April 7, 1959 A. S. HIGGIN 2,880,686

METAL CAN TOP MANUFACTURE

Filed April 14, 1955 6 Sheets-Sheet 1

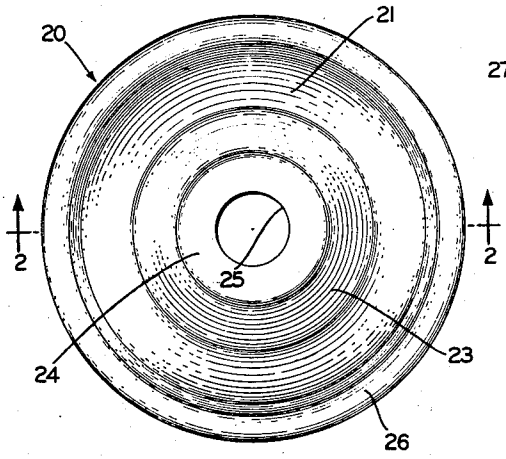


FIG.1

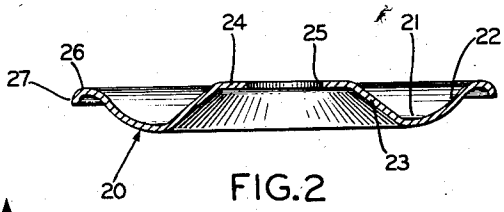


FIG.2

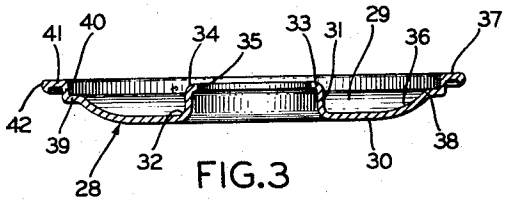


FIG.3

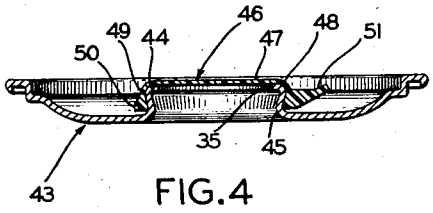


FIG.4

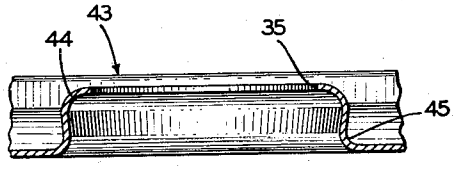


FIG.5

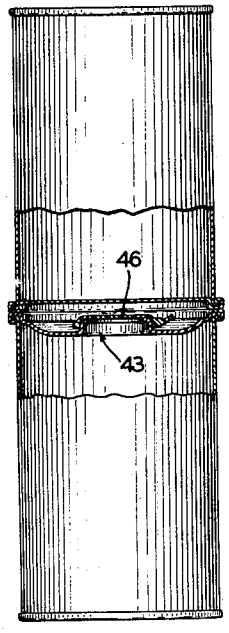


FIG.7

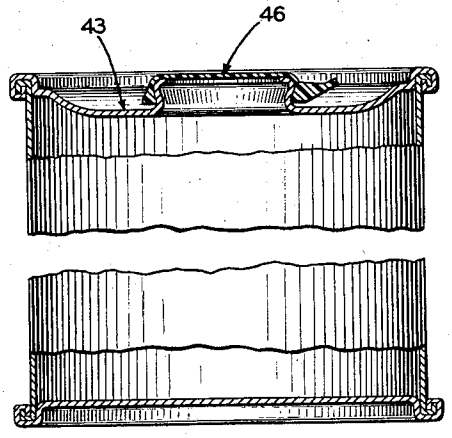


FIG.6

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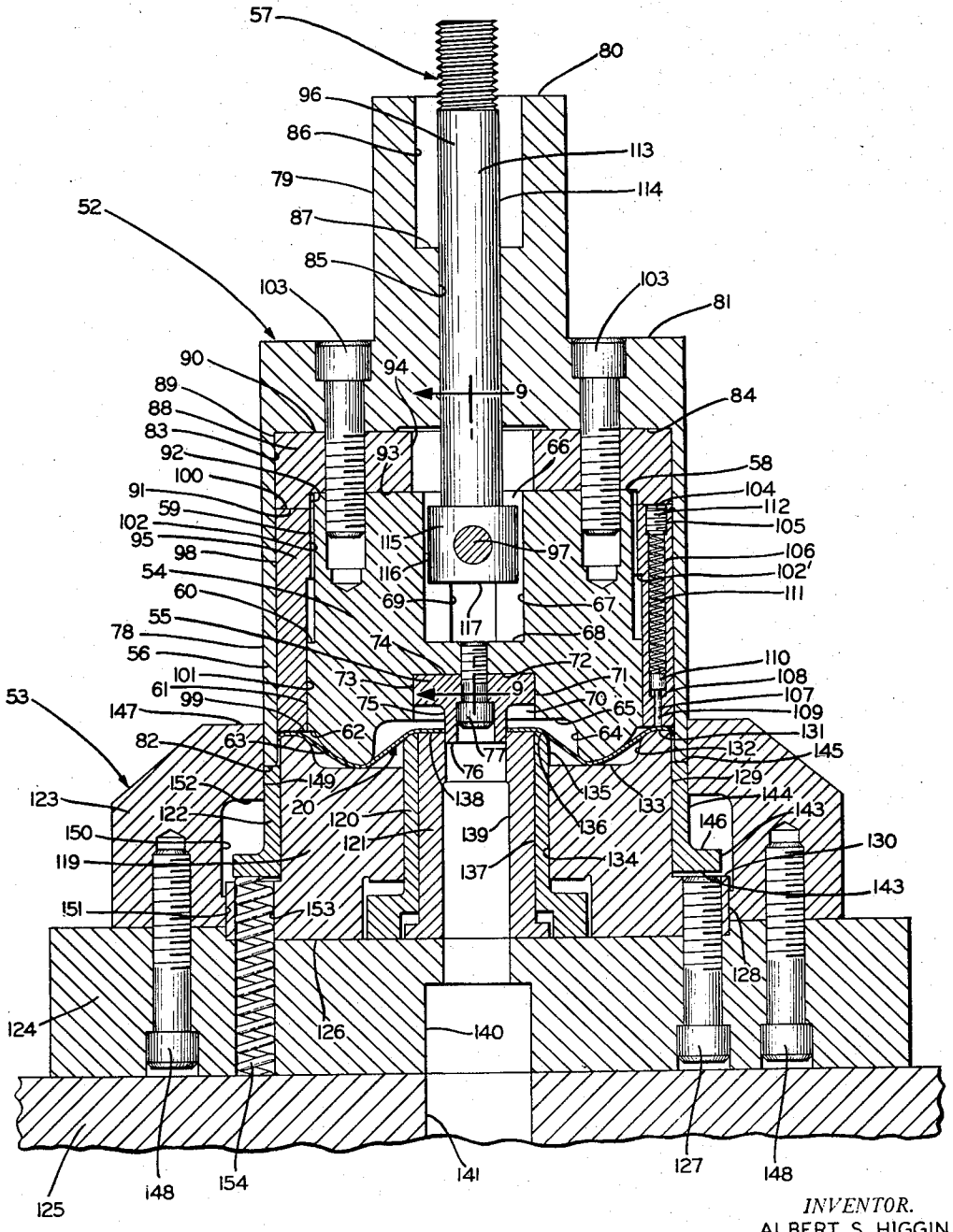


FIG.8

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METAL CAN TOP MANUFACTURE

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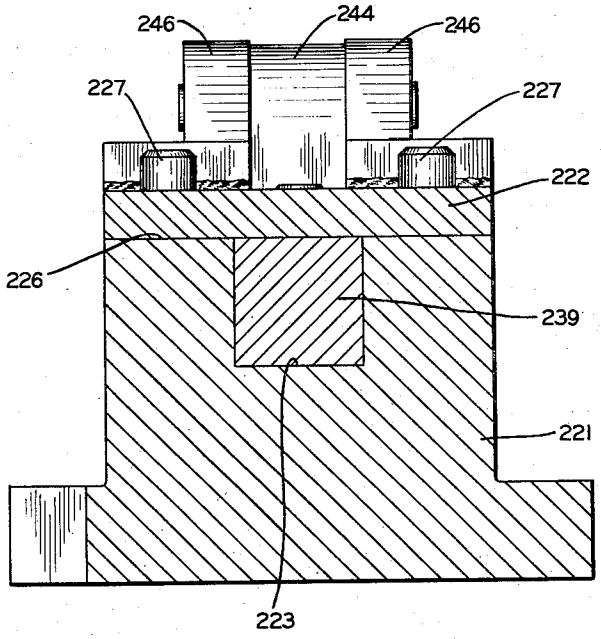


FIG.13

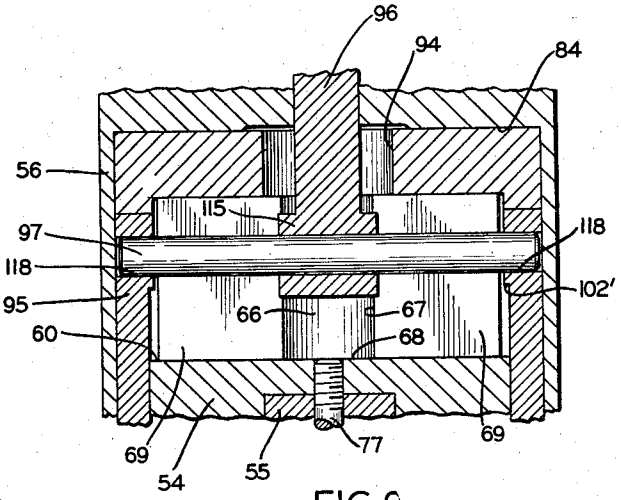


FIG.9

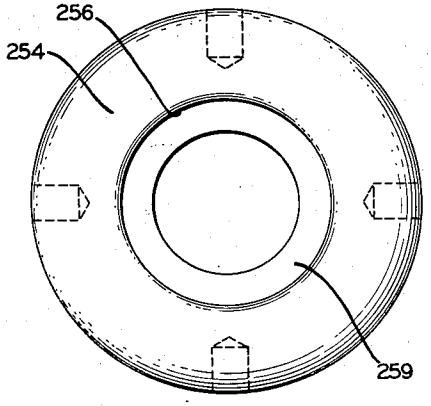


FIG.14

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METAL CAN TOP MANUFACTURE

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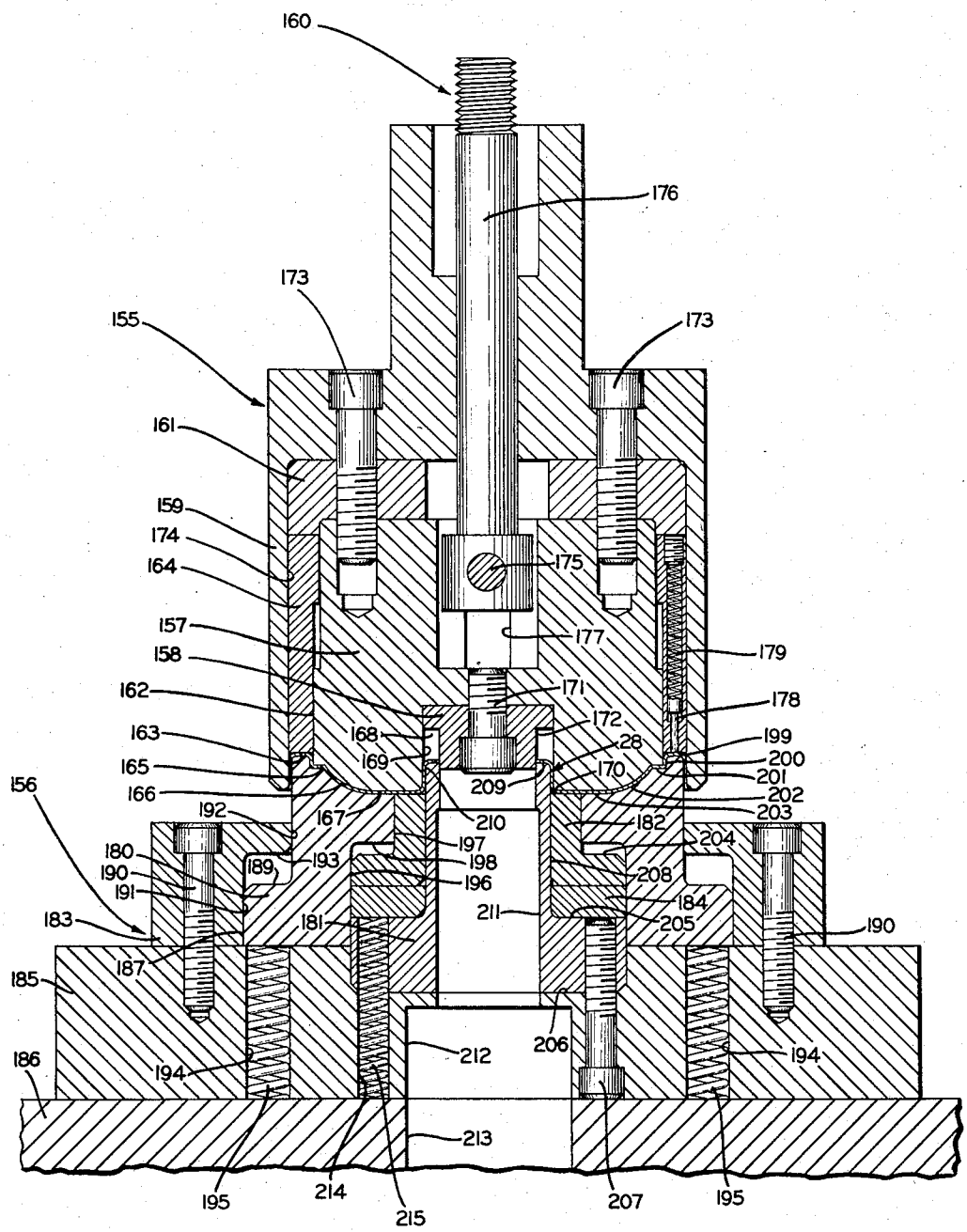


FIG. 10

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METAL CAN TOP MANUFACTURE

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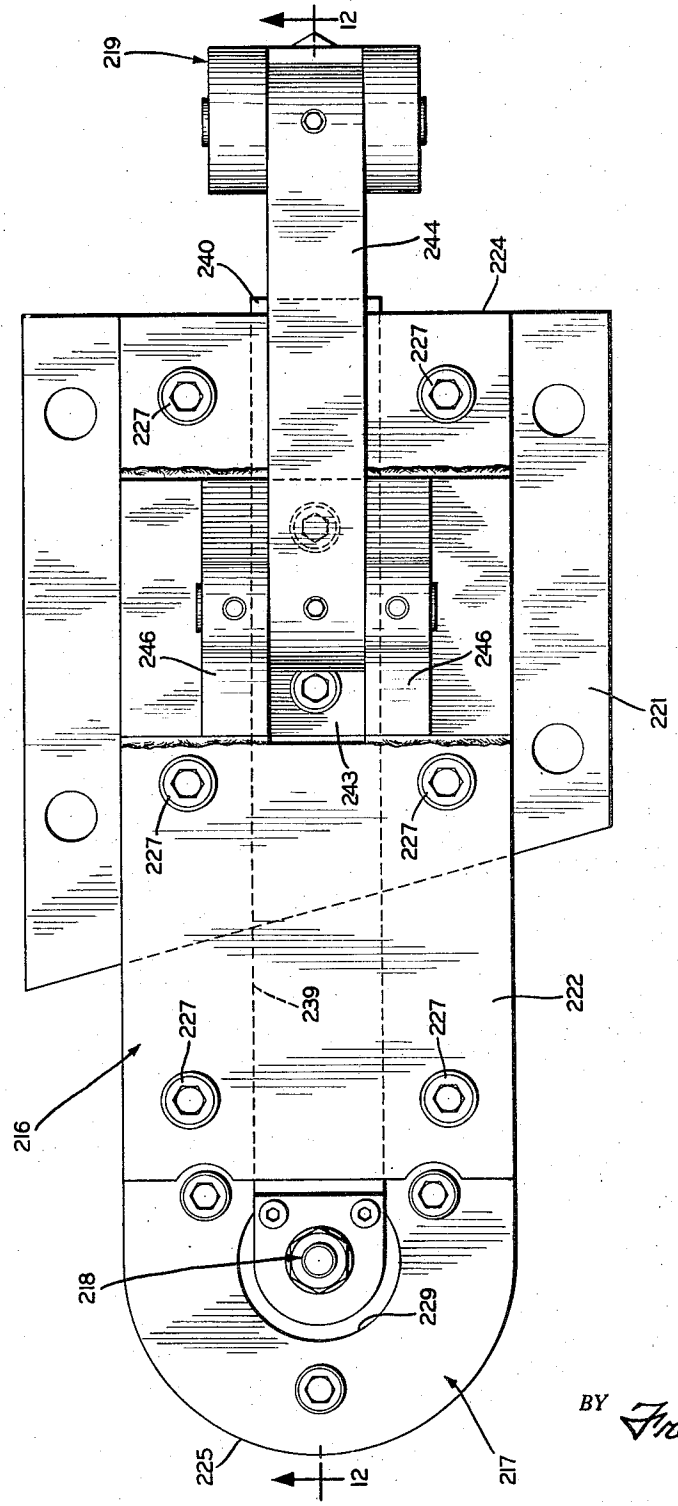


FIG. 11

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METAL CAN TOP MANUFACTURE

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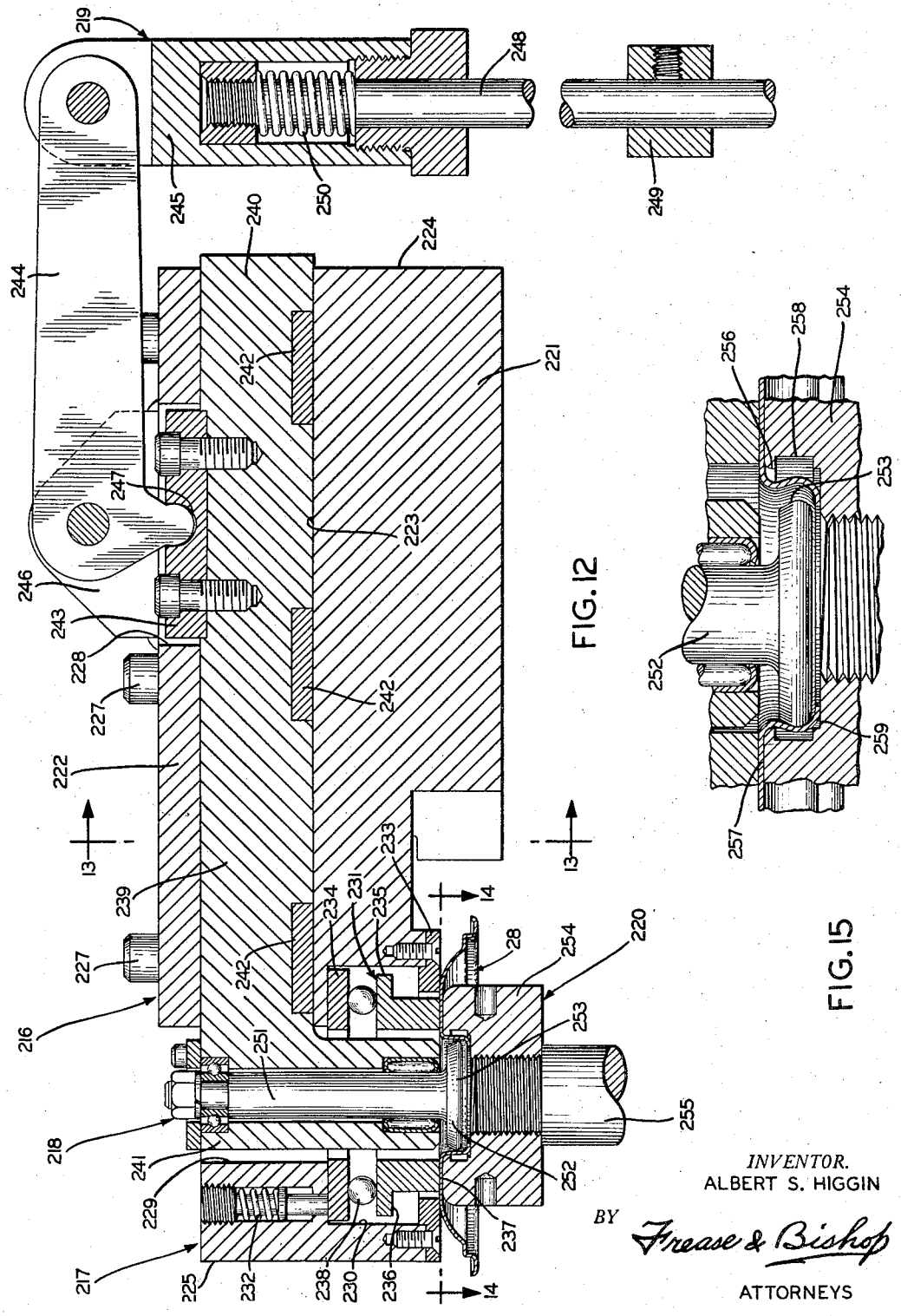


FIG. 12

FIG. 15

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United States Patent Office 2,880,686 Patented Apr. 7, 1959

2,880,686

METAL CAN TOP MANUFACTURE

Albert S. Higgin, Nashville, Tenn., assignor, by mesne assignments, to American Home Products Corporation, New York, N.Y., a corporation of Delaware

Application April 14, 1955, Serial No. 501,341

14 Claims. (Cl. 113—121)

My invention relates to the construction and method of forming metal can tops and more specifically to a construction and method of forming a can top of relatively light gauge metal having an opening for a closure therefor, which closure is completely recessed below the edge portions of the can top.

Various constructions of prior metal cans have been provided with openings in the tops thereof for reception of closures to retain the contents of the can therein. Further, various constructions of can tops and closures therefor have been provided which form a sufficiently tight seal between the can top and the closure to retain material having a relatively high specific gravity in the can, even though the can containing the material is laid on its side or turned completely upside down.

These prior can top and closure combinations fall in three general classifications, that is, those having threads formed around the opening in the can top with a metal or plastic closure threadably received over the opening and engaged with the threads; those provided with an outwardly extending ridge circumferentially surrounding the opening in the can top with a metal or plastic closure received over the ridge and with means on the closure for engaging the ridge; and those provided with a shoulder around the can top opening with a flat metal lid being received therein and retained therein by means of a press fit.

The first two classes of can top and closure combinations, that is, those with threads and those with outwardly projecting ridges formed on the can top, have usually required that the can top be necked upwardly, with the portion of the top containing the opening being spaced a distance above the edge portions of the top and the top edge of the can side walls. A major difficulty with such a can top construction is that cans provided with these upwardly necked tops cannot be conveniently stacked one above the other in shipping cartons or on store shelves, thus requiring larger cartons for transportation of these cans and also requiring a greater storage space for a given number of cans.

It is therefore highly desirable that cans not only be provided with a top having a tight and secure closure for covering the opening in the can top, but also a can top which permits stacking of the various cans, one above the other. This stacking feature not only provides advantages as to size of carton required to enclose and ship a given number of cans and as to the amount of space required for storage, but also from the standpoint that cans having a can top which permits stacking of the cans, one above the other, renders it easier to use a stack of cans on a store counter or floor for display purposes in advertising the product contained therein.

There have been certain prior constructions of can tops which permit stacking. One of these constructions includes a can top which is necked upwardly with that portion containing the opening located above the edge portions of the can top, as described above, and with either a threaded or clincher type closure therefor. In addition,

the bottoms of these cans are recessed upwardly in the shape of an upright cone which is of slightly larger dimensions than the necked top and closure to receive the necked top of the can next below in the stack.

Thus, with this prior necked top construction, one can may be stacked above another and the necked top of the lower can will be received in the recess formed in the bottom of the upper can. Although this type of can provides the stacking feature, it is expensive to manufacture for the reason that both the top and bottom are formed with an irregular contour, that is, not flat. A further difficulty is that this construction of can still requires somewhat more storage space and shipping carton space than can having flat tops for a given number of cans, since the uppermost can still has an upwardly extending necked top requiring additional storage or carton height.

Another prior stacking can construction in the third class outlined above, is one provided with a shoulder around the can top opening with a flat metal lid received in the can top opening and retained therein by a press fit. The lid for this can construction, when in place in the can top opening, is usually recessed below the outer edges of the can top and the side walls of the can, so that these cans may be conveniently stacked one above the other.

One of the difficulties with this type of construction is that the lids or closures are difficult to remove since they are not only recessed below the outer edges of the can top but also are retained therein by a press fit due to the compression of the lid against the edge of the can top opening. It is therefore usually necessary to use a tool, such as a screw driver, in order to remove these lids. Further, after the lids are once removed, they are frequently improperly replaced so that the can is not completely closed, since it requires considerable pressure to properly seat these lids in place within the can top opening.

If the lid or closure for the can top is improperly replaced, there is always presented the danger of accidentally tipping the can over, thereby spilling the contents thereof. This accidental spilling may cause considerable damage, particularly if the material contained in the can is of a composition that will stain floor coverings or is corrosive in nature.

A further consideration is, if the can lid or closure is improperly replaced so that the can is no longer airtight, that constant exposure to the air surrounding the can may cause deterioration to the contents of the can. This is particularly true if the can contains materials such as toilet bowl cleaners. If these materials are exposed constantly to air, they will in many cases not only absorb moisture from the outside air causing them to cake, but also with the addition of such moisture, they may become highly corrosive and eventually completely deteriorate the can.

It is therefore a general object of the present invention to provide a construction and method of making metal can tops which overcome the above-state difficulties in the prior constructions.

It is a primary object of the present invention to provide a construction and method of making metal can tops in which the can top opening with the closure positioned thereon is recessed below the outer portions of the can top and the top edges of the sides of the can, so that the cans may be stacked.

It is a further object of the present invention to provide a construction and method of making metal can tops in which the can top may be provided with a lid or closure which is easily removable by hand without the use of tools.

It is another object of the present invention to provide a construction and method of making metal can tops which can top retains an easily removable lid or closure thereon

in a secure and airtight manner, even though the material contained in the can is of a relatively high specific gravity and the can is upended with the top thereof extending downwardy.

It is still another object of the present invention to provide a construction and method of making metal can tops in which the can top may be assembled with a standard relatively thin gauge metal can by the usual seam-forming operation used in the can industry.

It is an additional object of the present invention to provide a construction and method of making metal can tops, which can top retains an easily removable lid thereon, which lid may be easily replaced thereon, after having been removed one or more times, in a secure and airtight manner with little care being required to properly replace such lid or closure.

Moreover, it is an object of the present invention to provide a new method of forming a small-diameter neck provided with an outwardly overhanging beaded extremity terminating in an inturned flange centrally of a light gauge sheet metal can top, which top also is formed with a chime flange at its periphery, and with the axial length of the neck less than the distance between the bottom surface of the can top and the top surface of the chime flange, the light gauge sheet metal being of the order of .012" in thickness, the can top chime flange diameter being approximately 3.238", and the outer neck diameter being approximately 1.0625" in diameter with a beaded extremity approximately 1.076" in diameter; and to provide a new can top having the stated characteristics.

Finally, it is an object of the present invention to provide a construction and method of making metal can tops, which can top provides all of the above enumerated advantages, but may be made from the usual relatively thin gauge metal from which standard can tops are made, and which can top may be made in a minimum of operations.

These and other objects are accomplished by the parts, constructions, arrangements, combinations, subcombinations, steps, and procedures comprising the present invention, the nature of which are set forth in the following general statements, a preferred embodiment of which—illustrative of the best mode in which applicant has contemplated applying the principles—is set forth in the following description and illustrated in the accompanying drawings, and which are particularly and distinctly pointed out and set forth in the appended claims forming a part hereof.

The construction of can top comprising one aspect of the present invention may be stated generally as including in a sheet metal can top, a preferably downwardly opening preferably U-shaped annular edge portion or chime flange; a generally horizontally extending substantially flat annular center portion positioned at a height spaced below the plane of the edge portion and having a circular hole formed centrally therein; there being an upwardly opening downwardly concave annular recess formed between the edge and center portions preferably having an annular upwardly generally vertically extending wall or neck terminating upwardly at a plane spaced below the plane of the edge portion and integrally connected to the center portion, the recess also having an annular generally horizontal substantially flat bottom wall spaced downwardly from the center portion integrally connected to the neck wall and extending outwardly thereof, the recess also having an annular upwardly extending arcuate concave wall integrally connected to the flat bottom wall extending outwardly and preferably terminating outwardly in a generally horizontal substantially flat portion integrally connected to the edge portion; and said recess vertical neck wall having an annular outwardly extending closure engagement ridge or bead formed therein spaced upwardly from the recess flat bottom wall and preferably downwardly from the center portion.

The method comprising another aspect of the present invention may be stated generally as including the steps of forming a first operation part by the stages of first blanking a circular blank from flat light gauge metal, preferably tin plate or black plate of the order of 0.012" thick; then forming an annular recess in the blank intermediate the center portion and outer edge portion thereof preferably having an upwardly extending arcuate concave annular wall extending outwardly and an upwardly angled substantially flat annular wall extending inwardly; forming an annular arcuate convex outer edge portion outwardly adjacent the recess and terminating in a downwardly curled lip portion at the outer circumference of the blank as the recess is being formed; forming an annular preferably flat generally horizontal center portion inwardly adjacent the recess preferably in the plane of the edge portion as the recess is being formed; forming a circular hole centrally of the center portion; and forming said hole while said recess, edge portion and center portion are being formed.

The improved method also includes the further steps of working the first operation part to form a second operation part by the stages of forming the first operation part edge portion into a downwardly opening generally U-shaped annular chime flange edge portion; at the same time forming the first operation part recess into an annular recess terminating inwardly in an annular upwardly generally vertically extending neck wall projecting upwardly to a plane spaced below the plane of the edge portion; at the same time forming said recess with an annular generally horizontal substantially flat wall extending outwardly from said vertical neck wall, with an annular upwardly extending concave wall between said flat wall and the edge portion, and with the concave wall terminating outwardly in an annular generally horizontal substantially flat portion inwardly adjacent and connected to said edge portion; and at the same time forming the first operation center portion into an annular generally horizontal substantially flat center portion at the upper end of said neck wall located in a plane below the plane of the edge portion; forming a circular hole larger than the first operation circular hole centrally of the center portion; and forming said larger hole during the formation of said edge portion, recess and center portion to permit metal to be drawn from the flat first operation part center portion in forming the neck.

The improved method also includes the further steps of positioning the neck wall of the second operation part within an outwardly circumferentially recessed cavity of a rotatable die, and rolling the extremity of the neck wall within the die cavity to expand the diameter thereof, thereby forming a radially outwardly extending arcuate closure engagement ridge or bead at the extremity of the neck wall spaced from the flat recessed wall portion of the second operation part.

By way of example, embodiments of improved apparatus for carrying out the improved method of making the improved metal can tops of the present invention, and the resulting metal can top construction, are illustrated in the accompanying drawings forming a part hereof, wherein like numerals indicate similar parts throughout the several views and in which:

Fig. 1 is a top plan view of the can top blank made by the method of the present invention after the first operation;

Fig. 2, a side sectional view of the can top blank of Fig. 1, looking in the direction of the arrows 2—2 in Fig. 1;

Fig. 3, a similar view to Fig. 2 of the can top blank further formed by a second operation;

Fig. 4, a similar view to Fig. 2 of the improved finished can top of the invention after forming by a third opera-

tion, with a plastic closure positioned in place over the top opening;

Fig. 5, an enlarged fragmentary view of the top center opening portion of the finished top of Fig. 4;

Fig. 6, a fragmentary side elevation, part in section, of a can having the can top construction of the present invention assembled thereon;

Fig. 7, a side elevation, part in section, of two cans having the can top construction of the present invention, with the cans in stacked position;

Fig. 8, an axial vertical section, part in elevation, of the die assembly for performing the first operation to make the part shown in Figs. 1 and 2;

Fig. 9, a fragmentary axial vertical section, part in elevation, looking in the direction of the arrows **9—9** in Fig. 8;

Fig. 10, an axial vertical section, part in elevation, of the die assembly for performing the second operation to make the part shown in Fig. 3;

Fig. 11, a top plan view of the apparatus for performing the third operation to make the part shown in Figs. 4 and 5;

Fig. 12, a side vertical longitudinal section, part in elevation, looking in the direction of the arrows **12—12** in Fig. 11;

Fig. 13, a side fragmentary vertical lateral section, part in elevation, looking in the direction of the arrows **13—13** in Fig. 12;

Fig. 14, a top plan view of the beading die looking in the direction of the arrows **14—14** in Fig. 12, with the can top part removed; and

Fig. 15, an enlarged fragmentary sectional view of the beading die and roller taken from Fig. 12, with the third operation being performed to make the part shown in Figs. 4 and 5.

The can top construction constituting a part of the present invention is illustrated in Figs. 1 through 7. Figs. 1 and 2 show the can top after the first operation, Fig. 3 the can top after the second operation, Figs. 4 and 5 the can top after the third and final top forming operation, Fig. 6 the top assembled with a typical can, and Fig. 7 two such assemblies in stacked relationship.

Referring to Figs. 1 and 2, the first operation part is generally indicated at **20** and, as shown in Fig. 1, is generally circular in configuration and is preferably formed from flat light gauge metal such as tin plate or black plate of the order of .012" thick. As shown in Fig. 2, part **20** in cross-section is provided with a downwardly projecting recess **21**, which recess is provided with an outwardly extending arcuate generally concave side wall portion **22** and an inwardly extending upwardly angled generally straight wall portion **23**.

Wall portion **23** terminates inwardly in a generally flat horizontal annular portion **24** which is provided with the preferably circular center opening **25**. Concave wall portion **22** terminates outwardly in an arcuate generally convex rim portion **26**, which rim portion terminates at the outer circumference of the part **20** in a downwardly extending lip portion **27**. As shown, the top surface of flat portion **24** preferably lies in the plane of the top surface of arcuate rim portion **26**.

The second operation part shown in Fig. 3 and generally indicated at **28**, is formed from the first operation part **20**. In the second operation, a different configuration of recess **29** is formed.

Recess **29** is formed with a generally horizontal flat bottom portion **30**. Portion **30** terminates inwardly in a generally vertical upwardly extending neck wall portion **31**, with portions **30** and **31** being preferably joined by a rounded corner **32**.

Vertical portion **31** terminates inwardly in a generally flat horizontal annular flange portion **33**, with portions **31** and **33** preferably being joined by a rounded corner **34**. Flat portion **34** terminates inwardly in a preferably circular center hole **35**.

Flat bottom portion **30** terminates outwardly in an outwardly extending arcuate generally concave portion **36** which extends upwardly to a rim portion **37**. Portions **36** and **37** are preferably joined by a rounded corner **38**.

Chime flange rim portion **37** is formed with a preferably flat generally horizontal portion **39** which is connected to the arcuate concave portion **36** by the rounded corner **38**. Portion **39** extends horizontally outwardly and is connected at substantially right angles to the generally vertical upwardly extending portion **40**. Portion **40** extends upwardly and is connected at substantially right angles to the upper rim generally horizontal flat portion **41**, which portion **41** terminates outwardly at the outer circumference of part **28** and is there connected at substantially right angles to the downwardly extending lip portion **42**.

The height of flat annular portion **33** of part **28** is a predetermined amount less than the height of the flat horizontal portion **41** forming a part of the rim portion **37**, for a purpose to be hereinafter described. Also, the vertical distance between the plane of the flat annular portion **33** and the plane of the flat bottom portion **30** forming the bottom wall of the recess **29** is predetermined, for a purpose to be hereinafter described.

The third operation part **43** is formed from the second operation part **28** and is identical to part **28** with the exception that the upwardly extending vertical neck portion **31** of part **28**, in the third operation, is formed or beaded circumferentially outwardly into a generally S-shape, as shown in Figs. 4 and 5. Thus, part **43** is provided with the outwardly extending arcuate closure engagement ridge or bead **44** and the inwardly curved undercut portion **45**. As shown, the maximum outer diameter of ridge portion **44** is greater than the maximum diameter of undercut portion **45**.

The finished can top, shown in Fig. 4 as the third operation part **43**, is secured to a usual cylindrical, flat-bottom can as shown in Fig. 7, by a usual seaming operation used in the can making industry. Rim portion **37**, shown on part **28** in Fig. 3 and part **43** in Fig. 4, with the vertical portion **40**, flat horizontal portion **41** and lip portion **42**, is the usual chime flange of any can top; and the novelty of the improved can top construction of the present invention relates to the construction of the can top inwardly of the rim portion, and to the relation of this construction to the rim portion.

The finished can top generally indicated at **43** in Fig. 4, is preferably used in combination with a plastic closure generally indicated at **46** in Fig. 4. Closure **46** is preferably provided with a flat top portion **47** which terminates outwardly in a downwardly rounded corner portion **48**; and closure **46** is also formed with a downwardly extending generally vertical inwardly tapered side portion **49**. Portion **49** is provided at its lowermost end and on the outer circumference thereof, with an outwardly extending bead portion **50**, which bead portion is formed at one point around the circumference thereof into an outwardly extending upwardly angled tab portion **51**.

Closure **46**, as shown is positioned with the flat top portion thereof closing the center hole **35** of part **43**, and with the rounded corner portion **48** of closure **46** tightly abutting the rounded corner portion **34** of part **43**. Also, the inwardly tapered side portion **49** of closure **46** engages the engagement ridge or bead **44** of part **43**, with side portion **49** of closure **46** also tightly gripping the undercut portion **45** of part **43**.

Thus, closure **46** tightly closes the center opening **35** in part **43**, and the upwardly angled tab portion **51** extends radially outwardly within the recess **29** of part **43**. Since tab portion **51** angles upwardly, a space is provided between the tab portion **51** and the flat bottom portion **30** of part **43** so that it is possible for a person to place the end of a finger under tab portion **51** and disengage closure **46** from the part **43**.

As seen in Fig. 4, horizontal annular portion 33, which surrounds the preferably circular opening 35 of part 43, is spaced a sufficient distance below horizontal portion 41, forming a part of the rim portion 37 of that part, so that when the plastic closure 46 is engaged with ridge 44 and covers the center opening 35, the flat top portion 47 of closure 46 is below the horizontal portion 41 of part 43. Thus, when the finished can top, indicated by 43 in Fig. 4, is seamed to the vertical side walls of a standard can as shown in Fig. 6, the uppermost portion of the closure 46 is below the uppermost portion of part 43, so that cans so assembled may be stacked one above the other without the closure 46 interfering with the bottom of the can stacked thereabove, as shown in Fig. 7.

One of the major problems of forming the can top construction of the present invention, the final form of which is illustrated in Figs. 4, 5, 6 and 7, is the forming of the beaded neck 31 in a can top having a relatively small outer diameter and chime depth so that such can top may be seamed to a conventional size of can, as illustrated in Figs. 6 and 7. Further, such a small diameter top also must be formed with a neck portion 31 and horizontal annular portion 33, such as shown in the second operation part in Fig. 3, and also with such neck portion formed with an adequately sized but small center hole 35 and with the horizontal portion 33 spaced below the horizontal rim portion 41. Finally, such a can top also must be formed from relatively thin gauge metal in a minimum of operations so that the cost thereof is not prohibitive.

For instance, the second operation part, illustrated in Fig. 3, is formed having an overall outer diameter of about 3.238", with the outer diameter of the neck portion, that is, the outer diameter of the vertical portion 31 shown in Fig. 3 being about 1.0625". Further, it is necessary to provide a rim portion 37 having a width of about 0.2815" in order that the horizontal portion 39, vertical portion 40, horizontal portion 41 and lip portion 42, as shown in Fig. 3, may be seamed to a can body by a usual seaming operation. Thus, the outer diameter of the recess 29, as shown in Fig. 3, is 2.675" with the width thereof being 0.80625".

In the finished or third operation part, the depth of the flat bottom portion 30 of the recess 29 from the top of the rim portion 37 as shown in Fig. 4, is 0.29688", and the height of the neck portion, that is, the distance from the bottom portion 30 of recess 29 to the horizontal portion 33 is 0.21875", so that the top of the neck portion or the horizontal portion 33 is spaced 0.07813" below the horizontal portion 41 of the rim portion 37. Thus, sufficient clearance is provided between the top of the neck portion and the top of the rim portion so that when the closure 46 is positioned on the neck portion, closure 46 will be spaced below or at least not extend above the horizontal portion 41 of the rim portion 37.

In the third operation, the neck portion, that is, the vertical portion 31, as shown in Fig. 3, is roller formed outwardly forming the closure engagement ridge 44 and the undercut portion 45, as shown in Figs. 4 and 5, so that the closure 46 may engage the ridge 44 and will be securely retained thereon. In this third operation, the neck portion is formed from an outer diameter of 1.0625" to an outer diameter of 1.076" at the closure engagement ridge 44. Except for the height and the outer diameter of the neck portion, the dimensions of the part do not change in the third operation.

Finally, the can top having the above dimensions and complicated configuration of rim portion, recess and neck portion is formed, with the various portions having the relative dimensions set out above, from 0.012" thickness tin plate or black plate. It is possible to form such a can top construction in only three operations, by use of the improved method of the present invention as hereinafter described.

The preferred construction of apparatus for forming the can top construction of the present invention and for performing the three operations included in the method of the present invention, are illustrated in Figs. 8 through 15. The apparatus for performing the first operation is illustrated in Figs. 8 and 9. The apparatus for performing the second operation is illustrated in Fig. 10, and the apparatus for performing the third operation in Figs. 11 through 15.

As illustrated in Figs. 8 and 9, the apparatus for performing the first operation includes an upper punch and shedder assembly, generally indicated at 52, and a lower die assembly, generally indicated at 53, both of which are preferably formed of steel. The upper assembly 52 includes a form punch 54, a center punch 55, a blanking punch 56 and a shedder assembly indicated at 57.

The form punch 54 is generally cylindrical in cross-section having a generally flat top end surface 58. The outer circumferential side surface of punch 54 is formed of one diameter from the top end surface 58, to within a distance of the lower end of punch 54, forming the small diameter side surface portion 59. At the lower end of side surface portion 59, an outwardly extending shoulder 60 is formed and a large diameter side surface portion 61 extends from shoulder 60 to the lower end of the punch 54.

The lower end of the punch 54 is formed with a relatively narrow flat annular horizontally extending surface portion 62 extending from the side surface 61 inwardly into a downwardly projecting arcuate convex surface portion 63. Convex surface portion 63 terminates inwardly in an upwardly extending inner cylindrical surface portion 64, with portion 64 extending upwardly to a generally horizontally extending flat surface 65.

A cylindrical hole 66 is formed axially within punch 54, extending from the top end surface 58 downwardly to within a distance of horizontal surface 65, forming the side cylindrical surface 67 and the generally flat horizontal bottom surface 68. A diametrical slot 69 is formed completely through punch 54, which slot is of the same length as the hole 66 and passes diametrically through hole 66. Also, a hole 70 is formed axially within punch 54 extending upwardly from horizontal surface 65 to within a distance of the bottom surface 68 of hole 66, forming the side cylindrical surface 71 and the horizontal top surface 72.

The center punch 55 is generally cylindrical in configuration having a large diameter outer circumferential surface portion 73 of a slightly smaller diameter than the diameter of the side cylindrical surface 71 of hole 70. Center punch 55 is received in the hole 70 with the large diameter outer surface portion 73 abutting the side cylindrical surface 71, and with the top generally horizontal flat surface 74 of punch 55 abutting the horizontal top surface 72 of hole 70.

Large diameter surface portion 73 of center punch 55 extends from the horizontal top surface 72 of hole 70 downwardly to within a distance of the lower end of side cylindrical surface 71 of hole 70, where the center punch 55 is formed into a small diameter outer circumferential surface portion 75. Small diameter surface 75 extends downwardly to a point spaced below the horizontal flat surface 65 of form punch 54, where the center punch 55 is provided with a flat generally horizontal lower end surface 76. Center punch 55 is fixedly secured in hole 70 of form punch 54 by a cap screw 77, which screw is received axially through center punch 55, countersunk below the lower end surface 76, and is threadably received in the form punch 54.

Blanking punch 56 is generally hollow cylindrical in configuration having the large diameter outer circumferential surface 78 extending from a point approximately radially aligned with the lowermost point of the downwardly projecting convex surface portion 63 of form punch 54. Surface 78 extends upwardly to a point

spaced above and radially outwardly of top end surface 58 of punch 54.

Small diameter outer circumferential surface 79 of blanking punch 56 extends upwardly from a point radially aligned with the upper end of surface 78 and terminates in an upper radially extending end surface 80. Surfaces 78 and 79 are connected by a radially extending shoulder surface 81, and at the lower end of surface 78 is formed the radially extending lower end surface 82.

A circular opening is formed axially through blanking punch 56 forming the large diameter inner circumferential surface 83 extending from the lower end surface 82 upwardly, with surface 83 being radially spaced outwardly from the side surface portions 59 and 61 of form punch 54. Surface 83 terminates upwardly in a generally horizontal or radially extending surface 84, which surface 84 is spaced a distance above the top end surface 58 of form punch 54 and spaced downwardly from the shoulder surface 81 of blanking punch 56.

A small diameter opening is formed axially of and extending upwardly from the radially extending surface 84, forming the small diameter inner circumferential surface 85, with surface 85 terminating at a point spaced downwardly from the upper radially extending surface 80. Surface 85 terminates upwardly in an increased diameter opening forming the increased diameter inner circumferential surface 86, which surface 86 terminates at the upper radially extending end surface 80, with surfaces 85 and 86 being connected by a radially extending shoulder surface 87.

A shim member 88 is received within the blanking punch 56, which shim member is generally cylindrical in configuration and is provided with an outer circumferential surface 89, a radially extending upper end surface 90 and a radially extending lower end surface 91. Shim member 88 is positioned with the outer circumferential surface 89 abutting the large diameter inner circumferential surface 83 of blanking punch 56, and with the upper end surface 90 of shim member 88 abutting the radially extending surface 84 of blanking punch 56.

Shim member 88 is also formed with an axially extending large diameter opening forming the large diameter inner circumferential surface 92, which surface extends from the lower end surface 91 of shim member 88 upwardly. Surface 92 terminates upwardly in a radially extending surface 93, which surface 93 connects surface 92 with a small diameter inner circumferential surface 94. Surface 94 extends upwardly from radial surface 93 to the upper end surface 90 of shim member 88, with surface 94 having a diameter larger than the cylindrical surface 67 of hole 66 formed in the form punch 54.

The shedder assembly 57 includes a generally hollow cylindrical shedder member 95, a cylindrical shedder stem 96 and a cylindrical bail pin 97. Shedder member 95 is provided with an outer circumferential surface 98, a lower radially extending end surface 99 and an upper radially extending end surface 100. Shedder member 95 is also provided with a large diameter inner circumferential surface 101, extending upwardly from the lower end surface 99 to a point spaced downwardly from the upper end surface 100, and the small diameter inner circumferential surface 102, extending from the upper end of surface 101 to the upper end surface 100, forming the radially extending shoulder 102'.

As before stated, the shim member 88 is received within the blanking punch 56, with the upper end surface 90 of member 88 abutting the radially extending surface 84 of blanking punch 56. Form punch 54 is received within shim member 88, with the small diameter side surface portion 59 of punch 54 spaced radially inwardly from the large diameter inner circumferential surface 92 of shim member 88, and with the top end surface 58 of punch 54 abutting the radially extending surface 93 of shim member 88.

Form punch 54, blanking punch 56 and shim member 88 are held in assembled position, as shown in Fig. 8, preferably by the radially spaced cap screws 103, which cap screws are received through the shoulder surface 81 and radially extending surface 84 of blanking punch 56, the upper end surface 90 and radially extending surface 93 of shim member 88, and the top end surface 58 of form punch 54. Bolts 103 are countersunk below the shoulder surface 81 of blanking punch 56, and threadably received in form punch 54.

Shedder member 95 is slidably received between the form punch 54 and the blanking punch 56, with the outer circumferential surface 98 of shedder member 95 abutting the large diameter inner circumferential surface 83 of blanking punch 56. Also, the large diameter inner circumferential surface 101 of shedder member 95 abuts the large diameter side surface portion 61 of form punch 54, and the small diameter inner circumferential surface 102 of member 95 is spaced from the small diameter side surface portion 59 of punch 54.

When the upper punch and shedder assembly 52 and the lower die assembly 53 are in closed position, as shown in Fig. 8, the lower end surface 99 of shedder member 95 is approximately in radial alignment with the flat annular surface portion 62 of form punch 54. Further, the upper end surface 100 of member 95 abuts the lower end surface 91 of shim member 88, with shoulder 102' of member 95 being spaced upwardly from shoulder 60 of form punch 54.

Radially spaced axially extending holes 104 are formed through the shedder member 95, with each hole having a screw-receiving portion 105, a spring-receiving portion 106 and a reduced diameter pin-receiving portion 107. Screw-receiving portion 105 extends from the upper end surface 100 a distance downwardly, with spring-receiving portion 106 extending from portion 105 downwardly to a point spaced above the lower end surface 99 and pin-receiving portion 107 extending from portion 106 to lower end surface 99. Since portion 107 is of a smaller diameter than portion 106, the shoulder 108 is formed therebetween.

Shedder pins 109 are received through pin-receiving portions 107 in holes 104, with pins 109 each being provided with a large diameter head portion 110, which is received within each of the spring-receiving portions 106 engageable with shoulders 108. A helical spring 111 is received in each of the spring-receiving portions abutting the head portions 110 of shedder pins 109, with springs 111 extending upwardly and abutting the set screws 112, which screws are threadably received in the screw-receiving portions 105 of holes 104. These spring-loaded shedder pins are for a purpose to be hereinafter described.

Shedder stem 96 is provided with a small diameter portion 113 extending from the upper end thereof over the greater portion of the length of stem 96, forming the small diameter outer circumferential surface 114. Stem 96 is also provided with a large diameter portion 115 extending from the lower end of portion 113 downwardly to the lower end of stem 96, forming the large diameter outer circumferential surface 116, with the lower end of portion 115 being provided with a radially extending stem bottom surface 117.

Shedder stem 96 is received in slidable relation within form die 54, shim member 88 and blanking die 56, with the small diameter outer circumferential surface 114 of small diameter portion 113 spaced from the increased diameter inner circumferential surface 86 and abutting the small diameter inner circumferential surface 85 of blanking punch 56. The outer surface 114 of stem 96 also extends through shim member 88 spaced from the small diameter inner circumferential surface 94 of member 88, with surface 114 also extending downwardly a distance within hole 66 of form punch 54.

The large diameter portion 115 of shedder stem 96 is received within hole 66, with the large diameter outer

circumferential surface 116 preferably spaced from the side cylindrical surface 67 of hole 66. Bail pin 97 is received centrally through large diameter portion 115 and extends radially projecting therefrom through the slot 69 in form punch 54, with the ends of the bail pin being received through radially aligned radially extending holes 118 formed through the shedder member 95, as best seen in Fig. 9.

Thus, shedder stem 96 is movable axially up or down in reference to form punch 54, blanking punch 56 and shim member 88, with the bail pin 97 forcing the shedder member 95 to move with shedder stem 96. When the assemblies 52 and 53 are in closed position as shown in Fig. 8, the shedder member 95 is forced to its maximum upward position, abutting shim member 88, as before described, and therefore the bottom surface 117 of shedder stem 96 is spaced upwardly from the bottom surface 68 of hole 66 in form punch 54, as shown.

When, however, assemblies 52 and 53 are separated (not shown), the shedder stem 96 may move downwardly until the bottom surface 117 thereof abuts the bottom surface 68 of hole 66 in form punch 54. As stem 96 moves downwardly, bail pin 97 will move downwardly in slot 69 in form punch 54, and also shedder member 95 will move downwardly in reference to form punch 54 and blanking punch 56, sliding in reference thereto until the shoulder 102' of shedder member 95 is only spaced slightly above shoulder 60 on form punch 54.

In this position, the lower end surface 99 of shedder member 95 will be extended below the lower end surface 82 of blanking punch 56. Further, with assemblies 52 and 53 separated, springs 111 will force the shedder pins 109 to move downwardly in hole portions 107, with the ends of pins 109 extending below the lower end surface 99 of shedder member 95.

The lower die assembly 53 includes a form die 119, a center form 120, a center cut 121, a pressure ring 122 and a blanking die 123. Die 119, center form and cut 120 and 121, pressure ring 122 and blanking die 123 are mounted assembled on a die shoe 124, which die shoe may be in turn mounted on the usual bottom die plate 125 of a standard stamping press (not shown).

The die shoe 124 is formed with a downwardly projecting centrally located cylindrical recess 126 and the generally cylindrical form die 119 is positioned partially telescoped therein. Die 119 is retained positioned in the recess 126 preferably by radially spaced bolts 127, which bolts are received through the die shoe 124 and threadably engaged in the die 119.

Form die 119 is provided with a large diameter side surface portion 128 extending from the lower end of die 119, within the recess 126, to a point spaced above the top surface of the die shoe 124. Die 119 is further provided with a small diameter side surface portion 129, which extends from the large diameter portion 128 to the upper end of die 119, forming the radially extending shoulder portion 130 between surfaces 128 and 129.

Small diameter surface portion 129 terminates in an arcuately curved generally radially extending upper surface portion 131, which surface portion extends from the small diameter surface 129 inwardly, and then is formed into an arcuately generally downwardly extending upper surface portion 132. Surface 132 terminates downwardly and inwardly in a generally radially extending upper surface portion 133.

Surface 133 terminates inwardly at the centrally located axially extending opening 134, which opening extends completely through die 119. Center form 120 is generally cylindrical in configuration and is telescopically received within the opening 134, with the lower end of center form 120 resting on the top surface of die shoe 124 and the upper end thereof extending a distance above the radially extending upper surface portion 133 of form die 119.

Center form 120 is provided with the outer side surface 135 which terminates at the upper end of form 120 in an upwardly inwardly curved end surface 136. End surface 136 terminates inwardly at a centrally located axially extending opening 137, which opening extends the complete length of form 120. Center cut 121, also being generally cylindrical in configuration, is telescopically received within the opening 137 with the bottom end thereof abutting the top surface of die shoe 124.

The upper end surface 138 of center cut 121 is in aligment with the uppermost point on end surface 136 of center form 120, with surface 138 extending generally radially inwardly in a centrally located axially extending opening 139. Opening 139 extends the complete length of center cut 121 and for a distance from the upper end downwardly is of a diameter slightly larger than the outside diameter of surface portion 75 of center punch 55, which punch forms a portion of the upper assembly 52 before described. Opening 139 also is aligned with and connects with the opening 140 of die shoe 124 and opening 141 of bottom die plate 125, for a purpose to be hereinafter described.

Small diameter side surface portion 129 of form die 119 is of a diameter slightly smaller than the inner surface 83 of blanking punch 56, which punch forms a part of the upper assembly 52, so that these two surfaces are spaced from each other when assemblies 52 and 53 are in closed position, as shown in Fig. 8, for a purpose to be hereinafter described. Pressure ring 122 is telescoped over the form die 119 in slidable relation, abutting the side surface portion 129 of die 119.

Pressure ring 122 is generally L-shaped in cross-section and is provided with the large diameter outer surface 142 extending from the lower end surface 143 upwardly, and the small diameter outer surface portion 144 extending from surface portion 142 to the upper end surface 145 of ring 122. A radially extending shoulder portion 146 is formed between surface portions 142 and 144, with the lower end 143 and the upper end 145 also extending in a general radial direction.

Blanking die 123 is positioned telescoped over the pressure ring 122 with the upper generally radially extending surface 147 spaced above the upper end of ring 122 and also spaced above the upper surface portion 131 of form die 119. The lower end of ring 123 abuts the top surface of die shoe 124 adjacent the recess 126, with ring 123 being solidly affixed thereto by means of the radially spaced bolts 148 received through the die shoe 124 and threadably received in the ring 123.

Upper end surface 147 terminates inwardly in a small diameter inner surface 149, with surface 149 extending from end surface 147 downwardly to a point spaced below the upper end surface 145 of pressure ring 122. Large diameter inner surface 150 extends from small diameter surface 149 downwardly to a point spaced below the shoulder portion 130 of form die 119, with the intermediate diameter inner surface portion 151 extending from surface 115 to the lower end of blanking die 123.

Radially extending shoulder portion 152 is formed between surfaces 149 and 150 and when assemblies 52 and 53 are in closed position, as shown in Fig. 8, shoulder portion 152 of blanking die 123 is spaced upwardly from shoulder portion 146 of pressure ring 122. Also, when the dies are in closed position, the blanking punch 56, forming a part of assembly 52, is received between the small diameter surface 149 of blanking die 123 and the small diamter surface portion 129 of form die 119, with the lower end surface 82 of blanking punch 56 abutting the upper end surface 145 of pressure ring 122.

Spring openings 153 are formed radially spaced through die shoe 124 and form die 119, opening at the shoulder portion 130 of die 119 below the lower end surface 143 of pressure ring 122. Preferably helical springs 154 are positioned within the openings 153 abutting the top surface of the bottom die plate 125 and extending through

the shoulder portion 130 of form die 119 thereby bearing against the lower end surface 143 of pressure ring 122.

Thus, when the assemblies 52 and 53 are in closed position, as shown in Fig. 8, the blanking punch 56 forces the pressure ring 122 to compress the springs 154, and causes the lower end surface 143 of pressure ring 122 to approach the shoulder portion 130 of form die 119. When assemblies 52 and 53 are in separated position, that is, the assembly 52 spaced vertically from the assembly 53, the springs 154 force the pressure ring 122 vertically upwardly in reference to form die 119 and blanking die 123, until the shoulder portion 146 of pressure ring 122 abuts the shoulder portion 152 of blanking die 123.

Referring to Fig. 8, at the start of the first operation, the assemblies 52 and 53 are in separated position (not shown), that is, the assembly 52 is spaced vertically from the assembly 53. A strip or sheet of flat relatively light gauge metal, preferably tin plate or black plate of the order of .012" thick, is placed over the opening formed by the small diameter inner surface 149 of the blanking die 123 and the upper end surface 145 of the pressure ring 122. The press (not shown), having the assemblies 52 and 53 mounted thereon, is then started in its downward stroke starting the first operation.

The lower end surface 82 of the blanking punch 56 is the first portion of assembly 52 which contacts the flat light gauge metal causing the pressure ring 122 to move downwardly compressing the helical springs 154. As surface 82 of blanking punch 56 approaches the radially extending surface 147 of blanking die 123, punch 56 shears out a circular blank between these surfaces, while the pressure ring 122, vertically aligned beneath the blanking punch 56, prevents the outer edge of the circular blank from wrinkling and distorting.

As assembly 52 continues its vertically downward movement, form punch 54 contacts the top surface of the circular blank and begins to form the recess 21 of the first operation part 20, shown in Fig. 2. This forming of recess 21 causes the outer diameter of the part 20 to decrease, enabling the blanking punch 56 to pass by the outer circumference of part 20 and contact the pressure ring 122, thereby forming the downwardly extending lip portion 27 of part 20 in the space between the blanking punch 56 and the form die 119 and starting to form the arcuate convex rim portion 26.

As the upper assembly 52 continues its downward movement, the form punch 54 begins to telescope into the center form 120 and around the center cut 121, thereby beginning to form the flat horizontal portion 24, the upwardly angled straight wall portion 23 and the arcuate concave wall portion 22 of part 20. This also continues to form the arcuate convex rim portion 26 of part 20.

As form punch 54 continues downwardly, the lower end surface 76 of center punch 55 contacts the top surface of part 20 centrally thereof, shearing out the circular center opening 25 of part 20, with center punch 55 telescoping within the center cut 121 in the opening 139. As the center opening 25 is formed, the resulting circular slug of metal falls through opening 139 in center cut 121, opening 140 in die shoe 124 and opening 141 in bottom die plate 125.

Form punch 54 continues downwardly as do center punch 55, blanking punch 56 and shedder member 95, with the blanking punch 56 telescoping within the blanking die 123, the shedder member 95 and form punch 54 approaching the form die 119, and with the center punch 55 telescoping further within the center cut 121, until the upper assembly 52 is in its lowermost position in reference to lower assembly 53, as shown in Fig. 8. After the center opening 25 of part 20 is formed by the center punch 55, the continued downward movement of the form punch 54, forming the recess 21, causes the center opening 25 to increase in diameter, thereby preventing the thin gauge metal forming part 20 from cracking or splitting over the center form 120 and the center cut 121.

Thus, the circular blank ultimately forming the part 20 is first blanked from the thin gauge metal by the blanking punch 56 and the blanking die 123. The form punch 54 then begins to form the recess 21 of part 20, causing the outer diameter of the part to decrease and allowing the blanking punch 56 to form the lip portion 27 over the arcuate upper surface portion 131 of form die 119, and between the side surface portion 129 of form die 119 and the inner circumferential surface 83 of blanking punch 56.

Intermediate the phase of the operation forming the recess 21, the center opening 25 of part 20 is formed by the center punch 55, with the form punch 54 thereafter continuing downwardly forming the final shape of the recess 21. The arcuate concave wall portion 22 of part 20 is formed by the downwardly projecting arcuate convex surface portion 63 of form punch 54, and the upwardly angled relatively straight wall portion 23 of part 20 is formed adjacent convex surface portion 63 of punch 54 between punch 54 and the center form 120.

The downward forming of recess 21 of part 20 causes the arcuate convex rim portion 26 to be formed over the arcuate upper surface portion 131 of form die 119. It also causes a rounded corner to be formed between the angled wall portion 23 and the horizontal annular portion 24 of part 20 by the upper end surface 136 of center form 120.

Thus, one of the critical features of the first operation in forming the intermediate blank 20 shown in Fig. 2 from the light gauge metal without appreciable thinning of the walls of the blank 20 is, the drawing of the metal inward from the outer regions of the blank cut by blanking punch 56, and the drawing of the metal outward from the central portion of the blank after opening 25 is formed therein. That is to say, prior to the forming of opening 25, the metal is drawn inward from the outer regions of the blank while the central portion of the blank resists substantially all outward drawing of metal from this central portion, but after the forming of opening 25, metal is drawn both inward from the outer regions of the blank and outward from the central portion thereof. This inward and outward metal drawing enables the recess 21 in blank 20 to be formed without thinning the blank metal and without so work-hardening the blank metal—except immediately adjacent the periphery of opening 25—as to prevent further forming of the metal. As indicated, the inward drawing of metal from the outer regions of the blank is accompanied by a decrease in the diameter of blank 20 from the size thereof sheared by blanking punch 56, and an increase in the diameter of hole 25 from the size thereof sheared by center punch 55.

As the press starts its upward stroke, causing the upper assembly 52 to move vertically upwardly away from the lower assembly 53, the finished part 20 is retained with the outer circumference thereof surrounded by the blanking punch 56, so that part 20 moves upwardly with the upper assembly 52 away from the lower assembly 53. After part 20 has been stripped from the lower assembly 53 and is spaced thereabove, the shedder stem 96 is stopped while the upper assembly 52 continues its upward movement.

This causes the bail pin 97 to move downwardly in reference to the form punch 54 in the slot 69, thereby causing the shedder member 95 to move downwardly in reference to the center punch 54 and the blanking punch 56, and causing the shedder member 95 to strip the part 20 from within the blanking punch 56 and away from the form punch 54. As part 20 strips from punches 54 and 56, springs 111 urge the shedder pins 109 downwardly, causing part 20 to be moved clear of shedder member 95, thereby completing the first operation.

The apparatus for performing the second operation is illustrated in Fig. 10 and includes an upper punch and

shedder assembly, generally indicated at 155, and a lower die assembly, generally indicated at 156. The upper assembly 155 of the apparatus for performing the second operation is very similar to the upper assembly 52 of the apparatus for performing the first operation, shown in Fig. 8, with assembly 155 including a form punch 157, a center punch 158, a punch holder 159, a shedder assembly 160 and a shim member 161.

The form punch 157 is formed and located similarly to the form punch in the apparatus for performing the first operation, with the exception of the configuration of the lower end thereof. Punch 157 is provided at its lower end, with a generally vertically extending outer circumferential surface 162, which surface extends below the lower end 163 of the shedder member 164, when the upper and lower assemblies 155 and 156 are in closed position, as shown in Fig. 10. Outer surface 162 terminates at the lower end of the punch 157 in a generally horizontally extending annular end surface portion 165, which end surface portion extends from the outer surface 162 a distance radially inwardly.

Horizontal end surface portion 165 terminates inwardly in the downwardly curved convex end surface portion 166, with convex end surface portion 166 terminating inwardly in a generally horizontally extending annular end surface portion 167. Horizontal surface portion 167 extends inwardly and terminates in an opening 168, which opening is formed centrally within the form punch 157 and extends axially and vertically upwardly within punch 157, forming the inner circumferential surface 169 and the rounded corner 170 between end surface 167 and surface 169.

Center punch 158 is received in opening 168 and is secured therein by the bolt 171. Punch 158 is similar to the center punch in the apparatus for performing the first operation, with the end thereof spaced above the end surface 167 of the form punch 157, but with the outer circumferential surface 172 thereof of a larger diameter than the center punch in the apparatus for performing the first operation.

The punch holder 159 is of similar configuration to the blanking punch 56, shown in Fig. 8, for the first operation, but the punch holder 159 merely serves as a retainer for the various parts of the upper assembly 155 while similarly aiding in forming the outer circumferential lip portion of the second operation part, as will be hereinafter described. Shim member 161 is similar in configuration to that in the first operation apparatus, being similarly located between the upper end of the form punch 157 and the punch holder 159, as shown in Fig. 10. Further, the form punch 157, punch holder 159 and shim member 161 are similarly retained in assembled position by a series of circumferentially spaced bolts 173.

Shedder member 164, as in the first operation apparatus, is slidably received between the outer circumferential surface 162 of form punch 157 and the inner circumferential surface 174 of punch holder 159. The remainder of the shedder assembly 160 includes the bail pin 175 and the shedder stem 176, with the various parts of shedder assembly 160 being assembled and operating substantially the same as in the first operation apparatus.

As before, the bail pin 175 is secured to the shedder stem 176 and also to the shedder member 164 through the slot 177 formed in the form punch 157. Also, as before, the shedder member 164 is provided with a series of circumferentially spaced shedder pins 178, which pins are urged downwardly in reference to shedder member 164 by the preferably helical springs 179.

The lower die assembly 156 is similar in construction and operation to the lower die assembly 53 in the first operation apparatus. Assembly 156, similar to assembly 53, includes a form die 180, a center cut and form 181, with the center form 120 and blanking die 123 of the first operation apparatus being replaced by similarly located die shedder member 182 and retaining ring 183, respectively. Additionally, a shim member 184 is positioned between the center cut and form 181 and the die shedder member 182, with all of these various parts being assembled, as before, on a die shoe 185, which shoe is in turn mounted on a bottom die plate 186 of a standard stamping press (not shown).

Form die 180 is provided with a large diameter outer circumferential surface 187 extending from the lower end thereof upwardly and a small diameter outer circumferential surface 188 extending from surface 187 to the upper end of die 180, thereby forming the radially extending shoulder 189 between surfaces 187 and 188. Retaining ring 183 is secured to the die shoe 185 by means of circumferentially spaced bolts 190 with ring 183 being provided with a large diameter inner circumferential surface 191, extending upwardly from die shoe 185, and small diameter inner circumferential surface 192, extending from surface 191 to the upper end of ring 183, with radially extending shoulder 193 being formed therebetween.

Spring openings 194 are formed vertically through the die shoe 185 beneath the lower end of form die 180, and the preferably helical springs 195 are positioned in holes 194, bearing against the top surface of the bottom die plate 186 and the lower end of the form die 180. Retaining ring 183 is telescoped over the form die 180 so that the large diameter surface 187 of die 180 is abutting and slidable along the large diameter surface 191 of ring 183, the small diameter surface 188 of die 180 is abutting and slidable along the small diameter surface 192 of ring 183, and so that shoulder 189 of die 180 is vertically opposite the shoulder 193 of ring 183.

Thus, when form die 180 is forced downwardly by the upper assembly 155, and when the assemblies 155 and 156 are in closed position, the lower end of the die 180 abuts the top surfaces of the die shoe 185, compressing the helical springs 195 between die 180 and the bottom die plate 186 and positioning shoulder 189 of die 180 below the shoulder 193 of ring 183. When, however, the assemblies 155 and 156 are in open position (not shown), that is, when the assembly 155 is spaced vertically from the assembly 156, the helical springs 195 urge the die 180 to slide vertically upwardly in reference to ring 183 until the shoulder 189 of die 180 abuts the shoulder 193 of ring 183.

Form die 180 is provided with a hole formed centrally therethrough, forming the large diameter inner circumferential surface 196, extending from the lower end of die 180 upwardly and the small diameter inner circumferential surface 197, extending from surface 196 to the upper end of die 180. Radially extending shoulder 198 is formed between surfaces 196 and 197.

The upper end of die 180 is formed with an arcuate generally radially extending surface 199 which extends from the outer circumferential surface 188 inwardly and terminates in a generally vertical downwardly extending surface 200. Surface 200 in turn terminates in a radially inwardly extending surface 201. Surface 201 terminates inwardly in an arcuate downwardly curved concave surface 202, which terminates in a radially extending surface 203, with surface 203 terminating inwardly at the small diameter inner circumferential surface 197.

Die shedder member 182 is generally L-shaped in cross-section and is provided with a shoulder 204. Shedder 182 is telescopically received in form die 180, with the shoulder 204 on shedder 182 vertically opposite the shoulder 198 of die 180.

Shim member 184 is positioned abutting the lower end of die shedder member 182, with both shedder member 182 and shim member 184 resting on the shoulder 205 of center cut and form 181, when the assemblies 155 and 156 are in closed position. Also, the upper end of shedder member 182 is radially aligned with the radially extending surface 203 of form die 180 when assemblies 155 and 156 are closed, as shown in Fig. 10.

Center cut and form 181 is also generally L-shaped in cross-section and is received in a recess 206 formed in the die shoe 185, being retained therein by the circumferentially spaced bolts 207, as shown. The small diameter outer circumferential surface portion 208 of form 181 is received telescopically through the shedder member 182 and the shim member 184, with the upper end of form 181 extending vertically above the upper end of shedder member 182, when assemblies 155 and 156 are in closed position.

Small diameter surface 208 of form 181 terminates at the upper end of form 181 in a radially extending upper end surface 209, with surfaces 208 and 209 being joined by a radiused corner 210. Upper end surface 209 terminates inwardly in a centrally located opening 211, which opening extends completely through form 181. Opening 211 is formed of a diameter slightly larger than the outer circumferential surface of center punch 158 of the upper assembly 155, below the end surface 209. Openings 212 and 213 in die shoe 185 and lower die plate 186 respectively, communicate with the opening 211 in form 181.

Circumferentially spaced spring openings 214 are formed vertically through the die shoe 185 and the form 181, terminating at the shoulder 185 of form 181. Preferably helical springs 215 are received in the openings 214 bearing against the upper surface of the lower die plate 186 and the lower surface of shim member 184.

Thus, when the assemblies 155 and 156 are in closed position, as shown in Fig. 10, the form die 180 is forced against the die shoe 185, compressing the springs 195, as before described. Further, the shedder member 182 is forced against the shim member 184, which is in turn forced against the shoulder 185 of form 181 compressing the springs 215 between the die shoe 186 and the shim member 184. Also, when in such position, the upper end of shedder member 185 is radially aligned with the surface 203 of form die 180, and the shoulder 204 of shedder member 182 is spaced vertically downwardly from the shoulder 198 of form die 180.

When the assemblies 155 and 156 are in open position (not shown), the springs 195 urge the form die 180 upwardly until the shoulder 189 of die 180 abuts the shoulder 193 of ring 183, as before described. Also, the springs 215 urge the shim member 184 and the shedder member 182 upwardly until the shoulder 204 of shedder member 182 abuts the shoulder 198 of form die 180, thereby spacing the upper end of the shedder member 182 vertically above the surface 203 of form die 180.

At the start of the second operation, the assemblies 155 and 156 are in open position (not shown), that is, the upper assembly 155 is spaced vertically above the lower assembly 156. The first operation part 20, as shown in Fig. 2, is placed over the upper end of the shedder member 182 and above the upper end of the form die 180.

The upper assembly 155 starts its downward stroke and the punch holder 159 contacts the edge portion of part 20 and begins to form the lip portion 42 of second operation part 28. Since the inner circumferential surface 174 of punch holder 159 is spaced from the outer circumferential surface 188 of form die 180, lip portion 42 is formed between these surfaces.

As assembly 155 continues its downward movement, form punch 157 begins to form the recess 29 of part 28. Intermediate the start of the forming of recess 29 and the bottoming of form punch 157 in the form die 180, the center hole 35 of part 28 is formed by the center punch 158. Center punch 158 merely shears out a ring of metal, that is, the annular width of metal between the center hole 25 of part 20 and the center hole 35 of part 28.

As form punch 157 telescopes over the center cut and form 181, the upwardly extending vertical portion of part 28 is formed as well as the flat horizontal annular portion 33 and the radiused corner 32 therebetween. Further, the recess 29, the flat horizontal portion 39, the vertical portion 40, the flat horizontal portion 41 and the lip 42 are formed to their final configuration.

As before stated, the lip portion 42 is formed between the inner circumferential surface 174 of punch holder 159 and the outer circumferential surface 188 of form die 180. Further, the flat horizontal portion 41 is formed between the lower end 163 of the shedder member 164 and the arcuate radially extending surface 199 of form die 180, with the vertical portion 40 of part 28 being formed between the outer circumferential surface 162 of form punch 157 and the vertically downwardly extending surface 200 of form die 180.

Still further, the flat horizontal portion 39 of part 28 is formed between the radial surface 201 of form die 180 and the annular end surface portion 165 of form punch 157. Also, the concave portion 36 of part 28 is formed between the convex end surface portion 166 of form punch 157 and the concave surface 202 of form die 180, with the flat bottom portion 30 of part 28 being formed between the end surface portion 167 of form punch 157 and the radially extending surface 203 of form die 180.

Finally, the vertical neck portion 31 of part 28 is formed between the inner circumferential surface 169 of form punch 157 and the outer circumferential surface 208 of center cut and form 181, with the rounded corner 34 and the flat horizontal annular portion 33 of part 28 being formed over the rounded corner 210 and upper end surface 209 of form 181. Since the center hole 35 of part 28 is formed by the center punch 158 intermediate the phase of the operation forming the recess 29 of the part 28, the formation of the final shape of the recess 29 draws metal from around the center hole 35 resulting in an increase in diameter of hole 35. This increase in diameter of hole 35 can take place without the metal around the hole tearing or splitting—as the recess 29 is formed downwardly and the vertical neck portion 31, rounded corner 32 and flat horizontal annular portion 33 are formed upwardly—because of the removal of work hardened metal immediately surrounding hole 25 in blank 20 by the shearing of a ring of metal surrounding hole 25 by center punch 158. This work hardening of metal around hole 25 in blank 20 occurs in forming blank 20 during the first operation and if the work-hardened metal is not removed by center punch 158 during the formation of recess 29 in blank 28 and of neck 31, it may be impossible to produce the blank 28 without destructive metal thinning, cracking or tearing.

Stated in general terms, the metal flow in the second operation is first outward and downward from around the center opening or hole 25 of the first operation part 20 which begins to increase the diameter of hole 25 to commence the forming of neck 31 of the second operation part. After this initial drawing, the ring of metal is sheared from around this first operation hole 25 with this ring of metal that is sheared including any work hardened metal around this hole, so that the latter stages of the second operation in the final formation of neck 31 can proceed and the final metal flow is not resisted by the work hardened metal around hole 25. Thus, although it is possible to draw metal outward from the central portion of the first operation blank in the initial stages of the second operation, the final neck formation could not take place without splitting, cracking and possibly tearing metal, without the aid of the work hardened metal around the first operation part hole 25 being removed, as well as any further work hardening resulting in the initial stages of the second operation, so that the final forming of the second operation part neck 31 can proceeed with ease and without damage to the metal.

Thus, the part 20 from the first operation is placed on lower assembly 156 forming a part of the apparatus for performing the second operation and the upper assembly 161 starts downwardly. The punch holder 159 contacts the outer circumference of part 20 and starts to form the lip portion 42, as shown on the second operation part 28,

The form punch 157 then begins to form the recess 29 of part 28, with the center punch 158 shearing out the center hole 35 intermediate or during the phase of the operation of forming recess 29. After center hole 35 has been formed, the form punch 157 continues downwardly finally bottoming in form die 180 and forming the recess 29 of part 28 having the horizontal flat bottom portion 30, the upwardly extending generally concave portion 36 and the upwardly extending vertical neck portion 31.

Also, the bottoming of form punch 157 forms the lip portion 42, the flat horizontal portion 41, the vertical portion 40 and the flat horizontal portion 39 into their final shapes, as shown in Fig. 3. Further, the flat horizontal annular portion 33 and the rounded corner 34 between portion 33 and the vertical portion 31 are formed into final shape, with the center hole 35 increasing slightly in diameter during this final forming without splitting or tearing over the center cut and form 181.

For removal of the second operation part, the upper assembly 155 is moved upwardly away from the lower assembly 156. As assembly 155 starts to move upwardly, the form die 180 is urged upwardly by the springs 195 stripping the part from the center cut and form 181, with the die 180 following assembly 155 until the shoulder 189 of die 180 engages the shoulder 193 of the retaining ring 183. Also, as die 180 moves upwardly, moving the part upwardly, the springs 215 urge the shim member 184 and the die shedder member 182 upwardly, so that parts 184 and 182 remain in the same position in reference to die 180 even though they are all moving upwardly with the upper assembly 155.

As the shoulder 189 of die 180 contacts the shoulder 193 of retaining ring 183, the die 180 stops its upward movement, but the springs 215 continue to urge the shim member 184 and die shedder member 182 upwardly, until the shoulder 204 of the shedder member 182 contacts the shoulder 198 of die 180. This causes the shedder member 182 to project above the end surface portion 167 of die 180 and strips the part 28 from die 180.

As the shoulder 204 of shedder member 182 contacts the shoulder 198 of die 180, the upward movement of shedder member 182 and the shim member 184 is stopped. Thus, as the upper assembly 155 continues its upward movement, part 28 is retained with the outer circumference thereof surrounded by the punch holder 159 and with the upper surface thereof retained against the lower end surface 163 of the upper assembly shedder member 164 and the form punch 157.

After the upper assembly 155 is sufficiently separated from the lower assembly 156 so that the part 28 is completely clear of and spaced from the lower assembly 156, the shedder stem 176 is stopped from further upward movement, while the upper assembly 155 continues upwardly. This causes the bail pin 175 to move downwardly in the slot 177 and thereby move the shedder member 164 downwardly stripping the part 28 from the punch holder 159 and the form punch 157. As part 28 is stripped from form punch 157 and punch holder 159, the springs 179 urge the shedder pins 178 downwardly freeing the part 28 from the shedder member 164 and thereby completing the second operation.

The apparatus for performing the third operation is illustrated in Figs. 11 through 15. As before stated, in the third operation, the second operation part 28 is formed into the third operation part 43, as shown in Figs. 4, 5, 6 and 7. The only portion of the part that is changed in the third operation is the upwardly extending vertical neck portion 31 of part 28, which is formed into the closure engagement ridge 44 and the undercut portion 45.

The apparatus for performing the third operation includes a mounting bracket assembly generally indicated at 216, a spindle slide assembly generally indicated at 217, a beading roll indicated at 218, a control rod assembly generally indicated at 219 and a beading die assembly generally indicated at 220.

The mounting bracket assembly 216 is formed of a lower member 221 and a cover member 222. The lower member 221 is formed with a longitudinally extending U-shaped recess 223, which recess extends from the rear end surface 224 the length of member 221 to a point spaced from the forward end surface 225 and opens upwardly.

Cover member 222 is secured to the upper surface 226 of lower member 221 closing recess 223 and extending the length thereof. Cover member 222 is secured to lower member 221 preferably by means of bolts 227, and member 222 is provided with a longitudinally extending slot 228.

Lower member 221 is further provided with a vertically extending opening 229 at the forward end thereof communicating with the recess 223, and the lower portion of opening 229 is formed with a large diameter bore 230. The thrust bearing assembly 231 is received in bore 230 of opening 229, with spring loaded pins 232 urging bearing 231 downwardly and with lower cover plate 233 restricting the downward movement of bearing 231, as shown in Fig. 12.

Bearing 231 is provided with an upper plate 234, abutted by the pins 232, and a lower plate 235. Plate 235 is provided with a flange 236 engageable with cover plate 233 and a lower abutment surface 237 for a purpose to be hereinafter described. Thrust balls 238 are positioned between plates 234 and 235, so that lower plate 235 is freely rotatable in reference to upper plate 234 but is restricted from vertical movement in reference to plate 234.

Spindle slide assembly 217 includes a slide 239 having a bracket mounting portion 240 and a spindle portion 241. Bracket mounting portion 240 is slidably mounted in recess 223 of lower member 221 beneath the cover member 222, and the spindle mounting portion 241 is received in the opening 229 in member 221 extending the vertical length of opening 229 and surrounded by thrust bearing 231. Spindle mounting portion 241 has smaller outside dimensions than the diameter of opening 229 and the inner diameter of bearing 231, so that portion 241 is horizontally movable in reference to the lower member 221.

Bearing blocks 242 are mounted at the lower surface of bracket mounting portion 240 of slide 239 so that slide 239 is freely horizontally movable in reference to lower member 221 and cover member 222. Lever block 243 is mounted at the upper surface of slide 239 secured thereto within the slot 228 formed in cover member 222. The lever block 243 is smaller than slot 228 so that block 243 is horizontally movable in slot 228 and cover member 222.

The control rod assembly 219 includes a generally horizontal rod 244 and a generally vertical rod 245. Rod 244 is pivotally mounted on the cover member 222 by bracket 246 and is rockably engaged with the lever block 243 as at 247.

The other end of horizontal rod 244 is pivotally connected to the vertical rod 245 at a point spaced from the rear end surface 224 of lower member 221, with vertical member 245 extending downwardly. The pull rod 248 and the pressure collar 249 are secured to the vertical rod 245 by a spring cushion 250.

The beading roll 218 is journalled in the spindle mounting portion 241 of slide 239, with spindle portion 251 extending below the lower surface of mounting portion 241 and with the roll portion 252 mounted at the lower end of portion 251. Roll portion 252 is provided with an arcuate outer circumferential surface 253 for a purpose to be hereinafter described.

Beading die assembly 220 includes a beading die 254 and a rotatable mounting shaft 255. Shaft 255 is connected to rotatable drive means (not shown) and extends

vertically, with the beading die 254 being secured to the upper end thereof for rotation therewith.

As best shown in Figs. 14 and 15, the beading die 254 is preferably cylindrical in configuration and is provided with a centrally located axially extending opening 256 extending downwardly from the upper surface 257 of die 254. Opening 256 has a larger diameter than the outer diameter of roll portion 252 of beading roll 218 and is provided intermediate the depth thereof with an enlarged circumferential recess 258. Recess 258 is located above the lower end surface 259 of opening 256 and is below the upper surface 257 of beading die 254.

In the third operation, the second operation part 28 is turned upside down and placed on beading die 254, with the vertical neck portion 31 of part 28 extending into the opening 256 in die 254 and adjacent the recess 258. Further, the horizontal portion 33 of part 28 rests on the lower end surface 259 of opening 256 and the flat bottom portion 30 rests on the upper surface 257, with the remainder of part 28 extending outwardly from die 254, as shown in Fig. 12.

The mounting shaft 255 is then rotated, rotating the beading die 254 and the part 28 mounted thereon. Thereafter the shaft 255, die 254 and part 28 are moved vertically upwardly until part 28 engages the lower abutment surface 237 of bearing 231 and compresses spring pins 232 until the roll portion 252 of beading roll 218 is received centrally within the opening 256 of die 254. Downward pressure is then applied to the pressure collar 249 moving the pull rod 248 and the vertical rod 245 downwardly, causing the horizontal rod 244 to pivot on bracket 246 and rock in reference to lever block 243. This urges block 243 horizontally toward the forward end 225 of mounting bracket lower member 221.

Horizontal movement of lever block 243 causes the slide 239 to slide horizontally in reference to the mounting bracket assembly 216 toward the forward end surface 225 of mounting bracket lower member 221. This causes the beading roll 218 to move horizontally so that the outer surface 253 of roll portion 252 engages the vertical portion 31 of part 28 in horizontal alignment with the recess 258 in beading die 254 (Fig. 15) and causes the beading roll 218 to rotate in reference to the slide 239.

The continued pressure of the control rod assembly 219 against the slide 239 causes the roll portion 252 of the beading roll 218 to move part 28 until vertical wall 31 abuts a portion of the side of opening 256 with roll portion 252 thereafter forming the third operation part 43 shown in Figs. 4, 5, 6 and 7. The arcuate outer circumferential surface 253 of roll portion 252 forms the metal outwardly within recess 258 in opening 256, forming the closure engagement ridge or bead 44 and the undercut portion 45, as shown in Fig. 15.

Thus, the third operation part 43 is formed from the second operation part 28 by placing part 28 on a rotating die and telescoping a rotatable roll within part 28 adjacent the vertical wall portion 31. The rotatable roll is then engaged with the vertical wall 31 of part 28 with the roll roller forming an outwardly extending closure engagement ridge 44 and thereby forming an undercut portion 45.

Thereafter, pressure is released from the control rod assembly 219 causing this assembly to move the slide 239 back to its original position and causing beading roll 218 to move to a position centrally of the opening 256 in beading die 254. This disengages the roll portion 252 from third operation part 43. The beading die 254 is then moved downwardly away from beading roll 218, and since the diameter of the opening 256 in beading die 254 is larger than the final outer diameter of the closure engagement ridge 44 of part 43, part 43 may be removed from die 254 completing the third operation.

The third operation part 43 may then be assembled on the open end of a standard can in the usual manner by a double seaming operation thereby providing the can construction shown in Figs. 6 and 7 having the advantageous can top construction of the present invention.

One of the important features of the present invention is the provision of a can top formed from relatively thin gauge metal, such as tin plate or black plate of the order of .012" thickness, which can top has the center opening and the neck portion thereof, for engagement with a removable closure, spaced below the edge portions of the can top a sufficient distance so that when a closure is secured thereon, this closure will also be recessed below the outer edges of the can top. This provides a final can construction which may be conveniently stacked one above the other and each can will only require the same vertical space necessary for the usual flat top permanently sealed can.

A further feature of the present invention is the provision of a can top construction which is provided with a closure engagement ridge around the center opening thereof for secure engagement by a removable and replaceable plastic closure. Thus, even though the contents of the can is of relatively high specific gravity and even though the can is upended, the plastic closure will be securely retained thereon in an airtight manner, with no danger of the contents of the can accidentally spilling.

A still further feature of the present invention is the provision for making the unique can top construction of relatively thin gauge metal and of the relatively small dimensions herein stated with only three operations. In this way, the can top construction is provided at a minimum of cost from a minimum amount of material for any usual size can.

Still another feature of the present invention is the forming of a can top of the dimensions stated which will provide cans which may be conveniently stacked, since the closure portion of the can top is recessed below the outer circumferential edges thereof, but yet this intricately formed can top is formed from relatively thin gauge metal of the order of .012" thick. It is possible to form the deep recesses and the complicated center opening configurations in the relatively small spaces by shearing out the center opening of the part in the first and second operations during the recess forming phase of each of these operations, thereby removing work-hardened metal and allowing the metal to draw from the center openings and preventing thinning, splitting or tearing of the metal.

The construction and method of making metal can tops described and illustrated overcomes the difficulties of the prior constructions stated herein; provides a top in which the can top opening with the closure positioned thereon is recessed below the outer portions of the can top and the top edges of the sides of the can so that the cans may be stacked; provides a construction in which the can top may be provided with a lid or closure which is easily removable by hand without the use of tools; provides a can top which retains an easily removable lid or closure thereon in a secure and airtight manner, even though the material contained in the can has a relatively high specific gravity and the can is upended with the top thereof extending downwardly; provides a can top which may be assembled with a standard relatively thin gauge metal can by the usual seaming operation used in the can industry; provides a can top which retains an easily removable lid thereon which lid may be easily replaced thereon after having been removed one or more times in a secure and air tight manner, with little care being required to properly replace such lid or closure; and provides a can top having all of the many enumerated advantages but which may be made from the usual relatively thin gauge metal from which standard can tops are made in a minimum of operations.

In the foregoing description, certain terms have been used for brevity, clearness and understanding, but no unnecessary limitations are to be implied therefrom, because such words are used for descriptive purposes herein, and are intended to be broadly construed.

Moreover, the embodiments of the improved construction and method illustrated and described herein are by way of example, and the scope of the present invention is not limited to the exact details of the construction and method shown.

Having now described the invention, the construction, the method, operation and use of a preferred embodiment thereof, and the advantageous new and useful results obtained thereby; the new and useful methods and constructions, and reasonable mechanical equivalents thereof, obvious to those skilled in the art, are set forth in the appended claims.

I claim:

1. In a method of making a one-piece, light gauge, sheet metal can top; in one operation consisting of a single stroke of a metal working die, blanking a metal disc from light gauge sheet metal stock, beginning the forming of an annular recess downward in the disc between the outer edge and central portion of the disc by initially drawing metal inward-downward from the outer region of the disc to begin reduction of the outer disc diameter while the central portion resists substantially all outward-downward drawing of metal from said central portion, cutting a central opening in the central portion of the disc intermediate the recess being formed and after said initial drawing, and continuing the recess formation after the central opening has been cut by simultaneously continuing to draw metal inward-downward from the outer region and drawing metal outward-downward from around the opening in the central portion of the disc in finally shaping the recess, thereby further reducing the outer disc diameter and at the same time increasing the diameter of the opening in the disc.

2. In the method defined in claim 1, in the same operation and the same single stroke of the metal working die, forming a downwardly curved annular edge portion around the recess and forming a substantially flat center portion around the opening and radially within the recess while the recess is being formed, and locating the upper surface of the curved annular edge portion and flat center portion in substantially the same plane.

3. In a method of making a one-piece, light gauge, sheet metal can top having a chime flange and center neck portion provided with an access opening; first providing a light gauge sheet metal blank having a downwardly concave annular recess wall portion formed therein intermediate the outer blank edge and a substantially flat centrally perforated blank portion with a ring-like work hardened portion around the perforated blank opening; then by a single operation consisting of a single stroke of a metal working die, forming the outer edge portion of the blank to annular chime flange shape, beginning to draw the central flat perforated portion and a connected inner zone of the recess wall to form a substantially cylindrical neck terminating at its upper end in a substantially flat inturned flange by beginning to draw metal outward and downward from the central flat perforated portion and beginning to enlarge the perforated blank opening diameter by said drawing, beginning to reform the recess wall portion connected between the chime flange and neck, cutting a central ring of metal including the ring-like work hardened portion from around the perforated blank opening intermediate the neck being drawn and the recess wall being reformed, and continuing the neck formation and the recess wall reformation after the ring of metal has been cut by continuing to draw metal outward and downward from around the ring-cut central opening to complete the neck formation and recess wall reformation, thereby increasing the ring-cut diameter.

4. In the method defined in claim 3, in the same operation and the same single stroke of the metal working die, forming a substantially flat wall portion in the reformed recess wall having at least a portion spaced below the chime flange and extending inwardly to the neck below the flat inturned neck flange.

5. In the method defined in claim 3, in the same operation and the same single stroke of the metal working die, locating the upper surface of the flat inturned neck flange below the plane of the chime flange as the neck is being formed.

6. In the method defined in claim 3, the further operation of forming closure engagement means on the neck after the neck has been formed.

7. In the method defined in claim 3, the further operation of rolling a closure engagement bead on the neck after the neck has been formed.

8. In the method defined in claim 3, the further operation of rolling an outwardly projecting annular bead at the top of the neck and connected with the flat inturned neck flange after the neck has been formed.

9. In a method of making a one-piece, light gauge, sheet metal can top having a chime flange and a center neck portion provided with an access opening; in a first operation consisting of a single stroke of a first metal working die, blanking a metal disc from light gauge sheet metal stock, beginning the forming of an annular recess wall downward in the disc between the outer edge and central portion of the disc by initially drawing metal inward-downward from the outer region of the disc to begin reduction of the outer disc diameter while the central portion resists substantially all outward-downward drawing of metal from said central portion, cutting a central opening in the central portion of the disc intermediate the recess wall being formed and after said initial drawing, and continuing the recess wall formation after the central opening has been cut by simultaneously continuing to draw metal inward-downward from the outer region and drawing metal outward-downward from around the opening in the central portion of the disc in finally shaping the recess wall, thereby further reducing the outer disc diameter and at the same time increasing the diameter of the opening in the disc to provide a formed blank having a ring-like work hardened portion around the central opening; then in a second operation consisting of a single stroke of a second metal working die, forming the outer edge portion of the formed blank to annular chime flange shape, beginning to draw the central portion of the blank around the opening and a connected inner zone of the recess wall to form a substantially cylindrical neck terminating at its upper end in a substantially flat inturned flange by beginning to draw metal outward and downward from the central portion of the disc and beginning to enlarge the central opening diameter by said drawing, beginning to reform the recess wall portion connected between the chime flange and neck, cutting a central ring of metal including the ring-like work hardened portion from around the opening in the central portion of the formed blank intermediate the neck being drawn and the recess wall being reformed, and continuing the neck formation and recess wall reformation after the ring of metal has been cut by continuing to draw metal outward and downward from around the ring-cut central opening to complete the neck formation and recess wall reformation, thereby increasing the ring-cut opening diameter.

10. In the method defined in claim 9, in the same first operation and same single stroke of the first metal working die, forming a downwardly curved annular edge portion around the recess wall and forming a substantially flat center portion around the opening and radially within the recess wall while the recess wall is being formed in the disc, and locating the upper surfaces of the curved annular edge portion and flat center portion in substantially the same plane.

11. In the method defined in claim 9, in the same second operation and same single stroke of the second metal working die, forming a substantially flat wall portion in the reformed recess wall spaced below the flat inturned neck flange.

12. In the method defined in claim 9, in the same second operation and same single stroke of the second metal working die, locating the upper surface of the flat inturned neck flange below the plane of the chime flange as the neck is being formed.

13. In the method defined in claim 9, the third operation of rolling a closure engagement bead on the neck after the neck has been formed.

14. In a method of making a one-piece, light gauge, sheet metal can top having a chime flange and a center neck portion provided with an access opening located below the top of the chime flange; in a first operation consisting of a single stroke of a first metal working die, blanking a metal disc from light gauge sheet metal stock, beginning the forming of an annular recess wall downward in the disc between the outer edge and central portion of the disc by initially drawing metal inward-downward from the outer region of the disc to begin reduction of the outer disc diameter while the central portion resists substantially all outward-downward drawing of metal from said central portion, cutting a central opening in the central portion of the disc intermediate the recess wall being formed and after said initial drawing, and continuing the recess wall formation after the central opening has been cut by simultaneously continuing to draw metal inward-downward from the outer region and drawing metal outward-downward from around the opening in the central portion of the disc in finally shaping the recess wall, thereby further reducing the outer disc diameter and at the same time increasing the diameter of the central opening in the disc and forming a ring-like work hardened portion around said central opening, forming a downwardly curved angular edge portion around the recess wall and forming a substantially flat center portion around the opening and radially within the recess wall while the recess wall is being formed, and locating the upper surfaces of the curved annular edge portion and flat center portion in substantially the same plane to provide a formed blank; then in a second operation consisting of a single stroke of a second metal working die, forming the outer curved annular edge portion of the formed blank to annular chime flange shape, beginning to draw the central flat portion of the blank around the opening and a connected inner zone of the recess wall to form a substantially cylindrical neck terminating at its upper end in a substantially flat inturned flange located below the plane of the chime flange by beginning to draw metal outward and downward from the central portion of the disc and beginning to enlarge the central opening diameter by said drawing, beginning to reform the recess wall portion connected between the chime flange and neck with a substantially flat wall portion spaced below and substantially parallel to the flat inturned neck flange, cutting a central ring of metal including the ring-like work hardened portion from around the blank opening in the flat central portion of the formed blank intermediate the neck being drawn and the recess wall being reformed, and continuing the neck formation and recess wall reformation after the ring of metal has been cut by continuing to draw metal outward and downward from around the ring-cut central opening to complete the neck formation and recess wall reformation, thereby increasing the ring-cut opening diameter; and then in a third operation, rolling a closure engagement bead on the neck after the neck has been formed.

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