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FIRING MEANS

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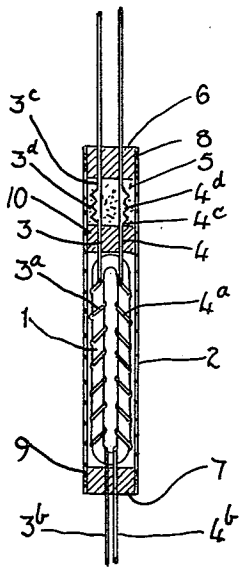


Fig. 1

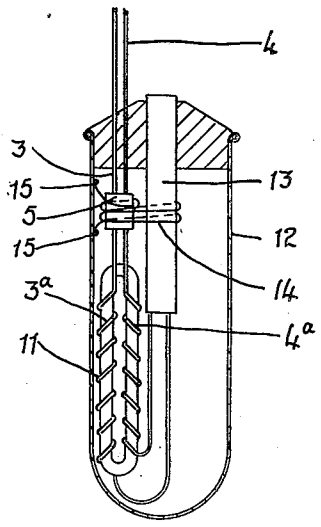


Fig. 2

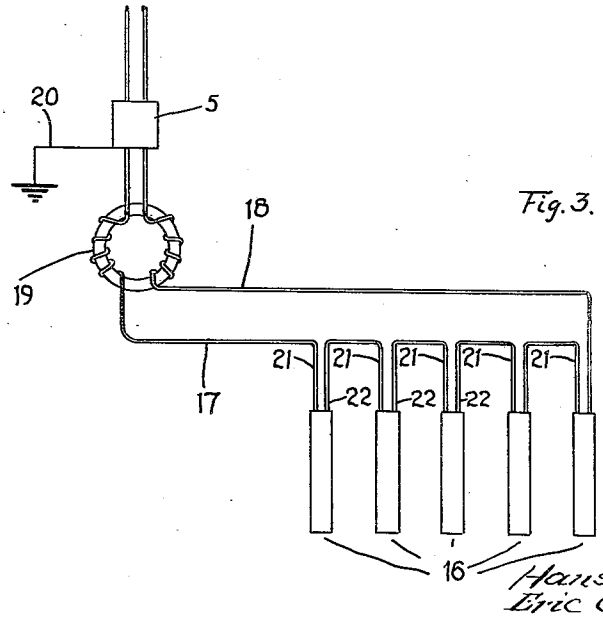


Fig. 3.

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FIRING MEANS

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1 Claim. (Cl. 102—28)

1

This invention relates to means for safeguarding the electric igniters of blasting detonators against accidental firing by electric currents or spark discharges produced respectively in, or in the vicinity of, the firing means of the igniter by atmospheric electricity.

It is obvious that a possible solution to this problem is to surround the two electric leads of the igniter at a position a safe distance from the firing means thereof by an earthed mass of a material which will exhibit a high resistance at voltages of the magnitude used for intentionally firing the igniter and a low resistance at voltages of the magnitude of the electrostatic charges which produce the currents and spark discharges aforesaid.

One means of obtaining a solution of the problem in the manner just indicated is described in the co-pending Patent Application No. 455,235, now Patent 2,403,125, viz. to employ a material which offers a complete or substantially complete resistance to voltages of the magnitude used for intentionally firing the igniter and which, on its being subjected to voltages of the magnitude of electrostatic charges caused by atmospheric electricity, becomes locally conductive through coherer action along a path or paths permitting the passage therethrough of the high voltage charge.

In any solution as above, it is important that the path or paths to earth afforded by the mass of material (which will hereinafter be referred to as the "filter means") to high voltage charges should be such as to ensure that as far as possible, the whole charge passes instantaneously to earth, without leaving any residual charge in one lead or the other capable of producing a flow of current in the firing means, e. g. bridge-wire, sufficient to heat the latter to incandescence. It may not be possible, however, to discharge the whole of the high voltage charge through the filter means to earth in every case, e. g. in the case of exceptionally heavy charges or charges of exceptionally high voltage.

According to the invention we provide, in combination with a filter means as aforesaid, a self-inductance means located in the igniter or blasting circuit leads between the filter means and the igniter or igniters, whereby flow of current caused in one lead or another by atmospheric electricity is choked back or prevented from reaching or setting off the igniter or igniters. In particular, the self-inductance means ensures that, even in cases in which the whole of the high voltage charge does not pass instantaneously to

2

earth but leaves a residual charge in one lead or the other, no flow of current in the igniter or igniters sufficient to set off the latter, will result.

As will be appreciated, the self-inductance means should be as small in dimensions as is consistent with its capability of producing the requisite choking effect. Preferably, therefore, the self-inductance means comprises a continuous soft iron or other magnetic core in the form of an oval link, ring, or the like on opposite halves of which the igniter or blasting circuit leads (enclosed in their usual insulated covering) are wound. For the same reason, the one lead in the case just-mentioned is wound in the form of a right-hand helix and the other in a left-hand helix, so that the inductances of the two helices or coils add together.

Three embodiments of the invention will now be described, by way of example, with reference to the annexed drawing, in which:

Fig. 1 is a sectional elevation of a combined filter means and self-inductance means enclosed in a separate casing.

Fig. 2 is an elevation, partly in section, of a self-inductance means enclosed in a container with a filter means and detonator.

Fig. 3 is a diagrammatic view of a self-inductance means and filter means applied to a blasting circuit including a group of detonators.

Referring to the drawing:

In the embodiment shown in Fig. 1, the self-inductance means consists of a soft-iron oval core 1 which is elongated in the direction of its enclosing copper casing 2 so as to fit neatly therein. On the opposite halves of the core 1, the insulated igniter leads 3, 4 are wound, the lead 3 being wound on the left-hand half of the core in the form of a right-hand helix 3^a and the lead 4 being wound on the right-hand half in the form of a left-hand helix 4^a, so that the inductances of the two helices add together.

The lower ends 3^b, 4^b of the leads 3, 4 are connected to the igniter (not shown) and on the side of the inductive helices 3^a, 4^a remote from these ends, the leads 3, 4 are bared for a short distance at parts 3^c, 4^c and surrounded by a filter means 5. This means may consist of any earthed mass of material which will exhibit, as aforesaid, a high resistance at voltages of the magnitude used for intentionally firing the igniter and a low resistance at voltages of the magnitude of the electrostatic charges induced by atmospheric electricity. For example, the filter means 5 may be a coherer plug as described in the co-pending Patent Application No. 455,235, now Patent

2,408,125, and the leads 3, 4 may, whatever be the filter means used, be provided or associated with discharge points to promote or facilitate the discharge of the high voltage charge from the leads or either of them into the earthed mass; e. g. discharge points constituted by outwardly directed teeth 3^d, 4^d are formed on the bared parts 3^c, 4^c of the leads 3, 4 within the filter mass 5 shown in Fig. 1.

The casing 2 is closed at the ends by rubber plugs 6, 7 or other sealing means secured in place by crimping 8, 9 at the said ends, and a rubber plug or other sealing means 10 is provided between the filter mass 5 and core 1.

With the means illustrated, high voltage electrostatic charges induced in the lead 3 and/or lead 4 will normally be discharged wholly and instantaneously through the discharge points 3^d and/or discharge points 4^d, and thence through the filter mass 5 and the copper casing 2 to earth. Any tendency for the high voltage charge to pass down the lead 3 and/or lead 4 to the igniter is prevented by the choking effect of the inductance means 1, 3^a and 4^a. Thus, even in the case of exceptionally heavy charges, or charges of exceptionally high voltage, which might otherwise leave a residual charge in one lead or the other, no flow of current takes place through the lead 3 or 4 to the firing means or bridge-wire sufficient to set off the igniter.

In the embodiment illustrated in Fig. 2, the inductance means consists of a soft-iron link or core 11 around which the leads 3, 4 are wound in the form of right and left hand helices 3^a and 4^a respectively. The inductance means is located within an aluminium container 12 which also contains the filter means 5 and a detonator 13 (which latter may be of any known type, e. g. instantaneous, Eschbach, or provided with a separate igniter and intervening flexible fuze). The filter means 5 is adapted to be earthed, e. g. by copper wire 14 wound round the copper casing of the detonator 13 and also connected if desired, as shown diagrammatically at the points 15, to the interior of the container 12. In function, as will be appreciated, the filter and inductance means shown in Fig. 2 are similar to those described with reference to Fig. 1.

Fig. 3 shows the application of the invention to the protection of a group of detonators 16. The leads 17, 18 of the blasting circuit are wound respectively around the opposite halves of a magnetic ring 19, the one lead 17 being wound as a right-hand helix and the other lead 18 being wound as a left-hand helix. The magnetic core 19 is located in the circuit between the detonators 16 and a filter means 5 shown earthed diagrammatically at 20. While the group of detonators illustrated is a series-connected group, it is to be understood that this filter and self-inductance means may be applied similarly to the circuit of a parallel-connected group of detonators.

By this use of a self-inductance means in the leads of the blasting circuit, the necessity for separate self-inductance means in the leads 21, 22 (Fig. 3) of the individual detonators 16 can be avoided.

As the result of experiment it has been determined that the self-inductance means should preferably have as a minimum a self-inductance of 30 milli-henries or thereabout, i. e. 15 milli-henries or thereabout in each lead.

If desired, the magnetic core may be made flexible to some degree, e. g. by building up the same from a length or strands of thin soft iron wire.

It is to be understood that in the appended claim the term "igniter leads" is intended to include the leads of either an individual igniter or the leads of a group of series-connected or parallel-connected igniters, and that by the term "filter means" we signify a filter means as hereinbefore referred to.

We claim:

In a blasting unit, electrically-responsive firing means, electric leads serving such means, a primary safeguarding means in electrical contact with such leads and electrically inert to normal voltage firing charge through said leads and fully conductive to current flow from said leads of an abnormal voltage current through said leads, and a secondary safeguarding means between the ignition means and said primary means, said secondary means being within the electrical influence of the leads and preventing flow through said leads to the ignition means of residual or like current flow uncontrolled by the primary means, said secondary means including a magnetic core on which the leads are wound in relatively-reversed helix form respectively.

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