United States Patent

[11] 3,599,470

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[21] Appl. No. 859,997
[22] Filed Sept. 22, 1969
[45] Patented Aug. 17, 1971

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[54] CONTROL SYSTEM FOR CONTAINER MANUFACTURING APPARATUS

16 Claims, 1 Drawing Fig.

[52] U.S. Cl. 72/349, 72/432

[51] Int. Cl. B21d 22/20, B21j 7/12

[50] Field of Search 72/347-49, 432; 60/54.5

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3,457,766	7/1969	Langewis et al.	72/432

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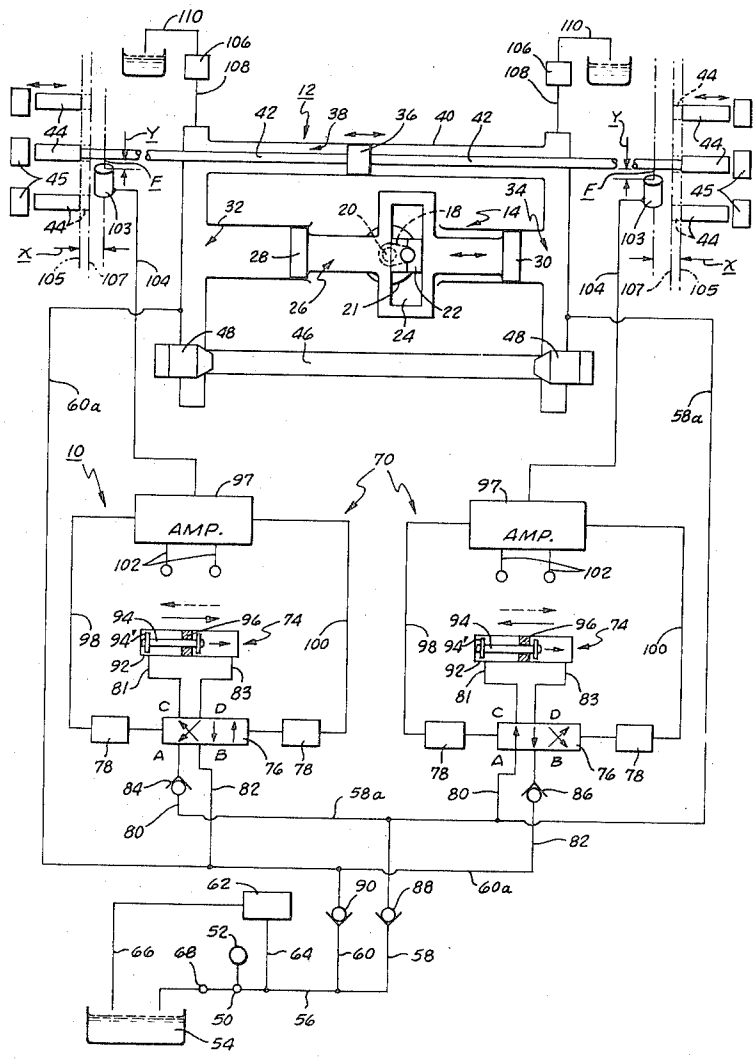
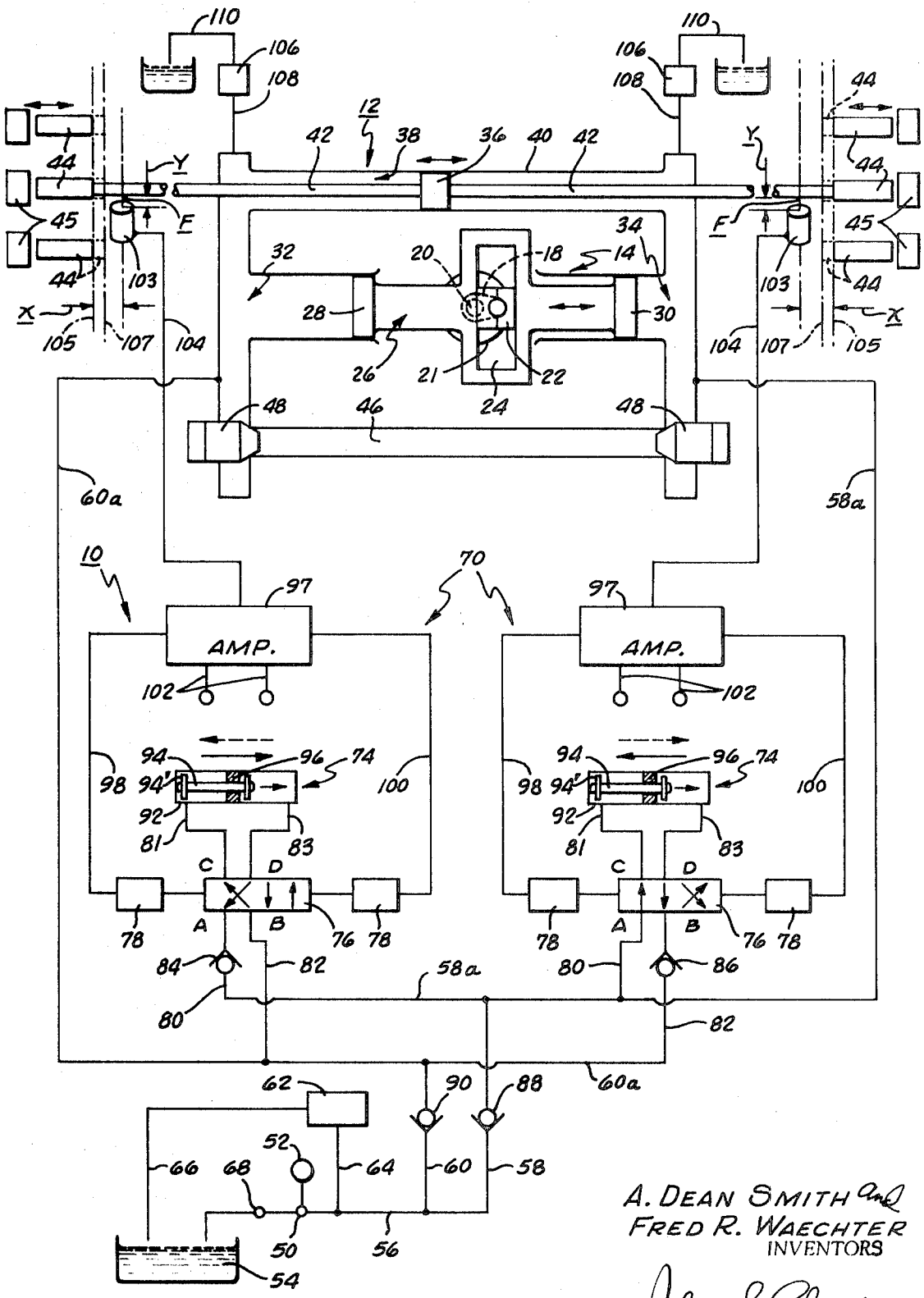
ABSTRACT: Improved device for sensing and replenishing fluid losses in selected portions of a closed fluid driving circuit within which a piston is mounted, said piston having at least one punch means attached to each side thereof so as to effectively regulate the amount of travel of the piston in either direction at all times as well as the punches attached thereto.

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CONTROL SYSTEM FOR CONTAINER MANUFACTURING APPARATUS

BACKGROUND OF THE INVENTION

Various schemes have been proposed in the past such as that shown particularly in U.S. Pat. No. 3,457,766; which issued July 29, 1969, for making container bodies by the draw and iron process and wherein a common driving or actuating piston is mounted in a closed fluid circuit along with a crank driven yoke device. At least one draw and iron punch means is attached to each side of the common driving piston and a fluid makeup system for the closed fluid circuit is also disclosed. This makeup system operates to eliminate unbalanced stroking of the actuating or slave piston by continually monitoring and adjusting when necessary the fluid volumes on opposing sides of the slave piston.

The instant fluid makeup system, while employing the basic principles of the fluid makeup system of the aforementioned patent, constitutes an improvement thereover in that the instant system eliminates certain of the elements of the prior system and thus provides for a more simplified and more overall trouble-free control system in lieu thereof.

SUMMARY OF THE INSTANT INVENTION

Accordingly, it is the primary purpose of the instant invention to provide an improved container manufacturing apparatus particularly of the draw and iron type wherein the proper stoking of the punch means attached to each of the opposing sides of a common drive piston is effected by a unique control arrangement. This arrangement reliably and smoothly controls the stroke of the common actuating piston at all times in a manner that constitutes an improvement over that shown in the aforesaid U.S. Pat. No. 3,457,766. As a result, under- or overtravel of a punch means through its associated dies is inhibited. In effect, the equipment is set to function at all times in a unique, self-correcting fashion.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawing is a schematic view with parts removed of the fluid actuating and control system for a container forming apparatus as well as the container forming apparatus in which the improved makeup or drift control device of the instant invention is incorporated.

With further reference to the drawing, the container forming apparatus embodying the improved control system of the instant invention generally comprises an overall housing **12** that includes, as in the case of the device of U.S. Pat. No. 3,457,766, a prime mover or power unit **14** comprised of a crank arm shaft **16** connected to a pair of crank arms **18**, only one of which is shown in dotted lines. Crank arms **18** are disposed on opposing stub journals, only one of which is shown at **20**. The journals are mounted in appropriate bearings and are adapted to be rotatably driven by a drive wheel **21** in a conventional fashion. As the drive wheel rotates, it causes movement of shaft **16** located in and connected to slide fitting **22**. At the same time slide fitting **22** moves up and down in the hollowed-out interior **24** of a double-acting yoke **26**, it causes corresponding movement of drive yoke **26** to the left or to the right in cyclic fashion whereupon left- and right-hand pistons **28** and **30** connected to yoke **26** will also be correspondingly moved forward and backward. As these pistons are forced forward and backward, they will act upon the fluid, such as hydraulic fluid, contained in the closed fluid circuit made up principally of the fluid in fluid-containing chambers **32** and **34** on opposing sides of a common actuating or slave piston **36**, and the interior chamber **38** of elongated cylinder **40** for piston **36** located at the top of housing **12**. Attached to each of the opposing sides of actuating piston **36** is an elongated piston rod **42**. One or more forming rams or punches **44** are suitably connected, such as in a forklike manner, to the outer free end of each piston rod **42**. With the fluid in chamber **38** and chambers **32** and **34** forming a common fluid circuit, slave or driving piston **36** is thus disposed in one portion of the circuit and yoke **26** in another portion of the circuit. Punches **44** are adapted to be passed along with cup-shaped workpieces to be drawn and ironed through their associated tool packs schematically indicated at **45** and made up of various die elements of the type shown and described, for example, in U.S. Pat. No. 3,399,558 to Langewis et al. granted on Sept. 3, 1968.

Chambers **32** and **34** are further provided with an overload fluid-filled bypass **46**, which includes poppet valve assemblies **48**, for bringing the bypass into fluid intercommunication with chambers **32**, **34** and **38** whenever one of the rams **44** encounters an obstruction, all as set forth in detail in the aforementioned U.S. Pat. No. 3,457,766.

Unbalanced stroking of common actuating piston **36** occasioned by the drifting of piston **36** to the left or right in chamber **38** as a result of leakage in the closed fluid circuit and the resultant over- and under-stroking of punches **44** is automatically corrected in an improved fashion by the improved control system of the instant invention.

This control system includes a makeup pump **50**, driven by a motor **52**. Pump **50** forces hydraulic fluid, such as oil, at a pressure usually on the order of 40—50 p.s.i., to pass from a tank or reservoir **54** through a main line **56** and branch conduits **58** and **58***a* and **60** and **60***a* to chambers **34** and **32** of housing **12** respectively and past one-way check valve **88** in line **58** and valve **90** in line **60**. A relief valve **62** is connected across main line **56** by way of conduit **64** and releases excess fluid from line **64** into exhaust line **66** and to the reservoir **54**. Although not shown, it is to be understood as indicated in U.S. Pat. No. 3,457,766 that the main line of pump **50** can be connected to various bearings for the crank arms **18** and various bearings for the yoke element **26** so as to adequately lubricate all of these bearings during continuous operation of the apparatus. If desired, an appropriate filter **68** can be incorporated in main line **56** on the inlet side of pump **50**. Thus pump **50** in cooperation with check valves **88** and **90** serves to maintain pressure fluid at the desired predetermined pressure level in chambers **32**, **34** and **38** during operation of the container forming apparatus even though fluid under pressure tends to leak from chambers **32**, **34** and **38** of housing **12**, and past pistons **28** and **30** of yoke **26** and in between a piston rod **42** and the openings therefrom in portions of overall housing **12**. Continuous maintenance by makeup pump **50** of the fluid under pressure at a predetermined level in chambers **32**, **34** and **38** advantageously assures proper performance of the control system of the instant invention as will be more fully discussed hereinafter.

In an advantageous embodiment of the instant invention, each one of the pair of fluid replenishing circuits **70** for the main closed fluid circuit is not only interconnected to pump **50**, but also to each other as well as being individually interconnected to a chamber **32** or **34**, as the case may be, on opposite sides of double-acting actuating piston **36**. Inasmuch as each fluid replenishment circuit **70** is made up of like parts, a description of one such circuit will generally suffice for both.

A fluid replenishing circuit **70** is generally comprised of a fluid replenishing and displacement chambered device **74**, a four-way two position valve **76**, and a pair of solenoids **78** for selectively positioning the valve in one of its two positions. A check valve **84** is disposed in branch conduit **80** between valve **76** and branch conduit **58***a* for the left-hand fluid replenishing circuit **70**, and a check valve **86** is disposed in branch conduit **82** between valve **76** and branch conduit **60***a* for the right-hand fluid circuit **70**, all as indicated in the drawing.

The fluid chamber device **74** of each fluid replenishing circuit **70** generally comprises a hollow cylinder **92** closed off at its opposite ends. A piston element **94** is disposed within the cylinder and an apertured piston bearing element **96** is intermediately disposed between the ends of the cylinder for bearingly supporting piston element **94** during its reciprocation between the ends of cylinder **92**. Although fluid

replenishing device **74** is illustrated as having a reciprocating piston **94**, other types of fluid replenishing devices **74** could be used, such as a rotary fluid displacement device, the vanes of which could be movable in clockwise or counterclockwise directions.

In order to automatically actuate a fluid replenishing circuit **70** in response to an unbalance in the stroke of piston **36**, a sensor control circuit advantageously ties in the pair of solenoids **78** controlling valve **76** with the movements of a given piston rod **42** element for piston **36**. The sensor control circuit for each fluid replenishing circuit **70** generally comprises a standard amplifier and signal comparator device **97** and a sensor **103** operatively associated therewith. Amplifier **97** can be of the type sold by Peco Corp. of Mountain view, California, under their Model No. C–2955. The amplifier **97** is connected by leads **98** and **100** to solenoids **78** disposed on opposite sides of valve **76** in circuit **70**. Amplifier **97** is normally energized by the usual input lines **102**, the outer terminal ends of which are usually connected to a 60-cycle AC source (not shown).

Sensor **103** of each circuit **70** is affixed to the framework (not shown) of the apparatus a predetermined distance back from the point identified by a dotted reference line **105** that would be the normally retracted position of the punch or punches **44** with which it is associated while being in radial alignment with a piston rod **42** to which the same ram or rams **44** are connected. During the normal return stroke of a given piston rod **42**, the punch or series of punches **44** associated therewith will be returned to a retracted or rearwardmost position as indicated by reference line **105** therefor in the drawing.

Sensor **103** connected to its associated amplifier **97** by a lead **104** can be of the type generally sold by Peco, Corp. of Mountain View, California, and commercially identified by Model No. A–3140 for generating an electromagnet field *F* in a general direction at right angles to the longitudinal axis of a piston rod **42**.

Since a piston rod **42** and the rams **44** associated with a given sensor **103** are of an electrically conductive material, such as a suitable grade of steel, the sensor **103** can be minutely adjusted whereby piston rod **42** and rams **44** will induce a certain selected counterreactance in the sensor **103** during relatively small out-of-balance or drifting movements of piston rod **42** during the reciprocation thereof. Thus, if the double-acting piston **36** is balanced relative to reciprocal movements of yoke **26** and does not deleteriously drift to the right or left, the resultant reciprocal movements of a piston rod **42** and its associated monitoring sensor **103** will not operate to induce a counterreactance signal in the sensor for transmission to amplifier **97** through lead **104**. However, if the stroking of the double-acting piston **36** becomes unbalanced relative to reciprocal movements of yoke **26** due to fluid leadage in any part of the system, the movements of a piston rod **42** will be correspondingly unbalanced whereby the inner edge portions of rams **44** will enter a greater part of field *F* of a given sensor **103** associated with a given piston rod **42** depending upon which side of the closed fluid circuit has lost fluid and have a retracted position along the dotted lines **107** in the drawing rather than line **105**.

Such entrance of the inner portions of the rams into a greater part of a field *F* generated by a sensor **103** during an unbalanced stroke of piston rod **42** induces the desired greater counterreactance in the sensor so affected. This causes the sensor to generate and transmit and electrical signal through its associated lead **104** to its amplifier **97** in a fluid replenishing circuit **70**. It has been found that, if in the initial positioning of sensor **103** the forward end of a sensor **103** is laterally or radially outwardly spaced by a gap *Y* on the order of one-sixteenth inch away from the surface of the associated rod **42** and at the same time is spaced in an axial direction inwardly of the normal retracted position of the associated rams **44** by a clearance *X* on the order of one-fourth inch, sensor **103** will not interfere with the normal operation of the draw and iron forming apparatus but will still detect unbalanced stroking of its associated piston rod **42**.

As indicated in the drawing, each piston **28** or **30** of yoke element **26** is advantageously of a substantially larger diameter than pistonlike element **94** of each fluid displacement and replenishing chamber device **74** as well as being of larger diameter than piston **36**. The stroke multiplier concept involved herein advantageously contributes to the control system of the instant invention for uniquely transferring excess fluid from one side of piston **36** to the opposite and fluid deficient side thereof whenever an unbalancing of piston **36** occurs as a result of the unequal amounts of fluid on the opposing sides of piston **36**, during operation of the apparatus as will be described below.

It is to be understood, of course, that the pressure of the fluid moved by pistons **28** and **30** upon reciprocation of the yoke **26** in the closed fluid circuit is greater than the pressure of the fluid being moved by pump **50**. Consequently, check valve **88** connected to chamber **34** by line **58***a* and check valve **90** connected to chamber **32** by line **60***a* will remain automatically closed when yoke **26** reciprocally moves to the right or to the left, thereby correspondingly isolating the fluid lines **60** and **58** containing fluid under pressure and connected to pump **50** from the pressure fluid located in the chambers **34** and **32** containing pistons **28** and **30**.

Operation of control systems **70** will now be described. Let us assume that actuating piston **36** has overtravelled to the right in the drawing due to a leakage of fluid from right main chamber **34** during leftward stroke movement of yoke **26**. When this occurs, the inner extremity of a left-hand ram **44** will pass to the right of left-hand reference line **105** and enter the associated field *F* in such fashion so as to induce a counterreactance in left-hand sensor **103** shown in the drawing. Induction of this reactance in sensor **103** results in sensor **103** generating and transmitting a signal through its lead **104** to its amplifier **97** in the left-hand replenishing circuit **70**. The signal from sensor **103** will cause this left-hand amplifier **97** to generate and transmit a signal through one of its leads, such as lead **100**, to energize the right-hand solenoid **78** for valve **76** in the left-hand replenishing circuit **70**, as viewed in the drawing. Right-hand solenoid **78** will then operate the valve spool of valve **76**, whereby valve ports *B* and *C* of valve **76** are interconnected at the same time ports *A* and *D* are interconnected. With left-hand valve **76** in this position, fluid from chamber **32** and activated as a result of the leftward stroke movement of yoke **26** and piston **28** can be passed from chamber **32** through lines **60***a* and **82** into valve **76** through ports *B* and *C* and then through line **81** and against the left side of piston **94** and the left-hand winged elements **94'** affixed to piston **94**. By virtue of piston **28** being of a substantially larger diameter than piston winged elements **94'**, the activated fluid under pressure from chamber **32** causes movement of piston **94** in chamber **74** proportionately a greater distance to the right for a small incremental leftward movement of piston **28** until the right end of piston **94** abuts the right end of left-hand cylinder **92**. Piston **94** upon its movement to the right effects passage of fluid out of cylinder **92**, line **84** and left-hand valve **76** by way of ports *A* and *D*.

The fluid then passes check valve **84** which is inactive due to the leftward movement of piston **30** of yoke **26**, and then moves through left-hand valve line **80** and line **58***a* into the fluid deficient chamber **34**. This transfer of activated fluid under pressure from chamber **32** to the left side of left-hand cylinder **92** and the resultant transfer of activated fluid under pressure from the right side of left-hand cylinder **92** to the fluid deficient chamber **34** all involve a certain time period even though relatively small. This time period is normally somewhat longer than and overlaps the overall time it takes for a full stroke movement of yoke **26** to the left or right as indicated in the drawing. Thus, activated fluid under pressure from the right side of left-hand replenishing device **74** is usually being admitted to fluid deficient chamber **34**, when yoke piston **30** starts moving to the right for activating the fluid of fluid deficient chamber **34**. In view of the fact that at this time the activated fluid under pressure from the right end of left cylinder **92** is at a higher pressure level than the ac-

tivated fluid under pressure within fluid deficient chamber 34 during the immediate return rightward stroke of yoke 26, the replenishing fluid from the right end of left-hand cylinder 92 can enter and refill fluid deficient chamber 34 thereby resulting in an immediate rebalancing of an unbalanced stroke of piston 36 to the right.

Further, since the volume of the activated replenishing fluid from the right end of left-hand cylinder 92 is substantially less than the volume of fluid within fluid deficient chamber 34, the volume of activated replenishing fluid admitted to chamber 34 will be immediately absorbed by the larger volume of the fluid therein without adversely affecting the reciprocal stroking of yoke 26 and the rebalancing of an unbalanced stroke of piston 36. At the same time, left-hand piston 94 operates to replenish chamber 34, the right-hand replenishing circuit 70 is automatically disconnected from chamber 32 by virtue of the one-way check valve 86 therefor as well as check valves 88 and 90, thus forcing fluid from chamber 32 to operate the left-hand plunger 94 only.

As soon as the balancing of the piston stroke for piston 36 occurs and the punches 44 operate properly, the counterreactance of a left-hand ram 44 on its sensor 103 disappears because the ram or rams fail to pass to the right of the normal left-hand retraction line 105. Although the right-hand solenoid 78 for left-hand valve 76 drops out along with left-hand sensor 103 upon the disappearance of any counterreactance, the valve setting for left-hand valve 76 will remain the same, i.e., ports *A* and *D* are connected, while ports *B* and *C* remain connected.

In an advantageous embodiment of the invention, each amplifier 97 is structured and electrically connected to the left- and right-hand solenoids 78 for its associated valve 76 in a manner well known in the art whereby it functions to transmits a signal impulse and trigger alternately first one solenoid 78 and then the other solenoid, e.g., first the right solenoid and then the left, each time a separate or individual signal is generated by a sensor 103.

Thus, as noted above in the case of a left-hand ram 44 being forced past the normal retraction line 105 due to a deficiency in the fluid volume on the right-hand side of piston 36, a signal was passed to amplifier 97 of left-hand circuit 70 to operate the right-hand solenoid thereof whereby valve ports *B* and *C* were interconnected at the same time ports *A* and *D* were interconnected.

This condition of the valve spool remains until on the next successive signal from the same sensor 103 on the left-hand side of the apparatus the left-hand solenoid for left-hand valve 76 is triggered and operates to move the valve spool to connect ports *A* and *C* and ports *B* and *D*. In other words, sensor 103 and its associated amplifier 97 act as an overall, simple flip-flop-type switch. This will allow activated fluid under pressure again from line 60*a* to pass as before through line 82 into valve 76 through ports *B* and *D* and through line 83 into the right end of chamber device 74 in order to effect movement of piston 94 to the left so as to pump activated fluid under pressure at a greater pressure level than the activated fluid from chamber 32 out through line 81 and through ports *C* and *A* of valve 76 into lines 80, and 58*a* and into the fluid deficient chamber 34 to replenish the volume of fluid in this part of the circuit and bring about a rebalancing in the stroking of the piston 36 in the fluid circuit.

Just as in the case of where piston plunger 94 of the left-hand device 74 previously moved to the right during a prior overstroking of piston 36 to the right, right-hand replenishing circuit 70 is automatically disconnected or isolated from chamber 32 by check valve 86 in line 82 during the successive actuations of left-hand valve 76. Thus, for any overtravel of actuating piston 36 to the right as viewed in the drawing, the proper amount of piston balancing restoration fluid under pressure will be directed through lines 60*a* and 82, and valve 76 to either side of replenishing chamber 74 so as to effect advancement of piston 94 toward one end of left-hand device 74 in order to pump a predetermined amount of replenishing fluid from left-hand device 74 to replenish the fluid loss in chamber 34 by way of conduit 81 or 83, valves 76 and 84 and conduits 80 and 58*a*. In other words, a valve 74 is always in a "ready" condition to supply fluid lost in one of the chamber circuit portions 32 or 34.

Conversely, if there is an overtravel of actuating piston 36 to the left, whereby a right-hand punch 44 will pass to the left of the right-hand dotted reference line 105 in the drawing and up to reference line 107, portions of a ram 44 associated with the right sensor 103 will induce a greater counterreactance therein. Induction of a greater counterreactance causes generation and transmission of a signal from the right-hand sensor 103 through lead 104 to amplifier 97 of the right-hand replenishing circuit. The transmitted signal from right-hand sensor 103 causes right-hand amplifier 97 to transmit a signal through conductor 98 or 100 depending on the specific signal generating condition of amplifier 97 in order to effect energization of right- or left-hand solenoid 78 for right-hand valve 76. Energization, for example, of the right-hand solenoid 78 causes the valve spool of valve 76 to place valve ports *A* and *C* in fluid interconnection at the same time ports *B* and *D* of the valve are connected. With valve port *A* connected to port *C* and port *B* to port *D* in the valve of right-hand circuit 70, activated fluid under pressure from chamber 34 is directed to the left-hand end of fluid pump device 74 through lines 58*a*, 80 and 81 to advance piston 94 in the right-hand pump device 74 to the right as indicated by dotted arrow lines in the drawing. This rightward advancement of piston 94 causes displacement from pump chamber device 74 in the right-hand replenishing circuit 74 of a predetermined amount of replenishing fluid at an activated pressure level greater then the activated pressure of excess fluid from chamber 34. This replenishing fluid is then admitted to fluid-deficient chamber 32 through check valve 86 and aligned ports *B* and *D* of valve 76 and lines 83, 82 and 60*a*.

Left-hand replenishing circuit 70 is at the same time automatically disconnected from chamber 34 by virtue of check valve 84 therein being subjected to fluid under pressure from chamber 34 through lines 58*a* and 80 during an overstroke of piston 36 to the left as viewed in the drawing.

Whenever piston 36 overstrokes to the left again, an inner portion of a ram 44 associated with the right-hand sensor 103 operates to induce a further counterreactance in the right-hand sensor 103, all as aforedescribed. This results in generation and transmission of a signal from right-hand sensor 103 to right-hand amplifier 97 through lead 104. The set condition of right-hand amplifier 97 will now be such in view of the initial assumption made above as to its first set condition that it will transmit a signal to the left-hand solenoid 78 through lead 98 of right-hand replenishing circuit 70 in order to effect energization of left-hand solenoid 78 for the right-hand valve 76. Such energization of left-hand solenoid 78 causes a leftward movement of the right-hand valve 76 thereby connecting valve port *A* to *D* and *B* to *C*, all as indicated in the drawing. By virtue of fluid under pressure within chamber 34 being activated when piston 36 overstrokes to the left in the drawing, the excess fluid under pressure is directed from chamber 34 to the right end portion of pump device 74 of right-hand replenishing circuit 70 through lines 58*a*, 80 and 83 and aligned ports *A* and *D* of valve 76.

Fluid in the right end of chamber 32 causes right-hand pump piston 94 to be displaced to the left as indicated by the solid arrow line in the drawing thereby displacing a predetermined amount of activated fluid from the left end of the pump device at a greater pressure level than the activated fluid from chamber 34. This replenishing fluid is then admitted to fluid circuit chamber 32 through aligned ports *B* and *C* of valve 76 and check valve 86 and lines 81, 82, 60*a* so as to replenish fluid lost from chamber 32 as the result of an overstroking of piston 36 to the left. At the same time, left replenishing circuit 70 is automatically disconnected from chamber 34 by virtue of closure of check valve 84 in the manner aforedescribed.

In view of the foregoing, it is evident that fluid pump device **74** of the right-hand replenishing circuit **70** automatically compensates for any fluid lost in chamber **32** and that both replenishing circuits **70** are exceptionally sensitive to changes in the fluid volumes of various portions of the closed circuit.

By use of the instant control system, it is evident that a simple and reliable monitoring arrangement is provided for sensing and correcting the unbalanced stroking or drifting of the actuating or slave piston **36** in either direction so that accurate stroke control of all forming rams **44** on the apparatus is assured at all times. Unbalanced stroking is substantially instantaneously corrected by virtue of the "ready" condition at all times of each valve **76** due to its actuation by its associated sensor **103** and amplifier **97**. In other words, the left- and right-hand fluid replenishing circuits **70** effectively cooperate with each other and the closed fluid circuit in a substantially instantaneous automatic and smooth fashion to compensate for overtravel of the actuating piston **36** either to the right or left. As the result of the instantaneous operation, smoothness and reliability of fluid replenishing circuits **70** of the control system of the instant invention, quality control of drawn and ironed thin-walled metal cans, such as aluminum or steel cans produced by multiple rams **44**, can be effectively maintained even when actuating piston **36** is repetitively stroked on the order of 120 or more strokes per minute.

Since electromagnetic sensor **103** involves no moving mechanical parts, the magnetic field *F* of the sensor immediately detects a greater counterreactance when a ram associated with the field enters a greater part thereof due to an overstroking of the ram as aforedescribed and instantaneously brings about the generation and transmission of the proper correcting signal to other parts of the device.

All of this in turn means that the equipment can be operated at very high production speeds because of the sensitivity and operating speeds of the piston balancing circuits **70**.

Chambers **32**, **34**, **46** and **38** are initially filled with fluid by the use of a pair of bleed valves **105** connected to the top of housing **12** through conduits **108** on opposite sides of actuating piston **36**. Conduits **110**, however, can operate to exhaust the bled fluid from valves **106** to reservoir **54**. Fluid replenishing and pump devices **74** of both circuits **70** include appropriate bleed valves (not shown) at opposite ends thereof for assuring proper filling of devices **74** prior to operation of the control system **10** of the instant invention.

It is to be understood that although the control system has been described in connection with the use of certain media, such as electrical signals for selectively directing excess and activated fluid under pressure from one chamber in order to effect admittance of activated fluid to a lost fluid chamber, e.g., as from **34** to **32** in the manner aforedescribed, during an overstroking of actuating piston **36**, the control system could readily use a fluidic-type sensor in lieu of each electromagnetic sensor **103** to generate and transmit electrical pulses to amplifiers **97**.

Advantageous embodiments of the invention have been shown and described. It is obvious that various changes and modifications may be made therein without departing from the scope thereof as defined in the appended claims, wherein:

What we claim is:

1. An apparatus for forming a deep drawn seamless can body provided with a bottom and sidewall formed integrally therewith comprising a closed fluid circuit, an actuating piston mounted in one portion of said fluid circuit and at least one separate forming punch secured to each of the opposing sides of said piston, drive means located in another portion of said circuit for activating the fluid in said closed fluid circuit and the said piston so as to alternately urge first one of said punches in a single uninterrupted stroke thereof through the die means associated therewith and then an opposing punch in a single uninterrupted stroke of the last-mentioned punch through the die means associated therewith, means for replenishing fluid lost on one side of said piston and in a selected portion of the closed fluid circuit said lost fluid resulting in an unbalancing of the stroke of said piston, said fluid replenishing means including a fluid pump device connectable to the fluid deficient portion of the fluid circuit for supplying fluid to said fluid deficient portion of the fluid circuit, means including a valve means for fluidly connecting said fluid pump device directly to another portion of the closed fluid circuit so as to actuate said pump device and thereby supply fluid to said fluid deficient portion of the fluid circuit and a sensor means activated by an overstroked punch for operating said valve means to connect said pump device simultaneously to the said different portions of said closed fluid circuit.

2. An apparatus as set forth in claim **1** including an amplifier means connected to said sensor means.

3. An apparatus as set forth in claim **1** in which said drive means is comprised of a pair of oppositely disposed pistons connected to a driving yoke.

4. An apparatus as set forth in claim **2** wherein said valve means is operated by solenoids controlled by said amplifier means.

5. In an apparatus as set forth in claim **1** wherein said sensor means is an electromagnetic sensor means.

6. An apparatus as set forth in claim **1** including a pair of fluid pump devices, each of said devices being operable to supply fluid lost from a different selected portion of the fluid circuit to said different selected portion of the circuit and each of said pump devices being operated by a different valve means controlled by a separate sensor means.

7. An apparatus as set forth in claim **1**, including a pump for keeping said first-mentioned pump device fully primed.

8. In an apparatus for forming a deep drawn seamless can body provided with a bottom and sidewall formed integrally therewith, the combination of a closed fluid circuit, an actuating piston mounted in one portion of said fluid circuit and at least one separate forming punch secured to each of the opposing sides of said piston, yoke-type drive means located in another portion of said circuit for reciprocating the fluid in said closed fluid circuit and the said piston so as to alternately urge first one of said punches in a single uninterrupted stroke of the punch through the die means associated therewith and then an opposing punch in a single uninterrupted stroke of the last-mentioned punch through the die means associated therewith, means for replenishing fluid lost on each side of said piston in the closed fluid circuit, the lost fluid on either side of said piston in the closed fluid circuit resulting in an unbalancing of the stroke of said piston, said fluid replenishing means including a pair of fluid displacement pump devices, one pump device being directly connectable to a portion of the fluid circuit on one side of said piston and the other displacement pump being directly connectable to the portion of the fluid circuit on the other side of said piston, separate valve means for fluidly connecting each pump device separately and directly to a different side of said yoke-type drive means simultaneously with connecting a given pump device to a fluid deficient portion of the fluid circuit so as to separately activate each of said pump devices, a separate sensor means on each side of the apparatus and activated by a given overstroked punch for selectively and separately operating one of said valve means so as to connect a selected one of said pump devices to one side of said yoke-type drive means simultaneously with connecting said last-mentioned pump device to a fluid deficient portion of the closed fluid circuit.

9. An apparatus as set forth in claim **8** in which said yoke drive means includes a drive piston at each side of the yoke-type drive means, each drive piston being in direct contact with the fluid in a given portion of said closed fluid circuit in order to effect reciprocation of the fluid in the closed circuit and reciprocation of said actuating piston.

10. An apparatus as set forth in claim **9** in which each displacement pump device includes a pump piston which has a smaller diameter than a drive piston attached to said yoke-type drive means.

11. An apparatus as set forth in claim **8** in which said sensor means are electromagnetic sensor means.

12. An apparatus as set forth in claim 8 including oppositely disposed solenoid means operated by a sensor means for controlling each of said valve means and keeping said valve means in a ready condition at all times.

13. An apparatus as set forth in claim 8 including a further valve means for isolating one pump device from the fluid circuit when the other pump device is operating.

14. An apparatus for forming a deep drawn seamless can body provided with a bottom and sidewall formed integrally therewith and comprising a closed fluid circuit, a piston means mounted in one portion of said fluid circuit, at least one separate forming punch means secured to each of the opposing sides of said piston means, yoke means located in another portion of said circuit for cyclically activating portions of the fluid in said closed fluid circuit in order to actuate said piston means so as to alternately urge first one of said punch means in a single uninterrupted stroke of the punch means through a die means associated therewith and then an opposing punch means in a single uninterrupted stroke of the last-mentioned punch means through the die means associated therewith,

means for replenishing fluid lost on one side of said piston means and in a selected portion of the fluid circuit, the said lost fluid on the one side of said piston means causing an unbalanced stroke thereof, said replenishing means including a sensor operatively associated with a punch means for detecting an overstroked punch means upon a fluid deficiency, the improvement comprising a sensor operated valve means for fluidly connecting a fluid pump device directly to a fluid activated portion of said fluid circuit simultaneously with connecting the same pump device to the fluid deficient portion of the fluid circuit whereby said pump device can in rapid fashion supply fluid to the fluid deficient part of the circuit upon the fluid deficiency being detected.

15. An apparatus as set forth in claim 14 wherein said sensor is an electromagnetic sensor.

16. An apparatus as set forth in claim 14 including an amplifier means interconnecting said valve means and said sensor for placing said valve means in a ready condition at all times.