MOLD CARRIERS FOR USE IN ROTATIONAL CASTING

Gilbert Thomas Porsch, Akron, Ohio, assignor to The McNeil Machine & Engineering Company, Akron, Ohio, a corporation of Ohio

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The present invention relates to improvements in rotational casting apparatus. More particularly, the invention relates to an improved mold carrier or "spider" for use with rotational casting apparatus.

In a process of rotational casting to which the invention is especially adapted, there is provided a series of hollow sectional molds which are loaded with a charge of plastisol such as a vinyl-resin compounded with a plastisol pigment of the type generally known in the art and are available from a number of sources. When the molds are charged, the spider is closed and locked and immediately thereafter is rotated simultaneously upon different axes to distribute the plastisol evenly over the inner surface of each mold. After the material has been gelled and fused by the controlled application of heat, the rotation of the spider is stopped and the spider is cooled to a degree where the molds can be opened and the finished article removed, whereupon the molds are readied for repeating the cycle.

The apparatus of the invention is particularly intended for use with a casting machine having one or more radially extending arms. Each casting arm may include a pair of shafts, one within the other, which are driven at differential speeds to impart simultaneous rotation on divergent axes to the spider or mold carrier supported on the outer ends of the shafts. The rate of rotation of either shaft may be changed without changing the speed of the other shaft and thus the spider may be subjected to a variety of speed ratios with a resultant extreme application of centrifugal forces. A satisfactory spider or mold carrier should thus be light in weight yet constructed to resist deformation under the driving force of the casting machine. A satisfactory spider should be easily closed when cool yet easily opened when warm after emergence from a curing oven. Finally, a satisfactory spider must maintain the sectional molds closed and in proper alignment despite extreme application of centrifugal casting forces.

Accordingly, it is an object of the present invention to provide an improved mold carrier or spider for use with rotational casting apparatus.

It is a further object of the invention to provide an improved mold carrier or spider which is light in weight, which will resist deformation by the driving force of the casting machine, which will be easily opened and closed, which will resist the heat of a curing oven, and which will maintain the sectional molds closed and in correct alignment despite extreme applications of centrifugal casting forces.

These and other objects of the invention will be apparent in view of the following description of the invention taken in connection with the attached drawings.

In the drawings:

FIG. 1 is a plan view of a mold carrier or spider according to the invention adapted for carrying round or spherical molds;

FIG. 2 is a sectional plan view of a spider adapted for carrying oval molds;

FIG. 3 is an enlarged sectional view substantially as indicated on line 5—5 of FIG. 2;

FIG. 4 is an end view taken substantially as indicated on line 4—4 of FIG. 3;

FIG. 5 is an enlarged section through an oval mold taken substantially as indicated on line 5—5 of FIG. 2; and

FIG. 6 is an enlarged view of a mold half registering means for use with spherical sectional molds having continuous pattern molding surfaces.

A mold carrier or spider according to the invention includes a lower grid member adapted for attachment to a casting machine, an upper grid member yieldably hinged to the lower grid member, and coupling means extending axially between the grid members for locking the grids together in substantially parallel planes. A plurality of upper mold halves are resiliently mounted on the upper grid and a plurality of lower mold halves, aligned and mating with the upper mold halves, are movably mounted on the lower grid.

In the drawings, a mold carrier or spider according to the invention is indicated at 10. In FIG. 1, the spider 10 is adapted for carrying a round or spherical mold 11 having a cavity such as could be used to manufacture a basketball or volleyball. In FIG. 2, the spider 10 is adapted for carrying an oval mold 12 having a cavity such as could be used to manufacture a football. The upper half (11a or 12a) of each sectional mold is resiliently mounted on an upper grid member indicated at 14. The lower half (11b or 12b) of each mold is movably mounted on a lower grid member indicated at 15.

Referring to FIG. 1, an upper grid member 14 has a central hub area 16. Extending radially from the hub area is a plurality of regularly spaced spoke ribs 17. Each spoke rib terminates in an upper mold half mounting boss 18. Each mounting boss is laterally connected with adjacent bosses by a peripheral rib 19. At one side of the grid 14, two parallel hinge struts 20 extend outwardly from the rib 19.

As best shown in FIG. 3, a lower grid member 15 preferably matches an upper grid member 14 and also has a central hub area 21, a plurality of regularly spaced spoke ribs 22, a lower mold half mounting boss 23 at the end of each spoke rib and a connecting peripheral rib 24. The grid 15 also has two parallel hinge struts 25, but offset in relation to the upper hinge struts 20, extending outwardly from the rib 24.

The grid members 14 and 15 are preferably cast from a stainless steel alloy or a ductile iron composition so as to be light in weight yet resistant to centrifugal forces and the heat of the curing oven.

Referring to FIG. 3, each upper grid mold mounting boss 18 has an upper small diameter sleeve bore 26 opening down into a larger diameter spring bore 29. A preferably stainless steel spacer sleeve 30 is loosely fitted in the bore 28 and extends a substantial distance downwardly into bore 29. A strong (e.g. 300—600 p.s.i.) compression spring 31, also preferably of stainless steel, is seated against a washer 32 in the upper end of bore 29. The under surface 33 of the boss is machined flat and is drilled to provide a blind bore 34. Referring briefly to FIG. 4, it will be observed that the mounting boss 18 of the spider adapted for carrying the oval molds 12 is similarly constructed.

The neck of each upper mold half 11a has a boss surface 35 which is substantially coextensive and in conformity with the under surface 33 of the mounting boss 18. At the center of the upper surface 35 is a mounting stud 36 having a tapped bore 37. On top of the stud 36 is placed a washer 38 for seating the lower end of the spacer sleeve 30. Around the stud 36 is another washer 39 for seating the lower end of the compression spring 31. Between the washer 39 and the edge of surface 35 is an aligning dowel 40 for insertion within the blind bore 34 in the under surface 33 of the mounting boss.

Each mold half 11a is attached to the mounting boss 18 by a cap screw having a hexhead 41 and a shank 42.
threaded into bore 37. The length of sleeve 30 is such that when the screw shank 42 is securely threaded into bore 37, the cap screw can "float" or move a slight distance longitudinally within bore 28. The extent of downward movement is limited by the screw head 41 and the extent of upward movement is limited by the mold surface 37. The compression spring 34 is always tending to move the screw head 41 into contact with the upper surface of the mounting boss 18 and the shank screw 42, and attached mold half 1la, away from the surface 33 of the mounting boss.

FIG. 3 shows the preferred normal position of the mold half 1la in relation to the mounting boss 18 when the spider 19 is closed. Rotation of the mold half about the axis of the screw shank 42 is prevented by the blind dowel 40. The mold half 1la is maintained in mating alignment with the lower mold half 1lb by the strong compression spring 31. It has been found desirable that the spring 31 yield a pressure of approximately 20 pounds per lineal inch of periphery of the mating mold surfaces.

As centrifugal casting forces or heat from the curing oven are applied to the spider, any significant distortion of the grid member 14 will be compensated or equalized by the flexibility of the upper mold half 1la.

Referring to FIG. 5, the neck of each upper mold half 12a is strengthened by longitudinal fins 44 and has an upper surface 45. The center of surface 45 has an annular recess 46 and a tapped bore 47. On top of the surface 45 is placed an annular member 48 having a hub 49 engaging the recess 46 and extending upwardly into the spring bore 29. Between the hub 49 and the edge of member 48 is an aligning dowel 50 for insertion within the blind bore 34 in the under surface 33 of the mounting boss.

Each mold half 12a is attached to the mounting boss in a manner similar to that described above for a mold half 1la, that is, by a resiliently mounted cap screw having a head 41 and a shank 42 threaded through hub 49 into bore 47.

Referring to FIG. 3, each lower grid mold mounting boss 23 has a lower small diameter sleeve bore 52 opening upwardly into a larger diameter stud bore 53. A preferably stainless steel sleeve 54 is loosely fitted in bore 52 and extends a slight distance upwardly into bore 53. The upper surface 55 of each mounting boss is machined flat and is drilled to provide a blind bore 56.

The neck of each lower mold half 1lb has a boss surface 57 which is radially concentric and in conformity with the upper surface 55 of each mounting boss 23. At the center of the undersurface 57 is a mounting stud 58 having a diameter slightly less than the diameter of bore 53. The mounting stud also has a tapped bore 59. Between the stud 58 and the edge of surface 57 is an aligning dowel 60 for insertion within the blind bore 56 on the upper surface 55 of the mounting boss.

Each mold half 1lb is attached to the mounting boss 23 by a cap screw having a hexhead 61 and a shank 62 threaded into bore 59. The lengths of sleeve 54 is such that when the screw shank 62 is securely threaded into bore 59, the lower end of stud 58 will be slightly above the lower end of the bore 53 so that slight longitudinal and lateral movement of the mold half is possible. Provision for such a slight movement permits the accurate alignment of the mating upper mold half 1la during closing of the spider, compensates or equalizes any distortion of the grid member 15, and lessens the possibility of injury to the mating mold surfaces during opening.

Referring to FIG. 5, each mounting boss 23 of the spider adapted for carrying the oval molds 12 also has a lower small diameter sleeve bore 64 opening upwardly into a larger diameter bore 65. A sleeve 66, similar to sleeve 54, is loosely fitted in bore 64 and extends a slight distance upwardly into bore 65. The upper surface 67 of each mounting boss is machined flat and is drilled to provide a blind bore 68.

The neck of each lower mold half 12b is strengthened by longitudinal fins 69 and has an under surface 70. The center of surface 70 has an annular recess 71 and a tapped bore 72. An annular member 73 having a hub 49 engaging recess 71 and extending downwardly into the annular bore 65 is located on the upper surface 67 of the mounting bore. Between the hub 74 and the edge of member 73 is an aligning dowel 75 for insertion within the blind bore 68 of the mounting boss.

Each mold half 12b is attached to the mounting boss 23 in a manner similar to that described above for a mold half 11b; that is, by a slightly movable cap screw having a head 61 and a shank 62 threaded through hub 74 into bore 72.

As best shown in FIG. 4, the means for yieldingly hinging grid members 14 and 15 together includes a rod or pin 80. The hinge pin is carried between the lower ends of a pair of rectangular straps 81 extending downwardly from the upper grid member 14. Each strap 81 is preferably attached to the "left hand" side surface of a hinge strut 82. As by bolts 85, and may be dowelled for accurate alignment.

The hinge pin 80 is movable within vertically elongate slots 84 in the upper ends of a second and preferably somewhat longer pair of rectangular straps 85 extending upwardly from the lower grid member 15. Each strap 85 is preferably attached to the "right hand" side surface of a hinge strut 25; as by bolts 86, and also may be dowelled, if desired.

During opening of the spider 10, as described in detail below, the hinge pin 80 is moved upwardly within the elongate slots 84 by a resilient means such as a pair of coiled compression springs 88. The lower portion of each spring 88 is supported by a fixed position spring stud 89. The spring studs 89 are preferably spaced equidistant from the center line of the grid members 14 and 15 and extend upwardly from a cross-plate 90 extending between the straps 81. Each stud 89 includes a cap screw having a head 41 and a shank 42 threaded through hub 91 into the upper portion of each spring 88 and carries a spring plunger 92, which is preferably somewhat shorter than a spring stud 89. Each plunger 92 has a transverse groove 93 to maintain the upper surface thereof in abutting contact with the under surface of the hinge rod 80.

Referring to FIG. 3, the coupling means for locking the grid members 14 and 15 together in substantially parallel planes extends between the central hub areas 16 and 21 of the respective grids. The coupling means includes a shaft extending transversely through hub area 16 and locating a hexhead 95, a collar 96 and an elongated body 97 with a pair of cross bores 98 extending through each other. The shaft body 97 is journaled preferably in a pair of upper and lower anti-fitting bearings 99.

When an upper grid member 14 is cast, the hub area 16 preferably has a transverse steel sleeve 100 inserted therein. The sleeve 100 is later machined to provide a shoulder seat 101 for the bearings 99. The upper surface 102 and the under surface 103 of the hub area 16 are also machined to provide annular grooves for insertion of upper and lower bearing seals 104. Each bearing seal 104 is of a grease and heat resistant material such as Teflon, suitably encased for attachment by screws 105. The bore of the hub area 16 is lubricated by a heat-resistant grease inserted through a conventional fitting 106.

The shaft body 97 extends downwardly into a hollow coupling member 108. The upper end of member 108 preferably extends through the cross-cores 104 and seats against the lower bearing 99. The shaft body 97 is rigidly connected to the member 108 as by bolts 109 extending through the cross-cores 98. The lower end of member 108 has exterior threads 110. The threads 110 are coarse and quick-acting (e.g. standard Acme, 4 threads per inch).

When the lower grid member 15 is cast, the hub area 21 preferably has a rough bore therethrough. The lower portion of the hub bore is then bored to provide a finished bore 112 for receiving the drive spindle 113 of a casting machine (not shown). Though the bore 112 is...
shown as tapered, the hub area 21 could be adapted in any suitable manner for connection to a casting machine.

The upper portion of the rough bore is machined to provide a finished bore 114. The upper surface of the hub area is also machined to provide a flat surface 115, a series of tapped bores 116, and if desired, dovetail holes 117. The drive connection between the grid 15 and the machine spindle 113 is provided by an annular plate 118 seated on surface 115. The plate 118 has a flat upper surface 119, a hub 120 fitting in bore 114, and drive keys 121 for engagement with the drive spindle 113.

The coupling means further includes a hexagon stud 122 seated in hub surface 119 of the drive plate and secured thereto as by bolts 123 inserted in bores 116, and if desired, dowels 124 inserted through the drive plate into holes 117. The upper portion of the bore of the coupling stud has interior threads 125. The threads 125 should mesh quickly with the threads 110 of coupling member 108 and therefore are machined to provide a slight radial play (e.g. .010 inch). The lower portion of the coupling stud bore is preferably machined to receive an Allen-head bolt having a head 127 and shank 128 extending longitudinally of the coupling stud, through the drive plate bore 120, into the threaded bore 115e in the drive spindle of the casting machine.

When each grid member has been assembled with its respective mold halves as described above, a stay wire 129 is preferably inserted through the hexheads (41 or 61) of the machine, an upper wheel-like mold carrying member resiliently and yieldably hinged to said lower member, and means extending between the hub areas of said members for coupling the members together in substantially parallel planes.

When the spider 10 is open, the hinge springs 88 are at maximum extension so that the hinge pin 80 is near the top of the elongate slots 84. The upper grid member 14 may thus be readily lowered in position over the lower grid 15. When the grids are closed, the threads 110 on the coupling member 108 will be ready for engagement with threads 125 of the coupling stud 122. A suitable wrench (shown in dotted lines in FIG. 3) applied to the shaft head 95 will pull the upper grid 14 parallel to and in locked engagement with the lower grid 15. The resilient mounting of the upper mold halves (11c or 12c) and the movable mounting of the lower mold halves (11b or 12b) enables the mold halves to mate and align without injury to the mold surface during coupling of the grid members.

During the casting operation, the drive forces of the casting members are applied to the lower grid 15 through the plate 118. Because the shank 97 of the upper grid coupling shaft is journaled in the bearings 99, the drive forces of the casting machine are applied to the upper grid 14 through the resiliently, fastened and aligned mold halves. Thus, the drive force is applied to the upper grid at several points and distortion thereof will be compensated or equalized.

After the casting operation, the shaft head 95 is turned to disengage the coupling member 108 from the coupling stud 122. As the threads 110 and 125 part, the upward movement of the grid 14 will be stabilized by extension of the hinge springs 88. During the opening movement, compression of the upper mold half mounting springs 29 is released so that when the coupling members are fully disengaged, the upper mold halves are lifted opening the molds without injury to the mating surfaces and freeing the molded articles from the mold cavities.

Referring to FIG. 6, when the spherical molds 11 have continuous pattern surfaces, that is, patterns or textures extending from one mold half to the other without interruption, it has been found desirable to provide means to accurately and quickly align the mold halves as the spider 10 is used. In most uses, the upper and lower dovetails 46 and 60 are sufficiently accurate. However, finely patterned molds benefit from a very accurate alignment.

Accordingly, a key lug 130 may be cast at one side of the mating flange of a lower mold half 11b. The key lug is machined to provide a seat for a registering pin or key 132. In cross-section, the lower end 133 of the aligning key is preferably rounded and the upper end 134 is pointed or equally tapered on either side. Referring to FIG. 3, the outer surface 135 of the key 132 is substantially vertical but the inner surface 136 is inwardly tapered at a slight angle (e.g. 5°) from approximately the midpoint of the key. The key 132 is attached to the lug 130 by a pin or screw 137.

A latch lug 140 may also be cast at one side of the mating lip of an upper mold half 11a. The latch lug is machined to provide a slot 141 having a vertical inner surface 142 (see FIG. 3) and an arcuate outer end 143. When the mold halves 11a and 11b are brought together by closing of the spider 10, the surface 142 will slide upon the key surface 136 and the slot end 143 will readily engage the pointed key end 134. Thus, the mold halves may be quickly and accurately aligned.

What is claimed is:

1. A spider for use with a rotational casting machine comprising, a wheel-like lower mold carrying member having a hub area adapted for connection to said machine, an upper wheel-like mold carrying member resiliently and yieldably hinged to said lower member, and means extending between the hub areas of said members for coupling the members together in substantially parallel planes.

2. A spider for use with a rotational casting machine comprising, a wheel-like lower mold carrying member having a hub area adapted for connection to said machine, an upper wheel-like mold carrying member resiliently and yieldably hinged to said lower member, a shaft journaled transversely of the hub area of said upper member, and means extending between said hub areas and associated with said shaft for coupling the members together in substantially parallel planes.

3. A spider for use with a rotational casting machine comprising, opposed wheel-like mold carrying members resiliently and yieldably hinged together, one of said members having a hub area adapted for connection to said machine, the other of said members having a shaft journaled transversely of the hub area, and means extending between said hub areas and associated with said shaft for coupling the members together in substantially parallel planes.

4. A spider for use with a rotational casting machine comprising, a lower member, an upper member resiliently and yieldably hinged to said lower member, and means for locking said members together in substantially parallel planes, at least one mold section resiliently depending from said upper member and at least one mold section movably mounted on said lower member in alignment with a mold section on said upper member and defining a mold cavity when mated therewith.

5. A spider for use with a rotational casting machine comprising, a wheel-like lower member having a hub area adapted for connection to said machine, an upper wheel-like member resiliently and yieldably hinged to said lower member, a shaft journaled transversely of the hub area of said upper member, means extending between said hub areas and associated with said shaft for coupling the members together in substantially parallel planes, at least one mold section resiliently depending from said upper member and at least one mold section movably mounted on said lower member in alignment with a mold section on said upper member and defining a mold cavity when mated therewith.

6. In combination with a spider for use with a rotational casting machine, said spider including an upper member for carrying at least one depending mold section, a lower member for carrying at least one mold section in alignment with a mold section on said upper member and defining a mold cavity when mated therewith, hinge means resiliently and yieldably connecting said upper and lower members and coupling means for locking said upper and lower members together in substantially parallel planes, means for resiliently mounting a mold section.
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7. In combination with a spider for use with a rotational casting machine, said spider including an upper member; comprising, a cap screw having a shank extending movably through said member and attached to the mold section, spacer means maintaining said cap a predetermined distance from said mold section and compression means extending between said member and mold section tending to move said cap into contact with said member.

8. In combination with a spider for use with a rotational casting machine, said spider, including a wheel-like lower mold carrying grid having a hub area adapted to be driven by said machine and a wheel-like upper mold carrying grid having a hub area adapted to be driven by said machine and a wheel-like upper mold carrying grid, a hub area adapted to be driven by said machine and a wheel-like upper mold carrying grid, and registry means extending axially between said members comprising, a registration key having a pointed upper end and a downwandy tapered inner facing surface, said key being located on the periphery of a lower member mold half, and a registration latch having an arcuate slot for engaging said pointed end and a vertical surface for engaging said tapered surface, said latch being located on the periphery of an upper member mold half.

9. In combination with a spider for use with a rotational casting machine, said spider, including a lower mold half carrying member, an upper mold half carrying member, and coupling means extending axially between said members, hinge means connecting said members comprising, a first pair of straps extending downwardly from the edge of said upper member, a second pair of straps extending upwardly from the edge of said lower member, each having an elongate slot in the upper end thereof, a hinge pin carried between the lower ends of said first pair of straps and extending through said elongate slots, and compression means carried by said second pair of straps tending to move said hinge pin away from said lower member.

10. In combination with a spider for use with a rotational casting machine, said spider, including a lower mold half carrying member, an upper mold half carrying member, and coupling means extending axially between said members, hinge means connecting said members comprising, a first pair of straps extending downwardly from the edge of said upper member, a second pair of straps extending upwardly from the edge of said lower member, each having an elongate slot in the upper end thereof, a hinge pin carried between the lower ends of said first pair of straps and extending through said elongate slots, a plate extending between said second pair of straps, and collared spring means on said plate tending to move said hinge pin away from said lower member.

11. In combination with a spider for use with a rotational casting machine, said spider, including a wheel-like lower mold carrying grid having a hub area adapted to be driven by said machine and a wheel-like upper mold carrying grid having a hub area adapted to be driven by said machine and a wheel-like upper mold carrying grid, and registry means extending axially between said members comprising, a registration key having a pointed upper end and a downwandy tapered inner facing surface, said key being located on the periphery of a lower member mold half, and a registration latch having an arcuate slot for engaging said pointed end and a vertical surface for engaging said tapered surface, said latch being located on the periphery of an upper member mold half.