United States Patent [19]

Moller

[11] **3,732,804**

[45] **May 15, 1973**

[54] **FLATTENING METAL CANS**

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[22] Filed: **Jan. 6, 1971**

[21] Appl. No.: **104,266**

[52] **U.S. Cl.** **100/42,** 100/DIG. 2, 100/137, 100/215, 100/218, 100/232, 100/233, 100/244, 100/295

[51] **Int. Cl.** **B30b 7/04**

[58] **Field of Search** 100/DIG. 2, 137, 100/42, 244, 295, 215, 218, 232, 233; 241/99

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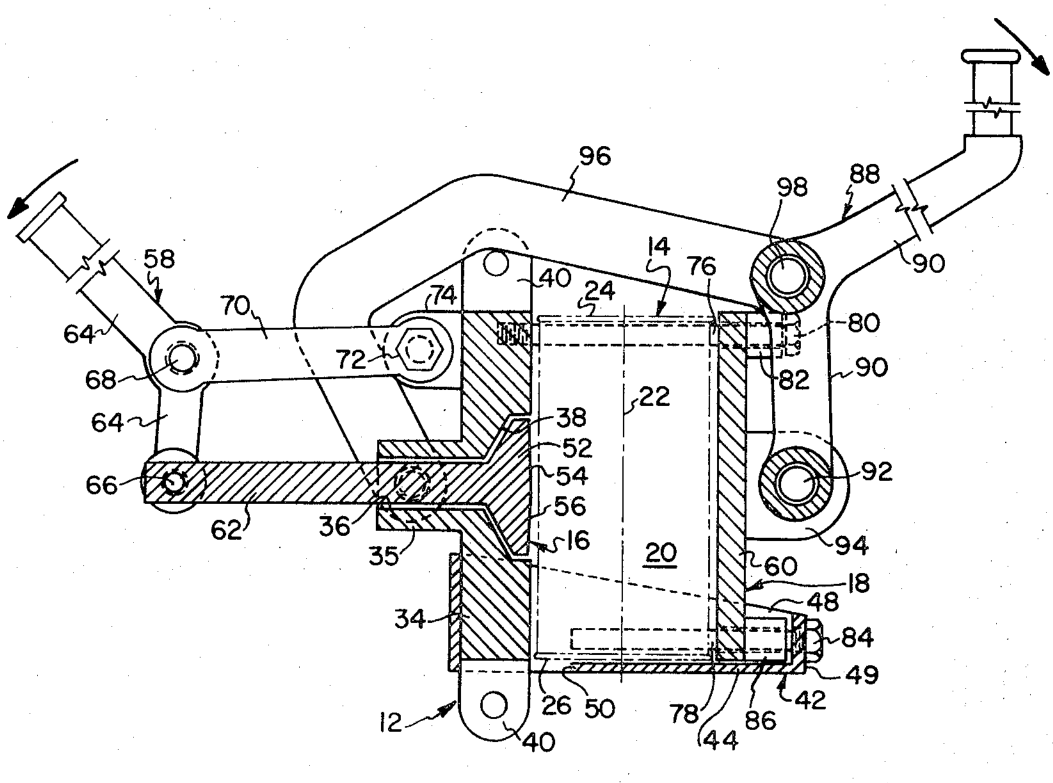
Primary Examiner—Billy J. Wilhite
Attorney—Turner Moller, Jr.

[57] **ABSTRACT**

A method and apparatus for flattening thin metal cans is disclosed wherein the can is first creased or notched to incline the can ends with respect to the can axis and each can end is then folded about an axis adjacent the juncture of the respective can end and the can side into a generally flat configuration.

8 Claims, 26 Drawing Figures



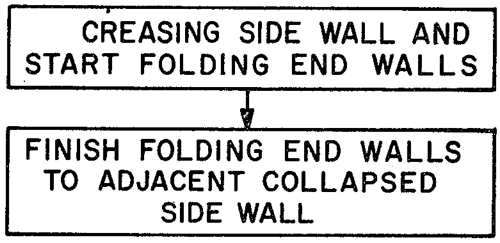


FIG. 1

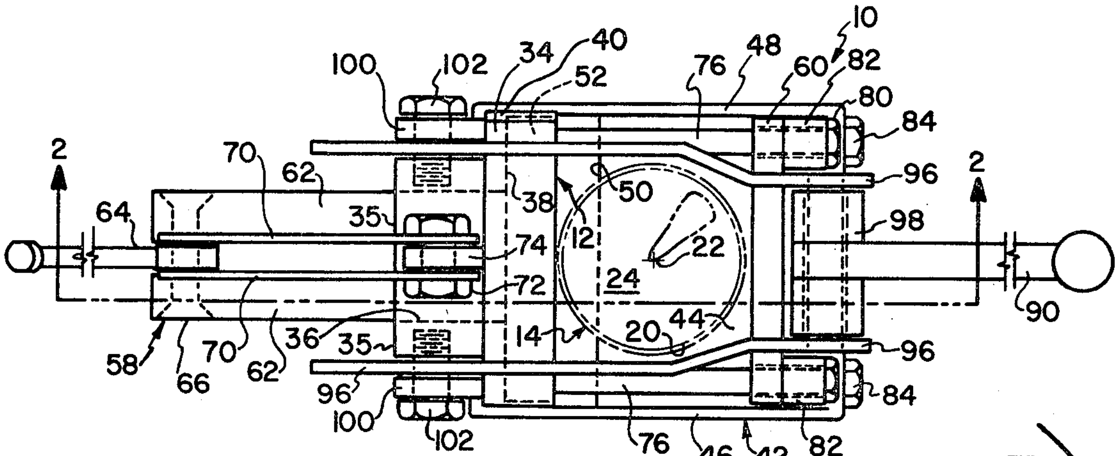


FIG. 2

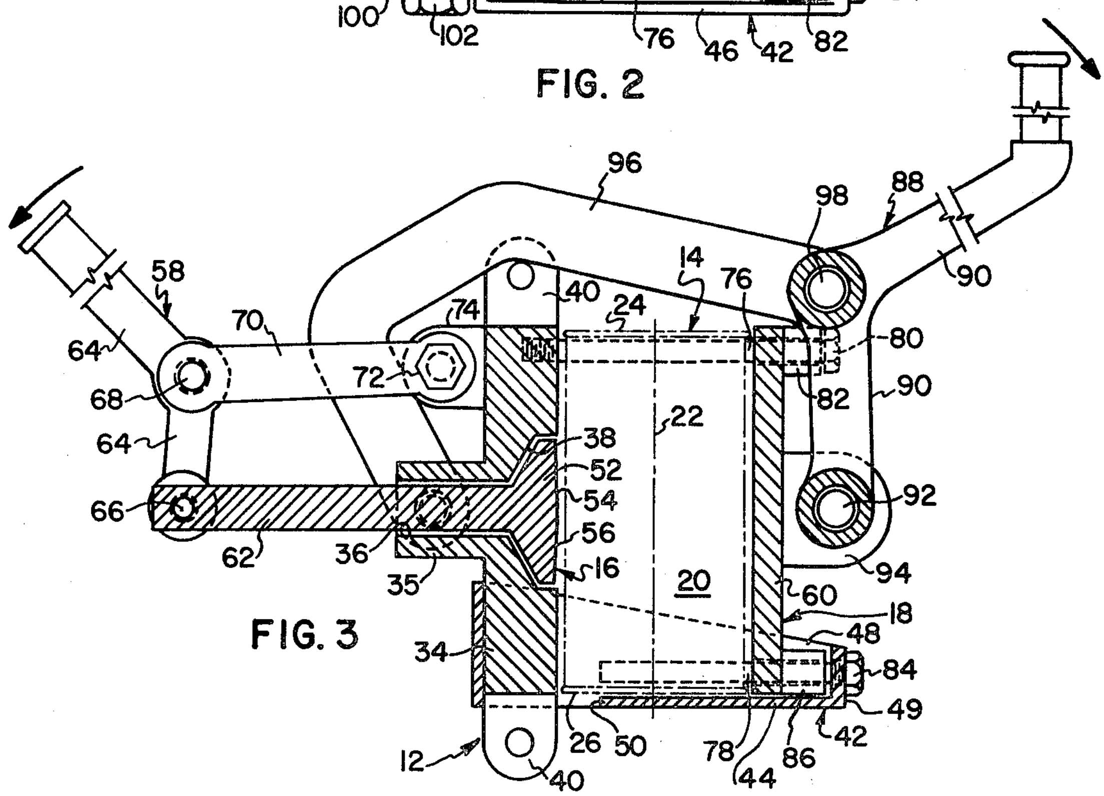


FIG. 3

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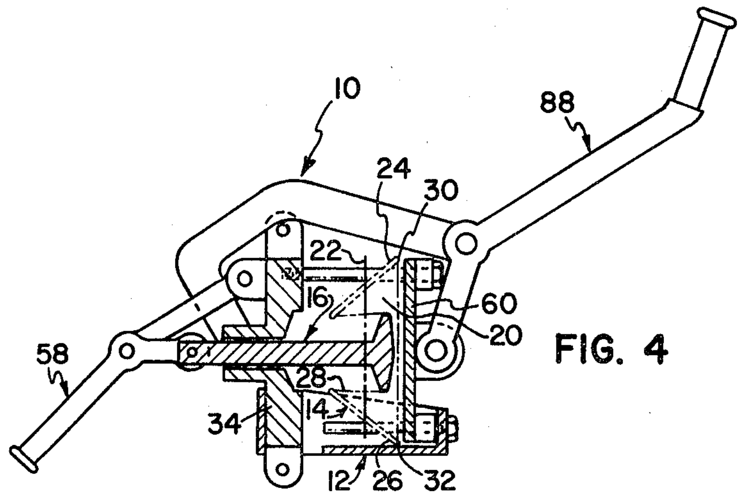

FIG. 4

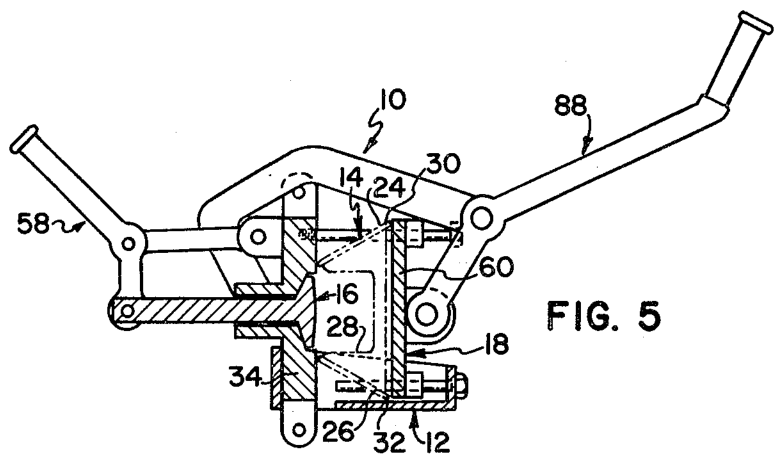

FIG. 5

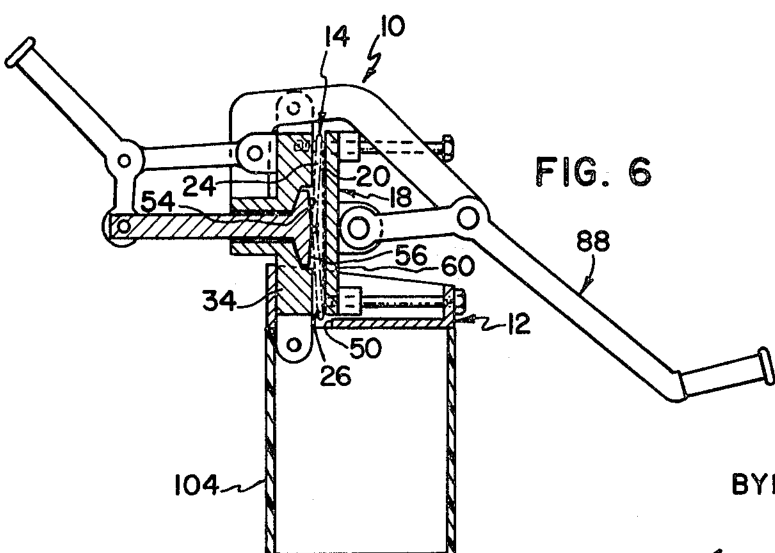

FIG. 6

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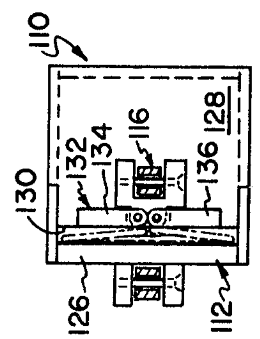

FIG. 9

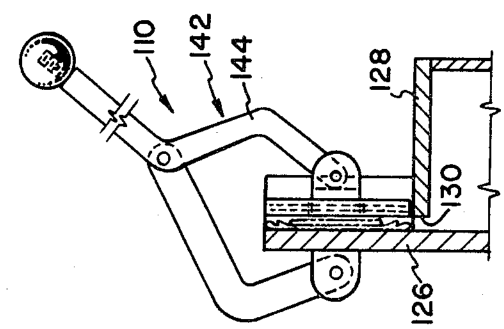

FIG. 12

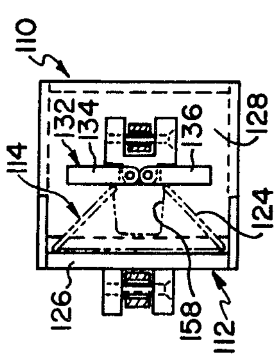

FIG. 8

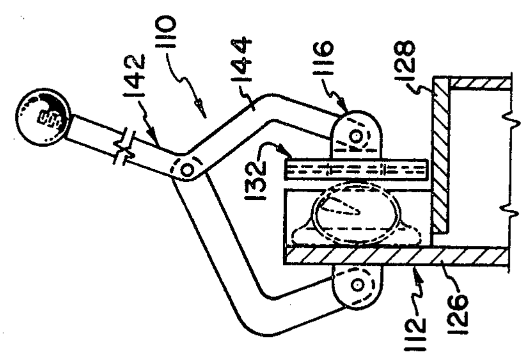

FIG. 11

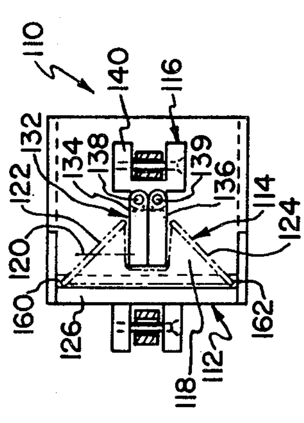

FIG. 7

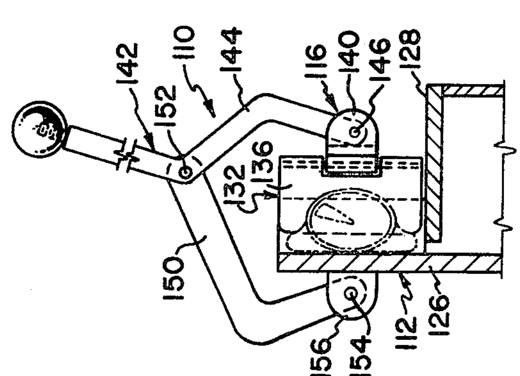

FIG. 10

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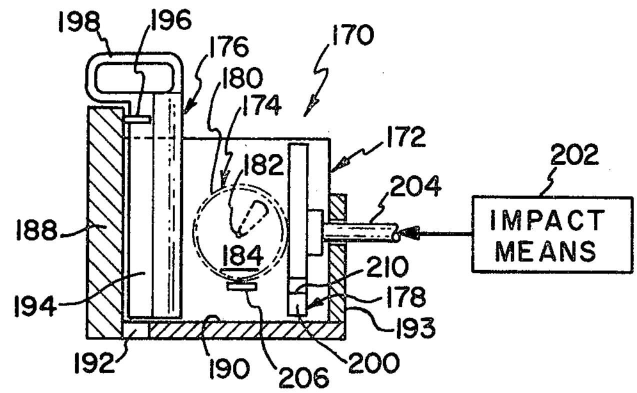

FIG. 13

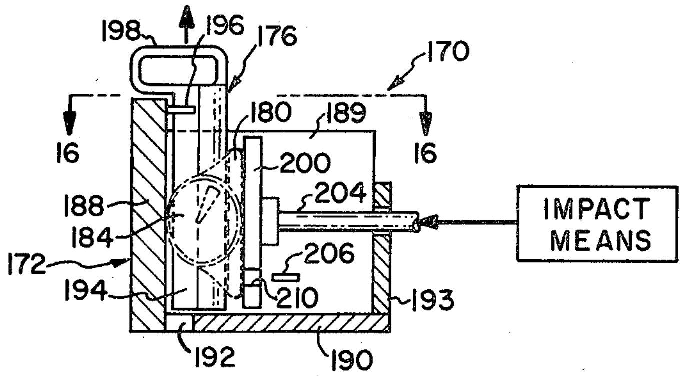

FIG. 14

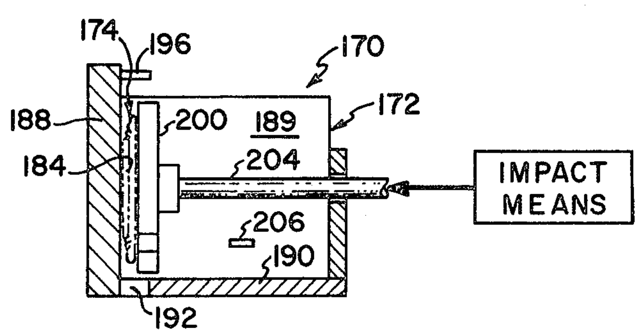

FIG. 15

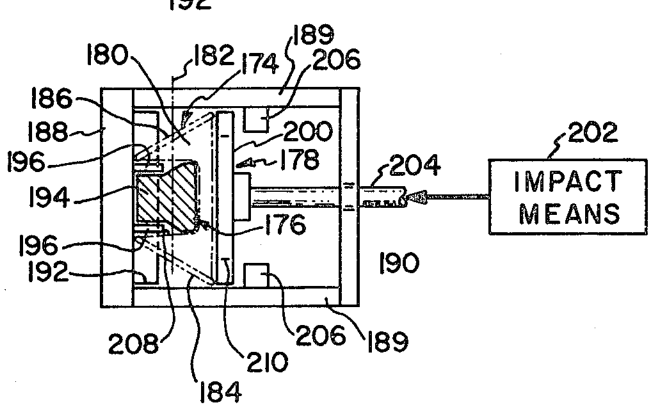

FIG. 16

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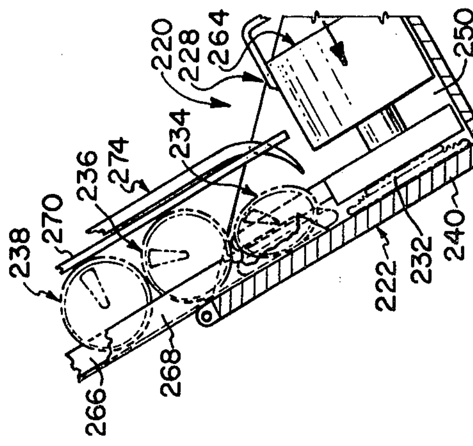

FIG. 19

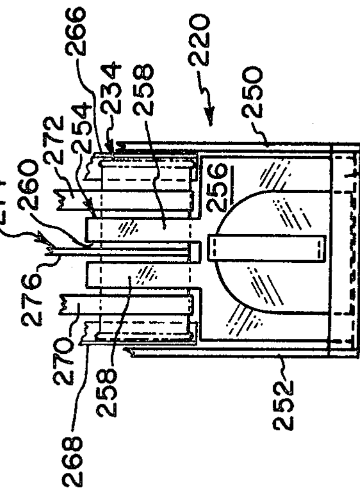

FIG. 21

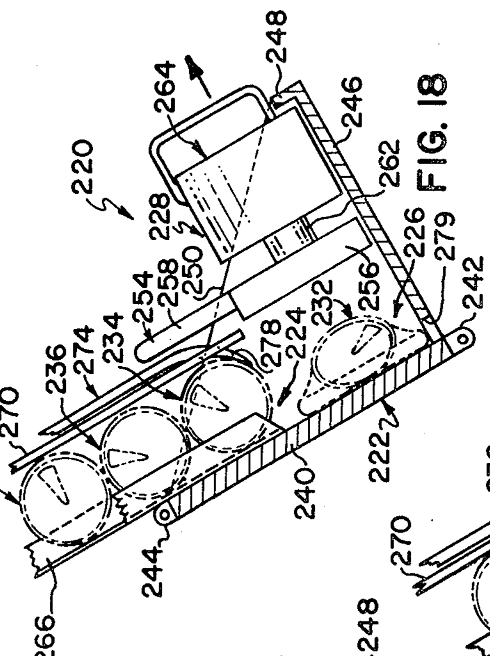

FIG. 18

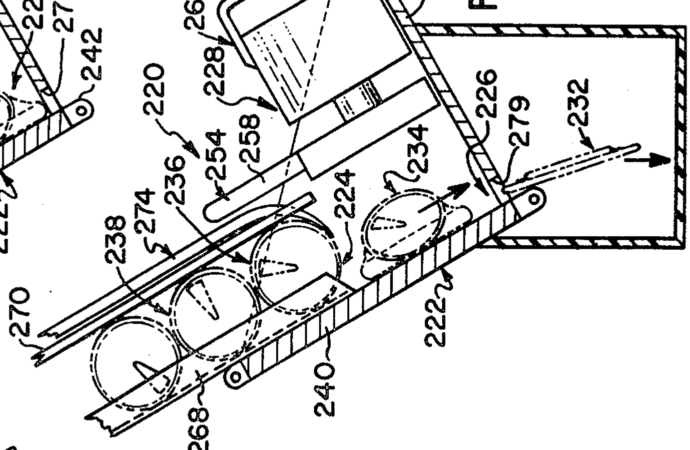

FIG. 20

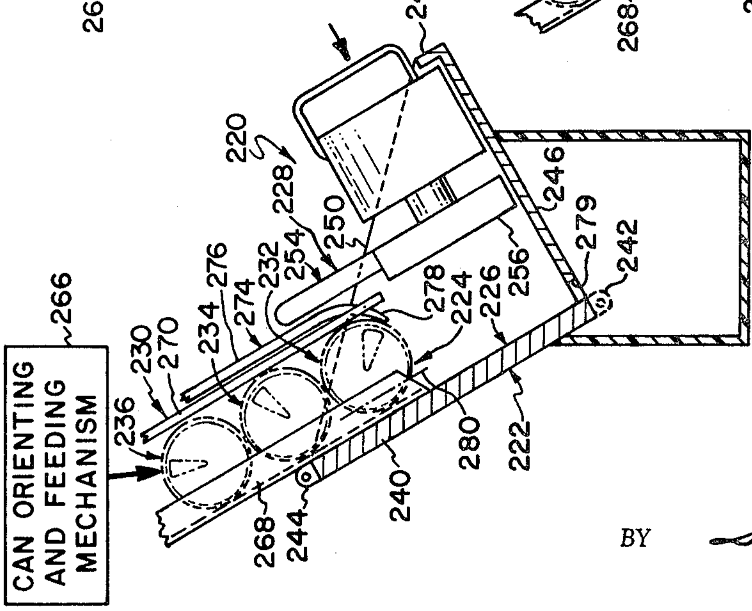

FIG. 17

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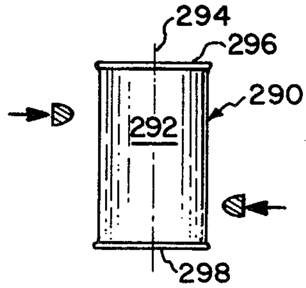

FIG. 22

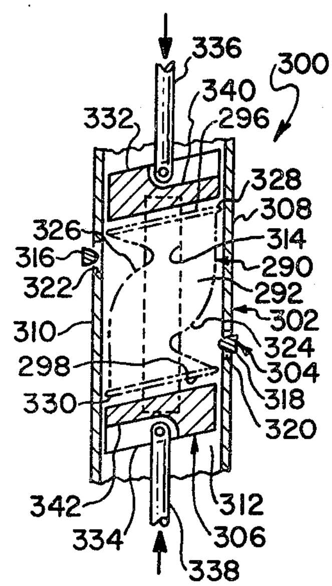

FIG. 23

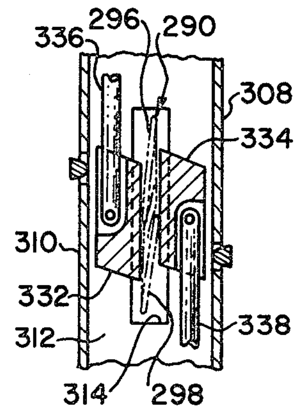

FIG. 24

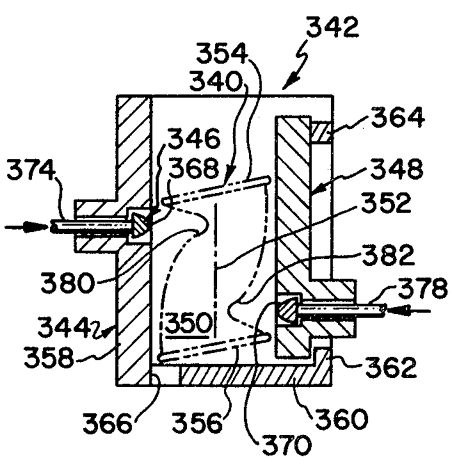

FIG. 25

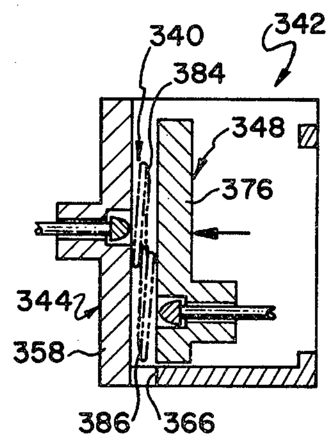

FIG. 26

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FLATTENING METAL CANS

BACKGROUND OF THE INVENTION

It hardly needs stating that the collection and disposal of metal containers, for example beer and soft drink cans, has become a matter of acute concern. This particular aspect of the litter problem may further be divided into the problem of collecting and disposing of so-called "tin" cans and the collection and disposal of aluminum cans. Since the metal values in used aluminum cans is significant, several programs have been instituted to collect used aluminum cans and treat the collected cans for reuse, as by melting the cans to form ingots and then extruding or rolling the ingots to form other useful articles.

One of the limitations inherent in the collection and disposal of used aluminum cans is the transportation costs involved in shipping the cans to a central facility for treatment. In one collection program, it is estimated that transportation costs limit the collection effort to within 50 miles of the treatment facility. It will accordingly be apparent that the effect of these programs will necessarily be limited.

Since empty aluminum cans have a high ratio of bulk to weight, transportation costs are governed by the volume of such containers rather than the weight thereof. As an example, a **55** gallon drum was filled with conventional cans by randomly throwing the cans therein. Three hundred twenty cans were required to fill the drum which calculates to be 44 cans per cubic foot. In contrast, by flattening the cans in accordance with one manually operated version of this invention, can counts in the range of 180 per cubic foot are typically obtained. The flattened cans accordingly comprise about 24 percent of the volume of the unflattened cans. The power operated versions of the invention should, of course, provide somewhat greater can counts. It will accordingly be apparent that the transportation costs of collection programs may be substantially reduced by flattening the cans before movement to the treating facility.

There are, of course, many diverse types of can flattening devices known in the prior art. One approach has been to pierce the ends of the can to destroy the mechanical strength thereof and then press the cylindrical side wall flat. Such devices are shown in U.S. Pat Nos. 2,178,461; 2,622,316 and 2,905,079. Such an approach is practicable with respect to so-called "tin" cans but has not operated satisfactorily on aluminum cans. This approach has proved unsatisfactory with aluminum cans since the sides are thin and flexible and tend to collapse before piercing of the ends is accomplished.

Other disclosures more pertinent to this invention are found in U.S. Pat Nos. 2,603,270 and 3,095,806. The devices disclosed in these references crease the can longitudinally during the flattening operation by forcibly applying a relatively thin member to the edge of the can. This approach requires the expenditure of substantial effort since both can ends are simultaneously creased and since the can ends are remarkably strong in the plane thereof. In contrast, this invention comprises forming a transverse notch in the can side wall, which is of relatively low strength. The creasing or notching of the can side wall angularly disposes the can ends with respect to the can axis. This step is followed, in the practice of this invention, by folding the can ends about parallel axes intersecting the end walls and side walls at opposite ends of the can.

The most pertinent prior art known is the time honored method used by beer drinkers to exhibit their strength. This approach is to squeeze the can side in the middle thereof which creases both sides of the can and deforms the can ends into shallow V-shaped configurations facing along the can axis in opposite directions away from the can. The can ends and a significant portion of the can side wall are then folded about a common axis in the center of the can so that the can assumes a generally V-shaped configuration. This approach is not suitable for present purposes since the can, as so collapsed, retains a significant proportion of its original volume.

Also of interest is the disclosure in U.S. Pat. No. 2,773,536 wherein a can flattening apparatus is provided with a slot therein for passing the flattened can into a suitable receptacle.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a convenient and simple method for flattening thin metal cans.

Another object of this invention is to provide a method for flattening metal cans by creasing or notching the side wall and folding the can ends about parallel axes adjacent the juncture of each can end and the can side wall.

In summary, the method of this invention comprises creasing the side wall of a cylindrical metal can to provide an open notch transverse to the can axis on at least one side thereof to incline the can ends to the can axis; and deformably folding each can end about an axis adjacent the juncture of the side wall and the respective can end to increase the inclination between the can end and the can axis.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing the sequence of operations in the practice of this invention;

FIG. **2** is a top view of one embodiment of this invention;

FIG. **3** is a longitudinal cross sectional view of the embodiment of FIG. **2**, taken substantially along line **2—2** thereof as viewed in the direction indicated by the arrows, illustrating a can about to be flattened;

FIGS. **4–6** illustrate the sequence of operation of the embodiment of FIGS. **2** and **3**;

FIGS. **7–9** are a series of partially sectioned top views of another embodiment of this invention illustrating the sequence of operation thereof;

FIGS. **10–12** comprise a series of side views of the embodiment of FIGS. **7–9** illustrating, in side view, the sequence of operation thereof;

FIGS. **13–15** illustrate, in sectioned side views, the sequence of operation of another embodiment of this invention;

FIG. **16** is a cross sectional view of the embodiment of FIGS. **13–15** taken substantially along line **16—16** of FIG. **14** as viewed in the direction shown by the arrows;

FIGS. **17—20** comprise a series of cross sections views of a preferred embodiment of this invention illustrating the sequence of operation thereof;

FIG. **21** is a partial rear view of the embodiment of FIGS. **17–20**;

FIG. 22 is a schematic view of a can being creased in accordance with an alternate mode of practicing this invention;

FIGS. 23 and 24 comprise sectional views of another embodiment of this invention for folding the can ends after creasing has been accomplished in accordance with FIG. 22; and

FIGS. 25 and 26 comprise sectional views of another embodiment of this invention for folding the can ends after creasing has been accomplished in accordance with FIG. 22.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is shown in block diagram a convenient breakdown or analysis of the operation of this invention. As will be seen, the first step in the operation of the invention is to crease the side wall of a typical metal can and begin the folding of the end walls followed by folding the end walls of the can to juxtapose the collapsed side wall.

Referring to FIGS. 2–6, there is illustrated a can flattener **10** comprising one embodiment of the apparatus of this invention. The can flattener **10** comprises as major components a frame **12** arranged to receive a can **14**, means **16** for creasing the can **14** and means **18** for folding and flattening the can **14**.

The can **14** is illustrated as a conventional beer or soft drink can comprising a cylindrical side wall **20** defining a can axis **22** and a pair of ends or end walls **24, 26** perpendicular to the can axis **22** and facing in opposite directions.

FIG. 3 illustrates the beginning of the sequence of operation of the can flattener **10**. In FIG. 4, the creasing means **16** has been actuated to crease or form a notch **28** in one side of the wall **20**. It will be seen that the ends **24, 26** of the can **14** are thereby inclined to the can axis **22**. It will be apparent that the can ends **24, 26** have been respectively folded about an axis **30, 32** passing through the juncture of the end walls **24, 26** and the side wall **20**. Concurrently with the formation of the notch **28**, the side of the wall **20** opposite therefrom is flattened against the folding and flattening means **18** causing an expansion of the lateral dimension of the can **14**. For example, in a conventional can 2 ⅝ inches in diameter, the transverse dimension thereof increases to about 4 inches during the creasing step.

FIG. 5 illustrates the next event in the sequence of operation where the creasing means **16** has been retracted from the notch **28**. Actuation of the folding and flattening means **18** causes the ends **24, 26** to be further respectively folded about the axes **30, 32** to increase the angle of inclination between the can ends **24, 26** and the can axis **22**. FIG. 6 illustrates the termination of movement of the folding and flattening means **18** and shows that the ends **24, 26** have closed the notch **28** and have come to reside in a common plane generally parallel to the side wall **20** which has now been flattened. It will also be seen that the ends **24, 26** now face in the same direction generally perpendicularly away from the can axis **22**.

Referring to FIGS. 2 and 3, a detailed view of the can flattener **10** is illustrated. The frame **12** comprises a stationary plate or member **34** having a boss **35** projecting from one side thereof. A pair of passages **36** extend through the plate **34** and boss **35** and communicates with an enlarged recess **38** which is at least as wide as the can **14** as may be seen in FIG. 2. As will be more fully apparent hereinafter, the stationary plate **34** comprises the base to which the moving members of the can flattener **10** are ultimately connected and also functions as a stationary platen in the folding and flattening means **18**. To mount the can flattener **10** in a vertical attitude, the plate **34** may be provided with suitable ears **40**.

The frame **12** also comprises a shallow tray **42** secured to the frame **12** and comprising a bottom wall **44** for supporting the can **14**, a pair of side walls **46, 48** substantially wider than the can **14** to allow the can **14** to grow in the lateral direction which occurs initially in the creasing operation, and a front wall **49**. The bottom wall **44** provides a slot **50** adjacent the stationary plate **34** to allow the can **14** to fall therethrough upon completion of the flattening operation.

The creasing means **16** comprises a movable platen **52** which is at least substantially as wide as the can **14** and which is preferably substantially wider, as shown in FIG. 2. As exemplary, in a conventional can of 2 ⅝ inches diameter, the movable platen preferably measures about 4 inches in the direction transverse to the can axis **22**. The platen **52** has a vertical dimension substantially less than the vertical dimension of the can **14**. As exemplary, when flattening a conventional can, the platen **52** is preferably slightly less than about half the height of the can. Best results have been obtained with a 2 inches vertical dimension and 2 ⅛ inches appears to be the upper limit for optimum results. It will be appreciated by those skilled in the art that the preferred dimensions of the platen **52** vary with the size and length-to-width ratio of the cans being flattened.

The platen **52** has converging faces **54, 56** which serve to ease the creasing of the can **14** and which also provide a function in the folding and flattening operation to be discussed hereinafter. The intersection of the faces **54, 56** conveniently lies in a plane substantially midway along the height of the can **14** perpendicular to the axis **22**.

The creasing means **16** also comprises means **58** for applying a force to the movable platen **52** for advancing the same toward a second platen **60**, which comprises part of the folding and flattening means **18** and acts as the stationary platen of the creasing means **16**. The force applying means **58** comprises a pair of spaced rods **62** connected to the movable platen **52** and extending outwardly through the passages **36**. A handle **64** is connected to the rods **62** by the provision of a suitable pivotal connection **66**. An intermediate portion of the handle **64** is connected by a suitable pivotal connection **68** to a pair of links **70** pivotally mounted by a suitable pin **72** to an ear **74** connected to the frame member **34**.

As will be apparent to those skilled in the art, rotation of the handle **64** in the direction shown by the arrow advances the rods **62** substantially linearly through the passage **36** until the pivot connection **66** engages the boss **35**. The length of travel afforded by the force applying means **58** is sufficient to move that segment of the can side wall **20** engaged by the platen **52** a substantial distance toward the opposite side of the can **14**. It is preferred that the platen **52** move at least as far as the can axis **22** and preferably to a location closely adjacent the second platen **60** as may be seen best in FIG. 4.

The folding and flattening means 18 comprises several elements previously discussed, specifically the frame member 34 and the platen 52 which together comprise a stationary platen and the second platen 60 which comprises the movable platen. The movable platen 60 is mounted for reciprocating movement by a pair of upper guide rods 76 and a pair of lower guide rods 78. The upper guide rods 76 are secured to the frame member 34 and provide an enlarged head 80 on the end thereof. A pair of bosses 82 are integrally provided by the platen 60 and slidably receive the rods 76. The guide rods 78 comprise a threaded section adjacent an enlarged head 84 on one end thereof and are threadably received by the front wall 49 of the tray 42. A pair of bosses 86 are provided on the lower section of the platen 60 and slidably receive the guide rods 78. The bosses 82, 86 provide greater bearing surface on the rods 76, 78 and accordingly lend greater vertical stability to the platen 60 during reciprocation toward the platen 34.

As seen in FIG. 3, the lower guide rods 78 extend toward the plane member 34 no farther than the slot 50 since the central part of the can 14 expands laterally during creasing to occupy substantially the entire distance between the side walls 46, 48 of the tray 42. By shortening the guide rods 78, the flattened can 14 has free access for exit through the slot 50.

The folding and flattening means 18 also comprises a force applying means 88 comprising a handle 90 mounted by a pivot connection 92 to an ear 94 affixed to the movable platen 60. The handle 90 is connected to a pair of links 96 by a pivot connection 98. Each of the links 96 is pivotally connected between an ear 100, carried by the frame member 34, and the boss 35 by a suitable fastener 102. It will be seen that rotation of the handle 90 in the direction shown by the arrow in FIG. 3 acts to advance the movable platen 60 toward the stationary platen comprised of the frame member 34 and the platen 52.

Referring to FIG. 5, it will be seen advancement of the platen 60 causes the leftmost edges of the can ends 24, 26 to engage the stationary frame member 34. Further advance of the platen 60 creates a moment in the can ends 24, 26 to fold the same about the respective axis 30, 32. Although some incidental tearing of the side wall 20 may occur, the flattening of the can 14 is not dependent thereon. Similarly, some deformation of the can ends 24, 26 may occur depending on the constructional details of the can being flattened.

Referring now to FIG. 6, it will be seen that the can 14 is flattened by folding the ends 24, 26 into a common plane generally parallel to the flattened side wall 20. It will be noted that the converging edges 54, 56 of the platen 52 act as an anvil to apply increased forces to the inner edges of the can ends 24, 26.

There is disposed beneath the slot 50 a receptacle 104, such as a box, a plastic bag or the like. After the can 14 has been flattened as shown in FIG. 6, the operator releases the force applying means 88 whereupon the can 14 falls by gravity into the receptacle 104. Upward movement of the force applying means 88 retracts the movable platen 60 to the position shown in FIG. 3 in order to receive an unflattened can.

A model in accordance with FIGS. 2–6 has been constructed in which the handle 64 provides a 4:1 mechanical advantage and the handle 90 provides a 10:1 mechanical advantage. The mechanical advantage of the handles 64, 90 may obviously be increased merely by lengthening the free ends thereof. The effort expended in flattening aluminum cans was rather moderate and the effort expended on tinplate cans was somewhat greater. The conventional 2⅝ inches diameter by 4 ⅞ inches tall cans were deformed into a flat configuration approximately 4 ⅞ inches long, 4 inches wide and about ⅜ inches thick.

Referring to FIGS. 7–12 there is schematically illustrated a can flattener 110 comprising another embodiment of this invention. FIGS. 7–9 illustrate a top view of the can flattener 110 in various stages of operation and correspond respectively to the side views shown in FIGS. 10–12. The can flattener 110 comprises as major components a frame 112 adapted to receive a conventional can 114 therein and means 116 for creasing the can 114 transversely of the longitudinal axis thereof and for folding and flattening the can 114.

The can 114 comprises a cylindrical side wall 118 defining a can axis 120 and a pair of ends or end walls 122, 124 facing in opposite directions along the can axis 120.

The frame 112 comprises a stationary plate or member 126 acting as a base for the moving parts of the can flattener 110 and also comprising a stationary platen of the creasing, folding and flattening means 116. The frame 112 also comprises a platform or base 128 on which the can 114 is disposed during flattening thereof. As shown best in FIG. 12, the base 128 provides a slot 130 to pass the flattened can into a convenient receptacle.

The means 116 comprises a foldable platen 132 which may be manipulated to present a relatively narrow creasing surface as shown in FIG. 7 and alternatively to present a relatively wide flattening surface as shown in FIG. 8. The platen 132 is mounted by suitable means (not shown) for reciprocating movement toward and away from the stationary plate 126 and is illustrated as comprising platen segments 134, 136 hinged about vertical axes 138, 139. The platen 132 is supported by a yoke 140 acting through the axes 138, 139. Suitable means are provided (not shown) to automatically move the platen segments 134, 136 between the positions shown in FIGS. 7 and 8. For example, a suitable indexing mechanism may be provided which operates during the retraction of the creasing means 116 from the position shown in FIG. 7 to expand the platen 132 into the position shown in FIG. 8. Similarly, the indexing mechanism may operate upon withdrawal of the flattening means 116 from the position shown in FIG. 9 to collapse the platen 132.

The creasing, folding and flattening means 116 preferably includes means 142 for applying a force to the movable platen 132. The force applying means 142 conveniently includes a handle 144 connected by a pivot connection 146 to the end of the yoke 140. A link 150 is connected at one end by a pivot connection 152 to the handle 144 and by a pivot connection 154 to an ear 156 on the frame member 126.

The operation of the can flattener 110 should now be apparent. A can 114 is placed on the platform 128 with the can axis 120 being generally horizontal. The creasing means 116 is advanced by the force applying means 142 with the platen 132 in the collapsed or creasing position shown in FIG. 7. A notch 158 transverse to the can axis 120 is accordingly formed in much the same manner as the creasing means 16 forms the notch 28.

It will be noted that the can ends 122, 124 are folded about axes 160, 162 to converge in the same general direction as the opening provided by the notch 158. Retraction of the creasing means 116 causes the platen 132 to expand to the position shown in FIG. 8.

Manipulation of the force applying means 142 again advances the platen 132 so that the inner edges of the ends 122, 124 engage the platen segments 134, 136 to fold the ends 122, 124 further inwardly thereby increasing the angle of convergence thereof and closing the notch 158. The resultant flattened can is illustrated in FIG. 9 with the can ends 122, 124 lying generally coplanar and parallel to the side wall 118 which has now been flattened. It will be seen that the can ends 122, 124 face in generally the same direction substantially perpendicular to the can axis 120. The release of forces on the handle 144 allows the can 114 to pass through the slot 130 into a suitable receptacle for ultimate disposal.

The can flatteners 10, 110 have been illustrated as hand operated devices. This invention is equally susceptible of use with power devices as illustrated in FIGS. 13-16. Referring to FIGS. 13–15, there is illustrated in sectioned side views a rudimentary can flattener 170 comprising another embodiment of this invention. The can flattener 170 comprises as major components a frame 172 for receiving a can 174 thereon, means 176 for creasing the can 174 and means 178 for folding and flattening the can 174.

The can 174 comprises a cylindrical side wall 180 defining a can axis 182 with a pair of can ends 184, 186 perpendicular to the can axis 182 and facing in opposite directions.

The frame 172 comprises a vertical stationary plate or member 188, a pair of stationary side walls 189, a horizontal base or platform 190 providing an exit slot 192 and a front wall 193. The creasing means 176 comprises a creaser bar 194 having a depth slightly less than the can diameter and a length somewhat larger than the maximum lateral dimension of the can 174 as shown in FIG. 14. The creaser bar 194 is positioned by any suitable means to engage the center part of the can 174 upon advance thereof toward the creasing means 176. This positioning may conveniently be accomplished by the provision of a pair of pegs 196 extending from the frame member 188. As shown best in FIG. 16, the creaser bar 194 has an enlarged section for engagement with the can 174 and a rearward section of reduced width to facilitate withdrawal of the creaser bar 194 from the position shown in FIG. 16. The creasing means 176 also includes a suitable handle 198 so that the creaser bar 194 may be manually removed after the creasing operation is completed.

The creasing means 176 also comprises a movable platen 200 for forcibly advancing the can 174 into engagement with the creaser bar 194. The movable platen 200 is connected to any suitable force applying means, for example a powered impact hammer or hydraulic cylinder 202 by a suitable rod 204. The creasing means 176 also comprises an abutment 206 extending inwardly from each of the frame side walls 189 to support the can 174 in the position shown in FIG. 13. As will be appreciated, the axis 182 of the can 174 is generally horizontal and the abutments 206 support the can 174 away from the base 190 to prevent the expanding can side 180 from contacting the base 190. If the can 174 were supported by the base 190 during the creasing operation, the expanding side wall 180 tends to drag on the base 190 and deform improperly.

As may be seen by a comparison of FIGS. 13, 14 and 16, advancement of the platen 200 toward the creaser bar 194 forms a notch 208 in the can 174 while the abutments 206 pass through a pair of suitable slots 210 in the movable platen 200. The notch 208 is formed in much the same manner as the cans are notched by the previously described embodiments of the invention such that the can ends 184, 186 are folded into converging relation.

The folding and flattening means 178 is comprised of elements previously mentioned, specifically the vertical plate 188, the movable platen 200, the rod 204 and the impact means 202. The vertical plate 188 acts as a stationary platen. Before operation of the folding and flattening means 178, the creaser bar 194 is removed from adjacent the vertical plate 188, as by grasping the handle 198 and pulling thereon transversely of the direction of movement of the platen 200. Further advancement of the platen 200 causes the can ends 184, 186 to abut the stationary platen 188 to fold the can ends 184, 186 thereby increasing the angle of convergence therebetween and closing the notch 208 as may be seen best in FIG. 15. After the platen 200 advances to the position shown in FIG. 15, retraction thereof allows the can 174 to pass through the slot 192 into a suitable container for disposal.

Referring to FIGS. 17–21, there is illustrated a can flattener 220 comprising an improved, simplified and preferred embodiment of this invention. The can flattener 220 comprises as major components a frame 222 providing a creasing station 224 and a flattening station 226, means 228 for creasing and flattening the cans presented at the creasing and flattening stations 224, 226 respectively and means 230 for feeding the cans to the creasing and flattening stations 224, 226. The cans pass sequentially through the flattener 220 and are denominated as cans 232, 234, 236, 238 to distinguish therebetween during the sequence of operation.

FIGS. 17–20 disclose a complete sequence of operation. FIG. 17 illustrates the beginning of the can flattening operation where no can is present at the flattening station 226 while the can 232 is located at the creasing station 224. Advancement of the creasing and flattening means 228 causes the can 232 to be creased or notched in much the same manner that the cans are notched by the previously discussed embodiments. FIG. 18 discloses a successive stage of operation where the creasing and flattening means 228 has been retracted whereupon the can 232 passes to the flattening station 226 while the can 234 is presented at the creasing station 224. FIG. 19 illustrates the advancement of the creasing and flattening means 228 to substantially simultaneously crease the can 234 at the creasing station 224 and flatten the can 232 at the flattening station 226. FIG. 20 illustrates the retraction of the creasing and flattening means 228 whereupon the flattened can 232 is discharged from the can flattener 220, the can 234 is moved to the flattening station 226 and the can 236 is presented at the creasing station 224. It will be apparent that the association of elements shown in FIG. 17 occurs only during the startup of the can flattener 220 while the sequence of operation illustrated in FIGS. 18-20 occurs successively during the continued operation of the can flattener 220.

The frame 222 comprises a stationary plate or member 240 which may be secured to any stationary support as by the provision of ears 242, 244. The frame 222 also comprises a platform 246 for supporting a can at the flattening station 226, a front wall 248 providing an abutment for the creasing and flattening means 228 and a pair of side walls 250, 252 which act to constrain the cans laterally in the flattener 220 and to constrain movement of the creasing and flattening means 228. The frame 222 is desirably positioned so that the path of can movement therethrough is inclined about 30° to the vertical for purposes more fully explained hereinafter.

The creasing and flattening means 228 comprises a bifurcated creaser bar 254 arranged in a plane common with a movable platen 256. As shown best in FIG. 21, the creaser bar 254 comprises a pair of upstanding spaced apart cylindrical pins 258 defining therebetween a slot 260. The leading edge of the pins 258 is offset, away from the stationary frame member 240, when compared to the leading edge of the movable platen 256 for purposes more fully apparent hereinafter. The platen 256 is connected by a force transmitting element 262 to means 264 for applying force thereto. Although the force applying means 264 may comprise a suitable lever-linkage arrangement for manual operation, a power operator such as an impact tool is highly desirable.

The can feeding means 230 may comprise a suitable orienting and feeding mechanism 266 to deliver the cans into the frame 222. The feeding means 230 preferably comprises guide means including a first pair of guide elements 266, 268 for delivering the cans into the flattener 220 between the side walls 250, 252 as may be seen in FIG. 21. The guide means further includes second guide elements 270, 272 which cooperate with the guide elements 266, 268 to constrain the cans for movement into the frame 222 in single file to present a single can at the creasing station 224 with the can ends spaced on opposite sides of the creaser pins 258 as may be seen best in FIG. 21.

An important part of the feeding means 230 comprises a retainer 274 for holding a can at the creasing station 224 as may be seen in FIGS. 17, 18 and 20. The retainer 274 comprises a thin strap 276 having a hook 278 on the end thereof extending into the path of can movement. As shown best in FIG. 21, the strap 276 is positioned to pass through the slot 260 upon advancement of the creasing means 254 into the creasing station 224. The hook 278 extends inwardly past the guide elements 270, 272 to prevent passage of the undeformed cans toward the flattening station 226. It will accordingly be apparent that the cans moving into the flattener 220 are held by the retainer 274 at the creasing station 224.

As in the previous embodiments, the frame 222 includes a slot 279 at the juncture of the platform 246 and the vertical member 240 to allow cans to pass therethrough into a convenient receptacle as shown in FIGS. 17–20.

When the can flattener 220 is initially started, the cans 232, 234, 236 are sequentially guided by the elements 266, 268, 270, 272 so that the can 232 is held at the creasing station 224 by the hook 278. Operation of the force applying means 264 advances the creasing means 254 such that the creaser pins 258 pass the retainer 274 and notch or crease the can 232 in much the same manner as cans are creased by the previously discussed embodiments. The forward travel of the creaser pins 258 arrested by engagement of the platen 256 with the frame member 240. The creaser pins 258 accordingly have a forward limit of travel indicated by a dot dash line 280 in FIG. 17. Since the hook 278 engages the can 232 only at the center thereof (see FIG. 21), retraction of the creasing and flattening means 228 allows the can 232 to pass out of the feeding means 230 to the flattening station 226 as shown in FIG. 18. Tilting of the frame 222 allows the can 232 to slide freely down the wall afforded thereby without tipping the can over onto the platform 246. It will be apparent that if the can 232 should tip over onto the platform 246, the final flattening operation will not occur as designed since the can ends will not be folded further to close the notch formed by the creaser pins 258.

As will be appreciated at this point, the formation of a notch in the can 234 causes the can ends to incline with respect to the can axis and causes the edges thereof adjacent the notch to move toward each other. This may be seen, for example, in the FIGS. 4, 7 and 16. This peculiarity allows the retainer 274 to be constructed, in the alternative, by positioning a lug to extend from the side walls 250, 252 to engage the lower right edge of the ends of the can 234 as viewed in FIG. 18.

Actuation of the force applying means 264 advances the creasing and flattening means 228 to the position shown in FIG. 19. It will be apparent that the can 232 is flattened by the platen 256 while the can 234 is creased or notched by the creaser pins 258. Flattening of the can 232 is accomplished by folding the can ends to increase the angle of convergence thereof and close the notch formed by the creasing means 254 in the preceding step of operation. Rearward movement of the creasing and flattening means 228 to the position illustrated in FIG. 20 allows the can 232 to exit through the slot 279 while the can 234 passes under the hook 278 to the flattening station 226. The can 236 is then presented to the creasing station 224 and held therein by the retainer 274. It will be apparent that forward and backward movement of the creasing and flattening means 228 will eject flattened cans from the frame 222 and accept undeformed cans at the creasing station 224 for as long as the supply of undeformed cans lasts.

The previously discussed embodiments of the invention have formed a notch in one side of the can and then folded the can ends to close the notch. This invention is also susceptible of deforming opposite sides of the cylindrical can wall and then folding the can ends to reside in substantially a common plane with the flattened side wall. In this regard, reference is made to FIGS. 22–24 which schematically illustrate such a technique. A familiar can 290 comprises a cylindrical side wall 292 defining a can axis 294 with a pair of can ends 296, 298 closing the side wall 292 and residing in parallel planes perpendicular to the can axis 294.

A can flattener 300 has, as the now familiar major components, a frame 302, means 304 for creasing the can side wall 292 and means 306 for folding and flattening the can 290. The elements of the can flattener 300 may be of any desired configuration to accomplish creasing on opposite sides of the can 290 and folding of the can ends 296, 298. One exemplary arrangement is shown in FIGS. 23 and 24 where the frame 302 comprises a trough-like structure having side walls 308, 310 and a bottom wall **312** having a slot **314** therein to discharge the flattened can **290** from the flattener **300**.

The creasing means **304** may comprise creaser bars **316, 318** on opposite sides of the can **290** and extending through suitable apertures **320, 322** in the side walls **308, 310**. It will be noted that the creaser bars **316, 318** are positioned to provide a notch **324, 326** in the can **292** adjacent the ends **296, 298** and thereby fold the can ends **296, 298** about axes **328, 330** at the juncture of the ends **296, 298** and the side wall **292**.

As shown in FIG. **23**, the creaser bars **316, 318** are retracted through the slots **320, 322** to allow advancement of the folding and flattening means **306**. The folding and flattening means **306** is illustrated as comprising a pair of relatively movable platens **332, 334** each of which is pivotally mounted on a force applying rod **336, 338**. Application of forced in the direction shown by the arrows in FIG. **23** causes the platens **332, 334** to engage the respective end walls **296, 298** and further fold the end walls **296, 298** about the axes **328, 330**. In contrast to the operation provided by the previous embodiments, the end walls **296, 298** are not convergent but are instead substantially parallel in planes angularly intersecting the can axis **294**.

The platens **332, 334** are provided with suitable slots **340, 342** to accommodate rotation of the platens **332, 334** and as may be seen in FIG. **24**. It will be apparent from FIG. **24** that the advancement of the platens **332, 334** toward each other causes folding of the can ends **296, 298** into more or less parallel planes parallel to the can axis **294** so that the can ends **296, 298** face generally perpendicularly therefrom in opposite directions. Retraction of the platens **332, 334** releases the can **290** for passage through the slot **314** into a suitable disposal receptacle.

It will be immediately apparent that other suitable arrangements may be provided for creasing the can sides and then folding the can ends to achieve a folded configuration similar to that illustrated by the can **290** in FIG. **24**. One such arrangement is shown in FIGS. **25** and **26** where a can **340** is shown in the process of being flattened by a can flattener **342**. The can flattener **342** comprises a frame **344**, means **346** for creasing the can **340** and means **348** for folding and flattening the can **340**. As will be apparent by a comparison of FIGS. **3** and **25**, the can flattener **342** is an adaptation of the can flattener **10** to crease the can **340** on both sides thereof.

The can **340** comprises a cylindrical side wall **350** defining a can axis **352** and a pair of end walls **354, 356** which reside in parallel planes perpendicular to the can axis **352** when the can **340** is undeformed.

The frame **344** comprises a stationary plate or member **358** and a platform **360** for supporting the can **340** during the creasing and flattening operations. A pair of abutments **362, 364** provide one limit of movement of the folding and flattening means **348** for purposes which will become more fully apparent hereinafter. A slot **366** is provided in the platform **360** for passing the flattened can **340** out of the frame **344** as will be apparent from FIG. **26**.

The creasing means **346** is a hybrid of the creasing mechanisms shown in FIGS. **3** and **23** and comprises a pair of creaser bars **368, 370** on opposite sides of the side wall **350** adjacent the end walls **354, 356** respectively. The creaser bar **368** is mounted in a recess provided by the stationary plate **358** and is connected to a force applying rod **374**. The creaser bar **370** is mounted in a recess provided in a platen **376** and has a force applying rod **378** connected thereto. It will be apparent that the application of force to the rods **374, 378** causes the creaser bars **368, 370** to engage the can side wall **350** and form notches **380, 382** therein. The formation of the notches **380, 382** causes the can ends **354, 356** to become inclined with respect to the can axis **352**. It will be seen that the platen **376** is supported by the abutments **362, 364** and acts as an anvil with respect to the creaser bar **368**. The creaser bars **368, 370** are then retracted in preparation for the next step of operation.

The folding and flattening means **348** comprises the platen **376** which is mounted by a suitable means (not shown) for reciprocating movement from the position shown in FIG. **5** toward the frame member **358** which constitutes a stationary platen. A suitable force applying member (not shown) is provided to forcibly advance the platen **376** as indicated by the arrow in FIG. **26**. As the platen **376** advances toward the frame member **358**, the ends **354, 356** of the can **340** are further folded about the axes **384, 386** and come to reside in substantially the configuration shown in FIG. **26**. Relaxation of the force applied to the platen **376** allows the flattened can **340** to pass through the slot **366** out of the frame **344**.

It will now be seen that there is provided an improved method and apparatus for flattening metal cans.

I claim as my invention:

1. The method of flattening a metal can having a generally cylindrical side wall defining a can axis and ends generally perpendicular to the can axis, the method comprising the steps of

providing a continuous flat support along the full length of one side of the side wall to prevent any creasing therein;

advancing a creasing element into engagement with the opposite side of the side wall at the midpoint between the can ends for creasing the can wall without severing thereof to provide a notch transverse to the can axis on only one side thereof while maintaining the can ends in essentially undeformed condition and to incline the can ends to the can axis;

retracting the creasing element from engagement with the opposite side of the side wall before severing thereof; and then

advancing a flattening element into engagement with the can ends for deformably folding each can end about an axis adjacent the juncture of the side wall and the respective can end to force the can ends into generally coplaner relation.

2. The method of claim **1** wherein the creasing and folding steps include collapsing the side wall into a generally flat configuration.

3. The method of claim **2** wherein the folding step comprises juxtaposing the ends to the side wall.

4. The method of claim **1** wherein the folding step comprises folding each can end about an axis residing in the side wall adjacent the juncture thereof with the respective can end.

5. The method of claim **1** wherein the folding step comprises maintaining the can ends in essentially undeformed condition.

6. The method of claim **1** wherein the metal can is more than twice as tall as it is wide and the notch in the side wall defines first and second segments projecting from immediately adjacent the can ends generally perpendicular to the can axis and a third segment generally parallel to the can axis and spaced between the can axis and the other side of the can and wherein the folding step comprises folding the side wall comprising the perpendicular segments in the same direction as the can ends adjacent thereto.

7. The method of claim **1** wherein the metal can is cylindrical and has a can end diameter of about 55 percent of the axial dimension of the can and the notch provided in the side wall is in excess of about 75 percent of the can end diameter.

8. The method of flattening a metal can having a generally cylindrical side wall defining a can axis and ends generally perpendicular to the can axis, the method comprising the steps of

deforming opposite sides of the can adjacent opposite ends thereof to provide notches at diametrically opposed edges of the can while maintaining the can ends in essentially undeformed condition and to incline the can ends to the can axis; and then

deformably folding each can end in the same direction about an axis adjacent the juncture of the side wall and the respective can end toward the notch adjacent thereto to increase the inclination of the can ends and the can axis.

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