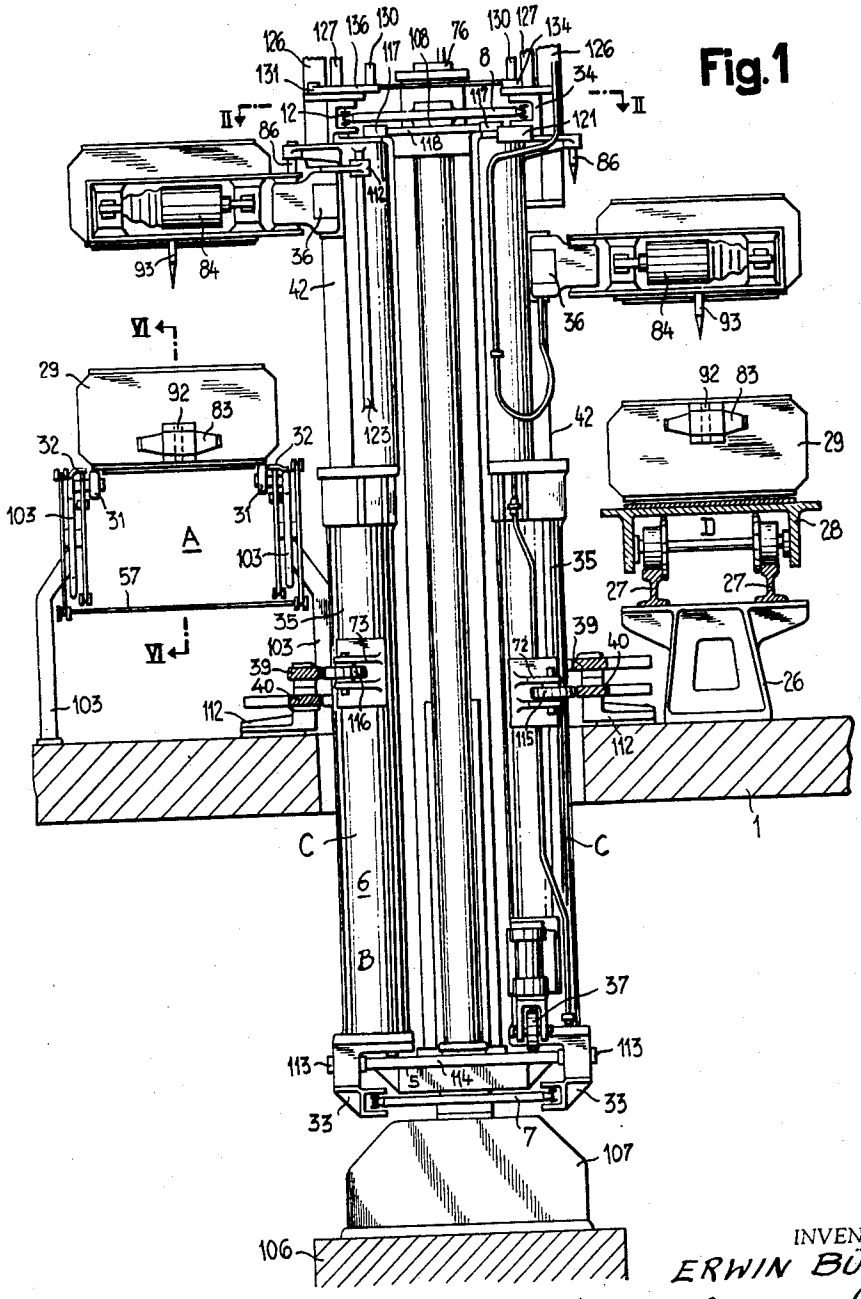
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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Fig.1




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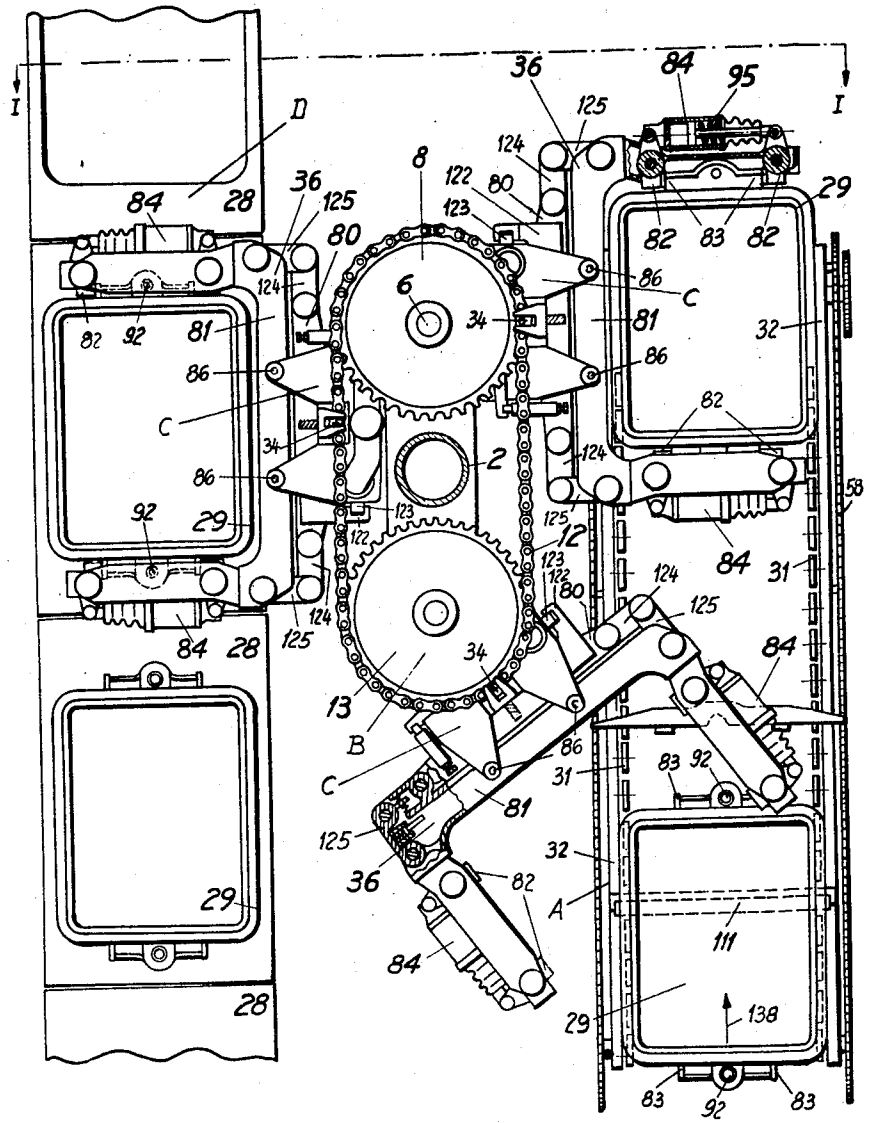
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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Fig. 2



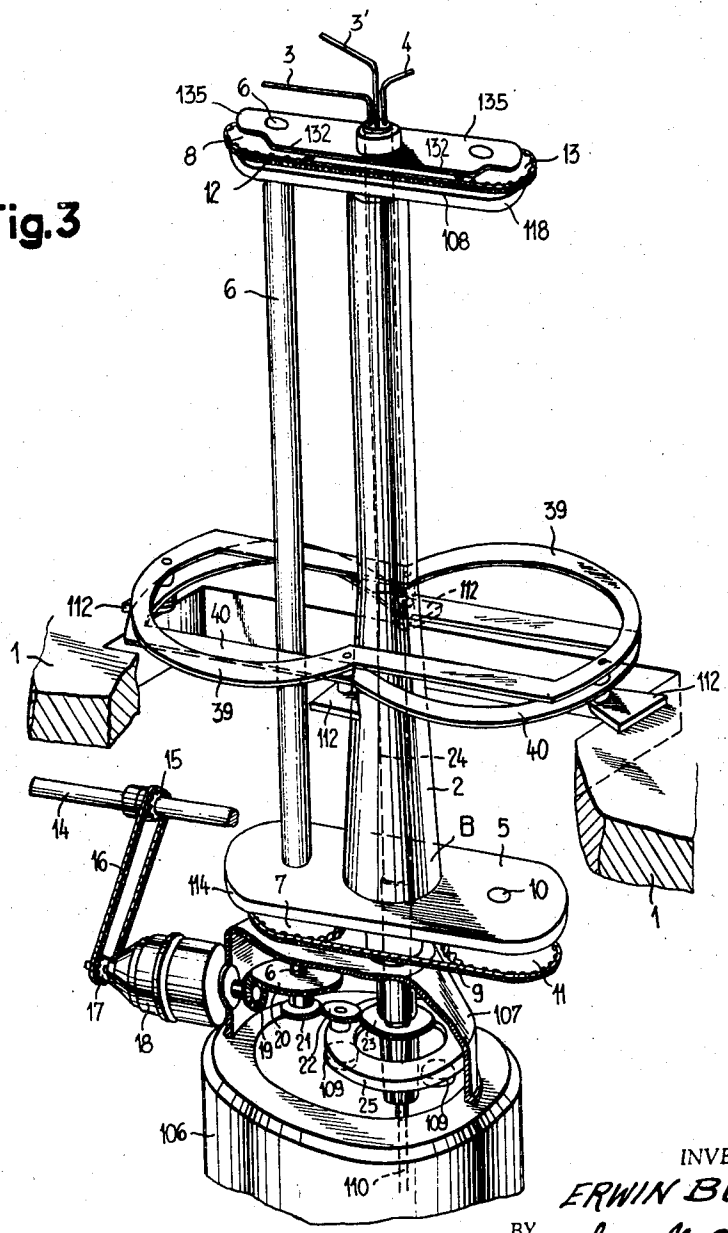

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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Fig.3




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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Fig. 4

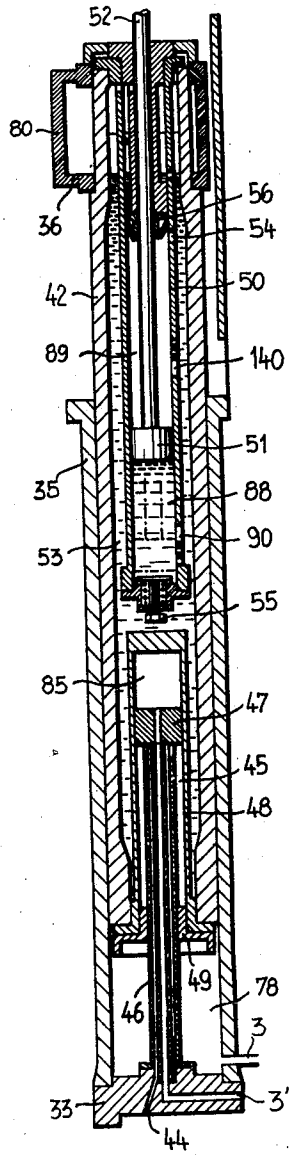
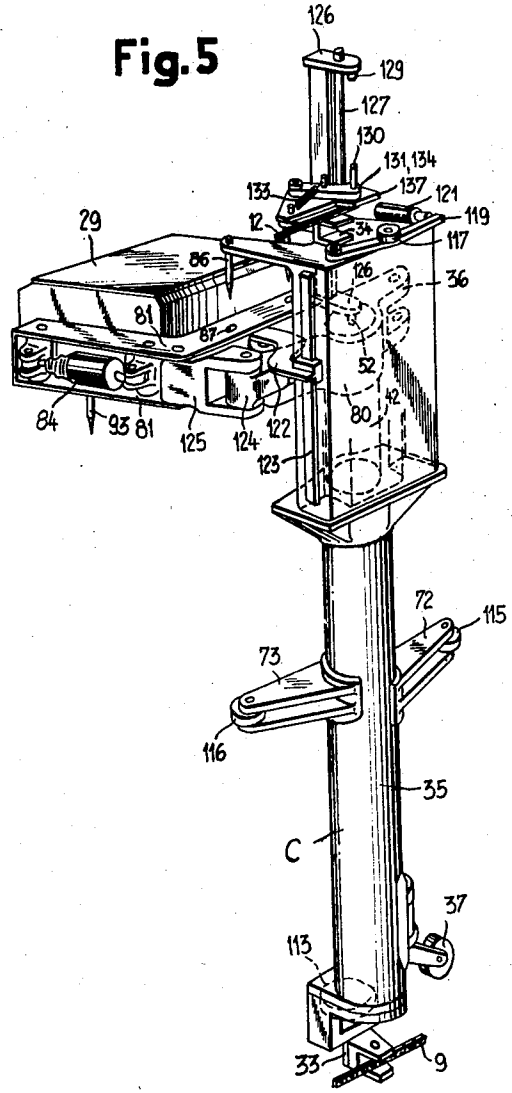



Fig. 5




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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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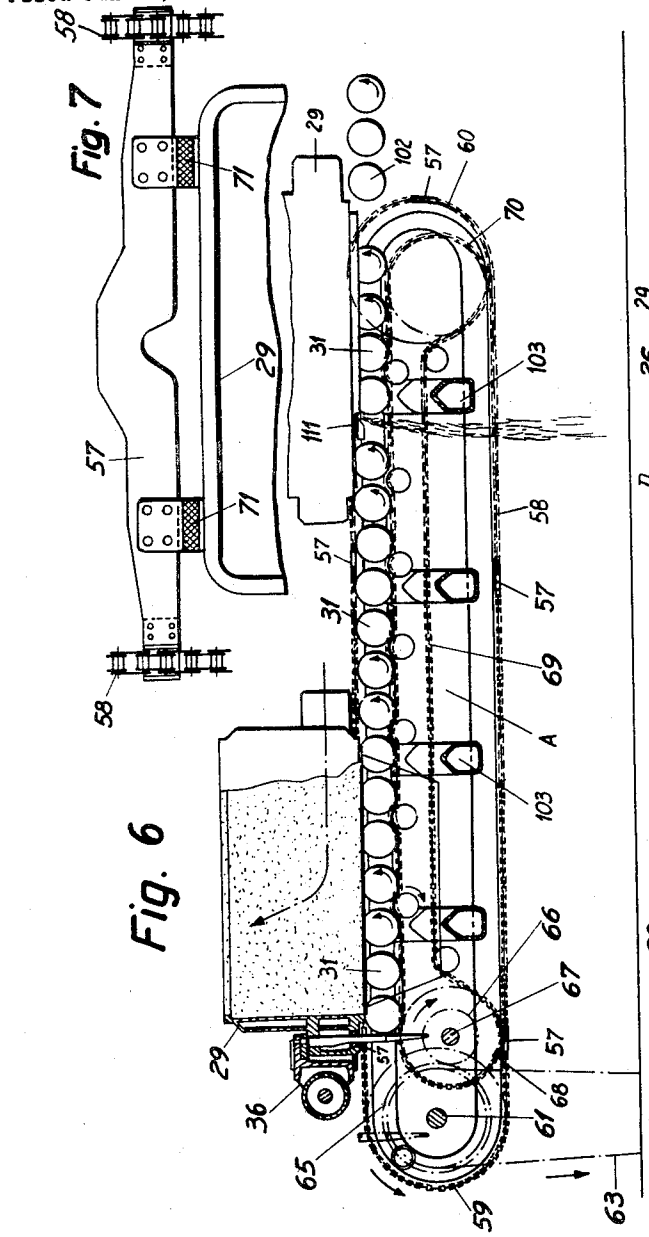


Fig. 6



Fig. 7

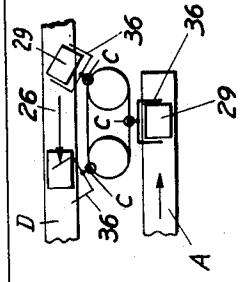


Fig. 13

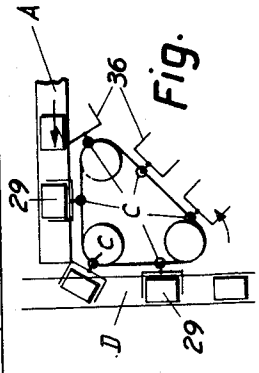


Fig. 14

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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Fig. 12

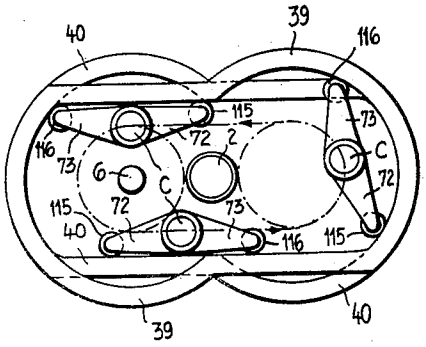
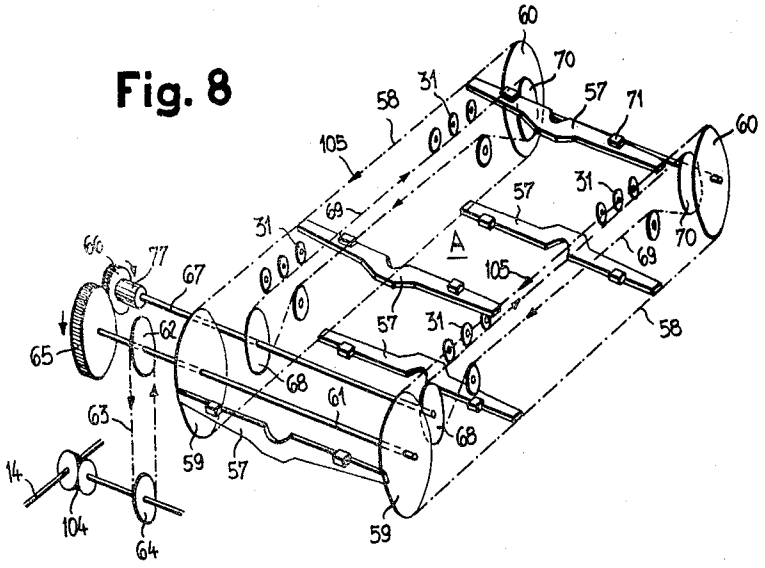



Fig. 8



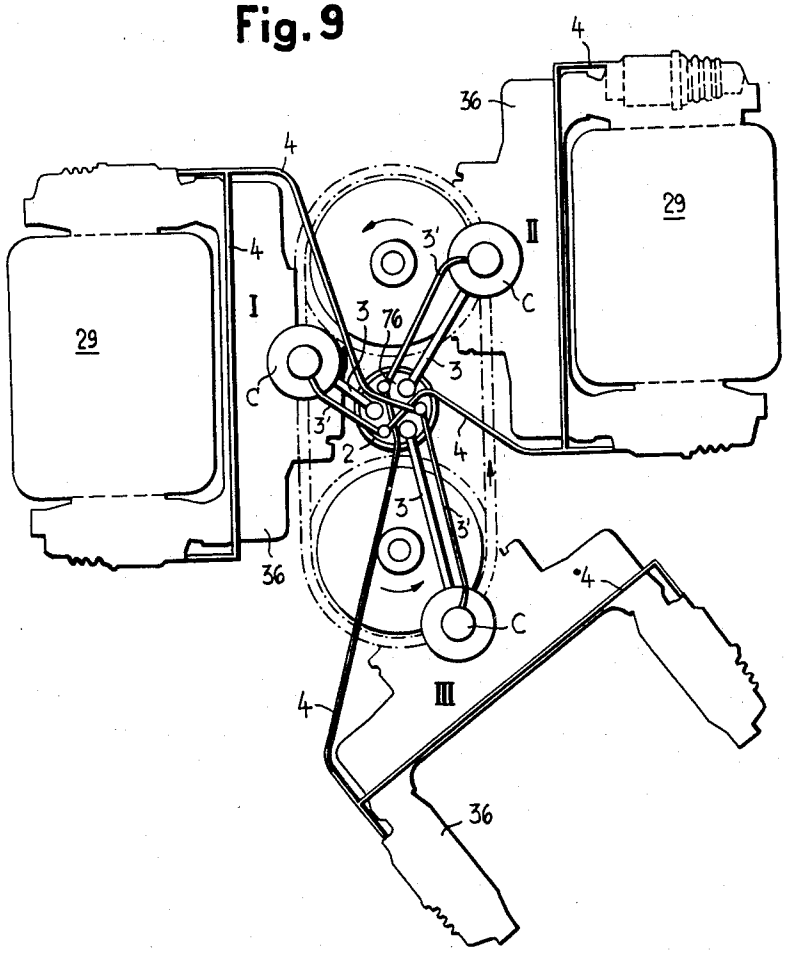

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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Fig. 9




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Fig. 10

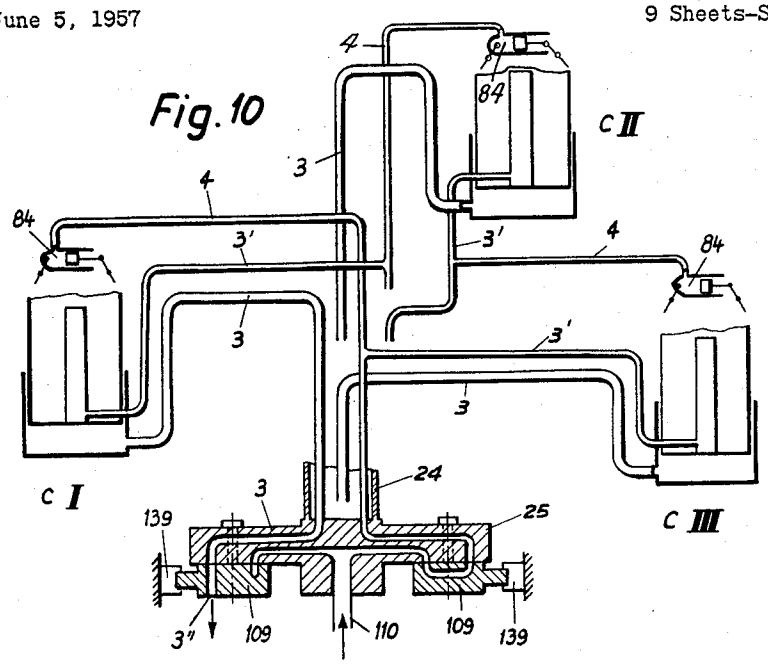
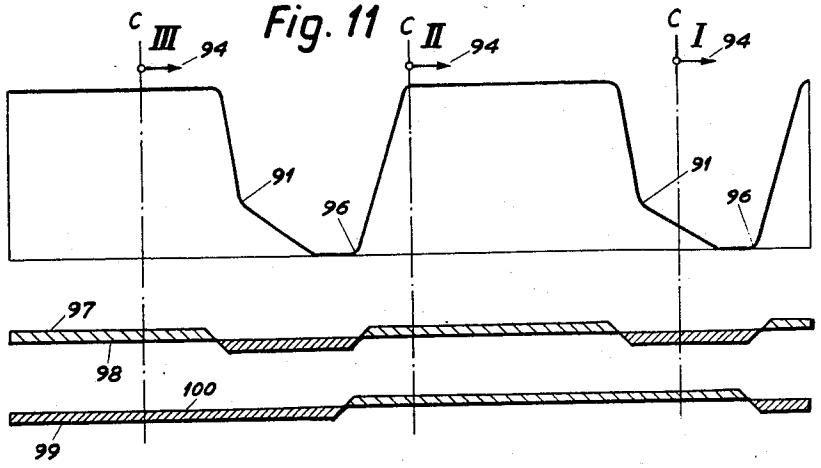



Fig. 11




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TRANSFER SYSTEM FOR FOUNDRY MOLDS

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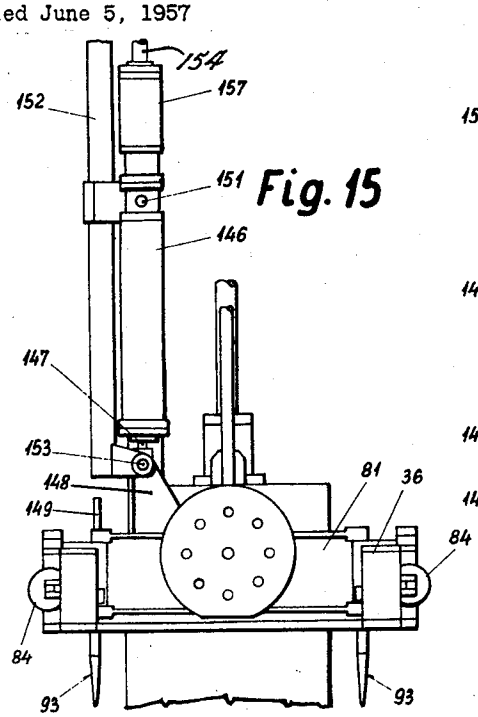
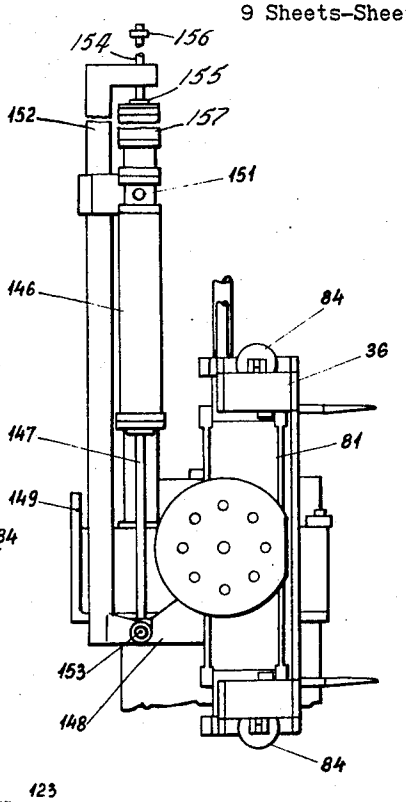



Fig. 15



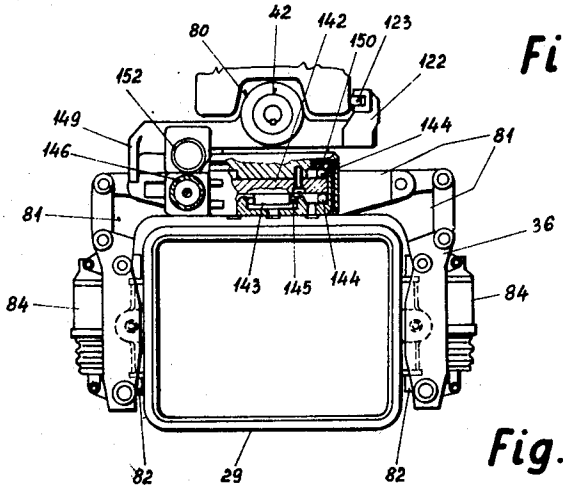




Fig. 16

Fig. 17

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United States Patent Office 2,948,932 Patented Aug. 16, 1960



2,948,932

# TRANSFER SYSTEM FOR FOUNDRY MOLDS

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Filed June 5, 1957, Ser. No. 663,720

Claims priority, application Switzerland June 6, 1956

16 Claims. (Cl. 22—20)

The present invention relates to a transporting system for foundry purposes, and more particularly, to a system for transporting or transferring molds, i.e. mold halves and molding flasks from and to conveyor or like support means, as well as for effectuating the assembly or closure of such mold halves or flasks.

It is a general experience in foundries to constantly increase the dimensions of those molds which are produced by molding machines. This in turn causes a corresponding increase in the weight of the molds i.e. the mold halves.

A transport or transfer of the mold halves by hand is, therefore, practically impossible, and also the use of hoisting or lifting equipment with gripping devices meets with great difficulties. The increased weights of the mold halves enhance the danger of damaging the molds in the course of their transfer from one conveyor system to another, and particularly when such molds are to be assembled and closed, i.e. when positioning the cope on the drag.

Since in addition to the enlargement of the size of the molds also an increase in the rate of production of the molds is desirable, it follows that less time will be available for the production of a complete mold and for carrying out the individual mold forming operations, as well as for handling the mold halves, which adds up to further complications and difficulties.

In order to have the mold halves properly fitted upon each other in practice, the parting plane of the mold should be located slightly above the upper edge or rim of the corresponding flask. If in this case, however, the cope upon closing of the mold is not set down upon the drag in practically parallel relationship, the cope will be subjected to a tilting or canting action, which leads to a partial deformation or depression of the mold in the parting plane. When pouring molten metal into such a mold this partial depression will cause undesirable flask formation.

When closing the molds a certain sagging effect of the copes may be noted, due to the elastic or resilient properties of the mold sand. If the cope is tilted when being deposited on the drag in non-parallel relationship thereto, a displacement of the two mold halves relative to their parting plane will result, which very often causes damage to the mold.

In order to facilitate pouring of the molten metal into the mold when the latter is placed on transporting means, for instance, on a conveyor, and to permit an automatic pouring operation, the mold should be set down on the conveyor in an accurately and evenly predetermined manner, and in an equally spaced relationship with respect to the other molds. Heretofore known devices did not, however, permit to fulfill and meet the aforesaid conditions.

It has further heretofore been suggested to employ electrically or pneumatically operated lifting devices in order to transfer the mold halves from one conveyor to another, which devices are suspended from trolleys on



rails. Such devices were also used to facilitate closing the molds. It has been found in practice that these devices, however, are not able to fulfill any of the aforementioned requirements.

It was further suggested to engage finished mold halves by means of stationary swivelling devices and to displace or deposit these molds onto roll gear tables or slide ways. In case of drags this operation would also necessitate simultaneous turning or revolving movement. These devices are especially unsatisfactory, if molds are to be delivered or fed in a continuous operation and in the course of a continuously driven transporting system, e.g. a conveyor or a roll gear table with driven rolls.

Similar difficulties were encountered in connection with stationary mold inverting devices used in foundries for closing of the molds.

Generally, it may be stated that all of the herein above mentioned devices were unsatisfactory for the transfer of heavy mold halves which either follow each other in rapid succession while being delivered from continuously operating foundry machines or conveyors for transfer onto further moving conveyors, or which are to close simultaneously the molds while transfer of copes or upper mold halves takes place.

It is, therefore, an important object of the present invention to provide means facilitating the transport of foundry molds and flasks in a continuous and uninterrupted sequence and in very efficacious and highly economical operational steps.

A further object of the present invention is to provide means serving to continuously and safely transfer foundry molds between a mold feeding location and a mold delivery location.

Another object of the present invention is the provision of means permitting the transfer and delivery of foundry molds to continuously driven conveyor means and in timed relation with the movement of the latter.

Another object of the present invention is the provision of means ensuring the delivery of foundry molds to continuously moving conveyor means in predetermined periods of time, so as to place said molds onto said conveyor means in equally spaced relationship.

Still another object of the present invention is the provision of means conducive to safely handling mold halves, whereby unto a drag which is arranged on continuously moving conveyor means, a cope may be deposited and the mold simultaneously closed in a fully mechanized manner.

Another object of the invention is to provide means affording that heavy foundry molds or mold halves, the weight of which prevents manual handling thereof and requires special measures, may be picked up, transported and then deposited carefully and safely.

A further object of the present invention is the provision of means permitting the fulfillment of more modern requirements of the foundry industry with respect to an increase in the rate of production of foundry molds and also with respect to the reduction of time required for handling finished mold halves and placing corresponding two mold halves upon each other for closing the molds.

Still a further object of the present invention is the provision of means aspiring to positively engage and guide the said mold halves during transfer thereof from a feeding to a delivery location, and moreover to insure deposit of a cope onto a drag at said delivery location in a precise, parallel relationship and in a non-tilting manner, so as to maintain the accuracy of the planar contact at the parting line of said mold halves.

Another object of the present invention is the provision of means facilitating the transfer of finished mold halves from a first conveyor to a second conveyor without caus-

ing any damage to said mold halves, thereby considerably improving the quality and reducing the cost of said molds, as the closing operation may, therefore, be performed in a controlled manner and with uniform pressure for all the molds.

Another object of the present invention is the provision of means redounding to equalization of the pressure distribution along and in the parting plane of the mold halves upon closing the same.

Still another object of the present invention is the provision of means aiming at imparting to a mold a predetermined speed for achieving the engagement of the said mold with a continuously moving first conveyor, transferring said mold thereafter to a continuously moving second conveyor, and depositing said mold onto said second conveyor, whereby adjustment of the speed of the mold transfer movement to the respective speeds of the conveyors may be had in a very effective and smooth operation.

The invention will be more fully comprehensively understood from a consideration of the following detailed description when read in connection with accompanying drawings which form part of the application, it being understood, however, that the improvement is capable of extended application and modification and is not confined to the showing of the drawings nor to the precise construction described, and, therefore, such changes and modifications may be made therein as do not affect the spirit of the invention nor exceed the scope thereof as expressed in the appended claims.

In the drawings:

Fig. 1 indicates a device for transferring molds embodying the invention, shown in elevation and partly in section taken along lines I—I of Fig. 2.

Fig. 2 is a plan view of the device of Fig. 1 together with conveyors for transporting the molds to and from the transfer device, parts of the latter being shown in section taken along lines II—II of Fig. 1.

Fig. 3 is a perspective view of the central part of the device partly in section, the conveyors and lifting means being omitted for clarity's sake.

Fig. 4 is a vertical section through a part of the lifting means.

Fig. 5 shows in perspective view of the lifting means.

Fig. 6 is a longitudinal section taken along lines VI—VI of Fig. 1.

Fig. 7 shows a detail of a conveyor for transporting or feeding molds to the transfer device.

Fig. 8 shows schematically and in perspective the feeding conveyor employable in the invention.

Fig. 9 is a diagrammatic view of the air conduit system for the gripping and lifting devices employed in the invention.

Fig. 10 is a diagrammatic view of the slide valve and compressed air conduit system.

Fig. 11 is a diagram indicating the lifting movements of the device to which reference is made in the specification.

Fig. 12 is a plan view of the superposed central guide curves for the lifting devices.

Fig. 13 and 14 are schematic representations of transfer devices equipped with three and six gripping members, respectively.

Figs. 15 to 17 show respective modifications of the lifting and gripping device seen in Fig. 5.

Referring now more particularly to the drawings, and in particular to Figs. 1 and 2 there is disclosed a feed conveyor A for transporting molds **29**. These molds **29** are received by lifting and gripping devices C which are operatively connected to column-shaped members B and which lift these molds off the said conveyor A. The aforesaid members B support said lifting and gripping devices C along a closed circuit or path in the course of which molds **29** are lowered by the lifting devices onto



delivery conveyor means D and thereafter disengaged from the gripping devices.

Feed conveyor means A, which will now be described in greater detail is shown in Figs. 1, 2, 6, 7, and 8. There are journalled in frame **103** which is anchored on floor **1** rolls **102** and **31**. On both sides of the rolls **31** rails **32** are arranged to guide the molds **29** as shown in Figs. 1 and 2. It will be noted that only the marginal rim of the mold box is supported on the rolls **31** and **102**, so that also molds with forming parts projecting downwardly from and beyond the box may be transported on such conveyor means. In the case of drags being delivered or fed by the conveyor a planing knife **111** is mounted in the frame **103** which knife slices off a part of the mold sand projecting below or beyond the mold box when the latter travels over this knife. If grooves are to be drawn in or provided on the mold proper, this knife **111** may be given a corresponding serrated profile or configuration, or alternatively a second knife for cutting such grooves may be applied.

In Figs. 6 and 8 there are disclosed motion adjustment and synchronizing means used with the feed conveyor means A. As shown in Fig. 8 a shaft **14** rotated by a suitable source of power (not shown) is driving over bevel gears **104** a sprocket wheel **64** and via a chain **63** a further sprocket wheel **62** on shaft **61**. On this shaft and connected thereto for rotation therewith are seated two rolls **59** over which are trained respective chains **58** each of the chains being further guided over second rolls **60**. The chains **58** carry between them transversely extending abutment or adjustment members **57** evenly spaced from each other over the length of the chains and travelling therewith in the direction of the arrows **105** (Fig. 7). Shaft **61** carries in addition a gear wheel **65** in mesh with a gear **66** which in turn is arranged on a shaft **67**, the latter extending parallel with respect to shaft **61** and carrying a pair of sprocket wheels **68** driven by respective chains **69**. The gear **66** is combined with a friction coupling **77**, the latter being adapted to compensate for differences in the respective rotational speeds of gear **66** and shaft **67**. The chains **69** are guided over sprocket wheels **70** also supported on the frame **103**.

These chains **69** serve to drive rolls **31** in order to ensure that the drag or cope **29** delivered to the conveyor will be received by the transverse support members **57** independently of the respective speed conditions with which said mold halves travel. The speed of the aforesaid members **57** corresponds to that of the lifting devices C. Each of said support members **57** is provided with two buffers or abutments **71**.

The device B shown in Figs. 1, 2, and 3 comprises a socket **107** mounted on a base **106**. A column **2**, connected to the socket **107**, carries a lower plate **5** and an upper plate **108** both said plates forming guide curves.

A speed reduction gearing **18**, mounted on socket **107**, is driven from a shaft **14** over a sprocket wheel **15**, a chain **16** and a sprocket wheel **17**. A bevel gear **19** of said gearing 18 meshes with a bevel gear **20** connected with a shaft **6**, the latter carrying sprocket wheels **7** and **8**.

On plate **5** a pin or trunnion **10** is provided carrying a sprocket wheel **11**, connected to the sprocket wheel **7** by means of a chain **9**. Sprocket wheel **8** is connected with a sprocket wheel **13** by a chain **12**, the sprocket wheel **13** being carried by plate **108**. Shaft **6** further supports a pinion **21**, meshing with an intermediate gear wheel **22**, the latter engaging with a gear **23**, which is fixed to a tube or pipe **24** (Figs. 9 and 10).

An annular plate **25** is rigidly connected with tube **24** and carries three slide valves **109**. A conduit **110** feeds compressed air to the plate **25** and via the slide valves **109** to air pipes **3** and **4** extending through tube **24** to the lifting devices C schematically indicated in Fig. 3.

Affixed to the floor **1** by means of supports **11** and **12** are an upper guide way **39** and a lower guide way **40**.

In Fig. 2 the three lifting devices C are shown, which are arranged equidistantly about the device B.

In Fig. 5 a single type of lifting device C carrying a mold 29 is shown in perspective and elevation. The lifting device C is in engagement with chains 9 and 12 over striking members 33 and 34. The lifting device C is supported on plate 5 by means of a roll 37. Furthermore, the lifting device is in engagement with a guide-way 114 over a roll 113, with a guide-way 40 over a roll 115; and with a guide-way 39 over a roll 116 (see also Fig. 12). Rolls 115 and 116 are arranged on supports 72 and 73, respectively, while roll 113 is carried by striking member 33. The supports 72 and 73, as well as member 33 are mounted on a cylinder 35 of the lifting device C. A further guide roll 117, engaging a guide-way 118 of the plate 108, is supported by a lever 119, hingedly connected to a pivot 120 on the lifting device C.

This lever 119 is biased together with its roll toward guide-way 118 by means of a spring (not shown) which is arranged within a casing 121. For movement around the column 2, the three lifting devices C are, therefore, guided with respect to their height by roll 37, and supported in vertical direction, i.e. perpendicular with respect to the direction of movement by means of chains 9 and 12 over striking connecting members 33 and 34, respectively, and guided transversely in respect to the direction of movement by means of guide rolls 113, 115, 116, and 117, the latter rolls also serving to secure the lifting devices C against rotation and to insure accurate perpendicular arrangement thereof.

The cylinder 35 of each lifting device C (see also Fig. 4) contains a piston 42 carrying a gripping member 36, in engagement with a vertical guide-way 123 over a guide support 122, to prevent rotation of this piston.

In Figs. 2 and 5 the gripping member 36 is shown more clearly. As will be seen therefrom the gripping member comprises a support 80 mounted on piston 42. The support is provided with two pairs of levers 124 and 125. Levers 125 are hingedly connected to a fork member 81 arranged for universal movement in horizontal direction, the range of relative movement, however, being limited. On its arms the fork member 81 carries gripping jaws 82 arranged for actuation by means of compressed air and adapted to engage the molds or flasks 29 at projections 83 thereof as described in my U.S. Patent #2,767,-447.

The cylinders for compressed air to facilitate actuation of the gripping means or jaws are indicated at 84. The bottom portion of cylinder 35 of each lifting device C, in which cylinder a piston 42 moves upwardly and downwardly is formed by the engaging member 33 provided with channels 3′ and 44. These channels are adapted to admit air into a tubular member 46 projecting into the piston 42 and terminating in a second piston 47, integral with tubular member 46. Piston 47 is guided in a compensating cylinder 48 of piston 42. The channel 44 extends into space 45, while channel 3′ is connected to chamber 85.

A sealing gland 49 serves to close the compensating cylinder 48 at its lower end. Channel 3′ serves to permit a flow of air to and from chamber 85, while channel 44 is adapted to maintain a constant air pressure within space 45. Piston 47 is adapted to take up a part of the weight of the vertically movable portions of the lifting device during the setting down operation of a drag onto the conveyor D or during the operation of closing a mold on this same conveyor. In such case it is desirable to attain a predetermined closing pressure upon deposit of the cope, but without reducing the speed of descent or lowering of the gripping member 36 before the engagement of the mold or molds 29.

The piston 42 contains a further cylinder 50, filled with a suitable brake fluid. A piston 51 having a piston rod 52 is movable in this cylinder, the piston rod being rigidly connected with a guide piece 126 which is slidably arranged on a guide member 127. When the piston 42 is raised the piston rod 52 and the guide piece 126 will also move upward, until the latter contacts or abuts against the lower face of a plate 128. The movement of the piston rod 52 is thereby stopped and the piston 51 will act as a dampening device due to the fact that the brake fluid will be displaced through relatively narrow openings 90 from space 88, provided in cylinder 50, into a chamber 53 surrounding this cylinder, said openings 90 being covered one after the other by piston 51 upon advancing downward movement thereof.

When the piston 42 is lowered, the piston rod together with the guide piece 126 will also be lowered until its bolt 129 abuts against a stop 130. The stop 130 is interchangeably arranged on a lever 131. This stop 130 may be exchanged with a similar stop of different height. The downward movement of the piston rod 52 is thereby interrupted. Such abutment will, however, take place only, if the lever 131 pivotably arranged on plate 137, is guided into the position 134 shown in Figs. 1 and 5, by means of a cam member 132 against the action of a spring 133 attached to said lever. This position of the guide lever 134 corresponds to an operation of the transfer device in which copes located on the feed conveyor A are to be engaged for removal therefrom.

If the lever 131 is released by the cam member 135, this lever will be moved into the position 136 shown in Fig. 1 by means of spring 133 acting thereon. When the piston rod 52 is lowered in this position of the lever, its stop 129 will abut against the stop plate 137. Position 136 of the lever corresponds to an operation wherein the copes have to be set down upon the drags, as the height of the latter may vary.

If the drags are to be transferred from conveyor A to conveyor D, cam member 132, 135, and lever 131 may be omitted and the interchangeable stop 130 may be connected with the stop plate 137, since engagement and setting down of the molds is to be effectuated at the same level. A space 53 is provided between the piston 42 and cylinder 50, this space serving as a reservoir for the brake or damping fluid.

In the wall of cylinder 50 bores 54 and 140 are provided, which will effect a variation of the speed of descent of piston 42 after the piston rod 52 has been stopped; thus in the upper portion of the stroke or movement of piston 42 a higher and in the lower stroke portion a lower speed of descent will prevail. At the lower end of the cylinder 50 a check valve 55 is provided, while at the upper end of said cylinder a sealing sleeve 56 is disposed through which the piston rod 52 extends. The lifting device C carries two guide bolts which at the end of the stroke engage with bores 87 of the fork member 81 and thereby define the raised position of the gripping member 36 in horizontal direction.

Figs. 15 to 17 show a modification of the lifting and gripping device of Fig. 5. In this modification the gripping member 36 may be swivelled about a horizontal axis through an angle of 90° together with the mold 29 engaged by said gripping member. The support 80 seated on piston 42 carries a circular guide plate 42 having a pivot 143 arranged in the center thereof.

The fork member 81 is guided axially by a pair of ball bearings 144 and by a further bearing 145 radially with respect to pivot 143. A cover 150 connected with fork member 81 encloses the ball bearings 144 and 145. The support member 80 carries a compressed air cylinder 146, the latter being arranged for swivelling movement about a pivot 151.

Cylinder 146 contains a piston (not shown) which is hingedly connected to an arm 148 of fork member 81 via piston rod 147. A stop or abutment 149 is provided to define the horizontal position of the gripping member and to thus limit the movement thereof to one of its extreme positions. The movement of the gripping member 36 into its vertical or other extreme position is limited by

the stroke of the piston within the cylinder 146. A damping element 157 is provided above cylinder 146 and connected thereto. An actuating rod 152 for said damping member 157 is hingedly connected to arm 148 over a pin 153. This rod is guided by a piston rod 154 of a damping piston (not shown).

Actuation of the damping member 157 is effected at the end of the swivelling movement of the gripping member 36 by means of stops 155 and 156 arranged on piston rod 154. The above described device for swivelling the gripping member 36 during the transfer operation permits the insertion of cores, as well as checking of the mold and removal of loose sand by means of a stream of air directed thereagainst.

In Fig. 9 the lifting devices C are shown and indicated at I, II, and III, respectively. The gripping members 36 associated with each of the lifting devices C are indicated in outline. The molds 29 are similarly represented. As will be seen from Fig. 9 the air conduits 3 for the lifting devices C, the air conduits 4 for the gripping members 36, and the air pipes 3' for the compensating cylinders 48, branch off from a pipe connecting member 76 arranged in column 2.

From Fig. 10, as well as Fig. 11 it may be noted that one air conduit or pipe 3' of each of the lifting devices C–I, C–II, C–III is connected with the air pipe 4 leading to the gripping member 36 of an immediately adjacent lifting device.

The delivery conveyor D comprises conveyor cars 28 running and guided on a pair of rails 27 which are supported through socket means 26 on floor 1. The conveyor cars 28 carry molds 29, as will be seen from Fig. 1.

Fig. 13 schematically represents the embodiment of Figs. 1 to 12 with three lifting devices, the conveyors extending parallel with respect to each other, and the transfer device being located intermediate thereof.

In contradistinction thereto Fig. 14 shows schematically an arrangement where the feed conveyor A does not extend parallel with respect to the delivery conveyor D, but at right angles thereto and wherein the transfer syster is provided with six lifting devices C.

The mode of operation of the embodiment shown in these figures and described in connection therewith is as follows:

From Figs. 1, 2, and 6 it will be seen that the molds are fed towards the transfer device via the feed conveyor A in the direction of arrow 138. It will be noted that the speed of the molds on the feed conveyor A is higher than the circumferential speed of the lifting devices C with their gripping members 36. During their movement on the feeding conveyor A the molds 29 reach first the synchronizing device (Fig. 6) the chains 69 of which drive the rolls 31. The speed of the movement imparted by the rolls 31 to the molds 29 is such that they will abut against the transverse members 57 of the chains 58. The latter travel with a speed corresponding to the circumferential speed of the lifting devices C, and are, therefore synchronized with the movement of these lifting devices.

When the mold travels over the planing knife 111, a portion of the mold sand projecting or bulging beyond the lower side of the mold flask is sliced off in a plane which is substantially parallel to the lower face or side of this mold flask. The height of sand projecting beyond the mold flask may be adjusted by relative vertical adjustment of the planing knife. After the mold has reached a position on the feed conveyor 30 to which the path of movement of the lifting devices C runs parallel, the gripping member 36 of the corresponding lifting device will be lowered to a position in which the gripping jaws 82 of said gripping means engage the mold 29.

When this engagement has been effected, the mold 29 is lifted off from the conveyor 30 by means of piston 42 to which an upward movement is imparted. The mold is then transferred along the closed path defined by chains 9 and 12 to the delivery conveyor D. When the gripping means together with the mold have reached a point along the path in which the path of the delivery conveyor meets the lifting device C at a tangent, the gripping device 36 is lowered until the mold rests on the delivery conveyor D. At this moment the gripping jaws 82 are opened for disengagement from the mold, and the empty gripping device 36 will be raised and transferred along the closed path back to the feeding conveyor A.

In the example just described the entire transfer device is controlled through slide valves 109 in plate 25 by means of cams 139 which initiate the lifting and lowering movement and regulate automatically the gripping movement and the operation of the compensating cylinder 48.

The ascending movement of the piston 42 of the lifting device C is affectuated by actuating the corresponding slide valve so as to open through the latter and thus permit the admission of air into channel 3. Compressed air then enters chamber 78 of cylinder 35, thus lifting piston 42 together with the gripping member 36 mounted thereon. When the piston 42 is being lifted, oil contained in chamber 88 of cylinder 50 will flow through openings 54 into an outer chamber 53. At the end of the upward or lifting stroke of the piston 42, piston 51 will gradually and successively cover up or close all of the lower openings 90, the remainder of the oil within cylinder 50 thereby preventing an abrupt or shock-like braking of the movement of the piston 42.

Engagement of mold 29 is effected by rotation of valve 109 so as to admit compressed air from conduit 4 to cylinder 84, whereby the gripping jaws 82 engage the mold 29, i.e. the flask at its projections 83. By further rotational movement of this valve 109 channel 3 is connected to the ambient air via channel 3'. Thus piston 42 of the lifting device C will descend due to its own weight and that of mold 29.

In order to increase the speed of descent the check valve 55 opens and admits oil from chamber 88 into space or chamber 53. During the first half of the lowering or descending stroke of piston 42 oil is forced out of space or chamber 89 through openings 54 and 140 into space or chamber 53. As soon as piston 51 has covered up openings 140 oil can escape from chamber 89 only through openings 54 of reduced cross-section into space 53, thereby decreasing the speed of piston 42 in downward direction.

In the diagram shown in Fig. 11 the initial decrease in downwardt speed is indicated at 91. The gripping means 36 are provided with guide pins 93 which accurately define the position of the gripping member with respect to the mold 29 prior to the engagement of said mold by the gripping jaws. The above mentioned guide pins penetrate the corresponding bores 92 provided in the aforesaid projection 83 of the drags. When closing a mold these guide pins orient or center the cope with respect to the drag.

The transfer device is operatively connected with the conveyors A and D via shaft 14. The speed for the conveyors and the transfer device are chosen to be equal.

The conveyor D may be driven in any known manner, such as disclosed in the copending application Serial No. 555,986, filed December 28, 1955, now Patent No. 2,861,672.

As soon as the molds or mold halves 29 are deposited on the delivery conveyor D the corresponding slide valve 109 opens and thereby connects pipe 4 with the ambient air.

A spring 95 in cylinder 84 will then effect an opening movement of the gripping jaws 82, and a disengagement of the latter from the projections 83 takes place. Subsequently the lifting device 35 is actuated to raise the gripping device by means of its piston 42. This operation is indicated in Fig. 11 at 96.

With respect to Fig. 11 it should be noted that the abscissa of said diagram indicates the time unit, where-

as the ordinate of the uppermost curve indicates the lifting or lowering stroke. Lines C–I, C–II, and C–III correspond to the momentary positions of the lifting devices C–I, C–II, C–III. Arrows **94** indicate the direction in which the lifting devices follow each other in this diagram. In the diagram the respective positions of the gripping devices **36** are indicated by the intersections of the dash and dot lines (I, II, III) with the uppermost curve. In the second diagram line **97** indicates the pressure condition in air conduits or pipes **3'** which are connected with the lifting devices C.

The hatched areas above line **98** indicate pipes under pressure which is substantially higher than atmospheric pressure. The corresponding hatched areas below line **98** indicate pipes under substantially atmospheric pressure. In the third diagram the hatched areas above line **100** indicate engagement of the gripping jaws with the mold thereby illustrating the condition of compressed air contained in pipes **4**. The areas below line **100** indicate the condition of the pipes **4**, wherein substantially atmospheric pressure prevails, i.e. when the gripping jaws are disengaged.

Summarizing the advantages of the present invention, it will be apparent that it affords the transfer of molds from first continuously moving conveyor means to second continuously moving conveyor means under absolutely vibrationless conditions and at any desirable rapid sequential rate of transfer operations adjustable within an extremely large range.

The horizontally movable gripping device permits centering thereof with respect to the mold by means of guide pins prior to the engagement of these molds by the gripping jaws and in addition renders the possibility of accurately adjusting the cope with respect to the drag before closing the mold by means of said guide pins. Due to the fact that the guide pins are attached to the gripping device, an additional operation involving insertion and removal of said guide pins and a transfer of these guide pins back into the mold engaging positions may be completely dispensed with.

Since the molds are transported on the feed conveyor means in an accurately defined horizontal position, and this position is strictly maintained during engagement, transfer movement and deposit of the mold onto delivery conveyor means, the latter receiving the molds in practically parallel relationship to each other as the horizontal position thereof is also precisely defined. Thus it is positively ensured that the copes may be deposited on the drags on a delivery conveyor without any tilting or canting movement whatsoever.

It will be noted that the present invention further provides means enabling cope and drag to be accurately fitted together by planing knives provided at the feed conveyor to ensure that the parting plane of the drag is practically parallel to the lower face of the drag flask, over which the drag is supported on the conveyor. In this case the sand of the finished drag must project beyond, i.e. below the edge or corresponding face of the drag flask.

In addition to this planing operation carried out on the conveyor, longitudinal grooves may simultaneously be drawn into the sand underface, which during pouring operation permit or facilitate the escape of gases.

The present invention permits the transfer of drags and copes of different heights and to deposit such drags and copes on conveyor means so that the molds follow each other at equal distances. Moreover, the described lifting device permits to close a mold under predetermined pressure, i.e. to press the cope into the drag when closing the mold. This results in further improvements as to the quality of the castings to be produced as the high quality of the molds is further guaranteed by the fact that an equal and uniform pressure may be attained during each closing operation.

Due to the fact that the finished molds follow each other on the delivery conveyor in equally spaced relation and in predetermined position, the deposit of weights onto and removal thereof from the closed mold and the pouring of molten metal into the mold may, therefore, be carried out mechanically and automatically in an absolutely positive and precise manner.

While in the embodiment herein shown and described the lifting devices C with their associated gripping devices are guided laterally of the feed and delivering conveyor means, it will be understood by those skilled in the art that the lifting and gripping devices may equally well be arranged above the conveyor means.

Various changes and modifications may be made without departing from the spirit and scope of the present invention, and it is intended that such obvious changes and modifications be embraced by the annexed claims.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. A system for transferring mold halves from a first continuously moving conveyor to a second continuously moving conveyor, each of said conveyors having mold supporting surfaces adapted to transport a mold half thereon; comprising lifting means intermediate said first and second conveyors and movable in a closed path, said closed path extending along and between said first and second conveyors, respectively, from a mold receiving location adjacent said first conveyor to a mold delivery location adjacent said second conveyor, support means for said lifting means guiding the latter along said closed path, mold carrying means arranged for upward and downward movement along said lifting means and perpendicularly with respect to said mold supporting surfaces, a mold gripping mechanism mounted on said mold carrying means and adapted to engage and disengage a mold half, mold centering means on said carrying means and adapted to provide for a predetermined relative horizontal position of said mold carrying means with respect to a mold half to be engaged by said gripping mechanism, first and second operating means each including a cylinder and a piston, said first operating means being mounted on said lifting means and operatively connected to said mold carrying means, said second operating means being supported on said mold carrying means and connected to said mold gripping mechanism, drive means operatively connected with at least one of said conveyors for continuously moving said lifting means on said support means along said closed path, control means for said first and second operating means operatively connected with said drive means and fluid supply means interconnecting said control means with said first and second operating means to thereby effect engagement of a mold half at said mold receiving location upon actuation of second operating means, lifting of said mold half from said first conveyor and lowering of said mold half onto said second conveyor, respectively, upon actuation of said first operating means, and disengagement of said mold half at said delivery location upon subsequent actuation of said second operating means, said respective actuations being carried out successively and commensurate with movement of said lifting means along said closed path.

2. A system according to claim 1, further comprising means connecting said mold carrying means with said lifting means for free horizontal displacement with respect to said lifting means to facilitate adjustment of said mold carrying means and said gripping means to said predetermined position relative to said mold half by said mold centering means, said mold centering means including guide pins extending downwardly from said mold carrying means and being adapted to engage with corresponding bores provided in said mold half.

3. A system according to claim 1, said lifting means comprising a compensating unit including a piston and a cylinder and serving to carry part of the weight of said mold carrying means and said gripping means.

4. A system as claimed in claim 1, said feeding conveyor comprising planing means adapted to cooperate with mold halves and to form a planar surface at the lower side of each of said mold halves during movement thereof along said conveyor.

5. A system according to claim 2, said mold carrying means being arranged for upward and downward movements between a lower position for engagement and disengagement of a mold half, respectively, and an upper position for transfer of said mold half, said lifting means further including means to engage said mold carrying means in said upper position to thereby prevent horizontal displacement of the latter with respect to said lifting means.

6. A system according to claim 5, wherein said lifting means comprise a cylinder containing brake fluid, and a piston movable in said cylinder to displace said brake fluid.

7. A system according to claim 6, wherein said cylinder and said piston cooperate to brake the upward movement of said mold carrying means into said upper position.

8. A system according to claim 6, wherein said cylinder includes a plurality of fluid escape ports arranged in longitudinal direction of said cylinder to define predetermined upper and lower portions of travel of said mold carrying means between said upper and said lower position, said fluid escape ports being arranged to permit a higher speed of downward movement in said upper portion and a lower speed of downward movement in said lower portion.

9. A system according to claim 8, wherein said lifting device comprises interchangeable stop means to vary said upper and lower portions of travel.

10. A system as claimed in claim 9, wherein said planing means include at least one cutting knife extending transversely with respect to said conveyor.

11. A system as claimed in claim 10, wherein said cutting knife is provided with groove-forming projections.

12. A system for transporting mold halves from first continuously moving conveyor means to second continuously moving conveyor means, each of said conveyor means including mold supporting surfaces; comprising lifting means located intermediate said first and said second conveyor means and adjacent thereto, respectively, movable in a closed path extending along said first and second conveyor means, respectively, mold holding means movable perpendicularly to said mold supporting surfaces and along said lifting means, a mold gripping mechanism arranged on said mold holding means and adapted to mechanically engage and disengage a mold half, first operating means for imparting movement to said mold holding means along said lifting means, second operating means for said gripping mechanism means for driving said lifting means along said closed path, control means for actuating said first and said second operating means to effect respective movements of said mold holding means for lifting a mold half from said first conveyor means and for depositing said mold half thereafter onto said second conveyor means and to effect engagement of said mold by said gripping mechanism prior to said lifting movement and disengagement of said gripping mechanism from said mold subsequently to said depositing movement, and further means operatively interconnecting said driving means with said first conveyor means and said second conveyor means, respectively, for moving the latter in synchronism and at substantially equal speed with said lifting means, to thereby permit substantially shock and tilt-free engagement and disengagement, respectively, of said mold half by said gripping mechanism.

13. In a system according to claim 12, wherein said first conveyor means is adapted to transport copes, and said second conveyor means carries drags toward a delivery location, said lifting means being adapted to lift one of said copes engaged by said gripping means from said feeding conveyor and to deposit said one cope onto a respective drage moving on said delivery conveyor to thereby close the respective mold half.

14. In a system according to claim 12, including further means for relative horizontal adjustment between said gripping means and said mold halves respectively and said lifting means respectively.

15. In a system according to claim 12, including further means for relative horizontal adjustment between said gripping means and said one cope, and said gripping means and said respective drag, said gripping means carrying guide pin means engageable with said one cope and said respective drag, respectively, to effect said adjustment, and to bring about an accurate coinciding superposition of said one cope on said respective drag.

16. A system for transporting mold halves from first continuously moving conveyor means to second continuously moving conveyor means, each of said conveyor means including mold supporting surfaces; comprising lifting means located intermediate said first and said second conveyor means and adjacent thereto, respectively, movable in a closed path extending along said first and second conveyor means, respectively, mold holding means movable perpendicularly to said mold supporting surfaces and along said lifting means, a mold gripping mechanism arranged on said mold holding means and adapted to mechanically engage and disengage a mold half, first operating means for imparting movement to said mold holding means along said lifting means, second operating means for said gripping mechanism means for driving said lifting means along said closed path, control means for actuating said first and said second operating means to effect respective movements of said mold holding means for lifting a mold half from said first conveyor means and for depositing said mold half thereafter onto said second conveyor means and to effect engagement of said mold by said gripping mechanism prior to said lifting movement and disengagement of said gripping mechanism from said mold subsequently to said depositing movement, and further means operatively interconnecting said driving means with said first conveyor means and said second conveyor means, respectively, said second conveyor means including means for getting said mold halves in synchronism with the movement of said lifting means, said further means for relative horizontal adjustment between said gripping means and said mold halves to thereby permit substantially shock and tilt-free engagement and disengagement, respectively, of said mold half by said gripping mechanism.

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