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(54) **BARRIER FOR PROTECTION AGAINST
SHOCK WAVES**

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(57) **ABSTRACT**

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A barrier for protection against shock waves comprises, in combination with each other, a plurality of soil containing and reinforcing structures (20, 22) superimposed on each other in such a way as to form two vertical walls (12). Means of absorbing shock waves (30) are positioned inside the said walls (12). The protective barrier also comprises transverse connecting means (14, 50, 80) engaged with the vertical walls (12) to enhance the compactness of the protective barrier.

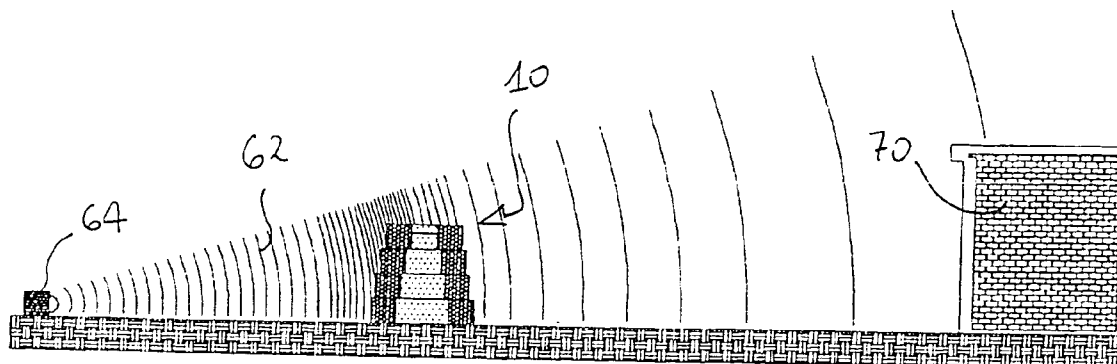


FIG. 1

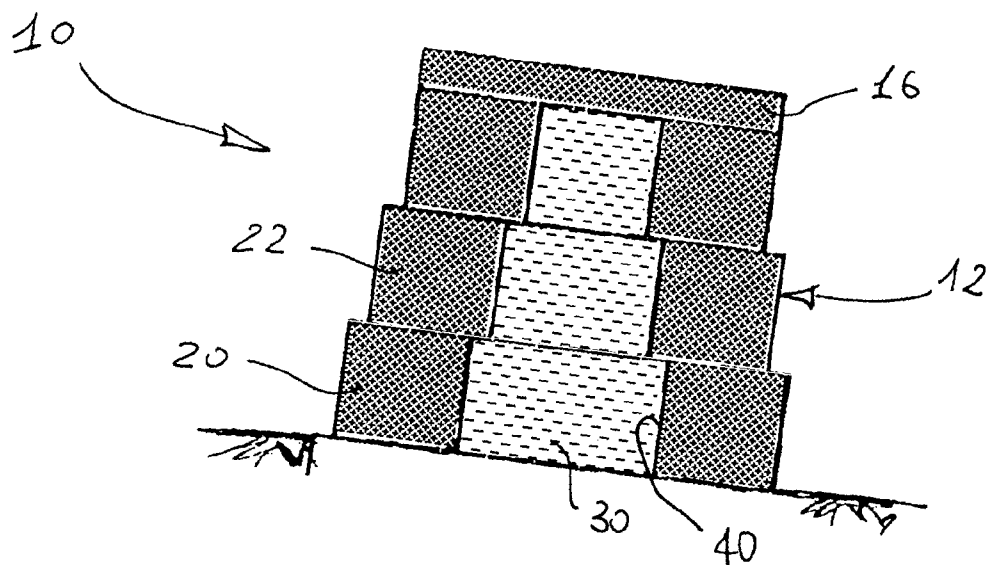


FIG. 2

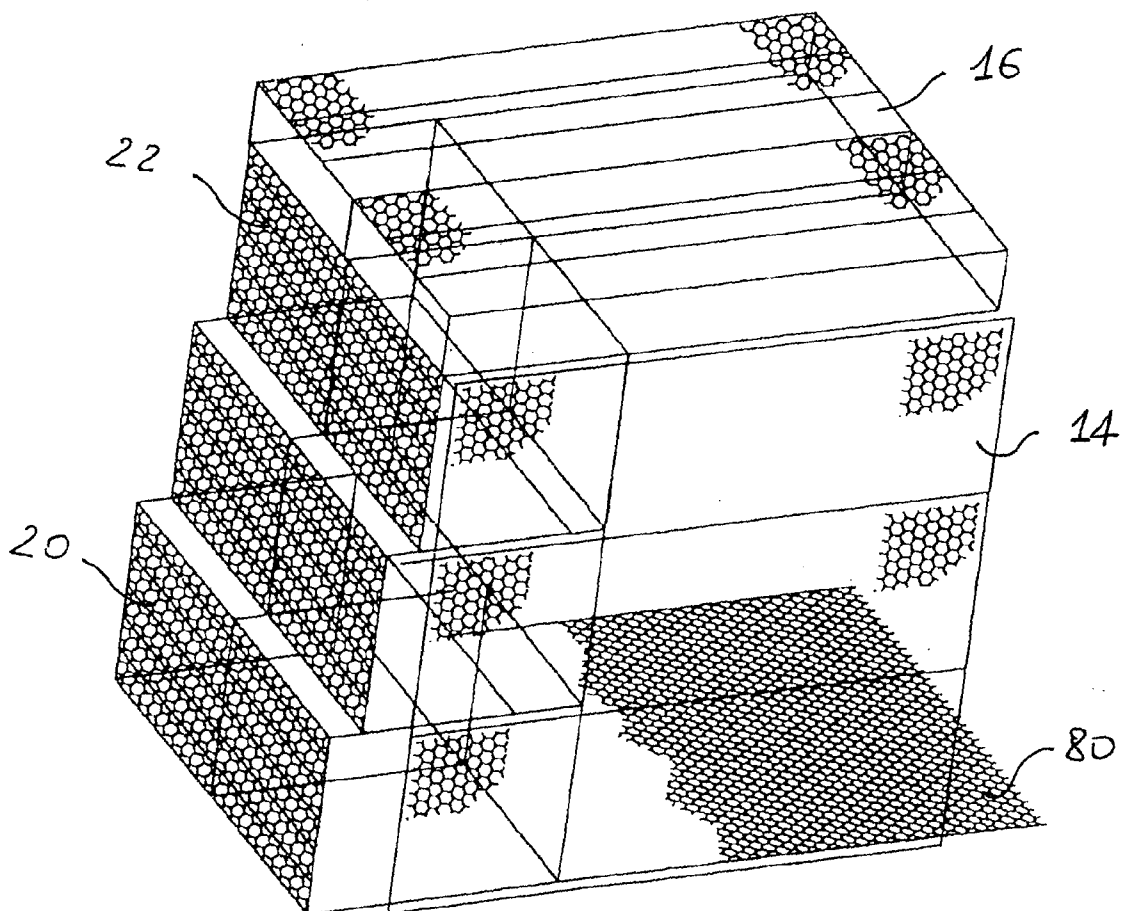


FIG. 3

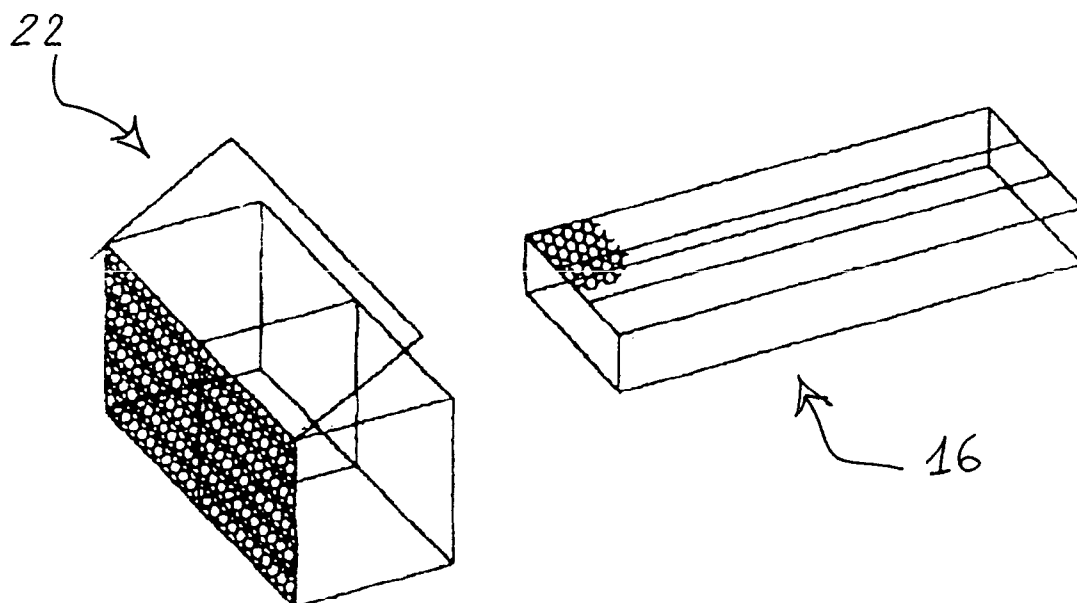


FIG. 4

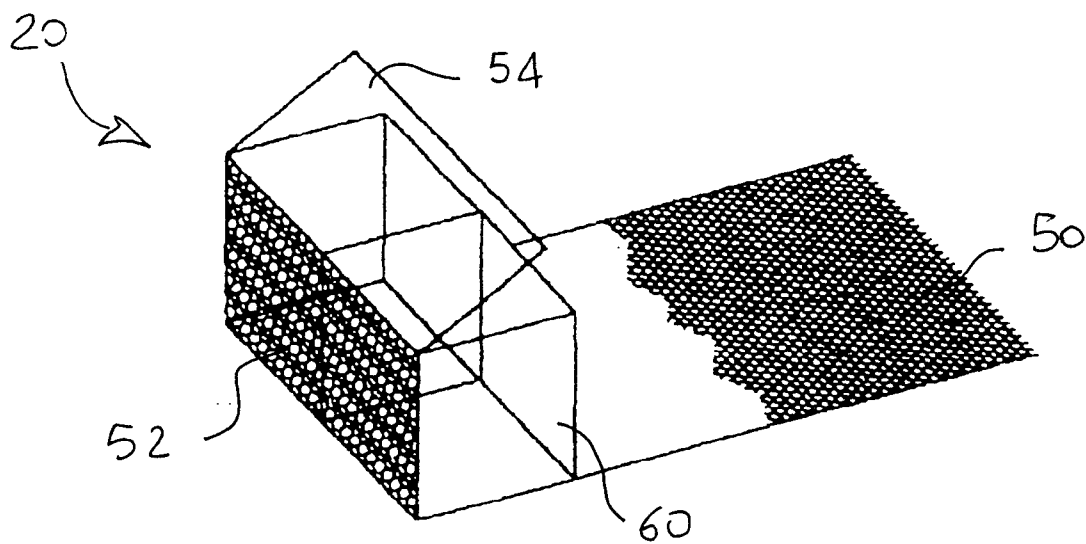


FIG. 5

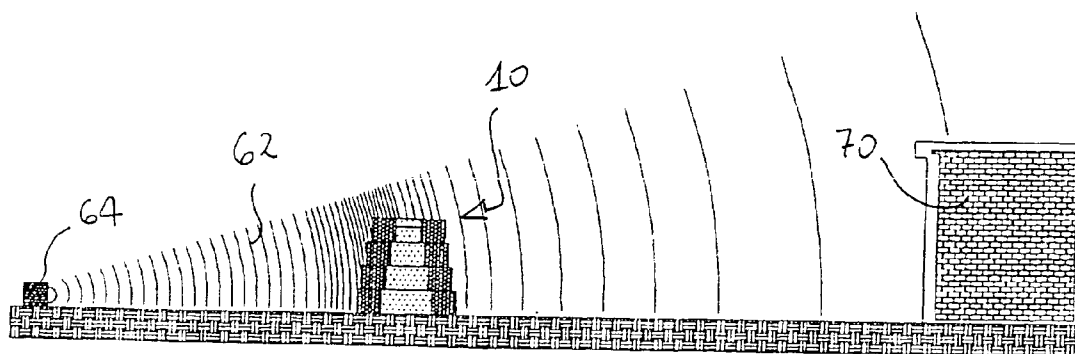
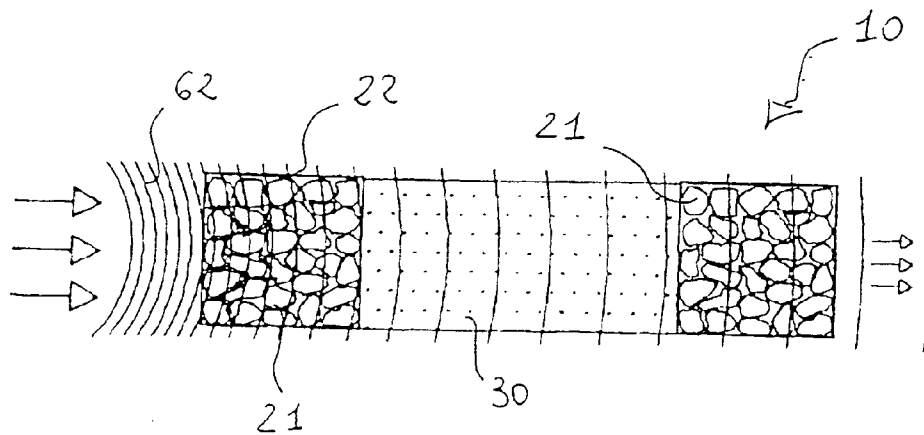


FIG. 6



BARRIER FOR PROTECTION AGAINST SHOCK WAVES

[0001] The present invention relates to a reinforced protective structure, and in particular a barrier for protection against shock waves, which can attenuate and absorb shock waves caused by sound waves and/or by air movements.

[0002] There are numerous known structures for absorbing the shock waves caused by different sources. These structures can be generally divided into two types. The first type comprises rigid structures which are sufficiently strong to reflect the shock waves. These structures have the advantage of being repeatedly reusable, but are usually heavy, difficult to handle and very expensive. The second type comprises structures which are deformed to a limited and predetermined extent in order to absorb the shock waves. These structures are far less heavy and less bulky, and can also provide adequate protection, but have the disadvantage of being usable once only.

[0003] The object of the present invention is to provide a barrier for protection against shock waves which can overcome the drawbacks of the known structures, and which can also attenuate and absorb in a highly effective way the shock waves caused by sound waves and/or by air movements.

[0004] Another object of the present invention is to provide a barrier for protection against shock waves which is economical to manufacture and install, is easily maintained and has high strength even after prolonged use.

[0005] In order to achieve the aforesaid objects, the present invention is concerned with a barrier for protection against shock waves as defined in the claims which follow.

[0006] One of the main advantages of the present invention is the simplification of the operations of transporting and installing the barrier for protection against shock waves. The soil containing and reinforcing elements which form the barrier for protection against shock waves can be carried to the installation site in a compact form, and can then be erected and filled with the filling material only at the time of use. Similarly, after use, the barrier can be easily dismantled and transported elsewhere.

[0007] Another advantage of the present invention is the possibility of easily and rapidly changing the dimensions of the protective barrier. The dimensions of the barrier can be changed according to the technical characteristics of the source of shock waves and/or the dimensions and distance of the element to be protected, by adding or removing the soil containing and reinforcing elements which form the barrier, or by changing their dimensions, or again by replacing the shock wave absorption means.

[0008] Further characteristics and advantages will be made clear by the following description, with reference to the attached figures, provided purely by way of example and without restrictive intent, in which:

[0009] FIG. 1 is a schematic side view of a barrier for protection against shock waves according to the present invention;

[0010] FIG. 2 is a schematic perspective view of the protective barrier of FIG. 1;

[0011] FIG. 3 is a perspective view of the containing elements forming the lateral and upper walls of the protective barrier according to the present invention;

[0012] FIG. 4 is a perspective view of containing elements according to a preferred embodiment of the present invention;

[0013] FIG. 5 is a schematic side view of the barrier for protection against shock waves according to the present invention in an operating position; and

[0014] FIG. 6 is a view in longitudinal section of the protective barrier illustrated in FIG. 5.

[0015] With reference to the figures, a barrier for protection against shock waves which can attenuate and absorb shock waves caused by sound waves and/or by air movements according to the present invention comprises a main structure 10, of essentially pyramidal or rectangular shape, having two frontal walls 12, transverse vertical connecting means 14 and horizontal connecting means 50, 80, and a cover 16.

[0016] The frontal walls 12 comprise a plurality of soil containing and reinforcing elements 20, 22, made, for example, but not exclusively, from one or more panels of wire mesh, preferably hexagonal wire mesh, bent to form a box structure and filled with filling material 21. As shown in the figures, the containing and reinforcing elements 20, 22 are positioned so that one is superimposed on another in a plurality of rows and have their longitudinal axes parallel to each other, and can preferably, but not exclusively, have identical dimensions. The containing and reinforcing elements 20, 22 of each wall 12 can be positioned so that they are slightly staggered with respect to each other, so that the main structure 10 takes on an essentially pyramidal shape.

[0017] The cover 16 is also preferably formed from one or more soil reinforcing and containing elements, positioned transversely above the rows of reinforcing and containing elements 20, 22.

[0018] As shown in FIG. 2, the two frontal walls 12 are interconnected by vertical transverse connecting means, for example, but not exclusively, vertical panels 14 of wire mesh, preferably hexagonal wire mesh. The vertical transverse connecting means 14 not only enclose the structure and protect the containing and reinforcing elements 20, 22, but are also used to increase the compactness of the protective barrier 10. Clearly, the vertical transverse connecting means can also be made in a different way from that shown, for example in the form of geosynthetic panels, metal panels, panels of sound-absorbent material and/or other soil containing and reinforcing elements.

[0019] As shown in FIGS. 3 and 4, the containing and reinforcing elements 20, 22 used to form the protective barrier 10 can be made by different methods and in different shapes.

[0020] Some containing and reinforcing elements 20 comprise, for example, but not exclusively, a single wire mesh panel divided into a base portion 50 which acts as a horizontal transverse connecting means, an intermediate portion 52 which acts as a front wall of the reinforcing and containing element 20, and an upper cover portion 54 of the reinforcing and containing element 20. The three portions are preferably demarcated from each other by metal bars used both as reinforcing means and as bending lines for the aforesaid portions 50, 52, 54. Further panels 60, hinged on the base portion 50 of the wire mesh panel, form the side

walls and the rear wall of the box structure of the reinforcing and containing element **20** when in use, and filling material **21** such as sand, pebbles, gravel or similar material, possibly available in situ, is placed within these walls.

[0021] Other containing elements comprise essentially box-shaped structures formed from a plurality of panels of wire mesh, preferably hexagonal wire mesh, connected to each other. In a preferred embodiment, these containing and reinforcing elements are made, for example, but not exclusively, in the form of gabions **22**. Each gabion **22** comprises at least four walls, including an upper wall which forms a cover element, a lower wall, two side walls, and a pair of walls which form a front and a rear wall of the gabion. Filling material **21** such as sand, pebbles, gravel or similar material, possibly available in situ, is placed within the gabions **22**. The gabions **22** generally have dimensions such that their length is greater than their width, and their height is essentially equal to their width. In this embodiment, the gabions **22** are connected by horizontal transverse connecting means **80** comprising wire mesh or geosynthetic panels.

[0022] Clearly, the horizontal transverse connecting means **50**, **80** can also be made in a different way from that illustrated, for example from geosynthetic panels, without departure from the scope of the present invention.

[0023] As also shown in FIG. 5, the containing and reinforcing elements used to form the cover **16** of the protective barrier **10** are generally also gabions whose height is smaller than their width. In an alternative embodiment, the cover **16** of the protective barrier **10** can be formed from a plurality of protective elements of the mattress type, comprising a flexible outer casing which covers a gabion made from metallic material and filled for example, but not exclusively, with a mixture of bitumen, sand and stones or pebbles.

[0024] The barrier for protection against shock waves according to the present invention also comprises absorption means **30** for attenuating and absorbing shock waves caused by sound waves and/or by air movements. The shock wave absorption means comprise, for example, but not exclusively, containers filled with liquids, preferably bags filled with water.

[0025] Clearly, a person skilled in the art will have no difficulty in identifying shock wave absorption means other than those described, which also have a high absorption coefficient, without departing from the scope of the present invention. This is because the reduction and absorption of shock waves can also be achieved by using other absorption means, for example, but not exclusively, expanded polyurethane combined with a layer of bitumen, open-cell expanded flexible polyurethane, or fibrous material in general.

[0026] The liquid containers **30** or other absorption means can be placed within further containing and reinforcing elements **40** located internally between the two frontal walls **12**. The internal containing and reinforcing elements **40** can vary from each other in their dimensions and are such that they fill the space between the containing and reinforcing elements **20**, **22** forming the two frontal walls **12**. The internal containing and reinforcing elements **40** can be gabions or, more generally, essentially box-shaped structures, made from one or more panels of wire mesh, preferably hexagonal wire mesh.

[0027] Clearly, the shape and arrangement of the reinforcing and containing elements described above and illustrated in the attached figures is indicated purely by way of example and without restrictive intent. A person skilled in the art will have no difficulty in modifying the shape and arrangement of these elements without departing from the scope of the present invention.

[0028] In order to form a barrier for protection against shock waves according to the present invention, a plurality of soil containing and reinforcing structures **20**, **22**, **40**, in the form of wire mesh panels, are carried to the installation site. Here the horizontal transverse connecting means **50**, **80** are positioned and the panels are bent on these in such a way as to form first soil containing and reinforcing structures **20**, **22**, as shown in FIG. 4. The soil containing and reinforcing structures **20**, **22** are then superimposed on each other to form the opposing frontal walls **12** of the protective barrier **10**, and are filled with pebbles, sand, gravel or similar material. Second soil containing and reinforcing structures **40**, are then fitted between the two frontal walls **12**, and the liquid containers **30** or other shock wave absorption means are placed within these second structures. Finally, the transverse connecting means **14** and the cover **16** are positioned to form the requisite barrier for protection against shock waves.

[0029] As shown in FIG. 5, the protective barrier **10** is located in a predetermined position with respect to a shock wave source **64**, in such a way as to attenuate and absorb the shock waves **62** travelling towards a target **70** to be protected. The distance and dimensions of the barrier **10** can be calculated in advance according to the technical characteristics of the shock wave source **64** and of the target **70** to be protected.

[0030] In use, as shown schematically in FIG. 6, the shock waves **62** originating from the source **64** initially strike the frontal walls **12** of the barrier **10** and in particular the soil containing and reinforcing structures **20**, **22** filled with sand, pebbles, gravel or similar material. This initial impact is enough to attenuate and disperse a significant proportion of the shock waves **62**. The shock waves **62** then pass through the absorption means **30**, where they are attenuated and absorbed to a significant extent because of the physical characteristics of the said means, such as the water for example. Finally, the residual shock waves **62** pass through the other frontal wall **12** and in particular the soil containing and reinforcing structures **20**, **22** filled with sand, pebbles, gravel or similar material.

[0031] A further advantage of the present invention is that the shock waves encounter three stages of absorption with technical and physical characteristics which differ from each other, for example, but not exclusively, gravel and water or other sound-absorbent materials. These variations provide greater absorption and an attenuation of the shock waves which is even more effective than that of the known devices.

[0032] Clearly, provided that the principle of the invention is retained, the forms and details of embodiment can be varied widely from what has been described and illustrated, without departure from the scope of the present invention.

1. Barrier for protection against shock waves, characterized in that it comprises, in combination with each other, a plurality of soil containing and reinforcing structures (**20**,

22) superimposed on each other in such a way as to form two vertical walls **(12)**, and means of absorbing shock waves **(30)** positioned inside the said walls **(12)**.

2. Protective barrier according to claim 1, characterized in that it additionally comprises transverse connecting means **(14, 50, 80)** engaged with the vertical walls **(12)** to increase the compactness of the protective barrier.

3. Protective barrier according to claim 2, characterized in that the transverse connecting means comprise vertical panels **(14)** and horizontal panels **(50, 80)**.

4. Protective barrier according to claim 3, characterized in that the vertical panels **(14)** and horizontal panels **(50, 80)** are made from wire mesh panels.

5. Protective barrier according to claim 3, characterized in that the vertical panels **(14)** and horizontal panels **(50, 80)** are made from geosynthetic panels.

6. Protective barrier according to claim 1, characterized in that the means of absorbing shock waves **(30)** are positioned inside further soil containing and reinforcing structures **(40)**.

7. Protective barrier according to claim 1, characterized in that the means of absorbing shock waves comprise sound-absorbent materials.

8. Protective barrier according to claim 7, characterized in that the means of absorbing shock waves comprise containers filled with liquids **(30)**.

9. Protective barrier according to claim 1, characterized in that the soil containing and reinforcing structures **(20, 22)** are filled with sand, pebbles, gravel or similar material **(21)**.

10. Barrier for protection against shock waves, characterized in that it comprises, in combination with each other, first soil containing and reinforcing structures **(20, 22)** superimposed on each other in such a way as to form two opposing vertical walls **(12)**, the first structures **(20, 22)** comprising box-shaped portions filled with sand, pebbles, gravel or similar material, second soil containing and reinforcing structures **(40)** positioned inside the vertical walls **(12)**, and means of absorbing shock waves **(30)** positioned inside the second soil containing and reinforcing structures **(40)**.

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