July 12, 1966 W. C. BLUE 3,259,946

AUTOMATIC FEEDER SYSTEM FOR MOLD SHAKE-OUT

Filed April 9, 1962 2 Sheets-Sheet 1

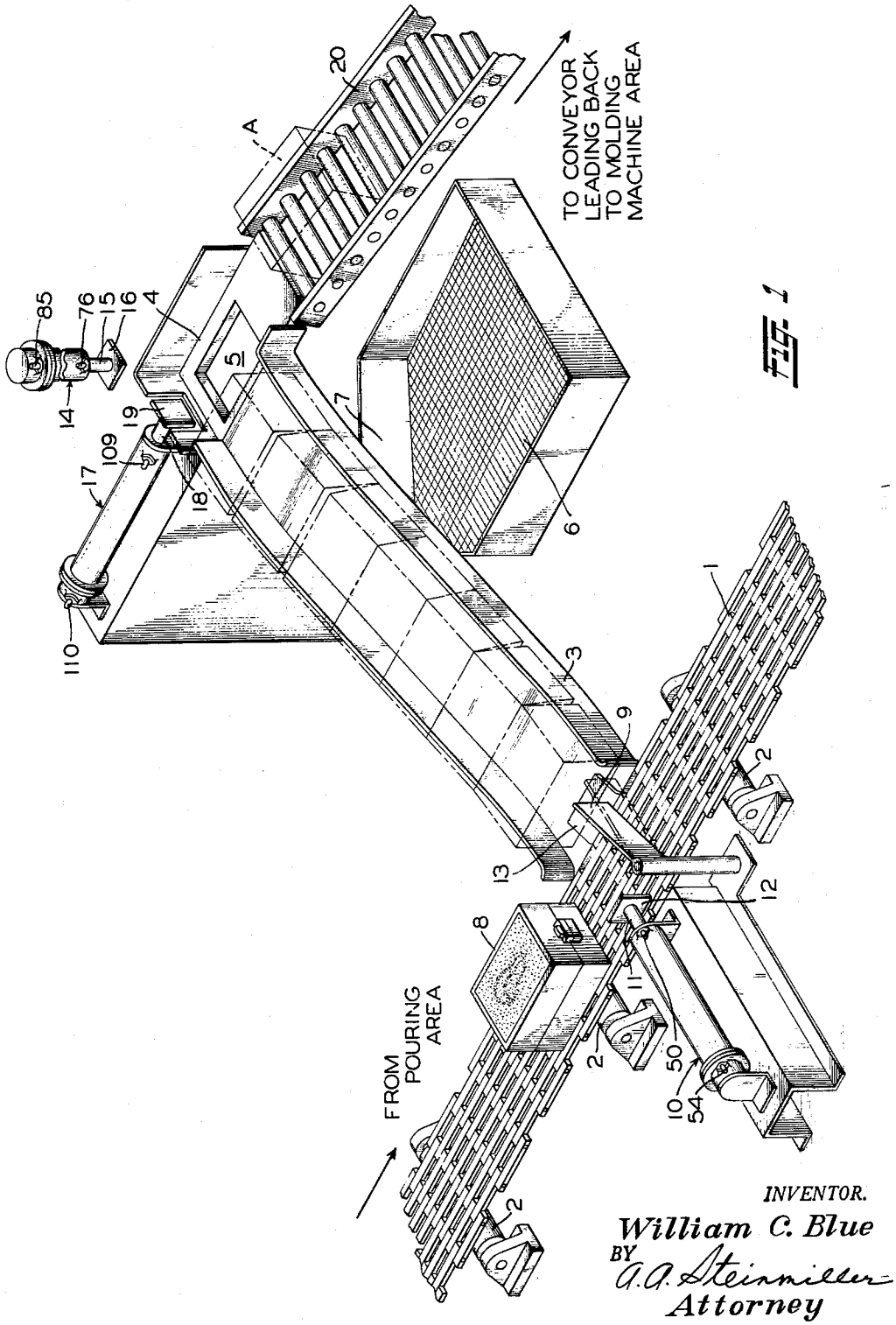


FIG. 1

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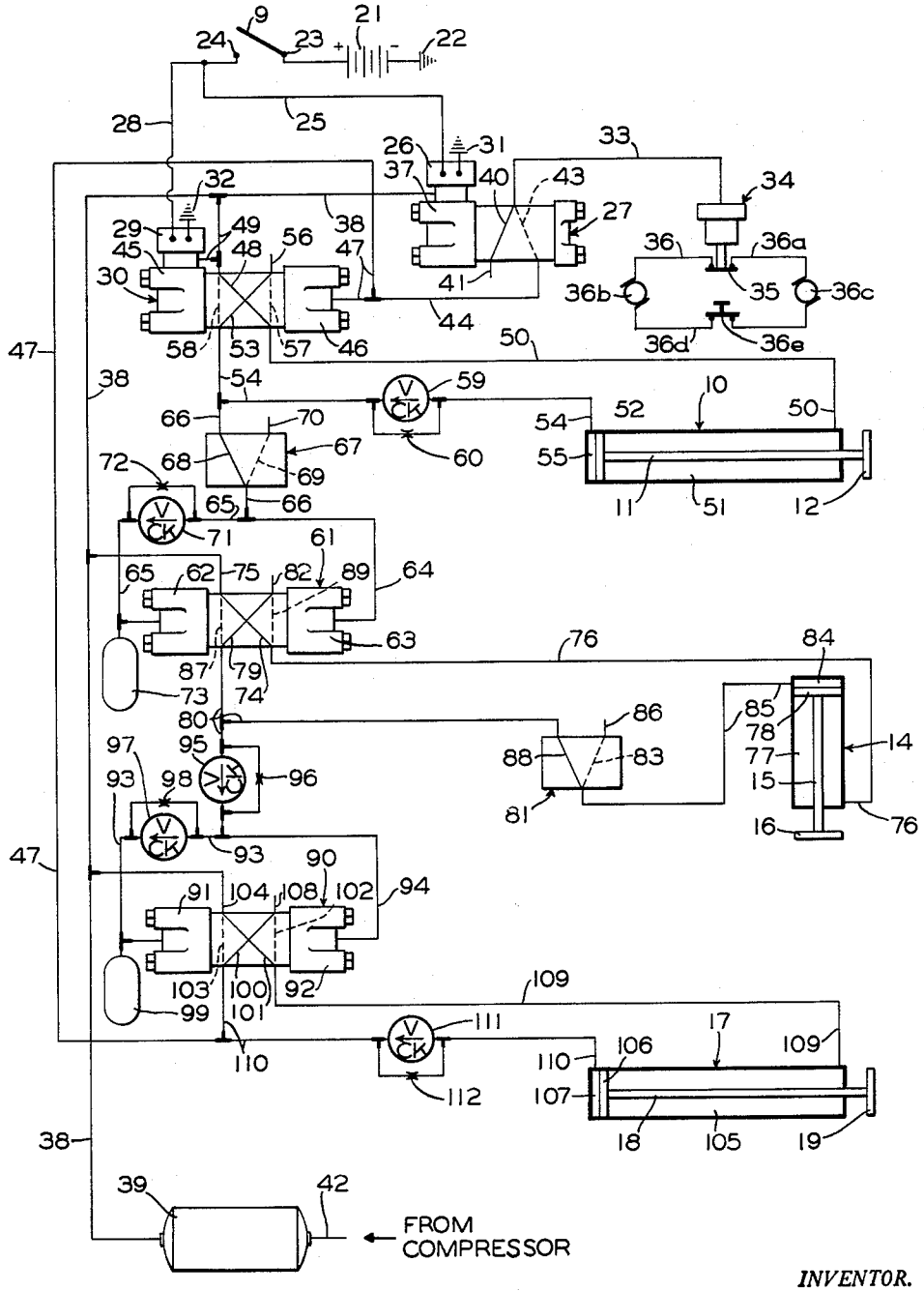


FIG. 2

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AUTOMATIC FEEDER SYSTEM FOR MOLD SHAKE-OUT

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4 Claims. (Cl. 22—95.5)

This invention relates to automatic feeder systems for mold shake-out apparatus employed in foundries and, more particularly, to such a feeder system which is entirely automatic in handling a continuous flow of molding flasks containing newly poured castings during the shake-out operation of the castings, that is, from the time that said castings have cooled off sufficiently to permit the molten metal to solidify until they are deposited on a shake-out machine for removing any sand adhering thereto.

Conveyor belts are commonly used in the foundry industry for conveying mold flasks from one station to another during the process of producing a casting, which process, as is well known, includes (i) forming the mold in a flask, (ii) pouring the molten metal, and (iii) after adequate time has elapsed to permit the metal to cool sufficiently for solidifying, removing the casting from the mold and removing any sand adhering thereto.

The present invention is primarily directed to step (iii) above recited, that is, the shaking out of the casting, after it has been removed from the flask, for the purpose of removing the molding sand adhering thereto. The shake-out operation is normally accomplished by a shake-out machine including a vibrating platform comprising a screen on which the casting is dropped, whereupon the sand is shaken off the casting and drops through the screen. One method of placing the flask containing the hot casting on the shake-out machine is by a power-operated hoist operated by one or two men whereby the flasks containing the hot castings are lifted, one at a time, from the conveyor belt and then lowered onto the platform of the shake-out machine where the castings are deposited. As the casting is removed from each flask, the empty flask is returned, by the hoist, from the platform to the conveyor belt.

The purpose of using a conveyor belt in the production of castings is to provide a continuous operating cycle which helps to speed up such production. The efficiency of the operating cycle, however, depends greatly on how well the several operations (above recited) comprising the cycle are coordinated. Occasionally the shake-out operation may cause a delay in production because the workmen are unable to remove the loaded flasks from the conveyor, deposit the hot castings on the shake-out screen, and return the empty flasks to the conveyor fast enough to keep up with the other steps of the production cycle. In such an event the conveyor belt has to be shut down to prevent too great an accumulation of loaded flasks at the shake-out operation area. While the conveyor is shut down, other operations must be suspended also, and production is thus delayed.

Accordingly, the object of the present invention is to provide a fully automatic feeder apparatus for transferring the flasks containing the hot castings, one at a time, from the conveyor to the shake-out machine, drop the castings onto the shake-out screen and return the empty flasks to the conveyor with little or no assistance from human operators, said apparatus being further characterized by control means for automatically keeping the conveyor operating at a rate corresponding to the rate at which the flasks are processed through the shake-out operation, thereby insuring a minimum loss of time and an efficient operating cycle.

Briefly, the invention comprises an inclined ramp onto and up which flasks containing hot solidified castings are pushed, in succession, from a conveyor belt by a first fluid pressure operable power cylinder device electrically actuated when a gate switch is closed by the flask as it moves alongside the lower end of the ramp. When enough flasks have thus been pushed onto the ramp so as to be solidly stacked up the entire length of said ramp, as each flask on the conveyor belt is thereafter successively pushed onto the lower end of the ramp, the flask at the upper end of said ramp is forced onto a horizontal platform adjacent said upper end of said ramp where a second fluid pressure operable power cylinder device forces the casting to drop out of the flask, through an opening in said platform, onto a shake-out screen situated directly beneath said platform. When the casting has been dropped, the empty flask is nudged by a third fluid pressure operable power cylinder device onto and down an inclined roller chute from which the empty flasks roll onto the conveyor belt leading back to molding machines. The timing and sequential operation of the several power cylinder devices is coordinated by electrical control circuits and a series of valve devices operatively interlocking said cylinder devices through fluid pressure conduits. The electrical control circuitry includes means for automatically shutting down the conveyor belt should the flask on the horizontal platform fail to be cleared therefrom for any reason whatsoever after having been emptied, thereby preventing a jam-up of flasks at the lower end of the inclined ramp, and then automatically restarting the conveyor belt when said platform has been cleared.

In the drawing, FIG. 1 is a perspective view of the automatic feeder apparatus embodying the invention, and FIG. 2 is a schematic view showing the arrangement of the power cylinder devices and associated electrical control circuitry.

Description

The automatic feeder apparatus embodying the invention and as shown in FIG. 1 comprises an endless conveyor belt **1**, only a portion of which is shown and which is power driven over a plurality of rollers **2** fixedly spaced on the floor along the route of travel of the belt. The belt **1**, in this instance, is set up to travel from a molding machine area (not shown), where molds are successively prepared in flasks and placed on said belt, to a pouring area (not shown), where molten metal is poured into each mold to form castings, thence to the shake-out area, with which phase of production the present invention is primarily concerned and where the hot castings are successively removed from the flasks, and thence back to the molding machine area where the returning empty flasks are again used in making new molds, thus providing a continuous operating cycle in the production of said castings.

As shown in FIG. 1 of the drawing, the invention further comprises an inclined stationary sliding ramp **3** disposed perpendicularly to the conveyor belt **1** with the lower end perpendicularly adjacent to and on the same level with said conveyor belt and the higher or upper end of said ramp terminating with a horizontal drop-out

platform 4 on a suitable level higher than said conveyor belt. Flasks containing hot castings are successively moved onto the platform 4, in a manner to be later explained, where the casting is caused to drop out of the flask, through an opening 5 formed in said platform, onto a shake-out screen 6 situated directly below said opening and constituting part of a shake-out machine (only said screen being shown) including an agitating mechanism which imparts a vibrating motion to said shake-out screen for loosening from the casting any molding sand tending to adhere thereto, said sand dropping through said screen into a collecting container or pit (not shown). The shake-out screen 6 is slightly inclined so as to slope downwardly toward a narrow portion 7 toward which the castings are caused to gravitate by the vibrating motion of the screen, the castings then dropping off from said screen into a container (not shown) by which they can be transported away for further processing.

A flask 8 containing a hot casting, but which has cooled off sufficiently to allow the molten metal to solidify, is shown on the conveyor belt 1 approaching the inclined ramp 3 from the pouring area, the direction of travel of said belt being indicated in FIG. 1 of the drawing by an arrow. The flask 8 containing the hot casting is open-bottomed, but due to the tamped condition of the sand and because of the support provided by the flat surfaces of the conveyor belt 1 and the inclined ramp 3, the sand and casting remain undisturbed until the casting is dropped through the opening 5 in the platform 4. As the flask 8 moves into alignment with the ramp 3, said flask contacts a gate switch 9 which is moved from an open position, in which it is shown in the drawing, to a closed position, shown in broken outline in the drawing, in which closed position an electrical control circuit (to be more fully described hereinafter) is closed to effect operation of a fluid pressure operable power cylinder device 10. The power cylinder device 10 has a retracted position in which a piston rod 11, having one end projecting exteriorly of the housing, is retracted out of the path of movement of the flask 8 or any succeeding flasks as said flasks successively approach the gate switch 9. As the gate switch 9 is moved to its closed position by the flask 8, the cylinder device 10 is actuated (as will later be described) to an extended position to cause a metal pad 12 fixed to the end of piston rod 11 to move into contact with the flask 8 and push said flask over a check latch 13 onto the ramp 3. The check latch 13 may be any suitable type spring-biased latch and is situated at the lower edge of the ramp 3 to prevent the flasks from sliding back onto the conveyor belt 1 once they have been pushed onto said ramp. As the flask 8 moves off the conveyor belt 1 onto the ramp 3, the gate switch 9, which is spring-biased, returns to its open position to open the actuating circuit of the power cylinder device 10, whereupon the piston rod 11 is retracted until a successive flask moves into alignment with the ramp 3 and operates gate switch 9 to its closed position.

As each successive flask is moved onto the ramp 3, it pushes the others ahead of it in a solid stack of flasks, as shown in phantom outline in FIG. 1 of the drawing, until the lead flask reaches the horizontal platform 4, at which point a fluid pressure operable power cylinder device 14 having a piston rod 15 on the end of which a metal pad 16 is fixed, similarly to the power cylinder device 10, is automatically actuated (in a manner to be hereinafter described) to force the casting out of the open-bottomed flask, through the opening 5, onto the shake-out screen 6. It will be understood that the power cylinder 14 is suitably mounted in vertical alignment above the opening 5 in the platform 4, as shown in FIG. 1, so that when the piston rod 15 is extended, the pad 16 on the end thereof engages the mold and pushes it out through the open bottom of the flask and through the opening 5, from which the mold and casting drop to the shake-out screen 6 below.

Upon retraction of the piston rod 15, a fluid pressure operable power cylinder device 17 having a piston rod 18 on the end of which a metal pad 19 is fixed, similarly to cylinder devices 10 and 14, is automatically actuated to cause said piston rod and pad to abuttingly contact the empty flask and nudge it off the platform 4 onto a downwardly sloping roller chute 20, such an empty flask being shown on said chute in phantom outline and designated by the letter A in FIG. 1 of the drawing. The roller chute 20 leads back to a different point (not shown) of the conveyor belt 1 onto which the empty flask A and succeeding flasks roll from said chute, said conveyor belt thus returning the empty flasks to the molding machine area where they are again made into new molds for successive castings. Thus, the cycle of operation is a continuous one coordinated by the electrical and fluid pressure control circuits shown in FIG. 2 of the drawings and immediately to be described.

In FIG. 2 of the drawing, the gate switch 9 is represented symbolically and is shown in an electrical circuit comprising a source of electrical energy 21 which is grounded on one side at 22 while one terminal 23 of said switch is connected to the other side of said source of energy. A contact 24, with which the switch 9 comes into contact when in its closed position, is connected via a wire 25 to one terminal of a solenoid 26 associated with a control valve device 27 and via a second wire 28 to one terminal of a solenoid 29 associated with a control valve device 30, whereby said solenoids are connected in parallel relation. The solenoids 26 and 29 are shown as being grounded at 31 and 32, respectively, in the drawing.

The control valve device 27 is connected via a pressure fluid conduit 33 to a fluid pressure responsive electrical switch device 34 having a switch member 35 operable by said switch device to either a closed position or an open position in which respective terminals of two wires 36 and 36*a* are electrically connected or disconnected, respectively. The switch member 35 and the wires 36 and 36*a* constitute components of an electrical control circuit for operating the conveyor belt 1 and shown schematically in FIG. 2 of the drawings, said control circuit further comprising a motor 36*b* connected to wire 36, a source of electrical energy such as a generator 36*c* connected to wire 36*a*, a wire 36*d* connecting said motor to said generator, and a manually operable switch 36*e* interposed in wire 36*d*, whereby the circuit may be opened or closed manually. When the pressure switch device 34 is vented of fluid pressure, the switch member 35 associated therewith is operated to its closed position, in which it is shown in the drawing and in which the conveyor belt control circuit is thus closed, to cause operation of motor 36*b* (which is drivingly connected to the conveyor belt 1 in suitable manner not shown) and thereby movement of said conveyor belt, and when said pressure switch device is supplied with pressurized fluid via conduit 33, the switch member 35 is moved to its open position for opening the conveyor belt control circuit and thereby stopping said motor and movement of the conveyor belt.

The control valve device 27 further comprises a solenoid-operated valve portion 37, connected via a pressure fluid conduit 38 to a source of fluid under pressure such as a reservoir 39, for piloting the supply and release of fluid pressure to and from a piston device (not shown) which operates a reciprocable valve member (not shown) in said control valve device. A spring (not shown) biases the reciprocable valve member toward a normal position in which an exhaust passageway 40 (represented by a solid line in the drawing) is opened whereby the pressure switch device 34 is vented to atmosphere via conduit 33 and an exhaust port 41. The reservoir 39 may be charged with fluid under pressure by a compressor

(not shown) via a conduit 42. When solenoid 26 is energized by closing of switch 9, the valve portion 37 operates to allow pressurized fluid to be admitted to the piston device of the control valve device 27 to cause operation of the reciprocable valve member, against opposition of the biasing spring, to a supply position in which exhaust passageway 40 is cut off and a supply passageway 43 (respresented by a broken line in the drawing) is established via which communication is established between conduit 33 and a conduit 44 and whereby pressurized fluid may be supplied to the pressure switch device 34 under certain operating conditions of the control apparatus to be later explained. Of course, when switch 9 is open, solenoid 26 is deenergized and the valve portion 37 operates to vent fluid pressure from the piston device of the valve device 27, whereupon the reciprocable valve member (not shown) is returned to its normal position by the biasing spring.

The primary function of the control valve device 30 is to control the operation of the power cylinder device 10, said control valve device further comprising a solenoid-operated valve portion 45 which cooperates with the solenoid 32 to function in a manner similar to the valve portion 37 and solenoid 26 of the control valve device 27 for piloting supply and release of fluid pressure to and from a piston device (not shown) which operates a reciprocable valve member (not shown) in said control valve device 30. The reciprocable valve member in the control valve device 30, however, in addition to being biased by a biasing spring (not shown) at the end opposite valve portion 45, in manner similar to the reciprocable valve member of the valve device 27, is also subjectable to fluid pressure as applied thereto through a piston portion 46 at the end opposite the solenoid operated valve portion 45. Thus, the reciprocable valve member in the valve device 30 is reciprocably responsive either to preponderance of fluid pressure acting on the piston device at one end as supplied via the valve portion 45 when the solenoid 29 is energized, or to preponderance of the combined opposing effects, acting on the other end, of the biasing spring and fluid pressure as applied by the piston portion 46 when subjected to fluid pressure supplied via a conduit 47 connected thereto (in a manner to be hereinafter described) and to which conduit the conduit 44 leading to the control valve device 27 is also connected.

When fluid pressure effective at the end of the reciprocable valve member of control valve device 30 adjacent piston portion 46, combined with the effects of the biasing spring adjacent thereto, predominates, said reciprocable valve member is moved to a piston-retracting position in which a first supply passageway 48 (indicated by a solid line in the drawing) is opened. With supply passageway 48 open, communication is thus established between a pressure fluid branch conduit 49, leading from the supply conduit 38 and connecting to said first supply passageway and the valve portion 45 of said control valve device 30, and a pressure fluid conduit 50 leading from said control valve device to a chamber 51 in the power cylinder device 10 adjacent one side of an operating piston 52 to which side the piston rod 11 is fixed. Also in the piston-restracting position of the reciprocable valve member in the control valve device 30, a first exhaust passageway 53 (indicated by a solid line in the drawing) is established via which communication is established between a pressure fluid conduit 54, connecting said control valve device with a pressure chamber 55 in power cylinder device 10 on the side of piston 52 opposite chamber 51, and a vent port 56 for venting said pressure chamber. With chamber 55 vented and chamber 51 connected to pressure fluid supply, piston 52 and piston rod 11 are operated to respective retracted positions, above described.

When fluid pressure effective at the end of the reciprocable valve member of the control valve device 30 adjacent the valve portion 45 predominates, said reciprocable valve member in operated to a piston-operating position in which the first supply passageway 48 and the exhaust passageway 53 are cut off, a second exhaust passageway 57 (indicated by a broken line in the drawing) is opened to connect conduit 50, and therefore chamber 51, to the vent port 56, and a second supply passageway 58 is opened to connect conduit 54, and therefore chamber 55, to conduit 49, whereupon piston 52 and piston rod 11 are operated to respective extended positions above described. A check valve 59 with a choke 60 in bypassing relation thereto is interposed in the conduit 54 to effect restricted flow of fluid under pressure during supply to pressure chamber 55 and unrestricted flow, as indicated by the arrow on said check valve, during release of fluid pressure therefrom. The flow restriction imposed by the check valve 59 and choke 60, when pressure fluid is supplied to chamber 55 for operating piston 52 and piston rod 11 to their respective extended positions, allows the pad 12 to gently abut against the flask 8 to push it onto ramp 3 rather than slam against said flask with a jarring impact, thus insuring against premature loosening of the sand and casting in the flask before it reaches the platform 4.

The control portion of the automatic feeder apparatus further comprises a control valve device 61 for controlling operation of the power cylinder device 14. The control valve device 61 is similar to the control valve device 30 to the extent that it also comprises a reciprocable valve member (not shown) operable therein. The reciprocable valve member is operably responsive either to preponderance of fluid pressure effective at one end thereof and as applied by an adjacently situated fluid pressure responsive piston portion 62, or to preponderance of fluid pressure effective at the opposite end, as applied by an adjacently situated piston portion 63, combined with the biasing effect of a biasing spring (not shown) acting on said opposite end. The piston portions 62 and 63 are correspondingly similar in function to the piston portions 45 and 46 of the valve device 30, except that, as indicated, both the piston portions 62 and 63 of the valve device 61 are fluid pressure operable and not solenoid-operated as is said valve portion 45 of the valve device 30.

Since the operation of the control valve device 61 is similar to that of control device 30, it will suffice to say that the reciprocable valve member therein is operable between a piston-retracting position and a piston-extending position depending upon whether fluid pressure at the end adjacent piston portion 63 or the combined effects of the biasing spring and fluid pressure acting at the other end adjacent piston portion 62 predominates said piston portions being connected to respective pressure fluid conduits 64 and 65 which branch from a pressure fluid conduit 66 connected to conduit 54.

A quick release valve device 67 of well-known type is interposed in conduit 66 and, very briefly, comprises fluid pressure operable valve means (not shown) operable responsively to fluid pressure, supplied via conduit 66, in a control chamber (not shown) to a supply position in which a supply passageway 68 (represented by a solid line in the drawing) is opened to permit communication between conduit 54 and conduits 64 and 65. Upon reduction of fluid pressure in the control chamber below a preselected value (when passageway 53 in control valve device 30 is open), the valve means in the quick release valve device 67 is caused to be operated to a release position in which supply passageway 68 is cut off and an exhaust passageway 69 (represented by a broken line in the drawing) is opened to connect conduits 64 and 65 to atmosphere via an atmospheric vent 70 for effecting rapid dissipation of fluid pressure from valve portion 63 of the control valve device 61 via conduit 65. A check valve 71, which permits flow in the direction indicated by the arrow, and a choke 72 in bypassing relation to said check valve, are interposed in conduit 65 to provide for restricted release of fluid pressure from the valve portion 62 and a timing volume 73 connected thereto

via conduit 65 when passageway 69 is open and for a purpose to be hereinafter disclosed.

When the reciprocable valve member in the control device 61 is in its piston-retracting position, a first supply passageway 74 is opened via which communication is established between a pressure fluid branch conduit 75 supply conduit 38 and a fluid pressure conduit 76 leading to a chamber 77 in the power cylinder device 14 adjacent one side of an operating piston 78 from which side the piston rod 15 extends. Also in the piston-retracting position of the reciprocable valve member of the control valve device 61, a first exhaust passageway 79 is established via which communication is established between a pressure fluid conduit 80, connecting said control valve device to a control chamber (not shown) of a quick release valve device 81, and a vent port 82 for venting said control chamber. When fluid pressure is released from the control chamber of the quick release valve device 81, fluid pressure operable valve means therein (not shown) are operated to a release position in which a release passageway 83 is established to cause a pressure chamber 84 in power cylinder device 14 on the side of piston 78 opposite chamber 77 to be vented to atmosphere via a pressure fluid conduit 85, connecting said pressure chamber with quick release valve device, and a vent port 86. Thus, with pressure chamber 84 vented and chamber 77 connected to fluid pressure supply conduit 38, piston 78 and piston rod 15 are operated to respective retracted positions above described.

When the reciprocable valve member in the control valve device 61 is in its piston-operating position, the passageways 74 and 79 are cut off and a second supply passageway 87 connecting conduit 75 with conduit 80 is established, whereby fluid pressure is effective in the control chamber of the quick release valve device 81 for operating the valve means therein to a supply position in which exhaust passageway 83 is closed and a supply passageway 88 is established via which communication is established between conduit 80 and conduit 85. Thus, fluid pressure is supplied to pressure chamber 84 of the power cylinder device 14, while chamber 77 is vented to atmosphere via conduit 76, a second exhaust passageway 89 (opened when the reciprocable valve member in the control device 61 is in its piston-operating position) and vent port 82. It will be apparent that piston 78 and piston rod 15 are thus operated to respective extended positions, above described, in which the pad 16 strikes the casting in the flask resting on the horizontal platform 4 to cause said casting to drop onto the shake-out screen 6

A control valve device 90, similar in structure and manner of function as the control valve device 61, is provided for controlling operation of the power cylinder device 17. The control valve device 90 is provided at its respective ends with fluid pressure responsive piston portions 91 and 92, including a biasing spring (not shown) at the end adjacent piston portion 92, for reciprocably operating a reciprocable valve member (not shown) in said control valve device, said valve portions being connected, respectively, via pressure fluid conduits 93 and 94 to conduit 80. A check valve 95 with a choke 96 in parallel relation thereto is interposed in conduct 80 between control valve device 61 and conduits 93 and 94, the direction of flow through the check valve being, as indicated by the arrow, toward said conduits 93 and 94. A check valve 97 with a choke 98 in parallel relation thereto is interposed in conduit 93, with direction of flow through said check valve being toward valve portion 91 and a timing volume 99 connected to conduit 93 between said check valve and said valve portion.

Similarly to the reciprocable valve member in control valve device 61, the reciprocable valve member in control valve device 90 operates between a piston-retracting position and a piston-operating position, in which piston-retracting position a first supply passageway 100 and a first exhaust passageway 101 are established, and in which piston-operating position, said first supply and exhaust passageways are closed and a second exhaust passageway 102 and a second supply passageway 103 are established. A pressure fluid conduit 104 connects supply conduit 38 with the control valve device 90 from which supply of pressurized fluid is effected, depending upon the position of the reciprocable valve member in said control valve device, to either a chamber 105 on one side of an operating piston 106, to which the piston rod 18 is fixed, or to a pressure chamber 107 on the opposite side of said piston for operating said piston and piston rod to respective retracted positions or respective extended positions, respectively and above described. A vent port 108 in the control valve device 90 is provided for venting one or the other of chambers 105 or 107 when the opposite chamber is connected to pressure fluid supply. Chambers 105 and 107 are connected to the control valve device 90 via pressure fluid conduits 109 and 110, respectively, the latter being connected to conduit 47, above mentioned.

As should be apparent, when piston 106 and piston rod 18 are operated to their extended positions, pad 19 engages the empty flask on platform 4 and pushes said flask down the roller chute 20, whence it is returned to the conveyor belt 1. A check valve 111 with a choke 112 in parallel relation thereto is interposed in conduit 110, the direction of flow through the check valve being from the power cylinder device 17 toward the control valve device 90.

Operation

In operation, when the flask 8, as seen in FIG. 1, moves into alignment with the inclined sliding ramp 3, the gate switch 9 is operated to its closed position, in which, as seen in FIG. 2, a first electrical circuit is established extending from ground at 22, via the source of electrical energy 21, switch 9, wire 28, solenoid 29 to ground at 32. The solenoid 29 is thus energized and, as above noted, such energization effects operation of the reciprocable valve member in the control valve device 30 from its piston-retracting position to its piston-operating position in which the power cylinder device 10, as hereinbefore described, gently nudges the flask 8 onto the ramp 3. As was above noted, the rate of supply of fluid under pressure to chember 55 is restricted to the rate determined by choke 60, thereby preventing a sudden impact of pad 12 on the flask being moved onto ramp 3 and thereby preventing any premature disturbance of the sand and casting in the flask until it reaches the platform 4. When the flask 8 has cleared the conveyor belt 1, gate switch 9 returns to its open position to break the circuit for energizing solenoid 29 and thereby effect deenergization of said solenoid. With deenergization of solenoid 29, fluid pressure from conduit 47 acting in the piston portion 46 (to be more fully explained hereinafter) of the control valve device 30 and the biasing spring (not shown) acting on the end of the reciprocable valve member adjacent said piston portion 46 are effective for operating said reciprocable valve member to its piston-retracting position in which, as above described, piston 52 and piston rod 11 are operated to their retracted positions. The direction of flow through check valve 59 permits unrestricted and rapid release of fluid pressure from chamber 55 thus causing rapid retracting movement of piston 52 and piston rod 11.

Assuming that a succeeding flask moves into alignment with sliding ramp 3, the gate switch 9 is again closed and the power cylinder device 10, as controlled by the control valve device 30 in the manner immediately above described, operates to move said succeeding flask onto the ramp 3 and move each preceding flask further up the ramp until the leading flask is pushed onto the horizontal platform 4 where the casting and sand therein is caused to drop through the opening 5 in said platform onto the screen 6 below in the manner presently described.

It will be observed that when the reciprocable valve member in the control valve device 30 is in its piston-

operating position in which the supply passageway **58** is established for permitting fluid under pressure to flow to chamber **55** of the power cylinder device **10** via conduit **54**, at the same time such fluid under pressure also flows through conduit **66** to effect operation of the quick release valve device **67** to its supply position (above described), whereupon said fluid under pressure also flows to both valve portions **62** and **63** of the control valve device **61** via conduits **65** and **64**, respectively. The direction of flow through the check valve **71** permits unrestricted flow of pressurized fluid to valve portion **62** and the associated timing volume **73** at the same time that such pressurized fluid is being supplied to the valve portion **63**. Due to the slight additional predetermined time required to charge timing volume **73** on the side of valve portion **62**, the maximum effect of the fluid pressure on the reciprocable valve member in the control valve device **61** occurs, along with the biasing effect of the biasing spring (not shown), on the end adjacent piston portion **63** ahead of maximum fluid pressure effect on the other end of said reciprocable valve member. Thus the reciprocable valve member is retained in its piston-retracting position, even if the effective fluid pressure on both ends of said reciprocable valve member equalizes after timing volume **73** is fully charged, until fluid pressure acting on the end of said valve member adjacent piston portion **63** is dissipated. This insures that the piston **78** and piston rod **15** of the power cylinder device **14** are in their retracted positions out of the way of the flask being pushed onto the platform **4** by action of the power cylinder device **10** acting on the lowermost flask on the ramp **3**.

When solenoid **29** is deenergized and the reciprocable valve member in the control valve device **30** is operated back to its piston-retracting position, as above described, control pressure in the release valve device **67** is vented by way of conduits **66** and **54**, exhaust passageway **53** and vent port **56**, whereupon said release valve device operates to its exhaust position for venting both piston portions **62** and **63** of the control valve device **61** by way of conduits **65** and **64**, conduit **66**, exhaust passageway **69** and vent port **70**. Due to the cut-off action of the check valve **71** in conduit **65** and the restrictive action of choke **72**, dissipation of fluid pressure bottled up in volume **73**, and therefore acting on the end of the reciprocable valve member adjacent piston portion **62**, is accordingly delayed while fluid pressure acting on the other end of said reciprocable valve member is rapidly dissipated, the resultant effect being the shifting of said reciprocable valve member, against the biasing effect of the biasing spring at the end adjacent piston portion **63**, from its piston-retracting position to its piston-operating position. Thus, after piston **52** and piston rod **11** of the power cylinder device **10** have been retracted and with the reciprocable valve member of the control valve device **61** in its piston-operating position, supply of fluid under pressure is effected to operate piston **78** and piston rod **15** of the power cylinder device, **14** as above described, to their extended positions for forcing the casting to drop out of the flask then resting on the platform **4** onto the shake-out screen **6** below.

The piston **78** and piston rod **15** remain in their extended positions momentarily until the position of the reciprocable valve member in the control valve device **61** is restored to the piston-retracting position by action of the biasing spring at the end of said reciprocable valve member adjacent piston portion **63** upon dissipation of fluid pressure acting on the other end of said reciprocable valve member, as above described. It will be noted that the respective actions of the power cylinder devices **10** and **14** are so coordinated and timed as to insure that the piston **78** and piston rod **15** of the power cylinder device **14** has been fully retracted before a succeeding flask is pushed onto the platform **4** by action of the piston **52** and piston rod **11** of the power cylinder device **10**. It will also be noted that due to the particular construction of the quick release valve device **81** interposed between conduits **80** and **85**, fluid under pressure is supplied to chamber **84** of the power cylinder device **14** via passageway **88** unrestrictedly, and such action, in cooperation with unrestricted venting of fluid pressure acting in chamber **77** via conduit **76**, passageway **89** and vent port **82**, causes piston **78** and piston rod **15** to be operated to their extended positions instantaneously, whereas, due to the effect of the check valve **59** and choke **60** interposed in conduit **54**, by comparison, extension of piston **52** and piston rod **11** is very deliberate and slow.

Again it will be noted, at the same time that pressurized fluid flows into conduit **80** for effecting operation of piston **78** and piston rod **15** of the power cylinder device **14** to the extended position, such pressurized fluid is supplied to both piston portions **91** and **92** of the control valve device **90** through check valve **95** and the respective conduits **93** and **94**. Again, such flow is unimpeded since the direction of flow through check valve **95** as well as check valve **97** is coincidental therewith. As in the case of the control valve device **61**, the effect of timing volume **99** is to retain the reciprocable valve member of the control valve device **90** in its piston-retracting position to insure that piston **106** and piston rod **18** of the power cylinder device **17** remain in their retracted positions until the piston **78** and piston rod **15** of the power cylinder device **14** have been fully retracted, as above described. Retraction of piston **78** and piston rod **15**, as above noted, occurs when the reciprocable valve member in the control valve device **61** returns to its piston-retracting position. With the reciprocable valve member of the control valve device **61** restored to its piston-retracting position, retraction of piston **78** and piston rod **15** is effected when exhaust passageway **79** is established to vent conduit **80** and, therefore, at the same time conduits **93** and **94**, the latter via choke **96**. Just as choke **72**, in the operation of the control valve device **61**, delays dissipation of fluid pressure from timing volume **73**, choke **98**, in addition to the restriction imposed by choke **96**, delays dissipation of fluid pressure from volume **99** to thereby create a differential pressure between the two ends of the reciprocable valve member in the control valve device **90** and cause said reciprocable valve member to be operated to its piston-operating position. The piston **106** and piston rod **18** of the power cylinder device **17** are thereby operated to their extended position for nudging the now empty flask off platform **4** onto the roller chute **20** whence it is returned to the conveyor belt **1** and returned to the molding machine area.

It should be apparent that choke **96** places enough of a restriction on the venting of conduits **93** and **94** to sufficiently delay operation of the piston **106** and piston rod **18** of the power cylinder device **17** to their extended positions until it is certain that piston rod **15** and pad **16** of power cylinder device **14** have been fully retracted. Since the direction of flow through check valve **111** is in opposition to flow in the direction toward chamber **107** of the power cylinder device **17**, rate of flow of pressurized fluid to said chamber is restricted to that permitted by choke **112**. This provides for gradual and deliberate movement of piston **106** and piston rod **18** toward their extended positions so as to gently nudge the empty flask onto the roller chute **20**. Of course, when fluid pressure acting on the end of the reciprocable valve member adjacent piston portion **91** of the control valve device **90** has been sufficiently dissipated, the biasing spring acting on the other end becomes effective for restoring said reciprocable valve member to its piston-retracting position, in the manner hereinbefore described, to thereby effect retraction of piston **106** and piston rod **18** of the power cylinder device **17**. Since flow of pressure fluid during exhaust

from chamber 107 is unimpeded by the check valve 111 and out through conduit 110, passageway 100 and vent port 108, retraction of piston 106 and piston rod 18 is effected without delay.

At this point it should be noted that when fluid pressure previals in conduit 110 during such time that piston 106 and piston rod 18 are operated to and remain in their extended positions, such fluid pressure also prevails in conduit 47 which, as above noted, connects with conduit 44 leading to the control valve device 27. It will also be noted that when gate switch 9 is closed by a flask moving into alignment with ramp 3, a second electrical circuit is also closed, said second electrical circuit extending from ground at 22, via the electrical energy source 21, the gate switch, wire 25, solenoid 26 of the control valve device 27 to ground at 31. Closing of this second electrical circuit just described causes energization of the solenoid 26, which energization, as above noted, effects operation of the reciprocable valve member in the control valve device 27 to its supply position in which the pressure switch 34 is placed in communication with conduit 47 by way of conduit 44, passageway 43 and conduit 33. If, therefore, fluid pressure is present in conduit 47 when said conduit is in communication with pressure switch 34, the switch member 35 of said pressure switch is operated by said fluid pressure to its open position to open the control circuit of the driving motor 36*b* of conveyor belt 1 and thereby stop movement of said conveyor belt. This prevents accumulation or "stack-up" of flasks at the gate switch 9 at a rate faster than can be handled by the automatic feeder apparatus. At the same time fluid pressure prevailing in conduit 47 is effective on the piston portion 46, along with the biasing spring (not shown), for positively restoring the reciprocable valve member to its normal position to thereby prevent operation of piston 52 and piston rod 11 to their extended positions to push another flask up ramp 3 while piston 106 and piston rod 18 are extended. As long as piston 106 and piston rod 18 are in their extended positions, such a condition is indicative that the ramp 3 is fully loaded. Of course, if piston 106 and piston rod 18 are retracted when switch 9 is operated to its closed position, conduit 47 is vented via port 108. Thus, switch member 35 of the pressure switch 34 is not opened by reason of lack of pressure in conduit 47, and the motor 36*b* continues to drive the conveyor belt 1.

If desired, a quick release valve device similar to the quick release valve devices 67 and 81 may be interposed in conduit 110 in place of the check valve 111 and choke 112. A quick release valve device interposed in conduit 111 would eliminate the rstrictive effect of choke 112 and, therefore, the slow deliberate movement of piston 106 and piston rod 18 to their extended positions. Instead, the unrestricted flow of fluid pressure to chamber 107 would effect sudden movement of piston 106 and piston rod 18 to cause pad 19 to strike the empty flask resting on platform 4 with a sudden, forceful impact and thereby assure that all the sand is jarred loose from the flask and drops out before the flask is returned to the conveyor. A second effect of having a quick release valve device interposed in conduit 110 in place of check valve 111 and choke 112 would be the rapid dissipation of fluid pressure from chamber 107 of the power cylinder device 17 through an exhaust passageway and vent port in the quick release valve device independently of the exhaust passageway 100 and vent port 108 in the control valve device 90. The latter exhaust passageway 100 would be available exclusively for exhausting fluid pressure from conduit 47 and, therefore, unnecessary delay in such venting of conduit 47 would be eliminated. The pressure switch 34 would not necessarily be affected, unless there was a long enough delay due to malfunctioning of the apparatus, and there would be less chance of unnecessary operation of a "stuttering" or hesitant nature of said pressure switch.

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

1. In an automatic conveyor feeder system for a mold shake-out apparatus, the combination of:

(a) conveyor means including a conveyor belt for conveyance of open-bottomed flasks each containing a mold and casting therein,

(b) driving means for driving said conveyor belt,

(c) an upwardly inclined ramp having the lower end adjacent said conveyor belt for receiving mold flasks from said conveyor belt and on which ramp the flasks are moved upwardly in stacked succession,

(d) a horizontal platform at the upper end of said ramp onto which flasks are moved from said ramp, said platform having a central opening therein through which the molds and castings contained in the flasks may fall to the shake-out apparatus,

(e) a downwardly inclined chute for receiving flasks moved from said platform and by which the flasks are returned slidably by gravity to said conveyor belt,

(f) a first power cylinder having a piston member operable to an extended position for pushing flasks in stacked succession from said conveyor belt onto said ramp and to a retracted position in which said piston member is clear of the path of travel of the flasks on the conveyor belt,

(g) a second power cylinder having a piston member operable to an extended position for pushing the mold and casting out of its flask and through the central opening in said platform and being operable to a retracted position clear of the path of movement of the flask moving onto said horizontal platform,

(h) a third power cylinder having a piston member operable to an extended position for pushing the flasks, in successive order, from said horizontal platform onto said chute for return to the conveyor belt and being operable to a retracted position clear of the path of movement of the flask moving onto said horizontal platform,

(i) interlocking control means associated with said first, second and third power cylinders for effecting operation of the respective piston members of said first, second and third power cylinders successively to their respective extended and retracted positions, in sequential order,

(j) said interlocking control means including delay means for delaying operation of the respective piston members of said second, third and first power cylinders to their respective extended positions until the respective piston members of the first, second and third power cylinders are restored to their respective retracted position in their proper sequential order, and

(k) actuating means operable from an inactive position to an actuating position, upon engagement thereof by movement of a flask into position adjacent the lower end of said ramp, for initiating operation of said interlocking control means to effect a complete sequential cycle of operation of the respective piston members, each successive cycle being initiated by movement of each successive flask into said position adjacent the lower end of said ramp, said actuating means being operative to its said inactive position upon disengagement thereof by movement of the flask from the conveyor belt onto the ramp by the piston member of the first power cylinder to its said extended position.

2. The combination, as defined in claim 1, further characterized by a safety interlock operatively associated with said actuating means, said third power cylinder and said conveyor belt driving means and being operable responsively to operation of said actuating means to its said actuating position and to operation of the piston member of said third power cylinder to its said extended position for causing said driving means for the conveyor belt to

be stopped until said piston member of said third power cylinder is restored to its said retracted position.

3. The combination, as defined in claim 1, wherein said interlocking control means for controlling sequential operation of said first, second and third power cylinders comprises:

(a) a source of fluid under pressure,

(b) first valve means for controlling operation of said first power cylinder and being operable, responsively to operation of said actuating means to its said actuating position, to a first position in which supply of fluid under pressure is effected from said source to said first power cylinder for causing operation of the piston member thereof to its said extended position,

(c) said first valve means being operable, responsively to operation of said actuating means to its said inactive position, to a second position in which release of fluid under pressure from said first power cylinder is effected for causing operation of the piston member thereof to its said retracted position,

(d) second valve means for controlling operation of said second power cylinder and being operable to a first position and a second position responsively to supply and release of fluid under pressure thereto and therefrom, respectively, for effecting supply and release of fluid under pressure to and from, respectively, said second power cylinder to effect operation of the piston member thereof to its said extended and retracted positions, respectively,

(e) third valve means for controlling operation of said third power cylinder and being operable to a first position and a second position responsively to supply and release of fluid under pressure thereto and therefrom, respectively, for effecting supply and release of fluid under pressure to and from, respectively, said third power cylinder to effect operation of the piston member thereof to its said extended and retracted positions, respectively,

(f) first conduit means connecting said first valve means and said second valve means and via which fluid under pressure is supplied to and released from said second valve means, upon operation of said first valve means to its said first and second positions, respectively, to effect sequential operation of the piston member of said second power cylinder to its said extended and retracted positions, respectively,

(g) first valve-conditioning means interposed in said first conduit means and effective for delaying operation of the piston member of said second power cylinder to its extended position until the piston member of said first power cylinder has been restored to its said retracted position by operation of said first valve means to its said second position,

(h) second conduit means connecting said second valve means and said third valve means and via which fluid under pressure is supplied to and released from said third valve means, upon operation of said second valve means to its said first and second position, respectively, to effect sequential operation of said piston member of said third power cylinder to its said extended and restracted positions, respectively, and

(i) second valve-conditioning means interposed in said second conduit means and effective for delaying operation of the piston member of said third power cylinder to its said extended position until the piston member of said second power cylinder has been restored to its said retracted position by operation of said second valve means to its said second position.

4. The combination, as defined in claim 3, further characterized by a safety interlock operatively associated with said actuating means, said third power cylinder and said conveyor belt driving means and being operable responsively to operation of said actuating means to its said actuating position and to operation of the piston member of said third power cylinder to its said extended position for causing said driving means for the conveyor belt to be stopped until said piston member of said third power cylinder is restored to its said retracted position.

References Cited by the Examiner

UNITED STATES PATENTS

1,011,735	12/1911	Brown	22—95.5
1,469,888	10/1923	Burgess	22—95.5
1,912,361	6/1933	Camerota	22—95.5
3,027,723	4/1962	Lewis	60—97
3,033,000	5/1962	Hibbert et al.	60—97
3,083,421	4/1963	Taccone	22—20
3,083,423	4/1963	Hartley	22—89

FOREIGN PATENTS

553,907	3/1958	Canada.

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