

Jan. 4, 1949.

E. L. WOLFF

2,458,236

CONTINUOUS POURING FURNACE

Filed Dec. 7, 1944

4 Sheets-Sheet 1

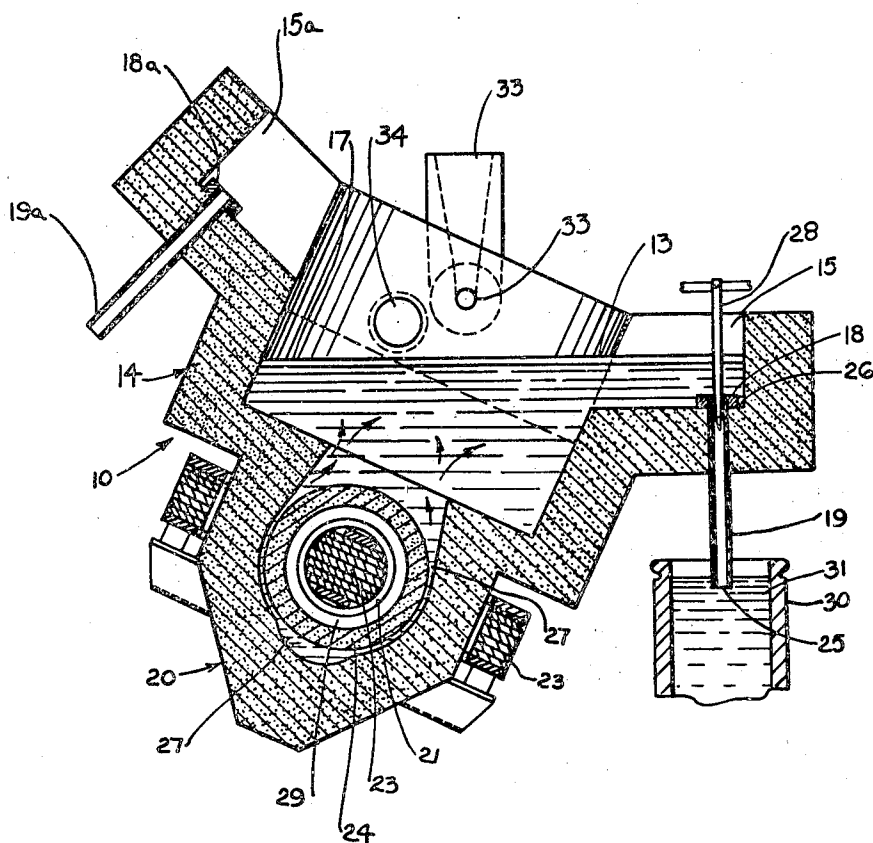


FIG. 1

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4 Sheets-Sheet 2

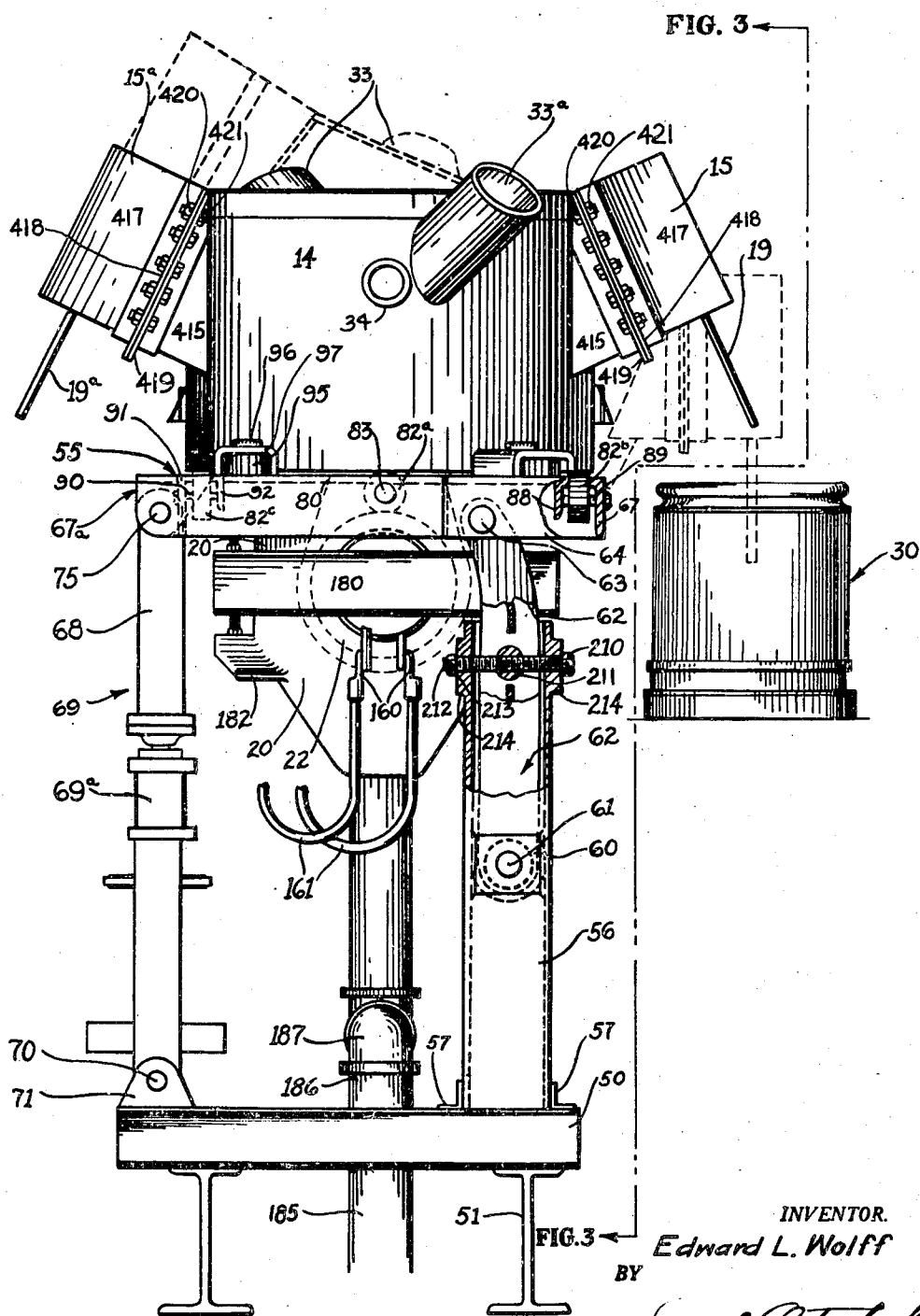


FIG. 2

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4 Sheets-Sheet 3

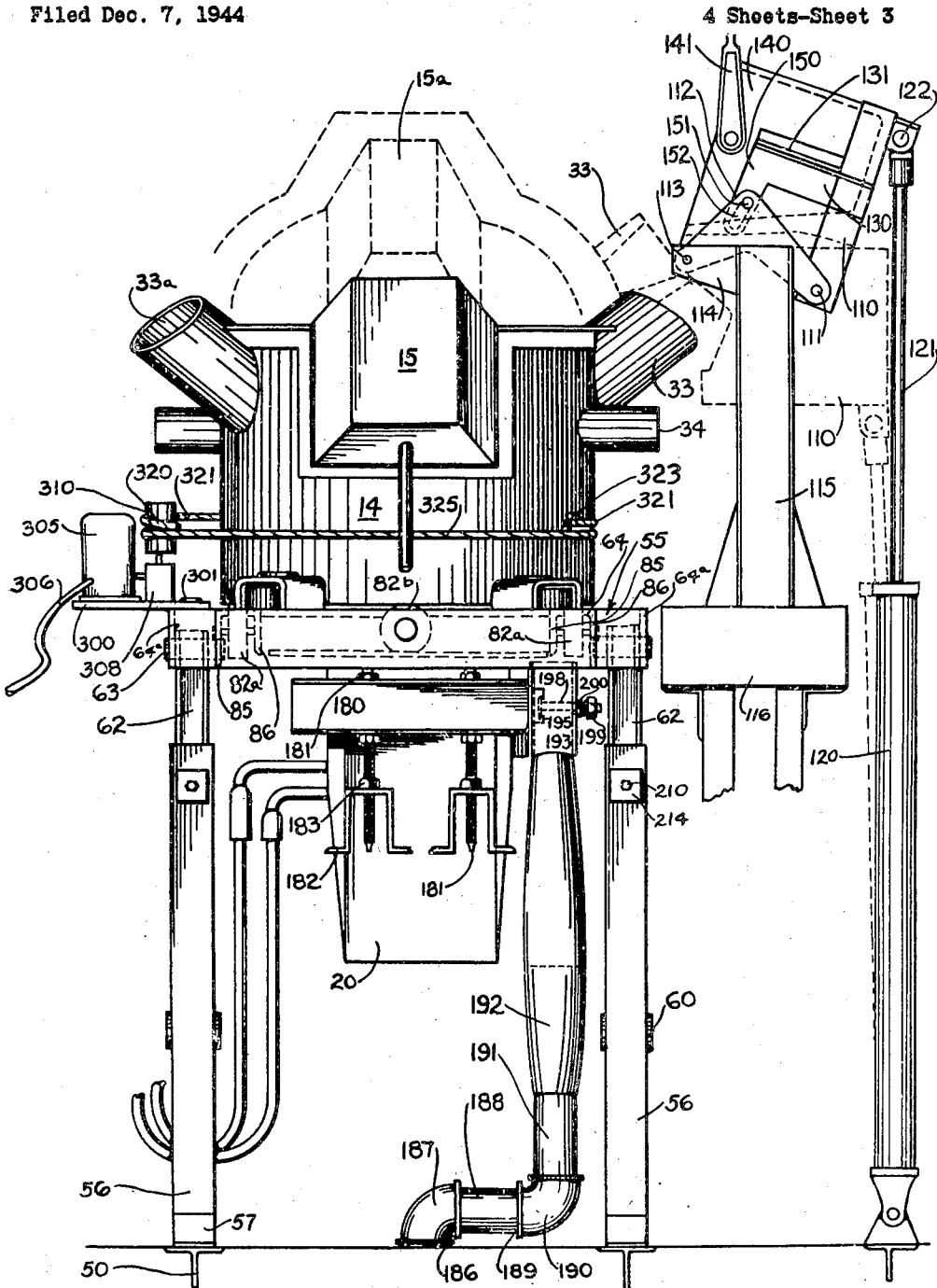


FIG. 3

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4 Sheets-Sheet 4

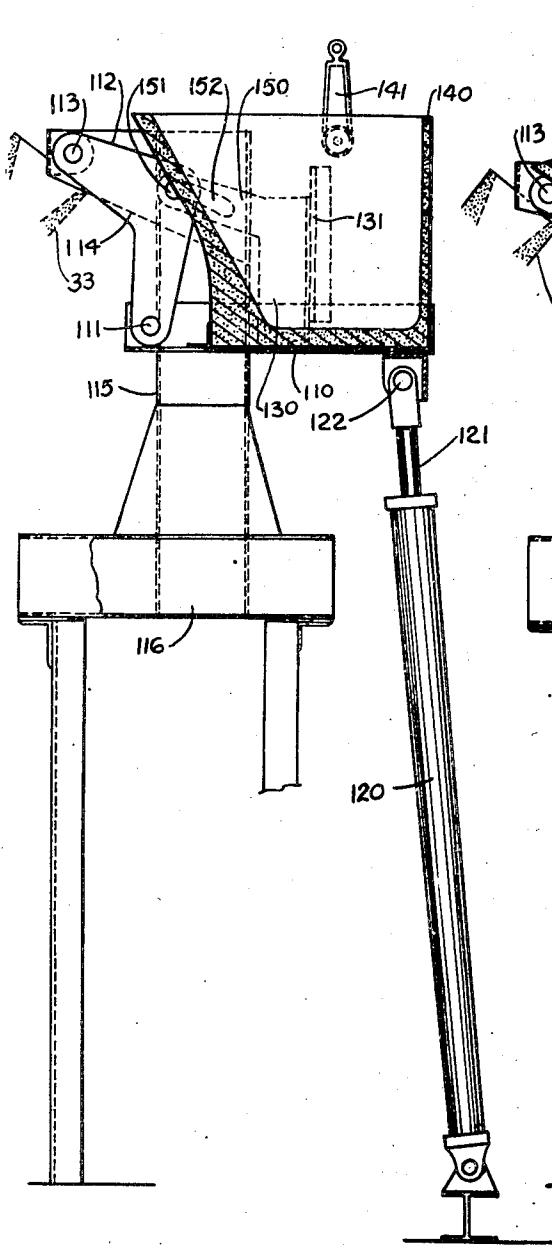


FIG. 4

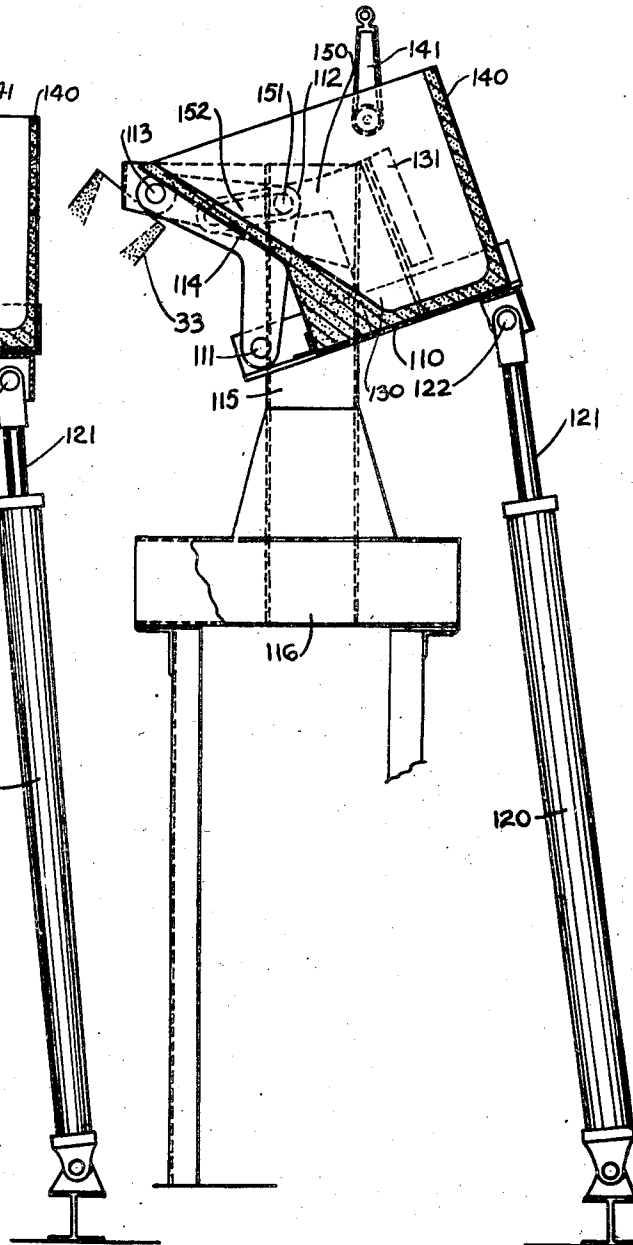


FIG. 5

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CONTINUOUS POURING FURNACE

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Application December 7, 1944, Serial No. 567,022

2 Claims. (Cl. 263—12)

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My present invention relates to the casting of metal, and more particularly to continuous casting apparatus adapted to form continuously cast lengths or bars of metal from a source of molten metal.

More specifically, my invention relates to the apparatus whereby the molten metal is transmitted to the continuous casting mold.

In connection with this basic problem of transmission of the molten metal from the furnace to the continuous casting mold, my invention contemplates an improved and novel casting furnace together with a channel-like reservoir for feeding the metal to the mold, which channel-like reservoir is integral with the furnace and is arranged to transmit the molten metal directly from the furnace to the continuous casting mold.

Heretofore in continuous casting processes, the molten metal was conducted from the melting furnace to the continuous casting apparatus in various ways. One of the more recent methods embodied the forcing of the molten metal by pressure from a holding furnace up and through a somewhat lengthy suitably formed continuous conduit to a reservoir from which the molten metal flowed down into the continuous casting mold. Such a conduit and reservoir always presented the possibility that the metal might freeze during transmission: or that after the operation was stopped, metal remaining in the conduit might freeze and block subsequent operation. Accordingly, complex apparatus was necessary, including auxiliary heating members to prevent freezing of the metal anywhere along the various paths through which it is required to flow.

A primary object of my present invention is to overcome this difficulty by making the reservoir for the continuous casting process integral with the furnace itself, and indeed to make the reservoir a channel-like extension of the upper portion of the furnace.

Another object of my invention is to so arrange the channel-like reservoir that when the metal is not intended to be poured therefrom, the positioning of the furnace itself in appropriate non-pouring position is sufficient to stop the flow into the said reservoir.

Still another object of my invention is the arrangement of a furnace having a reservoir comprising a channel member attached thereto so that the furnace may be tilted to cause the molten metal to flow into the reservoir and then to pour through a downspout attached to the bottom of the reservoir; and to so arrange the furnace that when it is replaced in horizontal position, the

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molten metal will recede from the reservoir so that it will no longer flow through the downspout.

Still another object of my invention is the arrangement of the furnace so that it will have at least two similar channel-like reservoirs each of which may separately be brought into appropriate position with respect to the single continuous casting mold so that these opposite reservoirs may be selectively used in the manner above set forth.

For this purpose, my invention contemplates that the furnace be rotatably mounted as well as tiltable, so that opposite channel-like reservoirs may selectively be used. This latter provision will enable repair and replacement of the downspout of either reservoir while the entire remaining apparatus is in use.

Still another object of my invention is the arrangement of the furnace and reservoir so that additional metal may readily be poured therein while the same is in operation, so that the operation may remain truly continuous. This additional means contemplates a pouring arrangement which will itself obviate any turbulence in the metal in the feed reservoir or channel.

My invention provides the advantages of mechanical simplicity; lessening of the possibility of freezing; direct pouring; continuous pouring to the downspout; and a reduction of oxidation since the surface in contact with air is reduced.

The foregoing and many other objects of my invention will become apparent in the following description and drawings in which:

Figure 1 is a schematic cross-sectional view of my novel furnace and reservoir arrangement adapted for a continuous casting process.

Figure 2 is a side view of the furnace shown in full lines in non-operating position and in dotted lines in the operating position, and showing the downspout for supplying metal to the mold.

Figure 3 is a view of my furnace taken from line 3—3 of Figure 2 looking in the direction of the arrows.

Figures 4 and 5 show different positions of the ladle tilting mechanism of Figure 3.

Referring now to Figure 1, I have shown my novel furnace 10 tilted into operating position.

As there shown, my structure comprises primarily a furnace for carrying molten metal to be cast and two channel-like reservoirs 15 and 15a integral with and extending from opposite ends of the furnace. Each channel-like reservoir is provided with an individual downspout 19 and 19a for feeding metal from its individual reservoir to the casting mold.

In the tilted position shown, it will be seen that only one channel-like reservoir (15 in this case) is operative at a time. The level 13 of molten metal within the furnace is such that the metal extends from the main chamber 14 of the furnace into the reservoir 15. When, at the conclusion of any casting operation, the furnace is returned to level position, it will be seen that the level of the molten metal, indicated by dotted line 17, will clear the openings 18 and 18a of the downspouts 19 and 19c of the two reservoirs 15 and 15a.

The furnace 10 comprises a main chamber 14 having walls of heat resisting material and the heater-containing chamber 20, also having walls of heat resisting material, securely attached beneath the main chamber 14 in any suitable manner. Heat losses by radiation in the holding furnace are overcome by attaching to the furnace shell an induction transformer of any well known construction.

One form of standard heater which may be used comprises the coil 21 surrounding the laminations 23. Channel 27 in which the molten metal flows defines the insulation block 24 (in which the air circulating passage 29 for cooling coil 21 is formed) which surrounds coil 23. In effect, therefore, the loop of molten metal in passage 27 is the secondary of a transformer of which coil 23 is the primary and heat is generated in the molten metal in channel 27 by induction.

The upper end of the mold 30 of the continuous casting apparatus is so arranged that when the furnace is tilted to the right, as seen in Figure 1, the downspout 19 of the particular channel-like reservoir 15 or 15a which happens to be in position to register with the mold 30, will enter the upper end of the mold 30.

As is well known in continuous casting processes, the level of liquid metal 31 in the mold 30 is maintained above the lower end 25 of the downspout 19 to obtain underpouring which will permit impurities to float to the top of the mold 30. Similarly, the upper level 13 of the molten metal in the furnace 14 and the channel-like reservoir 15 is maintained substantially above the upper opening 18 of the downspout to ensure that impurities will remain substantially clear of this spout.

Likewise, the upper opening 18 of the downspout 19 is elevated above the hearth 26 of the channel-like reservoir 15 to make certain that any sediment which may collect along the hearth 26 will not interfere with the opening 18 of the downspout 19.

Thus, when it is desired to begin the casting operation, the furnace which has been held at maintaining heat in order to prevent freezing of the metal in the lower chamber 20 and which has been held in vertical position, is tilted to the position shown in Figure 1.

The level 17 of molten metal now changes to level 13 and the upper end 18 of the downspout is beneath the level of molten metal.

The molten metal in the channel-like reservoir 15 flows down through the opening 18 of the downspout 19 into the mold 30. If desired, the rate of flow may be regulated by any appropriate valve 28 of heat resisting material placed in the opening 18 of the downspout 19 with the said opening 18 acting as a valve seat. The rate of flow of the metal through the downspout 19 may of course also be regulated by varying the diameter of the opening of the downspout 19.

As the level 13 of the molten metal in the

channel-like reservoir 15 of the furnace 14 drops, additional molten metal is poured in through the tube 33 without interfering in any way with the continuity of the flow of metal from the reservoir 15 into the mold 30.

The direct feeding from furnace chamber 14 and the channel-like reservoir 15 into the mold 30 obviates the difficulties previously encountered in connection with the pressure or gravity feeds which have been used between the furnace and feed reservoir.

If the downspout 19 becomes eroded or for any other reason requires a change or repair, the furnace may be rotated to the vertical position once more, at which time the molten metal level 17 will clear the downspout openings 18 on each side; and the downspout 19 will by this movement of the furnace be retracted from the mold 30.

The furnace is then rotated through 180°, bringing the opposite channel-like reservoir 15a in line with mold 30, and again tilted so as to insert downspout 19a into the mold. As the furnace is equipped with duplicate intake tubes 33 diametrically opposite each other, it may be charged from ladle 140 (shown in Figure 3) in either operating position. Two overflow pipes 34, also spaced 180° apart, are provided to maintain the maximum metal level at a given point in case an excess of metal is charged into the furnace unintentionally.

In Figures 2 and 3, I have illustrated a somewhat schematic actual physical embodiment of one form my invention may take. The entire apparatus is supported on a pair of I-beams 50, which in turn are supported by an underlying pair of I-beams 51 on a suitable foundation.

A tiltable platform 55 is supported, as seen in Figures 2 and 3, at the end adjacent the mold 30 by a pair of standards 56, the said standards 56 being secured in any suitable manner, as, for instance, by the angle irons 57 to the upper surface of I-beams 50. The vertical standards 56 are hollow members of rectangular cross-section. Each of the standards 56 is provided with appropriate bearings 60 for the pivot-pins 61. An adjustable supporting member 62 is rotatably mounted on the cross-pin 61 in each standard 56. The upper end of each adjustable supporting member 62 is pivotally connected to a stud 63 on each side, which stud is secured in U-shaped off-set projections 64a welded to each side of the channel member 64 on each side of the platform 55. The two standards 56, together with their adjustable supporting member 62, thus serve to support the end of the platform adjacent the mold 30.

The opposite side 67a of the platform 55 is supported by a pair of jacks 69, 69, one on each side, connected by the cross-member 69a. The base of each jack is pivoted on the pin 70 which is mounted in the supporting clevis 71 which in turn is secured in any suitable manner to the I-beam 50.

The member 68 of jack 69 on each side is pivotally secured to the stud 75 of the platform side member 64 on each side. It will now be clear that operating the jacks 69 will raise the side 67a of the platform so that the platform will tilt from the solid line position shown in Figures 2 and 3 to a position where the furnace will occupy the dotted line position shown therein, the said platform rotating about the opposite studs 63.

The platform 55 is provided with a central circular opening 80. The base of the main cham-

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ber 14 of the furnace has a greater diameter than the opening 80. The chamber 20 of the furnace has a smaller diameter than the opening 80 and passes through the opening as shown in Figures 2 and 3. The portion of the base of chamber 14 of the furnace which extends on the platform 55 beyond the edge of the opening 80 is supported by four vertical rollers 82a, 82a, 82b, 82c spaced at 90° intervals.

Rollers 82a are each rotatably supported on studs 83 between a pair of channels (having the legs 85, 85) at each side of the platform adjacent the platform side members 64. Roller 82b (Figure 2) is rotatably supported on stud 89 between side members 67 of platform 55 and the downwardly extending lug 88 of platform 55. Roller 82c is rotatably supported on stud 90 between downwardly extending lugs 91, 92 at the opposite side 67a of the platform which is acted on by the jacks 69.

The furnace as a whole, including its chambers 14 and 20 and the channel-like reservoirs 15 and 15a, may rotate with respect to platform 55 on the rollers 82. The furnace is retained on the platform by the horizontal rollers 95, each of which is rotatable on the stud 96 journaled in the bracket 87 secured to the upper surface of the platform 55.

Four rollers 95 are provided, spaced 90° from each other, acting against the side of chamber 14 of the furnace 14—20, thus maintaining the furnace in appropriate position on the platform at all times.

The interior construction of the furnace 14—20 has already been described in connection with Figure 1.

When it is desired to insert the downspout 19 in the mold 30, the jacks 69 are operated to raise the end 67 of the platform 55 so that the platform pivots about the studs 63 and the furnace as a whole is tilted to the position shown by the dotted lines of Figure 2 with the downspout 19 entering the top of mold 30.

Should it be desired to withdraw the downspout 19 of reservoir 15 for any reason, then the jacks 69 are operated to lower platform 55 back to the solid line position of Figure 2.

Should the downspout 19 of the reservoir 15 be withdrawn for replacement or repair while it is desired that the continuous casting operation proceed, then immediately upon the furnace being lowered to the solid line position of Figure 2, it may be rotated through 180° until the reservoir 15a has been rotated to a position where it overlies the top of the mold 30. Raising the jacks 69 will again tilt the platform 55 in the same direction but this time to insert the downspout 19a into the top of the mold 30.

Replacement and repair of the downspouts is facilitated by the construction of the channel-like reservoirs 15 and 15a. As seen in Figure 2, each reservoir 15 (or 15a) has a section 415 integral with the furnace and a section 417 removable therefrom. Flanges 418 on sections 417 match flanges 419 on sections 415 and the lining of sections 415 and 417 are cemented together with fire clay. They are also bolted together by bolts and nuts 420 and 421. When a downspout is to be changed on either reservoir, section 417 is removed by removing the bolts and nuts and breaking the fire clay bond between members 415 and 417. The downspout may then be changed at a distance from the furnace. This obviates the necessity for an operator to work above the top of the furnace while changing a downspout.

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Any suitable means for rotating the furnace on the rollers 82 may be provided. I have found that the furnace may even be rotated by hand. I have also found it feasible simply to attach a cable to a lug on the side of the furnace, pass the cable over a direction changing sheave and use an overhead crane pulling on the cable to rotate the furnace.

In Figure 3, I have shown a specific apparatus for rotating the furnace. A bracket 300 is secured to the left side (with respect to Figure 3) of platform 55 in any suitable manner as by bolts 301. The bracket 300 and the furnace rotating apparatus hereinafter described thus tilts with the platform 55 and furnace 14. A motor 305, which is connected to a source of current by flexible leads 306 of sufficient length to permit the platform to tilt, is mounted on bracket 300; and, through the speed reduction gearing in housing 308 drives the vertical drum 310 which has a suitably grooved surface. A wire rope 320 is wound around the drum, one end 321 of the rope passing behind the furnace (as seen in Figure 3) and being secured by a suitable clamp 323 to the furnace at a point more than 180° removed from drum 310. The other end 325 of the rope passes in front of the furnace (as seen in Figure 3) and is fastened to the furnace at a point more than 180° from the drum 310. Operation of the motor in either direction will rotate the drum 310 to wind up one end of the cable 300 and unwind the other end of the cable around the chamber 14, thus rotating the furnace in the desired direction for the purposes above described.

A ladle supporting platform 110 is provided at one side of the furnace, as shown in Figure 3. The said ladle supporting platform is pivotally supported on the shaft 111, which shaft is in turn supported between the pivoting yoke arms 112 on opposite sides. The pivoting yoke arms 112 are rotatably supported on the cross-shaft 113 between the stationary supporting brackets 114. The stationary supporting brackets 114 are mounted on opposite standards 115 which are supported on any suitable base 116.

A jack 120 is pivotally connected at 122 to the end of the platform 110 opposite the shaft 111. When the jack 120 is operated, the extending portion 121 thereof rises to raise the end 122 of platform 110 and tilt the same. The dotted line position of the platform 110 shows the position thereof when portion 121 of the jack 120 is lowered. The lowered position of platform 110 may also be seen in Figure 4.

A side plate 130 is secured in any suitable manner to each side of the platform 110.

Side plates 130, one on each side, each carries the extension 150 provided with slot 152. The yoke arms 112 have pins 151 engaged by the slot 152. In the lowered (dotted line and Fig. 4) position of the ladle, the platform 110 is horizontal and the outermost (or left) end of slot 152 engages pin 151. As the jack 120 raises the platform 110, the platform and its ladle pivot first around shaft 113. That is, yoke arms 112 first rise with the platform. As the platform rotates further in a counterclockwise direction, it moves down with slot 152 sliding with respect to pin 151 (as in Fig. 5) so that the innermost (or right) end of the slot engages pin 151, the platform now rotating also about shaft 111 as well; slot 152 is given a slight curvature to permit such rotation. The platform is then lifted to the full line position of Fig. 3 to pour the ladle. Thus, when the ladle is moved from the horizontal to pouring position,

the linkage ensures that it will first be tipped (by lifting its back end) and then slide down so that the ladle will be close to the charging spout.

A ladle 140 which is to be poured into the intake tube or funnel 33 of the furnace is lifted by a crane secured to the pivoted ball 141 of the ladle 140 and is placed on the platform 110. Stop lugs 131 on the side of the ladle bear against side plates 130 to prevent the ladle from tipping out of its frame support when the latter is being tilted.

When the channel-like reservoir 15 is in the lowered position, the charging spout 33 is in the dotted line position shown in Figure 3 and the pouring end of ladle 140 is positioned with respect to the charging spout 33 so as to pour metal directly into the furnace. When the ladle 140 has been emptied, the platform 110 may be lowered and the ladle removed.

Similarly, when the furnace has been rotated so that the reservoir 15a is positioned above the mold 30 and the furnace has been tilted to pouring position, the charging spout 33a is in position opposite the platform 110 so that a ladle may be poured therein. Thus the upper furnace chamber 14 may be continuously replenished as the level of metal therein falls owing to the pouring of the metal through the downspout 19 and 19a.

The transformer coil, as previously mentioned, is cooled by air. The structural frame work 180 which surrounds and supports the heater is secured by bolts 181 and lock nuts 183 on the flanged brackets which are secured to section 20 of the furnace. Air for cooling the coil of the heater is forced up through pipe 185 and swivel joint 186 into the elbow 187. The air then passes into pipe 188 and through swivel joint 189 into elbow 190 and then into the telescoping sheet metal duct 191-192; then into the small manifold 193 which has an opening matching a similar opening in the side of the supporting structure 180 and into and through the cooling passage of the heater. Bolt 198 passing through bracket 194 passes also through the outside of manifold 193 where the nut 199 acting on spring 200 may tighten the manifold 193 against the air intake opening of the heater. The manifold 193 thus may rotate about the bolt 198. The combination of swivel joints, the telescoping duct and the rotatable mounting of manifold 193 permits the furnace to rotate freely while the air cooling connection is maintained.

It will be obvious that each downspout 19 of each of the feed reservoir channels 15 or 15a may be adjusted circumferentially with respect to platform 55 to appropriate position in the mold 30.

It may be necessary, however, to make a slight adjustment of the downspout 19 or of the intake spout 33 in a direction forward or away from mold 30. This is provided for by the adjustable supports 62 for the platform which are pivotally supported on the studs 61 in the standards 56.

Supports 62 are each composed of double links interconnected by integral webs. A tapped nut 211 is rotatably mounted in suitable aligned openings in these links so that the nut is slightly adjustable relative to the link in view of the arc that that portion of the link passes through in effecting the swinging movement of the supports 62 hereinafter described.

A bolt 210 passes through an appropriate opening in one side of each standard 56 and then through the nut 211 in the adjustable support 62

and extends at 212 on the opposite side of the standard 56. The nut 212 is secured against rotation, preferably by means of the inset key pin 213. Appropriate square raised portions 214 integral with standards 56 are provided between the head of the bolt 210 and the nut 212 and the sides of the standard 56 for reinforcing and providing a suitable bearing for the bolt 210 at that portion thereof.

Rotation of the head 210 or of the nut 212 of the bolt will now cause the bolt to rotate with respect to the threaded opening 211 in the adjustable support 62 and cause the adjustable support to rotate slightly about the pin 61. This will cause a movement of the platform to the right or left with respect to Figure 2 in accordance with the direction of rotation of the bolt 210. Obviously, the jacks 69 will pivot at the pivots 75 and 70 to accommodate itself to this slight lateral movement. In this way appropriate adjustment of the position of the downspout 19 or of the intake spout 33 may be obtained for proper operation of the device.

It will thus be seen that my invention eliminates the necessity for any pressure feed or other complex feeding arrangements between the furnace and the feed reservoir, and that in fact the feed reservoir is a channel-like integral extension of the furnace. Apart from the fact that the heat-holding qualities of my apparatus are thus greatly improved over those previously used, the metal pours directly from the furnace through the feed reservoir and downspout into the mold.

Changes in the downspout made necessary by erosion thereof or for other reasons do not interfere with the continuous operation of the mold fed by my furnace since it only takes a few moments to return the furnace to horizontal position, rotate the same through 180° and rotate it again to the tilted position. I have found that a 25° inclination of the furnace with the arrangement herein shown is sufficient for accomplishing my purpose.

In the foregoing, I have described my invention only in connection with specific preferred embodiments thereof which have functioned commercially. Since, however, many variations and modifications of my invention within the spirit of the foregoing disclosure should now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein but only by the appended claims.

I claim:

1. A casting furnace; a plurality of channel members connected to the side of said furnace; said channel members being substantially regularly spaced around said furnace; said channel members each having a passage communicating with the interior of said furnace; each channel member extending substantially radially from the side of said furnace; the base of each channel member forming a hearth; an opening in each hearth; a spout mounted in each opening and extending beneath the hearth; means for tilting said furnace; molten metal flowing from the interior of said furnace into one of the channel members and over the hearth thereof when the furnace is tilted; and means for rotating said furnace to predetermine the particular channel member into which the molten metal will flow when the furnace is tilted.

2. A casting furnace; a plurality of channel members connected to the side of said furnace; said channel members being substantially regularly spaced around said furnace; said channel

members each having a passage communicating with the interior of said furnace; each channel member extending substantially radially from the side of said furnace; the base of each channel member forming a hearth; an opening in each hearth; a spout mounted in each opening and extending beneath the hearth; means for tilting said furnace; means for predetermining the upper level of molten metal in said furnace; said upper level of molten metal being below the channel members when the furnace is in vertical position; said molten metal flowing from the interior of said furnace into one of the channel members and over the hearth thereof when the furnace is tilted; and means for rotating said furnace to predetermine the particular channel member into which the molten metal will flow when the furnace is tilted.

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