2,699,117

METHOD OF BLASTING

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Application January 20, 1954, Serial No. 405,245

1 Claim. (Cl. 102—23)

The present invention relates to submarine blasting methods.

It is an object of this invention to provide a method of blasting in underwater locations whereby the shock wave produced by such blasts may be materially reduced.

It is a further object of the invention to avoid damaging any permanent installations, building foundations or the like which may be submerged and close to submarine blasts.

Other intended objects of this invention will be apparent from the following description.

Frequently during the course of construction work on hydro-electric projects and the like, it becomes necessary to carry on blasting underwater and relatively close to the side of existing structures such as pump houses, bridges, piers, involves plants, lighthouses, dams, wharves, retaining walls, cribs, vessels, disposal plants, or similar buildings. As is well known, water is virtually incompressible and will transmit the shock wave resulting from an underwater blast with little or no loss of force such as is experimental in air or soft earth.

The shock wave, as transmitted by the water may have serious and damaging effect upon permanent installations in the vicinity of the blast. Where it is impossible to shoot a lesser charge of explosive, the effects of the blast can be damaging and pose a difficult problem.

According to the present invention, a method is provided whereby the force of an underwater blast as propagated through the water is considerably lessened.

If a thin stream of air is released from the bottom of a body of water in which submariine blasting is to occur, the bubbles will rise steadily until a wall or curtain of rising air bubbles exists from the bottom to the surface. The air trapped in these bubbles is compressible and it has been found that this curtain of bubbles will effectively damp a major portion of the vibrations emanating from a submarine blast with the result that the shock wave felt on the side of the curtain of bubbles removed from the blast is materially reduced as opposed to the shock wave felt in ordinary circumstances.

A convenient method of producing a curtain of air bubbles between a blast location and an installation which it is desired to protect involves bubbling air through a string of perforated pipe or tubing in the proper position on the floor of the body of water concerned. A steady stream of compressed air is then forced into the pipe or tubing with the result that the air issues from the perforations and rises to the surface forming a band or curtain of air bubbles. The individual size of these bubbles will be controlled by the size of the perforations and the amount of air present within the curtain will be determined by the number of perforations in the pipe and the pressure under which the air is forced into the pipe.

If desired the perforated pipe may be laid out as a single string, a group of parallel strings interconnected or as a mat or network of pipe. These factors are all dependent upon the strength of the bubble to be set off and the amount of vibration the protected installation or building can safely withstand.

By way of example, several tests were conducted in a tank 5 feet high x 5 feet long x 3 feet wide filled with water. Six tubes three feet long with an internal diameter of 0.27 inch and with 0.040 inch diameter holes spaced about 1 inch apart down their length were disposed about 2 inches apart on the short axis on the bottom of the tank. These tubes were fed with air which escaped through the small holes down their length into the water and formed a curtain of air bubbles rising to the upper surface of the water. The density and width of the curtain was varied by using different combinations of tubes and by adjusting the air flow. The dynamic water pressure was measured at one end of the tank while a bursting cap was detonated at the other.

Pressures were read without the air curtain and then with it while varying its density and width. The results of these tests are tabulated in Table 1.

Table 1

| Tubes in Use | Total Air, cu. ft. | Air per linear ft. | Average Peak Blast Pressure (p.s.i.) | Average Peak Blast Pressure (p.s.i.) by Osci
graph | Pressure Ratio for cushioned | not cushioned from G. B. B. O. |
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<tr>
<td>0</td>
<td>0.18</td>
<td>0.08</td>
<td>10.0</td>
<td>21.3</td>
<td>0.38</td>
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<tr>
<td>1</td>
<td>0.19</td>
<td>0.09</td>
<td>6.1</td>
<td>8.2</td>
<td>0.24</td>
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<tr>
<td>2</td>
<td>0.15</td>
<td>0.08</td>
<td>4.8</td>
<td>6.9</td>
<td>0.18</td>
<td>0.18</td>
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<tr>
<td>3</td>
<td>0.20</td>
<td>0.10</td>
<td>4.2</td>
<td>1.6</td>
<td>0.16</td>
<td>0.16</td>
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<tr>
<td>4</td>
<td>0.21</td>
<td>0.10</td>
<td>3.7</td>
<td>1.6</td>
<td>0.16</td>
<td>0.16</td>
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<tr>
<td>5</td>
<td>0.20</td>
<td>0.07</td>
<td>3.5</td>
<td>1.4</td>
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<tr>
<td>6</td>
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The results as given in Table 1 indicate that the water pressures resulting from blasting can be reduced by about 90 per cent by interposing an air curtain of reasonable density between the source and the area requiring protection. In actual use, the method reduces the shock by a greater factor than is apparent from these laboratory shots since a great deal of reflection of shock wave off the sides of the small tank is experienced. When shooting explosive charges in a relatively large body of water the problem of wave reflection is greatly reduced.

It is also apparent from Table 1, as might be expected, that the degree of cushioning is dependent upon the amount of air present in the curtain.

It may be seen, from the data given in the table, that the logarithm of the transmitted pressure varies inversely as the amount of air used in the curtain. This relation is typical for the attenuation of wave motion in absorbing media.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that this invention is not limited to the specific embodiments thereof except as defined in appended claim.

Having thus described my invention what I claim is:

In a method of blasting in underwater locations wherein an existing submerged object of close proximity to a proposed blast must be protected from damage resulting from the shock wave produced by said blast, the improvement which comprises forcing compressed air through pipe fixed to the bottom of the body of water between the blast location and said object to be protected, said pipe being perforated along its length with a regular series of perforations, the forcing of said compressed air through said pipe occurring prior to and during the detonation of said blast, whereby said compressed air rises in the form of small bubbles from the bottom of said body of water to the surface forming a compressible shock absorbing curtain interposed between said blast and said object to be protected.

No references cited.