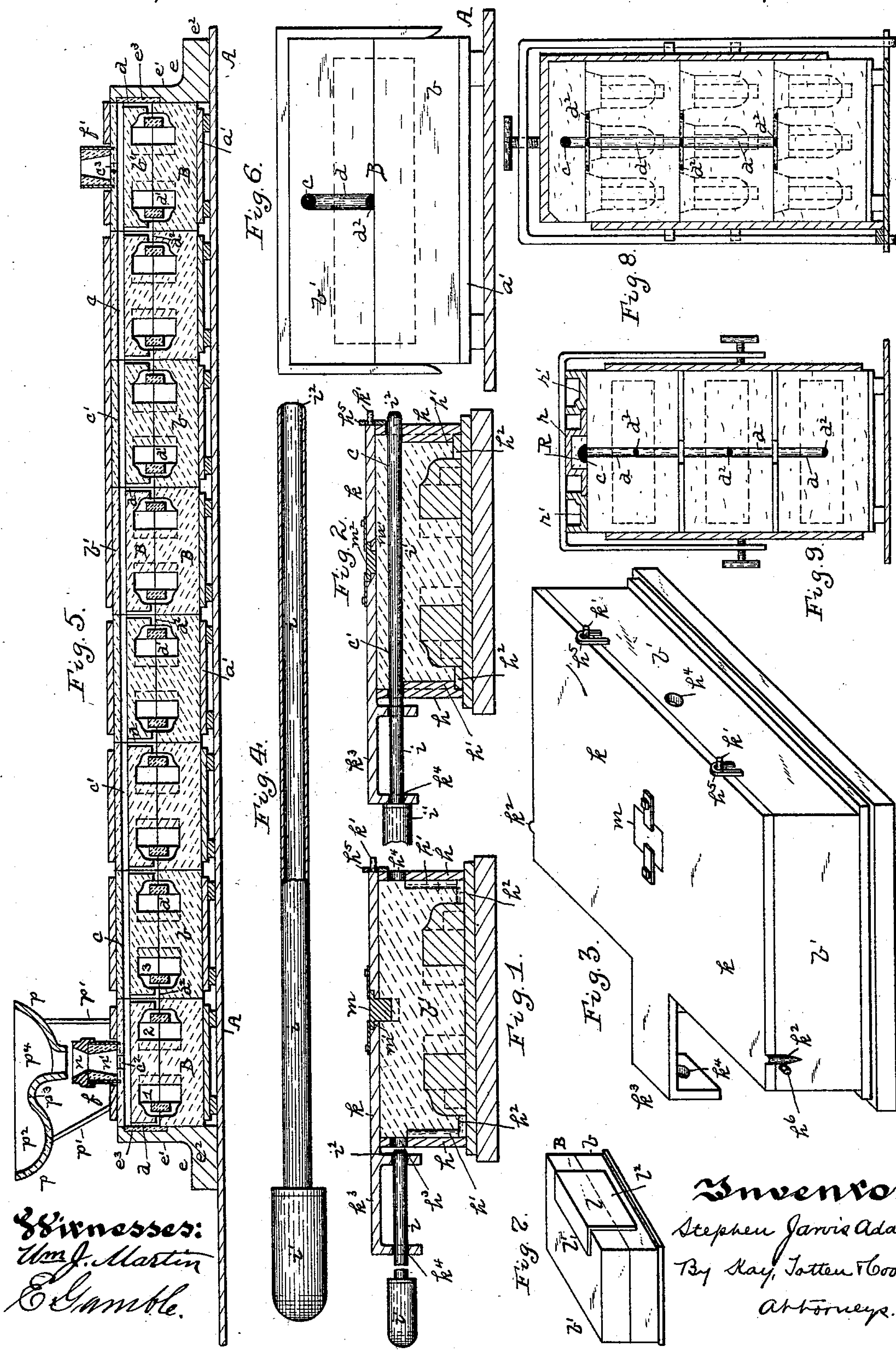
(No Model.)

S. J. ADAMS.

APPARATUS FOR FORMING SAND MOLDS.

No. 521,450. Patented June 19, 1894.



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APPARATUS FOR FORMING SAND MOLDS.

SPECIFICATION forming part of Letters Patent No. 521,450, dated June 19, 1894.

Application filed October 24, 1892. Serial No. 449,905. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN JARVIS ADAMS, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for Forming Sand Molds; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the making of sand molds and to the casting or pouring of the metal into the same, its object being to overcome the great labor heretofore experienced in the pouring of approximately small molds by means of hand ladles, my invention being of the same general class as that set forth in the application for Letters Patent filed by me of even date herewith, Serial No. 449,901, in which the broad idea of a continuous pouring gate communicating with several separate molds is described and claimed.

The present invention consists, generally stated, in the combination of a series of sand molds in line with each other and having mold cavities therein, and a horizontal continuous runner inclosed within the several sand molds above the mold cavities thereof and communicating with the different channels leading to the mold cavities, so that the metal is caused to flow horizontally through such continuous runner above the mold cavities and is fed therefrom downwardly into the mold cavities of the several molds; as well as in other improvements, such as by so constructing the mold that the metal first flowing through any one of the sections of the continuous runner formed in the respective sand molds passes by a down-take runner into the next mold cavity, so that it is not caused to heat more than one section of the continuous runner.

The main features of advantage to be obtained are the protection of the hot metal from contact with the atmosphere so that it can be carried for a long distance through the series of molds, the overcoming of the spilling of the metal such as might take place in an exposed runner, and the providing of a suitable head of metal by the employment of the continuous runner above the mold cavities which will prevent the back movement of any gases through the molten metal in the runner, and by the weight of the metal will force such gases through the sand walls of the mold and insure the formation of practically perfect castings.

To enable others skilled in the art to practice my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a cross section illustrating the formation of the mold which is taken to illustrate generally the invention desired to be covered, said figure showing the formation of the cope of the mold, and the position of the parts in forming the continuous runner through the mold, while Fig. 2 shows the position of the parts upon completing the formation of such runner. Fig. 3 is a perspective view of the mold showing the application of the continuous runner forming device thereto, and also illustrating generally the construction of the same. Fig. 4 is a separate view of the cutter for forming such continuous runner or passage. Fig. 5 is a longitudinal section showing a series of these molds in position for pouring; that is, ready to receive the metal. Fig. 6 is an enlarged end view of one of the molds shown in Fig. 5. Fig. 7 is a perspective view showing the mold protector employed for handling the finished mold while arranging it in line with the others; and Figs. 8 and 9 are sectional views showing other forms of the continuous runners.

Like letters and numerals of reference indicate like parts in each of the views.

The general invention is, of course, more clearly illustrated in Fig. 5, showing the longitudinal section of the mold to be formed, than in any of the other figures, and in order that the invention may be understood, both as to the method and apparatus and the uses of the different parts shown, I will first describe that figure.

The invention is illustrated in connection with any suitable cope and drag mold, though it is evident that it may well be employed with single part molds. As the molds are to be held in line and in contact with each other, and the inclosed runners or metal passages between the several molds must be made to communicate the first essential of the invention is an even floor, and for this purpose I prefer to employ a floor made of one or more metal or like plates to give a rigid support as at A, single plates being preferably employed so that there may be no fear of the parts getting out of alignment. These plates may, of course, be suitably supported on the foundry floor, and on them are placed the several molds. The bottom boards a' are also required to be carefully made, and are preferably made of metal so insuring in this way an even and regular support for the molds which will not warp, burn or get out of shape. The molds B are shown as made of the cope b' and drag b, and, as is seen by said figure, the molds fit closely against each other, so that a sand joint is formed which will prevent the escape of the metal between the molds during the pouring operation. The molds shown are for brake shoes, being illustrated in connection with the casting of these articles because the invention has heretofore been employed in connection with molds for making brake shoes. Extending continuously through the series of molds is the inclosed runner or passage c which, as is apparent in the drawings, leads through all the different molds placed in line and communicates by the down-take runners d with the mold cavities d' of each mold. This inclosed continuous runner may be formed in any suitable way, either in the mold section containing the mold cavity, a separate mold section resting thereon, as in Fig. 8, or by means of an inverted trough fitting closely on the molds, as in Fig. 9. It will be noticed that the vertical runners d extend down from the main passage c between the several molds, and that leading from them are cross passages or runners d^2 which feed into the mold cavities. The purpose of this is to provide for the formation of clean, unobstructed feeding passages which could not be well obtained if such vertical runners were formed inclosed with the bodies of the separate molds, open and free feeding passages being thus formed from the common continuous runner passage to the mold cavities. It will also be noticed that, as illustrated, these down-take runners are as large as the main runner passage, this being intentional so as to provide for the flow of the metal into the mold cavity or cavities fed by the first down-take runner before the metal enters the next down-take runner, or to provide so that the metal is only feeding into a limited number of the down take runners at the same time. The principle on which the runners are made is that the down-take runners shall be of sufficient size to receive so much of the metal from the continuous runner that only a limited number of down-take runners be receiving the metal at one time, and the metal shall not chill in heating up the continuous runner, and therefore that the metal first passing through any section c' of the continuous runner shall be carried by the next down-take runner to the mold cavity, and no two sections of the continuous runners shall be heated by the same portion of metal. The reason for this is that it is not desirable to carry the metal which first passes along the continuous runner for any long distance through the same, because it would be chilled by contact therewith and would finally lose its fluidity so as to clog the continuous passage and prevent the further flowing of the metal. By constructing the runner passages in the way above described, however, the metal first traveling through a section part of the continuous runner is carried into the down-take runner and into one of the mold cavities before it has been in contact with the sand long enough to be chilled, and it simply therefore serves to heat up a short section of the continuous runner, such as that part extending through one mold, and then enters into one of the mold cavities, and when it is filled a fresh body of hot metal being provided to pass through and heat the section of the continuous runner in the next mold, and that portion again being carried into the mold cavity as soon as it passes through it. It is found by practical experience that in the handling of the metal in this way within the continuous runner the metal may be carried any distance desired and maintained at practically the same heat as that in the pouring ladle, the only limit heretofore found being the length of the foundry floor. As hereinafter described, the continuous runner is made to pass entirely through each mold, and where there are two mold cavities in each mold each mold cavity is fed by the down-take runner formed in the side of the mold nearest to the mold cavity, and therefore such down-take runners extend down each side of said mold. To close such down-take runners at the ends of the series of molds, I provide abutments e, one or both of which may be connected to the foundry floor, though, as a matter of fact, if they are formed sufficiently heavy, that is not necessary. They have the vertical portions e' and the horizontal portions e^2 which rest upon the foundry floor, and they are made of the same width as the mold so as to confine the ends of the series of molds. At the point where the down-take runner is formed in the mold, I prefer to provide the abutment with sand pocket e^3 which is filled with sand, and the metal in passing along the continuous runner will, at each end of the line of molds, flow against such abutment and down through the runner d and thence into that particular mold cavity.

In order to feed the metal to the molds, I provide the feeding basin or reservoir f which communicates by means of a suitable passage c^2 with the continuous runner c, the construction of which will be hereinafter described, and at the other end of the line of molds, in order to discover when the molds are filled, I provide a riser or reservoir f' to retain the metal which communicates with the like passage c^3 leading into the runner c.

I will now describe the formation of the molds and the placing of the same in line for casting, and after having described all the parts will then describe the casting of the series of molds such as illustrated more particularly in Fig. 5. The drag b of the mold illustrated can, of course, be formed in any suitable way, being molded by hand or machinery, and being supported upon the bottom board a'. The cope b' is molded and placed upon the drag, the cope flask and drag flask being guided into proper relative position by suitable means and then removed from the finished mold. The preferred method of forming the cope is illustrated in Figs. 1 and 2, the cope flask h being placed over the patterns and guided to place and the sand compacted therein by suitable means. It will be noticed that extending along the cope flask are the ribs h' which form the vertical runners d above described, and that leading from such ribs h' to the patterns are the ribs h^2 for forming the feeding runners d^2 communicating with the mold cavities. After the compacting of the sand in the flask, the only necessary step to complete the same is the formation of the section c' of the continuous runner c in that mold, and for this purpose I employ the sand confining plate shown in Figs. 1 and 2 and shown in perspective in Fig. 3. It will be noticed that the flask h has the openings h^3 h^4 formed therein in line with each other and just above the ribs h' forming the down-take runners. It will also be noticed that the flask is provided with the loop h^5 at one end thereof. The sand confining plate k is of such size as to fit over the entire mold formed, and it has the pin or projection k' which enters the loop h^5 and also has on each side thereof the vertical lip k^2 adapted to pass on each side of the flask so as to direct the sand confining plate to exact position thereon, the lips k^2, if necessary, having inclined lower ends which by passing along pins or lugs h^6 on the flask force the projections k' into the loop and the plate k into exact position. At the opposite end of the plate from the projection k' is the guide k^3 which has formed through it a guide passage k^4 which, when the plate is brought into position on the flask, is exactly in line with the holes h^3 h^4 in the flask body. When the parts are brought to this position, the mold is ready for the formation of the continuous runner through the same which is accomplished by a runner cutter passed through the guide-way k^4 and forced through the sand of the mold, the preferable form of cutter being shown in Fig. 4. For this purpose any suitable solid or tubular cutter may be employed, the same being simply forced through the guide-way k^4 and thence through the sand of the mold so as to form the continuous runner through the same. I prefer, however, to employ a hollow or tubular cutter, such as the cutter i, which has a handle i', the forward end of the cutter being sharpened as at i^2, and, if desirable, spun in a little so that as it receives the sand, a free space for the reception of the sand within the cutter body will be obtained. To form the runner it is therefore only necessary for the operator, after having placed the plate k in position, to grasp the tubular cutter i and force it through the passage k^4 and thence through the sand of the mold until it passes out of the hole h^4, withdraw the same and by a blow drop the sand out of the tubular cutter. He then removes the plate k, withdraws the pattern, places the cope flask upon the drag flask, so completing the mold, the cope and drag flasks being then opened and taken from the finished mold which is ready to be placed upon the bed plate A. When the mold is completed, any fin or loose sand which might have been formed may be easily removed as the vertical runners are exposed at the side of the mold.

As above stated, it is important that the mold so formed and resting upon the bottom board shall be held intact, and especially that the face where the end of the continuous runner opens shall be properly protected, but in carrying the mold it is very liable to strike against the body of the workman and even such slight pressure is liable to crack or break off the upper edge of the mold where the continuous runner ends. To prevent this I employ the shield or mold protector shown in Fig. 7, consisting of a light angular shield l, part of which, as at l', rests upon the top of the mold, while the other part l^2 extends down the side thereof which would be liable to strike against the body of the workman, and such angular shield so prevents injury to that part of the mold body while it permits the workman to support it against his own body in carrying the mold out to its place on the plate A. It also gives a surface for the workman to press against in placing the mold in close contact with the mold previously made, so as to form a sand joint between the bodies of the two molds, this being practically the only careful work required in the molding operation. The workman places each mold in close contact with the preceding one, so that the runner section c' extending through the body of the same will be in communication with the like runner section c' in the adjoining mold and that the surfaces are brought to close contact to prevent leakage of the metal. In so doing he forms the continuous runner through the series of molds, and the vertical runner or down-take channel extending down between the molds and communicating with the cross gates leading to the mold cavities. Each mold in the series is formed in the manner above described, except, possibly, the end molds of the series. The metal may be fed to the continuous runner from any suitable reservoir or basin, which communicates with such runner c. That illustrated in the drawings is a reservoir f supported upon the end mold of the section, as shown in Fig. 5, the reservoir being arranged to communicate with the continuous runner by a passage formed through the top of the mold. When such device is employed, such inlet passage, as at c^2, can be easily formed in connection with the plate k. In such cases I connect to said plate the block m which fits in the seat in the plate k and is held there by suitable clamps, the lower face of the block corresponding in shape to that of the tubular cutter, and as the plate k is forced down to the position in which the cutter is passed through the mold, this block m forces the sand downwardly so as to form a depression therein, so that when the tubular cutter is forced through the mold, as its movement is in line with the face of the block, it passes along such face, the result being the formation of the passage c^2 communicating with the continuous runner c. Such block can be employed in forming the end molds, the flat plate m^2 being inserted in the seat m' of the plate k in forming the other molds of the series. In such case the reservoir f to receive the metal and form a head for the same, as above stated, may be simply formed of a short tubular flask lined with sand, or of a tile having the same shape. These reservoirs are supported on the mold bodies above the openings c^2, like reservoirs $f f'$ being preferably employed at each end of the series of molds, the one to direct the metal into the continuous runner, the other to receive the metal therefrom at the end of the series of molds, the two together holding a surplus of metal to supply any metal during the shrinking necessary to fill out the molds and by the weight or head of metal to insure solid castings. The metal may be poured into the feeding reservoir directly, if desired, and in that case the reservoir be made of such shape as to properly receive it, but I prefer to employ a movable hopper p, such as shown in Fig. 5, which may rest either upon the mold or upon the floor adjacent thereto, the mouth of which is placed over the feeding reservoir and from which the metal flows into the reservoir and then into the continuous runner. In the latter case, the hopper has the supporting legs p' by which the hopper is supported at a height above the feeding reservoir sufficient to enable the operator to see into the reservoir and be guided in the feeding of the metal by the amount flowing into the same. It also has the pocket p^2 into which he fills the metal, the metal flowing thence over the dam p^3 into the discharge opening p^4 of the hopper, a continuous solid stream of metal being thus fed into the feeding reservoir. The upper portion of the feeding reservoir is made upwardly flaring to direct the metal into the same, its lower portion being preferably made downwardly flaring; and in such case if the metal extends above the downwardly flaring portion when set it might lock the same so that the core of metal so formed therein could not be removed. If the reservoir of such shape is formed of fire clay it is for this reason divided horizontally into two parts n n' so that the upper portion may be lifted off and the metal contained therein, before it solidifies in the upper or reverse part, permitted to escape. The reservoir f' at the other end of the series of molds is generally made downwardly flaring, its purpose being simply to maintain the head of metal as above described.

After the series of molds have been completed, the abutments e, above referred to, are placed in position and so serve to confine the exposed faces of the end molds in the series, and these abutments may be clamped in place if not sufficiently heavy to sustain the pressure. It is also necessary to confine the side and top walls of the series of molds during the casting of the metal, and different devices for this purpose are described in several applications filed by me of even date herewith, Serial Nos. 449,906 to 449,909. One form of such devices is shown in the present application, consisting of trough-shaped covers R corresponding in shape to the molds formed, having the center plate r and the side plates r', such cover corresponding in length to a single mold, or being of sufficient length to extend over several of the different molds and fitting snugly around the same so as to confine the sand of the mold during the casting operation. Such covers may be of sufficient weight to hold themselves in place, but for safety can be easily clamped to the bottom boards a' at suitable points. After the series of molds are built up in the manner above described and cover plate or plates secured over the molds, the long mold cover extending over a number of molds, or short mold covers extending over each individual mold being employed, as desired, the series of molds are ready for the pouring of the metal. For this purpose only two men are required instead of a large number of skilled metal pourers, as would be required for casting the metal in each individual mold. The metal contained in a large ladle is brought by a suitable railroad, over-head or on the foundry floor, to the pouring end of the series of molds, and the metal is then poured into the hopper or basin p directly from the ladle, the one man controlling the flow of the metal while the other man watches the reservoir f' at the other end of the series to see when the metal enters the same and direct the first workman in the pouring operation. The metal enters the hopper and flows thence into the reservoir f and thence through the opening c^2 into the continuous runner. It flows within such continuous runner part backwardly until it reaches the down-take channel at the end of that mold, striking against the face of the abutment e, flowing down through that channel and filling that mold cavity. It also flows along the continuous runner until it reaches the first down-take channel between the two molds, and it passes down through that down-take channel and by the cross runners into the mold cavities, such as into the mold cavities 2—3. The down-take channel between the molds receives the mass of the stream of metal, and the metal which has first traveled along that section of the runner and acted to heat the same (being thereby correspondingly slightly chilled) passes down that down-take channel into the mold cavity so that it has no longer course to travel than in the ordinary filling of a mold, the first metal which passes through this section of the continuous runner being so prevented from flowing along the continuous runner for such distance as would chill the same to such an extent as would prevent its free flow and the clogging of the continuous runner, or the formation of defective castings. That is to say, that the metal passes along the continuous runner down the vertical channel and into the mold cavities, and the metal continues to flow in this way until these mold cavities are filled, and a fresh body of heated metal, which has passed through the previously heated section of the runner, enters the section of the runner extending through the next mold and heats that section, the metal which has served first to heat that section then passing down into the mold cavities fed by the next down-take channel; the flow of the metal being kept up in this way so that the main runner becomes more highly heated, or practically as hot as the metal itself, as more metal passes through it on its way into new mold cavities, so that there is always hot metal provided to flow through the section of the continuous runner in each mold; it being found that the metal in the last of a long series of molds is practically as hot as that which enters the first of the molds, and all danger of such chilling of metal as would obstruct the continuous runner is prevented. When the metal reaches the last of the series of molds, it flows to the end mold cavity along the end abutment as above described, and, if so constructed, rises within the reservoir f' at that end of the series, and the workman at that end of the series of molds then directs the workman pouring the metal so that it rises gradually within that reservoir, and then the pouring ceases. It will thus be seen that the metal flows horizontally through the inclosed continuous runner above the mold cavities, and thence downwardly into the mold cavities. By the term horizontal is of course meant practically horizontal, and any such runner arranged on a slight incline which would not affect the practical working of the invention would be included within such term. As the series of molds are thus filled and the mold cavities and continuous runner are all properly confined, and as there is a head of metal in both reservoirs $f f'$, it is evident that the metal within the several molds of the series is so confined that the gases cannot pass back from any of the mold cavities and through the runners to escape; and also that a body of hot metal is provided in the long continuous runner which will act by its weight, together with the weight of the metal in the reservoirs, to force the metal and hold it to place within the mold cavities and force any gases generated in the mold cavities through the sand walls of the mold, the weight of the metal of the continuous runner and reservoirs being such as to insure a perfect filling of the mold cavities and the metal gradually descending in the reservoirs to feed the shrinkage of metal in the mold cavities while the casting solidifies. As a matter of fact, in the molds poured from this continuous runner much more perfect molds are obtained, what is known as shrinking or blowing is entirely overcome, and the molds can be formed with a much finer grade of molding sand, even in the formation of large molds, than has heretofore been considered practicable, giving a much smoother surface to the finished castings. The operation requires no skillful pouring, all that is necessary being to maintain in the pouring reservoir a sufficient head of metal, and what has been considered the most skillful, heaviest and hardest work in metal founding is overcome, while the metal enters the mold cavities at a higher heat, the molds are more rapidly filled, and all chilling of the metal by exposure to the atmosphere during the pouring operation is prevented, practical use having demonstrated that much more perfect castings can be obtained by this method of pouring. As soon as the pouring operation is concluded, and the metal in the continuous runner sufficiently set, but while it is still soft, the operator may then cut through the metal in the continuous runner at suitable points so as to separate the castings from each other. The mold covers can then be removed and applied to another series of molds and the operation repeated.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In sand molds, the combination of a series of molds in line with each other and having mold cavities therein, and a horizontal continuous runner inclosed within the several sand molds above the mold cavities thereof and communicating with the different down-take runners leading to the mold cavities, substantially as and for the purposes set forth.

2. In sand molds, the combination of a series of sand molds in line with each other and having mold cavities therein, a horizontal continuous runner inclosed within the several sand molds above the mold cavities thereof and communicating with the different channels leading to the mold cavities, and a reservoir extending above the series of molds and communicating with the continuous runner, substantially as and for the purposes set forth.

3. In sand molds, the combination of a series of sand molds in line with each other having mold cavities therein, a horizontal continuous runner inclosed within the several

sand molds above the mold cavities thereof and communicating with the different channels leading to the mold cavities, a feeding reservoir communicating with the continuous runner, and a receiving reservoir communicating with the continuous runner, substantially as and for the purposes set forth.

4. In sand molds, the combination of a series of sand molds in line with each other, a horizontal continuous runner inclosed within the same series of molds above the mold cavities, and down-take runners leading therefrom to the mold cavities, each such down-take runner being of approximately the section of the continuous runner, substantially as and for the purposes set forth.

5. In sand molds, the combination of a mold support, a series of molds resting on said support and in line with each other, and an abutment confining the end mold of the series, such abutment resting on the mold support and being held in place and confining such end mold by its weight, substantially as set forth.

6. In sand molds, the combination of a series of molds set in line and in contact with each other, and an abutment confining the end face of the series of molds, such abutment resting on the mold floor and having the horizontal extension e^2 to support it against such end face, substantially as and for the purposes set forth.

7. In sand molds, the combination of a series of sand molds, set in line with each other, a horizontal continuous runner inclosed within said several sand molds, separate runners or channels leading therefrom to the mold cavities, and an abutment confining the end runner leading to the end mold cavity of the series, substantially as and for the purposes set forth.

8. In sand molds, the combination of a series of sand molds, a continuous runner extending through said series of molds, separate runners or channels leading therefrom to the mold cavities, and an abutment confining the end runner leading to the end mold cavity of the series, said abutment having a sand pocket in its face, substantially as and for the purposes set forth.

9. In sand molds, the combination of a series of molds set in line and in contact with each other, a continuous runner extending through said series of molds and runners leading therefrom to the mold cavities, abutments at the end of the series to confine the end faces of the series of molds, and a series of removable mold covers fitting over the tops and sides of the molds and resting thereon to confine the same, substantially as and for the purposes set forth.

10. In sand molds, the combination of a series of molds set in line with each other and having a horizontal continuous runner inclosed within and extending through the same, above the mold cavities, and down take runners leading thereto a reservoir supported on the molds, and a passage or opening between said reservoir and the continuous runner, substantially as and for the purposes set forth.

In testimony whereof I, the said STEPHEN JARVIS ADAMS, have hereunto set my hand.

STEPHEN JARVIS ADAMS.

Witnesses:
JAMES I. KAY,
J. N. COOKE.