Jan. 25, 1955 R. M. CARRIER, JR., ET AL 2,700,472

FOUNDRY MOLD SHAKEOUT DEVICE

Filed Jan. 28, 1950

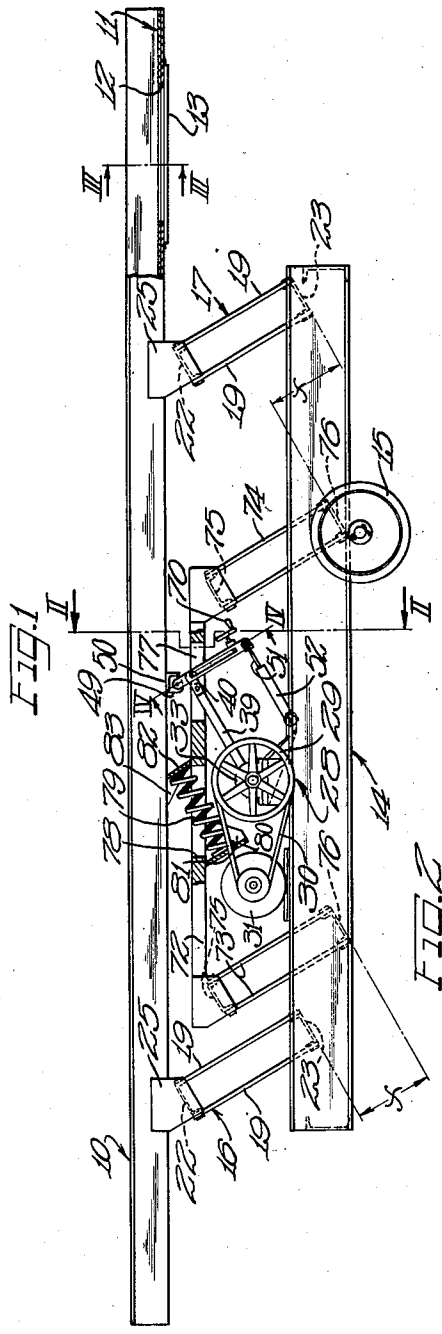


FIG. 1

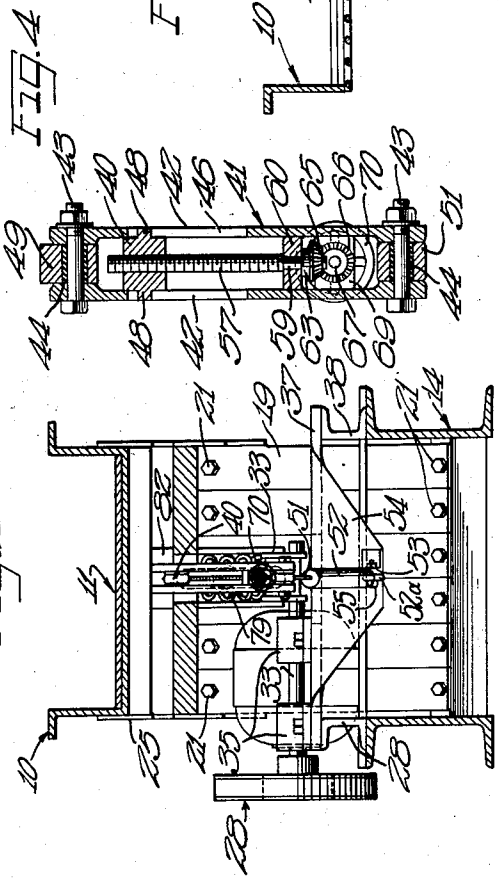


FIG. 2

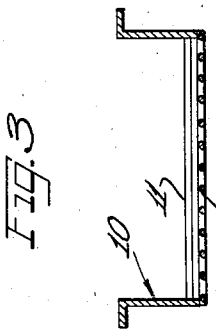


FIG. 3

FIG. 4

Inventor
Robert M. Carrier Jr.
Maurice G. Whitley

By [illegible] Atty's

United States Patent Office 2,700,472 Patented Jan. 25, 1955

2,700,472

FOUNDRY MOLD SHAKEOUT DEVICE

Robert M. Carrier, Jr., and Maurice G. Whitley, Louisville, Ky., assignors, by mesne assignments, to Carrier Conveyor Corporation, Louisville, Ky., a corporation of Kentucky

Application January 28, 1950, Serial No. 141,098

1 Claim. (Cl. 209—329)

This invention relates to an improved foundry mold shakeout device. More particularly, it has to do with an improved spring mounted device and means for vibrating the device in synchronism with the natural frequency of the spring mounting.

In foundries, a large portion of the castings are made in molds formed inside removable flasks, such as typical snap flasks. After the mold is formed, the flask is removed, and the molten metal poured into the mold. After the casting has solidified, the sand mold must be broken away from the casting.

At present, vibrating shakeout devices are used to separate the sand from the casting. It is an important object of the present invention to provide an improved, more efficient vibrating shakeout device.

Another object of this invention is to provide a shakeout device that is portable and may be moved from place to place in the foundry.

A still further object of this invention is the provision of a balanced shakeout device that has substantially no frame vibration, thus eliminating movement of the device relative to the floor even though it is mounted on wheels.

In accordance with the principles of the present invention there is provided a shakeout pan mounted on leaf springs above a rigid base. A counterbalance slab is disposed immediately below the pan and is also mounted on springs from the rigid base. A power-driven eccentric mechanism is mounted on the base and is connected to the pan for reciprocating the pan which is connected in driving relation to the counterbalance slab through a coil spring.

A self-adjusting fluid cylinder is connected in the eccentric drive mechanism so that the shakeout pan can move to accommodate itself to changes in the weight of the load on the pan. This fluid cylinder has the ability to slowly expand and contract under changes in loading on the pan. However, when the pan is being vibrated, the fluid cylinder acts as a rigid link which always keeps the drive mechanism and the pan vibrating in synchronism.

Other and further features, objects and advantages of the present invention will become apparent to one skilled in the art from the following detail description taken in connection with the accompanying drawings.

Figure 1 is a side elevational view of a mold shakeout device, with parts broken away, constructed according to the features of the present invention.

Figure 2 is a vertical sectional view taken substantially on line II—II of Figure 1.

Figure 3 is a vertical sectional view taken on line III—III of Figure 1.

Figure 4 is a vertical sectional view taken on line IV—IV of Figure 1.

As shown on the drawings:

One of the principal reasons why the shakeout device of the present invention is more efficient and more economical than the shakeout devices furnished heretofore is that the shakeout pan is vibrated at the natural frequency of the spring mounting.

This advantageous operation may best be explained by visualizing a long straight leaf spring mounted in a vertical position with its bottom end secured to a support structure and its upper end free to swing. If the upper end is flexed away from the central upright position and then released, the upper end will tend to move back through the central position to an opposite position as far on the other side of the central position as it was in the original

position. It will not flex quite as far away from the central position, however, due to inertia losses in the spring itself. However, once the spring is flexed, it will continue to make complete, full swing oscillations as long as the internal power loss is compensated for. Thus, in a mold shakeout operating at the natural frequency of the spring mounting, the power means must supply only enough power to replace internal losses. When the power means is not in synchronism with the natural frequency, it must supply power to actually move the pan and the load. Approximately ten times as much power is required to drive an empty shakeout device not operating at natural frequency as is required to drive a natural frequency shakeout device empty.

In the present invention, the advantages of natural frequency operations has been applied to a mold shakeout pan by mounting the pan on springs and providing a drive mechanism that is capable of reciprocating the pan at the natural frequency of the spring mounting.

The natural frequency of a spring mounting under a load mounted directly on the spring without externally connected dampening means may be computed from the equation

$$N=\frac{187.7}{\sqrt{d}}$$

where N equals the frequency in cpm. and d equals the deflection under the load in a vertical direction.

While the natural frequency of a spring mounting may be calculated from the above mentioned formula, it must be remembered that the relation of the drive mechanism and the shakeout device is such that they will operate in resonance in a range which extends approximately 5% above and below the calculated value. Thus, if the calculated or mean value of the natural frequency is 285 vibrations per minute, the range of resonance will extend approximately from 270 to 300 vibrations per minute.

Therefore, it is to be understood that hereinafter when the "natural frequency range" of a spring mounting is referred to, it means the range in which the drive means in the conveyor are in resonance.

Thus, when the natural frequency of the spring mounting is determined, the drive mechanism may be chosen to maintain the natural frequency reciprocation.

In Figure 1, the reference numeral **10** indicates mold and shakeout pan having a solid bottom wall **11** on which the molds are placed. At one end of the bottom wall **11**, an opening **12** therein is covered by a plurality of rods **13** which may be suitably secured to the underside of the wall **11**, as by welding.

The mold pan **10** is supported on spaced spring assemblies **16** and **17** from a rigid support base **14**. The support base **14** may be suitably made of longitudinal channel members secured at their ends by cross channel members and mounted intermediate their ends on wheels **15**. Each of the spring assemblies **16** and **17** includes a plurality of separate spring members **19** (Figure 2) secured at their ends by bolts **21** to transverse channel members **22** and **23**. The channel member **22** is secured at its end as by welding between flange plates **25** which are welded to the side of the moulding pan and extend slightly therebelow to receive the channel member **22**. The lower channel members **23** are welded at their ends between the web of the channel members of the base **14**.

The shakeout pan **10** is reciprocated by means of a drive mechanism **28** including a pulley wheel **29** driven by a belt **30** from a motor **31**. Pulley wheel **29** is keyed to a crankshaft **33** that is journalled in spaced bearings **35** (Figure 2) which are mounted on a transverse plate **37**. The plate **37** is secured at either end to channel members **38** supported on the base **14**.

The crank arm **39** has one end connected on the throw of the crankshaft **33** and the other end pivotally connected to a block **40** slidably disposed in a composite lever **41**. The lever **41** may be preferably made up of two spaced bars **42** connected at their ends by bolts **43** and spacer washers **44**.

Each link **42** has a longitudinal slot **46** arranged to receive upstanding outwardly extending projections **48** on the block **40** which is slidably disposed between the

arms. The upper end of the lever **41** pivotally receives a flange **49** of a transverse angle **50** while the lower end pivotally receives the end of a piston rod **51** which extends from a fluid power cylinder **52** which may take the form of a conventional direct acting shock absorber. The cylinder **52** has an ear **52***a* secured to one end thereof and pivotally connected to an upstanding ear **53** of a flange plate **54** by means of a bolt **55**. The flange plate **54** may be formed integrally with the cross transverse plate **37** on which the bearing members **35** are mounted.

To permit an adjustment of the length of stroke during operation of the pan, a feed screw **57** is mounted in the composite lever **41** between the side arms **42** extending longitudinally thereof and having a reduced portion **59** journalled in a cross block **60** which is secured between the arms **42**. The feed screw extends through a threaded opening in the sliding block **40** so that rotation of the screw will cause the block to move up and down in the composite lever arm **41**. A collar **63** is secured to the screw **57** above the block **60** together with a bevel gear **65** which is in mesh with a bevel gear **66** keyed to a shaft **67**. The shaft **67** is journalled in a bracket **69** secured to the lever **41** and is provided with a hand wheel **70**. It will be seen that rotation of the hand wheel **70** causes rotation of the feed screw **57** and movement of the block **40** up and down longitudinally of the arm **42** to vary the point of connection of the arm **39** with the lever **41** and thus vary the length of stroke of the shakeout pan **10**.

It is to be particularly noted that the shock absorber **52** is connected to the composite link **41** at a much greater distance from the shakeout pan than is the crank arm **39**. Thus, the movement of the end of shock absorber will be much less than the movement of the crank arm. In a typical installation there is no noticeable movement of the telescoping parts of the shock absorber while the pan is being reciprocated with a standard length of stroke.

The shock absorber **52** has the ability to slowly expand and contract on a change in load on the mold shakeout pan. However, when the pan is operating, the shock absorber acts as a substantially rigid link.

The shock absorber **52** therefore is connected in the drive linkage to aid the machine in starting and stopping; to allow the conveyor to settle on the spring mounting, and to guarantee that no weight is transferred back to the eccentric drive. The slow automatic settling action of the shock absorber could be accomplished of course through mechanical devices such as a friction link, inertia link, a pivotal link, or a magnetic link.

To counterbalance this mold shakeout device and make it substantially vibrationless in operation there is provided an elongated rectangular slab **72** which is mounted on spaced spring assemblies **73** and **74**, identical to the spring assemblies **16** and **17**, and similarly mounted on cross-channel members **75** and **76**.

The slab has an opening **77** in its surface through which a portion of the drive linkage **28** extends and an opening **78** through which a coil spring **79** extends. The coil spring **79** is suitably secured at one end in a slanted flange **80** connected to the bottom of the slab **72** by means of reinforcing side flanges **81**. At the upper end the coil spring is suitably secured in a slanted cross flange **82** which is braced by side flanges **83**. The slanted flanges **80** and **82** are substantially parallel so that the motion of the pan **11** can be transmitted to the slab **72** by means of the coil spring. Thus, when the drive mechanism **28** is started up, the mold pan **11** will begin to reciprocate and, through the medium of the coil spring **79**, the counterbalance slab **72** will begin to oscillate at the same speed but 180° out of phase. Thus, when the mold pan **11** is going in one direction, the slab is going in the opposite direction.

In operation, the mold with the solidified casting is placed on the left hand end of the mold pan **11** as seen in Figure 1. As the mold pan is reciprocated, the mold will gradually move toward the right due to the fact that, as the spring arms reciprocate, the pan **11** will move in a path such as to cause the mold to slightly leave the surface in a direction toward the right, as seen in Figure 1. While the molds are off of the surface the shakeout pan **11** moves in an opposite direction and thus the molds are displaced to the right a short distance at each reciprocation. This action shakes the mold and the casting and, as the mold progresses from the left hand side to the right hand side of the mold shakeout pan **11**, the sand becomes loose from the casting. When the sand reaches the cross bars **13**, it will be discharged therethrough while the casting will continue to the end of the mold pan and be discharged into a suitable casting receptacle.

It is a particular feature of this invention that the mold shakeout pan and the counterbalance slab which reciprocates 180° out of phase are so mounted that they do not set up vibrating or shaking movements. Referring to Figure 1 it will be seen that a line drawn through the channel **23** is exactly the same distance, measured in a direction parallel to the at rest position of the spring, from a line drawn through the base channel **76** of the spring assembly **73** in the spring assemblies, at both ends of the unit. This distance is indicated by the reference character *x*.

It will be seen therefore that the couple set up by each pair of spring assemblies will exactly balance out. Thus, there will be no tendency to shake the structure during the operation of the pan and the slab.

While we have illustrated and described a counterbalance slab **72** which is driven from the shakeout pan **10** through a spring **79**, it will be obvious that the slab could be driven independently from a second eccentric mechanism identical to the drive mechanism **28** but 180° out of phase therewith.

From the foregoing description it will be seen that there is provided in this invention a highly efficient mold shakeout device which makes use of the natural frequency theory of operation. This method of oscillating the mold pan in synchronism with the natural frequency of spring mounting permits efficient shaking movement which moves the mold and the casting along the mold shakeout pan with a substantial saving in power input.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

We claim as our invention:

In a mold shake-out device, the combination of a base, a sand mold and casting supporting and conveying structure having a grate portion through which the sand of such mold is adapted to be discharged, a counterbalance structure of substantially the same weight as said conveying structure, substantially identical resilient means respectively extending between said base and said conveying structure and between said base and said counterbalance structure for supporting said structures for directionally controlled vibration along the same paths and at substantially equal predetermined natural frequencies, said conveying structure when thus vibrated being effective to convey a sand mold therealong, drive means extending between said base and said conveying structure for substantially positively vibrating said conveying structure at its said natural frequency and at substantially uniform amplitude under varying conditions of load thereon, said drive means including a crank bearing mounted on said base, a crank journalled in said bearing, and a drive linkage pivotally connected at one end to said crank and pivotally connected at the other end to said conveying structure, said linkage being characterized in having a shock absorber therein which permits static settling of said conveying structure with respect to said base, under the influence of its own weight and a load thereon, on the resilient means for said conveying structure without imposing any substantial load on said crank and crank bearing, and further characterized in that said shock absorber is substantially inflexible during transmission of natural frequency energy impulses from said crank to said conveying structure whereby the distance between the pivotal connections of said linkage to said conveying structure and to said crank remains substantially constant to thus maintain substantially uniform amplitude vibration of said conveying structure under varying condition of load thereon, and resilient energy transmitting means extending between said structures and effective to transmit uniform amplitude, opposite phase vibration from said conveying structure to said counterbalance structure whereby the forces of the oppositely vibrating structures are balanced with respect to said base and further effective to transmit settling of said conveying structure due to load change to the resilient means for said counterbalance structure.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

1,022,332	Roth	Apr. 2, 1912
1,082,352	Morrow	Dec. 23, 1913
1,146,947	Norton	July 20, 1915
1,495,850	Jacquelin	May 27, 1924
1,563,531	Schieferstein	Dec. 1, 1925
1,720,131	Lemont	July 9, 1929
1,997,499	Schieferstein et al.	Apr. 9, 1935
2,008,648	Symons	July 16, 1935
2,159,777	Blackburn	May 23, 1939
2,208,596	Parks	July 23, 1940
2,312,477	Pollitz	Mar. 2, 1943
2,334,368	Wolf	Nov. 16, 1943
2,378,499	Rapp	June 19, 1945
2,398,177	Elliott	Apr. 9, 1946
2,630,211	Carrier, Jr., et al.	Mar. 3, 1953

FOREIGN PATENTS

26,606	Great Britain	of 1901