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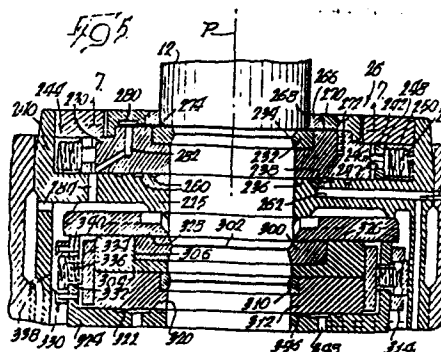
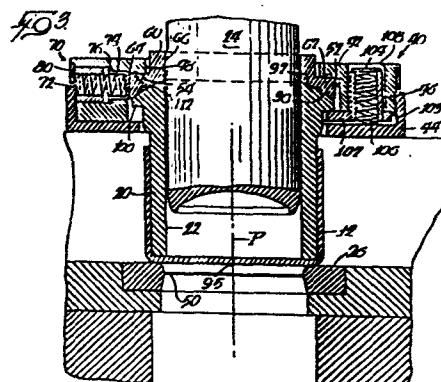
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54 Apparatus for drawing and ironing containers.

57 A drawing and ironing machine consists of a redraw assembly, at least one ironing assembly and a stripper assembly arranged in series and each having a ring having an opening to define a path for a punch. A cup holder sleeve (20) cooperates with the redraw assembly (26) to hold a cup (12) while it is forced through the redraw assembly (26) by the punch (24) which also cooperates with a domer assembly at the end of its path to reshape the end wall of the cup (12). Each of the rings (26, 232, 300, 310) are spring biased to a centered position by circumferentially spaced spring assemblies (70, 244) that accommodate radial movement of the ring with respect to the path. The cup holder sleeve (20) is also movable radially of the path and tiltable axially of the path while the domer assembly has a domer element which is also spring biased to a centered position. The various assemblies also have surfaces that cooperate with a surface on the frame that accommodate radial movement and have a fluid supplied thereto to reduce friction between the surfaces.



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Apparatus for Drawing
and Ironing Containers
Description

Technical Field

5 The present invention relates generally to can making machines and more specifically to an improved floating arrangement for various components of a drawing and ironing machine.

10 In the formation of a "two-piece" container, it has been customary to utilize a plurality of die assemblies that cooperate with a punch for converting circular metal discs into finished containers which have a sidewall and an integral end wall. One of these processes consists of originally drawing a circular
15 metal disc into a cup utilizing what is commonly referred to as a cupping machine. The cup is then transferred to a bodymaker wherein the cup is converted into the finished container. In one process, which is being used commercially, the preformed cup is first redrawn
20 to a smaller diameter and larger height and then is substantially simultaneously converted to an ironed container wherein the sidewall thickness is reduced in one or more steps. One type of such commercial machine is produced by Ragsdale Bros., Inc. and is identified as

a Model CR-24 canwall drawing and ironing press.
Normally the material for such containers is either
aluminum or tinplate.

5 In such a process, a punch normally cooperates
with a plurality of ironing dies and the stroke of the
punch is fairly long in order to produce conventional 12
and 16 ounce containers. The length of the stroke of
the punch for the bodymaker or press has heretofore
created substantial problems in producing a satisfactory
10 container which has a uniform wall thickness in the
sidewall thereof. One of the problems encountered has
been in maintaining all of the elements in very accurate
alignment with respect to each other in order to produce
a finished container which has a uniform wall thickness
15 around the entire perimeter thereof and also the entire
length thereof.

Background Prior Art

In order to alleviate some of the problems in
maintaining accurate alignment between the various dies
20 and the punch, several proposals for producing floating
ironing dies have been proposed. For example, British
Patent No. 724,251 published February 16, 1955 discloses
a method of supporting ironing dies that will accommodate
movement of the dies with respect to the punch but will
25 also provide a self-centering feature which theoretically
will reposition the die to a predetermined position
whenever all external forces have been removed.

The particular arrangement for accomplishing
the self-centering and floating feature in the assembly
30 disclosed in the British patent consists of cooperating
inclined surfaces between the ironing die and its
support mechanism with a biasing mechanism which will
automatically center the ironing dies with respect to a

predetermined axis whenever external forces are removed. The biasing mechanism in this patent has been illustrated as either consisting of an elastomeric member or rubber ring which produces a centering action between an ironing die and a cooperating support. Alternatively, the centering means in the disclosed patent also shows the use of springs that cooperate with the ironing die and the support to center the ironing die with respect to a predetermined axis. However, such arrangement has not been too successful in accurately returning the ironing die to a centered position after being moved away from the centered position.

One additional problem that has been encountered in the formation of two-piece drawn and ironed containers has been encountered when the cup is initially formed and then is redrawn just prior to the ironing of the sidewall. In a redraw operation just prior to the ironing of the sidewalls of the cups, it is customary to hold the cup through what may be termed a cup holder sleeve in an accurate position with respect to the redraw ring just prior to the punch entering into the cup and forcing the cup through the redraw ring. It has been found that, under certain conditions, the cup holder sleeve is not accurately centered, while applying uniform hold-down pressure on the cup to hold the cup in a fixed position with respect to the redraw ring. This will produce an uneven redrawn cup which can produce a tear-off of the longer end either in the redraw state or in subsequent ironing stages.

It has also been found that when there is no accurate alignment between the punch and the redraw ring which reshapes the cup, the wall thickness of selected portions of the cup may be reduced during the redraw process which results in ultimately having varying thicknesses in different portions of the sidewall of the finished container.

It has also been determined that if the cup holder sleeve face does not apply a uniform pressure to the cup it may wrinkle in selected areas during the redraw application.

5 A further problem has also been encountered in insuring that the domer assembly and stripper assembly are accurately aligned with the punch as the end wall is reformed and the partially finished container is stripped from the punch.

10 Summary of the Invention

 The present invention is particularly adapted for a drawing and ironing machine that includes a frame which has a redraw assembly, at least one ironing assembly and a stripper assembly arranged in series, and
15 each having an opening to define a path with a punch movable along the path through the openings. A cupholder sleeve assembly has an axial bore adapted to receive the punch and cooperates with the redraw die assembly to hold a cup while the cup is being forced through the redraw
20 die assembly and through the respective ironing assemblies. A domer assembly is also located at the end of the path of the punch and reforms the end wall of the cup after it has passed through the respective assemblies and the stripper assembly engages the upper free edge of the
25 partially finished container to strip the container from the punch as the punch is withdrawn through the respective assemblies.

 According to the present invention, at least one of the redraw, ironing or stripper assemblies is
30 designed to accommodate radial movement of the center of the opening through which the punch passes in order to accommodate any misalignment between the punch and the openings in the various assemblies. The domer assembly

is likewise movable radially of the path for the punch to insure that the center of the domer is centered with respect to the axis of the punch.

5 The primary aspect of the invention is the fact that the ironing dies are radially movable with respect to the path for the punch and are automatically returned to a centered position by circumferentially spaced centering spring means. The ironing dies are supported on an air float to reduce friction and lubricant is supplied to the opening in the die.

10 According to one aspect of the present invention, a cup holder sleeve assembly is designed to be capable of allowing the cup holder sleeve to automatically be moved radially with respect to the axis of a drawing and ironing machine and also be capable of
15 being tilted with respect to the axis to accommodate accurate positioning of the cup holder sleeve face with respect to the surface of the redraw ring and accurately position the cups with respect to a ring and apply
20 uniform pressure to the cup.

More specifically, the cup holder sleeve assembly includes a support having an opening therein with a
25 recess extending from the periphery of the opening and a cup holder sleeve and support element having portions received into the recess of the support. The support element and cup holder sleeve are normally maintained in a centered position with respect to the opening in the support by centering springs which accommodate radial movement of the support element and the cupper
30 sleeve. The cup holder sleeve and support element have cooperating spherical surface segments that are normally maintained in engagement with each other through further hold-down springs which accommodate tilting of the axial bore in the sleeve with respect to the axis of the

aperture in the support element. Lubricating means are provided for supplying lubricant between the cooperating spherical surface segments on the support element and the cup holder sleeve as well as the supporting surfaces
5 between the support element and the support which accommodates radial movement of the support element and cup holder sleeve within the support.

According to a further aspect of the present invention, the redraw die assembly has a redraw die that
10 is floatingly mounted with respect to the axis of the punch associated therewith so as to be movable in a radial plane with respect to the axis of the punch as well as the axis of the cup holder sleeve and the assembly is normally held in a centered position with respect
15 to the path for the punch by biasing springs that cooperate with the periphery of the assembly. The assembly includes a support and a redraw ring carried by the support and also preferably includes an enlarged nesting ring which acts as a pilot for receiving and accurately positioning the cup with respect to the redraw ring.
20

The redraw die assembly also incorporates lubricating means for supplying lubricant to the inner face between the redraw ring and the cup to reduce the frictional forces and produce a cup having a better
25 finish. The lubricating means consists of an annular lubricating channel within the support surrounding the nesting ring with the channel being in communication with the opening in the ring through a plurality of circumferentially spaced flow paths which have their
30 inner ends terminating non-radially with respect to the center of the opening in the ring. This arrangement creates a swirling or vortex flow for the lubricant fluid to the opening in the ring during the redraw operation and also cools the redraw ring during the remainder of the cycle.
35

The redraw ring assembly also is supported on a fluid bearing within the frame for the assembly to reduce frictional forces and aid in accommodating radial movement of the assembly with respect to the path.

5 According to a further aspect of the invention, the stripper assembly of the drawing and ironing assembly is also mounted for radial movement with respect to the path and is again centered with respect to the path by centering springs that cooperate with the periphery of
10 the assembly and is supported on a fluid bearing.

 The domer assembly includes a support that has a recess with the base of the recess defining a support surface. A carrier element is located in the recess and has a cooperating surface which engages the bottom of
15 the recess and both the carrier and the recess in the support are circular with the recess being enlarged so as to accommodate movement of the carrier element in all directions along a plane which extends perpendicular to the path of movement of the punch.

20 The domer assembly also includes supply means for introducing a bearing fluid between the two surfaces with biasing means between the support and the carrier element which normally maintain the surfaces in a predetermined position with respect to each other and accommodate radial movement of the carrier element within
25 the recess. The biasing means or springs are positioned such that the domer member or element supported on the carrier is always returned to the predetermined position whenever external forces are removed from the assembly.

30 According to one aspect of the invention, the support also includes prestressing means for prestressing the springs located between the support and the carrier element so that the carrier element is always returned to a predetermined position with respect to the path or axis
35 of the punch regardless of variations in spring forces being applied by the respective springs.

The prestressing means consists of a ring which surrounds a reduced portion of the carrier element and is spaced therefrom but is fixedly secured in a pre-determined position with respect to an enlarged portion
5 of the carrier element. The springs, which are equally spaced circumferentially around the periphery of the reduced portion, are biased into engagement with the inner surface of the positioning ring and also engage a sidewall of a reduced portion of the recess.

10 Brief Description of the Several Views of the Drawings

Fig. 1 schematically illustrates a fragmentary sectional view of a drawing and ironing machine into which the present invention can be incorporated;

Fig. 2 is an enlarged plan view of the cup holder
15 sleeve support with portions thereof broken away for purpose of clarity;

Fig. 3 is a fragmentary sectional view, as viewed along line 3-3 of Fig. 2;

Fig. 4 is a fragmentary sectional view, as
20 viewed along line 4-4 of Fig. 2;

Fig. 5 is an enlarged fragmentary sectional view similar to Fig. 3 showing the details of the redraw and ironing die assemblies;

Fig. 6 is an enlarged fragmentary sectional
25 view similar to Fig. 3 showing the details of the stripper assembly;

Fig. 7 is an enlarged fragmentary plan view, as viewed along line 7-7, showing part of the redraw assembly; and

30 Fig. 8 is an enlarged fragmentary sectional view similar to Fig. 3 showing the details of the domer assembly.

Detailed Description

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail preferred embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated.

10 Fig. 1 of the drawings schematically illustrates selected portions of a bodymaker 10 used for converting a cup 12 into a finished container 14. Bodymaker 10 includes a cup holder sleeve 20 which has an axial bore 22 therein through which a punch 24 is
15 adapted to be moved. Punch 24 is axially aligned with path P and is movable along a path P which has a plurality of die assemblies in a support 30. The first die assembly consists of a redraw ring assembly 26 and the other die assemblies are ironing ring assemblies 28.

20 Before the stroke of punch 24 and cup holder sleeve 20 is initiated, a cup 12 is generally aligned with redraw ring 26 through a cup locating mechanism (not shown) and cup holder sleeve 20 is then moved axially generally to the position illustrated in Fig. 1
25 to hold the cup 12 in a fixed position with respect to redraw ring 26. Punch 24 is then moved axially through bore 22 to force the cup initially through the redraw ring 26 wherein the cup diameter is decreased and the cup height is increased and subsequently through the
30 ironing rings 28 which cooperate with the peripheral surface of punch 24 to reduce the sidewall thickness of cup 12. After the cup has been passed through the respective rings, the lower end of the punch, which is generally dome shape in cross section, cooperates with

domer 34 to reform the bottom wall of the cup and produce a finished container. During the return stroke of punch 24, stripper assembly 32 engages the upper free edge of finished container 14 to strip the container from the
5 punch.

As was indicated above, one of the problems encountered in producing satisfactory containers utilizing a process described above, is to maintain accurate alignment of all of the various parts at all times. Any
10 misalignment of any of the elements by even as little as one ten-thousandths of an inch will result in having a finished container which has a sidewall of uneven thickness. One of the most critical initial areas in the above described process is to make sure that the cup is
15 accurately positioned with respect to the redraw ring and uniform hold-down pressure is applied to the cup before the drawing and ironing process is initiated.

For practical considerations, a clearance must be maintained between the periphery of punch 24 and the
20 inner surface of cup holder sleeve 20. Therefore, the punch cannot be utilized for aligning the cup holder sleeve with respect to the axis of the punch which is presumed to be aligned with the center of the opening in redraw ring 26. Therefore, in cases of jams, the large
25 unsymmetrical forces that are developed in the system may force the cup holder sleeve out of alignment with the axis of punch 24 and redraw ring 26. The result may be that the sleeve remains permanently misaligned after a jam and may become exaggerated during subsequent jams.

30 According to one aspect of the present invention, cup holder sleeve 20 is mounted for universal movement with respect to the path P to facilitate tilting and radial movement during a jam while still remaining aligned after a jam.

As most clearly illustrated in Fig. 3, cup holder sleeve 20 is supported in a cup holder sleeve support 40 which consists of first and second members 42 and 44 which have cooperating threads 46 to be assembled with respect to each other, for a purpose that will be described later. Support 40 has a substantial circular opening 48 therein which is aligned with the circular opening 50 that is defined in the redraw ring 26 and the centers of these openings are located along the path P of punch 24. Members 42 and 44 cooperate with each other to define a recess 52 extending from the periphery of opening 48 and recess 52 has a shoulder 54 which extends substantially radially from the axis of opening 48. A support element or cup holder sleeve support member 60 has a peripheral portion 62 which is received into recess 52 and also has a contiguous cooperating surface 64 which is in engagement with shoulder surface 54. Support element 60 also has a circular aperture 66, therein, which is generally of the same size as bore 22 in cup holder sleeve 20.

According to one aspect of the invention, cup holder support element 60 and cup holder sleeve 20 are normally centered with respect to opening 48 through centering means which will now be described. In the illustrated embodiment, the centering means consists of four circumferentially spaced biasing means 70 that are equally spaced from each other around the perimeter of the substantially circular support 40. The respective biasing means 70 are spaced approximately 90 degrees from each other and produce equal forces around the perimeter of support element 60 to maintain the support element in a centered position with respect to the circular support 40 more particularly opening 48. The respective biasing means 70 are identical in construction and only one will be described in connection with Figs. 2 and 3.

Each biasing means 70 consists of a spring 72 that has one end received into a cup 74 which has an annular shoulder 76 cooperating with an enlarged portion 78 of a radial opening in support 40. The opposite end
5 of spring 70 engages the inner surface of a support ring 80 which forms part of support 40. The springs 72 are selected so as to produce an equal force and cup 74 is designed so that the inner surface thereof is in engagement with the periphery of support element 60 as illustrated in Figs. 2 and 3.
10

The cups 74 are all accurately dimensioned so that when the shoulders 76 engage with support 40, the free ends of the cups are on a common circle which has a diameter that is equal to the peripheral diameter of the
15 support element 60. However, if external forces are applied to cup holder sleeve 20 which may result from a misfed cup or a defective cup, the springs will accommodate radial movement to prevent permanent misalignment between opening 48 and redraw ring 26. When the external
20 forces are removed the springs which were compressed will return the sleeve to a centered position. The centering means or biasing spring 70 will, therefore, always accurately position support element 60 in a centered position with respect to opening 48 which is accurately centered
25 with opening 50.

According to a further aspect of the invention, the axis of bore 22 of cup holder sleeve 20 can also be tilted with respect to the path P if there is a misfed cup to apply a uniform hold-down pressure at all times.
30 For this purpose, support element 60 has an arcuate or spherical surface segment 90 on the lower surface thereof surrounding aperture 66 and the concave surface segment 90 cooperates with a convex surface segment 92 defined on an enlarged portion 100 on the upper end of cupper
35 sleeve 20. The cooperating surface segments 90 and 92

will accommodate movement of the lower free end of cup holder sleeve 20 to allow the cup holder sleeve to assume an angular position wherein the axis of bore 22 is axially aligned with the axis of punch 24. The
5 centers of spherical surface segments 90 and 92 are located at a point 95 which is located on path P.

Flat surfaces 54 and 64 and spherical surfaces 90 and 92 are normally held in engagement with each other through biasing means that cooperate with support
10 40 and cupper sleeve 20, as well as support element 60. For this purpose, enlarged portion 100 of cup holder sleeve 20 is received into recess 52 and spring biased tabs 102 are received in recesses 103 and cooperate with
15 the lower surface of enlarged portion 100 for biasing the various surfaces into engagement with each other. More specifically, each tab (there being four equally spaced around the perimeter of support 40) has a cup 104 secured thereto as by welding and a hold-down spring 106
20 is telescoped into the cup. Cup 104 is received in an opening 108 in member 42 and one end of the spring engages the surface on member 44 which forms part of support 40.

The base of each recess 103 in member 42 defines an accurate space between the tab and surface 54
25 and such spacing will be maintained even when the spring forces for the respective springs are different.

Thus, each tab 102 is biased into the position illustrated in Fig. 3 wherein the axis of aperture 66 and the axis of bore 22 are aligned with the axes of
30 openings 48 and 50. However, should there be a need for having the cup holder sleeve 20 tilted with respect to the path P of punch 24, the tabs will allow a certain amount of tilting movement of the sleeve 20 with respect to support element 60.

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According to a further aspect of the invention, the various surfaces which are moved relative to each other are continuously lubricated through lubricating means which will now be described. The lubricating means is most clearly illustrated in Fig. 4 and consists of an opening 110 in member 42 which has a threaded exterior portion 111 to which a source of pressurized lubricant may be connected. The inner end of opening or bore 110 is in communication with a continuous circumferential recess 112 that is defined in shoulder surface 54 of member 42. The recess 112 extends around the entire perimeter of surface 54 and is also in communication with a second continuous recess 120 in surface 90 through one or more small openings 122. Therefore, a continuous flow of fluid from a source (not shown) through opening 110 will provide a constant supply of lubricant between the relatively movable surfaces of the cup holder sleeve assembly. This arrangement substantially reduces the frictional forces that must be overcome when the various elements have to be moved with respect to each other. Of course, the continuous supply of lubricant to these relatively movable surfaces will also substantially reduce the wear of the overall assembly.

According to another aspect of the present invention, redraw die assembly 26 is mounted on support 30 in a manner that allows radial movement of the assembly with respect to the normal path of movement P of punch 24 to allow the assembly to be moved to a centered position with respect to the axis A of punch 24, should the punch be offset from the path P.

As illustrated in Fig. 5, redraw die assembly 26 includes a support 230 which supports a redraw ring

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232 that has a circular opening 234. Support 230 has a lower flat surface 236 which extends perpendicular to path P and is in extended engagement with a flat surface 238 that is defined in frame structure 225. The periphery of support 230 is preferably circular, and centering means 240 cooperate with the periphery of support 230 to normally maintain support 230 and ring 232 centered with respect to path P. The centering means 240 consists of an annular ring 242 which is held in a fixed position on frame 225 and has a plurality of circumferentially spaced spring assemblies 244 associated therewith. Preferably, at least four such spring assemblies 244 are circumferentially equally spaced around the perimeter of support 230 and each spring assembly 244 includes a plunger 246 reciprocated in an opening 247 extending into the inner surface of ring 242. Plunger 246 has an enlarged flange 248 located in a cup 250 with a spring 252 also located in cup 250 which biases plunger 246 into engagement with the periphery of support 230. Normally, all plungers 246 are biased to a position illustrated in Fig. 5 wherein the flange 248 of each plunger 246 is in engagement with a surface of ring 242 around opening 247. This arrangement defines an extremely accurate centered position of the opening 234 with respect to path P. However, should there be any misalignment between the axis of the punch and path P, one or more of the springs 252 will be compressed and support 230 moves radially of path P to allow the axis of opening 234 to be aligned with the axis of the punch. During such radial movement, only a selected number, less than all, of the springs 252 are compressed, while the remaining springs located on the side opposite the direction of movement of support 230 will remain in their prestressed condition illustrated in

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Fig. 5. This arrangement insures that there is no resistance to having the die ring moved to a centered position with respect to path P after a cup has been forced through redraw ring 232 by punch 24. This
5 arrangement also eliminates the possibility of having the redraw assembly off-center with respect to path P because of varying forces applied by the respective springs.

According to another aspect of the invention,
10 a fluid bearing is interposed between cooperating surfaces 236 and 238 to reduce the friction forces that must be overcome to allow radial movement of support 230 with respect to path P. For this purpose, support surface 236 has one or more annular recesses 260 defined
15 therein and recesses 260 are in communication with a bore 262 which is defined in frame 225. A supply of pressurized fluid, such as air, is connected to the inlet end of bore 262 and is delivered to the respective annular recesses 260. Since the only exit from recesses
20 260 is along the surfaces 236 and 238, the fluid will act as a bearing surface to tend to separate these surfaces when external forces are applied to the redraw die assembly which will assist in allowing the opening 234 to move to a predetermined centered position with
25 respect to punch 24.

According to a further aspect of the invention, the redraw die assembly also includes a centered mechanism for centering the cup 12 with respect to redraw ring 232 prior to having the punch enter the
30 cup. This centering mechanism consists of a resting ring 266 that has an opening 268 which is larger than opening 234. Nesting ring 266 is held in a fixed position with respect to redraw ring 232 through a support ring 270 which is held in a fixed position with respect
35 to support 230 by screws 272 and thus forms a part of

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support 230. The diameter of opening 268 is substantially equal to the peripheral diameter of cup 12 as it is received by the redraw die assembly and is larger than the diameter of opening 234 so that a portion of the surface of ring 232 is exposed.

Thus, as the cup holder sleeve enters cup 12 and moves towards redraw die assembly 26, the nesting ring 266 aids in centering the center of the cup with respect to the center of redraw ring 232 before punch 14 enters sleeve 20. This movement is in part assured by the fact that the lower peripheral end of cup 12 normally has a radiused portion 274 and the radiused portion will aid in guiding the periphery of cup 12 into opening 268 of centering ring 266. Of course, if there is axial misalignment between the center of openings 268 and 234 with respect to the center or axis of cup 12, biasing means 240 will allow the entire redraw die assembly to move radially with respect to path P. The diameter of bore 22 in sleeve 20 is slightly larger than the diameter of punch 14 so that redraw die assembly 26 and sleeve 20 with cup 12 clamped between them can move radially and the center of opening 234 will align with the axis of punch 14.

According to a further aspect of the invention, the nesting ring 266 also incorporates means for supplying lubricant between the exposed surface of redraw ring 232, which initially supports the cup and the adjacent surface of cup 12. As most clearly illustrated in Fig. 7, the lower surface of support ring 270 has an annular recess 280 defined therein and recess 280 is closed by a surface of support 230 to produce a channel. The channel is in communication with the periphery of support 230 through openings 282. A pressurized lubricant is supplied to openings 282 through an

opening 284 in frame 225. Annular recess or channel 280 is in communication with opening 268 through a plurality of non-radial recesses 288 in one surface of nesting ring 266 and recesses 288 are circumferentially spaced around the perimeter of opening 268. The recesses are closed by adjacent surfaces of support 230 and redraw ring 232 to produce flow paths. As illustrated in Fig. 7, all of the recesses or flow paths are generally linear and the axes of the flow paths are radially offset from the center of opening 268 in nesting ring 266. This arrangement insures that there is non-radial flow of the fluid from channel 280 through flow paths 288 into opening 268. Also, the radiused peripheral lower edge 274 of cup 12 (Fig. 5) will cooperate with the upper exposed surface of redraw ring 232 and the annular inner surface of opening 268 to produce a small channel for lubricant flow around the perimeter of the cup to all areas of the exposed surface of redraw ring 232.

Thus, the lubricant that is received into annular recess 280 flows through the respective recesses 288 into the channel created by the radius portion 274 and results in a circumferential flow of the lubricant within the channel during the redraw operation. Stated another way, the non-radial recesses or slots 288 distribute the lubricant, which also acts as a coolant, in a vortex pattern across the redraw die surface during the redraw operation. The lubricant also cleans and cools the redraw die surface after the cup has been redrawn.

Each of the ironing assemblies 28 is generally identical in construction and again provides a floating arrangement for the ironing ring to accommodate radial movement of the ironing ring with respect to the path P and thereby insure more uniform wall thickness of the

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finished container. The details of one ironing assembly are illustrated in Fig. 5 and include an ironing die 300 that has a land 302 which cooperates with the peripheral surface of the punch 24 to reduce the sidewall thickness of a cup as it passes through the ironing die 300.

Ironing die 300 is supported in a circular support 304 which has a recess 306 for receiving and supporting die 300. In the illustrated embodiment, the ironing die assembly also has a locator die 310 supported on a circular plate 312 which acts as a guide for the cup as it leaves the ironing die 300. Support 302 and plate 312 have a peripheral band 314 engaging the peripheral surfaces thereof so that the ironing die and locator die 300 and 310 move as a unit when external forces are applied thereto.

The lower surface 320 of support 312 is in sliding contact with a radial surface 322 defined on a support structure 324 for the ironing die. Likewise, the upper surface 326 of upper ironing die support 302 is in sliding contact with a radial surface 328 that is also part of the support 324. The entire ironing die assembly 28 is again maintained in a predetermined position by a plurality of centering means 330 that are circumferentially spaced around the peripheral surface of ring or band 314 and are carried by support 324.

Each centering means or spring assembly includes a cup 332 that has a base thereof in juxtaposed relation to the peripheral surface of band 314 and has a radially extending flange 334 at the opposite open end thereof.

A spring 336 is telescoped into the cup and the outer end thereof engages a cover portion 338 that is removably secured to support 324 through suitable retaining means 340.

Again, preferably there are four such spring assemblies 330 equally spaced at 90 degrees around the

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perimeter of band 314 and are dimensioned such that when flanges 334 engage adjacent shoulders defined on the support 324 the ironing land 304 is accurately centered with respect to the path of punch 24. However, if the
5 center of the opening defined by land 304 is slightly offset with respect to the axis of the punch 24, at least some, but not all, of the spring assemblies will be compressed and allow radial movement of the entire die assembly 28 to center the land opening with respect to
10 the punch and insure a uniform wall thickness for the finished container.

Again, in order to reduce friction and accommodate this radial movement, a fluid bearing is interposed between surfaces 320 and 322 and consists of annular
15 recesses 346 that are in communication with an air supply through one or more openings 348.

While only one such die assembly has been disclosed, it will be appreciated that in most instances more than one ironing die assembly will be used so that
20 a sidewall of a cup will be reduced in thickness in stages to increase the overall efficiency of the system.

According to a further aspect of the present invention, stripper assembly 32 is also designed to accommodate radial movement of the assembly with respect
25 to path P during a drawing and ironing operation. The stripper assembly 32 is illustrated in greater detail in Fig. 6 and includes a stripper support element 410 that has an enlarged portion 412 received into a recess 414 defined in support 425. A plurality of pivoted jaws 416
30 are located around the perimeter of path P and the lower edges of jaws 416 cooperate to define an opening 418 through which the finished container and punch 24 pass during the last part of the stroke of a drawing and ironing process. The respective jaws or segments 416

are held in a predetermined position through a resilient support member 422 and support ring 423 as well as an elastomeric member 424 as illustrated in Fig. 6. The jaws are biased to a position wherein the opening 418 is slightly smaller than the peripheral diameter of the finished container which passes therethrough. Thus, as the container and punch pass through opening 418, the lower edges of pivoted jaws 416 are moved outwardly slightly to accommodate the movement of the container therethrough. However, after the upper free edge of the container moves beyond the lower edge of the pivoted jaws 416, the jaws will move inwardly into the path of return movement of the upper free end of the container.

Stripper assembly 32 is again held in a centered position with respect to path P through biasing means 430 which can be identical to the biasing or centering means 240 described above. Thus, should for any reason, the axis of punch 24 with the finished container on it be offset somewhat from path P during the downward movement of the punch and container, the biasing means 430 will again accommodate radial movement of the entire stripper assembly with respect to path P to insure that there is no substantial interference between the container and the stripper jaws. Again, support 410 and frame 425 have flat radially extending cooperating surfaces that accommodate such radial movement. This arrangement insures that all of the jaws are located in the same position with respect to the periphery of the punch. This insures that the jaws which engage the free edge will engage across the entire width of the edge for more reliable stripping and less damage to the free edge.

As illustrated in Fig. 6, the lower surface of enlarged portion 412 has a flat annular surface 432

which is supported on an annular flat surface 434 that is defined on frame structure 425. Frame structure 425 also has an upper annular surface 436 which cooperates with flat upper surface 438 of support member 410.

5 It has been found that the use of the floating redraw ring and stripper in combination with the plurality of floating ironing assemblies and the floating redraw assembly substantially increases the productivity of a bodymaker of this type and produces containers that
10 have a better finished appearance and have a uniform wall thickness throughout the entire diameter of each container as well as throughout the length thereof.

 As was indicated above, one of the problems in producing satisfactory containers utilizing a process
15 such as that described above, is to maintain extremely accurate alignment between the axis of punch 14 and the center or axis of domer assembly 34. Any misalignment of these two elements with respect to each other by even a small increment will result in a defect in the end wall
20 of the container which in turn will impair the strength of the container.

 According to the present invention, the domer assembly 34 is constructed in such a fashion that the domer element which forms part of the assembly can -
25 readily be moved in any direction radially of the axis or path P to move into a position in exact alignment with the center of punch 24 should the punch be offset from the path for any reason. For this purpose, domer assembly 34 (Fig. 8) consists of a support 530 which
30 may be accurately positioned with respect to the remainder of the frame structure of the bodymaker 10 and is supported on a cushion such as air, for axial movement (not shown). Support 530 has a recess or opening 532

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extending from the upper surface 534 and recess 532 has an enlarged portion 536 and a reduced portion 538 with a generally flat bottom wall or surface 540 defined in the reduced portion 538. The center of circular opening 532 is accurately positioned and centered with respect to path P.

Domer assembly 34 also includes a support element or member 542 which has an enlarged portion 544 received into enlarged portion 536 of recess 532 and a reduced portion 546 with reduced portion 546 having a bottom surface 548 which is in extended engagement with bottom wall or surface 540 for recess 532. Recess 532 and carrier element 542 are both circular in cross section and carrier element 542 is smaller in dimension than the recess 532, as will be described later.

The remainder of domer assembly 34 consists of a domer element or tool 550 which is supported in an opening 552 in carrier element 542 and is secured thereto by a bolt 554. The threaded bolt or stud 554 extends through an opening 556 in carrier element 552 and is threaded into an opening in the domer element 550 so that the carrier element 542 and domer element 550 move as a unit in a radial direction with respect to path P.

The domer assembly also includes biasing means 560 between support 530 and carrier element 542. Biasing means 560 consists of four or more circumferentially equally spaced spring assemblies that each consist of a spring 562 having one end received into a cup 564 which is reciprocated in a bore 566 in carrier element 542 and the opposite end received into a reduced portion of bore 566. The inner end of each cup 564 is received into the enlarged portion of bore 566 and is biased into engagement with the sidewall of the reduced portion 538 of recess 532. Thus, the four or

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more spring assemblies will always maintain the domer assembly, particularly domer element 550, in a predetermined position with respect to the axis or path P. However, should the axis of punch 24 be slightly offset
5 from the path P, the various spring assemblies will allow carrier element 542 and domer element 550 to move radially with respect to the punch and to accurately align itself with the axis of the punch to produce a satisfactory finished container having a reformed end wall of any
10 particular configuration.

According to another aspect of the invention, domer assembly 526 also includes prestressing means cooperating with the respective spring assemblies for insuring that the domer element 550 is always moved to
15 a same exact centered position with respect to path P when the external forces are removed. For this purpose, a circular or annular ring 570 extends around and is spaced from the periphery of the reduced portion 546 of support carrier 542 and cooperates with the respective
20 spring assemblies to maintain all of the springs in a certain prestressed condition at all times. Ring 570 is accurately positioned with respect to carrier element 542 by a cooperating offset portion 572 and a recess 574 respectively defined on the ring 570 and carrier
25 element 542. Ring 570 is releasably secured to carrier element 542 through a plurality of threaded studs 576.

With this arrangement, the various springs 562 and cups 564 can be positioned into openings 566 and ring 570 can then be telescoped to the position illustrated in Fig. 8 and secured to carrier element 542
30 through bolts or studs 572. The outer free edge of each of the cups, which is generally spherically shaped, thus cooperates partially with the inner surface of ring 570 to maintain all of the springs in a prestressed

condition, regardless of variations in spring force. If there is a need for the carrier element to move radially with respect to path P, only a certain number of spring assemblies, less than all, are further compressed, while
5 the remainder of the spring assemblies remain in the same prestressed condition. Thus, when an external force is removed, after the carrier assembly has been moved off its normally centered position, there is no interference by certain springs preventing the carrier
10 element 542 and domer 550 from moving to the predetermined centered position.

According to a further aspect of the invention, domer assembly 526 also includes fluid means for supplying a bearing fluid between surfaces 540 and 548 of
15 carrier element 542 and support 530. This fluid supply consists of a bore 580 extending through support 530 and in communication at its inner end with an annular recess or opening 582 that extends from surface 540. A pressurized fluid supply, such as air, is attached to the
20 outer end of bore 580 and supplies a constant flow of air to annular recess 582 which must then flow between bearing surfaces 540 and 548 which results in a fluid bearing between the surfaces. Such arrangement reduces the frictional forces encountered when carrier element
25 542 is attempted to be moved radially of path P.

The carrier element 542 is releasably retained in recess 532 by a cap 590 secured to support 530 by screws 592.

It should also be noted that while not
30 specifically shown, lubricating means could also be provided between surfaces 432, 434, 436, and 438 of stripper assembly 32, if desired.

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In summary, having all the components, except the punch, that come into contact with the cup during the drawing and ironing process movable radially will result in a finished container having a more uniform
5 wall thickness and will minimize tool damage in case of jams.

1. In a drawing and ironing machine including a frame (30) having a redraw die assembly (26), at least one ironing assembly (28), and a stripper assembly (32) arranged in series and each having an opening to define
5 a path with a punch (24) movable along said path through said openings, at least one of said assemblies including a ring (230, 300, 412) defining said opening and centering means between said frame and said ring, characterized
10 by said centering means including a plurality of circumferentially spaced biasing means (230, 240, 330) producing radial forces on said ring at circumferentially spaced locations, each of said biasing means having a first position when said ring is in a centered position,
15 at least some and less than all of said biasing means moving from said first position to accommodate radial movement of said ring with respect to said path.

2. A drawing and ironing machine as defined in claim 1, in which said ring is an ironing ring (300) carried by a support (304, 312).

20 3. A drawing and ironing machine as defined in claim 1, in which said ring is a stripper ring (412) carried by a support (410) and having a plurality of stripping jaws (416) pivoted thereon.

25 4. A drawing and ironing machine as defined in claim 1, in which said ring is a redraw ring (230) carried by a support (410).

5. A drawing and ironing machine as defined in any one of claims 2-4, in which said support and said frame have cooperating surfaces (236, 238, 326,
30 328, 436, 438) extending radially of said path further

characterized by means (260, 346, 348) for introducing a fluid between at least one pair of cooperating surfaces.

6. A drawing and ironing machine as defined
5 in any one of claims 1-5, and including a domer assembly spaced from said stripper assembly, further characterized by said domer assembly including a support (530) having a recess (532) with the base of the recess defining a support surface (540), a carrier element (542) received
10 in said recess and having a cooperating surface (548), a domer element (550) on said carrier element, means (580, 582) for supplying a bearing fluid between said surfaces, and biasing means (560) between said support and carrier element normally maintaining said surfaces in a pre-
15 determined position with respect to each other and accommodating movement of said carrier element in all directions within said recess.

7. A drawing and ironing machine as defined
in any one of claims 1-6 and including a cup holder
20 sleeve (20) interposed between said punch and said redraw die assembly and having an axial bore (22) for receiving said punch and a sleeve support for said cup holder sleeve, characterized by said sleeve support including a first member (60) having an opening (40)
25 therein aligned with said opening in said redraw assembly and having a circumferential recess (52) extending from the periphery thereof, a movable support element (60) having a peripheral portion (62) received in said recess and cooperating with one end of said
30 cup holder sleeve, and biasing means (70) between said first member and said support element normally maintaining said support element centered with respect to

said opening in said first member and accommodating radial movement of said one end of said cup holder sleeve and said support element with respect to said first member.

5 8. A drawing and ironing machine as defined in claim 7, further characterized by additional means (90, 92, 102-108) between said support element and said cup holder sleeve accommodating tilting of said axis of said bore with respect to said path.

10 9. A drawing and ironing assembly as defined in claim 8, further characterized by said additional means including confronting arcuate surfaces (90, 92) between said support element and said cup holder sleeve with at least one of said surfaces having a continuous
15 recess (120) therein and lubricating means (110, 112, 122) for supplying lubricant to said recess.

 10. A drawing and ironing machine as defined in any one of claims 1-9, characterized by said biasing means (230, 240, 330) including four circumferentially
20 spaced spring assemblies each including a plunger having a shoulder with a spring normally biasing said shoulder into engagement with a stop defining said centered position.

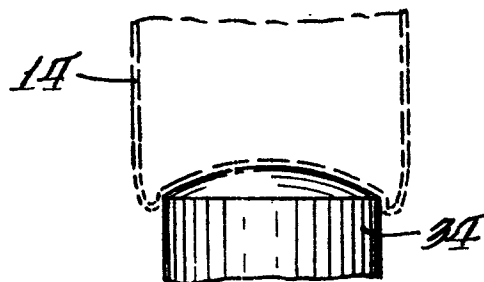
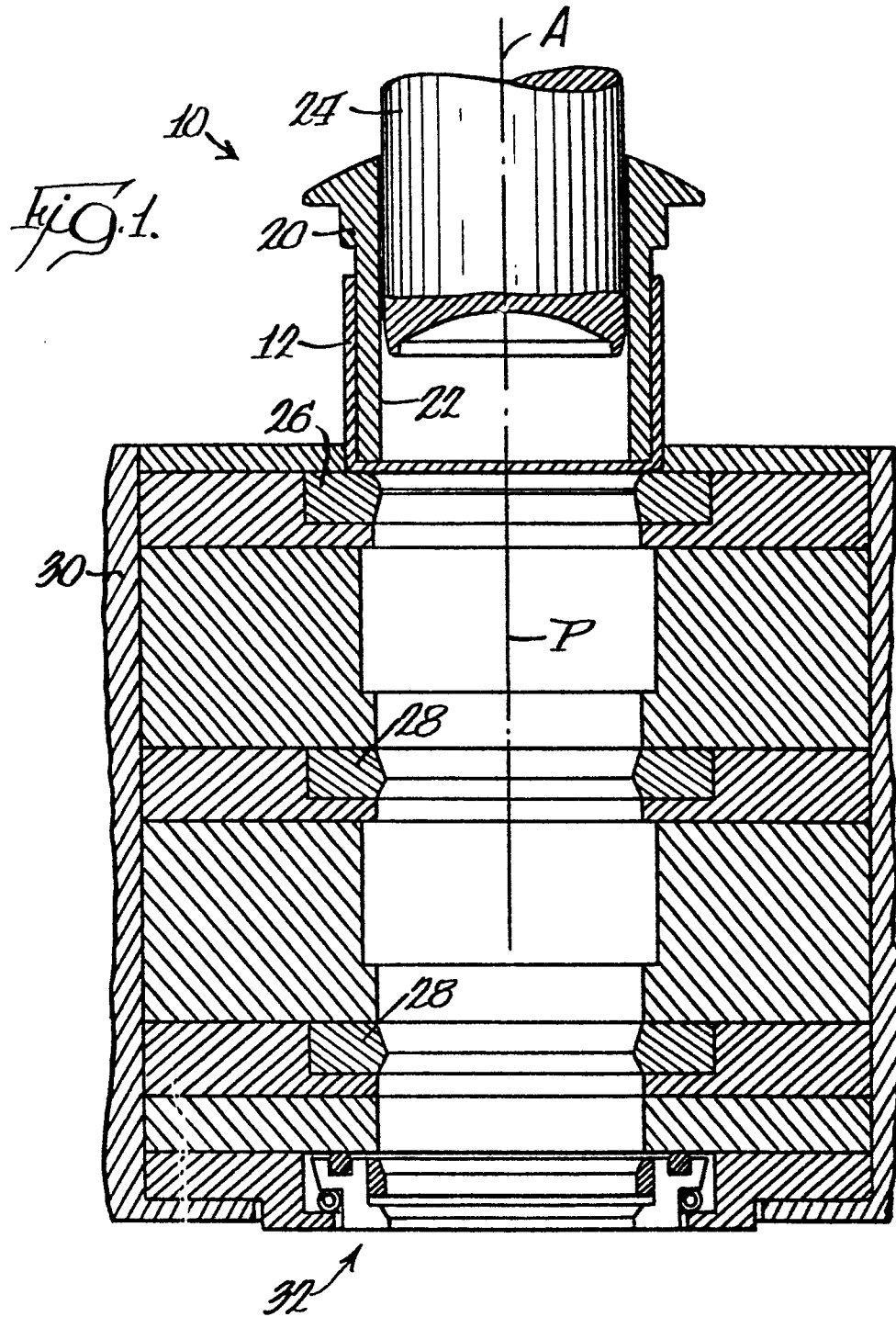
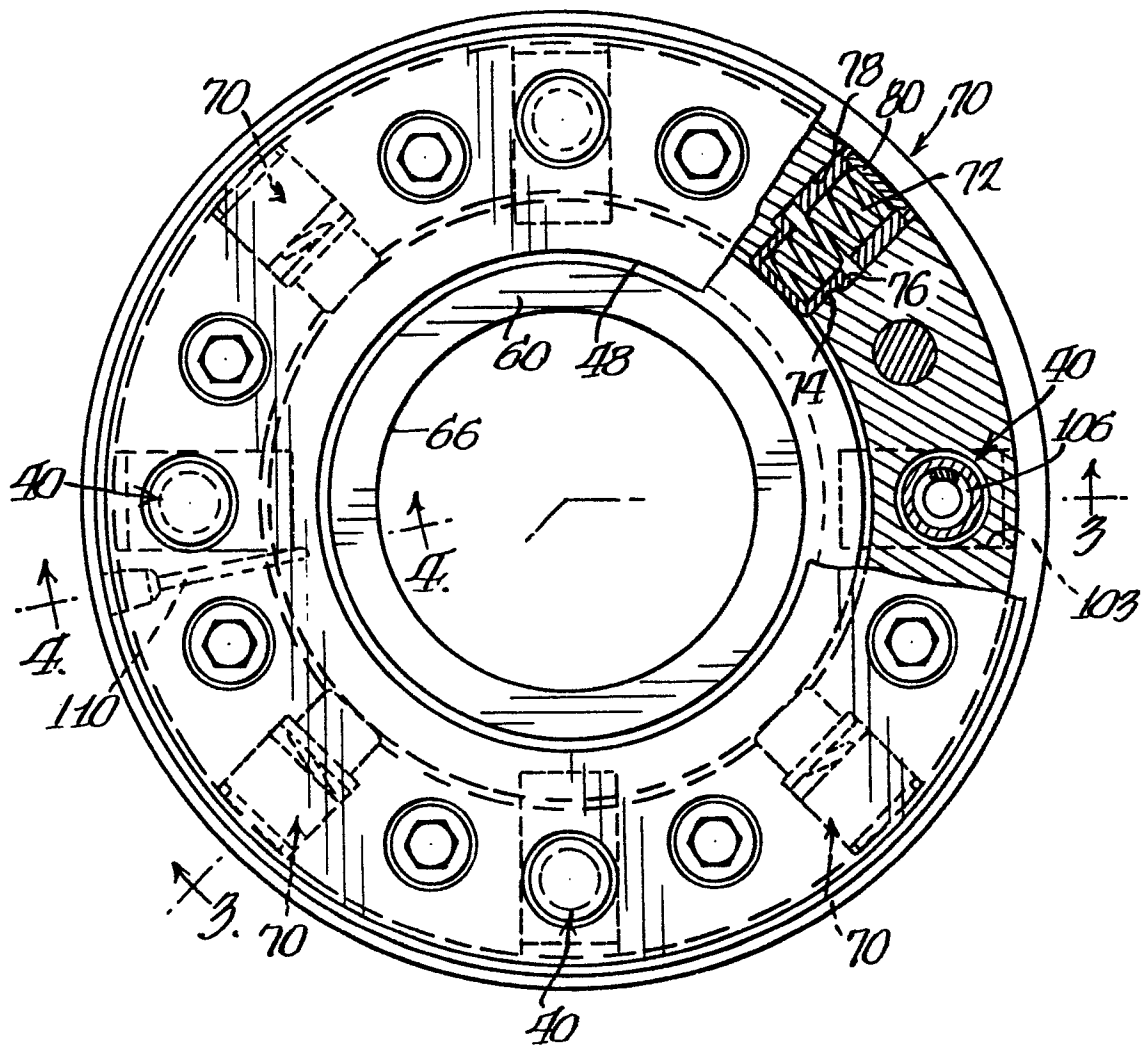
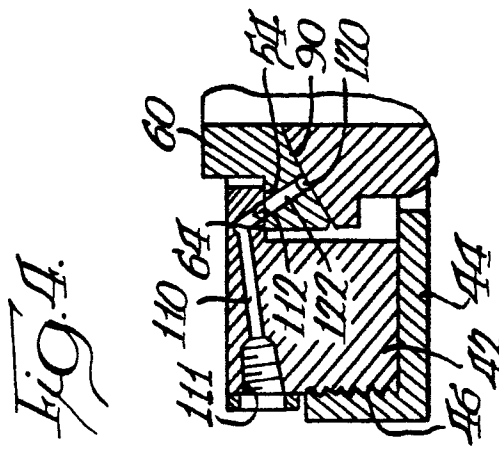
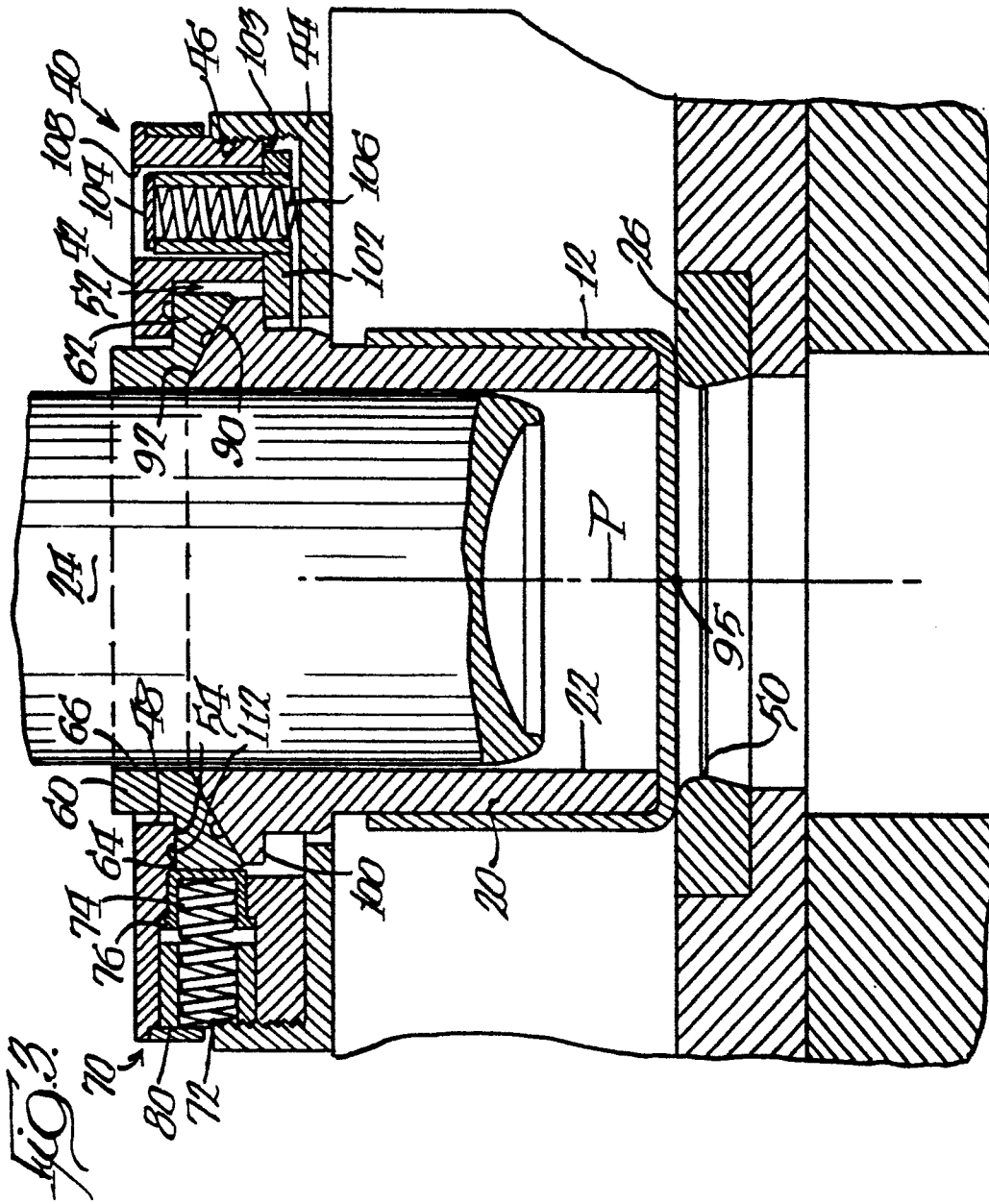


Fig. 2.



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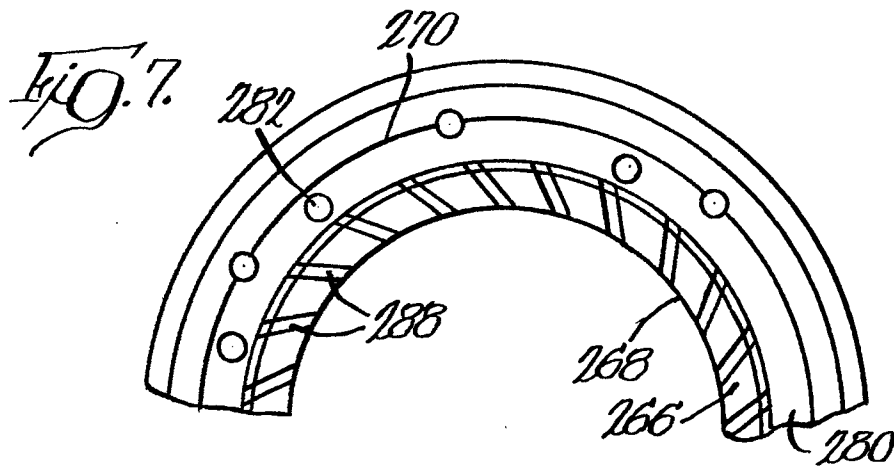
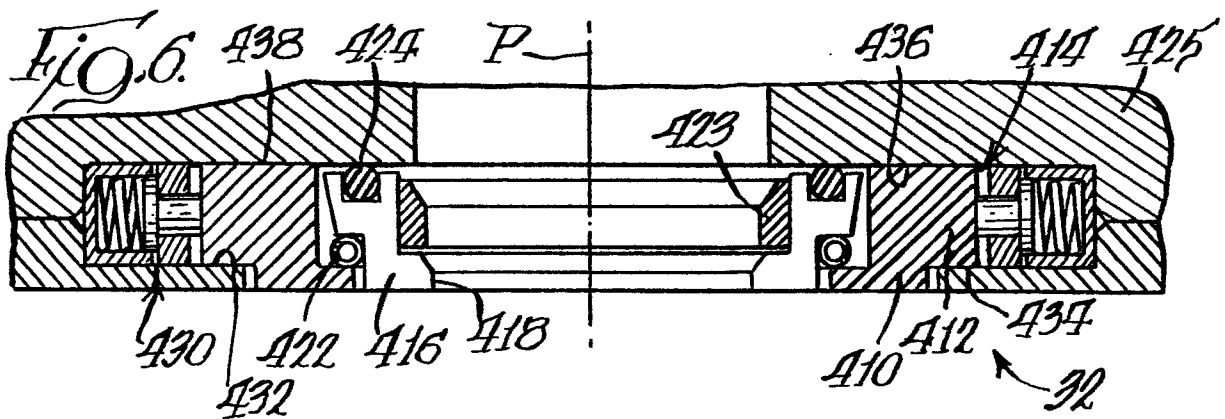
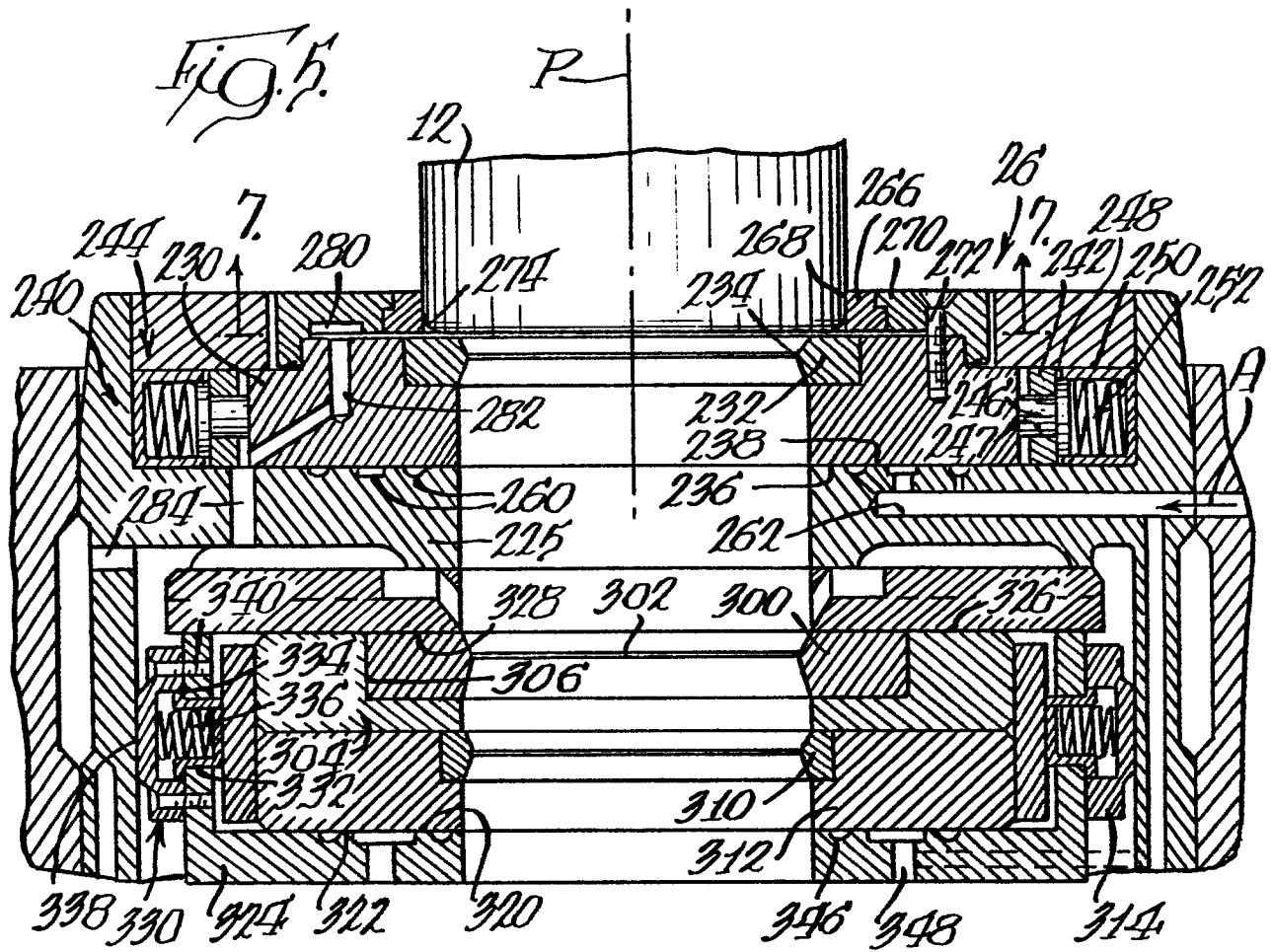
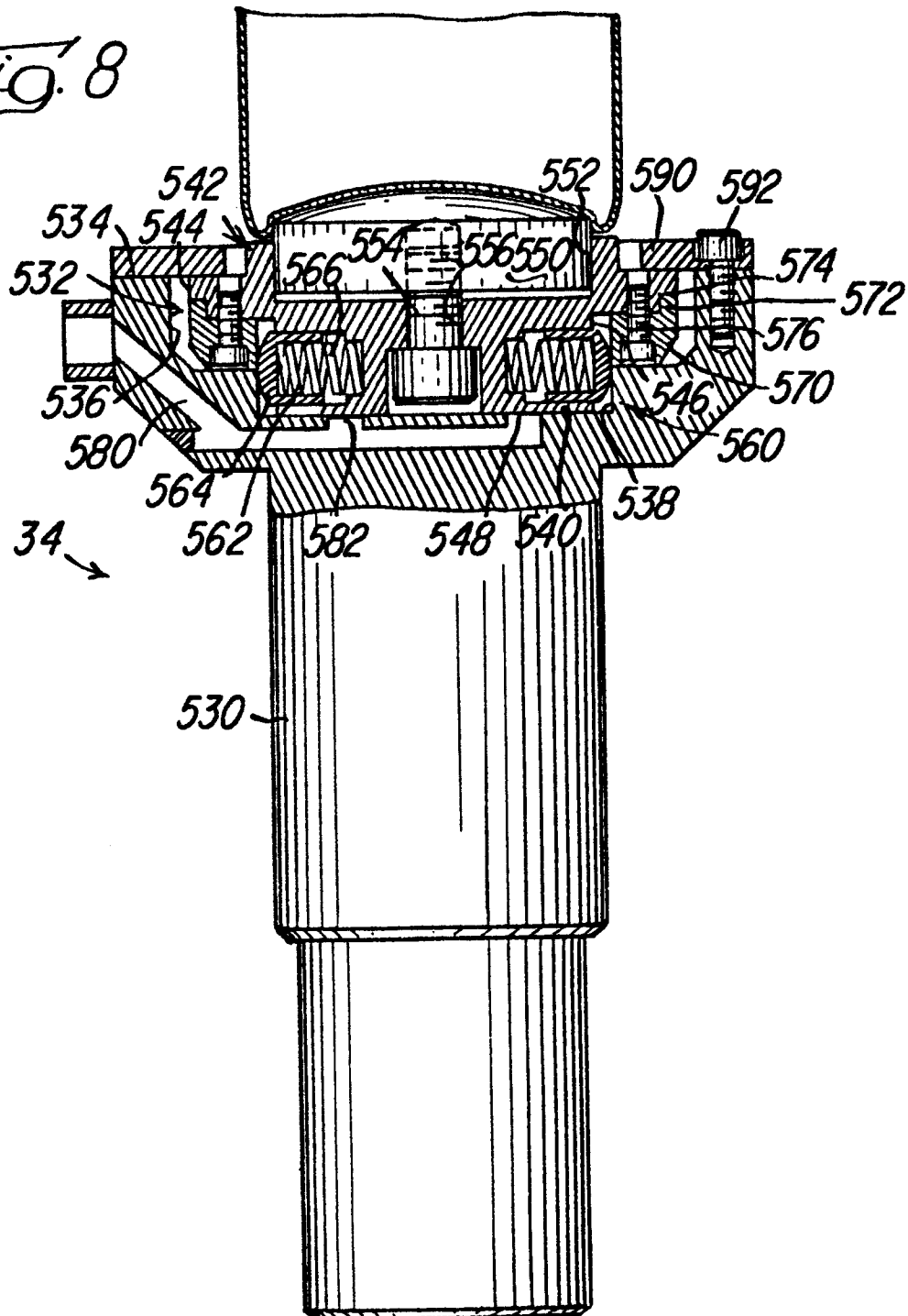


Fig. 8





European Patent
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EUROPEAN SEARCH REPORT

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Application number

EP 79 300 714.7

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
P,X	<u>DE - A - 2 818 379</u> (CARMET) * claim 1; fig. 1 *	1,2	B 21 D 22/28 B 21 D 37/08
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	<u>DE - A - 2 357 802</u> (GRIGORENKO) * page 17, lines 9 to 12; fig. 14 *	1	
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	<u>DE - C - 108 088</u> (BRENNER) * claim 1 *	1	
	--		
A	<u>DE - A - 2 049 686</u> (THE DUNLOP CO.) * whole document *		B 21 D 22/00 B 21 D 24/00 B 21 D 37/00
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A	<u>DE - A - 1 652 629</u> (KAISER ALUMINIUM & CHEMICAL CORP.) * whole document *		
	--		
A	<u>US - A - 2 528 577</u> (CATLIN et al.) * whole document *		

☒ The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.)
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family. corresponding document
Place of search Berlin		Date of completion of the search 25-07-1979	Examiner SCHLAITZ