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(54) **Mounting of sonic devices.**

(57) A number of sonic transducers (11) are mounted, and located as an array, in a block (22) of closed-cell foamed plastics material whose cells are filled with gas to be acoustically opaque. The active faces, or heads of the transducers are located in recesses (10J) in a mould (10) before introduction of the foamed material, so that the active faces will be exposed and protrude from the moulded block. The array in its block is mounted in an outer casing (30, 32) sealed (36) against entry of water. A space (34) within the casing and in communication with the active faces is filled with an acoustic coupling medium (35).

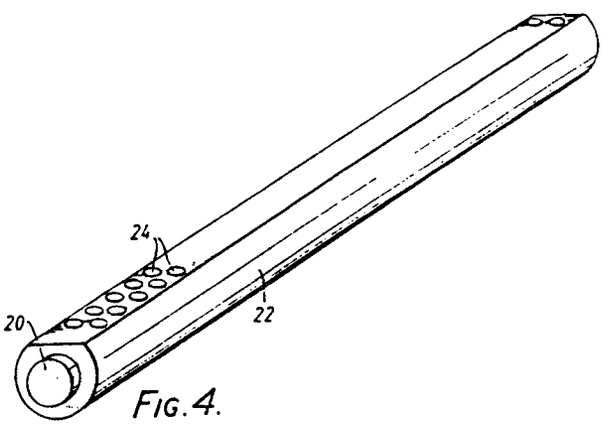

FIG. 4.

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MOUNTING OF SONIC DEVICES

This invention relates to the mounting of sonic devices by which term is meant a transducer for the transmission and/or reception of sound energy.

Particularly for underwater installations a number of such devices are often formed as an array, and it is therefore necessary accurately to locate each sonic device relative to other sonic devices of the array. Hitherto such arrays have been held and located by a form of mechanical structure which generally comprises a metallic block or stave. Such a stave is generally produced by machining, from the solid, the appropriate apertures for each sonic device and location means has to be provided to provide the required support, for example, of a resilient nature, for each device at its nodal point, in its respective aperture in the stave, whilst mechanically de-coupling it from every other device. Such constructions are relatively complex in design, expensive to manufacture, and unnecessarily heavy. These considerations also introduce complexities in the mechanical structure which may impair the acoustic performance of the elements of the array.

An object of the present invention therefore is to provide ways of mounting and locating one sonic device, or a number of sonic devices, e.g. to form an array, without having a complex supporting construction, but at the same time providing for optimum performance of each device once mounted and located.

According to one aspect of the present invention at least one sonic device is mounted and located in a block of acoustically-opaque foamed plastics materials,

with the sensitive head or heads left uncovered by the plastics material.

The foamed plastics material used for the formation of the block may vary according to requirements, but it may specifically be BIBBITHANE ISOFOAM 510 prepared and cured in accordance with the manufacturers' instructions.

The foamed plastics material may have closed cells which are filled with gas generated during foaming. This feature is found to improve the mechanical decoupling of one sonic device from each other device of the array, by virtue of the gas within the foam itself, which makes the material acoustically opaque.

According to another aspect of the present invention in a method of mounting a sonic device or an array of sonic devices the, or each, sonic device is located within a mould, preferably by its sensitive head, and a body of foamed plastics material is moulded around it.

Whilst it is envisaged that in most cases an array of sonic devices will be located within a single block of foamed plastics material, in certain circumstances, it may be appropriate for each sonic device to be located in an individual foamed plastics block, and for such blocks then to be assembled into an array.

The block with its sonic device or devices is preferably mounted in a sealed casing to protect it against sea water, for example. A space between a wall of the casing and the heads of the devices may be filled with an acoustic coupling material.

The invention may be carried into practice in various ways, but one specific embodiment will now be described by way of example with reference to the

accompanying drawings, in which:-

Figure 1 diagrammatically illustrates a completed moulding tool;

Figure 2 is a diagrammatic sectional end elevation through the tool of Figure 1 taken on the line 2-2 of Figure 3;

Figure 3 is a plan view of the tool of Figure 1;

Figure 4 is a diagrammatic perspective view of a completed array of sonic devices produced in accordance with the present invention;

Figure 5 is a transverse cross-section of one end of an array of the type shown in Figure 4, assembled in an acrylic casing, and

Figure 6 is a longitudinal cross-section of one end of the assembly of Figure 5.

Figure 1 illustrates a typical moulding tool 10 employed with the present invention and having a base 10A, end walls 10B and 10C, and side walls 10D and 10E, the latter having a recess 10F between them and defining a ledge 10G (see Figure 2) which forms the top of the mould.

As shown in the cross-section of Figure 2, within the mould a single longitudinal cavity 10H is formed within which an array of sonic devices 11 can be located, the array comprising two longitudinal rows of spaced devices. The location of the sonic devices within the mould is accurately carried out firstly by locating the sensitive heads 24 of the devices in locating recesses 10J of the base 10A. Thereafter, and before the remainder of the mould 10B, C, D, E, G is assembled, appropriate wiring of the devices takes place. Each sonic device is coated with an appropriate releasing agent in order that the foamed plastics

material to be moulded will not stick to it, since this would affect the vibration of the device. The end walls and side walls are then placed in position, the latter abutting one another in a vertical plane 40 following which a set of holding pins 12 are projected down through the ledge 10G to engage the top ends of the sonic devices. Each pair of pins 12 is connected to one of a series of horizontal bars 14 (one is shown in Figure 3), each of which, in turn, is connected to a pair of further supports 16 projecting upwardly therefrom.

In this way, the sonic devices are accurately located and secured wtihin the mould cavity 10H prior to a moulding operation, during which foamed plastics material is either poured, or injected, into the cavity via one or more injecting sprues or holes 18 formed in the ledge 10G as shown in Figure 3. Preferably, the choice of foam, e.g. BIBBITHANE ISOFOAM 510, is such that the injection, and curing can take place at room temperature. During curing, the holes 18 may be sealed. If the foamed plastics material requires heat-curing this can be carried out in an oven. The resulting foam block 22 is shown diagrammatically in Figure 4. It provides a lightweight structure in which all of the array of sonic devices are effectively encapsulated, although, as shown in Figure 4, the element heads 24 of the array of devices are left proud of the block and uncovered by the foam.

The foam moulding operation is such that the foam is formed with closed cells containing gas generated during moulding.

The resulting closed gas-filled cavity foam is rigid enough to provide an effective mounting for the

devices, and to give protection against shocks. In addition, the gas-filled foam has acoustic opacity to prevent acoustic coupling between devices.

The end walls 10B and 10C are preferably provided with circular recesses (not shown) so that the end product has integral disc-like protuberances 20.

The resultant block of foamed plastics material with the array of sonic devices embedded therein is now mounted in the manner shown in Figures 5 and 6 in a casing 30 of acrylic material. The casing comprises a longitudinal tube having end caps 32 of the form shown in Figure 6. It will be seen from Figures 5 and 6 that the casing 30 in the region of the heads 24 of the sonic devices is spaced from these heads. This space 34 is filled with an acoustic coupling medium 35, which may, for example, be a semi-liquid, petroleum jelly, lanolin, silicon oil, a melted solid, or a rubber. The choice of medium depends on the intended use of the completed array. Thus, it may have a similar acoustic refractive index to that of the sea water within which it is intended to operate.

The end caps 32 locate the protuberances 20 of the foamed plastics material in order to provide secure location for the array within the casing 30. Between the end caps 32 and the tube of the casing suitable O-ring seals 36 are provided so that there is a sealed casing between the foam of the block 22 and the sea water in which it is to operate.

CLAIMS

1. A sonic device (11) mounted and located in a block (22) of acoustically-opaque foamed plastics material, with the sensitive head (24) of the device left uncovered by the plastics material.

2. A sonic array comprising a plurality of spaced sonic devices (11) which are located with respect to one another by being mounted in a common block (22) of acoustically-opaque foamed plastics material, with the sensitive heads (24) of the devices left uncovered by the plastics material.

3. A device or devices as claimed in Claim 1 or Claim 2 in which electrical leads or other interconnections from the device or devices are encapsulated in the block of foamed plastics material.

4. A device or devices as claimed in any preceding claim in which the cells of the foamed plastics material are closed cells and are gas filled.

5. A device or devices as claimed in any preceding claim, in which the foamed plastics material is rigid enough to provide an effective mounting and to give protection against shocks.

6. A sonic device or an array of sonic devices as claimed in any preceding claim, in which the block is mounted in an outer casing (30, 32) sealed (at 36) against the entry of water.

7. A device or an array as claimed in Claim 6 in which a wall portion of the outer casing is spaced from the block (22) in the region of the operative head or heads (24), and the space in that region is filled with an acoustic coupling medium (35).

8. A device or an array as claimed in Claim 7 in which the acoustic coupling medium is a liquid, a semi-liquid, a jelly, lanolin, silicon oil, or a rubber.

9. A method of mounting a sonic device (11) or an array of sonic devices comprising locating the or each sonic device within a mould (10), and forming a foamed plastics material body (22) in the mould, to constitute a mounting for the device or devices.

10. A method as claimed in Claim 9 in which the, or each sonic device is located in the mould by its sensitive head or face (24), so that that head is not covered by the foamed material.

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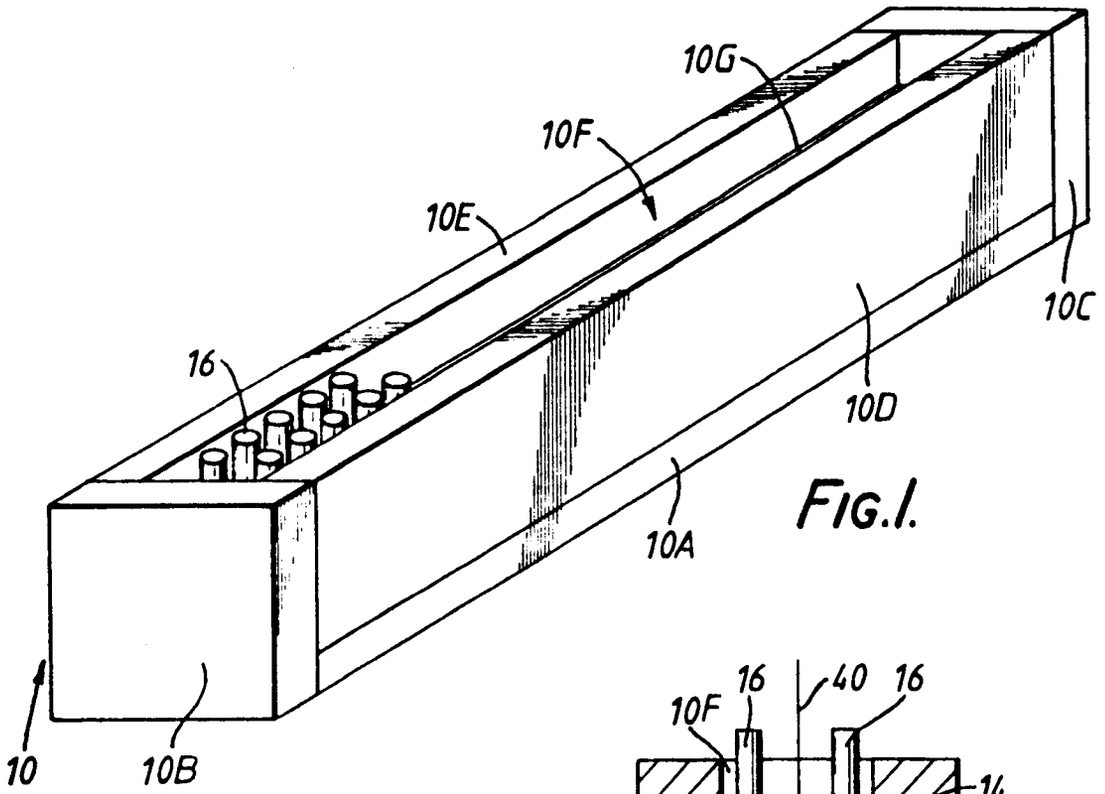

FIG.1.

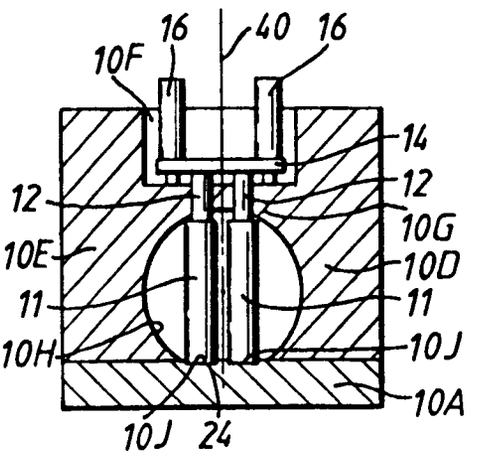

FIG.2.

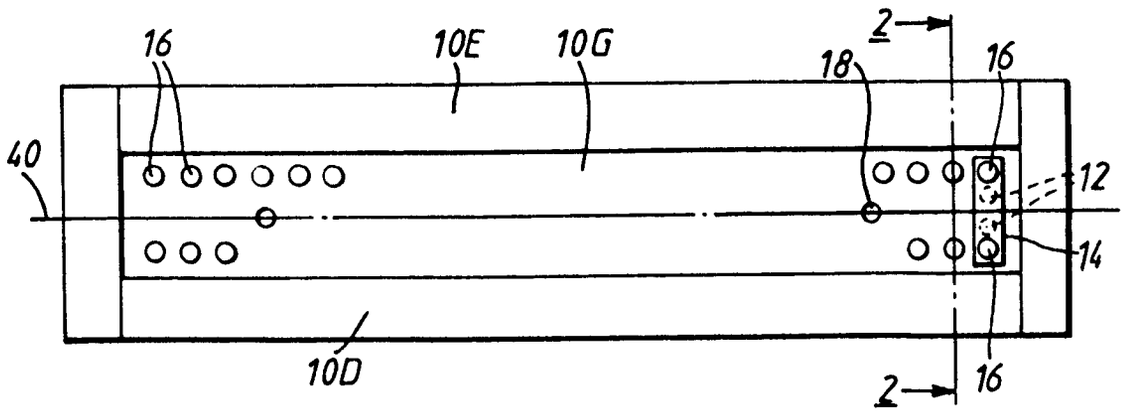

FIG.3.

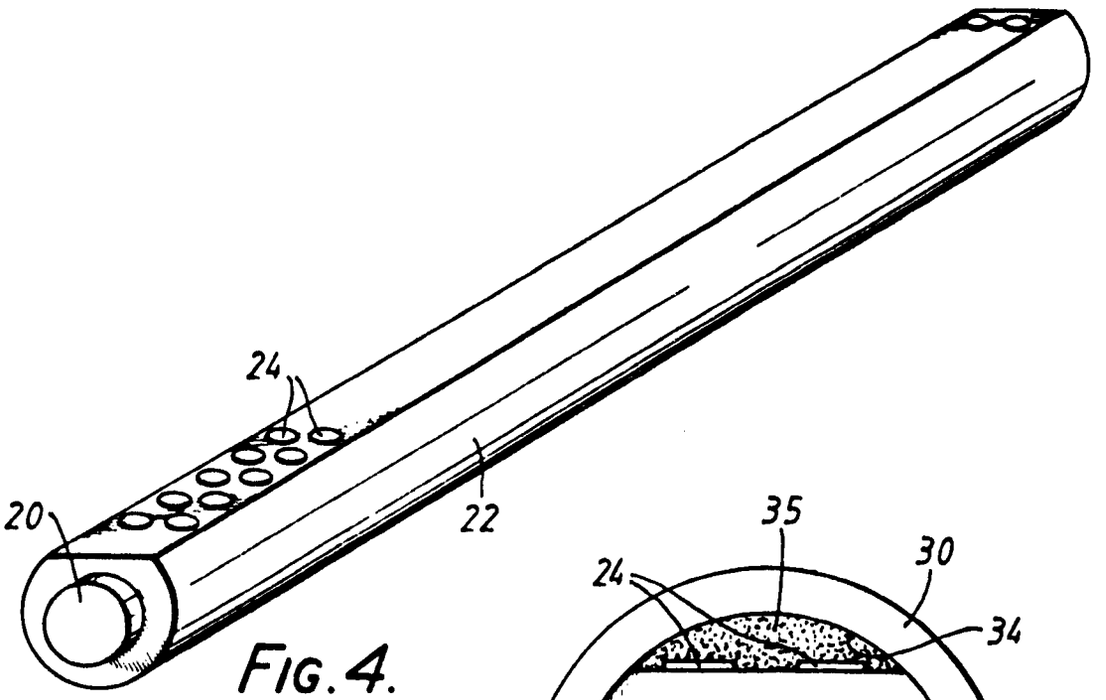

FIG. 4.

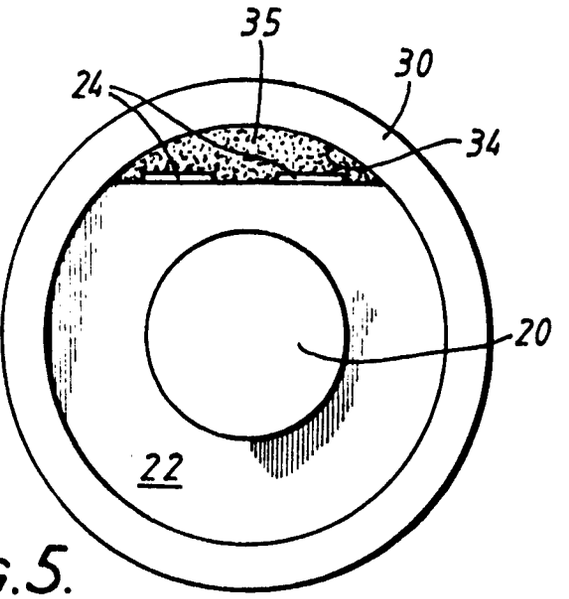

FIG. 5.

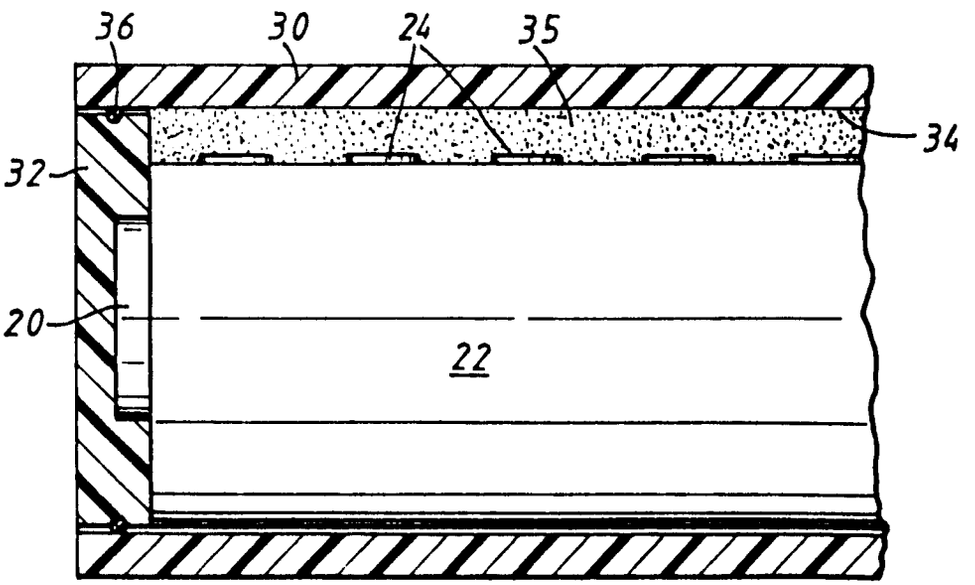

FIG. 6.