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G. G. OBERFELL ET AL

3,053,185

EXPANDABLE WADS FOR SHOTGUN SHELLS

Filed Dec. 3, 1959

2 Sheets-Sheet 1

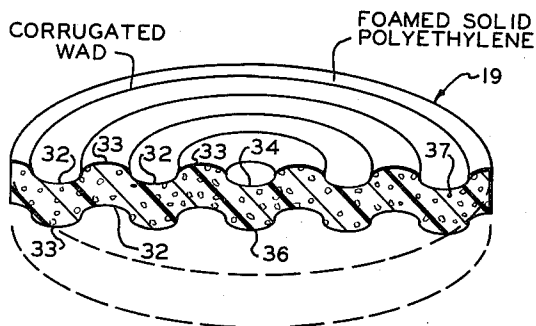


FIG. 2

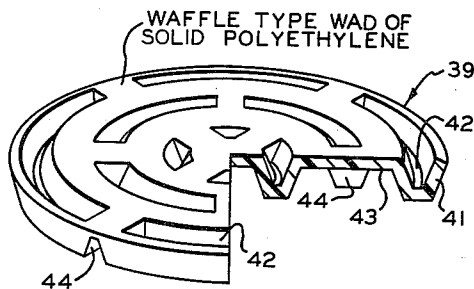


FIG. 4

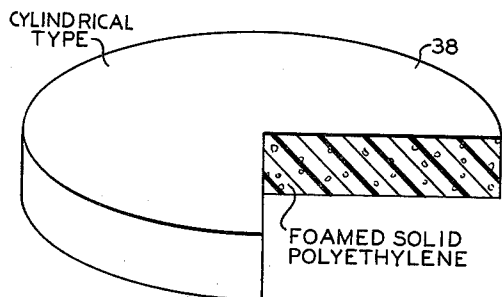


FIG. 3

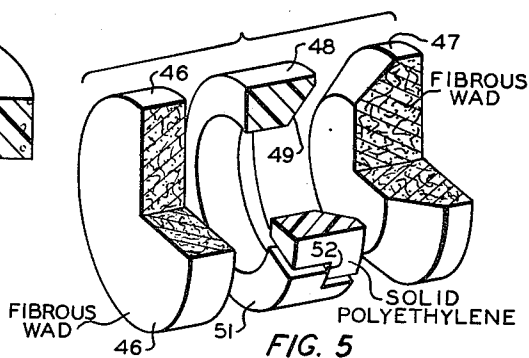


FIG. 5

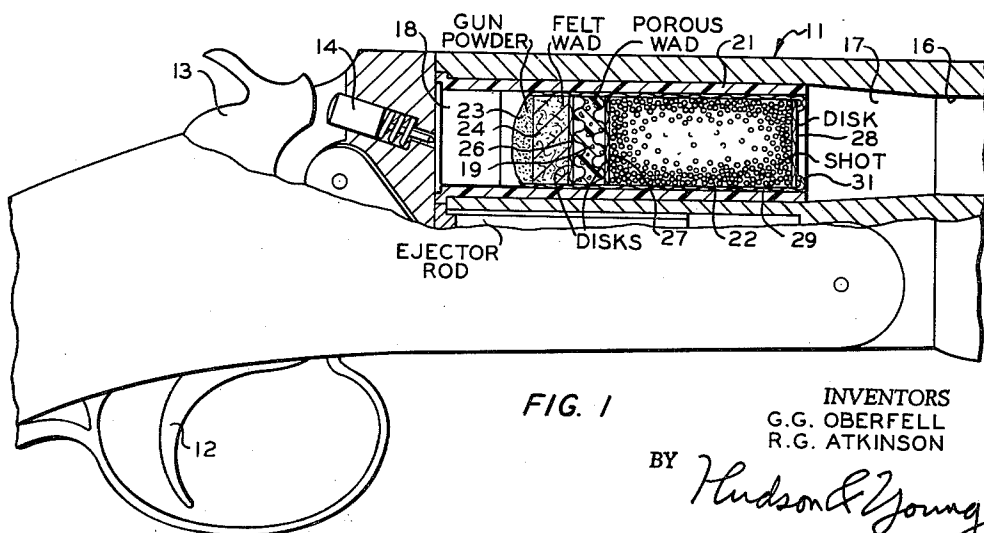


FIG. 1

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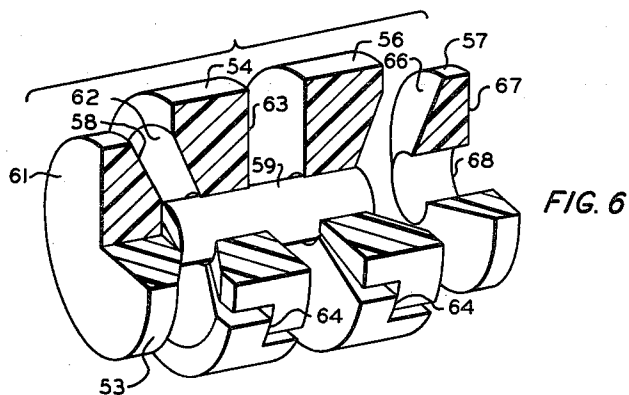


FIG. 6

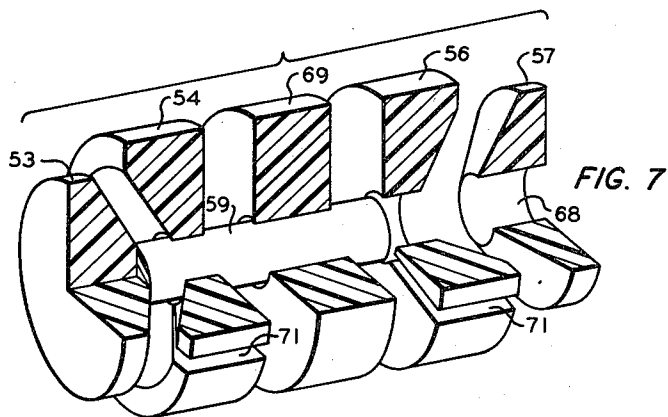


FIG. 7

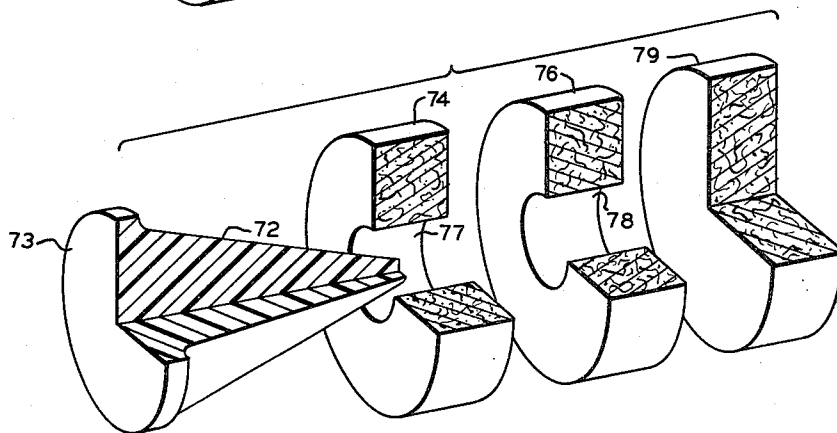


FIG. 8

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3,053,185

EXPANDABLE WADS FOR SHOTGUN SHELLS
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4 Claims. Cl. 102—95)

This invention relates to expandable wads for use in shotgun shells between the gunpowder and the shot. In one aspect it relates to highly expandable wads that enable improved power and penetration effects when shells designed for a smaller bore diameter shotgun are fired in a larger bore diameter shotgun, as when employing an adapter as shown in the copending U.S. patent application Serial No. 829,798 of G. G. Oberfell, filed July 27, 1959. In another aspect it relates to such expandable wads made entirely of solid polyethylene, or made of polyethylene in combination with fibrous wads or fibrous washers. In another aspect it relates to such expandable wads made of foamed solid polyethylene.

The purpose of an expandable wad is to produce an effective means of sealing the high pressure, rapidly expanding gases of the burning gunpowder from the shot charge when a shotgun is fired. The gas pressure generated upon firing the shotgun expands the wad, thereby sealing the bore of the barrel and minimizing the blow-by of gases into and around the shot charge. If the shot charge were allowed to become full of high pressure gas, then as it emerged from the muzzle this gas would expand and scatter the shot in the process of expansion. Naturally, the driving force on the shot of any gas that had passed through the shot charge would be lost almost completely, so the velocity and thereby the striking power (or kinetic energy) and hence the killing power of the shot on game would also be reduced.

When the expanding wad is employed in a smaller shotgun shell in an adapter as taught in said application Serial No. 829,798, then it is much harder to achieve an effective seal with the larger bore of the shotgun. If the cylindrical shotgun wad of the prior art were employed in such a situation, obviously a considerable amount of blow-by would occur.

One object of the present invention is to provide improved expandable wads for shotgun shells.

Another object is to provide such wads suitable for efficient sealing of shot from powder gases when a smaller gauge shotgun shell is fired in an adapter in a larger gauge shotgun.

Other objects are to provide expandable wads of solid polyethylene, of solid polyethylene in combination with fibrous wads, of solid polyethylene in combination with fibrous washers, and of foamed solid polyethylene.

Numerous other objects will be apparent to those skilled in the art upon reading the following specification, claims and drawings.

In the drawings:

FIGURE 1 is a fragmentary elevational view with parts broken away to show details of construction of a shotgun shell embodying the present invention mounted in firing position in an adapter in a conventional shotgun.

FIGURE 2 is a cross-sectional perspective view of a corrugated wad made of foamed solid polyethylene embodying a first species of the present invention. This is the same species shown in FIGURE 1, and is merely an enlarged view of the same taken at an angle to show the wad in perspective.

FIGURE 3 is an elevational view with a portion in section to show details of construction of a foamed solid polyethylene wad of the cylindrical type which is the third species of the present invention.

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FIGURE 4 is a perspective view with a portion in cross section to show details of construction of a solid polyethylene wad of the waffle type construction of the second species of the invention.

FIGURE 5 is an exploded quarter-sawed perspective view of a fourth species of the invention employing two fibrous wads and an expansible piston ring of a solid polyethylene forming a fourth species of the invention.

FIGURE 6 is an exploded quarter-sawed perspective view of a wad made entirely of solid polyethylene in the form of a pin, a washer, and two expansible piston rings forming a fifth species of the invention.

FIGURE 7 is a view similar to FIGURE 6 of a sixth species of the invention in which a solid polyethylene ring has been placed between two expansible radially split rings.

FIGURE 8 is an exploded quarter-sawed perspective view of a seventh species of the invention in which a solid polyethylene cone is forced to expand two fibrous wad rings and press against a fibrous wad disk.

While solid polyethylene of any type can be employed successfully in the practice of this invention, it is preferred to use a solid polyethylene having a density of 0.940 to 0.990, a crystallinity of at least 75 weight percent, and molecular weight of at least 25,000 preferably produced by the process of U.S. Patent 2,825,721 of March 4, 1958, filed March 26, 1956, to John Paul Hogan and Robert L. Banks, because the best results in the practice of this invention are obtained with this high density, resilient material. It is further preferred that said solid polyethylene contain a small proportion, preferably 2 to 5 percent by weight, of lower molecular weight polymer fractions which are soluble in paraffinic hydrocarbons at room temperature, preferably formed as a part of the total polyethylene. These lower molecular weight fractions are made up of waxy and semi-solid materials having molecular weights of 1,000 to 5,000, or even lower, and are particularly valuable because of their lubricating action as the wads are driven through the shotgun barrel.

The mode and manner of forming polymers suitable for fabricating shotgun wads according to the instant invention is also described in the copending applications of George G. Oberfell, Serial No. 596,522 filed July 9, 1956, now abandoned, and entitled "Firing Tubes For Firearms," and of Oberfell and Atkinson, Serial No. 815,014 filed May 22, 1959, now abandoned, for "Improved Shotgun Shell." To summarize the process for producing suitable polymers, it is stated that such polymers are produced by polymerizing at least one polymerizable olefin at a polymerization temperature up to about 500° F. with a catalyst active for such polymerization and comprising, as the sole essential effective catalytic ingredients thereof, chromium oxide and at least one material selected from the group consisting of silica, alumina, zirconia, and thoria, at least part of the chromium being in the hexavalent state at the initial contacting of hydrocarbon with said catalyst. Various temperature ranges, recovery process, details of specific catalysts, catalyst size, and suitable solvents are disclosed in said Hogan et al. patent and said earlier application. The recovered polymer can then be extruded as tubes or rods, and machined, or can be molded to form our novel shotgun wads.

In the modifications of the present invention in which foamed solid polyethylene is employed, the above-mentioned preferred high molecular weight solid polyethylene is preferably foamed by one of the processes described in U.S. patents to Johnston 2,256,483, September 23, 1941; Henning 2,848,739, August 26, 1958; Henning 2,885,738, May 12, 1959; or French patent to Isolering

aktiebolaget WBM 1,081,583 of December 21, 1954. It should be noted that while Johnston mentions wadding material for shotgun shells on page 4, column 1, line 11, and U.S. patent to Brown et al. 2,559,275, July 3, 1951, column 2, line 30, has a foamed polyethylene wad 15, that neither employs the high density polyethylene preferred in the present invention, nor teaches the use of such a wad in a smaller shotgun shell in an adapter as necessary in said application Serial No. 829,798. Said preferred high molecular weight polyethylene when foamed by the processes to an apparent specific gravity of from 0.50 to 0.01 is especially useful in the practice of this invention, especially if foamed with from 5 to 50 percent by weight of butane gas.

Examples of the nominal bore diameters of the various gauges are: 10 gauge—0.775 inch; 12 gauge—0.730 inch; 16 gauge—0.67 inch; 20 gauge—0.615 inch; 28 gauge—0.550 inch; 410 bore—0.410 inch (Western Ammunition Handbook, published 1954 by Olin Mathieson Chemical Corporation). When we refer to shells or guns having a "larger gauge," we refer in this discussion to those having larger bore diameters, and similarly we refer to those having smaller bore diameters when discussing smaller gauges.

In FIGURE 1 is shown a portion of a conventional shotgun generally designated as 11 with parts broken away in section to show details of construction. Shotgun 11 has the usual trigger 12, hammer 13, firing pin 14, barrel 16, and chamber 17. Inserted in chamber 17 is a shotgun shell 18 embodying the present invention in the form of a porous wad of corrugated, foamed, solid polyethylene 19 of the type shown in FIGURE 2, said shotgun shell being encased in an adapter 21 of solid polyethylene of the type disclosed in said application Serial No. 829,798. The shotgun shell 18 is conventional except for the expandable wad 19 and comprises lead shot 22, gunpowder 23, felt or hair wad 24, and solid disks 26, 27, and 28, all these parts being retained in cartridge case 29 by crimping the end of the same at 31, or any other suitable sealing arrangement old in the prior art. The disks 26, 27, and 28 and the cartridge case 29 may be made of solid polyethylene, or cardboard, or cardboard impregnated with solid polyethylene.

In FIGURE 2 an enlarged view of the first species of the invention is generally designated as 19 and comprises a corrugated, expandable wad of foamed solid polyethylene having annular grooves 32 and ridges 33, with a central depression 34 and central boss 36 on opposite sides. The foamed solid polyethylene contains a large number of pores 37 formed therein during the process of making the same as described above, and these pores 37 contain gas which is a residuum of the foaming process. The alternate grooves 32 and ridges 33 forming the corrugations, together with the resilient and porous nature of the wad 19, permit an expansion of the diameter of wad 19 as much as about 0.25 inch, which is sufficient to allow firing a 12-gauge shotgun shell in a 10-gauge shotgun without gas blowing by wad 19. The gas from the burning powder 23 exerts a pressure in the neighborhood of 6,000 p.s.i., which is transmitted to wad 19 in substantially its entire force due to the inertia of lead shot 22, so that wad 19 expands from the size at which it fills cartridge case 29 to a size sufficient to fill the larger bore 16 of the shotgun 11, as shown in FIGURE 1. This expansion can exceed 0.25 inch, so that a 410 bore wad will fit a 28 or 20 gauge bore, a 28 gauge wad a 20 or 16 gauge bore, a 20 gauge wad a 16 or 12 gauge bore, a 16 gauge wad a 12 or 10 gauge bore, a 12 gauge wad a 10 gauge or larger bore, and a 10 gauge wad will fit still larger bores in proportion thereto.

FIGURE 3 shows a second species of the invention which is less effective than the species shown in FIGURE 2. Instead of the corrugated wad 19 of FIGURE 2, a cylindrical wad 38 is employed, and it is necessary in this modification to employ foamed solid polyethylene

made from solid polyethylene having a density of 0.940 to 0.990, a crystallinity of at least 75 weight percent, and a molecular weight of at least 25,000, which has been foamed to an apparent specific gravity of not more than 0.50 with from 5 to 50 percent by weight of a suitable foaming gas known to the prior art. Only such material is able to expand 0.25 inch to allow a 12-gauge shotgun shell wad to be fired in a 10-gauge shotgun when the wad is merely a cylinder, and not corrugated as in FIGURE 2.

In FIGURE 4 is shown a third species of the invention which comprises a waffle-type wad of solid polyethylene generally designated as 39, which comprises a generally cylindrical disk of solid polyethylene 41 which preferably is molded to contain a concentric series of staggered semiannular grooves 42 on one side thereof in combination with a concentric series of staggered semiannular ridges 41 on the other side thereof, each of said grooves 42 being substantially coextensive with a respective one of said ridges 41 on opposite sides of said disk. The resulting concentric annular grooves 43 on the lower face of the disk 39 are connected by staggered radial grooves 44. The solid polyethylene has resiliency, but would be unable to expand as much as 0.25 inch in diameter from the size of a 12-gauge shotgun shell wad to that of a 10-gauge shotgun shell wad in the bore 16 of the shotgun 11 without gas blowing by the wad 39 were it not for the fact that grooves 42, 43, and 44 permit the waffle-type wad to be mashed flat by the explosive gases at 6,000 p.s.i. against the shot 22, which shot is slow in starting due to its inertia.

FIGURE 5 shows a further species of the invention in which the expansible wad comprises three elements, namely, a cylindrical fibrous wad or pad 46, a frusto conical fibrous wad or pad 47, and a split piston ring 48 of solid polyethylene therebetween, having an annular frusto conical surface 49 cooperating with the similar surface of wad 47, a flat annular surface 51 cooperating with the similar surface of wad 46, and an overlapping gas sealing portion 52 of the type common in piston rings for automobile engines. Because of this particular construction, the combined wad of FIGURE 5 is able to expand 0.25 inch from the size of a 12-gauge shotgun shell wad to that of a 10-gauge wad filling the bore of barrel 16.

In FIGURE 6 is shown in a fifth modification of the invention which comprises a composite expansible wad formed of four elements 53, 54, 56, and 57, all preferably formed of solid polyethylene, which cooperate to form the expansible wad. They comprise a plunger 53 having a conical face 58, a central boss 59, and a flat face 61, a first piston ring having a conical face 62 to cooperate with face 58, a flat face 63 and a sealing slot 64, a second piston ring 56 having similar but oppositely disposed parts as ring 54, and a washer 57 having a conical face 66 and a flat face 67, said rings and washer being mounted in serial order on said boss. FIGURE 6 is an exploded view, but when the parts are forced together with boss 59 extending into bore 68 of washer 57 the force of 6,000 p.s.i. from exploding gases on face 61 and the force of reaction from the inertia from shot 22 acting on face 67 further compress the assembly and expand the diameter of piston rings 54 and 55 as much as 0.25 inch, enabling such a wad from a 410 shotgun shell to fit a 20-gauge shotgun bore. FIGURE 6 may be modified in two ways (not shown), namely, instead of having a slot with an off-set sealing portion 62 in each of piston rings 54 and 56, it is possible to employ a simple radial slot 7 of FIGURE 7 in each piston ring provided these slots are carefully oriented on opposite sides of the wad when assembling the shotgun shell, and the other simplification (not shown) would be to employ only one piston ring 54 with an off-set sealing surface 64 but make surface 63 conical like surface 62 to cooperate with surface 66 with washer 67. While these last two forms of construction are simpler, they are not as preferred as the structure shown in FIGURE 6.

FIGURE 7 is a sixth modification of the invention which is identical to FIGURE 6 with the exception that a gas sealing ring 69 has been placed on boss 59 between piston rings 54 and 56, and as a result slots 71 are cut as simple radial slots and the orientation of slots 71 is immaterial because ring 69 seals a major portion of both slots.

FIGURE 8 is a seventh modification of the invention in which a conical plug of solid polyethylene 72 is assembled with flat face 73 toward the powder charge of the shotgun shell and with washers 74 and 76 aligned with the conical portion 72 extending into their central holes 77 and 78 while a cylindrical disk 79 is placed between washer 76 and the shot 22 in shell 29 of FIGURE 1. Rings 74 and 76 and disk 79 are made of fibrous wadding, or made of the preferred foamed solid polyethylene of FIGURE 3.

The various solid polyethylene parts of the different figures can all be made by means of stamping them out with dies from sheets of solid polyethylene, or they can be injection molded in a molten condition into molds, or extruded. They can also be made by machining the material, but this is regarded as a less economical expedient. The foamed polyethylene can be extruded in the form of rods or tubes of foam which cool and solidify and then are sawed or machined into suitable shapes, or the foam can be injected into a mold having the desired shape, the latter being preferred in the manufacture of the structure shown in FIGURE 2. While the solid polyethylene remains substantially the same size at all times, except for such mechanical expansion as provided by conical surfaces 58, 62 and slot 64 in FIGURE 6, for example, the foamed polyethylene may be compressed as much as 20 percent of its diameter and forced in its compressed condition into the shotgun shell where it is held in compressed condition by the case 29 until forced therefrom by gases of burning powder 23.

The fibrous wadding, or fibrous wads or pads 46, 47, 74, 76 and 79 mentioned above may be made of any suitable fibers, such as hair, paper fiber, solid polyethylene, or glass fibers matted together or preferably agglomerated together by a small amount, such as 1 to 5 percent by weight of a usual binder, such as a phenol formaldehyde resin, to maintain the wad in a coherent resilient state, and to permit the fibers under the gas pressure of the burning gunpowder to expand and pack together to provide a fairly gas-tight seal with the bore of the shotgun barrel.

While seven modifications have been shown for purposes of illustration, it is obvious that the invention is not limited thereto.

Having described our invention, we claim:

1. An expandable wad for a shotgun shell comprising a generally cylindrical disk of solid polyethylene formed to contain a concentric series of staggered semiannular grooves on one side thereof in combination with a concentric series of staggered semiannular ridges on the other side thereof, each of said grooves being substantially coextensive with a respective one of said ridges on opposite sides of said disk, whereby said expandable wad can be expanded by more than 0.25 inch in diameter for a 12-gauge shotgun shell wad and for other size wads by the same proportion to their diameter without gas blowing by the wad during the firing of said shotgun shell.
2. The wad of claim 1 in which said solid polyethylene has a specific density of 0.940 to 0.990, a crystallinity of at least 75 weight percent, and a molecular weight of at least 25,000.
3. The wad of claim 2 in which said solid polyethylene contains a small proportion by weight of lower molecular weight polymer fractions which are soluble in paraffinic hydrocarbons at room temperature and comprise waxy and semisolid materials having molecular weights of 1,000 to 5,000.
4. An expandable wad for a shotgun shell comprising a generally cylindrical disk formed to contain a concentric series of staggered semiannular grooves on one side thereof in combination with a concentric series of staggered semiannular ridges on the other side thereof, each of said grooves being substantially coextensive with a respective one of said ridges on opposite sides of said disk, whereby said expandable wad can be expanded by more than 0.25 inch in diameter for a 12-gauge shotgun shell wad and for other size wads by the same proportion to their diameter without gas blowing by the wad during the firing of said shotgun shell.

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