

March 5, 1968

P. O. I. OLSSON

3,371,607

ARRANGEMENT FOR INCREASING THE SAFETY AGAINST UNINTENTIONAL
INITIATION OF SO-CALLED LOW ENERGY DETONATING
CORD ASSEMBLIES

Filed Aug. 16, 1966

2 Sheets-Sheet 1

Fig. 1

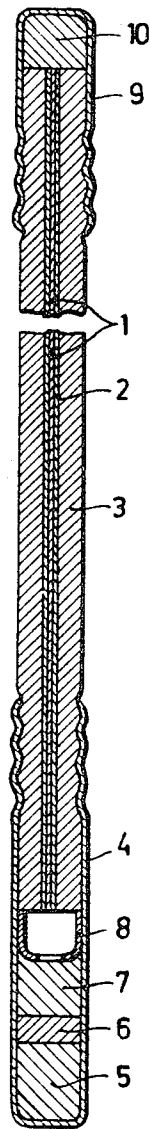


Fig. 2

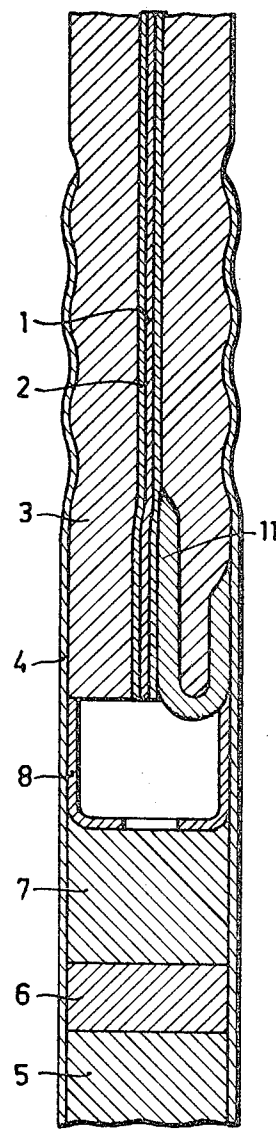
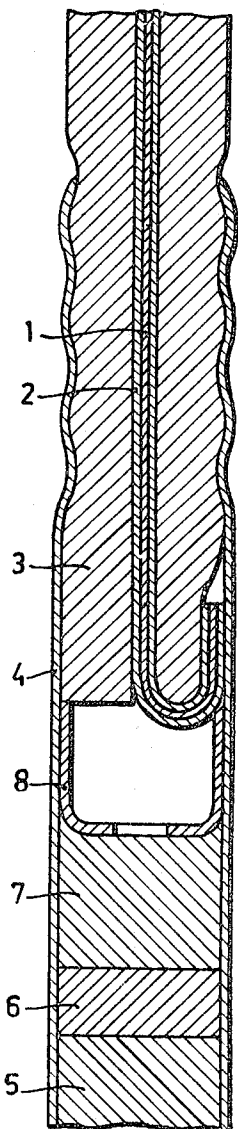


Fig. 3



March 5, 1968

P. O. I. OLSSON

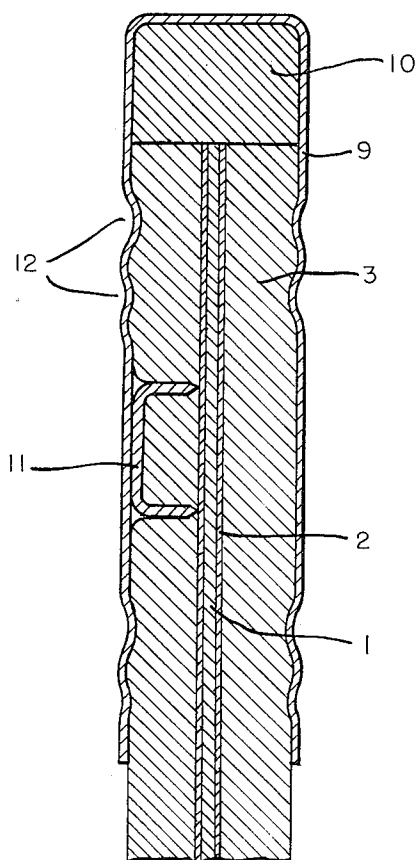
3,371,607

ARRANGEMENT FOR INCREASING THE SAFETY AGAINST UNINTENTIONAL
INITIATION OF SO-CALLED LOW ENERGY DETONATING
CORD ASSEMBLIES

Filed Aug. 16, 1966

2 Sheets-Sheet 2

FIG. 4.



INVENTOR

Olaf I. Olsson

1

3,371,607

ARRANGEMENT FOR INCREASING THE SAFETY AGAINST UNINTENTIONAL INITIATION OF SO-CALLED LOW ENERGY DETONATING CORD ASSEMBLIES

Per O. I. Olsson, Gyttopp, Sweden, assignor to Nitro Nobel AB, Gyttopp, Sweden, a company of Sweden
Continuation-in-part of application Ser. No. 428,660, Jan. 28, 1965. This application Aug. 16, 1966, Ser. No. 580,844

3 Claims. (Cl. 102—27)

This is a continuation-in-part of my application Ser. No. 428,660 now abandoned.

This invention pertains to an arrangement for increasing the safety against unintentional initiation of so-called low energy detonating cord assemblies.

Low energy detonating cord assemblies are known in the art (Patent No. 3,020,844). The main components of such an assembly is the cord, to one end of which is attached a booster cap and to the other end of which is attached a blasting cap. The cord consists of a metal tube enclosing a core of explosive with one or more layers of insulating material applied on the outside of the tube. The booster cap and the blasting cap are each provided with a metal casing. The blasting cap is either of the instantaneous action or the delayed action type. The core of explosive of the cord has a sufficient thickness to permit the detonation to propagate at a high velocity in the axial direction thereof, whereas in the radial direction the effect of the detonation is sufficiently low not to cause initiation even of very sensitive explosives surrounding the core of explosive to take place as the detonation passes. This is attained by using a very thin core of explosive, generally of the magnitude 0.2 g. of pentaerythritol tetranitrate (PETN) or equivalent per meter of the cord.

The low energy detonating cord assemblies as described above offer the possibility of carrying out so-called delay initiation with bottom-hole priming, which could previously only be effected while using electrical blasting caps.

As compared with the latter type of caps, the low energy detonating cord assemblies have the advantage that their use does not involve risks of unintentional initiation, owing to the influence of such low-tension voltage and current sources which are frequently present in the working places, such as galvanic cells, stray currents, wireless waves, or power lines, because the initiation is started through a detonating impulse and cannot be released directly by an electric current.

A device for increasing the safety against unintentional initiation of low energy detonating cord assemblies caused by high tensions has been disclosed in the above mentioned specification. This device comprises an open-ended metal capsule having a central aperture interposed adjacent the delay element of a delay blasting cap attached to one end of a cord.

That device is shown diagrammatically in longitudinal section in FIG. 1 of the annexed drawing.

In this figure, the reference numeral 1 designates a thin core of the explosive pentaerythritol tetranitrate (PETN) having a diameter of about 0.4 mm. The core is enclosed in a lead tube 2 with an external diameter of about 1.0 mm., and the lead tube is surrounded by one or more layers 3 of insulating material, such as paper or plastic. The core of explosive, lead tube and layers of insulating material constitute a detonating cord. Attached to and capping one end of this cord is a blasting cap, in principle consisting of a metal shell 4 containing a detonating charge 5, priming charge 6 and a pyrotechnical delay charge 7. Provided between this last-mentioned charge

2

and the cord end is a protecting metal capsule 8 having one end closed and its cylindrical wall resting against the inner wall of the metal shell 4 and its plane end portion provided with a central aperture, through which the detonation can pass to the blasting cap.

Attached to and capping the other end of the cord is a so-called booster cap, which serves to transmit, by means of a clamping device (branch sleeve) (not shown), the detonation from a trunk line of detonating fuse. The booster cap consists of a metal shell 9 having a detonating charge 10 enclosed therein.

The denomination "low energy detonating cord assembly" of course includes reasonable modifications of the embodiment here described. By way of example, the lead of the tube may be replaced by some other ductile metal, or the core of pentaerythritol tetranitrate enclosed in it may be replaced by a core of some other explosive.

In connection with the development of the present invention, tests were accomplished to establish the sensitivity to discharge of static electricity of known low energy detonating cord assemblies provided with a protecting metal capsule. These experiments have proved a very good safety at discharges equalling 0.003 μ f., 15,000 volts, which is the test standard measure normally used for static electricity.

In carrying out the tests, a condenser was connected via ball gap between the two conductor systems lead tube 2 and blasting cap shell 4. The capacitance and voltage of the condenser were variable and it was discharged by means of the ball gap.

However, when these discharges were extended to considerable higher values such as could in practice be caused by lightning striking near the blasting site, astonishing results were obtained. In this trial, the blasting cap and the booster cap detonated in spite of the jumping spark between the two conductor systems being separated from direct contact with the explosives of the cap by the protecting metal capsule 8. Obviously this experience will highly limit the value of the low energy detonating cord system (LEDC-system) and must be considered as a great drawback.

This drawback can be eliminated through this invention, according to which special metallic bodies are arranged in a certain way to create electrically conducting connections between the cap shells and the metallic tube of the cord.

Some embodiments of the invention are shown on the accompanying drawing, in which FIG. 2 shows diagrammatically one embodiment, and FIG. 3, likewise diagrammatically, another embodiment. In these figures, the same references are used as for corresponding parts in FIG. 1.

FIG. 2 shows a preferred embodiment of the invention. A metallic tack or staple 11 has been inserted radially into the cord, about 1 cm. from its end surface. Crimps 12 between said staple and end surface are preferred if the insulating layer 3 is of a porous material as paper. The tack or legs of the staple are just long enough for its points to make contact with the lead tube of the cord without interrupting its PETN-core. The head end of the tack or staple is in contact with the cap shell.

FIG. 3 shows another embodiment of the invention. A metallic staple 13 has been inserted axially into the cord, with one leg between the lead tube and the insulating layer and the other leg outside the cord. When the cord is pressed into the cap, the last mentioned leg makes contact with the inside wall of the cap shell, creating good contact pressures, staple to shell and staple to lead tube. In this embodiment of the invention it is important that the staple is made of a metal with high conductivity, preferably copper, and of a thick wire. In the investigated example the staple was made of a copper wire having a

diameter of 0.8 mm., and the legs were about 8 mm. and 5 mm. respectively.

FIGURE 4 shows another embodiment of the invention as applied to the booster cap portion of a low energy cord assembly. As illustrated in FIGURE 4, a metal shell 9 is crimped to insulating material 3 covering a lead tube 2, containing cord 1. A detonating charge 10 is enclosed by the metal shell 9 to form a booster cap assembly as

On the other hand, if the blasting cap is of the delay type and thus contains a pyrotechnical delay-producing charge, the protecting capsule will have another function in that it damps the shock wave from the detonating core so as to provide for a suitable retardation thereof, so as to secure that the pyrotechnical combustion is started. The good technical effect of the invention will appear clearly from the following tests records.

Test object	Condenser		Estimated current impulse, A's	Result, relative detonation frequency, percent
	Voltage, v.	Capacitance, μ f.		
Low energy detonating cord assemblies without arrangement according to the invention but with protecting capsule (8).	15,000	0.0003	-----	0
	5,000	0.10	3	0
	5,000	0.25	8	10
	5,000	0.50	16	100
Low energy detonating cord assemblies with device according to the invention:				
(a) Axial copper staple as per FIG. 3.....	5,000	20	600	0
(b) Radial staple as per FIG. 2.....	5,000	40	*3,000	0

*This test was carried out with a lower impedance in the discharge circuit.

shown at the top of FIGURE 1 of the drawings. Further, a metal tack or staple 11 is positioned through the insulation 3 to provide electrical contact between shell 9 and tube 2.

In the experiments which led to this invention, it was first tried to fit suitably shaped metallic bodies at the top in the booster- and detonating caps, the bodies making contact with the cap shells and with the end surfaces of the lead tube, when the cord was pressed into the caps and fastened with crimps. This device proved, however, to be quite ineffective in preventing detonation in the discharge tests at extended current impulses mentioned above.

It was not until the contact surface between the lead tube and the connecting metal body was located inside the cord, as in the embodiments mentioned above, that the experiments were successful. Then it was in fact possible to extend the current impulse of the discharges to values exceeding the melting impulse of the lead tube, which is about 600 A's, without any detonation to occur. Indeed at the limit of the discharge apparatus used in the experiments, about 3000 A's, no detonation occurred with the embodiment according to FIG. 2.

When assemblies subjected to such discharges are afterwards dissected, it is visible how the molten lead is pressed out into the insulating paper layer. The part of the lead tube which is between the staple point and the end of the cord is intact, however, and its core of PETN has not detonated. It is important that this distance is sufficient so that the molten lead is not pressed to the end surface of the cord and ejected to the heat sensitive charge in the blasting cap. In the investigated cord, whose insulating layer was made of paper cords, about 1 cm. was sufficient, but with other, denser insulating materials this distance could be substantially reduced.

The reason why a contact at the end surface of the lead tube is not able to prevent detonation, even at current impulses below the melting impulse of the lead tube, is not so easily demonstrated, but may depend on arcing, which is hard to avoid at such extreme current strengths. For this reason, it is important that in the embodiment of the invention according to FIG. 2, there is no metallic body in contact, or near contact, with the end surface of the lead tube, through which part of the discharge current could pass and cause arcing which ejects melted droplets into the heat-sensitive charge in the blasting cap.

A low energy detonating cord assembly having the arrangement according to the invention may be equipped with a protecting capsule in a known manner, although this is not necessary. As a protection against unintentional initiation the capsule is, on the whole, unnecessary.

A comparison of the test results for cord assemblies with the arrangement according to the invention and without such an arrangement proves that the improvement concerning safety against the effect of high tension discharges amounts to at least one centifactor.

In the embodiments shown, the arrangement according to the invention has not been introduced in the booster cap because corresponding discharge tests have not resulted in detonations. However, it is fully possible to do so without exceeding the scope of the invention.

What I claim is:

1. A low energy detonating cord assembly comprising a detonating cord, including, a central, elongated core of high velocity, detonating explosive, a metallic annular tube immediately surrounding said core, at least one annular layer of insulating material immediately surrounding said metallic tube; a booster cap, including, a cap-type, metal exterior shell having one end closed and its opposite end at least partially surrounding and in contact with said insulating layer at one end of said detonating cord; a blasting cap, including, a cap-type metal exterior shell having one end closed and its opposite end at least partially surrounding and in contact with said insulating layer at the other end of said detonating cord; a wire-like electrical conducting means, electrically connecting the outer lateral wall of said annular tube to the inner lateral wall of at least one of said blasting cap shell and said booster cap shell and passing through a substantial portion of said insulation, whereby detonation of said assemble by stray electrical current is substantially reduced.

2. An assembly as in claim 1 with an electrical conducting means, electrically connecting the outer lateral wall of said annular tube to the inner lateral wall of said booster cap shell, whereby detonation of said assembly by stray electrical currents is substantially reduced.

3. An assembly as in claim 1 with an electrical conducting means, electrically connecting the outer lateral wall of said annular tube to the inner lateral wall of said blasting cap shell, whereby detonation of said assembly by stray electrical currents is substantially reduced.

References Cited

UNITED STATES PATENTS

2,424,374	7/1947	Taylor et al.	102—27
3,106,892	10/1963	Miller	102—27
3,129,663	4/1964	Schnepfe	102—27

BENJAMIN A. BORCHELT, Primary Examiner.
V. R. PENDEGRASS, Assistant Examiner.