July 10, 1962 L. HEIDMANN 3,043,254

MACHINE FOR RAPID FORMING CARTRIDGE CASES

Filed Aug. 26, 1957 4 Sheets-Sheet 1

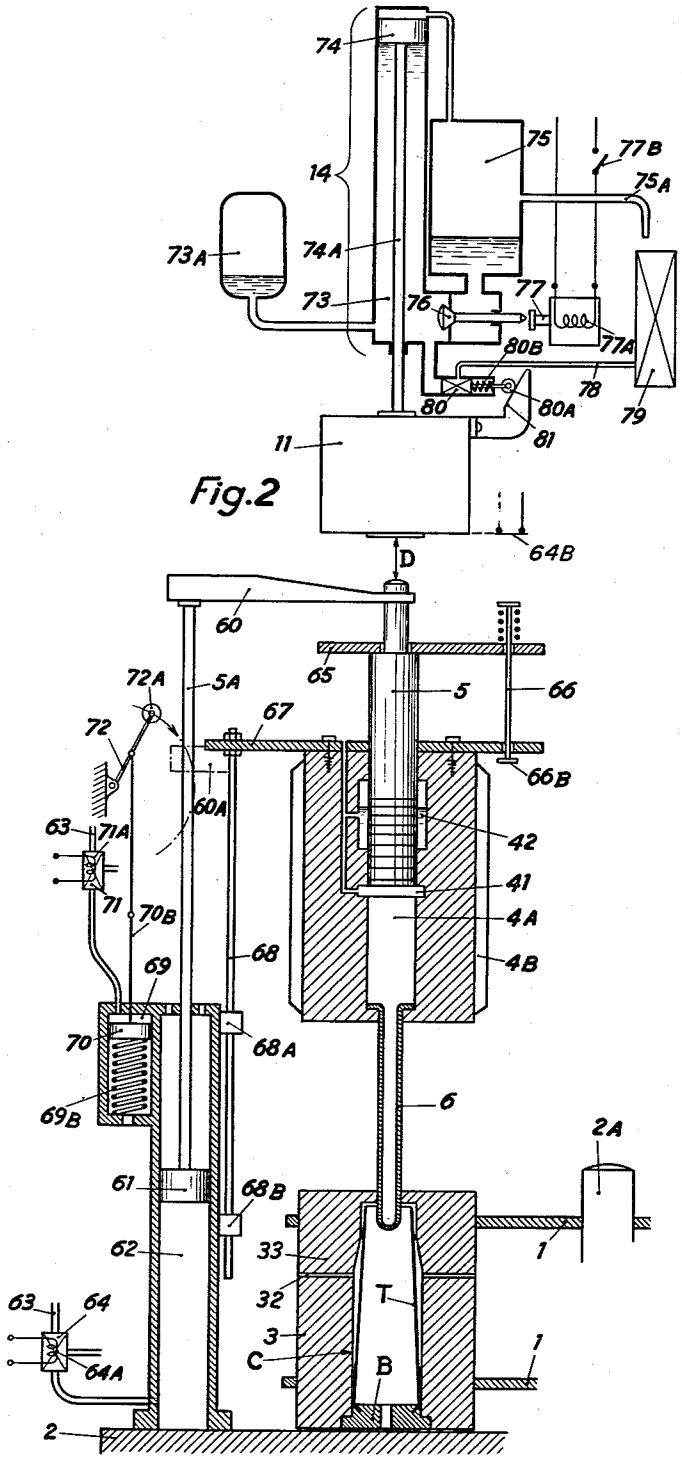
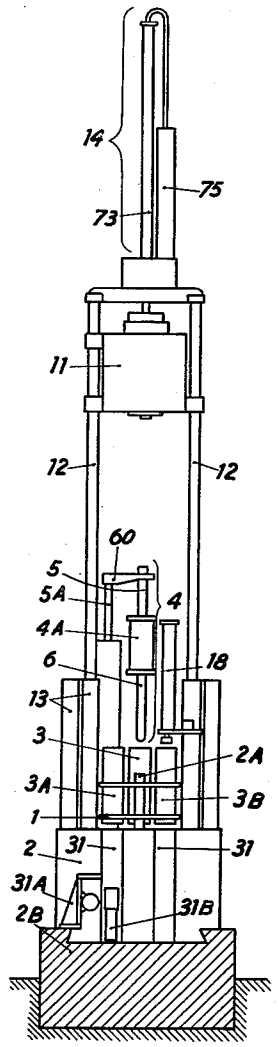


Fig.2

Fig.1



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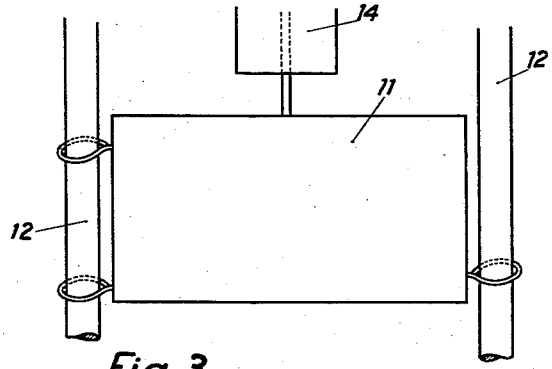
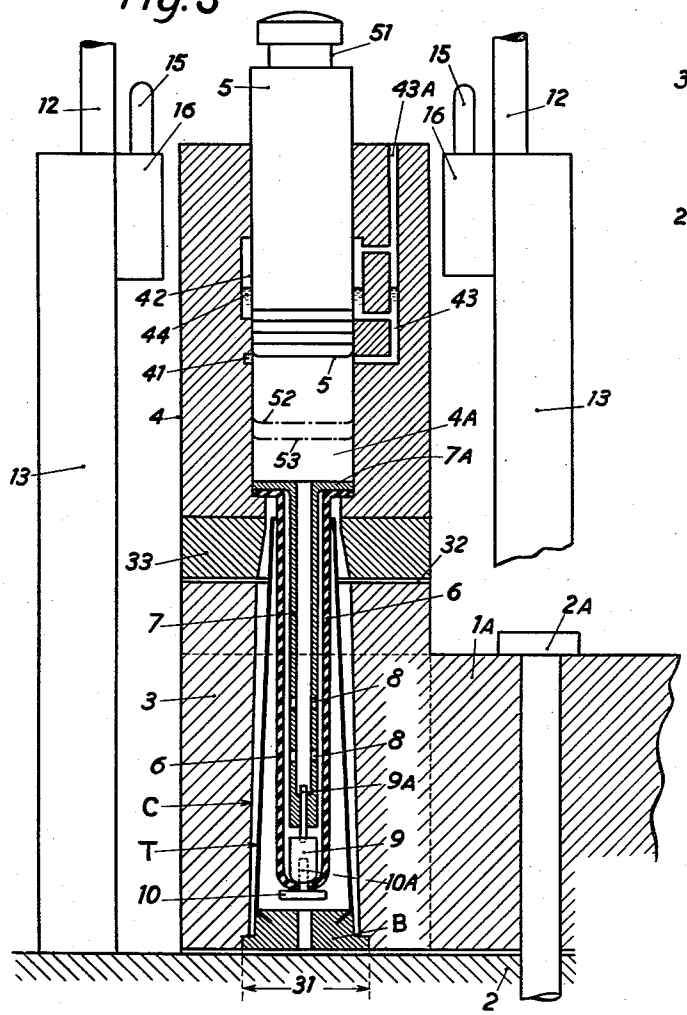


Fig. 3



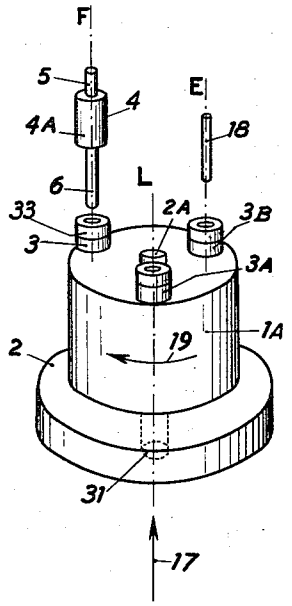
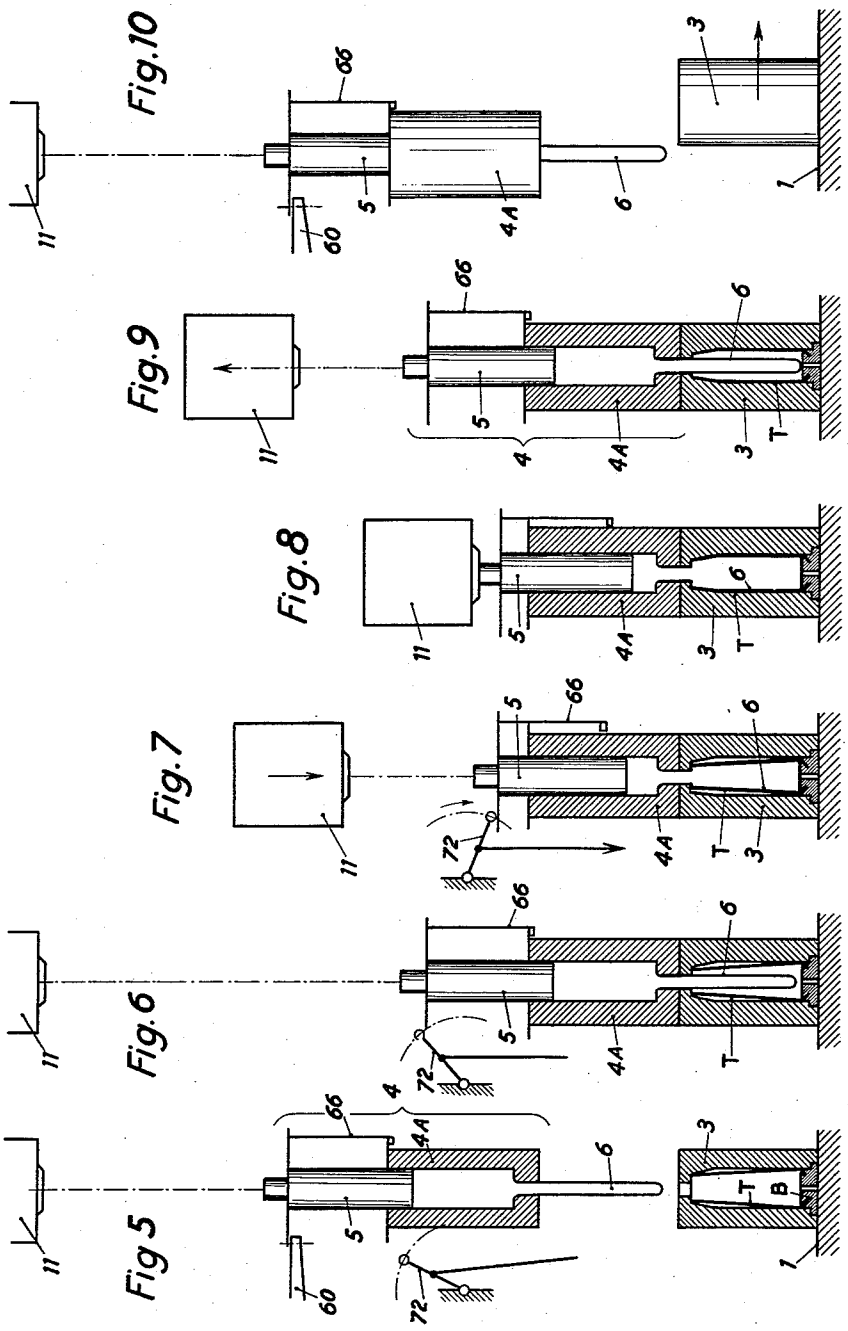


Fig. 4

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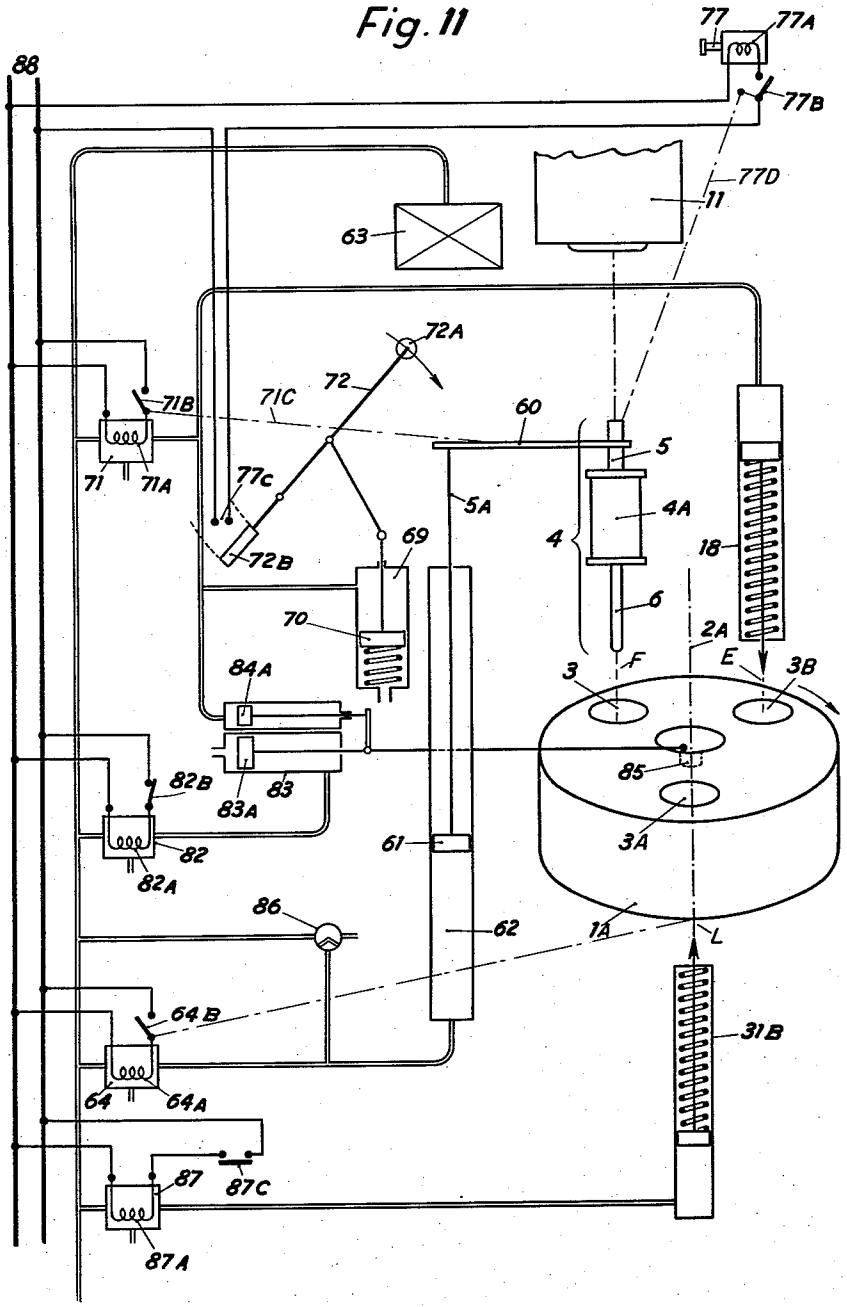


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Fig. 11



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3,043,254
MACHINE FOR RAPID FORMING CARTRIDGE CASES

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Filed Aug. 26, 1957, Ser. No. 680,097
Claims priority, application France Sept. 6, 1956
6 Claims. (Cl. 113—38.1)

The present invention relates to a machine for shaping or forming containers, cartridge cases or other receptacles and is a machine of the type described in my co-pending application, Serial No. 600,852, filed July 30, 1956, now abandoned, of which this application is a continuation-in-part.

In Patent 2,787,973 to Leon Heidmann granted April 9, 1957, there is disclosed a machine for shaping containers utilizing an envelope made of elastic material which is inserted in the container and then expanded hydraulically in order to produce a high internal pressure which by mechanical molding or shaping operation gives the final definite shape to the container.

It is an object of the present invention to provide an improved machine of this character having a greatly increased rate of production. In accordance with the invention, the production is increased by automatic and rapid operation of the machine and by simultaneously effecting several operations. The invention further provides improved methods which facilitate the work of the operating personnel and at the same time assures perfect regularity of the finished products. The machine in accordance with the present invention is particularly suitable for the production of cartridge cases somewhat smaller than those for which the machine of my above mentioned patent is intended, for example, cartridge cases of the order of 40 mm.

A feature of the machine in accordance with the invention is that it utilizes a removable hydraulic unit comprising an inflatable bag that is inserted into a container or cartridge case and cylinder and piston arranged to supply fluid pressure to the bag. The cylinder is of sufficiently large diameter and the piston has a sufficient stroke to effect successively the preliminary inflation of the bag as well as the molding of a cartridge case or receptable by an impulse of high pressure without the use of pipes, valves, pumps or other accessories. This hydraulic unit is operated at high speeds by dropping a weight on the piston and is arranged in such manner as to cooperate successively with a plurality of interchangeable molds, while new cartridge cases or open-ended containers are being inserted in other molds and finished pieces are being extracted or otherwise ejected from still other molds. A feature contributing to the high speed of the operation of the machine is that the hydraulic unit is dropped into operative position to insert its inflatable bag into a cartridge case held in a mold and, substantially simultaneously, the bag is preparatorily inflated and the weight is dropped to exert a force on the piston and thereby apply hydraulic pressure to the bag. Rebound of the weight not only effects a substantial economy of energy but also results in a material saving of time.

Further objects and advantages of the invention will be understood from the following description and claims in conjunction with the accompanying drawings which illustrate by way of example one embodiment of the machine in accordance with the invention, and in which:

FIG. 1 is an overall elevational view of a machine in accordance with the invention, with a foundation portion shown in vertical section.

FIG. 2 is a schematic elevational view of the machine shown in FIG. 1 with portions shown in vertical section and portions shown schematically.

FIG. 3 is a simplified elevational view of a machine in accordance with the invention with portions shown in vertical section and portions shown schematically, and shows the hydraulic unit in vertical section on an enlarged scale.

FIG. 4 is a simplified schematic perspective view illustrating the operation of the machine.

FIGS. 5 to 10 are schematic views illustrating the sequence of operations of the machine; inserting the hydraulic unit, applying a preliminary pressure thereto to preparatorily inflate the bag of the unit, dropping the weight so as to shape the container, the rebound of the weight and the withdrawal of the hydraulic unit.

FIG. 11 is a schematic view illustrating the fluid and electrical circuits for carrying out the sequence of operations of the machine in accordance with the invention.

As illustrated in FIGS. 1–4, the machine comprises a rotatable turret 1 which is mounted on a base 2 for rotation about a vertical axis 2A fixed on support means or foundation 2B. The turret 1 contains a plurality of molds or cavities 3, 3A, 3B which extend vertically through the turret and are adapted to receive the cartridge cases C to be formed. Each of the cartridge cases C comprises a base B and a tubular portion T attached at its lower end to the base, the upper end being open.

The structures of turret 1 and of molds 3, 3A, 3B may have different forms. According to FIGS. 1 and 2 the molds are carried by two parallel connectors 1, while according to FIGS. 3 and 4 the molds are integral with a full turret 1A.

Each of the molding cavities carries an upper crown portion 33 which may be tapered internally to a smaller diameter (FIG. 3) and is fixed with respect to the turret. The crown portion is provided with one or two or more slits or openings 32 which extend to the outside of the mold to permit the escape of air from the cavity during the process of molding a container or cartridge case.

A removable and self-contained hydraulic unit 4 is adapted (FIGS. 2 and 3) to cooperate successively with the mold cavities of the turret 1 so as to apply high internal pressure to the cartridge cases in the cavities. The hydraulic unit 4 is shown as comprising a cylinder 4A, a piston 5 and a bag 6 of elastic material such as natural or synthetic rubber which is attached to the lower end of the cylinder 4A; the latter may be provided with a cooling water jacket 4B. A tubular stem 7 provided with a plurality of openings 8 is also attached to the lower end of the cylinder and extends axially into the interior of the bag 6. At its lower end, the stem 7 carries a sliding head 9 guided by a rod 9A which is slidable in an axial bore provided in the lower end portion of the stem. A disc 10 is mounted on the head 9 by having a stem portion 10A inserted in an axial hole in the head. The lower end of the bag 6 is sealed tightly between the elements 9 and 10. The elements 7 through 10 have not been shown in FIG. 2 in order to simplify the drawing.

The hydraulic unit 4 is movable vertically between a lower or operating position shown in FIG. 3 and an upper or retracted position in which it is disposed above the turret, as illustrated in FIGS. 1, 4 and 5. Suitable means, later herein described, is provided for guiding the hydraulic unit 4 in its vertical movement and for raising it and releasably holding it in its upper position.

The piston 5 is reciprocable in the cylinder 4A. When the piston is in an upper position as illustrated in FIGS. 2 and 3, it uncovers an annular groove 41 provided in the inner surface of the cylinder 4A. Above the groove 41 there is provided an annular reserve cavity 42 which is connected to the groove 41 by at least one passageway 43. The circular groove 41 and the annular cavity

42 are both connected to the atmosphere by ducts 43A opening at the top end of the cylinder. The bag 6, hollow stem 7 and the lower portion of the cylinder 4A are filled with liquid, for example, glycerin. The normal level of the upper surface of the liquid is indicated at 44 approximately midway the height of the preserved cavity 42.

For lifting the piston 5 to the upper position shown in FIGS. 4, 5 and 10, the upper portion of this piston is shown as provided with a circular groove 51 adapted to be engaged by a lifting and driving fork 60 operated by suitable mechanism later herein fully disclosed to control the position of the piston automatically in timed relation with the operation of the machine.

The application of pressure to the liquid in the cylinder 4A and bag 6 for shaping or forming the case C is produced by dropping a weight 11 on the piston 5. The weight closes in its uppermost position a movable contact 64B adapted to close in its upper position a control circuit. The operation of this contact will be described below. This weight is guided by columns 12 which extend upwardly from, and are supported by frame structure 13. Suitable mechanism indicated schematically at 14 and more fully described later herein is provided for holding the weight 11 in an upper position and releasing it so as to drop and force the piston 5 downwardly, catching the weight on rebound and lifting it again to its initial upper position. In order to avoid the danger of excessive stroke of the falling weight 11, there are provided hydraulic emergency shock absorbers 15 comprising pistons reciprocable in cylinders 16 which are similar to cylinder 4A that are stationary, being for example supported by the frame 13.

Means hereinafter described are provided for indexing the turret 1 while the hydraulic unit 4 is in its upper position to bring a plurality of mold cavities successively into alignment with the hydraulic unit. In order to simplify an explanation of the operation of the machine the turret 1A is illustrated as having only 3 molding cavities (FIG. 4) but it will be understood that a greater number of cavities may be provided. One of the cavities is shown at the loading station L where a cartridge case is inserted by loading means 31B (FIGS. 1 and 11) comprising an automatically operated plunger by pushing it in the direction of the arrow 17 (FIG. 4). It will be understood that the base 2 is provided with suitable openings 31 at the loading station L where the cases are to be inserted and at an unloading or extracting station E where the cases are to be removed from the mold cavities. Moreover, it will be understood that at a forming station F there is no such opening, the base being solid at this point so as to support a case in a mold cavity 3 of the turret 1A.

Hence when a mold cavity 3A is aligned with one of the openings 31, the base 2 permits insertion of a new cartridge case into this cavity. A second molding cavity 3 is at station F in which it is aligned with the hydraulic unit 4 while in its raised position. A third molding cavity 3B is at an unloading or ejecting station E where the finished cartridge case is expelled by means of a suitable automatic push rod at 18 (FIGS. 1, 4 and 11).

As stated heretofore, during the insertion of a cartridge case in a mold cavity the hydraulic unit 4 is in its withdrawn position (FIG. 5) having been picked up by a fork 60 mounted as shown in FIG. 2 on piston rod 5A connected to piston 61 reciprocable in cylinder 62. The cylinder 62 is connected to a source of compressed air 63 (FIG. 11) actuating the piston under control of magnetic or solenoid-actuated valve 64 when solenoid winding 64A is energized in timed relationship with indexing of the machine as later herein disclosed.

As the hydraulic unit 4 is picked up by the fork 60 it carries upwardly along with it a plate 65 which is resiliently connected by means of a spring biased rod 66 to a second plate 67, thus picking up the second plate 67

when the head 66B of the rod 66 engages it. The second plate 67 is connected to a rod 68 arranged for sliding in guide ways 68A and 68B. Accordingly the hydraulic unit 4 is suitably guided in its upward and downward travel.

As stated heretofore the lifting of the hydraulic unit is under control of the solenoid-actuated valve 64 so that when solenoid winding 64A is energized the valve is opened permitting compressed air to raise the piston 61 until it is stopped by suitable stops (not shown) which limit the upward travel of fork 60 and plate 67. When the stops are reached the hydraulic unit 4 is completely withdrawn from the mold cavities. Subsequently, as later described, the solenoid winding 64A is de-energized, valve 64 closes and connects the cylinder 62 to atmosphere permitting the hydraulic unit 4 to drop by gravity so as to rest on a mold crown 33. The lifting fork 60 descends to the level shown in dotted lines in FIG. 2 as position 60A.

When the fork 60 moves to its lower position shown at 60A a second pneumatic cylinder 69 having a piston 70 reciprocable therein and normally biased in an upward position by spring 69B is connected to the air pressure source 63 under control of a solenoid-actuated valve 71 provided with a solenoid winding 71A energized in proper timed relationship with the dropping of the hydraulic unit 4. When the winding 71A is energized, valve 71 opens permitting compressed air to drive the piston 70 and piston rod 70B downwardly so as to move pivotally mounted lever 72 downwardly into engagement with fork 60 thereby to preparatorily inflate the bag 6 of the hydraulic unit 4. The lever 72 is provided with a roller 72A which bears against the fork 60 moving the piston 5 until the lower end of the piston reaches the level 52; the piston produce thereby (FIGS. 3, 6 and 7) a rapid inflation of the bag by forcing liquid from the cylinder 4A into the bag without encountering any substantial resistance. The disc 10 engages the base B of the cartridge case, thereby closing the timer cap hole in the base, and preventing the bag from being driven into this hole, after which the bag 6 engages the inner surface of the cartridge case. The pressure in the cylinder and the bag remains moderate.

Substantially simultaneously with the engagement of lever 72 with the fork 60, the mechanism 14, later herein described, releases the weight 11 and drops (FIGS. 6–8) it on the piston 5. As the weight strikes the piston 5 it continues to move from the level 52 to the level 53, so that a high pressure is produced in the cylinder 4A and bag 6 to force the tubular portion T of the cartridge case into engagement with the inner surface of the mold cavity 3 and thereby shape the cartridge. The hydraulic pressure is of a very high value and short duration, being in the nature of a pressure shock. The cartridge case is thereby set to a predetermined and exact size and shape determined by the mold cavity 3.

Following the pressure shock the weight 11 rebounds (FIGS. 8 and 9) by reason of inherent elasticity in the liquid and the structure by which the liquid is confined. At the top of its rebound (FIG. 10) the weight is caught by the lifting device 14 and raised to its upper position by means later herein described.

All of these successive operations last only for an extremely short time and are effected automatically. During this short period of time, any leakage of liquid between the cylinder 4A and the piston 5 is of small amount and is accumulated in the cavity 42 shown in FIGS. 2 and 3. After this period the lower end of the piston 5 is lifted above the groove 41 so that the groove is uncovered and any excess liquid which may have been accumulated in the cavity 42 returns to the cylinder 4A in order to reestablish the normal liquid level 44. The hydraulic system of the unit 4 is entirely self-contained and extremely simple with no valves, gaskets or other accessories required.

After a cartridge case has been molded as described and hydraulic unit 4 and the weight 11 have returned to the upward positions, the turret 1 is indexed by mechanism later described so as to bring the molded case to the ejection station E and to position another mold cavity containing a new case under the hydraulic unit 4. A further molding cavity is simultaneously positioned at the loading station L to receive a fresh cartridge case. Moreover, it will be understood that the weight 11 is spaced from the piston 5 in the relationship shown in FIG. 1 and not a short distance D as shown schematically in FIG. 2.

The mechanism 14 comprises (FIG. 2) a lifting cylinder 73 in which is reciprocably disposed a piston 74 connected to the weight 11 by a connecting rod 74A. The cylinder 73 is provided with an air cushion 73A in known manner and communicates with a hydraulic fluid reservoir 75 provided with an overflow pipe 75A as shown. The lower portion of cylinder 73 communicates with reservoir 75 under control of a check valve 76 which is normally closed when the weight is in its uppermost position as shown. The check valve 76 can be unseated or opened by a rod 77 actuated by a solenoid 77A, when a switch 77B is closed. Moreover, the cylinder 73 is in communication with a hydraulic pressure source 79 comprising a hydraulic pump and driving motor (not shown). A conduit 78 connects cylinder 73 to source 79 and is provided with a normally closed slide valve 80 operably connected to a cam follower 80A which cooperates with a cam surface 81 comprising an inclined plane carried by the weight 11.

When the weight is in its uppermost rest position as shown in FIG. 2, the piston 74 acts downwardly on the hydraulic fluid and closes the check valve 76; the slide valve 80 is closed by the cam surface 81 thus closing off conduit 78. The cylinder 73 is thus effectively isolated from reservoir 75 and hydraulic pressure source 79. In this manner the weight 11 is held in its uppermost position and cannot drop. In order to drop the weight switch 77B is closed under control of the machine in proper timed relationship as later herein disclosed, energizing solenoid 77A which displaces rod 77 to the left and unseats check valve 76 so as to permit hydraulic fluid to flow from cylinder 73 freely into reservoir 75, which permits weight 11 to drop. As the weight drops downwardly it carries with it the cam surface 81. However, slide valve 80 remains closed under control of a light spring 80B in view of the fact that the pressure in the cylinder 73 is at a reduced value.

As stated heretofore the weight 11, after having struck piston 5 and having produced the desired high pressure in order to form or shape cartridge case C in the mold 3, rebounds elastically. During the rebounding movement of the weight 11 the solenoid 77A is de-energized as it will be disclosed with reference to FIG. 11, this current interruption permits the check valve 76 to close, but as the weight 11 moves upwardly, piston 74 freely draws the hydraulic fluid from reservoir 75 through check valve 76. However, as soon as it stops in its upward travel and begins to descend under the action of gravity, the check valve 76 is closed and the weight 11 is stopped. The downward pressure created by the weight acting on the hydraulic fluid moves slide valve 80 toward the right permitting high pressure fluid to enter cylinder 73 from hydraulic pressure source 79 through conduit 78 thus raising the weight 11 to its uppermost position as shown in FIG. 2. As the weight is raised to its uppermost position the cam surface 81 closes the slide valve 80 thus cutting off delivery of the high pressure fluid and the weight is held there stationary ready for the next cycle.

The correct sequence of operations is automatically carried out by an electrical control circuit governing the operation cycle by means of hydraulic and pneumatic solenoid-actuated control valves operated in proper timed relationship and connected as shown in FIG. 11. For purposes of explanation of the control circuit and asscciated pneumatic and hydraulic systems it will be assumed that the machine is in the position as shown in FIG. 11 with the hydraulic unit 4 withdrawn from the cavity mold 3 after having shaped a case. In this position, control switch 82B energizes solenoid 82A, and valve 82 is opened permitting high pressure air from pressure source 63 to enter the cylinder 83 moving piston 83A and return piston 84A to the left as shown. The two pistons are connected to a conventional indexing mechanism 85 which may be of the ratchet type for indexing the turret 1A and rotating it in a clockwise direction as shown by the arrow so that mold cavity 3A is positioned instead of cavity 3 with an unshaped cartridge case under hydraulic unit 4.

In arriving at this indexed position the turret 1 opens a control contact or switch 64B which de-energizes the solenoid 64A permitting valve 64 to close thus closing off pressure air from pressure source 63 to the cylinder 62 and allowing this cylinder to exhaust to atmosphere so that piston 61 drops by gravity and inserts the bag 6 into the new mold cavity 3A and thus into the unshaped cartridge case disposed therein. The dropping of the fork 60 closes the switch means 71B and 77B which are closed by mechanical links 71C and 77D when the fork 60 reaches its low position; they are opened when 60 is in its uppermost position as shown. As switch means 71B closes, it energizes solenoid 71A opening the valve 71 so that the pneumatic ejector 18 is actuated expelling or otherwise ejecting a finished cartridge case from the mold 3 in its new position. Simultaneously air enters cylinder 69 driving piston 70 downwardly and rotating lever 72 in a clockwise direction as heretofore disclosed so as to engage roller 72A with fork 60 in order to preliminarily inflate bag 6. Moreover, the piston 84A is moved to the right bringing along with it the piston 83A and indexing mechanism 85 to prepare the indexing operation.

Closing the contact switch 77B simultaneously with the closing of 71B opens check valve 76 so that the weight 11 begins its downward fall as heretofore disclosed. The control contact or switch 87C is closed as a fresh or unshaped cartridge case is brought up by an automatic conveying device 31A of any conventional type which is shown in FIG. 1. Thereby solenoid 87A is energized so as to open solenoid-actuated valve 87 which permits air pressure to actuate the pneumatic loading device 31B which inserts this fresh cartridge into the mold. It will be understood that this electrical control circuit is energized from a common source of current as shown at 88.

In the meantime, the weight 11 which was dropped under the control of switch means 77B strikes the piston 5 and rebounds elastically as heretofore disclosed after which it is automatically brough up to its uppermost position. As the weight reaches its uppermost position it closes control contact 64B opening solenoid-actuated valve 64 which permits air pressure to enter cylinder 62 raising piston 61 and lifting or withdrawing the hydraulic unit 4 from the mold cavity. At the end of its upward movement the lifting mechanism closes control switch means or contact 82B thereby opening valve 82 and moving the piston 83A and its associated piston 84A to the left which indexes the turrent 1 in order to again begin the cycle.

It will be understood that the machine may be provided with a three-way valve 86 connected as shown for by-passing valve 64 and permitting manual withdrawal and insertion of the hydraulic unit 4 so as to control the cycle and render the machine semi-automatic, thus to permit manual control of the cycle.

The machine is provided with additional control and safety features as for example, the pivotally mounted lever 72 may be prlovided as shown with a movable contact 72B which bridges stationary contacts 77C connected in series with contact 77B controlling the weight 11. Accordingly when unit 4 is lowered into a mold cav-

ity and lever 72 depresses piston 5 for inflating the bag 6, movable contact 72B closes the circuit of the solenoid 77A and produces the dropping of weight 11. But if for some reason the piston 5 stops in a position which is too high or too low, the circuit of switch 77B controlled by switch 72B remains open and the weight 11 cannot fall.

On the other hand, the above switch 72B is used for producing, as mentioned above, the deenergization of solenoid 77A during the rebounding movement of weight 11. As shown in FIG. 9, the piston 5 rebounds simultaneously with the weight, whereby the lever 72 is returned to the position shown in FIG. 6 and solenoid 77A is deenergized by contact 72B. Meanwhile weight 11 which reaches its uppermost position recloses the contact 64B whereby the hydraulic unit 4 is extracted from the mold according to FIG. 10 and the lifting mechanism closes the contact 82B whereby the turret is indexed.

By the extraction of unit 4 the contact 71B is opened by a link 71C whereby lever 72 returns to its uppermost position shown in FIG. 5. In the course of the indexing operation the contact 64B is opened and the compressed air escapes from the cylinder 62, whereby the unit 4 drops slowly into the indexed turret and closes contacts 71B and 77B which produce the operation of lever 72 and a new dropping of weight 11.

Summing up, the operative cycle comprises the following main steps of operation: During its rebound the weight 11 stops and tends to descend. Thereby the pressure inside the cylinder 73 is increased and the check valve 76 is closed; the slide valve 80 is opened whereby the full raising movement of 11 is completed and contact 64B is closed.

The weight is held in its uppermost position first by the rebounding of unit 4 which opens the switch 72B, and then by the opening of switch 71B whereby 72B is maintained in its opened position, so that the tripping coil 77A is continuously deenergized.

The closure of 64B produces the extraction of unit 4 whereby switch 77B is opened and switch 82B is closed by the lifting mechanism whereby turrent 1A is indexed. This indexing movement opens 64B so that unit 4 is slowly reinserted into a new mold 3A.

After this slow movement of unit 4 switch 71B is closed to produce operation of the inflating lever 72, the ejection by 18 of a finished cartridge and the return of the indexing mechanism by piston 84A. At the end of the inflating movement switch 72B is closed as well as switch 77B, whereby coil 77A is energized and the weight 11 drops.

It will be noted that each of the above steps is only permitted by a complete achievement of the preceding steps, whereby a definite and suitably timed sequence is obtained. If for any reason a step fails to be effected normally, the machine stops. For instance, if the unit 4 is not fully inserted into the mold or if the bag 6 fails to be inflated correctly, the solenoid 77A cannot be excited and the weight 11 does not drop.

From the foregoing description, it will be seen that the rotating turret 1, movable and self-contained hydraulic unit 4 and weight 11 all cooperate to effect the rapid shaping or molding of cartridge cases or for similar open ended containers. The preliminary inflation of the bag 6 at low or moderate pressure and the final shaping of the cartridge case by high pressure shock are effected in rapid succession without requiring pipes, valves, pumps or other accessories. The movement of the piston 5 effected by the falling weight 11 is so rapid that any leakage of hydraulic fluid is small and is automatically recovered so as to preserve the initial liquid level. Moreover, the rapid movement of this piston effected by the falling weight 11 produces an impulse of extremely high pressure which forms and shapes the cartridge case to an exact shape and size. It will be seen that the machine in accordance with the present invention possesses many advantages over machines which have been heretofore available. Among the advantages are simplicity, uniform, extremely rapid operation and low power consumption. The machine requires a minimum of maintenance. Periodic replacement of the rubber bag 6 can be effected in a very short period of time.

While a preferred embodiment of the invention has been illustrated and described, it will be understood that the invention is in no way limited to this embodiment and that many changes may be made within the spirit and scope of the invention defined by the following claims.

What I claim and desire to secure by Letters Patent is:

1. In an automatic cyclical machine for shaping containers by internal hydraulic pressure, the combination for increasing the speed of operation and eliminating the effects of leakage comprising, mold means defining a plurality of mold cavities each of which is adapted to enclose a container to be shaped, a movable hydraulic unit comprising a single cylinder, a single piston reciprocable in said cylinder for producing successively low and high hydraulic pressure and an expansible bag attached to the lower end of said cylinder and in communication therewith, means for automatically, successively moving said hydraulic unit between an operative position in which said bag projects into one of said mold cavities and a retracted position in which said bag is withdrawn from said cavity, indexing means automatically operable in timed relationship with said unit moving means for moving the mold means along a predetermined path to successively bring the cavities in position to receive said bag, hydraulic liquid in said cylinder, first piston driving means cooperating with said piston and automatically operable for preparatorily partially inflating slowly said bag with hydraulic liquid under a reduced pressure, whereby leakage is reduced, second piston driving means automatically operable subsequently to said slow inflation of the bag for producing an additional rapid movement of said piston relative to said cylinder when said hydraulic unit is in an operative position with the inflated bag disposed inside a container inserted into one of said cavities, thereby to apply a high fluid pressure shock of short duration to said bag and to apply high internal pressure to said container to expand it rapidly without substantial leakage of said liquid to conform to the surface of said cavity, and a hydraulic circuit in said hydraulic unit for automatically recovering leakage of liquid from the cylinder past the liquid facing end of the piston comprising an annular groove in the inner surface of said cylinder, located to be uncovered when said piston is in its uppermost position and above said groove an annular reserve cavity connected to the atmosphere, and connected to said groove below the top of said reserve cavity, whereby any leakage of liquid between the cylinder and the piston is accumulated and returned to said cylinder by gravity after each operation of said piston.

2. A machine according to claim 1, in which the means for producing a rapid relative movement of said piston comprises a falling weight and fluid-operated automatic means for holding said weight in a rest position in readiness for engaging said piston and for automatically releasing it and returning it to said rest position in timed relation with said first inflating means and said mold moving means.

3. In an automatic cyclical machine for shaping containers by internal hydraulic pressure, the combination for increasing the speed of operation and eliminating the effects of leakage, comprising mold means defining a plurality of mold cavities each of which is adapted to enclose a container to be shaped, a movable hydraulic unit comprising a single cylinder, a single inflating and molding piston reciprocable in said cylinder and an expansible bag attached to the lower end of said cylinder and in communication therewith, reciprocable means automatically operable for successively moving the hydraulic unit between an operative position in which said bag projects into a container enclosed in one of said mold cavities and

a retracted position in which said bag is withdrawn from said cavity, indexing means automatically operable in timed sequence with said reciprocable means for moving the mold means along a predetermined path to successively bring the cavities in position to receive said bag, liquid in said cylinder, first pressure generating means coperating with the piston of said hydraulic unit and automatically operable by said reciprocable means for preparatorily and partially inflating slowly said bag and applying a moderate preliminary pressure to the piston in said hydraulic unit, second pressure generating means automatically operable in timed sequence with said first means for subsequently producing a rapid movement of said piston relative to said cylinder when said hydraulic unit is in operative position with the inflated bag inside a container inserted into one of said cavities, thereby to apply a high pressure shock of short duration to said bag and to expand said bag rapidly without substantial leakage to apply high internal pressure to said container to expand it to conform to the surface of said cavity, and a hydraulic circuit in said hydraulic unit for automatically recovering any leakage of operative liquid from the cylinder past the liquid facing end of the piston comprising, an annular groove in the inner surface of said cylinder located to be uncovered by said piston in its uppermost position and above said groove an annular reserve cavity connected to said groove below the top of said reserve cavity, whereby any leakage of liquid between the cylinder and the piston is accumulated and returned by gravity to said cylinder below the piston after each cycle of operation of the piston.

4. In an automatic machine for shaping containers by internal hydraulic pressure, the combination for increasing the speed of operation and eliminating the effects of leakage, comprising, mold means defining a plurality of mold cavities each of which is adapted to enclose a container to be shaped, a hydraulic unit comprising a cylinder, a single piston reciprocable in said cylinder for producing successively low and high pressure and an expansible bag attached to the lower end of said cylinder and in communication therewith, means automatically operable for successively moving the hydraulic unit between an operative position in which said bag projects into one of said mold cavities and a retracted position in which said bag is withdrawn from said cavity, indexing means automatically operable in timed sequence with said unit moving means for moving the mold means along a predetermined path to successively bring the cavities in position to receive said bag, liquid in said cylinder, means for preparatorily, partially inflating said bag comprising, a pneumatically operated driving element for applying slowly moderate pressure to the piston in said hydraulic unit, whereby leakage is substantially reduced, a weight releasably held above said piston for subsequently producing an additional rapid movement of said piston relative to said cylinder when said weight is released and the hydraulic unit is in operative position with the inflated bag inside a container disposed in one of said cavities thereby to apply a high pressure shock of short duration to said bag and to expand said bag rapidly without substantial leakage of liquid to apply high internal pressure to said container to expand it to conform to the surface of said cavity, whereupon inherent elasticity of the liquid in the hydraulic unit and the mold walls confining the bag in the container causes elastic rebound of the weight, means automatically operable for releasing the weight subsequent to the preparatory inflation of the bag, means automatically operable for returning the weight to a selected rest position after rebound, and a hydraulic circuit in said hydraulic unit for recovering automatically leakage of liquid from the cylinder past the liquid facing end of the piston comprising, an annular groove in said cylinder located so as to be uncovered when said piston is in its upper position and an annular reserve cavity located above said groove connected to said groove below the top of said reserve cavity, whereby any leakage is accumulated in said reserve cavity and returned to the cylinder after each return of the piston to its uppermost position.

5. In an automatic machine for shaping containers by internal liquid pressure the combination for increasing the speed of operation and recovering the leakage of liquid, comprising, mold means defining a plurality of mold cavities each of which is adapted to enclose a container to be shaped, a hydraulic unit comprising a cylinder, a single inflating and molding piston reciprocable in said cylinder and an expansible bag attached to the lower end of said cylinder and in communication therewith, means automatically operable for successively moving the hydraulic unit between an operative position in which said bag projects into one of said mold cavities and a retracted position in which said bag is withdrawn from said cavity, indexing means automatically operable in timed sequence with said unit moving means for moving the mold means along a circular path to successively bring the cavities in position to receive said bag, liquid in said cylinder, means operative in timed relationship with said last-mentioned means for automatically successively positioning a container in said cavities, means automatically operable for preparatorily inflating said bag comprising an oscillatable element for applying slowly moderate pressure to the piston in said hydraulic unit whereby leakage of liquid is reduced, a weight releasably held above said piston for subsequently producing an additional rapid movement of said piston relative to said cylinder when said weight is released and the hydraulic unit is in operative position with the inflated bag inside a container disposed in one of said cavities thereby to apply a high pressure shock of short duration to said bag and to expand said bag without substantial leakage to apply high internal pressure to said container to expand it to conform to the surface of said cavity, whereupon inherent elasticity of the liquid in the hydraulic unit and the mold walls confining the bag in the container causes elastic rebound of the weight, means automatically operable for releasing the weight subsequent to the preparatory inflation of the bag, means automatically operable for returning the weight to a selected rest position after rebound, and a hydraulic circuit in said hydraulic unit for automatically recovering leakage of liquid past the liquid facing end of said piston comprising, an annular groove in the inner surface of said cylinder, located to be uncovered when said piston is in its uppermost position and above said groove an annular reserve cavity connected to the groove below the top of said reverse cavity and connected to the atmosphere, whereby any leakage of liquid between the cylinder and the piston is accumulated and returned to said cylinder by gravity after each operation of said piston.

6. In an automatic cyclical machine for shaping cartridge cases by internal liquid pressure, the cartridge cases having a fuse hole in a base thereof, the combination for increasing the speed of operation and recovering leakage of liquid comprising, mold means defining a plurality of mold cavities each of which is adapted to enclose a case to be shaped, a hydraulic unit comprising a cylinder, a single piston reciprocable in said cylinder for producing cyclically low and high hydraulic pressures and an expansible bag attached to the lower end of said cylinder and in communication therewith, means for automatically, successively moving the hydraulic unit between an operative position in which said bag projects into one of said mold cavities and a retracted position in which said bag is withdrawn from said cavity, indexing means automatically operable in timed relationship with said unit moving means for moving the mold means along a circular path to successively bring the cavities in position to receive said bag, hydraulic operating liquid in said cylinder, first pressure generating means cooperating with said hydraulic unit and automatically operable for preparatorily partially inflating slowly said bag with hydraulic liquid at a preliminary low pressure so as to reduce leakage, second

pressure generating means automatically operable subsequently to said partial inflation of the bag for producing a rapid movement of said piston relative to said cylinder when said hydraulic unit is in an operative position with the inflated bag disposed inside a cartridge case disposed in one of said cavities thereby to apply a high fluid pressure shock of short duration to said bag and to expand said bag without substantial leakage of liquid to apply high internal pressure to said cartridge case to expand it to conform to the surface of said cavity, a hydraulic circuit in said hydraulic unit for returning automatically to said cylinder leakages of said hydraulic liquid from the cylinder past the liquid facing end of the piston of said hydraulic unit, and said bag having a disc mounted externally thereof for closing said fuse hole when the bag is preliminarily inflated, a tube on said unit extending into said bag, a stem connected to said disc and extending into said bag,

said stem being disposed axially in said tube for reciprocable operation therein.

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