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DESCRIPTION

The invention relates to apparatus in accordance with the definition of the species of claim 1. Such apparatus is known e.g. from DE-A-3 300 067.

It is known to use, as jamming and deceiving bodies, submerged towed bodies which, by electromechanical excitation (clapper blow against a hollow-body wall) or as electrically controlled emitters of water-borne sound, serve for the radiation of noise into the water, in order to distract from an object that is to be protected; or respectively to release compressed air in bubble form into the water, in order, as a result of the sound-reflecting effect of an accumulation of bubbles floating slowly past, to simulate a reflecting target object.

Underlying the invention is the recognition that the previously known items of apparatus of the type in accordance with the species are only of limited effectiveness, because more especially without considerable technical expenditure only a relatively narrow-band, and not very voluminous, sound spectrum can be radiated and a mere accumulation of bubbles is relatively easily identifiable as such, seeing that it volatilizes quite rapidly. In recognition of these factors the problem underlying the invention is to indicate jamming apparatus, effective both passively and actively, with comparatively little technological expenditure.

In accordance with the invention this problem is essentially solved in that the apparatus in accordance with the species has the characterising part of claim 1.

In accordance with this solution e.g. upon equipment of the carrying body with individual pyrotechnical charges, thus by the number thereof and by the detonation spacing thereof, the effective intensity and effective duration of the combustion gas bubbles thereof can be influenced within wide limits, but be restricted to the spatial environment of the carrying body itself and therefore be positioned or respectively delivered in accordance with the given camouflaging tasks. The three-dimensional distribution of the jamming effect of the pulsatingly expanding gas bubbles, acting both as secondary sound sources and as reflectors, can easily be adapted to the actual requirements as a result of the dependent length of a chain of strung-together individual charges. An appropriate staggering of these chains relative to one another and of the charges along the chains leads by reason of the local pressure-wave superimpositions in the surrounding water to the formation of virtual sound sources having intensities which can lie considerably above those at the locations of the individual charges and thereby further considerably reinforce the active jamming effect, thus the acoustic contamination of the surrounding water against the action of a water-borne-sound direction finder installation.



In order to bring about a wider-band jamming effect and additional deceiving effects, it is advantageous to carry out the explosion-shaped or impulse-shaped emission of the reaction gases within a flooded oscillatory housing, the wall of which then by reason of intensive vibration excitation not only leads to low-frequency but harmonic-rich pressure-waves, thus the radiation of solid-body-borne sound into the water, but in addition to the build-up of outer cavitation layers, thus, despite technologically easily controllable low-frequency excitation, to markedly high-frequency sound radiation. And despite quasi-stationary launching of the jamming body in the water there easily results for a remote detection installation by reason of these cavitation phenomena the impression of an object moving very rapidly through the water, thus of a target object. Added to this is again the deceiving effect of a sound-reflecting curtain of gas bubbles by reason of the emergence of explosion gases from the interior of the oscillating housing through its flooding apertures; with reinforcement of the mechanical oscillation excitation thereof as a result of the water-hammer effect of the gas bubbles collapsing against the outer wall. An even more favourable effect and breadth of use results if such water-hammer excitation of an oscillating housing is combined with impulse-shaped sound radiation through shock-wave tubes tuned to different frequency mixes. Reaction gases can finally also serve as means of propulsion for a driving mechanism, so that the pyroacoustic jamming body can in a self-steering or remote-controlled cover certain paths cover and thereby not only acoustically contaminate a larger spatial region, but can simulate a target object in a manner which is even truer to reality.

Conventional propelling charges can serve as energy supplier for an emission of gas bubbles which are rich in energy, expanding and collapsing again, into the water as well as for the function of the driving mechanism; or a lithergolic high-performance propellant system which is very rich in gas, with sodium boronate or potassium boronate and acid as supplier of very large quantities of reaction gases which are rich in energy, thus ones which expand strongly - as explained in more detail in our own, not previously published, older applications P 34 35 075.6 and P 34 35 076.4 dated 25.9.1984.

Additional alternatives and further developments as well as further features and advantages of the invention will become apparent from the further claims and, also taking into account what is set forth in the abstract, from the following description of preferred exemplified embodiments regarding the solution in accordance with the invention which are shown in the drawings in a highly abstracted manner along with a restriction to that which is essential.

Fig. 1 shows a submerged carrying body having pyrotechnical charge chains,

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Fig. 2 shows a flooded carrying body serving at the same time as oscillating housing and having pyrotechnical charges and

Fig. 3 shows a driven carrying body having pyrotechnical propellant for the operation of the drive, of the oscillating housing and of a tuned sound-pressure-wave generator.

The function of the apparatus, in accordance with the invention, for jamming and deceiving water-borne-sound detection installations, thus for parrying the threat which emanates from, for example, torpedos or mines, is based substantially on radiating pyrotechnical energy in an impulse-like manner as sound-wave energy into the water 1. For this pyroacoustic jamming bodies 2 are launched from an aircraft or watercraft, which consist substantially of a carrying body 3 (e.g. a towed body or one designed for buoyancy lift, suspended state or slow sinking in the water 1) for pyrotechnical charges 4. These can, as indicated in Fig. 1 and Fig. 2, be distributed discretely along detonating cords 5, or in accordance with Fig. 3 be designed as a compact or lamellar body or respectively one which is pressed in a granulate-shaped manner. The detonating cords 5 can be ignited already prior to the launching of the jamming bodies 2; or the carrying bodies 3 are equipped with ignition devices 6 which, for example after expiry of a delay time, and e.g. initiated by the contact with the sea-water 1, institute the ignition of the detonating cords 5, and by way thereof successively the explosion-like burning-off of the individual charges 4.

In the exemplified embodiment in accordance with Fig. 1 the pyrotechnical charges 4 are suspended along detonating cords 5 from the carrying body 3 freely into the water 1. The reaction-gas bubbles 7 of the individual successively detonated charges 4 expand in an impulse-like manner into the surrounding water 1, until the reaction pressure of the displaced water upon the absence of burn-off gas leads to the collapse of the respective gas bubble 7, and thereby give rise to local compression waves, thus a sound radiation which is very rich in harmonics into the water 1.

At the same time the expansion gas bubbles 7 act as a dynamic curtain of bubbles, thus as a spatially fluctuating reflector for oncoming water-borne-sound waves, which are radiated for instance from detection installations. From the superimposition of the pressure-wave fronts of the individual expanding gas bubbles 7 there results, furthermore, a number of virtual sound sources in the region aside from the individual charges 4.

As a whole the use of the jamming bodies 2 thus leads to a wide-band active and passive acoustic contamination of the sound transmission medium, water 1, so that the immediate vicinity of such a jamming body 2 for water-borne-sound detection installations on the one hand acts as a decoy target and on the other hand is scarcely penetrable for the detection of objects concealed therebehind.

2 An arrangement of the charges 4 in the interior 8, flooded by the water 1, of an oscillating housing 9 in accordance with Fig. 2 - instead of the chain-shaped suspension into the water 1 in accordance with Fig. 1 - has the advantage of giving rise, through the detonation of the charges 4, to intensive, relatively low but mixed-frequency, solid-body-borne-sound vibrations of the oscillatory wall parts of the housing 9, excited by the expansion-gas bubbles 7 in the interior 8. From these oscillations of short intensive excitation there results on the outside of the housing the formation of cavitation layers 10, as otherwise occur in practice only on objects moving very rapidly through water 1 (such as for instance on critical hull shapes of fast ships or more especially on propeller blades). This jamming body 2 thus simulates, as a result of the formation of such cavitation layers 10, for a remote detection installation also additionally the presence of a fast craft, although it is a matter merely of a quasi-stationary floating or sinking body for the longer-lasting build-up of a quasi-stationary jamming and deceiving field.

The reduction of the explosion-gas-bubble excess pressure in the interior 8 through its flooding apertures 11 by emerging bubbles 7, which collapse against the outer wall, increases through the water-hammer effect the oscillation intensity of the housing 9; and the jamming-sound effect is also increased in that the bubble collapses through their suction effects act as (secondary) sound sources. As a whole this actively and passively acting object in the form of the jamming body 2 is thus difficult to identify for a detection installation and, by reason of the intensive curtain of bubbles 12, scarcely penetrable. As a result of a different mechanical design of individual regions of the wall of the oscillating housing 9 different inherent resonances can be caused, with the result also of a high-frequency oscillation behaviour, tuned in a wide-band manner, of the cavitation layers 10.

In the symbolically simplified basic representation in accordance with Fig. 1 or Fig. 2, in the interests of clarity it is not taken into account that the jamming bodies 2 can also be equipped with a drive of their own, in order to open up a jamming region which is spatially fanned-out from the launch location, thus one having a broader sweep, for instance for screening operations going on therebehind.

A modified jamming body 2, driven at the same time by the supplier for the pulsating bubbles 7, is shown in Fig. 3. Deviating from the conditions in accordance with Fig. 2, here the reaction gases of a compact propelling charge are initially collected in at least one pressure chamber 13, out of which they then pass over, rationed by an excess-pressure valve 20, by way of an impulse tube 14 in an impulse-like manner into the actual oscillating housing 9. This has the advantage of being able to realise, in a manner which is simpler with respect to apparatus, a solid-body-borne-sound frequency tuning. Moreover, it is then also simpler to utilise the pyrotechnical charge 4 at the same time as

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propellant for a driving mechanism 15; in the case of which it can be a matter, as shown, of an exhaust-gas reaction system or, more advantageously still, of the fluid-piston water-jet driving system explained in more detail in our own, not previously published, older Patent application P 34 35 076.4 dated 25.9.1984.

In the case of the pyroacoustic jamming body 2 in accordance with Fig. 3 the charge 4 serves, furthermore, for the excitation of a tuned sound-pressure generator 16, which in the depicted exemplified instance is combined structurally with the driving mechanism 15. It consists of a number of shock-wave tubes 14 tuned - by virtue of their length and their diameter - to different fundamental frequencies between the surrounding water 1 and a periodically opened pressure chamber 13 for the reaction gases of the propellant charge 4. The defined temporal pressure courses 17 at the outlet of the shock-wave tubes 14 differ mutually more especially through their ascent and descent flanks, thus through very different harmonic contents; as illustrated in Fig. 3 respectively in the direction parallel to the axis 18 of the jamming body 2 over a radially extending time axis. The small pulsating gas bubbles 7 emerging through the shock-wave tubes 14 and the larger amounts of driving gas likewise emerging rearwardly from the driving mechanism 15 in a compressed-impulse-shaped manner join together in the far field (in the water 1) again to form a curtain of bubbles 12.

The pyroacoustic self-running jamming body 2 in accordance with Fig. 3 thus radiates sound waves 19 in various spectral regions. These are variable within wide limits as a result of constructional measures, since it is a matter of a superimposition of low-frequency solid-body-borne-sound effects with high-frequency cavitation effects and the frequency mix of periodic-impulse-shaped effects of the slow expansion and rapid collapse of a multiplicity of gas bubbles, supplemented by the effects, tunable frequencywise in a staggered manner, of the oscillation excitation of shock-wave tubes 14. The simple mechanical structure makes possible the provision of large amounts of relatively small, thus easily manageable, pyroacoustic jamming and deceiving bodies 2 as economically-priced consumer articles on board also merchant ships, in order rapidly to be able to put up against an impending threat, disclosing itself as a result of enemy water-borne-sound detection installations, protective measures behind which evasive or defensive manoeuvres can be prepared.



CLAIMS

1. Apparatus for jamming and deceiving water-borne-sound detection installations, having a device, launchable into the water, for generating and reflecting sound waves, characterised in that the device has carrying bodies (3), which are equipped with pyrotechnical charges (4) for the bubble-shaped radiation of reaction gases rich in energy.
2. Apparatus according to claim 1, characterised in that each carrying body (3) has at least one chain-shaped arrangement, suspended from the carrying body, of individual charges (4).
3. Apparatus according to claim 2, characterised in that the chains are formed by detonating cords (5) between the charges (4).
4. Apparatus according to one of the preceding claims, characterised in that charges (4) are arranged in the interior (8) of a flooded oscillating housing (9), the walls of which for the formation of cavitation layers (10) can be set into oscillations by detonation of the charges.
5. Apparatus according to one of the preceding claims, characterised in that the interior (8) of an oscillating housing (9) excitable into cavitation oscillations (10) is feedable from a pressure chamber (13) by way of an impulse tube (14') with reaction gases, which can emerge again from the oscillating housing (9) through flooding apertures (11) as a curtain of bubbles (12).
6. Apparatus according to one of the preceding claims, characterised in that a sound-pressure-wave generator (16) having differently tuned shock-wave tubes (14) extending between an expansion-gas pressure chamber (13) and the surrounding water (1) is provided.
7. Apparatus according to one of the preceding claims, characterised in that the charges (4) are at the same time provided as propellant for a driving mechanism (15) on the carrying body (3).