

Jan. 1, 1946.

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2,392,299

CENTRIFUGAL CASTING MACHINE

Filed Aug. 2, 1943

3 Sheets-Sheet 1

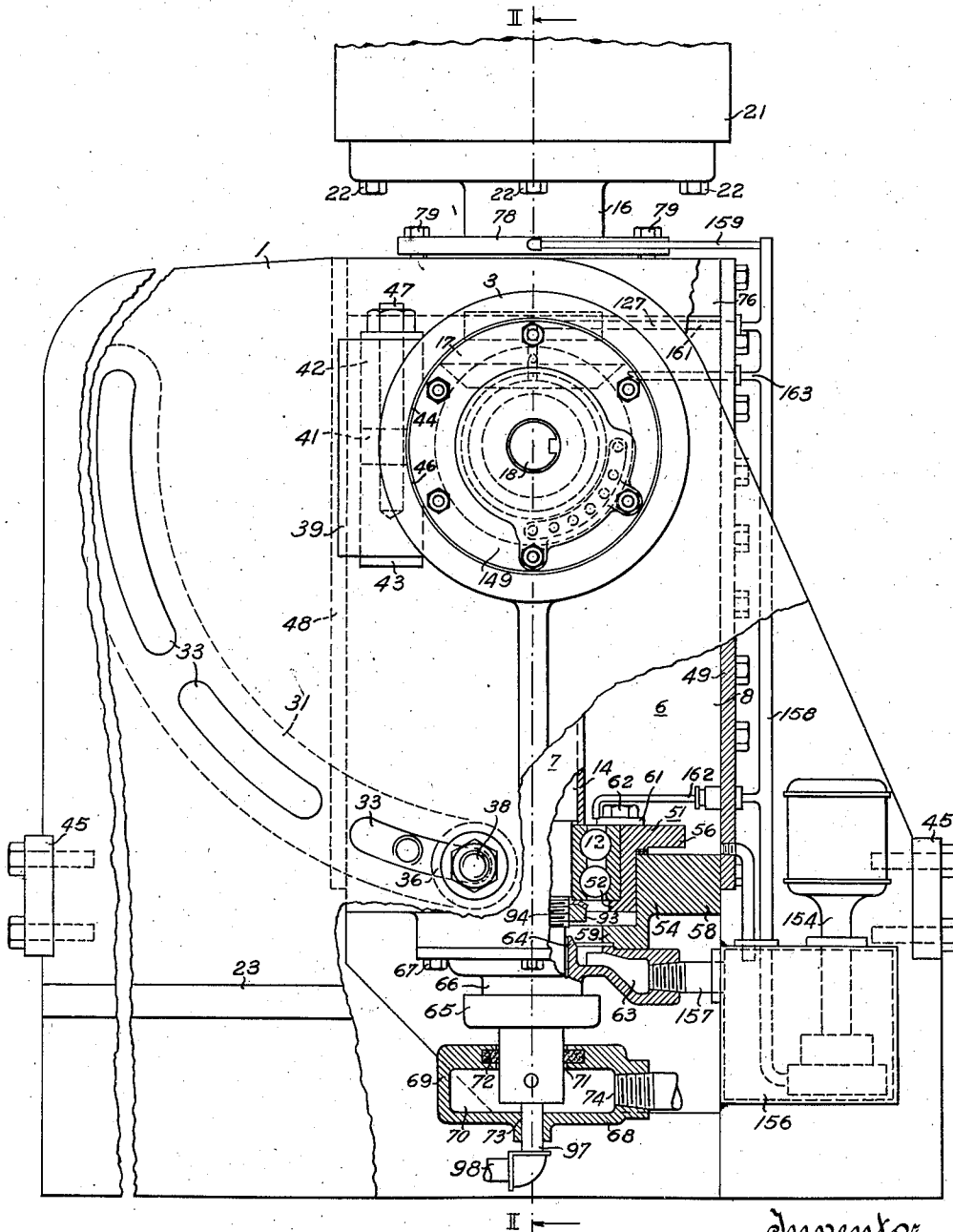


Fig. 1

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3 Sheets-Sheet 2

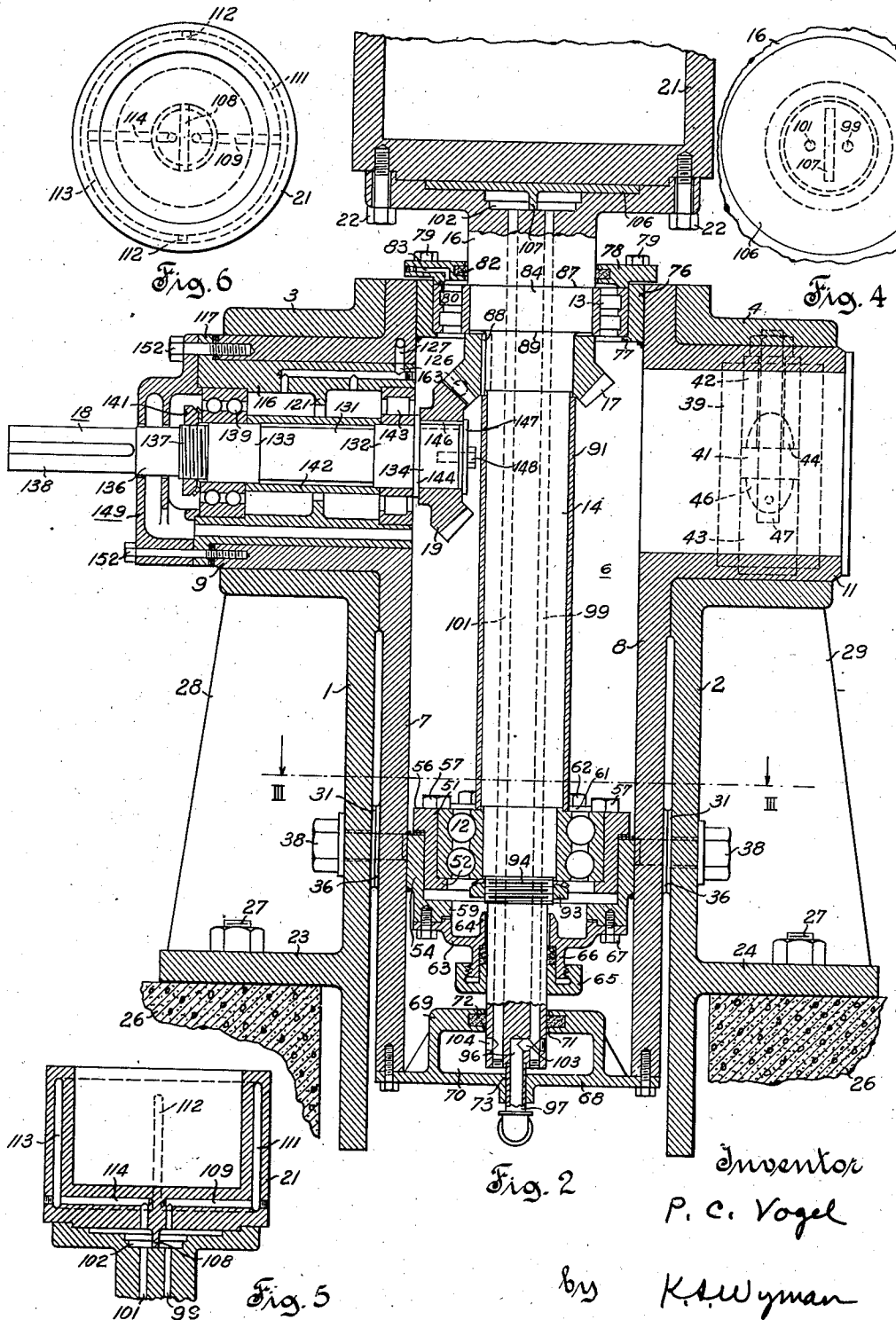


Fig. 2

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3 Sheets-Sheet 3

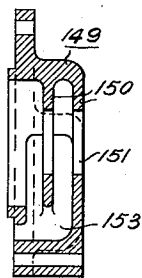
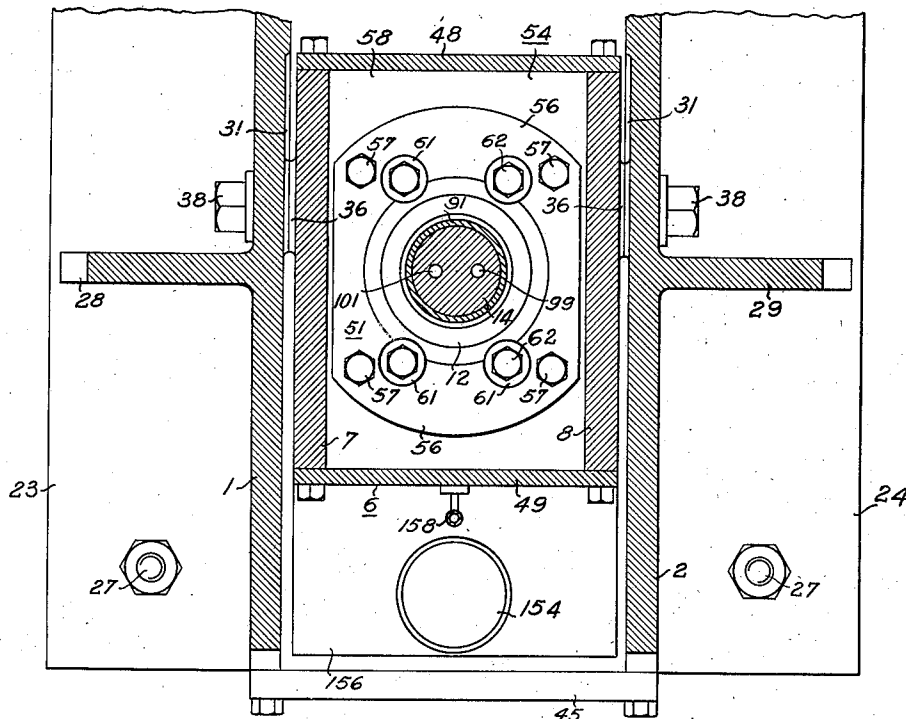


Fig. 10

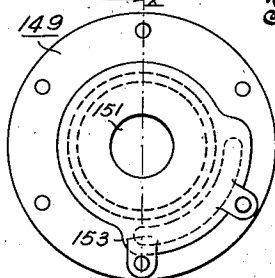


Fig. 9

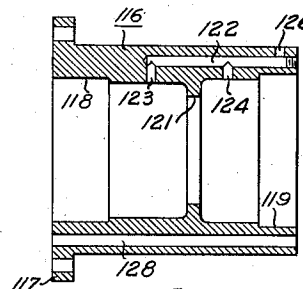


Fig. 7

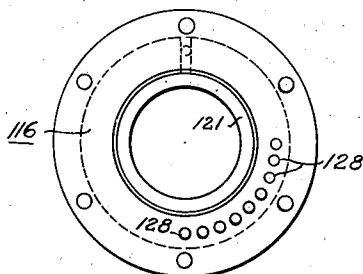


Fig. 8

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UNITED STATES PATENT OFFICE

2,392,299

CENTRIFUGAL CASTING MACHINE

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11 Claims. (Cl. 22—65)

This invention relates to centrifugal casting machines of the type selectively positionable to rotate with the axis of its mold supporting shaft disposed vertically or horizontally or in any one of an infinite number of intermediate positions; and its primary object is to provide an improved machine of such type which is compact, extremely durable and substantially free from objectional vibrations and which can be readily manufactured, assembled, operated and serviced with minimum expense.

Accordingly, the invention consists of the various details of construction, correlations of elements and arrangements of parts as is more fully set forth in the appended claims and in the detailed description, reference being had to the accompanying drawings, in which:

Fig. 1 is a side elevation of a casting machine embodying the invention with parts broken away to better show the construction;

Fig. 2 is a vertical section taken on line II—II of Fig. 1;

Fig. 3 is a section taken on line III—III of Fig. 2;

Fig. 4 is a partial plan view of the mold supporting head;

Fig. 5 is a vertical section illustrating a modified mold and mold supporting head construction;

Fig. 6 is a plan view of the structure shown in Fig. 5;

Fig. 7 shows the drive shaft supporting shell in longitudinal section;

Fig. 8 is a view of the left end of the shell shown in Fig. 7;

Fig. 9 is a view of the left side of the cover member shown in Fig. 2; and

Fig. 10 is a section taken on line X—X of Fig. 9.

Referring to the drawings and particularly to Figs. 1, 2 and 3, it is seen that apparatus embodying the invention may include spaced supporting elements comprising opposed parallel walls 1 and 2 presenting a pair of aligned hollow trunnion receiving projections 3 and 4 extending substantially perpendicular to the walls 1 and 2, respectively, a rectangular housing 6 disposed between and supported on the walls 1 and 2 for angular movement relative thereto by means of spaced side walls 7 and 8 presenting oppositely extending hollow supporting trunnions 9 and 11 journaled within the projections 3 and 4, respectively, a pair of shaft supporting bearings 12 and 13 mounted in spaced coaxial relation within the housing 6 on opposite sides of the trunnions 9 and 11 with their common axis extending sub-

stantially at right angles to the common axis of said trunnions and projections, a shaft 14 rotatably mounted in said bearings and including thereon for movement therewith a mold supporting head 16 which extends beyond the trunnioned end of the housing 6 and a gear 17 which is disposed between the bearings 12 and 13 and adjacent the trunnions 9 and 11, a gear carrying drive shaft 18 which is insertable through and rotatably mounted within one of said trunnions, the trunnion 9 in this illustration, with the gear 19 thereon in mesh with the gear 17 on the shaft 14, and a mold 21 which is removably secured to the head 16 by means of tap bolts 22.

The supporting elements, that is, the walls 1 and 2, are preferably provided with horizontally extending base or supporting flanges 23 and 24, respectively, which are rigidly secured to a fixed floor or foundation structure 26 by means of bolts or the like 27 and with vertically extending reinforcing or stiffening ribs or flanges 28 and 29 connecting the base flanges 23 and 24 with the underside of the trunnion receiving projections 3 and 4, respectively. The walls 1 and 2 are also provided on inner opposed portions thereof with similar arcuate bosses 31 having one or a series of similar arcuate slots 33 extending therethrough and the opposed portion of the housing 6, that is, the side walls 7 and 8 thereof, are provided with similar tapped circular bosses 36 which slidably engage the opposed portions of the bosses 31 and may be securely clamped thereto in a selected position by means of tap bolts 38. In this connection, the trunnion receiving projections 3 and 4 are each provided intermediate their ends with a boss 39 having an opening 41 therethrough and exposing a side portion of the housing trunnion journaled therein and the trunnion may be clamped in the projection receiving same by means of a pair of blocks 42 and 43 which are slidably mounted in the opening 41 in boss 39 and have arcuate surfaces 44 and 46 adapted to engage circumferentially spaced side portions of the trunnion and be clamped thereagainst by an interconnecting stud bolt 47. This construction permits selectively varying the angularity of the housing 6 relative to the supporting elements or walls 1 and 2 simply by loosening tap bolts 47 and, depending upon the arcuate length of slots 33 and 34 and the extent to which the housing is to be turned, by also loosening or removing tap bolts 38 whereupon the housing can be readily turned on its supporting trunnions to a selected one of an infinite number of positions between vertical and horizontal

limits as determined by the arcuate slots 33 in the walls 1 and 2 and then rigidly secured in the selected position merely by again tightening the tap bolts 47 and 38. The rigidity of the supporting walls 1 and 2 may be additionally increased by means of interconnecting braces or cross bars 45 as shown in Fig. 1.

The side walls 7 and 8 of housing 6 are interconnected by removal of cover plates or walls 48 and 49 (see Fig. 3) and the thrust bearing 12 is removably supported within the lower portion of the housing 6 by means of a cylindrical bearing retaining member 51 which embodies a lower inwardly extending annular flange 52 supportingly engaging the bottom surface of the outer ball retaining ring of bearing 12 and which is in turn suspended within a member 54 by means of an upper outwardly extending flange 56 and tap bolts 57. Member 54 includes an upper outwardly extending flange 58 having a rectangular periphery with the portions thereof contiguous to the side walls 7 and 8 of housing 6 welded or otherwise secured thereto as shown in Fig. 2 and a lower inwardly extending annular flange 59 which is axially spaced from the flange 52 on member 51. An axial upward movement of bearing 12 is prevented in part by means of washers 61 and tap bolts 62 secured to the upper flange 56 on member 51 as best shown in Figs. 2 and 3. An annular oil collecting sump 63 which embodies a shaft engaging portion 64 and an externally threaded depending packing confining flange 66 is coaxially and removably secured to the bottom flange of member 54 in any suitable manner such as by tap bolts 67.

A packing nut 65 is threadably secured to the flange 66. The housing 6 also includes a removable bottom wall or spider structure 68 embodying a hollow boss or the like 69 having therein a fluid confining chamber 70, an upper coaxial shaft receiving opening 71 provided with a shaft engaging seal ring 72, a lower restricted coaxial fluid admission opening 73, and a side drain or fluid return opening 74.

The bearing 13 is removably supported within the upper end of the housing 6 by means of a member 76 which has a cylindrical bearing receiving opening and an inwardly extending annular flange 77 supportingly engaging the bottom surface of the outer roller retaining ring of bearing 13 and which has an outer rectangular configuration conforming with that of the housing 6 with the portions of member 76 which are contiguous to the side walls 7 and 8 welded or otherwise secured thereto as best shown in Fig. 2. An axial upward movement of bearing 13 is prevented by an annular retaining member 78 which is secured to member 76 and/or housing 6 by means of tap bolts 79 and which includes a depending rib or flange 80 engaging the upper edge of the outer roller retaining ring thereof, a shaft engaging seal ring 82 and a lubricant admitting passage 83.

In assembling the structure hereinbefore described, the supportive elements, that is, the walls 1 and 2, are combined with the housing 6 and this much of the assembly is rigidly secured together by inserting and tightening tap bolts 38, by inserting blocks 42 and 43 and tightening the stud bolts 47 interconnecting same, and by securing the brace or cross bars 45 to the edges of walls 1 and 2. The lower or thrust bearing 12 and its retaining member 51, if not already in place within the housing 6, can be readily positioned therein, as previously described, simply by

removing one of the cover plates 48 and 49 after which the subassembly comprising the mold carrying shaft 14, the retaining member 78 for bearing 13, the bearing 13 which is pressed onto a bearing retaining portion 84 of shaft 14 with its inner roller engaging ring abutting a positioning shoulder 87 thereon, the gear 17 which is keyed to the shaft 14 as indicated by numeral 88 with its hub portion abutting a positioning shoulder 89 and a sleeve 91 which surrounds the shaft 14 with one end abutting the hub portion of gear 17 can be readily inserted coaxially through the supporting member 76 for bearing 13 and then through the bearing 12 until the end of the sleeve 91 abuts the inner ball retaining ring of bearing 12. The assembly can now be readily completed by slipping the clamping nut 93 over the lower end of the shaft and tightening same on the threaded portion 94 thereof, by slipping the oil sump 63 over the lower end of the shaft and securing same to the flange 59 on member 54, by slipping the packing nut 65 over the lower end of the shaft and securing same to the flange 66 on sump 63, by attaching the bottom wall or spider structure 68 to the side walls 7 and 8 of housing 6 with the lower end of shaft 14 projecting through the opening 71 in boss 69 to a point adjacent to and spaced from the bottom of chamber 70 and by inserting and tightening the tap bolts 79 to secure the member 78 and bearing 13 in place.

The outside diameter of gear 17 and bearing 12 is less than the diameter of the coaxial opening defined by flange 77 of member 76, and it should therefore be apparent that if for any reason it should become necessary to repair or replace shaft 14, retaining member 78, bearings 12 and 13, gear 17, sleeve 91 and clamping nut 93, these elements can be readily withdrawn as a unit simply by detaching the cover plates 48 and 49 in order to gain access to tap bolts 62 and then loosening nut 65 and removing the tap bolts 62, the washers 61, and the tap bolts 79. After making the necessary repairs or replacements, the elements when reassembled can be repositioned in the housing as a unit and made ready for operation by tightening packing nut 65 and replacing washers 61, tap bolts 62 and 79 and cover members 48 and 49.

Shaft 14 is bored or otherwise constructed to embody therein a short coaxial end bore or chamber 96 in which is telescoped a coaxial end portion of a cooling fluid supply pipe 97 which sealingly extends through the coaxial opening 73 in the bottom wall 68 of housing 6 and includes a flexible portion 98, a pair of axially extending fluid conducting passages 99 and 101 which terminate at their upper ends in a chamber 102 formed in the mold supporting head portion 16 thereof, and a pair of laterally extending passages 103 and 104 which place the lower ends of passages 99 and 101 in communication with the bore 96 and chamber 70, respectively. Chamber 102 may be formed in part by a removable cover plate 106 embodying a depending flange or the like 107 (see Fig. 4) adapted to produce a more positive circulation of cooling fluid throughout all portions of the chamber and thereby a more uniform cooling of the head portion 16. However, if it is desired to directly cool or chill the mold 21 which is secured to head portion 16, the mold may be provided with passages or jacketed for the positive circulation of cooling fluid therethrough as shown in Figs. 5 and 6 in which the cover plate 106 is removed and the bottom of the mold is provided with a depending flange 108 effective to cause the cooling fluid discharged from shaft

passage 99 to pass through a portion of chamber 102 and passage 109 into the jacket space 111 in which it flows upward and then over the top of partition elements 112 into jacket space 113 from which it flows through passage 114 and the remaining portion of chamber 102 to shaft passage 101. In general, the cooling fluid delivered through supply pipe 97 into bore 96 flows therefrom through passage 103, passage 99, chamber 102, passage 101 and passage 104 into chamber 70 from which it leaves through the side opening 74. Consequently, the shaft 14 and all parts directly connected therewith are or may be effectively cooled at all times irrespective of the angular position of the housing 6 relative to the supporting walls 1 and 2.

Drive shaft 18 projects through and is rotatably mounted within the hollow trunnion 9 by means of a cylindrical shell 116 which can be inserted into and withdrawn from the coaxial opening in said trunnion and which (see Figs. 7 and 8) embodies at its outer end a laterally extending annular positioning flange 117 adapted to abut the adjacent end of the trunnion 9, an outer end bearing receiving and positioning counterbore 118, an inner end bearing receiving and positioning counterbore 119, an intermediate internal strengthening rib or flange 121, an axially extending lubricant conducting passage 122 including axially spaced outlet branches 123 and 124 which terminate in the coaxial communicating chambers formed by the internal flange 121 and an inlet branch 126 which communicates with the admission passage 127 in trunnion 9, and a coaxial group of coextensive lubricant conducting passages 128.

Drive shaft 18 embodies a reduced intermediate portion 131 interconnecting axially spaced inner and outer enlarged bearing engaging portions 132 and 133, respectively, an inner gear hub receiving portion 134 contiguous to the bearing engaging portion 132, a seal engaging surface 136 axially spaced outwardly from the bearing engaging portion 133, an externally threaded portion 137 intermediate and contiguous to the bearing engaging portion 133 and the threaded portion 137, and an outer splined end 138 adapted for connection with a suitable driving means. Drive shaft 18 may be readily mounted within shell 116 by pressing ball bearing 139 into the bearing receiving counterbore 118, by inserting the outer splined end of the shaft through the inner end of the shell and bearing 139 until the latter engages the coating portion 133, by slipping a lock nut 141 over the outer end of the shaft and engaging same with the threaded portion 137, by slipping a sleeve 142 over the inner end of the shaft until its outer end engages the inner ball retaining ring of bearing 139, by slipping a roller bearing 143 over the inner end of the shaft and pressing same into the bearing receiving counterbore 119 with its inner roller engaging ring abutting the inner end of sleeve 142, by placing a washer 144 over the inner end of the shaft and against the inner roller engaging ring of bearing 143, by placing the gear 19 on the inner end of the shaft with its hub portion engaging the washer 144 and securing the gear in this position by means of a key 146, and by placing and securing a washer 147 against the inner hub portion of gear 19 by means of a tap bolt 148 threaded coaxially into the end of shaft 18.

The assembly comprising shell 116, bearings 139 and 143, sleeve 142 and lock nut 141 can be inserted axially through the trunnion 9 until the

gear 19 properly meshes with the gear 17 on shaft 14 whereupon the lock nut 141 can be tightened to the desired extent and a cover member 149, which embodies a pair of axially spaced shaft engaging seal rings 150 and a coaxial shaft receiving opening 151, can be slipped over the outer end of shaft 18 and attached to the end of trunnion 9 with the flange 117 of shell 116 clamped therebetween by means of tap bolts 152. Cover member 149 also has formed therein (see Figs. 9 and 10) an arcuate shaped chamber 153 which communicates with the coaxial group of lubricant conducting passages 128 to provide a return lubricant duct extending axially through the bottom portion of shell 116 irrespective of variations in the angularity of the trunnion 9 and shell 116 relative to the trunnion receiving projection 3. Consequently, when the housing 6 is moved angularly relative to the supporting elements, any lubricant delivered through passages 126, 122, 123 and 124 into the space provided between the interior of shell 116 and shaft sleeve 142 is substantially free after passing through bearing 139 to return to the upper interior portion of housing 6 from which it passes to the oil sump 63.

Lubricant is supplied to bearings 12, 13, 139 and 143 and to gears 17 and 19 by means of a motor driven pump 154 which is disposed within and mounted on a reservoir 156 which is in turn secured in any desired manner such as by welding as shown in Fig. 1 to the exposed lower edge portions of the side walls 7 and 8 of housing 6. Reservoir 156 is connected with oil sump 63 by means of a pipe 157 and the discharge of pump 154 is connected with the passages 83 and 127 by means of a pipe 158 and branches 159 and 161, respectively; pipe 158 also having additional branches 162 and 163 which extend through cover plate 49 of housing 6 and into proximity to the bearing 12 and gears 17 and 19, respectively, for flowing a lubricant thereover. Consequently, it should now be obvious that all moving parts of the machine can be adequately lubricated at all times irrespective of the angularity of the housing 6 relative to the fixed supports.

The gear carrying drive shaft 18 can be readily removed from the trunnioned portion of housing 6 simply by removing the tap bolts 152 and pulling the assembly comprising the shell 116, bearings 139 and 143 and shaft 18 from the trunnion 9 whereupon the elements can be taken apart and repaired or replaced as required and again reinserted in operative relation within the trunnion 9 with a minimum of effort and time.

The construction hereinbefore described provides an extremely compact, rigid and durable machine in which all assemblies of moving parts can be quickly and readily removed, repaired or replaced as required, reassembled, and again placed in operative relation within the machine with the least possible effort. In addition, all heated and moving parts of the machine are adequately cooled and lubricated, respectively, irrespective of the angular relation of the mold supporting and driving shafts, thus insuring a long life for all parts which are subject to wear.

The invention embodies numerous features which are applicable to centrifugal casting machines generally, and although the invention as a whole is particularly applicable to machines which are frequently operated at different speeds with the axis of the mold carrying shaft positioned at different angles relative to a reference axis, it should be understood that it is not intended to limit the invention to the exact details of con-

struction herein shown and described as various modifications within the scope of the appended claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and having a pair of alined oppositely extending hollow trunnions journaled in telescoped supported relation on said projections, means for selectively varying the angularity of said housing relative to said elements, a mold carrying shaft rotatably mounted within said housing for movement therewith with its longitudinal axis extending substantially at right angles to the longitudinal axis of said trunnions, and a gear carrying drive shaft movable coaxially as a unit through and supported by a telescoped projection and trunnion with the gear thereon rotatably connected with the adjacent portion of said mold carrying shaft.

2. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and including a pair of oppositely extending hollow supporting trunnions journaled on said projections, a pair of annular bearing supports mounted in spaced coaxial relation within said housing, a mold carrying shaft embodying thereon a pair of axially spaced bearings, a gear disposed between said bearings and means uniting and rendering said shaft, bearings and gear mountable on and removable from said pair of supports as a unit, and a gear carrying drive shaft extending through and carried by a supportingly combined projection and trunnion with the gear thereon in mesh with the gear on said mold carrying shaft.

3. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and including a pair of oppositely extending hollow supporting trunnions journaled on said projections, a mold carrying shaft rotatably mounted within said housing for movement therewith, a gear secured on said shaft adjacent said trunnions, a shell axially positionable within and withdrawable from one of said trunnions, a drive shaft extending through and carried by said shell for movement therewith and for rotation relative thereto, said drive shaft having on one end thereof a gear which is smaller than the outside diameter of said shell, and means removably securing said shell within said one trunnion with the gear thereon in mesh with the gear on said mold carrying shaft.

4. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and including a pair of oppositely extending hollow supporting trunnions journaled on said projections, a pair of annular bearing supports mounted in spaced coaxial relation within said housing, a mold carrying shaft embodying thereon a pair of axially spaced bearings, a gear disposed between said bearings and means uniting and rendering said shaft, bearings and gear mountable on and removable from said pair of supports as a unit, a shell axially positionable

within and withdrawable from one of said trunnions, a drive shaft extending through and carried by said shell for movement therewith and for rotation relative thereto, said drive shaft having on one end thereof a gear which is smaller than the outside diameter of said shell, and means removably securing said shell within said one trunnion with the gear thereon in mesh with the gear on said mold carrying shaft.

5. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and including side wall portions opposing said elements and presenting alined oppositely extending hollow trunnions journaled in telescoped supported relation on said projections, means for selectively varying the angularity of said housing relative to said elements, a pair of shaft supporting bearings mounted in spaced coaxial relation within said housing on opposite sides of said trunnions, a mold carrying shaft rotatably mounted in said bearings, and a gear carrying drive shaft movable coaxially as a unit through and supported by a telescoped projection and trunnion with the gear thereon drivingly connected with a part on said mold shaft intermediate the bearings supporting same.

6. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined hollow trunnion receiving projections, a housing disposed between said elements and having alined oppositely extending hollow trunnions journaled in telescoped supported relation within said projections, means for selectively varying the angularity of said housing relative to said elements, a pair of shaft supporting bearings mounted in spaced coaxial relation within said housing on opposite sides of said trunnions, a shaft rotatably mounted in said bearings and including thereon a mold supporting head projecting beyond the trunnioned end of said housing and a gear disposed between said bearings and adjacent said trunnions, and a gear carrying drive shaft coaxially movable as a unit through and supported by a telescoped projection and trunnion with the gear thereon in mesh with the gear on the shaft embodying said mold supporting head.

7. A centrifugal casting machine comprising spaced supporting elements including a pair of opposed walls presenting a pair of alined hollow trunnion receiving projections extending substantially perpendicular to said walls, a housing disposed between said walls and including spaced side walls opposing portions of said element walls and presenting alined oppositely extending hollow trunnions journaled in telescoped supported relation within said projections, means for selectively varying the angularity of said housing relative to said elements, a pair of shaft supporting bearings mounted in spaced coaxial relation within said housing on opposite sides of said trunnions with their common longitudinal axis extending substantially at right angles to the common longitudinal axis of said trunnions, a shaft rotatably mounted in said bearings and including thereon a mold supporting head projecting beyond the trunnioned end of said housing and gear disposed between said bearings and adjacent said trunnions, and a gear carrying drive shaft coaxially movable as a unit through and supported by a telescoped trunnion and projection with the gear thereon in mesh with the gear on the shaft embodying said mold supporting head.

8. A centrifugal casting machine comprising spaced supporting elements including a pair of opposed parallel walls presenting a pair of alined hollow trunnion receiving projections extending substantially perpendicular to said walls, a rectangular housing disposed between said walls and including spaced side walls opposing portions of said element walls and presenting alined oppositely extending hollow trunnions journaled in telescoped supported relation on said projections, means including slidably engaged portions of said side and element walls for selectively varying the angularity of said housing relative to said elements, a pair of shaft supporting bearings mounted in spaced coaxial relation within said housing on opposite sides of said trunnions with their common longitudinal axis extending substantially at right angles to the common longitudinal axis of said trunnions, a shaft rotatably mounted in said bearings and including thereon a mold supporting head projecting beyond the trunnioned end of said housing and a gear disposed between said bearings and adjacent said trunnions, and a gear carrying drive shaft coaxially movable as a unit through and supported by a telescoped trunnion and projection with the gear thereon in mesh with the gear on the shaft embodying said mold supporting head.

9. A centrifugal casting machine comprising spaced supporting elements presenting a fixed pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and having a pair of alined oppositely extending hollow trunnions journaled in telescoped supported relation on said fixed projections, a mold carrying shaft rotatably mounted within said housing, and a mold-shaft rotating means movable coaxially through and supported by a telescoped projection and trun-

nion with the inner end of said means drivingly connected with said shaft.

10. A centrifugal casting machine comprising spaced supporting elements presenting a pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and having a pair of oppositely extending hollow trunnions supportingly journaled on said projections, a pair of bearing supports mounted in spaced coaxial relation within said housing, a mold carrying shaft embodying thereon a pair of axially spaced bearings, a member for rotating the shaft and means uniting and rendering said shaft, bearings and member mountable on and removable from said pair of supports as a unit, and a drive shaft extending through and carried by a supportingly, combined projection and trunnion with its inner end drivingly connected with the member on said mold carrying shaft.

11. A centrifugal casting machine comprising spaced supporting elements presenting a fixed pair of alined oppositely extending hollow trunnion receiving projections, a housing disposed between said elements and having a pair of alined oppositely extending hollow trunnions journaled in telescoped supported relation on said projections, a pair of bearing supports mounted in spaced coaxial relation within said housing, a mold carrying shaft embodying thereon a pair of axially spaced bearings, a member for rotating the shaft and means uniting and rendering said shaft, bearings and member mountable on and removable from said pair of supports as a unit, and a mold-shaft rotating means extending through and carried by a telescoped projection and trunnion with its inner end drivingly engaged with said member.

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