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DELAY ACTION ELECTRIC FUSE

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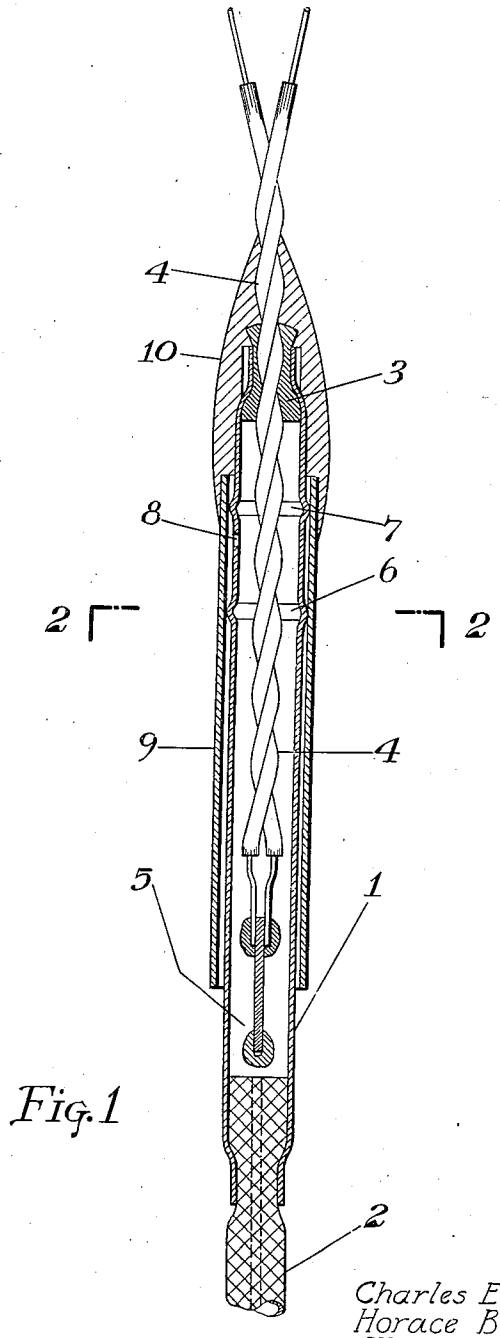


Fig. 1

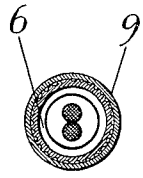


Fig. 2

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DELAY ACTION ELECTRIC FUSE

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4 Claims. (Cl. 102—10)

This invention relates to delay action electric fuses, and more particularly to such a fuse having provisions for cooling the hot gases which escape when the fuse is fired.

In delay action electric blasting fuses it is important to ensure the efficient filtration and cooling of the hot escaping gases so that premature ignition of the blasting explosive is avoided should the delay fuse be completely embedded in the charge. At the same time it is desirable that the gases should not be so confined that gas pressure can be built up inside the fuse, which results in fast burning times of the delay action fuse, and interference with the timing. In addition the delay fuses must be reasonably waterproof.

Previously proposed methods of cooling the escaping gases include the provision of filtering and cooling devices of fine wire gauze, lead shot, or silica sand, or the like, inside the case of the delay fuse, or the provision of a metal sleeve around the outside of the fuse.

With the normal very small amount of free space inside the tube, however, efficient filtration and cooling are incompatible with good timing owing to the choking up of the filters by the carbonaceous débris given off from the burning ignition and delay elements and carried along by the escaping gases. We have now found that this difficulty may be overcome by the provision of a large space or deposition chamber within the delay action case, wherein this débris is deposited, in conjunction with a cooling sleeve surrounding the ignition end of the fuse.

Our invention consists in a delay action electric blasting fuse which comprises an inner metal tube fitting closely over the delay fuse element at one end, an electric igniter therefor, the leads of which pass through the seal at the other end of the tube, an outer tube surrounding the inner tube and joined to it at the end remote from the delay element and open at the end near the delay element, a vent towards the end remote from the delay element leading from the inner to the outer tube, and a finely milled rib between the inner tube and the outer tube at a region nearer the delay element than is the said vent, the length of the inner tube being sufficient to provide a relatively large space for the deposition of the solid products of combustion, the end of the delay element remote from the fusehead being that which protrudes into the detonator or the like, the initiation of which is to be delayed.

We prefer to form the milled rib or ribs if more than one be used as protuberance on the inner metal tube, and to form the junction between the inner tube and the outer tube by pushing the outer tube over a plain protuberance on the inner tube situated at the end remote from the delay element and over the milled protuberance or protuberances. Any leakage of gas at this end may be additionally safeguarded against by pitching.

It will be understood that the number of millings on the rib or ribs can vary considerably, and by way of illustration we mention that a rib having 36 millings to the inch, the ridges and hollows being of substantially the same width, is particularly suitable. If more than one rib is employed it is convenient to mill the rib nearest the vent from the inner tube more coarsely than the succeeding rib or ribs.

The preferred form of the invention is illustrated in the accompanying drawing which, however, omits the detonator in the drawing. Fig. 1 is a central longitudinal section of the ignition end of a delay action blasting fuse showing a portion only of the delay element. Fig. 2 is a cross section on the line 2 of Fig. 1.

Referring to Fig. 1, the delay action electric fuse comprises an inner metal tube 1 fitted at one end with a delay element 2 and at the other end with a plug 3 which may conveniently be made of rubber. Insulated leading wires 4 pass through the plug 3 to an igniter element 5, the various component parts being so arranged that for fuse of ordinary diameter, the distance between the delay element 2 and the plug is at least 20 mm. The space so formed is empty, except for the igniter element and the leading wires thereto, and is much larger than the space normally provided in delay action electric fuses. At short distances from the plug end of the inner tube are provided two annular ribs 6 and 7 of which the rib 6 has a milled edge. Between the two ribs there is provided a vent hole 8 in the tube for the escape of the gases.

Over the inner tube 1 is slipped an outer metal tube 9 which is made to fit tightly over the ribs, forming a seal with the unmilled rib and leaving an open annular space around the inner tube. The outer tube may conveniently be made about 1 mm. greater in diameter than the inner tube.

After assembly the top of the delay fuse is coated with pitch 10 down to the top junction between the outer tube 9 and the top rib 7, which assists in making the seal gas tight.

The vent hole or holes 8 may be closed temporarily by any of the usual means of making such a vent waterproof, as for example, by means of a strip of thin paper shellacked on to the tube and coated with a waterproofing dope, such as benzyl

cellulose or nitrocellulose or material possessing similar properties.

On firing the fuse, the empty space inside the tube acts as a deposition chamber for a large amount of the tarry carbonaceous débris given off from the igniter element and more especially from the burning delay element, and the hot escaping gases burst the seal over the vent and escape along the outer sleeve by way of the milled rib or ribs.

The milled ribs act as a filtering device and along with the outer sleeve effectively cool the escaping gases.

Delay action electric fuses made in accordance with our invention are of good shape from the point of view of keeping them water-tight, there being little tendency for water to find its way into the inner tube. No difficulty is experienced in obtaining consistent delay times. Provided their overall length is not too great they can be completely embedded in the blasting charges without fear of premature ignition thereof.

As it is advantageous that the delay action electric fuse should be totally embedded in the cartridge, we prefer to arrange that the overall length, including the detonator, should be kept short. If very short cartridges are to be used, however, it will not be possible for the delay action electric fuse to be totally embedded within them.

Having now particularly described and ascertained the nature of our invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. An improved delay action electric blasting fuse comprising an inner metal tube fitting closely over a delay fuse element at one end, an electric igniter therefor, the leads of which pass through the seal at the other end of the tube, an outer tube surrounding the inner tube and joined to it at the end remote from the delay element, and open at the end near the delay element, a vent towards the end remote from the delay element leading from the inner to the outer tube, and a finely milled rib between the inner tube and the outer tube, at a region nearer the delay element than is the said vent, the length of the inner tube being sufficient to provide a relatively large space for the deposition of the solid products of combustion.

2. An improved delay action electric fuse as claimed in claim 1 wherein the distance between the delay element of the seal is not less than 20 mm.

3. The delay action electric fuse of claim 1 in which the outer and the inner tube are attached by pushing the outer tube over a milled rib or ribs and an unmilled rib or ribs formed on the inner tube nearer its extremity than is the vent, the junction at the outer unmilled rib being rendered gas tight by means of a waterproofing composition.

4. The delay action electric fuse of claim 1 wherein the vent between the inner and outer tubes is temporarily closed.

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