June 8, 1965 A. J. DUFFIELD 3,187,402

METAL CARTRIDGE MANUFACTURE

Filed March 18, 1963 2 Sheets-Sheet 1

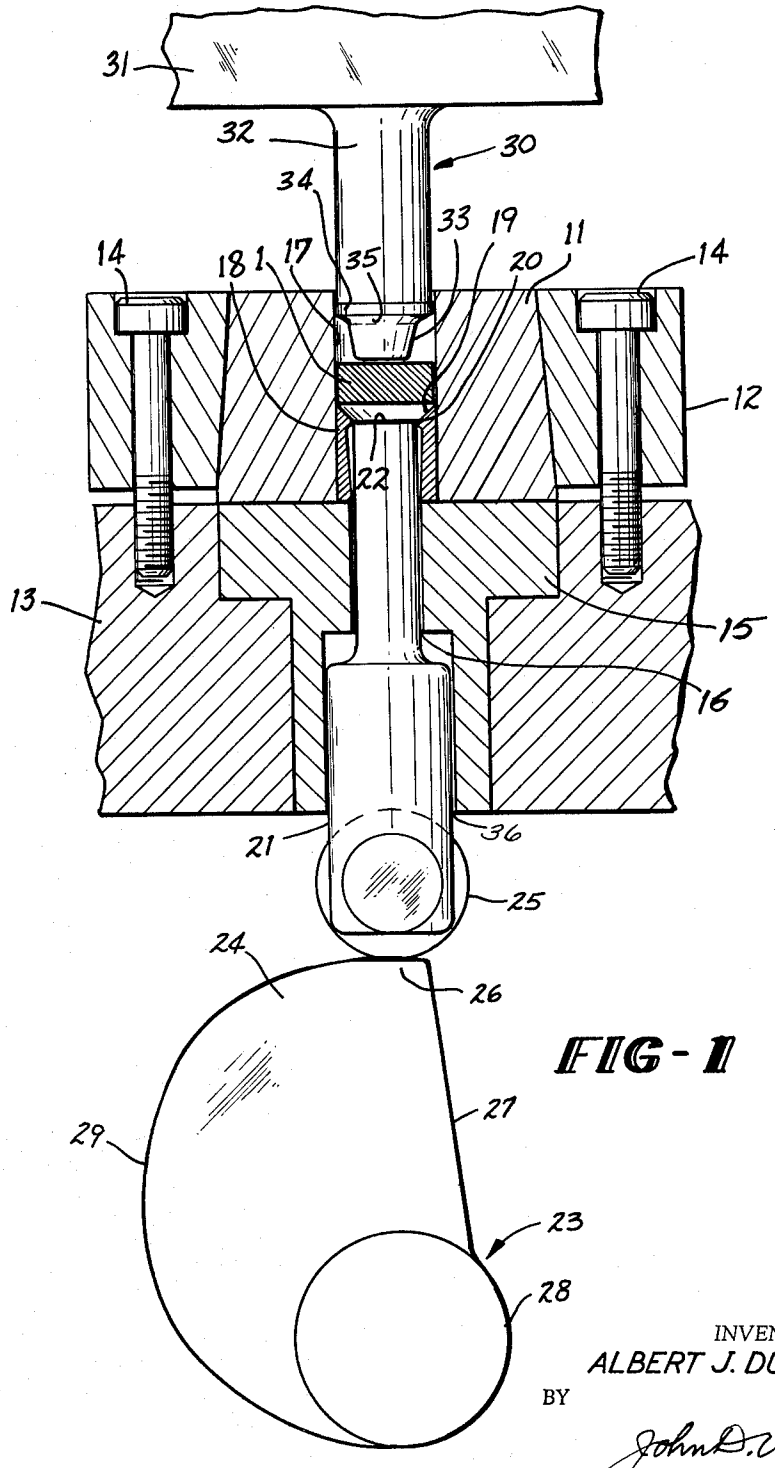


FIG - 1

INVENTOR.
ALBERT J. DUFFIELD

BY

John D. Williams
ATTORNEY

June 8, 1965 A. J. DUFFIELD 3,187,402

METAL CARTRIDGE MANUFACTURE

Filed March 18, 1963 2 Sheets-Sheet 2

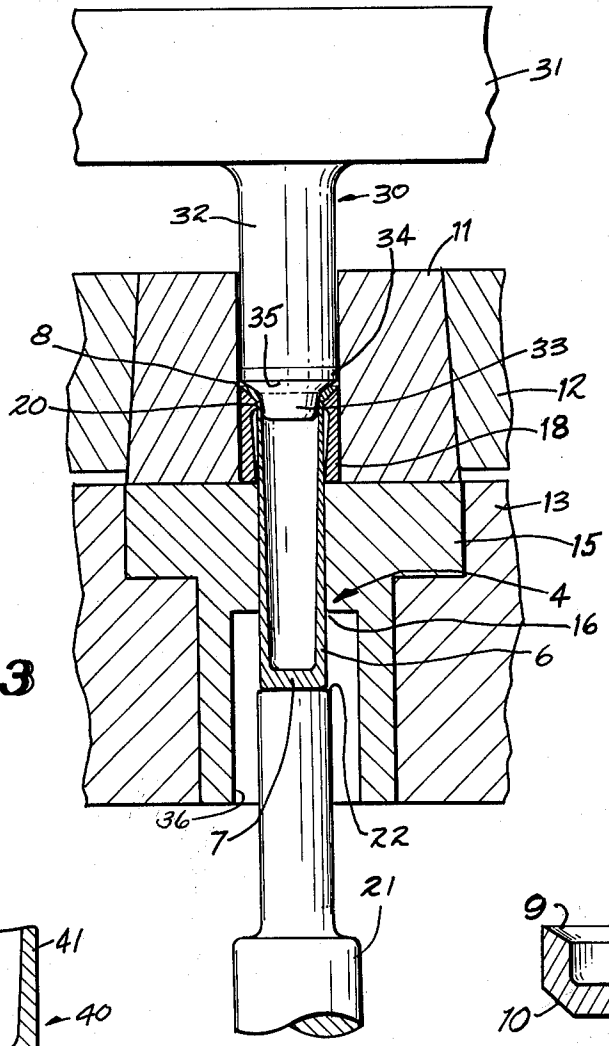


FIG-3

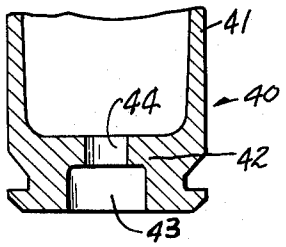


FIG-4

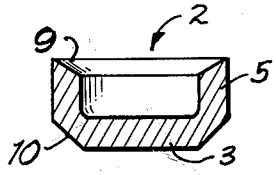


FIG-2

INVENTOR.
ALBERT J. DUFFIELD

BY

John D. Wilkins
ATTORNEY

United States Patent Office 3,187,402 Patented June 8, 1965

3,187,402

METAL CARTRIDGE MANUFACTURE

Albert J. Duffield, Woodbridge, Conn., assignor to Olin Mathieson Chemical Corporation, a corporation of Virginia

Filed Mar. 18, 1963, Ser. No. 265,783
8 Claims. (Cl. 29—1.3)

This invention relates to a method of preparing metal blanks and hollow shells closed at one end for fabrication of articles such as cartridge cases, and specifically relates to a novel method for fabrication of such tubular products at least initially and sometimes largely by impact extruding.

One object of the invention is to produce an improved closed-end tubular product adapted to be finished to a cartridge case with a superior head structure.

Another object is the fabrication of such tubular bodies in an economical manner comprising an impact extrusion modification eliminating the need for a rolling, blanking with the accompanying waste, and either eliminating or reducing the great multiplicity of drawing and annealing operations heretofore employed in conventional methods of making tubular bodies such as shells closed at one end, from rolled sheet metal.

Another object is to avoid in metal shell making the uneven mechanical properties found in hollow metallic bodies produced by extrusion either in a direction countercurrent to the direction of pressing into a blank placed in a mold according to prior methods such as those described in various U.S. patents such as No. 172,333, granted to Meigs; No. 457,767, granted to Bradley; and No. 1,024,840, granted to Ehrhardt; or in the direction of pressing as in the Hooker process, U.S. 922,985.

Other objects and advantages in method, product, and apparatus will be apparent from a description of a specific embodiment illustrated in the accompanying drawings in which:

FIG. 1 is an elevational view partly in cross section of apparatus for impact extrusion in a press by which the invention may be practiced, and showing a blank in cross section in position in the apparatus;

FIG. 2 is a sectional and enlarged view through the cupped blank produced as an intermediate product in the apparatus of FIG. 1;

FIG. 3 is an elevational view partly in cross section showing the apparatus in a subsequent stage of operation shown with the final extruded product ready for ejection and subsequent operations such as trimming, annealing, and final drawing, heading and mouth trimming; and

FIG. 4 is a fragmentary view of a cartridge case shown in cross section at the head and of the case made in accordance with this invention.

Metallic cartridge cases are usually manufactured from rolled strip and the finished cartridge case in being drawn from such stock has the same grain size in the head as that of the rolled stock. Grain refinement for strength here does not occur because of the relatively small working subsequently performed in this area in comparison with which the grain in the tubular wall is considerably finer. Another disadvantage of using blanks from rolled sheets is the high percentage of waste resulting from the necessity of cutting out the blanks, usually round ones. Moreover, there is a tendency to draw the metal irregularly because of oriented graining in the direction of rolling. Production from such cut blanks by direct extrusion in reverse, i.e. up the punch, still produces unfavorable differences in grain structure resulting in a tendency to separation of the head from the tube wall. In an effort to improve the processing, blanks have been cast or sheared from cast bars and then subjected to drawing or extruding, and sometimes the blank has been subjected to a flattening

known as "pancaking" before drawing or extruding, but disadvantages have persisted such as the many low reduction and intermediate handling steps needed in processing by drawing and also the inability to make the head structure more like that of the cartridge tube wall in processing either by drawing or extrusion.

According to the present invention a circular disc, rectangular slug, or the like suitable blank **1** of cast or hot extruded and annealed metal of sufficiently coarse grain structure is directly subjected to impact by a ram to first produce a reverse extrusion of an outside diameter, i.e. transverse dimensions, substantially that of the relatively thick blank, and the resulting extruded shallow cup **2** is then subjected to a forward extrusion driving the metal severely reduced cold by at least about 50 percent in the bottom **3** of the cup through an impact extrusion die of the Hooker type to produce a shell **4** of reduced diameter or dimensions having a tubular wall **6** of desired length and reduction in wall thickness from the annular walls **5** of the extruded cup. As a result the metal in both the side **6** and the base **7** of the shell is worked to a reduction of at least from about 45 percent to about 55 percent, producing a grain of desired structure with orientation extending longitudinally in the side and transversely in the base in continuity with the lines of orientation in the side. Formable metals such as 70:30 brass and aluminum are contemplated; in general, these metals are upset to achieve a total cold reduction of about 50 percent in the bottom of the cup formed at an intermediate stage from the relatively thick blank.

In the final extruded shell **4**, after an anneal, the metal in both the side **6** and base **7** was found to have a remarkable uniformity of worked grain structure, involving a considerable improvement in the base as well as the tubular wall. By anneal is meant the conventional recrystallization annealing heat treatment of metals, such as copper, aluminum, and their alloys, which must have been previously cold worked at a temperature not in the excess of the recrystallization temperature above which upon annealing, a new refined grain structure may occur, provided the metal has been deformed to a reduction while cold. (See Metals Handbook, 7th Edition, pp. 259–263.)

In lieu of a relatively thin and medium grained blank sheared out of rolled sheet metal, disc **1**, shown placed in the press of FIG. 1, is relatively thick and coarse grained in the range of grain size from about 0.150 mm. to about 6.5 mm. It may be, for example, a die-cast slug of brass of coarse grain of from about 0.6 mm. to about 0.8 mm., or a disc cut from a cast rod of brass of very coarse grain larger than 1.0 mm., or a disc cut from extruded and annealed brass rod of from 0.150 mm. to 0.3 mm. grain size.

With the press forming cavity closed at the bottom by plunger **21**, press ram **30** is first lowered to extrude the blank **1** to the intermediate product **2**, after which plunger **21** is released and ram **30** is lowered again to re-extrude the intermediate product to the final extruded shell **4**, excluding scrap ring **8** which is severed by any suitable trimming device.

First, the blank is placed in cylindrical die **11** carried in a stationary die holder **12** and mounted on lower supporting die block **13** by any suitable means as bolts **14**.

Die **11** rests on a supporting ring **15** also carried by the stationary die block **13**. Ring **15** has a central opening **16**.

Die **11** has a die bore **17** aligned with the smaller ring opening **16**; mounted in the bore **17** is a die bushing **18** resting adjacent ring **15** and having a squeeze surface **19** forming the entry to an extrusion constriction formed in the bushing.

Depending upon whether a round or polygonal tube is to be produced, cylindrical die bore **17** is made either

circular, square, rectangular, hexagonal, or of other appropriate transverse dimensions; and disc **1** is of a comparable shape to be received slideably in die bore **17** as shown in FIG. 1.

At the bottom, plunger **21** is reciprocably mounted in the larger ring opening **36** so that the end **22** of the plunger **21** may extend up into die bushing **18** where the plunger end **22** forms a die bottom at the constriction **20** in the stage shown in FIG. 1 and also forms a knockout after the stage shown in FIG. 3. The plunger is supported as shown by any means such as cam shaft **23** having a lobe **24** upon which the plunger roller **25** follows. Die bottom support is provided when roller **25** is at the high point **26** of the cam lobe.

At this position of the die bottom, ram **30**, carried by the upper press block **31**, is lowered into the die bore **17** against disc **1**. Ram **30** comprises a shank **32**, and a tapered forming end or nose **33**, between which there is an outwardly projecting flange or collar **34** having a guide fit in bore **17**. The bottom of the collar **34** has a beveled annular squeeze surface **35** somewhat flatter than the bevel of the die squeeze surface **19**, which facilitates extrusion of the metal in the later stage shown in FIG. 3.

With the parts positioned as shown in FIG. 1, when ram **30** is lowered the disc is cupped to the special shape shown in FIG. 2, by compression in bore **17** between the die bottom formed by bushing surface **19** and fixed plunger end **22** as the nose **33** presses into the metal of the disc.

As a result in the cup the metal in the bottom **3** is subjected to a compressive working of about 50 percent and a side wall extrusion **5** is produced up between the die bore **17** and the ram nose **33**. Here, for example, a brass disc having a weight of about 290–300 grains, a diameter of about 0.750 of an inch and a thickness of about 0.320 of an inch is reshaped at **3** to a thickness of about 0.160 of an inch and a height at **5** of about half of an inch varying in radial thickness from about 0.150 of an inch adjacent bevel **9** to about 0.170 of an inch adjacent bevel **10**.

Ram **30** is put in readiness for the next operation as soon as cam shaft **23** has turned counterclockwise sufficiently to align plunger **21** and its roller **25** first with the cam downgrade **27** and then with the low area **28**. While the cam moves in this way to free plunger **21**, ram **30** is lowered further into the same die so that after cupping by reverse extrusion, a forward extrusion may take place. Both operations occur consecutively in a single stroke or pass of the press by taking advantage of the extreme working of the metal accomplished in cup **2** as nose **33** and collar **34** advance against the metal.

Acting upon the work heated cup formed, ram squeeze surface **35** presses down against the beveled edge **9** of the cup the bottom of which at bevel **10** is thereby pressed against the die entry and squeeze surface **19** causing the metal to extrude forward through the open die bottom between the lateral surface of the tube wall former nose **33** and the die bushing constriction **20** as collar **34** approaches bushing **18** for coaction between the apparatus and cup **2**. Because of the conical shape of nose **33** the thickness of the metal produced as shown in FIG. 3 in the side wall **6** adjacent the bottom **7** will be slightly more than the thickness of the metal in the side wall adjacent the scrap ring **8** left at the end of the forward extrusion operation. In the example illustrated in FIG. 3, the cup having a diameter of about 0.750 of an inch was extruded through a constriction at **20** having a diameter of about 0.525 of an inch. As the tube product **4** is formed, plunger **21** is driven down by the extrusion until the roller **25** rests on the cam shaft low area **28**.

Further counterclockwise movement of cam shaft **23** brings the cam rise **29** into contact with roller **25** for lifting plunger **21** to effect an ejection of the tube product **4** as ram **30** is lifted by upper press block **31**, completing a cycle.

Although both cupping and forming takes place by extrusion consecutively in a single pass of the press, which mounts blocks **13** and **31** and the cam shaft **23**, it will be appreciated that the apparatus may be modified to permit ejection of the intermediate cup product **2**. In this event, the intermediate cup blank must be subjected to an intermediate anneal, where desired, to cleaning, and lubrication prior to reinsertion and further extrusion as shown in FIG. 3. This permits practice of the invention in two stages involving two independent strokes of the press.

By conducting the operation at a suitable speed, the sequence of operation is preferably conducted in a single pass of the press involving reverse extrusion, followed by forward extrusion.

A brass shell product **4** produced according to this invention has its base **7** produced from the compressively reduced central portion **3** of the cup blank and both this and the wall **6** of the extruded piece can both be annealed to about a 0.35–0.40 mm. grain size, a remarkable uniformity of grain refinement. A comparable tube product made from rolled strip stock has a much coarser grain in the base, usually about the same as in the rolled stock because of the little additional working occurring in this area.

The tubular product formed is especially suited for making a metal cartridge case **40**, the improved head of which is shown in FIG. 4 after further fabrication. By remaining finishing steps involving trimming off the scrap ring, annealing, washing, drawing, followed by indenting, heading, and piercing, case **40** is produced having not only a strong finished side wall **41** but also a strengthened head structure at a web **42** adjacent the primer pocket **43** and flash hole **44**.

The present method produces a superior cartridge case and is quicker and less productive of scrap. A significant cartridge case improvement and great saving in cost are made possible, even where an annealing operation is interposed between the cup extrusion and the shell extrusion.

This method makes possible further economy of production from use of various direct cast slugs of substantially uniform weight, size, shape, and composition, not only of the disc type shown in FIG. 1, for example, but also of the drop cast pellet type disclosed in U.S. Patent No. 2,919,471, granted January 5, 1960.

What is claimed is:

1. The method of making a metal shell product closed at its base comprising (*a*) placing into a round die one at a time substantially uniform round blanks of metal received therein in centered relationship and having a coarse grain in the range from about 0.150 mm. to about 6.5 mm., (*b*) pressing each said blank by a ram having a reduced end former centrally in the closed end of said round die receiving said blank and former and thereby compressing the center while simultaneously reverse extruding the marginal edge of said blank to form in said die a cup of said metal having a central bottom compressively cold worked in said die to a reduction of about 50 percent to produce a substantial length of cylindrical wall integral with the margin of said bottom, and then (*c*) pressing said wall lengthwise in said die to subject said margin and wall to a forward extruding around said former and through a reduced die aperture, thereby providing said shell product having a worked tubular section elongated by said pressing of said wall to at least a final increased length and reduced thickness integral with said compressed bottom forming said base, said section worked for grain refinement by said extruding and said base worked for grain refinement by said reduction, substantially equal to the refinement in said section.

2. The method of making a metal shell product closed at its base comprising (*a*) placing into a die one at a time substantially uniform metal blanks slidably fitting in said die and having a relatively coarse recrystallized grain structure, (*b*) pressing each said blank centrally in one

direction toward the closed end of said die receiving said blank in centered relationship for reducing the center and simultaneously extruding the marginal edge of each blank to form said blank to a cup of said metal having a central bottom reduced in thickness in said die by a cold reduction of at least about 50 percent and a cylindrical wall extruded reversely of said direction to a length integral with the margin of said bottom, and (*c*) with said cup in a die having a reduced aperture relative to said cylindrical wall, pressing said wall lengthwise in said direction to subject said margin and wall to a forward extruding through said reduced aperture thereby providing said shell product having a tubular section worked for grain refinement by said extruding and elongated to increased length and reduced thickness integral with said reduced bottom forming said base worked by said reduction for grain refinement substantially equal to said refinement of said section upon subsequent annealing.

3. The method of making a cartridge case from a metal shell product closed at its base comprising (*a*) placing into a die a disc of brass having a coarse grain size relative to that of the worked metal and comparable to that of the cast metal and having a diameter not more than the diameter of said die, (*b*) pressing said disc cold into the closed end of said die of said diameter with a ram of smaller diameter adapted to compress the central portion of said disc by a reduction of at least about 50 percent in thickness to a reduced bottom and simultaneously extrude back the marginal edge portion of said disc to a wall of substantially about the same thickness as said bottom and integral with the margin of said reduced bottom to form a shallow cup, and subsequently (*c*) pressing the wall to extrude said wall and margin with said ram forwardly through a reduced aperture of a die, thereby providing said shell product of elongated shape having a tubular section worked to increased length and reduced thickness for grain refinement and integral with said reduced bottom forming said base, said base worked by said reduction for about the same grain refinement upon annealing, and having opposite said base a residual ring adapted for severance from said wall for finishing said product to the shape of said case including a strengthened head from the grain refined metal at said base.

4. The method of making a cartridge case from a metal shell product closed at its base comprising (*a*) placing in an axially extending die a blank of 70:30 brass having a relatively coarse grain size of from about 0.150 mm. to about 6.5 mm. and transverse dimensions adapting said blank to slideably fit into said die in centered relationship, (*b*) axially pressing said disc cold with a ram into the closed end of said die of substantially the same diameter as said ram having an end former of smaller diameter adapted to compress the central portion of said blank to a reduction of at least about 50 percent and simultaneously extrude back the marginal edge portion of said blank in substantially about the same diameter for forming a cup with a reduced central bottom integral with a round cylindrical wall, and subsequently (*c*) pressing the wall to extrude a substantial part of said wall forwardly and drive said bottom end part through a reduced diameter aperture of a die over said end former of smaller diameter, thereby providing said shell product of elongated shape having a tubular section worked to increased length and reduced thickness for grain refinement of said section integral with said bottom forming said base, said base worked by said reduction for about the same refinement, and having opposite said base a residual ring of said brass adapted for severance from said wall, said refinement being in the range of from about 0.030 mm. to about 0.050 mm. grain size upon annealing of said product.

5. Apparatus for making a metal shell product closed at its base and adapted for metal grain refinement in said base as well as in its tubular section integral with the base

comprising an extrusion die having a bore for receiving a metal blank, fitting in centered relationship in said bore; said die having adjacent one end of said bore an extrusion bushing provided with an annular stationary constriction and a beveled squeeze surface leading from said bore to said constriction; plunger means moveable relative to said die to form in said bore at said constriction a die closure; a ram adapted to slideably fit in and close said bore opposite said die closure, said ram having a reduced leading end providing a metal former adapted for first pressing said blank centrally in said die against said die closure for centrally reducing said blank to a thinned bottom of worked metal and reversely extruding a substantially cylindrical wall of metal up between said die and former; means for imparting relative movement between said ram and closed die to effect said first pressing and reverse extrusion, said ram having a second squeeze surface annularly surrounding said former; and means for withdrawing said plunger from said constriction to provide thereat a reduced die aperture and to further move said ram former into said aperture and said second squeeze surface against said wall for pressing said wall to effect a forward extrusion between said constriction and former, thereby providing said shell product having said tubular section worked to increased length and reduced thickness integral with said base formed from said bottom worked for grain refinement by said first pressing and subsequent annealing.

6. The method of making a shell product closed at its base comprising

(a) placing into a die a blank of metal adapted to be received in centered relationship and having a coarse grain relative to the worked metal and comparable to that of the cast metal,

(b) pressing said blank centrally into the closed end of said die and thereby reducing the thickness of the blank centrally by a cold reduction and simultaneously reverse extruding the blank marginally to form a cup of said metal in said die having respectively a central bottom worked to a reduced thickness and also having integral with said bottom a cylindrical wall worked to a substantial length, and

(c) pressing said wall lengthwise in a die for forward extruding metal in said length about a central former and through a reduced die aperture thereby providing said product having a tubular section elongated by pressing of said wall to at least final length and reduced thickness of said section integral with said bottom forming said base, said base by said reduction and said section by said reverse and forward extruding being worked for more nearly equal grain refinement upon annealing to recrystallize the metal in said base as well as in said section.

7. The method of claim 6 wherein the pressings are such that the base and tubular section are worked to a reduction of at least from about 45 percent to about 55 percent for refinement in the base substantially equal to the refinement in the tubular section.

8. The method of claim 6 wherein the bottom is reduced in thickness by a reduction of about 50 percent.

References Cited by the Examiner

UNITED STATES PATENTS

1,925,823	9/33	Singer	29—1.3 X
2,805,466	9/57	Lyon	29—1.3
2,840,884	7/58	Biginelli	29—1.3

FOREIGN PATENTS

507,071	11/54	Belgium.
5,014	4/92	Great Britain.
627,697	8/49	Great Britain.
834,626	5/60	Great Britain.

RCHARD H. EANES, JR., *Primary Examiner.*