Dec. 1, 1964 G. L. HERTER 3,159,701

INJECTION MOLDING OF PLASTIC AMMUNITION CASE

Filed Dec. 12, 1960 2 Sheets-Sheet 1

FIG. 1

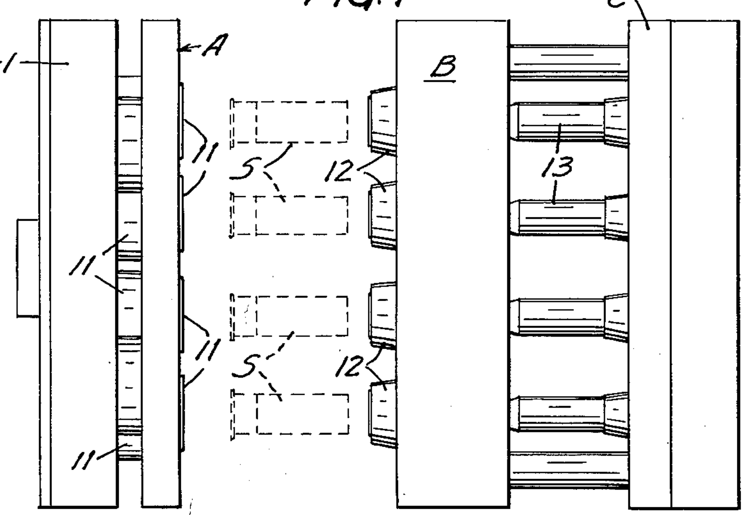


FIG. 10

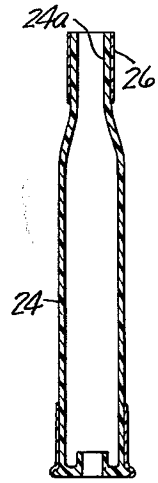
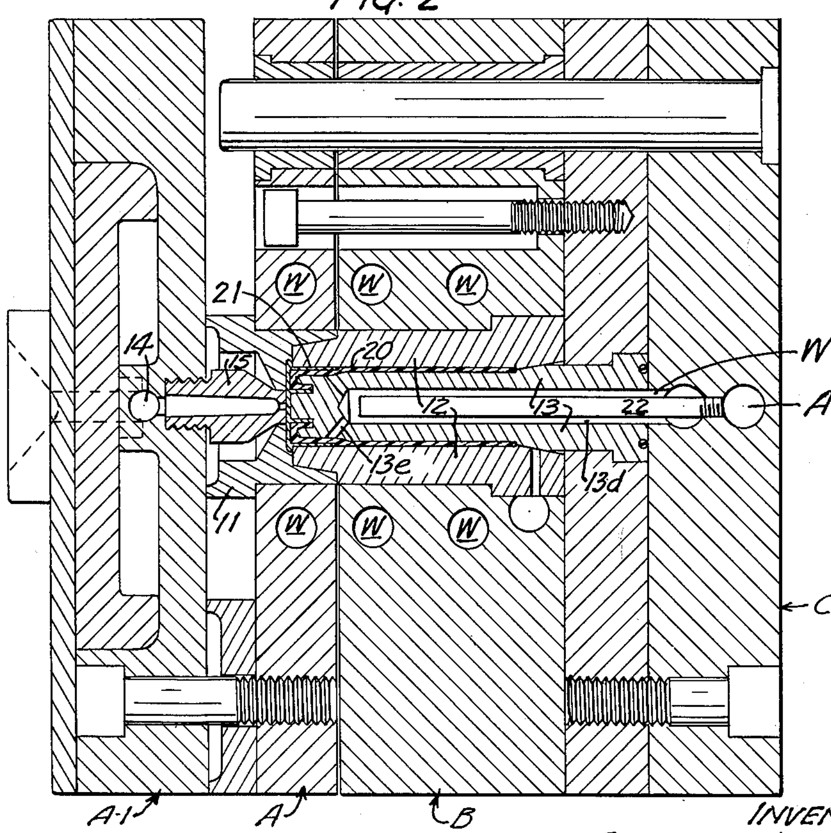


FIG. 2



INVENTOR
GEORGE L. HERTER
BY Williamson & Palmatier
ATTORNEYS

Dec. 1, 1964 G. L. HERTER 3,159,701

INJECTION MOLDING OF PLASTIC AMMUNITION CASE

Filed Dec. 12, 1960 2 Sheets-Sheet 2

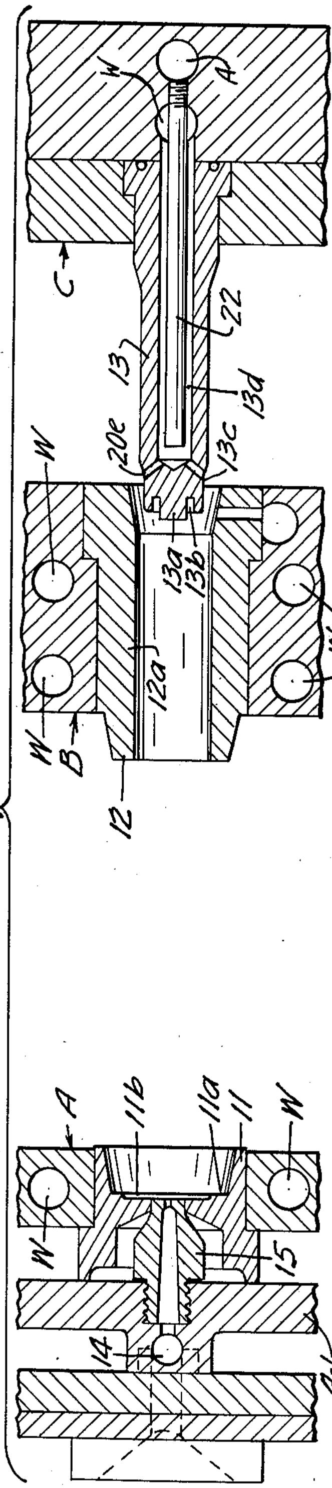


FIG. 3

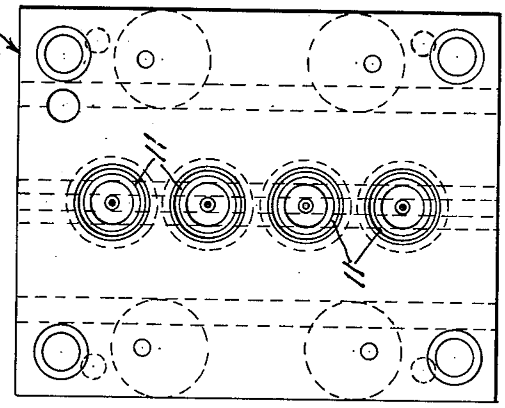


FIG. 5

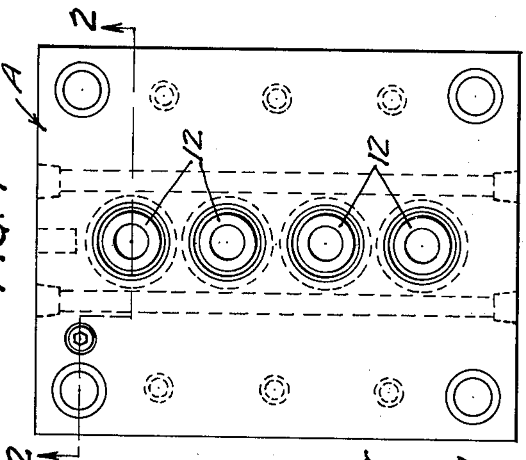


FIG. 4

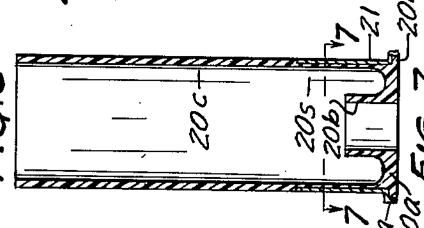


FIG. 6

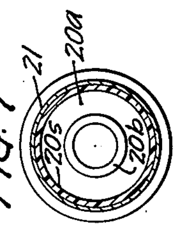


FIG. 7

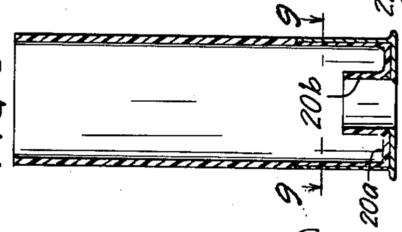


FIG. 8

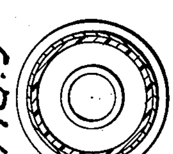


FIG. 9

INVENTOR
GEORGE L. HERTER
BY Williamson & Palmatier
ATTORNEYS

United States Patent Office

3,159,701
Patented Dec. 1, 1964

3,159,701

INJECTION MOLDING OF PLASTIC AMMUNITION CASE

George L. Herter, 929 3rd Ave. NE., Waseca, Minn.

Filed Dec. 12, 1960, Ser. No. 75,305
5 Claims. (Cl. 264—328)

This invention relates to the manufacture of integral or integrated ammunition cases from plastic, wherein a cylindrical case for containing the powder, projectiles or pellets, and the covering wads and including a complete base section with reinforced primer-containing part are integrally and very smoothly formed without presence of seams and preferably without ridges, and wherein the base section is so reinforced that the shells or ammunition can be successively fired in guns where the case of the shell is substantially without support, such an automatic shotguns.

While the process and structure of my invention is particularly applicable to shotgun shells, it is well adapted with integrated tubular reinforcing zone-sections for small arms ammunition and for shell cases of relatively large size used for field artillery and naval purposes.

In the manufacture of present conventional shotgun shells the greater portion of the cylindrical case is constructed from a tube impregnated with paraffin or the like, in some instances a plastic tube, and such tube is telescoped within the sleeve portion of a metallic base member. The sleeve portions of such metallic base members in not only shotgun shell cases, but other small arms and smaller artillery shells are very expensive to manufacture, requiring a large number of "draw" operations which prohibit the use of relatively inexpensive tubularly formed metal stock.

In the case of shotgun shells, connection is made between the telescoped cardboard or plastic tube and the open portion of the metallic sleeve by crimping the metal inwardly against sleeve and telescoped case portion or by crimping the paper tube into the metal base. Such crimping inwardly of the wall of the metal sleeve of course deforms said walls and also the interconnected portion of the cardboard case and the juncture surfaces are not smooth and continuous, resulting in a far-from-perfect seal between metal sleeve and cardboard tube or case. If a plastic tube is used with a metal base, in all instances known at this time, the seal is imperfect and moisture penetrates between the metal sleeve and the interconnected end of the plastic tube.

As is well known, even though the tubular case portions of conventional shotgun shells and the like are heavily impregnated with paraffin or other moisture-resistance material, they will swell and deform when subjected to moisture for even relatively short periods, and permit penetration of moisture within the case. Thereafter, trouble such as jamming in the loading of the magazine, or in the subsequent positioning of shell in breech, or in ejection after firing, often occurs.

It is an object of my invention to provide an integrally molded plastic ammunition case or shell, having wide application for small arms ammunition, and naval or artillery projectile cases with an integral circular base plate or heavy plastic web, having an ejection rim and an integrally formed elongated tubular shell, and capable when desired, of being integrated with one or more, zone-reinforcing sleeves constructed of metal or other strong reinforcing material which may be inexpensively obtained on the market as tubular stock.

A further object is the manufacture and provision of an integral plastic ammunition case of the class described wherein a reinforced circular base plate and elongated cylindrical case extending therefrom, are continuous and integrated, requiring no crimping or other connection of parts and preferably presenting both externally and internally, smooth, generally cylindrical surfaces without seams.

Another object is the provision of an injection-molded, integral plastic shell case which in addition to integral continuous tubular walls has an inherently provided reinforced axial portion in the circular base plate for insertion and support of the primer; and which may be manufactured commercially at low cost by flowing or gating plastic in fluid state to eliminate all seams, and where desired, ridges and discontinuous internal and external surfaces.

A still further object is the manufacture of plastic ammunition cases or shells of the class described which are particularly well adapted for reloading; which will not be distorted or swelled by moisture, nor allow moisture seepage between a plastic tube and metallic base, and which may often employ a reinforcing base sleeve member constructed of metal or other relatively inexpensive tubular stock, said reinforcing sleeve at least partially covering the edge of the rim of the plastic base plate or thickened web and if desired, covering all said rim and encircling the same and even covering the base plate, to strengthen the base portion of the shell and protect the edge of the rim so that the ejector of a gun will not damage the same.

A further object is the provision of a novel and efficient process, of mold and die procedure and steps, with gated injection of a plastic fluid before hardening, to cause the case of the shell to be perfectly formed with flow of the tube uniformly, first radially and outwardly from the injection point through the base plate or web, and then uniformly and tubularly forward through the cylindrical case portion of the shell.

Another important object is the provision of a process of the type described wherein one or more zone-reinforcing sleeves, or a complete base reinforcing section may be embodied in the integrated shell by insertion of a metallic tube, or reinforced plastic fiber tube in certain of the mold cavities before injection of the plastic in fluid state, and in fact, cooperating with certain mold surfaces to provide additions to the overall molding surfaces and whereby the interior wall of the shell from base plate to the outer filling end is continuous and smooth, and the reinforced zone-sleeves are interconnected throughout, flush with the plastic during the setting thereof, thereby providing a tight and efficient seal.

These and other objects and advantages of my invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the similar parts throughout the several views and in which:

FIG. 1 is a side elevation with some portions broken away and others shown in cross section of a form of successful injection molding and die apparatus for carrying out my novel, process shown in the first or mold-separated positions of the parts;

FIG. 2 is a section taken generally along the line 2—2 of FIG. 1, said section being offset as more accurately shown on the section line 2—2 of FIG. 4;

FIG. 3 is a fragmentary longitudinal section with the movable molding and die elements retracted for removal of a completed shell and/or for insertion of a metallic base-reinforcing sleeve, prior to telescoping or compacting of said mold and die elements;

FIG. 4 is a rear end elevation of the mold machine or apparatus;

FIG. 5 is a front end elevation of the same;

FIG. 6 is a cross section taken diametrically and longitudinally through a completed molded shell comprising one form of my invention;

FIG. 7 is a cross section taken on the line 7—7 of FIG. 6;

FIG. 8 is a longitudinal section taken diametrically showing another form of my improved plastic shell; and

FIG. 9 is a cross section taken on the line 9—9 of FIG. 8; and

FIG. 10 is a longitudinal section taken diametrically through a long rifle shell case.

Referring now to the form of ejection molding machine or apparatus illustrated and by which my novel process may be successfully practiced, provision is made as shown, for simultaneously molding four shotgun shells S although it will of course be understood that the mold and die elements, sprues or injection passages and cooling media might be multiplied or reproduced, to of course manufacture simultaneously, a substantially greater number of shells.

Essentially the machine or apparatus illustrated in the drawings comprises three mold die-heads indicated as entireties by the letters A, B and C, one of which, A, contains the external base-molding die **11** and as shown is stationary. The intermediate die-carrying head B has replaceably mounted therein the external shell-case-mold die **12** and said head is mounted for longitudinal movement relative to head A. The third head C has accurately and removably mounted therein the stud die **13** for forming the interior, smooth cylindrical surface of the shell case and which has a cup-forming die section **13***a* at its inner or protruding end for molding the interior of an important base-reinforcing primer pocket. Head C, as clearly shown in FIG. 3 may be retracted substantially beyond the extreme retracted position of head B.

Plastic injection passages **14** formed in the stationary portion of the mold machine (which has attached thereto, the head A) communicate with an axially disposed sprue member **15** for each shell production, removably connected with an intermediate heavy bar A–1 of the head A. The forward and reduced tip of the sprue **15** interfits with a circularly recessed, axial portion of base die **11** to properly gate and control the injection of plastic fluid to cause flow thereof uniformly and radially of the sprue discharge when shell-case-die **12** is thrust inwardly into operative molding poistion as shown in FIG. 2. The gating of the injected plastic fluid then causes flow of the plastic material in tubular form longitudinally and outwardly between the internal, substantially cylindrical molding surface of the shell-case-die **12** and the external generally cylindrical surface of the stud die **13**.

In the injection of the plastic material in fluid form inward longitudinal retractive movements of the heads B and C are correlated and timed by suitable mechanism (not shown), so that the inner extremity of the shell-case-die **12** abuts against an internal, annular shoulder **11***a* of the base die **11**, just prior to the initial injection of the plastic into die **11** and sequentially a slight time interval before the stud die **13** carried by head C moves to its extreme inward position.

It will be understood that head C with the stud die **13** moves inwardly with the head B to define, with the internal molding surface **12***a* of die **12**, an annular thin plastic-receiving mold cavity. The plastic material, in fluid state, flows longitudinally and outwardly in tubular form to substantially fill said annular space between the molding surfaces of dies **12** and **13** prior to the final inward projection of the stud die **13**; whereafter the stud die is moved inwardly to its extreme position leaving its forward extremity in slightly spaced relation to a special slightly recessed base-rim-molding portion **11***b* of the base die **11**. An annular mold-groove **13***b* is formed concentrically in the inner end of the cup-forming section **13***a* of stud die **13**, cooperating with the slightly recessed base rim molding portion **11***b* of die **11** to produce in the finished shell, a somewhat thickened base plate **20***a* and an integral annular primer pocket **20***b*, as shown in FIGS. 6 to 8. At the inner extremity of the shell-case-die **12**, the internal bore is beveled for a slight distance forming a narrow molding annulus **12***b* which cooperates with the base rim molding portion **11***b* of die **11** to provide for and mold the plastic rim **20***r* of the base web of the shell.

The circumference of the molding surface **13***c* from the extremity of stud die **13** rearwardly for the requisite length of a reinforcing metal sleeve is reduced as shown, whereby such a sleeve, designated **21** in the shell of FIG. 6 will be externally and very snugly accommodated in the terminal interior of the bore of molding surface **12***a* of the shell-case-die **12**, with the diminished surface **13***c* in operative molding relation spaced slightly therefrom to provide an integral tubular plastic connection between the thickened base plate **20***a* of the shell and the uncovered portion of the tubular plastic shell case **20***c*. The functional flow of the gated, ejected plastic material with the attendant inward movement of the projecting portion of the stud die **13** and the diminished external molding surface **13***c* causes outward radial force internally of the reinforcing metal sleeve **21** (which becomes part of the molding surface internally) and positively prevents any flow of the plastic material externally of metal sleeve **21**; and simultaneously produces intimate crowding and sealed contact between the cooperating, slightly thickened sleeve portion **20***s* of the plastic case and the metal reinforcing sleeve **21**.

The apparatus includes a synchronized injection control valve (not shown) which is timed and controlled to shut off, thus stopping the cycle of ejection of the plastic in fluid state just prior to the instant stud die member **13** is completely ejected rearwardly with the forward terminal **13***a* then in abutment with the orifice constituting the ejection channel of the sprue **15**.

The cycle of operation then includes a holding or retaining step with the mold parts compacted as shown in FIG. 2, during which time the plastic material then perfectly formed cures or hardens. Thereafter in the cycle of operation the die carrying heads B and C move axially into the ultimate separated positions as shown in FIG. 3.

It is important that a water jacket or cooling means may be provided for circulating a coolant through the jaws and surrounding portions. Several water passages are shown all indicated by the letter W which interconnect with the circulated source of refrigerant or coolant. It is important that the interior of the stud die **13** be cooled and to this end a longitudinal axial passage **13***d* is formed throughout the greater length of the stud die **13** communicating at its outer end with one of the water passages W.

In the apparatus shown air pressure is applied from peripheral portions of the free end of stud die **13** through a series of diagonal radial ports or air passages **13***e*.

Air supply tube **22** connected with air supply passage A communicates with ports **13***e*. As shown air pressure from **13***e* provided for additional outward pressure against the base sleeve portion of the plastic case causing the same to be pressed firmly against the material reinforcing sleeve **21**.

From the foregoing and inspection of FIGS. 2 and 3 of the drawings it will be seen that under pressure during the ejection or mold filling step of my process, the plastic in fluid state ejects from the forward orifice of sprue **15** entering the annular mold cavity and die **11** as related with the opposing end of molding die **12**. The ejected fluid disperses or proceeds to flow uniformly and radially outward from the discharge of the sprue nicely filling the shallow circular base plate mold cavity **11***b* and then through the cooperation of the interior stud die **13** and its surrounding external forming die **12** flowing uniformly in a tubular extrusion into the very thin tubular mold cavity to form the greater part of the length of the cylindrical shell case. The outer end of this thin tubular molding cavity is closed to leave an opening in the shell when the mold carrying dies B and C are fully compacted in the position shown in FIG. 2.

Referring now to the shells shown in FIGS. 6 to 9 are particularly suitable for shotgun shell cases and when on larger scale with some small variations can be utilized for artillery or naval projectile shells.

The shells shown in FIGS. 6 and 7 it will be noted has the thickened circular base plate **20**a (not reinforced by metal or other reinforcing means). The interior shell surface includes the base plate to the outer open end of the shell and is a continuous smooth plastic surface without interruption and has no seams or ridges although if desired the diameter of the plastic sleeve portion **20**s could be somewhat diminished relative to the exposed greater length of the case portion. Reinforced primer pockets **20**b of tubular form are integrally provided in both types of shells shown in FIGS. 7 to 9 inclusive, serving not only to perfectly center and hold the primer but also to substantially reinforce the entire base plate.

In the shell of FIGS. 6 and 7 the metallic reinforcing sleeve **21** has rim-edge engaging portions **21**a which at least partially cover the edges of rim **24**. It will of course be understood that the reinforcing sleeves **21** may have flanges **21**a which completely or partially encircle the edge of the plastic rim **20**r and/or which makes them even under the exposed base plate or may cover parts of the entire base plate **20**a.

In the shell of FIGS. 8 and 9 a complete reinforcing metal base is illustrated. It will of course be understood that the reinforcing sleeves **21** may be constructed of other suitable materials such as fiber-plastic instead of metal.

In FIG. 10 a rifle shell case is illustrated in axial longitudinal section. Here the base portion of the plastic shell is generally similar to that shown in FIGS. 7 and 8.

The plastic case for use in long rifle ammunition has a diminished outer tubular portion **24**a which is reinforced by, as shown, a metal zone-reinforcing sleeve or ring **26**.

It will be understood that with the metallic reinforcing sleeves as shown in FIGS. 6 and 10 of the drawings, ordinary relatively cheap tubular metallic or reinforced plastic stock can be utilized at great saving.

I have found that many types of plastic material are suitable for carrying out my new process and for producing my new articles of manufacture. Both thermoplastic and thermo-setting plastics under proper conditions may be utilized. I have found linear polyethylenes very satisfactory for my purposes. Also, butyrate and polyethylene may be successfully employed.

From the foregoing description it will be seen that I have provided efficient and relatively inexpensive plastic cases for ammunition of numerous types, adapted to be integrated with metallic or other reinforcing sleeves of comparatively inexpensive construction at desired zones (base, projectile accommodating or other in the casing). It will be understood that my invention is equally applicable without the use of metallic or other zone-reinforcing sleeves.

It will be further appreciated that I have provided a commercially operative simple injection molding process for manufacture of said improved ammunition cases, said process throughout the closely cooperating steps of ejection, gating and subsequent uniform tubular flow of the plastic in fluid state assures continuity of all internal and external surfaces of the produced plastic molding eliminating longitudinal seams and when desired, all ridges in the case itself.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. The process of manufacturing integral ammunition cases by plastic injection molding, which consists in axially gating plastic material uniformly in fluid state through a thin tubular mold cavity outwardly from the injection source to form the elongated case of a shell, and prior to said tubular flow, gating said plastic material radially outward through a transverse mold cavity communicating with said tubular mold cavity said material flowing axially into said cavity from an open circular sprue to form an integrally connected shell-base-plate, provided with a rim edge, and while gating said plastic material through said transverse mold cavity, simultaneously applying axial pressure toward said injection source in said transverse mold cavity to substantially assist in the flow of said plastic material radially outward from said injection source, stopping the flow of said plastic material when said mold cavities are filled and producing the hardening of the material in the filled mold cavities.

2. The process of manufacturing integral ammunition cases, by plastic injection molding, which consists in injecting and axially gating and uniformly extruding plastic material in fluid state into an ultimate, elongated, thin tubular mold cavity defined by relatively longitudinally movable inner cylindrical stud and outer substantially concentric die members, said outer die member having cooperating therewith an abutment end surface spaced from the inner extremity of said inner die member to provide an integral base plate in the plastic case, simultaneously applying pressure oppositely from the injection of said plastic material and from the telescopic longitudinal movement of said inner stud die member relative to said outer die member, causing flow of said injected material first uniformly radially through the area of said base web and then longitudinally and uniformly forward and outwardly through said thin tubular mold cavity to positively assure smooth, continuous inner and outer, generally cylindrical surfaces on the tubular case formed.

3. The process set forth in claim 1 further characterized by integrally defining and filling of a small integral cylinder-shaped mold pocket axially and internally of the base section of the case through provision of an annular mold channel concentrically disposed at the inner extremity of said inner die member in cooperation with said end abutment surface.

4. The process of manufacturing integral ammunition cases by plastic injection molding, said cases being of the type having a reinforced circular rear base plate and an integral cylindrical case section extending normal thereto,

which consists in the steps of

centrally and axially injecting plastic material in fluid state from the end of a tubular nozzle into a shallow mold cavity comprising a circular base plate section communicating near its peripheral edge with a forwardly and perpendicularly extending thin tubular passage,

said axial pressure injection being accompanied by simultaneous pressure movement of a cylindrical stud die member toward said circular plate section and the end of said nozzle,

thereby causing initial flow of plastic fluid uniformly and radially outward from said axis of injection, then uniformly in outward annular extrusion through said tubular mold cavity,

and continuing pressure movement of said stud die member until the extremity thereof substantially abuts the forward extremity of said nozzle.

5. The process set forth in previous claim 4 wherein said cylindrical stud die member at its forward operating end carries a cylindrical projection for substantially abutting the forward extremity of said nozzle in full operative position,

and provides a small concentric annular mold passage surrounding said projection for forming an integral apertured cylindrical reinforcing and primer-containing element extending axially and concentrically of said circular plate section.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

2,162,563	Oldham	June 13, 1939
2,193,573	Tackler	Mar. 12, 1940
2,377,393	Wiley	June 5, 1945
2,388,986	Morin	Nov. 13, 1945
2,418,856	Stacy	Apr. 15, 1947
2,684,502	Paulve	July 27, 1954
2,698,464	Wilson	Jan. 4, 1955
2,819,494	Morin	Jan. 14, 1958
2,890,615	Lefebvre	June 16, 1959
2,972,947	Fitzsimmons et al.	Feb. 28, 1961
3,023,458	Seymore	Mar. 6, 1962
3,025,567	Sherman	Mar. 29, 1962

FOREIGN PATENTS

560,315	Great Britain	Mar. 30, 1944