United States Patent

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[54] **ACOUSTIC IMPULSE SOURCE WITH DIRECTIONAL BAFFLE**
3 Claims, 1 Drawing Fig.

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[50] **Field of Search** ..... 181/0.5, 31(A), 27(A); 340/8(RT), 12

[56] **References Cited**
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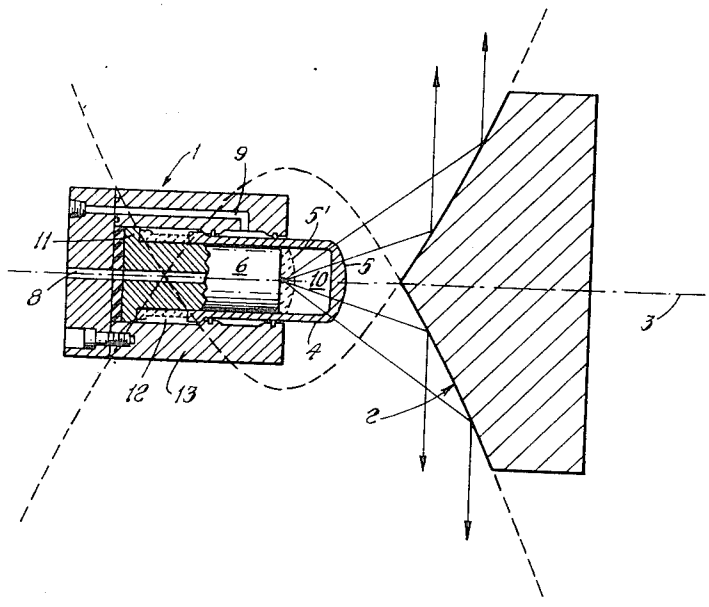
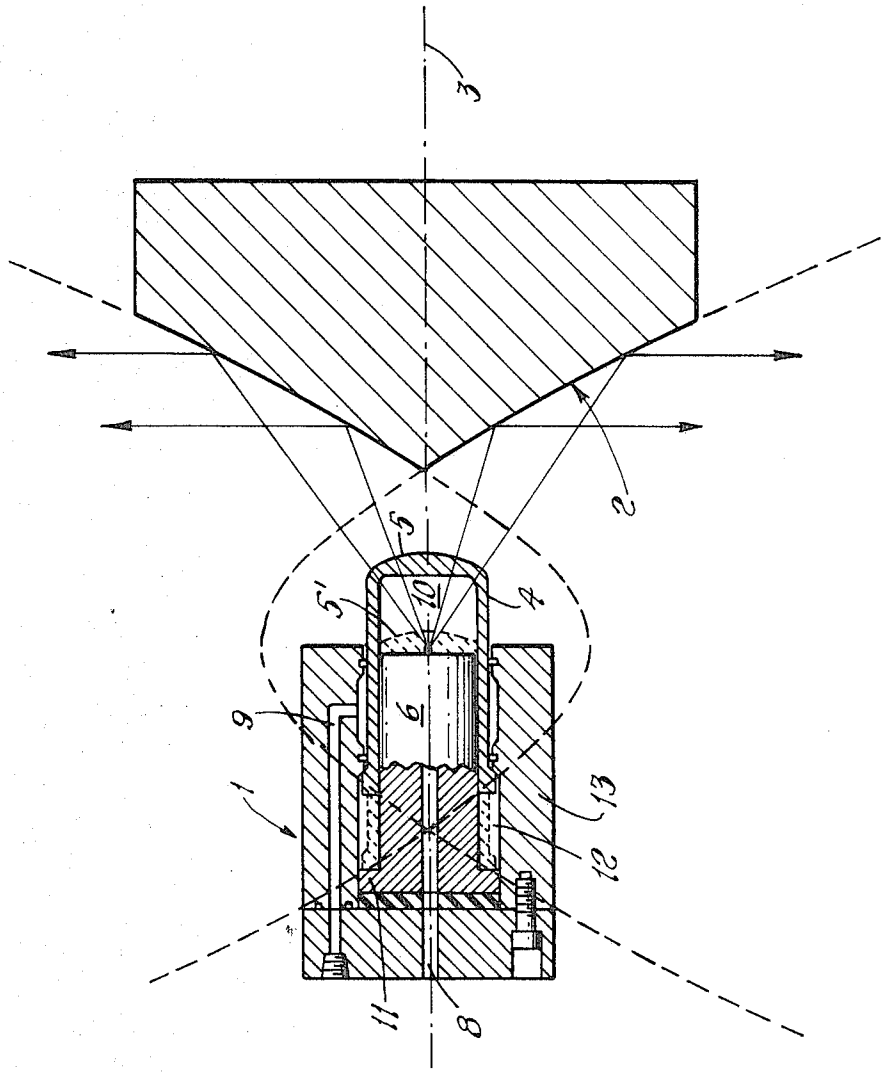
ABSTRACT: A pseudosphere is provided as a baffle positioned in the path of acoustically generated signals coming from a unidirectional acoustic impulse generator to reflect the signals in an omnidirectional pattern.





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ACOUSTIC IMPULSE SOURCE WITH DIRECTIONAL BAFFLE

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to acoustic generation of impulses in a fluid medium and more specifically to a baffle or reflector positioned ahead of the generator for providing an omnidirectional pattern about one axis to the radiated energy. The baffle takes the form of a pseudosphere, or more particularly, a tractoid, which is generated by revolving a tractrix, a plane curve of constant negative curvature, about its convergeant axis. In the subject invention, the plane curve of the tractrix is parabolic and is that part of a parabola whose focus is the center of the active generating means and whose directrix is parallel to the longitudinal axis of symmetry of the generator when a horizontal omnidirectional pattern is desired. The directrix need not be parallel to the longitudinal axis if a cone-shaped omnidirectional pattern is desired.

While this baffle may be employed to deflect acoustic radiation from any directional generating source, it is most effective with an impulse generator of the type described in my U.S. Pat. No. 3,277,437. This patent describes a generator comprising a hollow tubular piston which is partially exposed to seawater and whose internal surface provides a close fit to a shock-mounted anvil. In the operation of the generator, the piston is rapidly moved toward an anvil thus also drawing in water surrounding the outer face of the piston. When the piston is abruptly stopped at the anvil, a shock wave is produced in the indrawn fluid medium. The shape and propagation characteristics of the shock wave produced, which propagates in a single forward direction, have been found to vary with the shape of the outer face of the piston and the surrounding baffle. The impulse formed by this generator is intense and of relatively short duration. By various configurations of the piston head, varying pulse shapes may be achieved.

Most acoustic impulse sources are unidirectional so as to propagate a maximum amount of energy in a given direction. Acoustic impulse sources which impart a velocity step to pistons, however, generate such a great amount of energy that it is possible to utilize this energy in an omnidirectional pattern about at least one axis. For this purpose, a baffle or reflector, to be described herein, is positioned on the longitudinal axis of symmetry of the generator so as to deflect the substantially unidirectional radiation into an omnidirectional pattern about the longitudinal axis without distorting the form of the pulse.

It is therefore the object of this invention to provide a baffle located on the longitudinal axis of symmetry of an impulse source for deflecting radiation from such a source into an omnidirectional pattern about this longitudinal axis.

It is a further object of this invention to provide that the face of this baffle be that section of a parabola, ahead of the impulse source, revolved on an axis which passes through its focus located at the center of the piston and which corresponds to the longitudinal axis of symmetry of the generator.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description thereof when considered in conjunction with the accompanying drawing.

Referring now to the drawing, the single figure illustrates the type of generator described in my U.S. Pat. No. 3,277,437. Here the apparatus is shown vertically oriented with a baffle **2** ahead of generator **1** and disposed along its longitudinal axis of symmetry **3**. This generator **1** has a hollow piston **4** and a head **5** coacting with an anvil **6**. The piston head has a cocked position **5** and a rest position **5'**. When accelerated and then rapidly decelerated in the presence of a fluid medium, this member produces an intense shock wave which propagates outwardly along the longitudinal axis of symmetry of the generator into the surrounding fluid medium.

In the operation of the acoustic impulse generator, piston **4** is first moved into the cocked position **5** by a high pressure fluid medium introduced through channel **8**. Then it is clamped in this cocked position by the hydraulic clamp means **9**. The acoustic impulse generator is fired by evacuating chamber **10** and releasing clamp means **9**. The ambient sea pressure drives piston **4** towards shoulder **11** and anvil **6**. The instant deceleration upon contact with anvil **6** results in an instantaneous pressure rising at its face which propagates from the face **5** towards the baffle **2**.

Baffle **2** is located on the longitudinal axis of symmetry **3** of the generator **1**. The reflecting surface of this baffle is defined by that section of a parabola revolved about an axis which passes through its focus at the center **14** of piston head **5'** and which axis corresponds to the longitudinal axis of symmetry **3** of the generator. Because of the parabolic surface, acoustic radiation generated upwardly at **14** will be reflected horizontally and provide a laterally directed omnidirectional pattern of radiation if the directrix of the parabola (not shown) is parallel to axis **3**. It will be appreciated that if the directrix is skewed with respect to axis **3**, an annular cone of radiation will result. Because the piston head is of a finite length, acoustic radiation generated by points removed from the center **14** will not appear to radiate from the focus of the parabola, resulting in spreading of the energy. Additionally, the truncated baffle will result in scattering of some energy. This configuration will, however, be capable of diverting the upwardly propagating energy sideways and provide for a substantially omnidirectional directivity in the horizontal plane.

It will be appreciated that the head **5** of the piston **4** may take on a variety of shapes depending on the configuration of the pulse to be generated. The configuration of the pulse will be maintained during reflection such that its shape will remain constant in any horizontal direction. The baffle material may be a dense, highly damped material such as lead, which provides a large impedance discontinuity relative to the water.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

I claim:

1. In combination:

an acoustic generator having a radiating surface which produces an acoustic pulse that propagates along a predetermined axis; and

a tractoid spaced from said radiating surface and symmetrically disposed about said axis with its point of convergence being the closest point of said tractoid to said surface,

the surface of said tractoid being formed by revolving a tractrix around its convergent axis,

said tractrix being a portion of a parabola which has its focus located at said radiating surface.

2. The combination recited in claim **1** wherein the directrix of said parabola is parallel to said predetermined axis whereby said acoustic pulse propagating along said predetermined axis and impinging on the surface of said tractoid is reflected into an omnidirectional pattern.

3. In combination:

a hydroacoustic impulse generator of the type wherein an intense acoustic shock wave is produced at the face of a piston when said piston is rapidly accelerated and then instantaneously stopped thereby producing a short acoustic pulse which radiates outwardly from said piston face; and

a tractoid-shaped baffle spaced from said piston head and symmetrically disposed around an axis defined by the direction of acceleration of said piston and passing through the center of said piston face with the point of convergence of said tractoid-shaped baffle being the closest point of said baffle to said piston face,

the surface of said baffle being formed by revolving a tractrix about its convergent axis, said tractrix being that portion of a parabola which has its focus located at the center of the face of said piston and which starts at said convergent axis and moves outwardly therefrom and away from said piston head.