Feb. 15, 1949. E. C. FLETCHER 2,461,539

CARTRIDGE CASE

Filed March 16, 1945 3 Sheets-Sheet 1

Fig. 1.

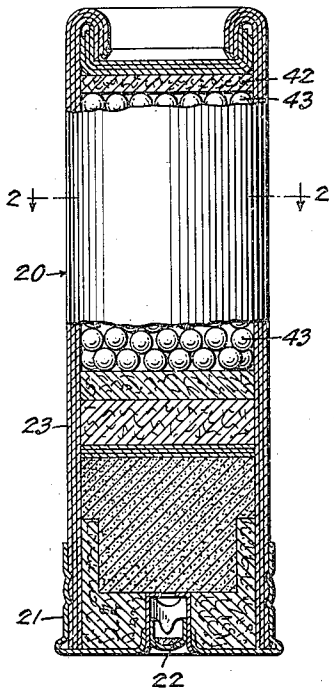


Fig. 2.

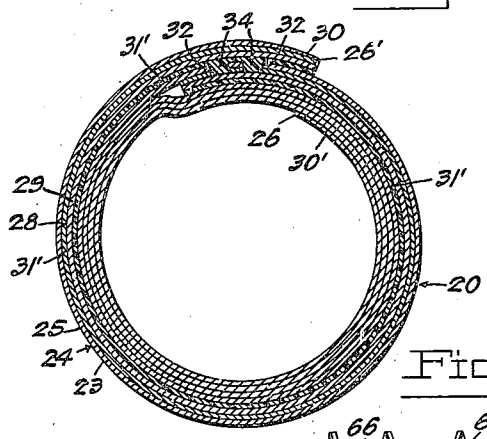
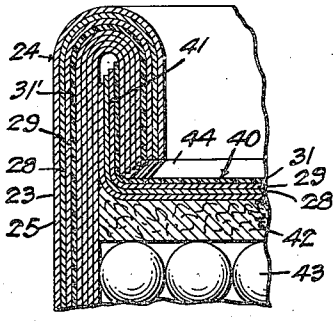


Fig. 10.

Fig. 3.



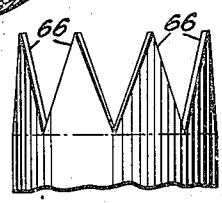
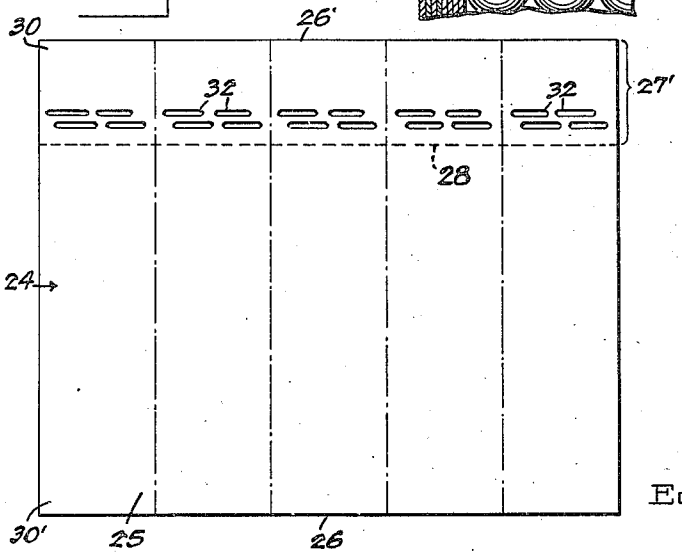


Fig. 11.

Fig. 5.



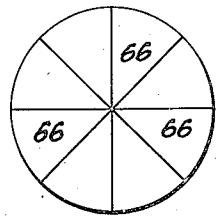


Fig. 12.

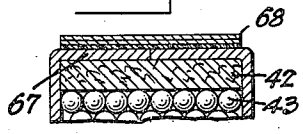
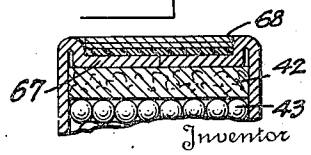


Fig. 13.



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CARTRIDGE CASE

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Fig. 4.

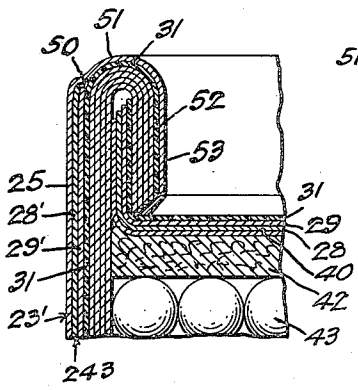


Fig. 14.

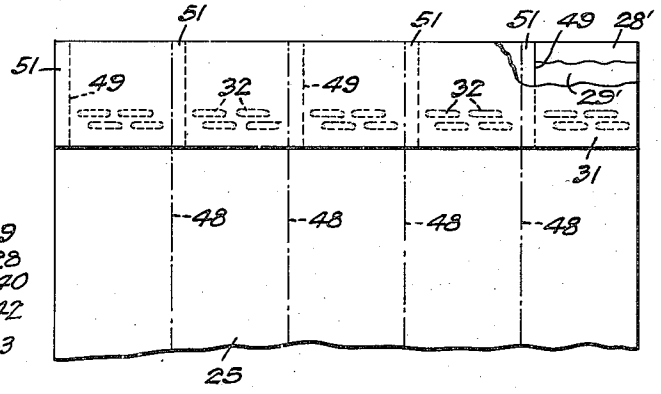


Fig. 15.

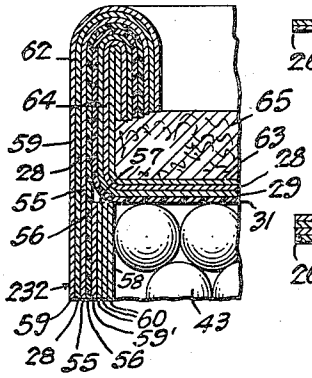


Fig. 17.

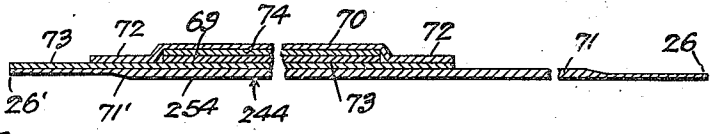
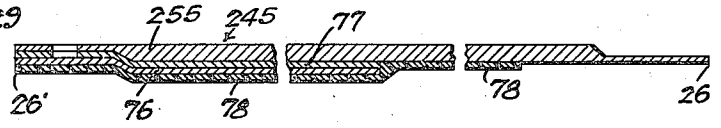


Fig. 18.



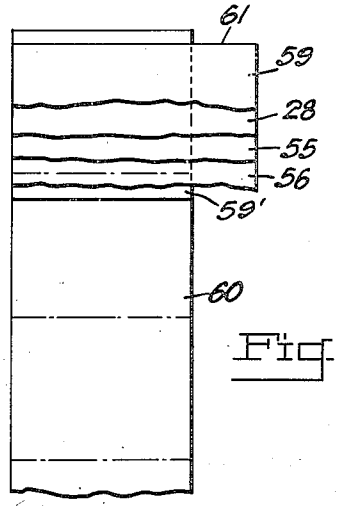


Fig. 16.

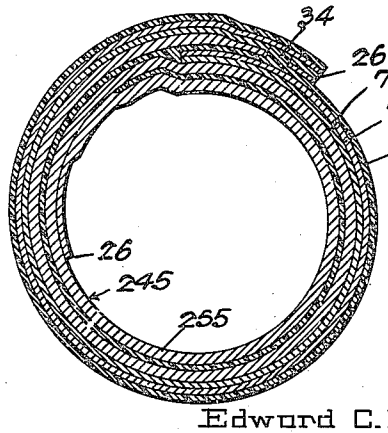


Fig. 19.

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CARTRIDGE CASE

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Fig. 6.

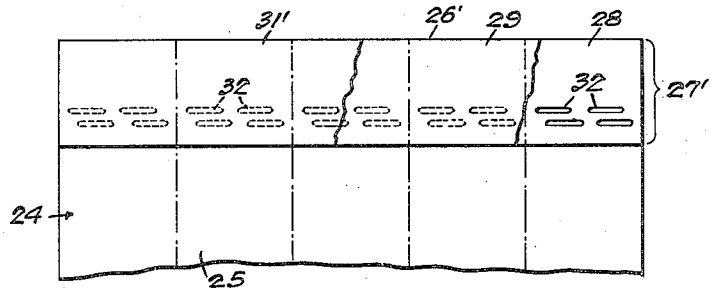


Fig. 6a.

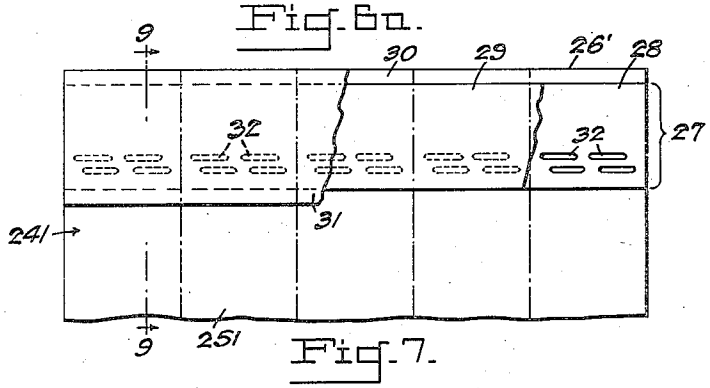


Fig. 7.

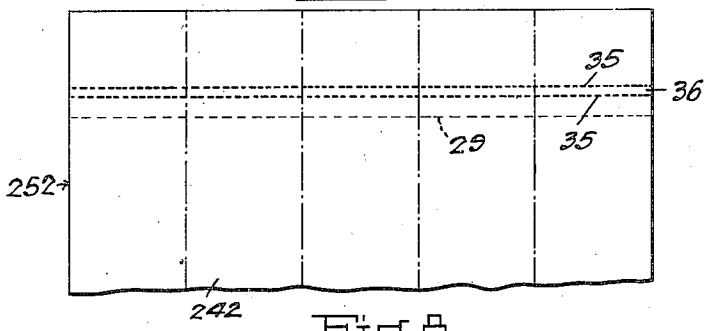


Fig. 8.

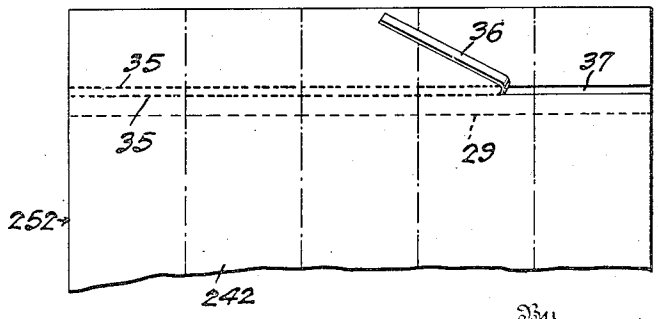
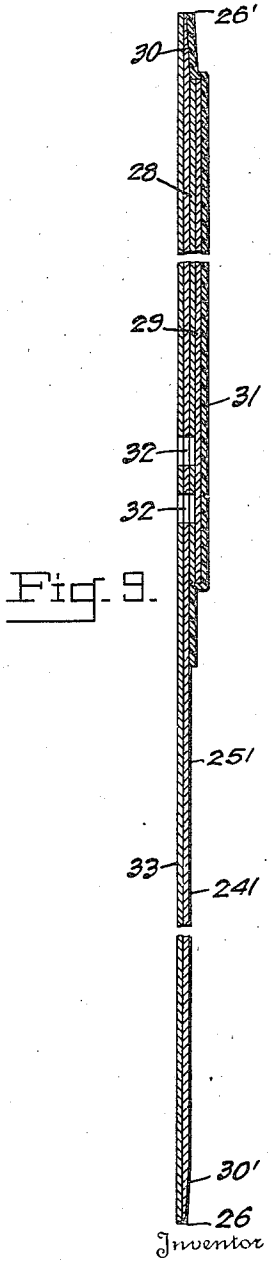


Fig. 9.



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Patented Feb. 15, 1949 2,461,539

UNITED STATES PATENT OFFICE

2,461,539

CARTRIDGE CASE

Edward C. Fletcher, East Lansing, Mich.

Application March 16, 1945, Serial No. 583,139

5 Claims. (Cl. 102—43)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to me of any royalty thereon.

The invention relates to wound sheet case devices, and particularly to shot and grenade propellant shells, the body walls of which largely comprise fiber sheet products such as paper, and has for an object to present a shell of this general description which will economically overcome objections to such shells which have been found insuperable heretofore except at high cost (as, for instance, by substitution of metal shells for the paper shells).

Among the principal objections are: susceptibility to gas penetration; absorption of moisture and consequent swelling, despite impregnation with wax or other water-proof materials; excessive burning or charring which tends to permit cutoff or breakage of the shell in extraction from a gun after firing.

It has been heretofore appreciated that the inclusion of a metal foil in the winding of shell paper even for a part of the convolutions would be less expensive than a metal shell and would overcome the objections above noted to a sufficient degree to enable satisfactory use of the shell. But difficulty has been encountered in securely incorporating the foil in place without weakening the shell wall and to avoid cracking of the foil in the course of manufacture of the shell, with loss of its imperviousness. The uniting of the foil with the paper sheet with sufficient tenacity to prevent separation of the foil and paper under stresses of use has been a serious consideration in the incorporation of the foil satisfactorily. It is therefore an impelling motive to present means to effect the securement of a metal foil in a shell or other laminated structure in such manner that the possibility of separation of the metal and attached plies is reduced to a workable minimum. It is a further important attainment held in view to present a novel structural sheet form for the making of structures with laminated metal and paper or the like, whereby a paper or like sheet and a foil facing held together by a material of moderate strength may be assembled with a surfacing of a stronger adhesive and so fabricated that the strength of the last named will be availed of to assure the permanent relation of the laminations under stresses excessive for the weaker adhesive alone.

It is a purpose to enable production of this improved shell by the use of prior machines in at least one form of the invention.

It should be remembered that shells for service by military guards are subject to repeated loading and unloading, coincident with exposure to

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water and mud, which tend to destroy the seal afforded by wax, and thereafter the paper stock rapidly absorbs moisture and swells. The wax impregnated paper shells will absorb moisture even without abrasion. It is an object of this invention to utilize the conventional paper stock to give the necessary bulk and stiffness to the body wall of the shell, and as a protective cover for an absolutely impervious metal layer. Owing to the tendency of paper fibers over a long period of exposure to moisture to function like a wick and transmit dampness throughout the whole body, the consequent swelling makes the shell unserviceable. It is therefore a dominant aim in one form of the invention to utilize a wound paper wall, with an outer paper convolution as a shield, but to establish an absolute moisture dam between it and the remainder of the wrapping.

Additional objects, advantages, and features of the invention reside in the structure, arrangement, and combination of parts, in the nature of the materials and methods of procedure involved in the practice of the invention as may be understood from the following description and accompanying drawings, wherein:

Figure 1 is a longitudinal sectional view of a shot shell made in accordance with my invention.

Figure 2 is a cross section on the line 2—2 of Fig. 1.

Figure 3 is an enlarged detail of the closure.

Figure 4 is an enlarged detail of a modified closure.

Figure 5 is a plan of the stock wrapper, outer side.

Figure 6 is a fragmentary view of the inner side of the wrapper.

Figure 6—*a* is a similar view of a modified wrapper.

Figure 7 is a fragmentary plan of the outer side of another form of stock wrapper for use in my invention.

Figure 8 is a similar view of the sheet of Fig. 7, as prepared for winding.

Figure 9 is an enlarged longitudinal section of the sheet used in Fig. 6—*a*.

Figure 10 is a fragmentary view of an open shell end.

Figure 11 is a top view of a shell in the first stage of closing.

Figure 12 is a section of a completed closure.

Figure 13 is a view similar to Fig. 12 of a modification of the closure.

Figure 14 is a plan of the stock wrapper for the article of Fig. 4.

Figure 15 is an enlarged fragmentary section of a modified wall and closure.

Figure 16 is a view of one of the strips from which the cartridge of Fig. 15 is wound.

Figure 17 is a longitudinal section of a modified stock wrapper.

Figure 18 is a similar view of a further modification.

Figure 19 is a cross section of the shell made with the wrapper of Fig. 18.

Referring specifically to details shown in the drawings, there is illustrated in Figs. 1 and 2 a shot shell 20, which mainly conforms to shell structure generally in use, and may embody the heretofore familiar stamped metal head 21 and primer 22. The head and primer structure and content being conventional, and well understood, the details thereof are not illustrated. In the head there is set a body 23 its form and external dimensions conforming to those of prior shells, and it may be similarly secured in the head, so as to function in gun chambers the same as prior shells. While its ballistic value is intended to be standard, the following disclosure will make apparent the possibility of control by the nature of the structure in the closure.

The body 23 is a simple hollow cylinder or wall intended to be formed by the winding of a composite stock wrapper sheet 24 such as shown in Figs. 5–6, upon a suitable mandrel to form a long tube from which a number of bodies 23 may be cut as indicated by dotted lines across the sheet 24. Heretofore the bodies have comprised five or six convolutions or layers of the wrapper and my invention may conform to this practice, or may have fewer turns of the wrapper and so be somewhat reduced in thickness if desired, owing to the superior rigidity of the wall structure produced by my invention. The stock wrapper includes a base paper sheet 25 (Fig. 5) having parallel starting and terminal edges 26—26′ representing respectively the parts for the beginning of the winding of the body and the termination of the outermost convolution of the paper sheet on the tube and body 23. Each of the adjacent edge portions of the base sheet are tapered in thickness to a very thin extreme terminal edge. While the paper of the finished body is intended to be impregnated with a water proof material and/or a dampproofing, this may be effected at any stage of production suited to the structure hereinafter described. In one form of the base paper sheet 25 it has been prepared substantially of the same fiber, quality, and shape heretofore used and familiar.

In a wrapper 24′, Fig. 6*a*, a zone 27, on the inner face of the paper base sheet 25′ stopping parallel to the finishing edge 26′, extending entirely across the sheet transverse to the direction of winding, and having a dimension in the direction of winding slightly greater than the circumferential measurement of the finished tube, is coated with a cementitious material 28—for instance a bituminous one (an asphalt composition having been used)—and upon this coating there is laid and pressed to an intimate united relation with the base sheet 25′ a sheet of metal foil 29 or the like, the cement 28 being one especially effective in holding upon smooth metal surfaces, so that the foil is securely fastened upon the sheet 25′. A foil of copper, lead, or other metal may be employed, it being a requirement that the metal be free of openings or voids which would permit transpiration of moisture. Lead has been commonly considered most desirable for the use, although aluminum, copper, and other metals are thought to be usable advantageously. Over and upon this foil 29 at the face opposite the

sheet 25′, and extending over the margin 30 of the sheet 25′ between the zone 27 and edge 26′, there is a coating 31 of a material highly adhesive to metal and of high flexibility and high tensile strength and at least moderately ductile, or strainable without fracture. For this material a butyral polyvinyl plastic has been used, a commercial form of which is named "Butvar"; but it is practicable to use other resinous products of similar qualities, as, for instance, some of those named in the patent to Harmon, No. 2,300,363, applied so as to provide a coating of say, 0.001 inch thickness or more upon the metal, and using those resins which have the greater strengths. It is possible to also use other of the known plastics either thermoplastic or thermosetting by appropriate procedure, where they have the desired structural strength, and in the case of the thermosetting forms, certain improvements in structure are possible, as will be explained.

In the sheet 25′ there are formed prior to application of the foil and before application of the asphalt also, if desired, a multiplicity of slots 32, in two closely spaced parallel series extending entirely across the sheet, the slots being elongated and arranged end to end, and spaced slightly in each series. The slots of one series are staggered with those in the other series. These slots are arranged within the area covered by the foil 29, close to the inner transverse edge of the foil 29—that is, parallel to the terminal edge 26′, but at the side of the foil furtherest from the terminal edge. These slots serve to expose the underlying foil so that in the winding of the sheet 25′ the edge portion of the foil distant from the terminal edge 26′ of the body sheet containing the slots is overlaid by the extreme opposite and outer edge portion of the foil which is next to the terminal edge 26′. In the form of sheet in Fig. 6—a, when it is wound into a tube upon a suitable mandrel, and heat and pressure applied to the terminal edge 26′, the latter will be secured so as to hold the tube firmly. Before the winding, paraffine 33 as in Fig. 9 or other thermo-softening material may be applied while hot to the entire outer face of the sheet 25′, and this may be effected after application of the plastic 31 at the opposite side, so as to avoid weakening the hold of the plastic 31 directly upon the fiber stock. Or, the paraffine may be applied after the winding of the tube. After the winding, if the mandrel used is heated, the convolutions of paper will become united in the one case by the paraffine, as well as the terminal edge portion 30 of the sheet secured by the thermoplastic 31. In the other case if the paraffine is applied after winding, the paraffine will unite the paper convolutions when the tube or body is drawn through the sizing die.

When the finished body is passed thru the sizing die a complete uniting of the layers or convolutions is effected by permeation of the paraffine, and if accompanied by a proper degree of heating, the thermoplastic is at the same time united intimately with the underlying paper, serving to secure the final convolution (including the foil) to the next inner layer of paper, and securing the terminal edge of the foil to its inner edge portion by a series of tacks 34 which consist of portions of the coating 31 extending through the slots 32 from the overlapping edge of the foil to the underlapped edge of the foil, flowing to and becoming attached to the latter under the effect of heat and pressure, as will be understood. At the same time the terminal edge portion 30 of the

sheet becomes attached to the underlying paper which lies over the foil.

Using the body sheet as prepared in accordance with Figs. 5 and 6, the procedure is substantially the same producing a stock wrapper 24. The zone 27' over which asphalt 28 or other cement is applied, however, is extended to the terminal edge 26' of the sheet 25, and foil 29—of the same area as before—is also extended to the edge 26'. Slots 32 are formed through the sheet 25 in the same relation to the inner transverse edge of the foil as before, so as to overlie the inner edge portion of the foil lapped by the terminal part of the wrapper when the winding is completed so as to form plastic tacks 34 between the lapped portions of the foil in the processing of the material, as before described. The thermoplastic 31' (of the same nature as the coating 31), covers only the foil. The winding and other treatments may be the same as before described, producing the shell of Figs. 1, 2 and 3.

In Figs. 7 and 8 a base sheet 252 is used for the body of the wrapper 242 which may be identical with the sheet 25 in its laying or felting and simple calendering, but instead of having the slots 32 cut therein is provided with parallel lines 35 of fine perforations extending entirely across the sheet, or otherwise weakened or predisposed to tear along the two parallel lines 35. The strip 36 of paper between these lines 35 may thus be readily separated and torn out of the sheet as indicated in Fig. 8 after attachment of the foil 29 as in either Figs. 6—*a* or 6, so as to form a slot 37 extending entirely across the sheet near and parallel to the inner edge of the foil. This strip 36 is not removed however, until after manufacturing and shipment of the wrapper stock sheets to the tube making plant and until shortly before the winding of the tubes is carried out, in order to safeguard the foil against injury due to its fragile nature. The adhesion of the asphalt composition to the paper is so superior to its hold upon the foil that the asphalt is entirely removed with the paper, leaving the surface of the foil clear and clean. The plastic 31 also serves as a support and protection for the foil 29, and might be sufficient in many respects if the strip 36 were not retained, but retention of the strip is thought desirable to safeguard the foil against graving or abrasive injury by objects which might otherwise directly engage the foil surface through the slot 37.

In the use of any of the wrappers as described, after completion of the winding and ring die-compaction and sizing of the tube, the cutting out of the bodies 23 and assembly of the heads 21 thereon, they may be filled and closed by conventional prior practices or other approved practices found applicable. In the instant disclosure I have used, as in Fig. 3, a cap 40 formed of flat paper stock the same as that used in the body of the sheet 25, upon which foil 29 is secured by intervening asphalt 28, and covered by a thermoplastic 31. Suitable discs of this built-up sheet are cut and each formed with an up-turned flange 41 (the foil and plastic 31 being at the top) to fit within and against the wall of the body 23 and the cup pressed down against the top wad 42 over the shot charge 43. The upper edge portion of the wall body 23 may then by turned in and downward through 180 degrees within and close upon the flange 41 and with its extremity pressed tightly against the flat part of the cap 40 to hold the latter in place. By applying a resinous composition to the end edges of the body 23 before

forming it against the cap 40 as last described, a seal as at 44 is formed between the extremity of the wall of the shell body 23 and the cap, insuring a water tight joint between the cap 40 and shell body. This seal 44 may be of the same material as the plastic 31, if desired, or may be an adhesive compounded in accordance with Patent No. 2,300,368, or otherwise.

It should be understood that the adhesive 28 may be compounded in accordance with the specification of Patent 2,300,368 in relation to preparation of adhesives, to assure good adhesion of the material and good damp-proofness, as required, or corresponding practice with other materials carried out.

If it is desired to control ballistic values of the round embodying my invention with standard and uniform propellant charges this may be done by varying the composition of the seal 44 and/or material 31 of the cap 40 so as to vary the retardance of the charge behind the cap and top wad upon firing of the round.

If desired, also, the form of closure shown in said prior patent may be utilized in a shell otherwise embodying my invention, or other approved practices followed.

It will be appreciated that owing to the nature of the plastic material 31, the formation of the slot 37 results in the interposition of a dam at 34 as well as a tack or anchorage between lapped portions of the foil. The interruption of the continuity of the sheet 25, 251, 252, prevents the wick action or vapor penetration of the fibers in the paper which becomes slowly manifest when the prior common waxed shell is subjected to contact with water or exposed to dampness; and the dam further stops any communication of moisture from the external convolution to inner paper parts of the shell body. The use of the cap 40 with its foil and seal 44 prevents the communication of moisture through the end of the shell.

It will be appreciated that in the production and handling of the tubing and loading of the shells, the securely attached material 31 limits excessive local distention of the foil which would tend to result in cracks; and similarly, due to this adhesion and the moderate ductility and coherence of the material 31, when accommodation is required the material 31 distributes the strain so that fracture of plastic or foil does not occur. Adhesion of the foil carries the latter with the strained parts of the plastic as well as preventing strain of the foil exceeding that of the plastic so that distension is widely and uniformly distributed in the foil and liability of its rupture minimized.

In Figs. 4 and 14 there is illustrated a modification of structure in the wrapper 243 and in the finished shell, wherein the foil 29' is applied to the base sheet 25 in areas stopping short of the boundaries 48 at which the completed tube is to be cut to form the shell bodies as shown at 49, but abutting these boundaries in the opposite direction, so that when wound and cut the foil 29' stops short of the outer or top open end of the body 23' in each shell, as at 50 in Fig. 4, but extends a short distance above the top wad 42. The adhesive 28 may extend to the full width of the cut for each body—that is, beyond the foil, to the end of the body 23, or may be only under the foil as in Fig. 4. The slotting of the sheet 24' may be the same as in Figs. 5, 6—*a*, or 7. When this shell is closed by the practice described in connection with Fig. 3, a similar seal may be formed by the cap 40 and end edge of the body 23'. By

extending the coating of plastic 31 over that upper part 51 of the inner face of the sheet 54 not covered by the foil, a moisture seal 52 is provided in the inturned part 53 of the shell end.

As has been heretofore appreciated the metal foil not only serves as a moisture insulation and positive hermetic dam (for which the plastic might also serve over a reasonable period), but is permanently effective in that respect. A consideration important in dictating the use of the foil in addition to the plactic is its high efficiency as a dam for hot gas products and in absorbing heat, which has a material effect in reducing charring and burning of the plastic and the outer convolutions of paper in the body 23. While not sufficient to act as a complete fire proofing, it is found sufficient as a delaying means during the short time elapsing in the propulsion of the shot load and escape of propellant products.

In the use of the cap 40 avoidance of production, on firing of matter tending to obscure vision is attained, the cap becoming quickly disintegrated and consumed the paper and plastic being burned and the foil dissipated in such small and inconspicuous particles that they cause no annoyance or obscuration of vision in the direction of firing.

The plastic 31 adds materially to the strength of the shell wall and therefore the size of the stock sheet 24 may be reduced by the extent of one or more convolutions, or may be made thinner. This would obviate introducing an excessive amount of material into the wall of the body 23 prior to its die pressing to standard radial dimensions.

In Fig. 15 there is illustrated a modification of the closure in which all convolutions of paper in the shell wall inward of the foil 55 and its plastic coating 56 stop short of the open end of the shell, forming a shoulder 57, the materials being the same as before indicated. In the production of this body 232 the short part 58 may be wound as a complete stock tube by prior methods, and bodies cut to the shorter length, after which there may be applied a sheet of paper stock 59 of proper size to form a single or more convolutions and having the foil 55 applied and secured by suitable adhesive 28 throughout or leaving projecting borders corresponding to the starting and finishing edges as before mentioned, as discretion dictates and a plastic layer 56 laid on the foil. Or, the short body may be wound individually from a strip 60 of the paper stock of a width corresponding to the distance between the base of the body and the shoulder 57, across one end portion of which the sheet 59 may be secured by adhesive 59', the sheet 59 and its foil 55 and plastic projecting beyond one longitudinal edge of the strip 60 as at 61, Fig. 16. When wound and the body completed by either method an upwardly projecting thin wall part 62 is presented consisting of the edge portion of the sheet 59, foil 55 and plastic 56, the latter being on the inner surface of the wall. In closing this body a cap 63 consisting of paper sheet material faced the same as in the cap 40 of Fig. 3 (with adhesive, foil, and outer plastic 31) is provided, but preferably having the foil presented inwardly in the shell instead of outward. It is flanged or dished outwardly, as at 64 so that when inserted in the open end of the wall its foil and plastic coated flange face lies against the plastic-coated foil at the inner face of the wall part 62 and also is coextensive therewith longitudinally of the shell. In the insertion of the cap, which may be done by a snug fitting hot mandrel, the cap material and wall part 62 are heated so that the plastic faces of the cap and wall are united, connecting the two foil pieces in cap and wall, and a complete hermetic seal effected. The connecting of the foil parts in the cap and wall perfects the hermetic value of the enclosure. A wad 65 may be set in the cap after sealing and the end edge portions of the wall part 62 and cap flange turned and crimped in against the wad; or the wad may be inserted in the shell body below, or on, the shoulder part 57 before placement of the cap.

Conventional or other special closure practices may be followed if desired, and in Figs. 10 to 13 the wall end is cut with sector shaped points 66 adapted to be turned inward to meet and form a flat end wall 67 upon which a disc 68 is secured, formed of material similar to that in the caps 40 and 63. The plastic face is applied flat upon the inturned sector points with application of heat, so that the disc is secured in place and the meeting edges of the points covered and united with a complete seal. By applying adequate pressure the end of the shell and sector points may be recessed so that the disc sets within the end of the shell wall as in Fig. 13.

Alternatively, the flanges of the cap 63 may stop short of the extremity of the wall, as described in reference to Figs. 3 and 4, and the outer part of the wall turned down within the flange, this being obvious from the previous description and illustration.

If desired, as conventionally represented in Fig. 17, the stock wrapper 244 for winding the tubes may be made up with a paper base sheet 254 similar to the one 25, except that it is without slots 32 or other opening, on which the foil 69 is laid and cemented, with asphalt or other adhesive 73 either to form one convolution in the wall, or several; and over and upon the foil a second paper sheet 70 is placed and secured. In this form the base sheet 254 has the thin zones at its starting and finishing edges 26—26', as before mentioned. The foil is spaced inward from the terminal edge 26' and also inward of the adjacent terminal edge 71' of the thicker central body portion 71 of the base sheet 254 so as to avoid abrupt thickening of the wrapper. The sheet 70 may be of a length slightly greater than that of the foil, and is secured by the adhesive 73 to the base sheet. This securement may be at the projecting transverse edge portions 72 of the sheet 70, only, or may be extended also throughout the area of the foil as at 74. The foil may be attached to either or both of these sheets by either or respectively a thermoplastic at 73 or/and a thermosetting plastic at 74 serving as a stiffener and armor for the foil. One or more convolution areas of the paper on one side of the stock wrapper may be externally coated with an adhesive (not shown in Fig. 17, but see Fig. 18), which may be thermoplastic or thermosetting if it is to be at the underside of the wrapper in winding, and may be a thermosetting resinous plastic if it is to be exposed in the finished shell, although a wax, as, paraffine, may be used to impregnate the sheet as an alternative. It is an advantage of the structure of Fig. 17 that a very secure inclusion of a foil in the wrapping may be attained without the use of the expensive plastic such as Butvar, but by mere prior practice in securement of the layers of paper together by paraffine or other impregnation in conjunction with the use of the sizing die. It is believed however that an adhesive at

73 or 74 should be used which is of the nature of Butvar, or which has similar adhesiveness, tensile strength, and possibly also the armoring values.

In production of the shell body with the stock sheet, the part, if any, of the base sheet 254 without foil thereon, next to the starting edge, is wound on a mandrel, as before indicated, and the terminal or finishing edge secured against the underlying convolution of the stock sheet. Either before or after winding the paper of the sheet may be impregnated with wax or other material which may serve as the adhesive between any convolutions of paper over paper. A thermoplastic such as Butvar or other of good tensile strength and adhesiveness is preferred on at least one of the foil, and if desired the slotting of one or both sheets may be carried out in accordance with Figs. 5, or 7 and 8, to effect a tack such as that at 34.

In Fig. 18, the stock wrapper 245 may be made up with the base paper sheet 255 (having the same tapered starting and terminal edges 26—26' as before), flush with the finishing edge of which a foil sheet 76 is laid and secured throughout as first described by an adhesive 77, which may be asphalt, while upon the exposed face of the foil so secured there is applied a coat of a thermosetting plastic 78 covering the entire areas of the foil, and part of the paper if desired, to form the external surface of the shell. In the use of this stock sheet, it is wound beginning at the starting edge distant from the foil, but with the foil and film arranged so as to be on the outside of the completed tube. If desired the adhesive 77 by which the foil is secured may be a thermoplastic of higher tensile strength than asphalt. The finished wrapping may be smaller than standard, after which it may be inserted in a standard cylindrical mold tube and expanded against the wall thereof while heated for the necessary curing period, either before or after cutting of the bodies and assembly on the heads 21. As in Fig. 19, the shell body produced has the metal foil showing under the plastic 78 which serves as a protection for the foil and affords a hard face to fit the gun chamber without sticking when the latter becomes hot. For this use there are available phenol aldehydes among which are Bakelite. Those available may be made harder by reaction with glycerol. Others may be found in glycerol-phthalic anhydride, as Glyptal, Rezyl, Teglac. The slow burning quality of certain of these compounds is a valuable attribute.

Having disclosed the invention in its best embodiment known to me, but as a purely exemplary measure, and with the understanding that various changes in the construction and arrangement of parts, substitution of materials and equivalents mechanical and otherwise, may be made without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. An inclosure comprising a body sheet including a base fiber sheet wound upon itself in a plurality of convolutions to form a tubular laminated member, a metal sheet forming part of the body sheet included in a terminal portion and extending over more than one convolution of said body sheet to provide an overlapping edge portion, a thin film of adhesive material between said metal sheet and said fiber sheet, said fiber sheet having a slotted region extending axially across the tubular member in the part underlying the metal sheet at said overlapping portion of the latter, and a normally solid elastic plastic highly adhesive to said metal sheet and of high tensile strength united with the metal sheet on the other side thereof from said adhesive film and united with at least one convolution of the base fiber sheet and including the slotted part thereof, whereby the outer edge portion of the metal sheet and its inner lapped part are secured directly together by said plastic through said slotted part.

2. The structure of claim 1 in which said metal sheet stops short of the top edge of said fiber sheet forming an outer end portion on said wall beyond the metal sheet, a closing disc fitted within and against the wall inwardly of the adjacent encircling edge of the metal sheet, the top edge of the body sheet above the metal sheet being recurved through 180 degrees flat against the subjacent wall part beyond the disc and with its extreme edge in bearing upon said disc.

3. The structure of claim 1 in which said metal sheet stops short of the top edge of said fiber sheet forming an outer end portion on said wall beyond the metal sheet, a closing disc fitted within and against the wall inwardly of the adjacent encircling edge of the metal sheet, the top edge of the body sheet above the metal sheet being recurved through 180 degrees flat beside the subjacent wall part beyond the disc and with its extreme edge in bearing upon said disc, said disc having a flanged edge at right angles to the plane of the disc projecting longitudinally of the tubular member beside and against the wall part containing said metal sheet and under said recurved part.

4. The structure of claim 1 in which said first named plurality of convolutions stop short of the end of the wall of the tubular member and at least said metal sheet and said plastic being extended to form the end portion of the wall, a flanged cap including a metal sheet and facing a plastic exteriorly thereon set within and against said end portion of the wall, the plastic on the flange of the cap being against and united with the said end portion of the wall.

5. The structure of claim 1 in which said first named plurality of convolutions stop short of the end of the wall of the tubular member and at least said metal sheet and said plastic being extended to form the end portion of the wall, a flanged cap including a metal sheet and facing of plastic exteriorly thereon set within and against said end portion of the wall, the plastic on the flange of the cap being against and united with the said end portion of the wall, said end portion of the wall being inturned and crimped permanently before the cap.

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