

June 29, 1954

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2,682,222

SHOT SHELL SEALING

Filed Jan. 26, 1951

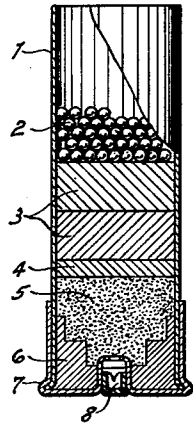


FIG-1

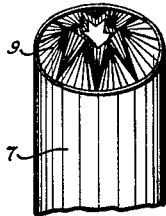


FIG-2

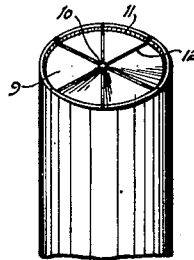


FIG-3

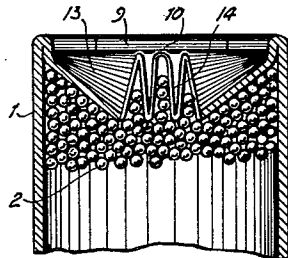
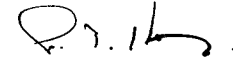


FIG-4

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## UNITED STATES PATENT OFFICE

2,682,222

## SHOT SHELL SEALING

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Application January 26, 1951, Serial No. 207,927

3 Claims. (Cl. 102—42)

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This invention relates to a paper cartridge of the type commonly known as a shot shell, for use in a shotgun, and more particularly to a method of sealing the end closure of the shot shell.

One of the problems associated with sporting ammunition of this type has been to seal the end closure of the shot shell so that it is completely resistant to the penetration of moisture normally encountered in practical usage, yet readily opened upon firing without the development of excessive internal pressure. It has long been appreciated by those familiar with this art that the degree of resistance to opening of a shot shell is a critical value affecting materially the ballistic properties and consequent performance thereof.

In order to overcome this problem, various modifications in the manner of closing the end of the shot shell have been suggested at least two of which have been widely adopted. The first of these is known as the "standard roll crimp" method which consists of inserting a card or disc known as the overshot card on top of the shot charge, turning over the mouth of the case to form a retaining rim which presses on top of the card and seals the end of the shell. The main disadvantage of this method was the rather frequent occurrence of "blown" patterns, i. e. accentuated scattering of shot beyond the normal area of spread, caused by the emergence of the flat surfaced overshot card which deflects some of the shot completely outside the target area. A second method of shot shell closure devised to overcome this disadvantage, and known as the pleated or "star" crimp closure was described originally in French Patent 593,010 issued to Garkovenko and Figura in 1925. In this type of shot shell the usual overshot card is omitted and the open end of the shell tube creased into segments which are folded inwardly to form an end closure substantially flush with the end of the shell. The main problem presented by this type of closure was to seal the small central aperture or unsealed juncture located at the apex of the folded segments in the end of the shell. The effect of moisture on this type of shell is particularly troublesome not only because it causes deterioration of the charge and poor ballistic properties resulting therefrom, but also

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for its adverse effects on the shot shell tube. Due to the concentration of paper, in this end of the shell, the entry of moisture causes severe dimensional changes and softening so much so in fact that after a relatively short time the crimped end of the shell swells to a point where it will no longer chamber in the gun.

Various arrangements have been used heretofore for the purpose of sealing this closure but none have been entirely satisfactory. Thus for example U. S. P. 2,242,907 described the use of a paper disc coated on one side with a thermoplastic adhesive composition which completely covers the end closure of the shell. The paper disc is adapted to closures of the planar type, i. e. where the flat segmental closure is in the plane of the end of the shell body and not recessed or indented. The main disadvantage of this type of closure is that the paper disc becomes easily dislodged in use. This occurs when shells of the type are used in modern pump and auto loading shotguns, where the closure discs are torn off by the action of the breach loading mechanism. Attempts to overcome the problem centered around improvements in the adhesive compositions used. Thus for example U. S. P. 2,300,367 and U. S. P. 2,300,368 disclose a large number of resin and wax type compositions suitable for sealing planar type closures. However all of these compositions required the use of heat and/or pressure when applied to the end of the shot shell. A further modification was described in U. S. P. 2,336,065, in which the end closure is indented i. e. a small depression made in the pleats in the end of the shell. Into this was spun a disc of plastic self hardening material. After a short period of use it became evident that while the recessed end closure containing a plastic disc was far less vulnerable to being dislodged in use, the considerable variation in resistance to opening upon firing of the shell completely upset the ballistic properties considered desirable for this type of shell. This appeared to be due to the fact that uniformity in the thickness of the disc and the degree of adhesion over the relatively large surface area of the end of the shell could not be easily controlled, and as a consequence successful commercial use was never attained.

It is an object of the present invention to pro-

vide a water resistant closure for a folded crimp type shot shell. A further object of our invention is the production of a simplified method of sealing the end closure of shot shells of this type.

The objects of the present invention are accomplished by the use of a paste-like adhesive composition applied by injection into the small centrally located juncture of the folded segments of the closure, the inner edges of which form the seal. In this manner no disc, either paper or plastic, is required to cover the exterior end of the shot shell.

Our invention will be more clearly understood by reference to the accompanying drawing in which Figure 1 shows partly in cross section, a loaded shot shell prior to the operation of crimping the end closure. Figure 2 shows a partial perspective view of a shot shell after crimping and Figure 3 shows the shell with the body top turned over to its final recessed position prior to the sealing operation. Figure 4 is a fragmentary sectional elevation view showing the inner edges of the folded segments of the top shell closure. Figure 5 is a cross section of a typical sealing gun. Figure 6 is a side elevation of a sealing gun assembled in the gate of a shot shell loading machine. Figure 7 is a top elevation of a section 7—7 of Figure 6.

Referring now in greater detail to the figures of the drawing, in Figure 1 the open ended shot shell consists of a wax-impregnated paper body 1, shot charge 2, filler wads 3, over powder wad 4, powder charge 5, base wad 6, brass head 7 and percussion cap 8. When the priming composition in cap 8 is ignited in shells of this type by striking the primer cup with a firing pin, the flame thereof ignites the charge of propellant powder 5 firing the shell. In Figure 2, the open end of the shot shell body 1 has been partially drawn into the frustoconical form illustrated to form the pleated segments 9. In Figure 3, the pleated segments 9 have been pressed further inward and planished until the surface thereof is approximately at right angles to the axis of the shell leaving an unsealed juncture or central aperture 10. As shown in the figure this segmented end, while substantially at right angles to the shell axis, is nevertheless recessed below the peripheral bead 11 and the pleated folds 12 between segments 9 extend further below the surface. In Figure 4 the closely abutting segments 9 joined by the downwardly extending webs 13 define the position of the inner edges 14 of the pleated folds 12, shown in Figure 3, located immediately below the central aperture 10. It will be noted that the shot charge 2 extends right into the crater-like enclosure formed by the inner edges 14.

Injections of a small amount of the paste-like adhesive composition of our invention is made through the small central aperture 10, where it flows into the edges 14 of the folds 12 in the form of a globule, causing them to adhere to each other and at the same time sealing across the aperture 10. It will be evident that substantially all of the adhesive as applied in this manner, remains in the crater-like cavity below the aperture 10 at the apex of the segments 9, and is not spread over the top surface itself.

The initial testing of a large number of adhesive compositions suitable for use in the device of our invention showed that it must be quick drying in air, and completely water insoluble when dry. In addition it was found that the viscosity factor of the adhesive was critical for proper op-

eration of the device on a production scale. One composition found to meet these requirements contains a resin modified synthetic rubber dissolved in a suitable organic solvent, with the addition of a suitable filler such as French chalk or aluminum powder. The use of a large excess of French chalk as filler was found to be particularly suitable for use in this adhesive composition.

A composition illustrative of our preferred adhesive is shown in the following example:

|                               | Per cent |
|-------------------------------|----------|
| Hycar OR-25* synthetic rubber | 7.6      |
| Bakelite phenolic resin       | 5.1      |
| Methyl ethyl ketone           | 42.6     |
| French chalk—pulverized       | 41.2     |
| Silene EF**                   | 2.7      |
| Zinc oxide                    | 0.8      |
| Magnesium oxide               |          |
| Sulphur                       | 100.0    |

\* A modified butadiene-acrylonitrile copolymer, produced by the B. F. Goodrich Rubber Company.

\*\* A hydrated calcium silicate-mineral pigment for compounding synthetic rubbers.

The above composition is illustrative only, and it is understood that variations in the choice of ingredients may be made, all of which are within the scope of our invention.

The following table illustrates a series of comparative tests carried out to evaluate the water resistance of shells produced according to our invention with those produced by heretofore known methods. For the purposes of the test a random selection of 20 shells of each type were immersed, paper ends down, in a bath of cold water for a total period of 24 hours. Each shell was then checked at hourly intervals to determine whether any swelling of the paper casing had occurred. Those samples which did not pass the minimum bore gauge as set by S. A. A. M. I. (Small Arms Ammunition Manufacturers' Institute American) were considered to have failed the test and the results are recorded below.

TABLE  
Water resistance of shot shells

| Immersion Time, Hours | Shot Shells Failed  |                   |                          |                              |
|-----------------------|---------------------|-------------------|--------------------------|------------------------------|
|                       | Roll Crimp, Percent | Pleated Crimp     |                          |                              |
|                       |                     | Wax Seal, Percent | Paper Disc Seal, Percent | Seal This Invention, Percent |
| 1.                    |                     |                   |                          |                              |
| 2.                    |                     |                   |                          |                              |
| 3.                    |                     | 20                | 40                       |                              |
| 5.                    | 1                   | 70                | 60                       |                              |
| 8.                    | 20                  | 90                | 80                       |                              |
| 24.                   | 100                 | 100               | 100                      | 20                           |

Results shown in the above table indicate clearly the superiority of shells sealed according to the method of our invention as far as water resistance is concerned. The table shows also that pleated crimp shells sealed by heretofore known methods are less effective against moisture penetration than the standard roll crimp shell.

Furthermore tests made of the shot shells sealed according to the method of our invention show improved ballistics as exhibited by improved shot patterns and consequently longer effective range. The adhesive composition used is admirably suited to this method of sealing the end closure of the shot shells. The problem of af-

fecting good adhesion between the waxed surfaces to be sealed has been successfully overcome. Fouling of the gun barrel has been eliminated due mainly to the relatively small amount of adhesive required to produce an effective end closure seal.

It will be understood that while the foregoing is a description of a preferred embodiment of our invention there can be many variations made without departing from the spirit and scope thereof.

Having thus described our invention what we claim is:

1. A waterproof shot shell comprising a lacquered wax impregnated paper body and end closure, said end closure being integral with said body and comprising a plurality of inwardly folded segments and a waterproof adhesive composition disposed in the aperture formed at the apices of the folded segments and along the inner edges of said folded segments, said waterproof adhesive composition comprising a butadiene-acrylonitrile copolymer, a phenol formaldehyde resin, a ketone solvent and an inorganic filler.

2. A waterproof shot shell comprising a lacquered wax impregnated paper body and end closure, said end closure being integral with said body and comprising a plurality of inwardly folded segments and a waterproof adhesive composition disposed in the aperture formed at the apices of the folded segments and along the inner edges of the folded segments, said waterproof adhesive composition being capable of extrusion at ordinary temperatures and pressures and comprising a modified butadiene-acrylonitrile copolymer, a

phenol formaldehyde resin, a ketone solvent and an inorganic filler.

3. A waterproof shot shell comprising a lacquered wax impregnated paper body and end closure, said end closure being integral with said body and comprising a plurality of inwardly folded segments recessed to form a depression slightly within the plane of the end of said body, and a waterproof adhesive composition disposed in the aperture formed at the apices of the folded segments and along the inner edges of the folded segments, said waterproof adhesive composition comprising a modified butadiene-acrylonitrile copolymer, a phenol formaldehyde resin, methyl ethyl ketone solvent and French chalk.

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