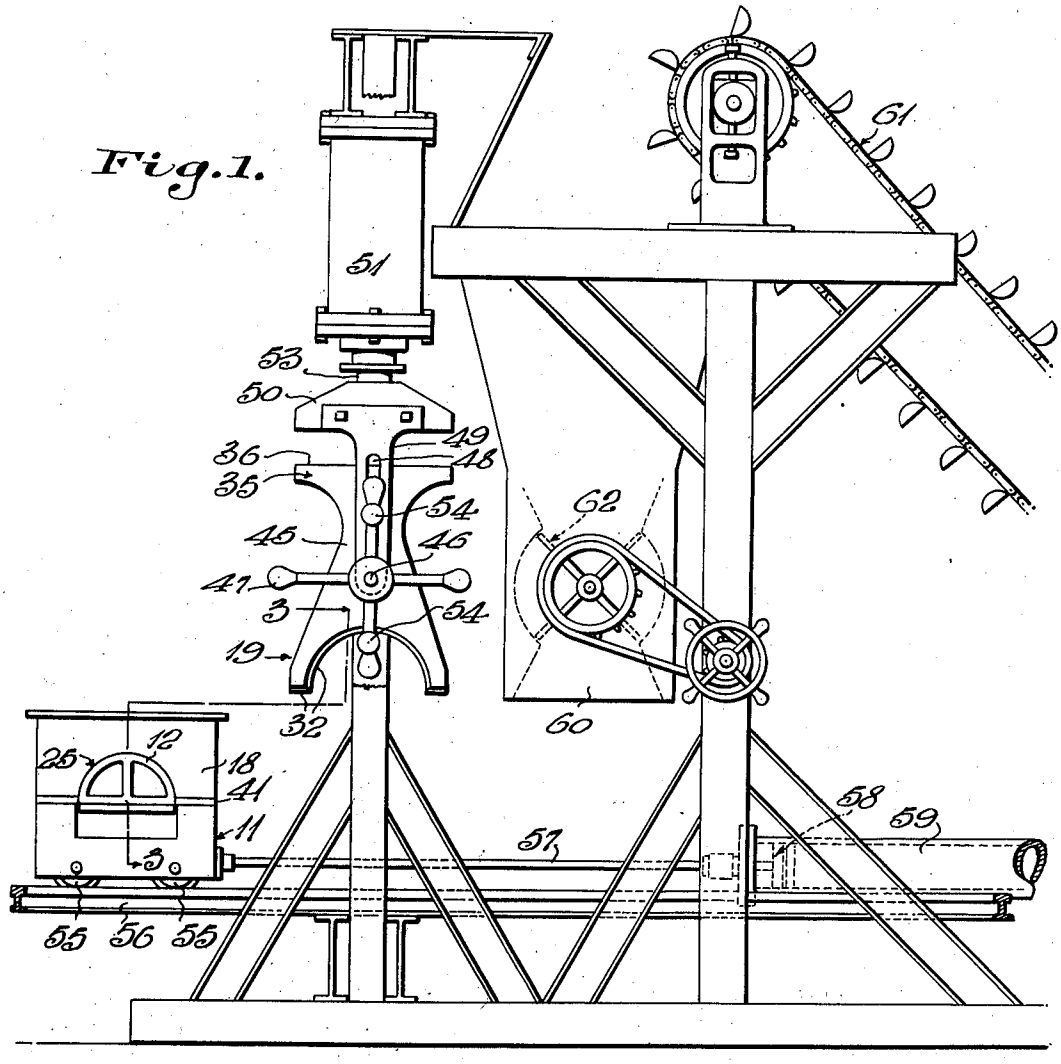
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SAND MOLD MAKING

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Fig. 1.



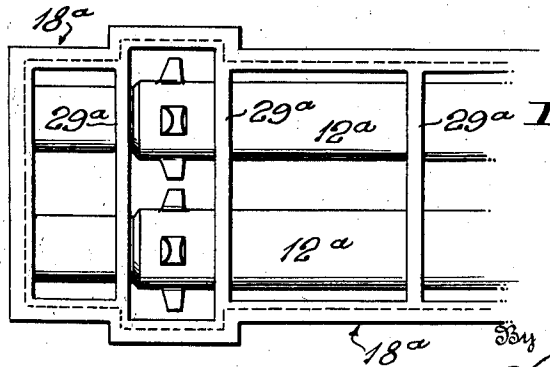




Fig. 9.

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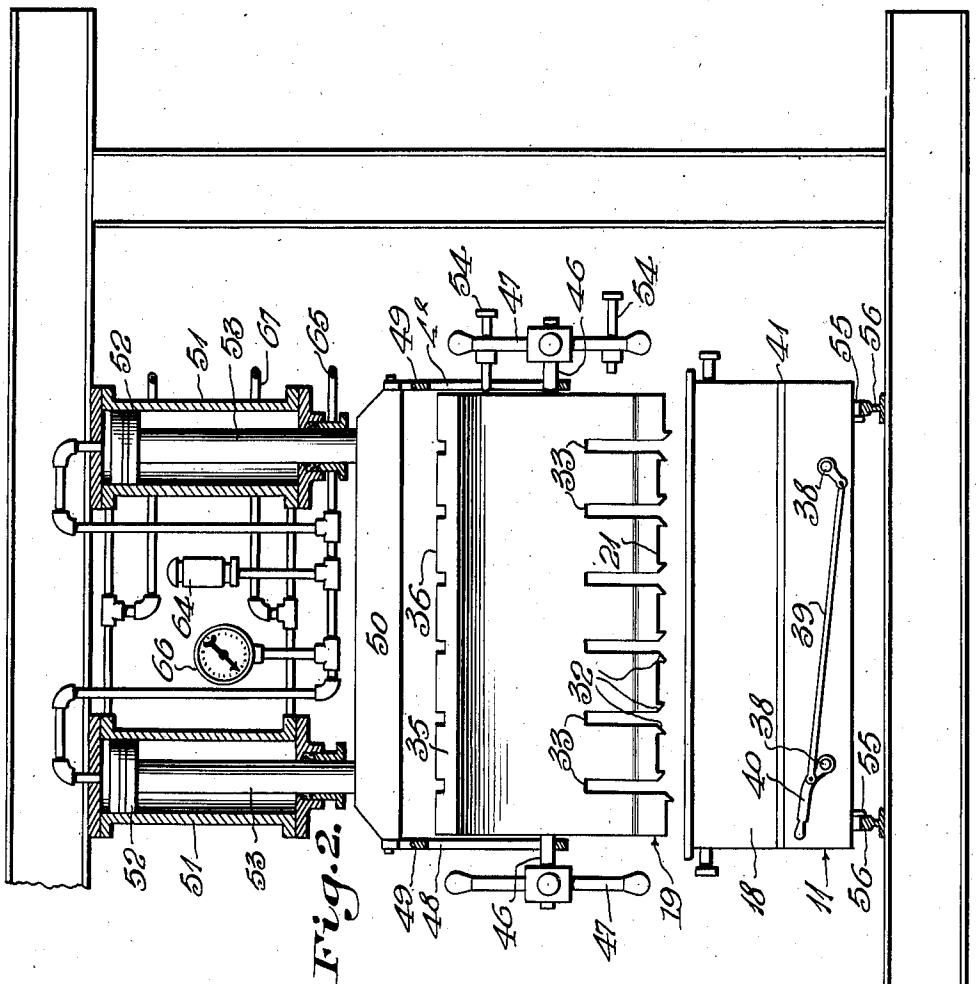


Fig. 2.

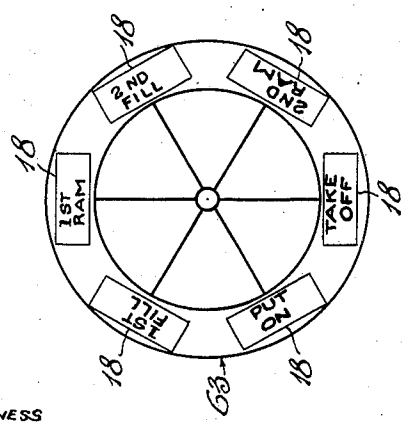



Fig. 10.

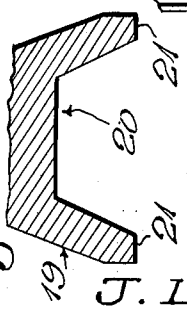


Fig. 11.

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Fig. 3.

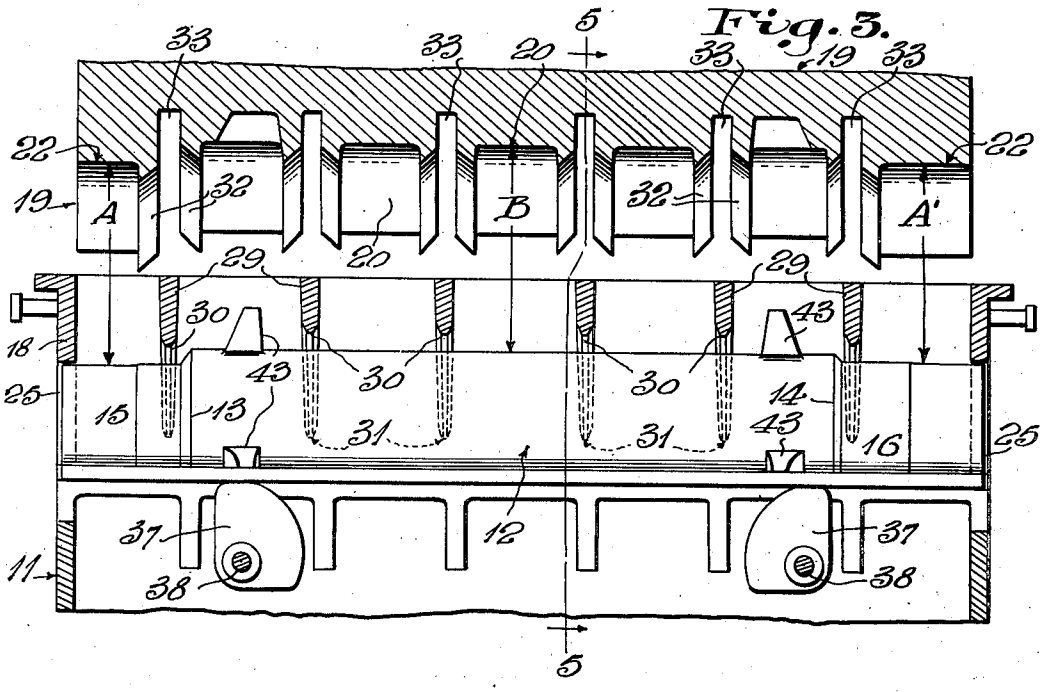
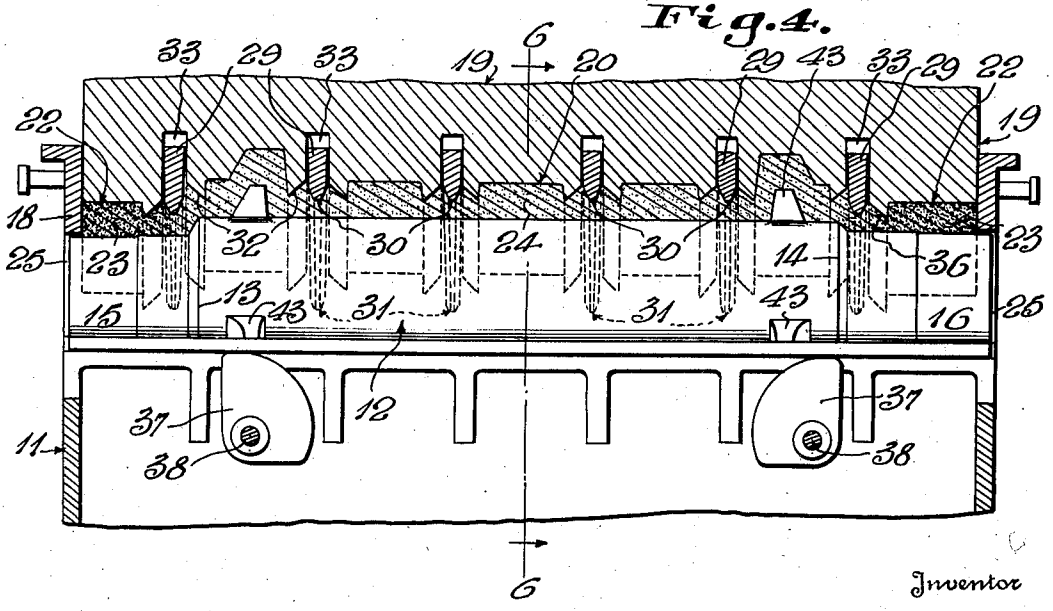



Fig. 4.




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Fig. 5.

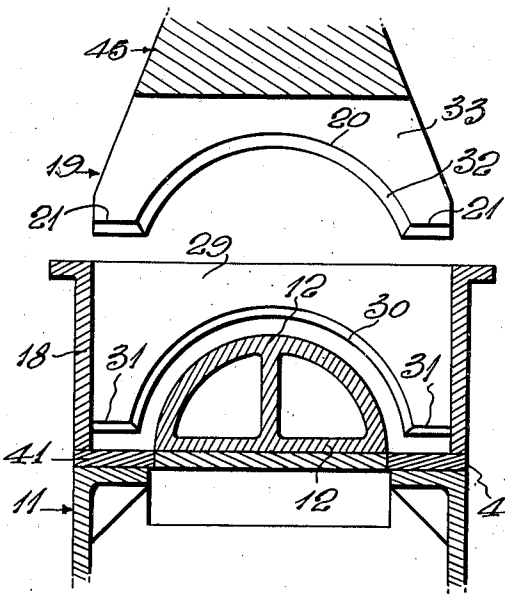



Fig. 6.

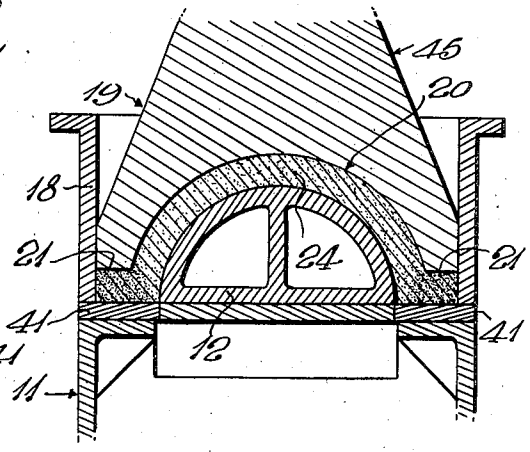



Fig. 7.

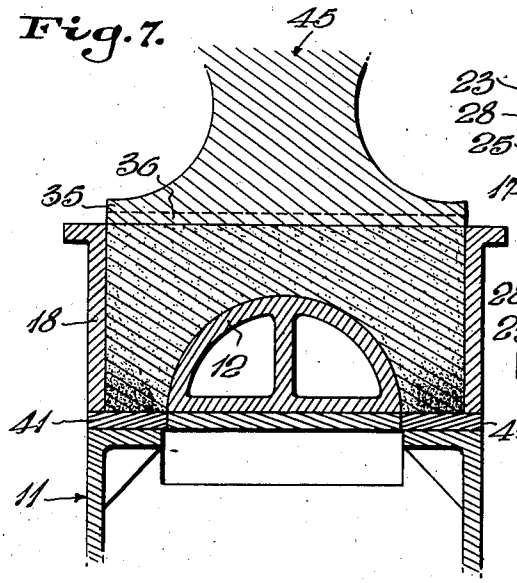
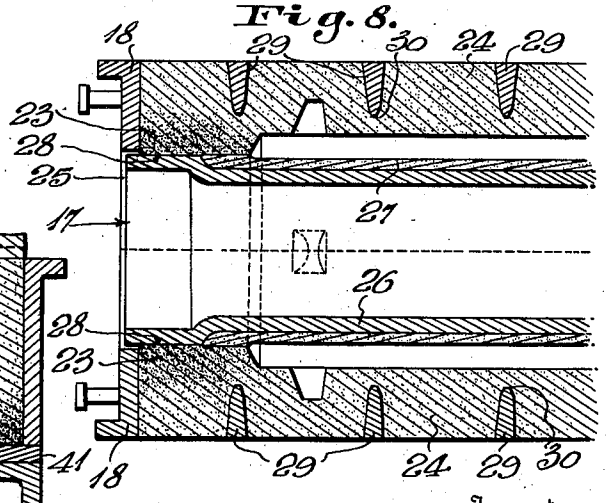



Fig. 8.




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# UNITED STATES PATENT OFFICE

2,191,687

## SAND MOLD MAKING

Jacob L. Skates, Bessemer, Ala.

Application December 21, 1938, Serial No. 247,127

6 Claims. (Cl. 22—25)

Heretofore, in the casting of metal pipe and the like with the aid of sand molds, it has been customary to prepare the molds by hand, necessarily giving slow production and making it virtually impossible for manufacturers using the sand mold process to compete with others using more rapid methods. Moreover, when the molding sand is hand-packed in the drag and cope, it has been impossible to obtain uniform packing of the sand. Non-uniform packing of course means a non-uniform mold, producing pipe of varying thickness and usually thicker than required, and not infrequently causing disruption of the mold while pouring.

It has heretofore been virtually impossible to so pack the sand which forms the usual core-holding prints, as to unyieldingly support the core in the completed mold, the result being that said core often rises when pouring, producing pipe of greater thickness at the lower side than at the upper. Even though the ends of the core are received in seats or notches at the ends of the drag and cope, it is customary to provide about one-quarter of an inch clearance between the ends of the core and said seats or notches, under which circumstances the prints in the sand mold (formed by the end portions of the pattern) must alone be relied upon to hold the core centered. With hand-packed sand, these prints often fail to properly perform this function resulting in a faulty product.

It is customary to provide the drag or cope with vertical partitions spaced above the pattern for holding the packed sand in place in the completed mold and it has been virtually impossible to properly pack the sand between the inner edges of these partitions and the pattern, the result being that the sand between said inner edges of said partitions and the core, is outwardly forced by the molten metal when pouring, causing the metal to form unnecessary and undesired circumferential ridges on the pipe.

It is to overcome all of the drawbacks above enumerated and place the sand mold process on equal footing with other processes, that the present invention has been produced.

With the above in view, the invention resides in the novel subject matter hereinafter described and claimed, description being accomplished by reference to the accompanying drawings.

Figure 1 is an end elevation of one form of machine constructed in accordance with the invention.

Fig. 2 is a front elevation, partly in section, of the machine shown in Fig. 1.

Fig. 3 is a vertical longitudinal sectional view substantially on line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 3 but showing the manner in which the first ram packs the sand in the drag or cope causing the pattern to form the desired molding impression and the core-holding prints.

Figs. 5 and 6 are vertical transverse sections on lines 5—5 and 6—6 of Figs. 3 and 4 respectively.

Fig. 7 is a view similar to Fig. 6 but showing the manner in which the second ram completes the sand packing operation.

Fig. 8 is a fragmentary longitudinal sectional view of the completed mold showing the manner in which the prints unyieldingly support the core even if the ends thereof cannot tightly engage seats or notches at the ends of the flask.

Fig. 9 is a fragmentary top plan view showing an arrangement which may be used in making a mold for a plurality of pipes.

Fig. 10 is a diagram showing the manner in which a turntable may be advantageously used in making the molds.

Fig. 11 is a detail transverse section showing a different formation for the ram 19.

The description will first explain the fundamental structural features of any machine constructed in accordance with the invention, will then explain the process carried out with the aid of said fundamentals, and will finally give examples of different ways in which said fundamentals may be associated with other elements.

Reference is first made more particularly to Figs. 3 to 7 inclusive. In these views, 11 denotes a suitable bed from which a horizontally elongated semicylindrical pattern 12 projects upwardly, said pattern having a main portion extending from the line 13 to the line 14 to form a molding impression in the sand, and having end portions 15 and 16 to form the usual prints in the sand, to later support the core (shown at 17 in Fig. 8). Operatively related with the bed 11 is a drag or cope 18 in which to pack molding sand to provide a sand mold having the desired molding impression and prints. Receivable in the drag or cope 18, is a ram 19, said ram having an arched formation 20 extending longitudinally of its lower side to pack the sand upon the pattern 12, and also having horizontal lower faces 21 at the lower terminals of said arched formation, to pack the sand upon the bed 11. The end portions 22 of the arched formation 20 which pack the sand upon the end portions 15 and 16 of the pattern 12, to produce

the core-holding prints are, in any position of the ram 19, spaced closer to said portions 15 and 16 than the intermediate portion of said arched formation 20 is spaced from the cooperating portion of the pattern 12, as will be seen by comparing the distances A and A' of Fig. 3 with the distance B. Thus, when the ram 19 is lowered to press the sand, the sand 23 which forms the core-holding prints, will be pressed much harder than the sand 24 which forms the molding impression. It is thus insured that these prints in the complete mold (see Fig. 8) will unyieldingly hold the core 17 centered within the molding impression 24, even if the ends of said core be spaced from the edges of the seats or notches 25 in the ends of the cope or drag, which spacing is customary. The core is thus held against shifting during pouring and consequently a pipe cannot be produced thicker at its lower side than at its upper, as now often occurs. The core 17 is shown as constructed from a metal arbor 26 covered with molding sand 27. The sand 27 ordinarily extends to the so-called "iron prints" 28 at both ends of the arbor 26 which prints snugly engage the sand prints 23 and hold the core centered.

It is preferable that the drag or cope 18 be provided with vertical transverse partitions 29 to better hold the packed sand in place, said partitions having arched lower edge portions 30 which extend over and are spaced upwardly from the pattern 12, and also having horizontal lower edge portions 31 spaced upwardly from the bed 11. To inwardly crowd the sand under the edge portions 30 and 31 as the ram 19 descends, I provide said ram with beveled formations 32 at opposite sides of the slots 33 which receive the partitions 29, said beveled portions 32 being disposed at the juncture of the opposite walls of the slots with the arched formation 20 of the ram and being preferably in the form of beveled ridges projecting downwardly from said formation 20 and from the horizontal portions 21 of the ram. The beveled faces of the ridges or the like 32 diverge downwardly and they thus tightly crowd the sand under the partitions 29 as seen in Fig. 4, giving to this sand a compaction or density equal to the rest of the sand which is to form the molding impression. Thus, in the completed mold, there are no relatively weak portions at the inner edges of the partitions 29 and consequently the molten metal will not crowd the sand outwardly and form undesirable circumferential ridges upon the pipe.

After the ram 19 is operated, more sand is added to the drag or cope and a second ram 35 having a flat lower side 36, is used to compress this sand, both the first fill and the second fill being compressed with the same amount of power.

Preferably, the bed 11 is in the form of an ordinary pipe jack having means for raising and lowering the pattern 12, and for illustrative purposes, I have shown the pattern supports in the form of cams 37 on rock shafts 38, said rock shafts being connected by a conventional link and lever mechanism 39, 40 so that the cams or the like may be operated to hold the pattern 12 operatively positioned, and to drop said pattern after the sand packing operation has been completed. The pipe jack is shown as provided with the usual stripping plates 41.

In order to form the necessary pour holes in the mold, conventional pins and gates (not shown) will of course be used at desired points, and any suitable number may be employed. The pattern which I have disclosed is provided with lugs 43 near its ends to form lugs on the ends of the pipe, to be bolted together, and suitable provision forming no part of the present invention, can of course be provided whereby the pipe lugs are cast with the required bolt holes therethrough. It may also be explained that the pattern 12 which has been shown, is intended to form a pipe having a male end and a female end, both of which are to be machined after casting, but it will be understood that I am not restricted to forming pipes of this nature.

In carrying out the process, the drag or cope 18 is operatively related with the bed 11 and the pattern 12, and a suitable quantity of sand is discharged into said drag or cope and substantially leveled. The ram 19 is then brought down under power to solidly pack the sand upon the pattern 12 and upon the bed 11 at opposite sides of said pattern. Due to the fact that the surface of the sand is about level when it is engaged by the ram 19, the sand will be packed more densely by the ram surfaces 21 than by the arched formation 20, which is proper, for the sand packed by the surfaces 21 must abut the sand of the other mold section and should be packed very tightly, whereas the sand around the pattern 12 should be densely packed, but not packed sufficiently tight to prevent air and gases from escaping during the molding of the pipe. It will also be observed that the sand pressing operation causes the ram surfaces 22 to compress the sand for the prints 23, much more densely than the sand 24 which forms the molding impression, insuring that said prints shall unyieldingly hold the core 17 centered in the completed mold, as seen in Fig. 8.

Further attention is drawn to the fact that simultaneously with the compaction produced by the ram surfaces 20, 22 and 21, the bevel means 32 effects thorough packing of the sand under the partitions 29, preventing weaknesses which would otherwise allow the formation of circumferential ridges on the pipe.

After the packing operation is performed by the ram 19, more sand is added and this sand is packed with equal pressure by means of the second ram 35, as seen in Fig. 7.

After the drag or cope is completely filled and completely packed, it and the pattern 12 are relatively disassembled, this being done in the present instance, by dropping said pattern. The filled drag or cope is then in readiness for use to form half of a sand mold, as will be clear from Fig. 8. Assuming that the cope is filled and packed as explained, the drag may be prepared in the same way either with the same machine or with a separate machine, preferably the latter, the drag and cope being then properly assembled with the core 17 to form the complete mold shown in Fig. 8. The prints 23 unyieldingly hold the core centered, irrespective of any holding action which may or may not be performed by the seats or notches 25, and as the sand is packed throughout to the proper density, a perfect mold is provided which will produce perfect pipe.

In Fig. 9, I have shown what may be termed a twin cope or drag 18a, for holding two patterns 12a, said drag or cope having the partitions 29a. For use with the assemblage shown by this view, one ram is of course provided having a twin formation shaped to perform the first sand pressing operation, and another ram is used to perform the final pressing operation.

The two rams 19 and 35 above described, or the two rams cooperable with the structure shown in Fig. 9, may be embodied in one press if desired,

as seen in Figs. 1 and 2 or in two different presses as diagrammatically illustrated in Fig. 10. Similarly any suitable means may be used to move the drag or cope from a first filling position to a first ramming position, and then to a second filling position, then to a second ramming position, and finally to a take-off position. For examples, Figs. 1 and 2 disclose a car and track arrangement for moving the drag or cope as required, and Fig. 10 diagrammatically illustrates a turntable for this purpose.

In Figs. 1 and 2, the rams **19** and **35** are formed by opposite sides of a single head **45**, said head having trunnions **46** upon which it may be turned to bring either of said rams into position for use, hand wheels or the like **47** being provided on said trunnions. These trunnions pass through vertical slots **48** in a pair of arms **49** which are secured to and project downwardly from a ram head **50**. Suitable operating means such as hydraulic cylinders **51**, pistons **52** and piston rods **53** connecting said pistons with the head **50**, are employed for depressing the latter with required pressure. Normally the head **45** is sufficiently below the head **50** to prevent the latter from interfering with turning of the former upon the trunnions **46**, but when either the ram **19** or the ram **35** comes down upon the sand, its movement is limited, whereupon the ram head **50** lowers into contact with whichever ram is then uppermost, whereupon the downward movement of said head **50** will depress the head **45** to perform the sand packing operation. After the first operation is carried out with the ram **18**, the head **45** is inverted and a second press is effected with the ram **35**.

Suitable provision is made to hold the head **45** against accidental turning. For illustrative purposes, two pins **54** are shown slidably carried by one of the hand wheels **47** to engage one of the slots **48**, one pin being used when the head **45** is in one position and the other pin when said head occupies its other position.

In Figs. 1 and 2, the bed **11** is provided with flanged wheels **55** resting upon a suitable track **56**, and said bed is operatively connected by means of a rod **57** and piston **58**, with a hydraulic cylinder or the like **59**, permitting shifting of the drag or cope **18** as required. It is preferable to provide a sand hopper **60** and a conveyor **61** for carrying sand thereto, and to provide an appropriate means **62** for controlling the discharge of sand to said hopper. When the drag or flask **18** is positioned under this hopper, the means **62** is operated to discharge the first quantity of sand into said drag or cope, whereupon this drag or cope is moved to a position under the ram head **45**. The ram **19** is now used to perform the first sand packing operation. Then the drag or cope is again moved under the hopper **60** and receives the final fill, whereupon it is again moved under the ram head **45** where the ram **35** is used to impart the final packing operation, the drag or cope being then moved to the position shown in Fig. 1 to permit removal of the completed mold section from the bed.

In Fig. 10, I have diagrammatically illustrated a turntable **63** to support the drags or copes **18**, said turntable being operated in any suitable way to move any drag or cope from an initial or "put on" position to a "first fill" position, then to a "first ram" position, then to a "second fill" position, next to a "second ram" position and finally to a "take off" position.

The extent to which the drag or cope is filled with sand for the first and the second filling operations will depend to a large extent upon the size of the drag or cope and the pattern or patterns. For a drag or cope seven and one-half inches deep, used in casting four-inch pipe, the pattern, of course, projects upwardly substantially two and a half inches. The sand is first filled within about one and one-half inches of the top of the drag or cope. This first fill of sand is compacted until the layer of sand over the pattern is about two inches thick. When filling with more sand, the level is approximately three-fourths of an inch above the upper edge of the drag or cope, and for the final compaction, this level is forced down even with said upper edge. Both of the sand-packing operations, regardless of the exact construction of the press, are preferably carried out with the same pressure. This may be insured by providing a pressure relief valve **64** in the line **65** which supplies the hydraulic fluid for operating the ram. When the pressure on the ram reaches the predetermined amount, the valve **64** will open and permit no pressure on said ram in excess of that for which said valve is set. A pressure gauge **66** is of course provided for obvious reasons. While a hydraulic fluid is preferably employed to force the pistons **52** downwardly, air under pressure may be admitted under said pistons to again raise the press, a suitable air line **67** being shown for this purpose. Any appropriate provision may, of course, be made for handling the exhaust of air from the lower end of the cylinders when the pistons are being forced down by the hydraulic fluid, and for handling the exhaust of hydraulic fluid when said pistons are being forced upwardly by the compressed air. Moreover, while hydraulic pressure, air pressure, or both are preferable in operating the press or presses, it will be obvious that other operating provision could be made if desired.

From the foregoing, it will be seen that novel and advantageous provision has been made for carrying out the object of the invention and while preferences have been disclosed, variations may, of course, be made within the scope of the invention as claimed.

I claim:

1. In a machine for making a pipe or similar mold, said machine having a bed-supported pattern provided with end portions to form core-holding prints; a ram for packing molding sand upon said pattern and its supporting bed, the lower side of said ram being provided with a longitudinally extending transversely arched formation to pack the sand upon said pattern, the end portions of said arched formation which pack the sand upon said print-forming end portions of said pattern being spaced, in all positions of the ram, a shorter distance above said print-forming end portions of the pattern than the intermediate portion of said arched formation is spaced above the intermediate portion of said pattern, insuring packing of the print-forming sand more tightly than that which forms the molding impression, causing the prints to unyieldingly hold the extremities of the core in the completed mold.

2. In a mold making machine having a bed-supported pattern, and a drag or cope provided with spaced vertical partitions above said pattern; a ram receivable in said drag or cope and having a working face to pack molding sand on said pattern and its supporting bed, said ram having downwardly open vertical slots to receive

said partitions, said ram being provided with beveled portions at the juncture of said working face with the side walls of said slots, the beveled portions at opposite sides of each slot being disposed in downwardly diverging relation with each other to inwardly crowd and pack the sand under said partitions, obviating low density zones in the mold under said partitions.

3. In a mold making machine having a bed-supported pattern, and a drag or cope provided with vertical partitions above said pattern; a ram receivable in said drag or cope and having a working face to pack molding sand on said pattern and its supporting bed, said ram having downwardly open vertical slots to receive said partitions, said ram being provided with downwardly projecting ribs at the juncture of said working face with the side walls of said slots, the inner opposed faces of the ribs at opposite sides of any slot being disposed in downwardly diverging relation with each other to inwardly crowd and pack the sand under said partitions, obviating low density zones in the mold under said partitions.

4. In a press, a ram having different working faces for performing different operations, said ram being provided with trunnions upon which it may be turned to position any of said working faces downwardly for use, a presser head normally spaced above said ram to permit turning of the latter upon said trunnions but movable downwardly onto said ram to depress the latter, means for suspending said ram from said presser head without prohibiting the necessary relative vertical movements of said ram and presser head, said suspending means having portions for preventing lateral movement of said ram with respect to said presser head, and releasable means for holding said ram against turning upon said trunnions during the relative vertical movements of said ram and presser head.

5. In a press, a ram having different working faces for performing different operations, said ram being provided with trunnions upon which it may be turned to position any of said working faces downwardly for use, a presser head normally spaced above said ram to permit turning of the latter upon said trunnions but movable downwardly onto said ram to depress the latter, rigid suspending arms for said ram secured to and projecting downwardly from said presser head, said arms having vertical slots in which said trunnions are received, to allow the necessary relative vertical movements of said presser head relative to said ram and to prevent lateral movement of said ram with respect to said presser head, and releasable means for holding said ram against turning upon said trunnions during the relative vertical movements of said ram and presser head.

6. In a press, a ram having different working faces for performing different operations, said ram being provided with trunnions upon which it may be turned to position any of said working faces downwardly for use, a presser head normally spaced above said ram to permit turning of the latter upon said trunnions but movable downwardly onto said ram to depress the latter, rigid suspending arms for said ram secured to and projecting downwardly from said presser head, said arms having vertical slots in which said trunnions are received, to allow the necessary relative vertical movements of said presser head relative to said ram and to prevent lateral movement of said ram with respect to said presser head, and latch means mounted on said trunnions and engageable with at least one of said slots to hold said ram against turning upon said trunnions during the relative vertical movements of said ram and presser head.

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