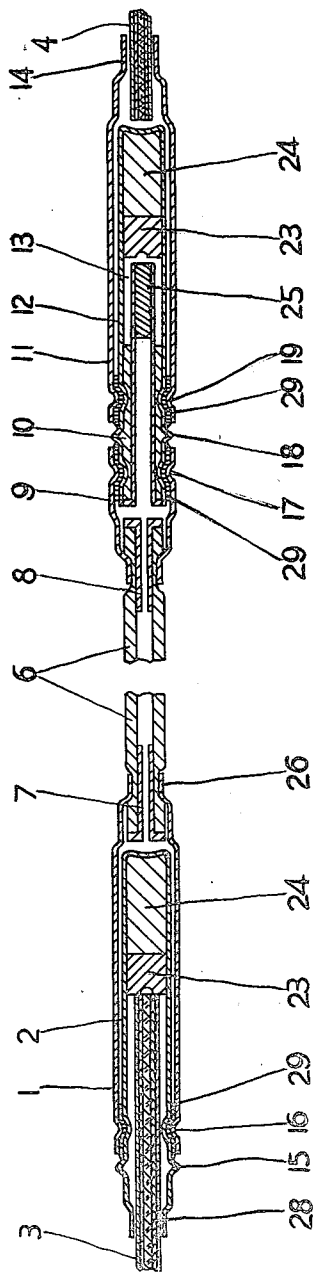


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DELAY BLASTING DEVICE
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DELAY BLASTING DEVICE

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8 Claims. (Cl. 102—29)

1

The present invention is concerned with a new or improved form of delay blasting device adapted for use when it is desired that a plurality of blasting explosive charges connected together by detonating fuse should detonate with predetermined time intervals between the detonations instead of simultaneously.

Hitherto when it has been desired to bring about the detonation of a round of shots of explosive separated by predetermined time intervals it has been the practice to initiate the detonations of the explosive charges by a series of delay detonators electrically connected together, the detonator for each blasting explosive charge having a delay element adapted to give the desired delay interval interposed between its electric ignition element and the detonating explosive charge contained within it. It would be more convenient in certain circumstances, as when the blasting explosive charges to be detonated are spaced at considerable distances apart, to employ a line of detonating fuse instead of individual detonators and it is an object of the present invention to provide an improved delay device which can be readily interposed in a line of detonating fuse whereby the desired delay blasting effect may be obtained.

There has already been proposed in United States application Serial No. 497,736, filed August 7, 1943, now abandoned, a delay detonation connector device comprising a length of detonating fuse having one of its ends secured in igniting position in one end of the tubular container of an explosive retarding element, of the nature of a delay detonator, comprising a charge of a heat ignitable deflagrating delay composition superimposed on a charge of a detonating explosive composition capable of initiating a detonating fuse, and if desired also an igniting composition charge superimposed on said deflagrating delay composition charge; and a second length of detonating fuse having one of its ends secured at the other end of the tubular container in position to be initiated by the detonation of said detonating explosive composition, but in practice considerable difficulty has been experienced in making a device of this nature that will function satisfactorily. In particular when a delay composition is directly ignited from a detonating fuse it may be blown away without initiating the detonating explosive charge or may burn at a rate much higher than that expected from its behavior when ignited by non-detonating means.

A device according to the present invention comprises two metallic tubular sheathing elements connected by a length of tubing of distensible resilient shock absorbing flexible material in which device one sheathing element retains therein in fixed position an instantaneous detonator and the other a delay detonator so that the closed end of the instantaneous detonator

2

and the open end of the delay detonator each points towards said tubing, said tubing is of narrower diameter than that of the tube of the instantaneous detonator, and each sheathing element at its end remote from said length of tubing of flexible material is open and of such diameter as to permit the insertion of a length of detonating fuse.

Said tubing of distensible resilient shock absorbing flexible material provides for the flame gases projected by the instantaneous detonator towards the delay fuse element of the delay detonator in the second tubular casing a constricted but expansible passage adapted to minimize the shock to which said combustible delay fuse element is exposed as it is ignited.

The tubular sheathing element surrounding the delay detonator is desirably made in portions whereof one is attached to the tubing made of said shock absorbing material and the portion of the delay detonator near the mouth thereof, and the other is attached to said delay detonator at a position further removed from its mouth.

The location of the instantaneous detonator and the delay detonator in the tubular sheathing elements is conveniently effected by crimping advantageously with an interposed layer of cushioning material adapted to assist in excluding water from the interior of the assembly in wet situations. In order to assist the crimping of the tubular sheathing elements on to the tubing of distensible resilient shocking-absorbing flexible material and keep the latter open, there may be conveniently inserted into ends of the tubing short lengths of rigid open ended tube, preferably of smaller bore, which may be flanged at one end to limit their movement during assembly.

Blasting assemblies according to the invention include lengths of detonating fuse each attached to an end of a device as hereinbefore defined. The attachment of the lengths of detonating fuse may conveniently be achieved by crimping.

The invention is illustrated by reference to the diagrammatic drawing accompanying the specification, which represents a longitudinal axial section showing a device in accordance with one form of the invention interposed in a line of detonating fuse.

In the diagrammatic drawing, 1 is a tubular sheath made of metal capable of being crimped, and is of somewhat smaller diameter at one end than the other. 2 is a metal detonator tube with its closed end facing the narrower end of the sheath 1. The metal of sheath 1 is made desirably the same as that of the detonator tube 2. 3 is a length of flexible textile covered and externally waterproofed detonating fuse having a core of pentaerythritol tetranitrate and 4 is a length of a similar detonating fuse. 5 is a thick walled tube made of soft rubber or a soft rubber-like material, for example neoprene, and 7 and 8 are

3

short rigid metal tubes having flanges at one end. The bore of the tube 7, is less than that of the tube 6 which is itself less than that of the detonator tube 2. The tubes 7 and 8 are too short to abut when inserted into the tube 6. 9 is a tubular sheath similar to the sheath 1 but of shorter length at its wider portion, the tube 6 being compressed between the rigid tubes 7 and 8 and the narrower ends of the sheaths 2 and 9. 11 is a sheath similar in nature and orientation to the sheath 1. 12 is a detonator tube orientated similarly to the detonator tube 2. The detonator tube 2 is charged with a secondary detonating explosive charge 24 and a primary detonating explosive charge 23 and the detonator tube 12 is charged with a secondary detonating explosive charge 24 and a primary detonating explosive charge 23, and further has an open ended flanged tube 13 extending into it just short of the charge 23 charged at its unflanged end with a compressed delay fuse composition 25. This delay fuse composition preferably comprises a lead salt of a polynitro phenolic compound. Between the flanged tube containing the delay composition and the detonator tube 12 there is interposed a friction fitting paper tube 10. The detonator tubes 2 and 12 have protuberances 15 and 18 a short distance from their mouths. 29 are thin rubber tubes assisting waterproofing of the joints formed between the detonator tubes and the metal sheaths 1, 9 and 11.

In assembling the device the flanged tube 7 is inserted as far as it will go into one end of the tube 6 and the latter is inserted through the end of the sheath 1 so that an unflanged end of the tube 7 is within the narrower portion of the sheath, and the tube 6 protrudes outwardly from this narrower portion, which is then crimped down as shown at 26. The charged detonator tube 2 surrounded by the rubber sleeve 29 is then slipped into the wider end of the sheath 1 as far as it will go until stopped by the protuberance 15, which is so positioned that the closed end of the detonator tube at least closely approaches the flange of the tube 7. The rubber sleeve is then crimped between the metal sheath and the detonator tube as shown at 16. The other end of the tube 6 with the flanged tube 8 slipped into it as far as it will go is inserted into the narrower end of the short metal sheath 9 until an unflanged portion of tube 8 lies within the narrower portion of the sheath 9 whereupon the tube 6 is pinched between the metal tube 8 and the sheath 9 by a crimping operation. The delay detonator consisting of the charged detonator tube 12 with the charged delay flanged tube 13 and its surrounding paper tube 10 is then pushed forward as far as it will go until stopped by the protuberance 18 through the rubber tube 29 in the wider end of the sheath 11 and affixed therein by a crimping operation as shown at 19. Finally the open end of the smaller metal sheath 9 is crimped on to the terminal portion of the detonator tube 12 with the interposition of a rubber tube 29 as shown at 17. When it is required to use the resulting assembly, the length of detonating fuse 4 is brought up through the narrow end of the sheath 11 until it touches or almost touches the closed end of the detonator tube 12 and the end of the sheath crimped around it as shown at 14. The other length of detonating fuse is carefully brought through the end of the detonator tube 2 until it just touches or just fails to touch the explosive charge 23 and is then crimped into position as shown at 28.

4

When the detonating fuse 3 is initiated by a detonator, by one of the blasting explosive charges to be detonated, or by a device according to the invention, it causes a substantially undelayed detonation of the charges 23 and 24 and a disruption of the detonator tube 2 and also results in the destruction of the sheath 1. A portion of the flame gases however enters the flanged tube 7 and in passing through the tube 6 bulges it out whereby its excessive energy is reduced and on emergence through the flanged tube 8 into the flanged tube 9 containing the delay fuse composition 25 the ignition of the latter takes place, and this delay composition burns through at the rate for which it was designed instead of instantaneously. The detonating charges 23 and 24 in the detonator tube 12 are therefore initiated after the desired predetermined time interval and their detonation results in the initiation of the detonation of the detonating fuse 4. As the speed of detonation in the detonating fuse is of the order of 6,700 metres per second, the only effective delay in the connection to the said explosive charge attached to the detonating fuse 4 is therefore provided by the delay composition 25.

What I claim is:

1. A device comprising two metallic tubular sheathing elements connected by a length of tubing of distensible resilient shock absorbing flexible material in which device one sheathing element retains therein in fixed position an instantaneous detonator and the other a delay detonator so that the closed end of the instantaneous detonator and the open end of the delay detonator each points towards said tubing, said tubing is of narrower diameter than that of the tube of the instantaneous detonator, and each sheathing element at its end remote from said length of tubing of flexible material is open and of such diameter as to permit the insertion of a length of detonating fuse.

2. A device as claimed in claim 1 wherein the tubular sheathing element surrounding the delay detonator consists of two portions, one portion being attached to the tubing of said shock absorbing material and the region of the delay detonator near the mouth thereof and the other portion being attached to said delay detonator at a position further removed from its mouth.

3. A device as claimed in claim 1 wherein the said sheathing elements retain by crimps the said detonators in fixed position.

4. A device as claimed in claim 3 wherein there is an interposed layer of cushioning material in the neighborhood of the crimp.

5. A device as claimed in claim 3 wherein each end of the length of tubing of distensible resilient shock absorbing flexible material has therein a short length of a rigid open ended tube.

6. A device as claimed in claim 5 wherein each of said rigid open ended tubes is of smaller bore than the said length of tubing of distensible material.

7. A device as claimed in claim 5 wherein each of said rigid tubes has a flange at that open end abutting the end of the length of tubing of distensible flexible material.

8. A blasting assembly comprising lengths of detonating fuse each attached to an end of a device as claimed in claim 1.

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No references cited.