

June 3, 1958

A. R. PARILLA

2,837,456

FILAMENT WOUND CONTAINER

Filed Feb. 29, 1952

2 Sheets-Sheet 1

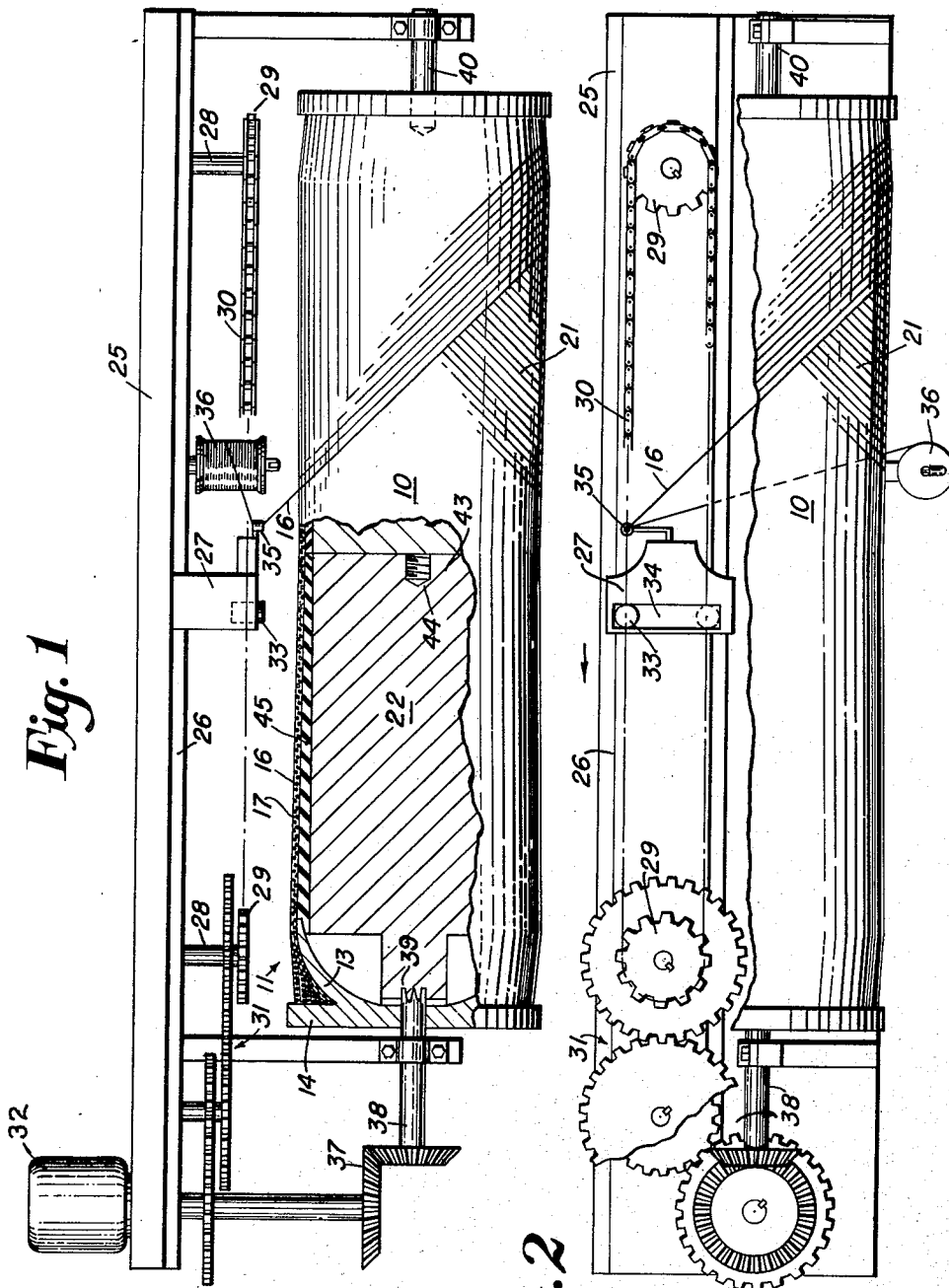


Fig. 2

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2 Sheets-Sheet 2

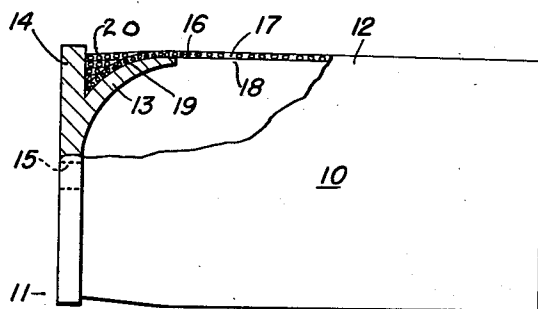


Fig. 3

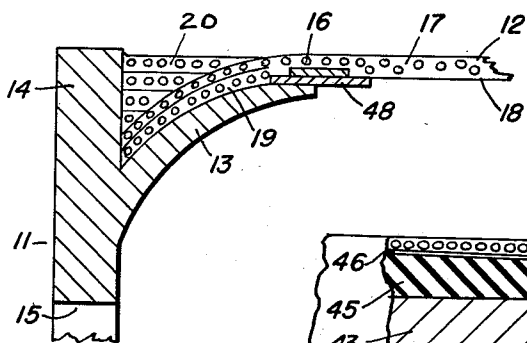


Fig. 4

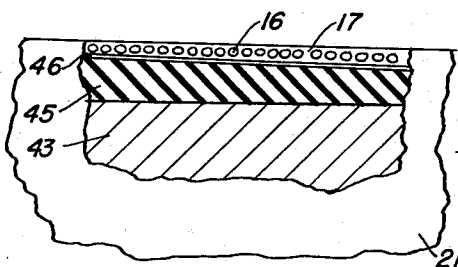


Fig. 5

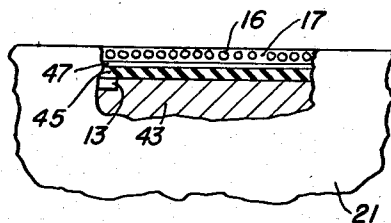


Fig. 6

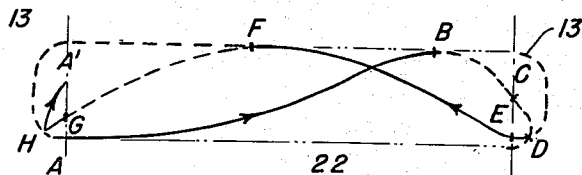


Fig. 7

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2,837,456

FILAMENT WOUND CONTAINER

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9 Claims. (Cl. 154—83)

This invention relates to containers and particularly to light weight containers made of wound filament.

Many types of containers with an open end are commonly made by deep drawing operations performed on a suitable metal blank. Generally, the metal for the blank is chosen because of the ease with which it may be drawn, its other properties, with the possible exception of its strength, are seldom considered or made use of to any important extent during the use-life of the container. Since most metals are at present strategic materials, the making of many of the deep drawn metal containers represents an injudicious use of strategic metals at present in short supply. Artillery shell cartridge cases are an example. Such cases are preferably made of brass, though some are made of steel, primarily because of the ease with which brass can be deep drawn. Steel came into use only when brass became difficult to obtain. Little or any use is made of the special properties of brass and steel during the use-life of a cartridge case. During most of said use-life a cartridge case is a simple container and is not subjected to any unusual conditions. During firing it is subjected to high internal pressures but it is so reinforced by the chamber of the piece that its strength requirements are not excessive. Many nonmetallic materials which are not considered strategic and are cheap and in ample supply could successfully be used instead of brass and steel as the cartridge case material and the cartridge case made by other than deep drawing operations. Deep drawing does have the advantage that large quantities of containers can be produced with a minimum expenditure of time and labor. However, since deep drawing operations require extensive tooling which is expensive to provide in terms of both the labor and the strategic materials required in its production, this advantage is not as great as it first appears to be.

It is a principal object of this invention to provide a novel container with an open end, as well as a novel method for its manufacture, which is light in weight in proportion to its strength, involves the use of a minimum of metals and other strategic materials in its manufacture and can be manufactured quickly and cheaply with a minimum of tooling.

It is a further principal object of this invention to provide a strong light weight container with an open end, as well as a novel method for its manufacture, whose body portion is composed of wound filaments integrally united to the base and includes only a minimum of strategically important metal.

It is a still further principal object of this invention to provide a strong light weight container with an open end, as well as a novel method for its manufacture, which is made up entirely of readily available nonmetallic, non-strategic materials and whose body portion is composed of wound filaments integrally united to the base.

The further objects, features and advantages of this invention will be apparent from a consideration of the

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following detailed description thereof taken with the accompanying drawings in which:

Fig. 1 is a plan view, partly in section, showing an apparatus setup with a container blank of the invention being wound thereon;

Fig. 2 is a front view of said apparatus and blank;

Fig. 3 is a front view, partly in section, of the novel container of the invention in the form of an artillery cartridge case;

Figs. 4, 5 and 6 are enlarged fragmentary views, partly in section, showing construction details of the novel cartridge case; and

Fig. 7 is a diagrammatic view illustrating a winding loop.

The novel container of the invention is of general application and may be such as is used without a top closure for the storage of liquids or solids or used with a closure for such storage at atmospheric, sub-atmospheric or super-atmospheric pressure.

For the purposes of this invention, the novel container and its novel method of manufacture will be disclosed in connection with the novel artillery cartridge case 10, Fig. 3. The cartridge case 10 is made up of an end cap 11 and a body portion 12 integrally united thereto. The cap 11 includes an annular cup-like flange 13 whose outer surface incorporates a small spherical radius. The section of the flange 13 is reduced outwardly to a comparatively thin edge. The cap 11 includes the usual rim 14 and the detonator hole 15. The cap 11 may be formed by any preferred shaping or casting operation and finished to size as required. The cap 11 may be made of metal, as for instance, brass, steel, aluminum, or it may be made of nonmetallic material, as for example, plastic, wood composition, and the like.

The body portion 12 is shown as slightly tapered but said body portion 12 may be straight, or tapered inwardly or outwardly, as required in the use. The body portion 12 is made of wound filament 16 bonded into an integral unit by means of an adhesive 17. Many strong readily available filaments are suited for this purpose. Thus, the filament 16 may be of glass fiber, nylon fiber, rayon fiber and the like, although, it is at present preferred to use glass fiber because of favorable strength-weight ratio and its superior heat and corrosion resistance. The adhesive 17 may be of any preferred kind suited for the intended service, thus, it may be a simple glue or it may be a plastic. At present plastic adhesives are preferred. The filament 16 is under tension and is helically disposed in the portion 18 of the body 12, extending from the open end of the body 12 to the outer edge of the flange 13, and is disposed along a geodesic in the portion 19 of the body 12 over the curved surface of the flange 13. The filament 16 of both portions 18 and 19 being wound under tension, is effective to form the body portion 12 and the end cap 11 into an integrated unitary structure. The type and characteristics of the adhesive employed determines the rigidity of the structure. The space between the portion 19 and the rim 14 is conveniently filled by layers 20 of wound filament. These layers 20 are wound as helices of small pitch.

The cartridge case 10 is made from the blank 21, Figs. 1 and 2. The blank 21 is of the form and size of two opposed, joined cartridge cases 10 and is formed by winding a continuous filament 16, while it is maintained under tension, over a body form 22 which carries an end cap 11 at each end thereof. The filament 16, preferably of glass fiber, is wound helically on the body form 22 between the flanges 13 and along a geodesic on the curved outer surfaces of the flanges 13. The filament tension acts to hold the filament loops tightly on the end caps 11 to form an integrated structure when the winding is completed.

The filament 16 is bonded by the adhesive 17, applied as the winding proceeds, to form said filament 16 and the end caps 11 into an integral structure. The character of the adhesive 17 employed determines the ultimate rigidity of the structure.

The typical winding pattern is schematically shown in Fig. 7 and begins at A, located at the inner end of the curved surface of the flange 13, and proceeds in a helical pattern around and along the tapered cylindrical surface of the body form 22 passing to the reverse side of the body form 22 at B. At point C, located at the inner end of the curved surface of the other flange 13, the filament 16 proceeds on an arc of a great circle returning to the obverse side at D and back onto the surface of the body form 22 at E. The helical pattern recommences at E, passing to the reverse side of the body form 22 at F and continuing to G where it goes onto the curved surface of the first mentioned flange 13 and passes through an arc of a great circle to A'. At A' the filament 16 is in a position comparable to A, when another loop can be started.

As many loops are generated as may be required to sustain the internal load of the structure. The pattern may vary from one in which the starting points of consecutive circuits are separated only by a filament width to one which is so complex as to appear completely random. It is apparent that the curved surfaces of the end caps 11 need not be spheroidal but may be any curved surface of revolution provided that the filament 16 may be passed over a geodesic of the surface, so oriented as to produce a net inward force to react against an internal load.

To produce the cartridge case 10, an apparatus such as is shown in Figs. 1 and 2 is preferably employed. This apparatus and the manner employed in winding the filament 16 is the subject matter of and is fully disclosed in the copending application of Richard E. Young, Serial No. 191,016, filed October 19, 1950, and consequently will not be described in full detail here. The apparatus includes a bed 25 provided with ways 26 over which a filament carriage 27 is reciprocated. The bed 25 mounts the jack-shafts 28 which support sprockets 29 on which is mounted the endless chain 30.

One of the jack-shafts 28 is driven by a gear train 31 actuated by the motor 32 to drive the sprockets 29 and the endless chain 30. Attached to the chain 30 at a fixed point is the slider 33 which is free to move vertically in the space 34 provided in the carriage 27 as it carries the carriage along during movement of the chain 30. The carriage 27 is provided with a filament guide 35 through which the filament 16 passes on its way from the supply spool 36 to the body form 22. Suitable let-off arrangements, not shown, are provided for maintaining a predetermined tension of the filament 16 on its way from the supply spool 36 to the body form 22. Suitable arrangements, also not shown, are provided for applying the adhesive 17 to the filament 16 as it is applied on the body form 22. The motor 32 also drives the bevel gears 37 which drive the shaft 38. A driving spur 39 is provided at the end of the shaft 38 for engaging the body form 22 to rotate it about its longitudinal axis. Aligned with the shaft 38 is a shaft 40 which is mounted for retractive movement into and out of engagement with the body form 22 and includes a conical center at its end about which said body form 22 may rotate.

At the motor 32 is set in motion the chain 30, through the slider 33, moves the carriage 27 in the direction indicated by the arrow, Fig. 2, simultaneously the shaft 38 rotates the body form 22 in the direction indicated by the arrow, Fig. 2. During the top straight course of movement of the slider 33 the movement of the carriage 27 is at a uniform rate and the filament 16 is deposited as a helix. When the slider 33 reaches the first sprocket 29 and travels around said sprocket 29 it will move down the slider space 34 to the bottom thereof in simple harmonic motion relative thereto and the filament 16 will

be deposited along a curved surface of the flange 13. During the harmonic movement of the slider 33 the movement of the carriage 27 is stopped and reversed. During the bottom straight course of movement of the slider 33 movement of the carriage will again be at a uniform rate and the filament 16 will again be deposited as a helix. When the slider 33 reaches the other sprocket 29 and travels around said sprocket 29 it will move up the slider space 34 to the top thereof in simple harmonic motion relative thereto and the filament 16 will be deposited along a great circle of the curved surface of the other flange 13 thus completing the loop shown in Fig. 7.

The body form 22 includes a pair of cylindrical aligned support members 43 releasably joined at their abutting inner ends as by the screw connection 44. The outer ends of the support members are reduced in section to enter the inner cup-like space of the caps 11 to be engaged respectively by the spur 39 of the shaft 38 and the conical center point of the shaft 40. Said shafts 38 and 40 in effecting said engagement pass through the detonator hole 15 of its respective end cap 11. On each of the support members 43 is positioned a sleeve 45 having a cylindrical inner surface in contact with the cylindrical surface of its respective support member 43 and an outer surface shaped to the desired configuration of the body portion 12. As shown the outer surface of each sleeve 45 is frusto-conical. The reduced outer end of the flange 13 engages and appropriately reduced section of its respective sleeve 45. The sleeves 45 are formed of a readily deformable material such as rubber so that they may easily be collapsed and removed from the finished cartridge case 10.

When the forming of the blank 21 has been completed by the deposition of the required number of winding loops of chosen pattern, an annular space remains between the flange 13 and the bonded deposited filament portion 19. This space may be conveniently filled to provide a blank 21 of more satisfactory contour by winding and bonding filament 16 therein in the form of helices 20 of small pitch.

The application of the adhesive 17 is generally such that the outer surface of the blank 21 is seldom uniform and smooth. When a smooth surface is desired it is a simple matter to finish the blank 21 by passing a suitable cutting tool along its length while the blank 21 is rotated to obtain an outer surface of required smoothness.

The finished blank 21 is parted in the plane of union of the cylindrical support members 43 while said blank is rotated about its longitudinal axis. The parting is easily effected by means of a cutting blade, as for instance, a hack-saw blade. After the parting step the shaft 40 is retracted and the body form 22 with the parted blank 21 thereon removed from the apparatus. The supports 43 are then separated and the respective cartridge cases 10, together with their respective sleeves 45 removed therefrom. A blunt tool is then inserted between the body portion 12 and the respective sleeve 45 and said sleeve 45 collapsed and withdrawn from respective cartridge case 10.

To avoid the difficulties which are encountered in the removal of the sleeve 45 from its respective cartridge case 10, when by reason of the adhesive 17 employed and/or by reason of the character of the surface of the sleeve 45, the sleeve 45 adheres to the body portion 12, a sheet of light gauge smooth surfaced material such as metal foil, waxed paper and the like, may be wrapped around said sleeve to cover the surface thereof that otherwise would be exposed to the filament 16 and the adhesive 17. At present light gauge aluminum foil is employed and it has been found that something over one complete wrap, say $1\frac{1}{2}$ wraps is sufficient. In Fig. 5 is shown a completed blank 21 in which a wrapping 46 of light gauge aluminum foil is positioned between the sleeve 45 and the filament wound portion of the blank.

With such wrapping 46 the sleeve 45 is easily removed, also said wrapping 46 is also easily removed as the adhesive will not adhere to its smooth metal surface.

It is sometimes required that the containers of the invention be impervious to fluids and sometimes that they be both impervious and able to resist the corrosive effects of the materials stored in them. While these results may often be attained by close multi-layer winding of the filament 16 and by choice of a proper adhesive these results are easily obtained by positioning a sleeve or stocking 47 of a plastic of the required characteristic on the sleeve 45 so that upon the subsequent winding and bonding of the filament 16 to form the blank 21 said sleeve or stocking 47 is incorporated in or made an integral part of said blank 21. In Fig. 6 is shown a completed blank 21 in which a sleeve 47 is positioned on the sleeve 45 and is incorporated in the blank 21 as an integral part thereof.

When the containers 10 made as described above, are subjected in use to high internal pressures, failure generally occurs at pressures considerably lower than those the container is expected to withstand. The failures always occur in the body 12 immediately adjacent the edge of the flange 13. Such failures may be explained by the fact that the wall of the container 12 being made of adhesive 17 and filament 16 has a relatively low modulus of elasticity. Hence, the internal pressure will stress said wall nearer to its ultimate stress than it will stress the contiguous portion of the flange 13, especially so since the thickness of the flange 13, at its edge must for ease of fabrication be kept to a substantial value. Thus, the wall of the body 12 adjacent the edge of the flange 13 is deformed to a much greater extent by the internal pressure than the edge of the flange 13. This excessive deformation results in very high local stresses which cause the premature failure. Premature failure may be eliminated by providing a wrapping 48, Fig. 4, of a thin metal ribbon of from .002 to .003 of an inch in thickness and from 1 to 2 inches wide over the edge of the flange 13. This metal reinforcement serves to distribute the discontinuity over a wider area making the transition from the stronger flange 13 to the weaker body portion 12 more gradual and thus eliminates premature failure of the body portion 12. The wrapping 48 may be 1½ to 2 turns of ribbon of constant width or it may be, as shown, separate, superimposed wrappings, each also of from 1½ to 2 turns, of metal ribbon of different widths. Furthermore, the wrappings 48 may be applied before the winding of the filament 16 or they may be applied after a layer or two of the filament 16 have been wound. The latter procedure provides smoother inner and outer surfaces.

Since many changes may be made without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not limitative.

I claim:

1. The method of fabricating a hollow container with a closed bottom end and an open top end which consists in providing a body form of substantially the configuration of a united opposed pair of the desired containers, positioning closures at the ends of said body form in opposed relation, each of said closures including a curved surface facing away from the other of said closures, winding and bonding filament under tension along a helix whose pitch exceeds the diameter of said body form over said body form between said closures to form a hollow body and along a geodesic over said curved surfaces to form said hollow body and said closures into an integrated structure which is held together against longitudinally acting disruptive forces substantially only by said bonded filament windings acting under tension, parting said hollow body intermediate its ends, and removing the thus produced containers from said body form.

2. The method of fabricating a container with a closed bottom end and an open top end which consists in providing a multi-part cylindrical support member, mounting a pair of collapsible sleeves in opposed relation on said support member, the outer configuration of each of said sleeves being substantially that of the body portion of the desired container, mounting a closure at each end of said support member in contact with the sleeve at the respective end, each of said closures including a curved surface facing away from the respective sleeve, winding and bonding filament under tension along a helix on said sleeve and along a geodesic on said curved surfaces to form an integrated structure, parting said structure intermediate its ends to form a pair of containers each with an open end, separating the parts of said support member and removing said parts and said sleeves from the respective containers.

3. The method of fabricating a container with a tapered body portion and an open end which consists in providing a multi-part cylindrical support member, mounting a pair of collapsible sleeves in opposed relation on said support member, the inner surface of each of said sleeves being cylindrical and the outer surface being tapered, mounting a closure at each end of said support member in contact with the sleeve at the respective end, each of said closures including a curved surface facing away from the respective sleeve, winding and bonding filament under tension along a helix on said sleeves and along a geodesic on said curved surfaces to form an integrated structure, parting said structure intermediate its ends to form a pair of containers each with an open end, separating the parts of said support member and removing them from the respective containers, and collapsing said sleeves and removing them from the respective containers.

4. The method of fabricating a container with a closed bottom end and an open top end which consists in providing a multi-part cylindrical support member, mounting a pair of collapsible sleeves in opposed relation on said support member, the outer configuration of each of said sleeves being substantially that of the body portion of the desired container, mounting a closure at each end of said support member in contact with the sleeve at the respective end, each of said closures including a curved surface facing away from the respective sleeve, covering the outer surface of said sleeves with thin metal foil, winding and bonding filament under tension along a helix on the foil covered surface of said sleeves and along a geodesic on said curved surfaces to form an integrated structure, parting said structure intermediate its ends to form a pair of containers, separating the parts of said support member and removing said parts and said sleeves from the respective containers.

5. The method of fabricating a container with a closed bottom end and an open top end which consists in providing a multi-part cylindrical support member, mounting a pair of collapsible sleeves in opposed relation on said support member, the outer configuration of each of said sleeves being substantially that of the body portion of the desired container, mounting a closure at each end of said support member in contact with the sleeve at the respective end, each of said closures including a curved surface facing away from the respective sleeve, covering said sleeves with a thin impervious preshaped plastic stocking, winding and bonding the filament under tension along a helix on said stocking and along a geodesic on said curved surfaces to incorporate said filament, said closures and said stocking into an integrated structure, parting said structure intermediate its ends to form a pair of containers, separating the parts of said support member and removing said parts and said sleeves from the respective containers.

6. The method of fabricating a container with a closed bottom end and an open top end which consists in providing a body form of substantially the configuration of a united opposed pair of the desired containers, positioning

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closures at the ends of said body form in opposed relation, each of said closures including a curved surface facing away from the other of said closures, wrapping thin metal ribbon at the inner end of each of said surfaces to overlap a portion thereof and a portion of the surface of said form adjacent said closure, winding and bonding filament under tension along a helix between said closures and along a geodesic on said curved surface to form said filament, said closures and said metal foil into an integral structure, and parting said structure intermediate said closures to form a pair of containers.

7. The method of fabricating an artillery cartridge case which consists in providing a body form including a pair of aligned collapsible forms disposed in opposed relation, each of said collapsible forms of substantially the configuration of the body section of a desired cartridge case, positioning a cartridge case bottom member at each end of said body form, said bottom members being in opposed relation and each including a cup-like part with an outer curved surface, winding and bonding a filament under tension along a helix whose pitch exceeds the diameter of said body form on said body form and along a geodesic on said curved surfaces to form said filament and said bottom members into an integral unit which is held together against longitudinally acting disruptive forces substantially only by said bonded filament windings acting under tension, parting said unit intermediate said bottom members, and removing said body form from the cartridge cases thus formed.

8. The method of fabricating an artillery cartridge case which consists in providing a body form including a pair of aligned collapsible forms disposed in opposed relation, each of said collapsible forms of substantially the configuration of the body section of a desired cartridge case, positioning a cartridge case bottom member at each end of said body form, said bottom members being in opposed relation and each including a bottom rim flange and a cup-like part with an outer curved surface extending from said flange, helically winding and bonding a filament under tension along a geodesic on said curved surfaces to form said filament and said bottom members into an

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integral unit, filling the space between said flange and the covered curved surfaces of said cup-like part by winding and bonding filament therein, parting said unit intermediate said bottom members, and removing said body form from the cartridges thus formed.

9. The method of fabricating an artillery cartridge case which consists in providing a body form including a pair of aligned collapsible forms disposed in opposed relation, each of said collapsible forms of substantially the configuration of the body section of a desired cartridge case, positioning a cartridge case bottom member at each end of said body form, said bottom members being in opposed relation and each including a cup-like part with an outer curved surface, wrapping thin metal ribbon at the inner end of each of said curved surfaces to overlap a portion thereof and an adjacent portion of the surface of said body form, winding and bonding a filament under tension along a helix on said body form and along a geodesic on said curved surfaces to form said filament, said bottom members and said ribbon into an integral unit, parting said unit intermediate said bottom members, and removing said body form from the cartridge cases thus formed.

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