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Noisser et al.

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[54] **DEVICE FOR AUTOMATICALLY CASTING OF MOLTEN MATERIAL**

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[73] Assignee: **Gravicast Patentverwertungsgesellschaft m.b.H.**

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[52] **U.S. Cl.** **164/326**
[51] **Int. Cl.** **B22d 5/02**
[58] **Field of Search** 164/324, 325, 329, 331, 164/130, 327, 328; 425/261

[56] **References Cited**

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[57] **ABSTRACT**

A device for automatically casting molten material comprises a pouring station having a pouring nozzle. A further station is provided for discharging or preparing each mold for the following casting operation. The device further comprises a carrier means constituted by two carrier members each of which is rotatable around a vertical pivotal axis. Each carrier member comprises at least two cantilever arms relatively dephased for equal angles and radially extending from the axis. These arms carry the molds. The radius of the enveloping line of the circular pathes of the molds and the cantilever arms is smaller than the distance between the two pivotal axes. Each carrier member rotates always in the same direction, but the one carrier member rotates in the opposite sense with respect to the other carrier member. The pathes of travel of the ingates of the molds intersect one another at two intersecting points, at the area of one of which the pouring station is arranged, whereas at the area of the other intersecting point the further station is arranged. The cantilever arms alternately pass the two intersecting points.

5 Claims, 2 Drawing Figures

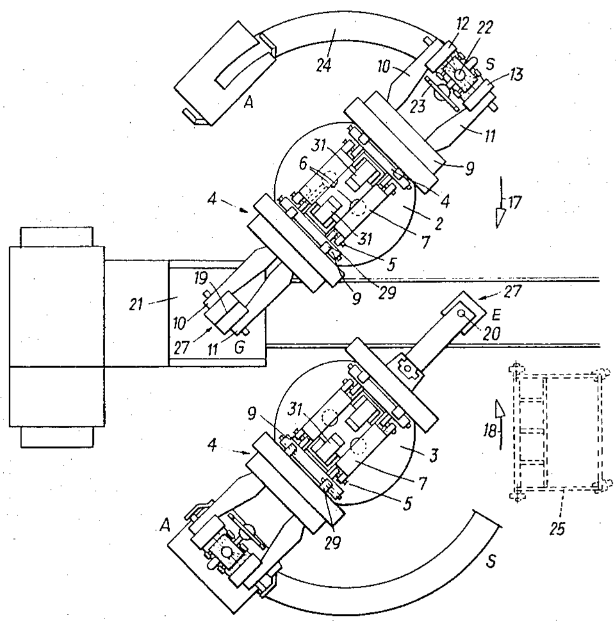

FIG. 1

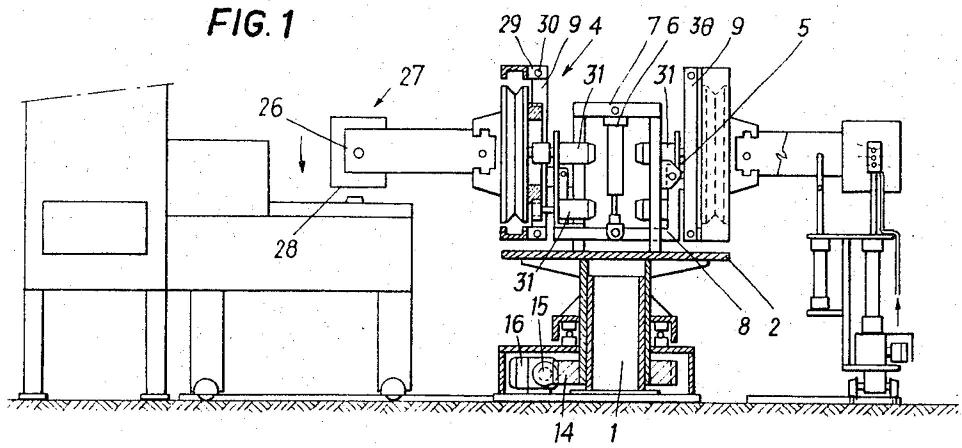
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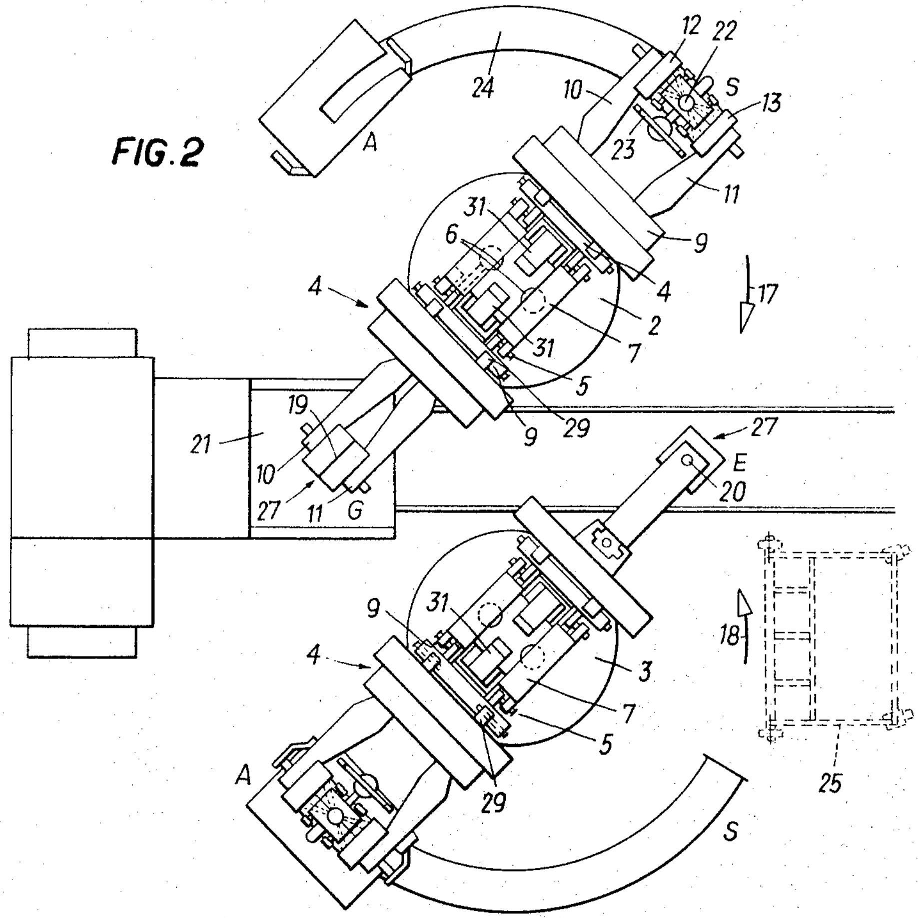
FIG. 2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DEVICE FOR AUTOMATICALLY CASTING OF MOLTEN MATERIAL

The invention refers to a device for automatically casting molten material, particularly metal melts, in which at least two molds are successively moved into a common pouring station, are filled there with molten material and then are again moved away. In at least one further station each mold is discharged, prepared for the following casting operation and, if desired, provided with cores. The molds are stepwisely guided between these stations along two circular arcuate pathes of travel by carrier members each of which is rotatable around a vertical axis and comprises a cantilever radially extending from the respective axis and carrying the mold. The radius of the enveloping line of the circular arcuate pathes of the molds and the cantilevers is smaller than the distance between said two axes.

In a known device of the kind described (German Patent Specification No. 564,457) the molds are arranged on the free ends of cantilever arms being pivotally supported on vertical axes for performing oscillating movement.

By means of said cantilever arms the molds are successively moved to a pouring nozzle for filling there the mold with molten material whereupon the molds are removed by further oscillating movement. It is a disadvantage of this known device that the cantilever arms jut out freely and thus are subjected to a bending stress. Further the individual operating stations are with the exception of the pouring station not effectively utilized. Further, in spite of allowing to connect to all cantilever arms molds of different types without substantially hindering the casting cycle, this known device suffers from the disadvantage that handling operations of the molds at the other stations, particularly at the station for preparing the molds for the following casting operation, can only be automated under very limited conditions. The oscillating movement of the cantilever arms does not only require a drive means of increased power but is also a hindrance for a smooth production cycle, particularly when manufacturing castings in great series. These drawbacks are present when producing small castings as well as when producing big castings because in the first case the oscillating movement is the prime disturbing factor while in the latter case the disturbing factor is the bending stress acting on the cantilever arms.

The invention now aims at avoiding these drawbacks and to improve a device as described above such that with only low space requirement and low constructional expenditure the device will reliably work. Before all, it is intended to provide for a high speed when changing the position of the molds and to keep low the masses to be moved. The invention essentially consists in that each carrier member comprises at least two cantilever arms relatively dephased for equal angles, in that each carrier member is arranged for rotation in only one sense of rotation but that these two carrier members are arranged for intermittent rotation in opposed senses of rotation and in that the pathes of travel of the gatings of the molds are intersecting one another at two intersecting points at the area of one of which intersecting points the pouring station is arranged whereas at the area of the other intersecting point another operating station is arranged. The cantilever arms pass each of said intersecting points alternately. The invention thus provides a device for automatically casting molten material having the smallest possible compact construction. For both carrier members only one single pouring station has to be provided and, for instance, only one station for inserting cores into the mold has to be provided. The production rate may thus be doubled without providing a second station for inserting cores into the mold. It would also be possible to take up a mold at the second station located at the point of intersection of the pathes of travel of the gatings of the molds, to connect there the mold to the cantilever arm, then to move the mold to the pouring station and to place the mold at the pouring station and then to lift the filled mold and to move the filled mold to a subsequent station and to let fall down the mold there. The molding boxes may be recycled to the molding equipment by means of a conveyor belt.

An alternate mode of operation consists in removing the base part of a new sand casting mold from the molding equipment at an operating station located before the core setting station and clamping this base part to the cantilever arm, then moving the base part to the core setting machine, then inserting the core into the mold, then placing the second half of the mold from above on the base part and then keying both mold halves, whereupon the working steps described above (transport, mold filling, placing of the mold and recycling of the mold halves) are repeated.

A device according to the invention has the additional advantage that when replacing a mold of one type by a mold of another type one of said both carrier members may be further operated while the other of the carrier members is readjusted, i.e., provided with other molds. The same applies in case of failure of molds or mold parts arranged on a carrier member, in case of failure of the carrier element itself or in case of failure of the drive means for the carrier member and, respectively, for the molds. Also in this case production can be continued by using the other carrier member while repairing the first mentioned carrier member. In view of each carrier element being always rotated in the same sense of rotation and thus not being driven for oscillating movement, the drive means for the carrier members becomes more simple than for the mentioned known device. A device according to the invention can much more easier be automated than the known device described above. This is of particular advantage with devices intended for high production rates. Highly effective pouring equipments are readily available and also setting of the cores into the mold can be effected in a very rapid manner so that it is a prime demand to accelerate the transport velocity between the single operating stations. The invention provides essential advantages when using molds for producing castings of approximately the same weight because the small masses to be moved allow for a rapid changing speed such that the rapid sequence of pouring operations and core setting operations can fully be made use of.

A device according to the invention is of advantage also in such plants in which the molds are filled manually or automatically by means of bailers. The number of operators required for manually operated plants can be reduced because the circular pathes described by the molds carried by said both carrier members are intersecting at two points and thus the pouring station is common for both carrier members as well as a further operating station, particularly the core setting station.

The invention also provides advantages over stationarily arranged guideways along which the molds are shifted (so-called standways). In such standways a plurality of sandmolds or permanent molds is to be moved so that the masses to be accelerated are essentially greater than in a construction according to the invention. Furthermore, it is much more difficult in standways than in a device according to the invention to lower and lift a sand mold or permanent mold. For these reasons the station time in a standway is much longer than in a device according to the invention so that the number of castings produced per unit of time is much greater than when using a standway.

According to an improvement of the device according to the invention each carrier element is provided with two cantilever arms carrying molds and symetrically extending from the pivotal axis of the carrier member in opposed directions, noting that said cantilever arms are intermeshing like combteeth. By providing two cantilever arms the bending stresses exerted on the axis are quite well compensated so that the pivotal axis of the carrier member is much less unilateral loaded as in the known device as described above, particularly if the cantilever arms are carrying molds of similar size.

According to a further feature of the invention it is of advantage to provide at the pouring station a means for lifting and, respectively, lowering the molds. This arrangement results in the advantage that any abrasive action of the mold on the front face of the pouring nozzle is avoided, which abrasive action might injure the front face of a pouring nozzle. Further, the mold can be rested onto the pouring nozzle with such a pressure that the desired seal between the mold and the pouring nozzle is realized. When lifting the mold after terminating the pouring operation and before removing the mold from the area of the pouring nozzle any liquid material falling in drops from the mold will fall into the pouring nozzle so that contamination of the surrounding of the pouring nozzle can be avoided to a great extent. The mentioned arrangement further allows penetration of the solidification front of the melt relatively deep into the pouring nozzle after each pouring operation, so that on lifting the mold, particularly permanent mold, a plug is drawn out of the pouring nozzle, in which plug the oxidation products are accumulated. This results in a very clean and sound surface of the casting and thus in a casting of high quality.

According to a preferred embodiment, the mold is arranged on a mold carrier which is arranged for swivelling movement around a horizontal axis and removably connected to the carrier member. With this construction the mold can be lowered onto the pouring nozzle and, respectively, lifted from the pouring nozzle in particularly a simple manner. Furthermore production may easily be changed over from one type of mold to another type of mold by interchanging the mold carriers.

According to the invention each mold may be arranged with the front face of its ingate passage, which front face cooperates with the pouring nozzle, with the same distance from an index stationarily arranged on a carrier element. With this arrangement it is possible to easily change over from one type of mold to another type of mold and thereby to maintain the front face of the ingate always in the same position. This is of importance for controlling the downward movement of the mold because then, even after interchanging molds, the mold will uniformally contact with its front face of the ingate passage the pouring nozzle after having been lowered for a predetermined distance.

Further features and advantages of the present invention result from the description of an embodiment of a device according to the invention schematically shown in the accompanying drawing.

FIG. **1** represents a device according to the invention, partially in front elevation and partially in section and

FIG. **2** represents a top plan view of a device according to FIG. **1.**

The inventive device for automatically casting molten material comprises two carrier members **2, 3** formed of turntables and being arranged for rotation around vertical axes **1.** These turntables are carrying cantilever arms **4** which are mounted for swivelling movement around horizontal axes **5** supported by the turntable. Each of said cantilever arms **4** forms a mold carrier. For effecting the mentioned swivelling movement, a hydraulic unit **6** comprising two cylinders is provided and supported against a rack **7,** on the one hand fixed to the turntable and on the other hand supported against an angled lever **8** which is mounted for swivelling movement around the axes **5** supported by the rack **7.** A frame **9** is rigidly connected to the angled lever **8** and the frame **9** is connected to the cantilever arm **4** by means of an easily releasable socket connection. For this purpose the mold carrier (cantilever arm **4**) is provided at its side opposed to the mold **27** with eyes **29** being in alignment with correspondingly shaped eyes of the frame **9,** noting that the connection is secured by bolts **30** inserted into the eyes. Each mold carrier comprises a plate-like base member carrying two protruding arms **10, 11,** in their turn carrying the mold halves **12, 13** of the mold **27.** For effecting opening movement and closing movement of the mold halves **12, 13** as well as for swivelling the molds **27** from a position with horizontally positioned junction plane into a position with vertically positioned junction plane, drive means **31,** f. i., electromotors, are provided on the angled lever **8** and, respectively, the frame **9,** noting that these drive means **31** are connected, via releaseable clutches, with gearings located within the base member of the mold carrier.

The cantilevers for forming the mold carriers can thus easily be removed from the frame **9.**

Each of the turntables is driven by a motor **16** via a gearing constituted by a worm wheel **14** and a worm **15.** The one turntable is rotated in direction of arrow **17** and the other turntable is rotated in direction of arrow **18.** The two turntables are thus rotated in opposed senses. Each of the mold **12, 13** is thus moved along a circular path of travel.

The distance between the pivotal axes **1** of the turntables is smaller than the double length of the radius as measured from the centre of the mold gating to the centre of axes **1** so that the circular pathes of travel described by the gatings of the molds **12, 13** are intersecting one another at two points **19, 20.** At the area of points **19** a pouring equipment **21** is provided so that at this point the pouring station G is located. The pouring equipment preferably has a storage chamber for the melt to be cast and for supplying melt via a stopper valve into an equalizing chamber within which the flow melt is calmed such that the melt can flow in a laminar stream from the equalizing chamber into the pouring nozzle directed in upward direction. The equalizing chamber is conveniently formed of the interior of a tube which is at least partially arranged within the storage chamber and is circumcirculated there by the melt. Such constructions are for instances discolosed in Austrian Patent No **285 840** and in German printed Patent Application No. 2,142,717 and provide the advantage that the melt is always maintained in a liquid condition within the pouring nozzle and is always ready for pouring operation and that a great number of castings can be produced per unit of time.

At the area of the other intersecting point **20** of the pathes of travel of the mold **12, 13,** a core setting station E is provided at which insertion of the core into the mold **27** is manually or automatically effected.

The molds **27** are rotated in direction of arrows **17, 18** for angles of 90°, each according to a synchronized program. Thus a core can be inserted into a mold while the other mold is in the casting station and filled with melt. The operation is as follows:

After terminating the pouring operation for the mold **27** just located at the pouring station G, the mold **27** is lifted off the opening of the pouring nozzle by correspondingly actuating the hydraulic unit **6** and thus correspondingly swivelling the cantilever arm **4.** Subsequently the turntable **2** is rotated for 90° in direction of arrow **17** so that the mold **27** is brought into the discharge station A in which the casting is discharged by opening movement of the mold halves **12, 13.** Subsequently a nozzle **22** for cooling liquid is extended from below between the mold halves **12, 13** being in opened position, said nozzle **22** being arranged on a carriage travelling on rails **24.** A follower **23** connected to said nozzle **22** is provided for moving the cooling nozzle equipment together with the mold from station A into station S where cooling of the mold halves **12, 13** is completed. Thus a full station time, i.e., the time interval required for rotating the mold for an angle of 90°, is at disposal for the cooling operation. While moving the mold **27** from station A into station S the mold can also be given a blackwash. After blackwashing the mold the follower **23** is moved downwardly and the carriage, together with the cooling nozzle **22,** can then be returned to its starting position (station A) by means of a drive means of any suitable construction, f. i., a weight loaded tackle being connected with the carriage. In starting position the cooling nozzle is ready for repeated actuation after discharging the next molds.

By further rotating the mold for an angle of 90° from station S to station E the mold is ready for inserting the cores.

As is shown in FIG. **2,** the molds moved by the carrier member (turntable) **3** are moved through the same stations as the molds moved by the carrier member (turntable) **2,** noting that only the sense of rotation along the circular pathes of the mold is different. Both turntables are timed such that the molds **12, 13, 27** are alternately passed through pouring station G and core setting station E, so that always one mold of the turntable **3** is followed by one mold of the turntable **2,** and vice versa.

The molds are conveniently not only moved in a stepwise manner along the circular path of travel but are also brought at the individual stations and, respectively, during movement from one station into the other, into a position most favourable for the intended operation, and this is effected by means of the mentioned drive means **31** noting that also the mold halves are opened or closed. As is shown in FIG. **2,** the junction plane of the mold half **12, 13** is in a vertical plane at the pouring station G, and this position of the junction plane is also maintained at the discharge station A and at the rinsing station S. At the core setting station E or while moving the mold into the station the mold is swivelled such that the junction plane of the mold halves **12, 13,** will assume a horizontal position.

During the transition of the mold from the core setting station E into the pouring station G the mold **27** is again swivelled such that the mold is rested upon the pouring nozzle **21** with the junction plane of its mold half being in vertical position. Furthermore, the mold halves **12, 13** are opened after entering the discharge station A and the mold halves are kept in opened position on its travel to the core setting station E. After inserting the core or the cores into the mold, this mold is closed and subsequently swivelled into the position suitable for performing the pouring operation. For performing the opening movements and, respectively, closing movements and the swivelling movements of the mold halves **12, 13,** the drive means **31** may cooperate at the individual stations with limit switches known per se.

If desired, the mold may also be lifted at the discharge station A for facilitating discharge of the casting by jerkyly moving the mold.

It is further of advantage to lift and, respectively, lower the mold by swivelling the mold carrier around its axis **5** while interchanging molds. For this purpose it is convenient to provide a mounting carriage **25** which can be shifted below the lifted mold and, respectively, even below the mold carrier. When descending the mold, the mold carrier (cantilever arm **4**) is rested on the mounting carriage **25** so that it is without further possible to loosen the connection between the mold carrier and the frame **9** by removing the bolts **30.** Thus it is possible to replace in an easy manner a mold carrier together with a mold by another mold carrier and another mold which are carried on by another mounting carriage. Such a replacement of mold carriers and molds is conveniently effected in a neutral position of arms **10, 11,** i. e., in such a position in which the axis common to this arms is perpendicular with respect to the connecting line between the axes of the carrier members **2, 3** (turntables). This results in the advantage that the other turntable can be further used for full production.

As a matter of course it is not only possible to replace mold carriers and molds for maintainance purposes but also to change over to the production of an other type of casting. In this case it has only to be considered that the solidification periods of the individual castings and the pouring periods need be comparable because these periods are defining the station time.

For warranting that even after an interchange of molds, the mold will uniformely engage the opening of the pouring nozzle after lowering the mold, each mold is arranged with its front face **28** of the ingate passage to cooperate with the pouring nozzle, with equal distance from an index **26** stationarily arranged on the cantilever arm **4** and, respectively, on the arms **10, 12.**

There further exists the possibility to place a sand mold in station E, to fill this sand mold in the pouring station G and to drop down or put on floor the mold in station A. In this case the station A either represents the end of a cooling bed or the end of a shaking apparatus serving for destroying the sand mold.

As a matter of fact, the invention is not limited to pouring of iron or other metals and metal alloys but is also applicable for pouring synthetic resins.

We claim:

1. A device for automatically casting molten material, comprising a pouring station having a pouring nozzle, carrier means for at least two molds having ingates successively movable into said pouring station, common for all carrier means, at least one further station for discharging and preparing each mold for the following casting operation, said carrier means comprising two carrier members for said molds stepwisely guided between said pouring and further stations along two circular pathes of travel, each of said carrier members being rotatable around a vertical pivotal axis and comprising at least two cantilever arms relatively dephased for equal angles and radially extending from said axis for carrying the mold, the radius of the enveloping line of the circular pathes of the molds and the cantilever arms being smaller than the distance between said two axes, each carrier member being arranged for rotation in only one sense of rotation, said two carrier members being arranged for timed rotation in opposed senses of rotation, wherein the pathes of travel of the ingates of said molds intersect one another at two intersecting points, said pouring station being arranged at the area of one of said intersecting points, whereas said further operating station is arranged at the area of the other of said intersecting points, said cantilever arms alternately passing said both intersecting points.

2. A device as claimed in claim **1,** wherein each carrier member comprises two cantilever arms carrying molds and symetrically extending from said pivotal axis of the carrying member in opposed directions, said cantilever arms intermeshing like combteeth.

3. A device as claimed in claim **1,** wherein at least at the pouring station a means for vertical displacement of the mold is provided.

4. A device as claimed in claim **3,** wherein the cantilever arm comprises further arms, said molds being arranged on said further arms, said further arms being arranged for swivelling movement around a horizontal axis and mounted on said carrier member in a releaseable manner.

5. A device as claimed in claim **1,** wherein a stationarily arranged index is provided, and each mold comprises an ingate passage and is arranged with the front face of said ingate passage, at the same distance from said index, said front face cooperating with said pouring nozzle.

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