United States Patent [19]

Schoffmann

[11] **3,866,665**

[45] **Feb. 18, 1975**

[54] **TWIN STRAND CONTINUOUS CASTING APPARATUS WITH A TUNDISH LOAD BALANCING VESSEL**

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[22] Filed: **Jan. 2, 1974**

[21] Appl. No.: **430,032**

[52] **U.S. Cl.** **164/281,** 164/337

[51] **Int. Cl.** **B22d 11/10,** B22d 37/00

[58] **Field of Search** 164/281, 335, 337; 222/160, 168.5; 266/38

[56] **References Cited**

UNITED STATES PATENTS

3,552,902	1/1971	Schoffmann et al.	164/281
3,773,228	11/1973	Koch et al.	164/281 X

FOREIGN PATENTS OR APPLICATIONS

701,189	12/1953	Great Britain	164/281

Primary Examiner—Robert D. Baldwin

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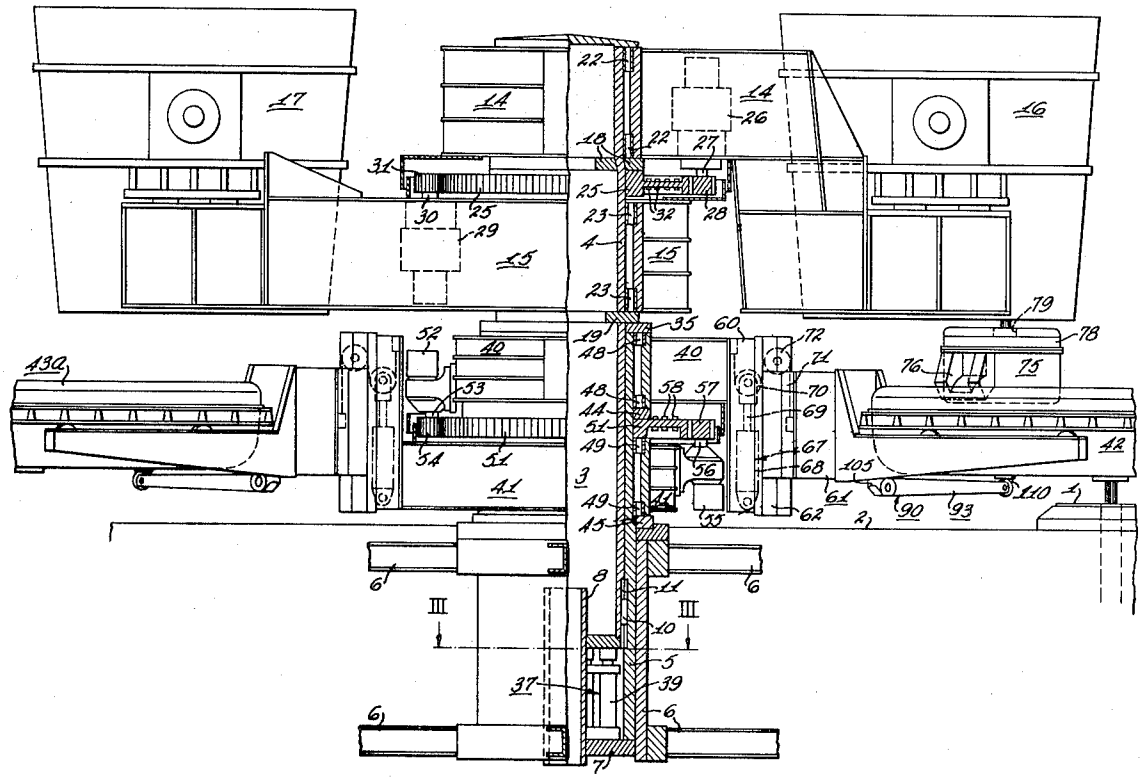
[57] **ABSTRACT**

A twin strand continuous metal casting apparatus is disclosed including two casting molds, a vertical arbor assembly, and a tundish carrier assembly mounted on the arbor with a pair of forks each carrying a tundish projecting radially outward from a common hub around the arbor. A tundish loading vessel is provided having a pair of discharge spouts projecting in opposite directions. A support is connected between the forks, which carry the tundish loading vessel transversely above the forks with each spout over one of the tundishes. A rocking mechanism is provided to rock the loading vessel for varying the rate of metal discharge through the two spouts to the two tundishes and equalize the load of molten metal in the two tundishes. The rocking assembly comprises linkages which automatically respond to unequal loading of the two tundishes and tilt the loading vessel to increase the flow of metal to the lesser loaded of the two tundishes.

8 Claims, 5 Drawing Figures



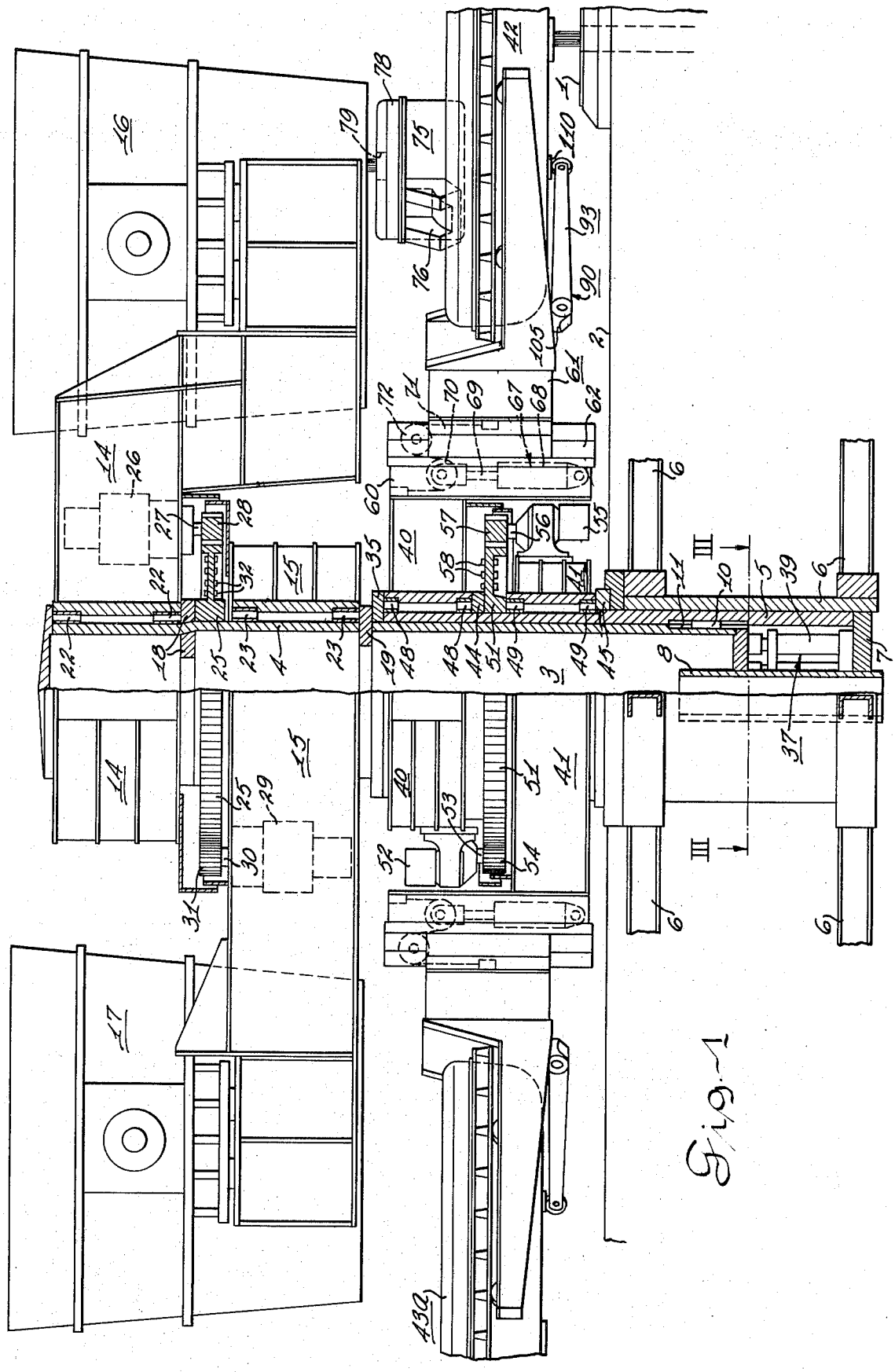


Fig. 1

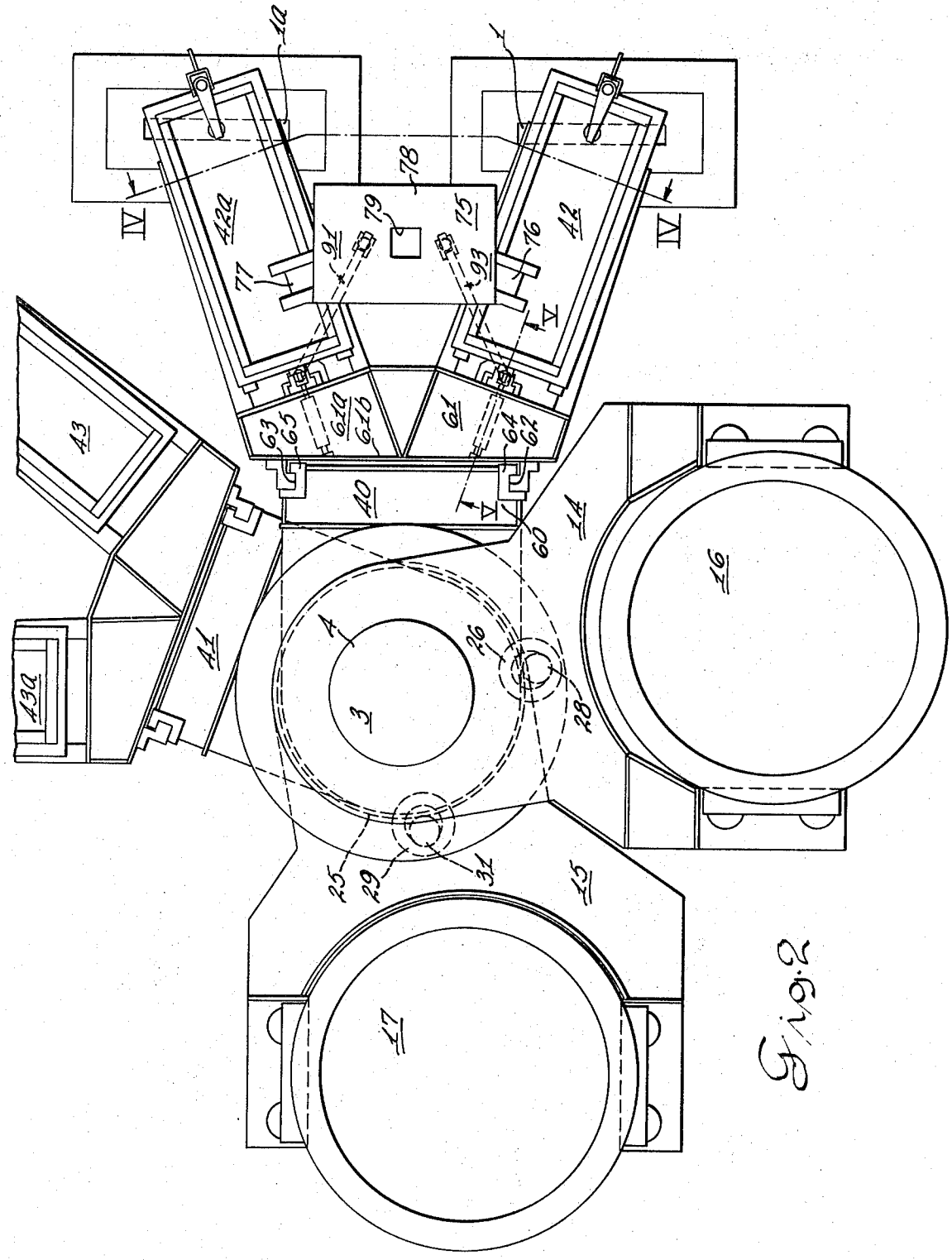

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Fig. 2

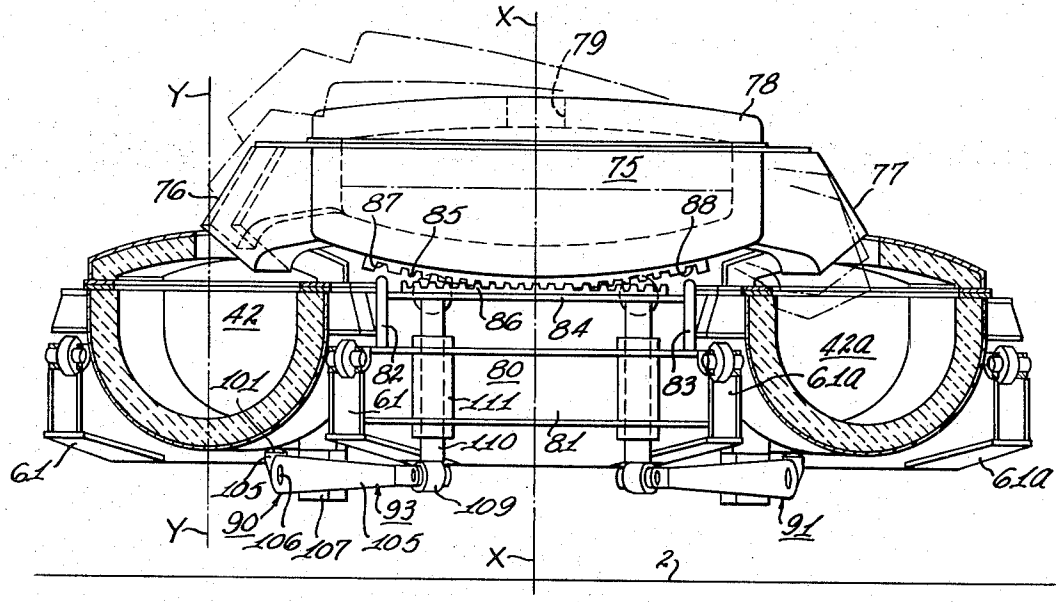

Fig. 4

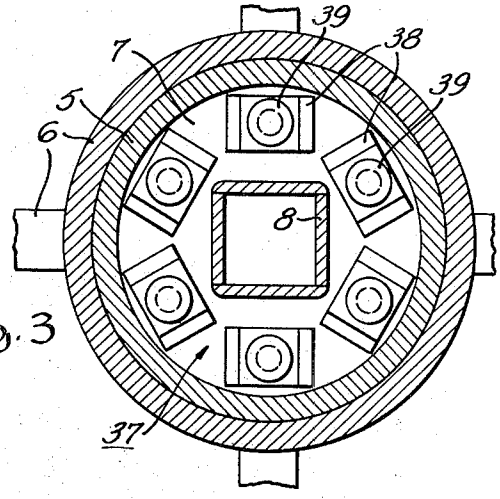

Fig. 3

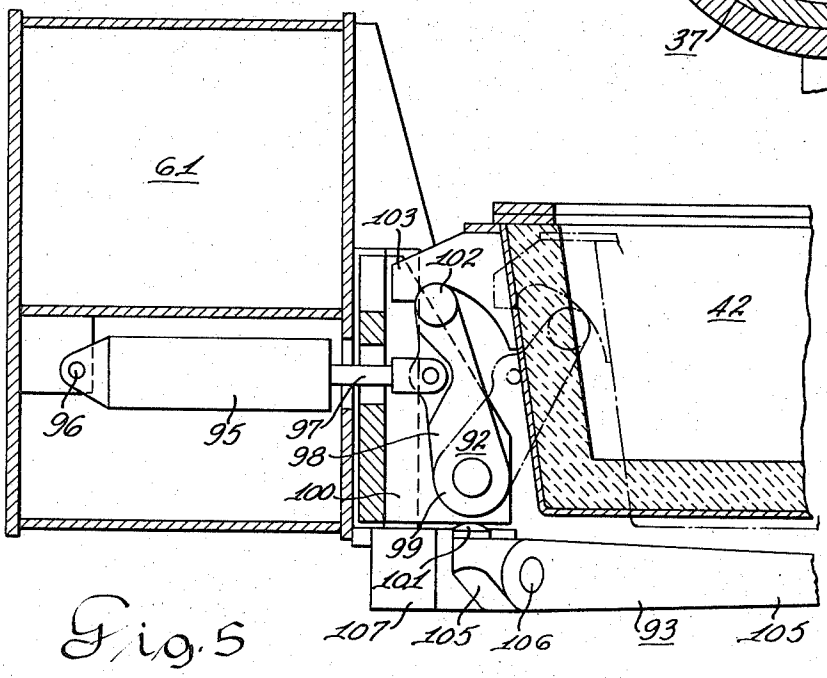

Fig. 5

TWIN STRAND CONTINUOUS CASTING APPARATUS WITH A TUNDISH LOAD BALANCING VESSEL

CROSS REFERENCE TO RELATED PATENT APPLICATION

This application discloses an invention which may be applied and is herein disclosed as being applied, to a continuous casting apparatus which is the subject of my copending U.S. Pat. application entitled "Continuous Casting Apparatus with Movable Ladles and Tundishes," Ser. No. 430,195, filed concurrently with this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a coontinuous casting of metals and in particular to a twin strand continuous casting apparatus with movable ladles and tundishes, and balanced metal flow to two casting molds. This invention further relates to improvements to apparatus such as disclosed in a prior patent to Anton Kubera and me, U.S. Pat. No. 3,552,902 of Jan. 5, 1971 and my aforesaid copending patent application.

2. Description of the Prior Art

Twin strand continuous casting machines are known to those skilled in this technology. U.S. Pat. No. 2,804,665 discloses a twin strand caster having a single tundish with two orifices for discharging metal simultaneously or alternately to two casting molds. This tundish is rocked to provide unbalanced metal flow into the molds according to a predetermined cycle.

Prior art patents also disclose arrangements for supporting the great weight of ladles and tundishes, with apparatus including carriages having wheels or rollers engaging railway tracks to support the ladles and/or tundishes being moved into and away from casting positions. Examples of such arrangements are disclosed in U.S. Pat. No. 3,344,847, Oct. 3, 1967; U.S. Pat. No. 3,382,913, May 14, 1968; U.S. Pat. No. 3,446,269, May 27, 1969; and U.S. Pat. No. 3,456,713, July 22, 1969.

U.S. Pat. No. 3,552,902, Jan. 5, 1971, granted to Anton Kubera and me, discloses a pair of ladle carrier arms pivotally mounted on a common vertical arbor, and a pair of tundishes each separately pivotable about its own vertical support column, with each of the ladles and tundishes being movable into and away from casting positions.

U.S. Pat. No. 3,556,349 discloses a pair of tundishes mounted to pivot together on a single vertical arbor and which can be raised and lowered, but which will require separate support structure for one or more ladles.

My copending patent application, to which cross reference has been made, discloses ladles and tundishes mounted on a common central arbor assembly which requires no other support for moving the ladles and tundishes into and away from casting positions.

SUMMARY OF THE PRESENT INVENTION

It is a feature of the present invention that a tundish carrier assembly is provided with a pair of tundishes carried by forks projecting radially outward from a common hub around an arbor, with a support connected between the forks which carries a tundish loading vessel transversely above the two tundishes for loading both tundishes with molten metal through a pair of discharge spouts, one over each tundish. The carrier assembly is pivotally mounted on the arbor to move both tundishes and their loading vessel in a horizontal plane as a single unit over two casting molds for casting twin strands of metal.

Another feature of the present invention is that the tundish loading vessel is mounted to rock on its support for varying the rate of dishcarge to the two tundishes, and with an axis of support moving as the loading vessel is tilted, to be beneath the center of gravity of the load of molten metal within the loading vessel.

Another feature of the invention is that a mechanism is provided which automatically responds to unequal loading of the two tundishes by tilting the loading vessel toward the lesser loaded of the two tundishes.

The objects of the invention comprise providing for the aforesaid features and with a compact single arbor assembly support for moving the ladles, tundishes and tundish loading vessel into and away from casting position.

Other features and objects of the invention that have been attained will appear from the more detailed description to follow with reference to an embodiment of the invention shown in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 of the accompanying drawings show a side elevation, partly in section, a ladle and tundish support apparatus according to the present invention;

FIG. 2 is a top view of the apparatus shown in FIG. 1;

FIG. 3 is a view taken along line III—III in FIG. 1 and viewing the structure in the direction indicated by arrows;

FIG. 4 is a view in section taken along line IV—IV in FIG. 2 and viewing the structure in the direction indicated by arrows; and

FIG. 5 is a fragmentary view in section taken along line V—V in FIG. 2 and viewing the structure in the direction indicated by arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 and FIG. 2 of the drawing, an apparatus is shown for continuous casting of metal in a pair of casting molds 1 and 1*a* opening at or above a casting floor 2 shown in FIG. 1. The apparatus is provided with a central vertical arbor assembly 3 having an upper cylindrical column 4 telescopically arranged within a lower cylindrical column member 5 with column 4 projecting vertically upward from column 5. The column member 5 is secured, as by welding, to support structures 6 beneath the casting floor 2. column 5 has a circular bottom piece 7 also welded to support structure 6, and having a square central opening through which a square key 8 projects (see also FIG. 3) to provide alignment of the arbor assembly 3 relative to the support structure 6.

Column 4 is telescopically fitted within the upper and open end of column 5. One or more keys 10 are provided which are arranged in vertical parallel alignment with arbor 3, which are welded to the inner surface of column 5 and project into a vertical slot 11 defined in the outer surface of column 4, to lock column 4 against rotation while permitting vertical movement of column 4 within column 5.

A pair of ladle carrier arms **14, 15** are mounted on an upper portion of column **4** to carry a pair of ladles **16, 17.** The arms **14, 15** rest upon thrust bearing collars **18, 19,** respectively, that are secured to column **4.** Antifriction roller bearings **22** are interposed between arm **14** and column **4,** and antifriction roller bearings **23** are interposed between arm **15** and column **4,** and thus both arms **14, 15** are pivotable around column **4,** each in a horizontal plane. The manner in which such pivotable movement is provided for will now be described. A nonrotating ring gear **25** is rigidly secured, as by welding, to the column **4** between arms **14, 15.** A reversible electric motor **26** is mounted on arm **14** with its drive shaft **27** projecting downwardly. A pinion gear **28** is mounted on drive shaft **27** and engages ring gear **25.** When motor **26** turns shaft **27** and pinion gear **28,** motor **26** and arm **14** pivot horizontally around column **4** because, as has been stated, ring gear **25** cannot turn as it is welded to column **4** and column **4** is held against rotation by the keys **10.** Likewise, a reversible electric motor **29** is mounted on arm **15** but with its drive shaft projecting upwardly. A pinion gear **31** is mounted on drive shaft **30** and also engages ring gear **25.** When motor **29** turns its shaft **30** and pinion gear **31,** motor **29** and arm **15** pivot horizontally around column **4.** Electric power for motors **26** and **29** may be delivered to movable arms **14, 15** for the motors by such as brushes (not shown) engaging slip rings **32** on gear **25.** Column **4,** arms **14** and **15,** ladles **16, 17,** ring gear **25,** and motors **26** and **29,** are also shown in the top view of FIG. **2.**

Referring again to FIG. **1,** in addition to arms **14, 15,** and ladles **16, 17** being pivotable about the arbor assembly **3,** such arms anad ladles may also be raised and lowered. As shown in FIG. **1** the arms **14, 15** are in their lowest position, with the thrust bearing collar **19** resting upon an annular cap **35** fastened to the top of the lower column **5.** Column **4,** arms **14, 15** and ladles **16, 17** may be raised from the position shown in FIG. **1,** and then lowered again, by a reversible lift mechanism **37** arranged within the lower column **5** and beneath the upper column **4.** As shown in FIG. **3,** the lift mechanism **37** may comprise several units (six are shown) each preferably comprising a cylinder defining block **38** containing a piston **39** actuated by hydraulic fluid pressure.

With reference again to FIG. **1,** a pair of tundish carrier arms **40, 41** are mounted on an upper portion of the lower column **5.** As shown in FIG. **2,** arm **40** carries a pair of tundishes **42, 42***a* and arm **41** carries a pair of tundishes **43, 43***a.* As shown in FIG. **1,** the arms **40, 41** rest upon thrust bearing collars **44, 45,** respectively, that are secured to column **5.** Antifriction roller bearings **48** are interposed between arm **40** and column **5,** and antifriction roller bearings **49** are interposed between arm **41** and column **5,** and thus both arms **40, 41** are pivotable around column **5,** each in a horizontal plane. The manner in which the pivotable movement of arms **40, 41** is provided for is similar to that which has been described for the arms **14, 15.** That is, a nonrotating ring gear **51** is rigidly secured, as by welding, to the column **5** between arms **40, 41.** a reversible electric motor **52** is mounted on arm **40** on the opposite side of column **5** from tundish **42.** Motor **52** is arranged with its drive shaft **53** projecting downwardly. A pinion gear **54** is mounted on drive shaft **53** and engages ring gear **51.** When motor **52** turns shaft **53** and pinion gear **54,** motor **52** and arm **40** pivot horizontally around column **5** because, as has been stated, ring gear **51** cannot turn as it is welded to column **5** and column **5** is held against rotation because it is welded to support structure **6.** Likewise, a reversible electric motor **55** is mounted on arm **41** (on the opposite side of column **5** from tundish **43**) but with its drive shaft **56** projecting upwardly. A pinion gear **57** is mounted on drive shaft **56** and also engages ring gear **51.** when motor **55** turns its shaft **56** and pinion gear **57,** motor **55** and arm **41** pivot horizontally around column **5.** Electric power for motors **52** and **55** may also be delivered to movable arms **40, 41** for the motors by such as brushes (not shown) engaging slip rings **58** on gear **51.**

In addition to arms **40, 41** and tundishes **41, 42***a*, **43,** 43*a* being pivotable about the arbor **3,** the tundishes may also be raised and lowered. The means for accomplishing this is identical for both tundish arms and therefore only tundish arm **40** will be described. Tundish carrier arm **40** comprises a hub assembly **60** mounted around the lower column **5** and as shown in FIG. **2** a pair tundish supporting forks **61, 61***a* project radially outward from hub assembly **60.** The forks **61,** 61*a* are connected together by a cross beam **61***b* and to the hub **60** for vertical movement relative to the hub **60.** The hub **60** defines a pair of slots **62, 63.** Only slot **62** can be seen in FIG. **1** but both slots **62, 63** are visible in the top view of FIG. **2.** The fork cross beam **61***b*, as shown in FIG. **2,** is provided with vertical guide bars **64** and **65** which project into slots **62, 63** to guide movement of beam **61***b* and forks **61, 61***a* up and down relative to hub **60.** The movement of beam **61***b* and forks **61, 61***a* is provided for by winch means **67** shown in FIG. **1** as comprising a hydraulic fluid pressure operated cylinder **68** connected to hub **60** which operates to move a piston rod **69** up and down. A roller **70** is connected to the upper end of rod **69.** A cable **71** is secured to hub **60,** looped around roller **70** and a second roller **72,** and cable **71** extends downwardly and is secured to forks **61, 61***a.* Fork **61** is shown in FIG. **1** to be in its uppermost position. To lower forks **61, 61***a*, rod **69** and roller **70** are moved upwardly and cable **71** moves over the second roller **72** clockwise, as shown, as gravity moves forks **61, 61***a* downwardly. To raise forks **61, 61***a* again, rod **69** and roller **70** are moved downwardly to pull cable **71** counterclockwise over the second roller **72** and forks **61, 61***a* are pulled upwardly. Thus forks **61, 61***a* and tundishes **42, 42***a* can be raised and lowered relative to the arbor assembly **3** and relative to ladles **16, 17.**

A tundish loading vessel **75** is shown in FIG. **1** as being arranged over tundish **42** and beneath ladle **16.** The vessel **75** will be described further with reference to FIG. **2** and FIG. **4.** The vessel **75** has a pair of discharge spouts **76, 77** projecting from opposite sides of the vessel **75** and as shown in FIG. **4,** vessel **75** may also be provided with a cover **78** having a single entrance port **79.**

Support means **80** will now be described with reference to FIG. **4,** which carry vessel **75** transversely above the forks **61, 61***a* with spout **76** over tundish **42** and spout **77** over tundish **42***a.* The support means **80** comprise a cross beam **81** connected between forks **61,** 61*a*, vertical posts **82, 83** mounted on beam **81,** and a table **84** connected to posts **82, 83** in a position above beam **81.** Means to accommodate rocking or tilting support of vessel **75** are interposed between the vessel

75 and table 84, which comprise an arcuate gear segment 85 secured, as by welding, to the bottom of vessel 75, and a planar gear rack 86 mounted on the table 84. The tops of posts 82, 83 project upwardly from table 84 toward notches 87, 88 formed in gear segment 85, to provide for limiting the angle through which vessel 75 can tilt in either direction.

Means to rock or tilt the tundish loading vessel 75 on the support means 80 comprise a pair of balance assemblies 90, 91. Since the balance assemblies 90, 91 are identical, only assembly 90 shall be described in detail. The balance assembly 90 comprises (see FIG. 5) a first linkage 92 and a second linkage 93.

With reference to FIG. 5, the first linkage 92 comprises a fluid pressure operated axially expandable motor 95 connected on one end by a pivot 96 to fork 61, for pivotal movement in a vertical plane, and has a piston rod 97 projecting from motor 95 which is pivotally connected to a cross arm 98 intermediate the ends of cross arm 98. A lower end 99 of arm 98 is pivotally connected to a frame 100 that rests on an end piece 101 of the second linkage 93. An upper end 102 of arm 98 engages a hook 103 attached to the radially inner end of tundish 42. Arm 98 makes contact with tundish 42 as shown in phantom lines. Piston rod 97 is then moved toward pivot 96 and the upper end 102 of cross arm 98 engages hook 103 and lifts the radially inner end of tundish 42 off fork 61 and the weight of tundish 42 (and its load of molten metal) then causes frame 100 to bear downwardly on end piece 101 of the second linkage 93, with a force depending upon the load within tundish 42. The piece 101 is mounted on an arm 105 of the second linkage 93. The arm 105 is connected by a pivot 106 to a member 107 which is in turn rigidly attached to fork 61. Referring now to FIG. 4 the end of arm 105 remote from piece 101 carries a roller 109 which engages a push rod 110. Push rod 110 is axially and vertically slidable in a sleeve 111 attached to cross beam 81. Push rod 110 projects upwardly from cross beam 81 and table 84 to engage the bottom of tundish loading vessel 75. Sleeve 110 is mounted on beam 81 at a location between a first vertical plane X—X projecting radially from arbor 3 through the centerline of vessel 75, and a second plane Y—Y projecting radially from arbor 3 through spout 76.

In the operation of the balance system, the downward force on piece 101 resulting from the weight of tundish 42 and the load of metal therein, is transmitted as an upward force to the bottom of tundish loading vessel 75. Since balance assemblies 90 and 91 are identical, except that assembly 91 is on the opposite side of plane X—X from assembly 90, when tundishes 42, 42*a* are equally loaded with molten metal the assemblies 90 and 91 transmit equal and balanced forces and vessel 75 remains horizontal and discharging metal equally to both tundishes 42, 42*a*. However if, for example, tundish 42 carries a greater load of metal than tundish 42*a*, the balance assembly will transmit a greater force through push rod 110 to vessel 75 than is transmitted to vessel 75 by balance assembly 91, and vessel 75 will then tilt toward tundish 42*a*, as shown with phantom lines in FIG. 4, until the accelerated flow to tundish 42*a* due to tilting vessel 75, restores equal loading in the two tundishes 42, 42*a*.

In the operation of the entire apparatus, with reference to FIG. 2, a pair of tundishes, for example tundishes 42, 42*a*, are positioned over the molds 1, 1*a*. Ladle carrier arm 14, with ladle 16 filled with molten metal, may then be pivoted counterclockwise around column 4 until ladle 16 is over tundish loading vessel 75. The vertical position of ladle 16 may be adjusted by the lift mechanism 37 and the vertical position of tundishes 42, 42*a* and vessel 75 may be adjusted as desired by the winch means 67. The pouring may then begin. When ladle 16 is almost empty, ladle 17 filled with molten metal will be pivoted clockwise around column 4 to a position alongside ladle 16. When ladle 16 is empty, ladle 16 will be pivoted clockwise away from vessel 75 and ladle 17 is pivoted clockwise to a position over tundish loading vessel 75. Tundish loading vessel 75 and tundishes 42, 42*a* have sufficient capacity that they do not empty during the brief time required to move ladle 16 out of the way and ladle 17 into position over the tundish loading vessel 75. The empty ladle 16 will be pivoted clockwise to a refill position on the opposite side of arbor 3 from molds 1, 1*a*. When ladle 16 is refilled it will be pivoted counterclockwise to a position alongside ladle 17 and when ladle 17 is empty it will be moved counterclockwise to the refill position and ladle 16 will be moved counterclockwise over tundish loading vessel 75. When the tundish loading vessel 75 and tundishes 42, 42*a* are to be taken out of operation, casting is interrupted briefly as arm 40 is turned clockwise around the arbor assembly 3 to make room for arm 41 to turn clockwise and locate tundish loading vessel 75*a* and tundishes 43, 43*a* over molds 1, 1*a*. Arm 40 continues to turn clockwise until arriving at a suitable position for lowering forks 61, 61*a* to lower tundishes 42, 42*a* on suitable carriage means (not shown). New or refurbished tundishes may then be moved over forks 61, 61*a* and forks 61, 61*a* raised to lift and carry the new or refurbished tundishes, when needed, over molds 1 and 1*a*. Additionally, the vertical adjustability of forks 61, 61*a* as well as hub 60 and the ladle arms 14, 15 can be utilized to provide improved access to various parts of the apparatus to facilitate inspection and maintenance work.

With a pair of tundishes such as 42, 42*a* and a tundish loading vessel such as 75, in position over molds 1, 1*a*, molten metal is poured from a ladle 16 or 17, through port 79 into vessel 75. The tundish loading vessel 75 discharges molten metal through both spouts 76, 77 to the tundishes 42, 42*a*. The tundish loading vessel 75 with its arcuate gear segment 85 may be rocked or tilted on the planar gear rack 86 and the load applied to gear rack 86 moves as vessel 75 and the arcuate gear rocks thereon, to a location that is always beneath the center of gravity of the charge of molten metal within vessel 75, and thus the metal charge itself produces no unbalanced forces on the support means 80. Furthermore, the rocking or tilting of the tundish loading vessel 75 when the tundishes 42, 42*a* are unequally loaded, occurs automatically as the balance assemblies 90, 91 operate to tilt the vessel as required to restore balanced loading of the tundishes.

The foregoing is accomplished with an apparatus that utilizes only a single vertical arbor assembly to support and move ladles, tundish loading vessels and tundishes as required for such operations and purposes as have been described, and thus it has been shown how the features and objects of the present invention have been attained in a preferred manner. However, modification and equivalents of the disclosed concepts such as readily occur to those skilled in the art are intended to

be included in the scope of this invention. Thus, the scope of the invention is intended to be limited only by the scope of the claims such as are or may hereafter be, appended hereto.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A twin strand continuous metal casting apparatus comprising:

a. two casting molds spaced apart in a common horizontal plane;

b. a vertical arbor assembly horizontally spaced from both molds;

c. a tundish carrier assembly mounted on the arbor for pivotal movement in a horizontal plane above the molds, said assembly having a hub around the arbor and a pair of forks projecting radially outward from the hub in a common horizontal plane;

d. a plurality of tundishes, with one tundish mounted on each fork;

e. a tiltable tundish loading vessel having a pair of discharge spouts projecting from opposite sides of the vessel;

f. vessel supporting means connected between said forks and carrying the tundish loading vessel transversely above the forks with each of the spouts over one of the tundishes; and

g. ladle supporting means adapted to carry a ladle containing molten metal and operative to move a ladle of molten metal into a teeming position over the tundish loading vessel to discharge metal thereto for selective flow through both said spouts to both said tundishes.

2. An apparatus according to claim **1** having an arcuate gear segment mounted on the bottom of the tundish loading vessel above the vessel supporting means and having gear teeth projecting downwardly therefrom, a planar gear rack mounted on the vessel supporting means having gear teeth engaging the teeth of the arcuate gear segment, and rocking means connected to the tundish loading vessel constructed and arranged to tilt the tundish loading vessel and arcuate gear on the supporting means and planar rack gear for varying the rate of metal discharge from the loading vessel through said spouts to said tundishes.

3. An apparatus according to claim **2** with said rocking means having a pair of balance assemblies each comprising:

a. a first linkage connected on one end to a radially inner portion of said fork and with a second end thereof being adapted to engage a radially inner end of the tundish on said fork for lifting the radially inner end of the tundish upwardly from its supporting fork;

b. a second linkage carried by said fork and having a first end engaging the second end of the first linkage, and a second end engaging the bottom of the tundish loading vessel at a location between a first vertical plane projecting radially from the arbor through the center of the vessel and a second vertical plane projecting radially from the arbor through the vessel spout above the tundish engaged by the first linkage, with said second linkage being operative to transmit downward force applied thereto by the first linkage as an upward lifting force to the bottom of the tundish loading vessel; whereupon the pair of balance assemblies respond to unequal loading of the two tundishes and tilt the tundish loading vessel toward the lesser loaded tundish to increase the flow of molten metal from the loading vessel to the lesser loaded of the two tundishes and decrease the flow of molten metal from the loading vessel to the greater loaded of the two tundishes until a balanced loading of the two tundishes is restored.

4. An apparatus according to claim **3** in which the first linkage comprises:

a. a fluid pressure axially expandable motor connected on a first end to said fork for pivotal movement in a vertical plane

b. a cross arm in a vertical plane connected intermediate the ends thereof to a second end of the expandable motor, said cross arm having a lower end connected to a pivot carried by the first end of the second linkage, and said cross arm having an upper end engageable with said tundish for lifting the radially inner end of the tundish off the fork when said motor pivots the cross arm about the pivot at the lower end of said cross arm, to thus apply the downward force of tundish loading to the first end of the second linkage.

5. An apparatus according to claim **1** in which said ladle supporting means comprise first and second carrier arms mounted in vertically spaced arrangement on an upper portion of the arbor assembly above the tundish carrier assembly for independent pivotal movement of said arms relative to said arbor and each other in a horizontal plane.

6. An apparatus according to claim **5** in which the tundish carrier assembly comprises third and fourth carrier arms mounted in vertically spaced arrangement on the arbor assembly for independent pivotal movement of the third and fourth arms relative to the arbor assembly in a horizontal plane, and with each of the tundish carrier arms having a pair of forks for carrying tundishes and a said tundish loading vessel above each pair of tundishes.

7. An apparatus according to claim **5** in which:

a. the vertical arbor assembly comprises telescoping upper and lower column members with the lower column adapted to be rigidly attached to support structure and the upper column projecting upwardly from and movable relative to the lower column;

b. the first and second ladle carrier arms are mounted in vertically spaced arrangement on the upper column for independent pivotal movement of said arms relative to said upper column in a horizontal plane;

c. a vertically arranged key attached to one of said column members and projecting into an elongated vertical slot defined in the other of said column members to limit movement of the upper column to vertical movement; and

d. a reversible lift mechanism between the telescoping column members for lifting and lowering the upper column and both of the ladle carrier arms relative to the tundish loading vessel.

8. An apparatus according to claim **6** in which the third and fourth arms are each constructed with the pair of forks connected to the hubs thereof by a winch mounted on the hub having a cable connected to the forks for raising and lowering the pair of forks, the tundish loading vessel supporting means, and the tundish loading vessel relative to the ladle carrier arms and the two casting molds.

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