May 28, 1946. C. H. CORDIE 2,401,140

EXPLOSIVE CARTRIDGE ASSEMBLY

Filed April 24, 1940 2 Sheets-Sheet 1

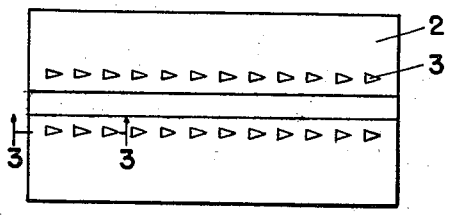

FIG.-1

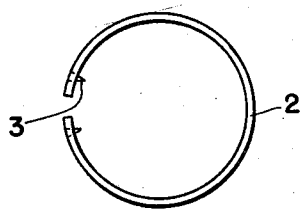

FIG.-2

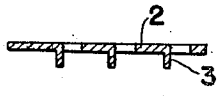

FIG.-3

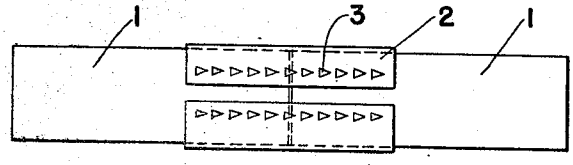

FIG.-4

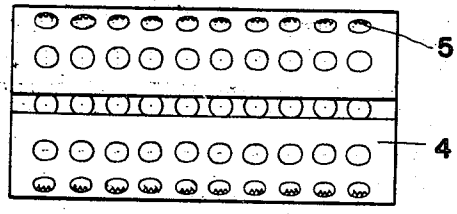

FIG.-5

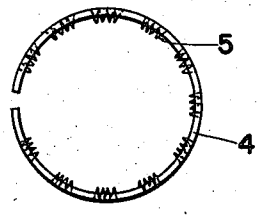

FIG.-6

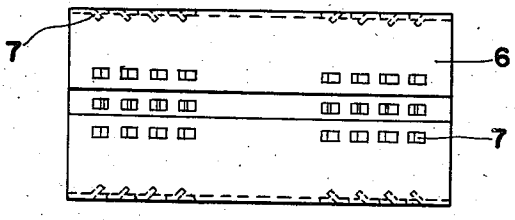

FIG.-7

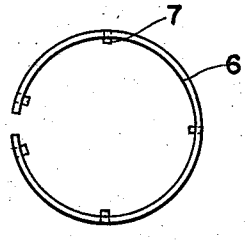

FIG.-8

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EXPLOSIVE CARTRIDGE ASSEMBLY

Filed April 24, 1940 2 Sheets-Sheet 2

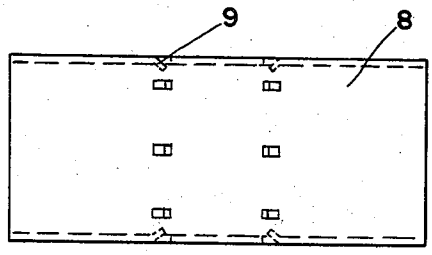

FIG.-9

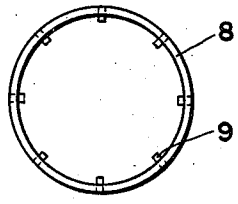

FIG.-10

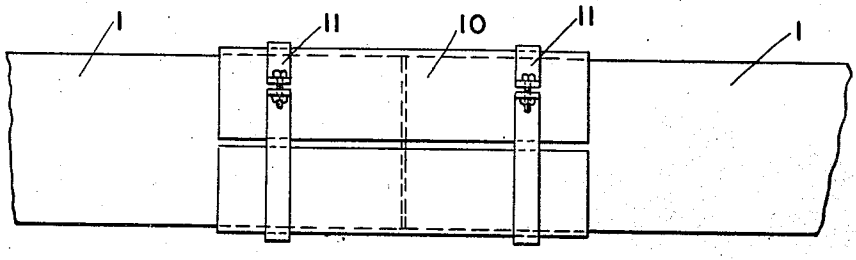

FIG.-11

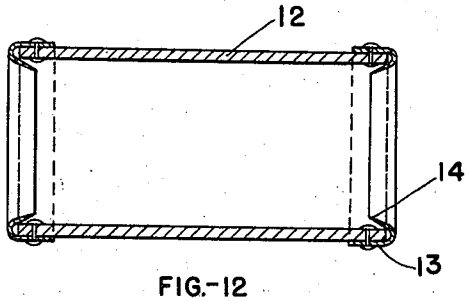

FIG.-12

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Patented May 28, 1946

2,401,140

UNITED STATES PATENT OFFICE

2,401,140

EXPLOSIVE CARTRIDGE ASSEMBLY

Cornell H. Cordie, Wilmington, Del., assignor to Hercules Powder Company, Wilmington, Del., a corporation of Delaware

Application April 24, 1940, Serial No. 331,288

10 Claims. (Cl. 102—24)

This invention relates to an explosive assembly, and more particularly to such an assembly which is especially adapted for use in geophysical prospecting (seismic exploration).

Heretofore in seismograph work, two methods have been employed. In one method there is placed in the bore 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 is otherwise disadvantageous.

In accordance with the other method sheet metal cartridges of an ammonium nitrate explosive are provided, these cartridges having threads at their ends 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.

It is a leading object of the present invention to devise means for interconnecting cartridges of explosive material into a unitary column in a manner which overcomes the difficulties attending the prior art practices outlined briefly above.

Another object is to provide for the interconnection of adjacent cartridges in a simple and positive manner.

Another object is to provide for the interconnection of the cartridges in such manner that endwise separation in response to an axial separating force, whether or not accompanied by a force tending to rotate the cartridges relative to one another or to the connecting means, is prevented.

Still other objects will more fully hereinafter appear.

In the copending application of Roscoe B. Smith, Serial No. 331,291, filed April 24, 1940, now patent No. 2,317,415, there is disclosed the use of a telescoping sleeve associated with each cartridge, the sleeve being adapted to be moved axially and to frictionally engage an adjacent cartridge so as to form an explosive column. This method of interconnection presents difficulties, because separation of the adjacent cartridges is not positively prevented. In the copending application of Thomas Frank Bennett, Serial No. 331,299, filed April 24, 1940, now Patent No. 2,317,354, there is disclosed the use of a connecting sleeve screw-threadedly engaging the adjacent cartridges. However, axial separation of the cartridges may be effected by rotating the cartridges relative to one another. Since frequently forces are exerted on the column during assembly thereof or during lowering thereof into the bore hole, which forces tend to rotate a portion of the column relative to the remainder, axial separation may occasionally occur. The present invention, in addition to overcoming the disadvantages of the prior art practices outlined above, overcomes these and other difficulties encountered in use of the Smith and Bennett devices described in the above-entitled applications.

The foregoing objects are accomplished by the present invention by providing a connecting sleeve surrounding the adjacent cartridges and extending across the joint formed therebetween and providing means for locking the sleeve to the adjacent cartridges in such manner as to prevent axial separation of the cartridges in response to forces applied in any direction and particularly to endwise forces and forces tending to rotate the cartridges relative to one another or relative to the sleeve. The present invention further comprehends the provision of inwardly extending teeth or the like carried by the connecting sleeve and extending inwardly into locking engagement with the surface of the cartridge. When the teeth are made of relatively hard material, such as metal, and the cartridge container is made of softer material, such as vulcanized fiber, paper, etc., the teeth bitingly engage the cartridge by surface deformation thereof, as, for example, by penetration, by rupture, or by indentation, and prevent axial movement of the cartridge relative to the sleeve. In another aspect, the present invention involves the provision of teeth which are carried by the sleeve at an angle to the axis of the column so that as the cartridges are inserted into the sleeve, removal of the cartridges from the sleeve is prevented, the teeth being spring pressed by reason of their own resiliency or because the sleeve which carries them is of resilient nature normally tending to spring inwardly in

such manner as to force the teeth into biting engagement with the cartridge by surface deformation thereof. In still another aspect, the present invention contemplates the provision of a sleeve which is slit from one end to the other, generally parallel to the axis, whereby the sleeve is adapted to be contracted inwardly into locking engagement with the cartridge under the influence of the inherent resilience of the sleeve due to its being made of spring sheet metal, or under the influence of an externally applied force directed inwardly, such as a manually exerted force where the sleeve is made of bendable sheet metal which retains the shape into which it is bent, or under the influence of the inwardly applied force of clamps around the sleeve. The clamps just mentioned may be of any suitable type which is adapted to compress the sleeve inwardly, and may, for example, be similar to the conventional hose clamps employed in connecting rubber hose to conduits.

In the accompanying drawings:

Fig. 1 is a side elevation of one form of connecting sleeve embodying the principles of the present invention.

Fig. 2 is an end view of the sleeve of Fig. 1.

Fig. 3 is a longitudinal section on the line 3—3 of Fig. 1.

Fig. 4 is a side elevation of an assembly of two cartridges connected with the sleeve of Fig. 1.

Fig. 5 is a side elevation of a modified form of the connecting sleeve.

Fig. 6 is an end view of the sleeve of Fig. 5.

Fig. 7 is a side elevation of a still further modification.

Fig. 8 is an end view of the sleeve of Fig. 7.

Fig. 9 is a side elevation of yet another modification.

Fig. 10 is an end view of the sleeve shown in Fig. 9.

Fig. 11 is a side elevation of a still further modification, showing two cartridges assembled with a connecting sleeve.

Fig. 12 is a longitudinal sectional view of another modification of connecting sleeve.

Referring to the drawings in detail and first to the embodiment portrayed in Figs. 1 to 4, the adjacent cartridges 1 are disposed in end-to-end abutting relationship as indicated in Fig. 4, whereupon a slit sleeve 2 is placed over the adjacent ends in any suitable manner. The sleeve 2 is preferably made of sheet metal and may be made either of resilient spring metal, in which case it will be opened at the slit portion, placed over the cartridges and allowed to spring inwardly into engagement with the cartridges, or of bendable sheet metal which is readily bent and which will retain the shape into which it is bent, in which case the sleeve is placed around the ends of the cartridges 1 and its edges are then bent inwardly so as to tightly engage the cartridges. In order to positively prevent separation of the cartridges, the sleeve 2 is provided with a row of spaced inwardly extending teeth 3 along each edge of the slit. The teeth 3 are suitably formed by indenting as by means of a triangular punch or in any other suitable manner.

The teeth 3, being made of metal, readily bite into the cartridges which are commonly wrapped with paper.

Instead of disposing the biting teeth only along the edges of the split, they may be disposed over substantially the entire area thereof as is indicated in the modification shown in Figs. 5 and 6, wherein the sleeve 4 is provided with a great number of teeth 5 which are formed by punching the metal of the sleeve 4 inwardly by means of a suitable circular punch, the metal which is pushed inwardly forming a number of jagged teeth 5 which are adapted to bitingly engage the surface of the cartridges. The sleeve 4, as before, may be made of either spring or bendable metal.

There is illustrated in Figs. 7 and 8 another modification wherein the sleeve 6 is provided with a plurality of longitudinal rows of inwardly angularly extending teeth 7, these teeth 7 being formed in any suitable manner as for example by means of an inwardly directed punch of suitable configuration. The teeth 7 extend inwardly at an angle such that they are directed towards the center of the sleeve 6. In this way they allow the sleeve 6 to be slipped over a cartridge until the end of the cartridge approaches the middle of the sleeve, but prevent the sleeve from slipping off the cartridge. It will be apparent that by the insertion of a pair of cartridges oppositely into the sleeve 6 until they meet in the center, separation of the cartridges is positively prevented. The sleeve 6 is split as before and may be made of resilient or non-resilient metal, although it is preferred that both the sleeve 6 and the teeth 7 be of resilient nature so that the locking action is still further enhanced.

In the modified form shown in Figs. 9 and 10, a sleeve 8 which is not split is shown, this sleeve being provided with two annular rows of oppositely directed teeth 9. Preferably the teeth 9 are of spring steel. In use, the ends of the cartridges are slipped into the sleeve 8 until they meet in the middle of the sleeve, whereupon it will be impossible to remove them outwardly.

In Fig. 11, there is portrayed a still further modification wherein the two cartridges 2 are interconnected by means of a split sleeve 10 which may be of any suitable material such as metal, paper, or cardboard, and which is held tightly into engagement with the cartridges 1 by means of the annular clamps 11 which encircle the sleeve 10 on opposite sides of the joint formed between the adjacent cartridges and press the sleeve 10 into very tight frictional engagement with the cartridges 1. The clamping members 11 may be metal bands and may be provided with means of any suitable type for tightening them into clamping engagement with the sleeve 10. As shown, the ends of the clamps 11 are tightened towards one another by means of bolts engaging the same in the known manner. Instead of the means shown for tightening the clamps 11, any other suitable means may be employed which is operable to lock or unlock the clamp 11 in a single manual movement. Instead, the bands 11 may be clamped in the manner in which metal bands which secure heat insulation to pipes are clamped, that is, by the provision of a slit in one end of the band, the other end being passed through the slit and after tightening being bent reversely to lock the band. If desired, the sleeve 10 may be lined with rubber or abrasive particles so as to increase the frictional engagement of the sleeve with the surface of the cartridges, or sleeve 10 may be provided internally with biting teeth as in the foregoing examples.

In the modification shown in Fig. 12, a connecting sleeve 12, which may be of metal or paper, cardboard, or the like, is provided at its ends with annular rings 13 of spring metal. The rings 13 are attached on the outside of the sleeve 12 and extend inwardly within the sleeve 12 at an angle. The rings 13 are preferably made of spring steel

and the edge 14 thereof is adapted to bite into the outer surface by deformation thereof, as, for example, by penetration, by rupture, or by indentation, of a cartridge inserted axially into the sleeve 12 and to prevent its removal in the reverse direction. Thus, by inserting a pair of cartridges into the sleeve 12 until they abut centrally thereof, the cartridges are positively locked against axial separation. The edge 14 may be continuous as shown or may be discontinuous, forming teeth which are resiliently urged inwardly.

The principles of the present invention are applicable to the interconnection of explosive cartridges for any use and while the above description refers particularly to seismograph explosives, the invention may be used with other explosives such as in coal mining where a high explosive cartridge sheathed with cushioning material may be employed, etc. While the invention has been described with particular reference to gelatin explosives, it will be understood that it may be applied to less sensitive explosives such as cartridges of ammonium nitrate explosive, black powder, or the like. While it is preferred to employ cardboard or paper wrapped cartridges, cartridges wherein the container is of metal, vulcanized fiber, Bakelite, synthetic resins, etc., may be employed in the present invention.

From the foregoing, it will be seen that the present invention provides for the attainment of the objects set forth above in a simple, convenient, and economical manner, and that it makes possible the ready provision of a rigid column of interconnected explosive cartridges which can be subjected to all of the ordinary uses involved in use without separation of the adjacent cartridges. The invention further positively prevents dirt, mud, or debris from getting between the separate cartridges as they are lowered into the bore hole. Numerous other advantages of the present invention will be apparent to those skilled in the art.

It is to 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 propagating relationship to each other, each of said explosive cartridges comprising a relatively thin-walled explosive container made of cardboard, connecting sleeves for joining pairs of said cartridges, and means comprising teeth-like projections carried by each of said sleeves and made of a resilient spring metal capable of permitting said teeth to be permanently moved into biting engagement with said container, whereby said cartridges are held against axial separation movement.

2. An explosive device comprising a plurality of explosive cartridges disposed co-axially in propagating relationship to each other, each of said explosive cartridges comprising a relatively thin-walled explosive container made of paper material, connecting sleeves for joining pairs of said cartridges, and means comprising teeth-like projections carried by each of said sleeves and made of resilient spring metal capable of permitting said teeth to be permanently moved into biting engagement with said container, whereby said cartridges are held against axial separation movement.

3. An explosive device comprising a plurality of explosive cartridges disposed co-axially in propagating relationship to each other, connecting sleeves for joining pairs of said cartridges, and lock means carried by said sleeves and comprising teeth-like projections for locking the sleeves to said cartridges, the cartridge material being relatively softer than the teeth material whereby biting engagement of the cartridge material by said projections produces the locking relationship of the parts.

4. An explosive device comprising a plurality of explosive cartridges disposed co-axially in propagating relationship to each other, connecting sleeves for joining pairs of said cartridges, said cartridges being made of a synthetic resinous material, and lock means carried by said sleeves and comprising teeth-like projections made of a resilient spring metal capable of permitting said teeth to be moved into biting engagement with the cartridge material, whereby said cartridges are held against axial separation movement.

5. An explosive device, adapted to be connected co-axially in propagating relationship with similar devices to form an explosive column, comprising an explosive cartridge, a connecting sleeve for said explosive cartridge, and lock means carried by said sleeve and comprising one set of teeth-like projections locking the sleeve to the cartridge and a second set of teeth-like projections adapted for locking said sleeve to a similar cartridge, the cartridge material being relatively softer than the teeth material whereby biting engagement of the cartridge material by said projections produces the locking relationship of the sleeve to the cartridge.

6. An explosive device, adapted to be connected co-axially in propagating relationship with similar devices to form an explosive column, comprising an explosive cartridge, a connecting sleeve for said explosive cartridge, and lock means carried by said sleeve and comprising one set of teeth-like projections made of resilient metal locking the sleeve to the cartridge and a second set of teeth-like projections made of resilient metal adapted for locking said sleeve to a similar cartridge, the cartridge material being relatively softer than the teeth material whereby biting engagement of the cartridge material by said projections produces the locking relationship of the sleeve to the cartridge.

7. An explosive device, adapted to be connected co-axially in propagating relationship with similar devices to form an explosive column, comprising an explosive cartridge, a connecting sleeve for said explosive cartridge, and lock means carried by said sleeve and comprising one set of teeth-like projections made of resilient metal locking the sleeve to the cartridge and a second set of teeth-like projections made of resilient metal adapted for locking said sleeve to a similar cartridge, the cartridge material being cardboard whereby biting engagement of the cartridge material by said projections produces the locking relationship of the sleeve to the cartridge.

8. An explosive device, adapted to be connected co-axially in propagating relationship with similar devices to form an explosive column, comprising an explosive cartridge, a connecting sleeve for said explosive cartridge, and lock means carried by said sleeve and comprising one set of teeth-like projections made of resilient metal locking the sleeve to the cartridge and a second set of teeth-like projections made of resilient metal adapted for locking said sleeve to a simi-

lar cartridge, the cartridge material being paper whereby biting engagement of the cartridge material by said projections produces the locking relationship of the sleeve to the cartridge.

9. An explosive device, adapted to be connected co-axially in propagating relationship with similar devices to form an explosive column, comprising an explosive cartridge, a connecting sleeve for said explosive cartridge, and lock means carried by said sleeve and comprising one set of teeth-like projections made of resilient metal locking the sleeve to the cartridge and a second set of teeth-like projections made of resilient metal adapted for locking said sleeve to a similar cartridge, the cartridge material being a synthetic resinous material whereby biting engagement of the cartridge material by said projections produces the locking relationship of the sleeve to the cartridge.

10. An explosive device, adapted to be connected co-axially in propagating relationship with similar devices to form an explosive column, comprising an explosive cartridge, a connecting sleeve for said explosive cartridge, and lock means carried by said sleeve and comprising one set of annular teeth-like projections made of resilient metal locking the sleeve to the cartridge and a second set of annular teeth-like projections made of resilient metal adapted for locking said sleeve to a similar cartridge, the cartridge material being relatively softer than the teeth material whereby biting engagement of the cartridge material by said projections produces the locking relationship of the sleeve to the cartridge.

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