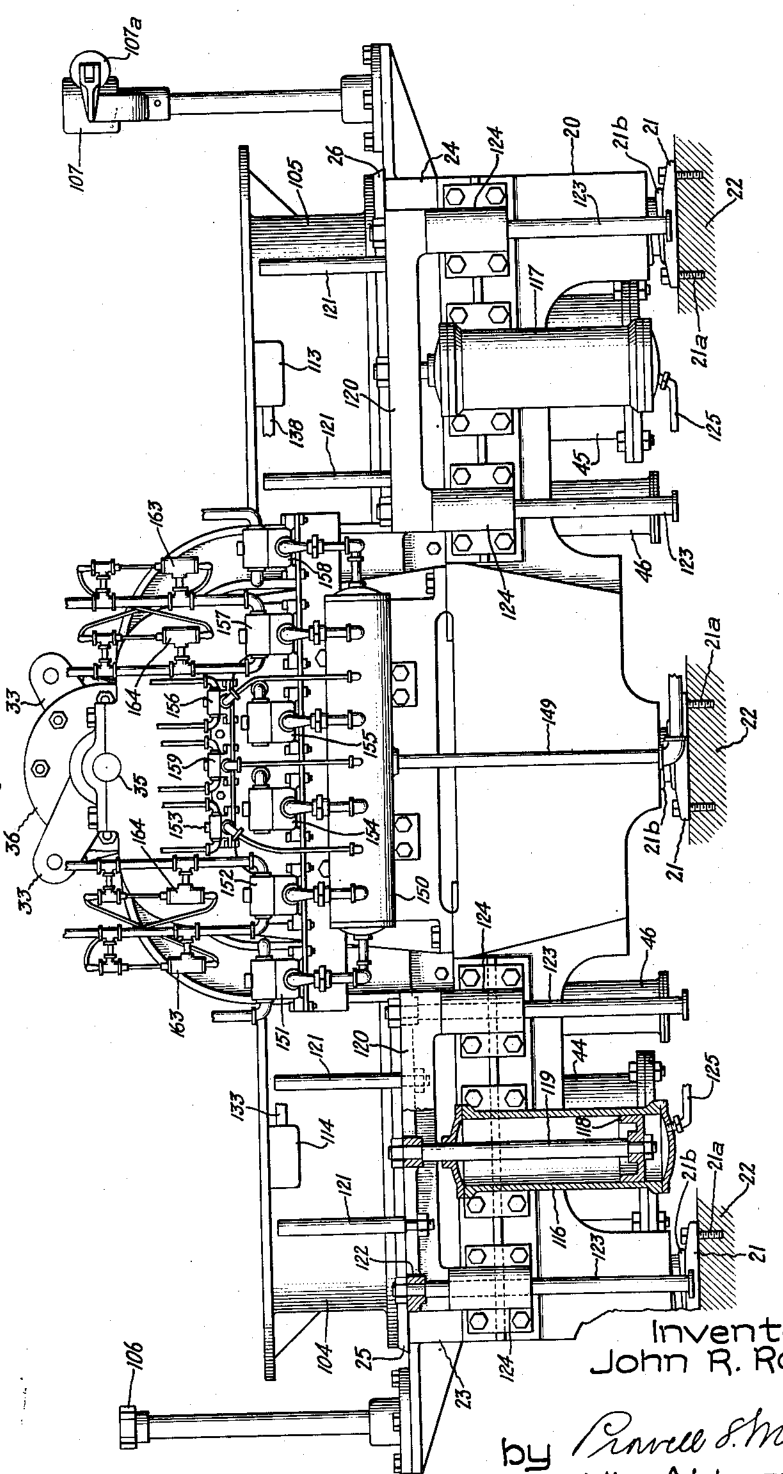
Jan. 6, 1953 J. R. ROW 2,624,084

MOLD AND COREMAKING MACHINE

Filed Oct. 21, 1948 6 Sheets-Sheet 1

Fig. 1.



Inventor:
John R. Row,

by Rowell S. Mack
His Attorney.

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MOLD AND COREMAKING MACHINE

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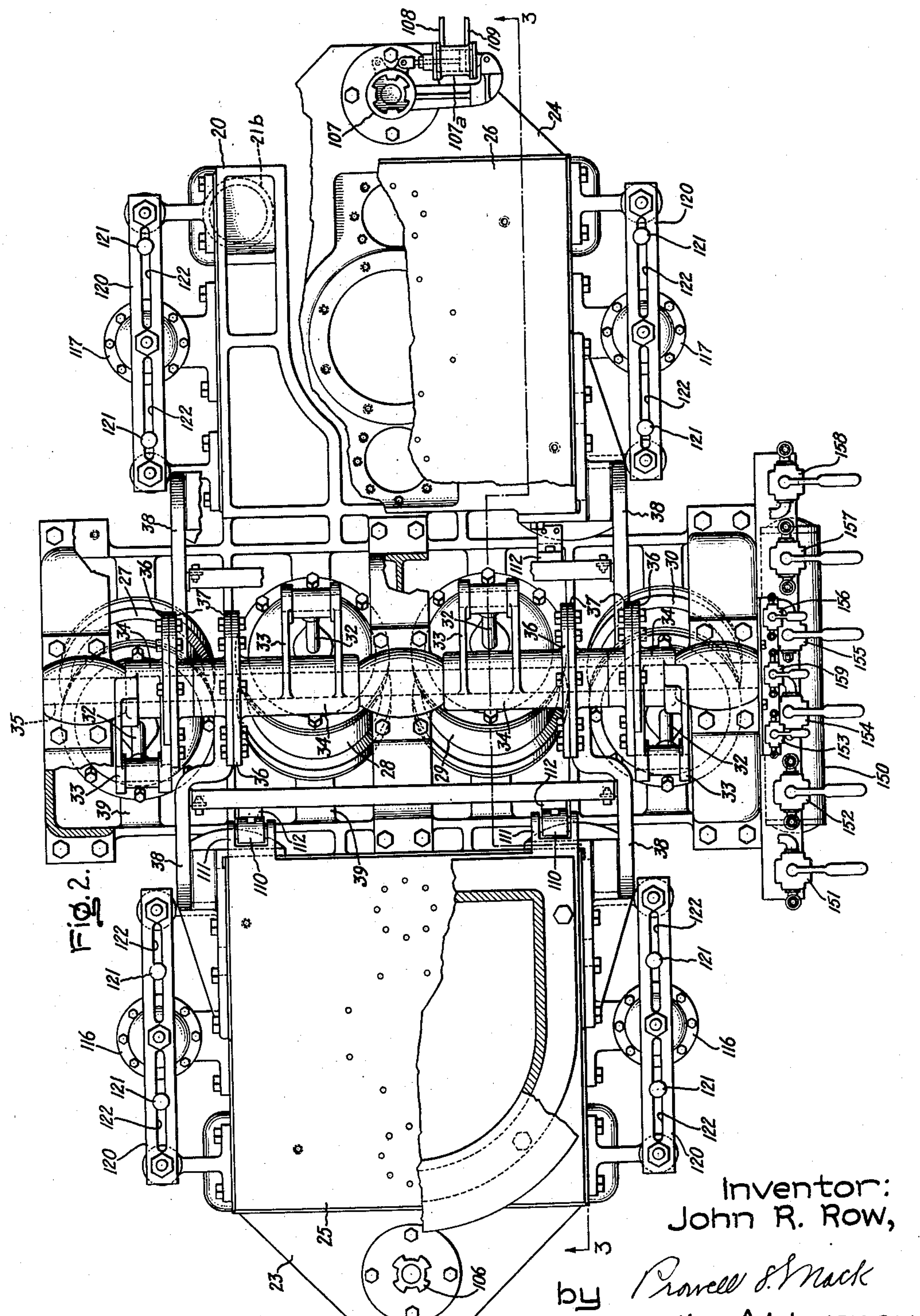

Fig. 2.

Inventor:
John R. Row,
by Prowell & Mack
His Attorney

Jan. 6, 1953 J. R. ROW 2,624,084

MOLD AND COREMAKING MACHINE

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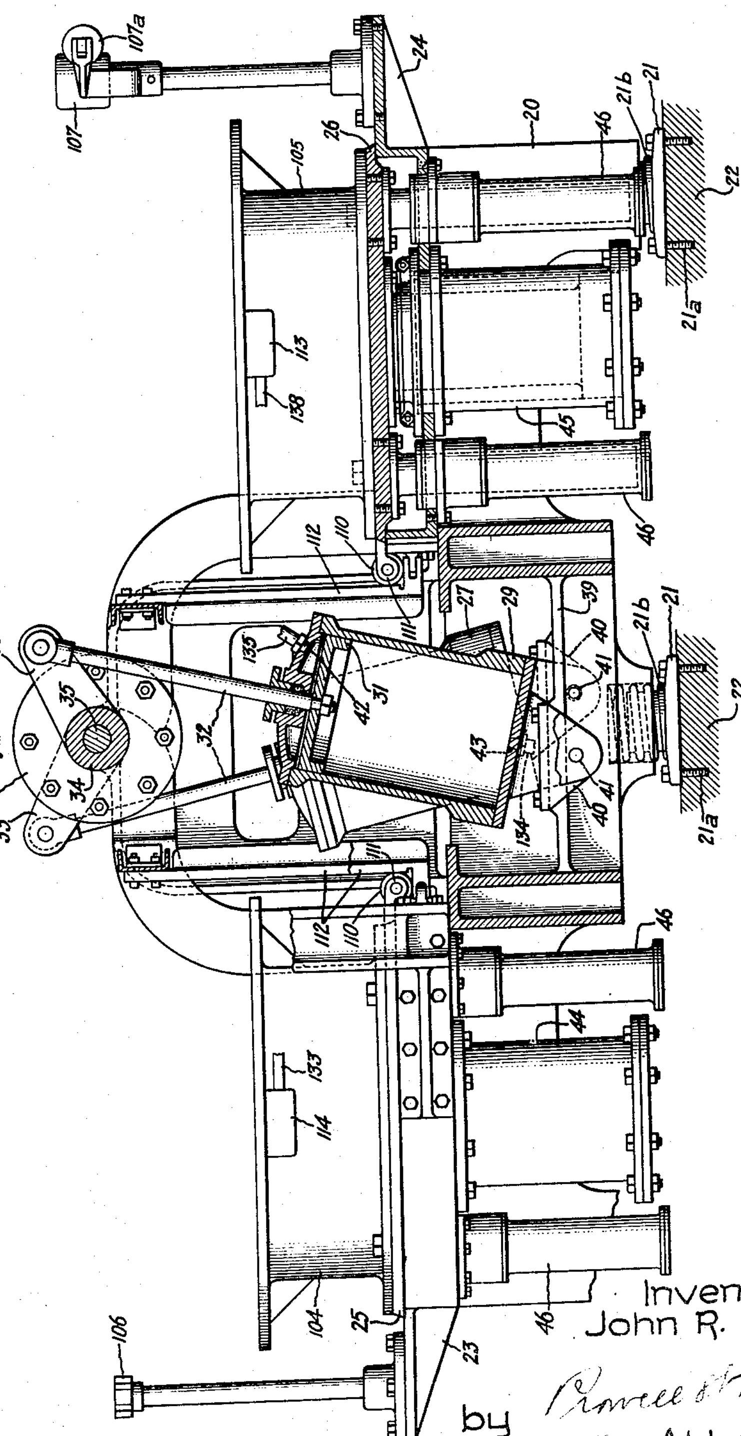

Fig. 3.

Inventor:
John R. Row,
by Brownell & Mack [signature]
His Attorney.

Jan. 6, 1953

J. R. ROW

2,624,084

MOLD AND COREMAKING MACHINE

Filed Oct. 21, 1948

6 Sheets-Sheet 4

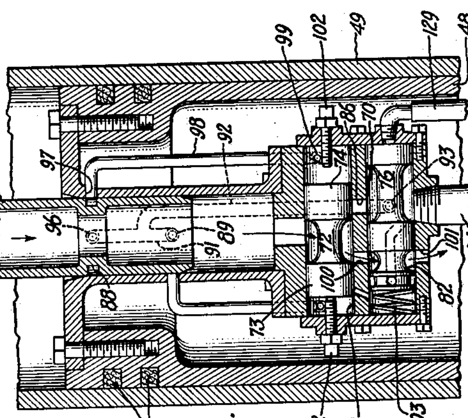

Fig. 5.

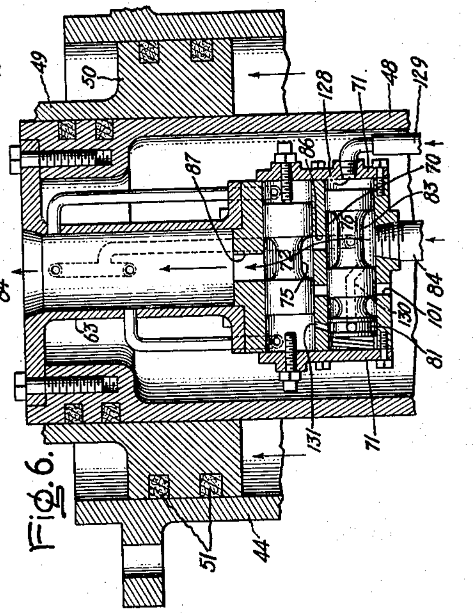

Fig. 6.

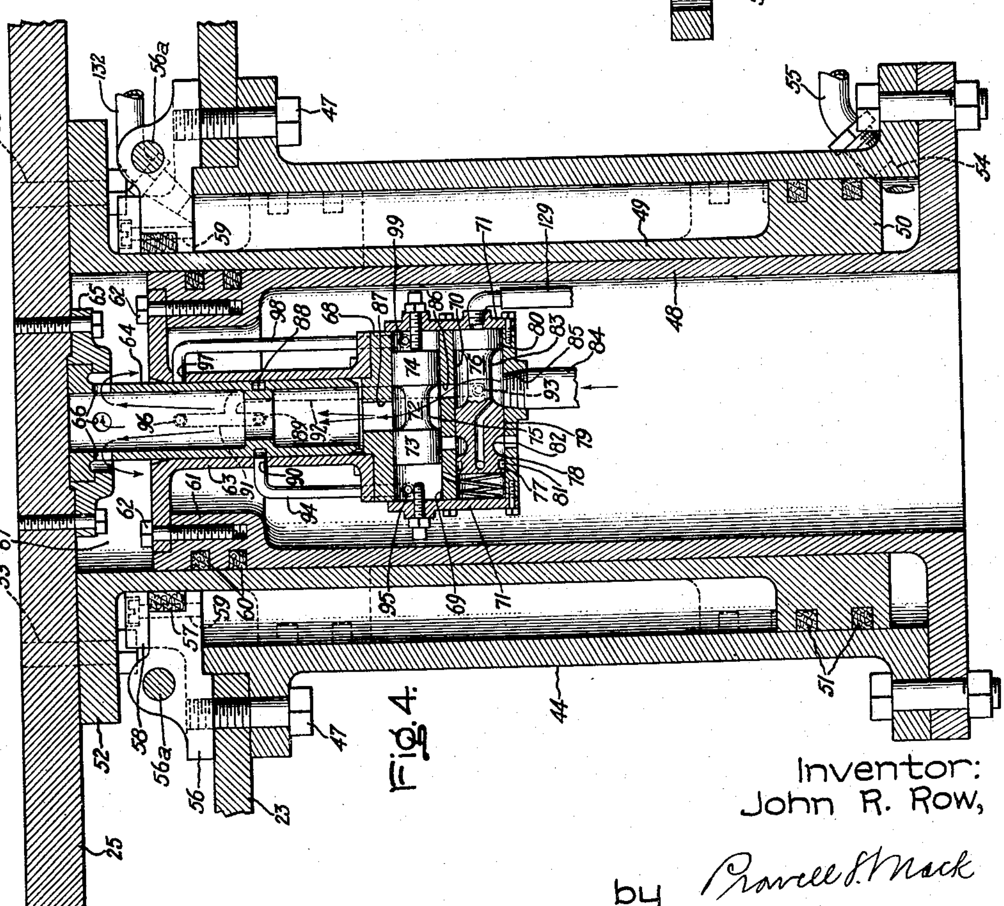

Fig. 4.

Inventor:
John R. Row,

by Powell S. Mack
His Attorney.

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MOLD AND COREMAKING MACHINE

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Fig. 7.

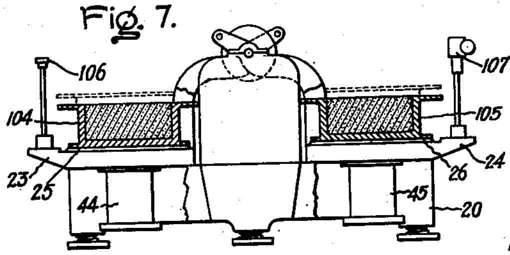


Fig. 8.

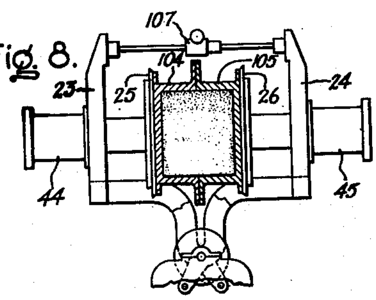


Fig. 11.

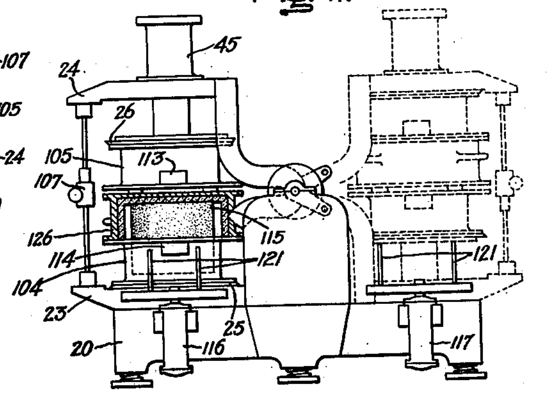


Fig. 12.

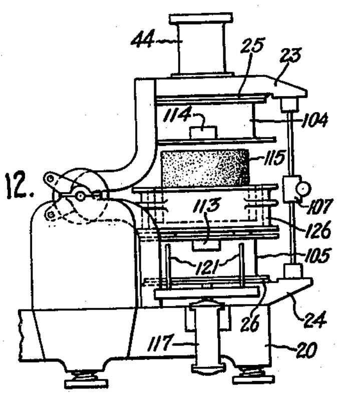


Fig. 9.

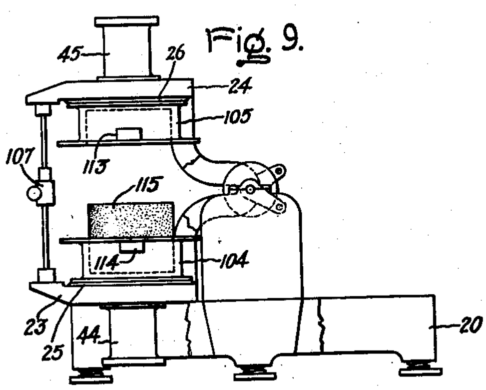


Fig. 10.

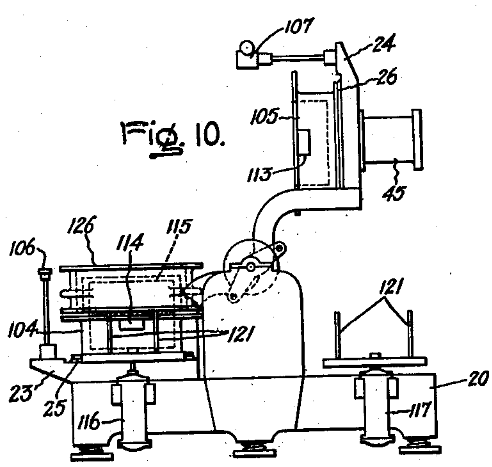
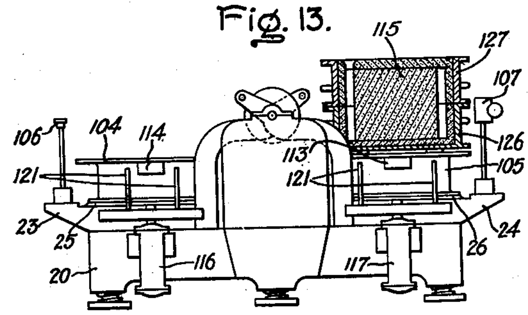


Fig. 13.



Inventor:
John R. Row,

by Pravell & Mack
His Attorney.

Jan. 6, 1953 J. R. ROW 2,624,084

MOLD AND COREMAKING MACHINE

Filed Oct. 21, 1948 6 Sheets-Sheet 6

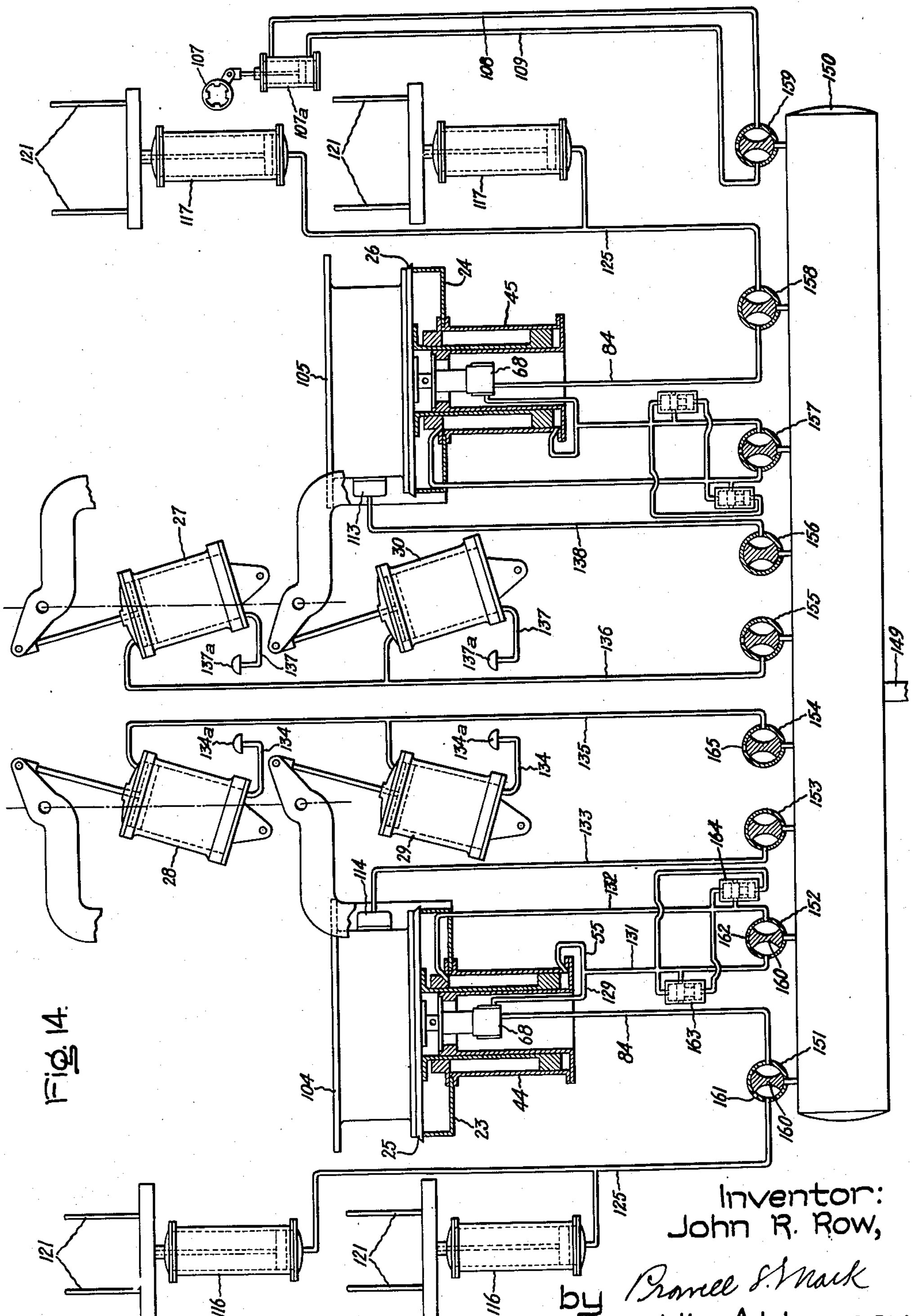


Fig. 14.

Inventor:
John R. Row,
by Bronell S. Mack
His Attorney.

Patented Jan. 6, 1953 2,624,084

UNITED STATES PATENT OFFICE

2,624,084

MOLD AND COREMAKING MACHINE

John R. Row, Elmira, N. Y.

Application October 21, 1948, Serial No. 55,661

10 Claims. (Cl. 22—10)

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My invention relates to mold and core making machines and more particularly to a machine designed to perform a number of related but sequential functions, for example, first packing sand in two flasks by jarring or jolting to form mold or core halves, then turning or rolling over each half of the mold or core to the vertical position, then booking (i. e., bringing the halves together), then rolling back the whole assembly to one side of the machine, where one flask is removed (or pattern drawn), then rolling over to the other side to remove the other flask or pattern.

Heretofore, relatively large sand cores (for example, cores for molds for making integral horsepower induction motor stator frames) because of their size have been made in halves, drawn from their boxes, and then the halves fitted and cemented together. Thereafter the completed core is inserted in an outer mold (which has been separately fashioned of sand in a flask and about a pattern) and then the complete mold is ready for pouring.

The present invention greatly decreases the time and expense of making a complete mold in that the core as well as the mold may be made in halves of "green sand," mechanically "booked" (i. e. the halves mechanically pressed together to form an integral unit) and then, while still in the machine of the invention, the core may be inserted into an outer mold which is then ready for pouring.

It is an object of the present invention to provide a mold and core making machine having two rollover tables independently operable but hinged or rotating in opposed relation on a common center to assure perfect alignment thereof.

It is a further object of the present invention to provide a mold and core making machine having arranged integral with each table thereof, a single cylinder housing containing pistons adapted to operate for jolt, book, squeeze and pattern draw operations.

It is a still further object of the present invention to provide a valve for a mold and core making machine which facilitates the use of jolt pressure for an additional, or "emergency," squeeze pressure.

Other objects and advantages will become apparent and my invention will be better understood from a consideration of the following description taken in connection with the accompanying drawings in which Fig. 1 is a front elevationoal view of a complete mold and core making machine; Fig. 2 is a top plan view of the machine of Fig. 1; Fig. 3 is a cut-away view of the same machine taken on the line 3—3 of Fig. 2 and showing operating cylinders which are located along the two transverse axes of the machine; Fig. 4 is a cross sectional view of a jolt-squeeze-pattern draw cylinder 44 of the machine of Figs. 1, 2 and 3; Fig. 5 is a like view of a portion of the same cylinder, but showing another step in the operation of its inner or valving piston 64; Fig. 6 is a like view of a portion of the same cylinder but showing still another step in its operation; Figs. 7-13 are diagrammatic representations of steps in the operation of the machine of Figs. 1, 2 and 3; and Fig. 14 is a schematic representation of the piping and valves (of the machine shown in the other figures).

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Referring now to Fig. 1 showing a front elevation, Fig. 2 showing a top plan view, and Fig. 3 showing a sectional elevation, I have shown a mold and core making machine having a main base 20 with bottom flanged portions 21 preferably secured to a floor or other building structure 22 as by a plurality of bolts 21*a*. If desired, the entire machine may be spring mounted by inserting spring members 21*b* between the flanged portions 21 and the main frame 20. The machine has two rollover tables identified as a left-hand table 23 and a right-hand table 24. These tables each have a vertically movable face, or platen, 25 and 26, respectively.

The machine is provided with four rollover pressure fluid motors in the form of cylinders 27, 28, 29 and 30 (Fig. 2), each provided with a piston 31 (Fig. 3) and a piston rod 32 connected to a crank 33. Each crank 33 is formed integral with a bushing section 34 (see Fig. 2) mounted on a central shaft 35. The bushing sections 34 are provided with end plates 36 each of which is bolted to an adjacent face plate 37 formed integral with an additional bushing section which is an integral part of a carrier arm 38. Two carrier arms are attached to the left-hand table 23 and two carrier arms are attached to the right-hand table 24 so that the pistons in the outer cylinders 27 and 30 operate right table 24 and the pistons in the inner cylinders 28 and 29 operate left table 23. The mechanism is adapted to have the tables operate independently of each other and the pistons and cylinders for the right table may be considered as one fluid pressure motor and those associated with the left table as another.

Frame 20 of the machine is provided at its center with a cut-out portion having a plurality of cross bars 39 (Figs. 2 and 3) which may be made integral with the frame itself. As shown in Fig. 3 each rollover cylinder 27—30 is pivotally connected to the respective cross bar 39 by mounting brackets 40 and pins 41 to allow for arc-like movement of each cylinder and piston with travel of the associated crank arm 33. Each cylinder (27—30) is of the closed head type, operation of the associated piston being caused by the introduction of operating fluid (such as air) at the top of each cylinder through a port 42. Fluid thus admitted will serve as a counter balance holding the piston in position until the fluid is released. At the other side of the piston an exhaust to atmosphere is provided through a port 43.

Associated with rollover table 23 is a jolt-squeeze-book and pattern draw pressure fluid motor in the form of a cylinder 44 and associated with rollover table 24 is a like cylinder 45. Each of these cylinders is mounted integral with the associated table (see Fig. 3) and has pistons operating the associated platen (25 or 26) and there are also, for each platen, two guide pistons co-operating with guide cylinders 46.

The pistons of each jolt-squeeze-pattern draw cylinder 44 and 45 may be more clearly understood by reference to Fig. 4 which is a cross-sectional front elevation of one of the identical cylinders (44 being selected) together with the associated platen and pistons. The cylinder 44 is secured by bolts 47 in a central cylindrical opening formed in its associated table 23. The cylinder also has a radially spaced concentric inner housing 48 with a principal sleeve piston 49 interposed between the inner and outer housings. Piston 49 has a lower flanged portion 50 provided with piston rings 51, and has an upper flanged portion 52 secured to the movable face 25 by bolts 53. At its lower end the outer cylinder 44 is provided with a tapered threaded port 54 with a conduit 55 secured therein so that when air is introduced thereby, the piston will lift and in turn lift the movable face 25. For convenience, piston 49 will be hereinafter referred to as the squeeze piston and it will be understood that operating fluid is introduced through conduit 55 for the squeeze, or booking operations. A guide for piston 49, as well as a seal for its enclosure, is provided at the top of the outer cylinder by an annular guide member 56 having packing 57 held in place by an annular top ring 58 fastened to the guide 56 by a plurality of screws 59. Annular guide member 56 may comprise two split halves (for convenience in assembling) with the two halves bolted together as by bolts 56*a* and also bolted to the table and to the outer cylinder by bolts 47. The upper end of the inner cylinder 48 is provided with packing rings 60 and a flange portion 61 to which is secured, by bolts 62, the flanged end of a cylindrical sleeve member 63. This stationary sleeve 63 encloses a cylindrical valve piston member 64. At its upper end piston 64 is held by a collar 65 bolted to platen 25. The piston 64 is provided with ports 66 allowing the escape of operating fluid from the center of the piston to the chamber 67 (defined, in part, by the upper face of sleeve 63, the lower face of platen 25, and the inner wall of piston 49) thereby raising the associated platen 25.

At its lower end, sleeve 63 is provided with a flanged portion to which is secured a block 68 having formed therein an upper transverse cylindrical bore 69 and a lower transverse cylindrical bore 70. Secured to block 68 at each end thereof are end plates 71 which form cylinder heads for bores 69, 70. The upper bore 69 is provided with a slidably arranged dumbbell-shaped valve member 72 having two spaced disks 73, 74 forming a circumferential groove 75 therebetween. The lower bore 70 is provided with a slidably arranged valve member 76 having four spaced disks 77, 78, 79, 80 formed integral therewith and forming circumferential grooves 81, 82, 83 respectively.

Pressure operating fluid for jolt action of platen 25 is supplied to lower bore 70 through a conduit 84 secured in a port 85 formed in the bottom of block 68. As may be seen in Fig. 4, when valves 72 and 76 are in their extreme right-hand positions, the operating fluid admitted to lower bore 70 is communicated through a connecting port 86 to upper bore 69, thence through a port 87 provided in the top of block 68 to establish communication between upper bore 69 and the space within sleeve 63 and within piston 64. As previously described, the operating fluid entering the center of piston 64 will escape through the upper ports 66 to the chamber 67 to lift the platen 25 for jolting action.

The jolting action is an automatically interrupted or reciprocating action, and to provide this feature the inner piston 64 is provided with a circumferential groove 88 formed in its outer periphery and intermediately spaced from its ends. A plurality of ports are provided to cooperate with this groove and thus ports 89 and 90 are provided in sleeve 63 to register with groove 88 when the platen 25 and piston 64 are in lowered position. Port 89 communicates through conduit members 91 and 92 with a port 93 provided in lower bore 70. Port 90 communicates through a conduit 94 to a port 95 in the wall of the upper valve bore 69 and at the left of the extreme left-hand travel of valve 72 therein. By way of summary it may be stated that a circuit can be traced from supply conduit 84 and, whenever valve piston 76 is biased to the right, then through port 93 and conduit 92 to conduit 91 and port 89 so that whenever the platen is lowered and groove 88 is in line with ports 89 and 90, the circuit is completed through conduit 90 to port 95 at the left end of the bore provided for valve piston 72. Thus when platen 25 is in the lowered position, air for jolting from conduit 84 reaches port 95 to keep valve 72 to the right to allow air from conduit 84 to travel upward to ports 66 to raise the valve piston 64 and the platen 25. This raising breaks the communication from port 89 to port 90 around the groove 88 of the valve piston. At a higher position groove 88 forms communication between ports 96 and 97 provided in sleeve member 63. Port 96 communicates through conduits 91 and 92 with port 93 in the lower valve bore. Port 97 communicates through a conduit 98 with a port 99 provided at the right-hand end of upper bore 69. When the platen and piston have traveled upward far enough for groove 88 to register with ports 96 and 97, as shown in Fig. 5, air from conduit 84 enters port 93 to travel from port 96 to port 97 to port 99 and cause the piston member 72 to travel to the left. As shown in Fig. 5, when valve 72 moves to its left-hand position its head 74 covers port 86 to cut off communication between bore 70 and bore 69. At the same time its head 73 uncovers a second connecting port 100 provided between the two bores so that operating fluid is permitted to exhaust around groove 82 of the lower valve member and through an exhaust port 101 to atmosphere, allowing valve piston 64 and platen 25 to lower due to their own weight.

The travel of valve 72 is limited at each end by setscrews 102 provided in the heads at the terminal end portions of the upper bore. During normal jolt operation, the lower valve 76 is maintained at its extreme right-hand position by a biasing spring 103. This lower piston functions for "emergency squeeze" operation and is described more particularly hereinafter in connection with Fig. 6.

Referring now to Figs. 7-13, which are diagrammatic representations of steps in the operation of the entire machine of Figs. 1-6, Fig. 7 shows the machine with a cope core box 104 secured to platen 25 and a drag core box 105 secured to platen 26. The boxes may be secured to the respective platens by bolts (not shown) and it will be understood by those skilled in the art that a pattern for the core half forms an integral part of each core box. In Fig. 7 (and 9) the machine is shown with a part of the front of base 20 cut away, at each end, to show the location of the jolt-squeeze-pattern draw cylinders 44 and 45, which may hereinafter be referred to as the J. S. P. D. cylinders. In Fig. 7 the machine is shown in normal position before starting operation. The core boxes are filled with a suitable molding sand, such as green sand, and are then jolted by use of the apparatus hereinabove described in connection with Figs. 4 and 5. This jolting action packs the sand tightly in the molds. When either valve piston (64 or the like piston for the other table) raises a distance equal to the distance as shown in Fig. 4 between the level of port 89 (and 90) and the level of port 96 (and 97), the air exhausts letting the platen fall to its original position whereupon the cycle is started again.

If desired, after jolting the two core boxes may be "butted off" (as by pounding with an air hammer) to pack the sand more tightly, and then may be "struck off" (as by scraping with a long rod) so that the top surfaces of the molds (i. e. halves of the final core) are smooth and flush with the tops of the core boxes. The two halves of the core are then ready for "booking" (bringing the core halves together) as shown in Fig. 8.

In order for the apparatus, as shown in Fig. 7, to achieve the position shown in Fig. 8, the rollover cylinders 27—30 (shown in Fig. 3) are operated to raise the tables 23 and 24 to the vertical positions and this brings together two elements or halves 106 and 107 of a lock which may be more clearly understood by reference to Figs. 1 and 2. The lock has a stationary male half 106 and a rotatable female half 107. As shown in Fig. 2, the rotatable half 107 is operated by a piston slidably arranged in a cylinder 107*a*. Operating fluid is supplied by means of a conduit 109 to one end of the cylinder to cause a locking action and by means of a conduit 108 to the other end of the cylinder to cause an unlocking action whenever the stationary part 106 is inserted in the rotatable part 107 as by operation of the rollover cylinders to bring the tables together.

In order that the respective tables will roll over freely and without binding related parts, I find it desirable to provide, as shown in Fig. 3, a plurality of rollers 110, each arranged to be carried in a roller housing 111 formed integral with the associated platen 25 or 26. As indicated in Fig. 2, there is a roller housing (and roller) at the front and another at the back of each platen. As shown in Figs. 2 and 3, the front rollers operate on a track 112 provided around the central part of the machine. The back rollers operate on a similar track.

Referring again to Fig. 8, showing the tables swung up to their vertical positions, where they are then locked by operation of lock half 107 previously described, it is seen that the two faces of the core boxes are exactly parallel at this position. Pressure is then applied (through squeeze conduit 55 of Fig. 4) to each J. S. P. D. cylinder to distend the squeeze piston (49) so that the two core boxes are squeezed together in a booking action to unite the two halves of the core.

The complete unit, still locked together, is then rolled over to the left-hand side of the machine. In this position the drag core box 105 is vibrated by applying operating fluid to a pneumatic vibrator 113 located on the drag core box. A similar pneumatic vibrator 114 is located on the cope core box (see Figs. 1 and 9). Such pneumatic vibrators are well known to those skilled in the art and need not be described. While the drag core box is thus vibrating, the cope core box 104 is lowered (by lowering platen 25 through operation of squeeze piston 49 of Fig. 4). Thus the top half of a completed core 115 is drawn from the drag core box 105 as shown in Fig. 9. The tables are then unlocked and the right-hand table 24 is rolled over and out of the way.

The next operation is shown in Fig. 10. While Figs. 7 and 9 show the base 20 of the machine cut away at each end, Fig. 10 is a view from the very front of the machine and shows a pin lift cylinder 116 on the left half of the machine and a pin lift cylinder 117 on the right half of the machine. The two cylinders are identical and a cross sectional detail of the pin lift cylinder 116 is shown in Fig. 1, where it is seen that a piston 118 is slidably arranged in said cylinder to drive a piston rod 119 in turn connected to a pin lift 120 in which two pins 121 are mounted. It may be desirable to have the pins adjustable by having them slidably mounted in slots 122 of the respective pin lift as shown in Fig. 2. As also shown in Fig. 2, the same arrangement is provided at the back of the table. As shown in Fig. 1, each pin lift 120 has two guide pistons 123 traveling in guide bushings 124 bolted to the frame 20. Operating fluid is introduced through a conduit 125 to the bottom of each pin lift cylinder to lift the pins. When this pressure is relieved, the pins together with the associated pin lift assemblies fall due to their own weight.

As shown in Fig. 10, the pins 121 at the left side of the machine are raised so that they are slightly above the top surface of the cope core box 104 after which a drag flask 126 is brought to the machine. It will be understood by those skilled in the art that an outer mold is already formed in this drag flask and, likewise, an outer mold is already formed in a cope flask 127 that is later brought up to the machine. These outer molds may be formed of suitable molding sand on other machines of a type well known in the art or, preferably, may be formed separately on the machine of the invention as hereinafter described. It will be understood, also, that when these flasks and molds are brought up to the machine of the invention for the purpose of putting them around the completed core which has just been made on the machine, their patterns have already been drawn (i. e., removed). Drag flask 126 is centered over the exposed drag half of the core 115 (Fig. 10) with the drag flask supported by pins 121, and then pressure is applied to the cope J. S. P. D. cylinder 44 which slightly raises the platen 25 and in so doing inserts the drag-core-half all the way into the drag flask. The front and back pins 121 at the left side of the machine are then lowered and the right-hand table 24 with the empty drag core box 105 is rolled to the left side and locked.

Pressure is applied (through proper conduits including squeeze conduit 55 of Fig. 4) to the cylinders 44 and 45 in order to clamp the drag flask firmly between the two core boxes, as shown in Fig. 11, so that when rolling over there can be no slippage between the drag flask 126 and the cope core box 104. If the molds or flasks are extremely heavy it may be necessary to use additional pressure. Therefore, an emergency squeeze feature is provided. This feature may be understood by reference to Fig. 6 showing a port 128 provided in end plate 71 at the right-hand end of lower valve bore 70. A conduit 129 is adapted to feed operating fluid into the bore through this port for emergency squeeze action. Pressure of the operating fluid forces valve member 76 to the left covering exhaust port 101 so that platen 25 and valve piston 64 are forced up (and held up). To achieve this end it is essential that top valve member 72 be held to the right (so that it uncovers ports 86 and 87) and to assure this a bore 130 is provided in lower valve member 76 to form communication from circumferential groove 83 to circumferential groove 81 of the lower valve. A port 131 is provided to establish communication between the two bores 69, 70 at their left-hand ends so that when, for emergency squeeze, lower valve 76 is forced to the left and its groove 81 registers with this port, operating fluid from conduit 84 will be introduced into the left end of the upper bore to hold upper valve 72 to the right as desired. Thus with valve members 72 and 76 maintained in these positions (i. e. 72 to the right and 76 to the left), fluid from conduit 84 (normally employed in the jolting operation described hereinbefore) is communicated through port 86 to upper bore 69, thence around groove 75 of member 72 and through port 87 to the interior of piston 64 as indicated by the arrows of Fig. 6. From the interior of piston 64, the fluid is communicated through ports 66 (Fig. 4) to chamber 67 whereby additional squeeze pressure is exerted on the underside of platen 25 to supplement the squeeze pressure exerted on the underside of piston flange 50 by fluid admitted through conduit 55 and port 54.

When pressure is introduced by conduit 129 to keep valve member 76 to the left and valve member 73 to the right as described, valve member 72 will prohibit any jolting action for even when platen 25 moves to a position such that the groove 88 of piston 64 registers with ports 96 and 97, valve member 72 remains in its extreme right-hand position (i. e. with inlet port 86 open and exhaust port 100 closed) because the fluid pressure transmitted through conduit 98 and port 99 (Fig. 5) to the right-hand side of valve member 72 is substantially equal to the pressure on the left-hand side, transmitted through bore 130 and port 131 (Fig. 6). Hence the additional squeeze pressure supplied through conduit 84 and exerted on platen 25 is continuous and uninterrupted for all positions of piston 64.

Returning now to consideration of Fig. 11, with the assembly of cope core box and drag flask held together by the pressure of empty drag core box 105 against the solid bottom of the drag flask (either with or without emergency squeeze, as necessary), the entire assembly is then rolled over to the right-hand position shown dotted in the right half of Fig. 11. The cope core box is then vibrated by introducing operating fluid to the pneumatic vibrator 114 and, at the same time, the pattern is drawn by lowering the core 115 out of the cope core box 104 or in effect, raising the cope core box as shown in Fig. 12. This raising of the core box for pattern draw is accomplished by reverse action of the squeeze piston (49), i. e. by introducing pressure fluid through conduit 132 (Fig. 4).

With the entire assembly in the position shown in Fig. 12, the tables are then unlocked and the table 23 (with the now empty cope core box 104) rolled over to its normal position at the left-hand side as shown in Fig. 13. A cope flask 127 containing the outer cope mold is then brought up to the machine and centered over the cope half of the core, so that when pressure is applied to the drag squeeze piston (similar to 49 of Fig. 4) the cope half of the core is fully inserted into the cope mold. The mold is now complete as shown in Fig. 13 and, after clamping flasks 126 and 127 together, the mold may be taken away for pouring.

In Fig. 14 I have shown a schematic arrangement of piping required for operation of the machine. It will be understood that where a conduit connects two relatively movable pieces of appartus, flexible conduit (such as rubber hose) may be found desirable even though it is not indicated as such on Fig. 14. Operating fluid, such as air, is introduced by a pipe 149 to a header 150 which, in turn, feeds a plurality of operating valves 151–159, each of which comprises a housing for a rotatable dumbbell-shaped valve member 160.

A conduit 125 (Fig. 1 and Fig. 14) connects the bottom of each left-hand pin lift cylinder 116 with one side of valve 151; operating fluid is introduced at the bottom of the valve and an exhaust port 161 is provided at the top of the valve, so that when the valve is turned approximately 45 degrees counterclockwise from the position shown in Fig. 14 the left-hand pins 121 are raised, and when the valve 151 is then turned approximately 45 degrees clockwise back to the position shown in Fig. 14 the same pins are lowered. From the right side of valve 151 connection is made through conduit 84 to the bottom of the jolt valve block 68 for the cope platen 25 (see Fig. 4). Thus, this same valve 151 is used both for pin lift (by turning in one direction) and for jolting (by turning it in the other direction).

The emergency squeeze conduit 129 (for left-hand table 23) and the squeeze conduit 55 (for the same table) are connected together and to a conduit 131 connected to the left side of operating valve 152. It will be understood, from a study of Figs. 4–6, that when valve 151 of Fig. 14 is operated for jolt action without operation of valve 152, the associated platen will "jolt," that when valve 152 is operated without operation of valve 151 the platen will "squeeze" (the only effective pressure being that supplied through conduit 55), but that when the jolt action of valve 151 and the squeeze action of valve 152 are both called for, the emergency squeeze feature (through conduit 129) is provided.

A conduit 132 is provided from the right side of valve member 152 to the top of the bore provided for squeeze piston 49 between cylinders 44 and 48 (see Fig. 4). The introduction of operating fluid through this conduit will effectuate the pattern draw previously explained. As shown in Fig. 14 operating fluid from header 150 is introduced at the bottom of valve 152 and port 162 (exhausting to atmosphere) is provided at the top of the valve.

Because squeeze piston 49 operates in a bore which is closed at both ends, it may be found desirable to use "breathers" interlocking the circuits of the conduits leading to the two ends of the bore. Such breathers are shown as 163 and 164 in Fig. 14. They are well known in the art, and, therefore, will not be described in detail except to say that each has a dumbbell-shaped valve member having a circumferential groove which, at one position of the valve member, establishes communication from the associated conduit to a port exhausting to atmosphere. Thus, when air is introduced from valve 152 through conduits 131 and 55 to the bottom of the main bore for squeeze action, the valve member in breather 164 is held upwards to allow air from the top of the main bore through conduit 132 to exhaust to atmosphere, and when air is introduced from valve 152 into the top of the main bore to lower piston 49, the valve member in breather 163 is held upwards to allow air from the bottom of the main bore through conduits 55 and 131 to exhaust to atmosphere. An interlock is provided to the top of each breather to assure that there will be no false operation.

The function just described would be served nearly as well by the exhaust port 162 in valve 152, but the breathers give added speed of operation and there are times (as when valve 151 is operated for jolt) when valve 152 is not operated but it is necessary that the breather valves function to relieve back pressures from chambers not working live air but under movement due to live air being applied to other working surfaces within the J. S. P. D. cylinder housing.

In order to actuate the pneumatic vibrator 114 on the cope core box a conduit 133 thereto is provided from operating valve member 153.

A conduit 135 is provided to connect from one side of valve member 154 of Fig. 14 to the port 42 (Fig. 3) at the top of rollover cylinders 28 and 29 operating the left-hand table 23, and a conduit 134 is provided to connect the port 43 (Fig. 3) at the bottom of the same cylinders to a strainer 134a exhausting to atmosphere. An exhaust port 165 is provided at the top of valve 154 and operating fluid from header 150 is introduced at the bottom so that when the valve is turned in the proper direction the table will "roll over." Those skilled in the art will realize that the table may be thus rolled over to any position and held there (by returning the valve to neutral position) or returned (by operation of the valve in the opposite direction to dissipate the pressure head at the top of the piston).

Similarly, conduit 136 connects one side of valve 155 to the ports 42 at the tops of rollover cylinders 27 and 30 and conduits 137 are provided to connect the ports 43 at the bottoms of the same cylinders to strainers 137a exhausting to atmosphere, so that operation of this valve will act to "roll over" or return table 24.

Valve 156 is connected by a conduit 138 to the pneumatic vibrator 113 on the drag core box 105.

The piping associated with valves 157 and 158 for the right-hand table is substantially the same as that associated with valves 152 and 151, respectively, for the left-hand table and, therefore, need not be described.

Valve 159 operates the rotatable half 107 of the locking mechanism previously described in connection with Fig. 2 by introducing air to one or the other ends of cylinder 107a through conduits 108 or 109.

A preferred arrangement (top view) of the operating valves 151—159 is shown in Fig. 2 and a front elevation of the same arrangement is shown in Fig. 1 which also shows the breathers 163 and 164.

The advantages of two rollover tables are believed to be obvious. Among these advantages are the fact that the operator can book cores without removing either half core box from the machine and without the necessity of using hinged boxes or box clamps. Both tables are mounted on one main straight through shaft (35 in Figs. 2 and 3) to assure perfect mechanical alignment of work "halves," since with the proper dimension of the locking arm the two tables when locked will always be perfectly parallel with each other assuring both accuracy and speed of operation. Hinge and clamp functions are inherent in the machine itself, although each table may be rolled over independently of the other. If desired, each core box may be permanently bolted to the table (so long as the same size cores are being made).

A molding machine having two rollover tables is believed to be new, as is the feature of having (for each rollover table) jolt, squeeze and pattern draw means (i. e., fluid pressure motors) in one cylinder housing. In the machine of the invention, as described, each rollover table is provided with a jolt - squeeze - pattern - draw cylinder mounted integral with the table. One advantage of this is that a long draw in a short length is permitted (since the action of the pistons associated with the two tables may be cumulative for a total twice the distance permitted by one piston, as will be seen from a comparison of Figs. 8 and 9). Thus it is unnecessary with the machine of the invention to provide pits in the floor or in other ways provide a bulky and expensive machine to allow a long draw.

In the machine of the invention by novel design within each J. S. P. D. cylinder the pressure fluid motor used for squeeze and draw has a piston (49) which forms the cylinder housing for the jolt action pressure fluid motor, since one cavity is provided for the function of part 49 acting as a movable piston for squeeze or draw, and a different cavity is provided for the function of part 49 acting as a movable cylinder around a stationary piston 48 for the jolt action. However, the entire arrangement within each jolt squeeze pattern draw cylinder may be regarded, rather, as a single fluid pressure motor designed to perform a number of related functions.

When the molding sand is first put in the core boxes the jolting means within these J. S. P. D. cylinders are used to pack the sand. When the tables are then locked together to "book" the core or later to clamp the work to be rolled over, the squeeze means of each of these J. S. P. D. cylinders is used, thereby eliminating the need for separate clamps or clamping arrangements. When the core boxes have been rolled over to the position for drawing one (or the other) core box from the core (i. e. for pattern draw) the squeeze piston of the then uppermost J. S. P. D. cylinder is normally used to draw off the pattern of the associated core box. Since there is a J. S. P. D.

cylinder for each rollover table either core box can be rolled to either side of center desired to effectuate the pattern draw for first one core box, then the other.

In the whole process of making and booking cores, and adaptaing flasks in outer molds thereto, it is unnecessary, with the machine of the invention, to use any clamping device (other than the rollover table lock 106—107). In the whole process of making molds and cores, with the machine of the invention, there is no need to clamp or handle core boxes. Many operations are thus eliminated.

One function of the pin lift cylinders is to enable the machine to produce a jolt strip mold as well as a jolt rollover mold. When making jolt strip molds, two different patterns may be run on the opposite ends of the machine at the same time since all operating valves are accessible to a single operator at one standing position. When the machine is used as a jolt rollover mold making machine, the one table carries the pattern and flask, sand is put in and then jolted, the other table is then used for clamping the job to roll over, the two tables are locked and the one table is then raised to draw the pattern off the other table which is then carrying the load of flask and molded sand. At this time, both pattern draw devices can be used to give a very great length of draw within the limit of the distance between the two tables when locked together. Thus when making molds the machine of the invention may be used for a mechanical pattern draw and again the use of separate clamps are unnecessary, and thus it is seen then that the features of double rollover tables and combining the jolt-squeeze-pattern-draw functions in each of the two single outer cylinder housings are applicable to making molds just as they are to making cores.

The function of the jolt control lockout valve is to enable the operator to use the full area of the jolt piston in the "emergency" squeeze operation, in addition to the available squeeze piston area. Whenever the air is turned on for operation of the squeeze piston, a branch connection to the jolt lockout valve moves this valve over to cut off the jolt exhaust and by then turning air into the jolt valve, the jolt mechanism provides an auxiliary or emergency squeeze. When the air is then exhausted at the close of the squeeze operation, the lockout valve returns to normal position.

The machine is also flexible in that operating the pattern draw with the jolt operation will give a heavier jolt for large work. In addition, inasmuch as loaded tables are never rolled over all the way except when the two tables are locked together (since otherwise the molding sand would fall out), dual power is always available for the rollover operation because all four rollover cylinders are in operation.

Another advantage of the machine of the invention is absence of vibration when jolting molds or cores. This feature is provided by the fact that both rollover tables are always associated with the same main and heavy base and are never brought to rest directly on the floor itself.

There is thus provided a combined power jolt, squeeze, book and pattern draw double table rollover mold and core making machine and a device of the character described capable of meeting the objects hereinabove set forth. The machine is useful whenever duplicate castings in large number are required and especially where large molds, which cannot be handled by hand, are involved. By using the machine in such applications the cost of making castings has been cut in half.

While I have illustrated and described a particular embodiment of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangements disclosed, and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A mold and core making machine comprising a transversed shaft, two rollover tables rotatable about said shaft in opposed relation, each of said tables having a fluid pressure motor connected for squeeze operation at the respective table, and each having a fluid pressure motor connected for jolt operation at the respective table, said squeeze fluid pressure motor including a piston which acts as a cylinder housing for said jolt fluid pressure motor.

2. A molding machine comprising a central portion forming a support and dual end portions each having a base, two rollover tables hinged in opposed relation on said central portion and each arranged to come to rest on a different one of said end portion bases, a pressure fluid actuated jolting platen connected with each rollover table, a cylinder attached to each of said rollover tables and having a piston supporting said jolting platen, guide pistons connected to each platen and operating in cylinders arranged to be stationary with respect to the respective rollover table, means for rolling each table together with the associated platen to either side of the machine, and means for locking said tables in substantially parallel relation.

3. A mold and core making machine having a central base forming a support and dual end bases forming supports for tables pivotally secured to said central base support, a pressure fluid actuated jolting platen connected with each of said tables and arranged to support a mold, means for locking said tables together, means for pivoting said tables around said central base support, a housing connected with each of said tables and containing pistons arranged to jolt, book, squeeze and pattern draw said molds.

4. A mold and core making machine comprising a main frame having a central portion and two end portions, a central shaft mounted transversely in said frame central portion, a plurality of rollover cylinders pivotally connected to said frame central portion and each having a piston therein cooperating with a piston rod attached to a crank arm rotatable around said central shaft, an end plate rotatable with each of said crank arms, a face plate attached to each of said end plates and arranged to be rotatable around said central shaft, a pair of rollover tables each arranged to be brought to rest on one of said frame end portions, and a plurality of carrier arms each connected to be rotatable with a different one of said end plates, half of said carrier arms being attached to one of said rollover tables and the other half of said carrier arms being attached to the other of said rollover tables.

5. A mold and core making machine provided with an even number of pressure fluid actuated rollover cylinders each having a piston and pis-

ton rod connected to a crank formed integral with a bushing section mounted on a central shaft of the machine, said bushing sections being provided with end plates, face plates bolted to said end plates and secured to carrier arms, a left-hand table for said machine and a right-hand table for said machine, the carrier arms associated with half of said rollover cylinders being arranged to effect rotatable movement of one of said tables, the carrier arms associated with the other of said rollover cylinders being arranged to effect rotatable movement of the other of said tables, conduit and pressure fluid control valve means for controlling operation of said rollover cylinders, a movable platen arranged to move toward and away from each of said tables, a cylinder mounted integral with each of said tables and containing at least one pressure fluid actuated piston arranged to effect jolt operation of the associated platen, each of said cylinders containing a pressure fluid actuated piston arranged to effect squeeze operation of said platen, conduit and valve means for controlling said jolt and squeeze operations, valve means arranged to lock out said jolt operation means to facilitate the use of the full area of said jolt piston as an emergency squeeze, pin lifting mechanism at each end of said machine and arranged to cooperate with the respective tables in their lowered positions, a pressure fluid operated locking means movable with one of said tables, and a stationary clamp arranged to cooperate with said locking means and movable with the other of said tables.

6. A mold and core making machine provided with two rollover tables mounted in opposed relation for rotation about a common axis, means including a plurality of rollover cylinders having piston means connected to each of said tables for rollover operation of said table, a movable platen arranged for movement to and away from each of said tables, a cylinder mounted integral with each of said tables and containing piston means arranged to cause movement of said platen with respect to said table, means located within said cylinder for causing squeeze operation of said piston means and said platen, means within said cylinder for causing draw operation of said piston means and said platen, means within said cylinder for causing reciprocating jolt operation of said platen, and means within said cylinder whereby the combination of jolt and squeeze means will effectuate a continuous emergency squeeze.

7. A mold and core making machine comprising a frame central portion and dual frame end portions, a pair of rollover tables each adapted to come to rest on one of said frame end portions, a plurality of pressure fluid motors supported by said frame central portion and adapted to actuate said tables for rollover operation substantially independently of each other, each of said rollover tables having connected therewih a pressure fluid motor actuated platen, said motor including a piston supporting said associated platen, and means including guide cylinders and pistons for preventing slippage of each of said platens with respect to the associated rollover table.

8. A mold and core making machine having a main base, a transversely extending central shaft journaled in said base, two rollover tables each mounted for rotation about said shaft in opposed relation to each other, each of said tables having a platen separately movable toward and away from the respective table, each of said tables having separate means each including a fluid pressure motor adapted to rockover the respective table about said shaft, each of said tables having a separate fluid pressure motor comprising a cylinder attached to said table and having a piston connected to move said platen with respect to said table in one direction for squeeze and book operation and in the opposite direction for pattern draw, said cylinder for each of said tables comprising concentric outer and inner walls with said piston positioned therebetween, a stationary sleeve located within the innermost of said concentric walls, and parts arranged to cooperate with said sleeve to form valve means operable from positioning of said sleeve and platen for intermittently introducing fluid pressure to a chamber bounded by said platen, said piston, and said inner wall to form a second fluid pressure motor for providing a reciprocating jolt action of said platen, and means for rendering said valve means inoperative thereby to provide a continuous pressure to said last mentioned chamber for emergency squeeze action.

9. A molding machine comprising a transverse shaft, two rollover tables hinged on said transverse shaft in opposed relation to each other, each of said tables having rotatable therewith and formed integral therewith a cylinder housing located on the generally under side of the associated table, each of said housings having a piston therein, each of said tables having a relatively movable platen located on the generally upper side thereof and connected to said piston, fluid pressure supply means, and connections for conducting fluid pressure from said supply means to either of said cylinder housings and at the ends thereof between said pistons and said tables for effecting pattern draw operation.

10. A molding machine comprising a transverse shaft, two rollover tables hinged on said transverse shaft in opposed relation to each other, each of said tables having associated therewith and arranged to be rotatable therewith first cooperating fluid pressure piston and cylinder mechanisms for effecting jolt operation at the respective table, and each of said tables having associated therewith and arranged to be rotatable therewith second cooperating fluid pressure piston and cylinder mechanisms, means for causing either of said second piston mechanisms to be operated in a first direction for squeeze operation, and means for causing either of said second piston mechanisms to be operated in a second direction for pattern draw operation.

JOHN R. ROW.

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