) - (u_\varphi / r)]};$

$(\partial \sigma_{r\varphi} / \partial r) + (2 \cdot \sigma_{r\varphi}) / r = 0;$

$\sigma_{r\varphi} = \mu \cdot [(\partial u_\varphi / \partial r) - (u_\varphi / r)].$

In the plane standing waves or plane traveling waves in an aqueous medium appears stationary eddies-stream of aquatic environment {**35**}.The horizontal component of the vortex flows of the aquatic environment, which moving along the horizontal surfaces of the cylindrical quasi-elastic body, causes the rotation a cylindrical quasi-elastic body around its vertical axis of symmetry (**Fig. 13;14;15.**).

Aquatic environment, which adjoins with the lateral surface of the rotating cylindrical quasi-elastic body, creates an external force of resistance to rotation.

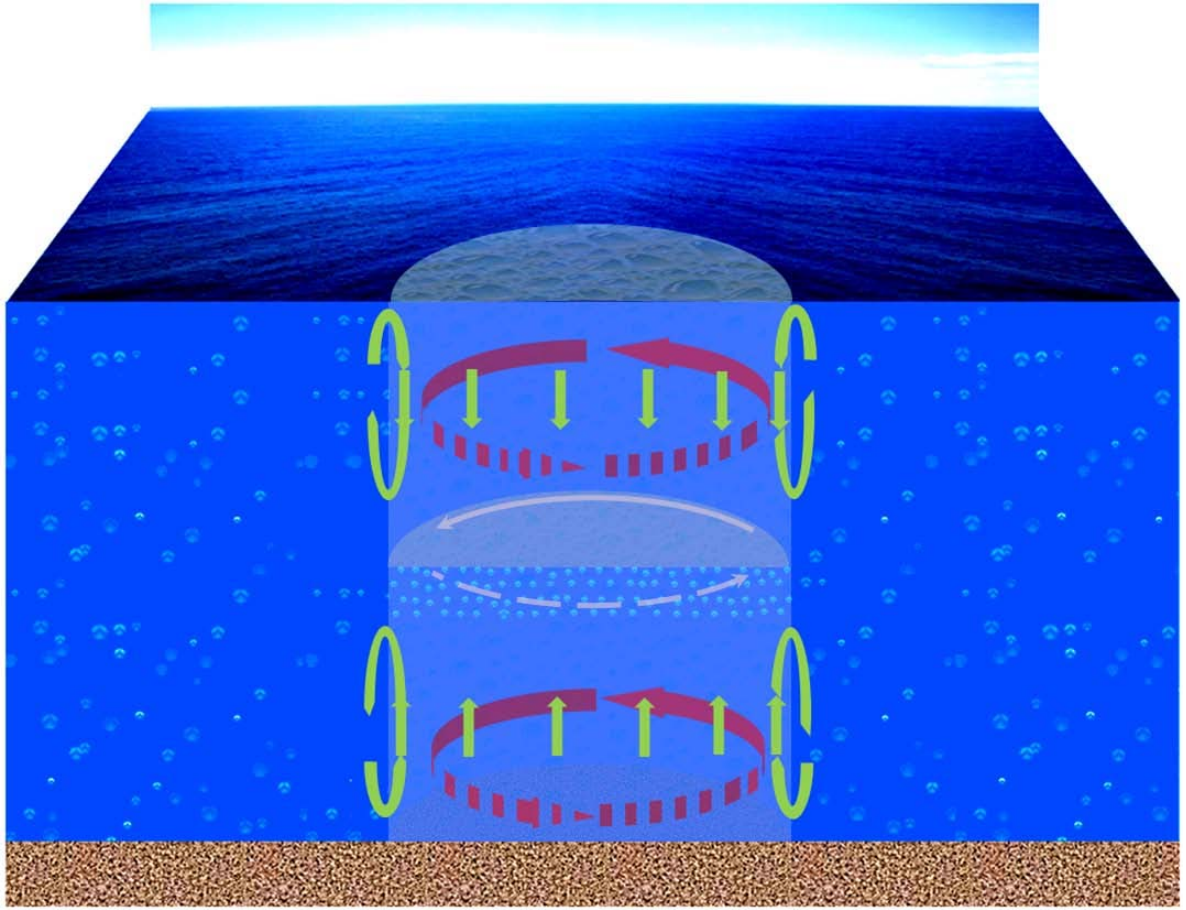


Fig. 13. A rotation of cylindrical quasi-elastic body (body consist of gas microbubbles), which caused by a vortical stream in the standing wave.
Yellowish green arrows mark the vertical components of the vortex flows;
the red arrows - the horizontal components of the vortex flows;
pink arrows - direction of rotation of the quasi-elastic body in the node of rate of standing waves.
(The vertical section of the water column.)

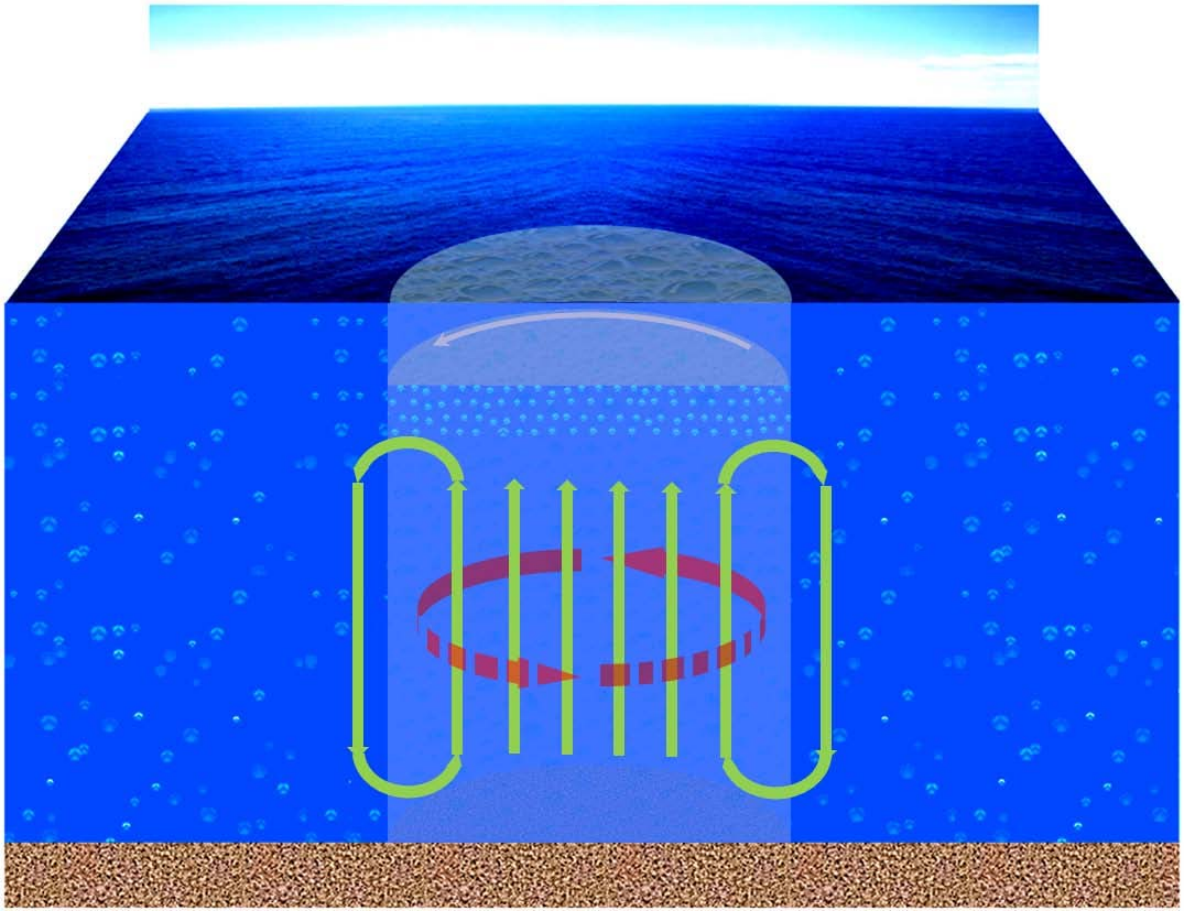


Fig.14. A rotation of cylindrical quasi-elastic body (body consist of gas microbubbles), which caused by a vortical stream in the traveling wave.
Yellowish green arrows mark the vertical components of the vortex flows;
the red arrows - the horizontal components of the vortex flows;
pink arrows - direction of rotation of the quasi-elastic body .
(The vertical section of the water column.)

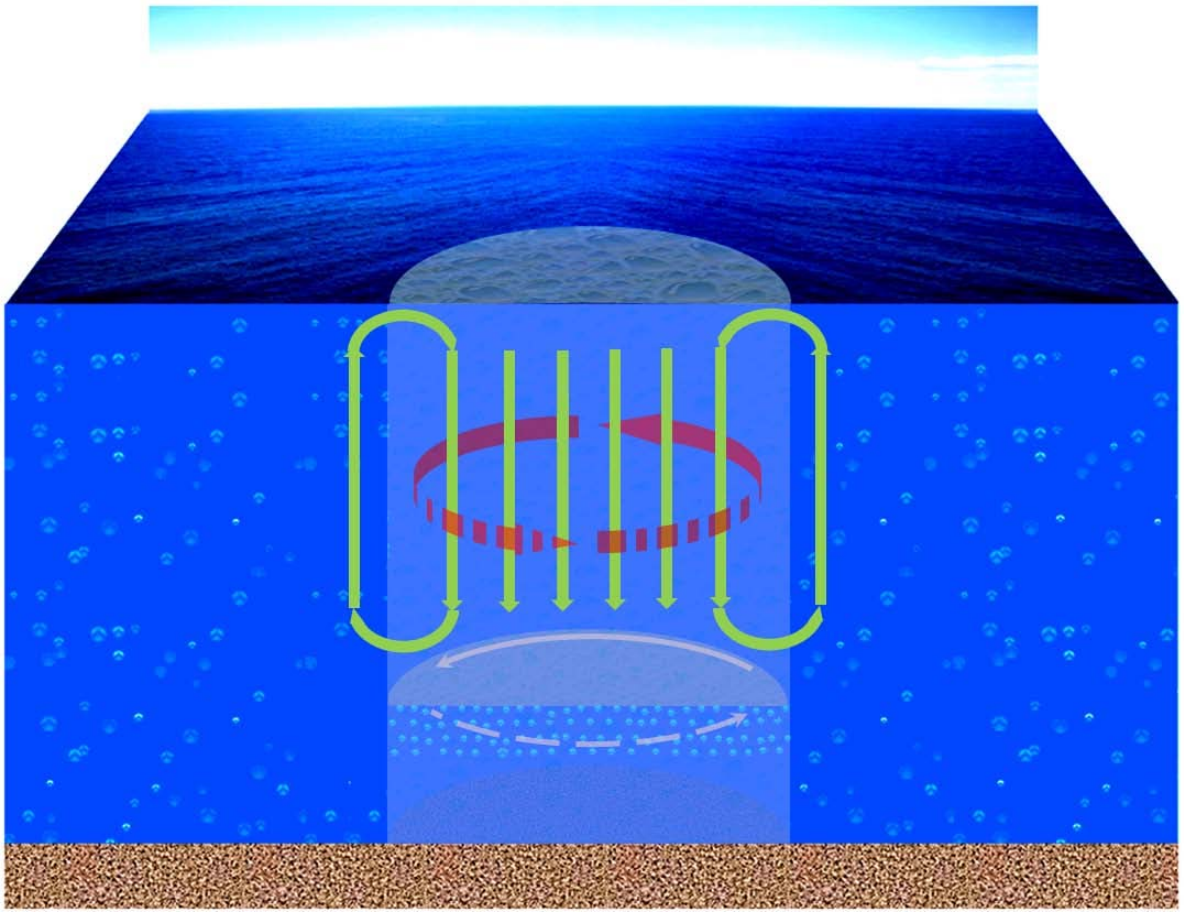


Fig.15. A rotation of cylindrical quasi-elastic body (body consist of gas microbubbles), which caused by a vortical stream in the traveling wave.
Yellowish green arrows mark the vertical components of the vortex flows;
the red arrows - the horizontal components of the vortex flows;
pink arrows - direction of rotation of the quasi-elastic body .
(The vertical section of the water column.)

φ-th component of the external force $\mathfrak{F}_\varphi$ resistance acting on a unit area of the lateral surface ($\mathbf{r=R}$;$0\leq \mathbf{z} \leq \mathbf{h}$) of cylindrical quasi-elastic body (which rotating in the aquatic environment) is proportional to the velocity **v** of the rotation of the body.
On the outer side surface of the rotating cylindrical quasi-elastic body holds:
$-\mathbf{n_r}\cdot\sigma_{r\varphi}\big|_{r=R;\ 0\leq z\leq h} = \mathfrak{F}_\varphi(\mathbf{v})$, where $\mathbf{n_r}$ – **r**- th component of unit normal vector (a normal is inner to the cylinder surface ($\mathbf{n_r}$ =-1)).
Having said that, we can write:

$$(\partial/\partial \mathbf{r})(\ln(\sigma_{r\varphi}\cdot \mathbf{r}^2))=0;$$

$$\sigma_{r\varphi}\big|_{r=R;\ 0\leq z\leq h} = \mathfrak{F}_\varphi(\mathbf{v}).$$

We can write: $\sigma_{r\varphi}\big|_{r=R;\ 0\leq z\leq h}\cdot \mathbf{R}^2=\sigma_{r\varphi}\big|_{r^*<r\leq R;\ 0\leq z\leq h}\cdot \mathbf{r}^2$, или $\sigma_{r\varphi}\big|_{r^*<r\leq R;\ 0\leq z\leq h}=\mathfrak{F}_\varphi(\mathbf{v})\cdot \mathbf{R}^2/\mathbf{r}^2$,
where $\mathbf{r}^*<\mathbf{r}\leq \mathbf{R}$ area, at which deformations ($\mathbf{u}_{r\varphi} \ll 1$) are small .
We can write:

$$[(\partial \mathbf{u}_\varphi/\partial \mathbf{r}) - (\mathbf{u}_\varphi/\mathbf{r})]\big|_{r^*\leq r\leq R;\ 0\leq z\leq h} =(\mathfrak{F}_\varphi(\mathbf{v})/\mu)\cdot(\mathbf{R}^2/\mathbf{r}^2);$$

$$(\mathbf{u}_\varphi(\mathbf{r}^*)) =0.$$

From such expressions ensues:

$$\mathbf{u}_{r\varphi}(\mathbf{r})=[\mathfrak{F}_\varphi(\mathbf{v})/(2\cdot\mu)]\cdot(\mathbf{R}/\mathbf{r})^2;$$

$$\mathbf{u}_\varphi(\mathbf{r})\big|_{r^*\leq r\leq R;\ 0\leq z\leq h} =[\mathfrak{F}_\varphi(\mathbf{v})/(2\cdot\mu)]\cdot(\mathbf{R}^2/\mathbf{r}^*)\cdot[(\mathbf{r}/\mathbf{r}^*) - (\mathbf{r}^*/\mathbf{r})];$$

$\mathbf{r}^*=([20\cdot\mathfrak{F}_\varphi(\mathbf{v})/(2\cdot\mu)]^{1/2})\cdot\mathbf{R}$, where **v** -speed rotation thin quasi-эластик plate around its center of symmetry, which arose under the influence of the vortex flow of aqueous medium.
With increasing speed rotation (**v**) the quasi-elastic of the plate are increased the value of $\mathbf{u}_\varphi(\mathbf{r})$ vector of the deformation (displacement).
Growth values $\mathbf{u}_\varphi(\mathbf{r})$ the displacement vector warps (deforms) the nodal lines on the plate, transforming initially straight lines nodal diameters in curved lines at sequence, to that shown in **Fig. 16.**.

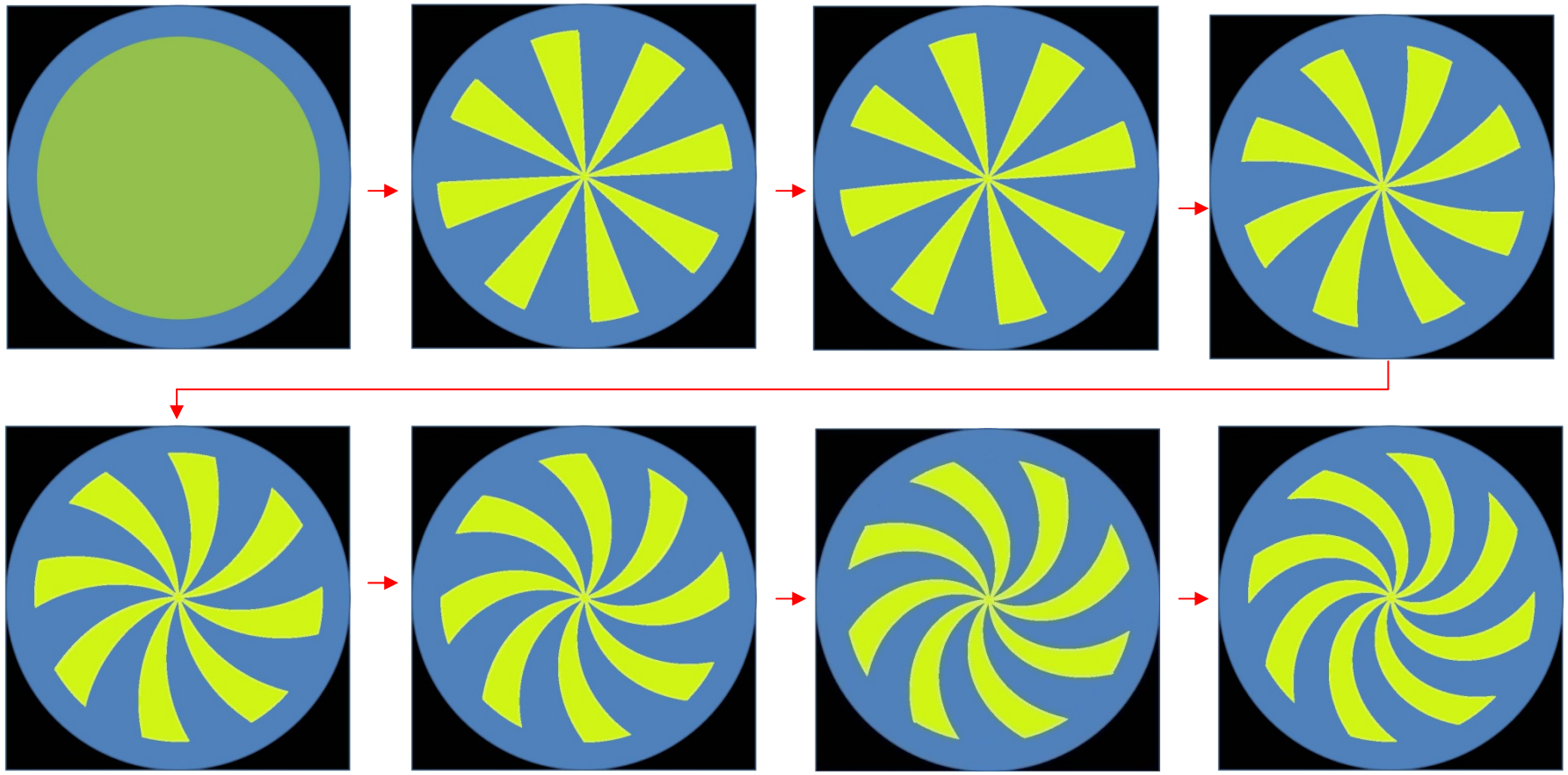


Fig.16. Warping (deformation) of initially straight lines a nodal diameters with increasing rotational speed of a circular quasi-elastic thin plate, which accomplishes a resonant transverse vibrations.

UNIDENTIFIED UNDERWATER QUASI-ELASTIC OBJECTS, WHICH CAN BE FORMED FROM THE PULSATING GAS MICROBUBBLES.

Quasi-elastic body, consisting of many pulsating quasi-elasto interconnected gas microbubbles, is formed under the influence of vibrational fields in the aquatic environment.

Differences the vibrational fields in the aquatic environment are creating differences in the shapes, sizes and other characteristics of the quasi-elastic body.

In the standing and traveling waves in the aquatic environment, is possible the formation of flat cylindrical, lenticular and others quasi-elastic bodies (**Fig. 17.**).

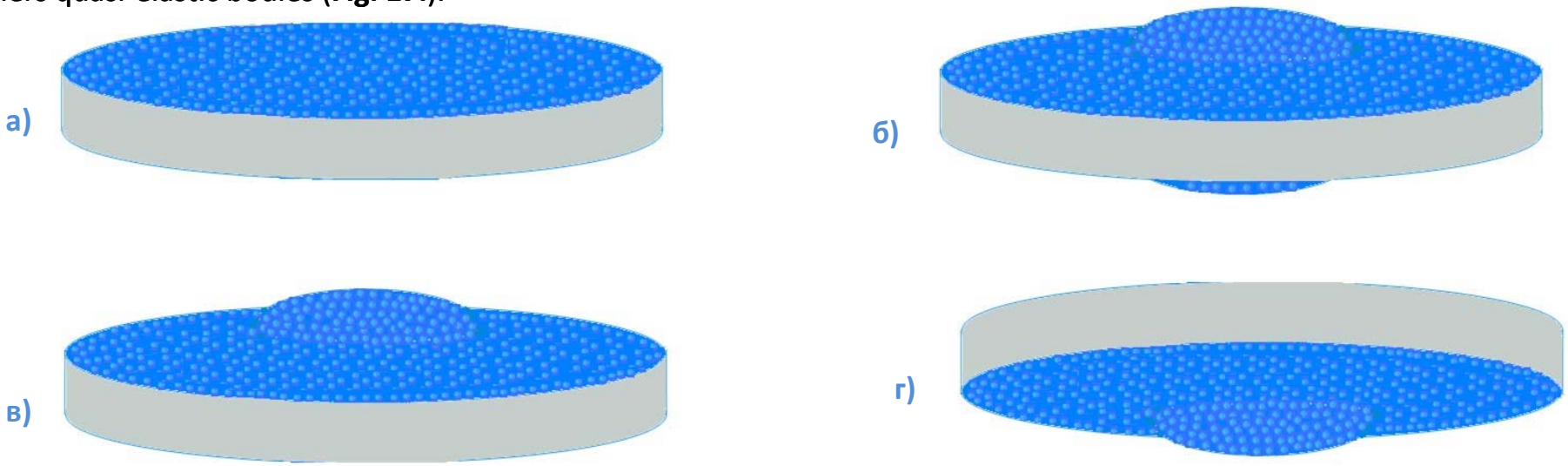


Fig.17. Forms of quasi-elastic bodies, which consist of a pulsating gas microbubbles:
а) -cylindrical; б) -lenticular;
в) -with lenticular with a flat underbody;
г) -with lenticular with a flat top.

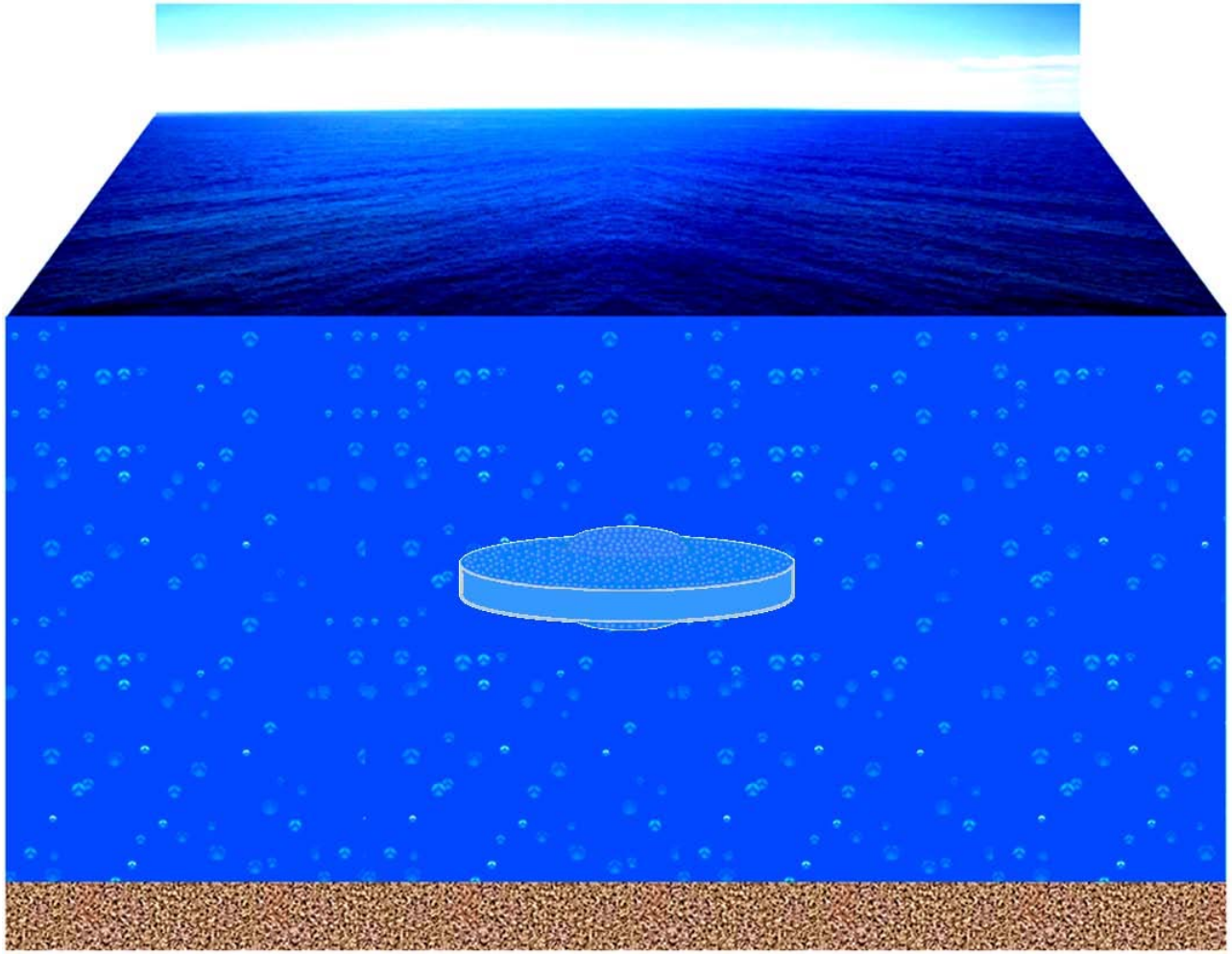


Fig.18. Lenticular quasi-elastic body (consisting of a pulsating gas microbubbles) moving to the aquatic environment.

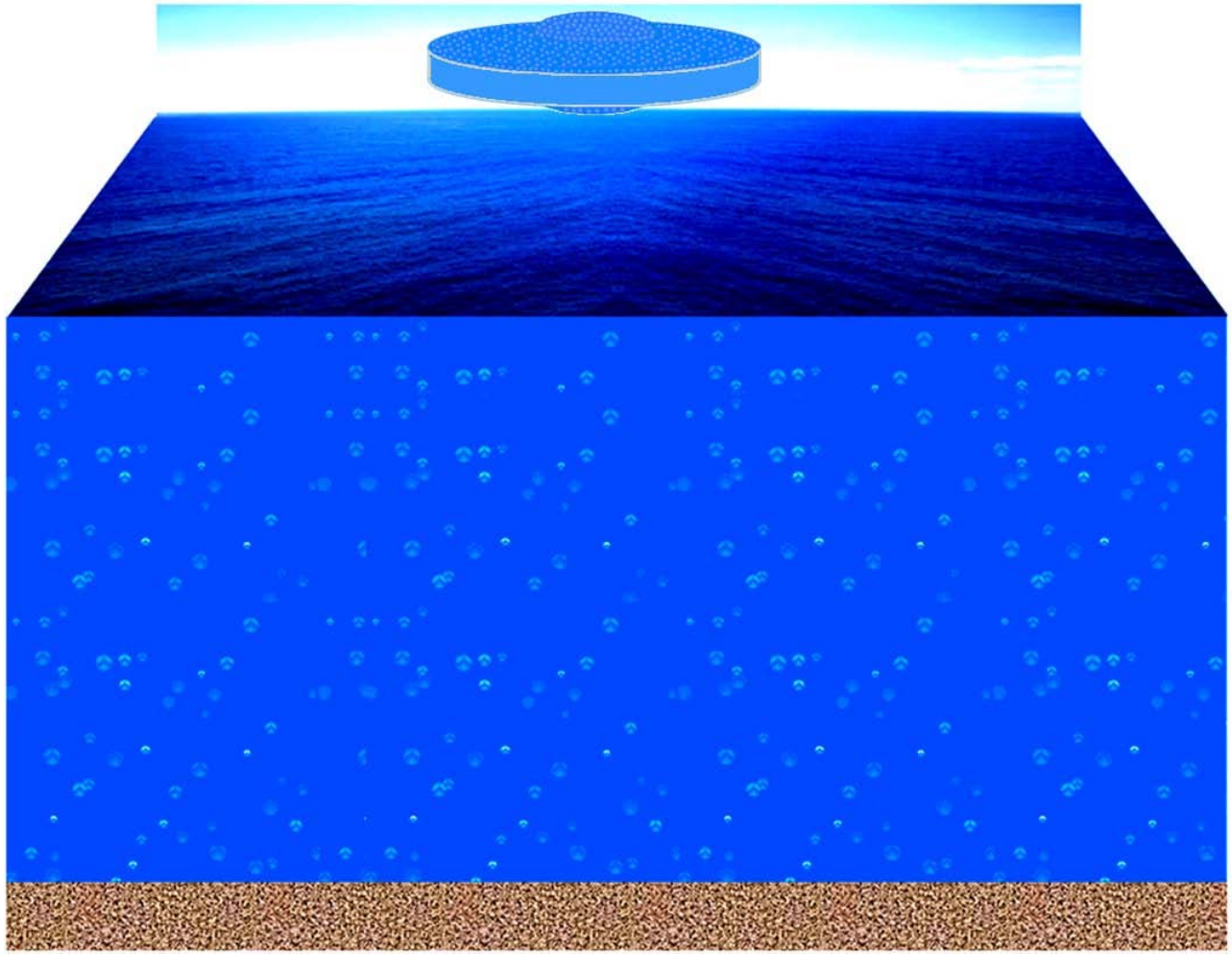


Fig.19. Lenticular quasi-elastic body (consisting of a pulsating gas microbubbles), was performed passing from the sea into the atmosphere.

Moving the quasi-elastic body, consisting of a pulsating gas microbubbles, (**Fig. 17.**) in a great deal like to moving of the pulsating gas microbubbles.
Under external vibration impacts and effects of buoyant **archimedean** force, quasi-elastic body can move in both vertical and horizontal directions, toward the ship's hull or away from the ship's hull, toward the sea bottom or away from the sea bottom, towards the interface between water layers of different density or away from the interface between water layers of different density, towards the boundary of the aquatic environment with the atmosphere or away from the interface of the aquatic environment with the atmosphere.
Quasi-elastic body, consisting of a pulsating gas microbubbles, under external vibration effects can move into the aquatic environment and the atmosphere (**Fig. 18, 19.**).
Quasi-elastic body, consisting of a pulsating gas microbubbles, can move from the water in the atmosphere and in the opposite direction.
External vibration exposure onto a limited surface area of the quasi-elastic body is capable to intensify the process collapsing gas microbubbles at this area.
Intensifying the collapsing of microbubbles of gas at a single area creates the changing (increases) at this area force effects on the body which arises when collapses of gas bubbles.
As a result, are changing (increases) the rate of movement of the body in the direction of the modified force.
Vibrational exposures, which intensify collapsing of gas microbubbles on the surface quasi-elastic body, are created during the radiation sonar, during the disturbance of aquatic and air environment during movement the ships and aircrafts, explosions and other external natural and anthropogenic phenomena.
External electromagnetic radiation of radar and other electrical devices can also intensify collapsing of gas microbubbles on a separate area surface quasi-elastic body.
Quasi-elastic body, consisting of a pulsating gas microbubbles, likewise as the microbubbles, is capable to emitting light, the pressure wave, is capable destroy in a collision of solid body, create cavitation damage upon contact of hard surfaces.
Processes electrization in quasi-elastic body, able to influence the electrical engineering of ships.
The impact of infrasound on the quasi-elastic body, created from pulsating gas microbubbles, alters the velocity moving of the body and can cause discomfort for the crew the ship, which appeared near-by .

Crew members during infrasound may be feel a headache, nausea, pain in the ears, hallucinations.
In the collision of a ship with the quasi-elastic body, which consisting of a pulsating gas microbubbles, the vessel may be damaged or even to drown.

Video

1. ROTATING LIGHTWEELS, CONSISTING FROM PULSATING GAS MICROBUBBLES, IN SEA;
2. ВОЛНЫ СВЕТА, ОБРАЗОВАННЫЕ ПУЛЬСИРУЮЩИМИ ГАЗОВЫМИ МИКРОПУЗЫРЬКАМИ;
3.ПОДВИЖНЫЕ СВЕТОВЫЕ ПЯТНА, ОБРАЗОВАННЫЕ ПУЛЬСИРУЮЩИМИ ГАЗОВЫМИ МИКРОПУЗЫРЬКАМИ.

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