To all whom it may concern:

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

My invention relates to a method of forming sand molds, and more especially to that class in which the sand is compacted around the patterns and within the flask or within the core-box by jarring.

The subject-matter of this invention is a division of my application filed March 30, 1897, Serial No. 629,917.

In the forming of a sand mold, according to the old methods employed in this system of molding, it was the regular practice to impart to the mold a series of jars of substantially the same length; but I have discovered that a series of heavy jars of equal length, while forcing down a large bulk of sand, permits the bridging over of the delicate parts or depressions of the pattern, so that the sand is not properly filled into the smallest depressions of the pattern to conform thereto, whereby defective molds are made.

It is the object of the present invention to overcome these defects and to provide a method whereby the sand is evenly distributed in the flask and over the pattern, so that it will properly fill the smallest depressions of the pattern and conform to the delicate parts thereof, whereby a perfect mold is produced.

To this end it consists in imparting to the mold a number of jars of short length in the first part of the operation, thereby distributing the sand throughout the mold and into the smallest depressions of the pattern and then following such short jars with one or more longer jars, which will act to compact the sand evenly within the mold after the distribution thereof by the short jars.

To enable others skilled in the art to practice my invention, I will describe the same in connection with the accompanying drawings, which illustrate suitable apparatus for carrying into effect the method, and in 50 which—

Figure 1 is a side view, partly broken away, of one form of apparatus, showing said apparatus in position to begin the jarring operation. Fig. 2 is a like view showing said apparatus at the end of the jarring operation. Fig. 3 is a cross-section through the anvil-block at 33, Fig. 2; and Fig. 4 is a side view of a modified form of mechanism for imparting the jarring action to the flask.

A suitable apparatus by which the method can be practiced may include different forms, such as the several forms illustrated in the drawings, but that shown in Figs. 1 and 2 is the preferable form, and I will give a more detailed description of it. The operative mechanism to be hereinafter described is located under the working floor a, and the anvil or jarring-block b rests on this floor, having the guide passage b' formed centrally thereof and passing vertically through the same, through which the lifting-bar c passes, said bar carrying at the upper end the jarring-table d, the lifting-bar c being secured to the table at the center thereof, so that it will lift the same and impart a perfectly vertical jarring thereto, the lifting-bar c being guided within the guideway b' of the jarring-block. Resting on the jarring-table d is the pattern-plate e, carrying the pattern e', around which is the flask f, while resting upon the flask is the reservoir g, the flask and reservoir being held in line in any suitable way, as by the guides g'. Above the reservoir and adapted to enter the same as the sand is jarred downwardly is the guided follower h, which is mounted in the yoke k, which yoke carries the guideway k' for the guided follower. Under the floor or working platform a is the mechanism for lifting the bar c, this mechanism in Figs. 1 and 2 being shown as a cam l of peculiar form mounted on the standards i and bearings i'. These are the general features of the apparatus, and I will now proceed to describe the same more in detail.

The anvil-block b is preferably of metal, the guideway b' being cast or drilled therein, and in the preferable construction suitable
guide-blocks $b'$ extend in seats $b''$, formed therefor in the block, and provide for accurate adjustment for the lifting-bar $c'$, and thereby insure accurate vertical movement of the same. I generally employ a set of guide-blocks $b''$ near the upper end of the anvil-block and a like set near the lower end thereof. It will be noticed that the lifting-bar $c'$ is angular, and the inner ends of the guide-blocks $b'$ therefore fit this angular bar. The body portions of the guide-blocks $b''$ are preferably cylindrical in shape and fit in like-shaped seats in the anvil-block, and they may be adjusted and locked in any suitable way, such as by adjusting-screws $b'$, bearing against the ends of the guide-block and passing through yokes $b''$, extending out from the blocks, or by set-screws $b''$ or in other ways well known to the skilled mechanic. In this way the power for lifting the jarring-table is applied centrally thereof, and the lifting-bar can be so adjusted as to give absolutely vertical movement in raising the jarring-table and guiding it in its descent.

It will be noticed that the lower end of the lifting-bar $c'$ extends below the platform $a$ and carries the antifriction-roller $c''$, which engages with the faces of the cam $l'$ by which the lifting-bar is raised. To prevent side strain upon the bar, I employ the two standards $i'$, mounting the cam $l'$ in bearings $s'$ upon these standards, so that it rotates between the same, while the lifting-bar $c'$ carries antifriction-rollers $c''$ which travel along the face of the standards $i'$, and so resist the side strain which would be brought upon the lifting-bar. This peculiar way of mounting the lifting-bar and cam forms the subject-matter of a separate application filed April 2, 1897, Serial No. 630,412. The cam illustrated is one well suited for the forming of the mold and illustrates the preferable way of obtaining the peculiar jarring action above referred to, having a series of cam-arms $l''$ and $s$, which give short strokes, while the cam-arms $l''$ and $s$ give long strokes, the length of the throws of these respective arms being regulated according to the mold to be formed, and, if desired, either the cam-arms giving short strokes or those giving long strokes, respectively, can be made with gradually-increasing length of stroke to each arm. This is generally desirable in connection with the long strokes, where each packing stroke will increase in length and therefore give a heavier jar, the last stroke being the longest and giving the heaviest jar. It will be noticed that each cam-arm is formed of an inclined face $l''$, by which the lifting-bar is raised and a straight or practically radial face $s$, which permits the bar to drop without contact with the cam until the jarring-table strikes the anvil-block $l$. The lifting-bar is sufficiently short to prevent the roller $c'$ from touching the cam when it reaches its lowest position, so that injury to the roller is prevented.

In Fig. 4 I have shown another means for obtaining strokes of different length, this being accomplished by means of a cylinder to be operated by steam or other fluid, the 70 cylinder being supported under the platform $a$ in such position that the lifting-bar $c'$ forms the continuation of the arm $b$ of the valve-box $C'$, with a central recess $k'$, corresponding substantially in shape to the pattern $c''$, this guided follower having rigidly secured thereto the guide-tube $k''$, which moves within the guide-tube $k'$, forming part of the yoke $k$, a spring-pawl $k''$ holding the follower up within the guide-box when not in use. To 95 provide for the proper clamping of the parts upon the table, the yoke has either the hollow box $k''$ or one having only side wards $k''$, extending down therefrom around or on each side of the follower $h$, and resting upon the top of the reservoir $g$, and so providing for the clamping of these parts to the jarring-table, the yoke $k$ having the swinging clamping bars $k'$ depending therefrom and engaging with the table $d$ in any suitable way. In the construction illustrated the table $d$ has slots $d'$ formed in the side thereof, and these yoke-bars $k'$ enter the slots sideways. They carry at the ends thereof any suitable tightening devices for clamping the yoke to the table, such as the cams or eccentrics $k''$, having the arms $k''$ extending out therefrom, so that when the yoke-bars $k''$ are swung sidewise into the slots $d'$ the operator by pushing down upon the arms $k''$ will turn the cams and clamp the yoke to the table. In this way he holds firmly to place not only the yoke but the pattern, with its plate, the flask, the reservoir, and the guide-box $k'$, inclining the follower $h$, so clamping all the parts rigidly together ready for forming the mold. The follower-guide-way $k'$ extends up a sufficient distance to provide for properly guiding the follower by means of its guide-bar $h'$ and at the upper end thereof has bearings $k''$, in which is mounted the eccentric $m''$, which acts as a retainer for the follower $h$ to prevent its upward movement after the jar, this eccentric being mounted, as shown, to one side of a vertical line through the guide-way $k'$, so that it has a tendency to drop to one side under the jar, and as the follower descends upon the jarring stroke the eccentric will, through the same jarring stroke,
The eccentric has an arm \( m' \), which forms a weight, giving it a tendency to follow down after the guide box \( h' \), and which has another advantage, as it provides an easy way for withdrawing the eccentric and for lifting off the clamping-yoke and follower when the mold is finished. A simple and handy way of arranging these parts is shown in the drawings. The clamping-yoke, with its follower and other parts carried thereby, is hung from a rope \( n \), which passes around pulleys \( n' \) and \( n'' \) and carries a weight \( n' \), which substantially counterbalances the yoke. Suitable counterweights may of course be added to the weight \( n'' \), as shown, according to the weight of the yoke and follower employed. These parts are thus held up out of the way until needed, when to lower the yoke I provide the pulley \( p' \), around which the rope \( p \) passes, being either connected to the rope or to the weight, the rope \( p \) extending down in position for the operator and having either the hand-stirrup \( p'' \) or the foot-stirrup \( p' \) in such position that it can be easily grasped and by pressure upon the same the weight \( n'' \) be raised, which will permit the descent of the yoke and the securing of the same in proper position for making the mold.

When the apparatus illustrated in Fig. 1 is employed, the usual course in forming molds is as follows: The jarring-table \( d \) of course rests normally upon the anvils-block \( b \), while the clamp-frame \( k' \), held by the counterweight \( n'' \), is held up out of the way of the workman. To make a mold, the operator places the flask upon a pattern-plate and sifts a certain amount of meal sand over the pattern to fill as well as possible the different depressions therein and then places the reservoir \( g \) upon the flask \( f \) and fills the reservoir with sand. Then he draws down upon the rope \( p \) by the hand-stirrup \( p'' \) or foot-stirrup \( p' \), which raises the weight \( n'' \) and permits the clamping-frame \( k' \), carrying the follower \( h \), to descend. He then brings the clamping-frame into position, so that the box \( k' \), inclosing the follower \( h \), fits upon the top of the reservoir \( g \), and he swings the bars \( k '' \) into the slots \( d \) of the jarring-table and presses down upon the cam-arms \( k'' \), and so clamps all the parts, clamp-frame, reservoir, flask, and pattern-plate firmly to the jarring-table. The apparatus is then ready for the forming of the mold, and the follower \( h \) is freed, so that it can drop upon the sand in the reservoir \( g \) when the apparatus is ready to form the mold. Power is then applied to rotate the cam \( l \), which through its several cam-arms imparts the necessary jars to pack the sand within the flask and form the mold. Where the irregular form of cam illustrated in Figs. 1 and 2 is employed, the first operation will be to impart a few short jars to the sand within the flask and reservoir, which will distribute the sand over the pattern and into the smallest recesses thereof, it being found that while a heavy jar in forcing down a large bulk of sand may permit bridging over the delicate parts of the pattern, yet a few short or light jars will properly fill the sand into the smallest depressions and cause it to conform to the delicate parts of the pattern, and so prepare it more perfectly for the actual packing jars. This is the action of the first three strokes imparted by the cam \( l \), and as a result of these distributing strokes, where the guided follower having a recess therein conforming substantially to the pattern is employed, this follower will descend with the sand, which will be permitted to rise under the rebound of the jars into the recess \( h'' \) thereof, while the lower portions of the follower conform to the space around the pattern, so that the body of sand around and above the pattern is of substantially the same thickness above both the pattern and the space around the pattern, the body of sand being brought to this condition before the heavy jarring strokes for packing are imparted thereto. When the sand is in this condition, a few long or heavy jars will properly pack the sand within the mold, and these are obtained by the long arms of the cam \( l \), which operate to raise the jarring-table, permit the same to drop upon the anvils-block \( b \), and impart such heavy jars, while the follower \( h \) descends at each jar and is sustained against rebound, and therefore holds the sand against such rebounding action, which is natural to it, so that in this way a solidly and evenly packed mold is obtained. During this operation the lift imparted to the jarring-table and parts carried by it is in a true vertical line, as the lifting-bar passing up through the anvils-block is properly guided and is perfectly free in its descent to permit the direct vertical drop of the table, so that all liability of side movement when the jar is imparted to the sand is done away with and the sand will pack by direct vertical movement and the formation of soft spots on one or the other side of the pattern prevented. In ease of wear on this lifting-bar provision is made to take this up by means of the guide-blocks \( b' \), above referred to, and at the same time the rollers \( c' \), traveling on the guide-face of the standards \( i \), resist any tendency to side movement of the lower or free end of the lifting-bar under pressure of the cam. When the jars are imparted to the table, the follower \( h \) of course descends under the influence of the jar; but it cannot cast away or move out of its proper course, because it is properly guided, as by the guide-bar \( l' \), and it cannot rebound, because the retainer, such as the eccentric \( m' \), turning un-
der the jarring action, holds down the guide-
bar and prevents its rising again if there be
any such tendency, acting therefore as a re-
tainer for the follower through such guide-
bar.

During the formation of the mold the op-
erator has through his hand or foot power to
hold up the weight \( n^2 \), and thereby permit the
weight of the cam-frame and its follower to
aid in the jarring action, and when the mold
is completed the operator simply frees the
cells-arms \( k \) through the movement of the
cams \( h \) and draws them out of the slots \( d^\prime \),
and he then permits the weight \( n^2 \) to raise the
clamping apparatus and follower out of the
way, the follower being either at that time or
before making the next mold raised to be en-
gaged by the pawl \( l^2 \) and held up out of the
way, so that the parts can be adjusted in
making another mold. He then removes the
reservoir, cuts off the surplus sand, and lifts
the mold, with the flask and pattern, from the
table, withdraws the pattern, and proceeds to
form another mold in the way above described.

By the above method I am enabled to form
more perfect molds than by the jarring meth-
ods heretofore used and overcome the diffi-
culties heretofore encountered in the working
of these methods, which affected both the way
of working them and the resultant molds.

The apparatus herein shown and described
is not claimed in this application, but is
claimed in the application of which this is a
division.

What I claim, and desire to secure by Let-
ters Patent, is—

1. The herein-described method of forming
sand molds consisting in imparting one or
more light or short distributing jars to the
sand within the flask or core-box and subse-
sequently imparting one or more heavy or long
packing jars to such sand.

2. The herein-described method of forming
sand molds consisting in imparting one or
more light distributing jars to the sand with-
in the flask, and then imparting two or more
heavy packing jars to such sand, said pack-
ing jars increasing gradually in strength.

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

STEPHEN JARVIS ADAMS.

Witnesses:

ROBERT C. TOTTEN,
F. W. WINTER.