

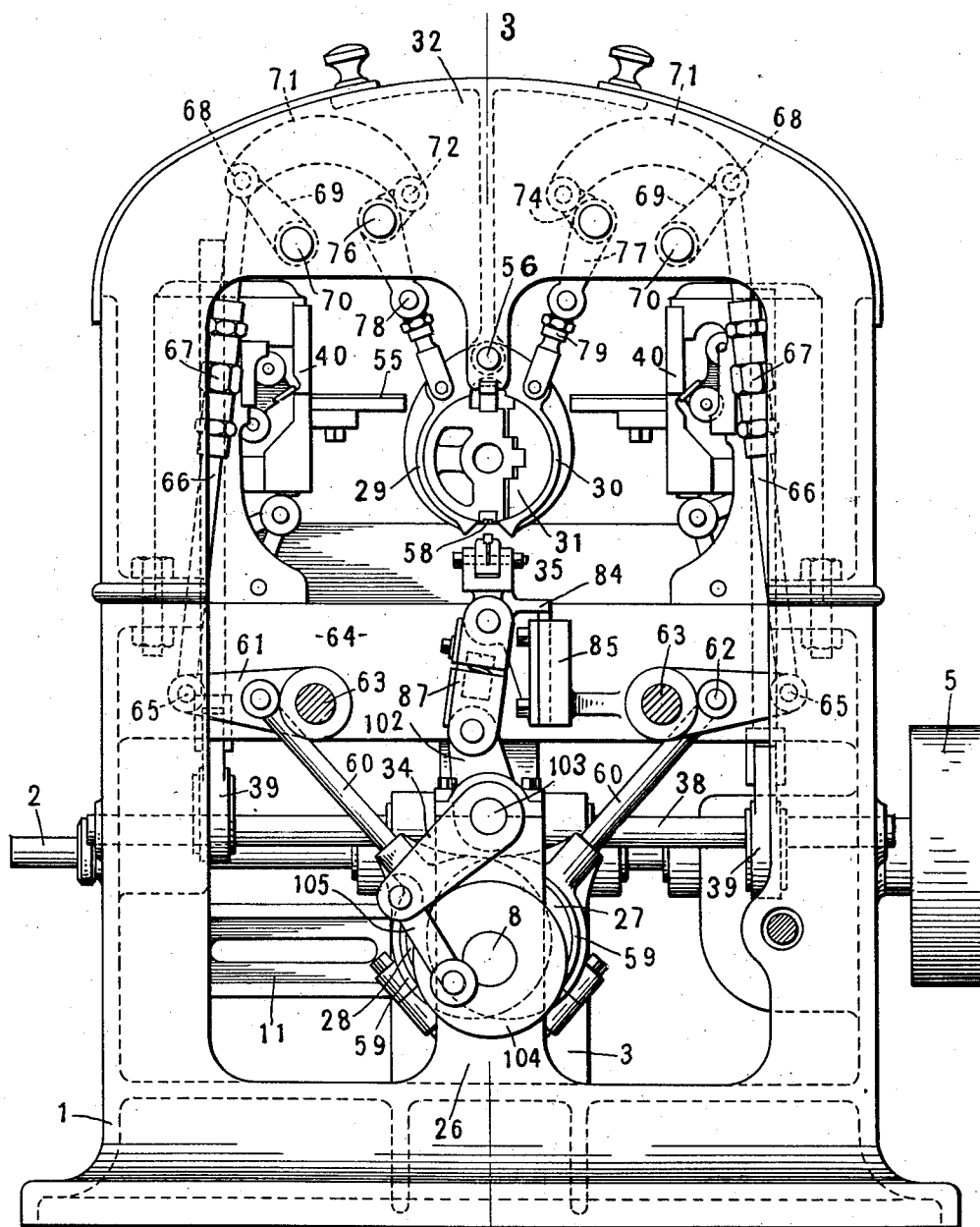
C. W. GRAHAM.
JAW MOTION FOR CAN BODY FORMING MACHINES.
APPLICATION FILED JAN. 28, 1910.

1,055,974.

Patented Mar. 11, 1913.

4 SHEETS—SHEET 1.

Fig. 1—



WITNESSES

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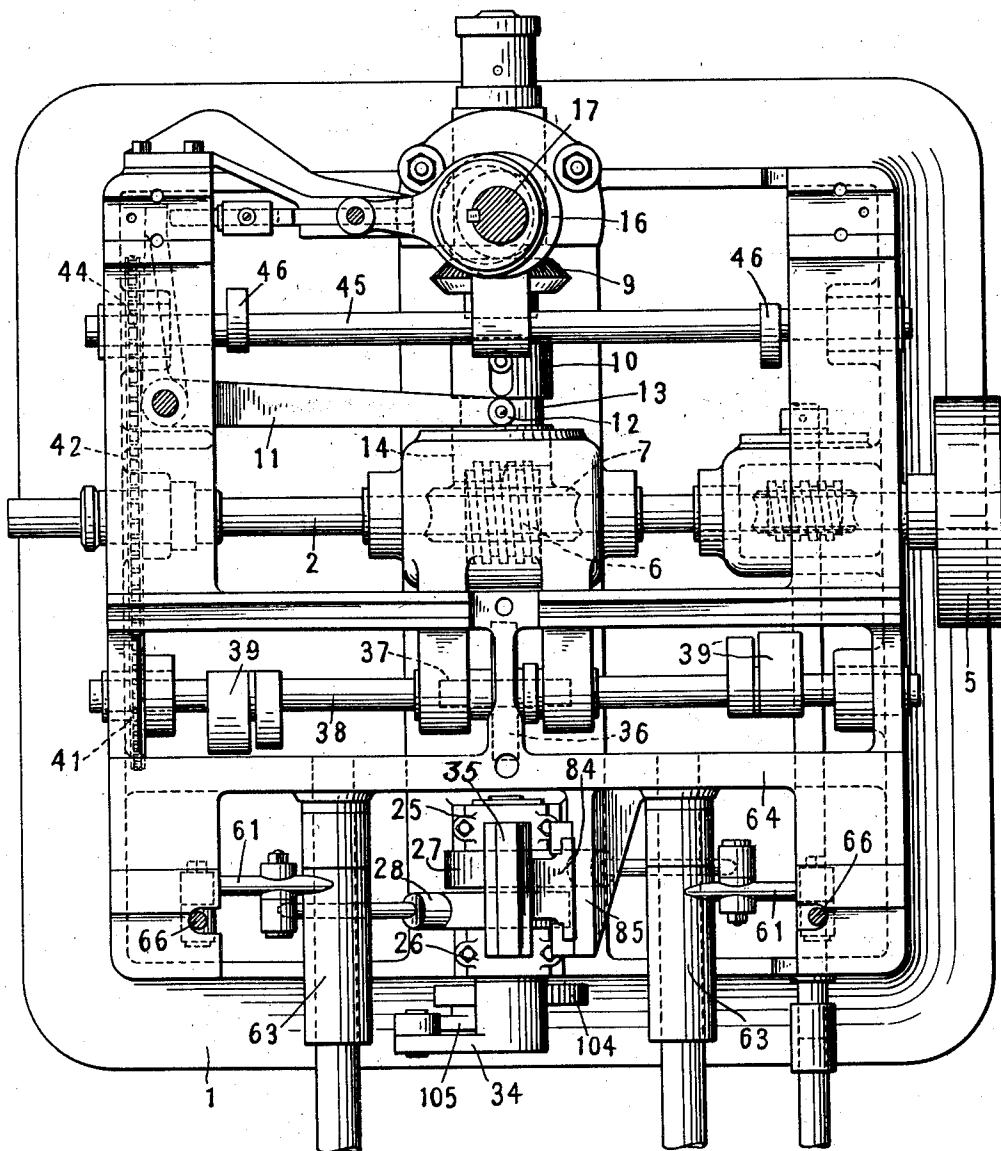
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4 SHEETS-SHEET 2.

Fig-2-



WITNESSES

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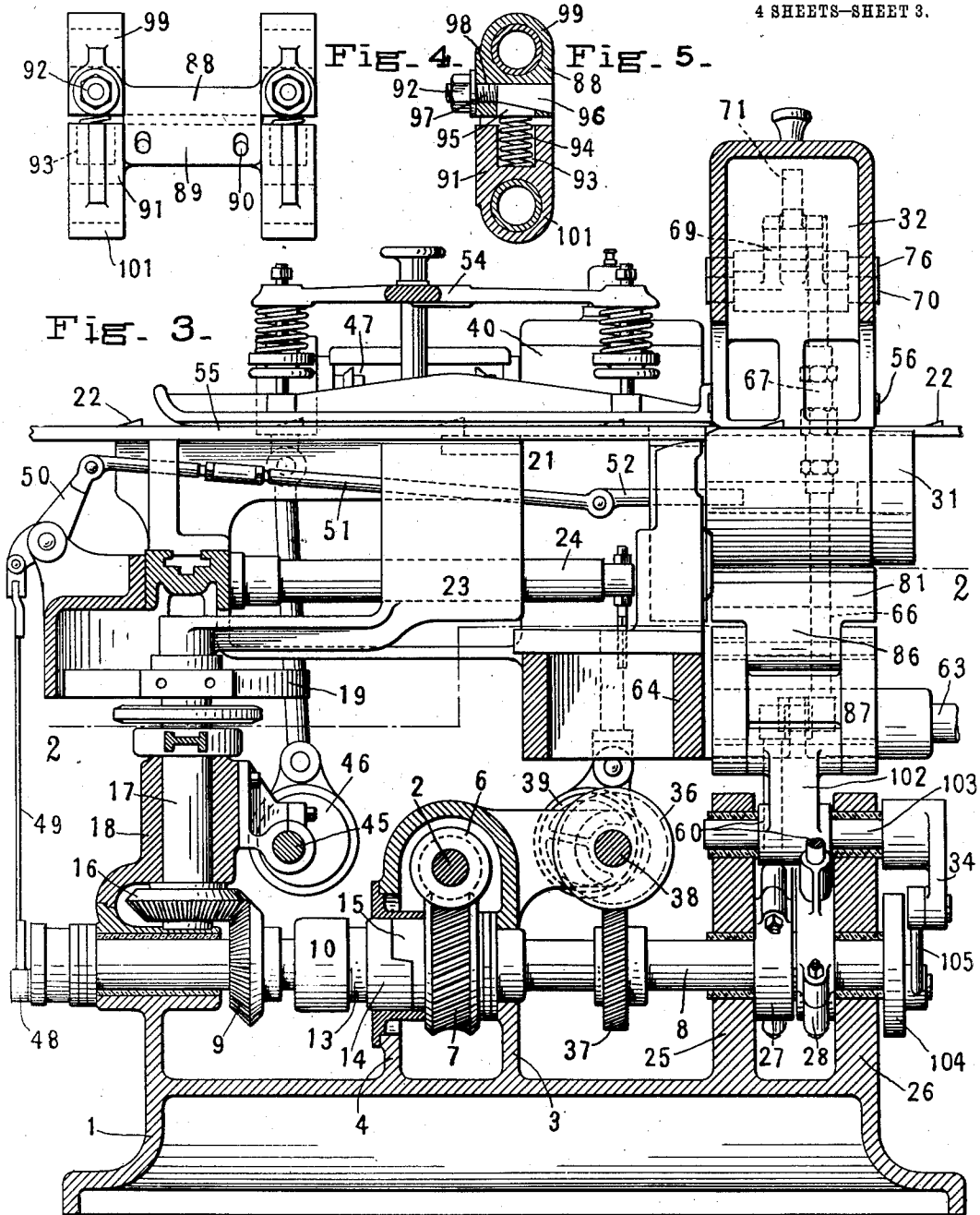
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4 SHEETS—SHEET 3.



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4 SHEETS—SHEET 4.

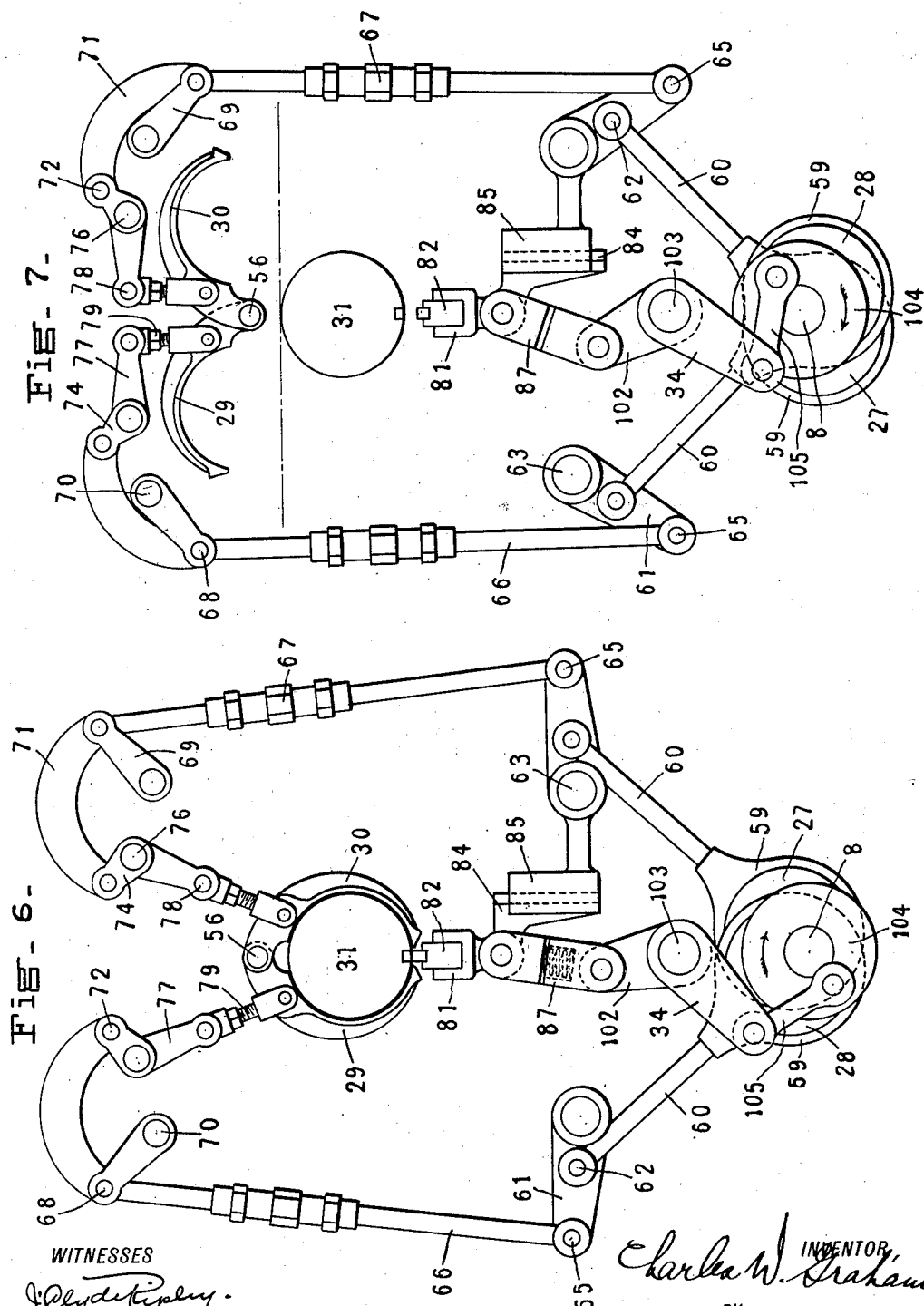


Fig. 6-

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UNITED STATES PATENT OFFICE.

CHARLES W. GRAHAM, OF ROME, NEW YORK.

JAW-MOTION FOR CAN-BODY-FORMING MACHINES.

1,055,974.

Specification of Letters Patent.

Patented Mar. 11, 1913.

Application filed January 28, 1910. Serial No. 540,567.

To all whom it may concern:

Be it known that I, CHARLES W. GRAHAM, residing at Rome, in the county of Oneida and State of New York, have invented certain new and useful Improvements in Jaw-Motions for Can-Body-Forming Machines, of which the following is a specification.

This invention relates to can making machinery, and has particularly to do with the body forming mechanism that constitutes a part of such machinery.

More specifically, the invention relates to a forming device of the type in which a blank is presented between a pair of pivoted jaws and an expansible horn or mandrel, the engagement of the jaws with the blank bending the latter about the horn to give it substantially the final form of can body desired, and the expansion of the horn causing the previously prepared opposite edges of the body to interlock, in a manner well understood in the art.

One of the objects of the invention is to provide a forming mechanism of the kind referred to in which the operating parts are such and so arranged that movement of the parts is arrested where desirable without shock of impact.

More specifically stated, an object is to provide a forming mechanism of the kind referred to in which the operating parts are such and so arranged that dead center effects are obtained at various phases of their operation where the elimination of shock, strain, vibration and unnecessary movement is especially desirable.

A further object is to devise an apparatus in which the parts are of such character and relation that the forming jaws are caused to move at different speeds during different phases of their movement, to the end that the jaws may move to a position of engagement with the blank slowly and positively, giving ample time for the feeding forward of the blank to a position adjacent the horn, without danger of jarring or displacement, and that after the blank has been engaged under pressure the succeeding forming movement of the jaws takes place quickly, while the opening movement of the jaws also takes place in accordance with the movements of other parts of the machine, and in view of the operative relation between the forming mechanism and other moving mechanisms.

Still another object is to correlate the

bumping mechanism with the means for moving the forming jaws in such a way as to make for greater simplicity of construction and insure harmony and sequence of operations.

Another object is to provide a bumping mechanism, related to the forming means as aforesaid, and of improved construction, whereby the last portion of the operative advance of the bumper is made with a rapid negative acceleration and the return movement with rapid, positive acceleration, and so that a powerful but not violent compressing action takes place, which is cushioned, withal, for the sake of uniformity, and to eliminate unnecessary vibration and noise.

A more specific object of the invention is to associate the mechanism referred to with other mechanism usually found in can making machinery, in such a way that the machine shall be particularly compact and simple.

Other objects and aims, more or less broad than those stated above, will be in part obvious and in part specifically adverted to in the course of the following detailed description, in which the elements, combinations, and arrangements of parts constituting the invention are set forth; and the scope of the application thereof will be indicated in the appended claims.

In the accompanying drawings, which are to be taken as a part of this specification, and in which I have shown preferred forms of embodiment of the invention and the various contributing devices: Figure 1 is a front elevation of a can making machine embodying my invention; Fig. 2 is a sectional plan view on the line 2—2 of Fig. 3; Fig. 3 is a vertical section on the line 3—3 of Fig. 1; Figs. 4 and 5 are details, in elevation and section, respectively, of a connection for the bumper; Fig. 6 is an elevation, detached, showing the driving mechanism, forming jaws, bumper and intermediate linkage, the parts occupying the position at which the forming jaws are clamping the blank about the horn and the bumper is approaching the end of its operative stroke. Fig. 7 is a view similar to Fig. 6, but with the parts in their relatively opposite position with the driving shaft rotated at approximately one hundred and eighty degrees.

Referring to the drawings, wherein is illustrated a machine embodying the above

and other features of my invention, there is shown a frame comprising broadly a base 1, upon which are erected various standards which support the driving shafts of various operative parts, constituting a can body making machine, said standards being preferably formed integral with the base portion as shown, in order that alinement and distance relations between parts may be conserved.

The various operative parts of the machine are driven from the main drive shaft 2, which extends transversely of the machine near the central portion thereof, journaled in bearings carried by suitable standards 3 and 4, and provided exteriorly of the machine with the pulley 5, which may be driven from any suitable source of power. Main drive shaft 2 is provided with the worm wheel 6, which meshes with the worm wheel 7 rotating freely on a main operating shaft 8.

9 indicates a bevel gear pinned upon shaft 8, and 10 a clutch member keyed to shaft 8 for reciprocatory movement. A clutch lever, or shipper fork 11 straddles the member 10, the bifurcated end of the lever being provided with friction rollers 12 that engage a circumferential groove 13 of the member 10. Obviously, by moving the lever 11 the clutch end 14 of the member 10 may be moved into or out of engagement with a correspondingly shaped clutch face 15 on the worm wheel, with the effect of positively driving the gear 9 or not as desired.

The gear 9 being fast on the shaft, by its engagement with bevel gear 16 drives an upright shaft 17, journaled in a standard 18, that drives, through the intermediary of an epicyclic gear 19, a reciprocating blank feeder 21 (see Fig. 3). It is not deemed necessary for the purposes of this specification to enter into some of the details of the blank feeding means. It is sufficient to say that the feeder comprises a reciprocating member, provided with spaced spring pressed dogs 22 for engaging the blanks, said dogs sliding under the blanks when moved in one direction, and engaging behind them and progressing them forward step by step by movement in the other direction. Straight line movement is assured by a depending member 23 that engages a guide-rod 24 suitably secured in the machine, and member 23 is also connected with the driven member of the epicyclic device 19. The office of the blank feeding device is to present simultaneously to various mechanisms comprised in the machine a single blank, in progressively varying stages of manufacture. And I provide for the interruption of the feed by electrically controlled means automatically operative upon the happening of a given circumstance, as when two blanks at one time are presented to the machine by

the feeder. Said means act to disrupt the operative relation between the gear 9 and shaft 8 by causing movement of the shipper fork, as explained in my copending application Serial No. 540,568 filed of even date.

The opposite end of shaft 8, which preferably extends through and is journaled in standards 25 and 26, operates, as by means of eccentrics 27 and 28 thereon between standards 25 and 26 and various connected parts, the jaws 29 and 30, which are adapted to bend the edged blanks about the horn 31 which rests against a yoke 32 located centrally of the machine. Shaft 8 also drives, as by means of the crank 34, the bumping mechanism 35 employed to press the interlocked flanged portions of the can body against horn 31. A worm wheel 36, driven from a worm gear 37 on shaft 8, actuates a shaft 38 suitably journaled in the frame parallel to shaft 2, which carries at its opposite ends eccentrics 39, through which are actuated edging devices 40. There is also mounted on shaft 38 a sprocket wheel 41, which drives, as by means of chain 42, a sprocket wheel 44, mounted on a shaft 45 suitably journaled in the machine frame parallel to shaft 2, but on the other side thereof from the shaft 38. Shaft 45 actuates eccentrics 46 at opposite ends thereof, through which are operated the notchers 47. 48 indicates a crank on the end of shaft 8, exteriorly of the machine, which, through connections 49, 50, and 51 reciprocates the horn expander 52.

A mechanism denoted by 54 mounted upon the top portion of the machine is adapted to maintain the blanks flatwise against the bed or table 55. The blank feeder 21 extends across the machine past notching devices 47, edging devices 40, and to horn 31 and bumper 35, and by its reciprocation is adapted, in a manner well understood, to progress a blank over the table to each of said operating mechanisms in turn.

The foregoing brief description of the machine as a whole is set forth merely for the sake of clear understanding. Inasmuch as the present invention is primarily concerned with the forming jaws, bumper, and their operative connections details of the remaining parts of the machine, except as above outlined, will be omitted.

Proceeding accordingly, 31 indicates an expanding horn, or mandrel (as to the details of which reference is made to my copending application filed of even date herewith), to a position above which a blank is intermittently fed in the operation of the machine, as already described, after receiving treatment from the notchers and edgers. The blank is left by the feeding device resting upon the horn, and the next op-

eration is the bending of the blank about the horn. This is accomplished by the movement of jaws 29 and 30, pivoted at 56 well above the horn in the machine frame, and having movement toward and from each other, the jaws being formed on their opposed faces so that when moved to the closed position shown in Figs. 1 and 6 they may substantially embrace the horn. When in their open position, as indicated in Fig. 7, the ends of the jaws are up and out of the way of the blank as it is fed to the horn, and of the formed body as it is withdrawn therefrom. With a blank at rest in the position indicated in Fig. 7, and the jaws open, movement of the jaws toward each other, to the position of Fig. 6, will bend the blank about the horn, which, by the properly timed movement of the horn expander, is at this time in its contracted condition. Jaws 29 and 30 by means of their swinging movement tightly stretch the blank about the contracted horn, and the oppositely flanged edges slip over one another. Horn 31 is now expanded through the properly timed movement of its expander, thus causing the hooked edges to interlock, one with another. The bumper 35, is slowly forced upwardly, contacts the interlocked edges and clenches the same, by driving them into a groove 58, formed in an edging steel carried by the horn, with considerable force. The bumper is then quickly retracted, and the horn being allowed to contract by means of the movement of its expander, and the jaws swung upwardly, the feed pawls take against the rear edge of the can body and move it away from the horn.

The mechanism, as above referred to, and its mode of operation is more or less familiar, but in its embodiment herein disclosed it possesses certain features of utility and advantage, due to construction and arrangement of parts now to be described, referring particularly to the forming jaws, and their operative connections.

Movement of jaws 29 and 30 about pivot 56 is brought about through connections with eccentrics 27 and 28 on shaft 8, respectively; and inasmuch as the jaws, with their connected parts are similar, the explanation will be confined to one of them.

Extending from the eccentric strap 59 of eccentric 27 is an eccentric rod 60, whose outer end is pivoted to a lever 61, intermediate the ends thereof, as at 62, said lever being pivoted as at 63 to a cross piece 64 of the machine frame. Pivoted to the free end of lever 61 as at 65 is a link 66, adjustable as to length as by means of a turn-buckle, or right-and-left connection 67. At its upper end the link is pivotally connected to the free end 68 of a controlling arm 69, which is pivoted in the upper part of the machine frame, as at 70. Pivoted to the free

end of arm 69, preferably also at 68, is the end of a link 71, whose other end is pivoted, as at 72, to one end 74 of a bell-crank lever, pivoted in the machine frame as at 76, and whose other end 77 is pivoted, as at 78, to one end of a link 79 that is adjustable as to length and pivoted at its other end to the jaw 29, adjacent the jaw pivot 56.

It may be additionally stated that the parts above set forth are of such lengths and so related that they constitute a connection between the shaft 8 and jaw 29 whereby the movement of the jaw is arrested, without shock or impact, when it reaches its closed position (Fig. 6) and when it reaches its open position (Fig. 7) at the ends of half revolutions of the shaft respectively. This result is due to the fact that the arm 77 of the bell crank and the link 79 constitute a toggle which is straightened, as in Fig. 6, at the end of one-half revolution of the shaft 8 when jaw 29 is in its closed position; while at the end of the second half-revolution, as in Fig. 7, when the jaw is in its open position, a dead center condition is established between the pivot points 68, 70 and 76. Furthermore, when the jaw is in the position of Fig. 6, at the end of the first half-revolution of shaft 8, a dead center condition is established between shaft 8, eccentric 27, and pivot 62, while a similar condition arises when shaft 8 has reached the end of its second half-revolution, as in Fig. 7, when the jaw is in its open position. Thus the connection between shaft 8 and the jaw provides a self-contained check effective at the ends of the opening and closing movements thereof, without impact with or the intervention of extraneous elements. In addition to attaining this important result, the jaw operating mechanism is so constructed and arranged, as shown, that it transmits the driving movement of the shaft to the jaw so that the jaw moves at varying speeds, in view of the movements of other parts of the assembled machine. For example, in the present device the parts are such and so related that the to-and-fro movement of the jaw above the line of the blank is accomplished in an interval of time substantially equal to that in which the to-and-fro movement of the jaw below the tin-line takes place. For the most practical engagement of the blank by the jaws the pivoted ends of the latter are positioned relatively near the line of the blank, and the movement of the end of a jaw from its open position to the tin or blank line is considerably less than its movement from the tin-line to the closed position. Therefore, in view of the fact that as stated, the to-and-fro movement of the jaw above the tin-line is accomplished in substantially the same length of time as the to-and-fro movement below the blank line, it follows that the rate of travel of the

jaw above the blank line is relatively slower than that below the line. Thus ample time is allowed for feeding the blank onto the horn before the actual bending movement of the jaw takes place.

The description heretofore given of the operative connections between shaft 8 and jaw 29 applies, element for element, to those between the shaft and complementary jaw or bending member 30, it being understood that the arrangement of parts is the same, except that they are disposed appropriately in view of the opposed relation of the jaw, as shown.

It will thus be apparent that I have devised a bending mechanism which is particularly effective and powerful for the performance of its function because of the simplicity of its operative connections and its powerful toggle action, in which noise, shock, strain, vibration, and wear are relatively slight, and whose operation is harmonious with that of other parts of the assembled machine, and yet without the use of cams or other undesirable instrumentalities.

Coöperative with the bending means in a manner previously referred to is the bumper 35. This device includes the bumper proper 35, which may be of any preferred construction, adapted to contact with the interlocked edges of a can body, but which may well comprise, as shown, a U-shaped member 81, between the arms of which is removably carried a bumper-steel 82. From the lower end of member 81 extends a piece 84, slidable in a guide 85 secured to the machine frame, and a depending part 86 of member 81 is pivoted to one end of link 87. Said link 87, in order to cushion the bumper and render its action uniform, is preferably made in two pieces, relatively movable, and with an interposed spring cushion, and may well be constructed as shown in Figs. 4 and 5. As there illustrated the upper member 88 carries a bifurcated depending part 89, provided with elongated slots 90, as shown in Fig. 4, and in said slots extend and have slight play, pins on the corresponding interfitting part of lower member 91. At each end the lower member is provided with a well 93 for the accommodation of coiled springs 94. Said springs bear respectively against beveled plates 95 carried within the ends of the upper member 88, and correspondingly beveled blocks 96, having threaded portions 97 extending through apertures 98 in the ends of upper member 88 are also located within the ends of the upper member, engaging with beveled blocks 95, and in an obvious manner causing the latter to regulate the pressure of springs 94 upon the turning of nuts 92 upon the ends of threaded extensions 97.

Rising from the ends of upper member 88 are journal members 99, suitably spaced to

embrace the depending parts 86 of bumper 35, a pin passing through and pivotally connecting said part 86 and members 99, as shown in dotted lines, Fig. 3. Similarly, lower link member 91 is provided at its ends with depending journal members 101, adapted to receive between them the end of arm 102, said journal members and arm 102, being pivotally connected as by a pin passing through suitable apertures therein, indicated in dotted lines, Fig. 3. Said arm 102 is fastened on a rock shaft 103 having bearings in standards 25 and 26. Also fast on shaft 103 is an arm 34, arm 102, shaft 103, and arm 34 thus constituting in effect a bell-crank lever. The outer end of arm 34 is pivoted to an arm 105 that is in turn pivoted to a crank-disk 104 upon the end of and coaxial with the shaft 8 exteriorly of standard 26. The parts are of course such and so related that the bumper will be thrown into contact with the can body upon the horn immediately after the jaws 29 and 30 have closed.

It will be noted that the arm 102 and the cushioned link are related after the manner of a toggle, and that in the bumping operation the toggle is tending to straighten.

An important feature in connection with the driving of the bending jaws and the bumper is the fact that shaft 8 has bearings in both standards 25 and 26, and the eccentrics 27 and 28 for the jaws are mounted on the shaft between said bearings. Thus bending strains on the shaft due to the jaw motion are minimized. Furthermore, the rock-shaft 103 has bearings in both standards 25 and 26, and the arm 102 is fast thereon between said bearings, so that in the operation of the bumper, no injurious strains are transmitted to the main operating shaft 8.

The operation of the mechanism herein described is believed to be plain from the explanations already made, and further detailed description thereof is accordingly omitted.

It will also be apparent that the most important members and arrangement of the link motion which has been previously described, for operating the bending members is in those parts above the adjustable links 66, or in other words if the points 66 are oscillated or moved by any means other than those shown, substantially the same result would be produced.

I desire it understood that I do not limit my claims by the details of construction shown, in which I have simply illustrated one way of embodying the creative part or conception of the invention in concrete form in a structure or machine.

The described devices are simply embodiments of the invention which other structures might embody, and some of the parts,

as also combinations of parts, might well be used without the other in different types of such machines, without departure from the purview of my invention, and I regard myself as entitled to such variations from the shown and described devices as fall within the scope of my invention as indicated in the claims.

It is also to be understood that materials, sizes, and relativities of parts are unimportant, except as they are specified in the claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In combination, a forming horn, movable bending members and mechanism for operating said members, said mechanism including a link, lever, and controlling arm having pivotal points so arranged that a dead center condition is established at the end of the opening movement of the bending members, substantially as specified.

2. In combination, a forming horn, movable bending members and mechanism for operating said members, said mechanism including a link, lever, and controlling arm having pivotal points so arranged that a dead center condition is established at the end of each bending and opening movement of the bending members, substantially as specified.

3. In combination, an expansible horn, a bumper having a cushioning member, movable bending members and mechanism for operating the bending members, said mechanism including a toggle and being so arranged that a substantially dead center condition is established between the members of the mechanism at the end of the bending movement of the bending members, substantially as specified.

4. In combination, an expansible horn, a bumper having a cushioning member, movable bending members and mechanism for operating said members, said mechanism including a link, lever, and controlling arm having pivotal points so arranged that a dead center condition is established at the end of the opening movement of the bending members, substantially as specified.

5. In combination, an expansible horn, a bumper having a cushioning member, movable bending members and mechanism for operating the bending members, said mechanism including a toggle and being so arranged that a substantially dead center condition is established between the members of the mechanism at the end of the bending movement of the bending members, substantially as specified.

6. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving

driving member, reciprocating link motions operated therefrom and connected to the bending members and so arranged that a period of comparative rest is approached at the end of the bending movement of the bending members, substantially as specified.

7. In combination, a forming horn, movable bending members, and mechanism for operating the bending members, said mechanism including a continuously moving driving member, reciprocating link motions operated therefrom and connected to the bending members and so arranged that a period of comparative rest is approached at the end of the opening movement of the bending members, substantially as specified.

8. In combination, a forming horn, movable bending members, and mechanism for operating the bending members, said mechanism including a continuously moving driving member, reciprocating link motions operated therefrom and connected to the bending members and so arranged that a period of comparative rest is approached at the end of each of the bending and opening movements of the bending members, substantially as specified.

9. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, reciprocating link motions operated therefrom and connected to the bending members, said link motions including an adjustable link, and so arranged that a period of comparative rest is approached at the end of the bending movement of the bending members, substantially as specified.

10. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, reciprocating link motions operated therefrom and connected to the bending members, said link motions including an adjustable link, and so arranged that a period of comparative rest is approached at the end of the opening movement of the bending members, substantially as specified.

11. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, reciprocating link motions operated therefrom and connected to the bending members, said link motions including an adjustable link and so arranged that a period of comparative rest is approached at the end of each of the opening and bending movements of the bending members, substantially as specified.

12. In combination, a forming horn, mov-

able bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of the bending movement of the bending members, substantially as specified.

13. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of the opening movement of the bending members, substantially as specified.

14. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of each of the bending and opening movements of the bending members, substantially as specified.

15. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of each of the bending and opening movements of the bending members, one set of the members forming the dead center relation being included at each end of the bending and opening movements, substantially as specified.

16. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and adjustable link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of the bending movement of the bending members, substantially as specified.

17. In combination, a forming horn, a

bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and adjustable link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of the opening movement of the bending members, substantially as specified.

18. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and adjustable link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of each of the bending and opening movements of the bending members, substantially as specified.

19. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a continuously moving driving member, and adjustable link and lever connections between the driving member and each of the bending members, said mechanism having two sets of dead center conditions proximated between the different members of the mechanism at the end of each of the bending and opening movements of the bending members, one set of the members forming the dead center relation being included at each end of the bending and opening movements, substantially as specified.

20. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said bending mechanism comprising a toggle having one element thereof pivoted to a bending member and interposed members between the toggle and a continuously operating driving member, whereby a substantially dead center condition is established in the toggle at the end of the bending movement of the bending members, substantially as specified.

21. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said mechanism including a toggle having an element thereof pivoted to a bending member, and members including a lever, link and a controlling arm interposed between the toggle and a continuously operating driving member, said lever, link and controlling arm having pivotal connections so arranged that a substantially dead center condition is established at the end of the opening movement of the bending members, substantially as specified.

22. In combination, a forming horn, movable bending members and mechanism for operating the bending members, said mechanism including a toggle having an element thereof pivoted to a bending member, and members including a lever, link and a controlling arm interposed between the toggle and a continuously operating driving member, said lever, link and controlling arm having pivotal connections so arranged that a substantially dead center condition is established at the end of the opening movement of the bending members, and a substantially dead center condition is also established in the toggle at the end of the bending movement of the bending members, substantially as specified.

23. In combination, a forming horn, a cushioned bumper, movable bending members and mechanism for operating the bending members, said mechanism comprising an adjustable toggle having one element thereof pivoted to a bending member and interposed members between the toggle and a continuously operating driving member, whereby a substantially dead center condition is established in the toggle at the end of the bending movement of the bending members, substantially as specified.

24. In combination, an expansible forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism including a toggle having an element thereof pivoted to a bending member, and adjustable members including a lever, link and a controlling arm interposed between the toggle and a continuously operating driving member, said lever, link and controlling arm having pivotal connections so arranged that a substantially dead center condition is established at the end of the opening movement of the bending members, substantially as specified.

25. In combination, a forming horn, a bumper, movable bending members and mechanism for operating the bending members, said mechanism comprising an adjustable toggle having one element thereof pivoted to a bending member, and adjustable members including a lever, link and a controlling arm interposed between the toggle and a continuously operating driving member, said lever, link and arm having pivotal connections so arranged that a substantially dead center condition is established at the end of the bending movement of the bending members and a substantially dead center condition is also established in the toggle at the end of the bending movement of the bending members, substantially as specified.

26. In combination, a forming horn, movable bending members and mechanism for moving the bending members at varying speeds, said mechanism including a driving shaft having an eccentric thereon, toggles

connected to the bending members, links between the eccentric and the toggles, said toggles being adapted to be straightened out at the end of one phase of movement of the bending members, substantially as specified.

27. In combination, a forming horn, movable bending members and mechanism for moving the bending members at varying speeds, said mechanism including a driving shaft having an eccentric thereon, adjustable toggles connected to the bending members, links and controlling arms between the eccentric and the toggles, said toggles being adapted to be straightened out at the end of one phase of movement of the bending members, substantially as specified.

28. In combination, an expansible horn, a cushioned bumper, movable bending members and mechanism for moving the bending members at varying speeds, said mechanism including a driving shaft having an eccentric thereon, toggles connected to the bending members, links between the eccentric and the toggles, said toggles being adapted to be straightened out at the end of one phase of movement of the bending members, substantially as specified.

29. In combination, an expansible horn, a bumper having an adjustable cushioning member, movable bending members and mechanism for moving the bending members at varying speeds, said mechanism including a driving shaft having an eccentric thereon, toggles connected to the bending members, links between the eccentric and the toggles, said toggles being adapted to be straightened out at the end of one phase of movement of the bending members, substantially as specified.

30. In combination, a horn, bending members pivoted adjacent thereto, portions of which are adapted to move back and forth and take positions on opposite sides of a plane tangential to the horn, and mechanism for moving the bending members so that the back and forth movement on one side of the plane is accomplished in approximately the same time as the back and forth movement on the opposite side of said plane, said mechanism including a toggle, substantially as specified.

31. In combination, a horn, bending members pivoted adjacent thereto, portions of which are adapted to move back and forth and take positions on opposite sides of a plane tangential to the horn, and mechanism for moving the bending members so that the back and forth movement on one side of the plane is accomplished in approximately the same time as the back and forth movement on the opposite side of said plane, said mechanism including a toggle, a lever and a controlling arm, substantially as specified.

32. In combination, a horn, bending members pivoted adjacent thereto, portions of

which are adapted to move back and forth and take positions on opposite sides of a plane tangential to the horn, and mechanism for moving the bending members so
5 that the back and forth movement on one side of the plane is accomplished in approximately the same time as the back and forth movement on the opposite side of said plane, said mechanism including a toggle
10 adapted to be straightened out at the end of the bending movement of the bending members, substantially as specified.

33. In combination, a horn, bending members pivoted adjacent thereto, portions of
15 which are adapted to move back and forth and take positions on opposite sides of a plane tangential to the horn, and mechanism for moving the bending members so that the back and forth movement on one side of the
20 plane is accomplished in approximately the same time as the back and forth movement on the opposite side of said plane, said mechanism including a link, a lever and a controlling arm, the pivotal points of said
25 link, lever and controlling arm being adapted to establish a substantially dead center condition at the end of the opening movement of the bending members, substantially as specified.

30 34. In combination, an expansible horn, a bumper operated by a toggle mechanism so that the blow is delivered with a powerful stroke and at a very slow speed, bending members pivoted adjacent thereto, portions
35 of which are adapted to move back and forth and take positions on opposite sides of a plane tangential to the horn, and mechanism

for moving the bending members so that the back and forth movement on one side of the plane is accomplished in approximately the
40 same time as the back and forth movement on the opposite side of said plane, said mechanism including a toggle, substantially as specified.

35. In combination, a forming horn, 45 pivoted bending members each operated by a toggle connected thereto, and a link pivoted to each toggle, a controlling arm for each link, a second link pivoted to the first link and means for reciprocating each second
50 named link, substantially as specified.

36. In combination, a forming horn, pivoted bending members each operated by an adjustable toggle connected thereto, a
55 link pivoted to the toggle, a controlling arm, a second adjustable link pivoted to the first link, and means for reciprocating each second named link, substantially as specified.

37. In combination, a forming horn, a bumper, pivoted bending members each
60 operated by a toggle connected thereto, and a link pivoted to each toggle, a controlling arm for each link, a second link pivoted to the first link and means for reciprocating each second named link, said second named
65 links and bumper being operated from the same driving member, substantially as specified.

In witness whereof, I affix my signature in the presence of two witnesses.

CHARLES W. GRAHAM.

Witnesses:

B. W. COULDOCK,
FRANK J. KENT.