Dec. 21, 1943. A. CALLESON ET AL 2,337,182

APPARATUS FOR MAKING CONTAINERS

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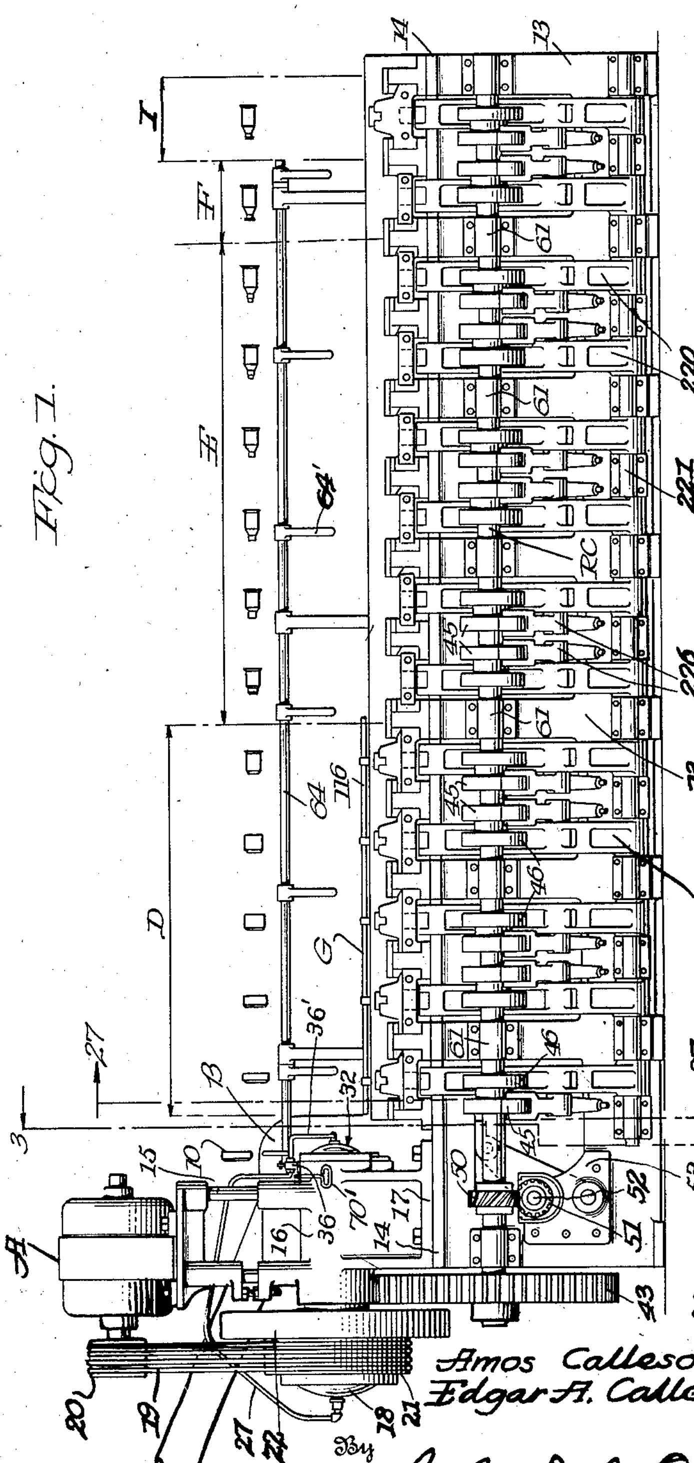

Fig. 1.

Inventors

Amos Calleson

Edgar A. Calleson

By Cushman, Darby & Cushman

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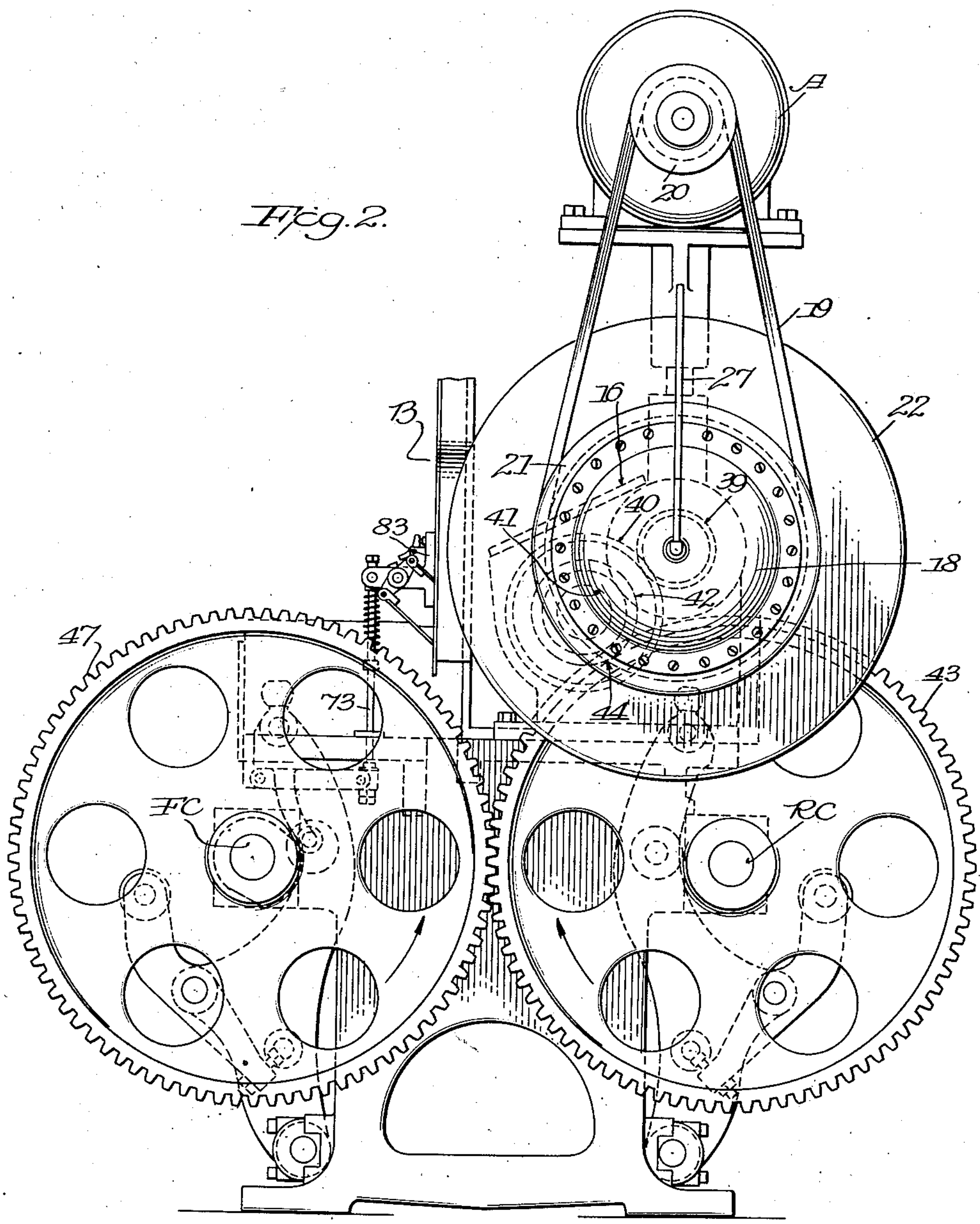
Fig. 2.



Inventors
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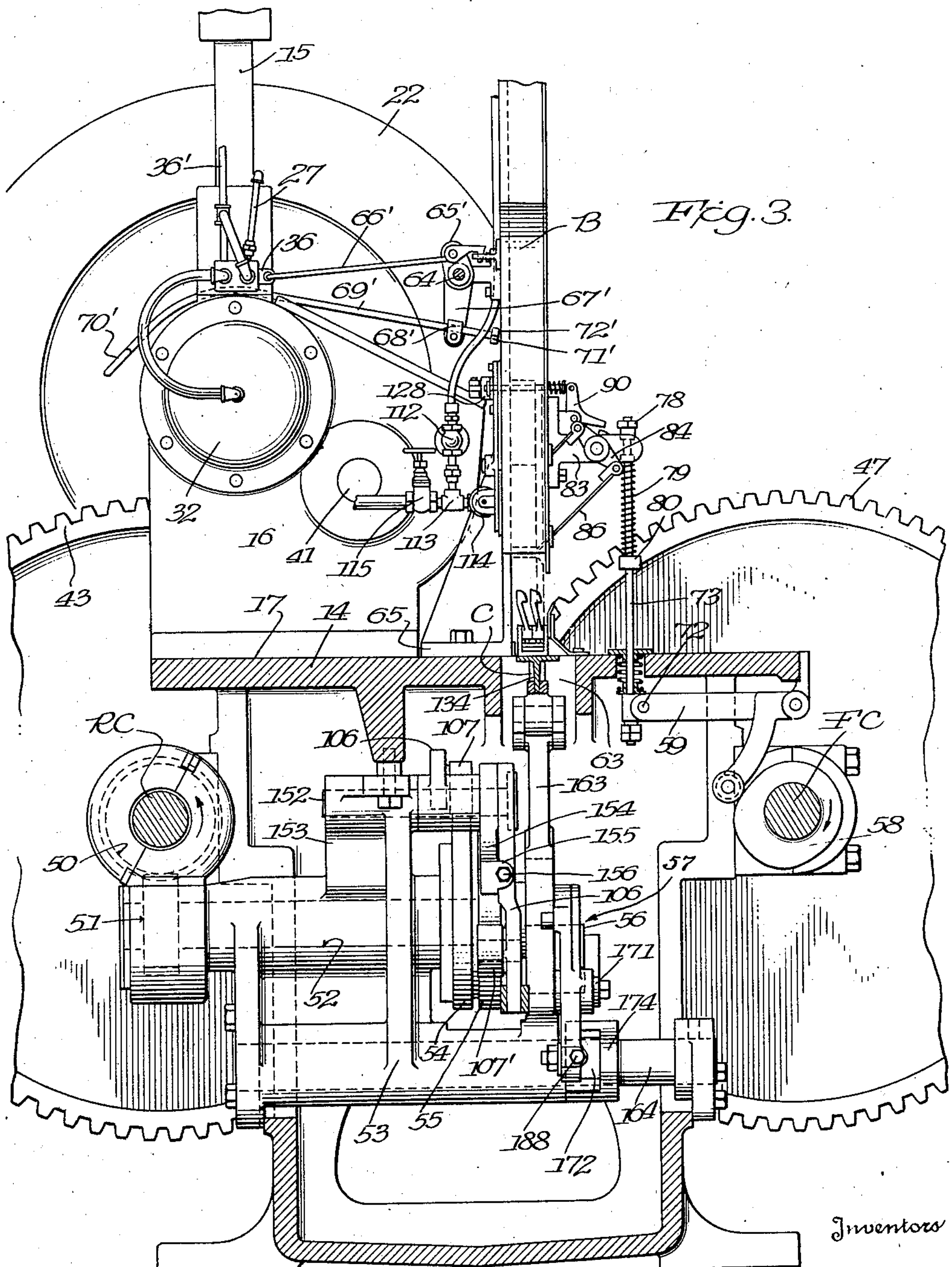
Fig. 3.



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APPARATUS FOR MAKING CONTAINERS

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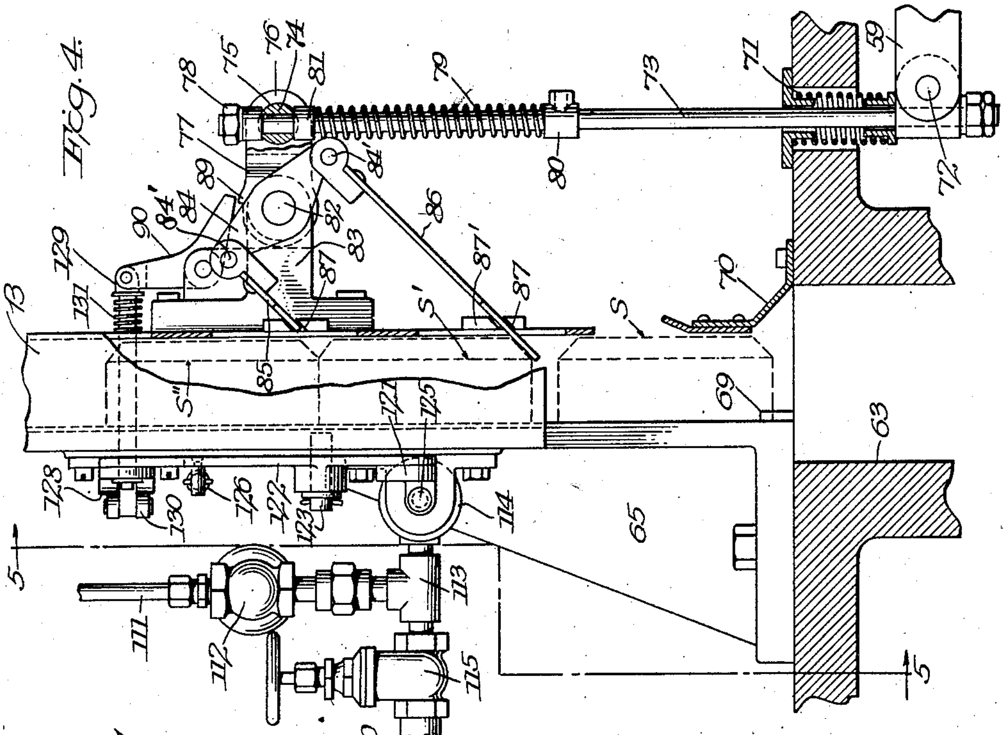
Fig. 4.



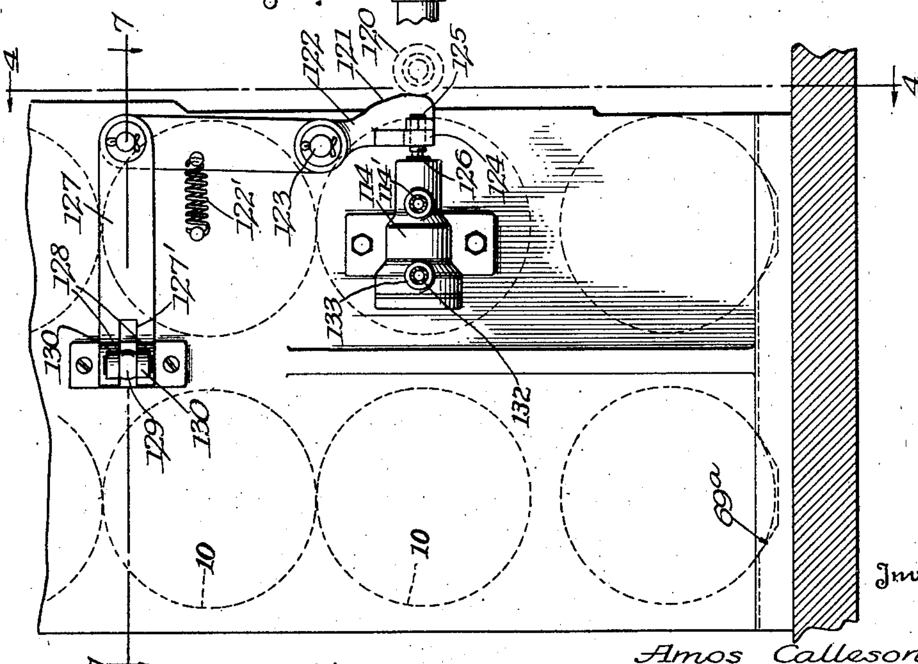


Fig. 5.

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APPARATUS FOR MAKING CONTAINERS

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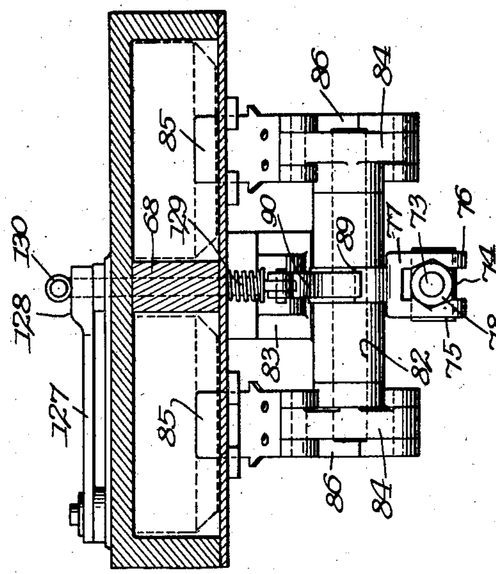

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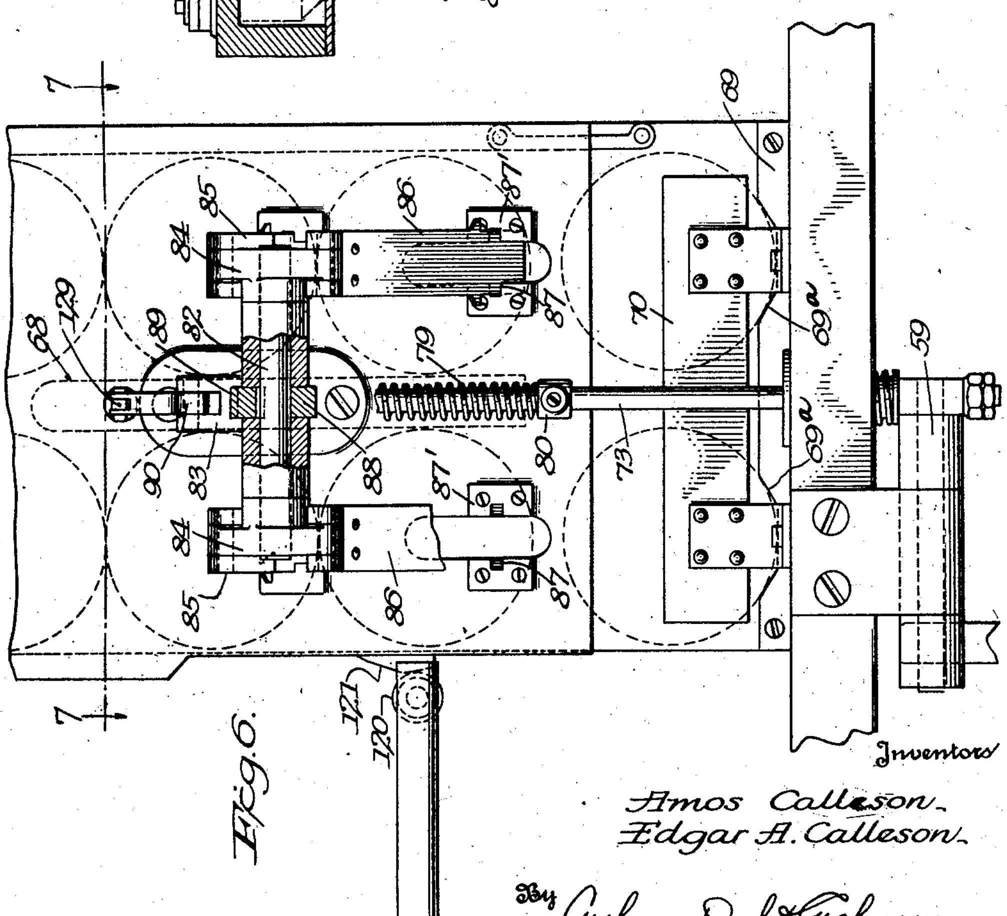

Fig. 6.

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APPARATUS FOR MAKING CONTAINERS

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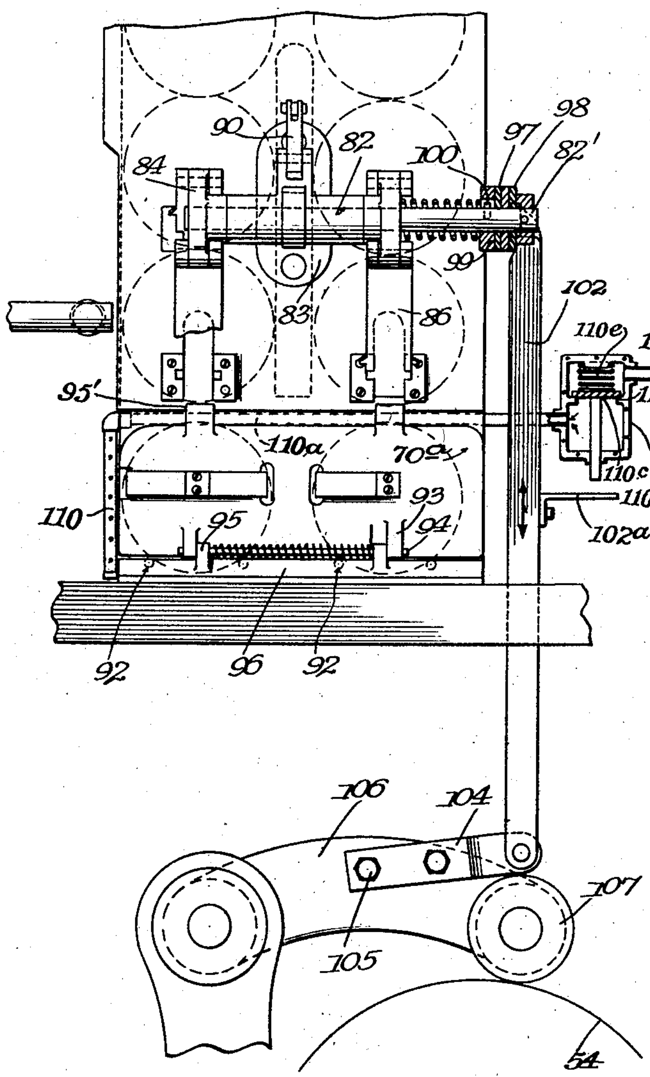

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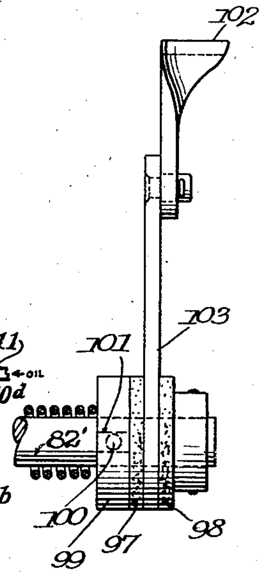

Fig. 9.

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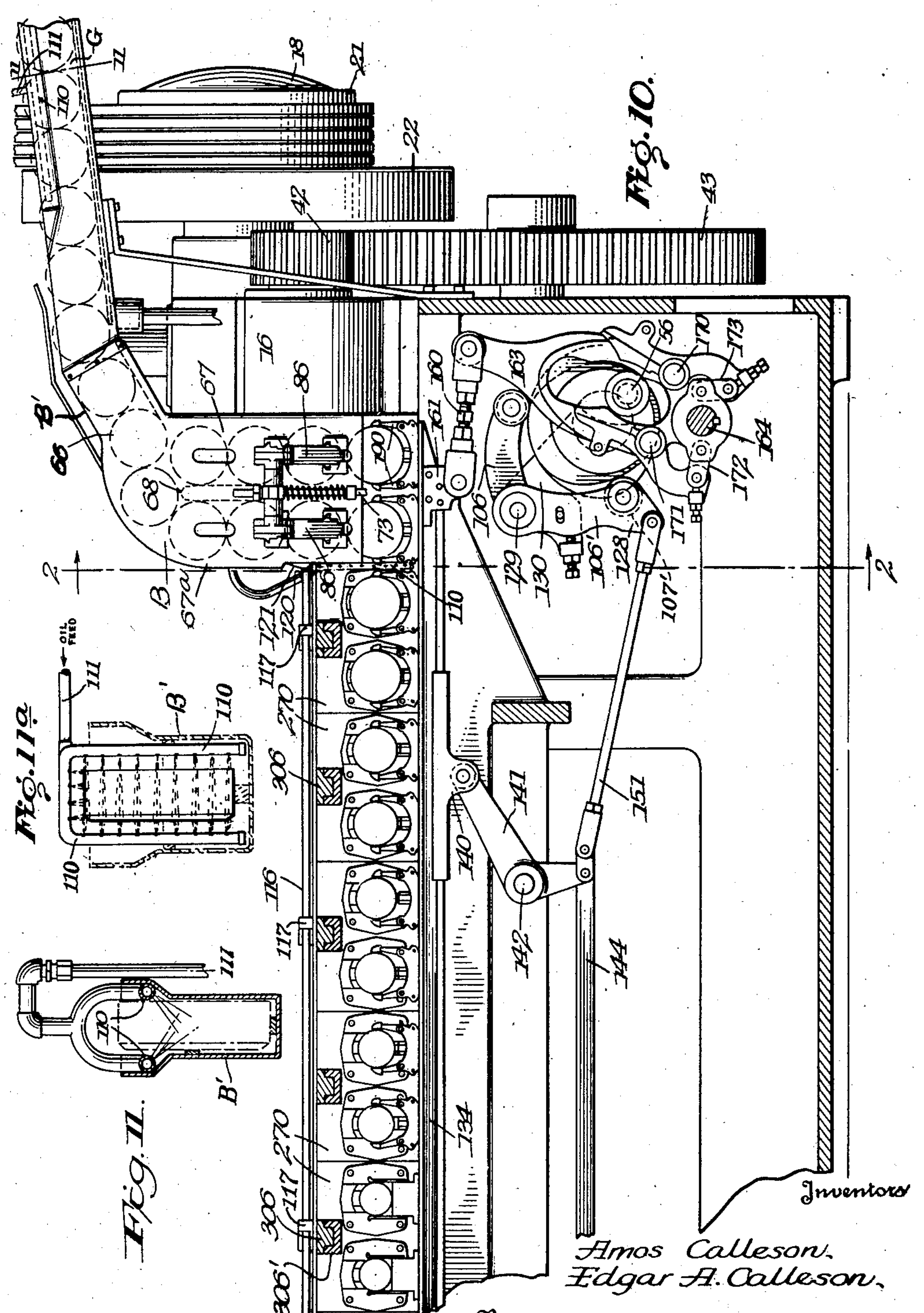

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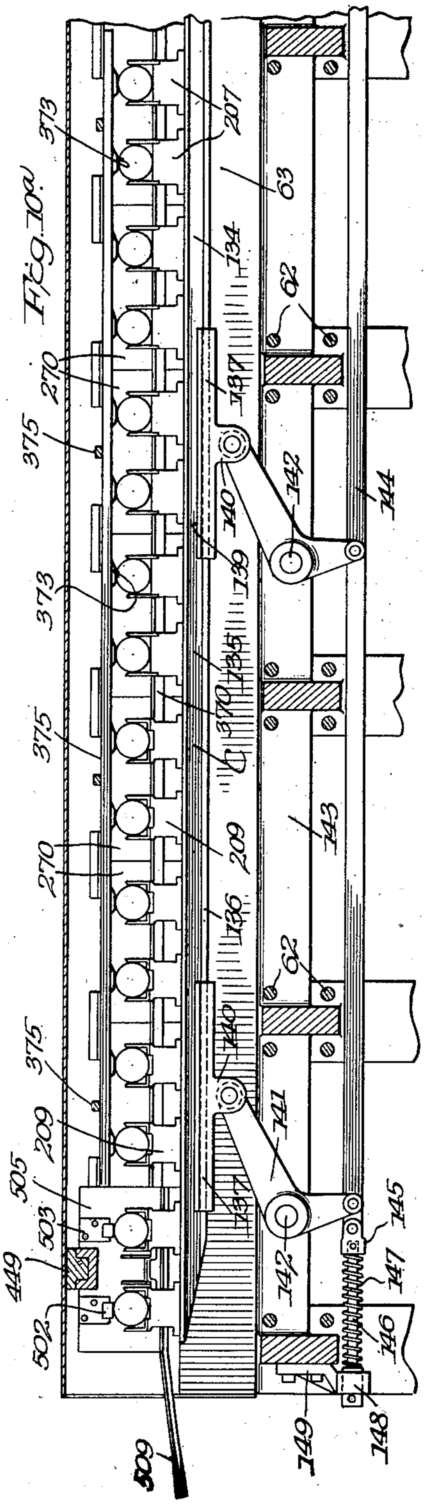

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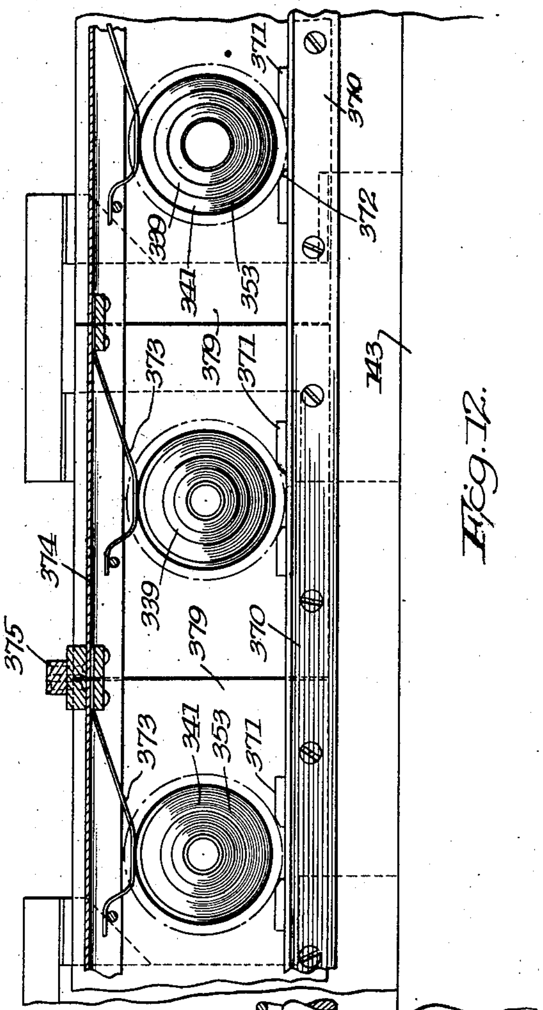

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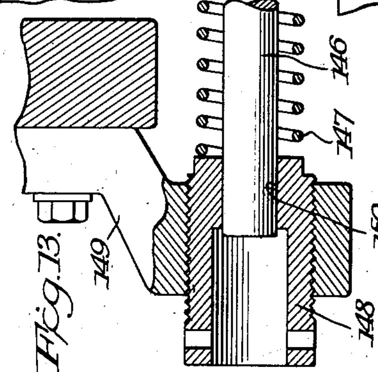

Fig. 13.

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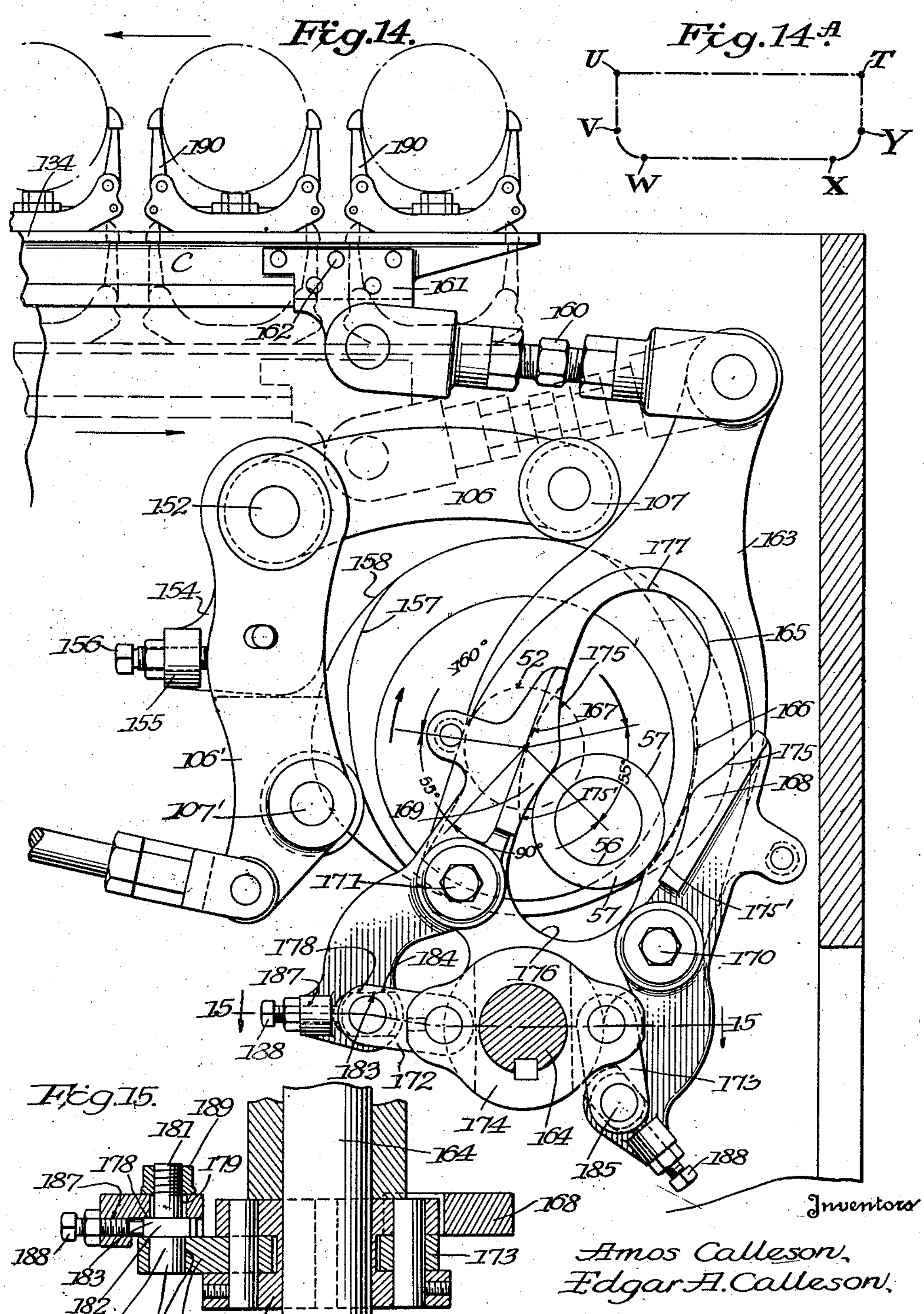

Inventors

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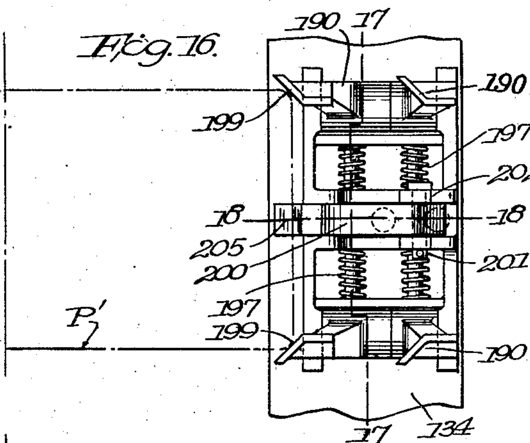
Attorneys

Fig. 16.



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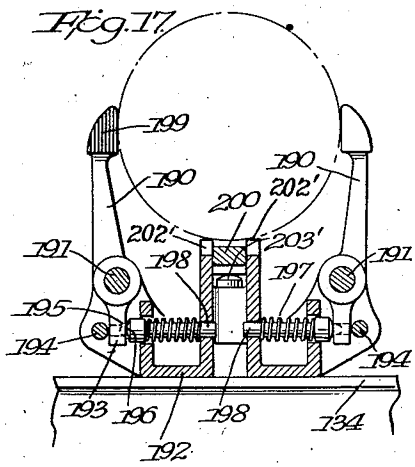

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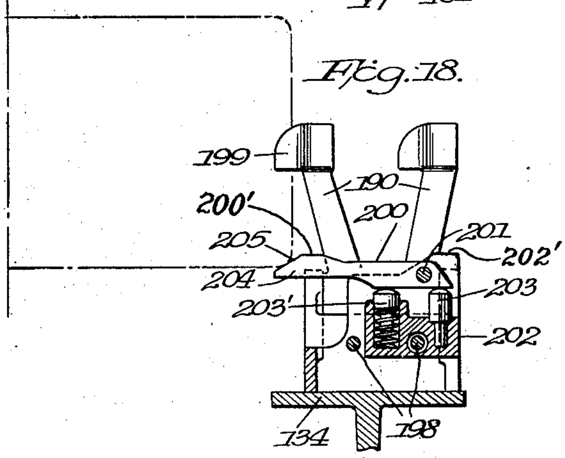

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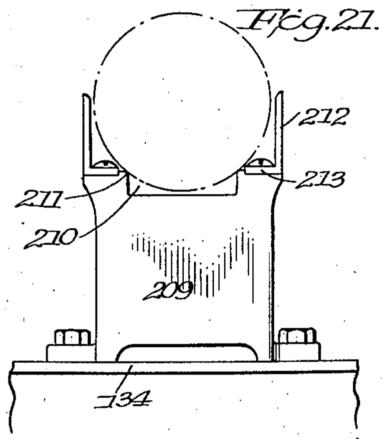

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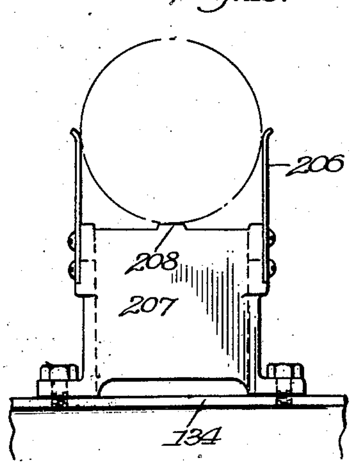

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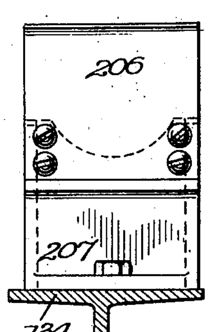

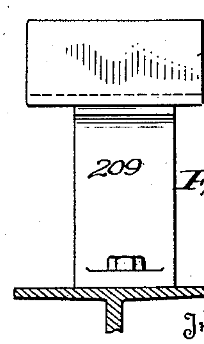

Fig. 22.

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APPARATUS FOR MAKING CONTAINERS

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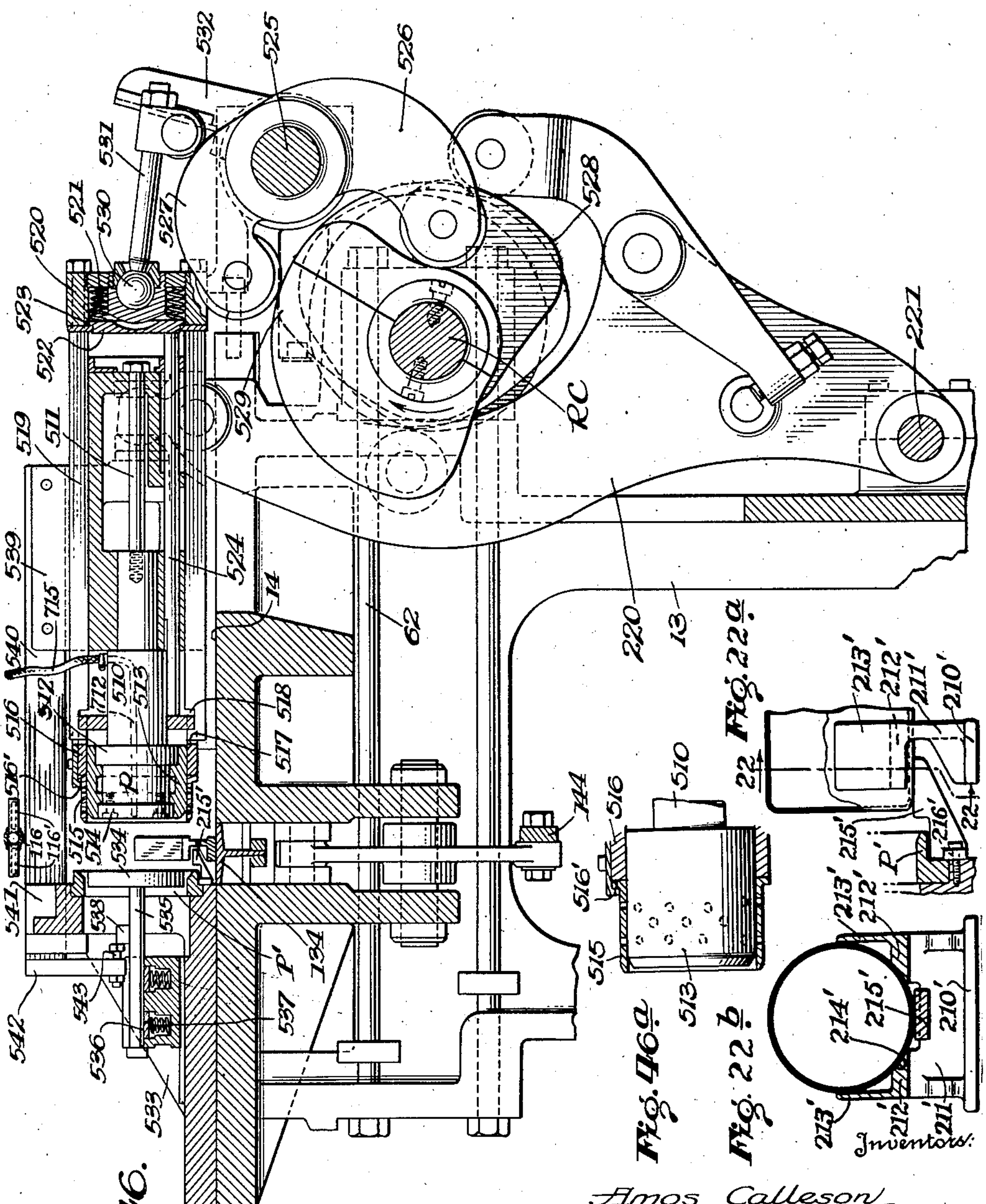

Fig. 46. Fig. 46a. Fig. 22a. Fig. 22b.

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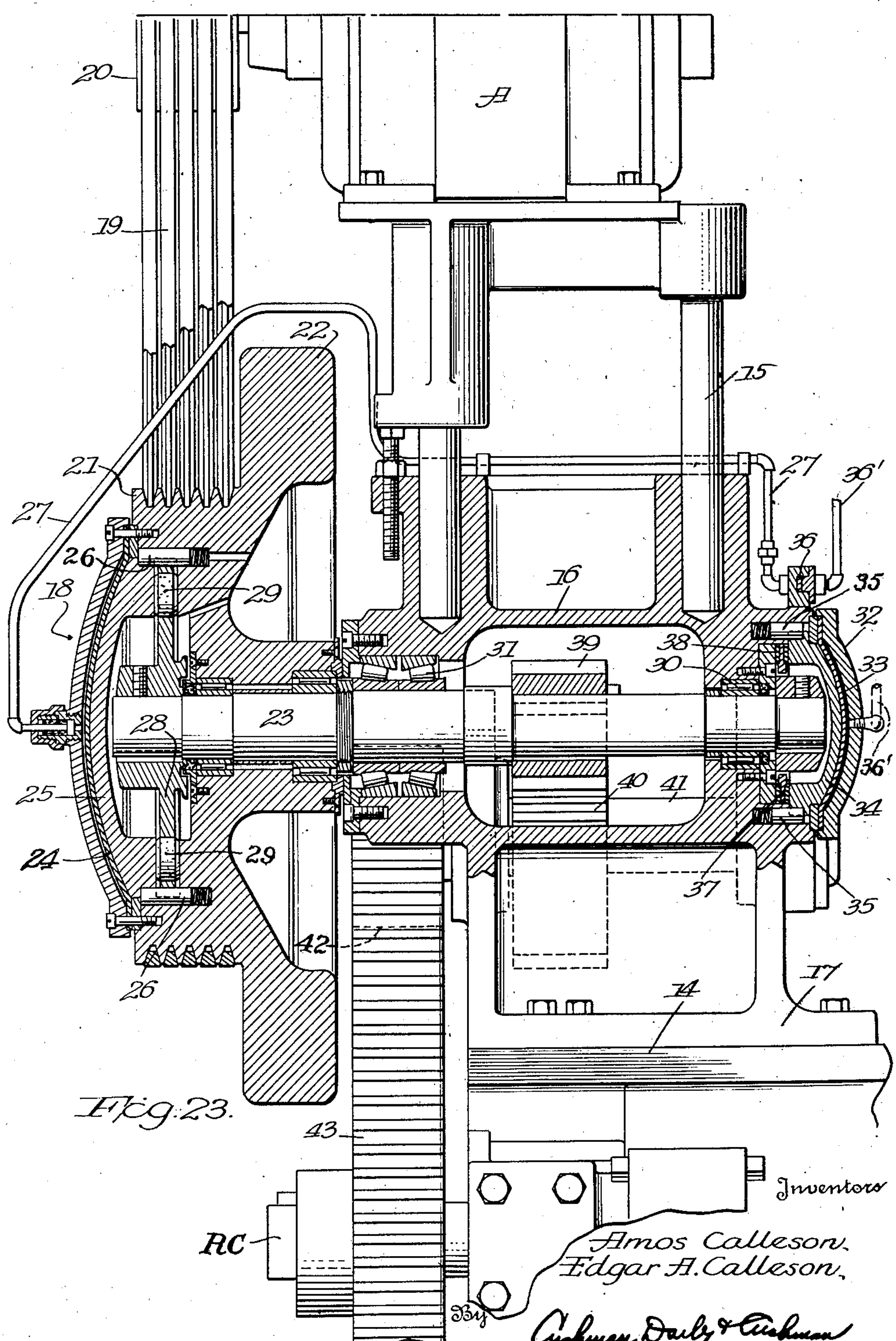

Fig. 23.

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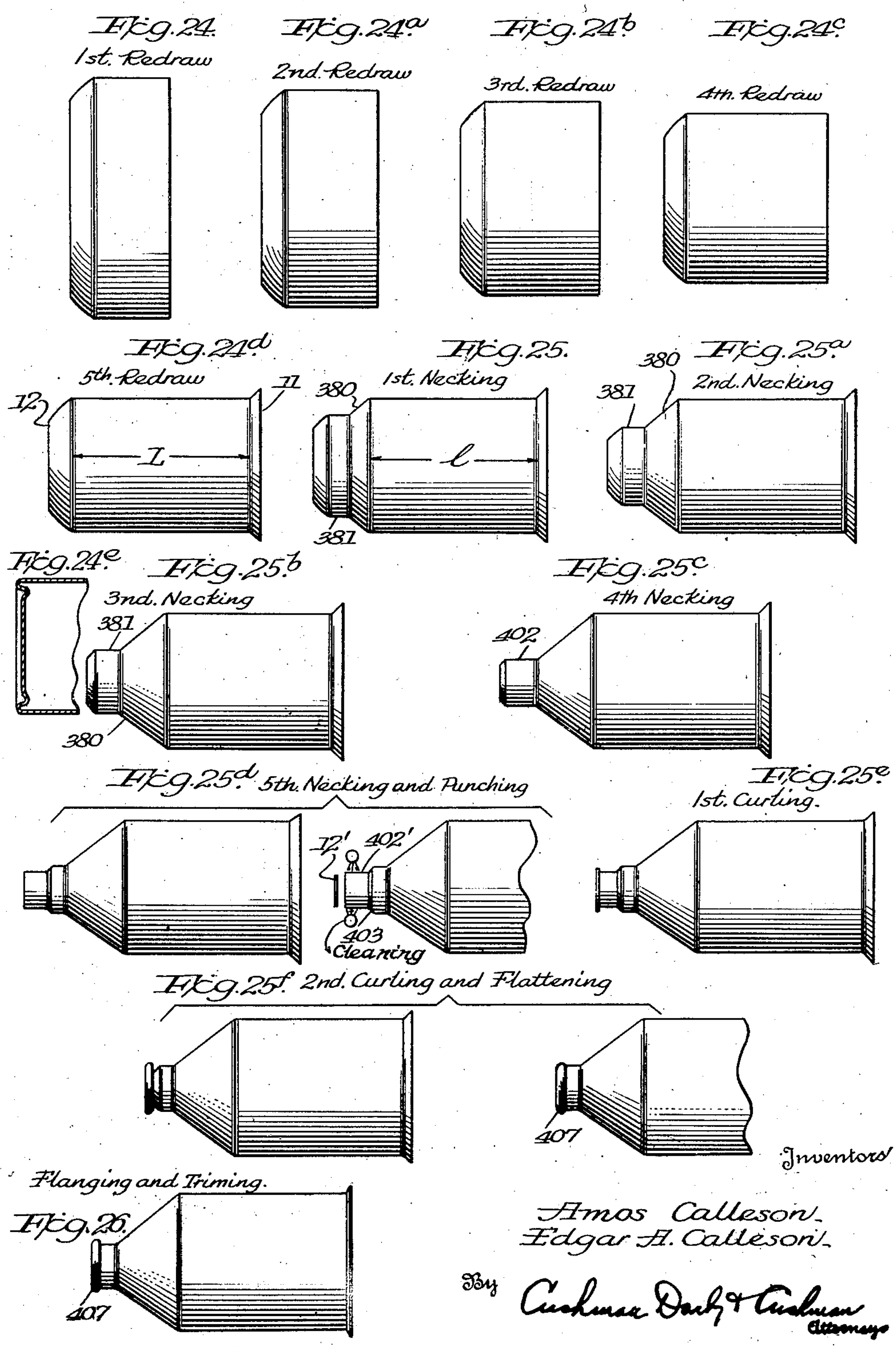

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APPARATUS FOR MAKING CONTAINERS

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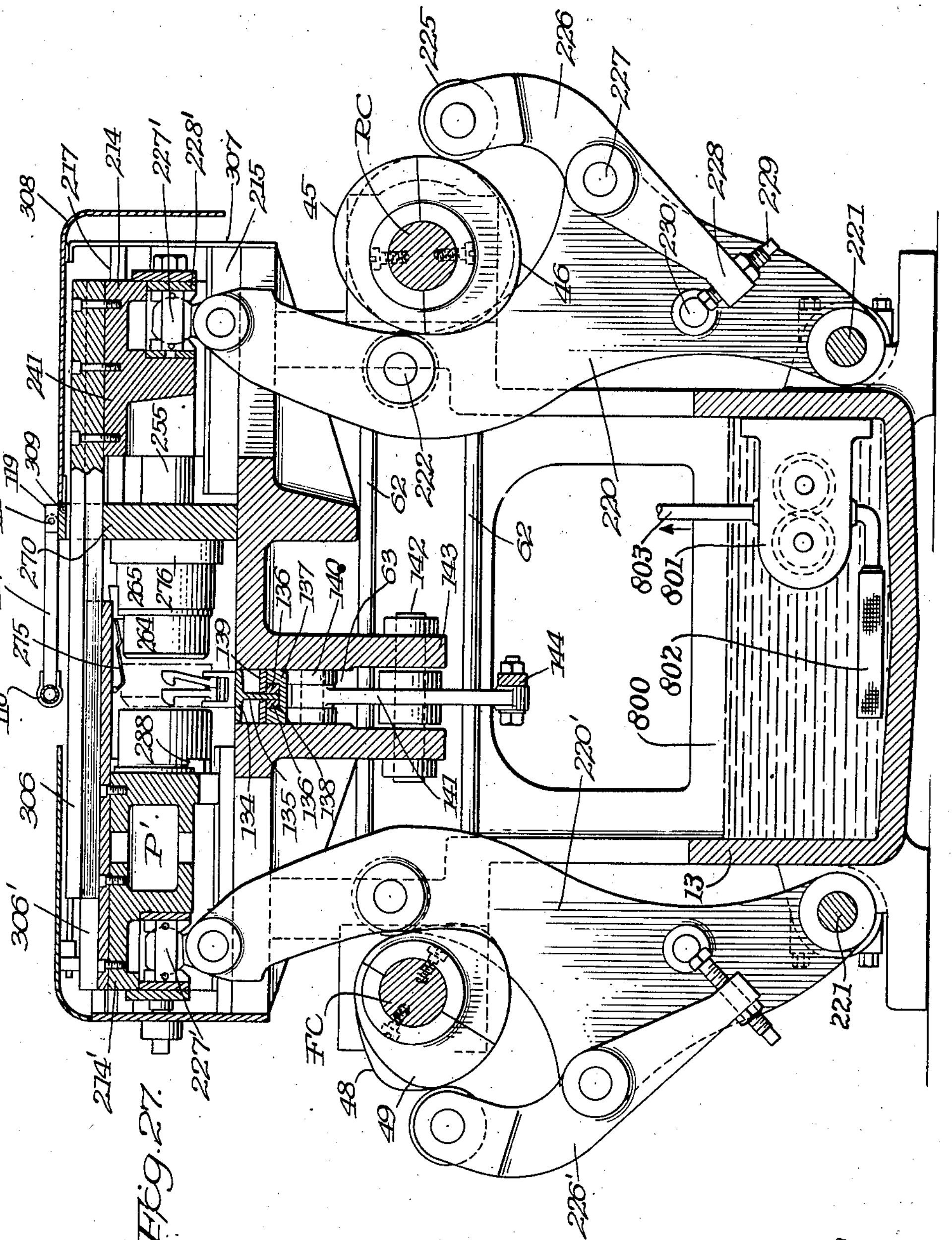

Fig. 27.

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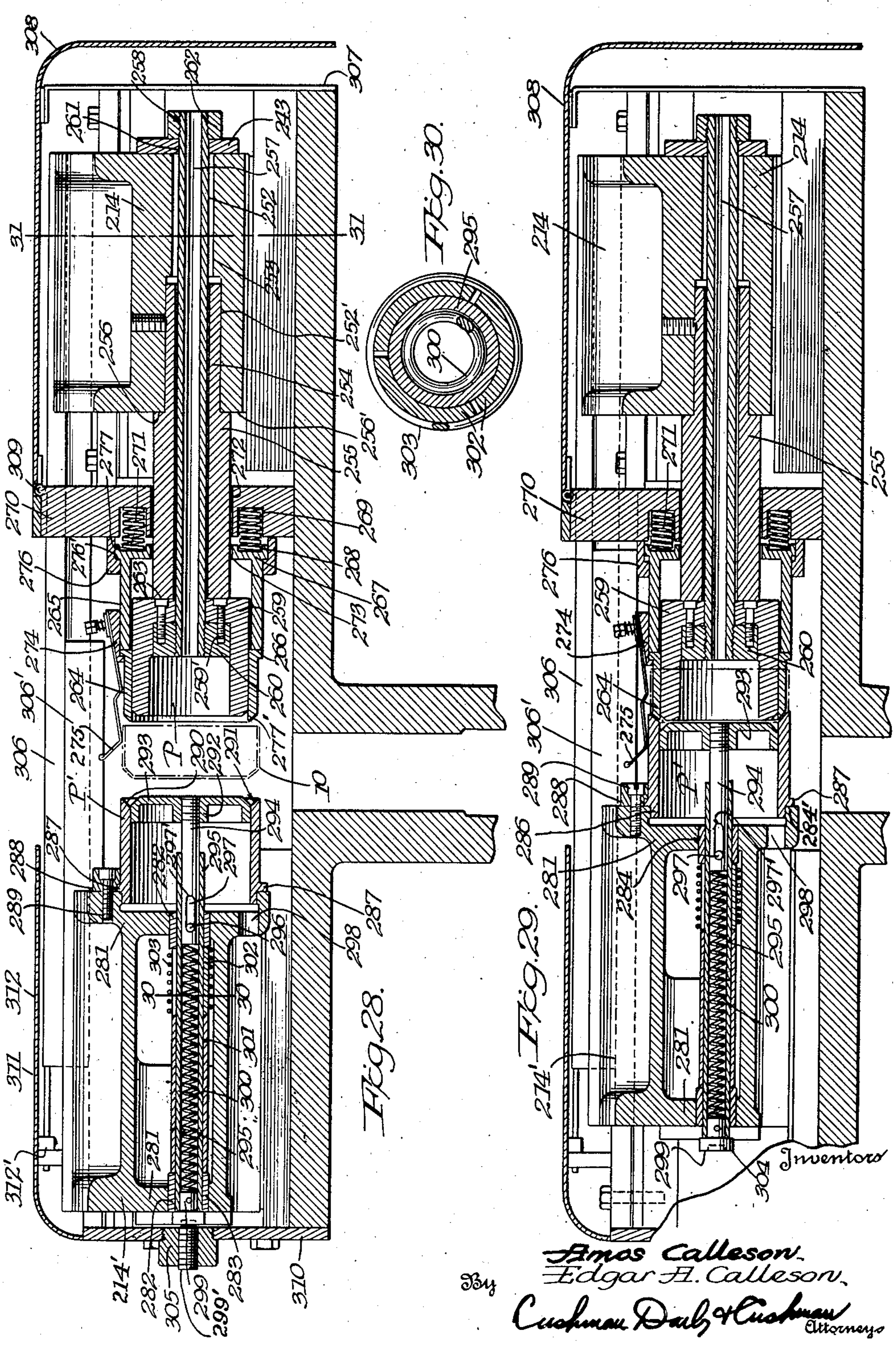

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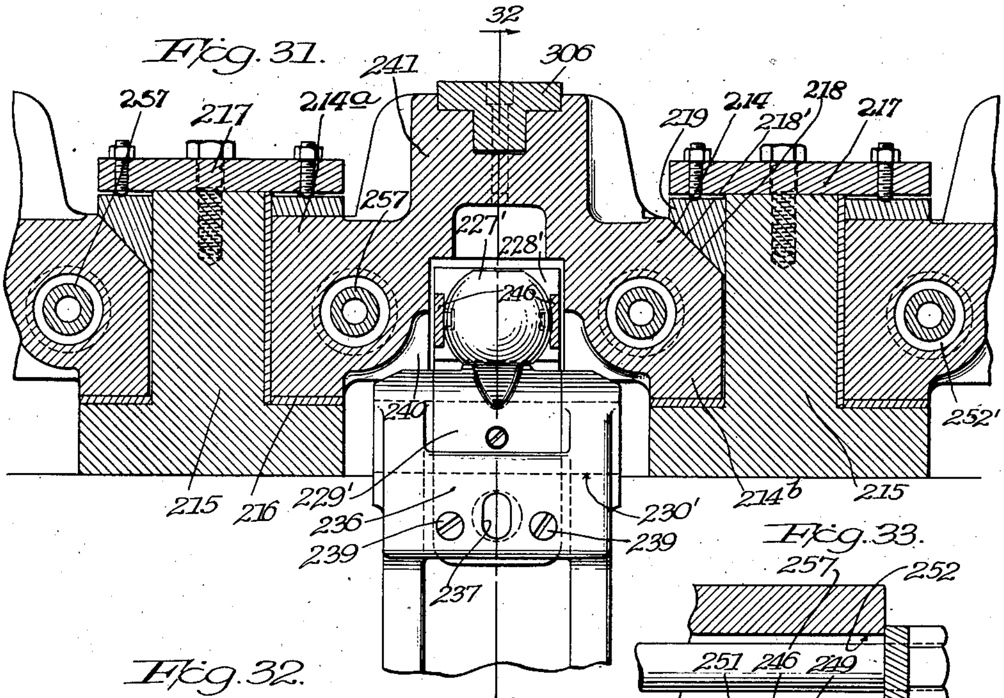
Fig. 31.



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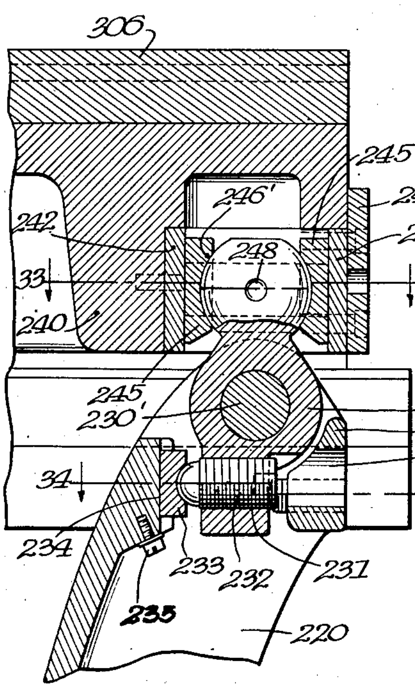

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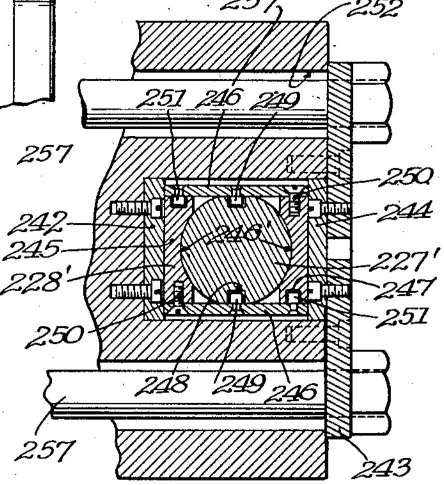

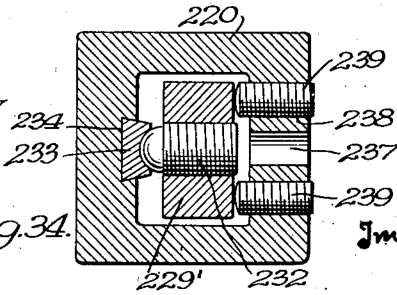

Fig. 34.

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APPARATUS FOR MAKING CONTAINERS

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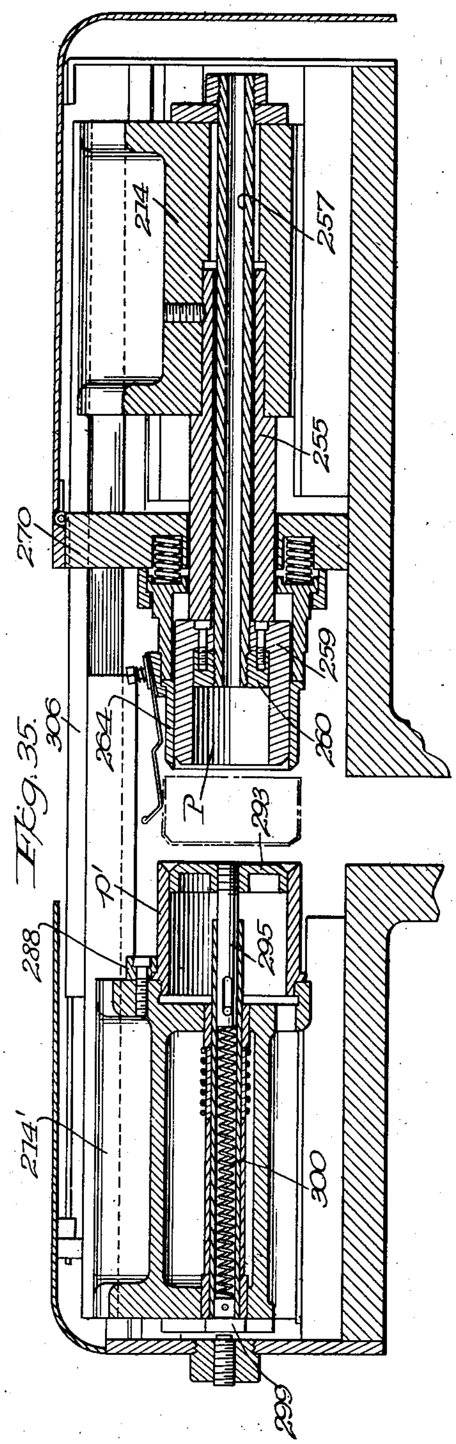

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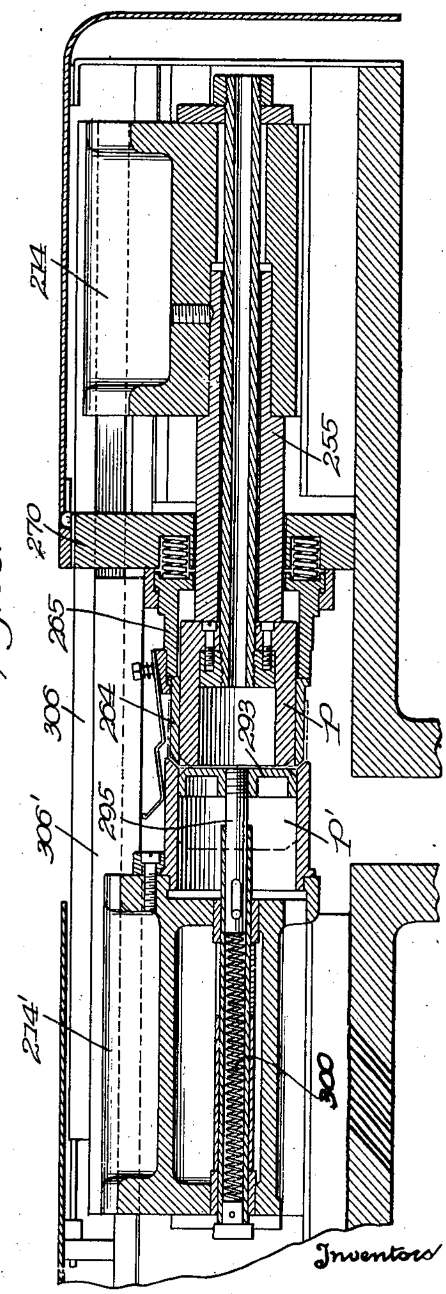

Fig. 36.

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Dec. 21, 1943. A. CALLESON ET AL 2,337,182

APPARATUS FOR MAKING CONTAINERS

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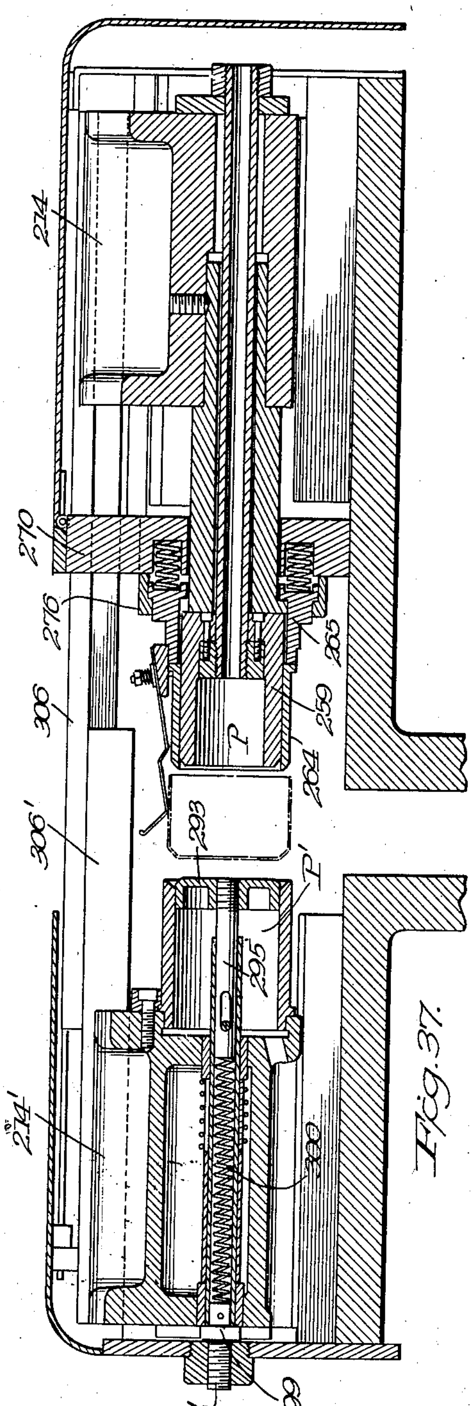

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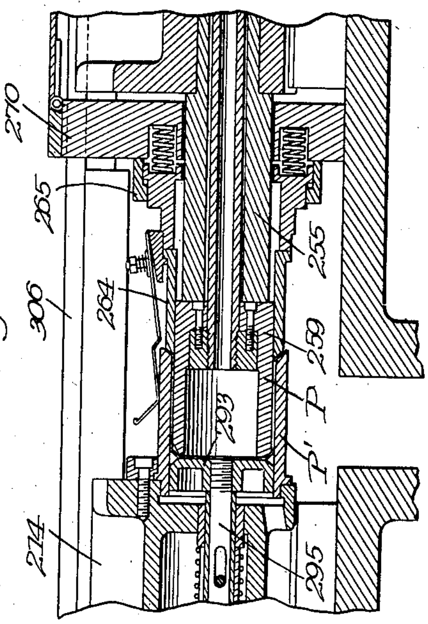

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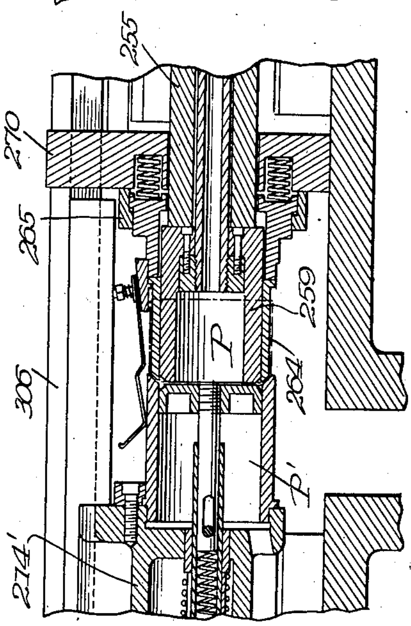

Fig. 38.

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APPARATUS FOR MAKING CONTAINERS

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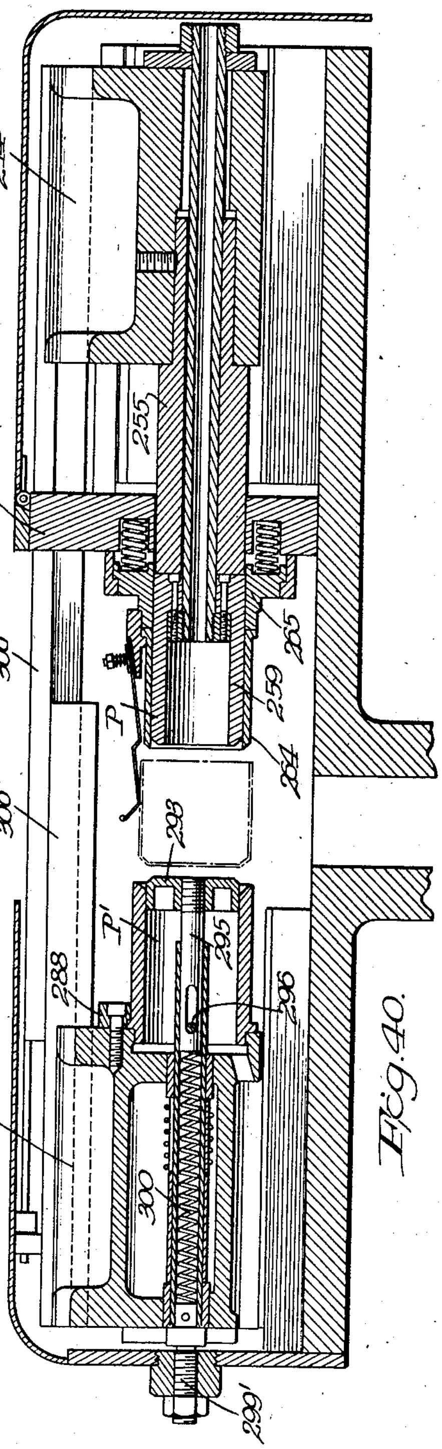

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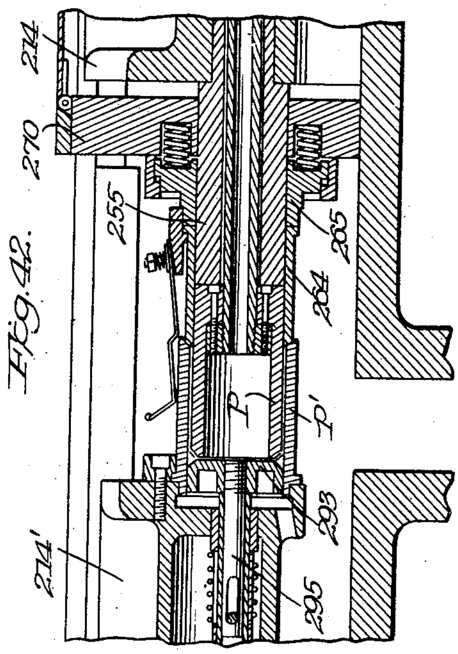

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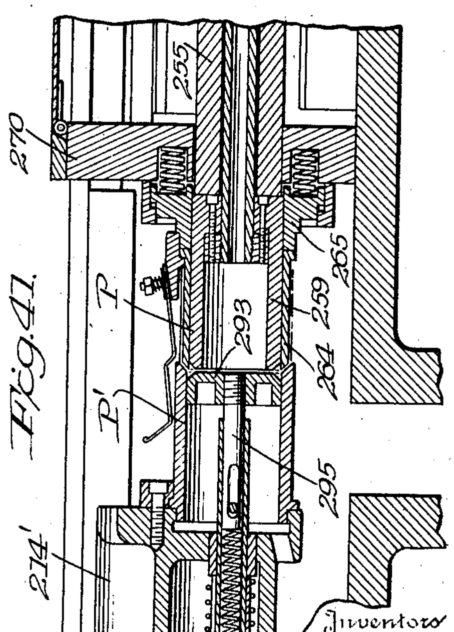

Fig. 41.

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APPARATUS FOR MAKING CONTAINERS

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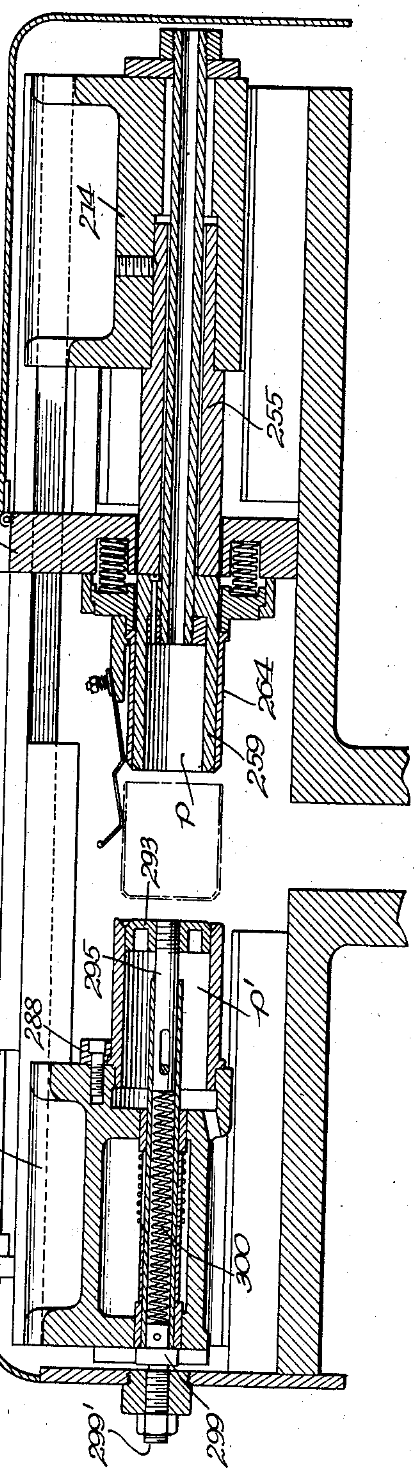

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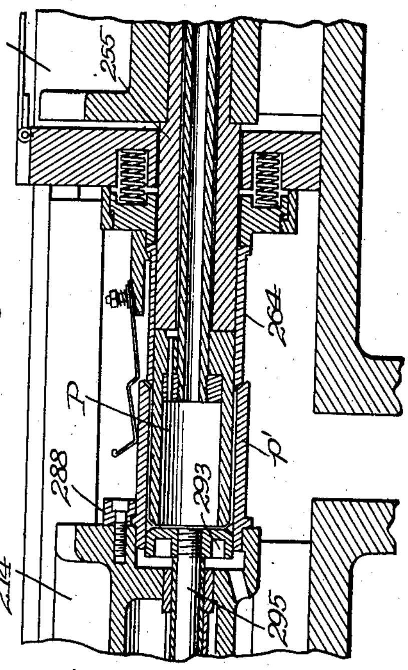

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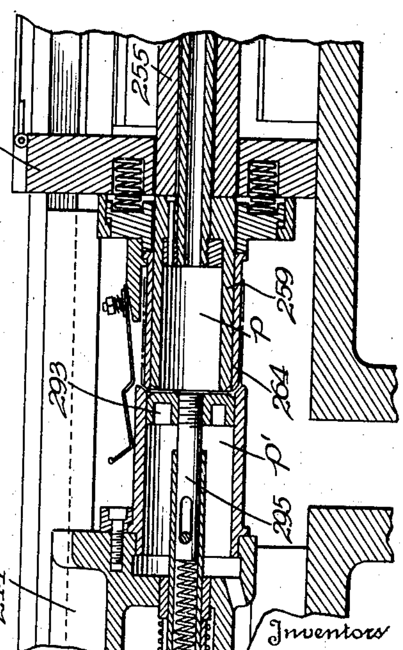

Fig. 44.

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APPARATUS FOR MAKING CONTAINERS

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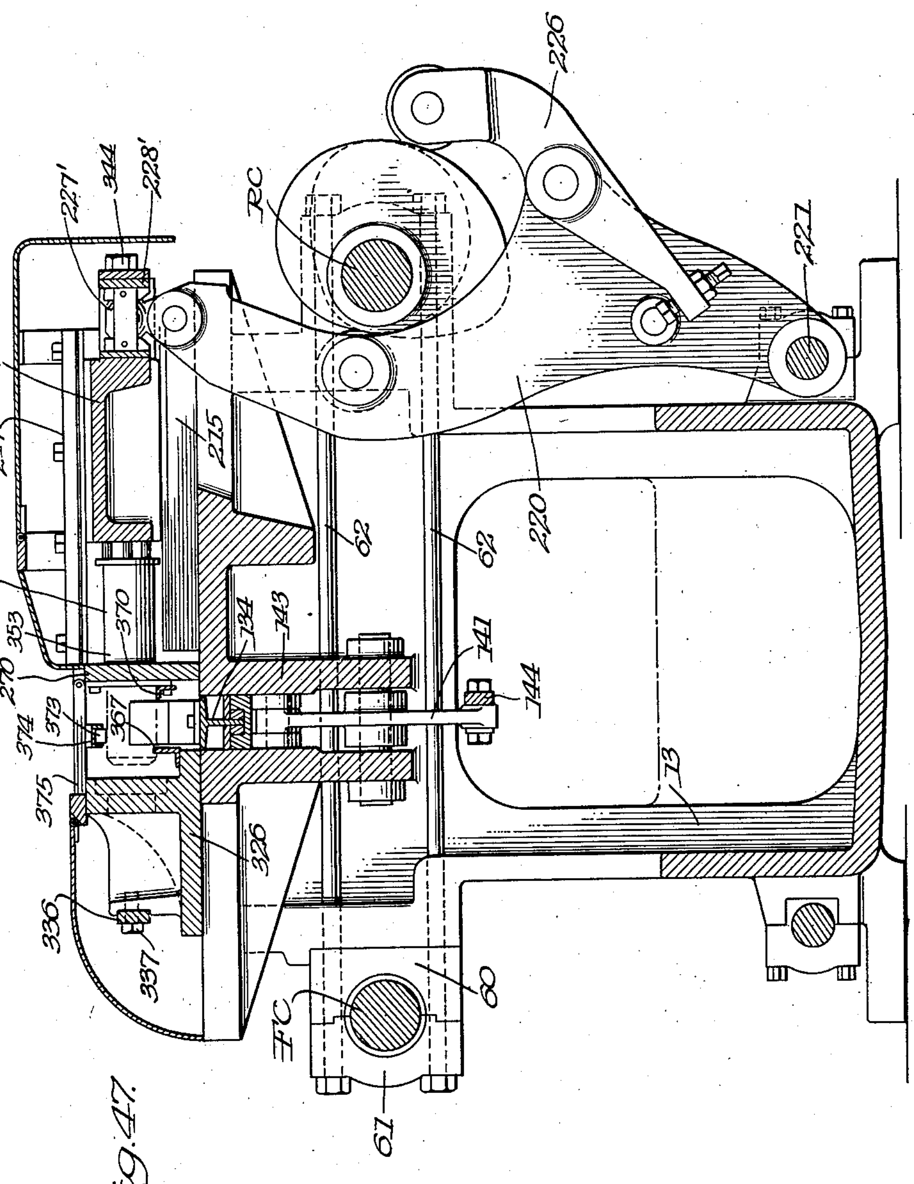

Fig. 47.

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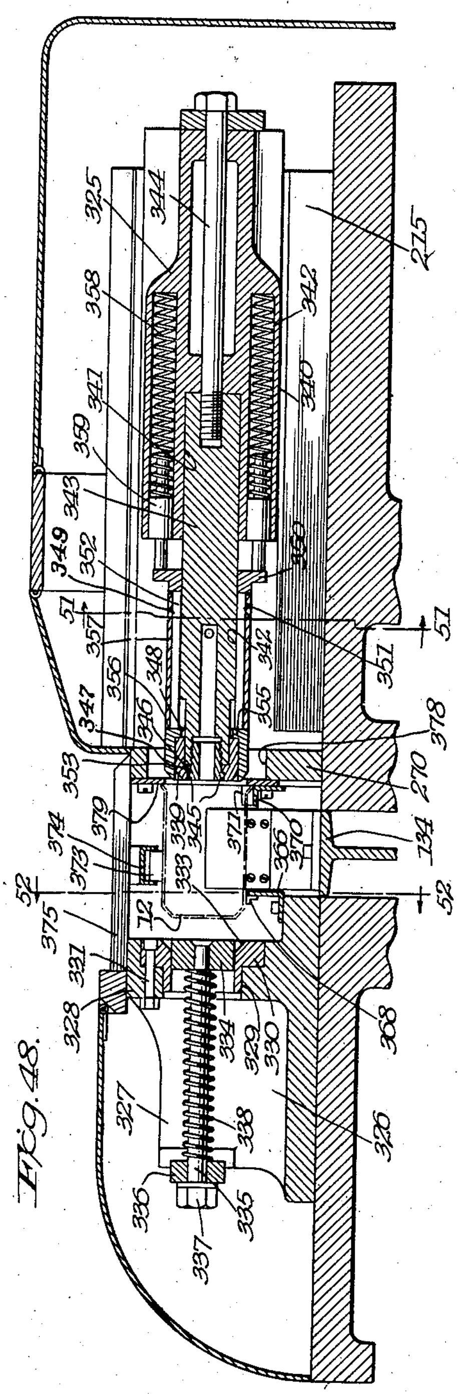

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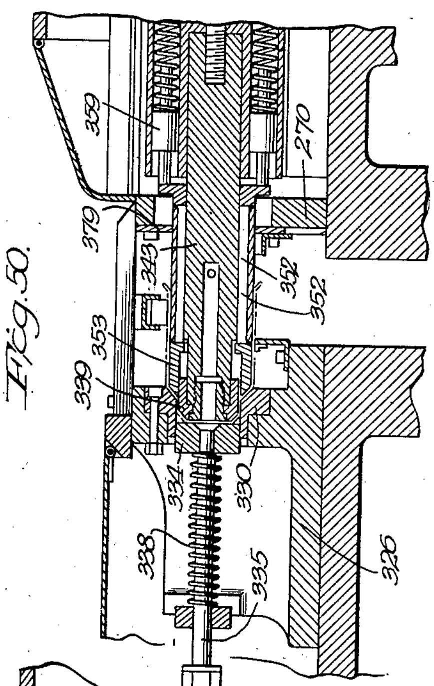

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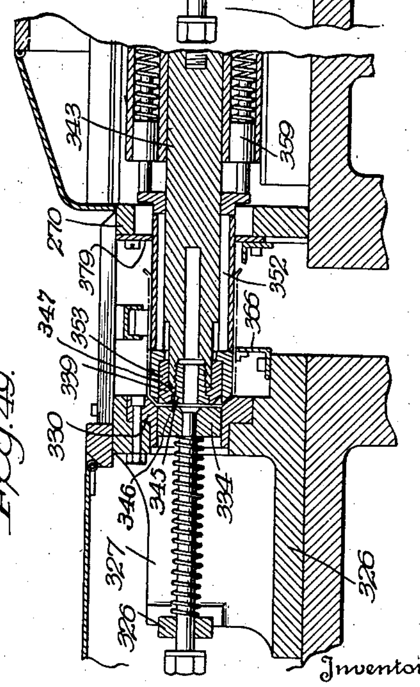

Fig. 49.

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Dec. 21, 1943.

A. CALLESON ET AL

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APPARATUS FOR MAKING CONTAINERS

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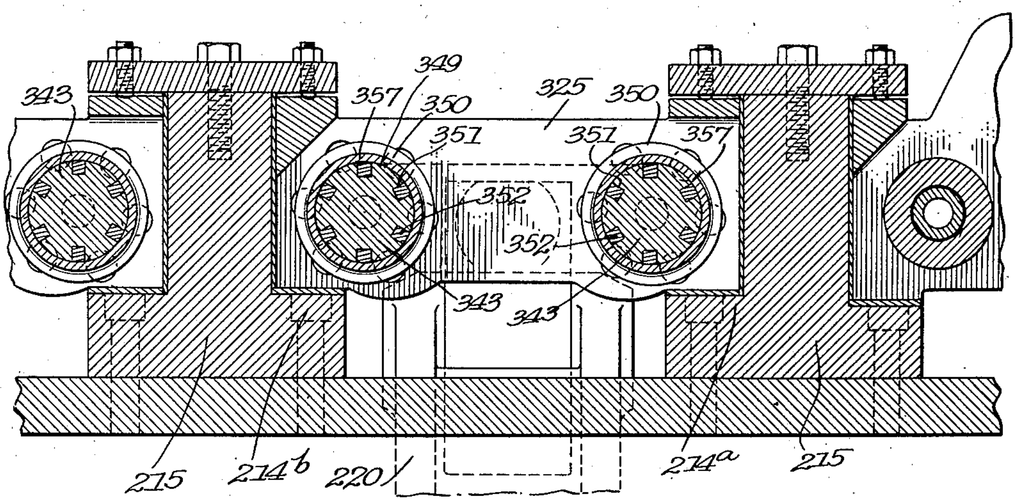
Fig. 51.



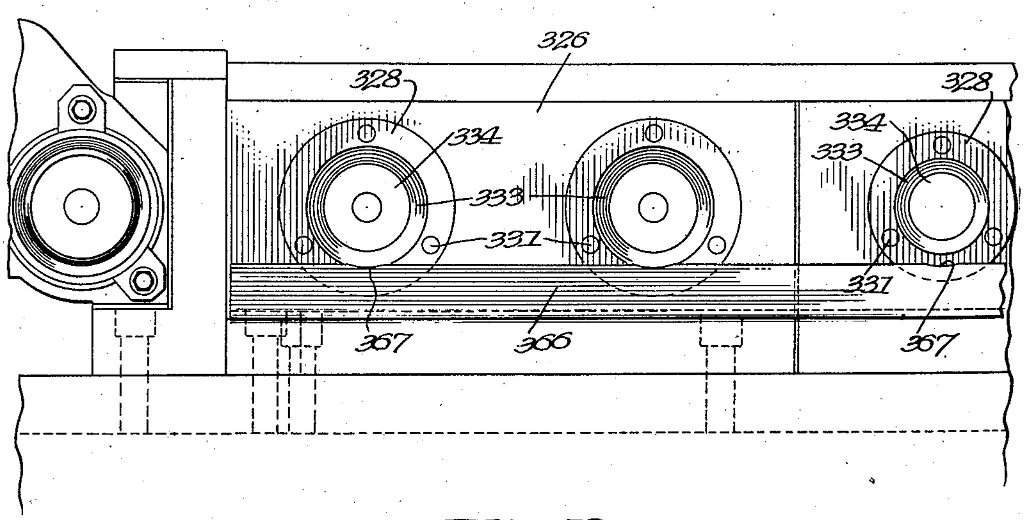


Fig. 52.

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Dec. 21, 1943. A. CALLESON ET AL 2,337,182

APPARATUS FOR MAKING CONTAINERS

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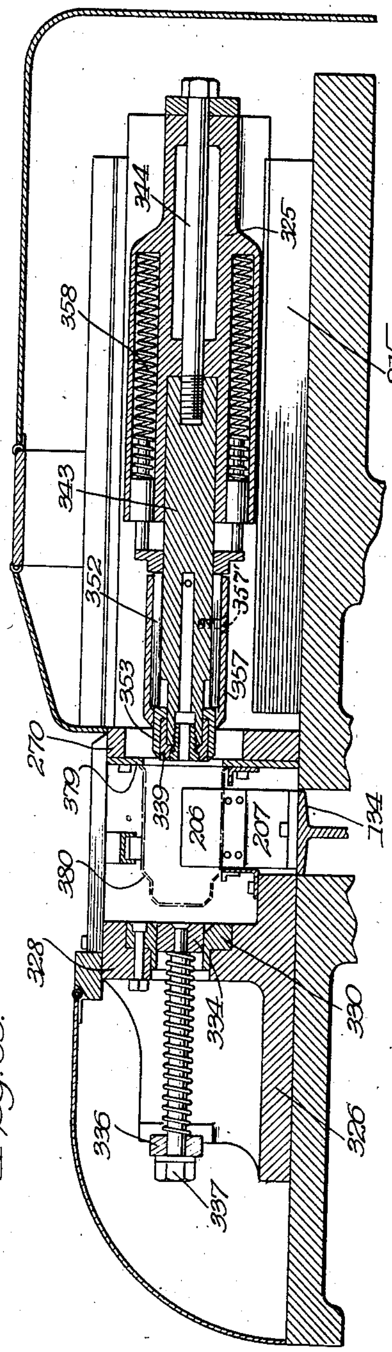

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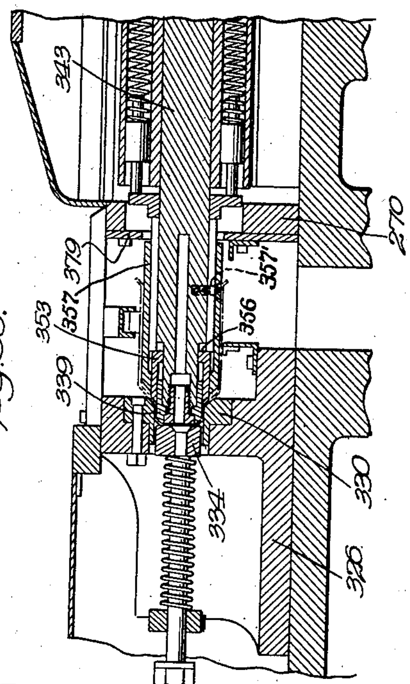

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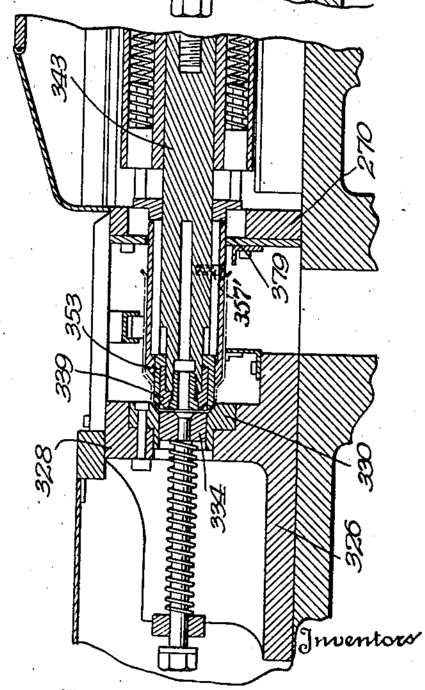

Fig. 54.

Inventors

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APPARATUS FOR MAKING CONTAINERS

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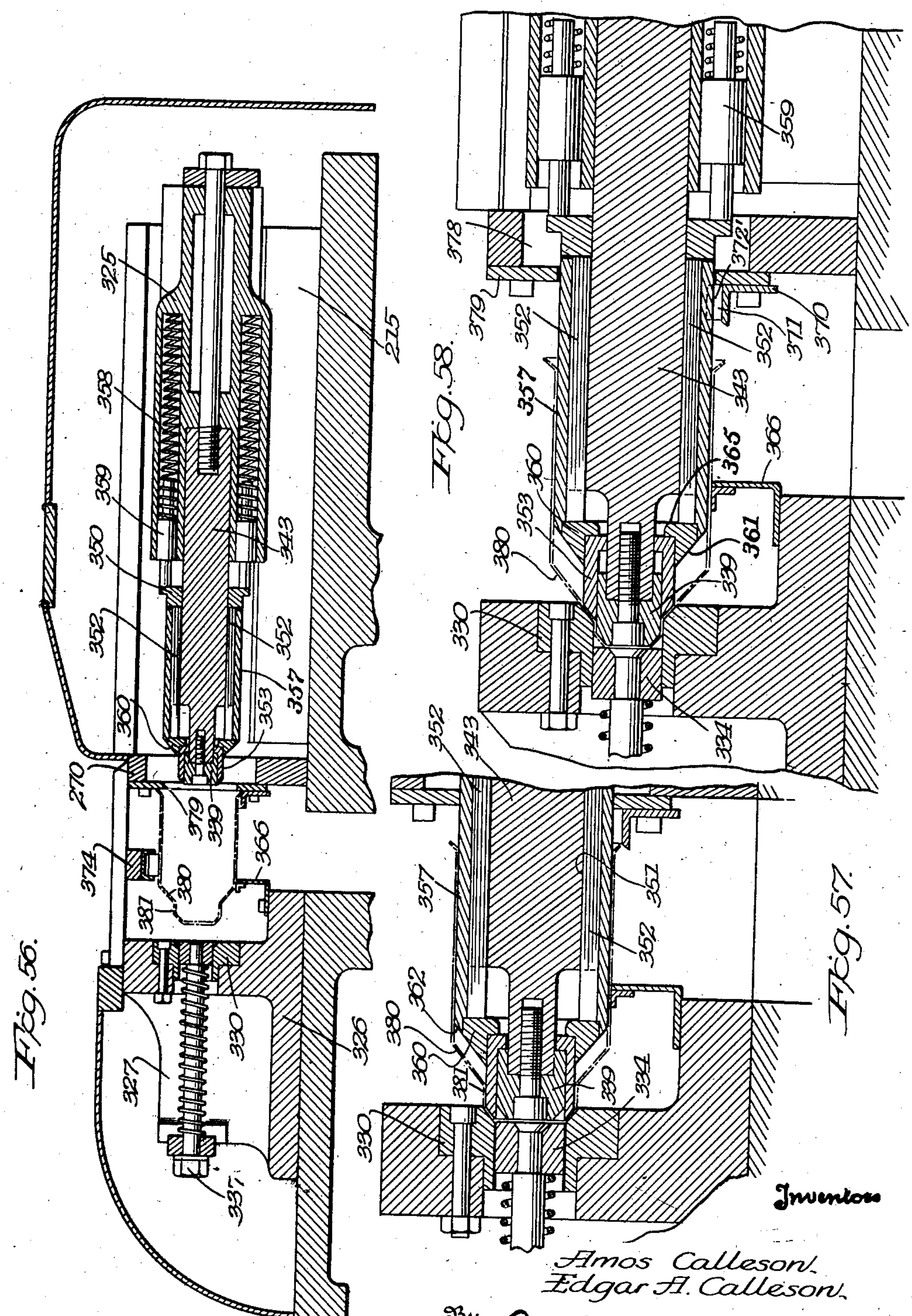

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APPARATUS FOR MAKING CONTAINERS

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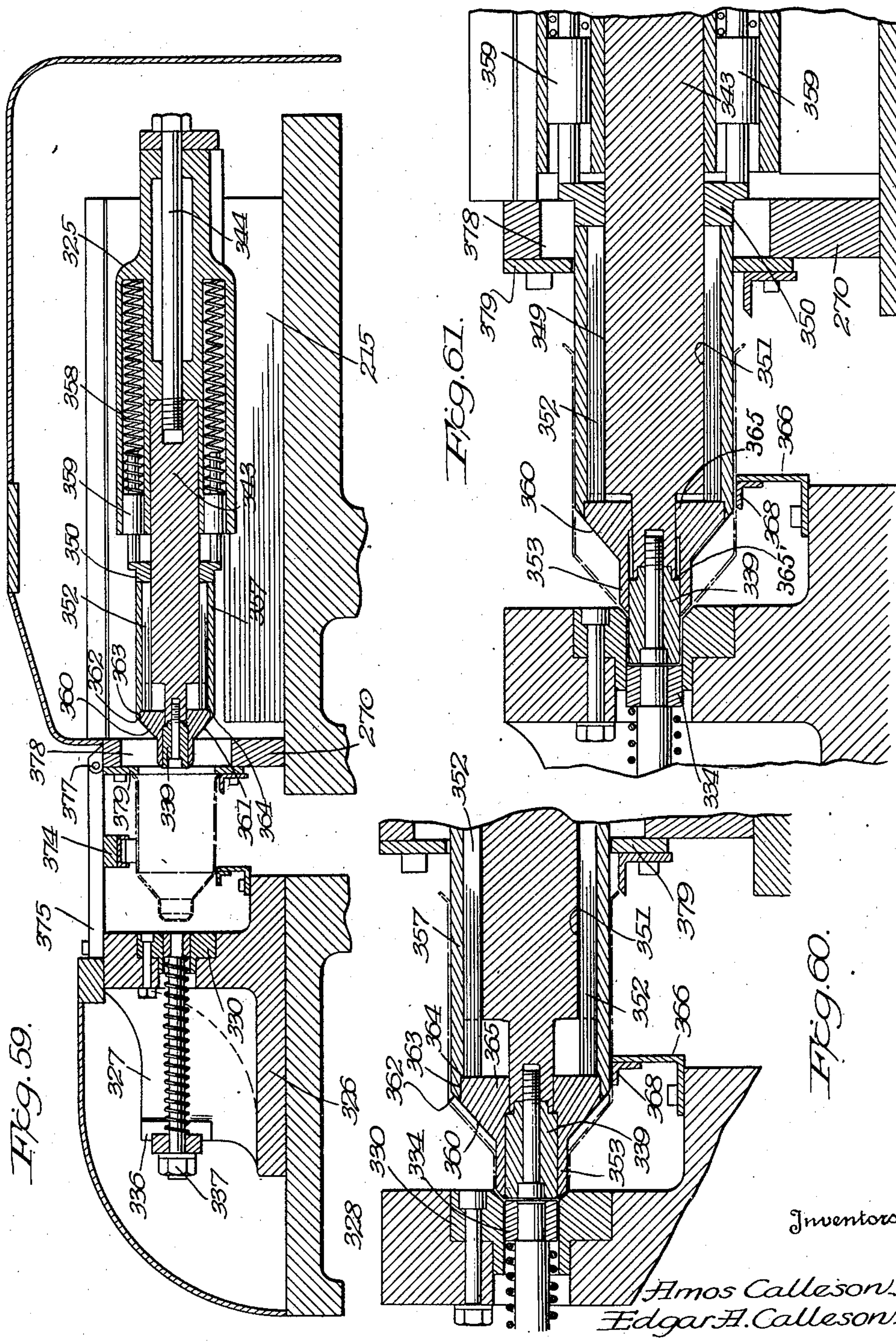

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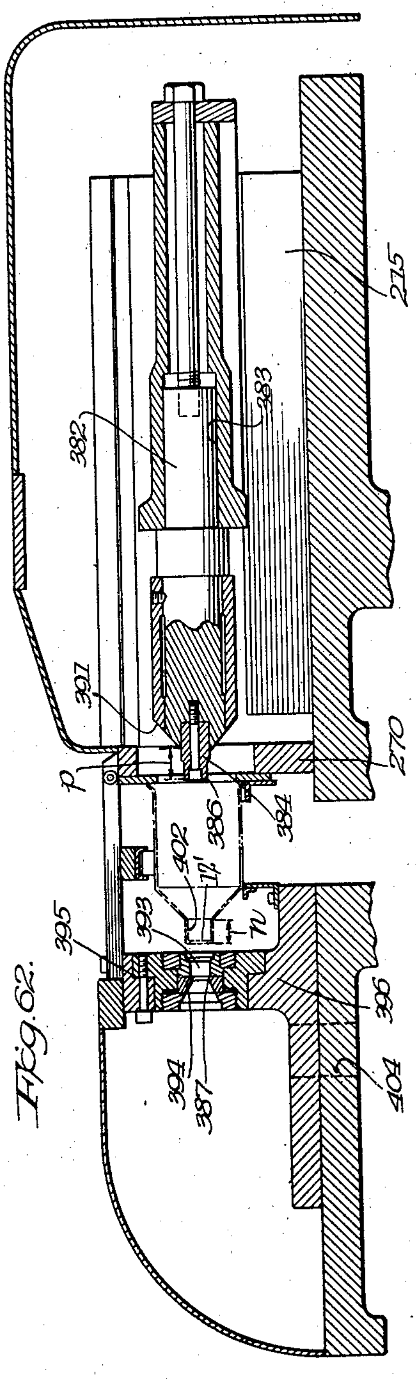

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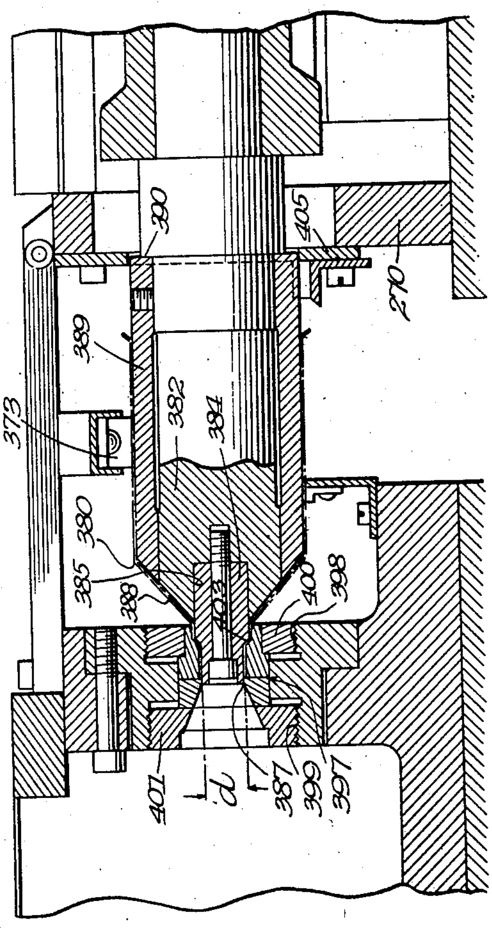

Fig. 63.

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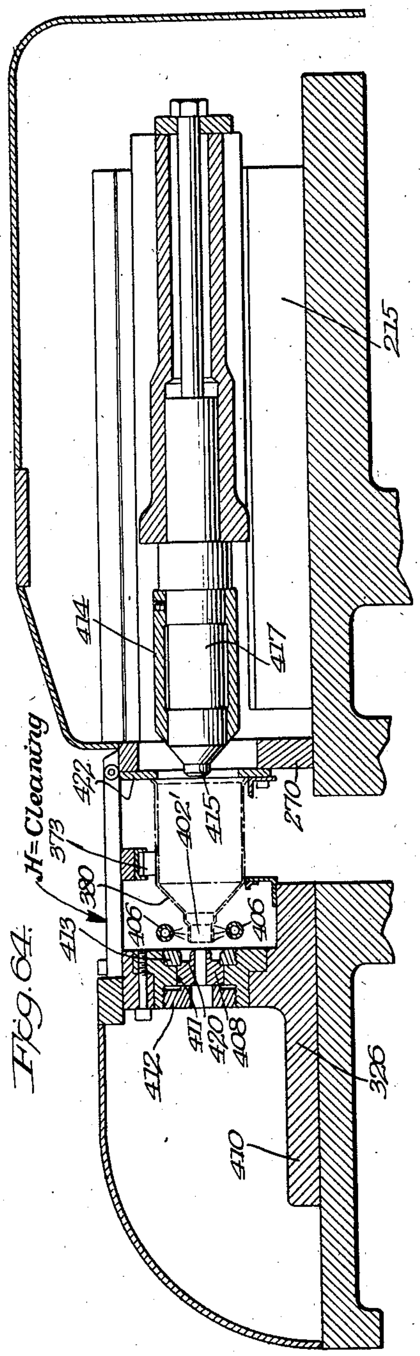

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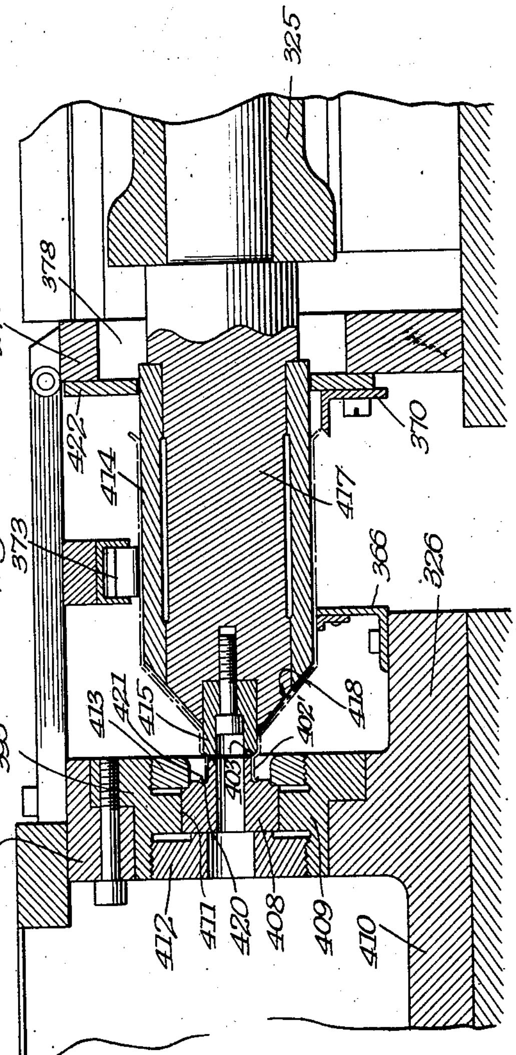

Fig. 65.

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APPARATUS FOR MAKING CONTAINERS

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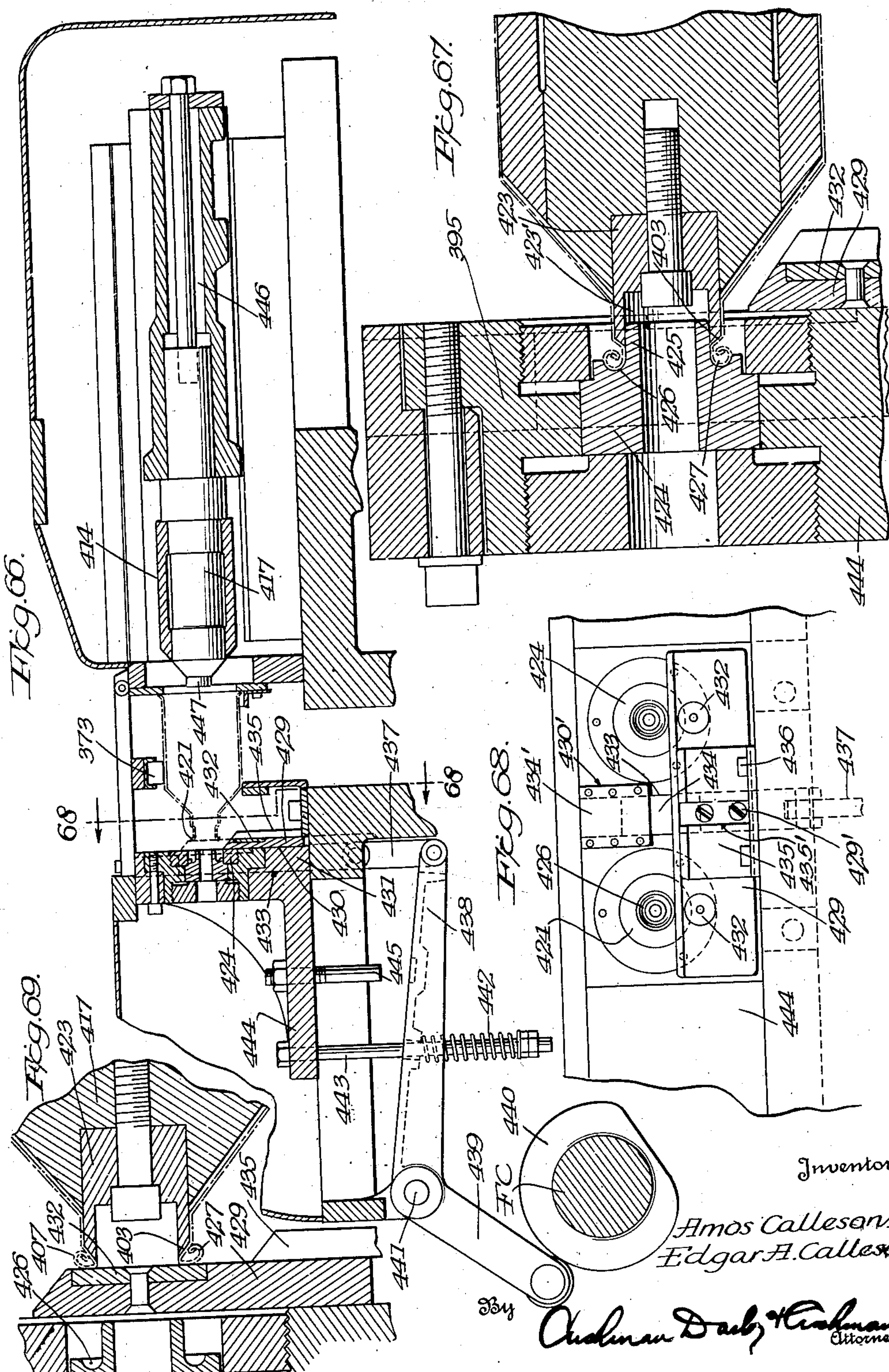

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Dec. 21, 1943. A. CALLESON ET AL 2,337,182

APPARATUS FOR MAKING CONTAINERS

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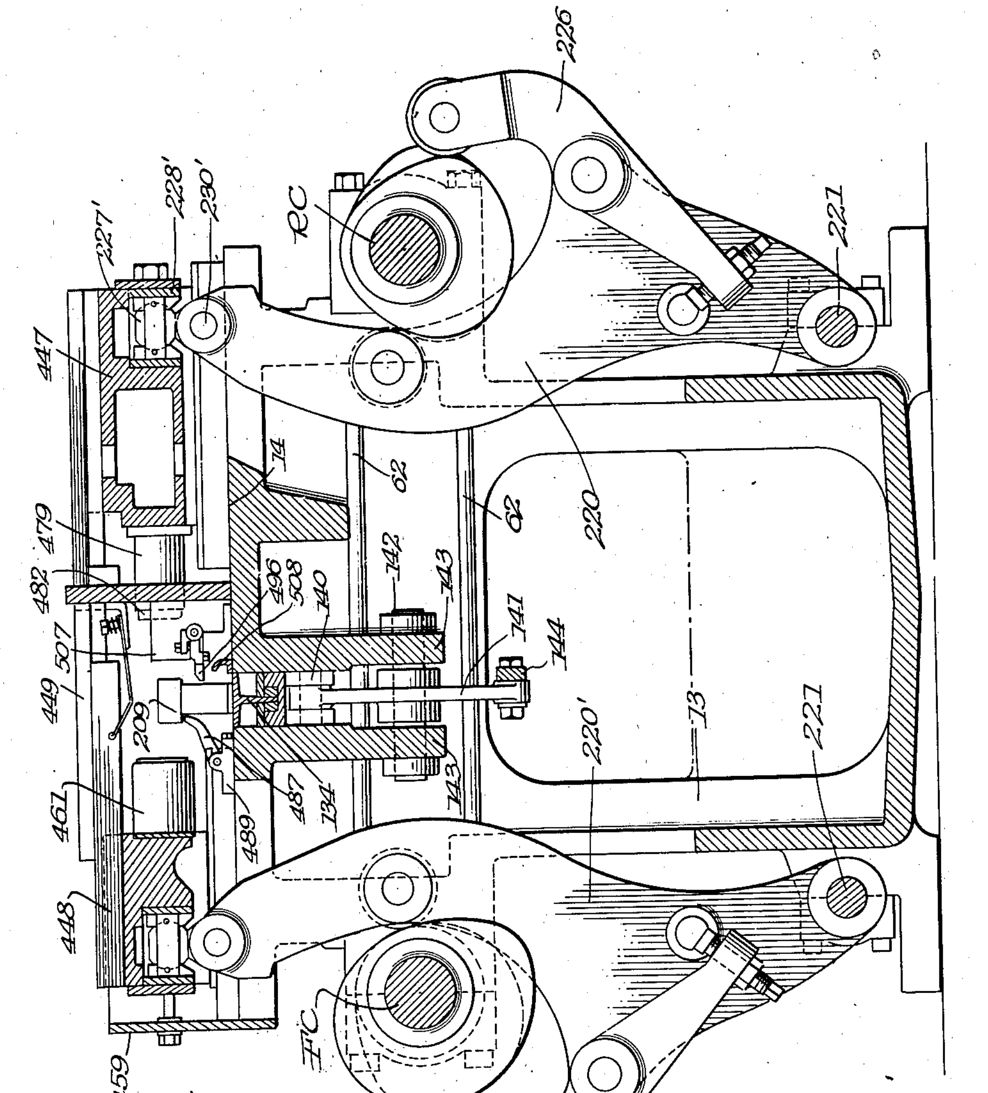

Fig. 70.

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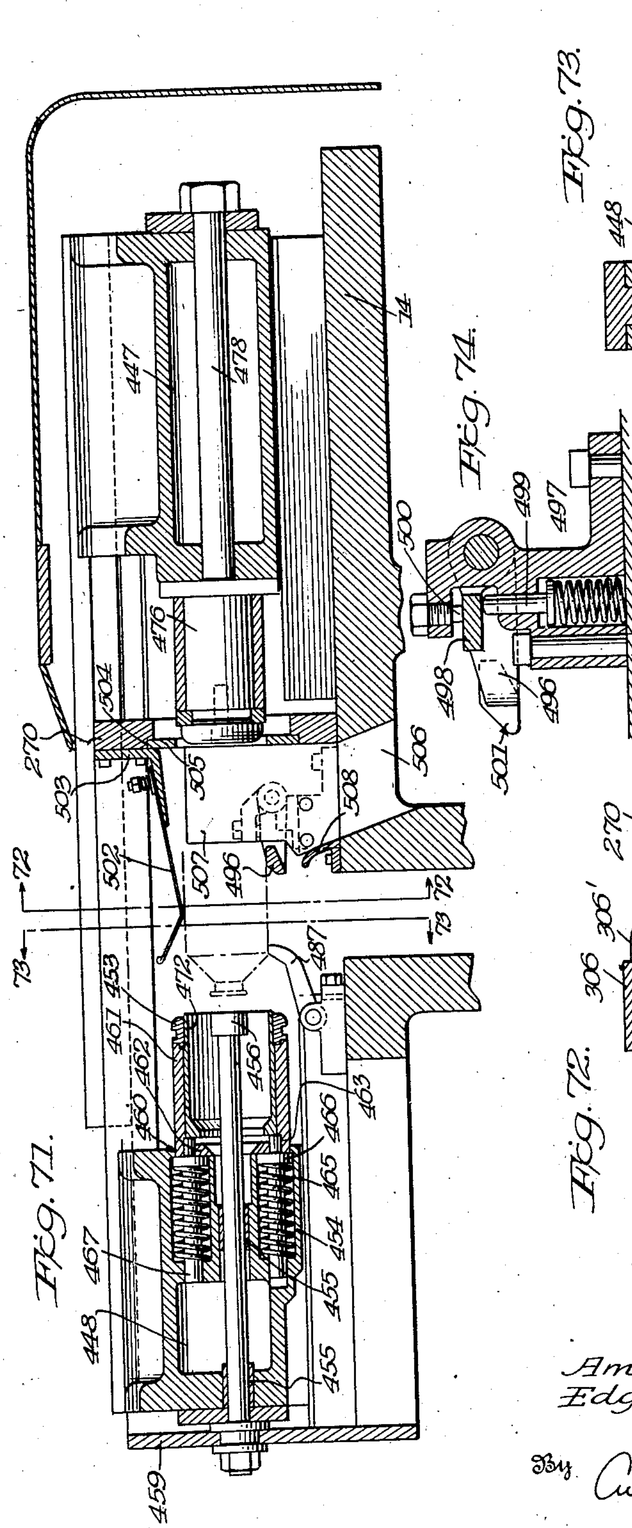

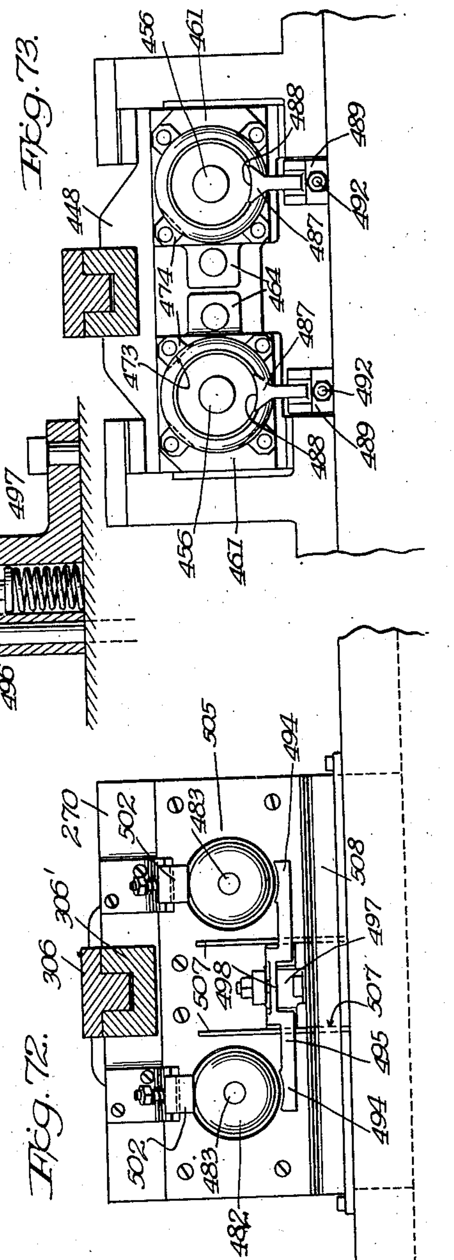

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APPARATUS FOR MAKING CONTAINERS

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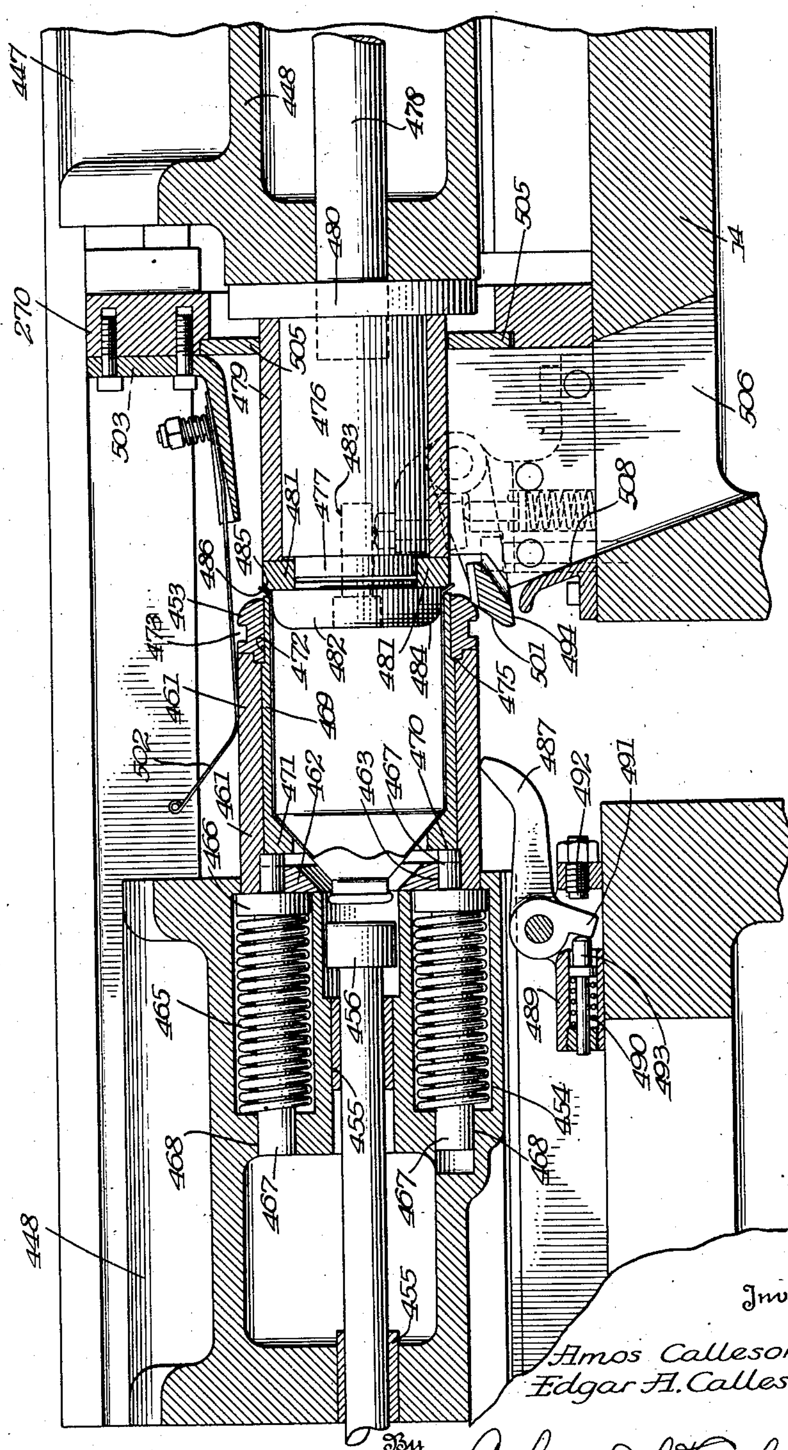

Fig. 75.

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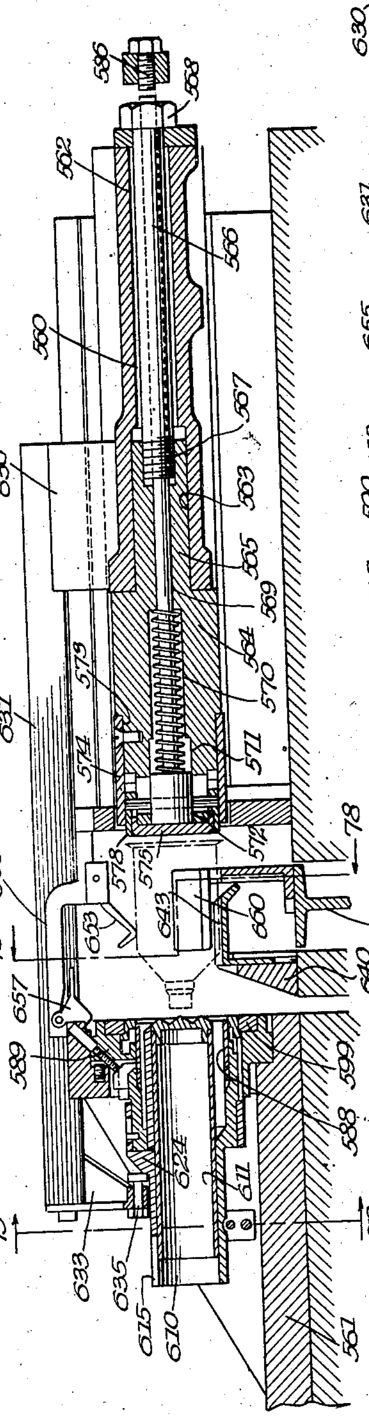

Fig. 76.

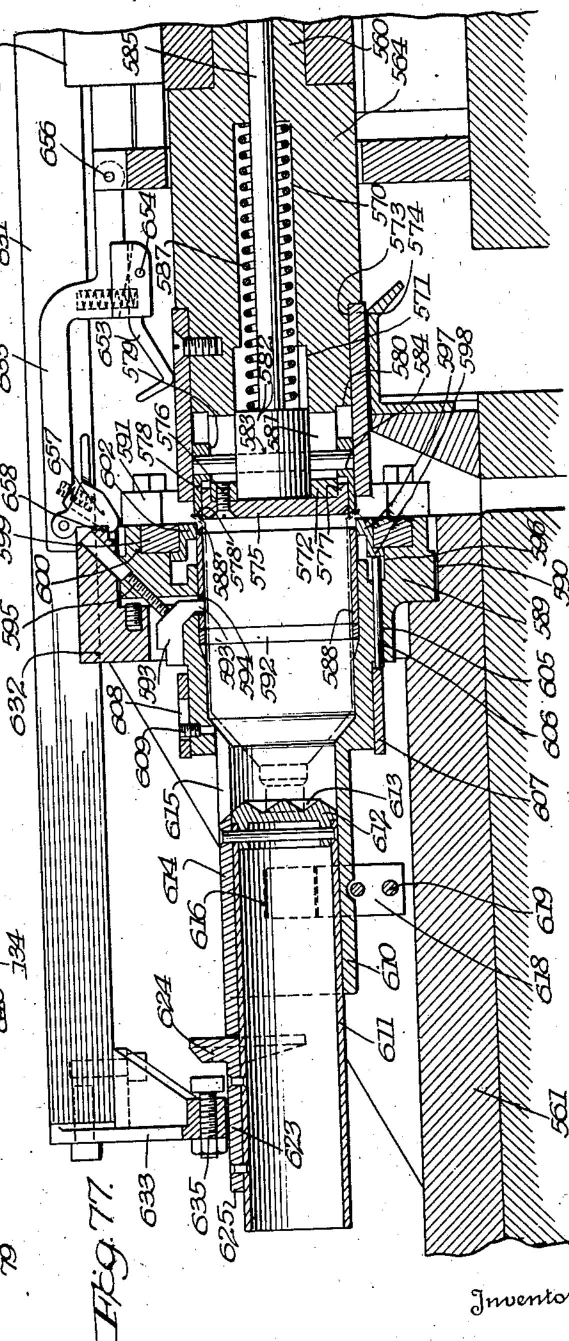

Fig. 77.

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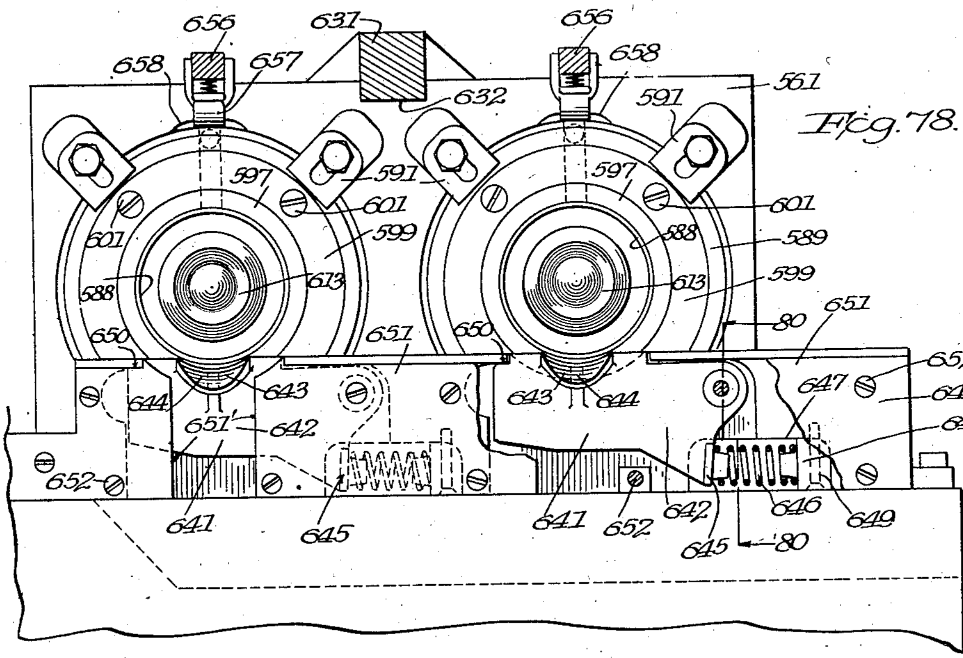
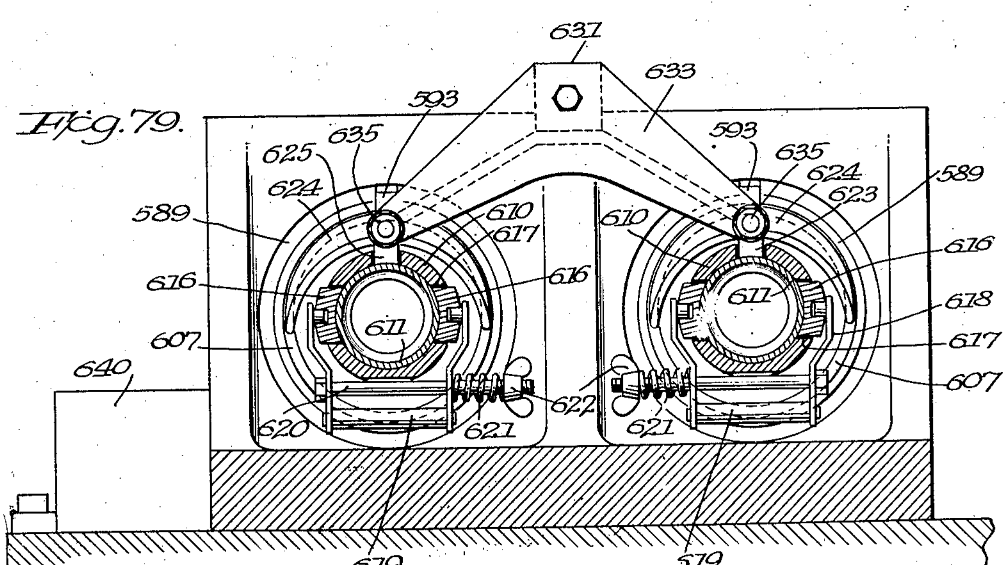


Fig. 78.

Fig. 79.



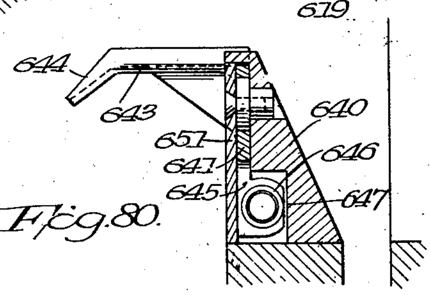


Fig. 80.

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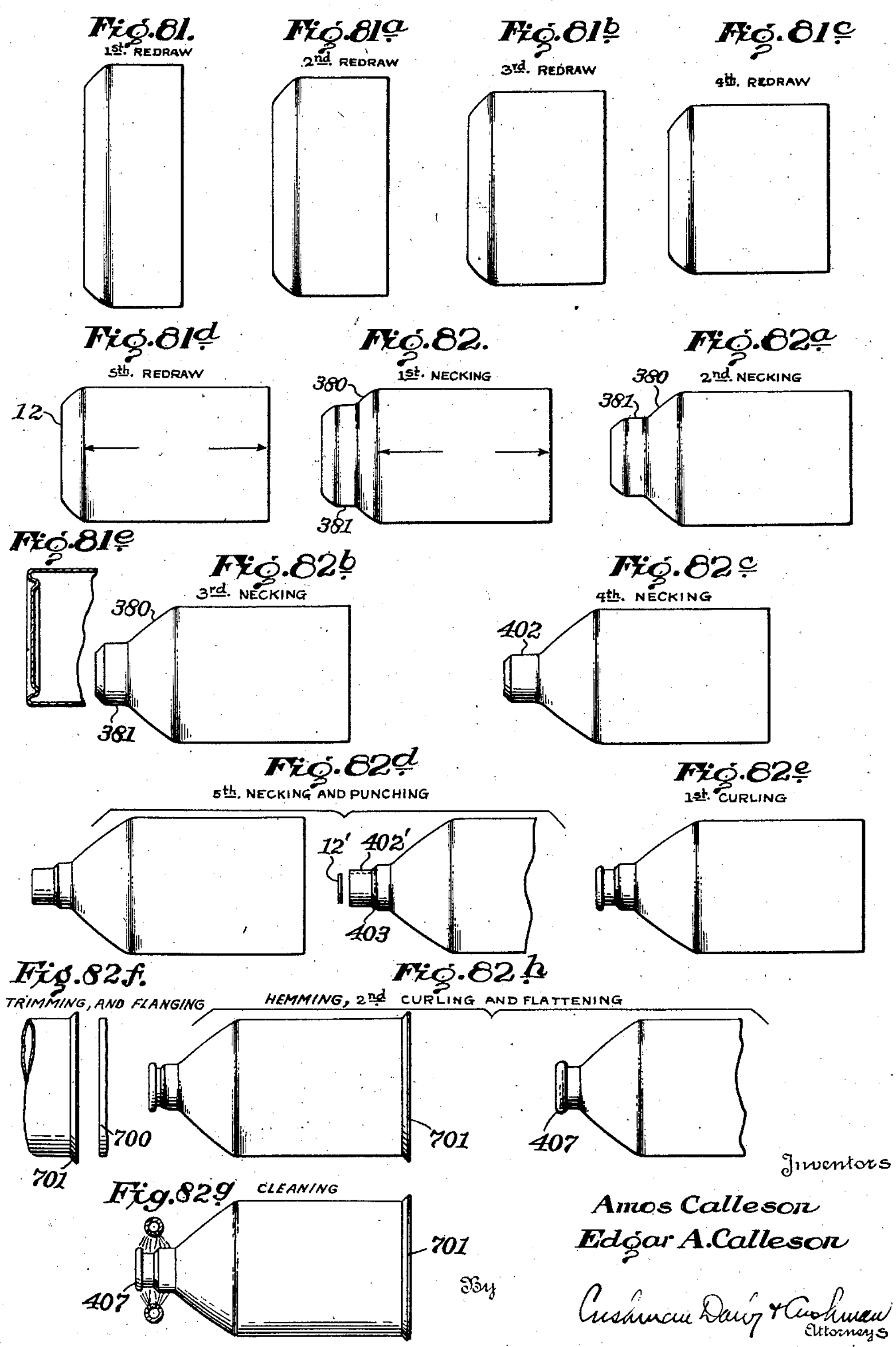

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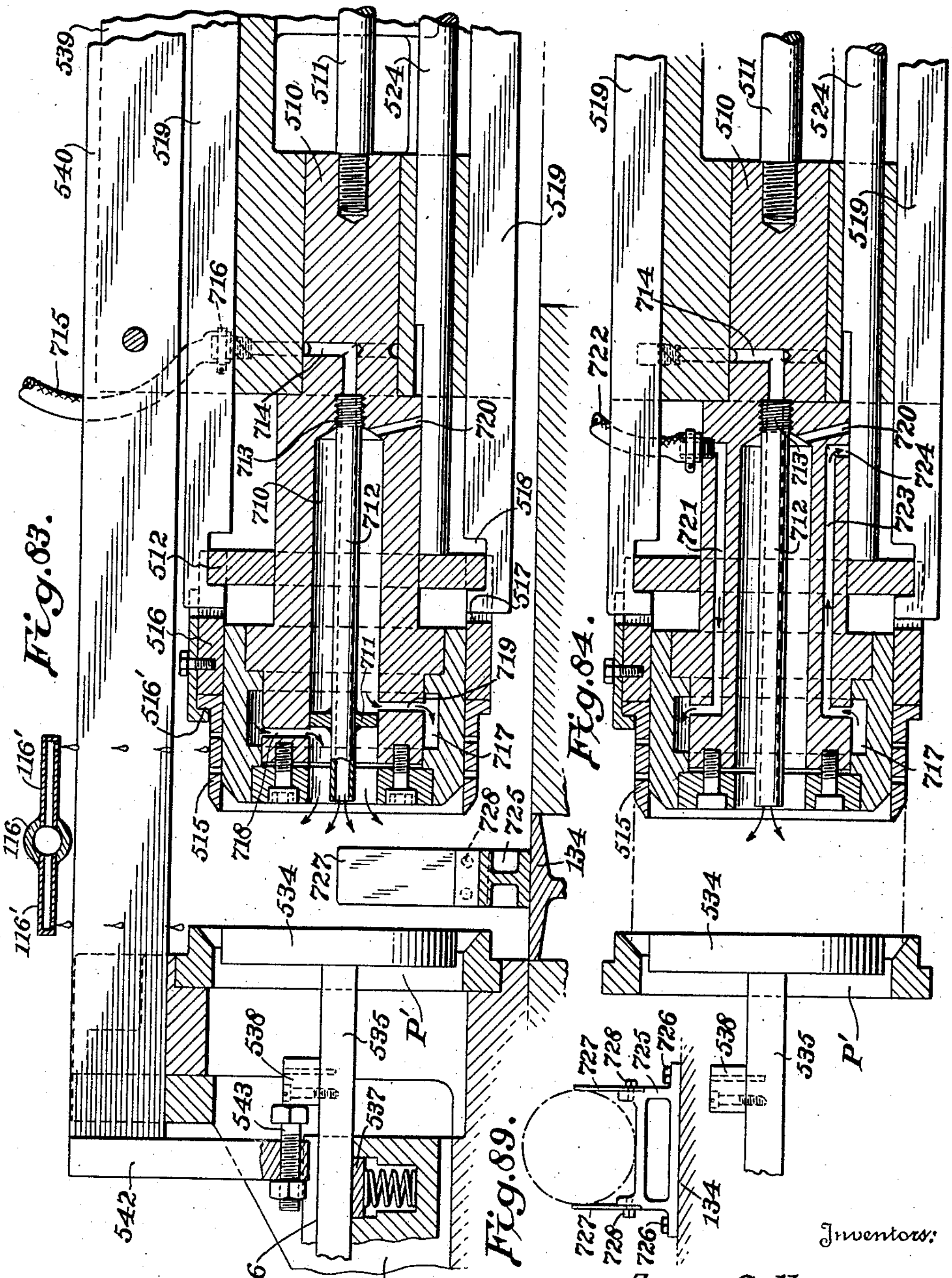

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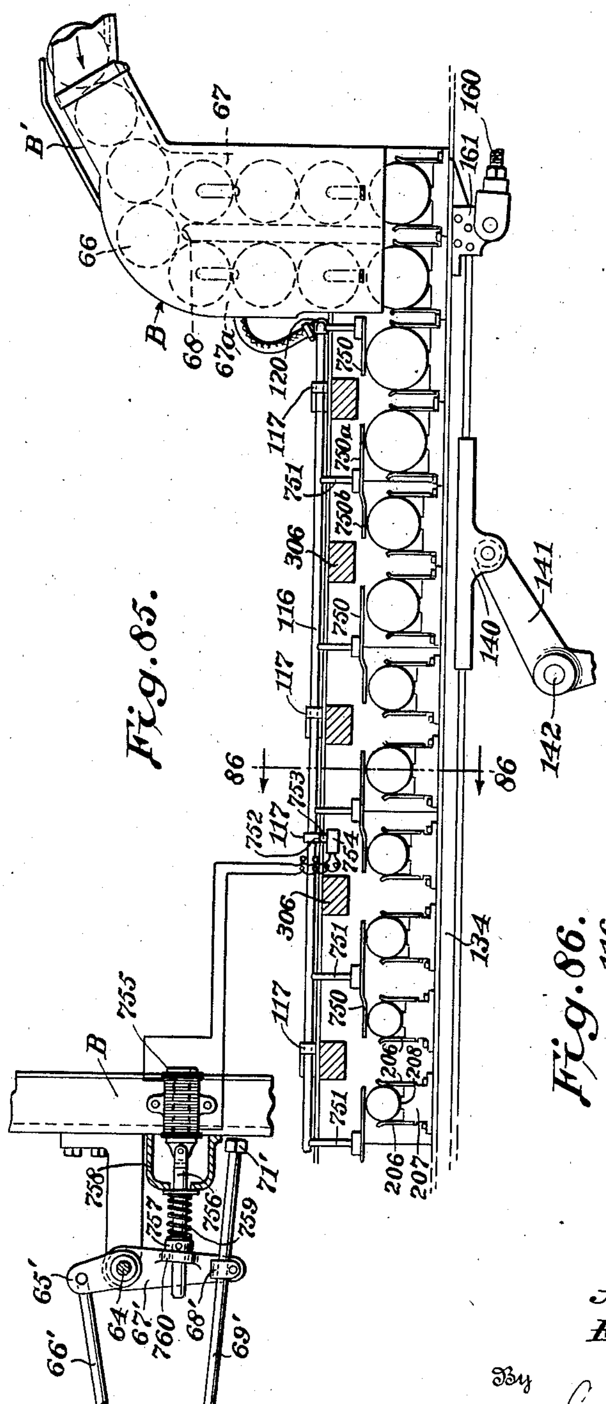

Fig. 85.

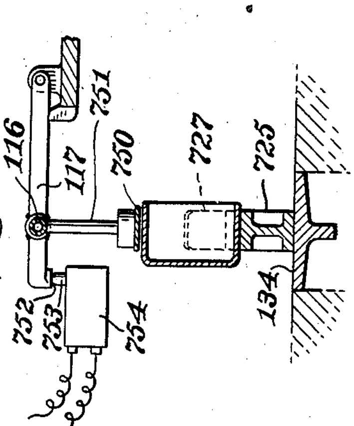

Fig. 86.

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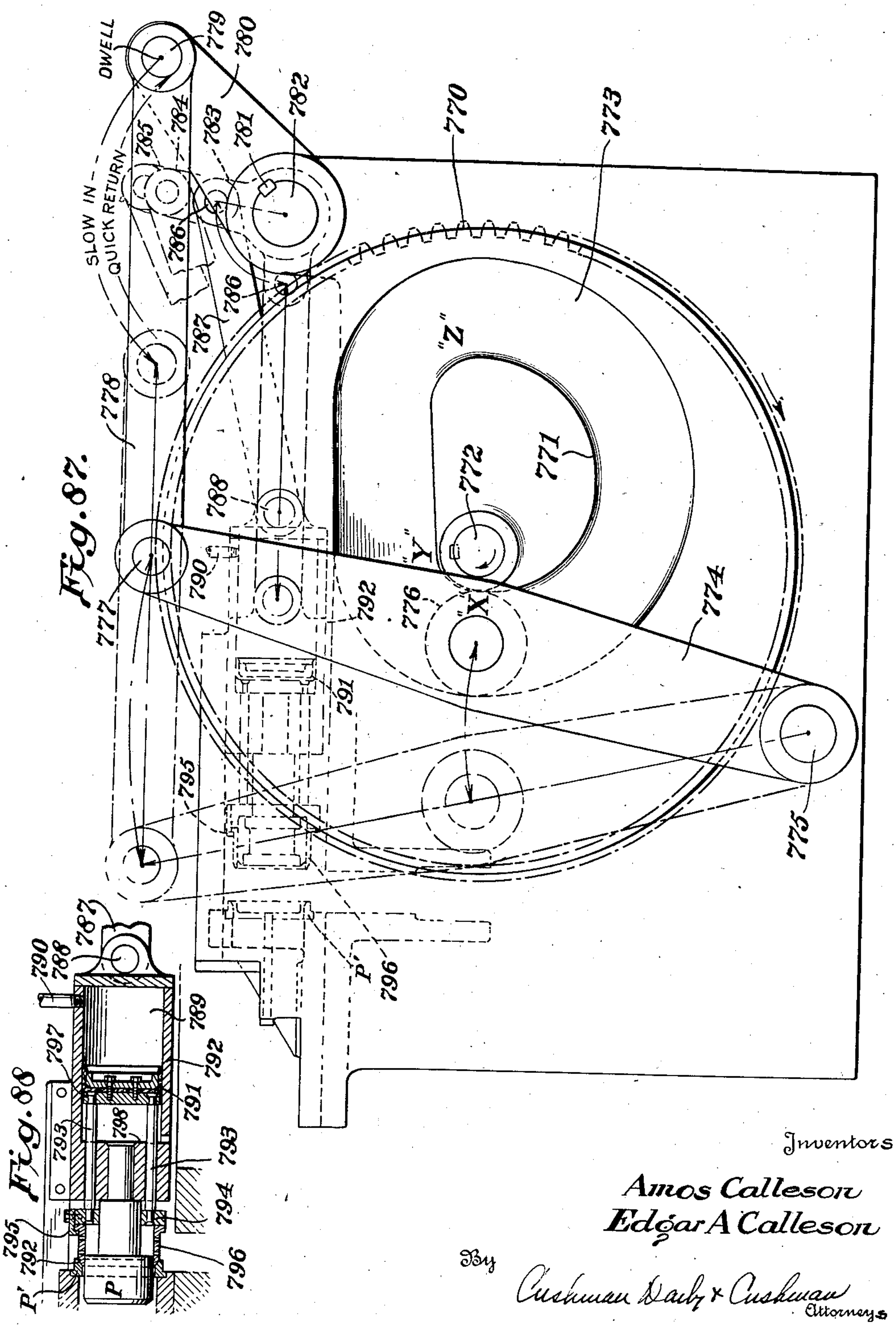

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Patented Dec. 21, 1943 2,337,182

UNITED STATES PATENT OFFICE

2,337,182

APPARATUS FOR MAKING CONTAINERS

Amos Calleson and Edgar A. Calleson, Merrick, N. Y., assignors to Crown Cork & Seal Company, Inc., Baltimore, Md., a corporation of New York

Application June 22, 1939, Serial No. 280,650

33 Claims. (Cl. 113—38)

This invention relates to an apparatus for making seamless containers. In the manufacture of such containers which are used generally as well as for the same purposes as popular types of "tin cans," it is fundamental that large scale uniform production be made available.

It is the object of the present invention therefore to provide a thoroughly reliable apparatus which will enable containers to be produced at high speed and at low cost. According to the invention, the containers are continuously drawn and formed from a metal blank while traveling along a line of metal working instrumentalities, the operation of which is entirely automatic.

The apparatus of the present invention embodies feeding hollow cup-shaped blanks which may be preformed or formed in the automatic apparatus or body maker to an intermittently actuated conveyor by which they are successively presented to a plurality of redrawing instrumentalities which continuously and progressively form the container to the required shape, depth and diameter. During the feeding and drawing steps, the containers and the apparatus are sprayed with a lubricant so that the metal is maintained in good condition for drawing, and all danger of sticking or overheating due to friction is avoided, and, at the same time wear on the apparatus is reduced to a minimum.

In one form of the invention at the last stage of the progressive redrawing of the blank, it is formed with a body flange at its open end which may be suitably trimmed and shaped. That is, the can is seamless and has one integral end which is suitably formed to provide a bottom and after removing the lubricant film, the can may be coated and lined as required, and filled and closed by seaming a top having a seaming flange with the aforesaid body flange to form a container which is a decided improvement upon the usual "tin can." In another form of the invention, the seaming flange is produced and shaped, after the body has been finally drawn.

If it is desired to further form the can to have a preferred construction, i. e., with an integral conical top terminating in an integral cylindrical neck, the conveyor continues automatically to progressively move the blank along the line for engagement by top and neck forming instrumentalities to accomplish this result. Thereafter, the container, while traveling in the line, is cleaned of lubricant so that subsequent lacquering or coating may be satisfactorily carried out, and the conveyor will continue to carry the container body along the line for engagement with instrumentalities for rolling screw threads into the neck to receive a suitable screw cap or for producing from the free edge portion of the neck a bead or finish suitable for receiving a crown cap. While I have referred to a finish for receiving a screw cap or a crown cap, it is to be understood that the neck may be provided with any suitable cap receiving finish. The body flange formed during the last redrawing step is now, if necessary, trimmed and shaped so that a bottom may be suitably seamed to the body. Where the top or bottom is welded to the body, it is unnecessary to resort to flanging, but a trimming of the open edge portion of the body may be required.

In referring to a "line" herein, we mean to include all of the apparatus whether embodied in a single machine or in separate machines.

As will be understood, the method is continuous and the operation of the apparatus is wholly automatic, the cans being moved intermittently by the conveyor along the line so as to be successively acted upon by the several instrumentalities for continuously, progressively forming, i. e., completing the formation of either the seamless integral bottom container or a seamless container having an integral body, top and neck provided with the desired cap receiving finish.

A preferred method comprises preforming the cup-shaped blanks or forming the same in the apparatus and carrying out the body forming and necking operations to produce a blank having a cylindrical body, a conical top, and a cylindrical neck terminating in a conical mouth with the free edge of the neck partially curled. Thereafter, the free edge of the body is trimmed and formed with a suitable seaming flange, and the blank then subjected to a cleaning operation for cleaning the entire blank both inside and out, and particularly the curled portion and neck. At the conclusion of the cleaning stage, the blank is now subjected to a further curling operation whereby the preliminarily curled portion is first formed into a hemmed edge and the curl continued and completed to form a hollow bead resting upon the outer surface of the conical end of the neck.

An important feature of the present invention consists in having a single prime mover for operating all of the various instrumentalities and in providing connections for associating these devices with the prime mover so that the feeding means, conveyor and the various metal drawing and forming instrumentalities in the line are all actuated in timed relation. In this connection, the metal working instrumentalities are all simultaneously operated.

Another feature of the invention is the provision of means whereby should the line lubricating device be out of proper position, the feeding of container blanks will be automatically discontinued. Also, the apparatus includes means whereby the machine can be stopped at the driving end from either side, but along its length can only be conveniently started and stopped from one side, and at which side an operator may readily view the line so as to not operate the machine should an obstruction be present or any of the parts be not in proper working order.

The metal working devices in the line comprise cooperating members arranged in substantial alignment, one group of members upon one side of the machine and another group upon the opposite side. In one form of the invention, the cooperating members for accomplishing the redrawing and the trimming of the body flange are mounted upon movable slides, while the cooperating members for producing the conical top and neck and the curling devices for forming a bead, include stationary members on one side of the machine and movable members on the opposite side of the machine. In another form of the invention, all of the members on one side of the machine are stationary while all of the other cooperating members are movably mounted.

A further feature of the invention is the provision of an operating mechanism for the conveyor or feed rack whereby the conveyor having container body carrying means moves through a substantially rectilinear path to pass the containers to the successive metal working instrumentalities. That is to say, the metal working devices are simultaneously operated and the conveyor intermittently presents the blanks in their various stages of formation progressively and in timed relation to such devices whereby blanks are continuously acted upon along the line to produce containers of the final form desired.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

Referring to the drawings:

Figure 1 is a rear elevation of the entire machine illustrating the drive and the arrangement of cams on one side of the machine and also showing the progressive reforming of blanks as they travel through the machine;

Figure 2 is an end elevation of the drive end of the machine;

Figure 3 is a cross-section on the line 3—3 of Figure 1 illustrating the driving mechanism for the shell feed and the conveyor;

Figure 4 is an enlarged detail view illustrating the shell feeding mechanism and magazine;

Figure 5 is a section on the line 5—5 of Figure 4;

Figure 6 is a view in front elevation of the shell feeding mechanism;

Figure 7 is a cross-section on the line 7—7 of Figures 5 and 6;

Figure 8 is a front elevation of a modified form of shell feeding mechanism;

Figure 9 is a detail view illustrating the friction clutch associated with the mechanism of Figure 8;

Figures 10 and 10*a* form a central longitudinal section throughout the length of the entire machine;

Figures 11 and 11*a* are detail cross-sections on the line 11—11 of Figure 10 showing means for supplying lubricant to the shells before they are fed to the forming instrumentalities; in some cases, the lubricating means shown in Figure 11*a* will be positioned to spray lubricant upon the shells issuing from the magazine and before they are acted upon by the initial metal working instrumentalities, the lubricating means being shown along the line 2—2 of Figure 10; in some cases lubricating means will be positioned along the line 11—11 and 2—2 of Figure 10 or at one of these positions only.

Figure 12 is an enlarged detail view of a portion of the machine illustrated in Figures 10 and 10*a* showing means for retaining the shells in position on the machine, i. e., at the necking stations;

Figure 13 is an enlarged detail cross-section through the discharge end of the machine illustrating the adjusting nut for the reciprocating bar of the shell conveyor;

Figure 14 is an enlarged detail view illustrating a mechanism for imparting rectilinear motion and particularly useful for actuating the shell conveyor;

Figure 14*a* is a diagrammatic view showing the rectilinear motion of the conveyor bar;

Figure 15 is an enlarged detail cross-section on the line 15—15 of Figure 14;

Figure 16 is an enlarged top plan view illustrating one of the spring fingered shell carriers mounted on the shell conveyor for a portion of its length, i. e., to comprehend the first five redrawing stages;

Figure 17 is a cross-section on the line 17—17 of Figure 16;

Figure 18 is a cross-section on the line 18—18 of Figure 16;

Figure 19 is a front elevation of one of another type of preferred shell carrier which is mounted on the shell conveyor for all or a portion of its length;

Figure 20 is a side elevation of the shell carrier shown in Figure 19;

Figure 21 is a front elevation of another form of shell carrier mounted on the shell conveyor for a portion of its length, i. e., to comprehend the two curling stages and the flange shaping and trimming stage;

Figure 22 is a side elevation of the shell carrier shown in Figure 21;

Figure 22*a* is an elevational view partly in section and partly broken away showing another modified form of conveyor shell carrier and supporting means mounted on the machine as illustrated in Figure 46;

Figure 22*b* is a section on the line 22—22 of Figure 22*a*;

Figure 23 is a detail cross-section through the main driving mechanism;

Figures 24 to 24*e* illustrate the progressive redrawing of the blank during travel through the first five stations of the machine, Figure 24*d* illustrating one type of container produced by the present invention and Figure 24*e* showing the closed end of this container formed into a suitable bottom;

Figures 25 to 25f illustrate the progressive formation of the shell of Figure 24d as it travels past the succeeding seven necking stations of the machine in which the conical top and neck are produced, the cleaning accomplished, and the cap receiving portion, e. g., a bead is formed;

Figure 26 is a view showing a container body after it has passed the final flange trimming and shaping station of the machine;

Figure 27 is a cross section on the line 27—27 of Figure 1 illustrating a typical cross-section through any one of the first five redrawing stations;

Figure 28 is an enlarged detail cross-section of the first redrawing station showing the shell in broken lines in position to be operated upon;

Figure 29 is an enlarged detail cross-section through the first redrawing stage illustrating the parts at an intermediate position in the drawing operation;

Figure 30 is a cross-section on the line 30—30 of Figure 28;

Figure 31 is a detail cross-section on the line 31—31 of Figure 28 illustrating one of the redraw slide operating lever connections;

Figure 32 is a cross-section on the line 32—32 of Figure 31;

Figure 33 is a cross-section on the line 33—33 of Figure 32;

Figure 34 is a cross-section on the line 34—34 of Figure 32;

Figure 35 is a detail cross-section through the second redrawing station showing the shell (Figure 24) in position to be operated upon;

Figure 36 is a detail cross-section through the second redrawing station illustrating the parts in an intermediate position;

Figure 37 is a detail cross-section through the third redrawing station showing the shell (Figure 24a) in position to be operated upon;

Figure 38 is a sectional view illustrating a portion of the third redrawing station with the parts in an intermediate position;

Figure 39 is a sectional view illustrating a portion of the third redrawing station showing the parts in completed redraw position;

Figure 40 is a detail cross-section through the fourth redrawing station showing the shell (Figure 24b) in position to be operated upon;

Figure 41 is a sectional view illustrating a portion of the fourth redrawing station with the parts in an intermediate position;

Figure 42 is a sectional view illustrating a portion of the fourth redrawing station showing the parts in completed redraw position;

Figure 43 is a detail cross-section through the fifth redrawing station showing the shell (Figure 24c) in position to be operated upon;

Figure 44 is a sectional view illustrating a portion of the fifth redrawing station with the parts in an intermediate position;

Figure 45 is a sectional view illustrating a portion of the fifth redrawing station showing the parts in completed redraw position to form the shell of Figure 24d;

Figure 46 is a typical cross-section through a redrawing station illustrating another form or single slide type machine of the present invention wherein only the plug members reciprocate and the female dies are fixed;

Figure 46a is a sectional view of a pressure ring showing the same perforated to allow oil to circulate and cool the ring and plug member, this construction being useful wherever a pressure ring or pressure ring and associated plug member are used throughout the various apparatus described herein;

Figure 47 is a typical cross-section through any of the succeeding forming instrumentalities for producing a conical top and neck on the container blank as produced from the last redraw stations of the apparatus typified by Figure 27 or 46;

Figure 48 is a detail sectional view of the necking apparatus of Figure 47 showing the shell from the last redrawing stage in position to be acted upon;

Figure 49 is a similar detail view showing the parts in an intermediate position;

Figure 50 is a similar view showing the forming apparatus in its completed redrawing or necking position to form the shell of Figure 25;

Figure 51 is a cross-section on the line 51—51 of Figure 48 showing the plug side of the drawing mechanism;

Figure 52 is a cross-section on the line 52—52 of Figure 48 showing in front elevation the die side of the drawing mechanism;

Figure 53 is a detail sectional view showing the position of the parts at the initiation of the second stage of the top and neck forming operation;

Figure 54 is a similar view showing the parts in intermediate position;

Figure 55 is a similar view showing the parts in their completed drawing positions for the second station to form the shell of Figure 25a;

Figure 56 is a detail sectional view showing the parts at the beginning of the third top and neck forming operation;

Figure 57 is a similar view showing the parts in an intermediate position;

Figure 58 is a similar view showing the parts in their completed drawing relation for the third station to form the shell of Figure 25b;

Figure 59 is a detail sectional view showing the container blank in position to be acted upon by the neck forming instrumentality;

Figure 60 is a similar view showing the parts in an intermediate position;

Figure 61 is a similar view showing the parts in their completed neck forming positions to form the shell of Figure 25c;

Figure 62 is a similar view showing the container blank in position for further drawing the neck, providing it with an inwardly and upwardly extending shoulder or mouth portion and punching out the closed end of the neck as illustrated by the shells of Figure 25d;

Figure 63 is a similar view showing the parts in their completed drawing and punching relation;

Figure 64 is a similar view showing the shell in position for initiating the curl of the free or open edge portion of the neck and also showing the provision of cleaning means for removing lubricant and foreign substances from the neck prior to or after the initial curling operation;

Figure 65 is a similar view showing the parts in their completed curling relation for initiating the curl to form the shell of Figure 25e;

Figure 66 is a similar view showing the shell in position for continuing the curling operation;

Figure 67 is an enlarged detail view showing the parts in their completed curling position as shown by the shell at the left of Figure 25f and after which the curl is closed as shown by the shell at the right of Figure 25f, it being noted the free edge of the curl is formed with a hemmed edge;

Figure 68 is a cross-section on the line 68—68 of Figure 66 showing in side elevation the devices for completing and closing the curl;

Figure 69 is an enlarged detail cross-section illustrating the flattening of the curl against the die with the hemmed edge resting against the conical mouth;

Figure 70 is a vertical cross-section through the machine at the shell trimming and flanging station;

Figure 71 is an enlarged detail cross-section through the trimming and flanging devices with the shell in position to be operated upon;

Figure 72 is a cross-section on the line 72—72 of Figure 71;

Figure 73 is a cross-section on the line 73—73 of Figure 71;

Figure 74 is an enlarged detail cross-section illustrating the shell supporting means on the bed of the machine for supporting the shell before and after its engagement by the trimming and shaping means;

Figure 75 is an enlarged detail cross-section similar to Figure 71 illustrating the parts in their shaping and trimming position and just before the edge of the flange is trimmed;

Figure 76 is a cross-section through a modified form of trimming and flanging mechanism showing the shell in position to be engaged by the shaping and trimming devices;

Figure 77 is an enlarged view of a portion of Figure 76 illustrating the parts in their shaping and trimming positions, the apparatus of Figures 76 and 77 being distinguished from the apparatus of Figures 71 to 75 by having one of the cooperating forming members in fixed position;

Figure 78 is a cross-section on the line 78—78 of Figure 76;

Figure 79 is a cross-section on the line 79—79 of Figure 76;

Figure 80 is a cross-section on the line 80—80 of Figure 78;

Figures 81 to 81*c* illustrate the redrawing of the shell as previously described in connection with Figures 24 to 24*c*;

Figure 81*d* illustrates the last redrawing stage, it being noted that as distinguished from Figure 24*d* the open edge remains straight;

Figure 81*e* illustrates one type of bottom which may be formed on the shell shown in Figure 81*d* whereby this shell may be at once used as a container, a top being applied in any suitable manner as by seaming or welding;

Figures 82, 82*a*, 82*b*, 82*c* and 82*d* are views corresponding to Figures 25 to 25*d*;

Figures 82*e* to 82*h* correspond to Figures 25*e* to 25*f*, but in this preferred method the neck is formed with an initial curl as shown in Figure 82*e* whereupon the straight open edge is trimmed and then shaped to form a seaming flange, and the container blank is then subjected to a washing operation to clean both the interior and exterior surfaces of the blank; thereafter the curl is continued forming the hemmed edge and then closed so as to rest upon the conical mouth whereby to form a cap receiving bead;

Figure 83 is a sectional view of a modified form of redrawing instrumentality useful in both the single slide and double slide machines and including means for cooling the plug as well as means for assuring that the shell will always be positioned on the conveyor adjacent the ejector pad when the conveyor bar initiates and concludes its feeding movement;

Figure 84 is a view similar to Figure 83 but showing another modification for circulating a cooling medium through the plug;

Figure 85 is an elevational view showing automatic means for stopping the machine in the event a shell suffers objectionable deformation at any point in its travel through the machine;

Figure 86 is a detail view showing the hold-down device of Figure 85 engaging a shell and associated with a switch mechanism whereby deformation of the shell will cause the circuit closed by the switch to be broken and the machine to stop;

Figure 87 is an end elevation of an improved operating mechanism for the movable members of either the double slide or single slide machine; this construction is particularly useful with the plug slides of the redrawing and necking mechanism and constitutes a single operating means for actuating all of the various movable slides in proper timed relation, i. e., simultaneously, and at the proper speeds and for the required strokes;

Figure 88 is a detail sectional view of a typical redrawing mechanism associated with the operating means of Figure 87 and with the plug at the end of its drawing stroke; and

Figure 89 is a side elevational view of the holder shown in Figure 83.

General description

Referring to Figures 1, 10 and 10*a*, the general construction of the machine will be understood. There is provided a single prime mover A which is preferably an electric motor having associated driving connections to operate the various apparatus in timed relation. Blanks or shells of shallow cup-shaped form produced in any suitable manner as by stamping, and as shown in Figure 1, at 10, are fed by gravity from a chute to the feeding magazine or hopper indicated as a whole at B in Figure 10 from which they are automatically supplied to the conveyor or feed shell rack indicated as a whole at C in Figures 10 and 10*a*, whence they are carried to the various drawing and forming instrumentalities of the line. In the construction illustrated, two blanks are simultaneously fed to the conveyor from the magazine and are acted upon by the metal working instrumentalities, but the number may be varied as desired.

Referring to Figure 1 and Figures 27 through 46, there are illustrated five redrawing instrumentalities D to produce progressively from the blank 10, containers of the form shown in Figures 24 to 24*d* or Figures 81 to 81*d*. It is to be understood that as many redrawing devices may be employed as desired, and we frequently employ seven. It will be noted that the product of the last redrawing step is provided with a body flange 11 at its open end in Figure 24*d* while in Figure 81*d* the free edge is straight, and has an integral closed end forming a bottom 12 which may be suitably shaped as shown in Figure 24*e* or 81*e*. The flange 11 is usually trimmed and shaped so as to receive the can top which may be seamed thereto. Where the free edge is not flanged in the machine as shown in Figure 81*e*, a flange may be produced in any suitable manner and a top seamed thereto or the top may be welded to the free edge.

When it is desired to produce containers of the character shown in Figure 26 having an integral conical top terminating in an integral neck having a suitable cap finish, e. g., to receive a crown cap, the container body shown in Figure 24d or 81d continues in the line and first progressively undergoes top and neck drawing or necking operations in the apparatus indicated as a whole at E in Figure 1 and shown in detail in Figures 47 to 63 to produce container bodies as shown in Figures 25 to 25d or 82 to 82d. That is, the conical top and neck are produced; the top or closed end of the neck is punched out, and then where, for example, a crown receiving finish is to be formed, the free edge of the neck is rolled over upon itself by curling devices indicated as a whole at F in Figure 1 and in detail in Figures 64 to 69 to form a suitable bead as shown in Figures 25e to 26.

During the feeding of each blank, and while it is undergoing redrawing, it is subjected to a spray of lubricant by suitable means indicated as a whole at G in Figures 1 and 11 which also lubricate and cool the feed mechanism and drawing instrumentalities.

The lubricant film is removed from the body, particularly the neck portion, by suitable cleaning instrumentalities indicated as a whole at H in Figure 64, and this step takes place in the line and before the neck is subjected to the curling devices or after the initial curl is formed, whereby lubricant cannot so collect within the curl to subsequently interfere with the formation of a nice appearing decoration or lacquer coating.

After the cap receiving finish has been formed, the flange 11 is suitably trimmed and shaped by apparatus shown at I in Figure 1 and in detail in Figures 70 to 80 so that a bottom of conventional character may be readily seamed thereto.

In the methods shown in Figures 24 to 26, the cleaning step preferably takes place after the initial curl shown in Figure 25e is formed, while in the method shown in Figures 81 to 82h, the trimming and flanging step takes place after the initial curl and is followed by the cleaning operation. In each method after the cleaning operation or, the trimming, flanging and cleaning operations, as the case may be, the initial curl is further formed into a bead by curling instrumentalities which produce a hemmed edge and a closed curl with the hemmed edge resting on the conical mouth of the neck.

In the operation of the invention, the blanks 10 are fed into the machine and carried along the line by the conveyor C to be acted upon by the metal working devices, and during this travel each blank 10 undergoes the various stages of formation represented by the appearance of the container in Figures 24 to 26 or Figures 81 to 82h. The conveyor operates intermittently, but, in effect, the metal working devices, which all operate simultaneously, produce a continuous progressive completion of the blank to the desired final form as shown in Figure 26.

The power and drive means

Referring to Figures 1, 23, 46 and 47, the machine includes a bed in the form of a single casting indicated as a whole at 13 and having a top or table indicated as a whole at 14. This bed is substantially rectangular and of a suitable length to support the various apparatus. As shown in Figure 23, the prime mover or motor A is supported on an adjustable pedestal 15 which in turn is supported upon a transmission or speed reducer housing 16, the base of which is supported on the table 14 as shown at 17. The motor drives one side of an air clutch indicated as a whole at 18 through belts 19 moving over the motor pulley wheel 20 and a fly wheel pulley 21 on fly wheel 22.

The driving side of the clutch as shown in Figure 23 includes the fly-wheel 22 freely rotatable on the main drive shaft 23 and operatively connected through the diaphragm 24 to the clutch piston 25 which is held in released position by the spring-pressed pins 26. The diaphragm is pressed by fluid air pressure from line 27 against the piston 25 to frictionally lock the driven plate 28 of the clutch which is fixed to the drive shaft, between the fly-wheel and the piston. The driven element or plate is engaged by the piston and fly wheel through the friction plugs 29 in the plate and the main drive shaft 23 is rotatably mounted in needle bearings 30 and roller bearing 31 supported in the housing 16.

The opposite end of shaft 23 is operatively connected to a fluid pressure braking means indicated as a whole at 32. Referring to Figure 23, this brake includes a diaphragm 33 fixed to the housing 16 and a brake piston 34 which is held against rotation by the spring-pressed pins 35. When it is desired to brake rotation of the shaft 23, the valve member 36 to which air is supplied under pressure from any suitable source through pipe 36' is shifted to transfer the air from the clutch 18 to the brake applying diaphragm 33 of the brake 32. This will cause the diaphragm to exert pressure against the brake piston 34 which in turn exerts a pressure against a friction plate 37 fixed to the shaft 23, whereby the plate is frictionally engaged between the piston 34 and the stationary plate 38 carried by the housing 16. When it is desired to resume operation of the machine, the valve member 36 is shifted to a position to divert the air pressure from the brake to the clutch.

Intermediate the roller bearing 31 and the needle bearing 30 on the shaft 23 is a main drive pinion gear 39 which meshes with gear 40 fixed to a countershaft 41 mounted in suitable bearings in the housing 16 as best shown in Figures 2 and 23. The outer end of shaft 41 has a pinion gear 42 fixed thereto which meshes with the large gear 43 as shown at 44 in Figure 2. The large gear 43 is keyed to a rear main cam shaft RC mounted in bearings provided along the rear of the bed of the machine and carries return cams 45 and operating drive cams 46 as shown in Figures 1 and 27. Driven from the gear 43 is a large gear 47 which is keyed to a front main cam shaft FC mounted in bearings provided along the front of the bed of the machine and likewise carrying operating and return cams 48 and 49 as shown in Figures 2 and 27 for the redrawing operations and the trimming and shaping step shown in Figure 70. Gears 43 and 47 being of equal diameter drive the front and rear cam shafts at the same speed, and it is to be understood that the cam shafts extend throughout the length of the machine at opposite sides of the bed. A modification of this latter construction will be described hereinafter.

Referring to Figures 1 and 3, the rear cam shaft RC carries a helical gear 50 keyed thereto which drives the helical gear 51 keyed to a transverse shaft 52 extending at right angles to shaft RC and mounted in bearings provided in bracket 53 secured to the bed. The shaft 52 is provided with shell feed bar raising and lowering cams 54 and 55 spaced apart on the shaft and carries at its end opposite the gear connection 50—51 crank pin 56 having a cam slot engaging roller 57 as shown in Figure 14. The cams and crank pin cooperate with a mechanism to be later described for actuating the shell conveyor or feed bar.

The front cam shaft FC in addition to the operation and return cams 48 and 49 carries a cam 58 as shown in Figure 3 for operating through bell crank 59 slidable mechanism to actuate the shell feed magazine B as shown in Figure 4.

Referring to Figures 1, 27 and 47, it will be noted that the cam shafts FC and RC are mounted in bearings which include bearing portions 60 integral with the bed and caps 61 which are held in connected relation by means of the tie bolts 62 extending transversely across the machine and located between the cams carried by the cam shafts as shown in Figure 1. The purpose of such a construction is to overcome the thrust due to the transverse movement of the drawing and forming instrumentalities with respect to the bed 13, the top or table 14 of which as shown in Figures 3 and 4 is longitudinally divided by a passageway throughout its length as at 63 to provide a working space for the conveyor or shell feed bar C.

Referring to Figures 1, 3 and 23, the air valve 36 is controlled by means of the horizontally disposed bar 64 mounted in brackets fixed to the machine so that the bar extends substantially centrally longitudinally thereof. Suitable handles 64′ are carried by the bar so that the machine may be started or stopped at various points throughout its length. The bar at the drive end of the machine carries a short lever 65′ which is connected by a rod 66′ to the air valve 36. This end of the bar also carries a lever 67′, one end of which is provided with a block 68′ and in which is slidably mounted a hand lever rod 69′ extending across the transmission housing 16 to the rear of the machine, as shown at 70′. One end of the rod 69′ carries a nut 71′ which acts as a stop for the rod 69′ when the rod 69′ is moved in either direction. That is, when the lever is pulled forward the nut 71′ engages the block 68′ and through the levers 65′ and 67′ and the rod 66′, the position of the air valve 36 is changed to stop the machine. Movement of the rod 69′ in a reverse direction causes the rod to slide freely through the block 68′ and stop against the rear of the shell feeding magazine, as shown at 72′. The rod 69′ merely slides through the block 68′ in the reverse motion above described, and does not affect the position of the air valves 36 whereby the machine cannot be started from the rear of the machine. It will be noted that the machine may be stopped at the driving end from either side, i. e., by means of the handles 70′ or 64′. However, the machine may only be started from the front side where the operator may view the various working instrumentalities of the machine and determine whether it is ready for operation.

Blank feeding magazine

As above stated, the present embodiment of the invention includes means to simultaneously operate upon two shells at each station to simultaneously produce two finished can bodies. To accomplish the proper feeding of a plurality of blanks, the machine is provided with a chute B′, as shown in Figure 10 having bottom and side rails as shown in Figure 11, which delivers shells 10 by gravity to the feed magazine B rigidly supported in vertical position on the table of the machine on a bracket as shown at 65, reference being now had to Figures 3 to 7 and 10. The inclined chute B′ feeds the blanks in single file to the magazine, opening into the same at one side of the top as shown at 66. The magazine has two substantially vertical feed passages 67 and 67*a* separated by a partition 68 terminating below the shell entrance opening 66. The blanks rolling into the upper end of the magazine fill the feed passage 67 and the passage is so designed that when full the blanks leaving the chute will roll over the uppermost shell in passage 67 and into the feed passage 67*a* as shown in Figure 10. In this manner, both passages are maintained continuously full by a gravity feed from chute B′.

Referring to Figures 3, 4, 5, 6 and 7, two shallow drawn cup-shaped blanks 10 are supplied from the magazine to a support bar 69, having recesses 69*a* and fixed to the rear wall of the magazine. The recesses 69*a* cooperate with a gate 70 to support the shells at their edges in a position as shown in Figures 3 and 4, from which they may be picked up by the shell feeding conveyor C.

The magazine feeding means includes the bell crank lever 59 driven from cam 58 on the front drive cam shaft FC as shown in Figure 3. The bell crank is resiliently urged against cam 58 at all times by a spring 71 positioned between the end of the bell crank-arm and the able of the machine. The end of the bell-crank arm 59 is connected by means of a pivoted block 72 to the lower end of a vertically disposed operating rod 73, the upper end of which is slidably carried in a block 74 pivoted at 75 in the outer bifurcated end 76 of a rocker arm 77 as shown in Figures 3, 4, 6 and 7.

The operating rod 73, as stated, is slidably mounted in bearing block 74 and the rocker arm is normally urged upwardly against stop nut 78 by spring 79 confined between a collar 80 fixed to the rod and a collar 81 slidable on the rod to form a flexible drive connection. The rocker arm 77 is fixed to a rock shaft 82 carried in a bracket 83 supported on the front face of the magazine B, and when the arm is driven from cam 58 through the bell crank 59 and rod 73, the shaft 82 is rocked. Fixed to opposite ends of the rocker shaft are arms 84 disposed at an angle to the horizontal. The arms extend substantially equal distances on each side of the rock shaft and carry magazine feed fingers 85 and 86 pivotally connected at their ends to the arms as shown at 84′ and extending substantially at right angles to the arms. The feed fingers extend in inclined relation to the horizontal and in parallel spaced relation to each other, being so positioned that their free ends will register and extend through apertures 87 in the wall of the magazine to engage the shells and control the feeding thereof to the shell conveyor C as shown in Figure 4. The apertures 87 register with openings in guide blocks 87′ and when the pivoted fingers are retracted, their ends are sustained by the walls of the apertures in the blocks, i. e., the fingers are not withdrawn beyond the blocks.

Referring to Figure 4, the feed fingers are actuated by the rocking of the shaft 82 in timed relation to the movement of the shell conveyor C, and cause two shells at a time to be deposited from the magazine in a position to be picked up by the conveyor. It will be noted in Figure 4 that the lowermost can blanks S are in position to be received by the conveyor, while the next blanks S′ are held against downward movement by the fingers 86 extending into the magazine through the apertures 87; the fingers 85 at this time are withdrawn from the magazine.

After the conveyor has picked up the shells S, and is clear of the magazine, the lowermost can blanks S' are released from the respective passages, as shown in Figure 4, and dropped by gravity upon the recessed member 69. This result takes place due to the withdrawal of the feed fingers 86 by reason of the rocking of the shaft 82 and simultaneously with the withdrawal of the fingers 86, the fingers 85 are projected into the passages to hold back the shells in the magazine above the fingers. Thereafter, for a brief period there are no shells above the shells S except the columns of shell S'' which are being held by the fingers 85. The positioning of the shells, as shown in Figure 4, takes place almost immediately due to the rocking of the shaft, whereby the fingers 86 are again moved into the magazine and the fingers 85 are retracted, before the conveyor returns to shell feeding position again. In other words, the shaft 82 rocks upwardly and back during each cycle of the cam 58 which controls the feeding operation.

It is to be noted that the feed mechanism is operated automatically and in timed relation with the operation of the conveyor C.

Referring to Figures 6 and 7, the rocker arm has a hub 88 keyed to the shaft 82, which hub is provided with a tooth 89, as shown in Figure 4, to cooperate with a locking dog 90 and prevent feeding of shells in the magazine, i. e., operation of the feed fingers 85 and 86, if the lubricating system is not in operative position.

If the lubrication spray system is not in operation, the tooth 89 on the hub of the rocker arm engages the dog 90 so that the feed mechanism is rendered inoperative and none of the blanks in the magazine can be fed to the machine. When the rocker arm is locked, the cam 58 may still drive the rod 73 connecting with the rocker arm, but due to the flexible connection provided by the spring 79, the rod slides through block 74 in the forked end of arm 77. During normal operation of the rocker mechanism the spring 79 is sufficiently stiff so that the rock shaft is driven by engagement of the collar 81 with the block 74. However, if the rock shaft is locked, the spring will be compressed as the rod slides vertically through block 74.

Referring to Figures 8 and 9, we have illustrated a modified form of magazine and feeding mechanism. In this construction, spaced pins 92 on the magazine are used in lieu of the recesses 69a in the member 69 and the gate 70a is similarly positioned to the gate 70 but is formed with ears 93 receiving a rod 94 which passes through ears 95 on a bracket 96 fixed to the table of the machine. The rod 94 is surrounded by a coiled spring, one end of which rests against the fixed bracket 93, the other end resting against the gate 70a so as to resiliently maintain the gate in closed position with the top lugs 95' formed on the upper portion of the gate engaging the adjacent wall of the magazine, whereby to guide and support the shells.

The feed fingers 85 and 86 are similarly operated, but, as distinguished from the mechanism shown in 3, the rock shaft 82 is extended as shown at 82' and carries friction discs 97 and 98, one of which bears against a slidably spring-pressed collar 99 mounted on the shaft. This collar is prevented from rotation by means of a pin 100 fixed to the rock shaft 82 and slidably engaging in a slot 101 in the collar. A vertically extending operating rod 102 is pivoted to a lever 103 pivotally mounted on the extended end 82' of the rock shaft between the friction discs 97 and 98. At its other end, the rod 102 is pivotally connected to a bracket 104 fixed as by bolts 105 to a compound cam lever 106 having rollers 107—107' bearing on the cam 54 of the shell conveyor mechanism operating shaft 52 as shown in Figures 3, 8 and 14. The movement of the lever 106 reciprocates rod 102 and lever 103 which through the medium of the friction disc structure rocks the shaft 82 in the manner previously described to cause the automatic withdrawal and insertion of the fingers 85, 86 in the magazine and in timed relation to the operation of the shell conveyor. If the rock shaft be locked by engagement of the dog 90 in latch 89, as when the lubricant supply is cut off, the rod 102 simply reciprocates the lever 103 against the friction discs without imparting movement to the rock shaft.

The construction shown in Figures 8 and 9 is used either with the double slide apparatus exemplified by Figure 27 or the single slide apparatus exemplified by Figure 46.

The lubricating system

As heretofore stated, the shells prior to delivery to the drawing instrumentalities, and while undergoing redrawing to progressively form the shell illustrated at 24d or 81d are sprayed with a suitable lubricant. This enables the drawing of the metal blank to be performed under the best conditions and danger of the blanks sticking to the metal working instrumentalities is avoided. Furthermore, the lubricant acts to cool both the metal working instrumentalities and the the metal of the blank which is being formed and this is desirable since the apparatus operates at high speed.

To accomplish effective lubrication of the shells, and referring to Figures 10, 11 and 11a, there is interposed in the chute B' a lubricant spray head 110 preferably of the arch type shown in Figure 11a for directing a spray of lubricant both interiorly and exteriorly of the shells which travel on the rail 110'. The lubricant is supplied to the spray devices 110 in the chute from a line 111 connected to a hand valve 112 in line 113 leading to the outlet side 114' of a master automatically controlled valve 114 as shown in Figures 4 and 5. The line 113 also has interposed therein a manual valve 115 leading to spray line 116 as shown in Figures 1, 10, 27 and 46. The spray line 116 is provided through out its length with a plurality of spray openings for providing a continuous spray, the spray means being preferably of the character shown in Figures 46 and 83 in the form of hollow wings 116' commmnuicating with the line 116 and having spray openings therein. The spray line 116 may extend throughout the various metal working instrumentalities but preferably extends throughout the drawing stations D, i. e., while the blanks are being progressively redrawn as shown in Figures 24 to 24d or 81 to 81d. As shown in Figure 27, the line 116 is supported by a series of arms 117 which are hinged at 118 to blocks 119 fixed to the main frame of the machine. As long as the arms 117 are in the position shown in Figure 27, whereby the spray line 116 will direct a spray upon the metal working devices and the shells which they are operating upon, the shells passing through the chute and the redraw stations comprehended by the line 116 which will be continuously sprayed with lubricant.

When, however, the spray pipe is raised from the horizontal position shown in Figure 27, the master valve 114 is automatically closed, shutting off the supply of lubricant to the spray devices 110 and the line 116 and simultaneously the shell feeding mechanism, i. e., the rock shaft 82 and spring fingers 85 and 86 are locked against actuation. This takes place by reason of the roller 120 carried by the end of the spray line 116 as shown in Figures 5 and 6, moving out of contact with the cam surface 121 carried on a lever 122 pivoted at 123 to the rear face of the magazine. This lever at one end has a lug 124 carrying a threaded adjusting screw 125 which bears against the stem 126 of the master valve 114. As the lever 122 moves out of the position shown in Figure 15, the spring-pressed valve member of the master valve is automatically closed and the stem 126 thereof is further projected outwardly. At the same time, the lever 122 under the influence of the spring 122' is drawn inwardly about its pivot 123. This lever 122 at its upper end has pivoted thereto a horizontally disposed bar 127 which is provided at one end with cam surfaces 128. Referring to Figures 4, 5, 6 and 7, the locking dog 90 shown in Figure 4 is pivotally mounted in bracket 83 and has an upstanding arm, to which is pivotally connected a rod 129 extending at right angles to bar 127 and having one end projected through a slot 127' in the bar 127 and carrying rollers 130 which normally rest on the cam surfaces 128. When the lever 122 moves inwardly carrying with it the bar 127, the rollers move off of the cam surfaces and permit the spring 131 on the rod 129 to push the same and the dog 90 downwardly so that it will be engaged behind the tooth 89. This engagement will lock the rock shaft against movement and in turn lock the fingers 85 and 86. Under these conditions, the rod 73 of Figure 4 or the rod 102 of Figure 8 will simply reciprocate by reason of their respective flexible or slip connections with the rock shaft, as above described. As soon as the spray line 116 resumes the horizontal position shown in Figure 27, the roller 120 will move the valve operating cam surface 121 inwardly to engage the stem 126 and unseat the valve, and the rollers 130 assume their position on the cam surfaces whence the locking engagement between the dog 90 and latch 89 is discontinued. Lubricant is thus automatically supplied to the spray devices 110 and 116, and the fingers 85 and 86 resume their automatic operation. In this form of the invention, the lubricant which flows from the shells and forming instrumentalities will collect in the bottom portion of the base of the machine from which it may be returned by means of suitable mechanism to the inlet side 133 of the master valve 114, e. g., a suitable pump operated from the shaft RC.

Referring to Figures 8, 10 and 11*a*, in some cases we omit the provision of a lubricating device 110 in the chute B' and place the same at a point shown on the line 2—2 of Figure 10 between the magazine and the first redrawing instrumentality. While this is a preferred construction, there are other instances where the lubricating spray devices are both located in the chute, and at the point along the line 2—2. The spray device interposed between the magazine and the first redrawing instrumentality is of the type shown in Figure 11*a*, namely, an arch feed type, and is fixed in position so as to spray the shells as they travel on the conveyor from the magazine to the first redrawing instrumentality. The spray device 110 is supplied with oil by a pipe 110*a* which communicates with a valve chamber 110*b* shown best in Figure 8. This valve chamber has a valve member 110*c* which includes a valve and valve stem mounted for reciprocation in the valve chamber between the top thereof and a valve seat 110*d*, the valve being constantly urged toward its seat by a spring 110*e*. Communicating with the valve chamber above the seat 110*d* is the line 111, and the supply of oil to the valve chamber may be automatically cut off in the manner previously described. However, it is preferred to connect the line 111 with the line 132 leading to the inlet side 133 of the master valve 114 whereby this arch feed spray device is not provided with the automatic cut-off previously described. Instead, lubricant pumped through the line 132 passes by the line 111 to the valve chamber 110*b* and is intermittently supplied to the arch spray device in the manner now to be described. Secured to the rod 102, shown in Figure 8, is a stop member 102*a* which in the upper position of the rod 102 engages the valve stem of the valve member 110*c* to unseat the same and permit lubricant to pass through the chamber and the line 110*a* to the spray device. When the rod 102 is in its lowered position, i. e., with the stop member 102*a* out of engagement with the valve stem, the oil pressure and the spring will serve to close the valve and cut off the supply of lubricant to the arch spray. There is thus provided an automatic intermittent but continuous supply of lubricant to the arch spray controlled according to the actuation of the magazine shell feeding means whereby when the machine is stopped, the intermittent feed is discontinued, and, furthermore, whereby the intermittent feed is timed by reason of the actuation of the lever 102 from the cam 54, to intermittently deliver the lubricant in accordance with the movement of the shell conveyor bar as it carries the shells from the magazine to the first redrawing instrumentality.

The shell conveyor

The shell conveyor and its operating mechanism are illustrated in Figures 3, 10, 10*a*, 14, 15, 16 to 22*b*, 27 and 46. The conveyor includes a T-shaped bar 134 as shown in Figures 3, 37 and 46 which constitutes a carrier upon which are mounted the feed fingers illustrated in Figures 16 to 22*b*. These fingers are positioned on the carrier in accordance with the station to which the shells have progressed. That is to say, the feed fingers illustrated in Figures 16, 17 and 18 are used during the redrawing stage D; the fingers illustrated in Figures 19 and 20 are used during the top and neck forming or necking stages E and the curling stages F, while the feed fingers illustrated in Figures 21 and 22 are used during the trimming and shaping stages indicated at I, all as illustrated in Figure 1. The bar is reciprocated longitudinally and vertically of the machine to feed the shells from the magazine and the shells held in the fingers from one operation to the next and from the machine, and this reciprocating movement of the carrier bar takes place in the guideway 63 as shown in Figure 3. In a preferred construction, fingers of the type shown in Figures 19 and 20 are used throughout the conveyor bar for all stations. The fingers shown at Figures 22*a* and 22*b* on the sheet with Figure 46 may likewise be used for all stations.

The bar 134 moves in a rectilinear path, i. e., it travels forwardly to feed the shells from the magazine and from and to the metal working instrumentalities, then remains stationary for a period of dwell or pause of sufficient length of time until the metal working instrumentalities engage the shells. Then the conveyor bar descends, moves rearwardly, and ascends to a position where (1) it can again pick up two shells from the magazine and feed the same as above described, and (2) receive shells as released from the respective metal working instrumentalities after the latter have completed their operations and feed them to the next succeeding stations and from the machine. The cycle of movement of the conveyor in its rectilinear path as just described automatically continues in the operation of the machine. It is to be understood that the operation of the conveyor, the magazine and the metal working instrumentalities take place in timed relation by reason of the cam structure above referred to and which will now be described in detail.

The T-shaped carrier bar is provided at the lower end of the vertical flange 135 on each side thereof with longitudinally extending guide bars 136 as shown in Figure 27, which slidably mount or support the bar in cradles or guides 137 disposed at spaced points on the bar as shown in Figures 10 and 10*a*, throughout the length of the machine. These cradles are each provided with a central longitudinal recess 138 which engages and receives the ribs or guide bars 136 carried by the T-shaped bar. This disposition of the parts is maintained by the provision of cap plates 139 which are detachably secured to the cradle in any suitable manner. Each cradle is provided with a pair of depending lugs 140 as shown in Figure 27 in which is pivotally mounted one end of a bell crank lever 141 as shown in Figures 10, 10*a* and 27. The bell crank is pivoted upon a transverse pin 142 carried by the depending flanges 143 forming the guideway 63. The opposite end of the bell crank is pivotally connected to and carries a bar 144 adapted to be reciprocated through suitable mechanism to be hereinafter described. In this connection, the guideway 63 for the bar and the cradles, presents two opposed finished surfaces between which the cradles ride to provide for guiding the bar in its vertical and horizontal reciprocation. It will be noted that the guideway 63, upon reference to Figure 27, is formed by the two depending flanges 143 on the bed, the inner faces of which provide accurate ways for the bar and cradles throughout the length of the machine.

The rocking of the cradle lever arms 141 will cause the cradles to be raised or dropped in the guideway 63 and as the motion of each of the levers is controlled by the connecting bar 144, all parts of the rack or bar will be raised and lowered simultaneously.

One end of the bar 144 is provided with a pivoted link 145 to which is secured one end of a guide rod 146, surrounded by a coil spring 147 which bears against a threaded nut 148, adjustably mounted in a bracket 149 carried by the bed of the machine. The guide rod 146 passes through an aperture 150 in the end of the adjusting nut. This permits the adjusting nut to increase or decrease the tension of the spring 147 to accurately balance the weight of the conveyor, cradles, and cradle levers, so that the rack lifting and dropping mechanism will have substantially no load to carry. The connecting bar 144 is driven to raise and lower the conveyor bar 134 by means of a rod 151 as shown in Figure 10 which is pivotally connected at one end to the end of the bar and at its opposite end to a lever 106′ which together with lever 106 forms a compound lever having a pair of raising and lowering cam follower rollers 107—107′. Referring to Figures 3, 11 and 14, the cam follower levers are pivotally supported by a pin 152 in an arm 153 on the bracket 53 carried by the base of the machine. The lever 106 has an extension 154 provided with a lug 155 which is threaded to receive an adjusting screw 156 bearing against one edge of the lever 106′ so that the relative spacing of the cam follower rollers 107 and 107′ may be controlled to accurately follow the periphery of the two cams 157 and 158 respectively, rotatably carried by the shaft 52 for raising and lowering the conveyor bar 134. As will be observed, the levers 106 and 106′ move as a compound lever upon actuation by the respective cam surfaces, as the shaft 52 is rotated. In this manner, rotation of the shaft 52 and the cams carried thereby will reciprocate the rod 151 to reciprocate the bar 144 and thereby raise and lower the conveyor bar 134 and cradles 137 through the instrumentality of the bell crank levers 141. It will be noted that a compound cam follower and cam structure is employed, thereby eliminating the use of springs and assuring that the raising and lowering of the carrier will be positive at all times and in proper timed relation to the other parts of the machine. Either the roller 107 and cam 158 or the roller 107′ and the cam 157 may be considered the main actuating means for imparting vertical reciprocation, in which event the other cam and roller will serve as the means for maintaining the main cam and roller constantly in contact and the roller on a predetermined path. Thus, assuming that the roller 107′ and cam 157 are the main cam means for imparting vertical reciprocation to the feed bar, when the cam and roller are in a position as shown in Figure 10, the rod 151 has been drawn inwardly to the required limit to cause the levers 141 to raise the feed bar to its uppermost position. When the roller 107′ is moved outwardly to the left of the position shown in Figure 10 and to the limits of its outward motion, the conveyor bar is caused to descend to its lowermost position. During this engagement of the cam 157 with the roller 107′, the roller 107 has been constantly in contact with the cam 158 and has described a path which assures that the roller 107′ is constantly in contact with and follows the path described by the contour of cam 157. A portion of each cam 157 and 158 has a surface which is concentric with the center of the shaft 52 and as such concentric portions engage the cam rollers, the connecting rod ceases to reciprocate, thus discontinuing vertical movement of the conveyor bar 134 and producing a dwell for a purpose as will be later explained.

Referring to Figure 14, the means for longitudinally, horizontally reciprocating the conveyor bar 134 includes an adjustable connecting rod 160, pivotally connected at one end to a bracket 161 fixed to the vertical flange of the bar as shown in Figure 14 at 162. The other end of the connecting rod 160 is pivotally connected to the upper end of a crank operated lever 163, the lower end of which is pivoted on a shaft 164 fixed in the frame 53 as shown in Figure 3. The lever 163 is provided with a vertically disposed cam slot 165 in which the crank pin 56 carrying the roller 57 on the shaft 52 engages to horizontally reciprocate the rack bar, through the medium of the connection 160. In order to provide a dwell at the end of each horizontal reciprocation or stroke of the carrier bar 134, the slot 165 in the lever 163 is provided with opposed arcuate recesses 166—167 which are respectively concentric with the crank shaft 52 at substantially the limit of forward and rearward movement of the lever 163, i. e., the recess 166 is concentric at the limit of rearward motion of the feed bar and the recess 167 at the end of the forward motion thereof so that during portions of the cycle of the crank pin roller 57, the lever 163 remains at rest. Each of the arcuate recesses in the present instance occupies substantially 55° in the cycle during rotation of the shaft. The opposed concentric recesses in the crank lever 163 are alternately opened and closed by means of auxiliary cam levers 168 and 169 pivoted at 170 and 171 respectively on opposite sides of the slot 165 in the crank lever 163. The lower ends of the auxiliary cam levers 168 and 169 are provided with pivoted links 172 and 173 which are in turn pivoted to a bracket 174 carried by and keyed to the fixed shaft 164. The levers 168 and 169 are moved in and out of recess closing position by means of the links 172 and 173, respectively, engaging the fixed bracket 174 and the pivotal connection of such auxiliary cam levers on the main operating lever 163 whereby movement of the main lever imparted by the rotation of the crank pin roller causes one or the other of the auxiliary levers to move into or out of position in timed relation to the movement of the crank shaft. The inner face of the upper end of each auxiliary cam lever is provided with correlated arcuate surfaces 175 and 175′, respectively. These surfaces 175 and 175′ are of such contour with relation to the contour of each recess 166—167 respectively in the main cam lever that the roller on the crank pin is maintained in contact with either the surfaces 175′ and 166 at the limit of the rearward movement of the lever 163, as shown in Figure 14 or in contact with the surfaces 175 and 167 at the limit of the forward movement of the lever 163. In this manner the roller on the crank pin is confined to a path which will provide a dwell in the motion of the feed bar at the limit of its forward and rearward horizontal reciprocation. It will thus be seen that when the roller is moving in the arcuate recess 166 of the cam slot 165 and in the opposed arcuate recess 175′ in the face of the auxiliary cam lever 169, the main cam lever 163 remains at rest throughout a distance of approximately 55° of the cycle of rotation of the crank pin and this dwell occurs before the feeding movement of the conveyor. The same result takes place when the roller is moving in the arcuate recess 167, and the dwell then takes place at the end of the feed stroke of the conveyor.

The mechanism described enables the carrier bar to be fed forward at a high speed and returned at a sufficiently slower rate to assure opportunity for the forming instrumentalities to act upon the shells before the carrier again operates to feed shells to the line. This result is obtained by having the conveyor bar move through its forward or feeding stroke while the crank pin 56 is moving through the portion of its cycle which is closest to the pivot point 164 of the main cam lever.

The forward stroke of the conveyor bar is produced when the crank pin roller is engaging in the lowermost portion 176 of the slot in the main cam lever while the return stroke is imparted when the crank pin roller is traveling in the opposite or uppermost portion 177 of the cam slot in the lever which is a greater distance from the pivot point 164 of said main cam lever. It will be noted that the distance of movement or stroke of the conveyor bar is the same in each case, but when the crank roller is engaging the lower portion of the slot to feed the conveyor bar, it traverses a path of 90°, while in returning the carrier bar, the roller traverses a path of 160°, whereby the rate of return is substantially slower.

At the position shown in Figure 14 of the drawings, a set of previous operations upon the shells has been completed, and they are now in a position to be transferred to the next succeeding forming operation, i. e., the conveyor bar has ascended to the limit of its vertical movement and will immediately start its forward horizontal feeding movement. The transfer of the shells from this position to the next succeeding position (accompanied by feeding two blanks from the magazine and delivering two completed shells from the machine), is accomplished through the medium of the crank pin roller 57 moving to the left in the lower portion of the slot in the main cam lever to a position approximately 90° from that which is shown in Figure 14. During this movement of the main cam lever through the arc of 90°, the auxiliary cam lever at the left of the slot moves from the position shown to a position in which the surface of the recess 167 on the left hand side of the main slot is exposed or uncovered. While this is being accomplished, the auxiliary cam lever on the right hand side of the main slot moves into a position closing the recess on the right hand side of the main cam lever slot. Continued rotation of the crank pin roller causes it to engage the recess on the left hand side of the slot and during this period, the horizontal movement of the conveyor bar ceases with the shells in position to be engaged by the drawing and forming instrumentalities, i. e., at the end of the feeding stroke. During this period of dwell in the horizontal motion of the conveyor bar, i. e., after the shells have been engaged by the metal working devices, the carrier bar is lowered to a position in which the carrier fingers are approximately below the level of the dies, which result is obtained by reason of the raising and lowering cam structure previously described and also mounted on the cam shaft 52. Continued movement of the crank roller within the slot in the main cam lever at the upper end thereof produces the return of the carrier bar to its rearmost position, during which period of time the auxiliary levers return to the position shown in Figure 14, whereupon the crank pin again enters the recess at the right of the slot in the main cam lever producing the necessary dwell which provides the required time to again elevate the carrier bar to its shell engaging feeding position. The importance of maintaining the conveyor or rack feed bar in an accurate location with respect to the dies, i. e., controlling the position of the fingers with relation to the forming instrumentalities will be appreciated, and this is provided for by maintaining the main cam lever 163 accurately located during the dwell of the carrier bar 134.

The lowermost ends of the auxiliary cam levers are provided with means for adjusting the position of the ends of the auxiliary levers with relation to the fixed shaft or pivot. This means is shown in Figure 15 and comprises forming a recess 178 in the lower end of each auxiliary lever which communicates with an enlarged opening or slot 179 in the lever in which the pivot pin 180 for connecting the lever to the link is disposed. This pivot pin has a reduced upper portion engaging in the said slot, said reduced portion terminating in a threaded end 181, and also has an enlarged portion 182 having oppositely disposed flat sides 183 conforming to similar sides 184 in the recess 178 formed in the lower end of the lever, and an enlarged projecting portion 185 forming the pivot pin and engaging in the opening 186 in the link. The lever is provided with a threaded opening 187 extending at right angles to and communicating with the recess 178 in which opening is disposed an adjusting screw 188. By adjusting the screw 188 in or out, the lower end of the auxiliary lever may be positioned inwardly or outwardly with respect to the link, and this adjusted position is maintained by means of the lock nut 189 engaging the exposed threaded end of the pivot pin 180. By reason of this adjustment, the upper end of each auxiliary lever is accurately placed to assure an accurate cam slot and thereby cause the shell holding devices on the rack to be accurately lined up with the working instrumentalities of the machine. This adjustment is, moreover, aided by the adjustable connecting rod 160 between the main cam lever and the conveyor bar 134.

From the above description and explanation of the conveyor bar and its operating mechanism, it will be understood that a reliable construction is afforded and one which is capable of continuously operating at high speed.

We have described the mechanism for imparting vertical and horizontal reciprocation to the feed bar, and referring to Figure 14*a*, the movement of the feed bar has been illustrated diagrammatically. Assuming that the feeding bar is in its uppermost position, as shown in Figure 14, and is ready to start its feed stroke, the feed bar then moves from the point T to the point U, during which period vertical movement of the feed bar ceases by reason of the roller 107′ engaging in one of the concentric surfaces on the cam 157. At the point U, the horizontal motion of the feed bar also ceases, due to the roller 57 engaging in the recess 167 and in contact with the arcuate recess 175 of the cam lever 168. The dwell of the feed bar at the point U is sufficient to permit the shells to be engaged by the metal working instrumentalities, whereupon roller 107′ moves out of the concentric cam surface and engages a rise on cam 157 to thereby cause the feed bar to descend to the point V during which time the roller 57 remains in contact with the recess 167 and arcuate surface 175 to arrest horizontal motion of the feed bar during the downward vertical movement. At substantially the point V, the roller 57 moves out of the recess 167 and completely or partly out of contact with the surface 175 into the upper portion of the cam slot 177, so as to initiate the return horizontal motion of the feed bar. At the same time, the vertical downward movement of the feed bar is continuing, and there results a motion which is the resultant of the vertical and horizontal movements imparted to the feed bar by the construction shown in Figure 14 and which is represented on the diagram by the line from V to W. At substantially the point W, the roller 107′ again enters a concentric cam surface in the cam 157, and vertical motion ceases, while the horizontal movement of the conveyor bar in its lowermost position continues rearwardly from the point W to the point X. Thereafter, the resultant vertical and horizontal motions imparted to the conveyor bar, as previously described, cause it to describe a path substantially similar to the line X—Y, and at about the point Y, the roller 57 engages the recess 166 and the arcuate surface 175′ so that horizontal rearward reciprocation of the conveyor bar ceases, while the vertical movement imparted by the roller 107′ engaging the cam drop on cam 157 continues and causes the conveyor bar to move vertically from the point Y to the point T which is the feeding position. Immediately this point T is reached, vertical reciprocation of the feed bar ceases by reason of the roller 107′ engaging a concentric surface in the cam outline 157, and the lever 163 begins its forward or feeding movement of the feed bar by reason of the roller 57 leaving the surface 166 and entering the lower portion 167 of the cam slot. This completes the cycle of movement of the feed bar. If desired, there may be a slight pause at the point T in both the vertical and horizontal movement of the feed bar similar to that which takes place at the point U but of considerably briefer period. However, this is to be avoided in most cases, since it will act to slow up the feeding of shells from the magazine and from one instrumentality to another by the feed bar.

While the mechanism shown in Figure 14 has been described for imparting a rectilinear motion to the feed bar 134, for which it is particularly useful, it is to be understood that this mechanism is not limited to such use and may be employed in numerous other applications.

Referring to Figures 16, 17 and 18, there is illustrated in detail the shell carriers which are mounted on the conveyor bar 134 for that portion of the line comprehended by the redrawing instrumentalities D, there being in the present case five of such carriers, the transverse spacing of the individual fingers of each group being progressively reduced as the redrawing continues. Each carrier includes spring fingers 190 arranged in transversely opposed aligned pairs and spaced longitudinally on the conveyor bar as shown in Figure 16. The spring finger members 190 are pivoted on pins 191 carried in a bracket 192 fixed to the conveyor bar in any suitable manner. Each finger is provided with a depending arm 193 adapted to engage on one side a stop pin 194 carried by the bracket to limit the contraction of the fingers toward each other, and on the opposite side each arm has a shallow recess 195 receiving a detent 196 resiliently pressed by a coil spring 197 mounted on a pin 198 carried in the bracket. The spring-pressed detent normally presses the arm outwardly to retain it in upstanding position, but at the same time allows the fingers to be expanded with relation to each other against the action of the springs as when the cam surfaces 199 on the upper ends of the fingers encounter the metal working instrumentalities as shown in Figure 16 and as will be later referred to. The shells are held between the fingers as shown in Figure 17.

The body of the shell rests upon the supporting member 200 at the point 200′ and this member, as shown in Figure 18, extends transversely of the conveyor bar 134 and is pivoted to the bracket by means of a pin 201 extending through one end of the lever and supported in upstanding intermediate portions 202' of the bracket 202 which upstanding portions 202' cooperate with the supports 200' to support the shell at its opposite side. The supporting member 200 extends longitudinally of the container shell and comprehends a distance substantially equal to that of a pair of fingers on one side of the conveyor bar as shown in Figure 18. At its pivoted end, the supporting member 200 is adapted to be engaged by a fixed stop member 203 mounted in the bracket as shown in Figure 18 and intermediate its length, a spring-pressed plug 203' engages the under-surface of the supporting member to normally urge it against said stop. The opposite end of the supporting member extends outward as shown at 204 and is provided with a cam surface 205. As will be noted upon reference to Figure 18, the surface 205 on the supporting member 200 is displaced by the incoming die and is depressed against the action of the spring-pressed pin 203'.

In the top and neck forming and curling stages, the shell retaining means includes a pair of thin resilient plates 206 as shown in Figures 19 and 20. These fingers are mounted on a bracket 207 fixed to the conveyor bar. In this form of can shell carrying member, the bracket is provided with a longitudinally extending upstanding ledge 208 upon which the shell is supported in sliding engagement with the fingers 206. The bracket 207 may be in the form of a box open at its top and bottom and the upper edges provided with ledges 208 or the ledge may extend across the top from one side to the other in the form of a bar.

In Figures 21 and 22 there is shown the type of shell carrying member mounted upon the conveyor in the trimming and shaped stages. Here the bracket 209 is fixed to the conveyor bar at its lower end and at its upper end is provided with a recess 210, the upper corner edge 211 of which supports the shell. The fingers or plates 212 are of rigid material and are fixed to the bracket as shown at 213.

Referring to Figures 22*a* and 22*b* on the sheet containing Figure 46, there is illustrated a further modified form of shell carrier construction. Here each shell carrier includes a bracket 210' which is fixed to the conveyor bar 134, as shown in Figure 46. Extending upwardly from the bracket 210' is an extension 211' supporting in offset relation a shell-receiving cradle 212'. The cradle has shell-retaining fingers 213' which, however, may be detachably fixed to the cradle by means of bolts, as shown in previously described constructions. The cradle is provided with a substantially central opening 214' for a purpose which will now be described. The shell carrier construction shown in Figures 22*a* and 22*b* is particularly useful with the single slide machine illustrated in Figure 46, and there is attached to the wall of the fixed die P' a suitable arm 215' by bolts 216'. This arm extends outwardly, and when the shell carrier is in its uppermost position, the shell rests in the cradle and in engagement with the upper surface of the arm as shown in Figure 22*b*. The opening 214' in the cradle permits the same to clear the arm in the vertical reciprocating movement of the conveyor bar. The advantage of the arm 215' resides in having a support for the shell in some cases where the dwell at the end of the feed stroke is quite brief and the conveyor bar moves downwardly before the shell is engaged by the metal working instrumentality. In such event, the arm 215' will sustain the shell in position to be acted upon by the metal working instrumentality, and the machine can be somewhat speeded up by elimination of a pause at the end of the feed stroke or by having but a relatively slight pause at the end of the feed stroke. In like manner, the shell ejected by the working instrumentality will be supported by the arm 215' momentarily until the feed bar reaches the position as shown in Figure 22*b*.

As explained, the construction shown in Figures 22*a* and 22*b* is primarily useful in the single slide machine, and it may be used on all stations.

The slide drive mechanism

As explained above, a plurality of blanks are operated upon at each of the successive redrawing, top and neck forming, curling and trimming-shaping stages and while in the present disclosure two shells are shown as being simultaneously operated upon, this number may be increased as desired. The mechanism to accomplish the reforming of the shallow cup-shaped blanks 10, includes two pairs of cooperating plug and die members P and P' respectively as shown in Figure 27. At each redrawing stage the plugs and dies are mounted upon horizontally reciprocating slides which drive the plugs and dies and engage the blanks therebetween to draw them. In the top and neck forming and curling stages only the plug member is mounted on a reciprocating slide, but in the trimming and shaping stage both the plug and the die members are mounted on reciprocating slides. In every stage, the slide construction and operating mechanism is substantially the same.

Referring to Figures 31 to 34, the slides 214 are mounted for transverse reciprocating movement on the bed of the machine in slide rails 215 which are rigidly mounted on the table of the machine at suitable spaced intervals. The rails have wear shims 216 removably mounted on the bottom, and one side thereof. Caps 217 are bolted to the upper ends of the slide rails as shown in Figures 31 and 51 and confine the slides in position. One upper edge 218 of each slide is beveled as at 218' to cooperate with a gib 219 adjustably fixed to the cap 217 so that the slide may be properly adjusted by the wedging action of the gib.

Each of the slides for operation of the plug members is reciprocated in the slide rails by a main cam lever 220 as shown in Figure 27 pivotally mounted at its bottom on fixed shaft 221 which is removably mounted on the machine in a longitudinal position at the base of the bed 13. The drive lever is generally U-shaped in cross-section and has a main cam follower roller 222 mounted between its walls to follow the cam 45 on the rear main cam shaft RC of the machine to move the lever and the associated plug slide inwardly. The drive lever is driven outwardly by return cam 46 on shaft RC which cooperates with a roller 225 mounted at the end of return arm 226 which is pivoted to the main cam drive lever as shown at 277. The arm is adjustable relative to the lever so that different sized cams may be used with the same driver lever and arm structure and also so that all the drive levers may be made alike and interchangeable. For this purpose, the lower end of the arm 226 has a threaded aperture 228 to receive an adjusting screw 229. The head of the adjusting screw is adapted to bear against a stop 230 extending out from the wall of the drive lever 220 to hold the arm 226 continually in contact with return cam 46. This construction provides a rigid, adjustable means on the drive lever 220 to positively drive it from return cam 46 through the return stroke.

The upper end of the main cam lever is provided with an adjustable ball element 227' as shown in Figures 27, 31 and 32, which cooperates with a socket means 228' in the slide to transfer the cam controlled reciprocating driving motion from the drive lever 220 to the slide. The adjustable ball element is integrally connected to a lever 229' pivotally mounted between the walls of the drive lever as shown at 230' in Figures 31 and 32. The upper portion of this lever 229' has the ball formed thereon and the opposite end of the lever is taped and threaded as shown at 231 in Figure 32 to receive an adjusting screw 232. The inner end of the adjusting screw bears against a plate 233 slidably mounted in the dove tail groove 234 as shown in Figure 34 provided in the upper portion of the drive lever and which plate is prevented from dropping out of the groove should it accidentally be released from under the end of the adjusting screw 232 by means of a set screw 235 that holds a washer in the lower entrance of the groove 234. A web 236 extending integral with and between the walls of the drive lever cooperates with the lower portion of the pivoted ball lever to lock this lever in adjusted position. The web has a central aperture 237 so that the adjusting screw 232 may be turned and is provided with threaded openings 238 to receive locking screws 239 which are adapted to be driven against the lower portion of the pivoted lever to lock it in adjusted position with the screw 232 against bearing plate 234.

The slide 214 has an integral rib 240 formed on its underside which extends across the rear of the arched portion 241 and between the two rail bearing elements 214a and 214b. The inner face of this rib has a thrust plate 242 fixed thereto and a plate 243 bolted across the open outer face of the slide has a thrust plate 244 mounted on it in opposed relation to the first named thrust plate. This arrangement provides a socket on the underside of the slide with which the ball fixed to drive lever 200 cooperates. The socket thus provided is rectangular, and a bearing cage is therefore positioned between the ball and the thrust plates. The bearing cage includes plates 245 which are held against the ball by the side straps 246. The plates 245 are ground out spherically to provide a seat 246' for the ball and are beveled or partially cut away on their lower edges to clear the main cam lever 220 as it oscillates.

The side edges of plates 245 have holes 247 drilled therein and the holes are disposed in diagonal relation across the ball, when the plates are in their assembled position. The ball is provided with holes 248 to receive pins 249 fixedly mounted in the side straps 246. The side straps are apertured to receive machine screws 250 and are assembled with the plates 245 so that pins 249 engage the ball and pins 251 engage the respective plates, this construction enabling the bearing cage to pivot on dowels 249 to turn about the ball. The plates 245 are adapted to engage thrust plates 242 and 244 and are vertically slidable with respect thereto, whereby the oscillating movement of the drive arm 220 will be imparted to the slide to cause the slide to be reciprocated transversely of the machine in slide rails 215. The bearing cage being vertically slidable within the socket, the ball may move through an arc about shaft 221 as a center to reciprocate the slide in a straight line in the bearing ways provided and with this construction a large effective bearing surface is provided between the ball and the wall of the socket.

The plates 245 and side straps 246 fixed thereon, each form one half of the bearing cage. The two halves are assembled around the ball with the pins in their respective sockets, and the slide is placed in position with the ball and its surrounding bearing cage in the socket. The plate 243 is bolted across the outer face of the slide and the ball and socket assembly is complete. The adjusting screw 231 on the lower portion of the pivoted ball lever 229 is provided so that the position of the slide may be varied relative to the main cam lever, i. e., toward or away from the longitudinal center line of the machine. The length of the stroke through which the slide moves is governed by the size of the cam operating the drive lever, it being understood that as the redrawing continues the strokes of the respective slides must be varied.

Wherever a movable slide member is employed in the present apparatus, the construction is substantially similar to that just explained and illustrated in Figures 1, 27, 46, 47, and 70. Therefore, but a single description of the slide and driving mechanism is given.

The redrawing mechanism

Referring to Figure 1, and Figures 24 to 25d and Figure 27 in the five redrawing stages D, two plug and die members P, P' cooperate at each stage. Referring to Figures 27 to 45, the plug members are fixedly mounted on the slide 214, and as shown, the slide includes two substantially rectangular rail bearing elements 214a and 214b which are spaced apart. Each of the bearing elements 214a and 214b is bored longitudinally to provide a passage 252 having a counter bore 252' of larger diameter than the portion 253 of the passage as shown in Figure 28. The slide is driven to reciprocate laterally with respect to the machine by the lever 220 as explained above, and is disposed with the portion 252' of the passage toward, i. e., nearest to the longitudinal center line of the machine. Each passage is adapted to have the reduced end 254 of a plug stem 255 mounted therein so that the shoulder 256 of the stem abuts the inner face 256' of the slide, the stem extending perpendicularly from this face toward the center of the machine. The plug stem is drilled longitudinally so that the hollow tie bolt 257 may extend therethrough. The hollow tie bolt provides a vent to pass any air entrapped when a shell is pushed over the plug as will appear below.

The tie bolt is provided with threads 258 on both ends and extends completely through passage 252 and beyond the end of the plug stem 255 and the outer face of the slide. The inner end of the tie bolt or end toward the center of the machine is adapted to support the plug member P which is fixedly mounted through the inturned flange 259 connected by screws 259' to the plug nut 260 which is threaded on the inner end of the tie bolt. The opposite or outer threaded end of the tie bolt passes through aperture 261 in the plate 243 bolted to the outer face of the slide 214 and cooperates with the tie bolt nut 262 to draw the plug member into firm abutting engagement with the inner end 263 of the plug stem 255. The plug member by its inturned flange 259 is thus operatively mounted with respect to the slide on the tie bolt between the plug nut 260 and the plug stem 255. The plate 243 extends entirely across the outer face of both bearing portions of the slide, each plug member P of this slide assembly being mounted in a passage 252' of the bearing elements 214a and 214b in exactly the same manner as just described.

Each plug member P is surrounded by a shell pressure ring 264 which as shown in Figure 46a may be perforated to permit circulation of oil to cool the ring and the plug member and which is resiliently urged toward the die P' by means of a spring-pressed collar 265, one end of which abuts against the pressure ring shoulder as shown at 266. At its other end, the pressure ring collar is provided with a flange 267, one face of which is in the form of a groove 268 cooperating with recesses 269 in the wall 270 to retain a plurality of coil springs 271. These coil springs 271 act upon the collar 265 and in turn resiliently press the pressure ring 264 inwardly. It is to be noted that the wall 270 is provided with an opening 272 through which the stem 255 and associated parts may pass. Also, in this connection, the flange 267 defining the groove 268 is in the form of a ring, the opening 273 of which will also pass the stem 255 and associated parts. The pressure ring is removably mounted on the outer end of the resiliently pressed collar 265 by means of the pressure ring lock 274 which also carries spring hold-down fingers 275. The spring-pressed collar 265 is slidably retained on the plug and stem relative to the fixed wall 270 by means of the spring collar retainer 276 having an internal shoulder 276' engaging the external shoulder 277 of the flange 267, the said retainer member being fixed to the wall 270 in any suitable manner. It will be noted that the collar 265 is limited in its outward movement to engage the pressure ring by the engagement of the shoulder 276' engaging the shoulder 277. As will be appreciated, the pressure ring may move inwardly against the pressure of the springs 271, but the outward movement of the collar 265 under the pressure of the springs is controlled to maintain the pressure ring tightly clamped in position between the collar 265 and the lock 274. It will be noted that the pressure ring has an outwardly beveled edge portion 277' which is adapted to cooperate with an inwardly beveled edge of the die member P' as will be presently described for the purpose of clamping a shell while the same is being drawn. In this connection, the tension created by the springs upon the pressure ring is carefully controlled so as to assure that the drawing will be smooth and continuous. The purpose of the spring hold-down 275 is to position the shells accurately before and after the dies act upon them, and these fingers thus also prevent the shells from moving upwardly when they are suddenly released from the plug and die members and are used throughout the five redrawing stages D.

The dies P' that cooperate with the plug redraw members P just described are both mounted on an opposed reciprocating slide 214' driven by a main cam lever 220' from the main cam shaft FC at the front of the machine as shown in Figure 27. Drive lever 220' has an adjustable ball and socket connection with the slide and has a return arm 226' pivotally and adjustably mounted upon the main lever 220', all as described in connection with the lever 220. The slide rails have rail shoes and a gib substantially as previously described with reference to slide rails 215. The slide upon which the dies are mounted is provided with bearing elements 214a and 214b that cooperate with the slide rails and generally has the same outlines as slide 214. The construction of the die slide as just described being so similar to that of the plug slide, another detail description of the die slide is not considered necessary. Each die slide is provided with inner and outer end walls 281 respectively, which support bushings 282 fitted in openings 283 in which the die ejectors indicated as a whole at 292 are slidably mounted. The inner wall 281 of the slide has cylindrical seats or recesses 284 formed thereon which are concentric with the bearings 282. The cylindrical dies P' are mounted to extend perpendicularly from the inner face of the slide and have reduced cylindrical portions 286 and shoulders 287 which cooperate with seats 284'. Each die is removably held against its seat 284' on the inner wall by a plurality of clamps 288 engaging the shoulder 287 and suitably secured as by bolts 289 to the adjacent slide wall 281. The edge 290 of each die P' is tapered or beveled inwardly as shown at 291 to accomplish the drawing process smoothly by cooperating with the beveled edge 277 of the plug clamping or pressure ring means 264.

The ejectors 292 are adapted to reciprocate within each of the dies P' and each of the ejectors has a pad 293 that extends slightly beyond the mouth of the die when the ejector is in extended position as shown in Figure 28. The pad of the ejector is mounted upon a stem 294 which is slidably mounted in the tube 295. The tube is adapted to reciprocate in bearings 283 supported in the end walls 281 of the slide and has a pin 296 disposed crosswise within it which cooperates with a slot 297 in the stem 294 to limit the movement of the stem within the tube. The inner wall 281 of the slide in back of the ejector pad is apertured as at 298 to provide a vent so that the ejector may reciprocate freely in the die, without interference from air entrapped within the die behind the pad. The outer end of the tube is provided with a stop plug 299 and a spring 300 is confined between the end of the stem 294 and the plug 299. Referring to Figures 28 and 30, a spacer sleeve 301 is positioned around the outside of the tube adjacent the outer bearing 283 and between the end of the spacer and the other bearing are disposed a plurality of segments 302 which are resiliently pressed against the tube 295 by a coil spring 303 tensioned around the segments which thus form a friction collar to resist longitudinal slippage of the tube in the bearings. The stop plug 299 in the end of the tube is provided with an enlarged head 304 which is operatively associated with the adjustable threaded stop 305 having a stop screw 299' mounted in the front wall of the casing of the machine.

The arched portion of the plug slide is slotted and has the T-shaped guide bar 306 fixedly secured therein as shown in Figure 31. The arched portion of the die slide is suitably machined for fixedly securing thereto as by screws a track 306' as shown in Figure 27. The guide bar is designed to reciprocate in the track as the slides move toward and away from each other as shown in Figures 27, 28 and 29, and in this manner the plug and die members are held and guided in accurate alignment as will appear more fully below. The plug slides are enclosed by casing 307 and a cover 308 which is hingedly mounted at 309 on the wall 270 that extends longitudinally along the top of the machine. The wall is suitably apertured so that the plug stems upon which the plug members are mounted and the T-shaped guide member 306 may reciprocate freely therethrough.

The die slides which are mounted on the front portion of the machine are enclosed by the casing 310 and cover 311 consisting of a plurality of plates 312 which are transversely hinged at 312' to the tops of the slide rails 215. The longitudinal wall 270 serves to support the lubricating pipe 116 which extends lengthwise of the machine over all the redraw die positions and is hingedly mounted on the top thereof as heretofore described.

The plug and die structure described is duplicated at successive stages to provide a plurality of redrawing stations. At each station the can blank is further drawn to reduce its diameter and elongate it as shown in Figures 24 to 24*d*. Each successive station includes plugs and dies of somewhat smaller diameter but having a longer stroke to accomplish the elongation of the can blank and reduction of its diameter.

The plug and die mechanism operates in the following manner to redraw the blanks. The blank is positioned by the conveyor means in exact alignment with the resilient pressure ring as shown in Figure 28. The slide 214' is then driven forward by the main cam drive lever 220' so that the can blank is driven home over the resilient pressure ring 264, and the die clamping the blank between the ring and itself, compresses the springs 271 to maintain the proper clamping tension on the blank during the drawing operation as shown in Figure 29. When the blank is thus firmly clamped the slide 214 is reciprocated forwardly to drive the plug P into the die to draw the can blank completely through the clamping means to smoothly elongate the blank as exemplified by Figure 39. The air confined between the plug and the blank will pass freely through the hollow tie bolt 255 and air confined behind the ejector will pass through aperture 298.

The ejector pad 293 is forced into the die before the blank until the plug reaches the end of its stroke. After the redrawing operation, the slides move apart and the shell follows or tends to follow within the die P'. When the plug 299 engages the stop screw 299' inward movement of the ejector pad is stopped, and continued movement of the slide causes the shell to be ejected into the feed conveyor path. The spring 300 is a cushion spring to soften the impact of the ejector pad on the shell if it should happen to stick in the die. At this time also, when the slide is at the limit of its retracted movement and the shell has been ejected, the conveyor bar has just reached its uppermost position for receiving shells from the metal working devices and transferring them to the next station, as well as feeding two new blanks from the magazine and discharging two completed shells from the machine.

This operation is repeated in five successive redrawing stages D in the present machine, to elongate the shallow drawn blank 10 progressively as shown in Figures 24 to 24*d*. The drawing operation is the same on both can blanks in each of the separate stages. In the last redraw position as shown in Figure 45, instead of completely drawing the blank through the pressure ring-die clamping means as in all the previous stages, a portion of the bottom edge of the blank may be left turned out as in Figure 24*d* to provide a flange 11 that may be trimmed and have a bottom seamed thereto. In some instances, in the last redraw stage, the can blank may be completely drawn through the pressure ring clamp to provide a cylindrical blank with an unflanged open end that may be suitably trimmed and welded to a can end.

The several stages of redrawing are illustrated in Figures 28, 29, and 35 to 45, the blanks being progressively carried from one instrumentality to the succeeding one on the intermittently reciprocated conveyor bar. In Figure 28 the blank 10 is illustrated in position on the conveyor bar ready to be acted upon by the plug and die, and in Figure 29, the blank is shown just after it has been pressed by the ejector pad upon the pressure ring of the plug and before the plug moves to accomplish drawing. In Figure 35 the blank shown in Figure 24 produced by the first redrawing operation is in position to be acted upon by the second set of redrawing plugs and dies, and in Figure 36, this shell is shown in position with the plug about to start the drawing operation. In Figure 37 the plug of Figure 24*a* produced by the second drawing operation is shown in position on the conveyor bar ready to be acted upon by the plug and die structure, and in Figure 38 the shell is shown in position over the pressure ring ready to be drawn. In Figure 39, the plug is shown as having completed its drawing stroke to form the shell of Figure 24*b*, this position of the parts being common to each of the redrawing operations. In Figure 40 the shell of Figure 24*b* is shown in position on the conveyor bar ready to be acted upon by the drawing devices and in Figure 41 the shell is shown upon the pressure ring just prior to the drawing action of the plug. In Figure 42 the plug is shown at the end of its drawing stroke to form the shell shown in Figure 24*c*. In each of these four redrawing operations, all of the metal of the body of the shell is drawn into the die member to form a substantially cylindrical container shell.

In Figure 43 the shell of Figure 24*c* is shown in position to be acted upon by the metal working instrumentalities. In Figure 44 the metal working instrumentalities have engaged the shell and the plug is ready to begin the drawing operation. This drawing operation is illustrated in Figure 45, and the shell may be completely drawn as shown in Figure 42 or all of the metal drawn except the marginal open edge portion whereby a container having a flange 11 shown in Figure 24*d* is formed. It is to be understood that in the drawing operations, the blank is progressively and continuously drawn to increase its length and decrease its diameter. While five redrawing stages have been indicated, a greater number, for instance, seven, has been found useful. The product of the fifth redrawing stage, as heretofore stated, may be used without further drawing, the flange 11 forming a seaming flange for a top after trimming and shaping if necessary. If desired, any of the shells of Figures 24 to 24*c* may be employed as container shells with or without a pressed-in bottom as shown in Figure 24*e* or the shell may be further drawn to produce a body not provided with a flange 11 and to which a top or cap may be suitably applied by welding after such trimming as may be necessary.

The top and neck forming mechanism

In the present disclosure, the elongated can blank produced in the redrawing stages and as shown at Figure 24*d* is subjected to further drawing or necking stages whereby the integral closed or front end **12** of the blank is shaped into a frusto-conical top having a cylindrical neck portion formed to receive a crown cap as shown in Figures 25 to 26. The top and neck of the can body are drawn in several stages and at each stage, two plug members P mounted on slides as heretofore described in connection with Figures 27 and 31 to 34 cooperate with two die members P' fixedly mounted on the table of the machine, to draw two can blanks at the same time. The top and neck forming operations E follow in the line as the next steps after the redrawing operations D for continuously producing a finished can shell.

The conical top and neck of the blank is formed in the plug and die devices shown in Figures 47 to 63, wherein it will be seen that the plug members are mounted on reciprocating slides **325** and the die members are fixedly mounted in die brackets **326** rigid with the table of the machine. The body portion of the die bracket is substantially L-shaped in cross section and is provided with a reinforcing web **327**. The upstanding front wall **328** of the die bracket is apertured as shown at **329** to receive the two dies **330** which are fixedly secured thereto by bolts **331**. The mouth of each of the dies **330** is tapered inwardly as shown at **333** and an ejector **334** is adapted to reciprocate within the die. The ejector is mounted upon a stem **335** that is reciprocably mounted in the end of a cross piece **336** supported centrally from the reinforcing web **327**. The stem carries the ejector pad **334** at its inner end and is threaded at its outer end to receive an adjusting nut **337**. A spring **338** is confined between the ejector pad and the supporting cross piece **336** to urge the ejector inwardly.

The plug means are mounted on the slide **325** for movement toward and away from the dies and the slide is driven from the main cam shaft RC at the rear of the machine. The drive lever **220**, associated ball and socket connection means, and return arm structure, the slide rail structure **215** and cooperating slide bearing portions **214*a*** and **214*b*** are similar to the structure previously described in connection with the redrawing mechanism and shown in Figures 31 to 34.

The slide has two plug elements **339** mounted thereon substantially as in the redrawing mechanism, but the remainder of the slide and plug structure per se is somewhat different from that heretofore described.

The slide has integral barrel-like portions **340** as shown in Figure 48 disposed within the bearing ways **214*a*** and **214*b***, each of which is provided with a cylindrical recess **341** and a series of smaller recesses **342** in concentric relation to the first mentioned recess. Each of the recesses **341** is adapted to receive the outer end of a plug stem **343** which is removably held therein by a bolt **344**. The plug stem extends inwardly and perpendicularly to the inner face of the slide and has the plug **339** removably mounted on its reduced inner end by means of the nut **345** having a shoulder **346** engaging a shoulder **347** on the plug, the nut being threaded into the stem **343** as shown at **348**. Adjacent the plug end, the stem **343** has a larger diameter portion **349** than the body of the stem, the enlarged portion being spaced intermediate intermediate the inner wall of a collar **350** to be later described and the plug on the stem **343**. This intermediate enlarged portion is provided with a series of slots **351** extending longitudinally along the stem forming a splined portion, in the slots of which pressure pins **352** as shown in Figures 49 and 51, are slidably positioned.

In the first and second stages of the top and neck forming operation E shown in Figures 48 to 55 the plug members each have a pressure ring **353** slidably surrounding them. Each pressure ring is adapted to clamp the shell against the die **330** with the required tension to smoothly draw the top of the shell as the plug member is driven inwardly by the slide **325**. The pressure ring **353** has an inturned flange **355** that engages behind the plug **339** and the outer surface **356** of which provides a thrust bearing surface against which the inner ends of pressure pins **352** exert the required pressure. The pins **352** are held slidably confined within the slots **351** by the sleeve **357** which has a slip fit around the enlarged portion **349** of the stem **343** and has an outside diameter which permits it to fit exactly within the body of a can blank. The sleeve is slightly shorter than the pins **352** so that it floats between the pressure ring **353** and spring follower collar **350** which latter is slidably mounted on the stem. This collar is adapted to engage the outer ends of pins **352** to transmit pressure from a series of springs **358** confined within recesses **342** which act through the spring followers **359** reciprocably mounted in the recesses **342** between the spring follower collar and the springs. In the necking instrumentality shown in Figure 53, the operation is held against movement by a screw **357'**.

In the third and fourth top and neck forming stages as shown in Figures 56 to 61, a pressure ring thrust collar **360** is mounted on the pressure ring **353** over the reduced portion of the stem **343**, and is interposed between the pressure pins **352** and has the pressure ring **353** as shown in Figures 56 to 58 or the collar and ring made integral as shown in Figures 59 to 61. The thrust collar has an outer beveled surface **361** conforming to the beveled surface of the sleeve **362** and a straight upper edge **363** engaging a shoulder **364** on the sleeve. The thrust collar **360**, substantially in line with the straight edge **363**, is provided with a flange **365** engaging behind the pressure ring in the structure shown in Figures 56 to 58 and behind a shoulder **365'** on the plug element **339** in Figures 59 to 61. This thrust collar is required in these later stages, in order to transmit the thrust of springs **358** to the pressure ring, due to the reduction in diameter of the plug and pressure ring required by the reduction in diameter of the cylindrical front end of the shell. In these stages, the sleeve **357** will float between the pressure ring thrust collar **360** and the spring follower collar **350**.

The conveyor bar **139** reciprocates longitudinally between the plug and die members to carry the blanks retained thereon by the fingers shown in Figures 19 and 20 from one stage to the next and then deposits the blanks on positioning rails to accurately align the blanks with the plugs and dies whereby to continuously progressively form the shells as shown in Figures 25 to 25*d*. The neck or front end of each blank is supported on shell support angle 366 carried by the bracket 326 and extending longitudinally of the machine adjacent the conveyor as shown in Figures 48 and 49. The shell support angle is recessed as shown at 367 in Figure 52, the curvature of each recess being the same as that of the body of the can blank and each recess has a shell support pad 368 fixed thereto as shown in Figures 48 and 61. A recess 367 is provided before each die member 330 in an exact relation thereto so that the can blanks resting in the recesses after being deposited there, by the conveyor, will be centered before the die members.

The open or rear end of the blank is supported on the rear shell support 370 in alignment with the plug 339 by the rear support rail pads 371 as shown in Figures 12, 48 and 58, which pads are fixed to the rail, the rail being mounted on the inner face of longitudinal wall 270. The pads 371 are beveled inwardly, i. e., longitudinally as at 372 and engage the flanges 11 formed on the rear ends of the blanks at the last stage of the redraw process as shown in Figure 24*d*. Also, the pads are transversely beveled as shown at 372′ in Figure 58 whereby the flange 11 may freely slide onto the pad as the slide 325 reciprocates. The blanks are firmly held in the niches 367 and pads 371 by the pressure of hold-down springs 373 which engage the top surfaces of the blanks as shown in Figure 12. The springs 373 are supported by and spaced longitudinally along a bar 374 to cooperate with each of the blanks at all the top and neck forming stages and bar 374 is hingedly mounted by cross bars 375 as shown in Figure 59 to wall 270 as shown at 377. The wall 270 is suitably apertured as shown at 378 to permit plugs 339 and stems 343 to reciprocate therethrough. Stripper means 379 are mounted on the inner face of the wall and between the wall and the rear shell stop rail pads 371. The stripper plate 379 engages the flanges 11 of the blanks as the plugs are withdrawn to force the blanks off the plugs into the niches and stop pads ready to be picked up by the conveyor as will appear below.

The operation of the neck drawing means just described is as follows:

The blanks or shells as completed in the five redrawing stages are delivered to the recesses 367 in the shell support angle and the stop pads 371 fixed to the rear shell rail. The hold-down springs 373 urge the can blanks firmly upon this aligning support means so that the shells are accurately positioned with respect to the die and plug means. The blanks being properly positioned, as shown in Figure 48, the slide 325 is driven inwardly and the plugs 339, pressure rings 353, and sleeves 357 are driven into the can blanks to carry them off the front and rear supporting rails into engagement with the die 330. At the first stage as shown in Figures 48 to 50, the outside diameters of the pressure rings 353 are the same as the inside diameters of the shells and the blanks are driven home over the pressure rings and sleeves when the shells are forced against the die.

As the slide drives forward the outwardly tapered front ends of the pressure rings 353 resiliently clamp the blanks against the inwardly tapered inner ends 333 of the dies, the pressure of springs 358 being exerted through pressure pins 352 and the pressure rings to properly tension the sheet metal blanks as they are drawn. After the shells are thus clamped as shown in Figure 49, as the slide continues inwardly, the plugs 339 drive through and past the pressure rings and into the dies 330 as shown in Figure 50 to form the conical portions 380 of the shell and cylindrical front ends 381 as shown in Figure 25. This first stage of the process reduces the length L of the body portion of the blanks shown in Figure 24*d* produced in the redraw process to length *l*, as shown in Figure 25 in order to provide a portion of the material from which the conical top is formed.

When the above described top drawing operation has been completed, the slide is withdrawn and spring-pressed ejector pads 334 force the shells out of the dies on the plugs. The shells remain on the plugs as the slide withdraws until the blanks are positioned over the front support angle and rear shell stop rail at which point the flanges 11 on the can bodies engage the stripper plate 379. The further withdrawal of the slide strips the shells from the plugs and deposits them on the front and rear support rails in proper position to be picked up by the conveyor rack to be carried to the next stage.

The drawing operations performed in the subsequent stages of the machine change the configuration of the front ends 380—381 of the blanks to a conical form as shown in the further steps of the process illustrated in Figures 25*a* to 25*d*. The diameter of the pressure rings 353 of each succeeding necking stage are of such size that they just fit within the cylindrical front ends 381 of the shells to clamp them against the dies and the strokes of the slides and plugs are just long enough to draw the cylindrical front ends 381 of the blanks through the pressure ring and die clamping means until the peripheries of the dies meet the previously drawn conical top portions 380. In this manner, the conical portion 308 is increased in height during the second necking stage while the cylindrical portion 381 is decreased in diameter, as shown in Figures 53 to 55 and Figure 25*a*, and this same result takes place in the third necking stage, as shown in Figures 56 to 58 and 25*b* and in the fourth necking stage, as shown in Figures 59 to 61 and Figure 25*c*. In the practical embodiment of this invention the conical portion of the top is completed in four stages and in the fifth operation the cylindrical front end is drawn to the shape shown in Figure 25*d* and its end is punched out.

In the fifth top and neck forming stage the structures of the plugs and dies are somewhat changed. The slide and slide drive are the same as those previously described, and the necking stem 382 is mounted within the deep cylindrical recess 383 as shown in Figure 62. The drawing plug 384 is removably mounted in the cylindrical seat 385 on the inner end of the necking stem, and the working end of the plug has square cutting edges 386 to cooperate with shoulders 387 of the punching die to cleanly punch the end 12′ out of the shell. The inner or front end of the stem 382 slopes outwardly from the seat 385 to form a conical end 388 that closely fits within the conical top 380 of the blank. The outer surface of the stem 382 is adapted to receive the removable cylindrical sleeve 389 which abuts a shoulder 390 integral with the stem 382. The front end 391 of the cylindrical sleeve is conical to fit within the top of the shell and when in place on the stem it forms a continuation of the conical front end surface 388 of the stem.

In this fifth stage, the die 393 and punch 394 are adjustably assembled in a die holder 395 which is adapted to be removably mounted in a die bracket 396. The die holder is provided with a seat 397 into which the dies are slidably fitted and on each side of the seat the holder is provided with the threaded recesses 398 and 399 to receive clamp nut 400 and adjusting ring 401 respectively. In assembling the dies in the holder the adjusting ring is driven into place, the punch die 394 slipped into position, the die 393 then is placed in the seat and the clamp nut 400 is loosely threaded into its recess. When the holder is assembled and mounted in bracket 396, the slide 383 is driven to the end of its inward stroke and while the plug 384 is at the end of its inward stroke, the adjusting ring 401 is turned to adjust the dies to the proper working relation with the plug. The clamping nut 400 is then driven home to lock the dies in their adjusted position.

The inside diameter of the punching die 394 as shown in Figure 63 is exactly equal to the inside diameter of the upper end or neck portion 402 of the neck of the shell which diameter d is the same as the outside diameter of the punching shoulder 386 of the plug. When the slide drives the plug inwardly, the cutting shoulder 386 of the plug will cooperate with the shoulder 387 of the punch die, as will appear more fully below, to punch the end out of the shell.

In operation of the fifth necking stage, the shells are properly aligned by the front support rail and the rear stop rail, and the slide in driving forward will drive the plugs into the shells to carry them off the rails, as shown in Figures 62 and 63. The continued forward drive of the slide will force the shells onto the cylindrical sleeve 389 until their conical tops are disposed over the conical front ends 388 of the stems, and the plugs 386 are in engagement with the ends 12′ of the necks. The neck-forming end of the plug has a dimension p which is greater than the dimension of the cylindrical neck portion n and therefore since each plug engages an end 12′, the respective conical portions 380 of the shell and 388 of the stem 382 can never be brought into contact with each other, i. e., there will always be a clearance between these two opposed conical portions while the plug is engaged with the end 12′ to draw, shape and punch the cylindrical neck 402. The plugs 386 carried by the stems 382 will force the cylindrical front ends 402 of the can blanks into the dies 393 to reduce the diameter of the extreme ends of the cylindrical front ends and provide the cylindrical head as at 402′ and initiate formation of a shoulder 403 as shown in Figures 25d and 63. This operation increases the overall length of the neck 402 by decreasing the diameter of the portion beyond the shoulder 403. Continued forward movement will drive the plug means through the punch dies 394 to remove the ends 12′ of the necks of the cans, i. e., the cutting edges 386 of the plugs cooperate with the cutting shoulders 387 of the punch die to neatly cut the end out of the can and at the same time the shoulder portion 403 is shaped to its final form. The ends 12′ punched out of the shells will fall through the punching die into chute 404 to be disposed of as shown in Figure 62. After the ends have been punched out of the shells the direction of movement of the slide is reversed, and the shells and plugs are withdrawn from the dies until the flanges on the shells engage the stripper plate 405. Then as the plugs are further withdrawn by the outward movement of the slide, the shells are stripped from around the cylindrical sleeves 389 and are deposited on the rail support means ready to be carried forward by the conveyor means.

The shells as finished in the fifth top and neck forming stage are carried by the conveyor to the next stage and during travel or in a separate stage subjected to suitable cleaning means such as the sprays 406 shown in Figures 25d and 64 for removing any oil film which may possibly have remained on the necks 402. The cleaning sprays operate upon the heads or necks of the shells while the shells rest upon the front support rail and rear stop rail and before the plug means of the sixth operation or initial curling stage is driven forward. It will be understood that the entire can both inside and out may be cleaned at this point.

In the sixth operation and subsequent neck curling stages the necks 402 are curled outwardly and around as shown in Figures 64 to 68, and the curled portions are then flattened against the shoulder 403 as shown in Figure 69 to provide a locking ring 407 for receiving a crown cap. It is important to remove the oil film from the neck before this curling is done, for if any oil is entrapped in the curled locking ring when the cans are finished, the oil may spread and destroy the appearance of the finish. The residual oil has a particularly deleterious effect where the finish applied to the can involves a process that includes a baking step.

While we have referred to the cleaning of the shells before the initial curling operation, we also find that this cleaning operation can be satisfactorily accomplished after the production of the initial curl, but as stated, the washing must take place before the curl is finally formed in order to preclude the possibility of objectionable residues collecting and remaining within the curl.

The curling mechanism

In the sixth or curling stage, the slide and stem construction are exactly the same as in the fifth necking stage except that the shape of the plugs is different. The plugs in the sixth step are adapted to engage within the front cylindrical ends of the shells behind the shoulders 403 as shown in Figure 65. The curling dies 408 used in the sixth operation are mounted in die holders 409 that are removably mounted in a die bracket 410. Each of the die holders is provided with a seat 411 into which the die 408 slidably fits and which is adjustably held in the holder by the adjusting ring 412 and clamp nut 413 in exactly the same manner as the dies in the fifth stage. The die is adjusted longitudinally in the seat by the relative adjustment of the adjusting ring 412 and clamp nut 413 when the cooperating plug is reciprocated to the innermost end of its stroke, so that the size of the preliminary curl is accurately determined as shown in Figure 65.

In the operation of the sixth stage, the slide reciprocates inwardly so that the stems pass into the shells which are driven onto the cylindrical sleeves 414 when the front open end edges of the necks 402 engage the curling dies 408. The shells are positioned over the necking stems with the plugs 415 abutting the shoulders 403 of the shells, the length of the plugs being such that there is a clearance between the conical top of the shell and the inner conical end of the stem 417 as shown at 418. Thus, the shells are positioned on the plugs so that the reduced neck portions 402' of the shells extend inwardly in front of the plugs 415. As the slide moves forward, these neck portions 402' drive onto the curling dies until their extreme front end edges are turned outwardly by the annular curling grooves 420 of the dies as shown in Figures 64 and 65. When this preliminary curl 421 of the neck has been formed, the slide will be withdrawn and the shells will be stripped off the necking stems by the stripper plate 422 as in the previous necking stages. The purpose of the preliminary curl is to prepare the edge of the neck for forming a hemmed edge when the preliminary curl is subjected to the next curling step as shown in Figure 67 whereby the hemmed edge will prevent breaking of the edge in the subsequent steps of forming the bead.

The conveyor means will then step the pair of shells one stage forward to the seventh stage for completing the curl and flattening the same on the shoulder 403 as shown in Figures 66 to 69. In this seventh stage, the construction of the slide and stems is the same as the corresponding structure of the previous stages, only the plug and die shapes being different. The plugs 423 are adapted to fit within the cylindrical front ends of the shells to engage behind the shoulders 403 of the shells and each plug has a central recess 423' as shown in Figure 67, the diameter of which is the same as the inside diameter of the neck above the shoulder 403. The dies 424 in the seventh position are mounted in holders like that of the fifth and sixth positions so that they may be adjusted to proper working relation with the plugs. Each of the dies is provided with an inwardly extending cylindrical end 425, that fits within the recesses 423' in the cooperating plug, and each die has an annular curling groove 426 that rolls or curls the curled edge 421 of the shell as the slide drives the shells inwardly onto the dies, as shown at 427 in Figure 67.

The curled ends so produced on the shells are pressed against a flat object to flatten the curl 427 against the shoulder 403 as shown in Figure 69, to make a locking ring 407 adapted to receive a crown cap as shown in Figures 25f and 26. A plate 429 mounted for vertical reciprocation between the opposed faces 430 of bracket 431 and angle bracket 429 fixed to the table of the machine by screws 436, is driven in timed relation as will be later described into position in front of the dies 424 and has wear cushions 432 as shown in Figure 68 on its inner face against which the curled shell ends are pressed to accomplish the flattening of the ends of the shells, whereby the curl 427 is closed against the shoulder 403 as shown in Figure 69.

The plate 429 is mounted for reciprocation in this manner so that the flat surface 430 of the bracket 431 will absorb the thrust, and for this purpose, the face of the bracket 431 is provided with a vertically extending slot 433 in which slides the bar 434 carrying the plate having flattening dies or wear cushions 432. The bar is retained in the slot by means of the plate 429 which straddles the slot and is positioned in between the opposed faces 430 of the brackets, the plate being fixed to the bar by means of screws 429' which move within a slot 435' in the bracket 435.

The upper end of the vertically extending slot 433 is closed by a plate 434' set into a recess 430' in the face of the bracket 431. By this construction, the bar is maintained within the slot at all times and the plate carrying the flattening dies is presented to a smooth flat surface against which it rides throughout its stroke. The lower end of the bar 434 is pivotally connected to a link 437 which in turn is pivotally connected to one arm 438 of a bell crank lever, the other arm 439 of which carries a roller which is engaged by a cam 440 on the front cam shaft FC. The bell crank lever is pivoted at 441 to the frame of the machine and is normally urged upward by the spring 442 carried on the rod 443 mounted on the bracket at 444. Upward movement of the bell crank lever 438 is limited by the adjustable stop pin 445 fixed to the bracket as shown, whereby the dies 432 may be accurately centered. The cam 440 is driven in timed relation to the reciprocation of the slide 446 carrying the curling plug 423 whereby after the slide has driven the shells onto the curling dies 424 as shown in Figure 67 to perform the curling operation, the slide is partially withdrawn and with it the shell during which period the plate 429 is reciprocated to the position shown in Figure 69 in front of the die holders, and the slide is again reciprocated inwardly to flatten the curls 427 and close the same upon the shoulder 403. When these two operations have been completed, the slide is fully withdrawn and the shells are stripped from the stems and deposited on the front and rear support rails 366 and 370.

The cam on the rear main cam shaft RC for operating the main cam lever which drives the slide 446 in the seventh position, is so shaped that the slide is initially driven inwardly to drive the shell off the support rails and onto the curling die to perform the curling operation. The cam then functions to partially withdraw the slide and then again cause the slide to drive inwardly to press the curled end against the plate 427 as above described. Continued rotation of the cam is thereafter effective to withdraw the slide completely and strip the shells from the necking stem as previously described. This cycle of operations is accomplished while all the other slides make a single working and return stroke.

Trimming and flanging

The finished blanks are now, if necessary, continuously subjected to a trimming and shaping operation whereby the flange 11 is trimmed and shaped so as to be readily seamed to the usual can bottom.

In carrying out the trimming and shaping operation, reference will be had to Figures 70 to 75, and it will be noted that the apparatus includes two cooperating slides 447 and 448. These slides are driven from the front and rear main cam shafts in the manner heretofore described in connection with the redrawing operations D, reference being had to Figure 27. These slides also have the same T-shaped guide bar 306 and cooperating track 306' to accurately guide the female die onto the punch.

The die slide 448 carries two flange trimming dies 453, each of which is mounted on the inner face of the slide to extend inwardly and perpendicular to the face. The die slide has a circular series of spring-received recesses 454 and is drilled longitudinally to provide bearings 455 for the ejector means 456 which is fixedly mounted within respect to the slide to extend inwardly from a front plate 459 of the machine. The inner face of the die slide has seats 460 with which the outer ends of the die holders 461 cooperate. These ends of the die holders have inturned flanges 462 which have a circular series of apertures 463 therein positioned in concentric relation to the spring recesses 454. Suitable flanges 464 as shown in Figure 73 are provided for bolting the die holder onto the inner face of the slide in perpendicular relation thereto.

Springs 465 are positioned in recesses 454 behind the spring followers 466 and the inturned flanges 462 confine the spring followers in the recesses 454. The followers are fixedly mounted on pins 467 which are adapted to reciprocate longitudinally with respect to the die slide and are mounted in bearings 468 for this purpose, the inner ends of the pins extending through the apertures 463 and beyond the inturned flange 462. The flanging sleeve 469 which is adapted to receive the shell within it, is slidably mounted within the die holder with its outer end abutting the ends of the spring-pressed pins 467 as shown at 470. An inwardly tapered seat 471 that cooperates with the conical top portion of the shell is formed within the flanging sleeve, and a cylindrical bearing surface 472 is formed around the outer surface of the other end of the sleeve upon which the trimming die 453 is mounted. The trimming die 453 has a plurality of slots 473 cut into its periphery for receiving the clamping lugs 474 which are bolted onto the inner end of the die holder 461 to clamp the trimming die against the die holder, the trimming die serving to lock the slidable flanging sleeve 469 within the die holder by engagement with shoulder 475 on the sleeve as shown in Figure 75. It is apparent that with this construction the flanging sleeve 469 floats in the die holder between the trimming die and the spring follower pins 467.

The punch slide carries two punches for cooperating with the trimming dies and which are perpendicularly mounted on the inner face of the slide. The punch holder assembly compresses a cylindrical body portion 476 and a neck portion 477 of smaller diameter, and is mounted on the face of the slide by means of the tie bolt 478. A punch holder sleeve 479, slightly longer than the body portion 476, is slidably mounted over the body of the holder in abutment with the flange 480 on the outer end of the holder. The trimming punch 481 is slidably mounted over the neck 477 of the holder against the punch holder sleeve, and the sleeve and punch assembly are drawn tight to a fixed relation by the trimming punch clamp plate 482 mounted in spaced relation to the inner end of the body on a suitable bolt 483. The periphery of the inner face of the clamp plate is rounded as at 484 to provide a centering means to accurately guide the punch into the shell and die as shown in Figure 75.

The inner end of the flanging sleeve 469 is tapered inwardly and cooperates with an outwardly flared portion 485 on the face of the punch to straighten the flange and give it the proper angle required for a seaming operation. The trimming die 453 is adapted to slidably fit over the punch 481 to cleanly trim the flange against the cutting shoulder 486 of the punch.

The shells delivered to the trimming and flanging position by the conveyor are supported at their front ends by the spring-pressed levers 487 as shown in Figure 75 which are provided with the arcuate seats 488 as shown in Figure 73 to receive the bodies of the can blanks. Each of the levers is pivotally supported in a bracket 489 which has a spring housing 490 as shown in Figure 75 integrally formed therewith, and each lever has an integral arm 491 which is adapted to engage an adjustable stop 492 to limit the upward movement of the lever, the arm being resiliently urged against the stop by the spring-pressed plunger 493.

The shells are supported at their rear ends by seats 494 as shown in Figure 74 provided on the inwardly extending arms 495 integrally formed at the ends of bar 496 as shown in Figure 72. The bar is pivotally mounted in bracket 497 and has an integral stop arm 498 that cooperates with the spring-pressed plunger 499 and stop 500 so that the seats 494 may swing upwardly until the stop arm 498 engages the stop 500. The stop 500 is adjustable to properly align the seats with the dies and plugs and the seats are normally urged to assume this position by the spring-pressed plunger 499 working against the stop arm 498 as shown in Figure 74. The pivoted front support levers 487 and the rear shell supports 494 each have a cam surface 501 that cooperate with a die as it moves inwardly to remove the support means from the path of the die travel after the die and plug pick the shell off the supports as will appear more fully below. A hold-down spring 502 resiliently mounted on bracket 503 supported on the inner face of the longitudinal wall 270 is adapted to engage a shell and hold it firmly in the front and rear shell supports in accurate alignment with the punch and die mechanism.

The longitudinal wall 270 is provided with a seat 504 in which a stripper plate 505 cooperating with the punch holder sleeve and punch is mounted. Directly under each of the punch devices, the table of the machine bed is apertured to provide a chute 506 to remove the waste metal trimmed from the blanks, and the mouth of the chute is provided with plates 507 and guides 508 to insure that the trimmings fall directly into the chute.

In the operation of the above described mechanism shells are delivered to the front and rear shell supports by the conveyor rack, and when the shells are properly positioned before the trimming die and punch as shown in Figure 71, the punch and die slides are driven toward each other by the cams of the front and rear main cam shafts. The punch slide is driven inwardly to cause the punch members 481 to engage the flange ends of the shells while the die slide is driven inwardly over the shell bodies as shown in Figure 75. Each of the trimming dies in moving inwardly will drive the flanging sleeve over the shell and the inwardly flared end 471 of the sleeve will engage the conical top of the can body. As the trimming slide 448 approaches the inner end of its stroke, the flanging sleeve 469 will engage behind the flange 11 of the shell, to force the shell over the punch clamp plate 482. The flange will be clamped firmly against the trimming punch 481 under the pressure of springs transmitted to the sleeve 469 through the pins 467 and the cooperation of the inner end of the flanging sleeve and the face of the trimming punch is effective to bend the flange on the shell blank to the proper seaming angle. Further relative reciprocation of the trimming slide and punch slide will cause the punch to drive the flanging sleeve into the trimming die holder, the flanging sleeve moving outwardly against the spring followers and springs. The trimming die 453 slidably passing over the sleeve 469 and punch 481 will cooperate with the cutting shoulder 486 of the punch to neatly trim the periphery of the flange.

When the cutting action has been completed, the slides are withdrawn. As the punch slide is driven back, the puncholder sleeves 479 will pass through the cooperating stripper plates 505 so that the rings of excess material trimmed from the flanges of the can blanks will be stripped off over the end of the punch means and these rings of scrap will fall by gravity into the trimming chutes 506 to be disposed of. The trimming die slide, upon moving outwardly, will bring the front ends of the can blanks into engagement with the ejectors 456 which are supported in stationary relation to the bed of the machine as shown in Figure 71. The further reciprocation of the die slide outwardly will be effective to cause the ejectors to push the shells out of the flanging sleeves. During withdrawal of the dies, the rear and front shell supports are displaced but will be urged by their respective spring plungers to assume their normal position as shown in Figure 75, and when the trimming dies are completely withdrawn, the shells will be positioned upon the front and rear supports. The completed blanks are carried by the next feeding cycle of the conveyor to the downwardly sloping rods 509 as shown in Figure 10*a* which strips the shells from the conveyor during its downward movement and the finished shells roll by gravity to suitable storage or other means.

Modified redraw mechanism

A modified and preferred construction of the machine of the present application is shown in Figures 46, 76, and 77 in which the redrawing, and trimming and flange-shaping operations are performed by a machine in which only one slide is used, i. e., instead of using two opposed reciprocating slides at these stages a single slide is used to accomplish the same drawing, trimming and shaping operations performed in the two slide construction. In the modified construction, the plug and die assembly in the necking and curling stages is exactly like the structure of the above described machine. Also, the structure of all the slide drive mechanisms in the single slide machine are the same as those of the above described two slide machine.

Referring to Figure 46, in the redraw stages of the modified structure the plug P is mounted on a stem 510 fixedly secured to the slide by a suitable tie bolt 511, and the inner end of the stem has a flange 512 against which the plug member 513 is fixedly held by cap 514. A pressure ring 515 which may also be perforated as shown in Figure 46*a* is slidably mounted over the plug 513 at the inner end of the cup-shaped thrust collar 516 and is held in place by a clamp 516′ mounted on the collar 516 which in turn is slidably mounted on stem 510. The wall of the collar adjacent the bottom is provided with a pair of slots 517 which cooperate with the recessed ends 518 of bars 519 which extend longitudinally through the slide. The outer ends of the bars 519 support a spring cage 520 in which a series of springs 521 bear against follower 522 and which are confined behind the flange 523 forming the inner cap of the spring cage. A series of pressure rods 524 extend through the slide between the bottom of the cup-shaped thrust collar 516 and the spring follower 522, the pressure rods transmitting pressure from springs 521 through rods 524 to the thrust collar 516. The pressure ring 515 is driven against the die member P′ by this construction to clamp the shell therebetween when the slide carrying the pressure ring means is actuated.

The pressure ring structure is adapted to slide relative to the plug 513, and its motion is controlled by a rock-shaft 525 which extends longitudinally along the back of the machine throughout the redraw portions. The rock-shaft is driven from one end of the machine only by the cam levers 526 and 527 which bear against cams 528 and 529 respectively, mounted on the rear main cam shaft RC, to rock the shaft forward for the drive stroke and backward for the return stroke. Each of the spring cages 520 is connected to the rock-shaft through a ball and socket connection 530 and a link 531 that is adjustable lengthwise and which is pivotally mounted on the upwardly extending arm 532 carried by the rock-shaft 525, the point of pivotal connection being adjustably along arm 532 to control the stroke through which the pressure ring is driven.

The fixed die member P′ is removably mounted in a die bracket 533 and has a knockout means 534 adapted to reciprocate therein. The knockout pad is mounted upon a square rod 535 that rides in a bearing 536 over the spring pressure friction shoes 537. The upper face of the bearing way 536 is slotted throughout its length so that the lug 538 fixed to the stem 535 may freely move therethrough as the knockout pad is pushed out by the return stroke of the slide carrying the plug P. The upper surface of the plug slide is provided with means 539 for fixedly mounting a guide bar 540 thereto, which bar extends across the machine and is slidably supported in the guide track 541 provided in the top of bracket 533. The end of the arm has an inverted U-shaped knockout bracket 542 fixedly attached to extend downwardly therefrom and the ends of which are provided with adjustable stop bolts 543 which engage behind the lugs 538 fixed to knockout stems 535.

In the operation of this structure when the shells are centered before the redraw mechanism, the plug slide is driven inwardly and rock-shaft 525 is actuated to cause arm 532 to drive pressure ring 515 inwardly. The pressure ring will clamp the shell against the die while the plug is driven inwardly to draw the shell, pushing the knockout before it. When the drawing operation has been completed, the pressure ring is withdrawn due to the actuation of the rock-shaft and at the same time the plug slide is withdrawn and guide bar 540 carrying the U-shaped knockout bracket 542 that engages behind the lugs 538, drives the knockout pad inwardly to force the drawn shell out of the die and onto a support 544 ready to be carried forward to the next redraw stage by the shell conveyor. The knock-out member 534 which has a frictional or yielding mounting is provided with a flat surface as shown, and constantly cooperates with the plug whereby any shells which may have assumed a cocked position on the plug are brought into alignment and maintained so throughout the movement of the plug.

It is to be understood that the apparatus described in connection with Figure 46 is typical of the construction employed in each of the redraw stages D, and that any suitable number of redrawing instrumentalities may be employed, five being illustrated in the present case, but seven being frequently used. The apparatus shown in Figure 46 will, in the manner previously described, form the container blank shown in Figures 24 to 24*d* or Figures 81 to 81*d*.

Modified trimming and flanging

Referring to Figures 76, 77, 78, 79 and 80, there is disclosed a modified form of trimming and flanging apparatus which is positioned in the line and is distinguished from the trimming and flanging apparatus previously described in that there is only one reciprocating slide 560. Reciprocating slide 560 is driven in the manner heretofore described from the rear main cam shaft RC and carries the female die members while the male die members are mounted in a bracket 561 fixed to the table of the machine. The movable die slide 560 is provided with central bores 562 terminating in counter bores 563 extending longitudinally through the slide. Die stems 564 having reduced ends 565 are received in said bores 563 and are held therein by hollow tie bolts 566, one end of each of which is threaded in a recess 567 in each die stem and extends through the passage 562 in the slide to the outer face of the slide where it is rigidly held to the slide by a nut as shown at 568. Each of the die stems is bored longitudinally as at 569 and is provided with a communicating recess 570 terminating in an enlarged bearing way 571, the recess and bearing way being concentric with the drill hole 569. The front end of the die stem has a reduced head 572 and is also provided with a cut-away portion or annular seat 573 in which the female die member 574 is fixedly mounted. A die center 575 is mounted on the inner reduced end of the die stem as by screws 576 and has a flange 577 which slidably fits over the reduced head 572 of the die stem. A pressure ring 578 is slidably mounted over the die center 575, the ring being adapted to reciprocate on the reduced end of the stem within the die 574, i. e., is confined between the die member 574 and the flange 577 of the die center. The pressure ring is provided with the inturned flange 579 which rides on the reduced head 572 between the flange 577 of the die center and the shoulder 580 defined by the reduced end of the head 572. The reduced end of the die stem has slots 581 cut therethrough and the pressure ring is fixedly connected to a spring-pressed plunger 582 by means of a pin 583 which passes through the plunger and has its outer ends confined in openings 584 in the pressure ring. The plunger 582 reciprocates in the bearing way 571 and is fixedly mounted on the end of a rod 585 which extends through the recess 570, the drill hole 569 and the hollow tie bolt 566 to the outer face of the slide. A stop member 586 in the end of the slide and mounted upon the frame is so positioned as to engage the free end of the rod 585 to positively return it to the position shown in Figure 76. The plunger confines the spring 587 around the rod within the recess 570 so that the plunger is continuously urged inwardly to project the pressure ring inwardly, i. e., through the medium of the pin 583.

The male member 588 of the trimming and shaping instrumentality is carried in a punch holder 589 which is carried by the bracket 561. The bracket 561 is provided with an integral upstanding front face recessed as shown at 590 to receive the punch holder and the punch holder is maintained in the recess through the provision of the clips 591 as shown in Figure 78. The punch holder 589 has an annular bore or recess to receive the punch member 588 and a filler ring 592 as shown in Figure 77. The recess in the punch holder is centrally located as shown in Figure 77 and in alignment with the female die slide 560. The provision of the filler ring 592 is for the purpose of maintaining the cutting edge of the punch member 588 always projected to the same point. That is to say, when it is necessary to sharpen the cutting edge of the punch member and thereby reduce the length thereof, a filler ring of a length corresponding to the decreased length of the punch member is used to maintain the cutting edge of the punch member at a constant point. The punch member is held in the punch holder by means of a block 593 having a depending finger 593' engaging in an opening 594 in the wall of the punch member. The block 593 is retained in position by means of the screw 595 engaging in a threaded recess in the punch holder as shown in Figure 77. The finger 593 will hold the punch member in position against rotation as well as longitudinal movement. Surrounding the punch member at its inner end and mounted in an annular recess 596 in the punch holder is a scrap ejector ring 597 having an outwardly turned flange 598. The ring is retained in position by means of the annular collar 599 disposed in a recess 600 in the punch holder and bearing against the outwardly directed flange 598 of the ring, the collar being retained in position by screws 601 as best shown in Figure 78. The scrap ejector ring 597 is provided with an inwardly directed flange 602, the inner periphery of which rides on the outer surface of the punch member 588. The scrap ejector ring 597 is slidably mounted as previously described and the punch holder is provided with a plurality of openings 605 receiving pins 606, which at one end bear against the outer face of the flange 598 of the said ring and the other ends of which bear against an ejector collar 607 slidably mounted on the punch holder. The collar 607 has a slot 608 in which rides the limit screw 609 fixed to the punch holder as shown in Figure 77. By reason of the construction just described, it will be noted that the scrap ejector ring 597 is provided with a positive means for causing it to eject scrap as will be later described. Mounted for sliding movement in an extension 610 of the punch holder is an ejector sleeve 611 having a head 612 provided with a conical recess 613 as shown in Figure 77. The sleeve 611 is provided with a key 614 secured to the sleeve in any suitable manner as by rivets and engaging in a slot or key-way 615 formed in the upper wall of the extension 610 of the punch holder. As explained, the ejecting sleeve 611 is slidably mounted in the extension of the punch holder and is retained in position and guided in its movement by the engagement of the key 614 in the keyway 615 of the punch holder. Referring to Figures 77 and 79, the sliding movement of the ejector sleeve in the punch holder is frictionally resisted by friction shoes 616 projecting through openings 617 in the side walls of the extension 610 of the die holder. These shoes are mounted with their arcuate surfaces in frictional engagement with the side walls of the sleeve by means of arms 618 held in spaced relation by means of a spacer member 619, and adjustable to vary the frictional resistance by means of the rod 620 carrying a spring 621 and an adjusting nut 622. In this manner, the adjustment of the nut

622 regulates the frictional resistance applied by the shoes to the ejector sleeve and thus controls the sliding movement of the sleeve within the extension of the punch holder which is desirable in order that the sleeve may be suitably retarded in its sliding movement. The sleeve is moved to its outward position as shown in Figure 77 by engagement with the end of the shell and is positively moved inwardly to eject the shell by means of the construction now to be described. Referring to Figures 77 and 79, positive means for returning the sleeve to eject a can is provided by means of yokes indicated as a whole at 623 which have integral arms 624. Extending outwardly from the yoke are integral bars 625 which are riveted or otherwise secured to the upper surface of the ejector sleeve. As will be apparent upon reference to Figures 77 and 79, the yokes are of sufficient diameter to straddle the extensions of the punch holders and are in substantial alignment with the scrap ejector collar 607. Mounted upon a projection 630 carried by the reciprocating slide 560 is a bar 631 extending longitudinally across the dies and guided in a slot 632 in the punch holder bracket 561. The outer end of the bar 631 carries a bracket 633, the lower ends of which are provided with adjustable yoke engaging means 635.

Referring to Figures 76 and 78, there is positioned upon the frame, means independent of the conveyor for supporting the shells before and after their engagement by the trimming and shaping instrumentalities. These supporting means are best illustrated in Figures 78 and 80 and comprise bracket 640 disposed across the lower face of the die holding bracket 561 in spaced relation thereto and supported on the table of the machine. Pivotally mounted on the bracket 640 is shell supporting means 641 comprising a plate 642 having an integral horizontal extension 643 provided with a depending lip or cam 644. The plate 642 has a downwardly projecting lug 645 which engages one end of a coil spring 646 disposed within a recess 647 in the bracket 640. The other end of the coil spring 646 is carried by a block 648 fixed within the recess 647 by means of a screw 649. The pressure of the spring 646 against the depending lug 645 causes the shell supporting extension 643 to remain in a horizontal position against a stop 650 carried by the bracket 640. The plates 642 are maintained in position by cover plates 651 fixed to the bracket 640 by means of screws 652 and the said plates 651 are so positioned as to provide a passageway 651′ for the movement of the shell supporting extension 643. In their upward position, the horizontal extensions 643 provide a means for supporting the shells between the dies at a time when the conveyor is out of shell transferring position. The shell is further maintained in this position by being gripped between the horizontal extension 643 and a spring-pressed hold-down finger 653 pivoted to a block 654 which is carried by an arm 655 hinged at 656 to the frame of the machine. The front portion of the arm 655 is provided with a spring-pressed latch member 657, the nose of which is adapted to engage a recess 658 in the front wall of the bracket 561 and thereby lock the assembly in horizontal position. The hinge 656 provides means whereby the assembly may be swung upwardly and rearwardly out of position when it is necessary to make changes in the die member. The spring hold-down fingers 653 in cooperation with the resiliently mounted horizontal support 643 support the shells in position to be picked up and transferred by the conveyor 134, and also in centered position to be engaged by the trimming and shaping instrumentalities.

In the operation of the modified form of trimming and shaping instrumentality just described, the same is preferably interposed in the line as the final operation, and the trimming and shaping may take place either before or after the neck of the shell has been curled and the curl closed to form a bead. The shells are transferred by the conveyor to the position shown in Figure 76, the conveyor being provided with fingers 660 of a character to clear the supporting means 643 in the horizontal movement of the conveyor as shown in Figures 76 and 77 and when the conveyor reaches a point where the shells in the fingers thereof are positioned over the support in horizontal alignment with the dies, the conveyor descends and deposits the shells upon the stationary supports 643 where they are positioned in horizontal centered relation to the dies and held in such position by means of the spring fingers 653.

Thereafter, the slide 560 moves inward and the pressure collar 578 engages the flange 11 of the shell to move the same into engagement with the knockout head 612. The continued inward movement of the shell causes the knockout head and the sleeve 611 to be moved outwardly as shown in Figure 77 and the shell to be positioned within the punch member 588 and the punch holder 589. The inward movement of the die center and pressure ring engage the lip 644 of the first support 643 and by reason of the pivotal mounting of the same cause the support to be depressed in order that the die may continue its inward movement. It will be noted that during this movement, the shell is firmly supported between the head 612 of the ejector sleeve and the pressure ring 578. The pressure ring and die center in their continued movement cause the opposed beveled edges 578′ and 588′ to engage and clamp the flange 11 so as to shape the same and when this engagement takes place, the movement of the pressure ring is stopped and the flange is clamped and shaped between the opposed faces 588′ and 578′ of the cutting die and the pressure ring. Continued movement of the die stem causes the cutting die member 574 to move inward, pressing the scrap ejector ring outward, and the movement of the cutting die is controlled by the slide operating cam mechanism. The cutting die moves over the punch member 588 and the die center projects within the shell and within the punch, and in this movement trims off the edge of the flange which projects beyond the meeting bevelled edges of the punch member and pressure ring. The depression of the scrap ejector ring 578 likewise moves the ejector collar 607 outwardly by reason of the pins 605. The movement of the slide also simultaneously moves the bar 631 carrying the yoke engaging member 635 outwardly in timed relation to the outward movement of the ejector sleeve as shown in Figure 77. When the cutting die 574 has reached the limit of its stroke and the trimming and shaping operation has been completed, the cam mechanism returns the cutting die and simultaneously with this return motion of the slide the yoke engaging member 635 engaging the yoke 624 causes the ejector sleeve to likewise move inwardly whereby the shell is ejected from the punch holder. This ejection of the shell continues until the shell reaches a position over the support 643 at which point the yoke 624 engages the ejector collar 607 to cause the scrap ejector ring 602 to move inward and eject the scrap. During the ejection of the scrap, the rod 585 reaches the stop 586 and further movement of the slide causes the rod to move inwardly carrying with it the pressure ring which strips the shell from the die center if the shell has followed the same and deposits the shell on the horizontal supports 643. From the shaping and trimming machine the finished cams are automatically discharged from the apparatus by the conveyor as previously described.

The use of a unitary single slide or double slide machine as herein described is of considerable advantage, particularly the unitary apparatus including the redrawing and necking instrumentalities. That is to say, heretofore in the production of sheet metal articles in which a number of different shaping and forming operations are necessary, particularly articles in which a large surface is changed at each step, or redrawn at high speed, it has been necessary to discontinue the operation after several changes have been made in the shape, and subject the article to an annealing or softening process. This annealing step is necessary due to the fact that continued working of the metal, causes the metal to heat to the point where it becomes brittle and cracks develop. The necessity of repeatedly stopping the redrawing and shaping of the articles and transferring them to other means to be treated in order to maintain the metal in a ductile condition to be worked, makes the process of forming such articles as common cans too long and expensive to be considered practical, particularly where high speed and quantity production are necessary for low cost. The machine as above described provides a means whereby an article of the class described is continuously produced in quantities at a high speed without the necessity of inter-spaced treatments to maintain the metal in proper working condition.

Referring to Figures 81 to 81*d*, the shells 10 are progressively formed in the manner heretofore described except that in the last redrawing stage the body remains straight and is not partially drawn to form the flange 11 as in Figure 24*d*. Thereafter, the blanks are progressively formed as shown in Figures 82 to 82*d* in the same manner as shown in Figures 25 to 25*d*. An initial curl is then produced on the neck as shown in Figure 82*e*, and, as distinguished from the previous method, the shells having the straight bottom edge and the initial curl are conducted to a trimming apparatus which may be a separate machine or a part of the unitary machine described herein where the raw edge is trimmed off as shown at 700 in Figure 82*f* and then, if desired in the same machine, a seaming flange 701 is produced. In some cases, the seaming flange is not required as where the bottom is welded to the trimmed raw edge. Thereafter, the containers travel through a cleaning apparatus which may likewise form a part of the line of the unitary machine, but may constitute a separate machine interposed in the line, and to which the shells are carried and thoroughly washed inside and out. This washing step is denoted diagrammatically by Figure 82*g*. Thereafter, the shells are subjected to a curling operation to form the hemmed edge and the hollow curled bead and for flattening the bead with the hemmed edge resting on the bevel or shoulder 403 as shown in Figures 65, 66, 67, 68 and 69. The machine for completing the curl may likewise be a part of the single slide or double slide unitary machine or may be a separate machine to which the shells are transferred and interposed in the line.

Referring to Figure 83, we have illustrated a modified type of redrawing plug which is provided with means for cooling the plug, and also means for assuring that at the beginning and end of each stroke of the feed bar the shells will be positioned against the ejector pad of the die P' and away from the plug and pressure ring so that the shells will lie accurately positioned either for engagement by the metal working instrumentalities or for transfer on the feed bar and without liability of being caught on the plug or pressure ring while being fed on the conveyor bar 134. It will be noted that the plug construction is generally similar to that illustrated in Figure 46 and this modification will be described in connection with the single slide machine, although it may be used in the double slide machine. The plug construction of Figure 83, referring also to Figure 46 includes a central bore 710 open at the plug end and in which is detachably supported by a sealing ring or disc 711 a tube 712 having one end threaded into the plug as shown at 713. The stem 510 is bored to provide a passage 714 communicating with the tube 712 at one end and at its opposite end communicates with a flexible tube 715 to which it is connected at 716. The flexible hose or line 715 is connected to an air supply (not shown) having valve means for supplying an air blast momentarily at the start and finish of the feed action of the conveyor bar 134. The operation of the valve means for supplying the air blast at the start and finish of the feed action of the conveyor 134 is suitably timed by reason of a connection to the cam shaft RC. Such operating connection from the shaft to the valve means may be of any suitable character as by means of cam pieces for giving the desired intermittent blast in the proper timed relation. For the purpose of cooling the plug, the same is provided with a circular recess 717 communicating on one side of the support 711 with the bore 710 through the port 718. The support 711 has the dual function of assisting in supporting the tube 712 adjacent one end and also of providing a suitable seal, whereby when the shell is forced over the pressure ring, air will be caused to enter the bore 710 and pass through the port 718 on one side of the seal 711 into the recess 717, and then pass through the port 719 on the other side of the seal into and through the bore whereby it circulates through the plug and then passes out through the outlet port 720. In this manner, the plug is effectively cooled.

A further modification of the plug shown in Figures 46 and 83 is shown in Figure 84 wherein the use of liquid cooling is resorted to. In this construction, the recess 717 communicates with a passage 721 to which is connected at one end a flexible tube 722 for supplying a cooling fluid such as oil, water, etc. The cooling fluid enters the recess 717 and passes therefrom by the port 723 whereby it is caused to thoroughly circulate through the plug and is discharged through the outlet port 724. As will be appreciated, the oil or other liquid may be recooled and then recirculated, if desired.

It will be noted that we have shown in detail in Figure 83 one form of construction for the line 116 for supplying lubricant to the shells during their travel through the redrawing stations. Also, it will be noted that the pressure ring is perforated as shown in Figure 46a to assure that the cooling lubricant will circulate about the pressure ring as well as the external surface of the plug.

There is also illustrated in section in Figure 83 and in detail in Figure 89 another preferred form of shell carrier means indicated as a whole at 725 in Figure 89. This preferred type of shell carrier may be used through the machine for all stations of the single slide machine. Each shell carrier is substantially in the form of an I beam having bottom flanges by which it is bolted to the conveyor bar 134 as shown at 726. At the upper end of the I beam there are secured flexible fingers 727 by means of bolts 728 and the shells rest in the carriers as shown in Figure 89.

In Figures 85 and 86, we have illustrated automatic means for preventing injury to the machine and waste of material should objectionable deformation take place in any of the shells under treatment and at any station through the machine. This automatic means will instantly stop the machine whereby the operator can remove the shells which are deformed, and can also make any necessary adjustments at once. The automatic means may be conveniently associated with the oil line 116 as shown, or it may be mounted on a separate rod extending the length of the machine or comprehended by the redrawing stations only. In the present instance, where we have shown the means mounted on the oil line, it extends over the redraw stations only.

The automatic means includes hold-down fingers 750 which are of rigid construction and are supported on stems 751 carried by the lubricant line 116. The hold-down fingers depend a distance such that they just touch the incoming shells arriving at the respective redraw stations. It will be noted that after the first finger positioned adjacent the magazine, the succeeding fingers have a stepped level so as to take care of the discrepancies in diameters between the shells of adjacent succeeding stations. Thus, one finger 750a depends the same distance as the first finger adjacent the magazine, while the other finger 750b depends a greater distance to accommodate the shell at the second redraw station. In some cases, it will be possible to have the fingers of each bar at the same level, but the construction shown has been found most convenient in the present instance.

Referring to Figure 86, if one of the shells is deformed and thereby extends upwardly beyond a predetermined maximum limit, it will engage a finger to force the line 116 upwardly on its pivot. The line 116 carries a member 752 which engages the contact member 753 of an insulated switch mechanism 754 to complete an electrical circuit. When the line 116 is raised as above described, this circuit is broken and deenergizes a solenoid 755 which normally retracts a rod 756 having a collar 757. Between this collar 757 and an abutment 758 there is interposed a spring 759 normally acting to press the rod and collar outwardly against the action of the energized solenoid. Thus, when the solenoid is deenergized, the rod will be released and the spring will act on the collar to press the same into contact with a lug or guide 760 in which the rod is freely movable. By this engagement of the collar 757 and the lug 760, the arm 67′ will be shifted to the left to move the rod 66′ to the right to act on the valve 36 and divert air from the clutch 18 to the brake 32 for instantly stopping the machine. When the objectionable condition has been remedied, the machine is started in the manner heretofore described, reference being had to Figures 3 and 23.

Referring to Figure 87, we have illustrated a slide operating means which is distinguished from that shown in Figure 1 and described in connection therewith in that means are provided for actuating the various slides from a single master time and motion control mechanism preferably disposed at one end of the machine, i. e., the feed end. This master control mechanism may be used with either the single slide machine or the double slide machine as herein described. In Figure 87, the master time and motion control mechanism has been illustrated for convenience in connection with the single slide machine. The mechanism includes a gear 770 which may be rotated in any suitable manner from the prime mover A or any other suitable prime mover and associated mechanism illustrated in Figures 2 and 23. For instance, the gear 770 may be actuated from the gear 42. This gear 770 carries a cam member 771 eccentrically disposed with relation to the central gear shaft 772 and the cam path is defined by the recess 773 formed in the gear about the cam. An operating lever 774 is pivoted at 775 and substantially intermediate its length and on one side thereof it carries a roller 776 adapted to engage the cam 771 and travel in the cam groove 773 as the cam and gear rotates on the shaft 772 in the direction shown by the arrow.

At its upper end the lever 774 is pivoted at 777 to a link 778 which at its other end 779 is pivoted to an arm 780 keyed at 781 to a shaft 782 which extends throughout the length of the machine as far as desired for operating the various instrumentalities. Also keyed on the shaft 782 is a series of arms 782 disposed in spaced relation to coincide with the locations of the slides of the respective metal working instrumentalities along the machine. These arms are of different lengths to give a varied stroke for the respective instrumentalities as shown at 784, 785, etc. We have illustrated in dotted lines, three of such arms 783, but it is to be understood that as many thereof are used as needed each having a required length as there are instrumentalities, and the length of the arm in each case will depend upon the stroke required at the specific station. At its outer end, each of the arms 783 is pivoted at 786 to a link 787 which in turn is pivotally connected at 788 (as best shown in Figure 88) to a slide device.

Where this mechanism is used in connection with the double slide machine, the construction just described will be repeated on the other side of the machine.

In the operation of this master control and timing mechanism, rotation of the shaft 772 will rotate the gear 770 and the cam 771, and as the cam engages the roller 776, the lever 774 is moved on its pivot to actuate the slide. At the position shown in Figure 87, the slide is at the limit of its outward movement and the cam outline provides a brief dwell sufficient to permit the feed bar 134 to accomplish the feeding of the shells. At this position of dwell, the cam outline X—Y is concentric with the center of the shaft 772. Thereafter, the cam 772 as it continues its rotation brings the outline denoted by the line X—Z into contact with the roller 776 to move the slide inwardly and bring the metal working instrumentality to engage and redraw the shell. In the illustration shown, the slide moves forward with a steady easy motion, and should it be desired to further slow up the speed of movement of the pressure ring 796 as it meets the die P', this can be accomplished by further varying the outline of the cam between the points X and Z. When the cam outline at the point Z engages the roller 776, there need not be a dwell, and in the present instance no dwell is provided, but in some cases a slight dwell may be desirable and the cam outline will be modified to this end. The point Z on the cam outline having reached the roller 776, the slide immediately starts to return and this return movement is quite rapid by reason of the nature of the cam outline between the points Z and Y. Likewise, this return speed can be controlled by varying the cam outline.

The construction just described provides a very efficient means for operating all of the slides or reciprocating metal working instrumentalities from a single point in proper timed relation with the required stroke. Furthermore, as will be appreciated from an examination of Figure 87, the arms 783 always move to a position in which the pivot point 786 is at the horizontal dead center so that the slides are accurately positioned. This is particularly important in the necking and curling stages where accurate positioning is necessary and is also true in the redrawing stages. The length of the arm 787 is preferably made adjustable by any suitable means, e. g., by dividing the arm and connecting the parts with an adjustable screw connection (not shown). As will be appreciated, the stroke of the lever will not be varied, but it may be desirable for accurate positioning that the length of this arm be adjusted.

Referring to Figure 88, we have shown a modified form of slide construction in which the pressure ring is actuated by compressed air as distinguished from the use of springs 521 in the slide shown in Figure 46 for furnishing flexible pressure to the pressure ring. This type of slide may be used throughout the machine and in both the single and double slide types. The master control mechanism described in connection with Figure 87 is particularly useful with this type of slide, but the slide may be actuated by any of the various operating means hereinbefore shown and described.

It will be noted that the slide includes a chamber 789 to which compressed air is supplied from a line 790 communicating with a conventional air supply, not shown. The air pressure in the cylinder acts upon a suitable piston structure indicated at 791. The piston is connected to pressure ring rods 793 which, in turn, are connected to the pressure ring collar 794 having means 795 for fastening the pressure ring 796 thereto. In this construction, movement of the slide carries the plug and pressure ring together until the bevelled surface of the pressure ring 796 clamps the shell against the bevelled surface 792 of the die member P'.

It is to be understood that normally the air pressure constantly maintains the pressure ring projected so that its free edge coincides with the outer face of the plug as long as the pressure ring is out of engagement with the die, i. e., the inner face 797 of the piston structure normally contacts with the surface 798 of the wall of the piston chamber which acts as a stop to prevent further movement of the piston and properly position the ring and plug.

When the slide is moved inwardly to bring the plug and die members into engagement as shown in Figure 88, the pressure ring and plug move together as above stated, but when the pressure ring engages metal of the shell to clamp the same against the die and the slide continues its movement, the plug moves in advance of the pressure ring as shown in Figure 88, and the pressure ring by reason of the air pressure in the cylinder 789 is pressed against the die during the drawing operation and until the slide retracts sufficiently to permit the surfaces 797 and 798 to become re-engaged whereupon the pressure ring and plug again move together on the slide in the retraction of the latter.

Referring to Figure 27, the base of the machine is cast so as to produce substantially a sump or basin 800. This basin is of sufficient capacity to contain a suitable quantity of lubricant and also is so disposed as to collect the lubricant which drips from the various parts of the machine. Disposed in the tank 800 is a pump 801 of conventional design having an inlet 802 provided with a strainer and an outlet 803 for distributing lubricant from the tank to the various lubricating means of the machine. As stated above, the pump is driven by suitable connections from the rear cam shaft RC as by a train of gearing or a sprocket mechanism.

In some cases, one unitary machine will comprise the various redrawing instrumentalities, and another separate unitary machine will include the necking instrumentalities, the two being connected by a suitable conveyor in the production line.

In a machine in which the redrawing and necking apparatus constitutes a single unitary machine or separate unitary machines, the curling, trimming and flanging and washing apparatus may constitute a unitary machine or all or one of such instrumentalities may be unitary with each other and/or with the necking apparatus.

As explained above, it is preferred not to have the conveyor 134 dwell in its movement before starting its feeding stroke, but in some cases this is desirable and in this event the cam outline 157 will be suitably modified to impart the desired dwell before the conveyor in its ascended feeding position moves on its feeding stroke.

Referring to Figure 87, it is to be understood that the shaft 772 is adapted to operate the conveyor and the magazine feeding means in timed relation to the operation of the slide in the same manner as heretofore described, suitable connections being provided from the shaft 772 to accomplish the proper timed movement of the conveyor bar, the magazine feed and the slides.

In this connection, the cam lever structure illustrated in Figure 87 may be modified so that the engagement of the cam 771 and roller 776 in the limit of the forward or working stroke of the slide will also impart a dwell thereto.

While we have illustrated in Figure 85 an electrical circuit for stopping the machine upon deformation of the shells together with suitable fingers 750, it is to be understood that an electric eye may be used in lieu of the fingers for actuating the electric circuit. Also instead of the electric circuit, the switch 754 may consist of an air valve associated with a line leading to the valve

36 to divert the same when a deformation occurs and thereby stop the machine. Also, the air valve which may be used instead of the switch 754 and the electric circuit may be associated with an air piston in place of the solenoid 755 for moving the lever 67' when a deformation of any shell occurs. The fingers 750 employed in connection with the means for automatically stopping the machine should deformation of shells occur have another function than that of detectors in that they also act to maintain the shells properly aligned in the feed fingers of the conveyor.

We claim:

1. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed drawing punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punch and die mechanism and below the path of operation of said mechanism, said conveyor extending transversely of said path and conveying blanks from one punch and die mechanism to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to permit blanks to be supported gravitationally on the bar and removed freely therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then away from, rearwardly and toward the punches and dies to gravitationally receive other blanks when released by the punches and dies, and means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating.

2. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed drawing punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punch and die mechanism and below the path of operation of said mechanism, said conveyor extending transversely of said path and conveying blanks from one punch and die mechanism to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to permit blanks to be supported gravitationally on the bar and removed freely therefrom, a straight horizontal guideway for said bar between the punches and dies means for moving the bar forwardly along a substantially straight horizontal path in said guideway to feed blanks to the punches and dies and then away from, rearwardly and toward the punches and dies to gravitationally receive other blanks when released by the punches and dies, and means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating.

3. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed drawing punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and vertically to one side of the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having thereon a plurality of pairs of fingers extending away from the bar to form blank receiving pockets opening toward the punches and dies to permit blanks to be inserted therein and removed therefrom, the fingers having a yielding movement longitudinally of the bar and transversely of the operating path of the punch and die mechanism to resiliently hold the blanks and means for moving the bar forwardly in the direction of its length to feed blanks to the punch and die mechanism, and then, away from, rearwardly and then toward the punches and dies to receive other blanks when released by the punches and dies, and means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating.

4. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a plurality of sets of cooperating drawing punches and dies entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a conveyor for feeding the blanks from one punch and die to another, said conveyor comprising a rigid bar, means to move said bar parallel to itself forwardly transversely of the paths of the punches and dies to feed blanks from one punch and die to another, then, after the punches and dies engage the blanks, away from the punches and dies and rearwardly and toward the punches and dies to blank-receiving position, means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating, and a plurality of inwardly spring-pressed gripping fingers connected to said bar for resiliently holding blanks drawn in said mechanism while transferring them from one punch and die to another.

5. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed drawing punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the

punches and dies and below the path of operation of the punch and die mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to permit blanks to be supported gravitationally on the bar and removed freely therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then after the punches and dies engage the blanks, away from, rearwardly and toward the punches and dies to gravitationally receive other blanks, means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating, and means for automatically presenting blanks in position to be engaged by the conveyor in its operating movement for delivering the blank to the first punch and die.

6. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed drawing punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and below the path of operation of said mechanism, said conveyor extending transversely of said path, means for operating the conveyor for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to permit blanks to be gravitationally supported on the bar and removed freely therefrom, means to mount the conveyor beneath the axes of the punches and dies and the blank receiving pockets opening upwardly whereby to utilize gravity in receiving and supporting the blanks, means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating, and pneumatic means operative to maintain the blanks in proper position on the bar as they are presented to the punches and dies.

7. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed drawing punches and dies having substantially horizontal axes and entirely supporting the blanks for operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and below the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to permit blanks to be gravitationally supported on the bar and removed freely therefrom, the conveyor being mounted beneath the axis of the punches and dies and the blank receiving pockets opening upwardly whereby to utilize gravity in receiving and supporting the blanks, said upwardly opening pockets being formed by a plurality of pairs of upstanding fingers, the fingers being yieldably mounted for movement longitudinally of the bar and transversely of the paths of reciprocation of the punches and dies to resiliently hold the blanks and means for moving the bar forwardly in the direction of its length to feed blanks to the punches and dies, said means holding the bar stationary with the blanks aligned with the punches and dies until after the same engage the blanks, and then moving the bar downwardly, rearwardly, and upwardly toward the punches and dies to gravitationally receive other blanks, and means operatively interconnecting the punch and die operating means and the operating means for the conveyor to maintain the bar in position to support the blanks until they are engaged by the punches and dies and to move the bar away from the punches and dies while the punch and die mechanism is operating.

8. A machine for subjecting cup-like metal blanks to successive drawing operations to draw a seamless container body, punch and die mechanism comprising a series of substantially axially horizontal opposed drawing punches and dies and entirely supporting the blanks during operation thereon, means for causing relative reciprocating movement between the opposed punches and dies to hold and draw the blanks, a conveyor disposed between the punches and dies and extending transversely of and below the path of reciprocation of the punches for conveying blanks from one punch and die mechanism to another, said conveyor having a plurality of pockets each open at its top and at its sides whereby to gravitationally support blanks on the conveyor for free removal through the pocket-tops and to permit movement of the drawing mechanism therethrough, means for intermittently moving said conveyor in a substantially horizontal plane to feed blanks to the punches and dies, then downwardly after the punches and dies engage the blanks, rearwardly and upwardly while the punches and dies are operating to again receive a drawn cup, said conveyor operating means having means for providing a dwell of the conveyor after its horizontal feeding movement and before downward movement, means operatively interconnecting the punch and die operating means and the operating means for the conveyor, and means for automatically presenting the blanks to said conveyor to be delivered thereby to the first punch and die.

9. A machine for subjecting cup-like metal blanks to successive drawing operations to draw a seamless container body, punch and die mechanism comprising a series of substantially axially horizontal opposed drawing punches and dies and entirely supporting the blanks during operation thereon, means for causing relative reciprocating movement between the opposed punches and dies to hold and draw the blanks, a conveyor disposed between the punches and dies and extending transversely of and below the path of reciprocation of the punches for conveying blanks from one punch and die mechanism to another, said conveyor having a plurality of pockets each open at its top and at its sides whereby to support blanks gravita-

tionally on the conveyor for free removal through the pocket-tops and to permit movement of the drawing mechanism therethrough, means for intermittently moving said conveyor in a substantially horizontal plane to feed blanks to the punches and dies, then downwardly after the punches engage the blanks, rearwardly and upwardly while the punches and dies are operating to again receive a drawn cup, said conveyor operating means having means for providing a dwell of the conveyor after its horizontal feeding movement and before downward movement, means for operating said first mentioned means to cause the blanks to be engaged by the punches and dies before further movement of the conveyor from said dwell, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and means having an operating movement in timed relation to said conveyor for automatically presenting the blanks to said conveyor to be delivered thereby to the first punch and die.

10. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes, means for operating the punches and dies to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punch and die mechanism and below the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly and toward the punches and dies to permit blanks to be inserted therein and removed therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then after the punches and dies engage the blanks, away from, rearwardly and upwardly toward the punches and dies to receive other blanks, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and means positioned over the conveyor for gravitationally supplying lubricant to the blanks on the conveyor and to the punches and dies.

11. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and below the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly and toward the punches and dies to permit blanks to be supported gravitationally on the bar and removed freely therefrom, means positioned over the dies for gravitationally supplying lubricant thereto and directly to the blanks while on the conveyor, means for moving the bar forwardly to feed blanks to the punches and dies and then after the punches and dies engage the blanks, away from, rearwardly and toward the punches and dies to receive other blanks, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and means for presenting blanks in position to be engaged by the conveyor in its operating movement and deliver the same to the first punch and die.

12. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and below the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to permit blanks to be gravitationally supported on the bar and removed freely therefrom, means positioned over the dies for gravitationally supplying lubricant to the dies and blanks on the conveyor bar, said last mentioned means being manually movable bodily from operative position and including means for cutting off the supply of lubricant when moved, means for moving the bar forwardly to feed blanks to the punches and dies and then after the punches and dies engage the blanks, downwardly away from, rearwardly and toward the punches and dies to receive other blanks, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and means for presenting blanks in position to be engaged by the conveyor in its operating movement and deliver the same to the first punch and die.

13. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and below the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening upwardly toward the punches and dies to gravitationally support the blanks on the bar, means for automatically delivering blanks to said conveyor in advance of the first punch and die, said delivering means comprising means for supporting blanks in position to be engaged by the most forward of said conveyor pockets and removed thereby from the delivery means to the first punch and die, means for automatically lubricating the blanks being delivered to the first punch and die, means for moving the bar forwardly to feed blanks to the punches and dies and then after the punches and dies engage the blanks, downwardly away from, rearwardly and toward the punches and dies to receive other blanks, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and means above the conveyor for gravitationally supplying lubricant to the blanks on the conveyor as they are fed from one punch and die to another.

14. In an apparatus for drawing metal cup-shaped blanks into seamless tubular form, a series of drawing punch and die mechanisms, means for conveying tubular blanks successively from one punch and die mechanism to another, the drawing punches each comprising a plug and a perforate ring about the same, said ring serving to grip the work in the drawing operation, means to mount the plug and ring for movement relative to each other, means for operating the punch and die mechanisms, and means for supplying lubricant to the exterior of certain of said punch mechanisms, the perforate walls of said rings permitting flow of the lubricant interiorly to the external surfaces of the plug.

15. In an apparatus for drawing metal cup-shaped blanks into seamless tubular form, a series of drawing punch and die mechanisms, means for conveying tubular blanks successively from one punch and die mechanism to another, means for operating the punch and die mechanisms, certain of said drawing punch mechanisms each comprising an internal punching element and an external slidable pressure ring thereon, said ring serving to grip the work in the drawing operation and having openings therethrough communicating with the punching element, and means for supplying lubricant and cooling fluid to the punching elements through the openings in the rings.

16. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and vertically to one side of the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening toward the punches and dies to permit blanks to be inserted therein and removed therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then while the punches and dies are operating, away from, rearwardly and toward the punches and dies to receive other blanks, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and an ejector member frictionally mounted for sliding movement with respect to each die, positive means for moving the ejector member to eject a shell from the die and position the same upon the conveyor when the conveyor is in its receiving position.

17. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and vertically to one side of the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening toward the punches and dies to permit blanks to be inserted therein and removed therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then while the punches and dies are operating, away from, rearwardly and toward the punches and dies to receive other blanks, said punch operating means including a slide, and an ejector member mounted for reciprocation in each die, means directly connected to said punch slide for positively actuating said ejector member during its ejection stroke to eject a shell from the die and position the same upon the conveyor when the conveyor is in its receiving position.

18. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and vertically to one side of the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening toward the punches and dies to permit blanks to be inserted therein and removed therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then while the punches and dies are operating, away from, rearwardly and toward the punches and dies to receive other blanks, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and an ejector member frictionally mounted for sliding movement with respect to each die, said ejector having a flat surface which is always presented to the blank, the ejector member being positively driven in one direction under the action of the punch and means for positively driving the ejector to eject the blank when the punch is moving in the opposite direction.

19. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanism including a substantially parallel series of opposed punches and dies having substantially horizontal axes and entirely supporting the blanks during operation thereon, means for operating the punch and die mechanism to hold and draw the blanks, a rigid conveyor disposed in a vertical plane between the punches and dies and vertically to one side of the path of operation of said mechanism, said conveyor extending transversely of said path for conveying blanks from one punch and die to another, the conveyor comprising a rigid bar having a plurality of pockets opening toward the punches and dies to permit blanks to be inserted therein and removed therefrom, means for moving the bar forwardly to feed blanks to the punches and dies and then while the punches and dies are operating, away from, rearwardly and toward the punches and dies to receive other blanks, an ejector member frictionally mounted for sliding movement with respect to each die, said ejector having a flat surface which is always presented to

the blank, the ejector member being positively driven in one direction under the action of the punch, and means for positively driving the ejector member to eject a shell from the die, said driving means being directly connected to the means for supporting the punch in its reciprocating movement.

20. In an apparatus of the class described for drawing cup-shaped blanks, a plurality of punch and die mechanisms, means for operating the same to hold and draw the blanks, means for conveying blanks successively from one punch and die mechanism to another to dispose the blanks therebetween, means for operating said conveying means, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, and means for directing a fluid blast against the blanks as the punch and die mechanisms separate to insure proper positioning of the blanks on the conveying means away from the retracted position of the punch mechanisms.

21. In an apparatus of the class described for drawing cup-shaped blanks, a plurality of drawing punch and die mechanisms, means for horizontally reciprocating at least one of said mechanisms to hold and draw the blanks, a moving conveyor disposed between the punches and dies for feeding blanks successively from one punch and die mechanism to another to dispose the blanks therebetween, means for operating said conveying means, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, said conveyor serving to support the blanks gravitationally thereon, and means for directing a fluid blast against the blanks on the conveyor as they are carried by the conveyor into positions between the punch and die mechanisms, whereby to insure proper positions of the blanks on the conveyor with respect to the punch and die mechanisms.

22. In an apparatus of the class described for drawing cup-shaped blanks, a plurality of drawing punch and die mechanisms, means for horizontally reciprocating at least one of said mechanisms to hold and draw the blanks, a moving conveyor disposed between the punches and dies for feeding blanks successively from one punch and die mechanism to another to dispose the blanks therebetween, means for operating said conveying means, means operatively interconnecting the punch and die mechanism operating means and the operating means for the conveyor, said conveyor serving to support the blanks gravitationally thereon, and means for directing a fluid blast against the blanks on the conveyor as they are moved by the conveyor into positions between the punch and die mechanisms and as the punch and die mechanisms separate whereby to insure the proper positions of the blanks on the conveyor with respect to the punch and die mechanisms.

23. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanisms including a substantially parallel series of opposed drawing punches and dies, means for operating the punch and die mechanism to hold and draw the blanks, a conveyor between the punch and die mechanisms adapted to receive the blanks from and deliver them to successive punch and die mechanisms, means for moving the conveyor to convey blanks to successive punch and die mechanisms, means operatively interconnecting the punch and die operating means and the operating means for the conveyor, and means for directing a blast of air upon the blanks substantially at the end of a delivery movement in which the conveyor delivers the blanks to the punch and die mechanisms to insure proper positions of the blanks on the conveyor.

24. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanisms including a substantially parallel series of opposed drawing punches and dies, means for operating the punch and die mechanisms to hold and draw the blanks, a conveyor between the punch and die mechanisms adapted to receive the blanks from and deliver them to successive punch and die mechanisms, means for moving the conveyor to convey blanks to successive punch and die mechanisms, means operatively interconnecting the punch and die operating means and the operating means for the conveyor, and means for directing an air blast upon the blanks on the conveyor as they are conveyed on the conveyor bar, whereby to maintain proper positions of the blanks on the conveyor with relation to the punch and die mechanisms.

25. In a machine for subjecting metal cup-shaped blanks to successive drawing operations to draw a seamless container body, punch and die mechanisms including a substantially parallel series of opposed drawing punches and dies, means for operating the punch and die mechanisms to hold and draw the blanks, a conveyor between the punch and die mechanisms adapted to receive the blanks from and deliver them to successive punch and die mechanisms, means for moving the conveyor to convey blanks to successive punch and die mechanisms, means operatively interconnecting the punch and die operating means and the operating means for the conveyor, and means for directing a blast of air upon the blanks substantially as the punch and die mechanisms disengage the same whereby to insure proper positions of the blanks upon the conveyor as they are released.

26. An apparatus for drawing metal cup-shaped blanks into seamless tubular form comprising a substantially horizontal base, punch and die mechanism including a series of drawing punch and die members mounted successively on said base transversely thereof on substantially horizontal axes to hold and draw the blanks, a rigid conveyor reciprocable longitudinally on said base between and below said punch and die members for conveying blanks in a line between the respective punches and dies from one punch and die mechanism to another, means for mounting the said mechanism for reciprocating movement transversely of the base, means for reciprocating said mechanism, said means comprising a shaft, and a single cam and lever mechanism for oscillating the shaft, said shaft having means connected to certain of said respective members for imparting reciprocation thereto and means for moving said conveyor transversely of the punch and die members to feed blanks from one to another, and then, after the punch and die members engage the blanks, downwardly away from the punches and dies, rearwardly, and then upwardly to receive other blanks as they are released by the punches and dies.

27. An apparatus for drawing metal cup-shaped blanks into seamless tubular form comprising a substantially horizontal base, punch

and die mechanism including a series of drawing punch and die members mounted successively on said base transversely thereof on substantially horizontal axes to hold and draw the blanks, a rigid conveyor bar reciprocable longitudinally on said base below and between said members for conveying blanks in a line between the respective punches and dies from one punch and die mechanism to another, means for mounting said mechanism for reciprocating movement transversely of the base, means for reciprocating said mechanism, said means comprising a shaft, and a single cam and lever mechanism for oscillating the shaft, said shaft having means connected to certain of said respective members for imparting reciprocation thereto, the last-named means and the cam and lever mechanism being arranged in relation to one another so that the last-named means occupy a position of substantially dead center when the reciprocating members are at the limit of their forward or working stroke and means for moving said bar in the direction of its length to feed blanks from one punch to another, and then, after the punches and dies engage the blanks, downwardly away from the punches and dies, rearwardly, and then upwardly to receive blanks as they are received by the punches and dies.

28. An apparatus for drawing metal cup-shaped blanks into seamless tubular form comprising a substantially horizontal base, punch and die mechanism including a series of punch and die members mounted successively on said base transversely thereof on substantially horizontal axes to hold and draw the blanks, a rigid conveyor bar reciprocable longitudinally on said base below and between said members for conveying blanks in a line between the respective punches and dies from one punch and die to another, said bar having a plurality of pockets opening upwardly to receive and support the blanks gravitationally, means for mounting said mechanism for reciprocating movement transversely of the base, means for reciprocating said mechanism, said means comprising a shaft, and a single cam and lever mechanism for oscillating the shaft, said shaft having means connected to certain of said respective members for imparting reciprocation thereto, the cam and lever mechanism being arranged to swing all of the last-mentioned means substantially to a position of dead center when the reciprocating members are at the limit of their forward or working stroke and means for moving said conveyor bar in the direction of its length transversely of the punch and die members to feed blanks from one punch to another and then, after the punches and dies engage the blanks, downwardly away from the punches and dies, rearwardly, and then upwardly toward the punches and dies to receive blanks as they are released by the punches and dies.

29. An apparatus for drawing cup-shaped blanks into seamless tubular form comprising a substantially horizontal base, a series of punch and die mechanisms mounted successively on said base transversely thereof on substantially horizontal axes to hold and draw the blanks, a rigid conveyor bar longitudinally movable on said base below and between said instrumentalities for conveying blanks in a line to said instrumentalities and from one instrumentality to another, the conveyor bar having a plurality of upwardly opening pockets to gravitationally receive and support blanks as they are released by the punches and dies, means for automatically supplying cup-shaped blanks to said conveyor, and means for moving said conveyor and reciprocating certain of said punch and die mechanisms and for operating said feeding mechanism, said last-mentioned means comprising a master control and timing mechanism which includes a cam and lever structure, means for connecting said conveyor to said cam and lever structure, and means for connecting said mechanisms to said cam and lever structure.

30. In an apparatus for drawing metal cup-shaped blanks into seamless tubular form, a series of punch and die mechanisms, means for conveying tubular blanks successively from one punch and die mechanism to another, means for operating the punch and die mechanisms, the said conveying means including a plurality of pockets in which the tubular blanks are supported gravitationally, the pockets being open at their tops and work feeler means associated with said conveying means and responsive to deformation of the tubular blanks from tubular form to effect stopping of the conveyor and punch and die operating means, the feeler means comprising a contact member disposed above the path of the conveyor and the open tops of the pockets whereby to contact the tubular blanks thereabove and in the direction in which they are free to deform.

31. An apparatus for drawing seamless container bodies comprising a substantially horizontal base, a plurality of drawing mechanisms horizontally mounted in longitudinal spaced relation on said base, each mechanism comprising a punch and a cooperating die disposed in spaced aligned relation transversely on the base, means for simultaneously reciprocating all of said punches horizontally, a conveyor operating longitudinally with respect to the base and transversely relative to the punches and dies between and below the punches and dies for feeding the body blanks in various stages of formation between the same, upwardly opening pockets on the conveyor for gravitationally supporting the drawn bodies with their axes disposed transversely to the longitudinal direction of the base, means for reciprocating the conveyor to support the bodies in alignment with said punches to be engaged by the latter for drawing all of the bodies simultaneously, said last-mentioned means serving to move the conveyor downwardly after the punches and dies have engaged the blanks, and then rearwardly and upwardly to bring the body supporting means in alignment with said dies after drawing to receive all the bodies simultaneously, and means for respectively timing the reciprocation of the conveyor and the transverse reciprocating movement of the punches with respect thereto, whereby all the punches are transversely reciprocated simultaneously at one time, and all the bodies are simultaneously fed longitudinally at a different time period.

32. An apparatus for drawing seamless metal container bodies comprising a base having a pair of horizontally spaced substantially horizontal supports, a plurality of drawing mechanisms mounted in longitudinally spaced relation on said supports, each mechanism comprising a punch and a cooperating die disposed in spaced aligned relation transversely on the base, a guideway on the base between the punches and dies and depressed below said supports between the same, means for simultaneously reciprocating all of said punches horizontally, a conveyor bar operating in said guideway longitudinally with respect to the base and transversely relative to the punches

and dies for feeding the bodies in various stages of formation between the same, means on the conveyor forming pockets for gravitationally supporting on the bar the drawn bodies with their axes disposed transversely to the guideway, means for reciprocating the conveyor in the guideway to support the bodies in alignment with said punches for drawing all of the bodies simultaneously, to bring the body supporting means into alignment with said dies after drawing to receive all of the bodies simultaneously, to feed all of the bodies simultaneously to the next respective drawing mechanisms and to move the can body supporting means out of the path of transverse movement of the reciprocating punches, and means for respectively timing the reciprocation of the conveyor and the transverse reciprocating movement of the punches with respect thereto, whereby all of the punches are transversely reciprocated simultaneously at one time, and all of the bodies are simultaneously fed longitudinally at a different time period.

33. An apparatus for drawing seamless container bodies comprising a substantially horizontal base, said base having a pair of transversely spaced substantially horizontal supports and a conveyor guideway therebetween, a plurality of drawing mechanisms horizontally mounted in longitudinal spaced relation on said supports, each mechanism comprising a punch and a cooperating die disposed in spaced aligned relation transversely on the base, means for simultaneously reciprocating all of said punches horizontally, means for feeding blanks to be drawn, a conveyor bar operating in said guideway below and between said punch and die mechanisms and longitudinally with respect to the base and transversely relative to the punches and dies for feeding the body blanks in various stages of formation between the same, means on the conveyor for forming pockets for gravitationally supporting on the conveyor bar the drawn bodies with their axes disposed transversely to the longitudinal direction of the base, means for reciprocating the conveyor to support the bodies in alignment with said punches for drawing all of the bodies simultaneously, to bring the body supporting means in alignment with said dies after drawing to receive all the bodies simultaneously, and undrawn blanks from said feeding means, to feed all of the bodies simultaneously to the next respective drawing mechanisms and to move the can body supporting means out of the path of transverse movement of the reciprocating punches, and means for respectively timing the reciprocation of the conveyor and the transverse reciprocating movement of the punches with respect thereto, whereby all the punches are transversely reciprocated simultaneously at one time, and all the bodies are simultaneously fed longitudinally at a different time period.

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