

Claims

- 1.- Device (30) for attenuating underwater sound pressure, whereby the device (30) comprises at least one bubble generation unit (32) and an air conduit (31) configured for supplying pressurized air to the bubble generation unit (32), characterized in that the bubble generation unit (32) comprises a fluidic oscillator (1a, 1b, 1c) for generating one or more pulsating air flows from a constant air flow.
- 2.- Device (30) according to claim 1, characterized in that the fluidic oscillator is a fluidic oscillator (1b, 1c) with an adjustable oscillation frequency, whereby the oscillation frequency of the fluidic oscillator (1b, 1c) is adjustable independently of the air pressure in the air conduit (31).
- 3.- Device (30) according to claim 2, characterized in that the device (30) comprises sound capturing means (38) and a control unit (37), whereby the control unit (37) is arranged to receive an input signal from the sound capturing means (38) and to send to the fluidic oscillator (1a, 1b, 1c) a control signal for controlling the oscillation frequency, whereby the control unit (37) is arranged to calculate the control signal using the input signal.
- 4.- Device (30) according to claim 3, characterized in that the control unit (37) is arranged to calculate a sound frequency distribution from the input signal, whereby the control unit (37) is arranged to calculate the control signal from the sound frequency distribution.
- 5.- Device (30) according to any of the previous claims, characterized in that the device (30) comprises a first type of said fluidic oscillator (1a, 1b, 1c) and a second type of said fluidic oscillator (1a, 1b, 1c), whereby the first type of said fluidic oscillator (1a, 1b, 1c) and the second type of said fluidic oscillator (1a, 1b, 1c) are designed to operate at different oscillation frequencies if they are supplied with air at the same pressure.

6.- Device (30) according to any of the previous claims, characterized in that the air conduit is a flexible air hose (31), whereby the device (30) comprises a plurality of said bubble generation units (32) arranged along at least a part of the length of the air hose (31).
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7.- Device (30) according to any of the previous claims, characterized in that the bubble generation unit (32) comprises a bubble generation unit body (35) having a bubble outlet channel (36) which is open at its top end and at its bottom end,
10 whereby the fluidic oscillator (1a, 1b, 1c) comprises an air outlet which debouches in the bubble outlet channel (36).

8.- Device (30) according to any of the previous claims, characterized in that the fluidic oscillator (1a, 1b, 1c) comprises at least two separate air outlets (2,3) operating at the same frequency but phase-shifted by half a wave period.
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9.- Use of a device (30) according to any of the previous claims for attenuating the sound energy of underwater sound, whereby the air conduit (31) and the bubble generation unit (32) are placed underwater, whereby pressurized air is supplied to the air conduit (31) and whereby air bubbles (40) are generated by the bubble generation unit (32).
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10.- Use according to claim 9, characterized in that the air conduit (31) or air conduits (31) of one or more such devices encircle a source of underwater sound, whereby the device (30) comprises at least four bubble generation units (32) which are placed underwater.
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11.- Use according to claim 9 or 10, characterized in that the device (30) is a device (30) according to claim 3 or 4, whereby the sound capturing means (38) is placed underwater, whereby the air conduit (31) is placed between the sound capturing means (38) and a source (29) of underwater sound.
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12.- Use according to claim 11, characterized in that the control unit (37) controls the oscillation frequency of the fluidic oscillator (1a, 1b, 1c) depending on the frequency distribution of the sound captured by the sound capturing means (38).

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13.- Use according to any of claims 9 to 12, characterized in that the device (30) comprises at least two fluidic oscillators (1a, 1b, 1c), each having an adjustable oscillation frequency, whereby the at least two fluidic oscillators (1a, 1b, 1c) are supplied with air from the same air conduit (31), whereby a first fluidic oscillator of
10 said fluidic oscillators (1a, 1b, 1c) is controlled to operate at a first oscillation frequency, whereby a second fluidic oscillator of said fluidic oscillators (1a, 1b, 1c) is controlled to operate at a second oscillation frequency.

14.- Use according to any of claims 9 to 13, whereby a first device (30) and a second
15 device (30), both according to any one of claims 1 to 8, are used, whereby the air conduit (31) of the first device (30) forms at least part of an encirclement of a source (29) of underwater sound, whereby the air conduit (31) of the second device (30) forms at least part of an encirclement of the air conduit (31) of the first device (30).

20 15.- Use according to any of claims 9 to 13, characterized in that the bubble generation unit (32) of the first device (30) generates bubbles (40) of a different size than the bubble generation unit (32) of the second device (30).

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