United States Patent [19]

Paramonoff

[11] **3,771,345**

[45] **Nov. 13, 1973**

[54] **END FORMING STATION FOR METALLIC CAN BODY FORMERS AND THE LIKE**

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[52] **U.S. Cl.** **72/349**

[51] **Int. Cl.** **B21d 22/28**

[58] **Field of Search** 72/1, 28, 348, 349, 72/465; 100/53; 267/119, 130; 83/58, 62

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Primary Examiner—Richard J. Herbst
Attorney—Thomas P. Mahoney et al.

[57] **ABSTRACT**

A doming station for a can body former of the type having a reciprocal ram carrying a metallic can body to and from the doming station for reforming the can body end has a doming die urged to a forward working position by compressible means such that under malfunctioning in which more than one can body is on the can end, the added force will permit the doming die to move rearwardly avoiding damage thereto. An edge forming die ring may be separately similarly mounted telescoping the doming die. A movable frame portion mounts the doming die and is pivotal to and from extending transversely across the ram path of movement. A securing part thereof is movable rectilinearly transversely into a final working position when pivoted into transverse position. In final working position, pressure screws are tightened to exert axial pressure between the movable frame and stationary frame portions to rigidify in the final working position.

8 Claims, 11 Drawing Figures

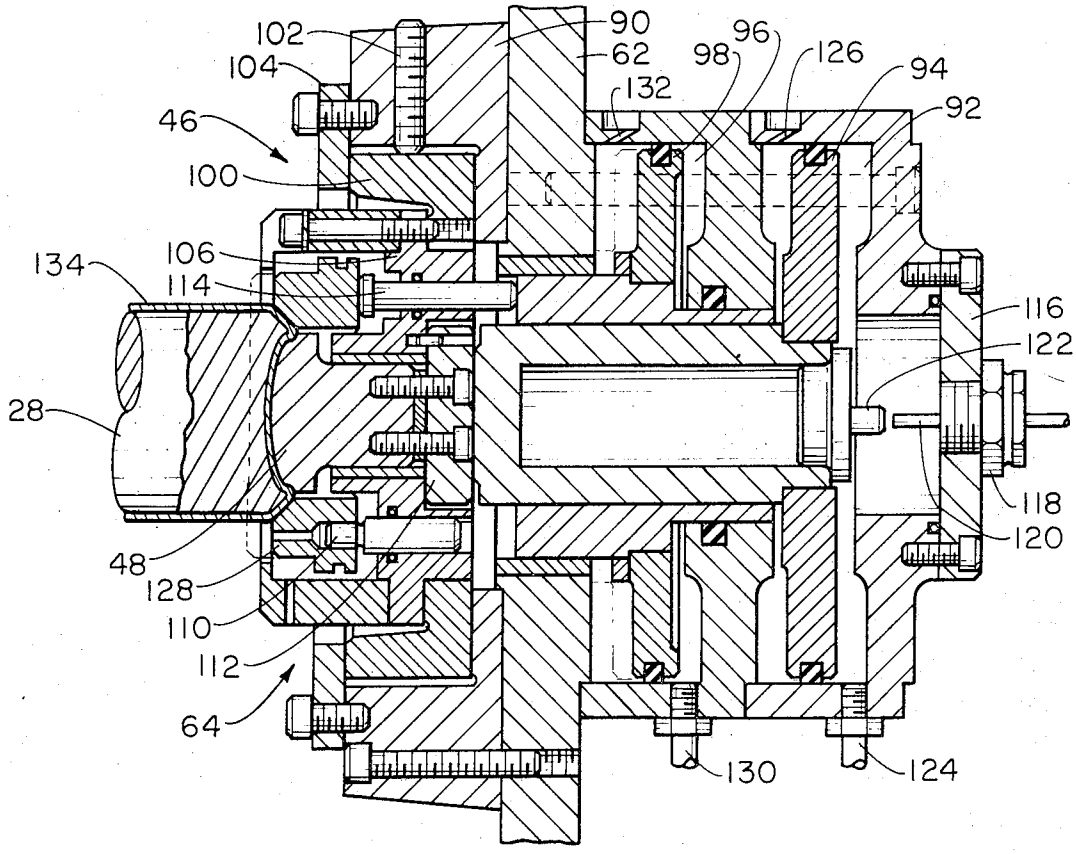


Fig. 1.

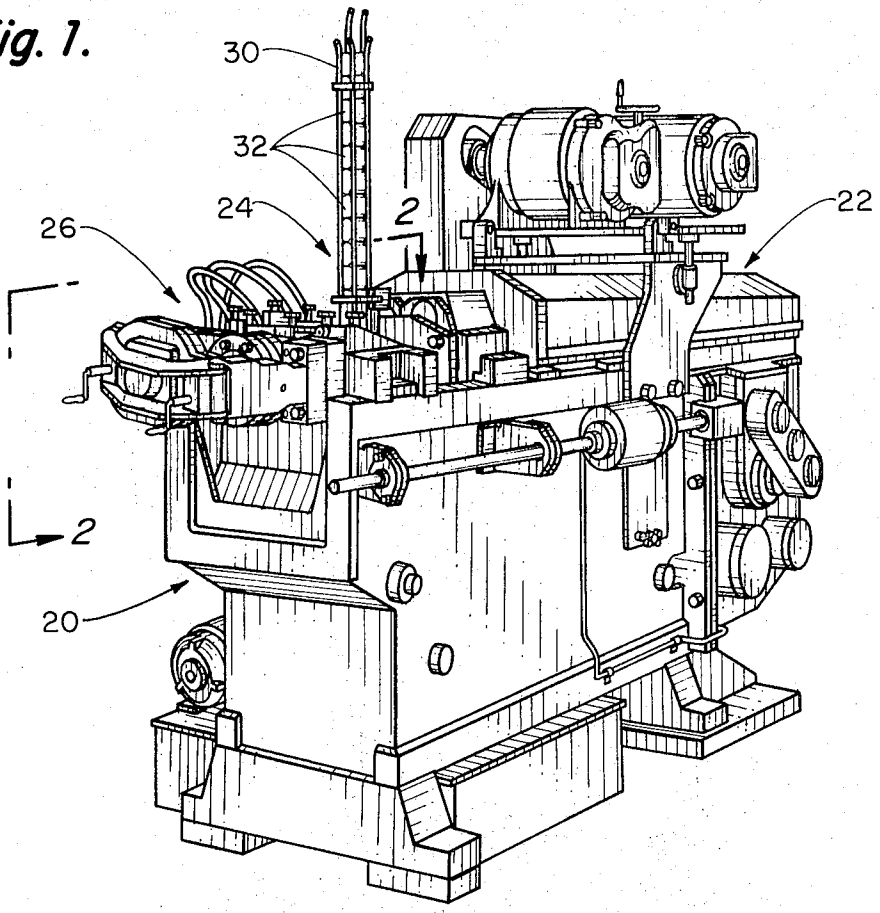


Fig. 2.

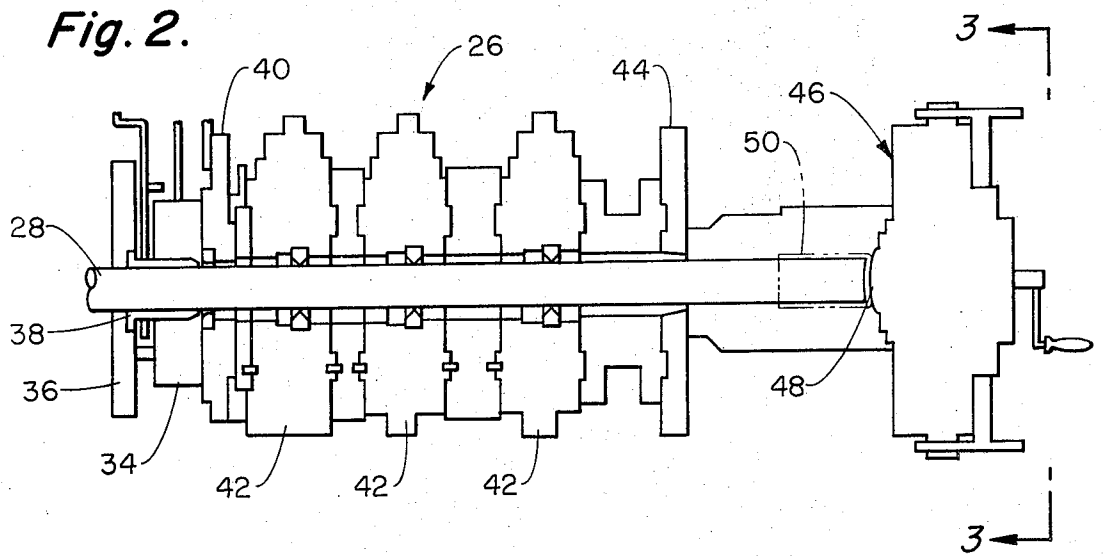


Fig. 3.

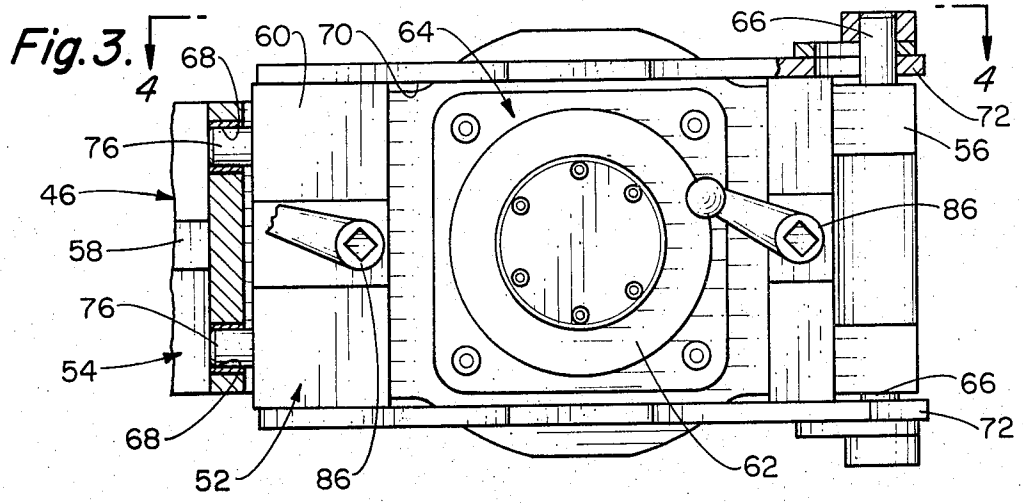


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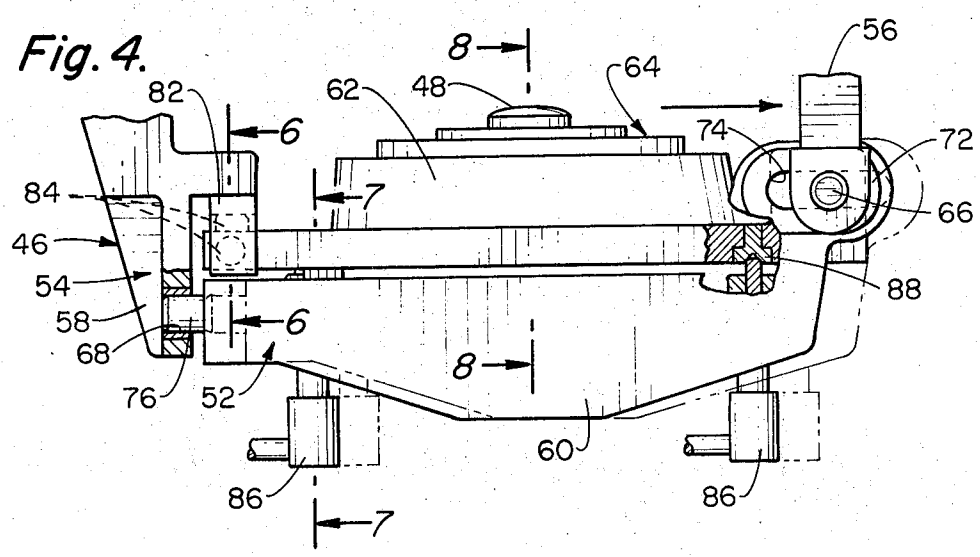


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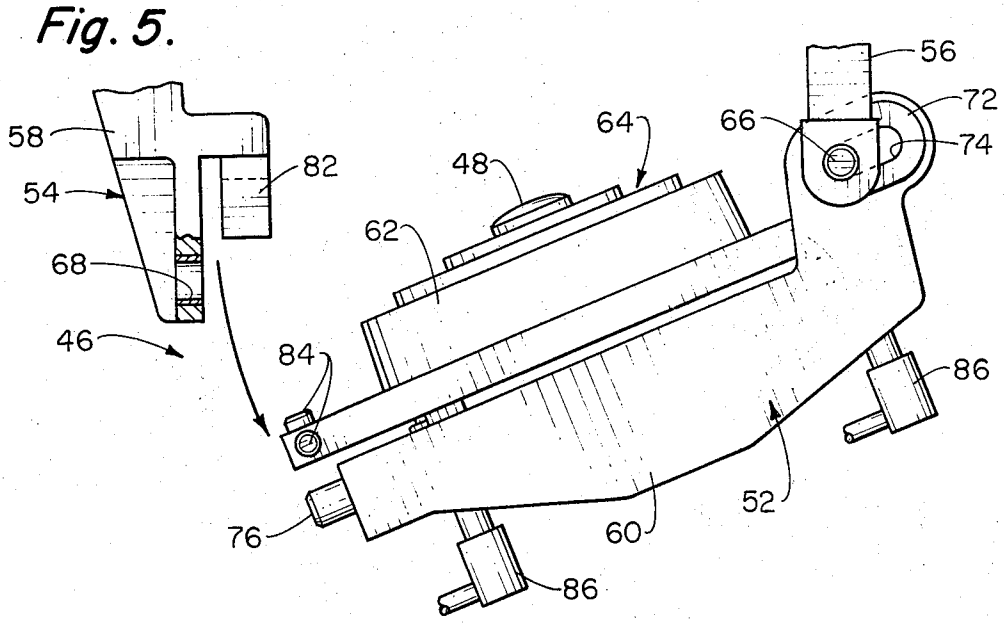


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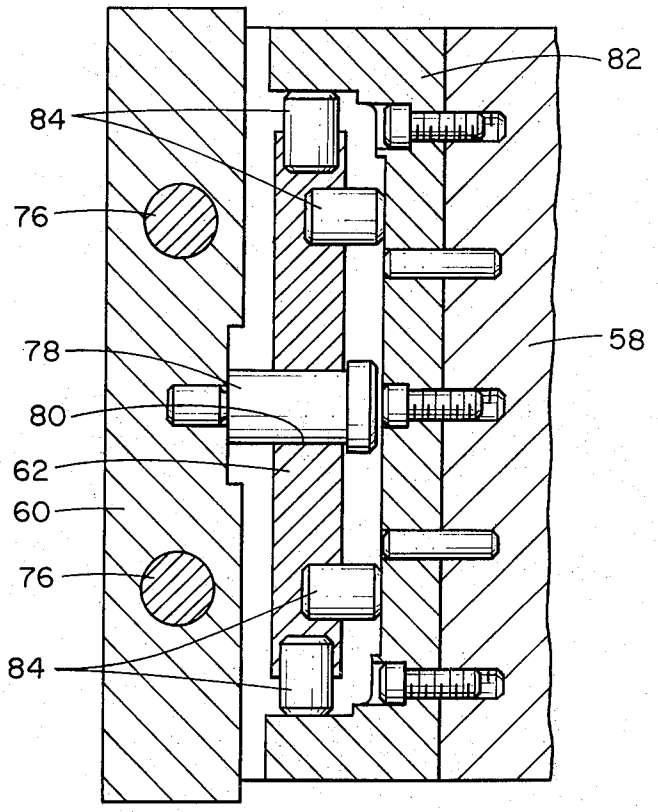


Fig. 7.

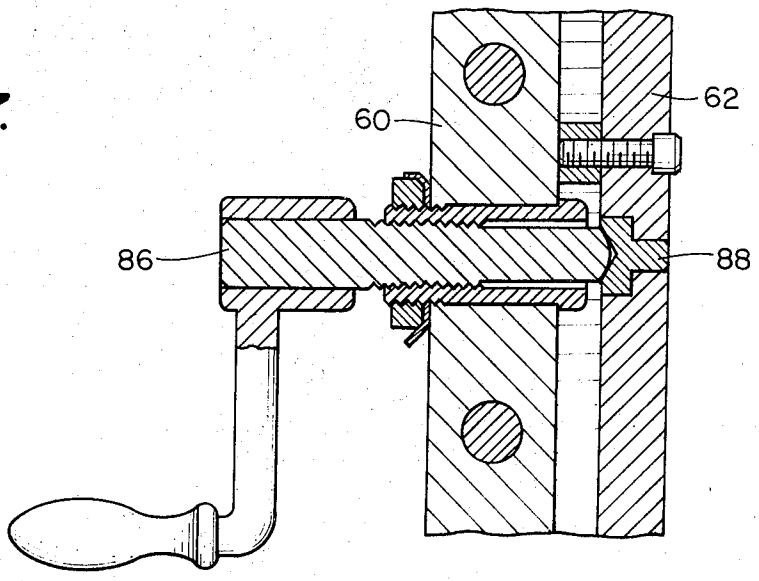


Fig. 8.

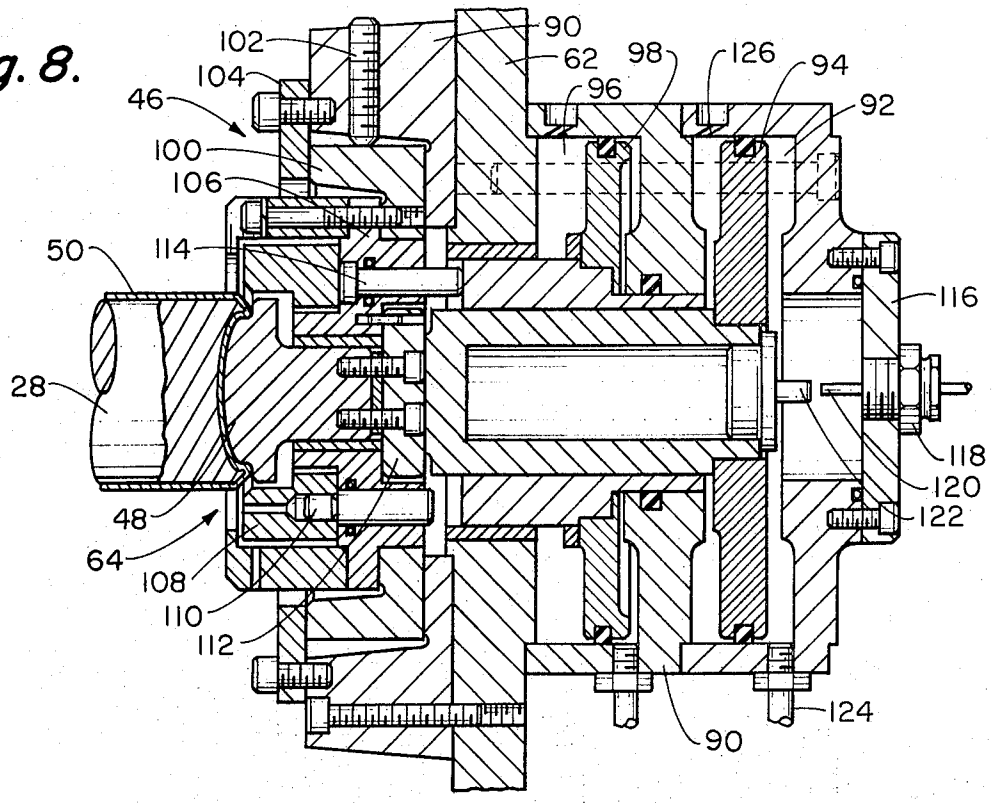

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Fig. 10.

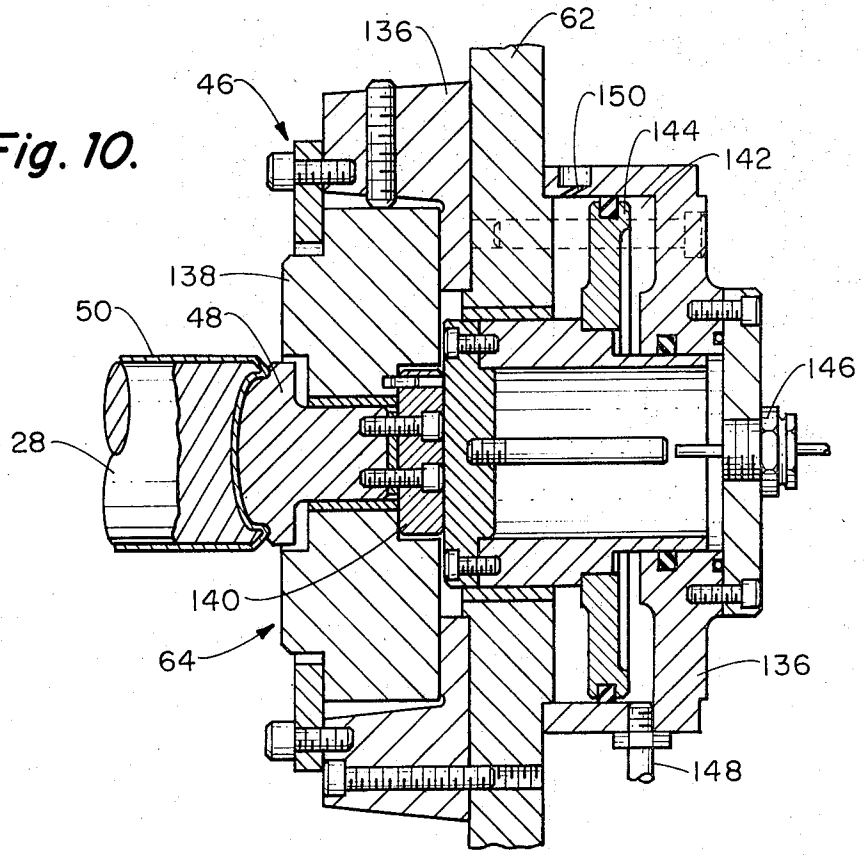

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Fig. 9.

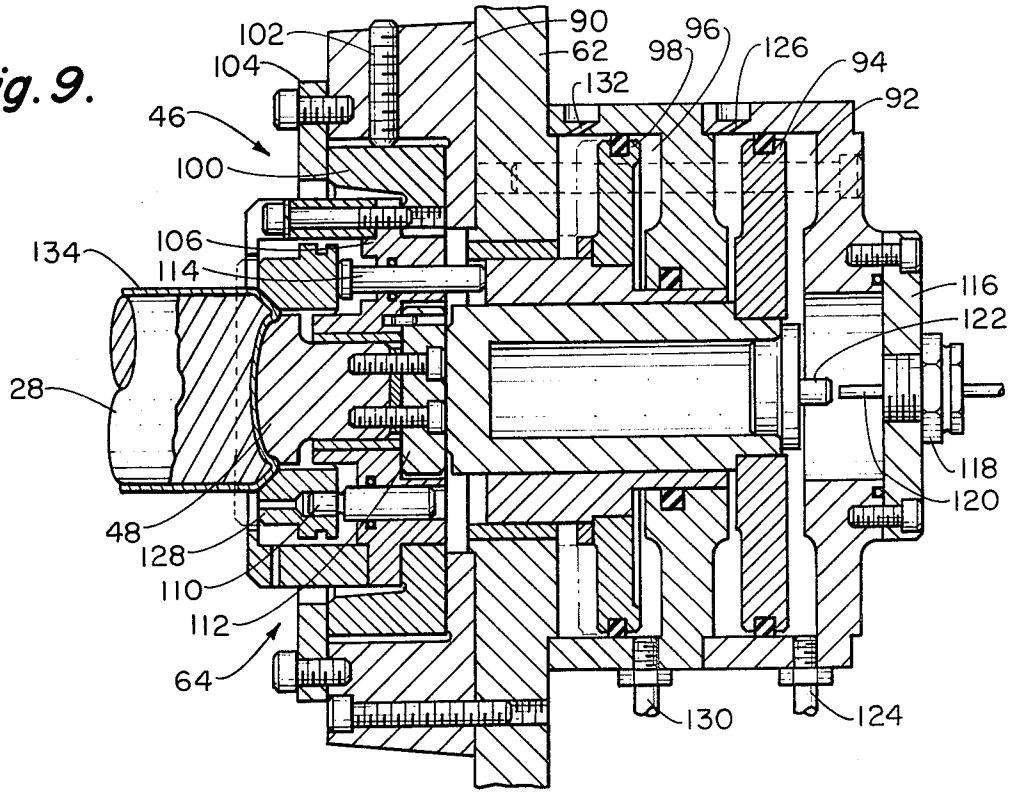
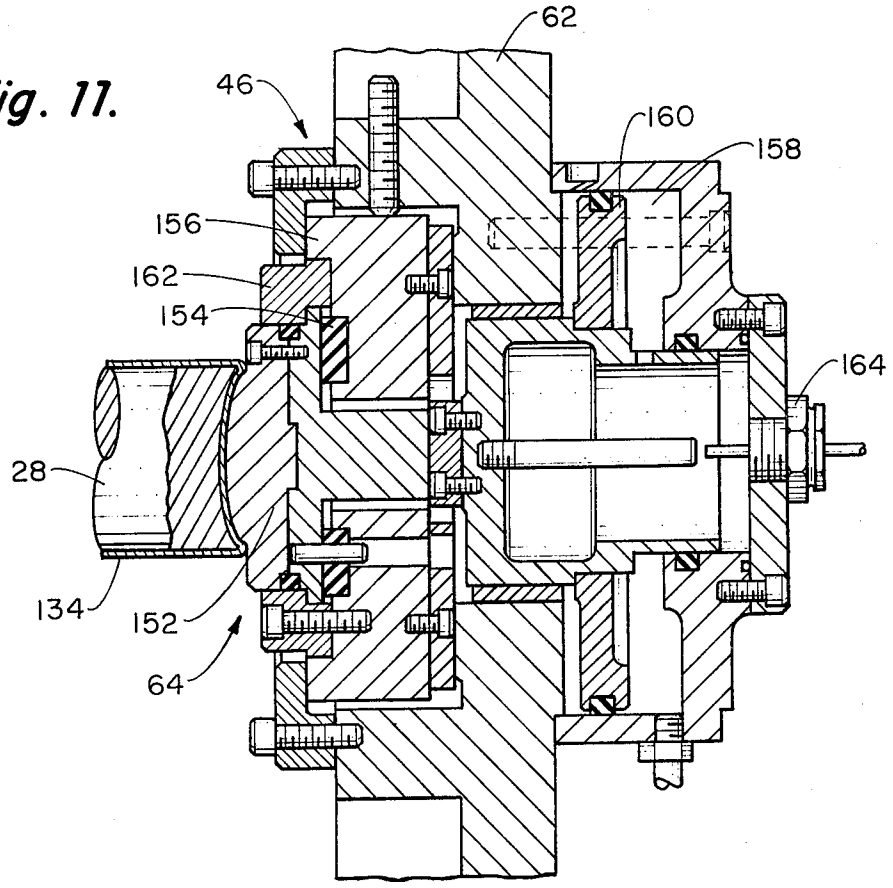

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Fig. 11.


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END FORMING STATION FOR METALLIC CAN BODY FORMERS AND THE LIKE

BACKGROUND OF THE INVENTION

This invention relates to an end forming station for metallic can body formers and the like, and more particularly, to such an end forming station wherein, through a unique mounting of the end forming die, and an edge forming die ring if included, the die elements are retained positioned properly and accurately functional, while still being guarded against damage thereto caused by accidental increased forces thereagainst resulting from a malfunctioning of the metallic can body former. Also, this invention relates to a unique overall construction of the end forming station such that the entire end forming die assembly, including the edge forming die ring where used, is normally retained positioned properly and accurately functional as hereinbefore set forth, yet where servicing of the die assembly is required, the entire of such assembly, through proper manipulation of certain components, may be selectively released and hingedly swung from its functioning position to a servicing position conveniently accessible at the side of the end forming station for workmen required to perform such servicing operations.

Various prior forms of end forming stations for reforming the ends of metallic cup-like articles, such as metallic can bodies, have heretofore been provided. Depending on the particular type and form of cup-like article being reformed, as well as the particular end produce desired, these end forming stations may be mounted as a single die station assembly in a given forming or press mechanism, or the end forming station may be one of a series of metal forming stations all included in the same former or press. In any event, in the former or press of the type to which the present invention is applicable, the metal cup-like article is carried at the end of a reciprocal ram and the end forming station is positioned so that when the ram reaches it full extension followed by reversal to begin its return stroke, the metallic cup-like article is forced axially against an end forming die to thereby carry out the end forming operation.

A prime example of this type of former is that used for reforming metallic can bodies into final or finished cans used ultimately for containing various forms of beverages. Such a can body former in the more recently produced forms will usually include a series of wall ironing stations, possibly preceded by a redrawing station where the particular can metal and final form of can dictates, with the final operation being the reforming of the can body end at the fully extended end of the ram stroke. Thus, in overall operation, metallic can bodies in the form of shallow cups, ar fed, one at a time, into position in the path of the reciprocal ram and when the ram is fully retracted, the ram proceeds axially beginning its stroke and telescopes the shallow cup over the end thereof, the ram proceeds axially carrying the shallow cup through the redraw die, if provided, and the series of ironing dies, and finally axially against the end forming die at the end forming station, the fully formed can then usually being stripped from the ram at the initial portion of the ram return stroke.

Now it is apparent that in this final end forming station, the ram maximum extended movement and the exact positioning of the end forming die must be closely calculated in order that the end forming operation on the can body will be properly performed while still maintaining the desired metal thickness in the can body upon forming completion. Such can bodies are formed of either aluminum or tinplate steel and the completed thicknesses thereof are in the order of **8** to **10** thousandths of an inch, yet these can bodies must be usable for beverage containers capable of withstanding reasonable sealed internal pressures. It can be seen, therefore, that uniform metal wall and bottom thicknesses are extremely critical and that the various dies, die rings and the like, accomplishing the metal formation must be maintained exactly positioned relative to ram movement and particularly including the end forming die carrying out the exact can body end formation during the ram stroke reversal.

For instance, assume that the exact point of reversal of the ram stroke is properly calculated and the end forming die is properly positioned relative thereto and solidly supported with proper spacing predicated on the can body arriving at the end forming station with a particular wall and end or bottom thickness in order that the end forming operation will be properly accomplished, if the can body wall and end thickness greatly exceeds, say by double, this precalculated thickness, one of two things must occur, either the ram cannot proceed to its normal stroke reversing position, or the end forming die, and possibly the ram, will be damaged. In the case where the ram is mechanically driven, the usual situation in metallic can body formers, the alternative of damage to the can body former components is the result. Furthermore, this situation can be presented with metallic can body formers when malfunctioning of shallow cup feeding causes the shallow cup resulting in the finally formed can body to be wrongly positioned so as not to be properly telescoped by the ram at the beginning of the forming stroke or when two shallow cups, one partially telescoped over the other, are improperly fed and simultaneously picked up by the end of the ram at the beginning of the can body forming stroke. Although proper shallow cup positioning for engagement by the ram or the improper feeding of two shallow cups simultaneously into ram pickup position has been of much easier and more positive accomplishment with can body formers in the past, due to the relatively slow operation of the prior can body formers, such has presented a greater problem recently with the advent of more modern designs. With the relatively recent metallic can body formers, it is now possible to operate such formers at speeds in the range of 150–175 parts per minute. Thus, with the required fast feeding and fast forming, and even with properly designed feeding mechanisms, the danger of the stated type of malfunctioning can occur unless refinements in the mounting and support of the end forming dies are made to prevent damage to the die and ram.

Another troublesome problem presented with end forming stations for metallic can body formers is occasioned by the fact that the end forming die must be mounted within the end forming station intermediate the supporting frame of the can body former since, as stated, this end forming die must be axially aligned with the reciprocal ram. With the end forming die thusly located, such die and its necessary mounting and alignment frame components are relatively inaccessible and difficult to service and replace as is required under normal high-speed operating conditions. For these reasons, it is highly desirable in high-spaced can body for-

mers to provide greater accessibility to the end forming station in order to reduce the time required by maintenance personnel for the various required servicing operations.

OBJECTS AND SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide an end forming station for metallic can body formers and the like wherein, through a unique mounting means, the end forming die, and the edge forming die ring where used, may be securely mounted properly maintained and accurately aligned for proper functioning in the metallic can body end formations under high-speed condition, while still being virtually completely guarded against damage from accidental increased forces caused by the various accidental malfunctioning of the can body former. According to the principles of the present invention, the end forming die, and the edge forming die ring if used, are mounted through a particularly functional compressible means retained in determined foward positions accurately aligned with the reciprocal ram and properly spaced therefrom during the end forming opration, yet both the end forming die and edge forming die ring are rearwardly movable as permitted by the compressible means upon forces being exerted thereagainst of a greater magnitude than that intended. In this manner, if a damaging thickness of metal caused by improperly fed or positioned can bodies is presented at the ram end at the time of intended contact of such metal with the end forming die station, the compressible means permits the die and die ring to move rearwardly beyond normal position, thereby avoiding damage thereto by eliminating the effect of excessive forces thereagainst.

It is a further object of this invention to provide an end forming station for metallic can body formers and the like which is readily adaptable to use with either a single end forming die or the combination of a central end forming die and a surrounding, separately movable, edge forming die ring, both the die and die ring being retained properly aligned with the axially moving ram, but guarded from damage which could result from excessive rearward forces being applied thereagainst through the stated body former malfunctioning. In the preferred form of the end forming station of the present invention, a first compressible means constantly urges the central end forming die to a predetermined forward position and retains the end forming die in such position throughout a normal end forming operation, again permitting this central end forming die to move rearwardly from this forward predetermined position in the event excessive forces are applied thereagainst. The edge forming die ring, on the other hand, is preferably mounted with a lesser forward force from a second compressible means retaining this die ring in its predetermined maximum forward position and when this die ring is contacted by the can body during the normal end forming operation, the die ring purposely moves a determined amount rearwardly to properly edge form the can body with the second compressible means still permitting even greater rearward movement of the die ring in the event the excessive rearward forces are applied thereagainst.

It is also an object of this invention to provide an end forming station for metallic can body formers and the like in which the functioning portions of the end forming station including the end forming die, the edge forming die ring where provided, and the mounting means and supporting frame for retaining the same properly functional as hereinbefore discussed, are uniquely hingedly mounted on the main can body former frame whereby the entire functioning portion of the end forming station and therefore, that portion requiring servicing from time to time, may be swung from normal functioning position extending transversely of the can body former to and from a side position at the side of the can body former freely accessible by the servicing personnel. In the preferred form, the hingedly movable portion of the end forming station is hingedly secured at one side and maintained positioned by keeper means at the other side with such hinge and keeper means being arranged for movement of certain of the movable components first transversely rectilinearly from the secured functioning position and then all of the movable components hingedly from the transverse extension to the side accessible position, return to the secured functioning position being the reverse procedure, the transverse rectilinear movement into the secured functional position not only securely retaining the end forming station movable portion securely in the functioning transversely extending position, but also maintaining the exact required alignment of the end forming die and edge forming die ring, if included, necessary for the proper high-speed end forming operations.

It is still another object of this invention to provide an end forming station or metallic can body formers and the like which, in the preferred form, and through uniquely positioned and actionable pressure applying means, permits pressure to be applied against the frame members directly mounting the die members to rigidify such mounting and die location. Still in the preferred form, as hereinbefore discussed, when the end forming station movable portion has been swung into its position extending transversely of the end forming station and has then had certain parts moved rectinlinearly transversely of such station into the final secured positioning, selectively actuated pressure members may be actuated to supply axial forces within the frame hingedly mounted components directly transmitted to the frame stationary portions, thereby rigidifying such final mounting. In such construction, preferably one or more pressure screws may be applied adjacent each of the hinge means and keeper means connections resulting in maximum rigidified alignment for the die components in carrying out the end forming operations.

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 side perspective view of a metallic can body former incorporating the improved end forming station of the present invention;

FIG. 2 is an enlarged, fragmentary, somewhat diagramatic vertical section of the die pack portion of the metallic can body former of FIG. 1 including a preferred embodiment of the end forming station of the present invention;

FIG. 3 is an enlarged, fragmentary, end elevation, with parts broken away and in section, looking in the direction of the arrows 3—3 in FIG. 2;

FIG. 4 is a fragmentary, top plan view, with parts broken away and in section, looking in the direction of the arrows 4—4 in FIG. 3, the end forming station being shown in solid lines in metallic can body end forming functional position;

FIg. 5 is a view similar to FIG. 4, but with a movable portion of the end forming station released and hingedly moved from metallic can body end forming functional position;

FIG. 6 is an enlarged, fragmentary, vertical sectional view looking in the direction of the arrows 6—6 in FIG. 4;

FIG. 7 is an enlarged, fragmentary, vertical sectional view looking in the direction of the arrows 7—7 in FIG. 4;

FIG. 8 is an enlarged, fragmentary, vertical sectional view with the ram of the metallic can body former against the end forming die of the end forming station in proper functional position and illustrating a first embodiment of the end forming station of the present invention;

FIG. 9 is a view similar to FIG. 8 and illustrating a second embodiment of the end forming station of the present invention;

FIG. 10 is a view similar to FIG. 8 and illustrating a third embodiment of the end forming station of the present invention; and

FIG. 11 is a view similar to FIG. 8 and illustrating a fourth embodiment of the end forming station of the present invention.

DESCRIPTION OF THE BEST EMBODIMENTS CONTEMPLATED:

A typical application of the end forming station principles of the present invention is use in a metallic can body former, a preferred construction thereo being generally indicated at 20 in FIG. 1, the end forming station forming an important component in such environment. Referring for the moment to FIG. 1, the metallic can body former 20 may include a ram guide and drive assembly generally indicated at 22, a part feed assembly generally indicated at 24 and a die pack assembly generally indicated at 26. In general, all of the can body former 20 including the foregoing components may be formed of usual materials by usual procedures properly adapted for the intended use, that is, the formation of aluminum or tinplate steel, shallow drawn cups into final can bodies for use principally as beverage containers.

Briefly, in order to more clearly understand the requirements and functioning of the various applications of the end forming station principles of the present invention and referring to FIGS. 1 and 2, the ram guide and drive assembly 22 of the can body former 20 supports and drives a horizontally reciprocal ram 28 in repeated can forming and return strokes through the part feed assembly 24 and the diepack assembly 26. The part feed assembly 24 includes a typical guide track 30 which feeds semi-finished can bodies in the form of shallow drawn cups 32 downwardly, one at a time, into a part positioning yoke 34. The diepack assembly 26 includes, in the particular construction shown, a horizontally reciprocal redraw blank holder positioning mechanism 36 controlling a redraw blank holder 38, a redraw die ring station 40, a series of wall ironing ring stations 42, a stripper station 44 and an end forming station 46, the latter mounting at least an end forming die or, in this case, a doming die 48 and incorporating the end forming station principles of the present invention.

In typical operation of the can body former 20, the metallic can body forming cycle begins with the ram 28 withdrawn or to the left as shown in FIG. 2, and the redraw blank holder positioning mechanism 36 likewise withdrawn to the left, permitting the downward feeding of a semi-finished can body or shallow drawn cup 32 by the part feed assembly 24 into the part positioning yoke 34 positioning the shallow drawn cup axially aligned with and with the open end thereof facing the withdrawn ram. The redraw blank holder positioning mechanism 36 then moves the redraw blank holder 38 axially into the positioned shallow drawn cup 32 forcing it against the die ring of the redraw die ring station 40 followed by the ram 28 entering the redraw blank holder and ultimately engaging the bottom wall of the shallow drawn cup to begin movement thereof through the diepack assembly 26. Continued movement of the ram 28 carries the shallow drawn cup 32 progressively through the redraw die ring and the wall ironing rings of the respective redraw die ring station 40 and the wall ironing ring stations 42 to thin and lengthen the various walls of the shallow drawn cup.

After leaving the last of the redraw die ring stations 40, the ram carries the now nearly finished can body or cup first through the stripper station 44 which expands to permit such passage and then axially against the doming die 48 of the end forming station 46. The doming die 48 forms an end arcuate recess to finish the can body formation and provide the finished can body 50 illustrated in phantom lines in FIG. 2. Furthermore, the forming stroke of the ram 28 is thereby completed and the ram immediately reverses to start the withdrawal stroke thereof carrying the finished can body 50 back to the stripper station 44 where the finished can body is stripped from the end of the ram and falls downwardly to conveying mechanism, (not shown).

More particularly to the principles of the present invention, and referring to FIGS. 3 through 7, the end forming station 46 includes a movable frame portion generally indicated at 52 and a stationary frame portion generallly indicated at 54, the former mounting and positioning the doming die 48 axially aligned with the path of travel of the ram 28 as will be hereinafter more clearly described and the latter being secured to the main frame of the can body former 20 and rigidly positioning the movable frame portion when the same is in operative working position as will also be hereinafter more fully described. As shown, stationary frame portion 54 is comprised of two side parts, a hinge part 56 and a keeper part 58, and in operative working position, the movable frame portion 52 extends transversely between and is rigidly supported on these stationary hinge and keeper parts. The movable frame portion 52 is also comprised of two major parts, a clamping part 60 and a die mounting part 62 with the die mounting part supporting a die assembly generally indicated at 64 preferably of unique construction according to certain of the principles of the present invention.

The stationary frame hinge part 56 mounts vertically upwardly and downwardly projecting hinge pins 66 and the stationary frame keeper part 58 is formed with a pair of vertically spaced and transversely extending keeper pin openings 68. The movable frame clamping

part 60 has a generally central, axially extending opening therethrough and at the stationary frame hinge part 56 is hingedly mounted on the hinge pins 66 through upper and lower hinge plates 72 receiving the hinge pins through transversely elongated hinge pin openings 74. At the stationary frame keeper part 58, the movable frame clamping part 60 mounts upper and lower, transversely extending, keeper pins 76 aligned with and engageable in the keeper pin opening 68 of the stationary frame keeper part 58 when the movable frame clamping part 60 is in transversely extending position and is moved transversely rectilinearly toward the stationary frame keeper part 58. That is, considering for the moment only the movable frame clamping part 60 of the movable frame portion 52, with the movable frame clamping part 60 engaged with the stationary frame keeper part 58 as shown in FIGS. 3 and 4, by transverse rectilinear movement of the movable frame clamping part to the right as shown in FIG. 4 and permitted by the transversely elongated hinge pin opening 74, the keeper pins 76 are transversely withdrawn from engagement with the stationary frame keeper part 58 so that the movable frame portion 52 is free to swing from transversely extending position ot the side as shown in FIG. 5, return and re-engagement being the exact opposite procedure.

The movable frame die mounting part 62 is mounted forwardly of the movable frame clamping part 60 through a series of pins 78 and transversely elongated slots 80, one such being shown in FIG. 6 so that the movable frame die mounting part 62 is hingedly movable with the clamping part 60, yet the clamping part is transversely rectilinearly movable relative to the die mounting part. At the stationary frame hinge part 56, the movable frame die mounting part 62 is conventionally hingedly mounted on the hinge pins 66, that is, hingedly movable thereon from and to transversely extending position, but not rectilinearly movable relative thereto. At the stationary frame keeper part 58, the movable frame die mounting part 62 at the latter part of hinged movement thereof into transversely extending position is received in a generally U-shaped locater 82, the movable frame die mounting part at this location having a series of vertically and axially projecting rest buttons 84 exactly aligning the movable frame die mounting part with the locator and, consequently, the stationary frame keeper part 58.

At opposite sides, the movable frame clamping part 60 threadably mounts a pair of axially extending pressure pins or screws 86 which, upon selective axially inward movement with the movable frame clamping portion in position engaging the stationary frame keeper part 58, engage hardened sockets 88 of the movable frame die mounting part 62 as shown in FIGS. 4 and 6. With the one pressure screw being adjacent the stationary frame hinge part 56, this applies axial pressure between the movable frame clamping and die mounting parts 60 and 62 and in view of the fact that each of the movable frame clamping and die mounting parts are each separately hingedly connected to the stationary frame hinge part, this pressure screw movement is effectively actionable to also apply axial pressure between the movable and stationary frame portions 52 and 54 so as to rigidify the movable frame portion on the stationary frame portion, and the particularly important die mounting part 62 of the movable frame portion. The selective inward threading of the other of the pressure screws 86 has a similar axial pressure effect between the movable frame clamping and die mounting parts 60 and 62 and the movable and stationary frame portions 52 and 54, that is, this other pressure screw 86 being adjacent the stationary frame keeper part 58 applies axial pressure between the movable frame clamping part 60 engaged in the stationary frame keeper part 58 and movable frame die mounting part 62 engaged axially against the stationary frame keeper part at the locater 82.

Thus, starting for example with the movable frame portion 52 hingedly moved toward open or side position displaced from normal transversely extending working position as shown in FIG. 5, the movable frame portion is first swung to transversely extending position axially engaging the movable frame die mounting part 62 with the stationary frame keeper part 58 which immediately axially aligns the doming die 48 in proper working position. The movable frame clamping part 60, still in the phantom line position soown in FIG. 4, is then moved or slid transversely rectilinearly to the left into the solid line showing in FIG. 4 and relative to both the movable frame die mounting part 62 and the stationary frame hinge and keeper parts 56 and 58 to engage the movable frame clamping part with the stationary frame keeper part. Finally, the pressure screws 86 are selectively actuated to thereby apply rigidifying axial pressure between the movable frame clamping and die mounting parts 60 and 62, and resulting in such rigidifying axial pressure also being applied between the movable and stationary frame portions 52 and 54. To return to the open position shown in FIG. 5, exactly the opposite procedure is obviously followed.

The purpose of mounting the die assembly 64, including the doming die 48, for this hinged movement is to provide more convenient access to the die assembly by workmen required to service the same. With the die assembly 64 in its working position transversely intermediate the can body former, it is difficult to service in view of the inaccessibility of the same, yet with this convenient hinged movement thereof through the movable frame portion 52, the die assembly may be brought to the side of the can body former much more conveniently accessible for such servicing. The purpose of the axial pressure application by the pressure screws 86 is, obviously, to rigidify the movable frame portion 52 on the stationary frame portion 54 exactly axially aligned with the axial movements of the ram 28 and capable of absorbing the usual metal working impacts occasioned by the can body end forming operations.

As hereinbefore stated, the movable frame die mounting part 62 mounts the die assembly 64 and a first embodiment of such die assembly according to certain of the principles of the present invention is shown in vertical section in FIG. 8. Referring to FIG. 8, the die assembly 64 projects both forwardly and rearwardly of the movable frame die mounting part 62 projecting axially rearwardly into the opening 70 (FIG. 3) of the movable frame clamping part 60 while remaining spaced from and free of the movable frame clamping part. In FIG. 8, the movable frame clamping part 60 is removed in order to more clearly show the detailed construction of the die assembly 64.

As shown, a multi-piece cylinder housing 90 is secured part forwardly and part rearwardly of the movable frame die mounting part 62. Rearwardly of the movable frame die mounting part 62, the cylinder

housing 92 forms a doming die cylinder 92 at the rearmost portion thereof which operably reciprocally mounts a doming die piston 94, a central portion of the doming die piston projecting forwardly through the movable frame die mounting part 62. Spaced forwardly of the doming die cylinder 92, the cylinder housing 90 forms an edge forming die ring cylinder 96 enclosing an edge forming die ring piston 98 which is reciprocal relative to both the doming die piston 94 telescoping the same and the stationary frame die mounting part 62.

Forwardly of the movable frame die mounting part 62 the cylinder housing 90 radially inwardly receives a centering ring 100 which is radially adjustably positioned therein by a series of centering screws 102 and retained therein axially by a retainer 104. A two-piece cover ring 106 is received radially within and secured to the centering ring 100 and this cover ring, in turn, radially outwardly encloses an axially reciprocal spacer ring 108 retained in proper relative positioning by a guide pin 110 received axially reciprocal in the centering ring 100. Radially inwardly of the spacer ring 108, the centering ring 100 also axially reciprocally mounts the doming die 48 which is rearwardly secured to a stopplate 112 with the stopplate rearwardly abutting the forward extremity of the doming die piston 94.

In the particular emboidment shown in FIG. 8, the die assembly 64 is alternately usable with only the central end forming or, in this case, doming die 48, or with both this doming die and an outwardly telescoping edge forming die ring (not shown) in place of the spacer ring 108, but in that form shown in FIG. 8, only the doming die is used so that the die ring cylinder and piston 96 and 98 are non-functional. Merely to complete the overall structure, however, it may be seen that the spacer ring 108 (in place of the edge forming die ring) rearwardly abuts a series of push pins 114 which extend axially through and are axially reciprocal relative to the cover ring 106 rearwardly abutting the forward extremity of the die ring piston 98.

Mounted extending axially through a rear cover 116 of the cylinder housing 90 is an emergency stop switch 118 which has a reciprocal plunger 120 projecting forwardly into the doming die cylinder 92. A rearwardly projecting actuator 122 is secured in and movable with the doming die piston 94 aligned with the stop switch plunger 120 but normally forwardly spaced therefrom. Thus, as will be hereinafter more clearly described, rearward movement of the doming die piston 94 from the position shown in FIG. 8 will cause the actuator 122 to engage the plunger 120 of the stop switch 118 and, through proper electrical circuit connection, well known to those skilled in the art, will stop the can body former 20.

In normal operation of the embodiment of the die assembly 64 shown in FIG. 8, air at a pressure in the order of 60–65 pounds per square inch is directed into the doming die cylinder 92 rearwardly of the doming die piston 94 through the air inlet 124, with there always being a slight bleed-off of air forwardly of the doming die piston through a bleed-off outlet 126. With this constant supply of pressurized air in the doming die cylinder 92 forcing the doming die piston 94 forwardly, the doming die piston normally constantly forces the doming die stopplate 112 forwardly to engage the cover ring 106 and thereby, normally retain the doming die 48 in a predetermined forward working position. This forward working position of the doming die 48 is exactly predetermined or precalculated to properly perform the desired end forming or end doming operation on a single, at this stage, nearly completed can body resulting in the finished can body 50 which has been properly positioned on the end of the ram 28 and brought to the doming die.

As shown in FIG. 8, the ram 28 is just at its maximum working stroke and ready to commence its withdrawal or return stroke. In this particular instance, the end forming die is the doming die 48 having a forwardly facing, arcuate working surface and forming a like centralized arcuate recess in the end of and to complete the finished can body 50. It is also seen that the annular edge portion of the end of the resulting finished can body 50 in this doming operation by the doming die 48 is formed somewhat angularly inwardly predetermined by the particular formation of the end of the ram 28 combined with the particular contour of the doming die 48.

During this end forming or doming operation in the normal manner and under the normal circumstances, the pressurized air within the doming die cylinder 92 exerts a sufficient predetermined forward force through the doming die piston 94 to retain the doming die 48 in its working position throughout such operation. If, however, the original shallow drawn cup 32 (FIG. 1) originally fed to the ram 28 is wrongly positioned on the ram 28 of if two of such cups are accidentally picked up by the ram 28 as hereinbefore described, the improperly positioned metal thickness or the increased metal thickness presented by the ram will exert a far greater than normal rearward force against the doming die 48 at the ram fully extended stroke and this excessive force will urge the doming die rearwardly as permitted by compression of the pressurized air within the doming die cylinder 92 rearwardly of the doming die piston 94 as caused by like rearward movement of this doming die piston. This will prevent damage to the ram 28 and the doming die 48 from such excessive forces and, at the same time, will cause the actuator 122 to engage the plunger 120 of the emergency stop switch 118 resulting in this emergency stop switch immediately stopping operation of the can body former 20 (FIG. 1) to permit a correction of the malfunction.

A second embodiment of the end forming station including certain of the principles of the present invention is shown in FIG. 9 and may include virtually identical components and assembly as the first embodiment of FIG. 8 with the sole exception that the spacer ring 108 of the first embodiment of FIG. 8 is replaced by a functionally reciprocal, edge forming die ring 128. As in the case of the spacer ring 108 of FIG. 8, the edge forming die ring 128 of FIG. 9 is retained positioned axially reciprocal by one or more of the die pins 110 and rearwardly abuts the forward extremity of the series of push pins 114, the push pins, in turn, rearwardly abutting the forward extremity of the now activated die ring piston 98 of the die ring cylinder 96. The die ring cylinder 96 is activated by directing pressurized air through the air inlet 130 into the cylinder rearwardly of the die ring piston 98, there again being a slight bleed-off of such pressurized air forwardly of the die ring piston through the bleed-off outlet 132. Furthermore, the pressure of the pressurized air directed into the die ring cylinder 96 through the air inlet 130 is of a lesser pressure than that into the doming die cylinder 92 prefera-

bly in the order of 15–20 pounds per square inch for a purpose to be hereinafter described.

In operation of the second embodiment of the end forming station of the present invention shown in FIG. **9**, the pressurized air maintained at a pressure in the order of **60-65** pounds per square inch in the doming die cylinder **92** rearwardly of the doming die piston **94** will again maintain, under normal conditions, the doming die **48** in its forward working position as hereinbefore described, whereas the pressurized air of lesser pressure in the order of **15-20** pounds per square inch in the die ring cylinder **96** rearwardly of the die ring piston **98** will force the die ring piston forwardly until this piston forwardly engages the rearward surface of the movable frame die mounting part **62** (phantom line in FIG. **9**) which, in turn, through the push pins **114** will force the edge forming die ring **128** axially forwardly to the phantom line position shown in FIG. **9.** This foregoing positioning of the edge forming die ring **128** is, of course, prior to the ram **28** reaching the end forming station in its can forming stroke.

As the ram **28** approaches the end forming station in such forming stroke, carrying a now nearly completed previously shallow drawn cup **32** (FIG. **1**), the ram and cup first generally axially engage the edge forming die ring **128** and being to move this edge forming die ring rearwardly relative to the doming die **48** while also beginning to form an angled, annular edge on the can end. As the ram **28** finally reaches its fully extended end forming position shown in FIG. **9**, the edge forming die ring **128** has been forced rearwardly to the position shown in FIG. **9** permitted by a precalculated compression of the pressurized air within the die cylinder **96** caused by rearward movement of the die ring piston **98**, again to the position shown in FIG. **9.** At the same time, under this normal operating condition, the doming die **48** has remained in its forward working position and has formed the centralized arcuate recess within the can body finally resulting in the finished can body **134** shown in FIG. **9.** This second embodiment end forming station shwon in FIG. **9** is normally used for the end forming of the shallow drawn cups **32** (FIG. **1**) formed of the more difficult to shape aluminums and tinplate steel as well as when a more pronounced angled end edge is desired.

In any event, if malfunctioning of the can body former **20** (FIG. **1**) occurs as hereinbefore discussed, thereby exerting increased rearward pressures against the doming die **48** and the edge forming die ring **128**, the doming die will move rearwardly in the same manner hereinbefore described permitted by compression of the pressurized air within the doming die cylinder **92** while the edge forming die ring will be permitted to similarly react by moving further rearwardly from its now partial rearward position by the compression of the pressurized air within the die ring cylinder **96.** This, thereby, again prevents damage to the die components, as well as the ram **28**, with the emergency stop switch **118** again shutting down the can body former **20** (FIG. **1**). It is also pointed out that this guarding of the edge forming die ring **128** in similar manner to the guarding of the doming die **48** is accomplished despite the fact that the edge forming die ring begins the normal end forming operation at a first contacted extreme forward position as determined by the die ring piston **98** being a maximum distance forwardly against stop means formed by rearward surfaces of the movable frame die mounting part **62** and this edge forming die ring is intended to reciprocate a determined axial distance rearwardly and then back forwardly in a normal can body end forming operation.

A third embodiment of the end forming station incorporating certain of the principles of the present invention is shown in FIG. **10** and this embodiment is greatly simplified over those forms shown in FIGS. **8** and **9.** As seen in FIG. **10**, the doming die **48** is again mounted reciprocal on the movable frame die mounting part **62** through a multi-piece cylinder housing **136** and an inner centering ring **138**, a doming die stopplate **140** determining maximum axial forward positioning or the working position of the doming die by abutting a stop surface of the centering ring. The cylinder housing **136** is again both part forwardly and part rearwardly of the movable housing die mounting part **62** and forms a doming die cylinder **142** enclosing a doming die piston **144** which normally forwardly abuts the doming die stopplate **140.** A similar arrangement of emergency stop switch **146** is provided functioning in the same manner as in the previous embodments.

Thus, in the use of this third embodiment, air under pressure is admitted to the doming die cylinder **142** through an air inlet **148** rearwardly of the doming die piston **144**, a same slight bleeding of such air from the cylinder forward of the piston being permitted by a bleed-off outlet **150.** The pressurized air in the doming die cylinder **142** provides the sufficient forward force to retain the doming die **48** in its normal working position during the normal forming of a can body into a finished can body **50** as shown. Malfunctioning and increased rearward forces against the doming die **48** again causes rearward movement thereof by compression of the pressurized air in the doming die cylinder **142** so as to guard the doming die and ram **28** against damage and the actuation of the emergency stop switch **146.**

A fourth embodiment of the end forming station of the present invention is shown in FIG. **11** and this fourth embodiment form is again a simplified form quite similar to the third embodiment form shown in FIG. **10.** The real exception is that a slightly different form of doming die **152** is provided so that the structure may incorporate resilient compressible means in the form of an annular resilient ring **154** between a rearward surface of the multipart doming die **152** and a forward surface of a centering ring **156.** A doming die cylinder **158** encloses a doming die piston **160** which forwardly abuts and urges the doming die **152** to its normal axially forward working position as determined by stop means formed partially by the doming die and partially by a mounting ring **162.**

Thus, the same general operation of this fourth embodiment form takes place, except under malfunctioning wherein rearward movement of the doming die **152** is permitted by compression of the combination of the resilient ring **154** and the pressurized air within the doming die cylinder **158** behind the doming die piston **160.** This, thereby, again guards the ram **28** and the doming die **152** against damage as in the other embodiments. An emergency stop switch **164** operable in the same manner is provided for the malfunctioning situation.

According to the principles of the present invention, therefore, various constructions of end forming stations are provided, all of which incorporate certain unique

principles for guarding the die components against damage which would normally be caused by malfunctioning of the machine within which these end forming stations are installed. Furthermore, any of the various embodiments of end forming stations may incorporate unique mounting means, also illustrated and described herein, which permits ready accessibility to the various components of the end forming stations by maintenance personnel, yet normally retains the end forming stations in proper working position. It is pointed out that, although specific constructions of end forming stations have been illustrated and described herein, all of which incorporate certain of the principles of the present invention, it is not intended to limit the principles of the present invention to these specific forms shown.

I claim:

1. In an end forming station for metallic can body formers and the like, the can body former being of the type having an axially reciprocal ram carrying a metallic can body on a ram end to and form an end forming die of said forming station for reforming an end of said can body generally axially against said end forming die; said forming station comprising: a frame including a die mounting portion and a stationary portion, said die mounting portion having die mounting means thereon mounting said end forming die in a normal axially forward position for limited movement axially rearwardly from said forward position, said die mounting portion in a normal working position extending generally transversely retaining said end forming die axially aligned with said reciprocal ram; rearwardly compressible means operably engaged with said end forming die constantly urging said die forwardly into said normal forward position and compressing to permit rearward movement of said die upon a determined generally rearward force being exerted against said die; hinge means operably connecting said frame die mounting portion to said frame stationary portion pivotal from and to extending generally transversely; keeper means selectively engageable between said frame die mounting and stationary portions when said die mounting portion is pivoted to extend generally transversely for retaining said die mounting portion extending generally transversely and in said normal working position, said keeper means being selectvely disengageable for permitting said pivotal movement of said die mounting portion from and to extending generally transversely supported on said hinge means; axial pressure means operably connected effectively actionable between said frame die mounting and stationary portions when said die mounting portion is in said normal working position selectvely actionable for applying axial rigidifying forces between said die mounting and stationary portions.

2. An end forming station as defined in claim **1** in which said hinge means operably connects said frame die mounting portion to said frame stationary portion pivotal from and to extending generally transversely and with certain part thereof movable generally rectilinearly transversely when extending generally transversely to and from said normal working position; and in which said keeper means is selectively engageable between said frame die mounting and stationary portions at least when said die mounting portion is pivoted to extend generally transversely and then said certain part thereof is moved generally rectilinearly transversely into said normal working position for retaining said die mounting portion extending generally transversely and in said normal working position, said keeper means being selectively disengageable at least when said die mounting portion certain part is moved generally rectilinearly transversely from said normal working position for permitting said pivotal movement of said die mounting portion from and to extending generally transversely supported on said hinge means.

3. In an end forming station for metallic can body formers and the like, the can body former being of the type having an axially reciprocal ram carrying a metallic can body on a ram end to and from an end forming die of said forming station for reforming an end of said can body generally axially against said end forming die; said forming station comprising: a frame including a die mounting portion and a stationary portion; said frame die mounting portion having said end forming die operably connected thereto, said die mounting portion in a normal working position extending generally transversely retaining said die axially aligned with said reciprocal ram; hinge means operably connecting said frame die mounting portion to said frame stationary portion pivotal from and to extending generally transversely; keeper means selectively engageable between said frame die mounting and stationary portions when said die mounting portion is pivoted to extend generally transversely for retaining said die mounting portion extending generally transversely and in said normal working position, said keeper means being selectively disengageable for permitting said pivotal movement of said die mounting portion from and to extending generally transversely supported on said hinge means; pressure means operably connected selectively effectively actionable between said frame die mounting and stationary portions when said die mounting portion is in said normal working position for exerting generally axial rigidifying forces between said die mounting and stationary portions.

4. An end forming station as defined in claim **3** in which said pressure means is operably connected selectively effectively actionable between said frame die mounting and stationary portions adjacent each of said hinge means and said keeper means when said die mounting portion is in said normal working position for exerting said generally axial rigidifying forces between said die mounting and stationary portions.

5. An end forming station as defined in claim **3** in which said pressure means is operably connected selectively effectively actionable between said frame die mounting and stationary portions adjacent each of said hinge means and said keeper means when said die mounting portion is in said normal working position for exerting said generally axial rigidifying forces between said die mounting and stationary portions, each of said pressure means including a selectively threadably adjustable pressure pin effectively exerting axial forces between said die mounting and stationary portions upon threaded movement thereof.

6. An end forming station as defined in claim **3** in which said hinge means include means thereon also connecting said frame die mounting portion to said frame stationary portion with at least part thereof movable generally rectilinearly transversely when said die mounting portion is pivotally moved to extending generally transversely, said generally rectilinear transverse movement moving said die mounting portion part

transversely to and from said normal working position.

7. An end forming station as defined in claim 3 in which said hinge means include means thereon also connecting said frame die mounting portion to said frame stationary portion with at least part thereof movable generally rectilinearly transversely when said die mounting portion is pivotally moved to extending generally transversely, said generally rectilinear transverse movement moving said die mounting portion part transversely to and from said normal working position; in which said keeper means includes stationary engagement members secured to one of said die mounting portion part and stationary portion engageable with the other of said die mounting portion part and stationary portion upon said die mounting portion part being moved in said generally rectilinear transverse movement into said normal working position and disengageable upon said die mounting portion part being moved in said generally rectilinear transverse movement from said normal working position permitting said die mounting portion pivotal movement; and in which said pressure means is operably connected selectively effectively actionable between said frame die mounting and stationary portions adjacent each of said hinge means and said keeper means when said die mounting portion is in said normal working position for exerting said generally axial rigidifying forces between said die mounting and stationary portions.

8. An end forming station as defined in claim 3 in which said hinge means include means thereon also connecting said frame die mounting portion to said frame stationary portion with at least part thereof movable generally rectilinearly transversely when said die mounting portion is pivotally moved to extending generally transversely, said generally rectilinear transverse movement moving said die mounting portion part transversely to and from said normal working position; in which said keeper means includes at least two pins secured to said frame die mounting portion part and projecting generally transversely when said die mounting portion extends generally transversely, said pins being engageable with said frame stationary portion when said die mounting portion part is moved in said generally rectilinear transverse movement into said normal working position; and in which said pressure means is operably connected selectively effectively actionable between said frame die mounting and stationary portions adjacent each of said hinge means and said keeper means when said die mounting portion is in said normal working position for exerting said generally axial rigidifying forces between said die mounting and stationary portions, each of said pressure means including a selectively threadably adjustable pressure pin effectively exerting axial forces between said die mounting and stationary portions upon threaded movement thereof.

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