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METAL END FOR EXPLOSIVE CARTRIDGE AND CARTRIDGE CONTAINING SAME

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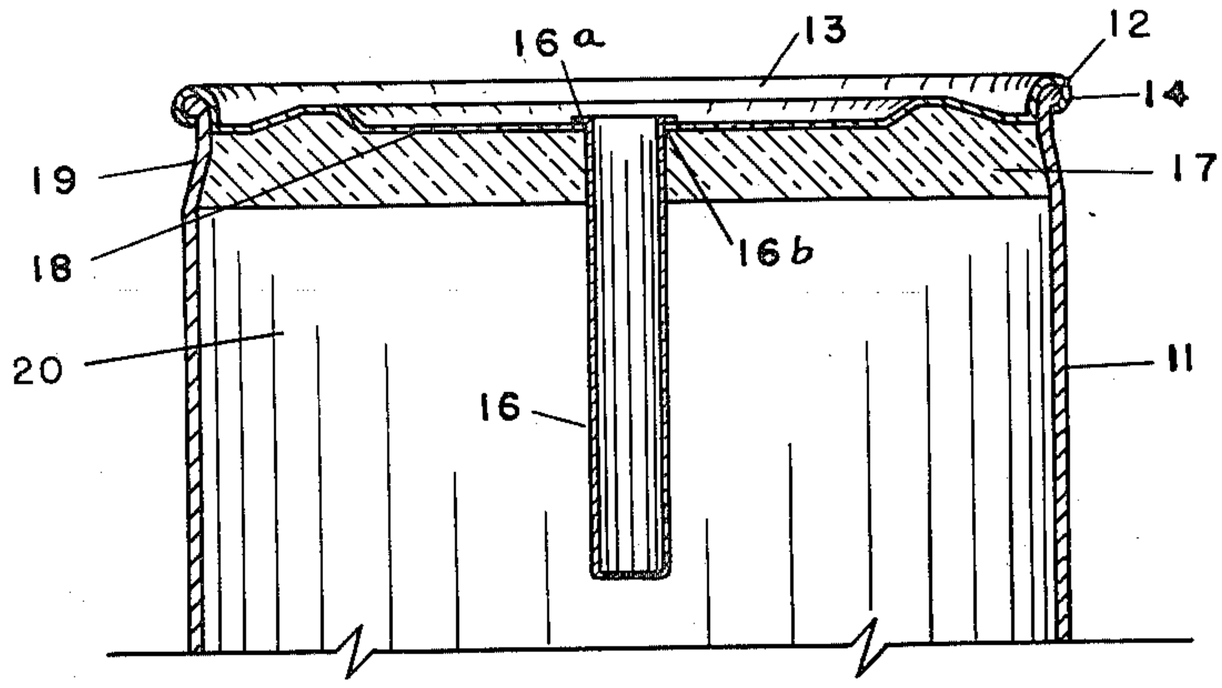


FIG. 1

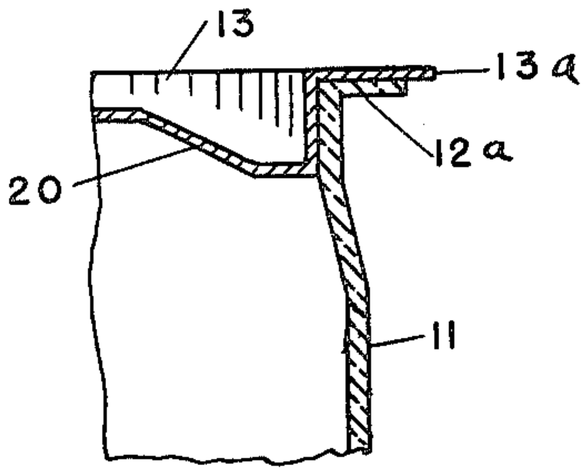


FIG. 2

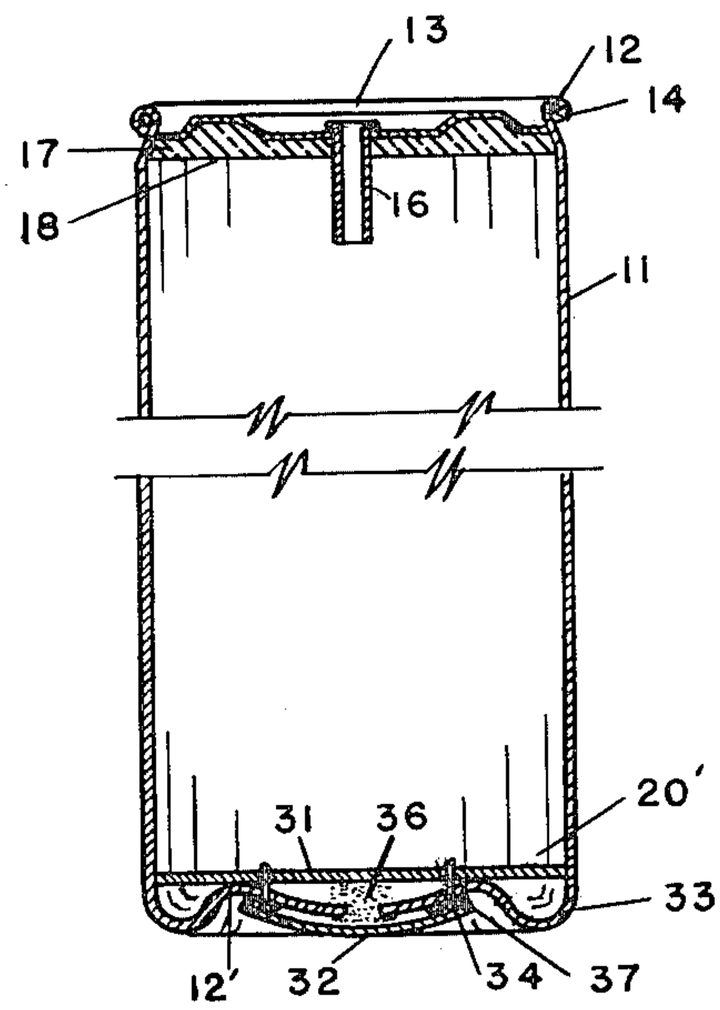


FIG. 3

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# METAL END FOR EXPLOSIVE CARTRIDGE AND CARTRIDGE CONTAINING SAME

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This invention relates to explosive cartridges. In one aspect this invention relates to improved metal end closures for explosive cartridges. In another aspect this invention relates to metal end closures of explosive cartridges improved by a layer of a sealing composition adjacent the metal member and in closed sealed relation to the side walls of the cartridge. In another aspect this invention relates to improved handling of explosive cartridges containing at least one metal end closure, prior to use in the field, by maintaining a layer of a sealing material in an end of the cartridge adjacent the metal member and in transverse sealed relation with the cartridge.

Explosive cartridges are made of various materials such as paper, metal, and a combination of waterproofed extensible papers and fibers. These cartridges are closed by various types of closures attached by folded crimp, rolled crimp, wire ties and the like, and are generally then dipped in a material to provide protection from water penetration such as a wax, asphalt, latex, and the like.

Metal end closures have been employed in many instances because they impart added resistance of the cartridge to rough handling during shipping and storage. They are affixed to the cartridge body in any suitable manner, generally by rolled crimp with the end of the cartridge. Use of metal closures for paper cartridges has been especially advantageous in those instances wherein the cartridges are stored in stacked horizontal position, sometimes as high as 10 to 20 cartridges high, paper end closures often failing under such conditions.

A problem associated with paper-type cartridges having metal end closures has been in the "wicking" of liquid component materials of the explosive through the metal-paper crimp to the outside of the container with the result that not only is the liquid material lost, but resulting "stain" on the outside of the container renders the container in an undesirable state for further handling.

Corrosion of metal end closures of explosive cartridges by explosive components has given rise to various additional problems with inherent weakening of the metal members.

There is always the requirement that an explosive cartridge be sufficiently strong to resist mechanical failure during shipping, storage and other handling prior to use in the field. There are various tests specified by the Interstate Commerce Commission to determine cartridge resistance to mechanical failure during shipping, storing and other such handling. These tests are set forth in "Interstate Commerce Commission Regulations for Transportation of Explosives and Other Dangerous Articles by Land and Water in Rail Freight, Express, and Baggage Services, and by Motor Vehicle, Highway and Water and Including Specifications for Shipping Containers" under section 78.218–13, Specification 236, paragraphs 1 to 4 inclusive. Of these, paragraph 3 requires that three samples (loaded cartridge) must be tested and each must withstand without rupture, four four-foot drops



diagonally on the end more likely to cause rupture on impact.

This invention is concerned with improved explosive cartridges, containing at least one metal end closure, which exhibit unpredicted high resistance to damage that may arise from shipping, storage and other such handling prior to use, and which are highly resistant to corrosion of the metal closure member and preclude wicking of liquid explosive components.

An object of this invention is to provide new explosives containers having at least one improved metal end closure. Another object is to provide improved metal end closure members for explosives containers. Another object is to provide explosive cartridges having at least one improved metal end closure member. Another object is to provide explosive cartridges exhibiting increased resistance to physical failure during handling prior to use in the field. Still another object is to provide for explosive cartridges containing at least one metal end closure and exhibiting increased resistance of such metal closure to corrosion by explosive components, and to wicking of liquid explosive components. Other aspects and objects will be apparent from the accompanying disclosure and the appended claims.

In accordance with this invention an improved end closure for a paper-wrapped explosive cartridge is provided which comprises a metal member adapted to close such a paper cartridge and a layer of a sealing material capable for forming a seal with said wrapper, disposed adjacent a surface of said metal member so as to transversely close said cartridge in sealed relation with the inner walls of said wrapper when said closure is attached to said cartridge. Further in accordance with this invention an improved explosive cartridge is provided comprising a tubular paper member, an explosive material in said tubular member, means for closing said tubular member, at least one of said means comprising a metal plate closing one end of said tubular member and attached thereto, and a layer of sealing material in said cartridge adjacent said metal member in transverse sealed relation with the inner walls of said paper member. Still further in accordance with this invention, resistance of a metal closure member of a paper-wrapped explosive cartridge to (1) corrosion by a component of the explosive, (2) wicking of a liquid component through the seal of metal and paper, generally a crimp, and (3) physical failure of the cartridge during shipping, storage and such handling prior to use in the field, is markedly increased by disposing a layer of a sealing material capable of forming a seal with the said paper in said paper body adjacent the said metal closure member and in transverse sealed relation with the inner walls of the said paper body.

The invention is more specifically illustrated with reference to the drawings of which Fig. 1 is a section of a paper cartridge showing a metal end closure member including an adjacent layer of seal material of this invention; Fig. 2 is a section illustrating a preferred crimp of metal closure member of this invention with the end of the paper tube; and Fig. 3 shows a now preferred cartridge of this invention.

With reference to Fig. 1, paper tubular member **11** is any suitable container for the explosive material such as one convolutely or spirally wrapped and interiorly paraffined and is closed at at least one end **20** with a metal member **13**, generally a "dished" out sheet metal member secured to the end **12** of tube **11** by a rolled crimp **14**. An initiator, or booster, well **16**, when one is employed, is retained in closure **13**, preferably in snug fit in an orifice **16***b* and is supported by a lip **16***a* retained on member **13**. A layer of seal material, microcrystal-

line wax being now preferred, is disposed in tubular member **11** adjacent the inner wall **18** of member **13** in transverse sealed relation with the inner walls at **19** of member **11**. The thickness of the seal material layer is sufficient to impart strength to the cartridge, particularly by strengthening the crimp **14**. The thickness employed is, of course, somewhat dependent upon the size of the cartridge. By way of further illustration a seal layer thickness of say from 1/32 to ½ inch per inch of maximum cross sectional dimension of the cartridge generally imparts the requisite increase in cartridge strength. Thus, in an 8 inch cylindrical cartridge, the layer of seal material is advantageously from ¼ to 4 inches thick.

The opposite end **20'** of tubular member **11** (Fig. 3) can be a metal closure with seal material layer adjacent thereto exactly as illustrated with reference to Fig. 1. However, we have found that in most instances if an improved metal closure of this invention is employed at one end of the cartridge, sufficient added strength will be imparted to the cartridge as to permit use of conventional closure means at the other end. Such, for example, is an inwardly crimped fluted end wall of tube **11** and a water-proofing compound sealing the closed end portion, such as disclosed and claimed in U.S. 2,461,209 of Grampp, assigned to Hercules Powder Company.

Paper tube **11**, in a now preferred form, is formed by either spirally or convolutely wrapping a heavy manila paper around a fixed mandrel and then spirally or convolutely wrapping a laminated asphalt paper on the manila tube.

Although any suitable means can be employed in securing the metal end **13** to the tubular member **11**, we prefer a roll crimp as illustrated with reference to Fig. 2, particularly in view of the strength that it imparts to the cartridge in conjunction with the layer **17** of sealing material. Thus, with reference to Fig. 2, metal member **13** prior to crimping is a "dished" metal plate fitted snugly in open end **20** of tube **11** with laterally extending flange **13***a* superposed on laterally extending flange **12***a* formed from end portion **12** of tube **11**. In these relative positions plate **13** and paper tube end **12** can be rolled to form crimp **14**.

With reference to Fig. 3, our now preferred packed cartridge comprises tubular member **11** with metal closure member **13** connected by rolled crimp **14** with edge **12**, booster well **16** and seal layer **17** adjacent surface **18**, all as described with reference to Fig. 1; and a conventional paper-type sealed closure member at open end **20'** such as disclosed and claimed in U.S. 2,461,209. Thus, as set forth in U.S. 2,461,209 interior disk **31** transversely closes tubular member **11**. Exterior disk **32** is made of laminated paper, heavy carboard or the like. The end wall **33** is fluted by crimping a tubular end portion **12'** of tube **11** inwardly, and is preferably in eight or more flutes. Securing the interior disk **31** and the fluted end wall **33** is a plurality of stitching staples **34**. The central cavity formed by the end of the flutes of end wall **33** is filled with a suitable waterproof adhesive thermoplastic material **36** to seal the ends of the flutes. A sealing ring **37** is placed over the circle of staples. The exterior disk **32** is applied to the end wall **33** and held in place by thermoplastic material **36** and ring **37**. Another form of paper or end closure of Fig. 3 is the same type as illustrated except that the end unit is shaped as a cup which is "cupped " over tube **11** and sealed with a sealing tape to tube **11**.

In accordance with a preferred method for forming the improved metal end closure of this invention, a dished metal sheet is cut with a flange so as to be superposed on the end of the flanged paper tube and with extended metal flange all as described with reference to Fig. 2. The metal sheet and paper tube end are then crimp rolled to strongly affix the metal end plate to the



paper tube. An orifice is then punched in the metal closure member for snugly accepting an initiator well which is sufficiently large to contain a booster and booster initiator, generally an electric blasting cap. The booster well can be affixed in any suitable manner such as by threading to the metal closure or by a flare with seal to the metal. The tube-end assembly is then inverted and a seal material capable of forming a seal with the paper wrapper is poured in molten state into the closed metal end in an amount to provide a layer of desired thickness such as one within the range above described. The mass is cooled to solidify the seal material and effect seal of same with the side walls of the paper wrapper. The tube is then filled with explosive charge through the remaining open end of the tubular body, and packed to the desired density by any suitable means. The bottom seal is then formed. This is preferably done by placing a cardboard disk of diameter equally to the inside diameter of the tubular body on the top of the packed explosive. The said open end is then crimped and seal-closed as illustrated with reference to the paper closure in end **20'** of Fig. 3. The cartridge is then ready for use.

In the event that it is desired to employ an improved metal closure of this invention in place of the paper closure of Fig. 3, that can be done by forming the metal closure with adjacent seal material layer and then packing through the open end, as described hereinabove. An internal disk of diameter equal to the inside diameter of the tubular member of the cartridge is then placed on top of the packed explosive. The desired amount of molten seal material is then poured onto the disk which is tightly fit to prevent seal material from direct contact with packed explosive. The end of the tube material (with edge **12**) is disposed to laterally extend from the seal layer to form a flange **12***a* as shown in Fig. 2. The metal closure is then placed on the tube **11** with metal flange **13***a* superposed on flange **12***a*, all as shown in Fig. 2, and then crimp rolled with the paper tube end. The length of the paper tube extending beyond the top of the sealing body is determined so that the metal member will be crimped down on the still soft material to dispose the latter immediately subjacent the metal closure.

The seal material adjacent the metal closure in accordance with this invention, e.g., seal material **17** of Fig. 1, can be any material that is capable of forming a liquidtight seal with the inner wall of the paper cartridge tube, e.g., inner wall **19** of tube **11**. When forming both ends of the cartridge with the improved metal closure member of this invention, it is important that the seal material employed in closing the charging end, i.e., the end last closed, have a melting point a below the danger point of the explosive or blasting agent.

Exemplary of suitable sealing materials in accordance with this invention are microcrystalline waxes, various resins, e.g., urea—formaldehyde and phenol—formaldehyde, and asphalts or mixtures of such materials. Microcrystalline waxes are now preferred. One such wax is Solvawax 100, a microcrystalline wax advantageously employed in molten state at about 180–200° F. These waxes are solid hydrocarbon mixtures that are separated from heavy petroleum distillates and residues such as by conventional dewaxing processes.

Although the invention is illustrated with reference to a booster well, it is to be understood that the improved metal end closure is equally well applied to an explosive cartridge that can be detonated from its exterior as by a detonator fuse disposed on the outside cartridge wall in detonating relation with a booster or the explosive directly, as the case may be.

Although the metal end closure of this invention can be of any suitable thickness, the metal will generally be from about 24 to about 28 gauge.

Although the invention is particularly well applied to explosives containing liquid components in view of wicking action of the liquid components that otherwise takes

place, it is well applied to any blasting cartridge, particularly in view of the unpredicted increase in strength that is imparted to the paper-wrapped cartridge. Exemplary of such liquid components are liquid nitric ester oils and oily nitrotoluene sensitizers, especially dinitrotoluene.

What is considered to be most surprising is the great strength that is added to the metal closure by the seal material disposed adjacent the metal closure member and in transversely sealed relation with the paper tube. The seal material adds rigidity to the metal member and greatly increases the strength of the metal to paper connection, e.g., the crimp 14 of Fig. 1.

Thus, when drop testing a group of cartridges in accordance with ICC drop tests above described, each cartridge closed at one end with a conventional paper closure and at the other end with a metal closure, the latter both with and without an adjacent layer of seal material in accordance with this invention, the cartridges without a layer of seal material adjacent the metal closure would withstand no more than 4–6 standard four-foot drops diagonally on the metal end, i.e., on the crimp. Four drops were run on each cartridge, the cartridge being disposed at 45° and being rotated 90° after each fall so as to provide a representative evaluation for each set of four tests. On the other hand, when a ⅜ inch layer of microcrystalline wax was disposed adjacent the metal closure and in sealed relation with the cartridge side walls, each cartridge withstood from 12 to 20 of such standard drops. The cartridges tested were each eight inches in diameter with a ⅜ inch microcrystalline wax layer and contained 40 pounds of nitrocarbonitrate explosive containing DNT as sensitizer. The paper closure in each case was that described with reference to Fig. 3.

The above examples demonstrate the unpredicted increase in strength imparted to the metal end members of the paper cartridges and the markedly improved safety in shipping, storing and other handling prior to use in the field that are inherent in this invention.

Although we are not certain as to the role of the seal layer in imparting unpredicted strength to the cartridge, it appears that great shock or stress applied to the metal end of the paper tube flows to and is absorbed by the seal layer to such an unpredicted high degree that the remaining shock or stress to the metal end is insufficient to cause it to deform, break, come apart or otherwise fail.

Our invention can be applied to any suitable explosive material 15. We generally pack our cartridges with blasting cap-insensitive nitrocarbonitrates with or without a sensitizer, exemplary compositions being say 95 percent ammonium nitrate and 5 percent carbonaceous material such as coal. Sensitizers employed are any suitable material, generally a nitrotoluene or mixtures thereof as, for example, dinitrotoluene or dinitrotoluene-trinitrotoluene mixtures. However, the invention is advantageously applied to other explosive materials such as dynamites, which are characterized by containing nitroglycerin, or cap-sensitive nonnitroglycerin blasting agents such as ammonium nitrate-nitrocellulose compositions.

As will be evident to those skilled in the art, various modifications can be made or followed in light of the foregoing discussion without departing from the spirit or scope of the disclosure or from the scope of the claims.

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

1. An explosive blasting cartridge comprising an elongated paper cartridge shell; a solid explosive blasting composition contained within said shell and containing a normally liquid component, and a closure member secured to each end of said shell in closing relation therewith; at least one of said closure members comprising a metal plate disposed substantially transverse to the longitudinal axis of said shell, and crimped about its entire periphery to an end of said shell in said closing relation; a layer of a solid sealing material selected from the group consisting of a wax, a resin, and an asphalt and mixtures thereof, within said shell, disposed transverse to the longitudinal axis of said shell, and closing same; said layer being disposed adjacent said metal plate in surface to surface contact therewith and in liquid-tight sealed relation along its entire periphery with the inner wall of said paper shell, and being characterized by a thickness of from 1/32 to ½ inch per inch of maximum cross sectional dimension of the said shell as measured normal to the longitudinal axis of said shell.

2. An explosive blasting cartridge comprising a tubular wrapped paper cartridge shell; a solid explosive blasting composition contained within said shell and containing an explosive oil as a normally liquid component thereof, and a closure member secured to each end of said shell in closing relation therewith; at least one of said closure members comprising a metal plate disposed substantially transverse to the longitudinal axis of said shell, and crimped about its entire periphery to an end of said shell in said closing relation; a layer of a solid wax within said shell, disposed transverse to the longitudinal axis of said shell, and closing same; said layer being disposed adjacent said metal plate in surface to surface contact therewith and in liquid-tight sealed relation along its entire periphery with the inner wall of said paper shell, and being characterized by a thickness of from 1/32 to ½ inch per inch of diameter.

3. In an explosive blasting cartridge of claim 2, a booster well supported in said metal plate in water-tight sealed relation therewith and extending through said plate and said wax layer into said blasting composition.

4. An explosive blasting cartridge of claim 2 wherein said wax is a microcrystalline wax.

5. An explosive assembly of claim 2 wherein said blasting composition comprises ammonium nitrate, in major proportion, together with a normally liquid sensitizer therefor.

6. An explosive assembly of claim 2 wherein said blasting composition is a dynamite.

7. An explosive blasting cartridge of claim 2 wherein said metal plate is characterized by a thickness of from 24 to 28 gauge.


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