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EXPLOSIVE ASSEMBLY AND METHOD OF MAKING IT

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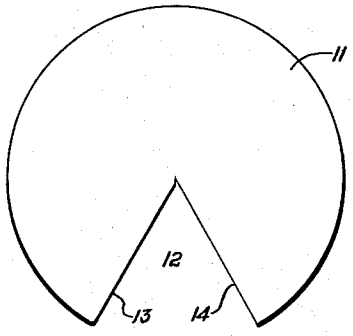



Fig 1

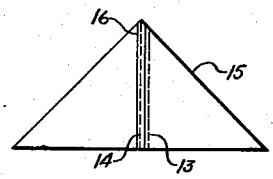



Fig 2

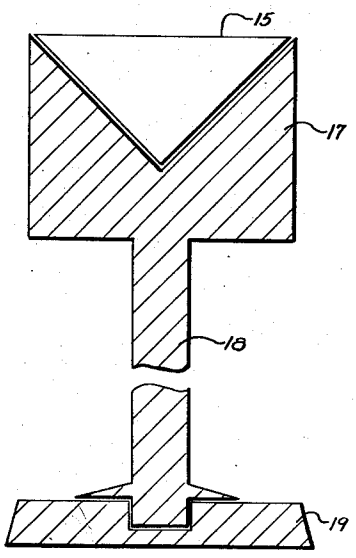



Fig 3

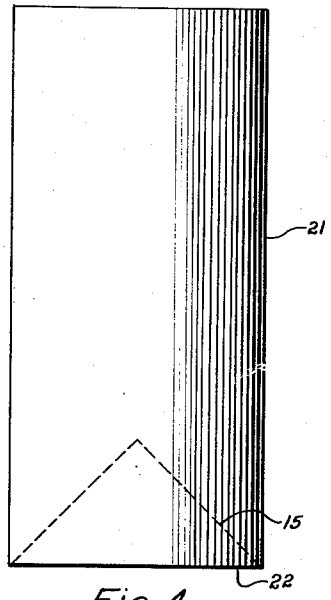



Fig 4

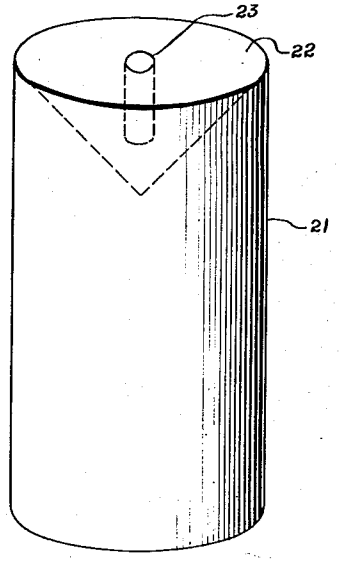



Fig 5

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## EXPLOSIVE ASSEMBLY AND METHOD OF MAKING IT

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5 Claims. (Cl. 86—20)

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The present invention relates to an improved explosive assembly.

An object of the invention is the provision of an improved assembly containing explosives of relatively low sensitivity.

Another object of the invention is the provision of an explosive assembly which may be initiated with assurance of complete propagation by means of commercial detonators.

Still another object of the invention is the provision of an explosive assembly which permits the use of explosive materials which are adversely affected in respect to sensitivity to detonation and propagation by an increase in apparent density of loading.

A still further object of the invention is to provide an improved explosive assembly permitting the use of different apparent densities of explosive in the same assembly.

Another object of the invention is the provision of an improved explosive assembly containing an explosive having a higher overall apparent density.

Still another object of the invention is the provision of an explosive assembly containing explosives under different states of compressibility.

A further object of the invention is the provision of an explosive assembly with improved control of apparent density during manufacture.

A still further object of the invention is the provision of an improved explosive assembly containing ammonium nitrate explosive.

Other objects will be apparent from the following description.

As the apparent density of most explosive compositions is increased, as by hard packing, there is a reduction in sensivity to detonation and a decrease in propagation sensitivity. This phenomenon is particulary pronounced with explosives containing a high proportion of ammonium nitrate and no, or but a small proportion of, nitro glycerine. It is to explosives of this type to which the present invention is principally directed.

The term "density" as used in the present specification and claims, in connection with explosive compositions, refers to apparent density, which may be altered by packing.

In most blasting operations, it is desirable from the economic point of view, that the explosive charge in a cartridge be as dense as possible and yet be sufficiently sensitive to detonation and propagation in a bore hole. With a dense explosive, a smaller diameter bore hole may be employed for the same weight of explosive than is required for a less dense explosive. Furthermore, it is required in some blasting operations that the explosive charge be concentrated into as small a space as is possible in order to secure the proper effect of the blast. Such an effect must be obtained by the use of a high density explosive. Also, where muddy water of high specific gravity exists in a bore hole, a dense explosive charge sinks more easily and more rapidly to the bottom. Furthermore, greater economy of manufacture is brought about by the use of smaller explosive assemblies with dense explosive compositions, as compared with the larger assemblies which are necessary when explosives of less density are used.

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Usually the density of the explosive charge in an assembly is controlled by the amount of pressure exerted on the charge in packing the assembly. Customarily, the charge is added to the assembly container in increments during the packing operation and packed down either mechanically or by hand with packing sticks. The greater the pressure during packing, the more the density of the finished cartridge and the more rigid and harder the cartridge becomes.

When the explosive is packed in thin sheet metal cans provided with rolled or locked seams, there are decided advantages derived from hard packed, and hence relatively incompressible, explosive charges. In handling there is less likelihood that the can will be deformed or dented by rough treatment. Deformation or denting, in addition to adversely affecting the shape of the can, often impairs the water resistance of the assembly. Also, it is found that a densely packed assembly has improved water resistance of itself when placed in bore holes containing a head of water. The hard packed explosive compositions aid in preventing deformation of the assembly container by water pressure.

It is often required that explosive assemblies be resistant to detonation when struck by bullets at high vlocity. Hard packed explosive compositions are usually more resistant to such detonation than are compositions of less density.

While a high density of packing for explosive assemblies is desirable for the reasons stated above, such assemblies often are difficult to detonate with commercial detonators because of the low sensitivity produced by compression to high densities. The difficult initiation of explosive assemblies in which the explosive is packed under high compression arises not only because of the inherent insensitivity of dense hard packed explosive but also because of the fact that hard packed explosive not being readily further compressible supports the assembly walls making it difficult for the initiating force from a detonating element to break through the assembly walls. Conversely, assemblies containing less highly packed, and hence more compressible explosive, not only are inherently more sensitive but also readily permit the force of initiation to break through the assembly walls.

The present invention provides a means where-

by a cartridge containing a densely packed, or relatively incompressible explosive may also include a more loosely packed, or more compressible booster charge of consequently greater sensitivity.

According to the present invention, an explosive assembly is provided in which a rigid container has included in it a rigid partition defining a volume having a base and a diminishing cross-sectional area proceeding away from that base. In the volume defined by the rigid partition is placed an explosive in a condition of high compressibility and sufficiently sensitive to be initiated by a commercial detonator. In the remainder of the explosive assembly is placed an explosive in a condition of lower compressibility.

In an assembly prepared according to the present invention, a detonating element may be used adjacent the more highly compressible booster portion of the cartridge, and the booster charge will sufficiently initiate the less highly compressible principal, or base, charge.

A specific embodiment of the invention will be particularly described in connection with the drawing in which:

Figure 1 represents a sheet from which is prepared a conical partition to separate the less highly compressible from the more high compressible explosive;

Figure 2 shows the partition finally prepared in the form of a cone;

Figure 3 is a view illustrating a holder for the partition during packing and insertion of the partition into the assembly;

Figure 4 is a view of a finished assembly; and

Figure 5 is an isometric view of a modified finished assembly.

Referring to Figure 1, 11 is a flat cardboard sheet in generally circular form having a radius equal to the desired slant height of the conical partition. A segment 12, defined by edges 13 and 14, is cut from sheet 11. Edge 13 is in the form of a flap for insertion under edge 14 to form cone 15 (Fig. 2). Cone 15 is held together by adhesive strip 16 placed over edge 14. Segment 12 is of such size that the circular base of cone 15 will fit snugly in cylindrical can 21 (Fig. 4). Fig. 3 shows a holder 17 provided with a long support 18, which stands up in a base 19 but is removable therefrom.

To prepare the assembly, cone 15 is placed in a recess provided in holder 17. The charge of booster explosive is packed into the cone to a desired cap-sensitive density. Cylindrical can 21 (Fig. 4) having one end open and the other end closed by circular end wall 22 is slipped over holder 17 until end wall 22 rests on cone 15. Then holder 17, bearing packed cone 15 and can 21, is lifted by means of support 18, which should be of sufficient length for the purpose, and can 21 is inverted and supported so that end wall 22 is at the bottom and cone 15 rests thereon. Holder 17 is then withdrawn from can 21 and the remainder of the cartridge packed with explosive to the density desired in the final cartridge. This density is usually considerably higher than the density of the explosive in cone 15 and requires greater compression during packing. Consequently, the base explosive having been packed harder than the booster explosive is less compressible than is the booster explosive. The open end of can 21 is then sealed and the explosive assembly shown in Fig. 4 is thereby completed.

In use, a detonating element such as a blasting cap or detonating fuse is fixed to end wall 22 of can 21 and the booster charge initiated therewith. The booster charge initiates the remainder of the explosive in can 21.



Fig. 5 shows a modification of the assembly. In Fig. 5 the can is shown inverted relative to its position in Fig. 4. The modification shown in Fig. 5 is similar to that shown in Fig. 4 except that the end wall 22 of can 21 is provided with a well 23 for insertion of a detonating element. A tunnel plate lying parallel to and against the end wall of the cartridge and adjacent the booster charge may also be used for this purpose.

It is evident that the present assembly provides a means whereby the same cartridge may contain explosives of different densities and different compressibilities. The shape of the partition separating the booster and base charges offers great resistance to deformation by external vertical pressure. Particularly is this true when the periphery of the partition is laterally supported. Since the partition is resistant to deformation, a low density or highly compressible explosive may be maintained in the partition even though explosive is packed to high density or less compressible condition on the other side of it. This is particularly important in the case of granular explosives having free flowing characteristics. Granular explosives are usually quite desirable for explosive assemblies of the present type for the reason that they permit uniform densities throughout their bodies. Uniform density is, of course, desirable to obtain uniform sensitivity throughout the charge.

It has been found that during the packing of partitions of the type of the present invention the shape of the partition has the important property of preventing the development of unduly high density in the booster charges. The explosive flows along the sides of the partition so that vertical packing force produced by packing sticks is dissipated into parts of the volume defined by the partition which are not directly affected by the packing pressure, and excess of packing pressure causes a flow of explosive upwards along the sloping partition. This action prevents unduly hard packing. The use of partitions according to the present invention results, therefore, in more uniform densities inside each booster charge and among a series of booster charges irrespective of ordinary variation in pressure exerted by packing sticks. This uniformity in density makes for desirable uniformity of sensitivity of detonation.

The separating partition may be made of metal, heavy paper, cardboard, plastic or other rigid materials, as also may be the external cartridge. The separating partition is preferably made in the form of a cone, though it may also be made in the form of a pyramid, or of a truncated cone or pyramid, or of a hemisphere, or in any form the cross-sectional area of which diminishes, proceeding away from the base. It is preferred that the partition be laterally supported at its base; though serviceable cartridges may be prepared even though this is not done. When a cone is to be employed and it is to be laterally supported, it is desired to use the cylindrical cartridge having diameter such that the cone will snugly fit therein.

If a rectangular cartridge is employed, a pyramid is the best partition to obtain this effect. However, since a cone is easy to make and gives great resistance to deformation, it is usually preferred that cylindrical assemblies with cones be employed.

When a cone is employed, the height of the cone depends upon the diameter of the cartridge and the apex angle of the cone. As the apex angle of the cone is unduly increased the resistance of the cone to compression undesirably decreases. Apex angles as high as 120° may be used, however, with entirely satisfactory results, and greater angles may be used with somewhat less protective effect.

On the other hand, as the apex angle of the cone is unduly decreased, the tendency of the walls to make the explosive flow outwardly under excessive packing pressures is undesirably reduced. Apex angles as low as 60° may be used satisfactorily and smaller angles may be used with somewhat less advantage.

An apex angle of about 90° has usually been found to be about optimum.

The invention has been found eminently satisfactory using an 8⅛ in. diameter sheet metal cartridge 17⅜ in. in length having a cone 8 in. in diameter at the base, 4 in. high, made from 8-ply cardboard faced on one side.

The present invention provides a definite advantage in that the amount of booster charge employed may be made quite small for the reason that a large area is provided upon which a detonating element may be affixed; and, at the same time, the boosting charge has considerable depth.

The booster charge and the base charge may be made of the same compositions, the increase in sensitivity necessary to the booster being obtained only by the decrease in density. On the other hand, the booster charge may be made of a different composition than the base charge including, for example, larger quantities of sensitizer, or sensitizers producing more highly sensitive charges.

For some applications, it has been found desirable to include a sensitizer and relatively loose charge in the cone, a charge containing similar or somewhat less sensitizer immediately adjacent this cone and a charge containing little sensitizer in the remainder of the assembly.

Explosive charges prepared according to application Serial Number 351,211, filed by Claude H. Carey August 3, 1940, now abandoned, are eminently satisfactory for use in cartridges of the present type.

Other modifications of this invention will be readily apparent to those skilled in the art.

The expression "cap sensitive" used in the claims as descriptive of explosive compositions is intended to mean a composition which is efficiently initiated by a commercial detonating element such as a fuse cap, an electric blasting cap, or a detonating fuse.

What is claimed is:

1. A power producing explosive assembly comprising a rigid cylindrical container having circular end walls, a rigid conical partition having an open base spanning said container and freely resting against one end wall of said container, said conical partition extending toward the opposite end of said container, and having an apex angle between about 60° and about 120°, a booster explosive in said conical partition, a more highly compressed and less sensitive explosive than said booster explosive in the remainder of said container and a receptacle for a detonating element adjacent said booster explosive.

2. A method of preparing an explosive assembly which comprises providing a rigid conical partition having an apex angle between about 60° and about 120°, packing said conical partition with explosive to a desired cap sensitive density, inserting said conical partition containing said explosive into a rigid cylindrical container with the base of said partition against a circular end wall of said container, and with said partition extending toward the opposite end of said container, said container having diameter such that it fits snugly around the base of said conical partition, packing explosive in said container and around said partition under greater pressure than was employed in packing said first-mentioned explosive, and closing said container.



3. A power producing explosive assembly comprising a rigid cylindrical container having circular end walls, a rigid conical partition having an open base spanning said container and freely resting against one end wall of said container, said conical partition extending toward the opposite end of said container and having an apex angle between about 60° and about 120°, a booster explosive in said conical partition, and a more highly compressed and less sensitive explosive than said booster explosive in the remainder of said container.

4. A power-producing explosive assembly comprising a rigid cylindrical container having circular end walls, a rigid cardboard conical partition having an open base spanning said container and freely resting against one end wall of said cotainer, said conical partition extending toward the opposite end of said container and having an apex angle between about 60° and about 120°, a booster explosive in said conical partition and a more highly compressed and less sensitive explosive than said booster explosive in the remainder of said container.

5. A method of preparing an explosive assembly which comprises providing a rigid conical partition having an apex angle between about 60° and about 120°, packing said conical partition with explosive to a desired cap sensitive density, inserting said conical partition containing said explosive into a rigid container with the base of said partition against an end wall of said container and with said partition extending toward the opposite end of said container, said container having dimensions such that it fits snugly around the base of said conical partition, packing explosive in said container and around said partition under greater pressure than was employed in packing said first mentioned explosive, and closing said container.

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