Dec. 5, 1933. G. G. BELL 1,938,276

SHAKER FOR INGOT MOLDS

Original Filed Oct. 23, 1928 3 Sheets-Sheet 1

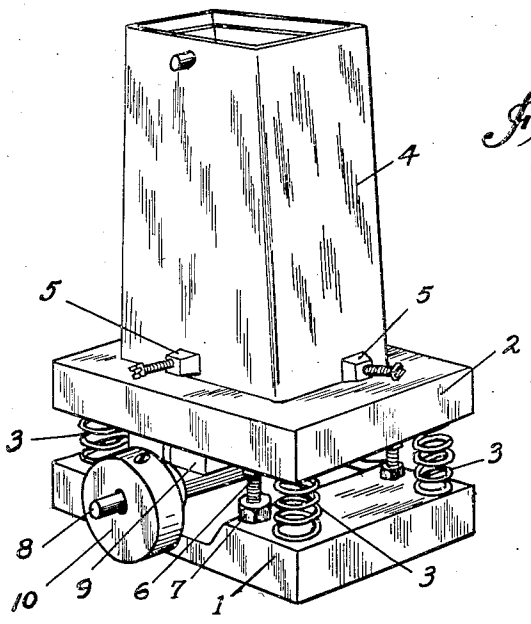


Fig. 1.

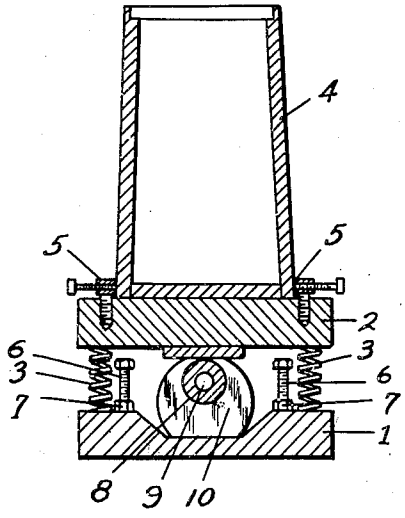


Fig. 2.

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SHAKER FOR INGOT MOLDS

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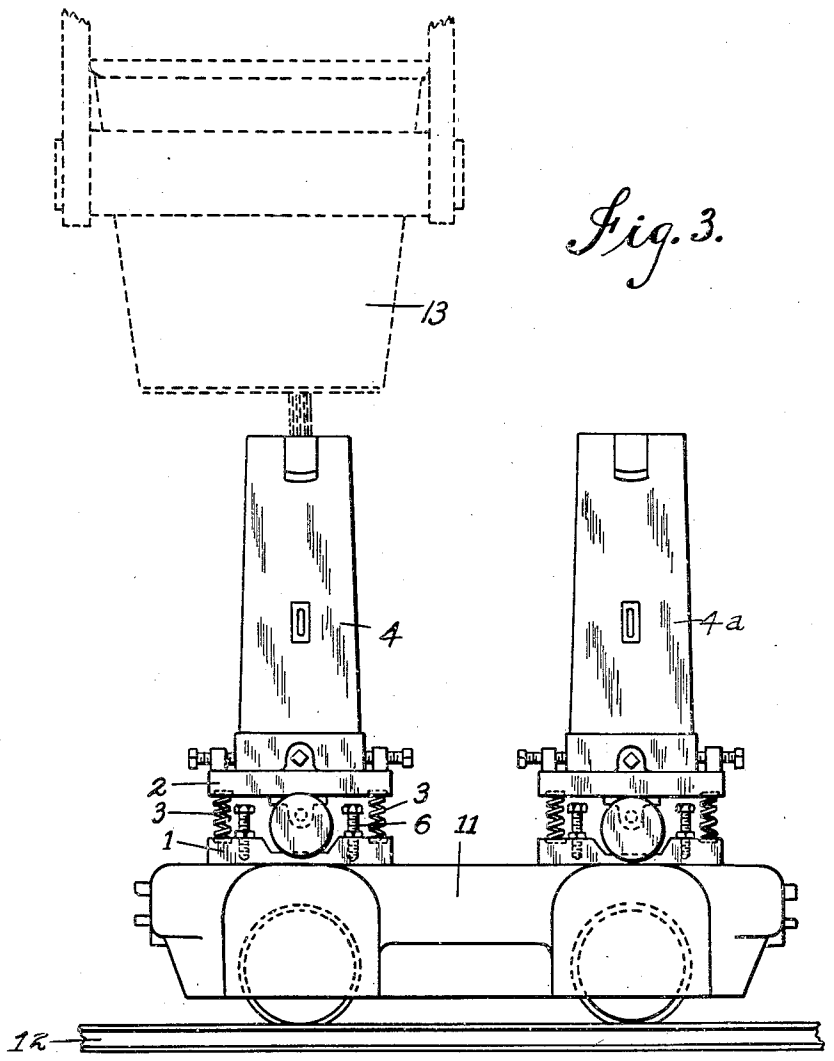


Fig. 3.

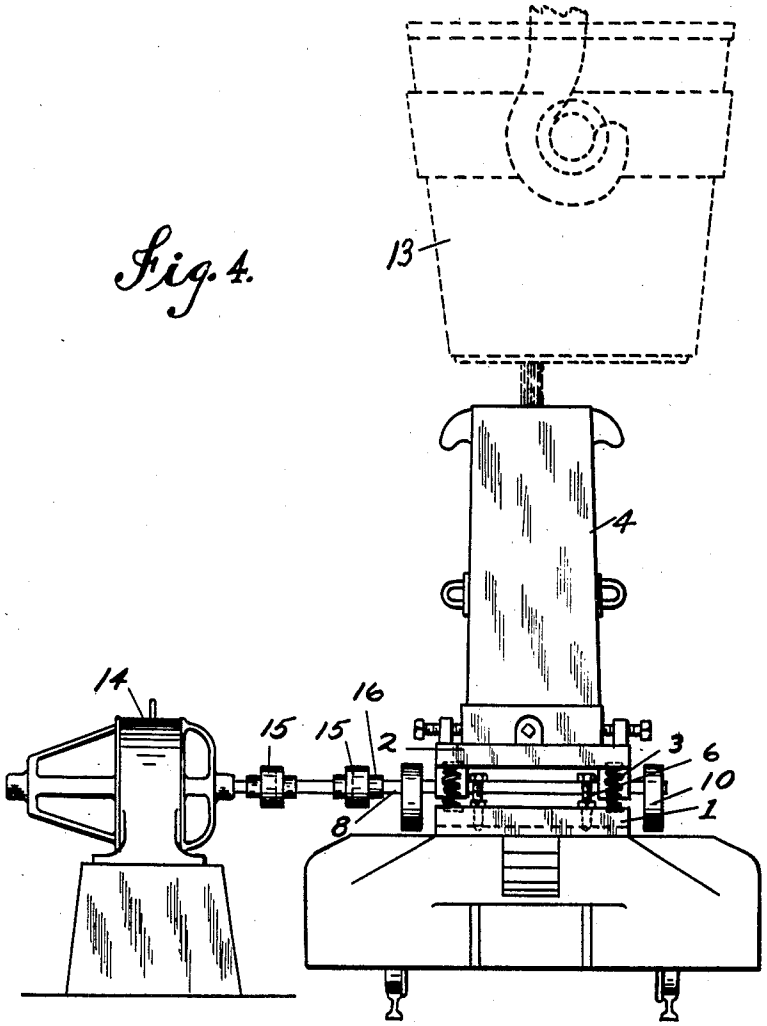
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Fig. 4.



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UNITED STATES PATENT OFFICE

1,938,276

SHAKER FOR INGOT MOLDS

George G. Bell, Ashland, Ky., assignor to The American Rolling Mill Company, Middletown, Ohio, a corporation of Ohio

Original application October 23, 1928, Serial No. 314,506. Divided and this application June 16, 1930. Serial No. 461,499

4 Claims. (Cl. 22—216)

This application is a division of my application Serial No. 314,506 filed Oct. 23, 1928.

It is well known that when molten metal is poured into ingot molds, defective ingots tend to be produced by a number of causes, the immediate trouble, in one aspect, being referable to a too-rapid freezing of the metal. Blisters, slag inclusions, and blow-holes are among these defects, the latter particularly being due to the release of gases held by occlusion or formed in the metal. The metal solidifies so rapidly that these gases, existing therein in bubbles cannot come to the surface. Much work has been and is being done to overcome these defects. It is possible to "kill" steel, for example, by adding materials tending to produce sounder castings. It has been proposed also to keep the metal molten by various means for a longer period of time, so as to permit the natural escape of gases and the segregation by floating of included impurities. Various measures have been proposed looking toward some mechanical treatment of the freshly poured ingot to speed up the freeing of foreign matters so that it will occur substantially within the natural freezing time of the metal.

It is with the latter art that my invention deals.

A number of proposals have been made to jar an ingot mold and its charge during pouring, and before the metal has frozen. These have contemplated a series of blows from beneath, administered by a mechanical or fluid-actuated means equivalent to a hammer, or by the simple expedient of repeatedly raising the mold and base a short distance and dropping them against a solid support. While these measures are so costly and cumbersome as to have achieved no wide-spread commercial use, yet upon trial they do result in improved castings. Even so they do not result in the utmost betterment which can be achieved by mechanical means. In recognition of this it has also been proposed to rotate the ingot mold while hammering it from beneath. I am not aware what improvement this produces, if any; but mechanism to follow the proposal is clearly out of the range of commercial practicability.

It is a fundamental object of my invention to provide means for mechanically treating ingots upon a commercial scale, which means are cheap, positive, not subject to disorder, simple in construction, and economical of operation. My shaking devices are useful in the casting of all metals subject to the disorders mentioned, or similar ones. An exemplary use is in the casting of ingots of the precious metals for dental purposes. An exceedingly important application, because of the simplicity and economy of my means as well as other advantages hereinafter to be discussed, is in the large scale casting of ingots of iron and steel, and I shall, in the ensuing disclosure describe a preferred embodiment of my invention as related to this art.

A second fundamental object of my invention is to provide means for imparting a new kind of motion to the ingot mold. The motion which I impart, while exactly controllable as to extent and frequency, has components in many directions. I also make use of jars or blows produced by the sudden stopping of the moving mold against a solid abutment. I provide an actual bodily movement of the mold itself which occurs in many directions, and a series of blows which also are administered from more than one effective direction. My invention thus results in a new motion and mechanical treatment which I shall hereinafter refer to as "shaking" or "vibration", bearing in mind its differences from the result of a series of unidirectional blows.

I have found that this new motion produces much improvement not only over ingots cast without treatment, but over ingots cast with the old mechanical treatments. A series of experiments has indicated that vibrating ingots by my method uniformly produces a decided improvement in the quality of the finished product; and this improvement appears to reside largely in a decrease of blisters, a reduction in slag inclusions, a reduction in blow holes, and a more satisfactory form of ingot pipe.

It is evident that a series of blows in one direction can be effective in eliminating gases and impurities practically only through the inertia effect of the metal. While I desire not to be bound by a theory which has been insufficiently tested, I believe that my shaking or vibration supplements this effect by an actual bodily movement of the metal with respect to the mold or to the frozen outer skin of the metal itself, which movement tends to facilitate the travel of inclusions to the surface and which does also tend to retard incipient freezing such as would bind impurities in place.

Broadly my invention provides a vibrating or shaking means comprising a table mounted so as to vibrate freely, a vibrating means therefor, and a series of stops against which the table is jarred by and during the vibration.

The objects of my invention set forth above, as well as ancillary objects which will be set forth hereinafter, or will be apparent to one skilled in the art upon reading these specifications, I accomplish by that certain construction and arrangement of parts of which I shall now describe a preferred embodiment. Reference is made to the drawings which form a part of these specifications.

In these drawings:

Figure 1 is a perspective view of my device with an ingot mold in place.

Figure 2 is a vertical section therethrough.

Figure 3 shows one of a series of buggies in an ingot train with two shakers and two ingot molds mounted thereon, during a pouring operation.

Figure 4 is an end elevation of the buggy showing a shaker, a mold, and a ladle, and showing also a convenient driving means for the vibration.

The base 1, of my shaker, may be if desired a part of a permanent support, or a part of a buggy in an ingot train, but I prefer to make it separate so that the shaker as such may be placed wherever desired and readily removed for use elsewhere or for repairs. The base is preferably a solid block of metal of a shape and size to underlie the table 2 which serves as a support for the ingot mold. Base and table are separated by four heavy springs 3, fastened at either end respectively to table and base, so that the table is free to oscillate with respect to the base. The table is adapted to receive an ingot mold 4 which will be held rigidly thereon during the pouring operation by clamps 5 of any suitable construction. It will be clear that if the base is solidly mounted and a vibratory force applied to the table, the table and ingot mold will shake or wabble with respect to the base, and that its motion will have components in many directions both horizontal and vertical. The springs will of course be heavy enough to bear the load of table, mold and molten metal.

To limit the oscillation of the table and also to produce jars and concussions which will have a metallurgical effect upon the mold charge ancillary to the vibration, I provide a series of stop means or abutments. These may conveniently comprise heavy bolts 6 threaded into the base and held therein adjustably as to height by lock nuts 7. These bolts will be adjusted so that their heads lie a short distance below the bottom of the table in the position in which the latter is held by the springs when the ingot mold is full. A variation of this distance will vary the limit of motion of the table when vibrated. It will also be obvious that during oscillation the table will strike the stops. This will have the effect of administering blows to the table, and since there are several stops, and since the table has horizontal as well as vertical oscillatory motion, the stops will not all be struck at once, and may all be struck severally. This will give the blows or concussions differing effective directions upon the table. I prefer to mount the springs at the four corners of base and table, and adjacent each an adjustable stop as shown. But different arrangements of springs and stops may be made if desired. Thus the springs may be mounted at the four corners and the stops centrally of the sides. Or each spring may have within it a central non-adjustable post serving as a stop. The number of springs and the number of stops may be varied as desired.

The vibrating means for the table top may take various forms. Pneumatic, hydraulic or steam vibrators with or without counter weights may be used but are somewhat expensive. It may set up sufficient vibration merely to move the device over a rough track when it is mounted upon a buggy, but in practice I have found this unreliable. Further, it is highly desirable that vibration be applied during pouring, when generally the ingot mold will be stationary. The vibrator which I prefer to use comprises a shaft 8 mounted upon the table in suitable bearings 9. The shaft extends beyond the table preferably at both ends, and carries excentric weights 10. When the shaft is rotated these weights set up a vibration in the table, and the frequency of that vibration may be readily controlled by the speed of rotation of the shaft. The weights may be mounted on the shaft in the same or in opposite excentric directions if desired; but I prefer to mount them at right angles so as to develop in full the multi-directional components of the shaking.

When vibration is applied, the ingot mold will be moved bodily in a number of directions both horizontally and vertically and will be struck blows in rapid succession coming from different effective directions. There may be even a rotary component to the movement. The bodily displacement of the mold will occur, of course, only through a small and carefully controlled space; but the top of the ingot mold will move more than the bottom, which is advantageous. As hereinbefore set forth, I have found that my peculiar combination of shaking and concussions produces enhanced metallurgical effects.

Further the construction of my shaker is so simple and economical that the buggies in ingot trains may be permanently equipped with them at an expense which is not prohibitive. In Figure 3 I have shown a buggy 11 of the usual construction, operating upon a track 12 and fitted with two of my shakers supporting ingot molds 4 and 4*a*. The mould 4 is being poured from the ladle 13. Each buggy or each shaker may have its own vibrator; but I prefer (as shown in Figure 4) for economy and convenience to provide a stationary driving means which may comprise an electric motor 14 connected by universals to a detachable coupling 16, which may be connected to the shaft 8 of each shaker as the buggy is drawn into pouring position.

Modifications in my invention will be within the purview of one skilled in the art to make without departing from the spirit of it.

Having described a preferred embodiment, what I claim as new and desire to secure by Letters Patent is:—

1. That process of treating ingots which comprises imparting to the ingot mold before the metal therein has solidified, vibratory motion in more than one direction, and at the same time jarring the mold.

2. That process of treating ingots which comprises imparting to the ingot mold before the metal therein has solidified, multi-directional vibratory motion and a series of blows from a plurality of effective directions.

3. That process of treating ingots which comprises imparting to the ingot mold before the metal therein has solidified, a multi-directional vibratory motion, said motion so applied that the upper part of said mold moves through a further distance than the lower part.

4. That process of treating ingots which comprises imparting to the ingot mold before the metal therein has solidified, a multi-directional vibratory motion, said motion so applied that the upper part of said mold moves through a further distance than the lower part, and subjecting said mold to a series of blows.

GEORGE G. BELL.