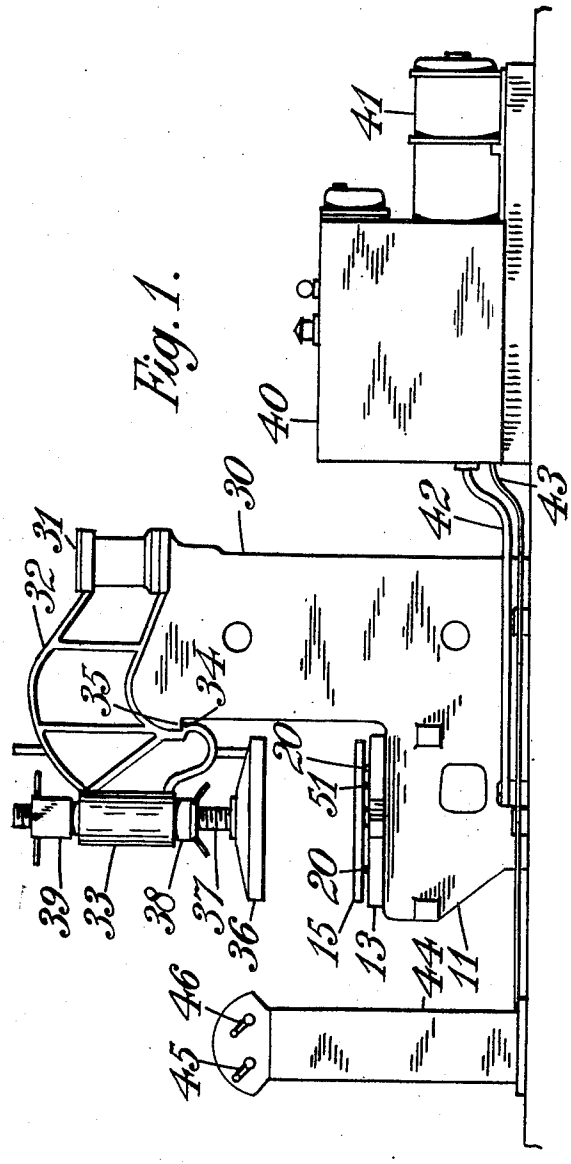
Dec. 24, 1957 A. S. BEECH 2,817,127

FOUNDRY MOULDING MACHINES

Filed Dec. 3, 1953 6 Sheets-Sheet 1

Fig. 1.



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FOUNDRY MOULDING MACHINES

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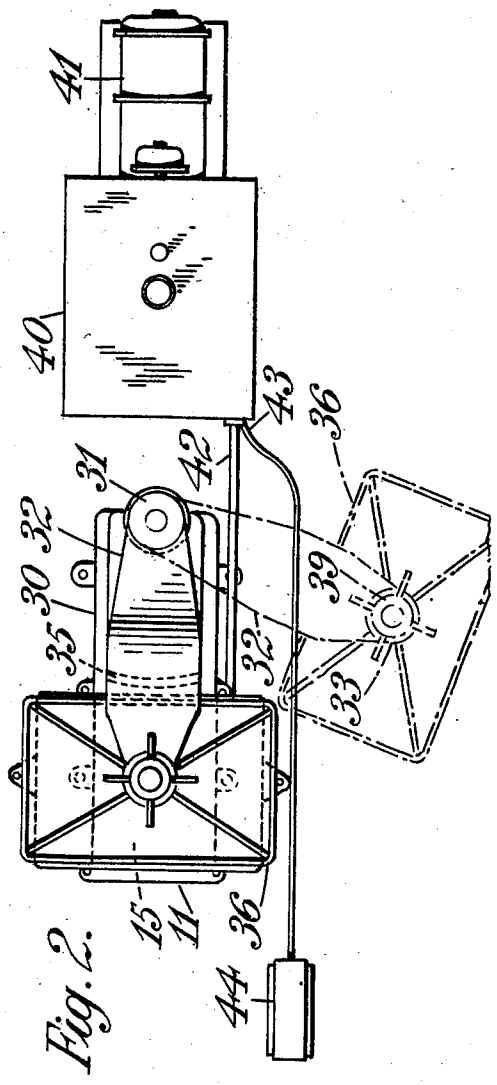

Fig. 2.

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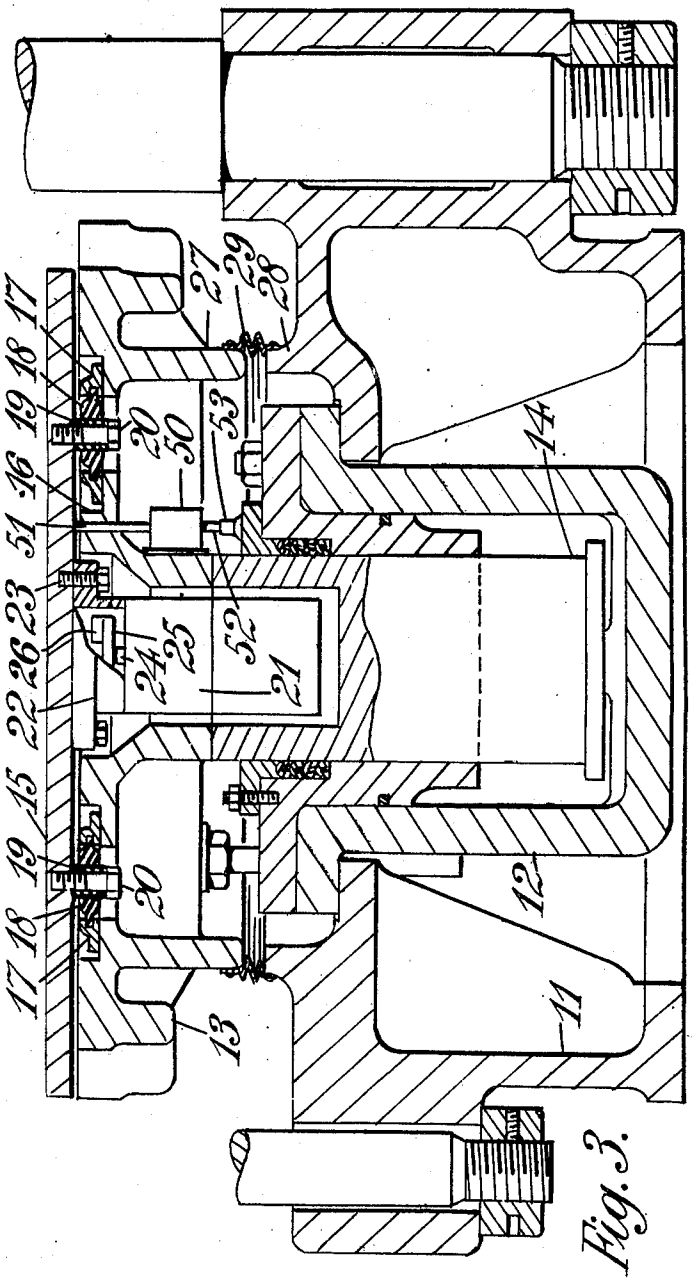

Fig. 3.

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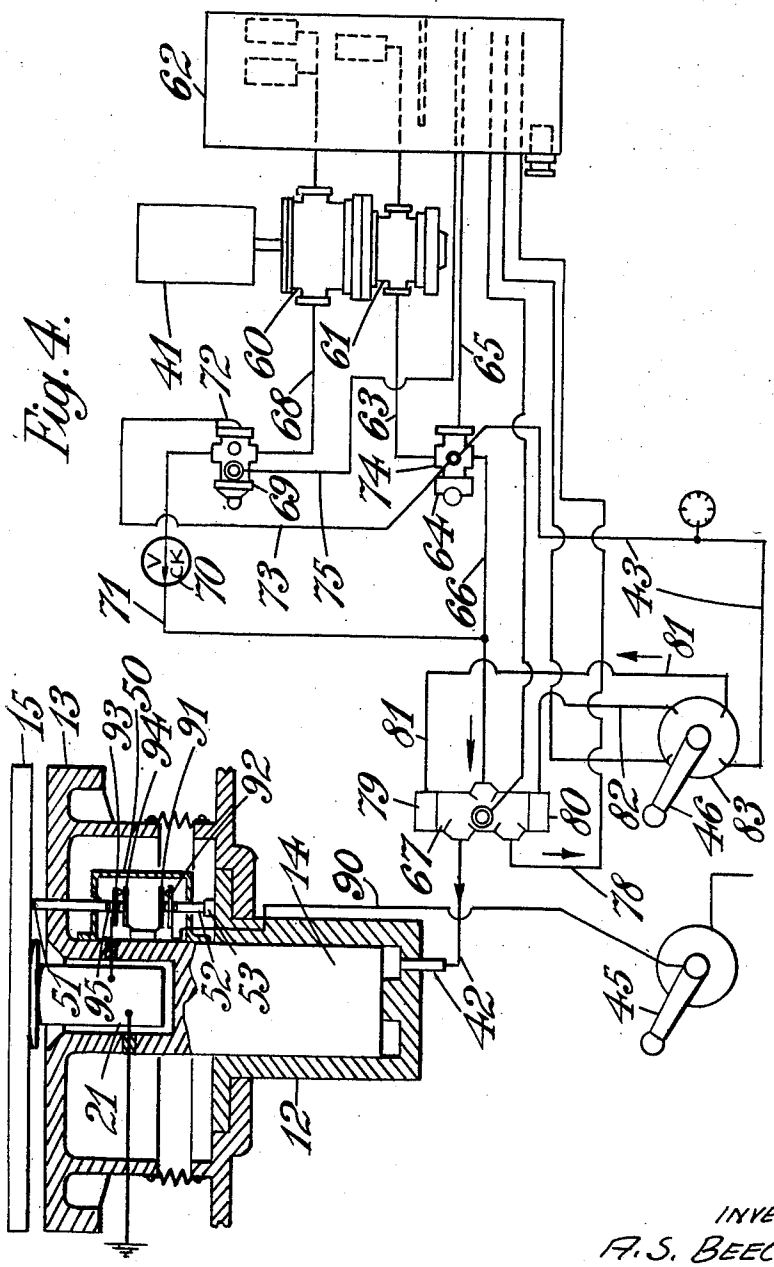
Fig. 4.



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FOUNDRY MOULDING MACHINES

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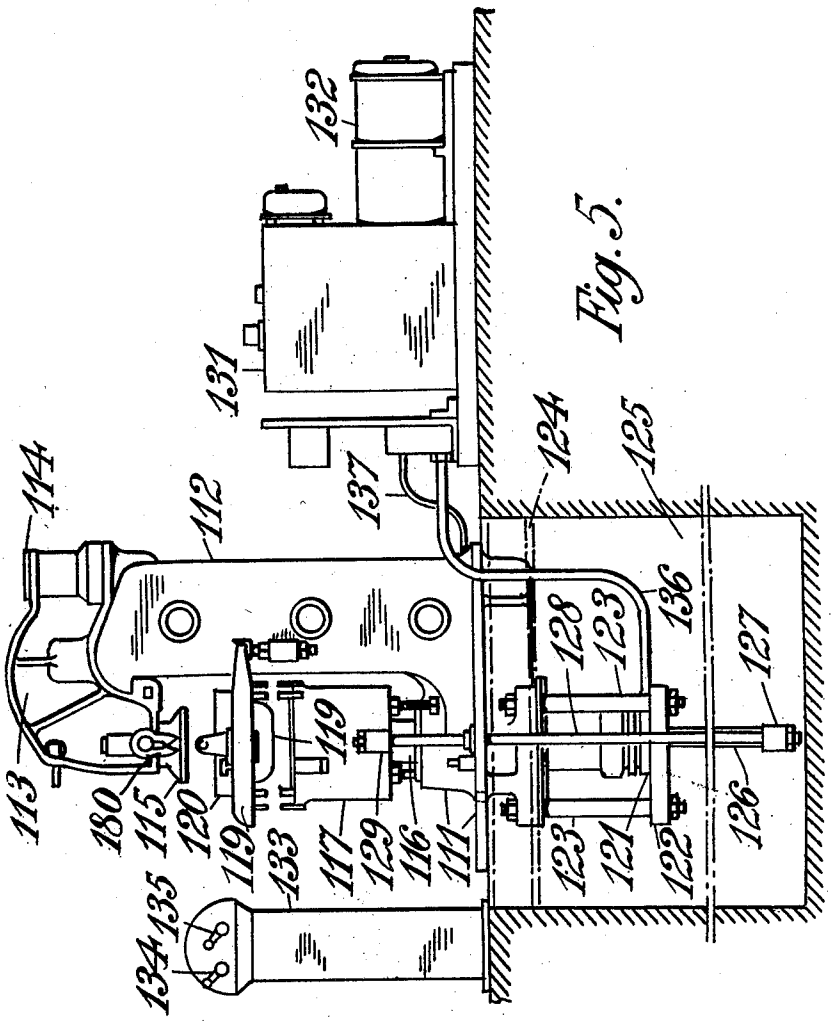

Fig. 5.

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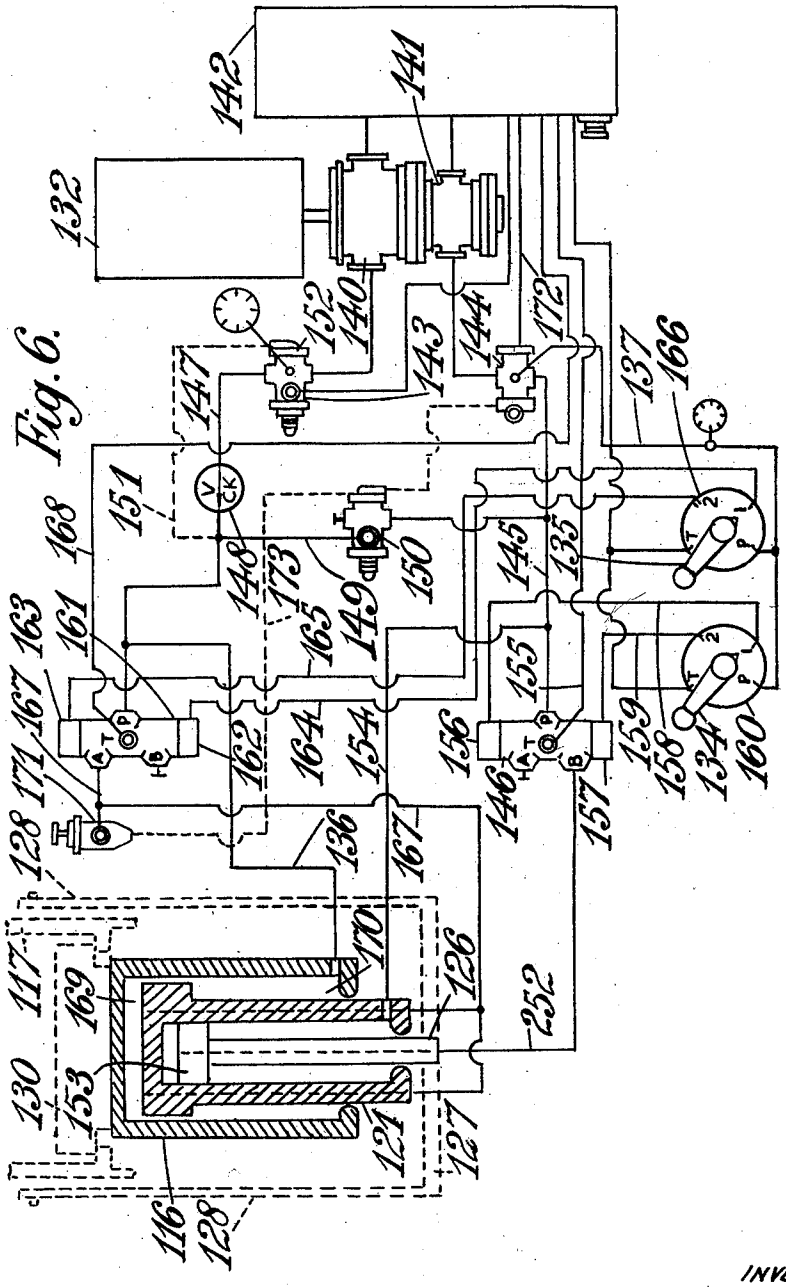
Fig. 6.



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2,817,127

FOUNDRY MOULDING MACHINES

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Application December 3, 1953, Serial No. 395,861

Claims priority, application Great Britain December 8, 1952

3 Claims. (Cl. 22—26)

This invention comprises improvements in foundry moulding machines.

The invention relates to foundry moulding machines of the hydraulic squeeze type. Such machines comprise platens and a hydraulic cylinder to urge the platens together so that if a pattern and moulding box are mounted between the platens, sand which has been filled into the moulding box around the pattern can be hydraulically squeezed and so consolidated. Such machines afford a rapid means of ramming moulding boxes with firmly packed sand and are in wide use. Other gear on the machines is commonly hydraulically operated such for example as a hydraulic stripper. The movable platen which is mounted on the hydraulic ram is commonly the lower platen and the upper platen is mounted on a column above it so that it can swing around the column and be brought into position either directly above the mould box when the mould is to be squeezed or swung out of the way when not in use.

In the known machines the hydraulic squeezing ram and the hydraulic stripper, if one is provided, are provided with pipe connections to control valves mounted on the machine, and the valves are connected to a hydraulic main common to other machines in the foundry. This arrangement tends to relatively slow operation and unduly costly supply equipment because the hydraulic pressure must be adequate to effect the final squeezing action properly, but most of the travel of the ram is exerted against little resistance, and to use a very high pressure supply for a long travel is a waste of power. Moreover, if more than one of the machines happen to be moved by the operators simultaneously, the time of movement is increased. The time of retraction after use is also slow.

According to the present invention the hydraulic squeeze moulding machine is employed in combination with an individual supply unit comprising a motor-driven duplex pump and control valves, the duplex pump and its control-valves being such as to provide a large-volume low pressure supply for the initial movements and return of the parts, and a higher pressure smaller-volume supply for the "squeeze" action.

It will be noted that it is not sufficient, for the purpose of speeding up the action and economising power, merely to supply an individual pump for each machine, but it is also necessary that the pump should be a duplex pump capable of providing a large-volume of low pressure supply and a higher pressure smaller-volume supply.

It is an important feature of the invention that the change-over from the large-volume low pressure supply to the higher pressure smaller-volume supply is automatic, and that both supplies are employed in the same cylinder on the machine so that the machine remains simple in construction.

The squeezing ram may be double acting if desired so that return movement is effected by pump action. In this case the supply-and-return conduit connected to the end of the ram-cylinder which moves the ram forward, may be made of greater cross-sectional area than that connected to the other end for returning it, in order to free the exhaust from the first-said end and so increase the speed of the return movement.

The invention further relates to the combination of the above mentioned features of a special form of automatic vibrator consolidating the sand before squeezing and for freeing the squeeze platens from the mould during return movement of the platen after squeezing, which vibrator obviates the trouble arising from known vibrators that the main body of the machine feels the vibration and that the pattern is not effectively freed all around. This vibrator also renders the known and inconvenient jolt mechanism, unnecessary.

The invention will now be described in further detail with reference to the accompanying drawings which show by way of example certain embodiments in accordance with the invention.

In the drawings:

Figure 1 is a side elevation of one form of machine showing the moulding machine proper, an individual motor-pump drive and the control column therefor.

Figure 2 is a plan of the same.

Figure 3 is a section through the squeeze cylinder therefor,

Figure 4 is a hydraulic connection diagram of the apparatus shown in Figures 1–3,

Figure 5 is a side elevation of a second type of machine with individual motor pump, and

Figure 6 is a diagram of hydraulic connections for the same.

Referring to the construction shown in Figures 1–3, the machine has a base **11** which contains a vertical cylinder **12** (Figure 3), supporting a table **13**. The cylinder **12** contains a ram **14** which projects upwardly and the table **13** is secured directly to the top of the ram. On the table there is supported a platen **15** which is spaced a little from the table. The table **13** has a number of recesses **16**, in its upper surface, in which are located frames **17**, bonded to rubber discs **18**. The rubber discs have central bushings **19** through which pass set screws **20** which enter the underside of the platen **15**. The rubber discs **18** are so proportioned that the platen **15** is supported clear of the table when no pressure is upon it, but in the event of pressure coming upon the platen **15**, the rubber discs permit the platen to be depressed into contact with the table **13**. The number of rubber disc mountings **18** beneath the platen **15** is determined in accordance with the shape of the platen so as to be adequate to afford the platen proper support.

The upper end of the ram **14**, and the part of the table which is secured to the ram, are hollowed out to receive an electric motor **21** which is secured to a vibrator casing **22**, having a flange **23** by which it is bolted to the platen **15**. The vibrator casing **22** is shown in Figure 3 partly broken away, to reveal the motor-shaft **24** carrying a disc **25** on which is supported an out-of-balance weight **26**. Operation of the electric motor when there is no pressure on the platen **15**, will cause the platen to vibrate in a horizontal plane with a circular movement of very small amplitude which is permitted by the rubber discs **18**. The effect of this is that any mould-box which is mounted on the platen **15** has this circular vibration imparted to it and before squeezing the sand is shaken well into the recesses of the pattern, while the pattern, after it has been rammed, is freed from the sand by such circular vibration sufficiently to permit its removal. The vibration before squeezing eliminates any need for a "jolt" mechanism. The vibration after squeezing is particularly important in a moulding machine according to the present invention because owing to the high squeezing pressure and rapid action of the machine, the patterns need to be effectively freed from the mould immediately after use.

As seen in Figure 3, the table 13 has a downwardly depending circular flange 27 which is connected to an upstanding flange 28 on the base of the machine by a bellows 29, thereby keeping out dust and dirt from the internal working parts.

The base 11 carries an upstanding column 30 on which is pivoted at 31 a horizontal swinging arm 32 carrying the head 33 of the machine. The arm 32 has an abutment 34 which faces upwardly and is capable of engaging beneath an over-hanging abutment 35 on the column 30 when the arm 32 is swung into place to bring the head 33 above the platen 15, and thereby to take the upward thrust of the reaction against the pressure of the hydraulic cylinder 12. The head 33 carries an upper platen 36 which faces the lower platen 15 and is adjustable by a screw 37 and nuts 38, 39 in known manner.

Directly behind the machine 30 is a duplex hydraulic pump in a casing 40, the pump being driven by an electric motor 41. The output of the pump is connected by a pipe 42 to the hydraulic cylinder 12, and the control pipe 43 extends to a control column 44 on which are control levers 45, 46 hereinafter referred to. The hydraulic and electric connections are shown in the diagram, Figure 4.

The shaking before squeezing should occur after the box has been filled with sand and before the platens come together. The vibration which frees the pattern from the sand in the mould box must occur during the time that the mould-box is resting on the platen 15 and as soon as possible after the squeezing pressure is relaxed. In order to ensure that the motor 21 is operating at the correct time, it is connected to the electrical supply through an automatic switch 50, which carries push rods 51, 52 (Figure 3). As the platen rises the push rod 52 comes away from abutment 53 and starts the motor. The push rod 51 engages the platen 15 and cuts off the motor current when the platen is fully raised and is pressed against the table 13. The push rod 52 again engages the fixed stop 53 on the cylinder 12, and cuts off the motor current when the table reaches its lowermost position. As soon therefore, as the squeezing pressure is over and the platen begins to descend, the push rod 51 will be allowed to move up by reason of the fact that the platen 15 rises out of contact with the table 13, as shown in Figure 3, and the motor circuit will be automatically completed. As soon as the table reaches the bottom of its stroke, the push rod 52 will automatically cut it off.

Referring now to Figure 4, this shows the motor 41 driving a duplex pump consisting of a low pressure section 60, and a high pressure section 61. Both pumps draw from a sump 62. The high pressure pump delivers by a pipe 63 to a relief valve 64 which is spring controlled so that, upon the maximum permitted pressure being reached, the sump delivery can escape back to the sump 62 by way of pipe 65. At other times, the high pressure pump delivery passes by way of pipe 66 to a control valve 67.

The low pressure pump delivers by pipe 68 to an unloader valve 69 and thence through a non-return valve 70 and pipe 71, to the delivery pipe 66 of the high pressure pump. The unloader valve 69 is operated by a piston in an operating cylinder 72 secured to the end of the unloader valve casing, which piston is open to pressure from a pipe 73, connected to a point 74 on the relief valve of the high-pressure pump 61.

Up to a predetermined pressure, the two pumps deliver in parallel to the control valve 67. Naturally during this joint-delivery stage, the two pumps deliver at the same pressure. The pressure in the line 73 derived from the connection to the relief valve 64 is equal to the pressure in line 66. As soon as the pressure in line 66 reaches the limit of that for which the low pressure pump 60 is designed, the unloader 69 is operated and delivery through pipe 71 is cut off. The high pressure pump continues to operate and to increase the pressure above that at which the unloader 69 operates. Above this pressure and until the relief valve 64 operates, the high pressure pump alone delivers to the valve 67.

The control valve 67 is a two-way valve which in one position connects the pressure supply through pipe 66 to the pipe line 42 which leads to the ram cylinder 12 of the machine, and in the other position connects the pipe line 42 to the pipe 78 leading to the sump 62. There is an operating cylinder 79 at one end of the valve 67, and an operating cylinder 80 at the other end thereof. The cylinders 79, 80 are connected respectively by pipe lines 81, 82 to a pilot valve 83 located in the column 44 and operated by the lever 46 on the column hereinbefore referred to. The pilot valve 83 is connected to the pressure take-off point 74 on the high-pressure relief-valve 64 by the pipe line 43 hereinbefore referred to. In one position of the lever 46 it connects the line 81 to pressure from pipe 43 and moves the valve 67 to the position where pressure is applied to the pipe 42. In a second position of the valve 46, it connects the pressure to the line 82 and moves the valve 67 to the position where pipe 42 is connected to tank. Therefore, in one position the lever 46 raises the ram 14 of the cylinder 12, and lifts the platen 15, whereas in the other position it allows these parts to sink under the action of gravity.

The motor 21 is required to operate for only a few seconds while the ram 140 is raised and sinking. To this end a supply line 90 from the electric circuit is taken through the automatic switch 50 and in series through contacts 91, 92 thereof, and then through the contacts 93, 94, and thence to the motor. When squeeze-pressure is applied to the platen 15, the push rod 51 presses on an insulating block 95 which forces the contact 94 away from the contact 93. As soon as squeeze-pressure is released however, and the ram 14 begins to fall, this circuit is connected and the motor 21 is re-started. As soon as the lower push rod 52 engages the stop 53, the contact 91 is pressed away from the contact 92 and the circuit is broken again.

Referring now to the construction shown in Figure 5 and the diagram, Figure 6, the principle of operation is broadly similar. The machine comprises a base 111, having a column 112 which carries a pivot arm 113, swingable about a pivot 114 and carrying an upper platen 115. On the base 111 is a ram 116 which supports a lower platen working in a bottom box 117. Between this and the upper platen 15, is a pattern-plate carrier 118, containing a pattern-plate 119 and a top box 120. The pattern-plate carrier with the pattern-plate and box 120 are mounted upon an arm pivoted upon the far side of the column 112 (as viewed in Figure 5), so that they can be swung aside when it is necessary to have them out of the way.

The ram 116, which carries the lower platen, is mounted so that it surrounds a fixed inner ram, the base 121 of which is supported by a cross-head 122 and tie-bars 123 from the under side of the base 111. The base is supported on joists 124, which span a pit 125, and the parts depending from the base are accommodated in the pit.

Inside the fixed ram 121 is a box-operating ram 126 to which is secured a cross-head 127 and the cross-head carries side-rods 128 which are attached to lugs 129 on the box 117. The internal arrangement of these parts, which are known per se, is shown in the diagram, Figure 6, in which also the lower platen 130 appears.

Behind the moulding machine is an individual oil pressure supply unit comprising a duplex pump in a casing 131, operated by a motor 132 under the control of a pilot valve column 133, which carries valve handles 134, 135. The supply outlet from the pump is connected by a number of pipe lines, one of which is indicated in Figure 5 at 136, to the operating cylinders for the platen 130 and the mould box 117. The pump is also connected by pilot pipe lines 137 to the control column 133.

Referring now to the diagram, Figure 6, this shows

the motor 132 connected to a duplex pump having two sections 140, 141, for low pressure and high pressure respectively, which are connected in a similar way to the description already given for Figure 4. They draw from the sump 142 and the low pressure section 140 delivers to an unloader 143, while the high pressure section delivers to a relief valve 144. From the relief valve, the high pressure delivery goes through pipe 145 to a box-operating ram control valve 146, and from the unloader valve the low pressure delivery 147 goes through a non-return valve 148, and pipe 149, through a further control valve 150 to join the high pressure delivery pipe 145. A connection 151 is taken from the pipe 149, which is at the same pressure as the high pressure delivery 145, to the control cylinder 152, and the unloader 143, and the general operation of these parts is the same as that of the corresponding parts of Figure 4, so that the two sections of the pump 140, 141, deliver together until a pressure is reached which corresponds to the maximum under which it is desired that the low pressure pump should operate, and thereafter the unloader 143 cuts out the low pressure section of the pump and the high pressure section alone delivers.

From the control valve 146 a pipe line 252 extends to the bottom of the ram 126, and thence up through the ram to the upper side of the ram piston 153. Bearing in mind that the inner ram 121 which contains the ram piston 123 is fixed at its lower end to the cross-head 127 (Figure 5), it will be seen that the effect of applying pressure to the pipe 252 will be to force the ram 126 and the cross-head 127 downwardly and with it the lower mould box 117. Pressure is applied constantly to the underside of the piston 153 by pipe 154, from the pipe 145. The area above the piston 153 is greater than the area below. Therefore, if the valve 146 is moved to admit pressure to the pipe 152, it will urge the mould box downwardly; if it is moved to connect the pipe 152 to the pump 142 by way of the pipe 155 it will permit the pressure in pipe 154 to urge the mould box upwardly. The valve 146 is urged to one or other of these two positions by cylinders 156, 157 connected respectively by pipes 158, 159 to a control valve 160 operated by the lever 134 under a similar way to the description already given for Figure 4.

A platen-ram control valve 161, is provided which is under the control of operating cylinders 162, 163, actuated respectively by pipes 164, 165, which are connected to a pilot valve 166, under the control of the operating lever 135 previously referred to. The control valve 161 serves to connect a pipe line 167, either to pressure from the line 149 or to the sump 142 through the line 168. The line 167 is connected by passages formed in the walls of the ram 121 to the space 169 above the head of the ram 121 within the outer ram 116. The access of pressure fluid to this space serves to raise the platen 130 secured to ram 116. Pressure is constantly applied by line 136 to the space 170 below the head of the ram 121 tending to lower the platen 130. Therefore, by operating the lever 135 of the pilot valve 166, either pressure can be applied in the space 169, to raise the platen 130, or, if this pressure is cut off, the constant pressure in the space 170 will lower the platen. The maximum pressure in the pipe line 167 is determined by the blow off pressure of relief valve 144. As this pressure is rather high for the high pressure section 141 of the pump to work against continuously when the machine is idle, an additional valve 171 is provided which is connected to valve 144 by line 173. The valve 171 relieves pressure in 172 when a pressure intermediate between the high pressure of valve 144 and the unloading pressure of valve 143 is reached. However valve 171 also contains a piston connected to line 167 and when pressure is applied in this line valve 171 is held shut and so the pressure rises to that of the blow off pressure of relief valve 144 through line 172 to sump.

In operation of a machine of this character, the operator first of all operates the pilot valve handles 134, 135 to move the mould-box 117 and the platen 130 up together and squeeze the sand against the pattern. Thereafter they can be moved down together leaving the top box 120 suspended on spring clips 180, and thus to open the mould and permit removal of the pattern plate and pattern 119. Then the box 117 and platen 130 can be again moved up to close the parts of the mold together. Thereafter the operator is able to move the mould box 117 downwardly while leaving the platen 130 raised and thereby to strip the mould from the mould-box and leave a completed bare sand mould ready to be removed from the machine.

The lifting of the platen, the piston for which has a large area, is, until the end of its stroke, against little pressure and is effected by both the pumps 140, 141, working together and therefore rapidly. In order to increase the ease of its movement and the speed of retraction or exhaust, several passages are provided in parallel through the walls of the fixed ram 121 as indicated in dotted lines in the diagram.

The purpose of control valve 150 is to regulate the ratio of pressures in lines 154 and 167 to ensure that the mould box 117 and platen 130 will rise at the same rate.

It will be observed that in a machine of this character the speed of operation is much increased by the provision of a two pressure supply from the two pump sections, working in parallel up to a certain pressure and driven by a single motor, and that the size of the motor is much reduced because the higher pressure delivery of the pump 141 is not required at the time when bulk delivery from the two pumps is called for.

I claim:

1. A foundry moulding unit comprising in combination a hydraulic squeeze moulding machine comprising opposed platens, supporting means therefor relative to which one of the platens is movably mounted for squeeze movement, a squeeze-cylinder having an operating member to urge the last said platen toward the other, a resilient mounting for one of the platens relative to its supporting means, an electrically driven vibrator, operative connections therefrom to the resiliently mounted platen to vibrate it, a pump unit having low pressure and high pressure deliveries, conduits connecting both said deliveries to the squeeze-cylinder, the high pressure delivery having a pressure adequate to compress the resilient platen-mounting and bring the platen into rigid connection with its supporting means, electric switch means operable to start the vibrator motor, and an operative connection from the resiliently mounted platen to the switch means to operate the latter when said high pressure is released and the platen therefore freed from rigid connection with its supporting means.

2. A squeeze moulding machine comprising a frame, an upper horizontal platen on the frame, a lower horizontal platen opposed thereto, a squeeze-cylinder beneath the lower platen, an operating member in the squeeze-cylinder to urge the platens together, a resilient mounting for the lower platen relative to the operating member, an electrically driven vibrator on the resiliently mounted platen to vibrate it, a pump unit having low pressure and high pressure deliveries, conduits connecting both said deliveries to the squeeze-cylinder, the high pressure delivery having a pressure adequate to compress the resilient mounting of the platen and bring it into rigid connection with the operating-member of the squeeze-cylinder, control means for determining the application of low and high pressure respectively to the cylinder, electric switch means on the said operating-member of the squeeze-cylinder operatively connected to the resiliently mounted platen to start the vibrator motor when the said resilient mounting is released and to cut off the vibrator motor when the high pressure is applied and the mounting is compressed.

3. A squeeze moulding machine as claimed in claim 2 wherein the electric switch means comprises a switch-box on the said operating-member of the squeeze-cylinder, vibrator motor circuit-making-contacts within the switch-box, contact-operating push rods protruding from the top and bottom of the switch-box to contact the underside of the said resiliently mounted platen and a fixed stop on the frame located so as to contact the underneath push-rod when the said operating member is in its lowermost position, whereby the vibrator motor is started and remains running while the push-rods are out of contact with both the said platen and stop.

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