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C. H. CAREY

2,448,658

METHOD FOR MAKING EXPLOSIVE ASSEMBLIES

Filed March 2, 1946

2 Sheets-Sheet 1

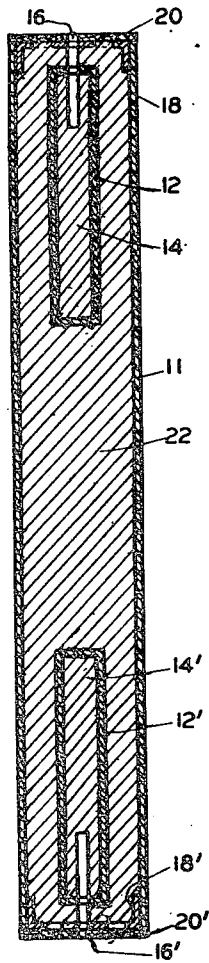


Fig. 1

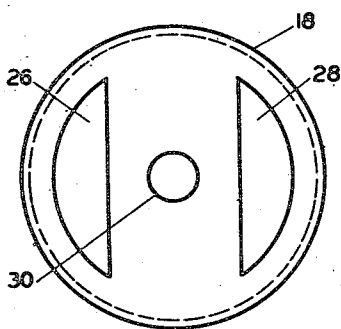


Fig. 3

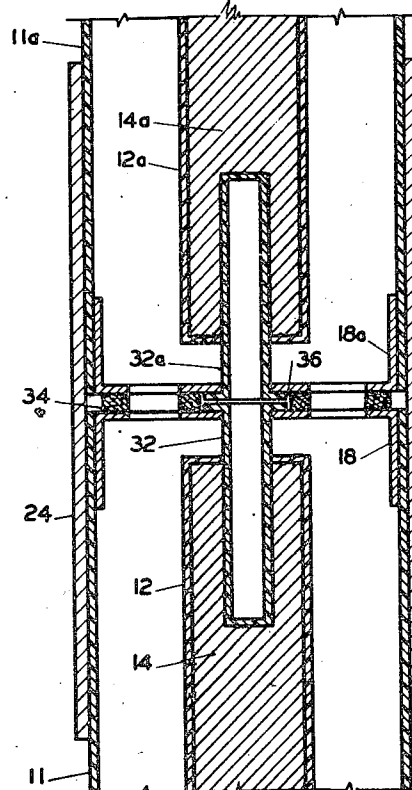


Fig. 2

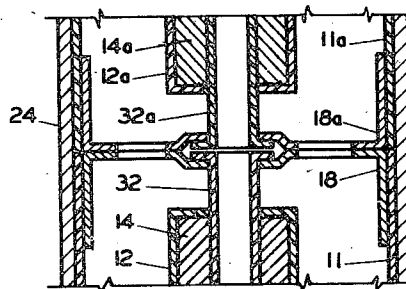


Fig. 4

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Fig. 6

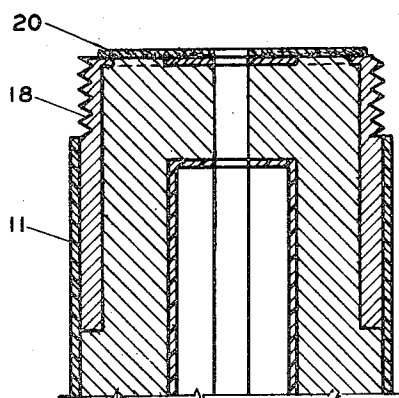


Fig. 5

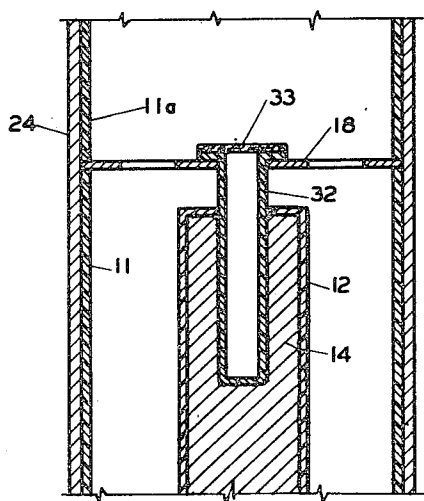


Fig. 8

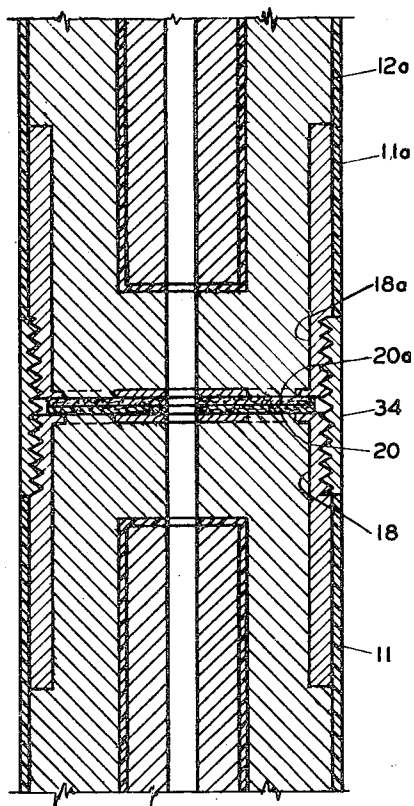


Fig. 7

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UNITED STATES PATENT OFFICE

2,448,658

METHOD FOR MAKING EXPLOSIVE ASSEMBLIES

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3 Claims. (Cl. 86—31)

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The present invention relates to the manufacture of explosive assemblies.

An object of the invention is the provision of a method for the manufacture of cast explosive assemblies.

Another object of the invention is the provision of a method for the manufacture of cast explosive assemblies with reduced cavitation.

A further object of the invention is the provision of a method for the rapid manufacture of cast explosive assemblies.

Other objects of the invention will be apparent from the following description and from the drawings.

Explosive assemblies have been made by pouring melted explosive into shells and then cooling to solidify the explosive. Simple pouring operations have, however, resulted in much undesired cavitation as the cast explosive shrinks on cooling. Since the melted explosive cools and solidifies gradually from the outside walls of the shell toward the center, the molten material in the center drops down, leaving a funnel shaped cavity in the upper interior portion of the explosive charge. Also, as local pockets of explosive cool independently, cavities often appear dispersed through the mass and particularly around any objects contained within the casting, such as pellets of primer charge, detonator wells, and so forth.

Cavitation is not only undesirable because it results in incompletely filled shells but also, for one reason, because it is very apt to hinder propagation of detonation in the explosive.

It has been attempted in the past to overcome cavitation by filling shells in a series of steps with a stirring or puddling operation between each step. This method improves cavitation conditions, but it is exceedingly cumbersome and time-consuming and unless carried out with great care will not adequately prevent undesirable cavitation.

The present invention provides a rapid and convenient method by which shells are filled with reduced resultant cavitation.

According to the present invention, a number of shells provided with exit and entrance ports are arranged in an upstanding communicating series. The series is then filled with melted explosive and the series is cooled until the explosive contained in it has solidified. As the cooling explosive shrinks, melter explosive under a head from the upper members of the series flows down filling cavities as they are formed, and it is usually found that all the cavitation has taken

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place in the upper member. The upper member of the series which has absorbed the shrinkage and, consequently, is not completely filled with explosive may then be used as the lower member in a subsequent series which is prepared and filled.

The invention will be particularly described in connection with the drawings which illustrate a number of constructions which may be used in specific embodiments of the invention and in which:

Figure 1 is a longitudinal sectional view of a completed assembly filled according to the method of the present invention;

Figure 2 is a longitudinal view of the juncture between two shells of the type shown in Figure 1 which are ready for filling with explosive;

Figure 3 is a top view of the end member of the shells shown in Figure 2;

Figure 4 is a longitudinal sectional view of a modified form of juncture of the type shown in Figure 2;

Figure 5 is a partial longitudinal sectional view of the end portion of another modified shell which has been filled in accordance with the invention.

Figure 6 is a longitudinal, sectional view of a sleeve member adapted to link together two shells of the type shown in Figure 5.

Figure 7 is a partial longitudinal sectional view of two completed assemblies of the type shown in Figure 6 and joined together for use; and

Figure 8 represents a simplified embodiment of the invention and is a longitudinal sectional view of the juncture between two shells ready for filling with explosive.

Referring to Figure 1 of the drawing, 11 is an elongated tubular shell circular in cross section; 12 and 12' are cartridges containing booster explosive 14 and 14'; 16 and 16' are detonator wells leading into booster explosive 14 and 14'; 18 and 18' are end members which will be described more fully below; 20 and 20' are end caps over the ends of the assembly; and 22 is the cast charge of melted explosive.

While any normally solid meltable explosive may be used in assemblies prepared according to the process of the present invention, it will usually be preferable to use such materials as TNT, amatols, pentolites, tetryls, TNT and cyclonite mixtures, picric acid, and the like.

The inclusion of booster charges in explosive assemblies made according to the present invention usually depends upon whether or not the

main explosive charge is sufficiently sensitive to take initiation from the initiating means employed, such as a detonator or a primer cartridge, and to propagate the detonation through the shell, and from shell to shell where the shells are employed in a series. When TNT is used as the explosive charge, it is usually found preferable to use an internal booster charge as shown in Figure 1. While it is not necessary to employ booster charges in both ends of the shells as shown in Figure 1, this construction is often most convenient since when a booster charge is contained in both ends of a long assembly, the assembly may be initiated at either end; and, also, care does not have to be taken to provide that an end containing a primer charge is located near the point of juncture where one assembly connects with a preceding assembly of a series as is otherwise sometimes important.

Any convenient sensitive materials may be used for booster charges. Pressed pentaerythritol tetranitrate, tetryl, and cyclonite are highly effective booster materials as are combinations of these with low melting explosives such as TNT and/or with plasticizing materials.

Assemblies of the type shown in Figure 1 may be prepared according to the present invention by pouring the charge into an upstanding end-to-end series of shells. Usually from about two to about six shells make a convenient series length. The bottom shell of the series is closed off; the connections between the shells are made tight against leakage; and the column is filled from the top with molten explosive. The whole column may then be permitted to cool, broken apart at the points of shell juncture after solidification, and individual assemblies capped if desired. Practically the entire amount of cavitation will be found to have taken place in the upper shell or so. Then, any unfilled shells may be used as bottom shells in a subsequent series so that they then become completely filled.

Figure 2 shows a construction which may be used for the juncture point of two assemblies in a series so as to permit retention of molten explosive and positioning of the elements of the assembly. Lower shell 11 is provided with end portion 18 constructed as shown in Figure 3. It will be noted from that figure that end portion 18 is provided with passages 26 and 28 on either side of a central hole 30. Referring again to Figure 2, through central hole 30 of end member 18 extends, in close fit, tubular detonator well former 32 in the form of a tube provided with flanges which rest on end member 18. Detonator well former 32 is inserted, again in close fit, into booster shell 12, containing booster explosive 14. Upper shell 11a is provided, similarly to shell 11, with end portion 18a, detonator well former 32a, booster shell 12a, and booster explosive 14a. Between end portions 18 and 18a lies spacer member 34. Spacer member 34 is provided with passages similar to those in end members 18 and 18a (26 and 28) and also with large central hole 36 into which fit the flange portions of detonator well formers 32 and 32a. Spacer 34 serves the function of providing a gasket between end members 18 and 18a and leaves room for the flanges on detonator well formers 32 and 32a.

The shells are aligned with the passages through the end pieces 18 and 18a and spacer 34 in registry as shown in Figure 2, and a sleeve 24 is then placed over the juncture point. After the column has been filled and permitted to cool, 75

sleeve member 24 is slipped off the juncture point, and the shells are broken apart at the juncture point. Any unevenness in the solidified explosive at the point of breakage is smoothed off, detonator well former 32 is pulled out, spacer 34 is removed, and cap members corresponding to cap members 20 and 20' of Figure 1 are placed over the ends of cartridges. If it is desired to protect detonator wells 16 and 16' an easily frangible member may be placed over them or the cap members may be made to cover the entire end of the shell and to be themselves easily frangible.

Figure 4 shows a modified construction in accordance with which spacer 34 of Figure 2 is eliminated. As shown in Figure 4, end members 18 and 18a are made somewhat dishd away from one another in the center so as to provide space for the flange members of detonator well formers 32 and 32a. Elsewhere on their surfaces end members 18 and 18a directly abut, providing a tight joint between them.

Figure 5 shows a further modification of the invention. According to this modification, end portion 18 is made in the form of an externally threaded tube, the threaded portion of which extends above shell 11. Otherwise, end portion 18 is similar to that shown in Figure 2.

Figure 6 shows an internally threaded sleeve 34 which screws onto the threads on member 18. Sleeve 34 may be used to connect together two shells prior to pouring and also after pouring when in use.

Figure 7 shows two filled cartridges of the type of Figure 5 connected together by the sleeve shown in Figure 6 preparatory to use in a bore hole.

The simplified modification shown in Figure 8 is constructed in somewhat the same form as the embodiment shown in Figure 2. The arrangement shown here, however, provides but one booster charge per cartridge. For this reason, but one end portion 18 is needed. As shown in Figure 8, end portion 18 is located inside sleeve 24 and between the ends of shells 11 and 11a. To prevent the filling of hollow well former 32 cap 33 is provided.

The shells of the present invention may be made of any convenient materials, though heavy paper is usually to be preferred for the sake of convenience.

For best results the end pieces and any spacer pieces through which molten explosive is to pass should be made of materials which are poor conductors of heat. Such materials as pressed cardboard, wood, and plastic compositions are useful in this connection. It is found when conductive materials such as metals are used they sometimes tend to conduct heat too rapidly and the explosive material solidifies blocking the passages between shells before they have been properly filled. Also to prevent clogging, the passages through end pieces and spacers which separate the shell should preferably be made as large as possible. Many variants of the form of passage shown in Figure 3 of the drawing are possible, however.

Sleeve members are also preferably made of insulating materials, and it is generally desirable that they be sufficiently long to cover the shell surfaces adjacent booster charges, in order that they may be of assistance in preventing premature solidification of the explosive in the relatively narrow passages through the assembly where the boosters are located.

Detonator well formers are usually preferably

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made of metal or other strong material so that they will be sufficiently rugged to permit easy extraction after the explosive is solidified.

It will be apparent that according to the present invention a novel and useful manner of manufacturing explosive assemblies is provided which fulfills the objects stated above, and it will furthermore be apparent that the specific embodiments shown represent only a few of the multitude of modes in which the invention can be performed.

What is claimed is:

1. A process for the manufacture of explosive assemblies which comprises arranging, in an upstanding communicating series, shells having exit and entrance ports, pouring melted explosive into said series, then, after cooling said series until said explosive solidifies, separating a shell not filled with solidified explosive from said series, placing said unfilled shell at the bottom of a subsequent series, and repeating the process.

2. A process for the manufacture of explosive assemblies which comprises placing a plurality

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of elongated shells having open end walls in end-to-end upstanding columnar relation, pouring melted explosive into the column, then, after cooling said column until said explosive solidifies therein, separating a shell not filled with solidified explosive from the column, placing said unfilled shell at the bottom of a subsequent series, and repeating the process.

3. A process for the manufacture of explosive assemblies which comprises arranging in upstanding, columnar, communicating relation shells having side walls, end walls provided with openings, detonator well formers in at least one of said end walls in each shell, and booster explosive assemblies over said detonator well formers, pouring melted explosive into the top of said series, then, after cooling said series until said explosive solidifies, separating a shell not filled with solidified explosive from said column, placing said unfilled shell at the bottom of another vertical columnar series of shells, and repeating the process.

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