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3,464,482

CONTINUOUS CASTING

Filed July 22, 1966

2 Sheets-Sheet 1

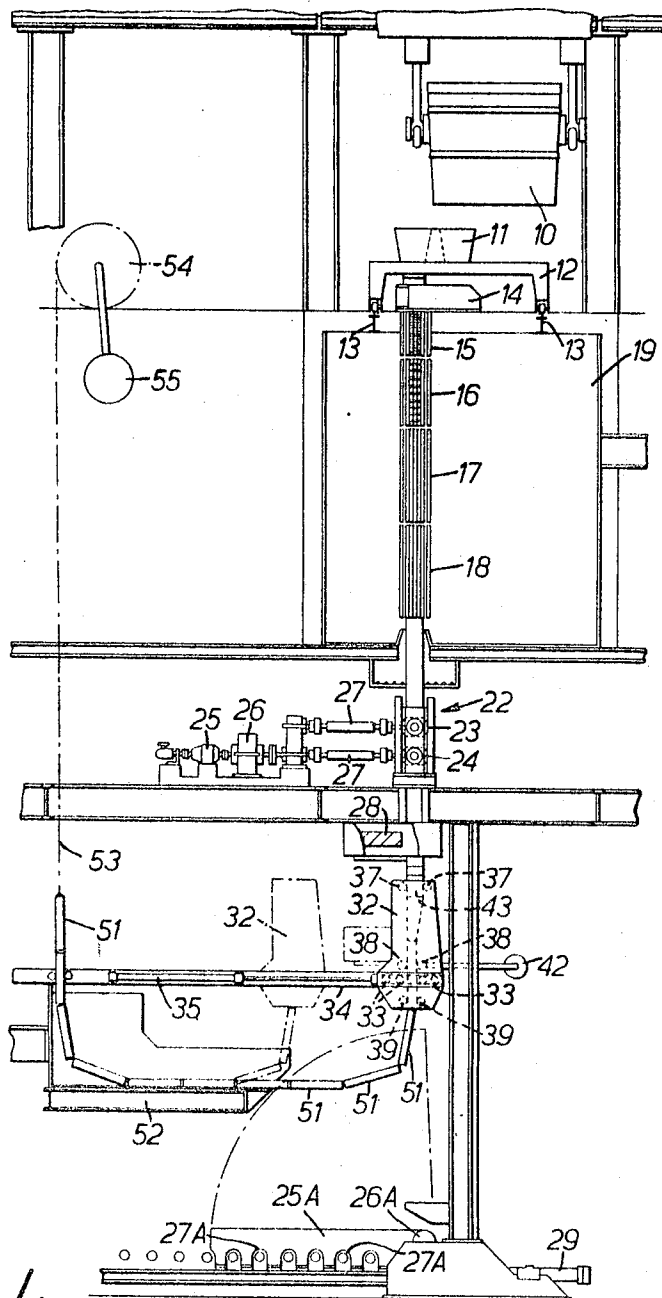


FIG. 1.

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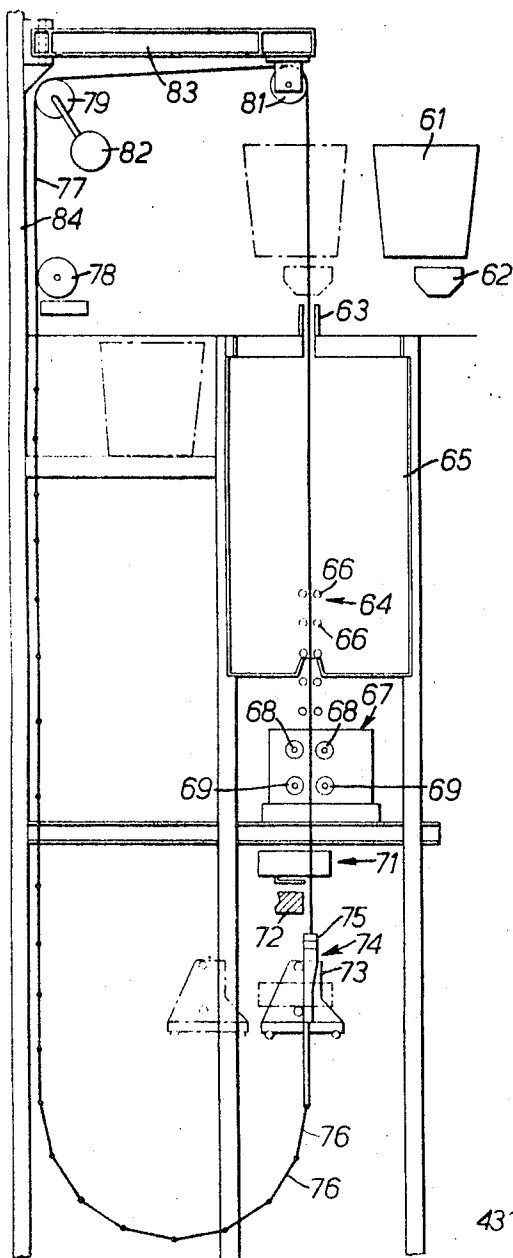


FIG. 2.

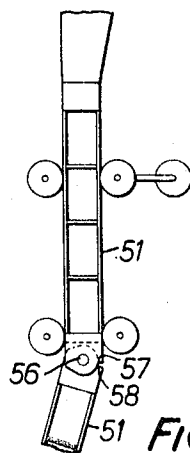


FIG. 3.

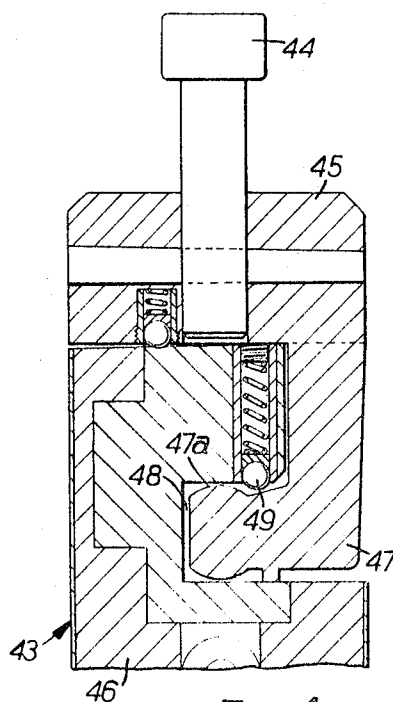


FIG. 4.

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CONTINUOUS CASTING

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6 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a dummy bar for a continuous casting machine, and to a dummy bar mechanism including a dummy bar and handling apparatus therefor. The dummy bar mechanism comprises a transversible carriage designed to support and guide the dummy bar section vertically in the direction of the mold. The dummy bar section includes a coupling element, one portion of which is adapted to engage an abutment on the transverse movement of the carriage, which movement automatically disengages the dummy bar section from the cast article.

For the purpose of explanation only, the invention will be explained in connection with a vertical type casting machine, wherein the casting is completely formed in a vertical plane and after being cut up into desired lengths the lengths are successively rotated approximately 90° to a horizontal plane for conveyance away from the machine. An arrangement such as this is shown in FIGURES 70 and 71 of p. 84 of a book entitled Continuous Casting of Steel by M. C. Boichenko, published by Butterworths, London, 1961.

An essential part of a casting machine consists of what is generally referred to as a dummy bar mechanism, which is employed to support the bottom of the casting as it is initially formed in the mould. The upper end of the dummy bar is usually provided with a plug or starter head which is inserted into the lower end of the open ended mould to which the molten metal initially solidifies and after which the dummy bar is gradually lowered away from the mould as the casting is progressively formed. The plug or starter head is usually designed to be quickly detachable from the dummy bar so that the bar can be disengaged during the downward travel of the bar, thus allowing the bar to be removed and permitting at the same time the casting to be cut into the required lengths after which it can be conveyed away from the casting machine.

Prior dummy bar mechanisms usually have been made up of a number of separate bars which, prior to the pouring of the molten metal into the mould, were individually passed up through the entire machine to furnish the necessary composite length dummy bar to provide the necessary support for the casting. Thus, the separate bars, which may have numbered sixteen in a multiple strand, extended from the withdrawal rolls of the casting machine to the mould for a distance that may have reached 40 to 50 feet. Since the separate dummy bar sections had to be individually handled when inserted into and when removed from the machine, it is evident that considerable time was required in addition to substantial manpower to use the usual dummy bar mechanism. Moreover, the removable dummy bars require space for storage, which space in the immediate vicinity of the machine is at a premium, so that the dummy bars were usually stored away from where they were used which increased the time and manpower re-

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quired to perform the dummy bar operation. It should also be pointed out that in the employment of the large number of disconnected bars difficulty is experienced in guiding the bars and keeping them in proper supporting position and continuous aligned relationship.

The present invention provides for a casting machine, a flexible dummy bar constructed so as to collapse in one direction only.

In another aspect the invention provides for a casting machine, a dummy bar having a plurality of links connected together so as to flex relative to one another in one direction and to resist relative flexing in the other direction.

Embodiment of dummy bar mechanisms in accordance with the invention, will now be described, by way of example only, with reference to the accompanying drawings of which:

FIGURE 1 is an elevational view of a casting machine incorporating a dummy bar mechanism built in accordance with the features of the present invention,

FIGURE 2 shows a second embodiment of dummy bar mechanism being an elevational section similar to FIGURE 1,

FIGURE 3 is an enlarged section of the flexible portion of the dummy bar illustrated in FIGURES 1 and 2, and

FIGURE 4 is an enlarged view of the upper end of the dummy bar shown in FIGURES 1 and 2.

With reference to FIGURE 1 and referring first to the upper portion of the casting machine, there is provided a ladle 10 that delivers molten metal to a tundish 11, the tundish being mounted on a car 12 supported by rails 13 to allow the tundish to be moved relative to the casting line. The entire assembly is carried by a super-structure. The tundish discharges molten metal into a mould 14 which in the form shown has a stationary secondary cooling section 15 attached to the lower end of the mould. Following the secondary cooling section 15 there are three secondary cooling sections 16, 17 and 18, the secondary cooling sections being contained in a shroud 19. Below the secondary cooling unit 18 there is provided a pinch roll unit 22 which consists of two pairs of pinch rolls 23 and 24 which are driven by a motor 25 through a gear reduction unit 26 and spindles 27. The pinch roll unit 22 is also carried by an upper super-structure. Immediately below the pinch roll unit 22 there is an abutment 28 against which the casting is engaged during the disengagement of the dummy bar from the casting. Also below the pinch roll 22 there is provided at the bottom of the casting machine a casting catching device 25A which is mounted on a trunnion 26A which allows the catching device to swing from a vertical position to a horizontal position in which the casting is disposed on a plurality of driven table rollers 27A by which the casting will be removed from the machine. The catching device 25A is rotated about the trunnion 26A by a piston cylinder assembly 29.

Between the catching device 25A and the pinch roll unit 22 there is provided a dummy bar mechanism which includes a housing carriage 32 having a number of wheels 33 which are received in parallel tracks 34 by which means the carriage 32 is traversed from a place in line with the path of travel of the casting to a place remote therefrom, the latter position being shown in the drawing in phantom. This movement is accomplished by cylinder 35.

FIGURE 1 shows that the carrier 32 has three pairs of vertically spaced-apart guide rollers, 37, 38 and 39. The rollers 38, as indicated, are driven by a reversible motor 42. The carriage 32 carries a transition head portion 43 of the dummy bar mechanism.

As FIGURE 4 shows, the transition head 43 actually consists of a secondary head 45 to which a plug 44 to which the casting will adhere on initial rapid solidification is secured and which head is detachably connected to the primary head 46 by a quick release detent connection. Forming part of this connection and projecting from the secondary head is an L shaped projection 47 having a cylindrical surface 47a at its projected end. This surface is received in a recess 48 formed in the primary head 46 and resiliently retained there by a spring-biased detent ball 49. The construction being such that the primary and secondary heads are normally held together by the spring-biased ball 49, but upon lateral force being applied, the heads can be quickly and easily separated from each other. In this way, the casting formed on the secondary head 45 can be quickly detached from the primary head 46 during downward movement of the casting.

The cross section of the head 43 approximates that of the casting being formed. Its lower end, however, is reduced in size and is connected to the first of a number of flexible links 51, as shown in FIGURE 1. These links are explained more fully hereinafter and are designed to collapse only in one direction and form a rigid column when in an upright supporting position. The links extend in a horizontal direction towards the left of the drawing where they are supported on a beam 52. The other end of the link is connected to a cable 53 which, in turn, is connected to a winch 54 which is driven by a reversible electrical motor 55.

Two of the flexible links 51 are illustrated in enlarged form in FIGURE 3. It will be noted that the links are connected together by a pin 56 about which they rotate and through which the weight of the casting is transferred. The links on one side are provided with mating straight surfaces 57 and 58 that engage each other, thereby giving substantial straight column stiffness to the two adjacent links. It will be appreciated that each of the links that assume a vertical position in the carriage 32 will have a similar construction and together constitute a sturdy support for the casting.

A brief description of the operation of the dummy bar mechanism, illustrated in FIGURE 1 will now be given.

When the casting machine is producing castings, the dummy bar carriage 32 will be in the withdrawn position, shown in phantom in FIGURE 1, having been brought there by the operation of the piston cylinder assembly 35. While in this position, the transition head 43, if such is necessary, can be changed to suit the new casting size should the next casting cycle involve a change. In any event, a plug 44 will be inserted in the secondary head 45. After the ladle is empty and the end of the casting has passed through the machine, the piston cylinder assembly 35 will be operated to move the carriage 32 into position directly under the pinch roll unit 22. Following this, the motor 42 will be operated to drive the pair of rollers 38 in a manner to cause the head 43 to move upwardly into the pinch roll unit 22. Of course, at the same time the motor 55 will be operated to provide slack in the cable 53. Since there will be no change in the size of the casting, there will be no need to adjust the pinch rolls 22 and 24 or the guides in the secondary cooling units 15 and 18. The operation of the motor 42 of the rollers 38 will cause the head 43 to move upwardly through the casting machine, which operation will be continued until the plug 44 supported by the transition head 43 has entered into the lower portion of the mould 14. As the flexible links 51 are advanced into the straight position, they will assume a rigid supporting condition to support the weight of the casting.

As the metal is passed to the mould 14 from the tundish 11, the motor 42 of the rollers 38 and the motor 55 of the winch 54 are operated to allow the transition head 43 to be slowly withdrawn from the mould 14 until the

secondary head 45 is in the vicinity above the abutment 28 when in the raised position. The piston cylinder assembly 35 will be then automatically operated so as to withdraw the carriage. When this occurs, the casting will come into engagement against the abutment 28 which will cause the detent connection of the head 43 to release the head 45 and allow automatic disengagement thereof from the casting without stopping the casting which will now be drivenly engaged by the pinch rolls 23 and 24.

With reference now to FIGURE 2, there is shown a ladle 61 and a tundish 62 which are adapted to be brought from a place to one side of the path of travel of the casting to a position over a mould 63. The drawing illustrates in hard lines the ladle 61 and tundish 62 in their inoperative position which is a position they assume when the dummy bar mechanism is being employed preparatory to a subsequent casting operation. Below the mould, moving in a downward direction, there is provided a secondary cooling section 64, which as in the case of FIGURE 1, is received in a shroud 65. The secondary cooling section has a number of guiding rolls 66, several of which are illustrated. Below the shroud 65 there is provided a pinch roll mechanism 67 consisting of two driven pairs of rolls 68 and 69. Immediately below the pinch roll there is a casting cut-off mechanism 71 which may take the form of an acetylene torch or shear or saw. Immediately below the cut-off mechanism 71 there is provided an abutment 72 followed by a carriage 73 of the dummy bar mechanism. As with the carriage 32 of FIGURE 1 the carriage 73 is positionable under the casting machine in one instance and in a second instance, to one side thereof, the latter position being illustrated in FIGURE 2 in phantom.

The casting machine receives a dummy bar head 74 to which there is secured a plug 75, the lower end of the head 74, as in the case of the FIGURE 1 embodiment, is connected to the series of flexible links 76 constructed in accordance with arrangements shown in FIGURES 1 and 3. Links 76 are connected to a cable 77 which is received in a pulley network, consisting of three pulleys, 78, 79 and 81; the pulley 79 being driven by a motor 82. As shown, the cable is long enough to form a continuous loop with its one end connected to the end link 76 and its other end to the top of the dummy bar plug 75. The pulleys 79 and 81 are mounted on an arm 83 being supported by a column 84 in such a manner that when not in use the pulley 81 can be moved to a position away from the mould 63, thereby allowing the ladle and tundish to be brought into their operative position, it being understood that when this occurs the cable 77 has been disconnected from the plug 75.

In the performance of inserting the dummy bar, the carriage 73 is positioned beneath the mould 63 and the cable 77 is brought down through the mould and cooling sections and attached to the plug 75. After this operation is performed, the motor 82 is operated to cause the cable 77 and head 74 to be brought up through the casting machine until the plug 75 is at the bottom of the mould 63. By providing such an arrangement very accurate guiding of the dummy bar head 74 can be obtained which heretofore has been a serious problem. The arrangement shown in FIGURE 2 will assure that the dummy bar head 74 is drawn accurately through the various components of the casting machine. Once the head 74 is in the casting position, the cable will be released from the plug and withdrawn from the mould after which the beam 83 will be removed to allow the ladle 61 and tundish 62 to be positioned for commencing of the casting operation. Once the metal has been poured into the mould 63 from the tundish 62 the motor 82 will be operated to withdraw the head 74 from the casting machine. As in the case of FIGURE 1, when the plug 75 is in the vicinity of the abutment 72, the carriage 73 will be withdrawn to its inoperative position during which action

the casting will be automatically disconnected from the head 74.

In accordance with the provisions of the patent statutes, I have explained the principle and operation of my invention and have illustrated and described what I consider to represent the best embodiment thereof. However, I desire to have it understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A dummy bar mechanism for use with a continuous vertical casting machine wherein the cast article has a predetermined path of travel;

said casting machine including a vertical open-ended mold in which the cast article is formed and a vertical article advancing means spaced downstream from the mold for advancing the cast article away from the mold;

said dummy bar mechanism comprising a starter section and a carrying section;

a carriage located below said advancing means adapted to support said starter and carrying sections and having an operative position where the sections are arranged to receive and support a cast article and an inoperative position to the one side of said path of travel;

means for supporting said carriage in a manner to allow the carriage to move in a direction substantially perpendicular to said path of travel into and out of said operative position;

an abutment located laterally of the path of travel in a manner to be engaged by said casting on movement of said carriage from its operative position to its inoperative position;

cooperative disengageable members connecting together said starter and carrying sections; and

means for moving said carriage transversely of the path of travel to effect the disengagement of the starter section from the carrying section once a portion of the cast article has passed into the advancing means.

2. In a dummy bar mechanism according to claim 1 wherein said disengageable member comprises cooperative coupling elements constructed to allow lateral movement of the carrying section away from the starter section.

3. In a dummy bar mechanism according to claim 1 wherein said carrying section is made up of a plurality of

links connected together so as to flex relative to one another in one direction and to resist relative flexing in the other direction.

4. In a dummy bar mechanism according to claim 1 in which said carriage includes a driving means for advancing said sections towards said advancing means.

5. In a dummy bar mechanism according to claim 1 including a drive means comprising a flexible pulley means one end of which is extendable through the mold of the casting machine and connected to the upper end of said starter section, support means for said pulley means arranged directly above the mold means for bringing said support means into an operative position where it is over the mold and to an inoperative position away from the mold.

6. In a dummy bar mechanism according to claim 1 including an abutment arranged below the mold of the casting machine and above said carriage on the side on which the carriage is withdrawable to said inoperative position, said abutment having a surface adjacent to the path of travel of the cast article and engageable by the moving cast article to cause relative movement between the cast article and said carrying section upon withdrawal of said carriage.

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