A cup-shaped article former has a hollow cylindrical redraw blankholder which moves from a rearward article feed position axially forwardly into a rearwardly opening cup-shaped article and positions the article against a redraw die ring maintaining a predetermined pressure thereon while a reciprocal ram moves forwardly internally of the blankholder and article engaging the article and carrying it forwardly between the blankholder and die ring in a drawing operation. The blankholder is moved forwardly and rearwardly between rearward article feed and forward article drawing positions and is maintained precisely positioned in the article drawing position by securement of the blankholder to a blankholder mounting frame secured to forward ends of spaced, reciprocal rods, the rods extending rearwardly of the former and being pivotally connected to upper ends of pivotal cam followers arms. The cam follower arms mount cam followers thereon engaged with cam surfaces of rotatable cams, the cam followers being maintained against the cam surfaces under constant pressure of retention air cylinders. A rearwardly compressible and forwardly expansible air cylinder is formed in the blankholder mounting frame for securing the blankholder to the blankholder mounting frame so as to exert a force against the cup-shaped article resisted by the cup-shaped article engagement against the redraw die ring during movement of the article from the blankholder through the die ring by the ram. A motion limiting mechanism is associated with the blankholder mounting frame air cylinder and the blankholder retaining the blankholder spaced from the die ring as the article leaves the blankholder and finally passes completely through the die ring.

29 Claims, 16 Drawing Figures
REDRAW BLANKHOLDER POSITIONING MECHANISM FOR CUP-SHAPED ARTICLE FORMERS SUCH AS METALLIC CAN BODY FORMERS AND THE LIKE

BACKGROUND OF THE INVENTION

This invention relates to a redraw blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like wherein the redraw blankholder positioning mechanism permits extremely high speed operation of the article former while still insuring correct and proper high speed feed and placement of the cup-shaped articles in exact proper position for accomplishing repeated predetermined and accurate cup-shaped articles redrawing operations. More particularly, the improved redraw blankholder positioning mechanism of the present invention is constructed to retain the cup-shaped articles in an exact placement relative to a redraw die ring during advancement, entrance and movement therethrough of a high speed ram which carries the cup-shaped articles from the blankholder and between the blankholder and the die ring for performing accurate redrawing operations on the articles. Furthermore, the redraw blankholder positioning mechanism of the present invention may include unique components insuring proper retention of the cup-shaped articles in the exact placement immediately prior to and during the ram movement and the performance of the redrawing operations in the die ring, yet such retention is closely controlled so as to minimize previously prevalent cup-shaped article edge thinning and scalloping which has heretofore normally been encountered in such cup-shaped article redrawing operations.

In the manufacture of deep drawn and wall ironed cup-shaped articles such as metallic can bodies, the usual manufacturing procedure has been to first blank and initially draw the cup-shaped articles from sheet metal stock, and particularly where the cup-shaped articles are of metals which are more difficult to form, such as the higher strength aluminum and tinplate, the initially drawn cup-shaped articles are of larger than final diameter and relatively shallow. These larger diameter and relatively shallow cup-shaped articles are then passed through a can body former being subjected therein to an initial redrawing operation followed by a series of subsequent wall ironing operations resulting in the final can bodies. In the latter can body former, the initially drawn cup-shaped articles are fed consecutively into a position for engagement, one at a time, by a redraw blankholder, positioning the same adjacent a redrawing die ring and followed by a ram entering the blankholder engaging the cup-shaped article and forcing it from the blankholder between the blankholder and redraw die ring and through a series of wall ironing rings in a continuous forward movement of the ram.

Specifically, in the can body former, the initially drawn cup-shaped articles are fed, one at a time, into a part holder, the hollow, cylindrical blankholder engaged therein through the open ends thereof, exactly positioning the cup-shaped article relative to the redraw die ring, and the ram is advanced through the blankholder into engagement with the lower wall of the cup-shaped article to advance the same between the blankholder and the redraw die ring and then consecutively through the series of wall ironing rings. In order to accomplish the cup-shaped article feeding, blankholder engagement and ultimate ram advancement, the can body former is necessarily constructed with the blankholder forwardly and rearwardly axially reciprocally to permit cup-shaped article feeding and then engagement by the blankholder, as well as the ram forwardly and rearwardly reciprocally for carrying the cup-shaped article through the redraw die ring and the wall ironing rings, having the cup-shaped article stripped therefrom at completion of the various operations and a return of the ram to a withdrawn position ready for the start of the next sequence of operations on a next cup-shaped article. Further increasing the complexity of the necessary cup-shaped article or can body former, despite the necessity of the part feeding, the redraw blankholder reciprocal movement and the ram reciprocally movement, it must be kept in mind that under modern mass production conditions, it is desirable to perform the redraw and wall ironing operation cycling at a minimum of approximately 100 parts per minute and preferably at rates ranging from 125 to 150 parts per minute.

Due to these high speed and close timing requirements, one of the major problem areas with prior cup-shaped article or can body formers has been the exact redraw blankholder advancement, placement and retention into the cup-shaped article ready for the ram movement through the blankholder and against the article, all of which has been obviously greatly aggravated by the increasing speed requirements. The exact advancement and final placement of the redraw blankholder relative to the cup-shaped article is obviously extremely critical since the initial redrawing operation is determined by the positioning of the cup-shaped article in exact relationship to the redraw die ring and the redraw blankholder, the success and accuracy of the entire redrawing operation being closely determined by such final relative positioning relationships. Thus, with the minimal time elements involved, the redraw blankholder must be moved from its rearward withdrawn or part feed position into the cup-shaped article by fast acceleration in movement immediately followed by fast deceleration in movement arriving at its final working positioning with the cup-shaped article against the redraw die ring without excessive metal to metal impacts, whether between the cup-shaped article and the various machine elements or merely between the various machine elements in carrying out the redraw blankholder movement.

If excessive metal to metal impacts involving the cup-shaped articles are permitted, the cup-shaped articles can be damaged as well as the machine elements engaged therewith and this is particularly true in the case of forming metallic can bodies when the relatively small metal thicknesses are considered. At the same time, all possible areas of vibration must be eliminated which again can cause wear and damage to the various machine elements and cup-shaped article parts, as well as result in improper placement and retention of the cup-shaped articles at the initiation of the redraw operation which could result in improperly redrawn and wall ironed parts at completion thereof. The overall operation, therefore, is one of a close coordination of a series of vital factors including exact high speed movements of machine elements, exact place-
ment of machine elements at the termination of such high speed movements and an exact timing of such movements in order to achieve the final goal of high-speed mass production of finely redrawn and wall ironed cup-shaped articles such as metallic can bodies and the like.

Still a further problem area in the use of the prior cup-shaped article formers and particularly in the high-speed production of thin walled metallic can bodies and similar articles has been involved in the exact method of redrawing which has resulted in the final redrawn and wall ironed cup-shaped articles having uneven wall thicknesses and relatively severely thinned and scalloped wall edges at the open ends of the final articles. Thinning and scalloping are the symptom of uneven metal flow in the cup-shaped articles particularly during the redrawing operation, and this is at least partially determined by the pressure on the cup-shaped articles between the redraw blankholder and the redraw die ring as the articles are carried therebetween. Obviously in any redrawing operation and particularly that herein involved, a certain pressure must be exerted against the cup-shaped articles by the redraw blankholder during the forcing of the articles between the blankholder and the redraw die ring in order that a proper closely controlled further drawing action will take place.

Due to the metal thickness tolerances in manufacture, there necessarily will be slight variations in metal thickness, one cup-shaped article to the next. Thus, in order to compensate for such metal thickness variations, while still accomplishing a proper redrawing action, it is desirable to retain the cup-shaped articles by expansible pressure against the redraw blankholder so that the positioning of the blankholder will automatically compensate for the variations in metal thickness, both from original metal thicknesses and metal flow during redrawing, while still exerting a proper and determined pressure against the articles during the redrawing operation. This, of course, would immediately suggest the use of a compressible and expansible cylinder or cylinders, such as an air cylinder or cylinders for performing the entire redraw blankholder reciprocal movement and positioning, but this has been found to be unsatisfactory both from the standpoint of required speed of blankholder placement and proper control of the compressibility and expansion after movement over the blankholder placement distances, thereby requiring equipment improvement for a totally satisfactory high speed redrawing operation.

OBJECTS AND SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide a redrew blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like which makes use of combined cam and mechanical linkage main movement and movement of the redrew blankholder in its reciprocal movement between a withdrawn part feed position and a forward part engaging redrew position permitting high-speed operation of the article former compatible with modern mass production standards and requirements. According to a preferred embodiment of the present invention, a cam mechanism including one or more cans and associated cam followers is arranged with mechanically linked, blankholder control rods which reciprocate the redrew blankholder in a closely controlled and high-speed manner between the blankholder withdrawn part feed and forward part redrew placement positions insuring the necessary acceleration and deceleration movements of the redrew blankholder without damaging impacts which could damage cup-shaped articles being formed and the various former elements carrying out such formation. At the same time, in the use of the combined cam and mechanical linkage placement of the redrew blankholder, the timing of redrew blankholder movement may be perfectly coordinated with the ram of the article former, again permitting the high-speed operation of the former and high-speed production of accurately formed cup-shaped articles consistent in size tolerance one part or article to the next.

It is a further object of this invention to provide a redrew blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like making use of the foregoing combined cam and mechanical linkage placement of the redrew blankholder necessary for modern high-speed mass production use which insures a precise guiding and placement of the redrew blankholder in its high-speed reciprocal movements without danger of vibrations and other erratic movement problems frequently heretofore encountered in the use of high-speed cam guiding of similar elements. As hereinbefore pointed out, it is preferred to use a cam mechanism including one or more cans with associated cam followers, but in view of the extremely high speeds involved, the cam followers are retained against their guiding cam surfaces during movements of the cam surface relative to the cam followers by closely controlled constantly operable compressible and expansible means resulting in virtually perfect cam follower guiding by the cam surfaces and completed predictable redrew blankholder movement despite the required high speed thereof. The constant pressure urging of the cam follower or cam followers in the preferred form is with the use of air cylinders, the compressibility and expansibility of the air under pressure serving to maintain the cam follower or followers against their guiding cam surfaces.

It is still a further object of this invention to provide a redrew blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like making use of the foregoing combined high-speed cam and mechanical linkage placement of the redrew blankholder which preferably further combines a unique connection of the redrew blankholder to the mechanical linkage reciprocally moving the same consisting of a further closely controlled pressure exerting compressible means permitting automatic placement compensations for slight variations in metal thickness of the cup-shaped articles being redrawn and formed within the normal limits of metal thickness production tolerances. In this manner, the redrew blankholder positioning mechanism of the present invention combines the advantageous features of extremely high-speed movement and placement of the redrew blankholder through cam and mechanical linkage control with purely fluid actuated movement and control, but while eliminating the disadvantages of
both as hereinbefore discussed. Again, according to a preferred embodiment of the present invention, the redraw blankholder is moved and placed through its principle movements by the combined cam and mechanical linkage arrangement, but the redraw blankholder is connected to the mechanical linkages providing such movement through preferably a further compressible means in the form of an air cylinder exerting a constant pressure against the redraw blankholder in the blankholder engagement with the cup-shaped article being formed and the cup-shaped article against the redraw die ring, thereby automatically adjusting the redraw blankholder placement for slight variations in metal thickness insuring a redrawing operation of maximum predictable uniformity.

It is an additional object of this invention to provide a redraw blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like which combines the high-speed cam and mechanical linkage movement and control of the redraw blankholder with the compressible and expansible connection of the redraw blankholder with the mechanical linkage as discussed in the foregoing, but preferably with the addition of still further unique cooperating elements, controls the movement of the redraw blankholder during the redrawing operation in order to minimize the problem of thinning and scalloping of the cup-shaped article wall trailing edges during the final stages of the redrawing operations. Although the redraw blankholder is preferably connected to the cam controlled mechanical linkages through the compressible and expansible air cylinder in the preferred form thereof, the adjusting movement of the redraw blankholder by the air cylinder is closely controlled for maximum closing movement of the blankholder with the redraw die ring so that the blankholder is limited to a predetermined maximum movement short of engaging the die ring during final movement of the cup-shaped articles from between the same during the redrawing operation. In one form of the present invention, such predetermined maximum movement or redraw blankholder movement limitation by the air cylinder toward the redraw die ring is accomplished through adjustable stops or limiting controls directly associated with the air cylinder, while in another form, a stationary stop or limiting surface stationary relative to the redraw die ring is positioned for engagement during redraw blankholder movement to provide the desired blankholder movement limitation.

It is also an object of this invention to provide a redraw blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like satisfying all of the foregoing objects in extremely high-speed redrawing and wall ironing of cup-shaped articles formed of previously difficult to form metals such as the higher strength aluminum and tinplate, yet the high speed formation of such cup-shaped articles may be accomplished with maximum accuracy heretofore impossible with such combined production speeds and metals. Furthermore, the resulting high-speed cup-shaped article former including the principles of the present invention is operable over a long period of high-speed production life with minimum maintenance requirements so as to minimize lost production time normally encountered with similar production apparatus. Thus, the improved cup-shaped article former of the present invention satisfies a long-felt want and need in the modern mass production of cup-shaped articles with maximum efficiency and while maintaining maximum predictable accuracy not heretofore possible.

Other objects and advantages of the invention will be apparent from the following specification and the accompanying drawings which are for the purpose of illustration only.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an embodiment of a cup-shaped article former, specifically a metallic can body former, incorporating the redraw blankholder positioning mechanism principles of the present invention;

FIG. 2 is a side elevational view of an embodiment of the redraw blankholder positioning mechanism of the present invention in the metallic can body former environment, the can body former of FIG. 1 having the major portion thereof indicated in phantom lines and the redraw blankholder positioning mechanism being positioned in forward can body forming redrawing position;

FIG. 3 is a view similar to FIG. 2, but with the redraw blankholder positioning mechanism in rearward can body feeding position;

FIG. 4 is an enlarged, fragmentary somewhat diagramatic view of the die pack section of the can body former of FIGS. 1 through 3, and with the redraw blankholder positioning mechanism in forward can body forming position;

FIG. 5 is a vertical sectional view, part in elevation and part in phantom lines, looking in the direction of the arrows 5—5 in FIG. 6, and showing the cam control portion of the redraw blankholder positioning mechanism at the rearward portion of the can body former of FIGS. 1 through 3;

FIG. 6 is a fragmentary, vertical sectional view, part in elevation, looking in the direction of the arrows 6—6 in FIG. 5, and further showing the cam control portion of the redraw blankholder positioning mechanism at the rearward portion of the can body former of FIGS. 1 through 3;

FIG. 7 is an enlarged, vertical sectional view, part in elevation and with parts in phantom lines, looking in the direction of the arrows 7—7 in FIG. 6;

FIG. 8 is an enlarged, top plan view of an intermediate portion of the can body former of FIGS. 1 through 3, looking in the direction of the arrows 8—8 in FIG. 1 and with the redraw blankholder positioning mechanism in the forward can body forming position;

FIG. 9 is a fragmentary, side elevational view, looking in the direction of the arrows 9—9 in FIG. 8;

FIG. 10 is an enlarged, fragmentary, horizontal sectional view looking in the direction of the arrows 10—10 in FIG. 9, but with the redraw blankholder positioning mechanism in rearward can body feeding position and with the can body feeding and redraw die ring section of the can body former shown properly located relative to the withdrawn redraw blankholder;

FIG. 11 is a fragmentary, vertical sectional view, looking in the direction of the arrows 11—11 in FIG. 10 and with the various elements in the same positions;
FIG. 12 is a fragmentary, vertical sectional view, looking in the direction of the arrows 12—12 in FIG. 10 and with the various elements in the same positions as in FIG. 10;

FIG. 13 is a front elevational view of the redraw blankholder positioning mechanism, looking in the direction of the arrows 13—13 in FIG. 11;

FIG. 14 is a view similar to FIG. 10 but with the redraw blankholder positioning mechanism in forward part forming position, the redraw blankholder engaging within a can body and positioning the same against the redraw die ring ready for the beginning of the redrawning operation and the ram of the can body former beginning to advance through the redraw blankholder;

FIG. 15 is a view similar to FIG. 14, but with the ram of the can body former advanced through the redraw blankholder and the can body having been advanced beyond the redraw die ring; and

FIG. 16 is a view similar to FIG. 15, but showing an alternate embodiment of certain portions of the redraw blankholder positioning mechanism of the present invention.

DESCRIPTION OF THE BEST EMBODIMENTS CONTEMPLATED:

Referring to FIGS. 1 through 4 of the drawings, a cup-shaped article former is illustrated, specifically, a metallic can body former, incorporating an embodiment of the redraw blankholder positioning mechanism principles of the present invention and the metallic can body former may be basically of the construction shown and described in my co-pending U.S. Patent application, Ser. No. 045,430, filed June 11, 1970 and entitled "APPARATUS FOR FORMING ONE PIECE METALLIC CAN BODIES." Generally, the metallic can body former including the redraw blankholder positioning mechanism improvements of the present invention may be formed from usual materials and by usual construction methods except as hereinafter specifically pointed out. Furthermore, the metallic can body former includes a main frame generally indicated at 20 mounting a main drive mechanism generally indicated at 22 for preferably mechanically driving a horizontally reciprocal ram 24 from a rearward reversing position forwardly through a part feed mechanism generally indicated at 26 and a die pack generally indicated at 28 to a forward reversing position and then return rearwardly.

The basic function of the metallic can body former, as described in detail in my referred-to co-pending U.S. application, Ser. No. 045,430, is to receive blanked and semi-drawn, cup-shaped, metallic can bodies, an example thereof being indicated at 30 in FIGS. 10 and 11, and subject the same, one at a time, to a first redrawning operation and then to a series of wall ironing operations, finally subjecting the same to a bottom doming operation prior to exiting from the metallic can body former. An example of a finished can body is illustrated in FIGS. 2 and 4 and indicated at 32, deep drawn and wall ironed just completing the bottom doming operation prior to exiting from the metallic can body former. The semi-drawn can bodies 30 and finished can bodies 32 may be formed of the higher strength aluminums and the tinplates conventionally used for metal containers, all of which are of the more difficult to form materials in the manufacture of thin walled, deep drawn containers.

Without at the moment entering into detail, the principles of the present invention involve an improved redraw blankholder positioning mechanism generally indicated at 34 in FIGS. 2, 3 and 4, the function thereof being to horizontally reciprocally move a hollow cylindrical redraw blankholder 36 between a rearward part feed position shown in FIG. 3 and a forward can body redrawing position shown in FIG. 2 in close synchronization with the reciprocal movements of the ram 24. The sequence of operations of the metallic can body former starting with the ram 24 in fully withdrawn rearward reversing position and the redraw blankholder 36 in withdrawn rearward part feed position is the positioning of one of the semi-drawn can bodies 30 with the sidewalls thereof extending horizontally and axially aligned with the ram 24 and the redraw blankholder 36, the closed bottom wall of the semi-drawn can body facing axially away from the ram and blankholder and the open end thereof facing the ram and blankholder. The semi-drawn can bodies 30 are consecutively fed into the metallic can body former in a chute 38 of the part feed mechanism 26 into and positioned by a part positioning yoke 40 thereof where the semi-drawn can body next to be formed is positioned as described relative to the ram 24 and the blankholder 36.

The redraw blankholder 36 is moved forwardly from its rearward part feed position forwardly into the rearward open end of the semi-drawn can body 30 and upon the blankholder finally reaching its forward redrawing position, the blankholder preferably engages the semi-drawn can body with a redrawing die ring 42 of the die pack 28, such position being shown in FIG. 2. The ram 24 advances forwardly internally of the redraw blankholder 36 and the semi-drawn can body 30 positioned thereon engaging the closed bottom wall of the semi-drawn can body and carrying it forwardly between the redraw blankholder forward end and the redrawing die ring 42. Continued advancement of the ram 24 carries the now redrawn can body 30 consecutively through a series of wall ironing die rings 44, through a part stripper 46 and against a bottom doming die 48 producing the finished can body 32 shown in FIG. 4, the ram then reversing rearwardly through the part stripper 46 which strips the finished can body therefrom. Finally to complete one sequence of operation, the ram 24 continues rearwardly to its fully withdrawn position and the redraw blankholder 36 is returned rearwardly to its part feed position as shown in FIG. 3.

More particularly to the improvements of the present invention, the redraw blankholder positioning mechanism 34 includes a cam mechanism generally indicated at 50 and shown in FIGS. 2, 3, 5, 6 and 7, a blankholder actuating mechanism generally indicated at 52 and shown or at least partially shown in FIGS. 2 through 4, 6 and 8 through 14, and a blankholder frame assembly generally indicated at 54 mounting the redraw blankholder 36 and shown or at least partially shown in FIGS. 2 through 4 and 8 through 16.

Referring to FIGS. 2, 3, 5, 6 and 7, the cam mechanism 50 includes a pair of spaced, substantially identical, rotatable cams 56, each secured for rotation
to a gear wheel 58, the gear wheels 58 being driven by drive gears 60 engaged therewith secured to a main jack shaft 62. The main jack shaft 62 is driven from and forms a part of the main drive mechanism 22 of the metallic can body former and also directly drives the ram 24 in its reciprocal movements. Thus, both the ram 24 and the cans 56 of the can mechanism 50 are driven from the same main jack shaft 62 and through the geared and other connections thereof are all moved in predetermined synchronization through such common driving.

The cans 56 have predetermined, substantially identical, peripheral cam surfaces 64, each engaged by a cylindrical, rotatable cam roller or follower 66, the cam followers preferably being positioned at rearward sides of the cans. Furthermore, each of the cam followers 66 is retained forwardly against its respective cam surface 64 at all times during movement of such cam surface by reception of a cam follower mounting shaft 68 mounting the cam 56 with a bifurcated forward end of a piston rod 70 on a piston 72. The piston 72 is forwardly and rearwardly movable in a cylinder 74 secured to the can body former main frame 20 and receives preferably gaseous fluid therein, such as air, to constantly urge the piston 72 and, thereby, the cam follower 66 forwardly against the cam surface 64 of the cam 56 while still being compressible for permitting proper movement of the cam follower in travel of the cam surface relative thereto.

As can be seen particularly in FIG. 7, each of the cam followers 66 is journalled on its respective mounting shaft 68 located within a cam follower opening 76 of a cam follower arm 78, the mounting shaft 68 being journalled in and extending oppositely outwardly through the cam follower arm into the mounting shaft 68 secured to the bifurcated end of the piston rod 70. The cam follower arms 78 extend generally vertically with the lower ends thereof pivotally connected to the can body former main frame 20 through mounting brackets 80, the cam follower 66 being intermediate the vertical height of the cam follower arms and upper ends of the cam follower arms being pivotally connected to rearwardly extending connecting links 82 forming parts of the blankholder actuating mechanism 52 of which the cam follower arms 78 also form parts. With such mounting of the cam followers 66, the movements of the cam followers are exactly pivotally followed and translated into pivotal motion of the cam follower arm 78 which cam follower arms, in turn, through forward and rearward movement of the upper ends thereof translate such pivotal motion into forward and rearward motion.

As previously described and shown in FIG. 5, the cans or cam plates 56 with their respective cam followers 66 and cam follower arms 78 are mounted transversely spaced so that the upper ends of the cam follower arms terminate upwardly pivotally connected to the connecting links 82, respectively, transversely spaced at either side of the can body former main frame 20 with the blankholder actuating mechanism 52 further including transversely spaced sets of upper and lower blankholder actuating rods 84 and 86, as shown for instance in FIGS. 6, 8 and 9. The upper and lower blankholder actuating rods 84 and 86 in each side set extend horizontally and are horizontally reciprocally mounted on the can body former main frame 20 generally horizontally straddling the horizontal reciprocal path of movement of the ram 24, as can be seen for instance in FIGS. 2, 8, 10, 11, 13 and 14. As shown in FIG. 8 and described in detail in my referred to co-pending U.S. application, Ser. No. 045,430, the ram 24 is horizontally reciprocally mounted on the can body former main frame 20 and driven through a rearward slide assembly 88, a forward portion of the ram being reciprocally journalled through a bearing sleeve 90, while according to the improvements of the present invention, the transversely spaced sets of the upper and lower blankholder actuating rods 84 and 86 are horizontally reciprocally journalled through the main frame rearward and forward stationary cross arms 92 and 94.

Each transversely spaced set of the upper and lower blankholder actuating rods 84 and 86 is secured at rod rearward ends rearwardly of the frame rearward cross arm 92 to one of the connecting links 82 through a connecting bracket 96 pivotally connected to forward ends of the connecting links, as best seen in FIG. 6. As shown in FIGS. 2 through 4, but more particularly in detail in FIGS. 8 through 14, the forward ends of the sets of blankholder actuating rods 84 and 86 are secured forwardly of the main frame forward cross arm 94 to the blankholder frame assembly 54, thereby transmitting the forward and rearward reciprocal movements of the blankholder actuating rods into reciprocal movements of the blankholder frame assembly 54. The reciprocal journalling of the forward ends of the blankholder actuating rods 84 and 86 through the main frame forward cross arm 94 is shown in detail in FIG. 12 for one of the lower blankholder actuating rods 86 and includes a bearing sleeve 98 with a lubricating oil feed slot 100 forwardly telescoped by an oil shield 102 secured to the particular blankholder actuating rod, the purpose of such construction being to maintain reasonable separation between the lubricating fluids in the rearward portion of the metallic can body former and the metal forming fluids used in the die pack 28 at the forward portion of the metallic can body former.

More important to the principles of the present invention, the forward ends of the blankholder actuating rods 84 and 86 are secured to the blankholder frame assembly 54 through support plates 104 which straddle the path of movement of the ram 24 and forwardly mount limited forwardly and rearwardly compressible and expansible means in the form of a fluid, preferably air, blankholder pressure cylinder generally indicated at 106, as shown in FIGS. 9 through 11 and 13 through 15. The blankholder pressure cylinder 106 includes a rearward, annular piston 108 and a forward, annular cylinder 110, both of which transversely surround the ram 24 at all times during the forward and rearward reciprocal movement of the ram. Limited forward and rearward relative movement between the piston 108 and the cylinder 110 is guided by a pair of transversely spaced guide pins 112 on the piston reciprocally received in the cylinder, such relative movement also being sealed and cushioned by resilient ring seal cushions 114 as shown.

Spaced transversely inwardly of the guide pins 112, the piston 108 and the cylinder 110 are formed with a.
3,704,619

sealed, annular air chamber 116 therebetween which communicates outwardly with a supply of air preferably maintained at a constant predetermined pressure. Spaced inwardly and outwardly of the air chamber 116 are further resilient ring seal cushions 118 and 120, all of said ring seal cushions freely compressing and expanding to perform their sealing and cushioning functions during the relative forward and rearward movement between the piston 108 and the cylinder 110. The redraw blankholder 36 is secured to a forward face of the cylinder 110 surrounding the ram 24, the blankholder being transversely adjustable for exact alignment with the ram by spaced adjustment screws 122 and clamped in such alignment by clamping screws 124 as shown in FIG. 13.

Important to certain of the principles of the present invention, expansion limiting means, preferably in the form of limiting screws 126, is formed between the piston 108 and the cylinder 110 of the blankholder pressure cylinder 106 for limiting the expansive relative movement between such piston and cylinder, thereby, in effect, limiting the forward movement of the redraw blankholder 36 relative to the blankholder actuating rods 84 and 86 of the blankholder actuating mechanism 52. The overall important function of this blankholder forward movement limiting means, whether in the form of the limiting screws 126 or otherwise is to limit the forward movement of the redraw blankholder 36 when in its forward redrawing position to a predetermined distance rearwardly of and free of engaging the redrawing die ring 42 after the particular semi-drawn can body 30 has been moved forwardly by the ram 24 from between the redraw blankholder 36 and the redrawing die ring 42, as shown in FIG. 15. In other words, and as will be hereinafter more clearly described in a description of the operation of the metallic can body former, directly prior to and during the redrawing portion of the overall can body forming cycle, the redraw blankholder 36 in its forward redrawing position and as urged forwardly by the blankholder pressure cylinder 106 exerts a predetermined forward pressure against the particular semi-drawn can body 30 being redrawn and wall ironed to forward pressure removably hold the semi-drawn can body forwardly against the redrawing die ring 42 for controlling the redrawing operation as shown in FIG. 14, but when such redrawing operation is completed by the semi-drawn can body 30 passing forwardly through the redrawing die ring 42, the redraw blankholder 36 is forced forwardly by the blankholder pressure cylinder 106 while being limited in such forward movement to a predetermined rearward spacing from the redrawing die ring 42.

In this manner, the necessary drawing retention is supplied to the semi-drawn can body 30 being redrawn as exactly determined by the predetermined pressure in the blankholder pressure cylinder 106, the air within the cylinder being compressible and expansible to permit slight forward and rearward movement of the redraw blankholder for slight metal thickness variations and metal flow in the semi-drawn can body for a proper redrawing operation. At the same time, the forward limitation of movement of the redraw blankholder 36 by the limiting screws 126 prevents the redraw blankholder from closing completely forwardly on the redrawing die ring 42 maintaining spacing therebetween to a predetermined minimum, but less than the metal thickness of the semi-drawn can body 30 so that thinning and scalloping of the semi-drawn can body trailing edge is minimized and a closely controlled more perfect final finished can body 32 is obtained from the final redrawing and wall ironing operations. This forward limitation of movement of the redraw blankholder 36 may be obtained in many ways while still accomplishing the same function, an alternate construction being shown in FIG. 16 wherein forward surfaces of the redraw blankholder 36 and or the cylinder 110 are formed to engage a rearward surface of the part positioning yoke 40 stationary relative to the redrawing die ring 42 to accomplish the same limitation of forward movement of the redraw blankholder relative to the redrawing die ring.

In operation of the metallic can body former shown and described and incorporating the redraw blankholder positioning mechanism of the present invention, assume that the ram 24 is in its rearward reversing position as shown in FIGS. 3, 10 and 11 at which time the redraw blankholder 36 is in its rearward part feed position as determined by the cam followers 66 being engaged with the greater radius portions of the cam surfaces 64 on the cams 56 as shown in FIG. 3. During such withdrawal of both of the ram 24 and the redraw blankholder 36, the next semi-drawn can body 30 is fed downwardly through the chute 38 into the part positioning yoke 40 of the part feed mechanism 26 to assume a position exactly axially aligned with the ram and redraw blankholder as shown. The cams 56 have now rotated to the appropriate positions and the cam followers 66 move forwardly onto the smaller radius portions of the cam surfaces 64, the cam follower retaining cylinders 74 requiring such movement and thereby moving the redraw blankholder 36 from its rearward part feed position forwardly to its forward redrawing position through the cam follower arms 78, the blankholder actuating rods 84 and 86 and the blankholder frame assembly 54 to the position shown in FIG. 14.

In the position shown in FIG. 14, the forward working portion of the redraw blankholder 36 enters the rearward open end of the semi-drawn can body 30 engaging the bottom wall thereof and forcing the semi-drawn can body forwardly against the redrawing die ring 42, the pressure of forward retention of the semi-drawn can body by the redraw blankholder against the redrawing die ring being determined by the air pressure in the air chamber 116 of the blankholder pressure cylinder 106 and the relative rearward movement of the cylinder 110 over the piston 108 as also shown in FIG. 14. At completion of positioning of the semi-drawn can body 30 by the redraw blankholder 36, the ram 24 has begun to move forwardly in its forward stroke and through the redraw blankholder to ultimately engage the exposed bottom wall of the semi-drawn can body. Further forward movement of the ram 24 in engagement with the bottom wall of the semi-drawn can body 30 carries the semi-drawn can body between the forward end of the redraw blankholder and the redrawing die ring 42 and ultimately through the redrawing die ring. As the semi-drawn can body 30 passes through the redrawing die ring 42, the redraw blankholder 36 is forced forwardly by the blankholder
pressure cylinder 106 to the forward limit of such pressure cylinder as determined by the limiting screws 126, but the ultimate position of the redraw blankholder is spaced rearwardly a predetermined distance from the redraw die ring 42, a distance a predetermined amount less than the metal thickness of the semi-drawn can body 30, as shown in FIG. 15 and hereinabove discussed.

Still continued forward movement of the ram 24 carries the now redrawn semi-drawn can body 30 forward progressively through the wall ironing die rings 44, the part stripper 46 and against the bottom doming die 48 to the positioning shown in FIGS. 2 and 4 completing the formation of the semi-drawn can body 30 into the finished can body 32. The movement of the ram 24 is immediately reversed carrying the finished can body 32 rearwardly into engagement with the part stripper 46 with the ram continued rearward movement stripping the finished can body therefrom and the finished can body dropping to a conveyor for transport away from the metallic can body former. The ram 24 progresses rearwardly through the die pack 28 and ultimately to its rearward reversing position as shown in FIG. 11 while the redraw blankholder 36 is withdrawn to its rearward part feed position by the cam mechanism 50 and the blankholder actuating mechanism 52 as previously described ready for a feeding of the next semi-drawn can body 30 to be redrawn and wall ironed, thereby completing one cycle of the metallic can body former.

According to the principles of the present invention, therefore, an improved redraw blankholder positioning mechanism 34 for the metallic can body former is provided, such redraw blankholder positioning mechanism including an improved cam mechanism 50, an improved blankholder actuating mechanism 52 and an improved blankholder frame assembly 54, all both individually and collectively providing distinct advantageous performance over anything heretofore provided.

The cam mechanism 50 includes the single cam surface engagement of the cam followers 66 with the cam surfaces 64 of the cans or cam plates 56 as compressibly and expansibly urged by the retaining cylinders 74 insuring cam follower exact cam surface guiding despite the cycling of the metallic can body former at rates between 125 and 150 cycles per minute or parts produced per minute. Although the control of the cam followers 66 by the cam surfaces 64 of the cans 56 is throughout the entire ram 24 and redraw blankholder 36 cycling, the important phases of such cycles for the redraw blankholder control by the cans 56 is during the forward movement of the redraw blankholder from its rearward part feed position into its forward redraw position and continuously in such forward redraw position until the ram has moved the semi-drawn can body 30 beyond control by the redraw blankholder. The remaining portion of the redraw blankholder forward positioning and the withdrawal thereof are of lesser importance in exact control and could be accomplished by means other than the exact cam control shown so that it is not intended to limit the principles of the present invention in the broader form thereof to the full cycle cam control as shown in the particular embodiment illustrated.

Continuing with the improvements of the present invention, the blankholder actuating mechanism 52 is cooperation with the dual cams 56, cam follower 66 and retaining cylinder 74 of the cam mechanism 50 provides increased accuracy of movement control of the redraw blankholder 36 important in the positioning of the redraw blankholder in its forward redraw position, not only to accurately position the semi-drawn can body 30 relative to the redraw die ring 42 at the initiation of such redrawing operation, but to maintain relative positioning of the redraw blankholder and the redraw die ring during the progression of the actual redrawing operation of the semi-drawn can body. As described, the identical halves of the cam mechanism 50 control and move identical pairs of upper and lower blankholder actuating rods 84 and 86, one pair connected to either side of the blankholder frame assembly 54 and with such arrangement, each side of the blankholder actuating mechanism 52 can minutely adjust to exactly move and position the blankholder frame assembly 54, again important for the extremely high speeds of movement.

Still further, the unique construction of the blankholder frame assembly 54 including the blankholder pressure cylinder 106 provides a wedding of the more advantageous features of a purely cam controlled positioning of the redraw blankholder 36 and a purely fluid cylinder positioning of the redraw blankholder. The combined cam mechanism 50 and the blankholder actuating mechanism 52 provide the extremely accurate and high-speed movement of the redraw blankholder 36 required for the extremely high-speed cycling of the metallic can body former, yet the blankholder pressure cylinder 106 of the blankholder frame assembly 54 provides the necessary cushioning from impact and necessary pressure retention against the redraw blankholder for finally redrawn and wall ironed finished can bodies 32 of maximum quality despite the high speeds of production. Still additionally, the quality of the finished can bodies 32 is even further improved by the provision of the blankholder movement limiting means either internally of the blankholder pressure cylinder 106 or externally thereof, the important thing being that the redraw blankholder 36 is limited to a predetermined distance from forward movement against the redraw die ring 42 so as to maintain proper pressure against the side walls of the semi-drawn can body 30 during the redrawing operation, but through such limitation minimizing any objectionable thinning of the can body trailing edge portions as well as objectionable scalloping thereof.

I claim:

1. In a redraw blankholder positioning mechanism for cup-shaped article formers such as metallic can body formers and the like; the article former being of the type wherein a hollow cylindrical blankholder is moved from a rearward article feed position axially forwardly into a rearwardly open end of a cup-shaped article to a forward article drawing position, said blankholder in said article drawing position locating said cup-shaped article centered directly rearwardly of a redraw die ring and maintaining said article in said location during forward axial movement of a reciprocal ram through said blankholder to engage and carry said cup-shaped article through said die ring, said blank-
holder being moved rearwardly to said article feed position at last during a portion of withdrawal of said ram; the improvements comprising: a blankholder mounting frame having said blankholder secured thereto, said blankholder mounting frame being operably connected to a main frame of said article former reciprocal forwardly and rearwardly moving said blankholder between said rearward article feed and said forward article drawing positions and maintaining said blankholder in said positions; a rotatable cam mounted on said former main frame having cam surface means for producing at least said blankholder mounting frame forward movement and positioning in said forward article drawing position at least during said ram carrying of said article through said redraw die ring; a cam follower engaged with and movable along said cam surface means at least during that part of said cam rotation producing said blankholder mounting frame movement and positioning; resiliently acting retention means for constantly retaining said cam follower against said cam surface means and constantly movable exactly along said cam surface means at least during said cam rotation part; and blankholder actuating means operably connected to said blankholder mounting frame for reciprocally moving said blankholder mounting frame between said rearward article feed and said forward article drawing positions and maintaining said blankholder in said positions including operable connection with said cam follower for movements exactly with said cam follower movements along said cam surface means at least during said cam rotation part.

2. A redraw blankholder positioning mechanism as defined in claim 1 in which said retention means includes a fluid cylinder mounted actionable between said cam follower and said article former main frame constantly retaining said cam follower against said cam surface means and constantly movable exactly along said cam surface means at least during said cam rotation part.

3. A redraw blankholder positioning mechanism as defined in claim 1 in which said retention means includes an air cylinder mounted actionable between said cam follower and said article former main frame constantly retaining said cam follower against said cam surface means and constantly movable exactly along said cam surface means at least during said cam rotation part.

4. A redraw blankholder positioning mechanism as defined in claim 1 in which said blankholder actuating means includes a cam follower arm pivotally connected to said article former main frame and having said cam follower thereon, said cam follower arm being operably connected to said blankholder mounting frame and translating movements of said cam follower into reciprocations and positioning of said blankholder mounting frame exactly with said cam follower movements at least during said cam rotation part.

5. A redraw blankholder positioning mechanism as defined in claim 1 in which said blankholder actuating means includes a cam follower arm having one end pivotally connected to said article former main frame and having said cam follower mounted thereon spaced from said one end, a rigid rod pivotally connected to said cam follower arm spaced from said cam follower arm one end, said rod being positioned forwardly and rearwardly reciprocal on said article former main frame and being secured to said blankholder mounting frame, said cam follower arm translating movements of said cam follower along said cam surface means at least during said cam rotation part into pivotal movements of said cam follower arm and into reciprocal movements and positioning of said blankholder mounting frame through said rod.

6. A redraw blankholder positioning mechanism as defined in claim 1 in which said retention means includes a fluid cylinder actionable between said article former main frame and said cam follower constantly retaining said cam follower against said cam surface means and constantly movable exactly along said cam surface means at least during said cam rotation part; and in which said blankholder actuating means includes a cam follower arm having one end pivotally connected to said article former main frame and having said cam follower mounted thereon spaced from said one end, a rigid rod pivotally connected to said cam follower arm spaced from said cam follower arm one end, said rod being positioned forwardly and rearwardly reciprocal on said article former main frame and being secured to said blankholder mounting frame, said cam follower arm translating movements of said cam follower along said cam surface means at least during said cam rotation part into pivotal movements of said cam follower arm and into reciprocal movements and positioning of said blankholder mounting frame through said rod.

7. A redraw blankholder positioning mechanism as defined in claim 1 in which gear means is operably connected to said cam for rotating said cam in an exact relative relationship to reciprocal movements of said article former ram.

8. A redraw blankholder positioning mechanism as defined in claim 1 in which gear means is operably connected to said cam for rotating said cam in an exact relative relationship to reciprocal movements of said article former ram; in which said retention means includes a fluid cylinder actionable between said article former main frame and said cam follower constantly retaining said cam follower against said cam surface means and constantly movable exactly along said cam surface means at least during said cam rotation part; and in which said blankholder actuating means includes a cam follower arm having one end pivotally connected to said article former main frame and having said cam follower mounted thereon spaced from said one end, a rigid rod pivotally connected to said cam follower arm spaced from said cam follower arm one end, said rod being positioned forwardly and rearwardly reciprocal on said article former main frame and being secured to said blankholder mounting frame, said cam follower arm translating movements of said cam follower along said cam surface means at least during said cam rotation part into pivotal movements of said cam follower arm and into reciprocal movements and positioning of said blankholder mounting frame through said rod.

9. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is mounted on said article former main frame spaced rearwardly of said blankholder mounting frame; and in which said blank-
holder actuating means includes a forwardly and rearwardly reciprocal rod operably connected forwardly to said blankholder mounting frame and rearwardly to said cam follower translating movements of said cam follower along said cam surface means at least during said cam rotation part into reciprocal movements and positioning of said blankholder mounting frame through reciprocal movements and positioning of said rod by said cam follower operable connection.

10. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is a first cam and a second rotatable cam is mounted on said former main frame parallel to and aligned with said first cam, said second cam having cam surface means substantially identical to said first cam for producing said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower and a second cam follower is engaged with and movable along said second cam surface means at least during a part of said second cam rotation substantially identical to said first cam rotation part; in which said retention means is a first retention means and a second resiliently acting retention means constantly retains said second cam follower against said second cam surface means and constantly movable exactly along said second cam surface means at least during said second cam rotation part; and in which said blankholder actuating means is between each of said first and second cam followers and said blankholder mounting frame for reciprocally moving said blankholder mounting frame exactly with said first and second cam surface means to move said blankholder between said article feed and drawing positions and maintain said blankholder in said positions according to said first and second cam rotations.

12. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is a first cam and a second rotatable cam is mounted on said former main frame parallel to and aligned with said first cam, said first and second cams each having cam surface means for producing all of said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower, said first cam follower and a second cam follower each being engaged with and movable along the respective of said first and second cam surface means throughout said first and second cam rotations; and in which said blankholder actuating means includes a first cam follower arm pivotally connected to said article former main frame and having said first cam follower thereon, a second cam follower arm pivotally connected to said article former main frame and having said second cam follower thereon, said first and second cam follower arms being operably connected to said blankholder mounting frame and translating movements of said first and second cam followers into reciprocations and positioning of said blankholder mounting frame exactly with said first and second cam follower movements.

13. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is a first cam and a second rotatable cam is mounted on said former main frame parallel to and aligned with said first cam, said second cam having cam surface means substantially identical to said first cam for producing said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower and a second cam follower is engaged with and movable along said second cam surface means at least during a part of said second cam rotation substantially identical to said first cam rotation part; in which said retention means is a first retention means and a second resiliently acting retention means constantly retains said second cam follower against said second cam surface means and constantly movable exactly along said second cam surface means at least during said second cam rotation part; and in which said blankholder actuating means includes a first cam follower arm having one end pivotally connected to said article former main frame and having said first cam follower mounted thereon spaced from said one end, a second cam follower arm having one end pivotally connected to said article former main frame and having said second cam follower mounted thereon spaced from said one end, a rigid rod pivotally connected to said first cam follower arm spaced from said first cam follower arm one end, a rigid rod pivotally connected to said second cam follower arm spaced from said second cam follower arm one end, said rods being positioned forwardly and rear-
wardly reciprocal on said article former main frame and being secured to said blankholder mounting frame, said first and second cam follower arms translating movements of said first and second cam followers along said first and second cam surface means at least during said first and second cam rotation parts into pivotal movements of said first and second cam follower arms and into reciprocal movements and positioning of said blankholder mounting frame through said rods.

14. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is a first cam and a second rotatable cam is mounted on said former main frame parallel to and aligned with said first cam, said second cam having cam surface means substantially identical to said first cam for producing said blankholder mounting frame movements and positioning; in which gear means is operably connected to each of said first and second cams for rotating said cams in an exact relative relationship to reciprocal movements of said article former ram; in which said cam follower is a first cam follower and a second cam follower is engaged with and movable along said second cam surface means at least during a part of said second cam rotation substantially identical to said first cam rotation part; in which said retention means is a first retention means and includes a fluid cylinder actionable between said article former main frame and said first cam follower constantly retaining said first cam follower against said first cam surface means and constantly movable exactly along said first cam surface means at least during said first cam rotation part, in which a second retention means includes a fluid cylinder actionable between said article former main frame and said second cam follower constantly retaining said second cam follower against said second cam surface means and constantly movable exactly along said second cam surface means at least during said second cam rotation part; and in which said blankholder actuating means includes a first cam follower arm having one end pivotally connected to said article former main frame and having said second cam follower mounted thereon spaced from said one end, a second cam follower arm having one end pivotally connected to said article former main frame and having said second cam follower mounted thereon spaced from said one end, a rigid rod pivotally connected to said first cam follower arm spaced from said first cam follower arm one end, a rigid rod pivotally connected to said second cam follower arm spaced from said second cam follower arm one end, said rods being positioned forwardly and rearwardly reciprocal on said article former main frame and being secured to said blankholder mounting frame, said first and second cam follower arms translating movements of said first and second cam followers along said first and second cam surface means at least during said first and second cam rotation parts into pivotal movements of said first and second cam follower arms and into reciprocal movements and positioning of said blankholder mounting frame through said rods.

15. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is a first cam and said first and second cams each having cam surface means for producing all of said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower, said first cam follower and a second cam follower each being engaged with and movable along the respective of said first and second cam surface means during said first and second cam rotations; in which said retention means is a first retention means, said first retention means and a second resiliently acting retention means constantly retaining the respective of said first and second cam followers against the respective of said first and second cam surface means and constantly movable exactly along said first and second cam surface means throughout said cam rotations; and in which said blankholder actuating means includes a forwardly and rearwardly reciprocal rod operably connected forwardly to said blankholder mounting frame and rearwardly to said first cam follower, a forwardly and rearwardly reciprocal rod operably connected forwardly to said blankholder mounting frame and rearwardly to said second cam follower, said rods translating movements of said first and second cam followers along said first and second cam surface means during said first and second cam rotations into reciprocal movements and positioning of said blankholder mounting frame through reciprocal movements and positioning of said blankholder mounting frame and rearwardly along said first and second cam follower operably connections at least during said cam rotations.

16. A redraw blankholder positioning mechanism as defined in claim 1 in which said cam is a first cam and is mounted on said article former main frame spaced rearwardly of said blankholder mounting frame; in which a second rotatable cam is mounted on said former main frame spaced rearwardly of said blankholder mounting frame and parallel to and aligned with said first cam, said first and second cams having cam surface means for producing all of said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower, said first cam follower and a second cam follower each being engaged with and movable along the respective of said first and second cam surface means during said first and second cam rotations; in which said retention means is a first retention means and includes an air cylinder mounted actionable between said first cam follower and said article former main frame constantly retaining said first cam follower against said first cam surface means and constantly movable exactly along said first cam surface means throughout said first cam rotation; in which a second retention means includes an air cylinder mounted actionable between said second cam follower and said article former main frame constantly retaining said second cam follower against said second cam surface means and constantly movable exactly along said second cam surface means throughout said cam rotation; and in which said blankholder actuating means includes a first cam follower arm having one end pivotally connected to said article former main frame and having said second cam follower mounted thereon spaced from said one end, a second cam follower arm having one end pivotally connected to said article former main frame and having said second cam follower mounted thereon spaced from said one end, a
21 18. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; and in which said blankholder mounting frame includes rearward compressible means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said rearward compressible means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring.

19. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes rearward compressible means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said rearward compressible means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring.

20. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; and in which said blankholder mounting frame includes rearward compressible means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said rearward compressible means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and
23 said redraw die ring until said article has been carried from said blankholder through said die ring.

21. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably associated with certain of said blankholder mounting frame air cylinder means and said blankholder for limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.

22. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably associated with certain of said blankholder mounting frame air cylinder means and said blankholder for limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.

24. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is positioned stationary with said die ring for engagement by surface means operably connected to said blankholder limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.

25. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring.

26. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring.

27. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably associated with said die ring for engagement by surface means operably connected to said blankholder limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.

28. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably associated with said die ring for engagement by surface means operably connected to said blankholder limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.
from said cam follower arm one end, said rod being positioned forwardly and rearwardly reciprocal on said article former main frame and being secured to said blankholder mounting frame, said cam follower arm translating movements of said cam follower along said cam surface means at least during said cam rotation part into pivotal movements of said cam follower arm and into reciprocal movements and positioning of said blankholder mounting frame through said rod; and in which said blankholder mounting frame includes rearward compressible means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said rearward compressible means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring.

26. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring, in which said cam is a first cam and a second rotatable cam is mounted on said article former main frame parallel to and aligned with said first cam, said second cam having cam surface means substantially identical to said first cam for producing said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower and a second cam follower is engaged with and movable along said second cam surface means at least during a part of said second cam rotation substantially identical to said first cam rotation part; in which said retention means is a first retention means and a second resiliently acting retention means constantly retains said second cam follower against said cam surface means and constantly movable exactly along said cam surface means at least during said cam rotation part; in which said blankholder actuating means is between each of said first and second cam followers and said blankholder mounting frame for reciprocally moving said blankholder mounting frame exactly with said first and second cam followers moving along said first and second cam surface means to at least move said blankholder from said article feed to said drawing position and maintain said blankholder in said drawing position at least according to said first and second cam rotation parts; in which said blankholder mounting frame includes rearward compressible means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said rearward compressible means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably associated with certain of said rearward compressible means and said blankholder for limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redrow die ring despite said rearward compressible means forward expansion and said ram carrying of said article from said blankholder through said die ring.

27. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring, in which said cam is a first cam and a second rotatable cam is mounted on said article former main frame parallel to and aligned with said first cam, said second cam having cam surface means substantially identical to said first cam for producing said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower and a second cam follower is engaged with and movable along said second cam surface means at least during a part of said second cam rotation substantially identical to said first cam rotation part; in which said retention means is a first retention means and a second resiliently acting retention means constantly retains said second cam follower against said second cam surface means and constantly movable exactly along said second cam surface means at least during said second cam rotation part; in which said blankholder actuating means is between each of said first and second cam followers and said blankholder mounting frame for reciprocally moving said blankholder mounting frame exactly with said first and second cam followers moving along said first and second cam surface means to at least move said blankholder from said article feed to said drawing position and maintain said blankholder in said drawing position at least according to said first and second cam rotation parts; in which said blankholder mounting frame includes rearward compressible means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said rearward compressible means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redrow die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably associated with certain of said rearward compressible means and said blankholder for limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redrow die ring despite said rearward compressible means forward expansion and said ram carrying of said article from said blankholder through said die ring.
27 former main frame spaced rearwardly of said blankholder mounting frame; in which a second rotatable cam is mounted on said former main frame spaced rearwardly of said blankholder mounting frame and parallel to an aligned with said first cam, said first and second cams each having cam surface means for producing all of said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower, said first cam follower and a second cam follower each being engaged with and movable along the respective of said first and second cam surface means during said first and second cam rotations in which said retention means is a first retention means, said first retention means and a second resiliently acting retention means constantly retaining the respective of said first and second cam followers against the respective of said first and second cam surface means and constantly movable exactly along said first and second cam surface means throughout said cam rotations; in which said blankholder actuating means includes a forwardly and rearwardly reciprocally operably connected forwardly to said blankholder mounting frame and rearwardly to said first cam follower translating movements of said first cam follower along said first cam surface means during said first cam rotation into reciprocal movements and positioning of said blankholder mounting frame through reciprocal movements and positioning of said rod by said first cam follower operably connection, a forwardly and rearwardly reciprocally operably connected forwardly to said blankholder mounting frame and rearward to said second cam follower translating movements of said second cam follower along said second cam surface means during said second cam rotation into reciprocal movements and positioning of said blankholder mounting frame through reciprocal movements and positioning of said rod by said second cam follower operably connection; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably connected to said air cylinder means for limiting forward expansion of said air cylinder means and thereby limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.

29. A redraw blankholder positioning mechanism as defined in claim 1 in which said article former is of the type wherein said blankholder in said article drawing position engages said cup-shaped article forwardly with said redraw die ring and maintains said article engagement with said die ring during said forward axial movement of said ram and until said article has been carried from said blankholder through said die ring; in which said cam is a first cam and is mounted on said article former main frame spaced rearwardly of said blankholder mounting frame; in which a second rotatable cam is mounted on said former main frame spaced rearwardly of said blankholder mounting frame and parallel to and aligned with said first cam, said first and second cams having cam surface means for producing all of said blankholder mounting frame movements and positioning; in which said cam follower is a first cam follower said first cam follower and a second cam follower each being engaged with and movable along the respective of said first and second cam surface means during said first and second cam rotations; in which said retention means is a first retention means and includes an air cylinder mounted actionable between said first cam follower and said article former main frame constantly retaining said first cam follower against said first cam surface means and constantly movable exactly along said first cam surface means throughout said first cam rotation; in which a second resiliently acting retention means includes an air cylinder mounted actionable between said second cam follower and said article former main frame constantly retaining said second cam follower against said second cam surface means and constantly movable exactly along said second cam surface means throughout said second cam rotation; in which said blankholder actuating means includes a first cam follower arm having one end pivotally connected to said article former main frame and having said first cam follower mounted thereon spaced from said one end, a second cam follower arm having one end pivotally connected to said article former main frame and having said cam follower mounted thereon spaced from said one end, a rigid rod pivotally connected to said first cam follower arm spaced from said first cam follower arm one end, a rigid rod pivotally connected to said second cam follower arm spaced from said second cam follower arm one end, said rods being positioned forwardly and rearwardly reciprocally on said article former main frame and being secured to said blankholder mounting frame, said first and second cam followers along said first and second cam surface means during said first and second cam rotations into pivotal movements of said first and second cam followers and into reciprocal movements and positioning of said blankholder mounting frame through said rods; in which said blankholder mounting frame includes air cylinder means thereon for mounting said blankholder in limited forward and rearward movement relative thereto, said air cylinder means rearwardly compressing during said blankholder engagement of said cup-shaped article forwardly with said redraw die ring in said blankholder article drawing position and exerting a forward expansive force between said blankholder and said article and between said article and said redraw die ring until said article has been carried from said blankholder through said die ring; and in which motion limiting means is operably connected to said air cylinder means for limiting forward expansion of said air cylinder means and thereby limiting forward movement of said blankholder in said forward article drawing position spaced rearwardly at a predetermined distance from said redraw die ring.
despite said air cylinder means forward expansion and said ram carrying of said article from said blankholder through said die ring.

* * * *