



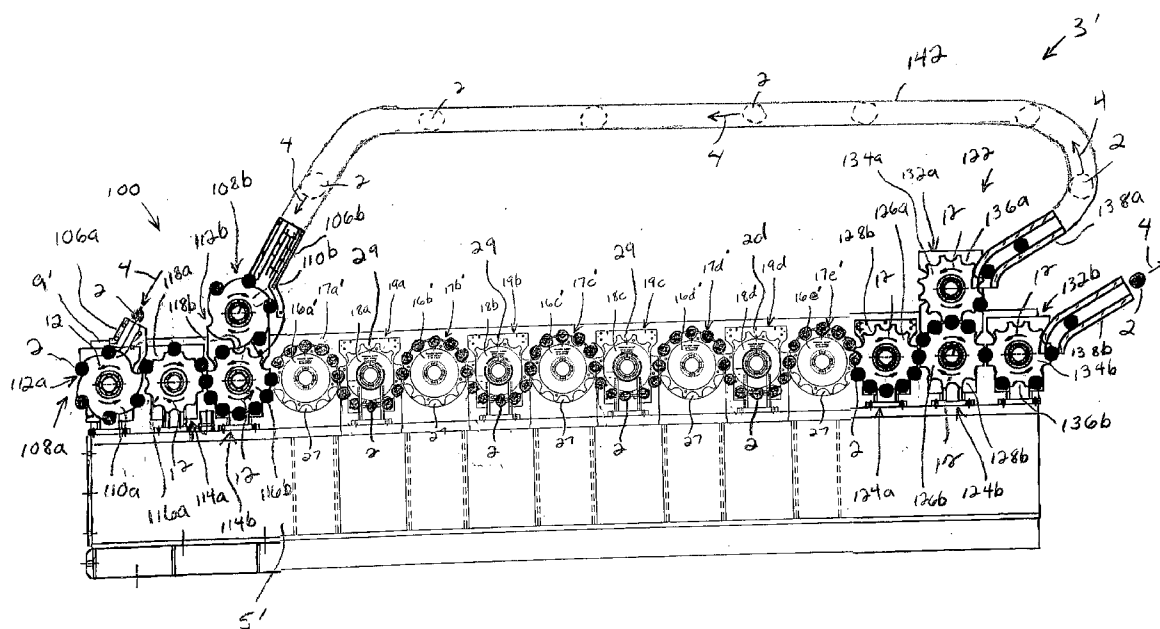
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(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0193796 A1**
Heiberger et al. (43) **Pub. Date: Sep. 8, 2005**(54) **APPARATUS FOR NECKING A CAN BODY**(52) **U.S. Cl. 72/356**(76) **Inventors: Joseph M. Heiberger, Downers Grove, IL (US); Richard Mark Orlando Golding, Wilmette, IL (US)**(57) **ABSTRACT**

Correspondence Address:
WOODCOCK WASHBURN LLP
ONE LIBERTY PLACE, 46TH FLOOR
1650 MARKET STREET
PHILADELPHIA, PA 19103 (US)

(21) **Appl. No.: 10/793,255**(22) **Filed: Mar. 4, 2004****Publication Classification**(51) **Int. Cl.⁷ B21D 51/26**

A preferred embodiment of an apparatus for necking a can body includes a first necking station for reducing a diameter of an end of the can body, and a second necking station for further reducing the diameter of the end of the can body. The apparatus further includes at least one transfer wheel for transferring the can body from the first necking station to the second necking station after the diameter of the end of the can body has been reduced by the first die. The second necking station is mechanically coupled to the first necking station so that the first necking station receives the can body after the diameter of the can body has been reduced by the second necking station.



Prior art

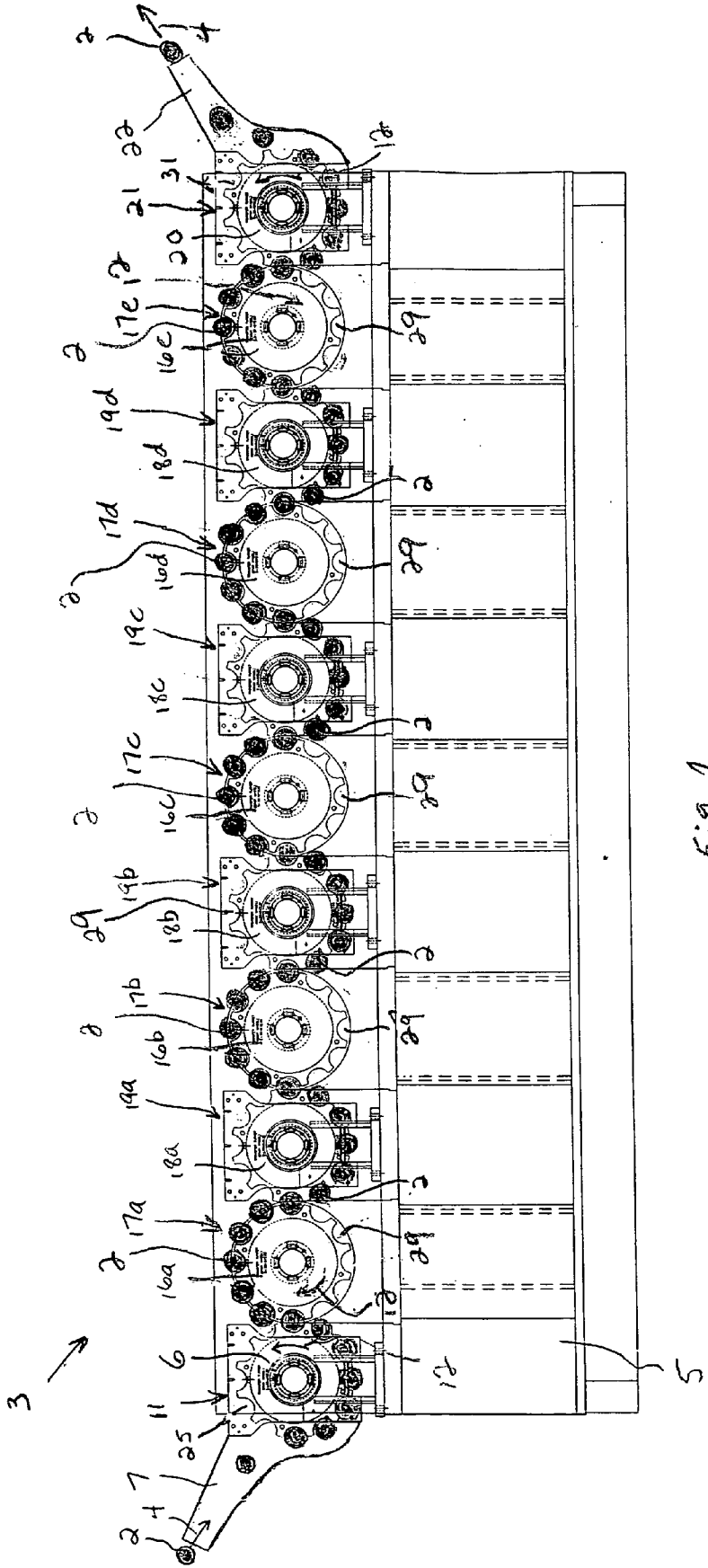
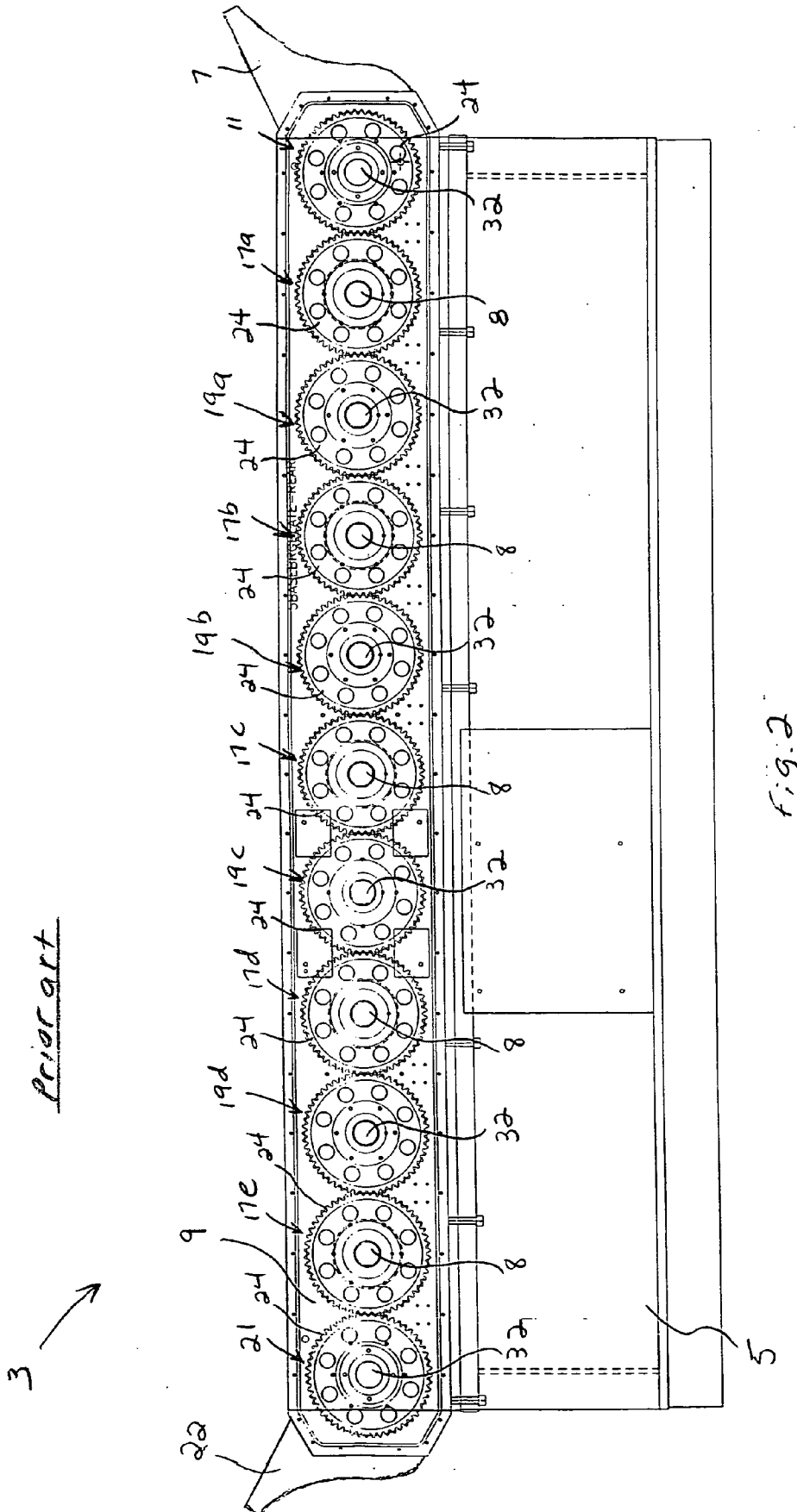


Fig. 1



Prior art

3

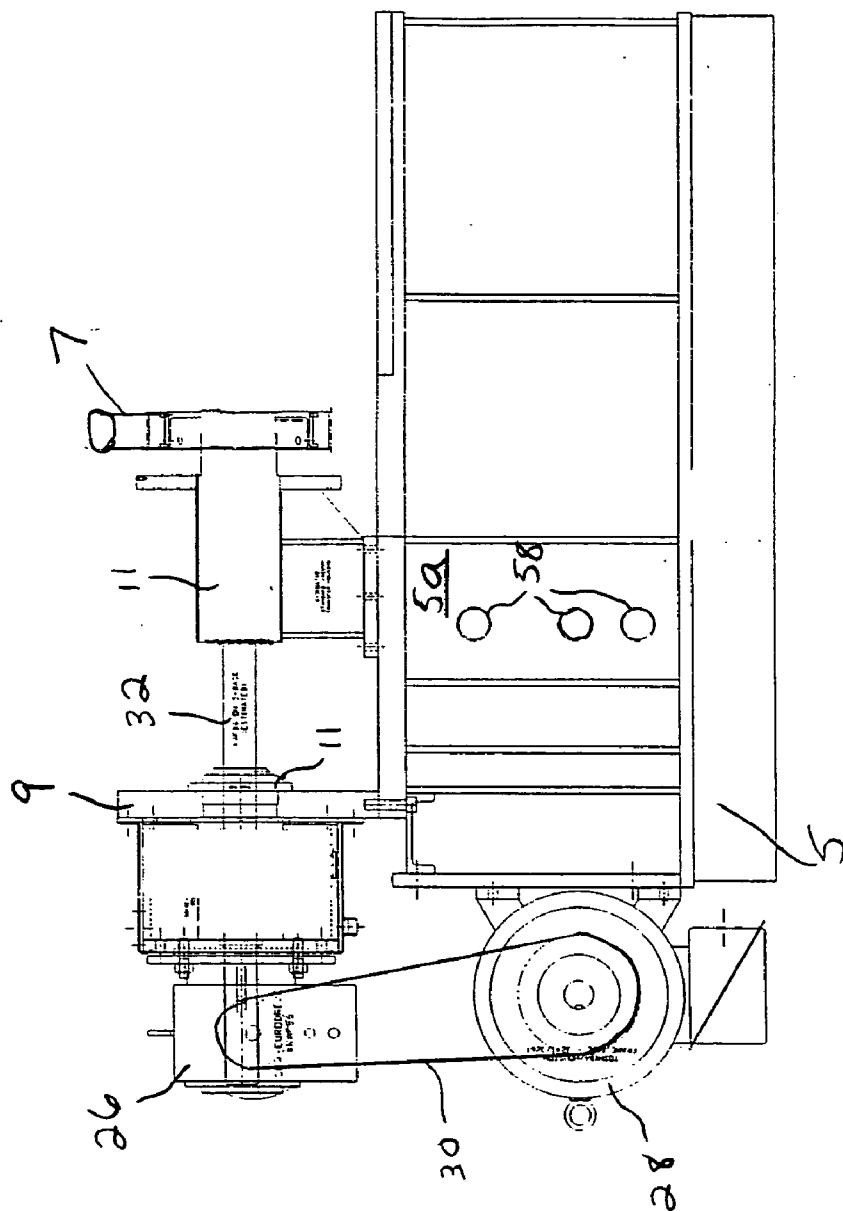


Fig. 3

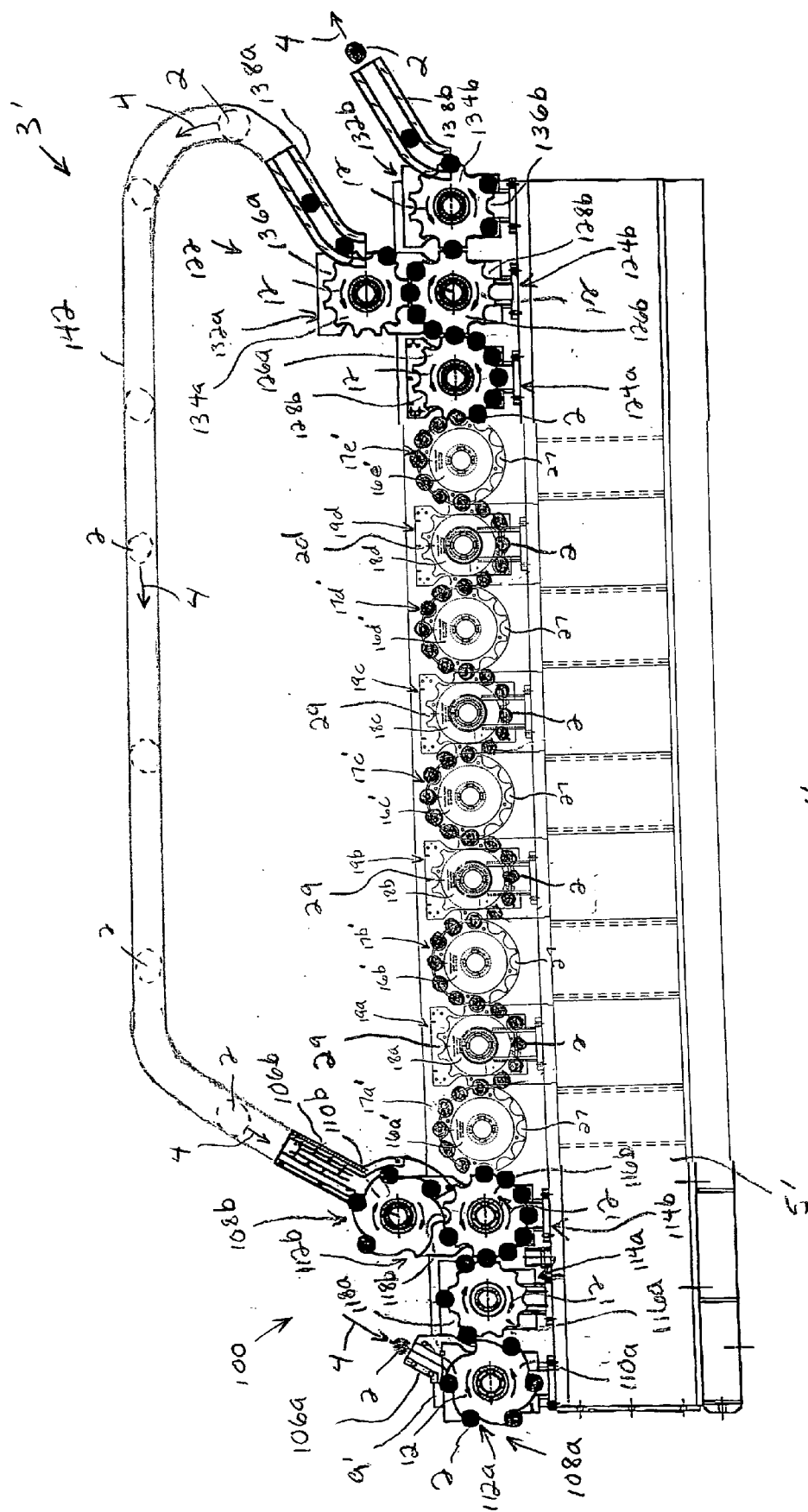
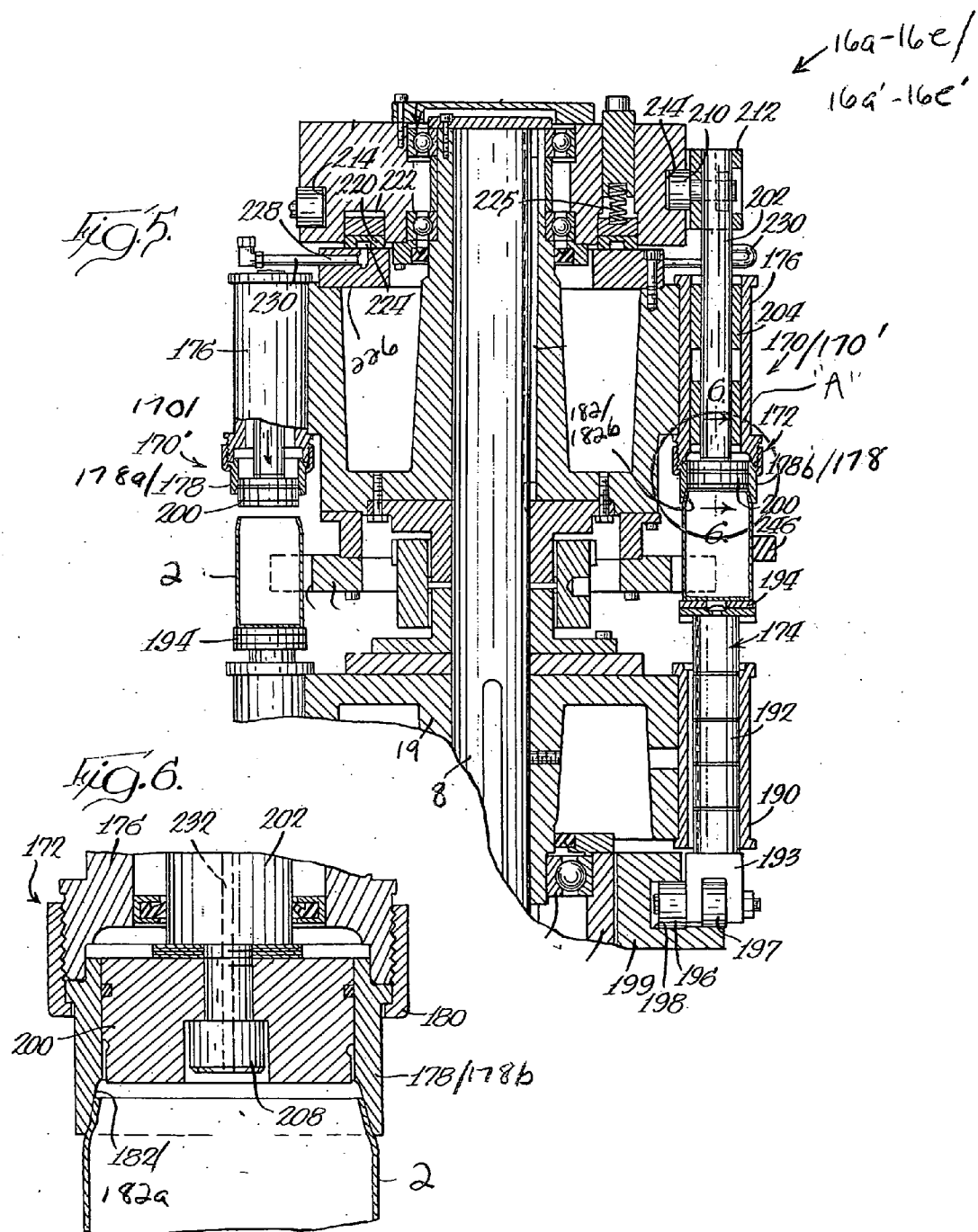


Fig. 4



APPARATUS FOR NECKING A CAN BODY

FIELD OF THE INVENTION

[0001] The present invention relates to machinery for manufacturing containers. More specifically, the invention relates to an apparatus for necking metallic can bodies.

BACKGROUND OF THE INVENTION

[0002] Beverages such as beer and carbonated soft drinks are commonly packaged in two-piece cans formed from aluminum material. Two-piece cans are typically manufactured by attaching a circular lid to an open end of a generally cylindrical can body formed by a drawing and ironing process.

[0003] The diameter of the open end of the can body can be reduced prior to attaching the lid thereto. Reducing the diameter of the open end facilitates the use of a smaller-diameter lid than would otherwise be possible (thereby reducing the amount of raw material needed to manufacture the lid). The process by which the diameter of the can end is reduced is known as “necking.”

[0004] Necking is typically performed in a number of incremental steps, with the diameter of the can end being reduced only slightly in each step. Necking the can end in this manner reduces the potential for the can end to become wrinkled or otherwise distorted as its diameter is reduced.

[0005] Necking can be performed in several different manners. For example, a process known as “die necking” is disclosed in U.S. Pat. Nos. 5,755,130 (Tung et al.); U.S. Pat. No. 4,519,232 (Traczyk et al.); and U.S. Pat. No. 4,774,839 (Caleffi et al.), each of which is incorporated by reference herein in its entirety. Die necking involves forcing an open end of a can body into a die so that an inwardly tapered surface of the die permanently deforms the open end inward. (Necking operations can also be performed using techniques broadly referred to as “spin necking.”)

[0006] A variety of machines have been developed for necking can ends. For example, FIGS. 1-3 depict a five-stage necking machine 3 for performing a die necking process on a can body 2. (The can body 2 is depicted as entering the necking machine 3 in FIG. 1, with the direction of travel of the can body 2 denoted by the arrow 4).

[0007] Necking machines such as the necking machine 3 are available from Belvac Production Machinery of Lynchburg, Va., as model 595. A necking machine substantially similar to the necking machine 3 is described in detail in U.S. Pat. No. 6,085,563 (Heiberger et al.), which is incorporated by reference herein in its entirety.

[0008] The necking machine 3 comprises a unitary base 5, and a bearing plate 9 fixedly coupled to a top surface of the base 5. The base 5 forms an enclosure for containing a vacuum generated by an external source (not pictured). In other words, the base 5 has a sealed internal volume for containing an externally-generated vacuum (see FIG. 2). (The purpose of this feature is explained below.)

[0009] Three pipes 58 extend into and out of the base 5 by way of through holes formed in end plates 5a of the base 5 (see FIG. 3). The uppermost pipe 58 conveys vacuum, and the remaining pipes convey positive or pressurized air to the necking machine 3.

[0010] The necking machine 3 further comprises an input chute 7 and an input module 11 (see FIG. 1). The input module 11 comprises a feed wheel 6 having a plurality of pockets 25 formed therein. The pockets 25 each receive a respective can body 2 from the input chute 7. The feed wheel 6 rotates in a counterclockwise direction (from the perspective of FIG. 1). (Rotational directions are denoted in the figures by arrows 12.)

[0011] The can bodies 2 are retained in the pockets 25 by a vacuum force. More particularly, a port (not shown) is defined in the surface that defines each of the respective pockets 25. The port is in fluid communication with the internal volume within the base 5 by way of a hose (not shown) coupled to the internal volume, and a rotary manifold (not shown) within the feed wheel 6. The vacuum is transmitted to the port by the hose and the rotary manifold, and generates a suction force that retains the can body 2 in the pocket 25.

[0012] The necking machine 3 further comprises a first, second, third, fourth, and fifth necking module, respectively designated 17a, 17b, 17c, 17d, 17e (see FIG. 1). The necking modules 17a, 17b, 17c, 17d, 17e each comprise a necking station, respectively designated 16a, 16b, 16c, 16d, 16e. The necking stations 16a, 16b, 16c, 16d, 16e incrementally reduce the diameter of the open end of the can body 2.

[0013] The necking stations 16a, 16b, 16c, 16d, 16e each include a turret 19. Each turret 19 has twelve pockets 27 formed therein for receiving the can bodies 2. Each turret 19 is fixedly coupled to a respective shaft 8. The shafts 8 are each rotatably coupled to the base 5 and the bearing plate 9 by bearings (not shown). This arrangement permits the turrets 19 to rotate in a clockwise direction (from the perspective of FIG. 1) during necking operations.

[0014] The feed wheel 6 carries the can bodies 2 through an arc of approximately 210 degrees, and deposits each can body 2 into a corresponding one of the pockets 27 of the necking station 16a.

[0015] An open end of the can body 2 is brought into contact with a die of a necking assembly on the necking station 16a, using techniques well known in the art of can making. The turret 19 carries the can body 2 through an arc of approximately 180 degrees. The noted contact between the can body 2 and the die slightly reduces the diameter of the open (upper) end of the can body 2. (The process by which the diameter of the can body 2 is reduced, as noted above, is commonly referred to as “necking.”)

[0016] FIGS. 5 and 6 depict a necking assembly 170 that can be used to reduce the diameter of the can body 2. The necking station 16a can comprise twelve of the necking assemblies 170. Each of the necking assemblies 170 is associated with a corresponding one of the pockets 27.

[0017] The twelve necking assemblies 170 are substantially identical. Each necking assembly 170 comprises a deforming element 172 for engaging the upper end of the can body 2. The deforming element 172 comprises a sleeve 176 and a die 178. The sleeve 176 is fixedly coupled to a periphery of the turret 19. The die 178 is secured to an end of the sleeve 176 by a cap 180. The die 178 has a necking surface 182 formed along an inner periphery thereof.

[0018] Each necking assembly 170 also comprises a support member 174 for engaging a bottom wall of the can body 2. The support member 174 includes a sleeve 190. The sleeve 190 is fixedly coupled to a periphery of the turret 19 so that a longitudinal axis of the sleeve 190 is substantially aligned with a longitudinal axis of the sleeve 176.

[0019] The support member 174 also includes a shaft 192, and a platform 194 secured to a first end of the shaft 192. The shaft 192 reciprocates within the sleeve 190. The support member 174 further includes a cam block 193 and cams 196, 197. The cams 196, 197 are mechanically coupled to a second end of the shaft 192 by way of the cam block 193.

[0020] The necking assembly 170 further comprises a cam plate 199. The cam 196 contacts a camming surface 198 formed on cam plate 199. The cam plate 199 is fixedly coupled to a periphery of a hub 154 of the base 5 (the cam plate 199 thus remains stationary in relation to the support member 174 as the turret 19 rotates).

[0021] The cam plate 199 is configured so that the distance between the camming surface 198 and the deforming element 172 varies along the length (circumference) of the camming surface 198. This feature causes the cam plate 199 to drive the support member 174 between a first and a second position (shown respectively on the left and right-hand sides of FIG. 5) during each revolution of the turret 19, by way of the cam 196. In other words, the cam plate 199 drives support member 174 toward and away from the deforming element 172 (and the die 178) during each revolution of the turret 19.

[0022] The noted movement of the support member 174 toward the deforming element 172 brings the necking surface 182 of the die 178 into contact with the upper end of the can body 2. Further movement of the support member 174 toward the deforming element 172 forces the upper end of the can body 2 into the die 178. The tapered profile of the necking surface 182 reduces the diameter of the upper end as the upper end is forced into the die 178.

[0023] A plug (knockout punch) 200 can be used to remove the can body 2 from the die 178. The plug 200 is secured to an end of a shaft 202. The shaft 202 reciprocates within the sleeve 176 (a suitable bearing 204 is positioned between the sleeve 176 and the shaft 202 to permit relative movement therebetween).

[0024] The plug 200 is secured to a first end of the shaft 202 by a screw 208. A cam 210 is secured to a second end of the shaft 202 by way of a cam block 212. The cam 210 contacts a camming surface 214 formed along an outer periphery of a plate 160 of the base 5. This contact causes the plug 200 to move between a first and a second position, shown respectively on the left and right hand sides of FIG. 5, during each revolution of the turret 19. Contact between the plug 200 and the upper edge of the can body 2 as the plug 200 moves from its second to its first position can urge the can body 2 toward the support member 174.

[0025] The camming surface 214 has a substantially identical configuration to the camming surface 198 on the cam plate 199, with the following exception. The camming surface 214 is offset with respect to the surface 198 so that the movement of the plug 200 away from the deforming element 172 trails that of the support platform 174. The plug

200 thus moves from its second to its first position after the can body 2 has been necked by the die 178 as described above.

[0026] The can body 2 can also be removed from the die 178 by pressurized air. The pressurized air is directed into the can body 2 by way of a ring 220. The ring 220 is positioned within an annular slot 222 formed in the plate 160. The ring 220 has a circumferentially-extending groove 224 of predetermined length formed therein.

[0027] A plate 226 is secured to the turret 19 so that a surface of the plate 226 abuts an adjacent surface of the ring 220. The contact between the plate 226 and the ring 220 forms a seal therebetween. The contact force between the plate 226 and the ring 220 is increased by springs 225 located between the ring 220 and the plate 160.

[0028] The plate 226 has a plurality of circumferentially-spaced openings 228 formed therein. Rotation of the turret 19 causes the openings 228 to align with the groove 224 of the ring 220 on an intermittent basis. Hence, the openings 228 are in fluid communication with the groove 224 on an intermittent basis, as the turret 19 rotates. The openings 228 each adjoin a conduit 230 of the associated necking assembly 170. Each conduit 230, in turn, adjoins an axially-extending passage 232 formed in the associated shaft 202 and screw 208.

[0029] Pressurized air is supplied to the partial annular groove 224 from a source (not shown). The pressurized air flows from the groove 224 to the openings 228 on an intermittent basis. The pressurized air subsequently flows from each opening 228 to the associated conduit 230 and passages 232, and is discharged into the can body 2. (The ring 220 is configured so that the groove 224 aligns with each of the openings 228 of the necking assemblies 170 in a manner that causes the air to be discharged into the can body 2 as the support platform 174 is drawn away from the deforming element 172 following the necking operation.)

[0030] The pressurized air can be used as the primary means for removing the can body 2 from the die 178. The pressurized air can also help to ensure that the can body 2 remains supported on the platform 194 as the support member 174 moves away from the deforming element 172 following the necking operation. The plug 200 can assist in removing the can body 2 when the pressurized air, by itself, is insufficient to remove the can body from the die 178, e.g., when the upper end of the can body 2 jams in the die 178 due to misalignment between the die 178 and the can body 2 during the necking process.

[0031] The necking station 16a includes a guide rail that extends around an upper periphery of the turret 19. The guide rail helps to ensure that the can bodies 2 are positively held on the platforms 194 in substantial alignment with the die 178 (the guide rail is not shown in the figures, for clarity).

[0032] The necking stations 16b, 16c, 16d, 16e are configured in a substantially identical manner to the necking station 16a, with the following exception. The diameters of the dies in the necking assemblies of the necking stations 16b, 16c, 16d, 16e become progressively smaller toward the final necking station, i.e., toward the necking station 16e, to effect further incremental reductions in the diameter of the end of the can body 2 as the can body 2 passes through the necking machine 3.

[0033] The necking assembly 170 has been described in detail for exemplary purposes only. The necking machine 3 can be equipped with necking assemblies having other configurations.

[0034] The necking machine 3 also comprises first, second, third, and fourth intermediate, or transfer, modules, respectively designated 19a, 19b, 19c, 19d. The transfer modules 19a, 19b, 19c, 19d each comprise an intermediate, or transfer, wheel, respectively designated 18a, 18b, 18c, 18d (see FIG. 1). The transfer wheels 18a, 18b, 18c, 18d each rotate in a counterclockwise direction (from the perspective of FIG. 1).

[0035] Each of the transfer wheels 18a, 18b, 18c, 18d has a plurality of pockets 29 formed therein. The pockets 29 receive the can body 2. The can body 2 is retained in the pockets 29 in a manner substantially identical to that described above with respect to the pockets 25 of the feed wheel 6.

[0036] The transfer modules 19a, 19b, 19c, 19d are each located between a respective pair of the necking modules 17a, 17b, 17c, 17d, 17e, as depicted in FIG. 1. The necking station 16a deposits the can body 2 into one of the pockets 29 of the transfer wheel 18a after the necking station 16a has reduced the diameter of the end of the can body 2 as described above.

[0037] The transfer wheel 18a carries the can body 2 through an arc of approximately 180 degrees, and deposits the can body 2 into one of the pockets 27 of the necking station 16b. The necking station 16b further reduces the diameter of the end of the can body 2 in a manner substantially identical to that noted above with respect to the necking station 16a.

[0038] The can body 2 is subsequently transferred between the necking stations 16b, 16c, 16d, 16e by the transfer wheels 18b, 18c, 18d, in a manner substantially identical to that described above with respect to the transfer wheel 18a. The diameter of the end of the can body 2 is further reduced by the necking stations 16c, 16d, 16e, in a manner substantially identical to that noted above with respect to the necking station 16a.

[0039] The necking machine 3 further comprises a discharge module 21 located immediately downstream of the necking station 16e, and a discharge chute 22. The discharge module 21 comprises a discharge wheel 20 having a plurality of pockets 31 formed therein. The pockets 31 receive the can body 2 from the necking station 16e. The can body 2 is retained in the pockets 31 in a manner substantially identical to that described above with respect to the pockets 25 of the feed wheel 6.

[0040] The discharge wheel 20 rotates in a counterclockwise direction (from the perspective of FIG. 1). The discharge wheel 20 carries the can body 2 through an arc of approximately 180 degrees, and deposits the can body 2 in the discharge chute 22. The discharge chute 22 subsequently guides the can body 2 out of the necking machine 3.

[0041] The input feed wheel 6, the transfer wheels 18a, 18b, 18c, 18d, and the discharge wheel 20 are each driven by a respective shaft 32 that, in turn, is driven by a corresponding gear 24 (see FIGS. 2 and 3). The shafts 8 of the necking

stations 16a, 16b, 16c, 16d, 16e are each driven by a corresponding gear 24 (see FIGS. 3 and 4C).

[0042] The gear 24 associated with the transfer module 19c is coupled to and driven by a motor 28 by way of a gearbox 26 and a drive belt 30 (see FIG. 3; the motor 28, gearbox 26, and drive belt 30 are not shown in FIG. 2, for clarity). The motor-driven gear 24 drives the two immediately adjacent gears 24 which, in turn, drive the next gears 24, and so on.

[0043] The shafts 32, 8 are each rotatably coupled to bearings (not shown) mounted on the bearing plate 9. The necking stations 16a, 16b, 16c, 16d, 16e each support an end of their associated shaft 8 by way of a respective bearing housing (not shown). The transfer modules 19a, 19b, 19c, 19d each support an end of their associated drive shaft 32 by way of a respective bearing housing (not shown).

[0044] The necking machine 3 can operate at a throughput of up to 2,400 can bodies per minute. In other words, the necking machine 3 can neck 2,400 cans each minute in the above-noted manner. The necking machine 3 may not be required to operate at its maximum throughput, however, in many potential applications. For example, the necking machine 3 may be required to operate at only half of its maximum throughput (or less), i.e., at a throughput of approximately 1,200 can bodies per minute (or less), in a particular application.

[0045] The necking machine 3, as configured in the above-described manner, cannot perform more than five diameter reductions on each can body 2, regardless of the throughput at which the necking machine 3 is operated. A second necking machine (not shown) is therefore required in applications requiring, for example, ten diameter reductions. (The second necking machine can be equipped with dies 178 sized appropriately for the additional diameter reductions performed by the second necking machine. The second necking machine can be operably coupled to the necking machine 3 using any of the conventional techniques commonly known to those skilled in the relevant art).

[0046] Operating a necking machine such as the necking machine 3 at less than its maximum throughput results in unused capacity in the necking machine 3. Necking machines such as the necking machine 3, in general, are relatively expensive to procure, operate, and maintain. Necking machines can also require a relatively large amount of floor space in a manufacturing or processing plant. Hence, unused capacity in a necking machine such as the necking machine 3 can represent a substantial underutilization or waste of resources.

SUMMARY OF THE INVENTION

[0047] A preferred embodiment of an apparatus for necking a can body comprises a first necking station comprising a first and a second die for reducing a diameter of an end of the can body. The first die has a first diameter and the second die has a second diameter less than the first diameter. The apparatus also comprises a second necking station comprising a third and a fourth die for reducing the diameter of the end of the can body. The third die has a third diameter and the fourth die has a fourth diameter less than the third diameter.

[0048] The apparatus further comprises a transfer wheel for transporting the can body at least part of the way between

the first and the second necking stations, and a conveying mechanism for transporting the can body at least part of the way between the second and the first necking stations after the diameter of the can body has been reduced by the third die.

[0049] Another preferred embodiment of an apparatus for necking a can body comprises a first necking station for reducing a diameter of an end of the can body, and a second necking station for further reducing the diameter of the end of the can body. The apparatus further comprises at least one transfer wheel for transferring the can body from the first necking station to the second necking station after the diameter of the end of the can body has been reduced by the first die. The second necking station is mechanically coupled to the first necking station so that the first necking station receives the can body after the diameter of the can body has been reduced by the second necking station.

[0050] A preferred embodiment of an apparatus for necking can bodies comprises a first necking station comprising a first plurality of dies for reducing a diameter of un-necked ones of the can bodies, and a second plurality of dies for reducing a diameter of partially-necked ones of the can bodies. The second plurality of dies has a nominal diameter less than a nominal diameter of the first plurality of dies. The apparatus also comprises an input portion comprising a first and a second input wheel and a first and a second transfer wheel.

[0051] The first input wheel receives the un-necked ones of the can bodies and transports the un-necked ones of the can bodies to the first transfer wheel, and the first transfer wheel transports the un-necked ones of the can bodies to the second transfer wheel. The second input wheel receives the partially-necked ones of the can bodies from a second necking machine of the apparatus and transports the partially-necked ones of the can bodies to the second transfer wheel, and the second transfer wheel transports the un-necked and partially-necked ones of the can bodies to the first necking station.

[0052] Another preferred embodiment of an apparatus for necking can bodies comprises a first necking station comprising a first plurality of dies for reducing a diameter of a first plurality of the can bodies, and a second plurality of dies for reducing a diameter of a second plurality of the can bodies having an end diameter less than an end diameter of the first plurality of the can bodies. The apparatus also comprises a discharge portion comprising a first and a second transfer wheel and a first and a second discharge wheel.

[0053] The first transfer wheel receives the first and the second pluralities of the can bodies from the first necking station and transports the first and the second pluralities of the can bodies to the second transfer wheel. The second transfer wheel transports the first plurality of the can bodies to the first discharge wheel, and the second transfer wheel transports the second plurality of the can bodies to the second discharge wheel. The first discharge wheel directs the second plurality of the can bodies at least part of the way to a second necking station of the apparatus, and the second discharge wheel directs the first plurality of the can bodies at least a part of the way to a discharge point on the apparatus.

[0054] Another preferred embodiment of an apparatus for necking a can body comprises a first necking station com-

prising a first and a second die for reducing a diameter of an end of the can body. The first die has a first diameter and the second die has a second diameter less than the first diameter. The apparatus also comprises a second necking station comprising a third and a fourth die for reducing the diameter of the end of the can body. The third die has a third diameter and the fourth die has a fourth diameter less than the third diameter.

[0055] The second necking station receives the can body after the diameter of the can body has been reduced by the first die, and the first necking station receives the can body before and after the diameter of the can body has been reduced by the third die.

[0056] A preferred method for necking a can body comprises reducing a diameter of an end of the can body using a first die of a first necking station of a necking machine, and transferring the can body from the first necking station to a second necking station of the necking machine. The preferred method also comprises further reducing the diameter of the end of the can body using a first die of a second necking station of the necking machine, and transferring the can body from the second necking station to the first necking station. The preferred method also comprises further reducing the diameter of the end of the can body using a second die of the first necking station after transferring the can body from the second necking station to the first necking station.

BRIEF DESCRIPTION OF THE DRAWINGS

[0057] The foregoing summary, as well as the following detailed description of a presently-preferred embodiment, is better understood when read in conjunction with the appended drawings. For the purpose of illustrating the invention, the drawings show an embodiment that is presently preferred. The invention is not limited, however, to the specific instrumentalities disclosed in the drawings. In the drawings:

[0058] FIG. 1 is a front view of a conventional five-stage necking machine;

[0059] FIG. 2 is a rear view of the necking machine shown in FIG. 1, with a motor, gearbox, and drive belt of the necking machine not depicted, for clarity;

[0060] FIG. 3 is a side view of the necking machine shown in FIGS. 1 and 2;

[0061] FIG. 4 is a front view of a preferred embodiment of a necking machine in accordance with the present invention;

[0062] FIG. 5 is a top, cross-sectional view of a necking station of the necking machines shown in FIGS. 1-4; and

[0063] FIG. 6 is a magnified view of the area designated "A" in FIG. 5.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0064] A preferred embodiment of a necking machine 3' is depicted in FIGS. 4-6. The necking machine 3' can be used to perform necking operations on a can body such as the can body 2.

[0065] The necking machine 3' is configured so that each can body 2 passes through the necking machine 3' twice. An

initial series of necking operations (diameter reductions) take place during the initial pass through the necking machine **3**, and further diameter reductions take place during the second pass. More specifically, the diameter of an end of the can body **5** is reduce five times during its initial pass through the necking machine **3'**, and another five times during its second pass.

[0066] The necking machine **3'** comprises a base **5'** and a bearing plate **9'** (see FIG. 4). The necking machine **3'** also comprises an input portion **100**. The input portion **100** includes a first input chute **106a** and a first input module **108a**. The first input module **108a** comprises a first feed wheel **110a** having six pockets **112a** formed therein.

[0067] The first input chute **106a** receives the can bodies **2** before any necking operations have been performed thereon. Each pocket **112a** of the first feed wheel **110a** receives a respective one of the can bodies **2** from the first input chute **106a**. The first feed wheel **110a** rotates in a counterclockwise direction (from the perspective of FIG. 4).

[0068] The can bodies **2** are retained in the pockets **112a** by a vacuum force, in a manner substantially identical to that described above in connection with the pockets **25** in the feed wheel **6** of the necking machine **3**.

[0069] The input portion **100** of the necking machine **3'** also comprises a second input chute **106b** and a second input module **108b**. The second input module **108b** comprises a second feed wheel **110b** having six pockets **112b** formed therein.

[0070] The second input chute **106b** receives the can bodies **2** after an initial series of necking operations have been performed thereon by the necking machine **3** (the mechanism and process by which the partially-necked can bodies **2** are fed to the second input chute **108b** are discussed below).

[0071] Each pocket **112b** of the second feed wheel **110b** receives a respective one of the can bodies **2** from the second input chute **106b** (the second feed wheel **110b** thus receives the can bodies **2** in a partially-necked condition). The can bodies **2** are retained in the pockets **112b** in the manner described above in connection with the feed wheel **6** of the necking machine **3**. The second feed wheel **110b** rotates in a clockwise direction (from the perspective of FIG. 4).

[0072] The input portion **100** of the necking machine **3'** further comprises a first transfer (intermediate) module **114a**, and a second transfer module **114b**. The first transfer module **114a** comprises a first transfer (intermediate) wheel **116a**, and the second transfer module **114b** comprises a second transfer wheel **116b**. The first transfer wheel **116a** rotates in a clockwise direction, and the second transfer wheel **116b** rotates in a counterclockwise direction (from the perspective of FIG. 4).

[0073] The first transfer wheel **116a** has twelve pockets **118a** formed therein for receiving the can bodies **2**. The second transfer wheel **116b** likewise has twelve pockets **118b** formed therein for receiving the can bodies **2**. The can bodies **2** are retained in the pockets **118a**, **118b** in the manner described above in connection with the feed wheel **6** of the necking machine **3**.

[0074] The first transfer wheel **116a** receives the can bodies **2** from the first feed wheel **110a**. In particular, the first

feed wheel **110a** and the first transfer wheel **116a** are indexed so that the first feed wheel **110a** deposits the can bodies **2** in alternate ones, i.e., every other one, of the pockets **118a** in the first transfer wheel **116a**.

[0075] The second transfer wheel **116b** receives the can bodies **2** from both the first transfer wheel **116a** and the second feed wheel **110b**. The first transfer wheel **116a** and the second transfer wheel **116b** are indexed so that the first transfer wheel **116a** deposits the can bodies **2** into alternate ones of the pockets **118b** in the second transfer wheel **116b**. In addition, the second feed wheel **110b** and the second transfer wheel **116b** are indexed so that the second feed wheel **110b** deposits the can bodies **2** into the pockets **118b** that are not occupied by the can bodies **2** received from the first transfer wheel **116a**.

[0076] The can bodies **2** that are fed to the first feed wheel **110a** from the first input chute **106a** have not undergone any necking operations, as discussed above. Hence, the can bodies **2** that are received by the second transfer wheel **116b** from the first transfer wheel **116a** have not undergone any necking operations.

[0077] The can bodies **2** that are fed to the second feed wheel **110b** from the second input chute **106b** are partially necked, as discussed above. Hence, the can bodies **2** that are received by the second transfer wheel **116b** from the second feed wheel **110b** are partially necked. Adjacent ones of the pockets **118b** of the second transfer wheel **116b** thus receive an un-necked can body **2** and a partially-necked can body **2**. In other words, every other pocket **118b** of the second transfer wheel **116b** receives an un-necked can body **2**, and the remaining pockets **118b** each receive a partially-necked can body **2**.

[0078] The necking machine **3'** comprises a gearbox **26**, a motor **28**, and a drive belt **30** as described above in connection with the necking machine **3**. The first and second feed wheels **110a**, **110b** and the first and second transfer wheels **116a**, **116b** each include a respective gear **24** and a shaft **32** as described above in connection with the necking machine **3**. The first and second feed wheels **110a**, **110b** and the first and second transfer wheels **116a**, **116b** can be driven by the gearbox **26**, motor **28**, and drive belt **30**, by way of the respective gears **24** and shafts **32**.

[0079] The necking machine **3'** further comprises a first necking module **17a'** (see FIG. 4). The first necking module **17a'** includes a first necking station **16a'**. The first necking station **16a'** comprises twelve necking assemblies **170'**. Each necking assembly **170'** is substantially identical to the necking assembly **170** described above in connection with the necking machine **3**, with the below-noted exceptions. The above description of the necking assembly **170**, and the depiction of the necking assembly **170** in the figures thus apply equally to the necking assembly **170'**, except as otherwise noted. Moreover, the above description of the first necking module **17a** and the first necking station **16a**, and the depictions of the first necking module **17a** and the first necking station **16a** in the figures, apply equally to the first necking module **17a'** and the first necking station **16a'**, except as otherwise noted.

[0080] Six of the necking assemblies **170'** of the first necking station **16a'** each comprise a die **178a** (see FIG. 5). Each die **178a** has a necking surface **182a** formed along an

inner periphery thereof. The necking surfaces **182a** each have a first nominal diameter. The remaining six necking assemblies **170'** of the first necking station **16a'** each comprise a die **178b** (see FIGS. 5 and 6). Each die **178b** has a necking surface **182b** formed along an inner periphery thereof. The necking surfaces **182b** each have a second nominal diameter. The second nominal diameter is less than the first nominal diameter.

[0081] The dies **178a** are each associated with alternating ones of the pockets **27** of the necking station **16a'**. The dies **178b** likewise are each associated with alternating ones of the pockets **27**. Hence, each die **178a** is positioned between two of the dies **178b** around the periphery of the turret **19**. Each die **178b** is likewise positioned between two of the dies **178a** around the periphery of the turret **19**. In other words, every other one of the pockets **27** of the necking station **16a'** is associated with one of the dies **178a**, and the remaining pockets **27** are each associated with one of the dies **178b**.

[0082] The necking station **16a'** receives the can bodies **2** from the second transfer wheel **116b** of the second transfer module **114b**. Every other pocket **118b** of the second transfer wheel **116b** carries an un-necked can body **2**, and the remaining pockets **118b** each carry a partially-necked can body **2**, as discussed above.

[0083] The second transfer wheel **116b** and the turret **19** of the necking station **16a'** are indexed so that the un-necked can bodies **2** are deposited in the pockets **27** associated with the dies **178a**, and the partially-necked can bodies **2** are deposited in the pockets **27** associated with the dies **178b**. Hence, the can bodies **2** that have not yet been undergone any reduction in diameter are necked by the larger-diameter dies **178a** (the dies **178a** are thus sized appropriately for the initial diameter reduction in the necking process). The partially-necked can bodies **2** are necked by the relatively smaller-diameter dies **178b** (the dies **178b** are thus sized appropriately for the further diameter reduction appropriate for this stage of the necking process).

[0084] The necking machine **3** further comprises a second, third, fourth, and fifth necking module, respectively designated **17b'**, **17c'**, **17d'**, **17e'**. The necking modules **17b'**, **17c'**, **17d'**, **17e'** each comprise a necking station, respectively designated **16b'**, **16c'**, **16d'**, **16e'** (see FIG. 4).

[0085] The necking modules **17b'**, **17c'**, **17d'**, **17e'** are substantially identical to the respective necking modules **17b**, **17c**, **17d**, **17e** of the necking machine **3**, with the following exceptions. The die assemblies **170** of each necking station **16b'**, **16c'**, **16d'**, **16e'** are equipped with die assemblies **170** having a first set of relatively large-diameter dies **178a**, and a second set of relatively small-diameter dies **178b**. The dies **178a**, **178b** are arranged in the alternating (staggered) manner described above in connection with the necking station **16a'**.

[0086] The necking machine **3'** further comprises the first, second, third, and fourth transfer modules **19a**, **19b**, **19c**, **19d**, as described above in connection with the necking machine **3**.

[0087] The first transfer module **19a** receives the can bodies **2** from the necking station **16a'** after the necking station **16a'** has reduced (or further reduced) is diameters of the can bodies **2** in the above-described manner. The transfer wheel **18a** of the first transfer module **19a** carries the can

bodies **2** through an arc of approximately 180 degrees, and deposits each can body **2** into a corresponding one of the pockets **27** of the necking station **16b'**.

[0088] The transfer wheel **18a** and the turret **19** of the necking station **16b'** are indexed so that the pockets **27** associated with the larger-diameter dies **178a** receive the can bodies **2** that have undergone only one diameter reduction, i.e., the can bodies that were received by the necking station **16a'** in the previous operation in an un-necked condition. The remaining pockets **27** receive the remaining can bodies **2**, i.e., the can bodies **2** that have previously undergone multiple diameter reductions.

[0089] The necking station **16b'** further reduces the diameters of the can bodies **2**, in the manner described above in connection with the necking module **16a**. The dies **178a**, **178b** of the necking station **16b'** are sized appropriately for the further diameter reductions required at this stage of the necking process for each of the two differently-sized sets of can bodies **2**. (The dies **178a** of the necking station **16b'** are thus sized incrementally smaller than the dies **178a** of the necking station **16a'**. The dies **178b** of the necking station **16b'** are likewise sized incrementally smaller than the dies **178b** of the necking station **16a'**.)

[0090] The can bodies **2** are subsequently transferred to the third, fourth, and fifth necking modules **17c'**, **17d'**, **17e'** by the respective second, third, and fourth transfer modules **19b**, **19c**, **19d**. Further diameter reductions are performed on the can bodies **2** by each of the necking stations **16c'**, **16d'**, **16e'**. The further diameter reductions are performed using a combination of differently-sized dies **178a**, **178b** appropriate for the progressive diameter reductions required at each subsequent stage of the necking process, for each differently-sized set of can bodies **2** (as described above in connection with the necking modules **17a'**, **17b'**). (The dies **178a** of the necking stations **16a'**-**16e'** thus become progressively smaller moving from the necking station **16a'** to the necking station **16e'**. The dies **178b** of the necking stations **16a'**-**16e'** likewise become progressively smaller moving from the necking station **16a'** to the necking station **16e'**.)

[0091] The necking machine **3'** further comprises a discharge portion **122** (see FIG. 4). The discharge portion **122** comprises a first transfer module **124a** and a second transfer module **124b**. The first transfer module **124a** comprises a first transfer wheel **126a**, and the second transfer module **124b** comprises a second transfer wheel **126b**. The first transfer wheel **126a** rotates in a counterclockwise direction, and the second transfer wheel **126b** rotates in a clockwise direction (from the perspective of FIG. 4).

[0092] The first transfer wheel **126a** has twelve pockets **128a** formed therein for receiving the can bodies **2**. The second transfer wheel **126b** likewise has twelve pockets **128b** formed therein for receiving the can bodies **2**. The can bodies **2** are retained in the pockets **128a**, **128b** in the manner described above in connection with the feed wheel **6** of the necking machine **3**.

[0093] The pockets **128a** of the first transfer wheel **126a** receive the can bodies **2** from the necking station **16e'** of the fifth necking module **17e'**. Half of the can bodies **2** received by the first transfer wheel **126a** have an relatively large-diameter end, and the remaining can bodies **2** have a relatively small-diameter end due to the alternating arrange-

ment of the relatively large and small dies **178a**, **178b** on the necking station **16e'** (discussed above).

[0094] The can bodies **2** having the relatively small-diameter ends have passed through each of the necking stations **16a'**, **16b'**, **16c'**, **16d'**, **16e'** twice by this point in the necking process. The ends of these can bodies **2** have thus been reduced in size to their final configuration, and the can bodies **2** are ready to be discharged from the necking machine **3'**. (These can bodies **2** are hereinafter referred to as "the finished can bodies **2**." The remaining can bodies **2**, as discussed below, are recirculated through the necking stations **16a'**, **16b'**, **16c'**, **16d'**, **16e'** for additional diameter reductions. (These can bodies **2** are hereinafter referred to as "the partially-necked can bodies **2**."))

[0095] The first transfer wheel **126a** carries the can bodies **2** through an arc of approximately 180 degrees, to the second transfer wheel **126b**. The can bodies **2** are received by the pockets **128b** of the second transfer wheel **126b**.

[0096] The discharge portion **122** also comprises a first discharge module **132a** and a second discharge module **132b**. The first discharge module **132a** comprises a first discharge wheel **134a**, and the second discharge module **132b** comprises a second discharge wheel **134b**. The first discharge wheel **134a** rotates in a counterclockwise direction, and the second discharge wheel **134b** rotates in a counterclockwise direction (from the perspective of **FIG. 4**).

[0097] The first discharge wheel **134a** has twelve pockets **136a** formed therein. The second discharge wheel **134b** likewise has twelve pockets **136b** formed therein. The can bodies **2** can be retained in the pockets **136a**, **136b** in the manner described above in connection with the feed wheel **6** of the necking machine **3**.

[0098] The first discharge wheel **134a** receives the partially-necked can bodies **2** from the second transfer wheel **126b**. More particularly, the second transfer wheel **126b** carries the partially-necked can bodies **2** through an arc of approximately 90 degrees, to the first discharge wheel **134a**. The second transfer wheel **126b** and the first discharge wheel **134a** are indexed so that the partially-necked can bodies **2** are received in alternating ones of the pockets **136a** of the first discharge wheel **134a**. (The vacuum to the remaining pockets **136a** of the first discharge wheel **134a** is deactivated to preclude the finished can bodies **2** from being picked up by the first discharge wheel **134a**.)

[0099] The discharge portion **122** further comprises a first discharge chute **138a** mounted on the first discharge module **132a**. The second discharge wheel **134b** carries the partially-necked can bodies **2** upward, through an arc of approximately 90 degrees, and deposits the partially-necked can bodies **2** in the first discharge chute **138a**. (The partially-necked can bodies **2** are subsequently returned to the first necking module **17a'**, as discussed below.)

[0100] The finished can bodies **2** are carried through an arc of approximately 180 degrees by the second transfer wheel **126b**, to the second discharge wheel **136b**.

[0101] The second transfer wheel **126b** and the second discharge wheel **136b** are indexed so that the finished can bodies **2** are received in alternating pockets **136b** of the second discharge wheel **134b**.

[0102] The discharge portion **122** further comprises a second discharge chute **138b** mounted on the second discharge module **132b**. The second discharge wheel **134b** carries the finished can bodies **2** through an arc of approximately 180 degrees, and deposits the finished can bodies **2** in the second discharge chute **138b**. The second discharge chute **22** guides the finished can bodies **2** out of the necking machine **3'**.

[0103] The first and second transfer wheels **126a**, **126b** and the first and second discharge wheels **134a**, **134b** each include a respective gear **24** and a shaft **32** as described above in connection with the necking machine **3**. The first and second transfer wheels **126a**, **126b** and the first and second discharge wheels **134a**, **134b** can be driven by the gearbox **26**, the motor **30**, and the drive belt **30**, by way of the respective gears **24** and shafts **32**.

[0104] The necking machine **3'** further comprises a conveying mechanism **142**. The conveying mechanism **142** receives the partially-necked can bodies **2** from the first discharge chute **138a**. The conveying mechanism **142** transports the partially-necked can bodies **2** to the second input chute **106b** of the input portion **100**. The conveying mechanism **142** can be any suitable mechanism capable of transporting the can bodies **2** from the first discharge chute **138a** to the second input chute **106b**. For example, the conveying mechanism **142** can be a series of transfer turrets, a mass conveyor, a single-track conveyor, another type of conventional conveyor, a tunnel track, a pocket chain, a pin chain, etc.

[0105] The second input chute **106b** guides the partially-necked can bodies **2** to the second feed wheel **110b** of the second input module **108b**. The partially-necked can bodies **2** are received by the pockets **112b** of second feed wheel **110b**. The partially-necked can bodies **2** are subsequently transported to the necking station **16a'** by the second feed wheel **110b** and the second transfer wheel **116b**, as described above. The end of the partially necked can body **2** undergoes further reductions in diameter as it subsequently passes through the necking stations **16a'**, **16b'**, **16c'**, **16d'**, **16e'**, as also described above.

[0106] Other suitable arrangements for directing the un-necked and partially-necked can bodies **2** to the first station **16a'** in the required sequence can be used in the alternative to the input portion **100**. Moreover, other suitable arrangements for recirculating and discharging the partially-necked and finished can bodies **2** can be used in the alternative to the discharge portion **122**. For example, the first discharge module **132a** can be positioned directly above the first transfer module **124a** (from the perspective of **FIG. 4**) so that the first discharge module **132a** receives the partially-necked can bodies directly from the first transfer module **124a**. Moreover, the first and second discharge wheels **134a**, **134b** can be configured with less than twelve of the respective pockets **136a**, **136b**.

[0107] Each of the necking stations **16a'**, **16b'**, **16c'**, **16d'**, **16e'** can include dies having more than two different sizes in alternative embodiments of the necking machine **3'**. For example, each necking station **16a'**, **16b'**, **16c'**, **16d'**, **16e'** can be equipped with three (or more) sets of dies. Each set can include four (or less than four) dies. The nominal diameters of the dies in each set can differ from those of the dies in the other two (or more) sets. The dies can be sequenced on the

turrets **19** of the necking stations **16a'**, **16b'**, **16c'**, **16d'**, **16e'** so that dies of particular nominal diameter are located between dies of the other two nominal diameters. In other words, dies having a first, a second, and a third nominal diameter can be located in consecutive positions around the turret **19**. The can bodies **2** can be circulated through the necking stations **16a'**, **16b'**, **16c'**, **16d'**, **16e'** three (or more) times, using the techniques described above in connection with the necking machine **3'**.

[0108] Recirculating the can bodies **2** through a necking machine in the above-described manner can increase the number of diameter reductions that can be performed on the can body **2** using the necking machine. This feature can be particularly advantageous where the required throughput in a particular application is approximately half (or less) than the maximum throughput of the necking machines available for that application.

[0109] For example, the maximum throughput of the necking machine **3** is approximately 2,400 can bodies per minute. The necking machine **3** can perform no more than five diameter reductions on the can bodies **2** passing there-through, regardless of its throughput in a particular application. Hence, the necking machine **3** is limited to five diameter reductions when operated at half (or less than half) of its maximum throughput, i.e., when operated at a throughput of approximately 1,200 can bodies per minute or less. Two of the necking machines **3** must therefore be used in applications requiring ten diameter reductions, regardless of the required throughput, when the necking machines **3** are configured and operated in a conventional manner.

[0110] Recirculating the can body **2** through the necking machine **3'** allows the necking machine **3'** to perform ten diameter reductions, at a throughput of approximately 1,200 can bodies per minute or less. The necking machine **3'** can thus perform the same number of diameter reductions on an equivalent number of can bodies **2** as two of the necking machines **3**, under this particular set of operating conditions.

[0111] The use of the present invention, in certain applications, can thus facilitate necking operations using fewer necking machines than would otherwise be required. The substantial expenses associated with procuring, operating, and maintaining additional necking machines can thus be eliminated through the use of the present invention. The need to allocate floor space for the additional necking machines can also be eliminated. In other words, the use of the invention can, in some applications, eliminate the underutilization and waste of resources that can occur when operating multiple necking machines at less than their full capacities. (Similar, or greater savings can be achieved in applications where the can body **2** is recirculated through the necking machine **3** three or more times.)

[0112] The foregoing description is provided for the purpose of explanation and is not to be construed as limiting the invention. While the invention has been described with reference to preferred embodiments or preferred methods, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Furthermore, although the invention has been described herein with reference to particular structure, methods, and embodiments, the invention is not intended to be limited to the particulars disclosed herein, as the invention extends to all structures, methods and uses that are within

the scope of the appended claims. Those skilled in the relevant art, having the benefit of the teachings of this specification, may effect numerous modifications to the invention as described herein, and changes may be made without departing from the scope and spirit of the invention as defined by the appended claims.

[0113] For example, the present invention has been described in connection with a necking machine that performs ten diameter reduction using five necking modules. Alternative embodiments can be configured to perform less or more than ten necking operations using less or more than five necking modules. Also, the direction of circulation of the can bodies **2** can be reversed in alternative embodiments.

[0114] Parts List

- [0115] Can body **2**
- [0116] Necking machine **3**
- [0117] Base **5**
- [0118] End plates **5a** (of base **5**)
- [0119] Input chute **7**
- [0120] Bearing plate **9**
- [0121] Feed wheel **6** (of input module **11**)
- [0122] Shaft **8** (of necking stations **16a**, **16b**, **16c**, **16d**, **16e**)
- [0123] Input module **11**
- [0124] Necking station **16a** (of first necking module **17a**)
- [0125] Necking station **16b** (of second necking module **17b**)
- [0126] Necking station **16c** (of third necking module **17c**)
- [0127] Necking station **16d** (of fourth necking module **17d**)
- [0128] Necking station **16e** (of fifth necking module **17e**)
- [0129] First necking module **17a**
- [0130] Second necking module **17b**
- [0131] Third necking module **17c**
- [0132] Fourth necking module **17d**
- [0133] Fifth necking module **17e**
- [0134] Transfer wheel **18a** (of first transfer module **19a**)
- [0135] Transfer wheel **18b** (of second transfer module **19b**)
- [0136] Transfer wheel **18c** (of third transfer module **19c**)
- [0137] Transfer wheel **18d** (of fourth transfer module **19d**)
- [0138] First transfer module **19a**
- [0139] Second transfer module **19b**
- [0140] Third transfer module **19c**
- [0141] Fourth transfer module **19d**

- [0142] Turrets **19** (of necking stations **16a**, **16b**, **16c**, **16d**, **16e**)
- [0143] Discharge wheel **20** (of discharge module **21**)
- [0144] Discharge module **21**
- [0145] Discharge chute **22**
- [0146] Gear **24** (see **FIGS. 3 and 4C**)
- [0147] Pockets **25** (of feed wheel **6**)
- [0148] Gearbox **26**
- [0149] Pockets **27** (of turrets **19**)
- [0150] Motor **28**
- [0151] Drive belt **30**
- [0152] Pocket **31** (of discharge wheel **20**)
- [0153] Shaft **32** (of transfer wheels **18a**, **18b**, **18c**, **18d**)
- [0154] Pipes **58**
- [0155] Input portion **100** (of necking machine **3'**)
- [0156] First input chute **106a** (of input portion **100**)
- [0157] Second input chute **106b** (of input portion **100**)
- [0158] First input module **108a**
- [0159] Second input module **108b**
- [0160] First feed wheel **110a** (of first input module **108a**)
- [0161] Second feed wheel **110b** (of second input module **108b**)
- [0162] Pockets **112a** (of first feed wheel **110a**)
- [0163] Pockets **112b** (of second feed wheel **110b**)
- [0164] First transfer module **114a**
- [0165] Second transfer module **114b**
- [0166] First transfer wheel **116a** (of first transfer module **114a**)
- [0167] Second transfer wheel **116b** (of first transfer module **114b**)
- [0168] Pockets **118a** (in first transfer wheel **116a**)
- [0169] Pockets **118b** (in first transfer wheel **116b**)
- [0170] Discharge portion **122** (of necking machine **3'**)
- [0171] First transfer module **124a** (of discharge portion **122**)
- [0172] Second transfer module **124b**
- [0173] First transfer wheel **126a** (of first transfer module **124a**)
- [0174] Second transfer wheel **126b**
- [0175] Pockets **128a** (of first transfer wheel **126a**)
- [0176] Pockets **128b** (of second transfer wheel **126b**)
- [0177] First discharge module **132a**
- [0178] Second discharge module **132b**
- [0179] First discharge wheel **134a** (of first discharge module **132a**)
- [0180] Second discharge wheel **134b** (of second discharge module **132b**)
- [0181] Pockets **136a** (of first discharge wheel **134a**)
- [0182] Pockets **136b** (of second discharge wheel **134b**)
- [0183] First discharge chute **138a**
- [0184] Second discharge chute **138b**
- [0185] Conveying mechanism **142**
- [0186] Hub **154** (of base **5**)
- [0187] Plate **160** (of base **5**)
- [0188] Necking assemblies **170** (of necking stations **16a**, **16b**, **16c**, **16d**, **16e**)
- [0189] Deforming element **172** (of die assembly **170**)
- [0190] Support member **174**
- [0191] Sleeve **176**
- [0192] Dies **178**
- [0193] Relatively large diameter dies **178a**
- [0194] Relatively small diameter dies **178b**
- [0195] Cap **180**
- [0196] Necking surface **182** (of dies **178**)
- [0197] Necking surface **182a** (of dies **178a**)
- [0198] Necking surface **182b** (of dies **178b**)
- [0199] Sleeve **190** (of support member **174**)
- [0200] Shaft **192**
- [0201] Cam block **193**
- [0202] Platform **194**
- [0203] Cams **196**, **197**
- [0204] Camming surface **198** (on cam plate **199**)
- [0205] Cam plate **199**
- [0206] Plug **200**
- [0207] Shaft **202**
- [0208] Bearing **204**
- [0209] Screw **208**
- [0210] Cam **210**
- [0211] Cam block **212**
- [0212] Camming surface **214** (on plate **160**)
- [0213] Ring **220**
- [0214] Slot **222** (in plate **160**)
- [0215] Groove **224** (in ring **220**)
- [0216] Springs **225**
- [0217] Plate **226**
- [0218] Openings **228** (in plate **226**)
- [0219] Conduit **230**
- [0220] Passage **232** (in shaft **202** and screw **208**)

What is claimed is:

1. An apparatus for necking a can body, comprising:
 - a first necking station comprising a first and a second die for reducing a diameter of an end of the can body, the first die having a first diameter and the second die having a second diameter less than the first diameter;
 - a second necking station comprising a third and a fourth die for reducing the diameter of the end of the can body, the third die having a third diameter and the fourth die having a fourth diameter less than the third diameter;
 - a transfer wheel for transporting the can body at least part of the way between the first and the second necking stations; and
 - a conveying mechanism for transporting the can body at least part of the way between the second and the first necking stations after the diameter of the can body has been reduced by the third die.
2. The apparatus of claim 1, wherein the conveying mechanism comprises at least one of a transfer turret; a mass conveyor; a single-track conveyor; a tunnel track, a pocket chain; and a pin chain.
3. The apparatus of claim 1, further comprising a first and a second input wheel and a first and a second transfer wheel, wherein the first input wheel transports a first of the can bodies to the first transfer wheel, the first transfer wheel transports the first of the can bodies to the second transfer wheel, the second input wheel transports a second of the can bodies to the second transfer wheel, and the second transfer wheel transports the first and the second of the can bodies to the first necking station.
4. The apparatus of claim 3, wherein the second input wheel receives the second of the can bodies from the conveying mechanism.
5. The apparatus of claim 4, wherein the first and the second transfer wheels are indexed so that the second transfer wheel receives the first of the can bodies in a first pocket of the second transfer wheel, and the second transfer wheel receives the second of the can bodies in an adjacent second pocket of the second transfer wheel.
6. The apparatus of claim 5, wherein:
 - the second transfer wheel and the first necking station are indexed so that the first necking station receives the first of the can bodies in a first pocket of the first necking station, the first pocket being associated with the first die; and
 - the first necking station receives the second of the can bodies in a second pocket of the first necking station, the second pocket being located adjacent to the first pocket and being associated with the second die.
7. The apparatus of claim 3, further comprising a first input chute for transporting the first of the can bodies to the first input wheel, and a second input chute for transporting the second of the can bodies from the conveying mechanism.
8. The apparatus of claim 1, further comprising a third and a fourth transfer wheel and a first and a second discharge wheel, wherein the third transfer wheel receives the first and the second of the can bodies from the second necking station and transports the first and the second of the can bodies to the second transfer wheel, the fourth transfer wheel transports the second of the can bodies to the first discharge

wheel, and the fourth transfer wheel transports the first of the can bodies to the second of the discharge wheels.

9. The apparatus of claim 8, wherein the fourth transfer wheel and the first discharge wheel are indexed so that first discharge wheel receives only the second of the can bodies from the fourth transfer wheel.

10. The apparatus of claim 8, wherein the apparatus further comprises a first discharge chute for discharging the first of the can bodies from the apparatus, and a second discharge chute for transporting the second of the can bodies to the conveying mechanism.

11. The apparatus of claim 1, wherein the first necking station further comprises a first turret and the second necking station further comprises a second turret, the first turret having a plurality of the first dies and a plurality of the second dies mounted thereon in an alternating arrangement and the second turret having a plurality of the third dies and a plurality of the fourth dies mounted thereon in an alternating arrangement.

12. The apparatus of claim 1, wherein the first necking station reduces the diameter of the can body using the second die after the can body has been returned to the first necking station by the conveying mechanism.

13. The apparatus of claim 12, wherein the second necking station reduces the diameter of the can body using the fourth die after the diameter of the can body has been reduced using the second die.

14. An apparatus for necking a can body, comprising:

- a first necking station for reducing a diameter of an end of the can body;

- a second necking station for further reducing the diameter of the end of the can body; and

- at least one transfer wheel for transferring the can body from the first necking station to the second necking station after the diameter of the end of the can body has been reduced by the first die, wherein the second necking station is mechanically coupled to the first necking station so that the first necking station receives the can body after the diameter of the can body has been reduced by the second necking station.

15. The apparatus of claim 14, wherein the second necking station is mechanically coupled to the first necking station by a conveying mechanism.

16. The apparatus of claim 15, wherein the conveying mechanism comprises at least one of a conveyor; a transfer turret; a mass conveyor; a single-track conveyor; a tunnel track, a pocket chain; and a pin chain.

17. The apparatus of claim 15, further comprising a first and a second transfer wheel, a discharge wheel, and a discharge chute, the first transfer wheel receiving the can body from the second necking station, the second transfer wheel transporting the can body from the first transfer wheel to the second transfer wheel, the discharge wheel transporting the can body from the second transfer wheel to the discharge chute, and the discharge chute directing the can body to the conveying mechanism.

18. The apparatus of claim 17, further comprising an input wheel and a third transfer wheel, the input wheel receiving the can body from the conveying mechanism and transporting the can body to the third transfer wheel, the third transfer wheel transporting the can body to the first necking station.

19. An apparatus for necking can bodies, comprising (i) a first necking station comprising a first plurality of dies for

reducing a diameter of un-necked ones of the can bodies, and a second plurality of dies for reducing a diameter of partially-necked ones of the can bodies, the second plurality of dies having a nominal diameter less than an nominal diameter of the first plurality of dies; and (ii) an input portion comprising a first and a second input wheel and a first and a second transfer wheel, wherein:

the first input wheel receives the un-necked ones of the can bodies and transports the un-necked ones of the can bodies to the first transfer wheel;

the first transfer wheel transports the un-necked ones of the can bodies to the second transfer wheel;

the second input wheel receives the partially-necked ones of the can bodies from a second necking machine of the apparatus and transports the partially-necked ones of the can bodies to the second transfer wheel; and

the second transfer wheel transports the un-necked and partially-necked ones of the can bodies to the first necking station.

20. The apparatus of claim 19, wherein the second transfer wheel and the first necking station are indexed so that pockets of the first necking station associated with the first plurality of dies receive the un-necked ones of the can bodies, and pockets of the first necking station associated with the second plurality of dies receive the partially-necked ones of the can bodies.

21. An apparatus for necking can bodies, comprising (i) a first necking station comprising a first plurality of dies for reducing a diameter of a first plurality of the can bodies, and a second plurality of dies for reducing a diameter of a second plurality of the can bodies having an end diameter less than an end diameter of the first plurality of the can bodies; and (ii) a discharge portion comprising a first and a second transfer wheel and a first and a second discharge wheel, wherein:

the first transfer wheel receives the first and the second pluralities of the can bodies from the first necking station and transports the first and the second pluralities of the can bodies to the second transfer wheel;

the second transfer wheel transports the first plurality of the can bodies to the first discharge wheel;

the second transfer wheel transports the second plurality of the can bodies to the second discharge wheel;

the first discharge wheel directs the second plurality of the can bodies at least part of the way to a second necking station of the apparatus; and

the second discharge wheel directs the first plurality of the can bodies at least a part of the way to a discharge point on the apparatus.

22. The apparatus of claim 21, wherein the first discharge wheel and the second transfer wheel are indexed so that the first discharge wheel receives only the first plurality of the can bodies.

23. An apparatus for necking a can body, comprising:

a first necking station comprising a first and a second die for reducing a diameter of an end of the can body, the first die having a first diameter and the second die having a second diameter less than the first diameter;

a second necking station comprising a third and a fourth die for reducing the diameter of the end of the can body, the third die having a third diameter and the fourth die having a fourth diameter less than the third diameter, wherein the second necking station receives the can body after the diameter of the can body has been reduced by the first die, and the first necking station receives the can body before and after the diameter of the can body has been reduced by the third die.

24. The apparatus of claim 23, wherein the second necking station also receives the can body after the diameter of the can body has been reduced by the first and second dies.

25. A method for necking a can body, comprising:

reducing a diameter of an end of the can body using a first die of a first necking station of a necking machine;

transferring the can body from the first necking station to a second necking station of the necking machine;

further reducing the diameter of the end of the can body using a first die of a second necking station of the necking machine;

transferring the can body from the second necking station to the first necking station; and

further reducing the diameter of the end of the can body using a second die of the first necking station after transferring the can body from the second necking station to the first necking station.

26. The method of claim 25, further comprising transferring the can body from the first necking station to the second necking station after further reducing the diameter of the end of the can body using the second die of the first necking station, and further reducing the diameter of the end of the can body using a second die of the second necking station.

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