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2,113,004

DETONATING FUSE

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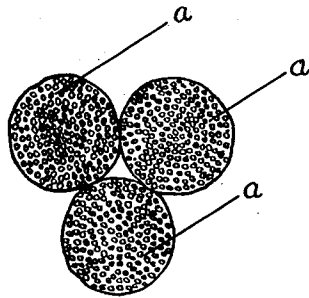


Fig. 1

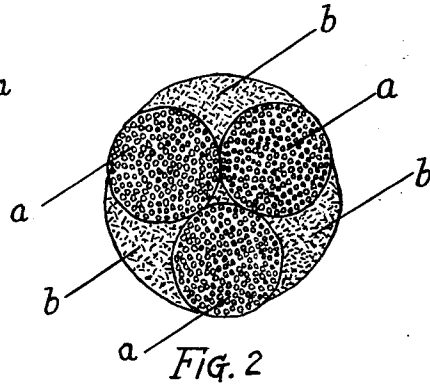


Fig. 2

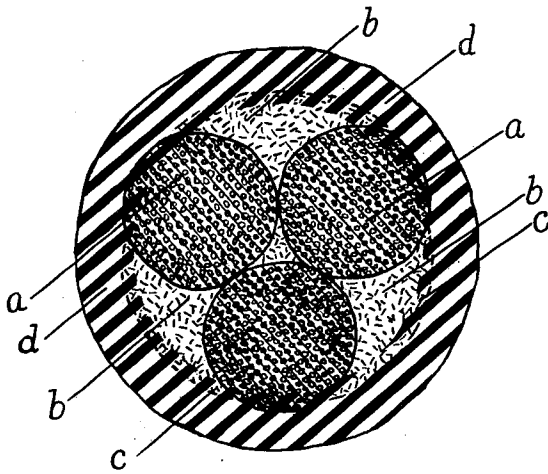


Fig. 3

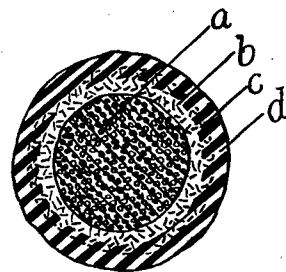


Fig. 4

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DETONATING FUSE

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3 Claims. (Cl. 102—8)

My invention relates to improvements in fuse of the type commonly known as instantaneous fuse or detonating fuse, and more particularly relates to a novel detonating fuse of the type invented by Hess and described on page 47 of the 1909 edition of the book "Manufacture of Explosives, Twenty Years Progress" by Oscar Gutt-

rubber or equivalent material *d*, completely confining the pulverulent explosive *b*, and penetrating into the pulverulent detonating explosive within an area shown as the zone *c*. The drawing is not to scale, and Figures 3 and 4 are shown on a somewhat larger scale than was used in Figures 1 and 2, for the purpose of more clearly bringing out the details of structure of the finished detonating fuse.

The principal object of my invention is to provide a detonating fuse containing individual or discrete particles of a pulverulent initial detonating explosive adhesively so held and collectively so confined in both a matrix and an imperforate coating that individual particles of the detonating explosive cannot become detached from the fuse during handling, transportation or use. My present invention is a continuation in part of my pending application S. N. 27,130, filed June 17, 1935.

In the drawing, there are illustrated greatly enlarged cross-sections through the component parts and completed detonating fuse made in accordance with my present invention.

Figure 1 is a cross-section of a cord such as may be used to form the base of my present detonating fuse, and consisting of three strands *a, a, a*. These strands may be made of cotton, jute, rubber or any other suitable material, although nitrocellulose is the preferred material. Although the base cord as shown in the illustration is made up of three strands, I may use a single strand, or any desired number of strands of longitudinal base cord.

Figure 2 is a cross-section of the cord shown in Figure 1 after a pulverulent detonating explosive *b, b, b* has been adhesively attached to the base cord, and excess adhesive and explosive has been wiped off, as by passing the fuse through a scraper opening. Figure 3 is a cross-section of the cord shown in Figure 2, after an imperforate elastic coating of rubber or equivalent material *d* has been applied to the cord, to penetrate the outer surface and completely confine the pulverulent explosive *b*. The intermediate zone where the rubber has penetrated into the core is shown in the drawing as *c*, and to indicate penetration, the conventional cross-hatching to represent rubber has been extended over a portion of both the cross-sectional area of the cord and the pulverulent explosive material.

Figure 4 is a cross-section of a completed detonating fuse employing a single strand of base cord *a*, surrounded by a concentric covering of adhesively secured detonating explosive *b*, confined by an outer imperforate elastic coating of

In detonating fuse of the type invented by Hess, a cord or tape of any convenient type is first saturated or coated with any suitable adhesive or agglutinant, and is then covered with a detonating material such as fulminate of mercury, pentaerythritol tetranitrate or any other like initial detonating material. The pulverulent initial detonating explosive is adhesively secured to the base cord, and the pulverulent nature of the detonating explosive allows the composite product to be bent or twisted, without substantial loss of the detonating material. Since the detonating explosive used in the manufacture of fuse of this type is usually very sensitive to friction or percussion, it is highly important that none of the adhesively-secured detonating agent should drop off or flake off from the cord, as in this case the detached particle of explosive material would be liable to be a source of accident through being stepped upon, or through being subjected to friction or percussion in any of the operations in which the detonating fuse was used.

The protecting of the adhesively-secured detonating agent by wrappings of paper, tape or like material or by the braiding thereover of additional threads of fabric represents possible means of protecting the pulverulent detonating material, and of preventing particles of this sensitive detonating material from becoming displaced or separated.

I have discovered that by running the detonating fuse of Hess through a solution or suspension of rubber, in much the same way that wire is coated with rubber by the cold rubber solution or by the latex process, I obtain a highly desirable result in that the coating of rubber which is thus obtained upon the detonating fuse of Hess penetrates into the porous detonatable mass to some extent, in addition to forming a highly elastic and entirely imperforate covering over the pulverulent particles of explosive, and exerts an elastic pressure upon such pulverulent particles, tending to not only prevent their loss from the assembled detonating fuse, but actually

to hold them in their initial position, against any possibility of movement.

In order to explain this result, it must be remembered that in the process of running the detonating fuse through a solution or suspension of rubber or equivalent material, the solution penetrates the pulverulent detonating explosive to some extent, and upon the rubber solution or suspension changing to solid rubber, I not only obtain a coating over the pulverulent explosive, but in addition I obtain a coating, the inner edge of which is actually within the porous outer edge of the pulverulent explosive material.

I do not claim as any portion of my invention detonating fuse comprising an inner detonating core and an outer metal envelope surrounding but not adhesively secured to the detonating core, and my invention relates essentially to detonating fuse comprising a detonating core and an impermeate non-metallic elastic covering on and over and extending into the detonating core, and adhesively secured thereto, and exerting elastic pressure thereon, as I find that all of these elements are important features of my complete invention.

In the manufacture of my present detonating fuse, I may employ a base core, tape or cord of any convenient material, but I preferably find that a core made up of strands of cotton fibers, or equivalent fibers of flax, silk, hemp, jute or the like represents a very satisfactory base cord, and that the use of nitrocellulose as recommended by Hess is desirable. I may employ, however, a base cord made up entirely of rubber, or I may employ a base cord made up of such a mixture of rubber and detonatable explosive material as is described in my pending application S. N. 27,130, filed June 17, 1935.

As the pulverulent detonating explosive employed in the practice of my present invention, I may use any of those sensitive explosive materials which are collectively known as initial detonating agents, and of which the best known and most commonly used are the fulminates of cadmium, silver, gold and mercury, the azides of cadmium, silver, lead and mercury, nitrogen sulfide, silver acetylide, and any of the large number of organic initial detonating agents of which pent-erythritol tetranitrate, sucrose octanitrate and mannitol hexanitrate form particularly desirable representatives. As my agglutinant I may employ any suitable adhesive, a mixture of glue and an alcohol such as glycerol, ethylene glycol, diethylene glycol, sorbitol or the like being particularly satisfactory, but modified starch adhesives, casein adhesives, rubber adhesives and the like being also entirely satisfactory, the requirement being an adhesive material that will mechanically secure or hold together the individual particles of the pulverulent initial detonating agent without having damaging chemical action thereon. The number of such materials is very large, and practically any of the commonly used adhesives may be employed in the practice of the invention.

The final coating which I employ in the practice of my invention is applied as a liquid solution in a solvent or as a suspension in a non-solvent of natural rubber, synthetic rubber or rubber surrogate, the liquid condition of the solution or suspension permitting it to not only coat the outer surface of the pulverulent detonating agent, but to penetrate within the porous mass that is constituted by the pulverulent particles of initial detonating agent. Upon the

solidification or hardening of this liquid coating agent I then obtain an imperforate, elastic covering which not only completely surrounds and encloses the pulverulent initial detonating agent, but which penetrates in part into the mass of the pulverulent explosive, and which in its solidified condition exerts elastic pressure upon the pulverulent explosive material, holding and retaining the pulverulent particles not only within the outer covering, but actually in their predetermined positions with relation to the cord and to the outer coating.

In the practice of my invention I prefer to employ a supporting longitudinal cord or wick of nitrocellulose or other fibrous material, loosely twisted so that it may be readily impregnated by the mixture of initial detonating agent and adhesive, and I then prefer to draw this impregnated cord or wick through a scraper opening, for the purpose of wiping off and removing the excess mixture of detonating agent and adhesive. This procedure has the effect of wiping the outer edges of the cord substantially free of particles of detonating agent, and in the subsequent step of coating the fuse so made with a solution of rubber in a solvent, or in a suspension of rubber in a non-solvent, as in the latex process, I find that the rubber solution or suspension passes readily into the outer portion of the cord, and that upon the hardening of the rubber this establishes an integral relationship between the outer rubber coating and the inner longitudinal core, through the partial penetration of the liquid coating agent into the outer portion of the longitudinal core as well as into the porous mass constituted by the pulverulent particles of the initial detonating agent adhesively secured to each other by the agglutinant material.

Instantaneous fuse made in accordance with my present invention is distinguished from fuse made by methods previously known, in the fact that my present fuse consists essentially of a core of discrete individual pulverulent particles of an initial detonating agent adhesively secured to a central supporting cord and surrounded by a coating of rubber or like material exerting elastic pressure upon the inner core, and adhesively secured to the inner core of discrete particles of pulverulent initial detonating agent, and partially coextensive with such pulverulent initial detonating agent through the penetration of the elastic coating agent into the open spaces within the outer portion of the mass of pulverulent particles of the detonating agent. The individual discrete particles of pulverulent detonating agent are adhesively secured to the central supporting core, and the individual discrete particles of pulverulent detonating agent toward and at the outer boundary of the detonating fuse are cemented together by the outer rubber coating, and are also elastically compressed and held in position by the outer portion of the rubber coating material which is free from particles of the initial detonating agent. The particles of initial detonating agent in my instantaneous fuse are all adhesively secured to each other, and those near the center of the fuse are adhesively secured to the central cord, and those near the outer periphery of the fuse are both penetrated by and adhesively secured to the inner portion of the rubber coating of the fuse, while all of the individual discrete pulverulent particles forming the detonating fuse are elastically held, supported and compressed by the elastic action of

the pure rubber or equivalent material forming the outer coating of the fuse.

It will of course be evident that the complete detonating fuse made in accordance with the present invention could if desired be still further covered with wrapped or braided coverings of any desired type or with any other type of covering such as talc, asphalt or other material, but such outer coatings are unnecessary in connection with my present invention, and if employed form no part of the invention as herein disclosed.

The detonating fuse made in accordance with my present invention offers important advantages, particularly in its greatly increased safety, over any of the types of detonating fuse made in accordance with the procedure initially described by Hess, and detonating fuse made in accordance with my present invention may be employed as a substitute for the common types of cordeau detonant employing a lead or tin tubing, and are quite as free from the chance of accidental loss of explosive material as are these more expensive types of metal-coated detonating fuse.

It will be evident that many modifications may be made without departing from the essential principles of the invention as herein described, and accordingly no limitations should be placed upon my invention, except such as are indicated in the appended claims.

I claim:

1. Instantaneous fuse comprising a fabric reinforcing member, a train of individual discrete particles of a detonating agent adhesively attached to such fabric reinforcing member, and an imperforate adherent rubber sheath surrounding and at least partially penetrating the adhesively-attached particles of detonating agent.

2. Instantaneous fuse comprising a longitudinal fabric reinforcing member, a train of discrete particles of a detonating agent, a matrix of rubber, and an imperforate adherent rubber sheath, the matrix of rubber surrounding and impregnating the separate particles of the detonating agent, and being in turn surrounded by and at least partially penetrated by the imperforate adherent rubber sheath.

3. Instantaneous fuse comprising a longitudinal fabric reinforcing member, adhesively-attached individual discrete particles of a detonating agent, and an imperforate adherent rubber sheath, the individual discrete particles of detonating agent being adhesively attached to each other and also to the longitudinal fabric reinforcing member, and the assembly thus constituted being in turn surrounded by and at least in part penetrated by the imperforate adherent rubber sheath.

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