July 8, 1958 R. D. MASON 2,842,055

EXPLOSIVE CHARGE CONTAINER

Filed April 23, 1954

Fig. 1.

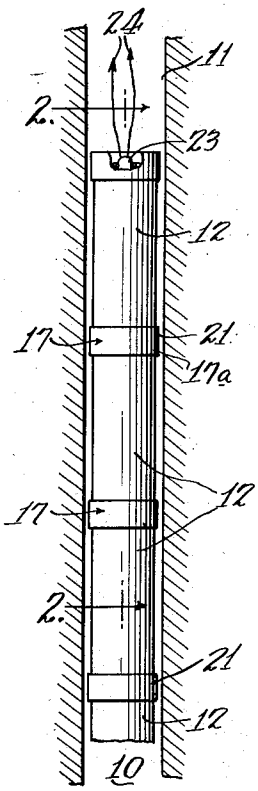


Fig. 2.

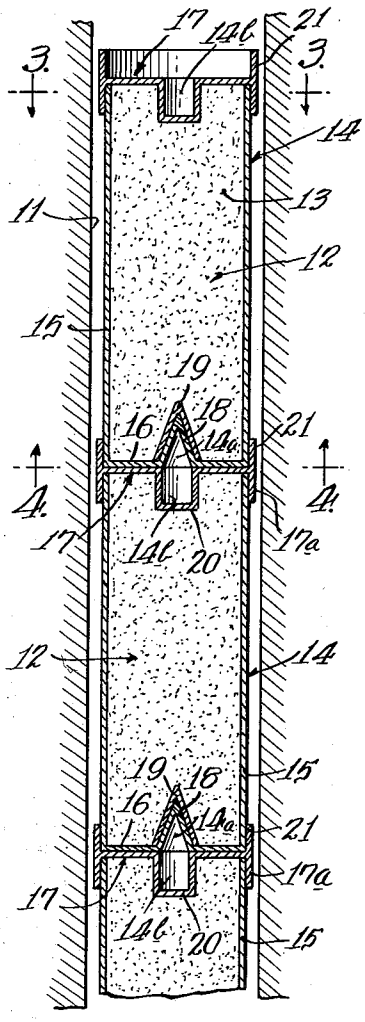


Fig. 3.

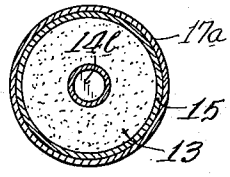


Fig. 4.

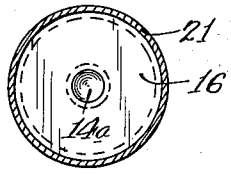
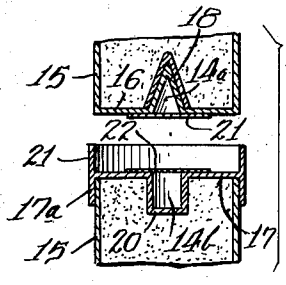


Fig. 5.



INVENTOR.

Richard D. Mason

BY

Mason, Holekmainen, Rathburn & Hyss

Attys.

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EXPLOSIVE CHARGE CONTAINER

Richard D. Mason, Winnetka, Ill., assignor to Seismograph Service Corporation, Tulsa, Okla., a corporation of Delaware

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7 Claims. (Cl. 102—24)

The present invention relates to containers for explosive materials and more particularly to containers equipped with facilities for insuring complete detonation of a number of explosive cartridges when arranged in end-to-end relationship to form an elongated explosive column.

One method of insuring complete detonation of a long column of low sensitivity explosives of the type commonly used in seismic survey operations, mining, quarrying and similar operations, is described and claimed in co-pending application Serial No. 746,578, filed May 7, 1947, by Robert L. Klotz, Jr. and assigned to the same assignee as the present invention, which application matured into Patent No. 2,683,414 on July 13, 1954. The above identified application discloses an arrangement wherein a plurality of cartridges, at least some of which have jet forming cavities in one end, are aligned in end-to-end relationship to form an explosive column of the desired length. When the column is detonated, the jet forming cavity in the end of each cartridge of the column which is so equipped produces an explosive jet effect which is directed into the next adjacent cartridge, thereby to strengthen and revitalize the detonating wave traveling along the column. The present invention relates to improved explosive charge containers for instrumenting the arrangement disclosed in the identified Klotz application in a simple and economical manner.

It is an object of the present invention to provide an improved container assembly for explosive charges.

It is another object of the present invention to provide an improved container for explosive charges which is so formed and arranged that when two cartridges are placed in end-to-end relationship a jet forming cavity is provided in one end wall of one of the cartridge containers for producing an explosive jet upon detonation of the one cartridge which is directed into the adjacent end of the other cartridge.

According to a further object of the invention, one end wall of the present improved explosive container is provided with end wall parts defining an inwardly extending stand-off chamber which is adapted to be axially aligned with the jet forming cavity in the opposite end wall of an identical container when the two containers are arranged in end-to-end relationship.

In accordance with still another object of the invention, the present improved container is provided with exceedingly simple facilities for maintaining two or more stacked cartridges in axial alignment so that the jet forming cavity provided in one end of one cartridge container is aligned with the stand-off cavity or chamber provided in the opposite end of the abutting cartridge container.

Further objects and advantages of the present invention will become apparent as the following description proceeds, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the present invention,

reference may be had to the accompanying drawing, in which:

Fig. 1 is a view of a charge formed of a plurality of cartridges embodying containers characterized by the features of the present invention and aligned in end-to-end relationship within a shot hole;

Fig. 2 is an enlarged sectional view taken along the line 2—2 in Fig. 1 showing one positional arrangement of the aligned cartridges;

Fig. 3 is a sectional view taken along the line 3—3 in Fig. 2;

Fig. 4 is a view, partially in section, taken along the line 4—4 in Fig. 2; and

Fig. 5 is a fragmentary sectional view illustrating a modified embodiment of the present improved container.

Referring now to the drawing, and more particularly to Fig. 1 thereof, there is illustrated a charge or column of explosive cartridges generally designated by the reference numeral 10 and aligned within a shot hole 11 drilled into the earth. This charge or column 10 of explosive cartridges comprises a plurality of individual cartridges 12 positioned in end-to-end relationship within the shot hole. If required by the particular application involved, these cartridges may be fastened together in any well known manner, such as by "taping," "lathing," "stringing," "pegging" and the like, or, as is even more common, each of the cartridges 12 may be dropped endwise into the shot hole 11 to form the column 10.

It is well known that the detonation or propagation wave traversing a column of explosive material tends to become less intense the further the detonating wave travels from the point of initiation. This tendency increases as the diameter of the explosive column decreases. It also increases as the pressure, such as the fluid tamping pressure used in the shot hole increases, and as the sensitivity of the explosive material used is decreased. As a consequence, only a portion of the explosive material provided in a long column of low sensitivity explosive material may be exploded in response to detonation of the column at one end thereof. Moreover, when the column is sectionalized, as by stacking a number of cartridges in the manner described above, any foreign matter such as dirt, water, etc. which may inadvertently get between the adjacent ends of any pair of cartridges, in many cases has the effect of attenuating the detonating wave as it travels from one cartridge to the adjacent cartridge to the point where the adjacent cartridge is not detonated. Any such undetonated explosive material used in a given charge is not only waste of material, but, in addition, constitutes an explosives hazard which remains after the blasting or shooting operation is completed.

The problem outlined above is solved in a simple and economical manner by packaging the low sensitivity explosive material 13 in containers 14 characterized by the features of the present invention. Briefly, each container 14 is provided with end wall parts which define a conical jet forming cavity 14*a* in the explosive material 13 disposed at the bottom of each cartridge, and a cylindrical stand-off chamber 14*b* in the explosive material disposed at the top of each cartridge. More specifically, each container 14 comprises an elongated cylindrical body portion 15 having a bottom end closure wall 16 integrally formed therewith and a top end closure member 17. The top closure member 17 is provided with a downwardly depending flange 17*a* for receiving and embracing the top of the container body portion 15. If desired, the flange 17*a* may be provided with internal threads, not shown, which coact with external threads provided at the top of the container body portion 15 to hold the two container components 15 and 17 in assembled relationship. For the purpose of defining the jet forming cavity 14*a*, the end wall 16 of the container is provided with a

formed portion **18** shaped to define a cavity **14***a* of the desired configuration. The lower end wall **16** of the container **14** obviously seals the container and prevents the explosive material from entering the cavity **14***a*. As shown in the drawing, the cavity **14***a* has a conical configuration, although it will be evident to those skilled in the art that other configurations may be used, if desired. Many explosive cartridges presently sold commercially include a container **14** made of heavy cardboard or other non-metallic material having relatively little strength. If the container **14** is comprised of such material, it may be difficult to maintain the desired shape of the formed bottom wall portion **18**. Accordingly, if the container **14** is made of such material a backing or liner plate **19** should be provided within the container **14**. This plate is shaped to define the desired configuration for the cavity **14***a* and functions to reinforce the formed bottom wall portion **18** of the container and thus maintain the shape of the cavity.

For the purpose of defining the stand-off chamber **14***b* in the explosive material **13** provided at the upper end of each cartridge, the end closure member **16** sealing the upper end of the cartridge is provided with a downwardly formed portion **20** located at the center of the closure member. This formed portion of the closure member is illustrated as being of generally cylindrical configuration and, as shown, is adapted to register with the jet forming cavity **14***a* in the adjacent abutting cartridge when two or more cartridges are stacked or otherwise arranged in end-to-end relationship. In order to retain the stacked cartridges in axially aligned positions, so that the jet forming cavity **14***a* of each cartridge is in exact registry with the stand-off chamber **14***b* of the adjacent abutting cartridge, each of the closure members **17** is provided with an upstanding flange **21** for receiving the bottom end wall **16** and the bottom portion of the container **14** of the next uppermost cartridge **12**. If desired, the upstanding flange **21** may be provided with internal threads, not shown, which coact with external threads provided at the bottom portion of the next uppermost container **14** to hold the two adjacent containers in connected relationship. As will be understood, the height of the chamber or well **14***b* defined by the formed wall portion **20** of the closure member **17** for each cartridge defines the stand-off distance between the explosive material of the cartridge and the mouth of the jet forming cavity **14***a* provided in the abutting cartridge.

Although the formed portion **18** of the container **14** is illustrated as having a conical shape, other similar shapes symmetrical about the axis of the cartridge, such as hemispherical or hemispheroidal, may be employed. In any case the purpose of providing the bottom wall formations to define the cavities **14***a* is to permit the well known "Munroe Effect," i. e., directionalized explosive effect, to be obtained. In other words, each cavity **14***a* acts to redistribute and concentrate the energy of that portion of the explosive material **13** nearest the cavity **14***a*. Each stand-off chamber **14***b* permits the explosive jet to form. More specifically, the explosive forces developed at the surface of the formed wall portion **18** of each cartridge **12**, meet at the axis of the cavity **14***a* within the cavity **14***b* of the next lower cartridge and add vectorially, thereby to effect concentration of explosive energy into a jet which is directed into the explosive material of the next lower cartridge.

In order to insure that the shapes of the cavities **14***a* and **14***b* in the ends of each cartridge will be preserved, it is desirable to employ relatively rigid material, such as heavy cardboard or the like, in the construction of the end closure member **17** and the container body portion **15**. Alternatively, the backing or liner plate **19** may be used to insure preservation of the desired configuration of each jet forming cavity **14***a*. The annular flanges **17***a* and **21** of the end closure member **17** should preferably fit snugly against the sides of the cartridges in engagement therewith in order to insure that foreign material, such as the water used for tamping, will not enter the cavities **14***a* and **14***b* and reduce the effectiveness of the cavitated charge or nullify it entirely. Alternatively, and as illustrated in Fig. 5 of the drawing, frangible sealing disks **21** and **22** may be adhesively secured to the container wall **16** and the wall of the closure member **17** of each container **14** to cover and seal the cavities **14***a* and **14***b* thereof against fluid entry into these cavities.

In use, the cartridges **12** are arranged in end-to-end relationship with the apexes of the cone-shaped cavities **14***a* pointing toward the point of detonation of the column thus formed. Thus when the cartridges are arranged in the manner shown in Fig. 1, with a detonating cap or fuse **23** located at the top of the column and connected to the fuse wires indicated at **24**, the apexes of the cavities **14***a* in the cartridges **12** point upwardly toward the cap **23**. The cylindrically shaped cavity or chamber **14***b* in the top cartridge **12** of the column may be used to house the detonating cap **23**. Under certain conditions, it may be desirable to detonate the charge from the bottom, in which case the entire column would be rotated through an angle of one hundred and eighty degrees and the detonating cap **23** would be inserted in the cylindrical cavity **14***b* in the bottom of the lowest cartridge in the column. It will be understood that the column may also be detonated from an intermediate point. In such case, however, the apexes of the conically shaped cavities **14***a* should all point toward the cap **23** regardless of its location in the column. Thus, the detonating cap is disposed in the middle of the explosive column, then the apexes of the cavities **14***a* above the cap should point downwardly toward the cap, and the apexes of the cavities **14***a* below the cap should point upwardly toward the cap.

By employing the improved container arrangement described above, a high intensity detonation jet is formed and directed from each cartridge into the next succeeding cartridge in the column which insures complete detonation of all explosive material in the column. Also by employing the present improved containers, it is possible to use less sensitive explosives which are less expensive and far less dangerous to handle. Furthermore, much longer columns may be detonated and propagation of the explosive effect is assured even where there is a substantial space between the cartridges, which space might be filled with air, water, mud or the like.

It will be apparent to those skilled in the art that the present invention is not limited to the particular construction shown but that changes and modifications may be made without departing from the spirit and scope of the present invention. It is aimed in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, at least one of said cartridges having a unitary end structure closing one end and including structure defining a closed shaped jet forming cavity extending into the explosive material in said one cartridge for producing a jet explosive effect directed into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary end member including structure extending into the explosive material in said adjacent cartridge and defining a shaped stand-off cavity aligned with but of different shape than the first mentioned shaped cavity for directing the jet explosive effect into said next cartridge, thereby insuring complete detonation of all of said cartridges.

2. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, and a detonating means for detonating said charge located at a predetermined point in said column, at least one of

said cartridges having a unitary end closure at the end thereof remote from said detonating means, said closure including integral structure extending into the explosive material in said cartridge in order to define a shaped jet forming cavity therein for producing a jet explosive effect in a direction away from said point and into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary end closure including an integral structural element extending into the explosive material in said adjacent cartridge and defining a shaped stand-off cavity aligned with and of a different shape than the first mentioned shaped cavity for directing the jet explosive effect into said next cartridge.

3. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, at least one of said cartridges having a unitary end closure which includes an integral structural element extending into the explosive material in said one cartridge in order to define a cone-shaped jet forming cavity for producing a jet explosive effect directed into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary end closure which includes an integral structural element extending into the explosive material in said adjacent cartridge and defining a cylindrically shaped stand-off chamber having a diameter equal to that of the base of the cone-shaped cavity and aligned with the first mentioned cone-shaped cavity for directing the jet explosive effect into said next cartridge, thereby insuring complete detonation of said cartridges.

4. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, at least one of said cartridges having a unitary closure at one end thereof which includes an integral structural element extending into the explosive material in said one cartridge in order to define a shaped jet forming cavity therein for producing a jet explosive effect directed into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary closure therefor which includes an integral structural element extending into the explosive material in said adjacent cartridge in order to define a shaped stand-off chamber aligned with and of different shape than the first mentioned shaped cavity for directing the jet explosive effect into said next cartridge, thereby insuring complete detonation of all of said cartridges, one of said closures having formed thereon a flange surrounding the end of the adjacent cartridge in the column in order to align each of the jet forming cavities and its associated stand-off chamber.

5. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, at least one of said cartridges having a unitary closure at one end which includes an integral structural element extending into the explosive material in said one cartridge in order to define a cone-shaped jet forming cavity for producing a jet explosive effect directed into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary closure which includes an integral structural element extending into the explosive material in said adjacent cartridge and defining a cylindrically shaped stand-off chamber having a diameter equal to that of the base of the cone-shaped cavity and aligned with the first mentioned shaped cavity for directing the jet explosive effect into said next cartridge, thereby insuring complete detonation of all of said cartridges, one of said closures having formed thereon a flange surrounding the end of the adjacent cartridge in the column in order to align the jet forming cavity and its associated stand-off chamber.

6. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, and a detonating means for detonating said charge located at a predetermined point in said column, at least one of said cartridges having a unitary end closure member which includes an integral structural element extending into the explosive material at an end of the cartridge remote from said detonating means in order to define a shaped jet forming cavity for producing a jet explosive effect in a direction away from said point and into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary closure member which includes an integral structural element extending into the explosive material in said adjacent cartridge and defining a stand-off chamber aligned with and of different shape than the first mentioned shaped cavity for directing the jet explosive effect into said next cartridge, one of said closure members having formed thereon a flange surrounding the end of the adjacent cartridge in the column in order to align the jet forming cavity and its associated stand-off chamber.

7. An explosive charge comprising a plurality of explosive cartridges arranged in end-to-end relationship to form a column of cartridges each containing explosive material, and a detonating means for detonating said charge located at a predetermined point in said column, at least one of said cartridges having a unitary end closure member which includes an integral structural element extending into the explosive material in an end of said one cartridge remote from said detonating means in order to define a cone-shaped jet forming cavity for producing a jet explosive effect in a direction away from said point and into the adjacent end of the next cartridge, said adjacent end of said next cartridge having a unitary end closure member which includes an integral structural element extending into the explosive material in said adjacent cartridge and defining a cylindrically shaped stand-off chamber aligned with and having a diameter equal to that of the base of said shaped cavity for directing the jet explosive effect into said next cartridge, one of said closure members having formed thereon a flange surrounding the end of the adjacent cartridge in the column in order to align the jet forming cavity and its associated stand-off chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

969,186	Peters	Sept. 6, 1910
2,238,939	Lewis et al.	Apr. 22, 1941
2,305,729	Neff	Dec. 22, 1942
2,326,310	Johnson et al.	Aug. 10, 1943
2,481,814	Brecker	Sept. 13, 1949
2,494,256	Muskat	Jan. 10, 1950
2,605,703	Lawson	Aug. 5, 1952
2,683,414	Klotz	July 13, 1954

FOREIGN PATENTS

851,474	Germany	Oct. 6, 1952