April 27, 1943. T. F. BENNETT 2,317,354

EXPLOSIVE CARTRIDGE ASSEMBLY

Filed April 24, 1940 2 Sheets-Sheet 1

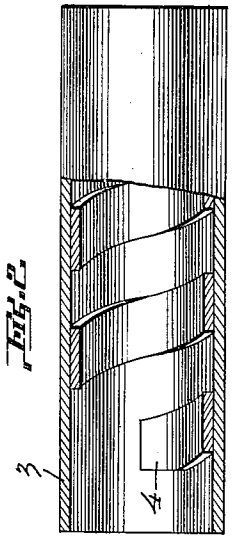


Fig. 2.

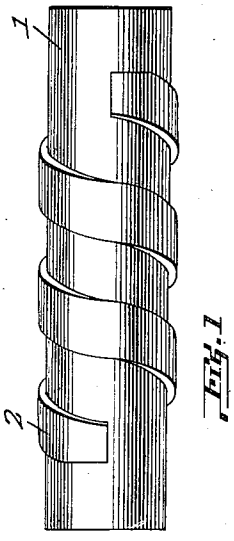


Fig. 1.

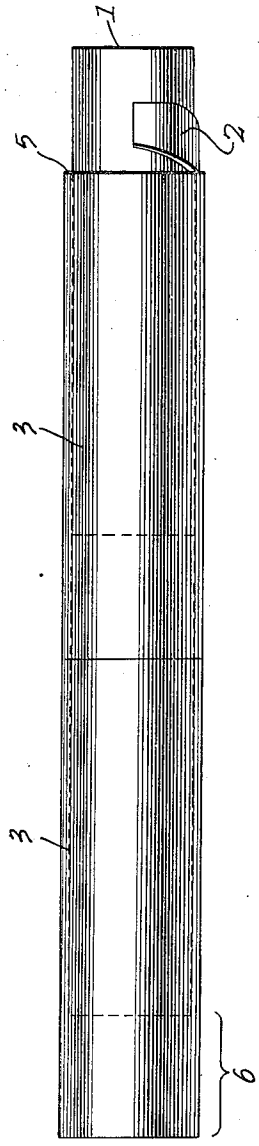


Fig. 3.

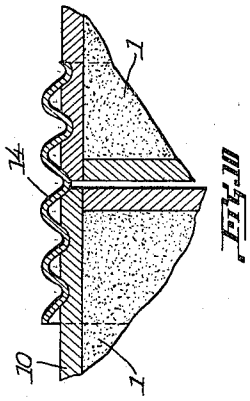


Fig. 10.

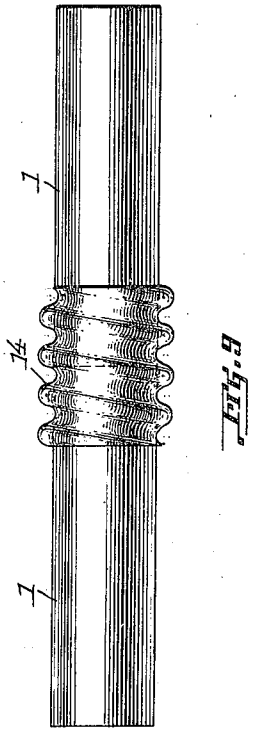


Fig. 9.

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EXPLOSIVE CARTRIDGE ASSEMBLY

Filed April 24, 1940 2 Sheets-Sheet 2

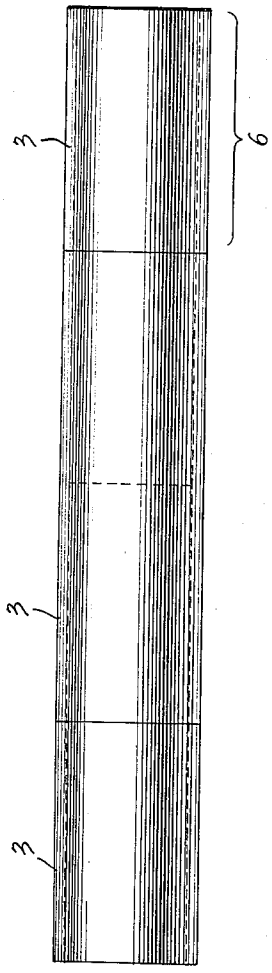


Fig. 4

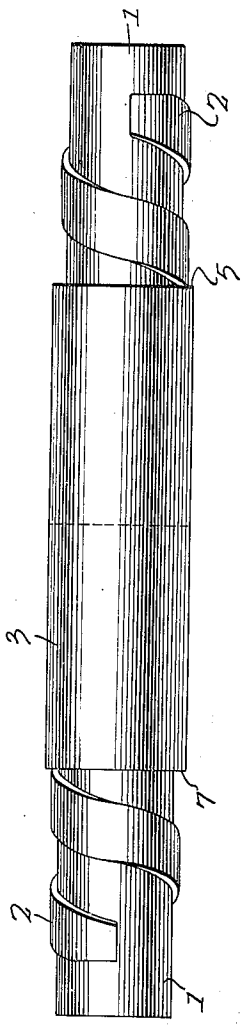


Fig. 5

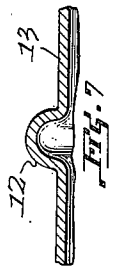


Fig. 7

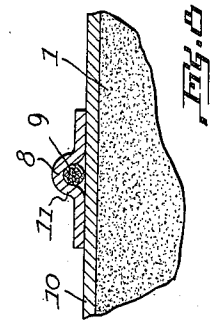


Fig. 8

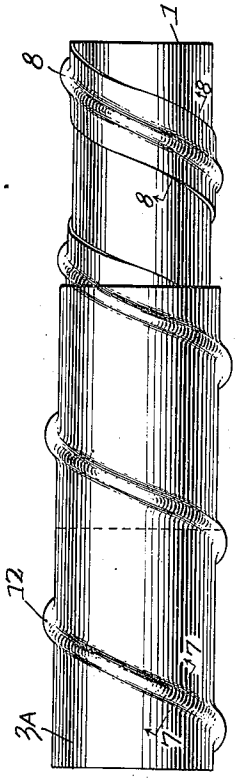


Fig. 6

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ATTY.

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# UNITED STATES PATENT OFFICE

2,317,354

## EXPLOSIVE CARTRIDGE ASSEMBLY

Thomas Francis Bennett, Joplin, Mo., assignor to Hercules Powder Company, Wilmington, Del., a corporation of Delaware

Application April 24, 1940, Serial No. 331,299

6 Claims. (Cl. 102—24)

This invention relates to an explosive cartridge assembly and more particularly to an explosive assembly which is adaptable to use in the seismograph blasting art.

Heretofore in seismograph blasting two procedures have been followed. In accordance with one procedure, it has been customary to place in the drilled hole a plurality of explosive cartridges attached together in various ways as, for example, by attachment to a relatively long stick of wood. This method is tedious and time-consuming, and otherwise undesirable.

It has also been proposed to use an ammonium nitrate explosive in a sheet metal cartridge, these cartridges being provided at their ends with threads so that the assembly can be made by interthreading a number of these cartridges. In order to explode the assembly thus produced, there is screw-threadedly attached at a point in the column a priming charge in the form of a special cartridge of trinitrotoluene or amatol (a mixture of trinitrotoluene and ammonium nitrate) which is provided with a blasting cap. This method is disadvantageous because the metal containers are expensive to manufacture and unduly increase the handling cost. Moreover, the use of a relatively heavy metal container unduly lowers the percentage by weight of actual explosive in the unit. In addition, the length of the metal cartridge shell is limited to about 8" because of manufacturing difficulties, whereas paper cartridges may be made in any length up to the 30" maximum allowed by I. C. C. shipping regulations.

In the copending application of Roscoe B. Smith, Serial No. 331,291, filed April 24, 1940, (R. B. Smith Case 5) there is disclosed the provision of a cartridge of explosive which is provided with a slidable frictionally held sleeve surrounding it, this sleeve being slidable along the cartridge into corresponding frictional engagement with an adjacent cartridge placed in end-abutting relationship to the first-named cartridge. In this manner, a standard unit is provided which is readily built up by the operator into an explosive column of any desired length. Difficulty arises in the use of telescoping cartridges of this type because there is frequently a tendency for the adjacent cartridges to slip apart from one another as the column is lowered into a vertical bore hole.

It is an object of the present invention to overcome this difficulty with the telescoping cartridges described in the Smith application above-identified, while at the same time attaining all of the advantages of such telescoping cartridges over the prior art practices outlined briefly above.

Another object is to positively prevent separation of the individual cartridges after they have been connected into a column.

Still other objects will more fully hereinafter appear.

These objects are attained in accordance with the present invention by providing for screw-threaded engagement between the connecting sleeve, which extends across the joint between adjacent cartridges, and the cartridges themselves. It is preferred to provide screw-threads on each of the exterior of the cartridge and the interior of the connecting sleeve.

In the accompanying drawings:

Fig. 1 is a side elevation of a cartridge employed in one embodiment of the present invention.

Fig. 2 is a side elevation of a connecting sleeve, partly in longitudinal section, this sleeve being adapted to be used in conjunction with cartridges of the type shown in Fig. 1.

Fig. 3 is a side elevation of two cartridges joined together preparatory to use.

Fig. 4 is a side elevation showing two cartridges joined together by a single sleeve, the top sleeve having its projecting portion cut off and placed on the bottom end of the bottom cartridge.

Fig. 5 is a side elevation showing two cartridges joined by a single sleeve, originally associated with one of the cartridges, the sleeve associated with the other cartridge having been discarded.

Fig. 6 is a view of a modification, the cartridge being extended from the sleeve for a more complete showing.

Fig. 7 is a sectional view on the line 7—7 of Fig. 6.

Fig. 8 is a sectional view on the line 8—8 of Fig. 6.

Fig. 9 is an elevation of a still further modification, wherein the cartridges are interconnected by a short-threaded sleeve.

Fig. 10 is a fragmentary sectional view of the joint in the assembly of Fig. 9.

In accordance with one form of the present invention, the cartridges are provided with an outside thread and with a sleeve of about the same length as the cartridge, which sleeve is provided with threads on its inside which are adapted to cooperate in spiral sliding engagement with the threads on the cartridges. The unit assembly consisting of the cartridge with the sleeve thereover is a standard unit identical

with all other units which facilitates ordering, packing, and shipping. In order to connect two cartridges together each of the cartridges is threaded into a single tube or sleeve until they meet. If desired, any number of cartridges may be joined together in this manner so as to form a column of the desired length. The provision of the screw-threaded connection positively locks the cartridge against separation as the composite assembly is lowered into the vertical bore hole. In order to join the cartridges together or take them apart, they must be rotated relative to the connecting sleeve. In this way, the tendency for the cartridge assembly to come apart, which is particularly pronounced in the case of long lengths of cartridges, is completely eliminated, the angle of spiral of the threads being such that the cartridges must be rotated relative to one another in order to separate them.

While the inventive concept as outlined above may be specifically realized in a number of ways, a particularly advantageous way is to provide a spiral spaced band on the exterior of the cartridge and a similarly spiral spaced band on the interior of the sleeve, these bands being disposed at the same angle of inclination so that the threads formed thereby cooperate with one another in locking the sleeve against longitudinal or axial movement relative to the cartridge. Other ways of carrying out the inventive thought includes the provision of an upstanding member such as a spirally wrapped cord on the surface of either the cartridge or the sleeve and of a groove in the cooperating surface of the other member which groove is spirally disposed and is adapted to receive in spiral sliding relationship the cord on the first-named member. Under certain circumstances the advantages of the invention may be realized by the provision of a relatively short connecting sleeve or ferrule which is threaded throughout its length and which is adapted to tightly, threadably engage the cylindrical surface of the cartridge, this ferrule being disposed substantially centrally of the joint formed between the end-to-end abutting cartridges. However, such an embodiment may be deemed undesirable because it is necessary to supply sleeves separately from the package of cartridges, whereas it is desirable to supply a single unit assembly which in itself contains means adapted to cooperate with other similar or identical unit assemblies in the making of the desired composite assembly.

Referring to the drawings in detail, the cartridges of high explosive such as gelatin dynamite are designated as 1. These cartridges may be of the usual paper wrapped type. Formed on or adhered to the outer surface of the cartridge 1 in any suitable manner is a spiral band 2 which forms a thread thereon. The band 2 terminates short of the ends of the cartridge 1 so that entry of the cartridge 1 into the sleeve is facilitated, the smooth ends of the cartridge 1 being readily insertable into the smooth ends of the sleeve presently to be described.

The sleeve 3 may be of paper or cardboard and is of substantially the same length as the cartridge 1 and is correspondingly provided with a spiral band 4 adhered to its inner surface. This band 4 is disposed at the same angle of spiral as the band 2 on the cartridge 1 so that it is adapted to cooperate in screw-threaded relationship with the thread formed by the band 2 to prevent endwise movement of the cartridge 1 relative to the sleeve 3. Preferably the ends of the band 4 terminate short of the ends of the sleeve 3 so that initiation of the locking is facilitated. The unit cartridge assembly comprises the sleeve 3 with the cartridge 1 disposed co-extensively therein.

Where paper-wrapped cartridges 1 and paper or cardboard sleeves 3 are employed, the thread-forming bands 2 and 4 may be made of paper or cardboard. In any event these bands are of substantial thickness.

If desired the cartridges 1 may comprise a metal container filled with explosive and the sleeves 3 may likewise be made of metal, the bands 2 and 4 being formed integrally or made of metal and attached to the metal container and sleeve in any suitable manner as by soldering.

The cartridges 1 and the sleeve 3 are provided with a very fast thread in order to save time in interconnecting. Use of such a high-pitched thread is permissible because such a thread will exert sufficient force to prevent axial separation in response to axially applied forces.

In order to interconnect two or more cartridges so as to form a unitary rigid explosive column, the sleeve of the first cartridge is first rotated so as to project it outwardly from the cartridge 1. A second cartridge has its sleeve extended in a similar manner and the projecting cartridge of the second unit is inserted within the projecting sleeve of the first unit and rotated therein until the two cartridges abut against one another. The double assembly thus formed is portrayed in Fig. 3. Any number of cartridges may be joined by this same procedure. The tamping rod may be inserted inside the projecting cartridge end 6, in lowering of the assembly into the bore-hole.

If it is desired to eliminate the ledge 5 formed by the lower end of the lowermost sleeve on the assembly, the projecting portion 6 of the topmost sleeve is cut off and is screwed onto the lower end of the first cartridge so as to give an assembly as indicated in Fig. 4 wherein the presence of ledges or projections along the column is eliminated.

In assembling the cartridges, it is preferable to rotate the adjacent cartridges slightly relative to one another in the locking direction after the ends of the cartridges have come together. This causes a locking or wedging action which still more tightly holds the assembly against separation.

Instead of utilizing the uppermost sleeve in the manner suggested in Fig. 3 or in Fig. 4, this sleeve may be discarded, in which case the joined assembly will have the appearance of Fig. 5 wherein the top and bottom cartridges are surrounded by the sleeves 3 and have their ends exposed. In such an assembly separation of the cartridges is positively prevented, the only disadvantage being that the ledges formed at either end, indicated at 5 and 7, tend to cause difficulties in lowering into the bore hole.

The modification shown in Figs. 6 to 8 embodies an upstanding thread formed on the cartridge and received within a grooved thread formed on the inside of the telescoping sleeve. The upstanding thread 8 on the cartridge 1 may be formed by applying spirally a cord 9 which may be held in place on the paper wrapping 10 of the cartridge 1 by the overlaid band of paper 11 which is relatively thin and which is secured to the cord 9 and the surface of the paper wrapping 10 by any suitable adhesive. This upstanding thread 8 thus formed is accommodated with

in a corresponding spirally formed outward groove 12 produced in the paper 13 of the sleeve 3a in any suitable manner as, for example, by disposing a wire spirally on the mandrel used in forming the sleeve 3a. The cartridges are interconnected in the same manner as that described above. The angle at which the threads are formed in the cartridge and in the sleeve is such that the frictional resistance to relative rotation prevents an axially applied force from separating the sleeve and cartridge, it being necessary to rotate them relative to one another in order to cause axial movement.

In the modified form shown in Figs. 9 and 10, the cartridges 1 are interconnected by means of a threaded sleeve 14, which may be of vulcanized fibre, metal or other hard material and which is adapted to bitingly engage the wall 10 of the cartridges adjacent their ends and to thereby hold them against axial separation. The wall 10 may be of paper, metal, vulcanized fiber, etc. The sleeve 14 may be formed of tinned sheet iron. This sleeve 14 may be shipped separately or may be shipped attached to a cartridge in which case it would be screw-threadedly engaged with a succeeding cartridge to assemble the explosive column. If desired, the sleeve 14 necessary for the interconnection of a case of cartridges may be shipped in separate packages in order to promote safety. Threads may or may not be preformed upon the ends of the cartridges 1 for the reception of the threaded sleeve 14. If desired, the threads on the sleeve 14 may be directed oppositely from the ends of the sleeve towards the middle. For example, the threads may be right handed from one end to the middle and may be left handed from the other end to the middle, although usually this expedient will not be considered necessary or desirable.

From the foregoing it will be seen that the present invention provides for the interconnection of a plurality of explosive cartridges into a single unitary assembly in a convenient and economical manner. It will further be seen that the interconnection is such that endwise separation of the cartridges in the assembly is positively prevented.

While the invention has been described with particular reference to seismograph blasting, it will be understood that it is applicable generally in the interconnection of explosive cartridges into a unitary explosive column and for example may be applied in the interconnection of black powder cartridges, cartridges of permissible explosives, dynamites, extra dynamites, ammonium nitrate explosives, and various types of gelatin dynamites, or the like. For example in the field of permissible explosives, the sheathing which is sometimes applied around the cartridges for the purpose of reducing the temperature of the explosion may be provided internally with threads which engage corresponding threads formed on the exterior of the cartridges of explosives, and adjacent cartridges interconnected by means of the sheathing in a manner analogous to that described above.

It will be understood that where the cartridge wrapper and the sleeve are of paper, the paper of the cartridge wrapping and of the paper sleeve may be wrapped either spirally or convolutely so as to form the laminated structure of the desired strength. By "convolute," I mean wrapping inwardly from one side. It will further be understood that the construction of the cartridge and the sleeves themselves is not a part of the present invention except insofar as the thread formation is concerned.

It will further be understood that while the cartridge container and connecting sleeve may be made of metal, it is preferred to provide a construction wherein no metal is employed as for example where the cartridge wrapper, the sleeve and the threads are made of paper, cardboard, fibre or the like, particularly where a gelatin type explosive is employed.

It will be understood that the details hereinbefore set forth are illustrative only, and that the invention as broadly described and claimed is in no way limited thereby.

What I claim and desire to protect by Letters Patent is:

1. An explosive device comprising a plurality of explosive cartridges disposed co-axially in end-to-end abutting relationship, threads formed on the exterior throughout the length of each of said cartridges, said threads being directed in a common direction and forming a thread throughout the length of the cartridge assembly, a connecting sleeve surrounding each pair of adjacent cartridges and extending across the joint therebetween, said sleeves abutting one another end-to-end, and threads formed on the interior of said sleeves and in engagement with the threads on said cartridges, said threads on said sleeves forming a thread throughout the length of the sleeve assembly.

2. An explosive device comprising a plurality of explosive cartridges disposed co-axially in end-to-end abutting relationship, threads formed on the exterior throughout the length of each of said cartridges, said threads being directed in a common direction and forming a thread throughout the length of the cartridge assembly, a connecting sleeve surrounding each pair of adjacent cartridges and extending across the joint therebetween, an end sleeve surrounding each end cartridge of the cartridge assembly and extending from the termination of the end connecting sleeve to the end of said end cartridge, said sleeves abutting one another end-to-end, and threads formed on the interior of said sleeves and in engagement with the threads on said cartridges, said threads on said sleeves forming a thread throughout the length of the sleeve assembly.

3. An explosive device comprising a plurality of explosive cartridges disposed co-axially in end-to-end abutting relationship, threads formed on the exterior throughout the length of each of said cartridges, said threads being directed in a common direction and forming a thread throughout the length of the cartridge assembly, a connecting sleeve surrounding each pair of adjacent cartridges and extending across the joint therebetween, an end sleeve surrounding each end cartridge of the cartridge assembly and extending from the termination of the end connecting sleeve to the end of said end cartridge, said sleeves abutting one another end-to-end, and threads formed in the interior of said sleeves and in engagement with the threads on said cartridges, said threads on said sleeves forming a thread throughout the length of the sleeve assembly, said cartridges and said connecting sleeves being of a common length, and said end sleeves together equalling in length said common length.

4. An explosive device comprising a plurality of tubular explosive cartridges of approximately equal length disposed in substantially continuous co-axially end-to-end relationship and being in propagating contact with one another, threads

formed on the exterior throughout the length of each of said cartridges said threads being directed in a common direction and forming a thread throughout the length of the explosive device, a connecting tubular sleeve of a length approximately equal to that of each of said cartridges around each pair of adjacent cartridges and extending across the joint therebetween, said sleeves forming a substantially continuous tubular reinforcing and joining member for said cartridges, threads formed on the interior throughout the length of each of said sleeves, said threads being directed in a common direction and forming a thread throughout the length of the explosive device, said cartridges and sleeves being threadedly engaged and producing a rigid explosive device.

5. An explosive device comprising a plurality of tubular explosive cartridges of approximately equal length disposed in substantially continuous co-axially end-to-end relationship and being in propagating contact with one another, threads formed on the exterior of each of said cartridges and being directed in a common direction, a connecting tubular sleeve of a length approximately equal to that of each of said cartridges around each pair of adjacent cartridges and extending across the joint therebetween, said sleeves forming a substantially continuous tubular reinforcing and joining member for said cartridges, threads formed on the interior of each of said sleeves and being directed in a common direction, said cartridges and sleeves being threadedly engaged and producing a rigid explosive device.

6. An explosive device comprising a plurality of tubular explosive cartridges made of paper of approximately equal length disposed in substantially continuous co-axially end-to-end relationship and being in propagating contact with one another, threads formed on the exterior of each of said cartridges and being directed in a common direction, a connecting tubular sleeve made of paper of a length approximately equal to that of each of said cartridges around each pair of adjacent cartridges and extending across the joint therebetween, said sleeves forming a substantially continuous tubular reinforcing and joining member for said cartridges, threads formed on the interior of each of said sleeves and being directed in a common direction, said cartridges and sleeves being threadedly engaged and producing a rigid explosive device.

THOMAS FRANCIS BENNETT.