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2,387,665

SHOT SHELL CLOSURE

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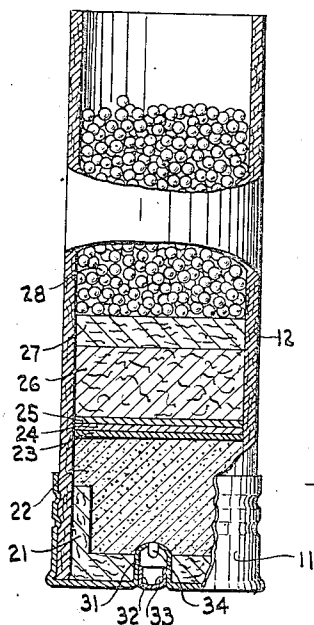


Fig. 1

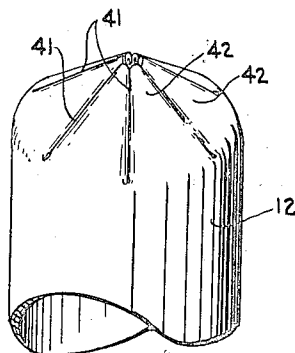


Fig. 2

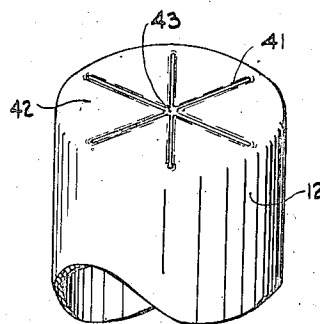


Fig. 3

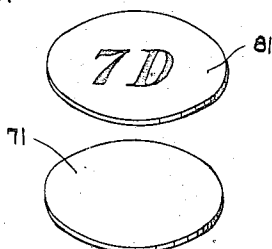


Fig. 4

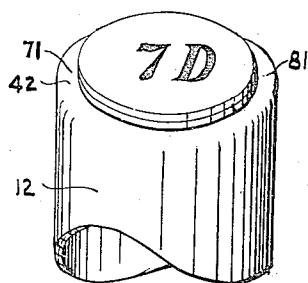
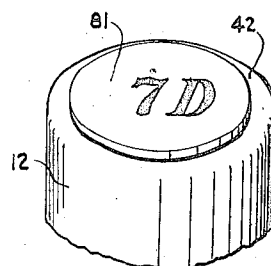


Fig. 5

Fig. 6

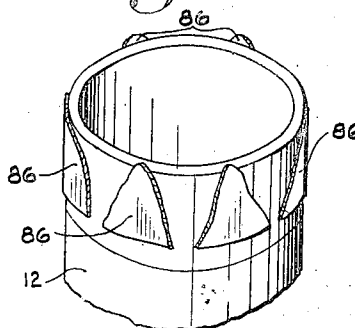


Fig. 7

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2,387,665

SHOT SHELL CLOSURE

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8 Claims. (Cl. 102—42)

This invention relates to shot shells, especially the closing of the paper body over the shot charge. More particularly it appertains to the method of sealing the end of the shell against the entrance of moisture, etc.

The shot shell as generally produced comprises a fairly rigid paper cylinder (called the "body") having over one end a metal cap (called the "head"). Ordinarily the head contains the propellant powder and means for igniting it, and the body contains the shot charge and a partition (filler wad) separating it from the powder.

Shot shell bodies are made by rolling a specially prepared porous paper into tube form, the successive layers or convolutions of the paper being secured together by a starch adhesive. For protection against moisture and for other purposes, the rolled tubes are heavily impregnated with wax, usually paraffin wax, the wax content of the finished tube constituting not less than 20% of the weight of the tube.

Since shot shells must fit rather closely in a gun chamber, the finished bodies must be brought to a given outside diameter with very low tolerance. For this purpose the wax impregnated tubes are passed through a sizing die, which somewhat reduces their outside diameter, and in so doing irons the surface very hard and smooth.

In the past it has been universal commercial closing practice to place a card (top wad) over the shot charge and fold the open edge of the stock body centrally, inwardly and downwardly to form a head that rests on top of the wad. It is self-evident that such a closure has substantially fixed resistance to opening. No part of it can be varied to control pressure or ballistics.

In U. S. A. Patent No. 2,242,907 a way of closing the shell, which permits considerable control of the resistance to opening, is disclosed. In general this comprises dispensing with the top wad by folding in a considerable portion of the tube end and securing an adhesive coated paper disc over the folded end. In this procedure some difficulty has been encountered in "triangulation," or the breaking of the paper disc when the shell is fired. Frequently the end of the shell is blown off. Apparently large scale manufacturing operations utilizing this procedure, require a paper disc that does not give the shell the best firing characteristics.

The primary object of this invention was to improve the closing and closures of shot shells. Other objects were to utilize a paper shell body sealing disc capable of giving better shell opening results, to improve the triangulation of shot shells, and to devise improved procedures for sealing shot shell closures. A general advance in the art, and other objects which will appear hereinafter, are also contemplated.

It has now been found that sealing the paper

disc to the end of the shell with a disc of self-supporting plasticized organic solvent soluble ethyl cellulose, in the manner described in detail hereinafter, overcomes the common objections heretofore encountered with this type of shell closure.

How the foregoing objects and related ends are accomplished will be apparent from the following exposition, in which are disclosed the principle and divers embodiments of the invention, including the best mode contemplated for carrying out the same. The written description is amplified by the accompanying drawing, in which:

Figure 1 is an elevation view, partly in section, of a shot shell primed, loaded and ready for closing;

Figure 2 is a fragmentary perspective view of a shot shell after it has been subjected to the first or preliminary end folding operation;

Figure 3 is a fragmentary perspective view of a shot shell at the completion of the end folding operation;

Figure 4 is a view showing the relation between the folded end of a shot shell and the seal laminae of the present invention;

Figure 5 is a fragmentary view similar to Figures 3 and 4, with the seal components and the shell assembled for the heat sealing operation;

Figure 6 is a fragmentary view showing the completed end closure; and

Figure 7 is a fragmentary view of the open end of a shot shell of the type shown in Figures 1 and 6, after firing, showing good triangulation.

Similar characters refer to similar parts throughout the drawing.

In Figure 1 of the drawing there is illustrated a conventional shot shell comprising a waxed cardboard tube or body 12 with a metal head 11 swaged thereon. Within the shell is a paper base wad 21, a powder charge 22, an "over powder" wad of sections 23, 24 and 25, filler wads 26 and 27, and the shot charge 28. Within the thimble-like head, which is usually made of brass or steel, is a battery cup 31, a primer cup 32 containing the charge of priming composition 33, and an anvil 34. Variations in this typical arrangement will be obvious to those skilled in the art, since different manufacturers prefer different loading schemes.

When the priming composition is ignited by striking the primer cup with a firing pin, the flame thereof ignites the charge of propellant powder 22, firing the shell.

In the closing and sealing of the shot shell, wherein the novelty of the present invention lies, the open end of the body is closed by folding the end portion inwardly. This is carried out by first forming in that part of the tube 12 above the shot charge, a number of creases 41. As a result, the end of the body being closed is drawn into the frusto-conical form illustrated in Fig-

ure 2. It is desirable, but not necessary, that this operation precede the preferred final closing operation in which the thus-partially closed body is subjected to the action of a rotating die of such configuration as to press the segments 42 (between the creases 41) into a plane perpendicular to the axis of the shell. This brings about a substantially complete sealing of the body, but there remains at the center of the folded-in planar end an unsealed juncture 43, for which a seal is desirable.

According to this invention, the need for the known paper disc coated with an adhesive is obviated by using a plain paper disc and securing it to the shell end with a thin coherent self-sustaining disc of a material which, upon the application of heat, causes the paper to adhere to the waxed shell end. To close the juncture, a thin disc 71, comprising essentially organic solvent soluble ethyl cellulose and plasticizer, and a disc 81 of paper or similar material, are placed on the folded end of the body 12 (Figure 5), and the assembly subjected to a hot heat sealing tool or iron. As a result, the cellulosic sheet becomes adhesive and secures the paper disc firmly to the shell body (Figure 6), effectively sealing the juncture 43, and the end of the shell, against the entry of moisture, etc. The paper disc 81 is of such a character, as will be clear from the specific examples, that it breaks satisfactorily, giving fairly regular triangulation sectors 86 (good "triangulations") when the shell is fired.

Examples of the invention are tabulated below. In each instance circular discs of corresponding size were cut from the paper and the plasticized ethyl cellulose sheet. These discs were superimposed on the shell end in the manner illustrated in Figures 4 and 5. In most cases the characteristics of the shell loading were printed on the paper disc. Usually the flattened end of the shell body was roughened by rubbing against an emery wheel before the ethyl cellulose disc was applied. Pressing the assembly against a hot plate maintained at 190° C. for 4 seconds gave an excellent seal.

Ex.	Plasticizer	Percent of plasticizer	Film thickness	Paper bursting strength (Mullen test)
I.....	MPDB-PO ¹	15	.001	15 pounds.
II.....	do ¹	20	.002	Do.
III.....	do ¹	30	.0019	Do.
IV.....	HTP-PT ²	15	.00093	Do.
V.....	do ²	20	.0014	Do.
VI.....	do ²	30	.00088	Do.
VII.....	MPDB-PO ¹	15	.00089	Do.
VIII.....	HTP-PT ²	15	.00087	Do.
IX.....	MPDB-PO ¹	2	.0015	Do.
X.....	do ¹	15	.003	20 pounds.
XI.....	do ¹	20	.002	20 pounds (35# sulfite).
XII.....	do ¹	30	.0017	20 pounds.
XIII.....	HTP-PT ²	15	.0009	Do.
XIV.....	do ²	20	.0011	Do.
XV.....	do ²	30	.002	20 pounds (35# sulfite).

¹ Monophenyl-di-biphenyl phosphate.

² Hithpaphthalate, a material which has a boiling point within the range 220°-240° C. at 5 mm., and which is a phthalate alcohol ester obtained by reacting phthalic anhydride with that fraction of the branched-chain oxygenated organic compounds (prepared by the catalytic hydrogenation of carbon oxides under elevated temperatures and pressures, as described in U. S. A. Patents 1,820,417, 1,844,129, 1,844,857, 1,995,915, 1,939,708 and 2,221,485) which have the boiling range 170°-190° C. at atmospheric pressure.

In the hithpaphthalate-ethyl cellulose combination the latter may be replaced by cellulose acetate, and in the monophenyl-di-biphenyl phosphate combinations the other component may be polyvinyl acetate, polyisobutyl methacrylate or polystyrene, with satisfactory results. Other useful compositions include butyl stearate-

benzyl cellulose; triphenyl phosphate-cellulose acetatebutyrate; dibutoxyethyl sebacate-polyvinyl butyral, and the interpolyamide of hexamethylene diammonium adipate, hexamethylene diammonium sebacate and caprolactam.

Preferably the adhesive sheet is an ethyl cellulose having approximately 48% ethoxyl substitution and 15% to 30% plasticizer content. Higher or lower plasticizer contents may be useful in special instances, but they give rise to operating difficulties which militate against their use. Solvent type plasticizers are preferred.

The plasticized ethyl cellulose sheet can be prepared in any desired manner, for example, by extruding or dry casting. The extruding procedures are preferred, and can be used satisfactorily with plasticizer contents above the aforementioned range, for example 40%, or even up to 50%. The conventional details of dry or evaporative casting are disclosed in U. S. A. Patents 1,458,592, 2,176,903, 2,201,747 and 2,253,821. No advantage is seen for burdening this specification with details of the casting art.

Heat sealing temperatures below 250° C., for example near the lower end of the range 175°-250° C., are preferred.

The best results have been obtained with the weaker papers, for example, those having a Mullen bursting strength on the order of 15 pounds, but stronger papers can be employed if desired.

Under some operating conditions it is desirable to secure the paper and plasticized ethyl cellulose sheet together as a unit before assembling the discs on the end of the shell for the heat sealing operation. A slight warming of the plasticized ethyl cellulose foil gives it sufficient tackiness to produce adequate adherence to the paper for this preliminary association. This association can be made before or after the cutting of the discs to size suitable for the shell end joining operation.

The pressure necessary to secure the preliminary adherence of the paper and film and the final sealing of the shell end juncture, is not especially critical. Quite moderate pressures, for example the weight of a heated ironing roll, is sufficient.

The principal advantages of the present invention lie in the improved results obtained when the shells are fired. In comparative tests, shells manufactured according to the present invention (using paper having a 15# Mullen breaking strength and a film containing 15% monophenyl-di-biphenyl phosphate) gave 83% of perfect triangulation upon firing, whereas shells prepared by using sealing units composed of paper upon which the ethyl cellulose plasticized with the same material had been spread by the hot melt procedure, commonly used in making adhesive coated paper, gave only 33% of perfect triangulation. These contrasting data are on the conservative side, because the ethyl cellulose coated on the paper had a higher plasticizer content, namely, about 50%.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that this invention is not limited to the specific embodiments thereof except as defined in the appended claims.

I claim:

1. The method of sealing shot shells comprising the steps of providing a wax impregnated paper body shot shell with an exteriorly planar end closure, said end closure having a plurality

of abutting segments and folds joining said segments, placing on said end a coherent self-supporting sheet of highly plasticized organic solvent soluble ethyl cellulose; superimposing on the surface of said sheet a disc of weak paper having a Mullen breaking strength of about fifteen pounds, said sheet being between said paper and shot shell end; and thereafter affixing the paper to the shell end by subjecting the assembly to heat and pressure.

2. The method of sealing shot shells comprising the steps of providing a wax impregnated paper body shot shell with an exteriorly planar end closure, said end closure having a plurality of abutting segments and folds joining said segments, placing on said end a coherent self-supporting film of plasticized organic solvent soluble ethyl cellulose containing at least 15% hithpaphthalate; superimposing on the surface of said film a disc of weak paper having a Mullen breaking strength of less than fifteen pounds, said film being between said paper and shot shell end; and thereafter affixing the paper to the shell end by subjecting the assembly to heat and pressure.

3. The method of sealing shot shells comprising the steps of providing a wax impregnated paper body shot shell with an exteriorly planar end closure, said end closure having a plurality of abutting segments and folds joining said segments, placing on said end a coherent self-supporting film of plasticized organic solvent soluble ethyl cellulose containing at least 20% monophenyldi-biphenyl phosphate; superimposing on the surface of said film a disc of weak paper having a Mullen breaking strength of about fifteen pounds, said film being between said paper and shot shell end; and thereafter affixing the paper to the shell end by subjecting the assembly to heat and pressure.

4. The method of sealing shot shells comprising the steps of providing a wax impregnated paper body shot shell with an exteriorly planar end closure, said end closure having a plurality of abutting segments and folds joining said segments, placing on said end a coherent self-supporting film of organic solvent soluble ethyl cellulose containing at least 15% solvent plasticizer; superimposing on the surface of said film a disc of weak paper having a Mullen breaking strength of about fifteen pounds, said film being between

said paper and shot shell end; and thereafter affixing the paper to the shell end by subjecting the assembly to heat and pressure.

5. In a shot shell, the combination comprising a body of wax impregnated paper having an exteriorly planar end closure integral with said body, said closure including a plurality of abutting segments and folds joining said segments; a coherent self-sustaining film of plasticized organic solvent soluble ethyl cellulose on said end closure; and a paper disc exteriorly of said film on said end closure, said paper having a Mullen breaking strength of about fifteen pounds.

6. In a shot shell, the combination comprising a body of wax impregnated paper having an exteriorly planar end closure integral with said body, said closure including a plurality of abutting segments and folds joining said segments; a coherent self-sustaining film of plasticized organic solvent soluble ethyl cellulose containing at least 15% hithpaphthalate on said end closure; and a paper disc exteriorly of said film on said end closure, said paper having a Mullen breaking strength of about fifteen pounds.

7. In a shot shell, the combination comprising a body of wax impregnated paper having an exteriorly planar end closure integral with said body, said closure including a plurality of abutting segments and folds joining said segments; a coherent self-sustaining film of plasticized organic solvent soluble ethyl cellulose containing at least 20% monophenyldi-biphenyl phosphate on said end closure; and a paper disc exteriorly of said film on said end closure, said paper having a Mullen breaking strength of about fifteen pounds.

8. In a shot shell, the combination comprising a body of wax impregnated paper having an exteriorly planar end closure integral with said body, said closure including a plurality of abutting segments and folds joining said segments; a coherent self-sustaining film of organic solvent soluble ethyl cellulose containing at least 15% solvent plasticizer on said end closure; and a paper disc exteriorly of said film on said end closure, said paper having a Mullen breaking strength of about fifteen pounds.

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