

June 11, 1963

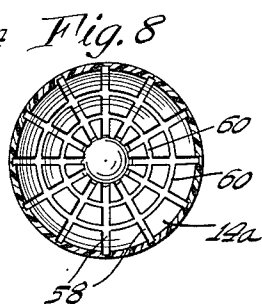
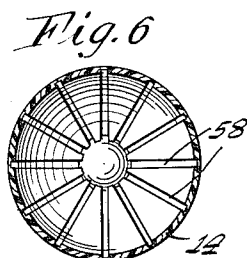
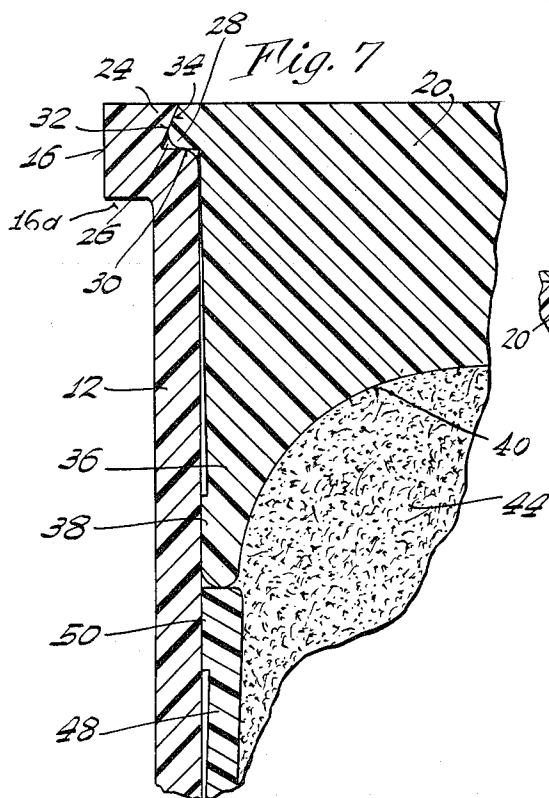
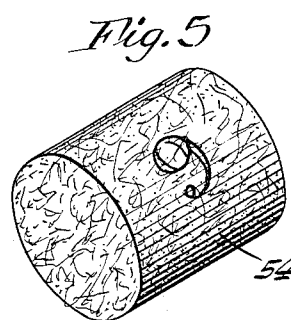
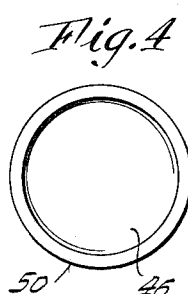
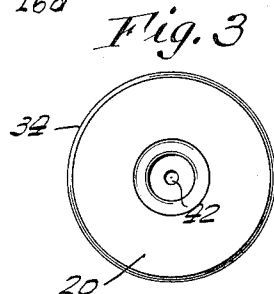
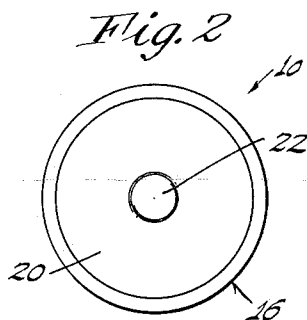
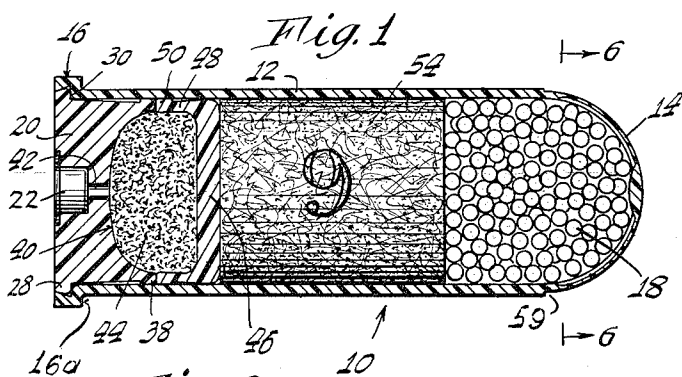
H. A. LOCKWOOD ETAL

3,093,073

SHELL FOR GUNS

Filed Aug. 31, 1959

2 Sheets-Sheet 1



INVENTORS

Harry A. Lockwood
Roscoe L. Hockley
BY *Gibner Lehmann*
AGENT

June 11, 1963

H. A. LOCKWOOD ETAL

3,093,073

SHELL FOR GUNS

Filed Aug. 31, 1959

2 Sheets-Sheet 2

Fig. 10

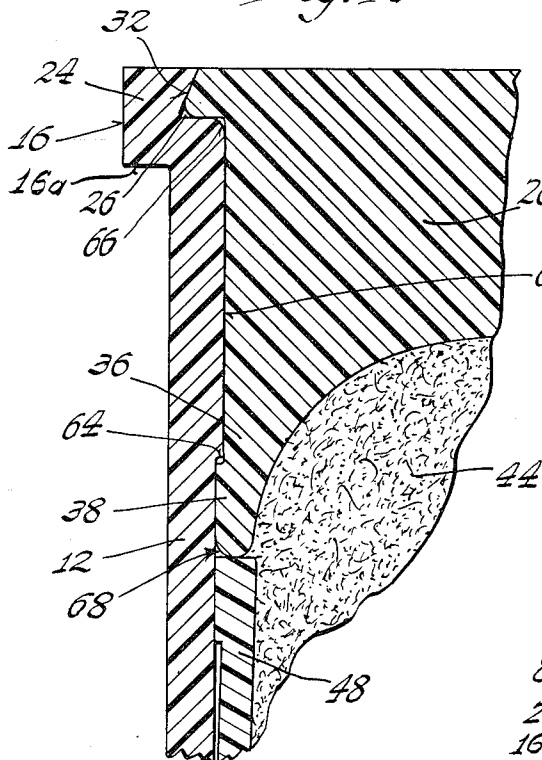


Fig. 13

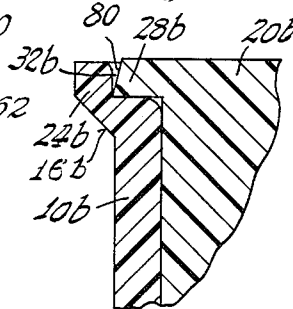


Fig. 14

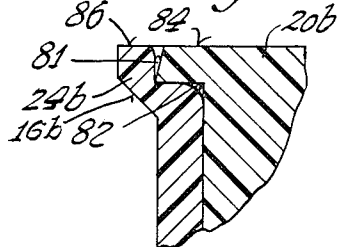


Fig. 11

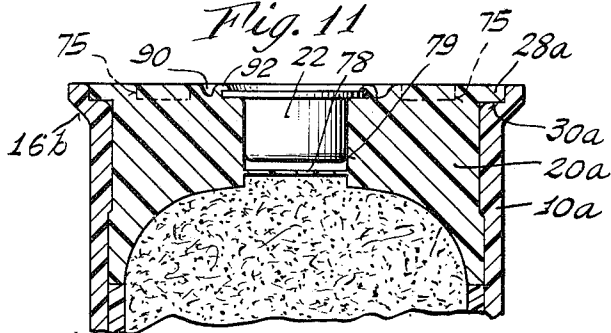
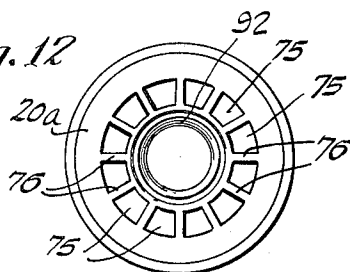


Fig. 12



INVENTORS
Harry A. Lockwood
Roscoe L. Hockley
BY *J. Gibner* *Edmann*
AGENT

1

3,093,073

SHELL FOR GUNS

Harry A. Lockwood, Weston, Conn., and Roscoe L. Hockley, Baltimore, Md. (both % DriAire Inc., 26 Fitch St., East Norwalk, Conn.)

Filed Aug. 31, 1959, Ser. No. 836,998

3 Claims. (Cl. 102-42)

This invention relates to shells or cartridges for rifles, shotguns and the like, and more particularly to shells or cartridges of the type constituted essentially of plastic or synthetic components.

Shell or cartridge constructions constituted mainly of plastic parts have heretofore been proposed, and it is believed that attempts have also been made to produce or manufacture such shells or cartridges. However, to our knowledge there has never been developed a commercially practicable and feasible plastic shell or cartridge of this type. It is well known that the properties of plastic substances are greatly different from those of metals, paper and cardboard, and the absence of certain desirable characteristics in plastic substances have, insofar as we have been able to determine, defeated the successful production and use of a practical shell or cartridge constituted in the main of plastic substances.

The problems involved in creating a practical shell or cartridge of the type which may be termed virtually an "all-plastic product" (since only the primer and shot pellets are of metal) have been successfully solved by the present invention. Such problems have involved the matter of uncontrolled or random rupturing of the side walls of the shell body intermediate the front and back end portions thereof when the shell is fired, the producing of a satisfactory shot pattern, reliability and uniformity in performance as between individual shells, the prevention or minimizing of distortion and cold flow of the plastic product or components due to necessary internal forces existing in the shell structure, the effecting of a satisfactory loading density of the powder charge, the retention of assembled plastic components in their proper, given positions, the matter of obtaining stability in the shape and dimensions of the shell, and the permanent marking of the shells to indicate their type, use and other characteristics. To our belief prior attempts at producing successful and practicable plastic shell and cartridge structures have not succeeded due to several or all of the above problems being not satisfactorily solved.

The plastic shell or cartridge construction provided by the present invention satisfactorily solves the various problems encountered through the use of plastic materials and the substitution of such materials for metal, paper or cardboard parts which have been previously used in the manufacture of cartridges. In accomplishing this, there is provided by the invention a plastic shell characterized by a novel, compressible and friable plastic wad means of synthetic gas-cell construction by which a gradual mechanical loading of the driving wad is effected to minimize the above mentioned side wall fracture, and by which there is also established a desired loading density of the powder charge in the shell body to provide for satisfactory performance, both of which factors contribute very appreciably to the feasibility of the shell.

The shell body is molded in one piece, in the form of a deep plastic cup having an integral rounded, friable and rupturable transverse wall which constitutes the nose or front end of the shell or cartridge. The said round front wall is made to have a thinner section, and is further provided with grooves or depressions by which it represents a small mass that may be readily broken into relatively small, light particles so as to not interfere with the shot pattern.

Because of the rounded configuration of the front wall,

2

in spite of its small mass and thinness it will successfully resist internal forces in the shell during assembly as well as residual forces existing during storage and by which the loading density of the powder charge is maintained. The rounded nose in resisting such forces experiences mainly tensile stresses whereby it does not appreciably distort, nor will it cold flow or bend and ultimately fail as a consequence of said internal forces.

Also, the molded shell body is provided with an integral shoulder or flange at its back end or rim portion, said shoulder being engageable with a cooperable shoulder of the gun chamber and providing an effective and accurate positioning and retention of the shell in the gun chamber and further assuring positive extraction of the fired shell from the gun. The provision of the integral shoulder at the rim of the molded shell body also conveniently enables an internal shoulder to be arranged at the said location, for engagement by a cooperable shoulder of a molded plastic primer base component. Such component, which carries the primer, may then be spun against the said internal shoulder to cause heating and melting of the plastic substance by which a desirable two-fold effect is obtained. The plastic primer base is securely bonded to or made integral with portions of the rim of the shell body, thereby to securely retain the primer base in the body against inadvertent removal. Also, the melting and merging of the engaging surfaces of the primer base and shell body enable the primer base and the primer which is carried thereby to be very accurately positioned with respect to the integral external shoulder on the shell body, thereby insuring accurate positioning of the primer in the gun chamber at all times, and minimizing the likelihood of the shell not firing when the primer is struck by the firing pin.

Further, the compressible and friable wad means formed of a foam plastic structure has appreciable axial length whereby its outer peripheral surface is quite expansive and may be readily viewed through the translucent side walls of the shell body. By imprinting desired information or data on the friable wad means, such data may be readily viewed through the walls of the shell body, and this organization advantageously replaces imprinting of the shell body which has such drawbacks as the likelihood of smudging or smearing, lack of performance (being easily removable by abrasion) and the difficulty encountered in printing plastic materials or substances, such as polyethylene for example.

By the above structures those characteristic drawbacks of plastic materials and substances which in the past have rendered them unsuitable for use in making shells or cartridges mainly of such material, have been successfully overcome by the present invention, and accordingly one object of the invention is to provide an improved gun shell or cartridge which is constituted mainly of plastic materials and which is yet practical and feasible in its manufacture and use.

Another object of the invention is to provide an improved feasible plastic cartridge or shell construction as above set forth, wherein an effective seal is provided of the contents of the shell body by virtue of the structure and assembly of such body and the primer base.

A feature of the invention resides in the provision of a novel multi-part plastic shell or cartridge construction wherein a distinct separation of the impelling charge from the primer is maintained at all times by an integral, impervious wall provided on the primer base and spanning the bottom of the recess provided for the primer.

An additional object of the invention is to provide an improved plastic shell or cartridge construction as above characterized, which is economical to manufacture and produce, and is characterized by relatively few, separate components or parts.

A further and important object of the invention is to provide an improved plastic or synthetic cartridge construction wherein the likelihood of rupture of the shell case at points intermediate its front and back end portions is greatly minimized.

An additional feature of the invention resides in the provision of an improved plastic or synthetic shell or cartridge construction, wherein to a great extent axial or longitudinal dimensions of the components may be non-critical so that appreciable variation may be readily compensated for.

Yet another feature of the invention resides in the provision of an improved shell or cartridge wherein the driving wad for the projectile means may get into and have appreciable motion before being fully loaded or impeded by the said means, said loading when it occurs being to an extent gradual, thereby improving flame progression through the powder charge and also lessening the suddenness of the stress on the walls of the shell body due to the loading of the wad.

Other objects and features are to improve plastic shell performance and construction which in general compensates for weaknesses or drawbacks of the plastic material, in such a manner that a practical and feasible product is had which is safe to use, and reliable and uniform in its performance.

Other features and advantages will hereinafter appear.

In the drawings accompanying this specification similar characters of reference are used to designate like components throughout the several views, in which:

FIG. 1 is an axial sectional view of an improved plastic shell or cartridge construction made in accordance with the invention.

FIG. 2 is an end view of the shell or cartridge shown in FIG. 1, looking at the back or primer end.

FIG. 3 is an end view of one type of primer-carrying member or primer base of the shell or cartridge, looking at the rear or outside surface thereof.

FIG. 4 is a view of the resilient sealing or driving wad used in the shell or cartridge adjacent the impelling charge.

FIG. 5 is a perspective view of a compressible and friable wad used in the shell or cartridge.

FIG. 6 is a transverse sectional view, taken on the line 6-6 of FIG. 1.

FIG. 7 is an enlarged fragmentary sectional view through the back rim portion of the cartridge or shell, shown on an enlarged scale to better illustrate the configurations of the interfitting parts.

FIG. 8 is a view like FIG. 6, but illustrating a modified form of the invention.

FIG. 9 is a fragmentary sectional view of the cartridge or shell, illustrating a modified construction wherein the impelling cup is spaced from the primer base.

FIG. 10 is an enlarged fragmentary sectional view similar to that of FIG. 7, showing an interlocking construction between the side walls of the shell case and the separate primer base or carrier piece.

FIG. 11 is a fragmentary axial sectional view through the back end portion of a plastic shell or cartridge construction, illustrating a modified form of the invention.

FIG. 12 is a back end view of the shell construction shown in FIG. 11.

FIG. 13 is a fragmentary sectional view through a back portion of the shell body and primer base, illustrating another modified form of the invention.

FIG. 14 is a view like FIG. 13 but illustrating the structure after the primer base has been spun into and adhered to the shell body.

The embodiments of the invention illustrated and described herein consist of plastic or synthetic shells or cartridges of the type commonly referred to as "shot shells," since they employ projectile means in the form of charges of shot such as small pellets. However, the

invention is not limited to these specific illustrated embodiments nor the specific materials mentioned, since it has utility in connection with other types and styles of shells or cartridges, and other specific synthetics. The term "shell" as used herein is intended to include both shell and cartridges within the meanings commonly attached to both said terms. Accordingly, the scope of the invention is to be determined more properly by the appended claims with the meaning intended above, instead of by the specific disclosure and description given in the specification.

While various commercially practical and feasible shot shell construction have been made and proposed in the past the most common, satisfactory type has consisted of a metallic primer base in the form of a small, drawn metal shell or cup in which the primer is mounted, the said base having attached to it a paper or cardboard shell body of tubular and cylindrical configuration with an end opening or mouth through which the shell is filled. In the filling operation powder is generally first placed in the shell body through the end opening, and then one or several wads are put on top of the powder, after which the charge of shot is deposited in the body to almost completely fill the latter. A suitable closure disk may then be applied, and the ends of the paper body may be turned inward, or other suitable means employed to secure the closure disk in place. In some instances the closure disk is omitted and the closure effected by the turned-in end of the body.

With this prior, conventional construction both the primer base and the shot pellets are made of metal, whereas the remainder of the shell is constituted of thick paper or cardboard. The metallic cup constituting the primer base was fabricated of nonrusting material such as brass which is expensive and at certain time in short supply.

In accordance with the present invention there is provided a novel and improved commercially practical, satisfactory cartridge or shot shell construction wherein the shell case is constituted as one piece, having an integral front wall or closure which latter is provided with predetermined weakened or fractureable portions to effect a desired control over the issuance of the projectile, the shell body and also the primer base being further devoid of metallic materials and instead being constituted entirely of plastic or synthetic substance which is not readily effected by moisture, corrosive agents and the like. This improved shell construction further provides not only a highly uniform performance but permits a simplified fabrication and automatic assembly and loading of the shell, whereby desirable manufacturing economies are achieved. Moreover, the wad means which is disposed within the shell body and which constitutes the driving means for the projectile means or charge of shot, is also constituted of a non-metallic substance such as plastic, plastic-like, or synthetic material with the result that accurate production pieces may be readily obtained in large volume while having the advantages of an improved material and close control of the properties thereof, together with manufacturing economy. By virtue of the novel plastic or synthetic construction provided by the invention as later brought out in detail, there results a desirable uniformity of performance and a high quality cartridge or shell, while simultaneously effecting appreciable manufacturing economies.

With the present improved cartridge or shell construction the only metallic parts which need be utilized consist of the projectile means, as for example the metallic shot pellets, and also the primer assemblage, both of which per se form no part of the present invention.

In accordance with the invention, the plastic or synthetic components which are provided and which replace the paper-type shell body, closure disk and wad means, and the metallic primer base, are so constituted and organized that they are few in number and may be readily

molded in large production quantities and with simple molding equipment having the advantages of low initial cost and economical molding operations.

Referring now to the figures of the drawings, there is illustrated in FIG. 1 a one-piece plastic or synthetic shell body designated generally by the numeral 10, said body being in the form of a deep cup having a cylindrical side wall 12 and having an integral transverse bottom wall 14, which wall shall also be referred to herein as the "front" wall of the cartridge or shell. Preferably, as shown, the transverse wall 14 is made spherical or at least with rounded corners having a large radius, and this has a distinct advantage over shell or cartridge cases having substantially straight or flat end walls in those situations where the shells are to be used in a self loading or manually repeating gun. For, with the rounded corner or spherical end wall 14 of the present shell body there are no prominent, sharp or small-radius corner portions which interfere with the loading cycle of a gun, as with existing shell bodies having flat ends.

In accordance with the present invention the shell body 10 at its mouth or open end, herein also referred to as the "back" end, is provided with an integral external flange or shoulder 16. The flange 16 is engageable with a cooperable shoulder in the cartridge chamber of the gun, as will be readily understood, to retain the shell body 10 in the gun when the shell is fired.

Within the shell body 10 and adjacent the rounded nose or front end 14 thereof there is disposed a usual charge of shot 18, as shown. Of course, other projectile means may be utilized in place of the shot pellets 18, as will be readily understood.

At the back of the shell body 10, and disposed within the annular external flange 16 there is provided by the present invention a plastic or synthetic primer base or holder 20, having a central opening in which a usual type of primer 22 may be disposed. In accordance with the invention the primer base 20 is constituted in a novel manner to secure an effective sealing engagement with the cylindrical walls 12 of the shell body 10 for the purpose of preventing escape of gases, and also to effect a secure retention of the primer base in the shell body.

In accordance with the invention, as shown, the lip portion 24 of the shell body 10 is provided with an internal annular groove 26 which is arranged to accommodate an external annular bead 28 provided on the primer base 20. Preferably, as seen in FIGS. 1 and 7, the annular groove 26 has a wall 30 which is perpendicular to the axis of the shell body 10; that is, it lies in a plane which is normal to the said axis. The bead 28 on the primer base 20 has a corresponding perpendicular wall adapted to engage and abut the wall 30, thereby to positively position the primer base 20 within the shell body 10 at the location shown in FIG. 1. The annular groove 26 also has a tapering or conical wall 32 engaging a similar shaped wall 34 on the bead 28 of the primer base 20.

As provided by the invention, the shell body 10 may be advantageously molded of a polyethylene formulation, being of flexible or resilient construction. By the use of such material or an equivalent or similar synthetic substance, the shell body 10 may be readily molded in simple mold equipment, and may be stripped from the mold in spite of the presence of the internal annular groove 26 provided in the mouth portion 24. It will be understood that during such stripping, the mouth portion yields to enable it to be withdrawn from the mold cavity. After such withdrawal, the mouth portion again resumes its normal molded shape such as is shown in FIGS. 1 and 7.

By the above construction we have found that the primer base 20 is securely retained within the mouth portion of the shell body 10 not only during the time that the shell is being shipped, stored and handled, but also at the time that the shell is fired.

The likelihood of blow-by is minimized by an effective sealing construction provided on the inner portion

of the primer base 20. As seen in FIG. 7, the primer base 20 is provided with an annular skirt 36 having a tapered cross section, the lip of the skirt 36 being provided with an exterior annular bead 38, adapted to engage, preferably under continuous pressure, the inside of the wall 12 of the shell body 10. The inner face 40 of the primer base 20 is generally spherical or concave as shown, and a flash hole 42 leads from the primer chamber to the powder chamber, which latter is bounded by the concave surface 40. As shown in FIG. 1, an impelling charge such as for example a charge of gun powder 44, is provided within the shell body 10 in the chamber defined by the concave face 40 of the primer base 20. The powder chamber is also defined by a pressure wad or movable driving wall 46, said wad being in the form of a shallow circular cup having side walls 48, which walls are preferably formed with an exterior annular bead 50 adapted to engage preferably under continual pressure, the inside surface of the side walls 12 of the shell body 10. Also, after the wad leaves the shell body the bead 50 will engage the inside of the gun barrel with a certain amount of pressure.

By the provision of the beads 38 and 50 on the primer base 20 and wad 46 respectively there is prevented or minimized leakage of gases between the wall 12 and these components when the shell is fired. Thus, the likelihood of blow-by wherein the gases leak past the primer base 20 is minimized, and also the likelihood of blow-by around the wad 46, thereby resulting in a maximum driving force being imparted to the said wad and projectile or projectiles.

The primer base 20 is preferably molded of a plastic synthetic composition known as "linear polyethylene," whereas the wad 46 is preferably molded of a regular polyethylene formulation.

Further, in accordance with the present invention, novel compressible and friable wad means are provided between the wad 46 and the charge of shot 18, which means serves a number of important functions and has special advantages in connection with shells or cartridges which are constituted of plastic or synthetic composition or formulations, to enable these to now be feasible and to function in an entirely satisfactory manner.

Referring to FIGS. 1 and 5 in this novel wad means, indicated by the numeral 54, is in the form of a compressible and friable, sponge-like plug, and is preferably constituted of foam plastic or synthetic such as polyurethane having air cells or gas-filled cells. By the use of the rigid polyurethane formulation the compressible wad 54 may be readily crushed and torn apart, and it further will not return to its original position or condition upon removal of the deforming force. The term "cellular" is used herein to designate a sponge-like structure having air or gas cells.

With the provision of the friable, compressible and deformable wad 54 there is reduced the likelihood of rupture of the wall 12 of the shell body 10 at points removed from the front, bulbous end 14 of the shell body, and we attribute this to the readily compressible nature of the wad 54 which, as at present understood, allows the cup wad 46 to be brought into motion by the ignited powder charge 44 before full load is imposed on the said wad. That is, upon the powder 44 being ignited the wad 46 will travel forward under an increasing restraining load, compressing the wad 54 to a very great extent and gradually taking on its full load as it meets the resistance represented by the charge of shot 18. Shortly after the powder 44 ignites, the traveling wad 46 will experience the full load or restraint of the charge of shot 18, and thereafter the shot will be impelled forward, bursting open the rounded nose 18 of the shell body 12 whereupon the shot will issue from the muzzle of the gun, together with the wad 46 and fragments of the compressible wad 54 and of the bulbous nose 14 of the shell case.

By virtue of the light weight of the cup wad 46 it has relatively little inertia, and accordingly will not travel far beyond the muzzle of the gun. Therefore the wad 46 will not interfere with the pattern of the shot pellets 18 to the extent that a heavier wad would. Also, the compressible wad 54 will be crumbled and reduced to small particles, which will not travel far from the gun muzzle to interfere with the shot.

By the invention we have found that desirable shot patterns are obtained, and that such patterns are not unfavorably affected by fragments resulting from fracture of a rounded nose normally under tensile stress, as will shortly be explained more fully. In effecting this the rounded nose is preferably provided with a plurality of radially extending grooves 58 as shown in FIGS. 1 and 6. By the provision of such grooves the wall portions of the nose 14 are weakened by being made thinner, whereupon the rupturing of said nose portion will occur along the lines of weakness, resulting in a number of small fragments which will travel but a small distance from the gun muzzle and not interfere with the pattern of the shot.

To further reduce the likelihood of interference with the shot pattern, and to facilitate the rupture and fragmentation of the rounded nose 14 of the shell body 10 into small non-interfering pieces 10, the said tensioned nose portion where not weakened by the grooves 58 is formed with a thinner wall section than the cylindrical wall 12, as may be readily seen in FIG. 1, this being done by reducing the thickness on the exterior, leaving a shoulder 59. The provision of such reduced wall and external shoulder 59 provides external space laterally of the shell body at the front thereof, for expansion of the projectile charge, gases, etc. whereby a better propulsion and pattern may ensure. A slight modification of the invention is illustrated in FIG. 8, wherein the rounded nose portion 14a of a plastic or synthetic shell body as provided by the invention not only has radial grooves 58 but also a plurality of concentric annular grooves 60, thereby to provide further lines of weakness and effect a rupturing of the rounded nose 14a into still smaller fragments.

The method of assembling and loading the improved plastic or synthetic shell structure as illustrated in the drawings is also novel. It will be readily understood from the foregoing description that in the fabrication of the shell, the shell body 12 is molded as a single piece with the front bulging transverse wall 14 being constituted as an integral part of the molded piece. In loading the shell, the charge of shot 18 is first placed in the shell body 10 with the latter preferably held in an upright position, with its open end uppermost. The compressible foam plastic wad 54 is next placed in the shell body 10 on top of the shot 18. Thereafter, the cup wad 46 is placed in the shell body on top of the wad 54 and pushed down without appreciably compressing the wad 54. The powder charge 44 is now deposited in the body 10 on top of the cup wad 46, and at this time the cup wad 46 will be positioned closer to the mouth of the shell body than when it is in finally assembled position. The primer base 20 having assembled to it the primer 22, is now placed within the mouth of the shell body and forced downward to its ultimate position as shown in FIG. 1. When this is done, the charge of powder 44 will be brought to a desired or controlled loading density and the lip portions of the cup wad 46 and the skirt 36 of the primer base 20 may be brought into engagement as seen in FIG. 1 or closely spaced as in FIG. 9, by virtue of the resistance being offered by the compressible wad 54. Also, the cup wad 46 will now be shifted deeper into the shell body 10, compressing the wad 54 to a further extent and applying pressure to the shot 18, so that the various components will occupy the positions shown in FIG. 1, or in FIG. 9. The shell or cartridge of the present invention is thus completely loaded from its back end,

as distinguished from the front-end loading heretofore practiced in the manufacture and fabrication of commercially feasible shells and cartridges.

It should be noted that resisting the above forces existing in the shot charge 18 is the thin bulbous or rounded nose, such resistance being characterized by mainly tensile stresses in the nose. This is of considerable importance, since it enables the thin, flexible front wall or nose 14 of the shell body 10 to stay virtually distortion free, and to successfully resist deformation, cold flow and/or ultimate failure. Such construction contributes to the feasibility and practicability of the present plastic shell.

Further, by the provision of the compressible and friable wad 54 and by controlling the length and characteristics thereof any reasonable desired uniformity necessary to the proper performance of the plastic shell construction may be achieved in the density of the powder charge 44. Also, the slightly compressed wad 54 will hold the charge of shot 18 tightly, preventing any looseness of the said charge, and by the provision of the compressible wad 54 there is effected an automatic take-up of the components within the shell body, and also a compensation for variations in axial dimensions, which may result from production practices.

Through the use of a controlled compressible wad 54 the initial movement of the cup wad 46 is not characterized by as great an expansion of the side walls 48 thereof as would be occasioned if the entire load of the charge of shot 18 were to be borne immediately by the cup wad. That is, the cup wad may be quite easily shifted, under light loading, by virtue of the crushable property of the wad 54 and during such shifting the walls 48 of the cup wad will not grip too tightly the cylindrical side wall 12 of the shell body 10. Accordingly, the likelihood of rupture or tearing of the said side wall 12 at points behind or to the rear of the base of the rounded nose 14 is greatly minimized if not completely prevented thereby contributing greatly to the feasibility of a plastic shell construction by reducing the likelihood of interference with the shell pattern and generally improving the performance. As the cup wad 46 is finally subjected to the full resistance of the charge of shot 18, the internal pressures within the shell will cause the annular wall 48 of the cup wad to be more forcibly expanded, and to more tightly engage the side wall 12 of the shell body and thereafter the barrel of the gun, thereby preventing blow-by and causing the expanding gases to exert the greatest possible driving force upon the cup wad and the charge of shot.

In consequence of this action the improved shell construction as provided by this invention is efficient in the utilization of the power of the charge 44.

Another embodiment of the invention is illustrated in FIG. 10, wherein an interlocking structure is provided between the cylindrical walls 12 of the shell body 10 and the primer base 20 which is constituted as a separate piece. As shown in this figure, the cylindrical wall 12 adjacent the mouth of the shell body 10 has a slightly reduced diameter for a given distance, resulting in an inner cylindrical surface 62 being formed which is arranged to snugly fit the major portion of the outer peripheral surface of the primer base 20. By virtue of the said reduced diameter and the provision of the cylindrical surface 62 a small shoulder 64 is formed on the interior of the cylindrical wall 12, said shoulder being cooperable with a similar small exterior shoulder formed by the annular bead 38 provided on the lip of the skirt 36. Thus, an interlock is had between the said shell body 10 and the primer base 20, and such interlock becomes very effective when the propellant charge 44 is ignited and the skirt 36 is as a consequence radially expanded, as will be understood. By virtue of this interlock, a more secure retention of the primer base 20 in the shell body 10 is had, especially at the time that the shell is being fired.

Also, as shown in FIG. 10, a radius 66 is provided at the mouth of the shell body 10 and an additional radius 68 is provided at the lip or lower edge of the skirt 36, to facilitate insertion of the primer base 20 in the shell body.

Another embodiment of the invention is illustrated in FIGS. 11 and 12. In accordance with the invention as illustrated in this embodiment, the plastic primer base 20a is securely fastened to the shell body 10a by a procedure which provides integral fastening portions on the body and base. Such integral fastening portions are formed by heating and melting adjoining parts of the body and base, preferably by a spinning procedure whereby frictional heat is employed to melt the plastic, and whereby circular or annular integral fastening portions are produced for securing the base to the body. While a spinning procedure is preferably employed to produce the heat, the two parts may also be welded together by another suitable means or procedure to effect a secure retention of the base in the body.

As shown, the shell body 10a has an annular shoulder 30a which is arranged for engagement by an annular flange or bead 28a on the primer base. After assembly of the shot load, wads, impelling charge and the shell body 10a, the primer base 20a is inserted in the body and the shoulder or bead 28a is brought into engagement with the shoulder 30a of the body. Thereafter, the primer base is quickly spun for a very short period of time, with the bead and shoulder pressing against each other. The frictional heat produced quickly melts the plastic, after which the spinning force is removed from the primer base, with the result that the shoulder or bead 28a is securely fastened to the rim portion of the shell body 10a by annular portions which are integral with the primer base 20a and the shell body 10a.

As shown in FIG. 12, the primer base 20a may be provided with recesses 75 to accommodate the projections of a spinning head, as will be readily understood. Preferably, the recesses 75 are quite shallow, on the order of one thirty-second of an inch deep, and the separating ribs 76 disposed between the recesses are preferably rounded to facilitate the engagement of the spinning head, and also the removal thereof after the spinning operation has been completed.

As shown in FIG. 11, the primer base 20a is also provided with a solid or imperforate, thin, transverse wall 78 at the bottom of the recess 79 provided for the primer cup. The transverse wall 78 effectively isolates and separates the propellant charge from the primer, while at the same time providing virtually no resistance to transmission of the products of combustion from the primer to the propellant charge at the time that the primer is ignited. Also by such construction the entire shell is completely sealed and watertight except for the primer.

Referring to FIGS. 13 and 14, the primer base 20b shown therein may have the periphery of the flange or bead 28b thereof beveled or sloped as indicated at 80, to provide clearance from the rim or lip portion 24b of the shell body 10b, and the flange 28b may be slightly thicker in its axial dimension, with respect to the axial depth of the groove 32b in the lip portion 24b. Upon the primer base 20b being spun in place, the molten plastic may assume a disposition as indicated at the points 81 and 82 shown in FIG. 14, and the back or external surface 84 of the primer base 20b may be brought into the same plane which contains the back surface 86 of the lip portion 24b of the shell body. Thus, no protruding shoulders will result, as a consequence.

In accordance with the present invention, the above construction shown in FIGS. 13 and 14 whereby the primer base 20b is spun in place, may be advantageously utilized to effect an accurate placement of the primer 22 with respect to the front-facing shoulders 16a and 16b on the rim or lip portions of the shell bodies, thereby to accurately position the primer in the gun when the

shell is in place, so as to insure proper firing. By such accurate placement or positioning of the primer there is virtually completely eliminated any likelihood of the shell or cartridge not firing because of lack of primer ignition resulting from improper placement of the primer with respect to the cartridge chamber. It will be readily understood that the exposed face of the primer 22 may be engaged with the spinning head when the assemblage of the primer base and primer is spun into the shell body, and the advance of the spinning head accurately controlled. Thus, an accurate control of the position of the primer with respect to the shoulder 16a, 16b may be had by such assembly procedure, and this is an important feature of the invention.

By the present invention there is provided a novel and improved means for marking the shell or cartridge, whereby there is no likelihood of smudging or smearing of the mark, or obliteration of the same due to abrasion, moisture or wetting of the shells, etc. Instead, the marking constitutes a permanent imprint or indication, and may reliably indicate the properties and/or uses of the shell or cartridge. Referring to FIGS. 1 and 5, the compressible or friable wad 54 may have indicia printed on it, such as the numeral 9 shown in these figures. This imprint may be done by any suitable process, involving rolling of the wad, etc. Besides the numeral 9 or other desired numeral data as to the use and composition or makeup of the shell may be included. The polyethylene composition of the shell body 10 is translucent, and because of its thinness the indicia imprinted on the wad 54 may be readily read through the shell body walls. Thus, the indicia is protected by the shell body, and cannot be smudged or smeared, nor can it come off on the hands or be removed because of abrasion, conditions of moisture and the like. If the walls of the shell body are transparent the indicia will be more clearly visible but we have found that even with translucent plastic material whereby the shell body walls are not perfectly transparent, the indicia may be seen with surprising and remarkable clarity and detail; accordingly such marking means constitutes an important feature of the invention.

In all of the illustrated embodiments of the invention the shell body has the accurately formed integral external flange at its rim, which provides accurate positioning of the shell body in the gun chamber and positive extraction of the shell without dependence on an assembled joint and, the possibility of misalignment of a flange causing jamming, etc.

The embodiment of the invention illustrated in FIGS. 11 and 12 shows, in addition to the sealing means provided by the imperforate wall 78 of the primer base, an additional sealing means associated with the primer 22. It will be understood that the imperforate wall 78 in conjunction with the spinning of the primer base to cause it to be heat-sealed to the shell body, provides a complete and effective hermetic sealing of the entire contents of the shell body. However, such seal excludes the primer 22, and in accordance with the invention an additional seal is provided, associated with the said primer whereby an overall seal of the shell is had. As seen in FIGS. 11 and 12, the primer base 20a is formed with an annular groove 90, preferably at the time that it is molded. Also, immediately adjacent and inside of the annular groove 90 the primer base 20a has an annular raised portion or bead 92 which as shown in FIGS. 11 and 12 has been heat formed over the outer periphery of the flange of the primer 22. The shoulder or bead 92 does not initially have the shape shown in FIGS. 11 and 12 at the time that the primer base is molded, but as will be readily understood, such shape and overlay of the primer periphery is accomplished by a secondary operation which may, for example, comprise a spinning process by which heat is formed to melt the bead. When molding the primer base 20a, the bead or shoulder 92 thus does not have the undercut side wall seen in FIG. 11, but instead

is in the form of a circular or annular rib of generally semi-circular cross section. By such construction, the process of heat forming the rib 92 in the manner illustrated provides an effective seal between the primer base 20a and the primer 22, and insofar as the contents of the shell body are concerned the sealing bead 92 is a supplemental or additional seal, considering the sealing wall 78 as being the primary seal for the shell contents. With the above sealed construction there is avoided any detrimental effects from the presence of moisture around the shell, and accordingly a desirable uniformity of performance is had as a consequence.

The annular recess 90 facilitates removal of the primer 22, in the event the latter is to be salvaged, by rendering the bead 92 more yieldable.

It will now be understood from the foregoing that we have provided by the present invention an improved, practical and feasible plastic shell or cartridge for guns utilizing a novel compressible wad, which shell may be economically fabricated of noncritical plastic or synthetic materials, and which is at the same time of high and uniform quality, and is efficient in the utilization of the power of the impelling charge. A desirable consistency of performance is also obtained as between individual shells. The various individual components may be economically fabricated in large quantities, and the assembly of the components and loading of the shell may be carried out by automatic assembling equipment.

The cellular structure of the compressible and friable plug or wad 54 is characterized by a multiplicity of juxtaposed air or gas spaces or cells, and applicants have used the term "gas-cell structure" in the appended claims to characterize such cellular structure as distinguished from the cellular structure of materials which are commonly regarded as solids, wherein the cells are minute and do not contain air or other gas. Further, in the appended claims, the terms "crushable" and "foam" are used in referring to the compressible wad 54, and applicants intend the term "crushable" to describe any structure which may be readily crushed upon the application of moderate pressures (such as a sponge, for example) as distinguished from cardboard or similar structures which may usually be crushed by the use of tools but which normally may not be readily crushed by hand or similar pressures. The term "foam" as used in the appended claims is in line with common usage of the word in the plastics field, where light, cellular plastic structures are commonly referred to as "foam plastic."

In the appended claims, the concave wall surface 40 of the primer base 20 is referred to as a "recessed wall," since obviously a truly spherical or concave surface is not essential to proper functioning of this component but instead the front portion of the primer base may function properly with virtually any hollowed shape. Thus, the term "recessed wall" is intended to cover various hollow configurations which may be given to the front portion of the primer base 20.

The cup wad 46 is referred to in the appended claims as a "driving wall," since such wad actually drives before it the crushable wad 54 and the charge of shot 18, upon the wad 46 being impelled by ignition of the powder charge 44.

In the present specification and claims, the word "plastic" is used in its broadest sense to designate materials which are non-metallic and which are usually fabricated by molding, extruding, vacuum forming, heat forming, casting, etc. Accordingly, the meaning of this term is to be considered as broad and generic rather than in a restrictive sense, and the term is intended to include not only substances made from synthetic fibers or materials, but also substances made from materials which are found free in nature.

Variations and modifications may be used within the scope of the claims, and portions of the improvements may be used without others.

We claim:

1. A shotgun cartridge comprising, in combination, a tubular molded one piece plastic casing having a cylindrical side wall and an integral substantially smooth and imperforate bulbous transverse front wall constituting a substantially smooth continuation of the front portions of, and joined to the front-most annular edge of, the casing side wall, an entire major portion of said bulbous front wall having appreciably less thickness than the thickness of the side wall of the casing, said front wall having an annular area of appreciable size and continuously of said lesser thickness immediately adjacent the said front-most annular edge of the side wall and the casing having an annular shoulder bordering said area and setting off the thin front wall from the thicker side wall whereby the front wall at said shoulder is relatively readily fracturable and separable from the side wall, thereby to minimize tearing of the side wall; a projectile means carried at the front end of and within the said casing next to said transverse front wall; a readily crushable wad of air-cell structure, disposed in the casing adjacent and to the rear of the projectile means; movable wall means disposed adjacent and to the rear of the crushable wad, constituting a movable transverse driving wall closely fitting within the casing; an impelling charge in the casing, disposed to the rear of the said movable wall means; breech closure means disposed at the rear of the casing for sealing said impelling charge and said casing; and primer means disposed in said breech closure means adjacent the said impelling charge.

2. A cartridge as in claim 1, wherein the front-most portion of the bulbous front wall is located an appreciable distance ahead of the said annular shoulder, and wherein the annular shoulder setting off the front wall from the side wall is disposed externally of the casing and faces axially forward thereof, thereby to effect a close spacing of the said annular area of the front wall from the bore of the gun chamber when the cartridge is disposed in said chamber, said spacing constituting air space into which the said area of the front wall may be forced when the cartridge is fired.

3. A cartridge as in claim 2, wherein the casing has a circular rim at its rear, breech end and constituting its rear edge, and has an integral external annular peripheral flange surrounding said rim and extending to the rear, breech end of the casing, wherein the breech closure means includes a primer base disposed in the casing at the rim thereof, said rim and primer base having respectively cooperable annular engaged internal and external shoulders positioning the primer base in the casing, said external flange on the casing being engageable with a cooperable internal shoulder in the cartridge chamber of a gun to position the cartridge therein when the gun is being loaded, said cooperable annular shoulders of the primer base and casing having common fused fastening portions of annular configuration which are integral with both of the said shoulders and by which the primer base is retained in the casing, said fused fastening portions lying substantially in a plane which is transverse to the axis of the cartridge.

References Cited in the file of this patent

UNITED STATES PATENTS

222,332	Tillmes	Dec. 2, 1879
345,165	Morse	July 6, 1886
1,605,655	Du Pont	Nov. 2, 1926
1,853,262	Dickerman	Apr. 12, 1932
2,286,064	Coxe	June 9, 1942
2,349,840	Babbitt	May 30, 1944
2,559,275	Brown et al.	July 3, 1951
2,582,124	Holmes	Jan. 8, 1952
2,682,222	Richardson et al.	June 29, 1954

13

UNITED STATES PATENTS

2,759,420	Schultz	Aug. 21, 1956	1,110,473
2,819,644	Corcoran	Jan. 14, 1958	65,682
2,920,563	De Caro	Jan. 12, 1960	1,147,004
3,009,387	Puth	Nov. 21, 1961	1,146,646

FOREIGN PATENTS

973,692	France	Sept. 20, 1950	1,168,999
732,633	Great Britain	June 29, 1955	1,183,607

14

France	Oct. 12, 1955
France	Nov. 2, 1955
(Reissue of No. 1,094,753)	
France	June 3, 1957
France	Dec. 27, 1957
France	Mar. 17, 1958
(2nd Addition to No. 1,094,753)	
France	Sept. 8, 1958
France	Jan. 26, 1959