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DELAY CAP

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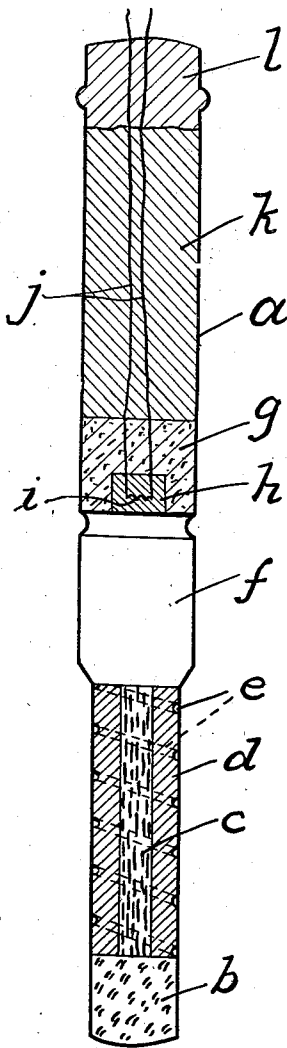


FIG. 1.

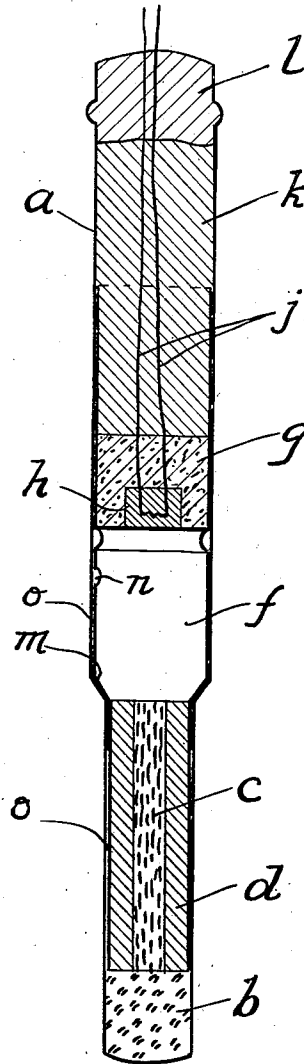


FIG. 2.

WITNESS:

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DELAY CAP

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6 Claims. (Cl. 102-10)

This invention relates to an improvement in delay caps such as are used for the firing of commercial explosives.

More particularly this invention relates to an improvement in delay caps of the ventless type whereby the burning rate of the delay fuse or train will be rendered regular and the delay intended will be substantially uniform.

Heretofore delay caps of the ventless type, that is to say, caps which are not provided with a vent for the escape of gas evolved on burning of the igniting composition and fuse train, and in which the provision of a vent is, for example, avoided by the provision of an igniting composition and fuse train composed of ingredients which on burning will not evolve any substantial amount of gas, have not proved entirely satisfactory due to irregularity in the burning of the fuse train, and substantially wide variation in the delay afforded by identical caps provided for a given delay period has been noted.

From a study with a view to determining the cause of variation, or irregularity, in the delay period of identical caps and with a view to providing for regularity, it has been found that the irregularity noted was caused by the pressure of such gas as was evolved, on burning of the igniting composition and the fuse train, acting unequally upon the fuse train, that is to say, upon one end only, and through diffusion influencing its burning rate, more or less depending upon the actual gas pressure developed, upon the composition of the fuse train and its permeability to gas.

As a consequence, it was determined that irregularity could be avoided and substantial uniformity could be obtained by providing for an equalization of pressure upon the fuse train as a whole, or, in other words, providing for an equalization of pressure at both ends of the fuse.

As generally illustrative, the object of this invention, substantial uniformity of delay period, is obtained by providing a delay cap structure arranged so that both ends of the fuse train will be subjected equally to any gas pressure tending to act on one of the ends. More particularly, connection will be provided between the ends of the fuse train so that any pressure developed at the end from which the fuse is burning will be communicated to its other end, at the same time communication will be provided in a manner to avoid premature firing of the detonating charge of the cap by hot gases.

Having now generally indicated the nature and purpose of this invention, I will proceed to a de-

tailed description of preferred practical embodiments thereof with reference to the accompanying drawing, in which:

Figure 1 is a diagrammatic showing of a delay cap, of the single shell type, embodying this invention.

Figure 2 is a diagrammatic showing of a delay cap, of the double shell type, embodying this invention.

Referring more particularly to Figure 1, *a* indicates a casing, which may be of any usual type and material used in connection with delay caps. The casing may be in one or a plurality of parts and may be composed, for example, of copper. At the bottom of the casing is positioned a detonating charge *b*, which may be of any usual or desired composition, as, for example, fulminate, fulminate-chlorate mixture, etc. Above the detonating composition *b* is a length of fuse *c* provided with a lead sheath *d*, having a spiral groove *e* in its outer surface and extending from end to end of the fuse. As will be noted, the spiral groove *e* forms with the casing *a*, within which the fuse fits tightly, a passage affording communication between the opposite ends of the fuse. Above the upper end of the fuse the casing is enlarged to form an air chamber *f* at the upper end of which is positioned a plug *g* provided with a recess in which is positioned a suitable igniting composition *h*, adapted to be fired, for ignition of the fuse train *c*, by the heating of a bridge wire *i* under the influence of electric current supplied from a suitable source through lead wires *j*. Above the plug *h* the casing is closed and sealed by a waterproofing composition *k* and finally by a sulphur plug *l*, in any usual or desired manner.

In the cap described above the igniting composition *h* and the fuse train *c* may be of any desired composition, which on burning will not develop sufficient gas to rupture the casing or blow out the plug *g*, waterproofing composition *k* and plug *l*. The fuse train will desirably be, for example, composed of an oxidizing agent and an element of group six of the right hand column of the periodic table, the oxidizing agent and element being chosen so that on burning together a minimum of gas will be developed. For example, the igniting composition and/or the fuse train may be composed of a mixture of barium peroxide and selenium, red lead and sulphur, or the like. The igniting composition may desirably be, for example, composed of a mixture of fulminate, potassium chlorate, charcoal and nitrostarch in suitable proportions.

As will now be observed any gas pressure developed in chamber *f*, from the burning of the igniting composition *h* and the fuse train *c* and acting on the upper end of the fuse will be communicated through spiral passage or groove *e* to the lower end of the fuse so that the pressure on the fuse will be equalized. Equalization of the pressure on the ends of the fuse will avoid irregularity in the burning rate thereof due to differential pressure on its ends and substantial uniformity in burning rate will be obtained as between fuses intended to give the same delay period. As will be observed, the spiral groove forms a passage of such length as to permit the cooling of gases to a point so as to avoid firing of the detonating charge by the heat thereof.

Referring now to Figure 2, the delay cap illustrated is in its general structure similar to that illustrated in Figure 1 and differs essentially only in the provision of an inner shell *m* crimped to an end of the fuse and extending up into the waterproofing material *k*. The plug *g* carrying the igniting composition *h* is positioned within the inner shell, as is the air chamber *f* formed between the plug *g* and the end of the fuse. A port *n* is provided in the inner shell and affords communication between air chamber *f* and clearance *o* left between the inner shell and the lead sheath *d* and the outer shell, and which forms a passage permitting the equalization of pressure, which may be developed on the burning of the igniting composition and the fuse train, on the ends of the fuse train.

What I claim and desire to protect by Letters Patent is:

1. A delay cap including, in combination, a casing, an igniting charge, a fuse train, a detonating charge and means whereby pressure developed on burning of the fuse train is equalized on opposite ends of the fuse train.

2. A delay cap including, in combination, a ventless casing, an igniting charge, a fuse train, a detonating charge and means whereby pressure developed on burning of the fuse train is equalized on opposite ends of the fuse train.

3. A delay cap including, in combination, a ventless casing, an igniting charge, a fuse train, a detonating charge, the fuse train comprising a composition which will develop a minimum amount of gas on burning and means whereby pressure developed on burning of the fuse train is equalized on opposite ends of the fuse train.

4. A delay cap including, in combination, a casing, an igniting charge, a fuse train, a detonating charge and means forming a passage connecting opposite ends of the fuse train whereby pressure developed on burning of the fuse train will be equalized on opposite ends thereof.

5. A delay cap including, in combination, a casing, an igniting charge, a fuse train, a detonating charge, a chamber formed in the casing between the igniting charge and an end of the fuse train and a passage extending from said chamber and communicating with the other end of the fuse train.

6. A delay cap including, in combination, a casing, an igniting charge, a fuse train, a detonating charge, a chamber formed in the casing between the igniting charge and an end of the fuse train, the fuse train being surrounded by a sheath fitted within the casing, the sheath having a spiral groove cut in its outer surface and forming with the casing a passage affording communication between said chamber and the other end of said fuse train.

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