July 14, 1959 J. M. OLIN 2,894,456

SHOT SHELLS

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FIG. 1

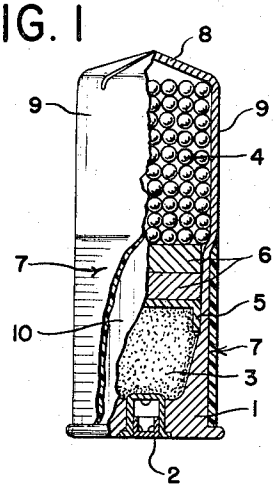


FIG. 2

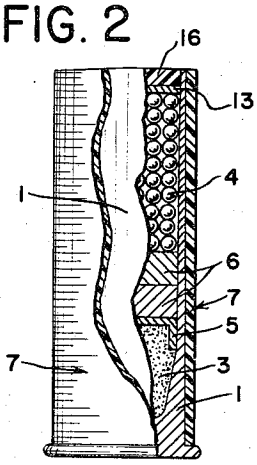


FIG. 3

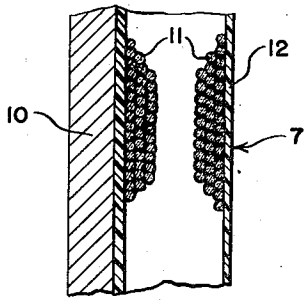
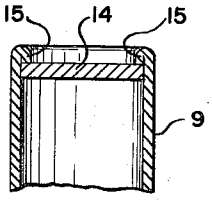


FIG. 4



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SHOT SHELLS

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1 Claim. (Cl. 102—42)

This invention relates to shot shells and particularly to improved shot shells provided with a metallic case successfully reinforced against bulging. Such shot shells are characterized by improved functioning in use, particularly in overcoming the most serious defect of previous metallic shot shells, the resistance to extraction of fired cases from the breech end of a shotgun barrel.

When a shot shell is fired in a gun, the combustion of the propellant charge results in the rapid development of high pressures, of the order of about five tons per square inch. Such instaneous high pressures are sufficient in many instances to expand the powder chamber portion of metal shot shells, such as of brass or aluminum, which have been available heretofore. Such shells are externally bulged to a sufficient extent so as to make it difficult to extract the case from a gun barrel in which the shell has been fired. While extraction may be carried out in hand-operated guns even when the case has bulged by exerting more or less force as required, a serious problem exists in attempting to use such shot shells in certain automatic shotguns. It has not been feasible to adjust the automatic extraction devices thereof so as to extract consistently such metal cases as have acquired a significant bulge as a result of firing. Increasing the extracting force does not provide a solution, as the extractor can then merely cut through the rim of any fired shell which is firmly held in the gun barrel because of extreme bulging or pass over the rim. An extraction failure in an automatic shotgun results in jamming of the gun when the feeding of the next shell is attempted.

It is the main object of this invention to provide improved shot shells characterized by having a metal case which is reinforced against bulging. A further object is to provide metal shot shells so reinforced as to avoid functional failures, such as extraction difficulties which characterized prior metal shot shells.

In accordance with this invention, the above and other objectives are achieved by the provision of metal shot shells in which at least the powder chamber portion is reinforced by an external layer of fibrous material embedded in a synthetic resin. Such shells have been found to display excellent functioning in all respects including trouble-free operation in automatic shotguns.

In the drawings forming part of this specification:

Fig. 1 is a side elevation, partly in section, of a shot shell in accordance with this invention;

Fig. 2 is a side elevation, partly in section, of another embodiment of a shot shell in accordance with this invention;

Fig. 3 is a fragmentary, sectional view in a greatly magnified scale of a portion of the shot shell powder chamber wall of Fig. 1; and

Fig. 4 is a fragmentary, sectional view of an alternative closure for the shot shell of Fig. 1.

Referring to Fig. 1 of the drawing, the shot shell forming an illustrative embodiment of the invention comprises a metal tube 1 containing a conventional primer assembly 2, propellant charge 3, and shot charge 4. A

gun wad assembly consisting preferably of a cup wad 5 in accordance with U.S. Patent 2,582,124 and two cylindrical wads 6 in accordance with U.S. Patent 2,628,560 is provided between the propellant and shot charges.

The powder chamber portion of tube 1 is provided with an external reinforcing layer 7, to be described in detail hereinafter, comprising fibrous material bonded with a synthetic resin, which imparts adequate bulge resistance to the shot shell when fired in a shotgun. The closure 8 of the shot shell may be formed by turning the end inwardly after first providing six inward folds or slits spaced equally around the circumference of the end of the shell.

The tube 1 is preferably formed of aluminum by an extrusion operation, for example, in accordance with the process of U.S. Patent 2,630,916, followed by a drawing step and then, by formation of the shell base and piercing of the opening for the primer flash. During or following these operations, the upper part 9 of the tube intended to contain the shot charge is expanded somewhat so as to provide the lower powder chamber portion 10 adequately recessed so that a smooth outer cylindrical wall results after the application of the reinforcing layer 7.

The reinforcing layer is preferably formed of a suitable high strength fiber coated with a synthetic resin binder, wound in superposed layers and treated so as to form a composite reinforcing layer. Glass fibers are particularly suitable as the high strength fiber, for example, "Egg-150–1/0 Fiberglas," a commercial glass fiber furnished by Owens-Corning Fiberglas Corporation in continuous lengths of yarn consisting of eight strands, each strand consisting of 204 filaments having an average diameter of 0.00038 inch. A preferred synthetic resin binder is an "epoxy" resin, a condensation product of epichlorohydrin and a polyhydric alcohol, particularly diphenylol propane, as such resins are convenient to handle and apply and exhibit desirable strength after curing as well as strong adhesion to the fibrous material and metal. The "epoxy" resin sold by Shell Chemical Corporation under the name "Epon 828" mixed with several percent by weight of an amino catalyst and thinned by about five percent by weight of xylene has been found particularly effective.

The reinforced shot shell may be prepared by first coating the outside of the lower portion 10 of the tube with the resin and winding resin-coated yarn, in adjacent turns and successive layers back and forth, to the desired thickness. Before being coated with resin as by a dipping or brushing process, the yarn is dehydrated thoroughly, for example by heating for two hours at a temperature of about 400° F. It is also desirable that the yarn be of the type in which each filament was provided at the time of manufacture with a standard coating of a chromium complex for protection against moisture, for lubrication during handling and for promoting wetting by and adhesion to the resin binder. The winding is conveniently accomplished by rotating the tubes in suitable fixtures, with the yarn being maintained under tension and while an excess of resin is supplied. When the layer has been built up to the desired thickness, excess resin beyond that required to leave a thin external film over the layer is removed, the tube is wrapped tightly in a suitable film, as of polyvinyl alcohol, and cured. The conditions of cure are chosen in accordance with the amount and type of amino catalyst, a half-hour treatment at 250° F. being adequate with an active catalyst, while a less active one requires treatment for an hour or two at 300°–400° F. After being cooled to room temperature, the covering film may be removed and the jacket sanded and polished.

In the completed shell, the metal side wall may have a thickness of 0.02 inch and the reinforcing layer 7 a

maximum thickness of 0.030 to 0.035 inch. As customary with shot shells, the side wall is provided with a slight taper, the shell diameter at the mouth being slightly smaller than at the base. The assembly is completed by inserting the primer **2**, and loading in turn the powder charge **3**, cup wad **5**, cylindrical wads **6** and shot **4**. The closure **8** may then be formed by creasing the shell rim inwardly at six equidistant points and pressing the folds together by means of a crimping tool having the desired configuration.

Other types of closures may be used, for example as shown in Fig. 4, wherein a cardboard disc top wad **14** is retained in position by an inward roll crimp **15** of the shell rim.

A shot shell of somewhat modified construction in accordance with the invention is shown in Fig. 2, wherein the reinforcing layer **7** of fiber and synthetic resin extends over substantially the entire length of the shell. As in the embodiment shown in Fig. 1, a tube of aluminum, brass or other suitable metal may be prepared by drawing a cup made by extrusion or conventional drawing operations and then subjecting it to the usual finishing steps of trimming, heading and piercing the primer flash opening.

In this instance, the metal tube is substantially cylindrical, having a wall thickness of about 0.02 inch at the center of the shell, gradually thickening toward the base and becoming thinner toward the rim which is about 0.01 inch thick. The external diameter is slightly less at the rim than at the base.

The shot shell in accordance with Fig. 2 is loaded as described above with respect to the shell of Fig. 1 with the exception that the closure consists of a thin paper disc **13** placed over the shot column and a superposed seal **16**. The latter may consist of a mixture of about equal parts by weight of finely divided asbestos and an "epoxy" resin containing a highly active amino catalyst. The mixture is poured in place and quickly hardens at a temperature somewhat above ordinary room temperatures to result in a seal which disintegrates into fine fragments when the shell is fired. An alternative frangible closure which may be used instead of the above consists of a chipboard disc which has been impregnated with an aqueous solution of sodium silicate and dried, as described in U.S. Patent 2,582,125.

Layer **7** may be applied as above described in connection with the embodiment of Fig. 1 to provide a reinforcing layer of 0.030 to 0.035 inch. Alternatively, layer **7** may be formed by providing the fibrous material as a piece of woven fabric saturated with the resin binder, coiling the same convolutely around the metal tube, and curing so as to produce a tightly adhered composite jacket. Likewise, the fibrous material may be provided in tape form saturated with resin, helically wound back and forth with successive turns overlapping, so that after curing a strong well-adhered reinforcing layer results.

According to a further variation, a woven seamless tube of the fibrous material may be saturated with resin, inserted in place over the metal shell, and the assembly subjected to curing conditions. In this case, the required extent of shrinkage is controlled by initially incorporating the appropriate proportion of solvent with the resin.

While glass fibers are the preferred fibrous material, advantageous results may also be secured with other mineral fibers and synthetic fibers, such as high strength rayon, nylon, Dacron, polyvinylidene chloride or polyacrylonitrile. Although best results have been obtained with "epoxy" resin binders, other synthetic resins may be employed advantageously, particularly the polymerizable unsaturated esters such as allyl phthalate resins, polyamides, silicones and phenolics.

The resulting reinforcing layers after the application of the fibrous material and resin binder to the metal tube of the shot shell and after the resin has been set or cured has a structure as represented in the enlarged sectional view of Fig. 3. Individual filaments **11** of the fibrous material are firmly embedded in a matrix of set resin, a thin layer **12** of which is strongly adhered to the exterior wall of the metal tube. Also, a thin layer of the resin constitutes the outer surface of the composite jacket.

The above-described shot shells assembled in accordance with this invention have displayed uniformly satisfactory functioning in all respects when fired in shotguns. In particular, they can be fired in unbroken series in various automatic shotguns without extraction or other difficulties. Measurements made on shells before and after firing have shown the absence of any substantial bulging in contrast to the expansion encountered in the firing of aluminum or other metal shells having the same over-all configuration. Such bulging has been responsible for shells sticking in the gun barrels and causing the jamming of automatic shotguns. Such difficulties have been overcome by shot shells prepared in accordance with this invention.

I claim:

A shotshell cartridge comprising a thin-walled metal case, a charge of powder disposed in the base end of the case, a charge of shot disposed in the opposite end of the case and a jacket formed of a plurality of glass fibers bonded to each other and to the case in mutual stress-transmitting relation covering the end of the case in which the powder is received, the wall of said base end of the case being offset inwardly with respect to the wall of the end thereof receiving the shot charge so that the jacket blends with the case to define a straight-sided surface on the exterior of the composite shotshell wall.

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