June 20, 1950 T. A. RENKENBERGER 2,512,531

ACTUATING MECHANISM

Filed Aug. 28, 1945 5 Sheets-Sheet 1

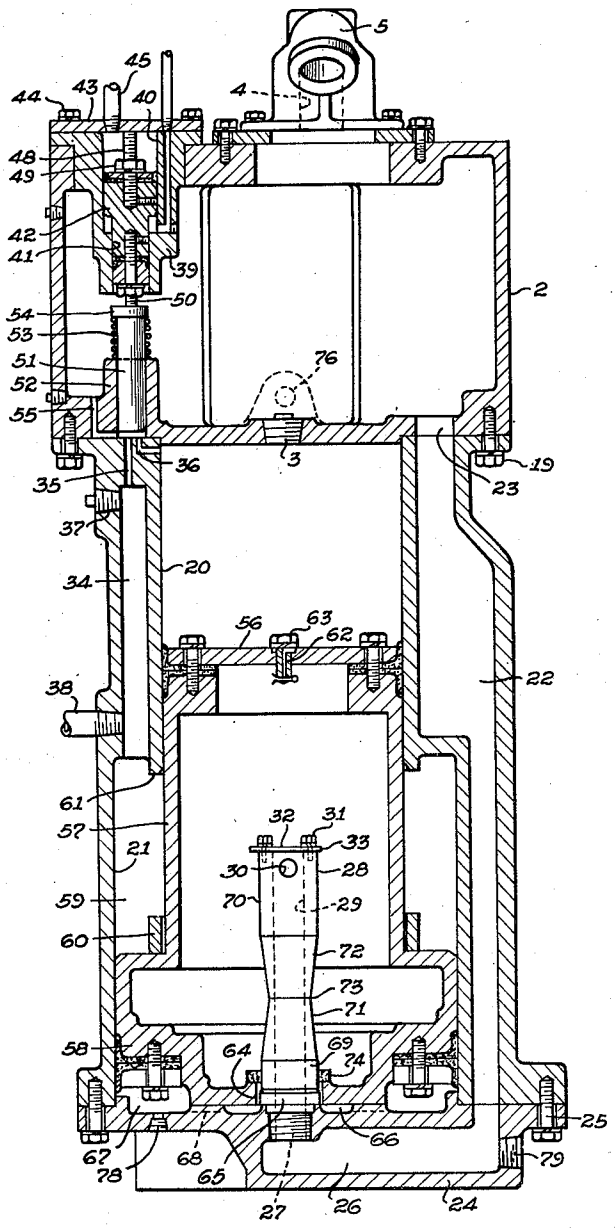


Fig. 1.

INVENTOR
TIRZAH A. RENKENBERGER.

BY
his ATTORNEYS.

June 20, 1950 T. A. RENKENBERGER 2,512,531

ACTUATING MECHANISM

Filed Aug. 28, 1945 5 Sheets-Sheet 2

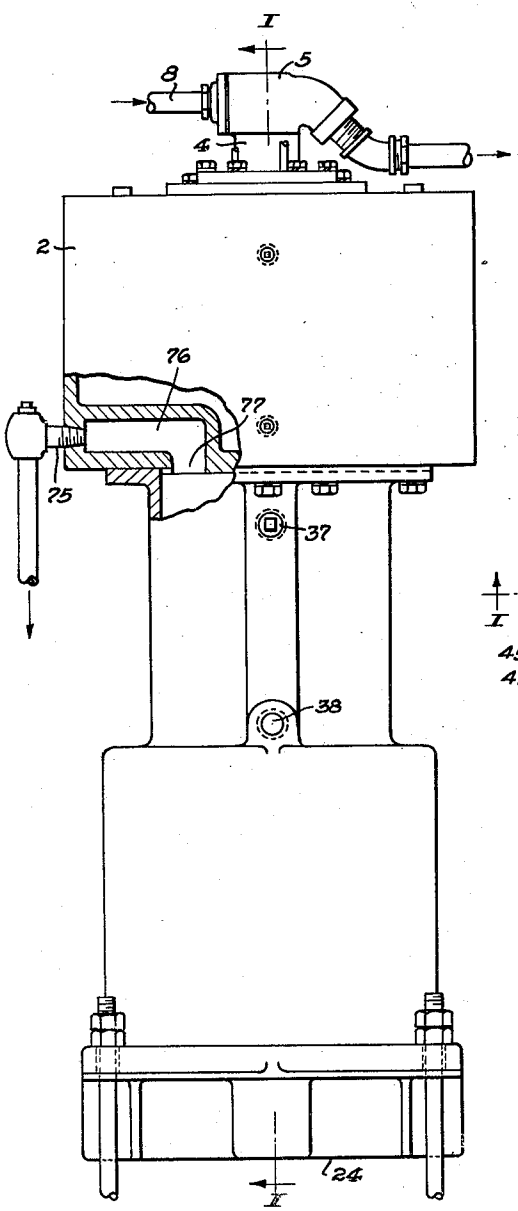


Fig:2.

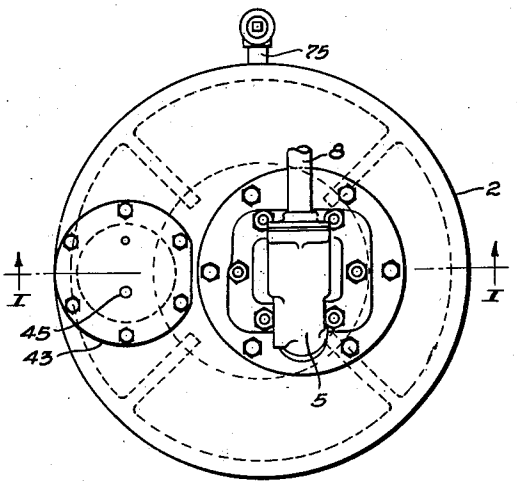


Fig:3.

INVENTOR
TIRZAH A. RENKENBERGER.

BY
his ATTORNEYS.

June 20, 1950 T. A. RENKENBERGER 2,512,531

ACTUATING MECHANISM

Filed Aug. 28, 1945 5 Sheets-Sheet 3

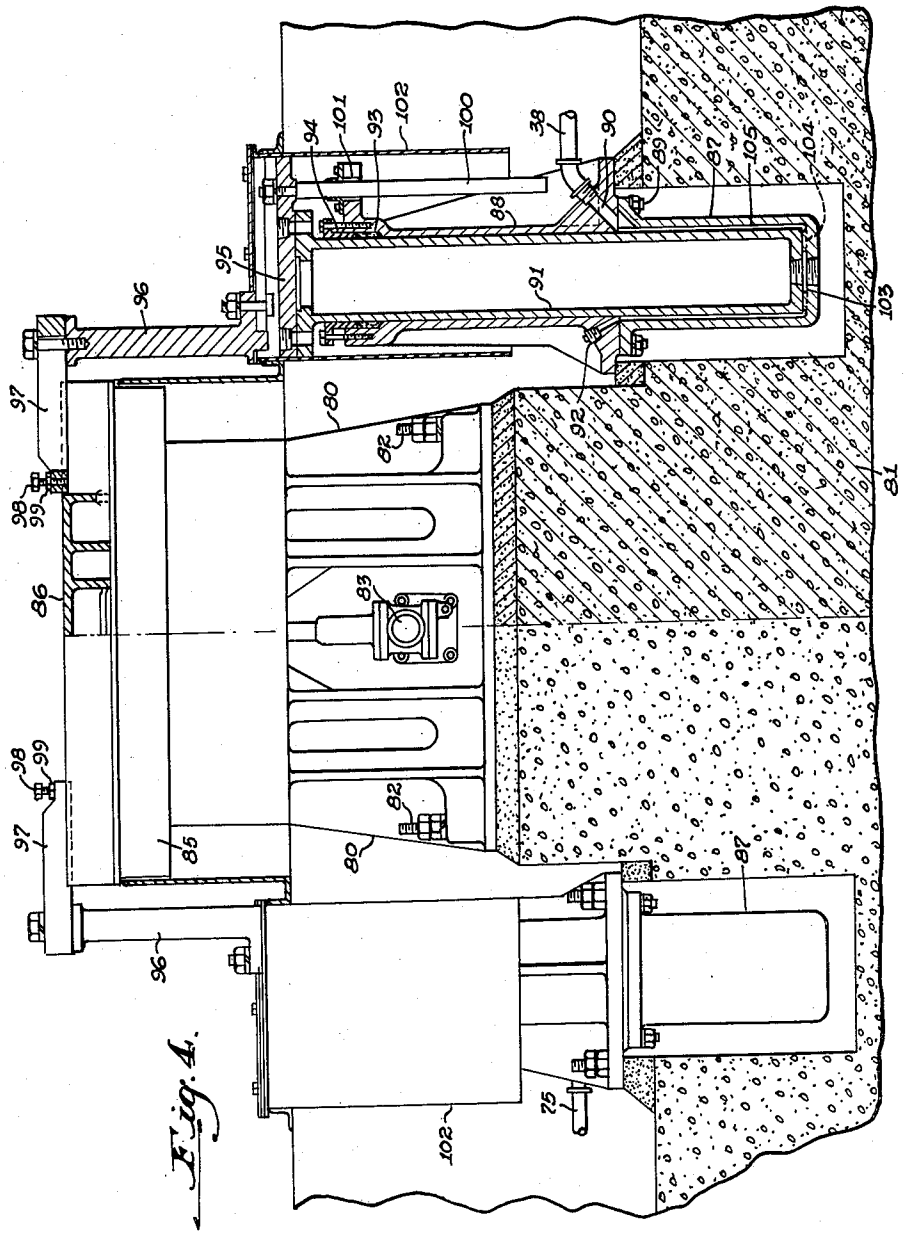


Fig. 4.

INVENTOR
TIRZAH A. RENKENBERGER.

BY Fulbright, Crooker, Freeman & Webb
its ATTORNEYS.

June 20, 1950 T. A. RENKENBERGER 2,512,531

ACTUATING MECHANISM

Filed Aug. 28, 1945 5 Sheets-Sheet 4

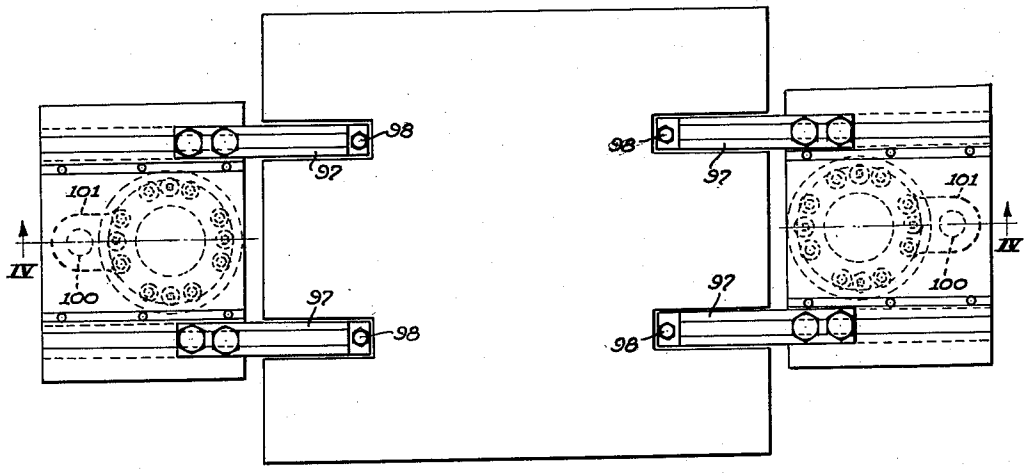


Fig. 5.

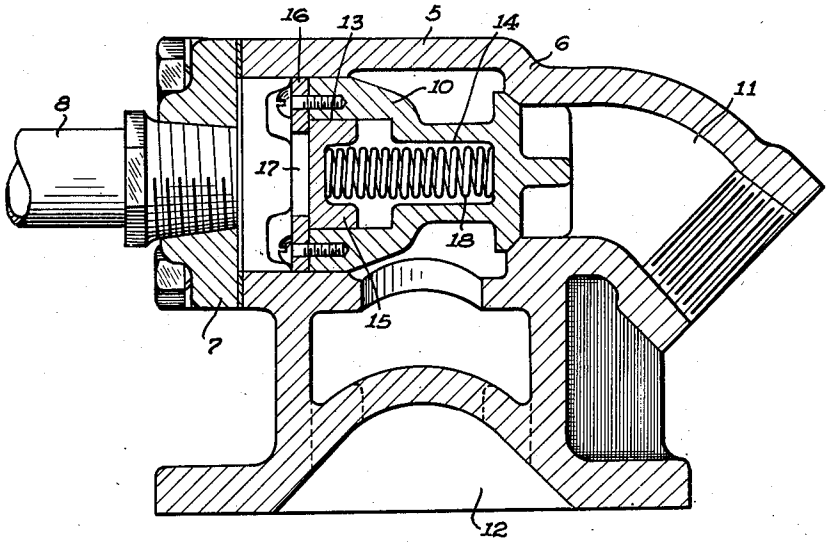


Fig. 8.

INVENTOR
TIRZAH A. RENKENBERGER.

BY Fabling, Blum & Webb
his ATTORNEYS.

June 20, 1950 T. A. RENKENBERGER 2,512,531

ACTUATING MECHANISM

Filed Aug. 28, 1945 5 Sheets-Sheet 5

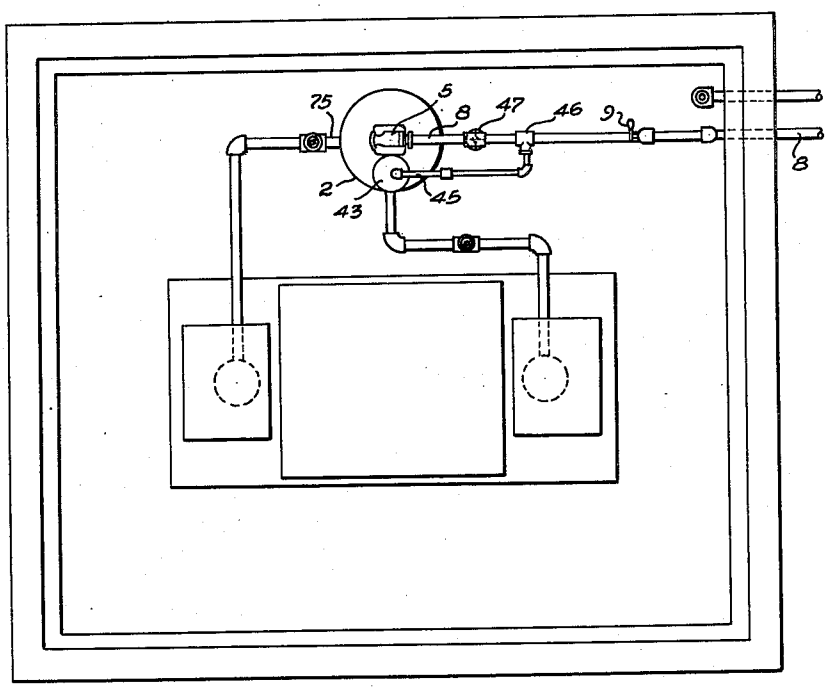


Fig. 6.

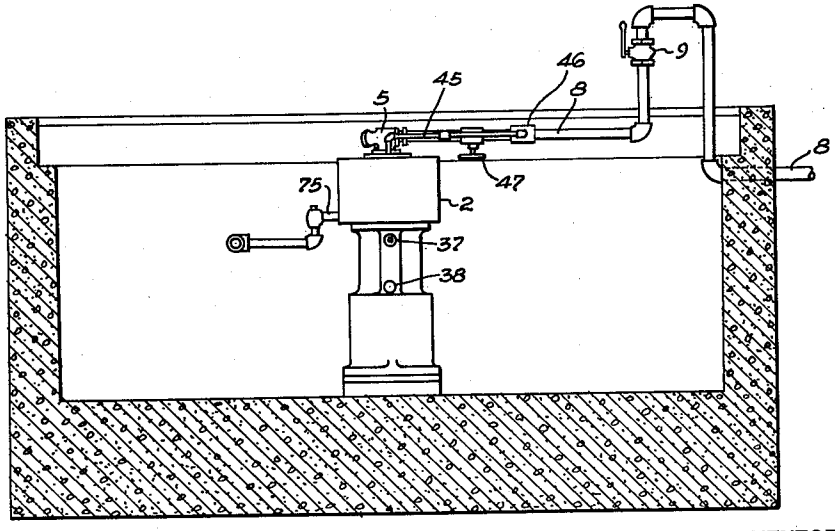


Fig. 7.

INVENTOR
TIRZAH A. RENKENBERGER.

BY
his ATTORNEYS.

Patented June 20, 1950 2,512,531

UNITED STATES PATENT OFFICE

2,512,531

ACTUATING MECHANISM

Tirzah A. Renkenberger, Penn Township, Butler County, Pa., assignor to Herman Pneumatic Machine Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application August 28, 1945, Serial No. 613,088

3 Claims. (Cl. 60—54.5)

1

This invention relates to actuating mechanism. In certain aspects it relates to mechanism for separating molds and the patterns on which they have been formed. In other aspects the invention relates to actuating mechanism adaptable for use in such separating mechanism and also adaptable for various other uses.

In the making of molds out of sand and other molding materials the molding material is packed against a pattern after which the mold and pattern are separated to enable the mold to be used for forming a casting. Great care must be taken in separating the mold and pattern to avoid damage to the mold during stripping. I here use the term "stripping" to refer specifically to the relative movement of the mold and pattern from their initial position with the mold lying against the pattern just until the mold and pattern are out of contact with each other, while "separating" is used to comprehend the entire relative movement of the mold and pattern from the beginning of stripping until relative movement ceases. The stripping must be accomplished by relative straight line movement between the mold and pattern without turning or tilting of either. If the mold and pattern turn or tilt relatively to each other during stripping the molding material of which the mold is made is likely to be deformed so that a casting poured in the mold would be defective.

It is usual in the art to provide mechanism for separating molds and the patterns on which they have been formed in conjunction with mechanism for packing the molding material against the pattern so that as soon as the packing step has been completed the mold and pattern may be separated without the necessity of transferring the assembled mold and pattern from the packing mechanism to a separating or stripping station at another location. Since ordinarily the mold and pattern are mounted on the packing mechanism it is necessary in separating them to engage the one which is to be moved, for example, the mold, at points removed from its center, and ordinarily separation is effected by engaging the flask in which the mold is formed at points spaced about its periphery to lift it up off of the pattern. It is important to avoid tilting that the means for lifting the flask and which engage it at spaced points about its periphery move uniformly. If, for example, the flask is engaged at diametrically opposed portions the means engaging the flask and moving it away from the pattern must move with absolute synchronism. This is not a new problem; it has been recognized for many years and numerous attempts to solve it have been made.

2

It is also important that at the time of initial engagement between the separating means and the one of the mold and pattern which is to be moved—for example, the flask containing the mold—the separating means move very slowly to avoid a sharp impact which might disturb the molding material. Likewise the relative movement between the mold and the pattern during stripping and until the mold and pattern are entirely out of contact with each other should be very slow. But during separation the mold and pattern are moved relatively to each other until they are spaced apart a substantial distance so as to facilitate subsequent separate handling of the mold and pattern without danger of their striking one another. To avoid waste of time the relative movement of the mold and pattern after stripping should be speeded up, but, particularly when the flask containing the mold is moved to effect stripping and separation, the relative movement should be terminated very gently to avoid shock which might damage the mold. This problem likewise is not new but is well recognized in the art.

It is also important to confine the separating equipment and the actuating mechanism therefor within a restricted space since floor space in a foundry is at a premium. Still another desideratum is to provide for relatively rapid movement of the separating means on the return stroke so as to avoid waste of time. Still further, in hydraulically actuated separating mechanism provision should be made for compensating upon each cycle of operation for loss of fluid by leakage since such loss may result in improper operation of the apparatus and consequent relative tilting of the mold and pattern during stripping, causing damage to the mold. These problems likewise are well recognized in the art.

All mechanisms for separating molds and the patterns on which they have been formed heretofore employed have so far as I am aware failed to meet the requirements of a fully satisfactory separating mechanism. Attempts to solve the primary problem of straight line stripping have involved the provision of complicated and cumbersome equipment expensive to manufacture, costly to keep up and extravagant of floor space. No entirely satisfactory actuating mechanism operating during the various portions of the cycle at the relative speeds desired has been provided. In various other respects the best separating equipment devised by those skilled in the art has been found wanting.

I provide mechanism for separating molds and the patterns on which they have been formed and actuating mechanism therefor which for the first

time so far as I am aware satisfactorily solve all the long existing problems above referred to. My separating mechanism insures at all times accurate straight line stripping and accomplishes separation with great efficiency of time. The mechanism is compact and highly economical of floor space. It is preferably hydraulically actuated and provision is made for automatic compensation for leakage of fluid, insuring accurate operation upon each cycle. My mechanism is fully automatic and eliminates the human element in operation.

I provide mechanism for separating molds and the patterns on which they have been formed comprising means for moving one of a mold and the pattern on which it has been formed relatively to the other thereof to separate the mold and pattern, said means comprising a smaller and a larger cylinder arranged in tandem, a piston fitting in the smaller cylinder and having an extension extending into the larger cylinder, a piston fitting in the larger cylinder carried by the extension, the extension and the larger cylinder defining an annular space whose cross-sectional area is substantially equal to the cross-sectional area of the smaller cylinder, outlets from the annular space and the smaller cylinder, means for moving the pistons to discharge fluid from the annular space and the smaller cylinder through the respective outlets, the rate of discharge of fluid from the annular space and the rate of discharge of fluid from the smaller cylinder being substantially equal, and means operated by the fluid discharged from the annular space and the fluid discharged from the smaller cylinder connected with said one of the mold and pattern. I desirably employ a liquid receptacle, a source of compressed gas, a connection from the source of compressed gas to the liquid receptacle, a plurality of cylinders each having a piston therein and a fluid outlet, the cylinders having substantially equal effective cross-sectional areas, said pistons being connected together for movement as a unit, a connection from said liquid receptacle to said pistons whereby liquid compressed by said gas advances said pistons simultaneously in said cylinders to discharge fluid through said respective outlets at substantially equal rates and means operated by the fluid discharged through said respective outlets connected with said one of the mold and pattern.

I have not attempted in this preliminary portion of my specification to refer specifically to all the features of my separating and actuating mechanism which I deem novel. Such features will be described hereinafter and defined in the appended claims. Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings I have shown a present preferred embodiment of the invention, in which:

Figure 1 is a central vertical cross-sectional view, taken on the lines I—I of Figures 2 and 3, through actuating mechanism which I prefer to employ for actuating my mold and pattern separating mechanism;

Figure 2 is an elevational view, partly in vertical cross section, of the actuating mechanism shown in Figure 1;

Figure 3 is a fragmentary top plan view of the mechanism shown in Figures 1 and 2;

Figure 4 is a view partly in elevation and partly in central vertical cross section on the line IV—IV of Figure 5 of mold and pattern separating mechanism;

Figure 5 is a top plan view of the mechanism shown in Figure 4;

Figure 6 is a diagrammatic view in plan showing the hydraulic system;

Figure 7 is a diagrammatic view in elevation showing the hydraulic system; and

Figure 8 is a detail cross-sectional view through the unloading valve used in the actuating mechanism.

Referring now more particularly to the drawings, there is provided a liquid receptacle 2 adapted to contain hydraulic liquid such as oil and to receive also gas under pressure, such, for example, as compressed air, the receptacle 2 being adapted normally to be closed so that the compressed air is effective for compressing the oil which serves as the actuating fluid of my mechanism. In the bottom of the receptacle 2 is a vent normally closed by a plug 3. Connected with the top of the receptacle 2 and communicating with the interior thereof is a conduit 4 leading to an unloading valve 5 shown in cross section to enlarged scale in Figure 8. The unloading valve 5 comprises a casing 6 with which the conduit 4 may be integral, the casing being closed at the left hand end viewing Figure 8 by a plate 7 threadedly receiving an air line 8. The air line 8 extends to a source of compressed air, as, for example, any ordinary air compressor, a manual control valve 9 (Figure 7) being disposed between the air line 8 and the source of compressed air and being operable to admit compressed air to the valve 5 or to shut off the supply of compressed air as desired, and, when the supply of compressed air is shut off, to open line 8 to the atmosphere. As will presently appear, manual opening of the valve 9 actuates my apparatus to separate a mold and the pattern on which it has been formed, the apparatus functioning automatically to the end of the separating movement. Likewise when the valve 9 is closed the effective elements of my apparatus automatically return to their initial positions ready for repetition of the cycle.

Referring to Figure 8, the unloading valve 5 contains a valve element 10 movable as a whole between a seated position at the right hand extremity of its travel to close the exhaust passage 11 and an unseated position at the left hand extremity of its travel which allows communication between the exhaust passage 11 and the passage 12 communicating with the liquid receptacle 2. The valve element 10 is of spider form, containing a bore having a portion 13 of relatively great transverse dimension and a portion 14 of relatively small transverse dimension. Operating in the bore 13 is an inner valve element 15 adapted to cooperate with a plate 16 having therein an opening 17. A spring 18 urges the inner valve element 15 toward the left viewing Figure 8 to seated position against the plate 16 to close the opening 17.

When the manual control valve 9 is opened to admit compressed air to the valve 5 the compressed air entering such valve from the left viewing Figure 8 moves the valve element 10 to seated position at the right hand extremity of its stroke to close the exhaust passage 11 and also moves the inner valve element 15 toward the right against the action of the spring 18 to open the opening 17. The compressed air passes through

the opening 17 and through passages in the spider-like valve element 10 to the passage 12 and thence into the liquid receptacle 2. During operation of the mechanism compressed air continues to pass from the line 8 through the valve 5 into the liquid receptacle 2. At the end of the movement of the separating means the air pressure in the liquid receptacle 2 builds up so that it is substantially equal to the pressure in the line 8. When the elements of the mechanism are to be returned to their initial position the manual control valve 9 is closed, shutting off the supply of compressed air and exhausting line 8. This relieves the pressure holding open the inner valve element 15 and such valve element is closed by the spring 18. Due to the fact that the valve element 10 has a greater area at its left hand end than at its right hand end exposed to the air in the passage 12 the compressed air in the liquid receptacle 2 immediately moves the valve element 10 to the left, opening the exhaust passage 11. The action of the unloading valve 5 is very fast and the exhaust passage 11 is large so that the air pressure in the liquid receptacle 2 is relieved virtually instantaneously upon the closing of the valve 9.

The liquid receptacle 2 is mounted on and fastened by bolts 19 to an underlying supporting structure including a relatively small vertical cylinder 20 and a larger vertical cylinder 21 coaxial with the cylinder 20. The structure has a passage 22 outside the cylinders 20 and 21 which communicates through an opening 23 with the liquid receptacle 2. A base plate 24 is bolted to the structure by bolts 25. The base plate 24 has a passage 26 which communicates with the passage 22 and also with a central upwardly extending threaded opening 27 in the base plate which threadedly receives a vertically extending speed control member 28 having therethrough a bore 29 communicating with the passage 26 and with openings 30 in the wall of the speed control member 28 near the top thereof. Bolted to the top of the speed control member 28 by bolts 31 is a plate 32 whose edges project outwardly beyond the surface of the speed control member as shown at 33.

A passage 34 is formed within the wall of the cylinder 20 and opens at its bottom into the cylinder 21. A passage 35 extends between the liquid receptacle 2 and the passage 34. A passage 36 extends between the liquid receptacle 2 and the cylinder 20. A vent in the upper end of the passage 34 is closed by a plug 37. An oil line 38 communicates with the passage 34 near the lower end thereof.

Connected with the top of the liquid receptacle 2 and extending downwardly thereinto is a stepped cylinder 39 having an upper bore 40 of relatively large diameter and a lower bore 41 of relatively small diameter. A piston 42 has an upper portion fitting the upper bore 40 and a lower portion fitting the lower bore 41. The upper bore 40 is closed by a top plate 43 held in place by bolts 44. Threaded through the plate 43 is an air line 45 which connects with the air line 8 through a T 46. A globe valve 47 is disposed in the line 8 between the unloading valve 5 and the T 46. When the valve 9 is opened compressed air is admitted to the bore 40 through the air line 45 as well as to the liquid receptacle 2 through the unloading valve 5.

Upward movement of the piston 42 is limited by a set screw 48 threaded into the top of the piston and held in adjusted position by a nut 49.

Connected with the bottom of the piston through a screw 50 is a plunger 51 which operates within a vertical guide 52. The plunger 51 is urged upwardly by a compression coil spring 53 bearing between an enlarged head 54 on the plunger and the top of the guide 52. A passage 55 extends through the base of the guide 52 and communicates with the bore thereof at its bottom. The passages 35 and 36 open upwardly into the bore of the guide 52. Thus when the plunger 51 is in its upper position as shown in Figure 1 free communication is permitted between the interior of the liquid receptacle 2 and each of the cylinders 20 and 21. When, however, the plunger 51 is in its lowermost position it closes the passages 35 and 36 where they open into the bore of the guide 52, thus disestablishing communication between the liquid receptacle 2 and the respective cylinders 20 and 21.

When the valve 9 is open the oil in the receptacle 2 is compressed by the air entering through the air line 8 and at the same time the piston 42 is moved downwardly by the air in the air line 45 to hold the plunger 51 in its lowermost position and close the passages 35 and 36. When the valve 9 is closed the spring 53 moves the plunger 51 and the piston 42 upwardly to the position shown in Figure 1, reestablishing communication between the receptacle 2 and the respective cylinders 20 and 21. The purpose of this mechanism is to compensate for any leakage of oil from the cylinders 20 and 21 during the primary operation of the actuating mechanism which will presently be described. At the conclusion of each cycle of operation communication is established between the receptacle 2 and each of the two cylinders so that any oil which has leaked out during the preceding cycle is replaced.

In the cylinder 20 operates a piston 56. The piston 56 is axially elongated as shown at 57, projecting downwardly and terminating in a piston 58 fitting and operating within the cylinder 21. Thus the pistons 56 and 58 are integrally connected together to operate as a unit. An annular space 59 is formed within the cylinder 21 and outside the downward extension 57 of the piston 56. The parts are so proportioned that the cross-sectional area of the annular space 59 is equal to the cross-sectional area of the cylinder 20. A ring 60 surrounds the lower end of the extension 57 and upon upward movement of the pistons engages a stop 61 integral with the cylinders to limit the stroke of the pistons. The piston 56 has a central vent opening 62 closed by a plug 63.

The piston 58 has a circular central opening 64 through which the speed control member 28 passes. The speed control member 28 has a lower cylindrical portion 65 of maximum diameter slightly smaller than the opening 64 so as always to provide a passage between the speed control member 28 and the periphery of the opening 64. The base plate 24 has an annular depression 66 communicating with the passage between the speed control member 28 and the periphery of the opening 64. The base plate 24 also has another annular depression 67 surrounding the annular depression 66. The depressions 66 and 67 are connected together by a series of radiating channels 68.

The speed control member 28 has above the cylindrical portion 65 a cylindrical portion 69 of somewhat smaller diameter than the cylindrical portion 65 and adjacent its upper end another cy-

lindrical portion 70 of the same diameter as the cylindrical portion 69. Intermediate the cylindrical portions 69 and 70 are two frusto-conical portions 71 and 72. The lower frusto-conical portion 71 tapers gradually from the diameter of the portion 69 to a minimum diameter at its upper extremity at 73 and the upper frusto-conical portion 72 tapers gradually from the minimum diameter at 73 to the diameter of the portion 70. A collar 74 surrounds the speed control member 28 and normally seats upon the upper surface of the piston 58 coaxially with the opening 64. The internal diameter of the collar 74 is very slightly greater than the external diameter of the portion 69 of the speed control member 28 so that when the collar 74 is seated on the piston 58 and the parts are in the position shown in Figure 1 a very restricted passage is provided between the collar and the speed control member. Under certain conditions as will presently be described the collar 74 is lifted from its seat upon the piston 58 and when this occurs a passage of relatively great cross-sectional area is immediately opened between the interior of the hollow piston and the depressions 66 and 67 and the channels 68. The piston 56, the piston 58 and the extension 57 joining these two pistons form in effect a hollow duplex piston with the speed control member 28 projecting up into the interior thereof.

An oil line 75 communicates with a passage 76 which in turn communicates through an opening 77 with the top of the cylinder 20. Vents in the base plate 24 are normally closed by plugs 78 and 79, respectively.

The actuating mechanism which has been described is for the purpose of delivering oil simultaneously through the two oil lines 38 and 75 at equal rates. The manner in which this is accomplished will now be described. The oil lines 38 and 75, the cylinder 20, the annular space 21 and the passages 34, 35 and 36 are filled with oil. Likewise the receptacle 2 contains oil to a level somewhat below the top thereof and oil fills the passages 22 and 26, the bore in the speed control member 28, the space within the hollow composite piston 56—57—58, the passage between the speed control member 28 and the periphery of the opening 64, the depressions 66 and 67 and the channels 68. Normally when the mechanism is not operating the valve 9 is closed. When the valve 9 is closed the plunger 51 is in its uppermost position as shown in Figure 1 allowing communication between the receptacle 2, the cylinder 20 and the annular space 59 so that oil from the receptacle may flow into the cylinder 20 and the annular space 59 to replace any oil which has escaped by leakage or otherwise during the preceding cycle. Since there is no pressure upon the oil in the receptacle 2 the oil in the oil lines 38 and 75, being under pressure from the opposite ends of those lines, respectively, as will presently appear, backs up into the annular space 59 and the cylinder 20, respectively, and the piston 56—57—58 moves to its lowermost position. After the parts have moved to the position shown in Figure 1 the collar 74 settles upon the piston 58 and the mechanism is ready for operation. Its operation is effected simply by opening the valve 9.

Immediately upon opening of the valve 9 compressed air passes through the lines 8 and 45 into the receptacle 2 and the bore 46, respectively. The plunger 51 is moved to the bottom of its stroke, closing the passages 35 and 36. Oil moves

from the receptacle 2 through the passages 22 and 26 up through the hollow bore of the speed control member 28 and out through the openings 30 into the hollow piston and thence downwardly outside of the speed control member 28 and through the very restricted passage provided between the portion 69 thereof and the collar 74 into the depression 66, the channels 68 and the depression 67. The oil beneath the piston 58, being under pressure, forces the piston to rise, and since the piston 56 is integral with the piston 58 both pistons rise together. But since the area of the cylinder 20 is equal to the area of the annular space 59 oil is delivered simultaneously through the oil lines 38 and 75 at the same rate.

The initial upward movement of the pistons is very slow due to the fact that the oil forcing the pistons upwardly has to pass through the very restricted opening between the portion 69 of the speed control member 28 and the collar 74. However, after the pistons have moved upwardly to the point at which the collar 74 is opposite the lower frusto-conical portion 71 of the speed control member 28 the passage between the speed control member and the collar gradually increases in area and as such passage increases in area the rate of flow of oil therethrough increases and hence the speed of upward movement of the pistons increases. This increase in speed continues until the portion 73 of smallest cross-sectional area of the speed control member 28 passes within the collar 74, after which the upper frusto-conical portion 72 of the speed control member 28 enters the collar, gradually reducing the area of the passage between the speed control member and the collar until the upper cylindrical portion 70 of the speed control member enters the collar, and consequently gradually decreasing the speed of upward movement of the pistons, whereafter movement of the pistons is at the same very slow rate as at the beginning of the stroke when the portion 69 of the speed control member was passing through the collar.

As will presently appear, the reason for controlling the speed of the pistons as just described is to correspondingly control the rate of delivery of the oil through the oil lines 38 and 75 to in turn correspondingly control the rate of movement of the mechanism being actuated, in this instance mechanism for separating molds and the patterns on which they have been formed. Initial slow movement of such mechanism is desired to prevent shock which might damage the mold when the lifting mechanism presently to be described engages the mold. The speeding up of movement thereafter is simply to save time. The slowing down of movement near the end of the stroke is to avoid shock to the mold as it comes to a stop which might cause damage to it.

The entire operation of the actuating mechanism is automatic in response to opening of the valve 9. The speed of movement of the pistons and hence the speed of delivery to the oil is ordinarily controlled first at low speed, then gradually increasing in speed, then gradually slowing down and finally coming to a gentle stop.

When the parts are to be returned to their initial position the valve 9 is closed. Immediately the plunger 51 rises, establishing communication between the receptacle 2 on the one hand and the cylinder 20 and the annular space 59 on the other hand. The pressure above the oil in the receptacle 2 is relieved so that oil may pass upwardly into the receptacle. As the oil in the oil lines 38 and 75 is under pressure that oil flows

back into the annular space 59 and the cylinder 20, respectively, forcing the hollow piston 56—57—58 downwardly. As the piston 58 moves downwardly the oil therebelow passes upwardly through the opening 64 about the speed control member 28. Such upward passage of oil unseats the collar 74, which rises, immediately providing a passage of much greater area for upflow of oil than the passage provided for downflow during the preceding stroke in the opposite direction. Thus downward movement of the pistons is at a materially faster rate than upward movement thereof. The collar 74 is prevented from rising above the top of the speed control member 28 by the projecting peripheral portion 33 of the plate 32. The oil entering the hollow piston 56—57—58 flows downwardly through the bore in the speed control member 28, thence laterally through the passage 26 and thence upwardly through the passage 22 into the receptacle 2. When the hollow piston 56—57—58 reaches the bottom of its stroke (the position shown in Figure 1) the mechanism is ready for the succeeding cycle of operations.

Referring now more particularly to Figures 4 and 5, there is shown a mold packing mechanism designated generally by reference numeral 80 which is bolted to a concrete foundation 81 by bolts 82. The mold packing mechanism may, for example, be a jolting machine of the Herman Pneumatic type comprising a control valve 83 and a movable head 85 upon which is mounted a pattern stool 86 which carries a pattern (not shown). The flask containing sand or other molding material is disposed over the pattern. The jolting machine packs the molding material against the pattern. The jolting machine is well known.

Mounted in the concrete foundation are opposed cylinders. Since these cylinders are identical only one of them will be described, that description sufficing for both. The cylinder comprises a base portion 87 to which an upper portion 88 is bolted by bolts 89. The diameter of the portion 87 is greater than that of the portion 88. The oil line 38 is let into the cylinder portion 87 through a passage 90. Similarly the oil line 75 is let into the cylinder on the opposite side which, as above stated, is identical to the cylinder being described. Disposed in the cylinder is a piston 91 which fits into the upper portion 88 of the cylinder. The cylinder is provided with a vent closed by a plug 92. At its upper end the cylinder is provided with packing 93 held in place by a packing gland 94 sealing against the piston.

Each piston carries a plate 95 to which is connected a bracket 96 carrying a pair of parallel horizontally extending arms 97. In the end of each arm 97 is threaded a bolt 98 maintained in adjusted position by a nut 99. A guide rod 100 operating in a guide 101 assists in guiding the piston. A sand guard 102 protects the piston and cylinder from sand from the mold.

The two pairs of bolts 98, one pair on each side of the mechanism, as shown in Figure 5, are adjusted so that their upper surfaces lie in the same horizontal plane. These four bolts are flask engaging members and when the two pistons 91 are in their lowermost position as shown in Figure 4 the four bolt heads underlie the rim of the flask.

When oil passes through the oil lines 38 and 75 into the cylinders containing the pistons 91 those pistons are caused to rise since the oil acts

against the under surfaces thereof, this being provided for by recess 103 in the bottom of each cylinder which is connected with the passage 90 and radial channels 104 communicating with the annular space 105 between the base portion 87 of the cylinder and the piston. Since the oil supplied to the respective cylinders containing the pistons 91 flows at the same rate the pistons rise in synchronism. As explained above, the initial movement is very slow so that when the heads of the bolts 98 engage the flask they will not strike it with sufficient impact to damage the mold. After the heads of the bolts 98 have engaged the flask and the cylinders continue their upward movement the flask is stripped from the pattern. The stripping is accomplished at very low speed to avoid any possible damage to the mold. After completion of stripping the upward movement of the flask carried by the bolts 98 increases and as the flask nears the upper limit of its movement its speed decreases until it is brought gently to rest. This is accomplished by the actuating mechanism fully described and explained above.

After the flask comes to rest at the end of the upward movement of the pistons 91 it is removed from the bolts 98 whereupon the pistons 91 are lowered in their cylinders to their lowermost position as shown in Figure 4. When the valve 9 is closed the oil flows back from the cylinders containing the pistons 91 through the oil lines 38 and 75 to the annular space 59 and the cylinder 20, respectively. This reverse oil flow is caused by the downward movement of the pistons 91 due to gravity, the pistons and the superstructure carried thereby being of sufficient mass to cause the reverse oil flow. Both the pistons 91 and the hollow piston 56—57—58 are urged downwardly by gravity. However the downward movement of the later piston is due primarily to the backflow of oil through the oil lines 38 and 75 caused by the downward movement of the pistons 91.

While I have shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. Actuating mechanism comprising a liquid receptacle, a source of compressed gas, a connection from the source of compressed gas to the liquid receptacle, a plurality of cylinders each having a piston therein and a liquid outlet, the cylinders having substantially equal effective cross-sectional areas, the pistons being connected together for movement as a unit, a connection from the liquid receptacle to the pistons whereby liquid compressed by said gas advances the pistons simultaneouly in the cylinders to discharge liquid through the respective outlets at substantially equal rates, connections from the liquid receptacle to the respective cylinders, means adapted to close said latter mentioned connections but urged to inoperative position and means connected with the source of compressed gas operable when the liquid in the receptacle is under compression by said gas rendering said first mentioned means operative to close said connections.

2. Actuating mechanism comprising a liquid receptacle, means for placing liquid in the liquid receptacle under pressure, a plurality of cylinders each having a piston therein and a liquid outlet, the cylinders having substantially equal effective cross-sectional areas, the pistons being connected

together for movement as a unit, a connection from the liquid receptacle to the pistons whereby compressed liquid advances the pistons simultaneously in the cylinders to discharge liquid through the respective outlets at substantially equal rates, connections from a source of liquid under pressure to the respective cylinders, means adapted to close said latter mentioned connections but urged to inoperative position and means connected with the means for placing liquid in the liquid receptacle under pressure operable when the liquid in the receptacle is under pressure rendering said first mentioned means operative to close said connections.

3. Actuating mechanism comprising a liquid receptacle, means for placing liquid in the liquid receptacle under pressure, a plurality of cylinders each having a piston therein and a liquid outlet, the cylinders having substantially equal effective cross-sectional areas, the pistons being connected together for movement as a unit, a connection from the liquid receptacle to the pistons whereby compressed liquid advances the pistons simultaneously in the cylinders to discharge liquid through the respective outlets at substantially equal rates, connections from a source of liquid under pressure to the respective cylinders, means adapted to close said latter

mentioned connections and means for rendering operative said last mentioned means not later than when said means for placing liquid in the liquid receptacle under pressure becomes operative to close said connections.

TIRZAH A. RENKENBERGER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
635,848	Dutton	Oct. 31, 1899
881,165	Taylor	Mar. 10, 1908
961,702	Lewis	June 14, 1910
1,010,000	Snyder	Nov. 28, 1911
1,389,300	Gasche	Aug. 30, 1921
1,517,798	Nesham	Dec. 2, 1924
1,626,225	Campbell	Apr. 26, 1927
1,661,621	Pieper	Mar. 6, 1928
1,707,781	Blanchard	Apr. 2, 1929
1,877,102	Whitesell	Sept. 13, 1932
2,060,854	Carroll	Nov. 17, 1936
2,206,459	Hagemeyer	July 2, 1940
2,252,418	Shelley	Aug. 12, 1941
2,380,575	Brown	July 31, 1945
2,381,664	Hansen	Aug. 7, 1945