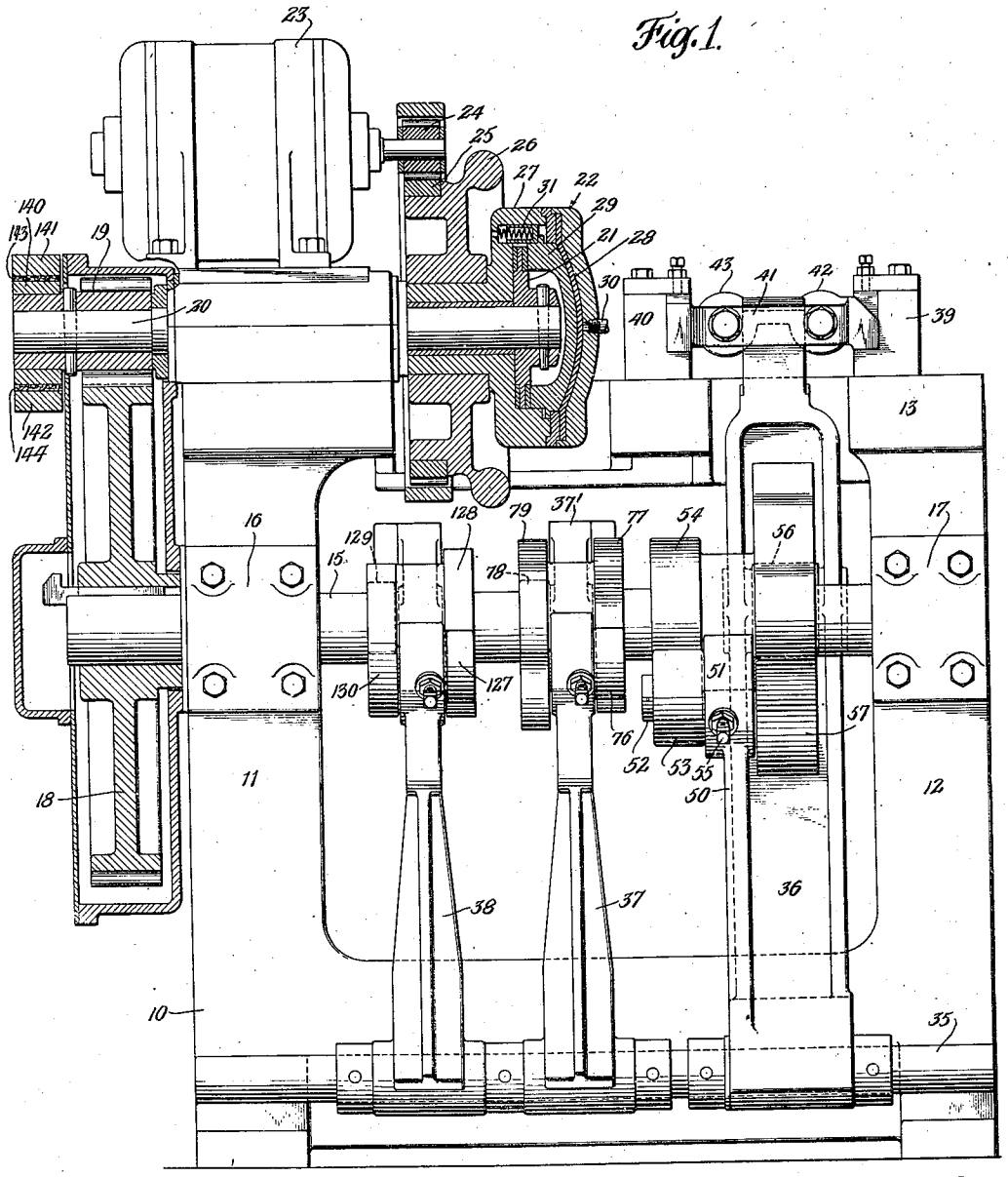
May 5, 1942. A. CALLESON ET AL 2,281,554

CURLING MACHINE

Filed Sept. 9, 1939 9 Sheets-Sheet 1

Fig. 1.



INVENTORS.
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BY Cushman Darby & Cushman.

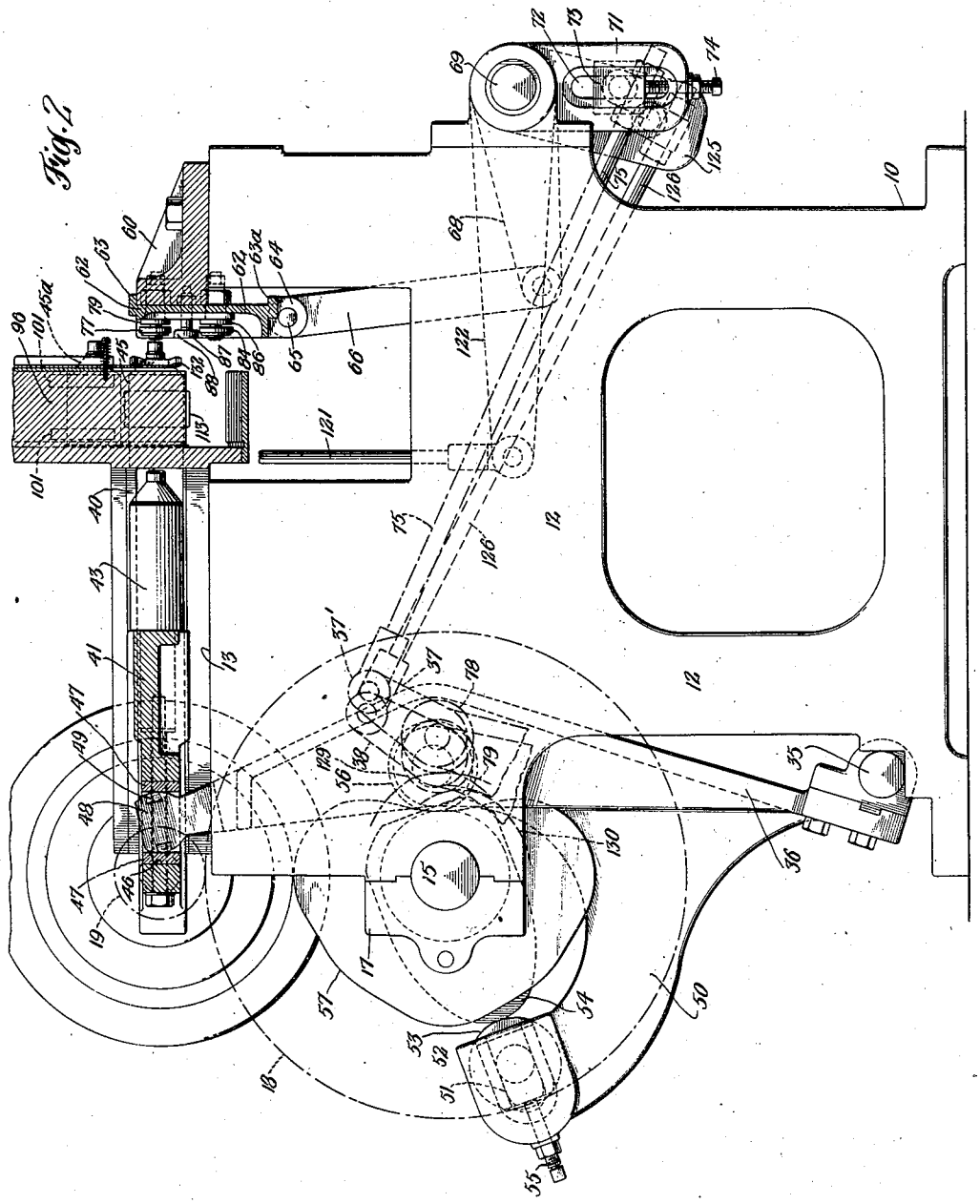
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CURLING MACHINE

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Fig. 2.



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CURLING MACHINE

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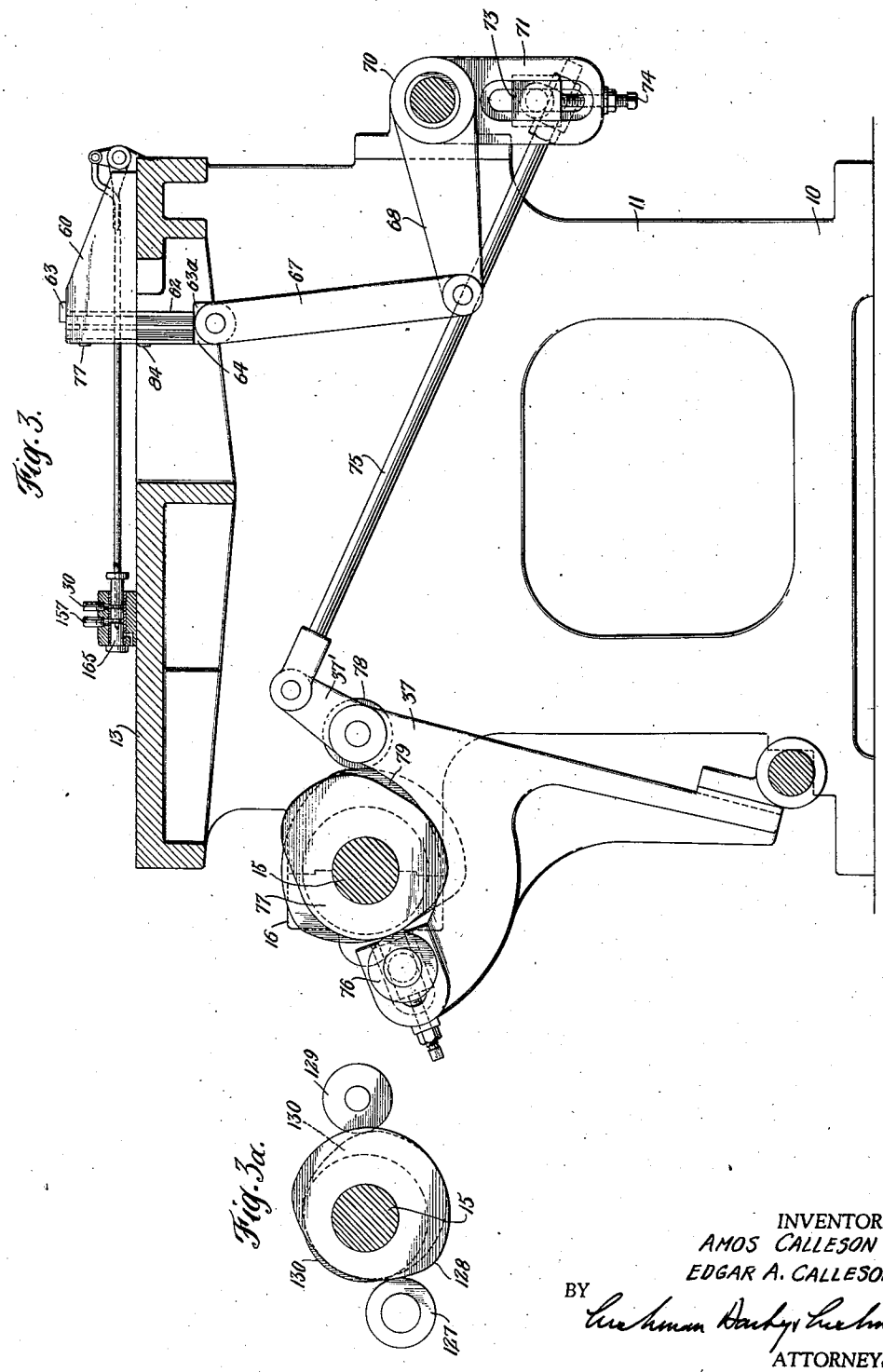


Fig. 3.

Fig. 3a.

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CURLING MACHINE

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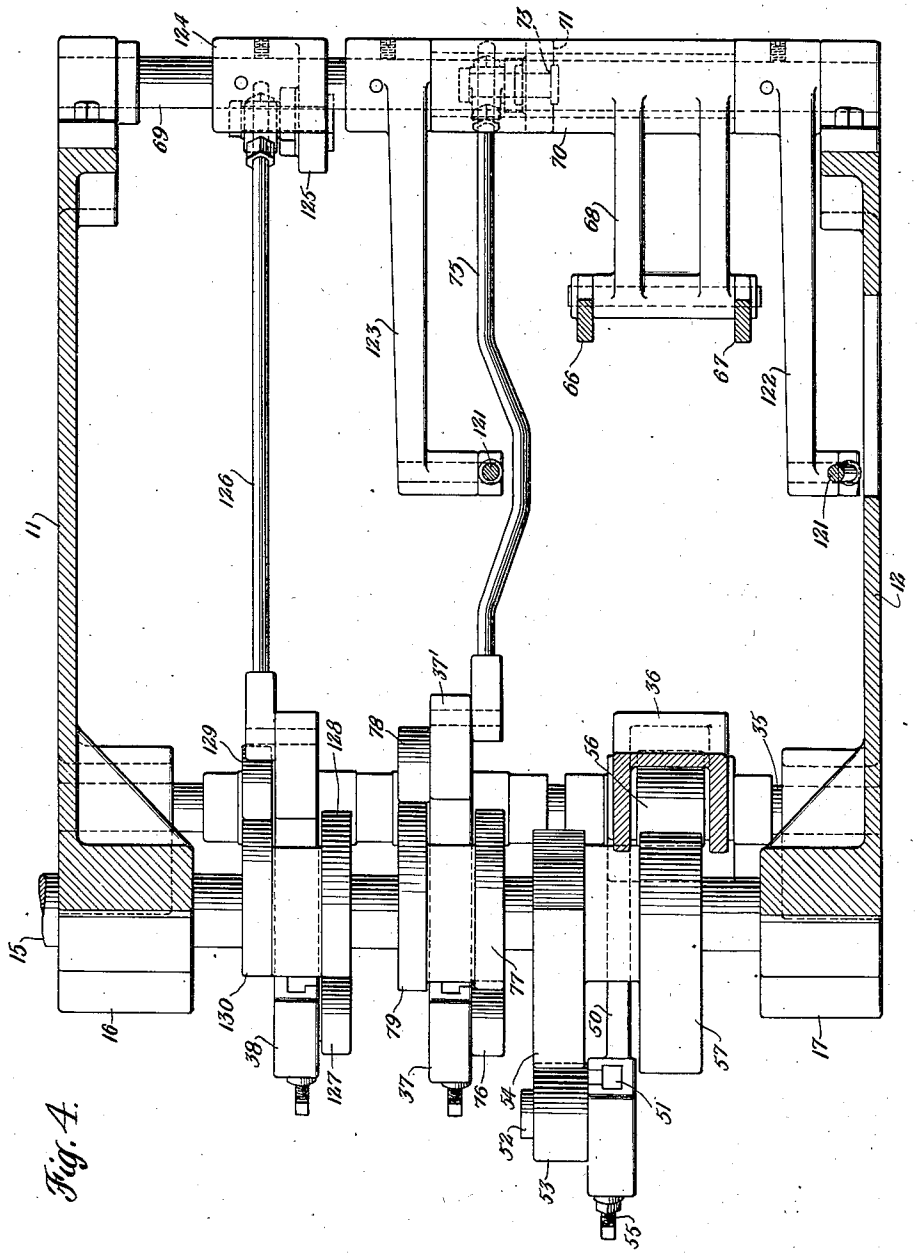


Fig. 4.

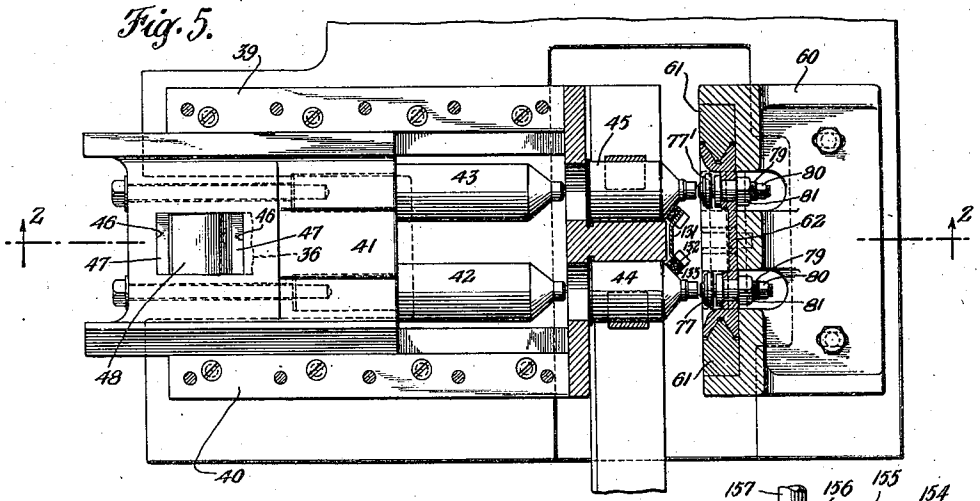
INVENTORS.
AMOS CALLESON &
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CURLING MACHINE

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Fig. 5.



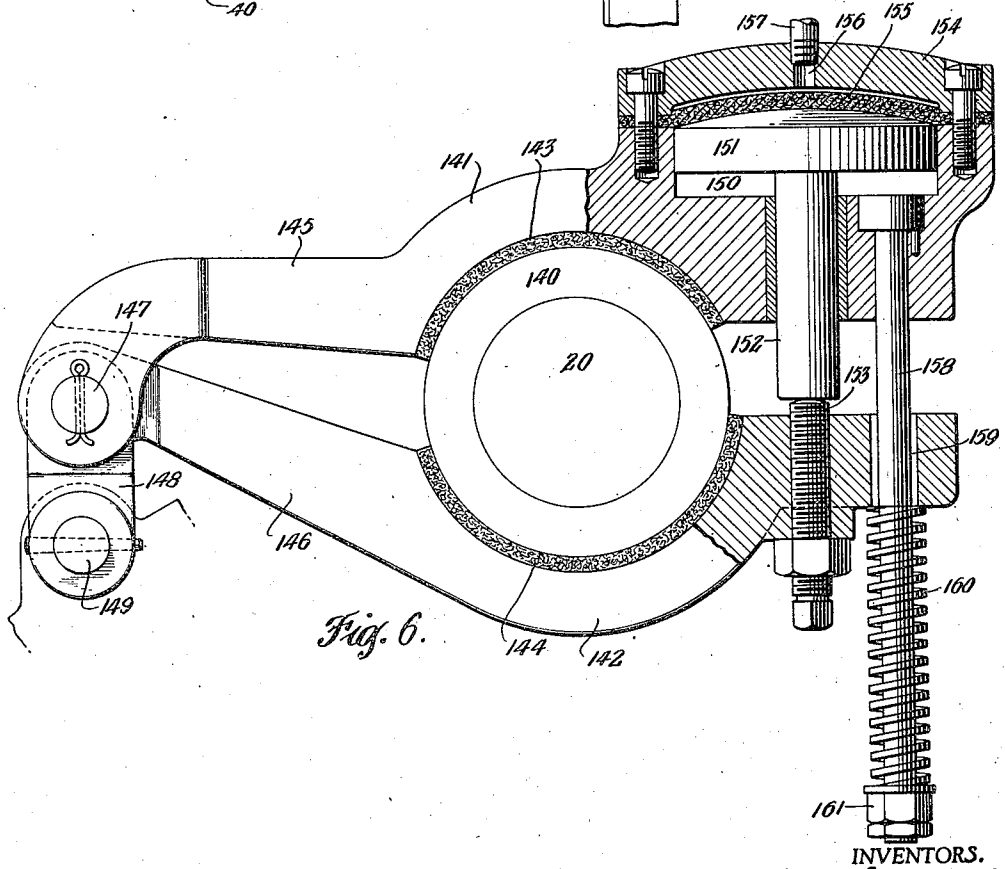


Fig. 6.

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May 5, 1942. A. CALLESON ET AL 2,281,554

CURLING MACHINE

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Fig. 7.

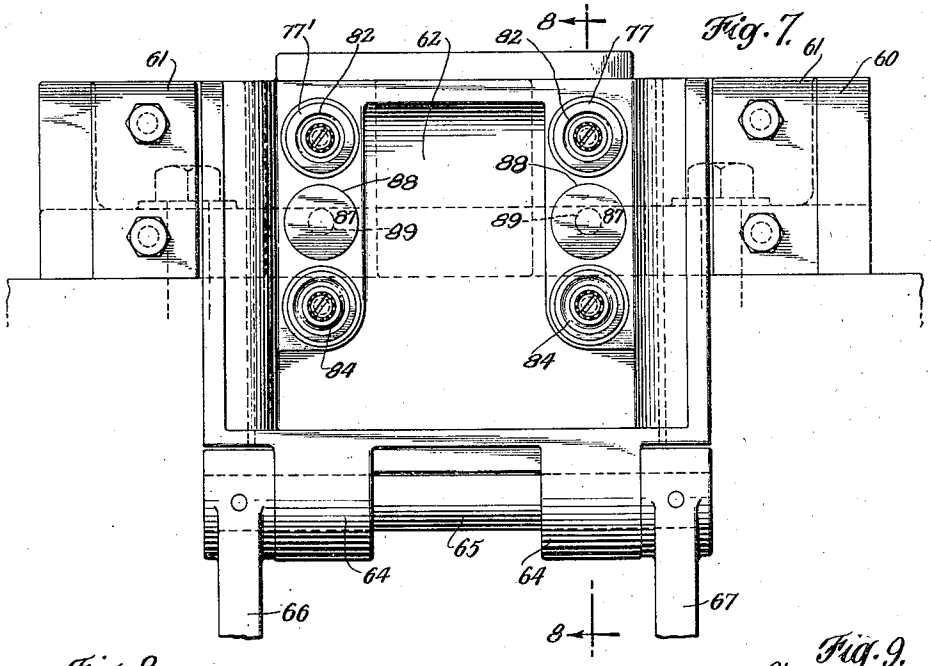


Fig. 8.

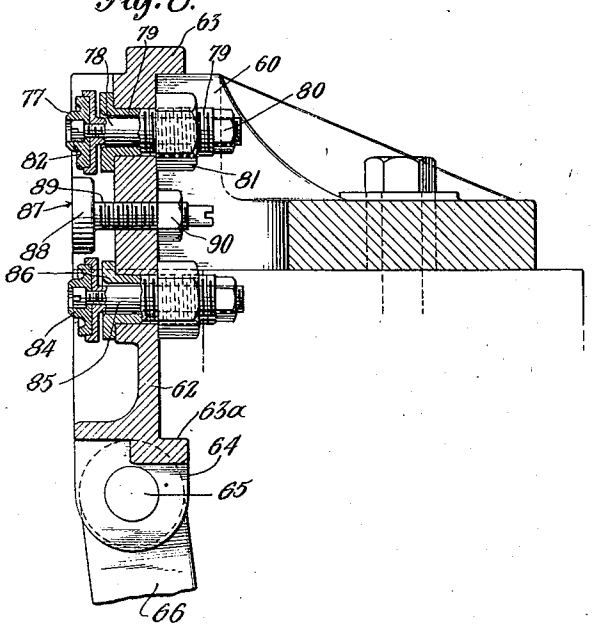
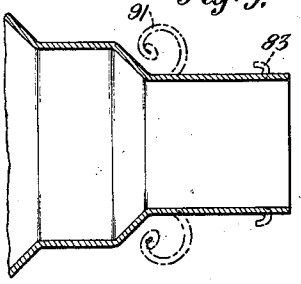


Fig. 9.



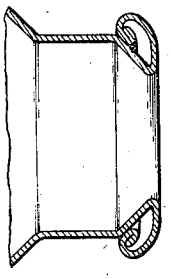


Fig. 10.

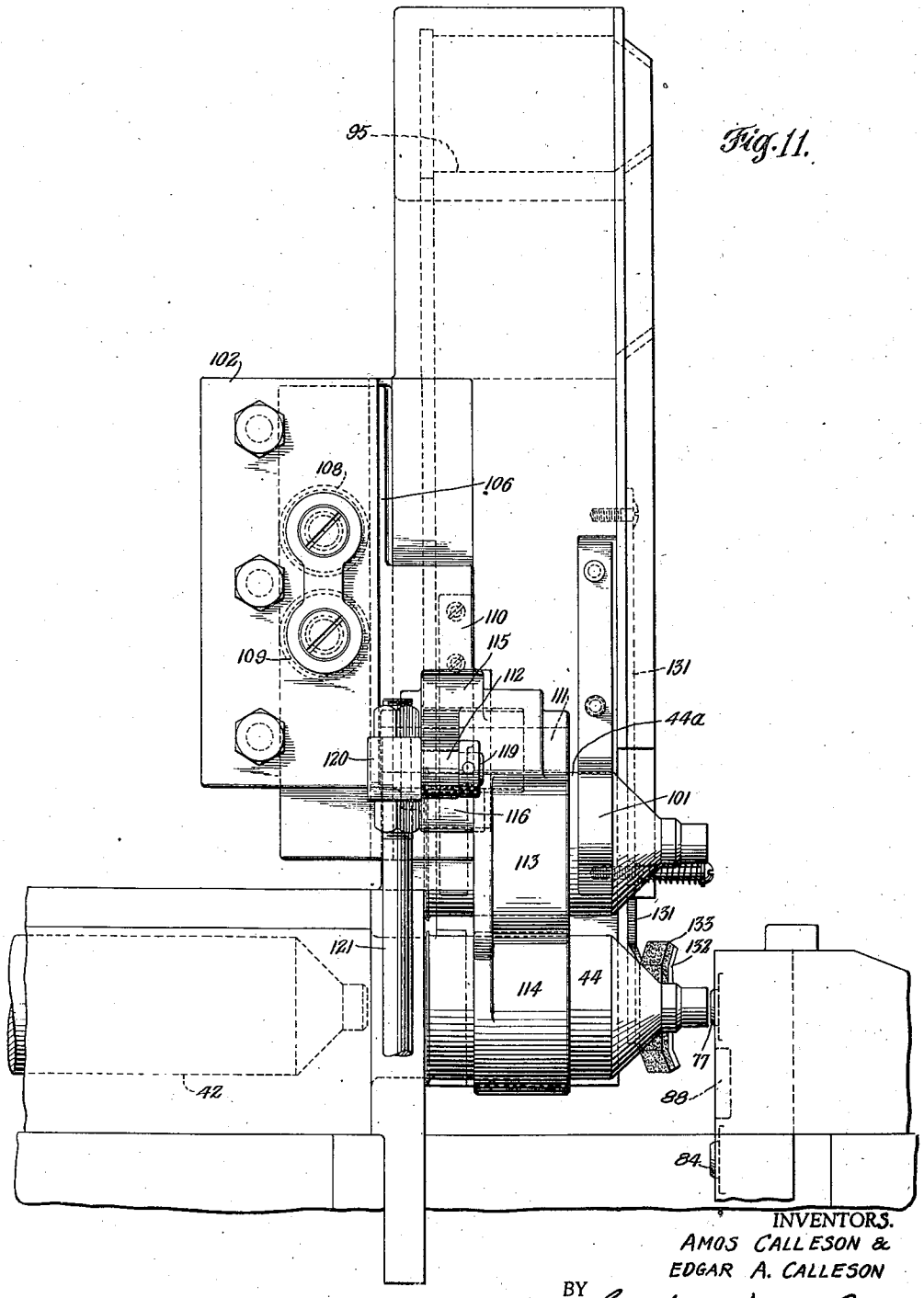
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CURLING MACHINE

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Fig. 11.



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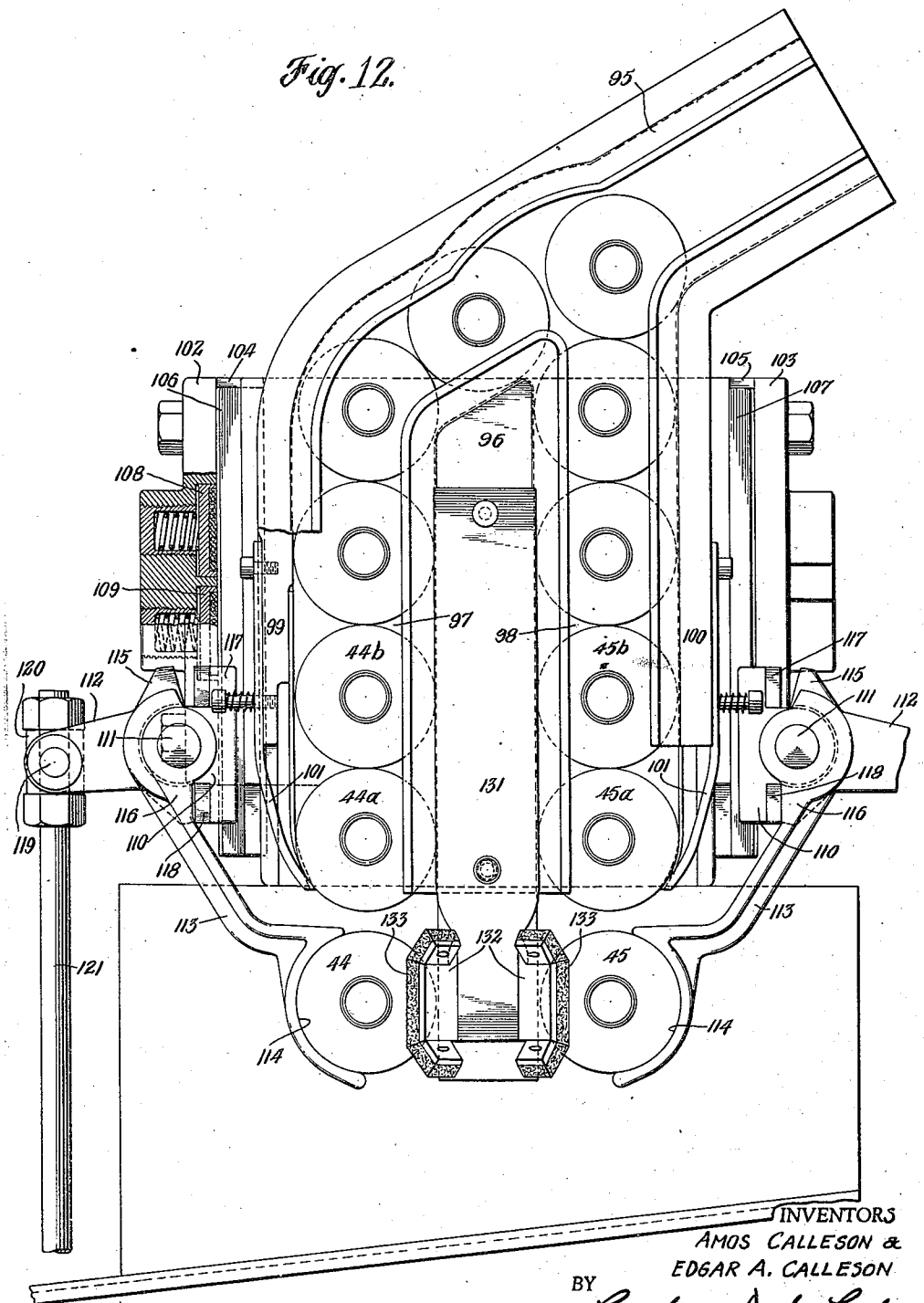
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CURLING MACHINE

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Fig. 12.



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May 5, 1942. A. CALLESON ET AL 2,281,554

CURLING MACHINE

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Fig. 13.

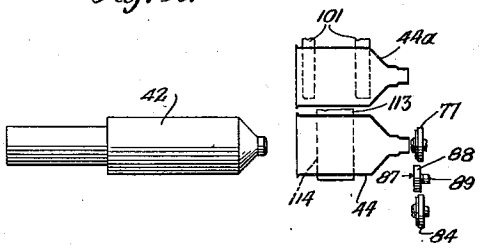


Fig. 14.

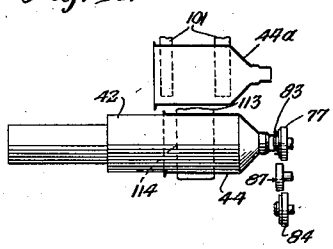


Fig. 15.

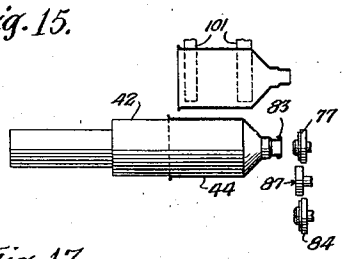


Fig. 16.

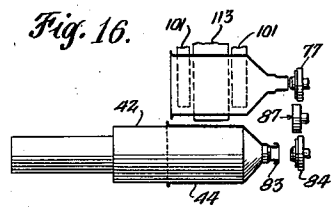


Fig. 17.

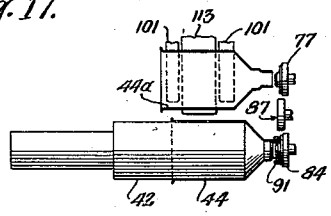


Fig. 18.

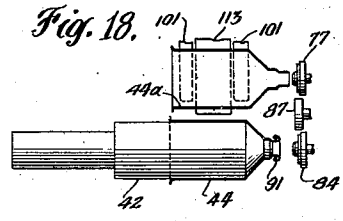


Fig. 19.

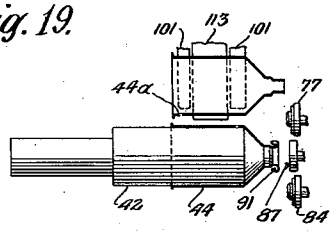


Fig. 20.

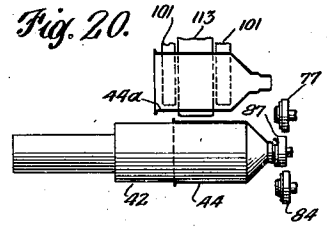
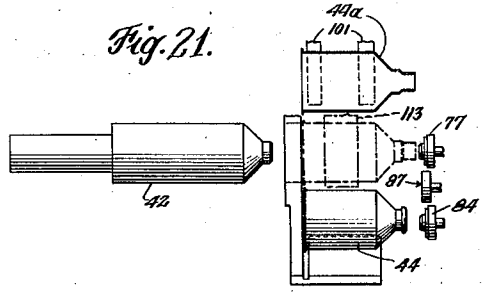


Fig. 21.



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Patented May 5, 1942

2,281,554

UNITED STATES PATENT OFFICE

2,281,554

CURLING MACHINE

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

Application September 9, 1939, Serial No. 294,182

23 Claims. (Cl. 153—48)

This invention relates to a machine for and method of curling metal, and, more particularly, curling the ends of metallic containers. In the specific embodiment illustrated in the accompanying drawings and described below, the invention is disclosed as embodied in a machine for curling the upper ends of the cylindrical necks of sheet metal containers of novel type adapted for the packaging of beer and other pressure beverages.

The primary object of the present invention is to provide means and methods for curling the ends of containers, to provide a curl of novel structure adapted to function as a crown finish, to receive closures of the crown type.

It is a further object of the invention to provide a machine for curling the ends of beer cans which is rapid and efficient in operation, and which forms the curl in a plurality of operations in such manner that the metal of the container is not split, torn or otherwise harmed.

It is a further object of the invention to provide improved means for feeding can blanks to the machine and to provide improved curling and curl-setting instrumentalities operating in conjunction with and in timed relation to the can body blank feeding means.

In order to accomplish the foregoing and other objects, the invention provides means for feeding blanks to a mandrel, means for projecting the mandrel into the interior of the blank, and means for projecting the mandrel and the blank forwardly, so that the end of the blank is projected into a curling die, to impart an outward circumferential curl to the neck end of the blank. The blanks may each be provided with a slight, preliminary curl before they are fed into the machine of the present invention, or the machine itself may do the preliminary curling. In any event, after the end of the neck is curled to the form of a circular bead, the blank is retracted with the mandrel, the die is shifted, a curl-setting die, which may be a substantially plane or otherwise shaped abutment surface is positioned in alignment with the curled end of the can, and the mandrel is again projected forwardly to cause the curled end of the can to strike the abutment surface and partially flatten the bead, thereby providing on the upper end of the bead, an annular surface around the mouth of the container, the shape of which surface corresponds to the shape of the surface of the curl-setting die or abutment surface, said annular surface serving as a highly efficient sealing surface for cooperation with the cushion disc in a crown closure. Instead of having a plane surface, the curl-setting die may have a curved surface of a concave frusto-conical surface, to apply a downwardly sloping face to the end of the neck. After the curl-setting operation just described, the mandrel is automatically withdrawn from the can body and the can is discharged from the machine by gravity or otherwise.

In the form of the invention illustrated in the accompanying drawings, the end of the can is given a preliminary curl by projecting the same into a die having a curling groove of narrow cross-section, struck on a relatively short radius. The can is retracted and the die is shifted so as to bring the second curling die into alignment with the end of the can, the latter die having a curling groove of wider cross-section, struck on a longer radius. The mandrel and the can are again projected forwardly and then retracted, as aforesaid, and the curled end is finally set by engagement with the abutment surface, but it must be understood that the invention is not limited to applying the preliminary curl in the same machine as the machine which performs the final curl and curl-setting operations, since, in some cases, it is found desirable to interpose a cleaning step between the preliminary curling and the final operations.

In the accompanying drawings:

Figure 1 is a rear elevation of the machine;

Figure 2 is a side elevation partially in section, looking from the right of Figure 1;

Figure 3 is a longitudinal section, with certain parts omitted for the sake of clarity;

Figure 3*a* is a diagrammatic elevation of a pair of cams and cam following rollers;

Figure 4 is a horizontal section, partially in plan;

Figure 5 is a plan view, partially in section, on a reduced scale;

Figure 6 is a vertical section and partial elevation of a brake mechanism associated with the invention;

Figure 7 is an elevation of the die slide;

Figure 8 is a vertical section on line 8—8 of Figure 7;

Figure 9 is a fragmentary section of the end of a can blank, showing, diagrammatically, the first two curling operations;

Figure 10 is a similar section of the completed can end;

Figure 11 is a side elevation of the can blank feeding means;

Figure 12 is a front elevation of the same, and

Figures 13–21 are diagrammatic representations of the successive steps performed in the operation of the machine.

The machine comprises a base 10 having upwardly projecting sides 11, 12 terminating at their upper ends in a platform 13. At the rear of the machine, a horizontally disposed, main cam shaft 15, journalled for rotation in bearings 16, 17, has a large spur gear 18 keyed to its end, in mesh with a driving pinion 19 secured to one end of a counter-shaft 20, the other end of which is pinned to the driven disc 21 of an air clutch represented generally at 22. Power is transmitted to the shaft 20 from an electric motor or the like 23 through a driving pinion 24 in mesh with a gear 25 on the flywheel 26, the latter being keyed to the clutch casing 27, loose on the shaft 20. Interiorly of the casing 27, there is a diaphragm 28, clamped around the periphery of the casing and positioned to urge the driving disc 29 into engagement with the driven plate 21, when air under pressure is admitted to the casing through a pipe 30 from any suitable source of air under pressure. When the air pressure is cut off, springs 31 urge the driving member 29 away from the disc, and transmission of power is automatically interrupted. As hereinafter pointed out, an air controlled friction brake is simultaneously applied, to stop the machine.

Below the main cam shaft 15, there is mounted a stationary shaft 35, upon which a plurality of cam following levers are fulcrumed. As hereinafter pointed out, the lever 36 controls the movements of the body blank supporting mandrels; lever 37 operates the curling die slide, and lever 38 the can body blank feeding mechanism.

On the upper platform 13, there are secured by appropriate bolts, a pair of ways 39, 40 for a horizontally reciprocable slide 41, which carries at its forward end a pair of can supporting mandrels 42, 43, each of which is shaped to correspond to the shape of the interior of the can body blanks 44, 45 (Fig. 5). The rear end of the slide 41 is provided with an opening 46 in which hardened steel bearing plates 47 are secured, to take the wear from the upper end 48 of the driving lever 36, said end being provided with hardened inserts 49 (Fig. 2). The lever 36 is formed with an integral, rearwardly and upwardly projecting web 50 having at its end a socket 51 in which there is adjustably mounted a block carrying a laterally projecting stub shaft 52 upon which a cam following roller 53 is journalled, the roller being in contact with a cam 54 fast on the shaft 15. The position of the block in the socket may be adjusted by a screw 55. The lever 36 also has an elongated arm extending upwardly on the other side of the cam shaft 15, which arm terminates in the end 48 disposed in the opening in the slide 41, as previously explained. At an intermediate point, the said arm carries a second cam following roller 56 in engagement with a cam 57 on the shaft 15. The cam 54 operates upon the roller 53 to swing the lever 36 toward the left, Figure 2, while the cam 57, through the roller 56, swings the lever in the opposite direction. Thus the slide 41 and the mandrels carried thereby are reciprocated and in accordance with the contours of the cams 54, 57.

The main frame of the machine, at its forward end, carries a bracket 60 (Figs. 2 and 5) in which vertically disposed track members 61 are secured. A vertically disposed curling die slide 62, provided with grooved side edges slidably mounted on the tracks, is formed with forwardly projecting flanges 63, 63a, at its upper and lower edges, positioned to abut the upper and lower surfaces, respectively, of the bracket 60 at its upper and lower limits of movement. At its lower end, the slide has downwardly projecting ears 64, in which a transverse pin 65 is mounted (Fig. 7), carrying, at its outer ends, links 66, 67 secured at their lower ends (Figs. 2 and 4) to a lever 68 journalled loosely on a transverse rock shaft 69. The lever 68 is one arm of a bell crank, comprising a sleeve 70 and a downwardly projecting arm 71 having a slot 72 formed therein for the reception of a block 73 adjustably secured therein by a screw 74. The block carries a laterally projecting coupling member, adjustably secured to the end of a rod or link 75, connected at its other end to the upper, inner end 37' of the cam following lever 37. Lever 37 is bifurcated to provide arms disposed respectively on opposite sides of the cam shaft 15. One arm carries a roller 76 in engagement with a cam 77, while the other carries a roller 78 in engagement with cam 79. Hence, as the cams rock the lever 36, the movements thereof are transmitted through the link 75, bell crank 71, 68 and links 66, 67, to reciprocate the die slide 62 vertically.

The die slide 62 carries, at its upper end, a pair of preliminary curling dies 77, 77' (Figs. 7 and 8), each of which is secured upon a threaded pin 78 secured in a sleeve 79 by a lock nut 80, the sleeve 79 being in turn bolted in an aperture in the slide 62 by a nut 81. The position of each die, therefore, may be accurately adjusted by screwing the pin 78 into the sleeve, more or less, as desired, and by then tightening the lock nut 80.

The die 77 has a relatively narrow curling groove 82, adapted to form a relatively sharply turned, partial bead as indicated in dotted lines at 83 in Figure 9.

At a lower point, the slide 62 carries a pair of second curling dies 84, vertically aligned with the dies 77, 77' and each secured to a pin 85 adjustably mounted in a sleeve 86 in substantially the same manner as previously described. At an intermediate point, preferably between each pair of preliminary and secondary curling dies 77, 84, there is positioned an abutment surface 87, which, in the embodiment illustrated, comprises a head 88 on the outer end of a threaded shank 89, screwed in the die slide and adjustably secured therein by a lock nut 90. As hereinafter described, in connection with the operation of the machine, the slide is reciprocated vertically during retraction of the can body supporting mandrels, first to place the preliminary curling die 77 in alignment with the end of the can, then to place the second curling die 84 in alignment, and finally to bring the abutment surface 87 into alignment. The die serves to curl the neck of the container from the shape shown at 83 in Figure 9 to that represented by 91, while the curl is changed to the form shown in Figure 10 by striking the abutment surface 87.

A preferred form of can feeding mechanism is disclosed in Figures 11 and 12, the driving mechanism therefor being shown in Figures 1, 2 and 4. An upwardly and laterally inclined chute 95 receives can bodies from an appropriate conveyor along which the bodies roll. The chute leads to a partition block 96, where it is divided into two substantially vertical chutes 97, 98, in which the cans arrange themselves in stacks. The sides 99, 100 of the chutes terminate in spaced relation

to the upper surface of the table, and inwardly projecting spring-pressed fingers 101 hold the cans in the stacked relation until they are positively fed downwardly into the path of movement of the mandrels 42, 43. The support for the chutes 97, 98 carries rearwardly projecting plates 102, 103 having forwardly facing ways 104, 105 therein, in which are mounted for vertical movement, slides 106, 107, the vertical movements of the latter being restrained or retarded by spring-pressed friction pads 108, 109. The plates 106, 107, adjacent their lower ends, carry forwardly projecting brackets 110 having stub shafts 111 journalled therein. Fixedly secured to each shaft 111, is a bell crank lever comprising an outwardly projecting arm 112 and a downwardly and inwardly projecting arm 113, the latter being shaped at its lower end to provide a concave portion 114 adapted to embrace and closely fit the side wall of a can body. The bell crank also includes upwardly and downwardly projecting stop lugs 115, 116, each adapted to engage plates 117, 118 to limit the pivoting movements of the bell cranks in both directions.

The outer ends of the lever arms 112 are connected, through pins 119 and collars 120, to vertically disposed rods 121, the latter being secured at their lower ends (Fig. 4) to substantially horizontally projecting rock arms 122, 123 fast on the rock shaft 69, carrying a fixed collar 124 having an integral, downwardly projecting lever arm 125 (Fig. 2). By means of an adjustably mounted block, a laterally projecting pin, and a sleeve secured thereto, the arm 125 is connected to the lower end of a rod or link 126, the other end of which is secured to the upper end of the cam following lever 38.

The lever 38 is similar in construction to the lever 37 and carries, on its rearwardly projecting limb (Figs. 1 and 3*a*), a roller 127 disposed in engagement with the face of a cam 128, fast on the cam shaft 15. The forwardly projecting limb of the lever 38 likewise carries a laterally projecting roller 129 in engagement with the face of a cam 130 on the shaft 15. Hence, oscillating movements of the lever 38 are transmitted through the link 126, rock shaft 69, rock arms 122, 123, and links 121, to impart vertical reciprocations to the slides 106, since the latter are connected to the links 121 by the short arms 112 of the bell cranks pivoted on the stub shafts 111 carried by the brackets 110 secured to the slides 106, 107. As previously pointed out, the vertical reciprocations of the slides 106, 107 are retarded by the friction pads 108, 109. Therefore, if an upward force is applied by the vertical rods 121 when the parts are in the position shown in Figure 12, the bell crank levers are swung about the axes of the stub shafts 111, the arms 112 moving upwardly and the arms 113 outwardly, such movement being limited by the abutment of the lugs 115 with the plates 117. This outward swinging movement of the arms 113 releases the ends 114 thereof from engagement with the can bodies 44, 45. When the short arms 112 have reached their limit of upward swinging movement, continued upward movement of the links 121 forces the slide plates 106, 107 upwardly, until at the upper limit of movement of the parts, the ends 114 of the arms 113 are disposed opposite the next pair of cans thereabove, 44*a*, 45*a*, but still spaced outwardly therefrom. Since the slides 106, 107 are frictionally restrained against downward movement, the first result of lowering the rods 121 is to swing the bell cranks downwardly and inwardly, so that the ends 114 of the arms 113 move inwardly to embrace the cans 44*a*, 45*a*. As the downward movement continues, those cans are carried downwardly by the arms, past the spring-pressed retaining fingers 101, the latter serving to catch and retain the next pair of cans 44*b*, 45*b*. Meanwhile, of course, the first pair of cans 44, 45, have been curled and discharged from the machine.

Secured to the front face of the partition block 96, between the two chutes 97, 98, there is secured a downwardly projecting spring plate 131, having at its lower end, a pair of laterally and forwardly inclined wings 132, each provided with appropriate pads 133, bearing against the conical end surface of the adjacent can body. The spring 131 and the wings carried thereby prevent the cans from inadvertently becoming stuck in the curling dies and serve as positive means for retracting the cans from the dies when the mandrels 42, 43 are retracted by their cam-operating means, to permit shifting of the die slot.

As previously pointed out, friction brake means are provided for stopping the operations of the machine when the air clutch 22 is disengaged. As shown in Figures 1 and 6, a brake drum 140 is fixed on the drive shaft 20, and a pair of brake shoes 141, 142 carrying brake linings 143, 144 are disposed in engagement with the periphery thereof. The shoes have forwardly projecting arms 145, 146 pivoted upon a pin 147, connected through a link 148 and pin 149 to any appropriate part of the machine frame. The free end of the brake shoe 141 is chambered at 150, thereby providing a cylinder in which a piston 151 is positioned, the latter having a stem 152 projecting downwardly through an appropriate opening in the lower face of the brake shoe into contact with a stop screw 153 carried by the forwardly projecting end of the shoe 142. A cap 154 closing the chamber 150, serves as a means for clamping a diaphragm 155 over the upper end of the chamber above the piston 151. The cap is bored and threaded at 156 for the reception of a compressed air pipe 157, leading from any suitable source of supply. The forward end of the brake shoe 141 also carries a rod 158 projecting downwardly through an opening 159 in the shoe 142 and on which a relatively heavy coil compression spring 160 is arranged between the forward end of the brake shoe 142 and a lock nut 161 on the rod, so that the brake shoes are constantly drawn toward each other to apply a braking action to the drum 140. However, when air under pressure is admitted through the pipe 157, the diaphragm 155 is forced into contact with the upper face of the piston, which, through reaction of the stem 152 on the adjustable screw 153, overcomes the action of the spring 160 and separates the brake shoes.

Preferably, the supply of pressure air led to the brake and to the clutch 22, through the pipes 30 and 157, is controlled by common valve means, such as that shown at 165 in Figure 3, so that the clutch is released and the brake applied simultaneously, by cutting off the supply of pressure air and relieving the air pressure in the respective chambers simultaneously. Likewise, when the supply is turned on, the clutch is engaged and the brake simultaneously released.

In the operation of the machine, can bodies are fed from a suitable conveyor downwardly in the chute 95, where they arrange themselves in two vertical stacks in vertical chutes 97, 98 (Fig. 12). A pair of cans 44, 45, are held by the arcuate grippers 114 on arms 113. At the start of a cycle

of operation, the cam 57, in engagement with the roller 56, swings the lever 36 forwardly, thereby advancing the slide 41 and the mandrels 42, 43, so that the latter are inserted into the can bodies. At this time, the preliminary curling dies 77, 77' (Figs. 2 and 13) are in alignment with the cylindrical necks of the can bodies. The movement of the mandrels is continued by cam 57, with the result that the necks of the can bodies are forced into the curling grooves of the preliminary curling dies, as represented in Figure 14, and a preliminary curl is imparted thereto.

The cam 54, operating on the roller 53 carried by the rearwardly extending arm 50 of the lever 36, then retracts the mandrels a short distance, as indicated in Figure 15, and the can bodies move rearwardly therewith, the movement being assured by the wings 132 on the spring member 131 (Fig. 12). Simultaneously with this retracting movement of the mandrels, the lever 38 is swung rearwardly by the cam 128 and the follower 127, thereby oscillating the rock shaft 69 in a direction to raise the vertical links 121, connected to the cam feed mechanism. Hence, the arcuate grippers 114 are first swung outwardly, out of engagement with the cans 44, 45, and then the slides 110 move upwardly until the grippers 114 are positioned opposite the next pair of cans 44a, 45a, the said cans being held in place by the spring-pressed retaining fingers 101.

Also, during the period of retraction of the mandrels 42, 43, the cam 77, through its action on the roller 76, swings the lever 37 rearwardly, thereby raising the die-carrying slide 62 from its lowermost position, to its uppermost position, as indicated in Figure 16. In this position, the curling dies 84 are in alignment with the preliminarily curled necks of the can bodies.

The contour of the cam 57 is such that the slide 41 and the mandrels are again advanced, to project the ends of the can bodies into the second curling dies 84, as indicated in Figure 17, to effect a further curling of the necks. During the two curling operations, the positions of the die-carrying slide 62 and the dies are accurately determined by the flanges 63, 63a (Fig. 8), abutting the upper and lower faces of the bracket 60.

Upon the completion of the second curling operation, the mandrels and the can bodies are again retracted, and the die-carrying slide is lowered to an intermediate position (Fig. 19) by the action of the cam 79 operating on the roller 78 carried by the lever 37. That lowering action aligns the abutment surfaces 87 with the curled necks of the can bodies. The mandrels and the can bodies are again advanced, to cause the necks 91 to strike the abutment surfaces and thereby impart a final set thereto (Fig. 20).

At the conclusion of the final, curl-setting step (Fig. 20), the mandrels 42, 43 are withdrawn entirely from the can bodies, and the latter drop by gravity onto an appropriate outfeed conveyor (Fig. 21). Simultaneously, the lever 38 is rocked forwardly by the cam 130 in engagement with the roller 129. The links 121 are thereby drawn downwardly, with the result that the arms 113 swing inwardly to cause the arcuate grippers 114 to engage the next pair of can bodies 44a, 45a (Fig. 12). As the downward movement of the links 121 continues, the slides 110 and the arms 113 move downwardly, and the cans 44a, 45a are drawn downwardly past the spring-pressed retaining fingers 101, into alignment with the mandrels 42, 43. The next pair of cans 44b, 45b, will now be retained by the fingers 101, and the cycle of operation is repeated. During the discharge of the curled cans and the feeding of a new pair of cans into alignment with the mandrels, the die-carrying slide is moved downwardly again to align the preliminary curling dies 77, 77', with the mandrels, as indicated in Figure 21.

As pointed out above, the invention is not limited to the details of construction shown herein, nor to all of the method steps described. For instance, the invention contemplates that the preliminary curling step may be performed in a separate machine, such as in the body forming machine, and a neck-cleaning step may be interposed between the first and second curling operations. Therefore, it must be understood that the present invention covers all modifications coming within the scope of the appended claims and their equivalents.

We claim:

1. A curling machine comprising primary and secondary curling dies, means for projecting the end of a can blank into the primary die to effect a preliminary curling thereof and then to retract the blank, means for shifting the dies relative to the blank to bring the secondary curling die into alignment with the preliminarily curled end of the blank, means for forcing said end into the secondary die to effect a further curling operation, and means for withdrawing the blank therefrom.

2. A curling machine comprising primary and secondary curling dies having annular curling surfaces and a curl-setting abutment plate, means for automatically, separately and successively presenting the end of a blank to the curling surfaces of the primary and secondary curling dies and for automatically shifting the position of the dies relative to the blank before, between and after said presentations, and means for projecting the curled end of the blank against said abutment surface to set the curl in the desired position.

3. A curling machine comprising a curling die having an annular curling groove in its end face, a curl-setting abutment plate, means for presenting the end of a blank to the curling groove in the die to curl the end thereof, means for shifting the positions of the curling die and the abutment plate relative to the blank, to align the abutment plate with the curled end of the blank, and means for projecting the curled end of the blank against said abutment plate, to set the curl in the desired position.

4. A curling machine comprising a die slide, a preliminary curling die, a secondary curling die and a curl-setting abutment plate all carried by said slide, means for projecting the end of a blank into the first die and for withdrawing the same therefrom, means for shifting the slide to bring the second die into alignment with said end, means for projecting the end of the blank into the second die and for withdrawing the same therefrom, means for shifting the slide to bring the plate into alignment with said blank end, and means for projecting the curled end of the blank against said plate to impart a final set thereto.

5. A curling machine comprising a die-holding slide, preliminary, intermediate and final curling instrumentalities carried thereby, means for successively projecting and retracting a blank to-

ward said slide, and means for shifting the position of the slide during periods of retraction of the blank to cause the end of the blank, during the projections thereof, to be subjected successively to the operations of the preliminary, intermediate and final curling instrumentalities successively.

6. A curling machine comprising a movably mounted die carrier, a plurality of curling dies carried thereby, means for feeding can blanks into the machine, a mandrel for the blanks, means for projecting the mandrel and a blank supported thereon forwardly toward the die carrier and rearwardly therefrom a plurality of times in succession during each machine cycle, and means for shifting said carrier to position, separately and successively, different dies in alignment with the can blank, thereby to perform a plurality of independent curling operations on the blank.

7. A curling machine comprising a movably mounted die carrier, a curling die and a curl-setting abutment surface carried thereby, means for feeding can blanks into the machine, a mandrel for the blanks, means for projecting the mandrel and a blank supported thereon forwardly toward the die carrier and rearwardly therefrom a plurality of times in succession during each machine cycle, and means for shifting said carrier to position the curling die and the curl-setting abutment surface in alignment with each can blank, separately and successively, thereby to perform, independently, a curling operation and a curl-setting operation on each blank.

8. A curling machine comprising a die-holding slide, a preliminary curling die carried thereby, a substantially plane curl-setting abutment surface carried thereby, a blank supporting mandrel, means for projecting the mandrel and a blank into operative relation to the die to curl the end thereof and for then retracting the same, means for shifting the slide to position the abutment surface in alignment with the curled end of the blank, means for projecting the mandrel forwardly to cause the curled end of the blank to abut said plate and then for withdrawing the mandrel and the blank from the plate, and means for stripping the mandrel from the blank.

9. A curling machine comprising a die-holding slide, preliminary and final curling dies and a curl-setting die carried by the slide in spaced relation to each other, a can blank supporting mandrel, means for projecting the mandrel and blank into operative relation to the first die to effect a preliminary curl and for then retracting the same, means for shifting the slide to align the final curling die with the can blank, means for projecting the mandrel and the preliminarily curled end of the blank into the final die and for then retracting the same, means for shifting the slide to align the curl-setting die with the curled end of the blank, and means for projecting the mandrel and the curled blank forwardly to cause the curled end to abut to engage the curl-setting die and for then retracting the same.

10. A curling machine comprising a die-holding slide, a preliminary curling die at one end thereof, a final curling die at the other end thereof, and a substantially plane, curl-setting abutment plate carried at an intermediate point on the slide, a can blank supporting mandrel, means for projecting the mandrel and a blank into operative relation to the first die to effect a preliminary curl and for then retracting the same, means for shifting the slide to its other limit of movement to align the second die with the can blank, means for projecting the preliminarily curled end of the can into the second die and for then retracting the same, means for shifting the slide to an intermediate position to align said plate with the curled end on the can blank, means for projecting the mandrel and the blank forwardly to cause the curled end to abut said plate and for then withdrawing the mandrel and the blank from the plate, and means for stripping the mandrel from the blank.

11. A can end-curling machine comprising a can body supporting mandrel, a cam shaft, connections between the shaft and mandrel for reciprocating the latter, a die-holding slide mounted for movement in a plane perpendicular to the line of movement of the mandrel, a curling die and a curl-setting die carried by the slide, and connections between said cam shaft and said slide for reciprocating the latter in timed relation to movements of the mandrel, whereby the end of a can body is presented to and retracted from said curling die and said curl-setting die successively.

12. A can end-curling machine comprising a can body supporting mandrel, a cam shaft, connections between the shaft and mandrel for reciprocating the latter, a die-holding slide mounted for movement in a plane perpendicular to the line of movement of the mandrel, a pair of curling dies carried by the slide, and connections between said cam shaft and said slide for reciprocating the latter in timed relation to movements of the mandrel, whereby the end of a can body is presented to and retracted from each of said dies successively.

13. A can end-curling machine comprising a can body supporting mandrel, a cam shaft, connections between the shaft and mandrel for reciprocating the latter, a die-holding slide mounted for movement in a plane perpendicular to the line of movement of the mandrel, a pair of curling dies and a curl-setting abutment surface carried by the slide, and connections between the cam shaft and said slide for reciprocating the latter in timed relation to movements of the mandrel, whereby the end of a can body is presented to and retracted from the two curling dies and the curl-setting abutment surface successively.

14. A can end-curling machine comprising a horizontally reciprocable can body supporting mandrel, a cam shaft, connections between the shaft and mandrel for reciprocating the latter, a vertically reciprocable die-holding slide, a plurality of curling instrumentalities carried by the slide, and connections between said cam shaft and said slide for reciprocating the latter in timed relation to movements of the mandrel, whereby the end of the can body is presented to and retracted from said instrumentalities successively.

15. A can end-curling machine comprising a cam shaft, a reciprocable mandrel-supporting slide, a mandrel carried thereby, connections between said shaft and said slide for reciprocating the mandrel, means for feeding blanks into the path of movement of the mandrel, connections from said cam shaft to said feeding means for feeding blanks in timed relation to the movements of the mandrel, a die-holding slide mounted for movement in a plane transverse to the line of movement of the mandrel, a pair of dies carried thereby, and connections between said cam shaft and said die-holding slide for reciprocating the latter in timed relation to the movements of

the mandrel, whereby each can body blank is fed to the mandrel and is presented by the mandrel to and retracted from said dies successively.

16. A can end-curling machine comprising a cam shaft, a reciprocable mandrel supporting slide, a mandrel carried thereby, connections between said shaft and said slide for reciprocating the mandrel, a can blank hopper, means for feeding blanks from the hopper into the path of movement of the mandrel, connections from said cam shaft to said feeding means for feeding blanks in timed relation to the movements of the mandrel, a die-holding slide mounted for movement in a plane transverse to the line of movement of the mandrel, a pair of dies carried thereby, and connections between said cam shaft and said die-holding slide for reciprocating the latter in timed relation to the movements of the mandrel, whereby each can body blank is fed to the mandrel and is presented by the mandrel to and retracted from said dies successively.

17. A can end-curling machine comprising a horizontally reciprocable blank supporting mandrel, means for feeding blanks into the path of movement thereof, a vertically movable die slide, a pair of end-curling dies carried by the slide, and cam means for operating the mandrel, the blank feeding means, and the die-holding slide, said cam means serving to feed a blank into position to receive the mandrel, to project the mandrel and a blank and thereby present the end of the blank to one of said dies and then retract the blank, to shift the position of the die slide and project the blank into the second die and then retract the same; and thereafter to retract the mandrel from the interior of the blank.

18. A can end-curling machine comprising a horizontally reciprocating blank-supporting mandrel, means for feeding blanks into the path of movement thereof, a vertically movable die-holding slide, a pair of end-curling dies and a curl-setting abutment plate carried by the slide in spaced relation to each other, and cam means for operating the mandrel, the blank feeding means, and the die-holding slide, said cam means serving to feed a blank into position to receive the mandrel, to project the mandrel and a blank carried thereby forwardly and rearwardly to present the end of the blank to one of said dies and then to retract the blank; to shift the position of the die-holding slide and project the blank into the second die and then retract the same; to shift the position of the die-holding slide and then project the blank against said abutment surface, and then to retract the mandrel from the interior of the blank.

19. A can end-curling machine comprising a cam shaft, a horizontally movable mandrel, a cam following lever having an end positioned to reciprocate the slide, means for feeding blanks into the path of movement of the mandrel, a vertically reciprocable die-carrying slide, and means for actuating the blank feeding means and the die slide in predetermined timed relation to the movements of the mandrel, said means comprising a rock shaft, and connections between the cam shaft, the rock shaft and the slide and blank feeding means.

20. A can end-curling machine comprising a horizontally reciprocable mandrel, vertically reciprocable can feeding means for delivering blanks into the path of movement of the mandrel, a vertically reciprocable die-holding slide, and means for actuating the mandrel, the feeding means and the slide in predetermined timed relation to each other, said means comprising a continuously rotating shaft having a plurality of cans thereon, a plurality of levers fulcrumed below the cam shaft and each having cam following means associated therewith, and connections between said levers and said mandrel, said feeding means and said slide, respectively.

21. A can end-curling machine comprising a horizontally reciprocable mandrel, vertically reciprocable can feeding means for delivering blanks into the path of movement of the mandrel, a vertically reciprocable die-holding slide and means for reciprocating the mandrel, the feeding means and the slide in predetermined timed relation to each other, said means comprising a continuously rotating cam shaft, a plurality of pairs of cams thereon, a plurality of levers fulcrumed below the cam shaft, and each having a pair of cam following means associated with the cams of one of said pairs, whereby one cam of each pair shifts the associated lever in one direction and the other cam of each pair shifts the lever in the opposite direction, and connections between said levers and said mandrel, said feeding means and said slide respectively.

22. A can end-curling machine comprising a can blank supporting mandrel, means for reciprocating the same horizontally, a vertically disposed die-holding slide, a preliminary curling die at the upper end of the slide, a second curling die at the lower end of the slide, a plane curl-setting surface positioned between the curling dies, means for lowering the slide to its lowermost position to align the first die with the end of said blank, means for projecting and retracting the mandrel to impart a preliminary curl to the end of the blank, means for raising the slide to its uppermost position to align the second die with the can end, means for again projecting and retracting the mandrel to impart a further curl to the can end, means for lowering the slide substantially midway between the first-mentioned positions to align to curl-setting surface with the can end, means for again projecting the mandrel to cause the curled end to strike said surface and to impart a final set to the curl, and means for retracting the mandrel from the can body.

23. A can end-curling machine comprising a curling die having an annular curling groove in its end face, a curl-setting surface, means for supporting a can body blank with the end to be curled in alignment with said die and facing said groove, means for relatively moving the die and the blank to cause said end to engage said annular groove, whereby a curl is imparted thereto, means for separating the die and the blank, means for aligning the blank and said curl-setting surface, and means for moving the curled end of the blank and said surface into engagement to partially flatten and finally set said curl.

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