Sept. 11, 1962 W. KERBER 3,052,934

CASTING APPARATUS

Filed Nov. 10, 1958 2 Sheets-Sheet 1

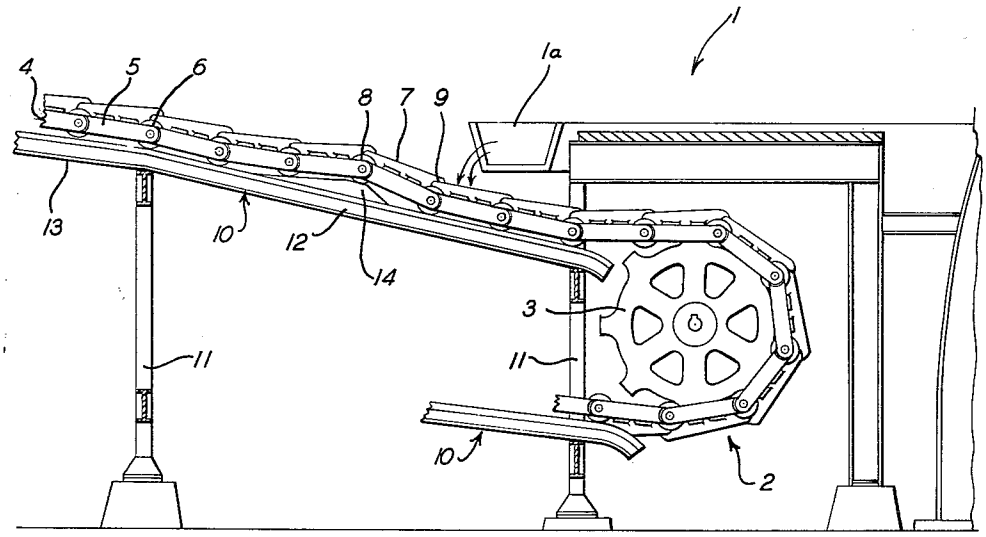


FIG. 1.

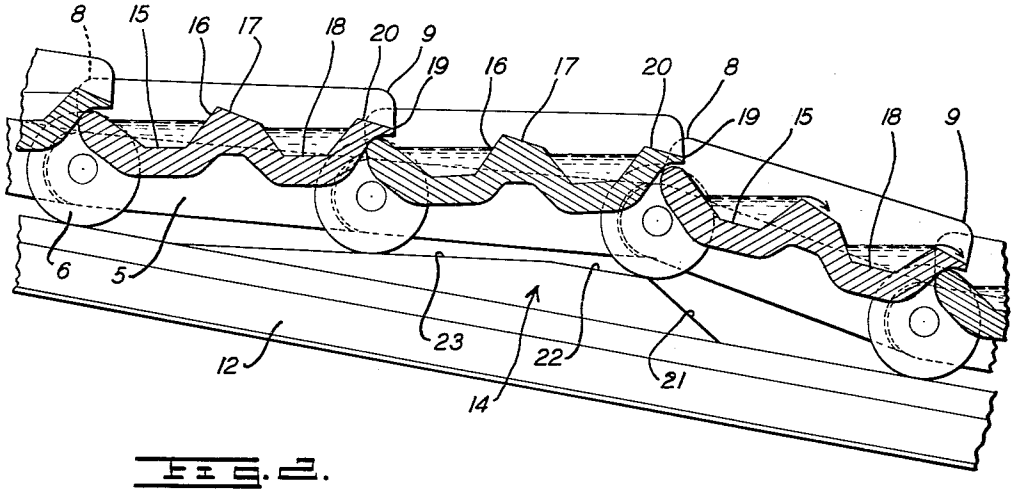


FIG. 2.

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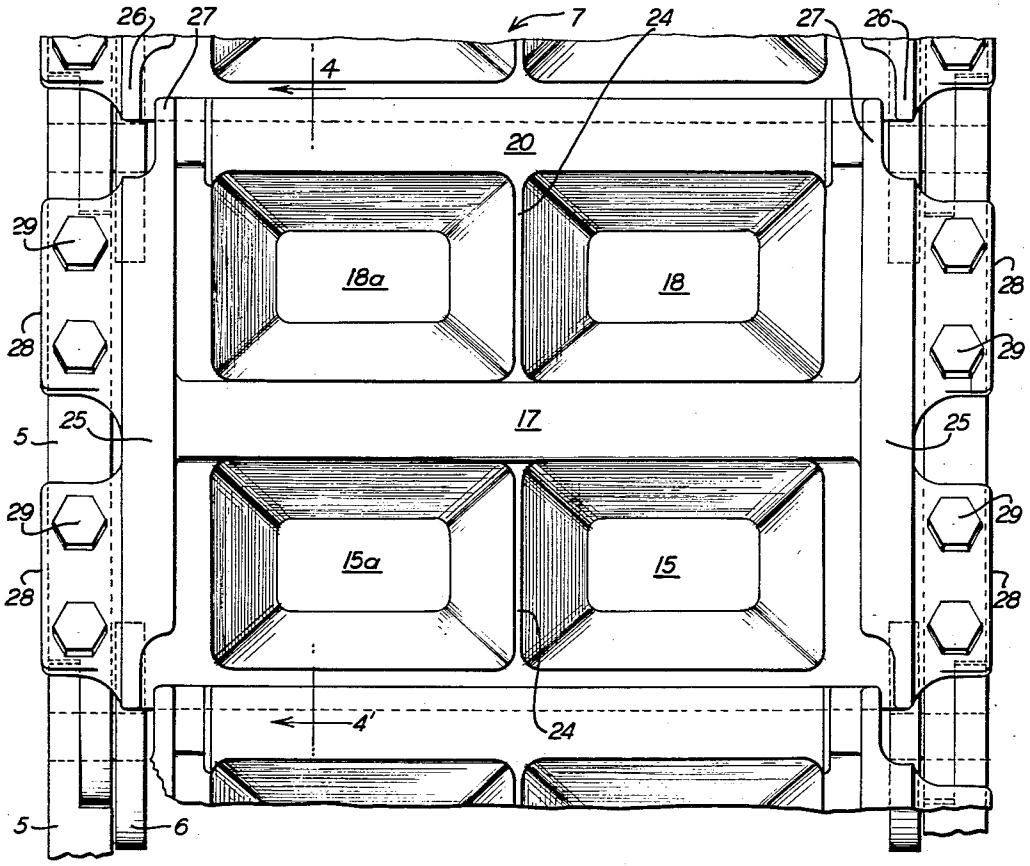


Fig. 3.

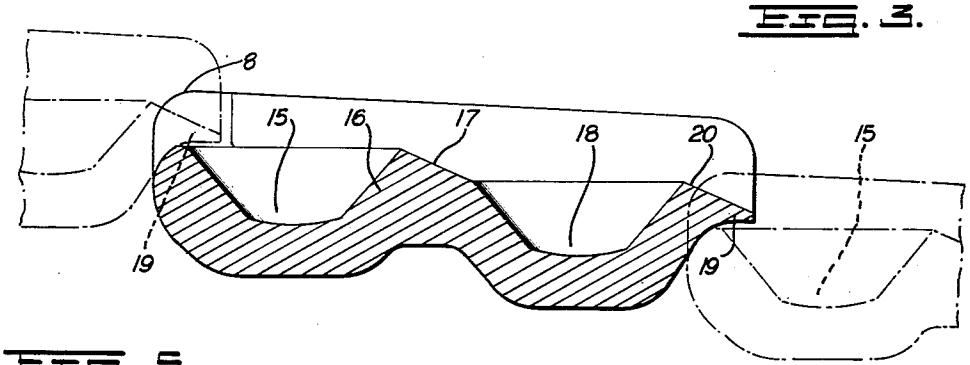


Fig. 5.

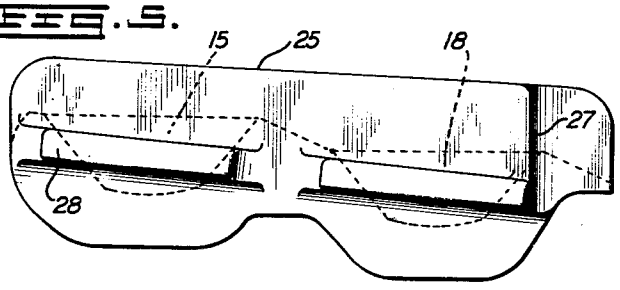


Fig. 4.

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CASTING APPARATUS

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5 Claims. (Cl. 22—76)

The invention relates to improvements in casting apparatus and more particularly to casting apparatus for producing casts of uniform characteristics.

Desirable features for casting apparatus are simplicity of operation so as to withstand continuous use, and automatic functioning with a minimum of attention from working personnel. It is also desirable to have a casting apparatus which will produce an end product which is uniform and within the required specifications. For example, in pig casting, there is a demand to have pigs of uniform weight so that alloying operations can be carried out with precision, yet without a weighing operation; this requires a pig which is free of fins, as fins would alter the weight of the pig as well as make handling difficult. Uniform pigs not only make a better appearance for sales purposes, but also alleviate many shipping and storing problems. Casting machines of the prior art are not capable of producing pigs with these uniform characteristics.

It is therefore an object of this invention to provide a novel casting apparatus operable to achieve the desirable results discussed above.

It is an object of this invention to provide a casting apparatus which is simple in operation, rugged, and effective in producing uniform castings.

It is also an object of this invention to provide a casting apparatus with controlled metering.

Another object of this invention is to provide a casting apparatus which will produce castings of uniform weight, dimensions, texture and appearance.

An additional object of the invention is to provide apparatus which can be easily and quickly converted from one casting operation to another to produce castings of differing magnitudes.

Other objects and features of the present invention will appear more fully from the following detailed description considered in connection with the accompanying drawings which disclose one embodiment of the invention. It is to be expressly understood that the drawings are designed for purposes of illustration only and not as a definition of the limits of the invention, reference for the latter purpose being had to the appended claims.

In the drawings, in which similar reference characters denote similar elements throughout the several views:

FIGURE 1 is a schematic illustration of a continuous casting apparatus embodying the invention;

FIGURE 2 is an enlarged view of a portion of the apparatus shown in FIGURE 1;

FIGURE 3 is a detailed plan view of a mold structure used in a continuous casting apparatus of FIGURE 1;

FIGURE 4 is a cross-section of the mold structure of FIGURE 3 along lines 4—4, and

FIGURE 5 is a side view of the mold structure of FIGURE 3.

The invention provides a casting apparatus made up of a charging means for the material to be cast, a continuous conveyor means having a driven endless chain, molding means, support means for the conveyor means, and a cam means coacting with the molding means to effect uniform characteristics in the castings.

With reference to the drawings, a pig casting machine for molten metal, for example, pig iron, which embodies the invention, is illustrated. In FIGURE 1 a charging station, indicated generally at 1, includes molten metal pouring means 1(*a*) which is disposed in charging relationship to a continuous conveyor system, indicated generally at 2. The continuous conveyor system 2 comprises a sprocket wheel 3 and a driven endless chain 4 including pivotal links 5 and rollers 6. Operating in conjunction with the continuous conveyor system, as illustrated, are traveling mold structures 7, each having a leading edge 8, and a trailing edge 9. The conveyor system also includes an upper and lower support means 10 for the endless chain 4. The upper support means is shown in the form of a track mounted on posts 11, for example. The first section 12 of upper support means 10 defines a charging path, and a second section 13 defines a solidifying path; section 13 leads to a collection station, not shown, where the pigs are discharged. From the collection station the endless chain 4 returns to the charging station along the lower support means 10.

Considering the endless chain 4, the links 5 are pivotally connected in end-to-end relation and a roller 6 is located at each pivotal connection. As seen from FIGURE 3, the endless chain includes two spaced parallel sets of pivotably connected links each with rollers and a mold structure mounted between each pair of opposing links.

Considering the traveling mold structure, reference should be had to FIGURE 4 for a more detailed view. The mold structures have a leading edge 8 and an overhanging lip 19 with a spilling surface 20 which communicates with adjacent and following traveling molds. When the traveling mold structures have more than one mold cavity, such as cavities 15 and 18, in FIGURE 4, a dam 16 is provided; in order to obtain uniform castings the dam is provided with spilling surface 17 which has the same positional relationship to the adjacent mold cavity which it controls as the trailing edge spilling surface 20 has to the adjacent mold cavity which it controls. The positional relationship of these spilling surfaces with the bottom of the mold cavities, along with other factors to be taken up in subsequent paragraphs determines the magnitude of the pigs cast.

In the operation conducted at the charging station 1 of FIGURE 1, there is an unbroken flow of molten metal from the pouring means 1(*a*) into the traveling molds 7 which are successively moved past the charging station 1 by the driven endless chain 4 along the inclined charging path 12. In this operation a crude charging of the mold cavities takes place. Because of the inclination of the charging path 12 and the communication between successive mold structures, surplus metal charged in any cavity flows out to adjacent and following mold structures. This permits the operation to be continuous but makes control of the uniformity difficult, requiring coordination between pouring rate and speed of travel of the traveling molds. If an attempt is made to overfill all mold cavities, there is a great waste of metal and the pigs former have fins of surplus metal which preclude uniformity. Pigs thus formed have jagged edges which make handling difficult. These deficiencies are corrected by other novel features of the invention to be discussed in relation to FIGURE 2 below.

Referring to FIGURE 2, after the traveling molds have been charged they move along the charging path until they coact with a cam or metering means 14 which functions to bring about the desirable objects of controlled metering and uniform castings. As shown, the metering means is positioned in the charging path intermediate the pouring means 1(*a*) and the solidifying path 13 and includes a rise cam path 21, an intermediate cam path 22, and a return cam path 23.

In the operation conducted at the metering means 14 in FIGURE 2, the charged molds are metered so that a uniform amount of metal remains in each mold cavity. In this operation when the roller 6 at the leading edge

of the traveling mold contacts the rise cam path 21, the leading edge of the mold structure is raised and continues to be raised during its entire travel along the rise cam path 21. The height above the charging path 12 reached by the rise cam path 21 and the positional relationship of the spilling surfaces of the mold structures, described earlier, determines the magnitude of the pigs cast. Metering can be terminated by allowing sufficient interval for the leading edge to travel at its maximum height so that all excess metal will flow out, by lowering the leading edge of the mold structure, by raising the trailing edge of the mold structure, or by a combination of these methods. In the preferred embodiment set forth in FIGURE 2, when the roller 6 at the leading edge of the traveling mold 7 reaches the intermediate cam path 22, it is at its point of maximum rise above the charging path 12. As the roller 6 travels along the intermediate cam path 22, which may be parallel to the charging path 12 as shown, the precision metering from the mold cavities takes place. By the time the roller 6 at the leading edge of the traveling mold 7 is in contact with the return cam path 23 the metering step is completed and the return cam path 23 lowers the leading edge 8 of the traveling mold 7.

In addition to the controlled metering taking place at metering means 14 the metal remaining in the cavities is agitated so as to settle it in the cavities and produce pigs of uniform appearance. It can be seen from FIGURE 2 that the distance traveled along the charging path 12 between the beginning of rise cam path 21 and the beginning of return cam path 23 is related to the distance between the roller at the leading edge of the traveling mold and the roller at the trailing edge of the traveling mold. When this distance, between the beginning of the rise cam path and the beginning of the return cam path, is made shorter than the distance between the leading and trailing rollers, most satisfactory results are achieved because metering is terminated and the remaining metal somewhat centered in the mold cavity before the roller at the trailing edge of the mold structure strikes the rise cam path 21 with its attendant abrupt change in direction of travel. This abrupt change in direction imparts a shock to the mold structure 7 which releases any air or gases pocketed in the molten metal and also settles the molten metal in the cavities. The shock imparted to the traveling mold 7 as the rollers contact rise cam path 21, and the additional shock at each change in direction of travel encountered along the metering means 14, agitates the charged metal remaining in the mold cavities, causing the metal adhering to the sides of the mold cavities to settle in the bottom of the mold cavity producing a pig with rounded edges and free from fins. Additionally, this agitation causes a substantial reduction in the formation of kish.

A short distance beyond the metering means 14, the mold structures 7 start their travel along the solidifying path 13, at which time the mold cavities 15 and 18 have a disposition in the mold structure such that the pig formed is symmetrical in both horizontal and vertical planes, as shown in FIGURE 5.

The metering means 14 shown in FIGURES 1 and 2 as a unitary structure, can be removed from the charging path 12 and another metering means of different cam surfaces may be put in its place so that the amount of charge remaining in the pigs can be controlled and pigs of different weights can thus be metered. Additionally, in place of the unitary structure, metering means 14 may also be a structure having adjustable cam surfaces, so that the weight of the pig to be cast can be controlled by adjusting the inclination of the cam paths without removing the metering means 14. It is also to be understood that while the embodiment of FIGURES 1 and 2 shows a conveyor system in which the rollers are carried on the endless chain, the invention is equally adaptable to a conveyor system in which the rollers are stationary being mounted on a support means and define the path of travel described above. Further, while the metering means described is adequate of itself to accurately meter the metal in the mold cavities regardless of what method of crude charging is employed, the inclined path crude charging means cooperates most fully with a metering means and overhanging lip type mold structure which have interrelated surfaces.

Referring to FIGURE 3, one form of traveling mold structure 7 is shown in a plan view. The mold structure has two leading mold cavities 15 and 15(*a*) and two trailing mold cavities 18 and 18(*a*), between the leading and trailing mold cavities there is a dam 16 having a dam spilling surface 17, and separating mold cavities 15 and 18 from 15(*a*) and 18(*a*) are the lateral separators 24. The mold structure has side walls 25 which have leading edge nesting means 26, and trailing edge nesting means 27. The mold structure 7 has side grips 28 and attachment means 29. It can be seen from the view of FIGURE 3 that a substantially solid surface is presented at the charging station so that surplus metal at the charging station and excess metal at the metering means can flow to adjacent and following traveling molds with virtually no waste of metal. The invention is in no way limited to the shape of the mold cavity illustrated in FIGURE 3 and is equally adaptable to mold structures having a fewer or greater number of mold cavities.

FIGURE 4 is a cross-section of the mold structure of FIGURE 3 along the line 4 and 4', showing the relation of the overhanging lip 19 to the leading mold cavity 15, and the relation of the dam 16 and dam spilling surface 17 to the trailing mold cavity 18.

FIGURE 5 is a side view of the mold structure 7 of FIGURE 3 showing the side wall 25, the trailing edge nesting means 27 and the side grips 28. Also shown, in dotted lines, are the mold cavities 15 and 18 showing their symmetrical disposition in the mold structure 7 when it travels along the cooling path 13.

Although the invention has been described with a certain degree of particularity in an environment of a pig casting operation, it is understood that the present disclosure has been made only by way of an example and that the invention is not limited to such an operation and may be used in any founding operation. Additionally, numerous changes in the details of construction may be resorted to without departing from the spirit and scope of the invention as hereafter claimed.

What is claimed is:

1. Casting apparatus comprising a charging means for the material to be cast, molding means made up of a series of individual molds, the individual molds being connected in an endless chain and having a flowout surface which communicates with the adjacent and following mold, a continuous conveyor means having a series of interconnected pivotal links and rollers for conveying the moldig means, a support means defining a charging path for the continuous conveyor means which guides the molding means past the charging means in receiving relation to the charging means, and cam means located in the charging path including a cam path inclined at an acute angle from the charging path which raises the molding means above the charging path to meter and agitate the material to be cast.

2. Casting apparatus comprising a charging means for the material to be cast, molding means including a series of connected individual molds, the individual molds having a leading edge, a trailing edge with a flowout surface extending the full width of the trailing edge and communicating with adjacent and following molds, a continuous conveyor means including a series of interconnected pivotal links and rollers which form an endless chain in which a roller is mounted at the leading and trailing edges of the individual molds, support means defining a path for the continuous conveyor means to follow, including a charging path positioned in receiving

relation to the charging means and a solidifying path, and cam means positioned in the charging path between the charging means and the solidifying path including a cam surface inclined at a predetermined acute angle from the charging path, the predetermined angle and the flow-out surface of the individual molds coacting to determine the quantity of charged material retained in the molds.

3. Pig casting apparatus comprising charging means for the metal to be cast, molding means including a series of pig molds, a continuous conveyor means which moves the pig molds successively past the charging means to receive the metal to be cast, a support means defining a charging path for the molding means to follow, and a cam means disposed in the charging path including a rise cam path and a return cam path which coact with the charged pig molds to meter and agitate metal remaining in the pig mold.

4. Apparatus for making uniform castings from a foundable material in a continuous operation comprising molding means including an endless chain of individual mold structures, the individual mold structures having a leading edge, a trailing edge, and a flowout surface in spilling relationship with adjacent and following molding means, and cam means defining a rise cam path for the molding means to follow which raises the leading edge

of the mold structure to cause excess foundable material to flow out of the mold structure in a predetermined manner and a return cam path to co-operate with the rise cam path in terminating metering and agitating foundable material remaining in the mold structure.

5. Apparatus for making uniform pigs from molten metal comprising molding means including individual pig molds having a leading edge, a pig cavity, a trailing edge, and a flowout surface, the pig molds being positioned in end-to-end relationship to form an endless chain of pig molds in which the flowout surface of an individual pig mold communicates with the adjacent and following pig mold, and cam means coacting with the molding means, the cam means including a rise cam path to raise the leading edge of the pig mold, an intermediate cam path to allow precision metering of the molten metal, and a return cam path to cooperate with the rise cam path and intermediate cam path in terminating metering and agitating the molten metal remaining in the pig cavity.

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