June 28, 1949. M. TAMA ET AL 2,474,443

DRUM TYPE INDUCTION FURNACE

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FIG. 1

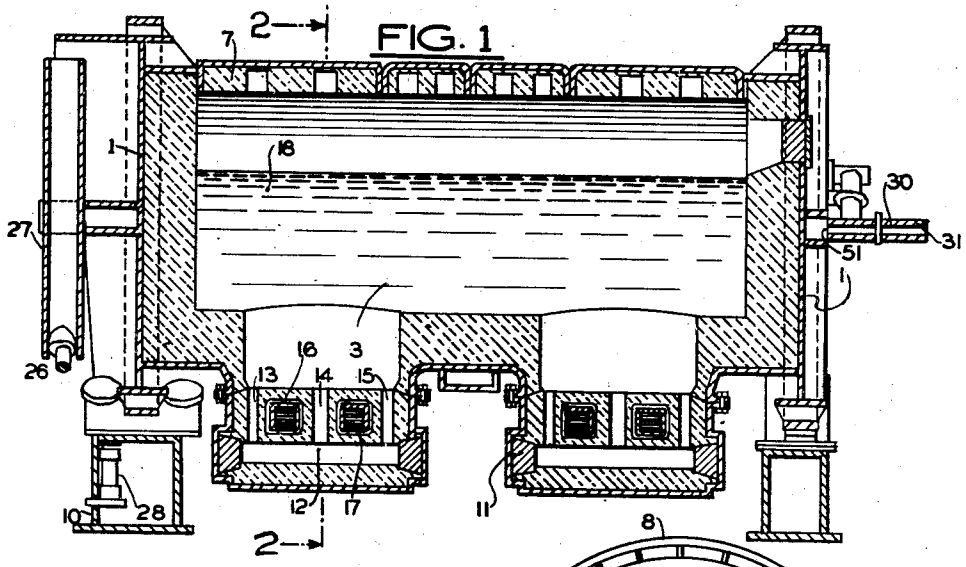


FIG 14.

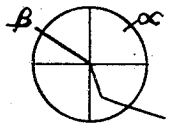


FIG. 15.

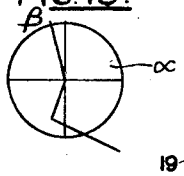


FIG. 16.

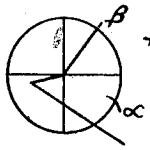
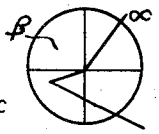


FIG 17.



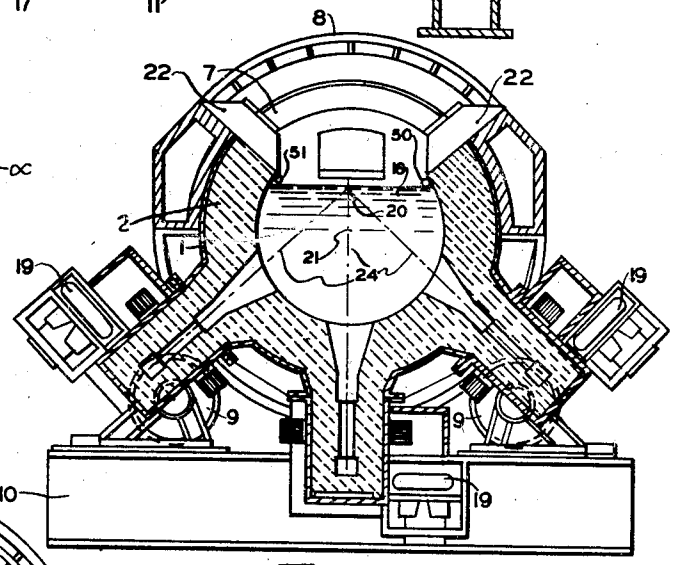


FIG. 2.

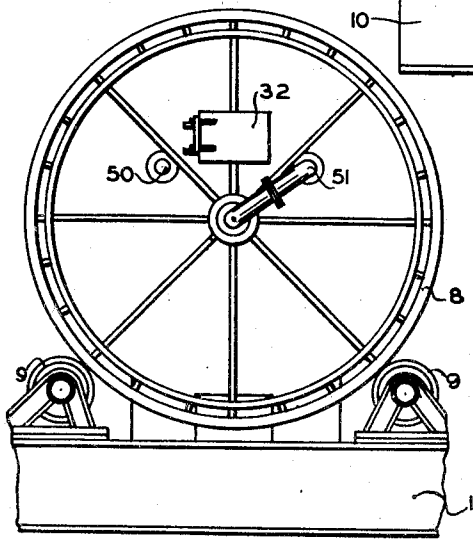


FIG. 3

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FIG.4

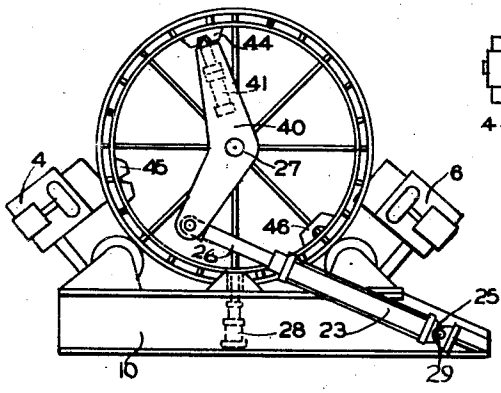


FIG.5

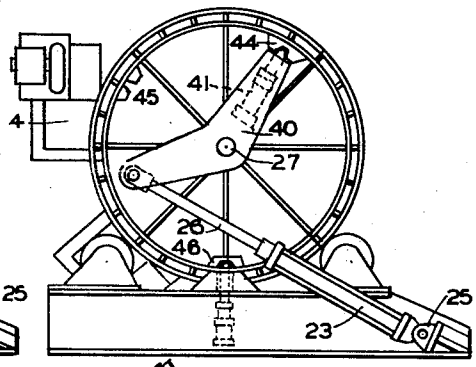


FIG.6

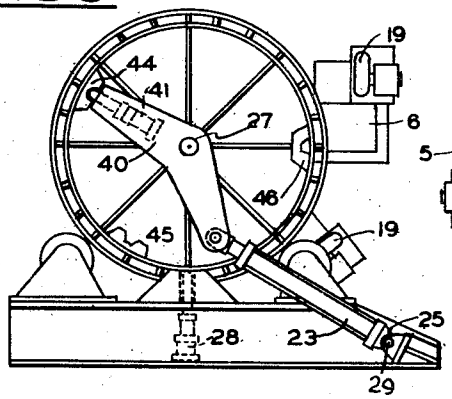
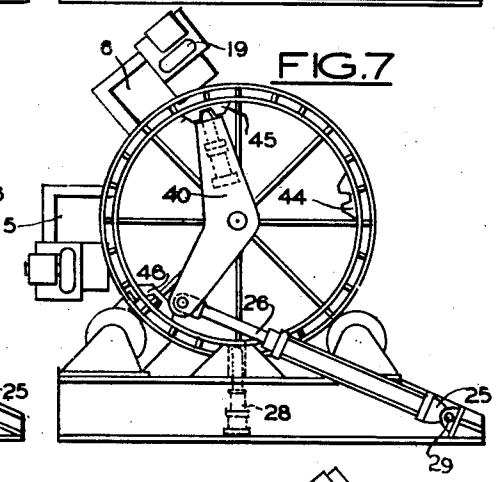


FIG.7



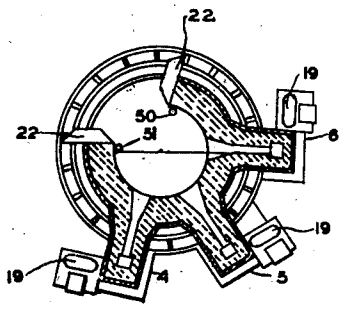


FIG.9.

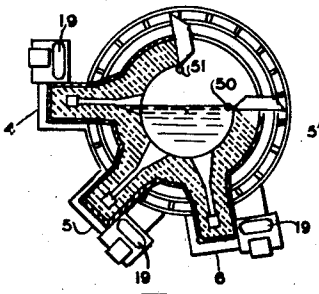


FIG.8

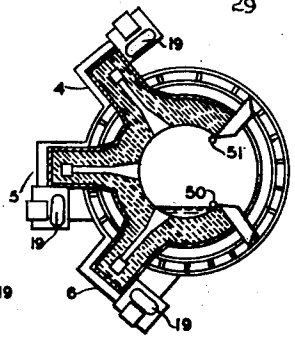


FIG.10

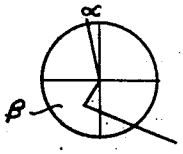


FIG.11.

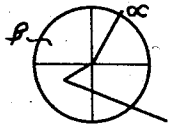


FIG.12.

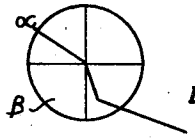


FIG.13.

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UNITED STATES PATENT OFFICE

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DRUM TYPE INDUCTION FURNACE

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Application November 29, 1947, Serial No. 788,912

16 Claims. (Cl. 13—29)

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This invention is a further development of the drum-type induction furnace disclosed in pending U. S. application Ser. No. 771,360, filed August 29, 1947 and it relates particularly to the equipment for tilting a drum-type induction furnace into its various operating positions.

The metal holding chamber or hearth of this induction furnace has preferably a cylindrical shape. The furnace is equipped with three inductor units or inductor unit rows and these inductor units are attached to the circumference of the furnace casing below its horizontal center plane. The inductor units contain in the usual manner a primary transformer assembly and a secondary melting loop, the latter being threaded by the transformer assembly and being connected with the metal holding chamber or hearth of the furnace.

In the normal operating position the melting loop of one inductor unit or inductor unit row extends through the vertical center plane of the furnace and the melting loops of the other inductor units or inductor unit rows are located laterally of the center inductor unit and extend through planes forming an acute angle with the vertical center plane of the furnace.

The invention is concerned with the important problem of rotating or tilting the furnace in its various operating positions while maintaining the same in working order.

The here appertaining operational particularities of a drum-type furnace of the present type are, as follows.

The furnace is to be rotated in three different positions for the emptying of a faulty inductor unit and its replacement and into a further position for the total discharge of the metal; moreover, the cleaning of the melting ducts and the reorientation of certain parts of the rotating equipment necessitates the tilting of the furnace into corresponding positions.

It is therefore the primary object of this invention to provide an equipment for rotating or tilting the furnace in three positions which will enable the emptying of the metal from the melting loop and the replacement or removal of the faulty inductor unit.

It is a further object of the invention to provide a tilting equipment which renders it possible to keep during the removal of a faulty inductor unit a sufficient heel of metal in the furnace and in the other inductor units and to assure during the replacement an uninterrupted working of the furnace.

It is a further object of this invention to provide a tilting equipment which enables the rotation of the furnace in a position for a total removal of the molten metal charge.

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It is also an object of this invention to secure the furnace during its rotative movement and in its operating positions.

It is a further object of the invention to simplify the exchange of the inductor units and to considerably shorten the time which is required for their replacement.

It is also an object of the invention to provide a tilting equipment which will enable the furnace to be rotated in a position for the easy cleaning of the melting channels.

It is another object of the invention to prevent the accumulation of slag deposits in the melting channels of the inductor units and to eliminate the clogging thereof, thereby greatly reducing the necessity for their replacement or exchange; in this respect the instant furnace shows a decided improvement over the art, because it permits the cleaning of the melting channels from the outside of the furnace without interrupting the melting while an inductor unit is being exchanged.

With these and other objects in view which will become apparent as this application proceeds, the tilting equipment of the instant drum-type furnace will now be described in several preferred embodiments which are illustrated in the attached drawings. However, it is to be understood that the invention is not restricted to the modifications described and shown.

In the drawings,

Fig. 1 is a vertical sectional view of a drum-type furnace in accordance with this invention taken in its longitudinal direction,

Fig. 2 is a vertical cross-sectional view taken on line 2 to 2 of Fig. 1 showing the furnace in its normal working position,

Fig. 3 is a plan view of the right end side of the furnace,

Figs. 4, 5, 6 and 7 are plan views of the left end side of the furnace showing the furnace tilting equipment in various operating positions.

Fig. 4 shows this equipment in the normal operating position,

Fig. 5 shows it in the position for replacement of the left inductor unit,

Fig. 6 shows it in the position for the replacement of the right inductor unit,

Fig. 7 shows it in the position for the replacement of the center inductor unit,

Fig. 8 is a vertical scale-reduced sectional view similar to that of Fig. 2 of the furnace in the position for the replacement of the left inductor unit,

Fig. 9 is a similar vertical sectional view of the furnace in the position for the replacement of the right inductor unit,

Fig. 10 is a similar vertical sectional view of the furnace in the position for the replacement of the center inductor unit,

Figs. 11 to 17 are schematical views of the furnace tilting or rotating mechanism in its various operating positions.

The furnace shown in the drawing is provided with a cylindrical casing 1 which is protected by a refractory lining 2; the casing houses a horizontal hearth or metal holding chamber 3; the casing has attached to its circumference three inductor units 4, 5 and 6. Rows of inductor units may replace the single units.

The normal working position of the furnace corresponds to the one shown in Figures 2, 4, 11.

The furnace has a top opening which is closed by a removable cover 7. The furnace drum is provided at both ends with circular tracks 8 resting on wheels 9 supported by roller bearings; the latter are mounted on base 10; rollers 33 are provided to prevent the longitudinal displacement of the furnace drum.

The inductor units are so arranged that in the normal working position of the furnace the melting loop of the center or bottom unit 5 extends through the vertical center plane whereas the melting loops of the lateral inductor units 4 and 6 extend through planes which form acute angles of preferably 50° with the vertical center plane.

The melting loops consist of a melting channel 12 which is spaced from the hearth 3 and preferably extends parallel to the longitudinal direction of the drum axis and three straight channels 13, 14, 15 connecting channel 12 with hearth 3. The melting channels are in the customary manner threaded by the transformer units having coil windings 16 of insulated copper wire and an iron core 17 closed toward the coil windings. Cooling blowers 19 are attached to the inductor units; they serve to remove the heat from the primary windings.

In view of the generally known arrangement of these inductor units a more detailed description thereof is not deemed to be required. The units are housed in refractory lined casings 11 which are removably attached to the drum casing 1 in the manner shown in U. S. Patent 2,423,912; the inductor units may be removed by loosening bolts, not shown, which connect the drum casing 1 with the inductor casings 11.

The furnace may be filled in its normal operating position up to level 18.

The inclination of the lateral inductor units 4, 6 may be preferably chosen in such a manner that the center lines 24 of all melting channels located in the same vertical plane converge at a point 20 located above the geometrical center 21 of the furnace, see Fig. 2. In the extension of the center lines 24 openings 22 are provided in the drum cover through which cleaning tools may be introduced into the melting channels while the same are full with the molten metal. An inclination of about 50 degrees of the lateral melting loops relative to the center or bottom melting loop has proven to be particularly advantageous; the melting channels having this inclination can be cleaned without emptying the furnace.

The important advantage of this furnace is the easy replacement of worn-out inductor units without interrupting the working of the furnace; this is rendered possible by an equipment for rotating the furnace into its various operating positions, which forms the subject matter of this invention.

The exchange of an inductor unit is performed after rotating the furnace to a position where the melting loop of the unit to be replaced has reached approximately the horizontal center plane of the furnace and the molten metal has been discharged from its melting loop.

The metal is discharged from the drum over opening 51 connected with a discharge spout 30 made of cast iron and provided with a refractory lining 31. By tilting the furnace, molten metal can be taken out gradually under full control of the pouring speed. The furnace reaches its highest metal level 18 when in the position shown in Fig. 2. From there on molten metal can be discharged over spout 30 until the working limit is reached; further tilting would be of no avail. If additional metal is to be discharged another opening 50 located in a sidewall of the furnace has to be used, which opening is ordinarily closed by a refractory plug.

A door 32 is provided which facilitates the removal of slags from the surface of the bath. One or more of the cover sections should be removed before the slags are pushed-out through this door opening.

The rotation of the furnace into its operating positions and the equipment for performing this work will now be described in detail.

The furnace drum is, as already mentioned, rotatably mounted on base 10 by means of circular tracks 8 which are supported on rollers 9.

Three notches 44, 45, 46 are attached to the left sidewall of the furnace casing 1; notches 44, 45 open out towards the center of the drum and notch 46 opens out in an opposite direction. A small hydraulic cylinder 41 is fastened to arm 40 of lever 27; a second hydraulic cylinder 28 is mounted on base 10.

The rotation of the furnace casing is effected by the hydraulic cylinder 23, its ram 26 and rotatable double arm lever 27 which may be mounted in a suitable bearing located in the center of the furnace casing; the two arms of this lever may be inclined relative to each other at an angle of 134°. Cylinder 23 is rotatably mounted on base 10 by means of lugs 25 and a pin 29.

The normal operating position of the furnace is shown in Figs. 2, 4, 12.

The ram of hydraulic cylinder 28 is kept out of engagement with notch 46; the furnace casing is operatively coupled with lever 27 by engagement of the ram of cylinder 41 with notch 44.

The melting duct of inductor unit 5 is positioned in the vertical center plane of the furnace; the melting ducts of inductor units 4 and 6 are inclined at an angle of about 50° relative to this vertical center plane.

In order to replace inductor unit 4 the furnace is clockwise tilted in the position which is shown in Figs. 5, 8, 12. For this purpose the ram of hydraulic cylinder 28 is retracted, lever 27 is in engagement with notch 44. The melting duct of inductor unit 4 is in this position slightly above the horizontal center plane of the furnace and slopes down thus allowing the metal to be emptied from the inductor unit into the furnace hearth. Since the hole 50 is below the level of the inductor unit the metal level in the furnace is also below the inductor unit. In this position the inductor may be changed without spilling metal while keeping enough metal in the drum to keep the two units 5 and 6 operative while the inductor

unit 4 is being changed. Further, there is sufficient metal in the drum to fill the new unit when the furnace is returned to the normal position of Figs. 2 or 4. Hence, it is possible to change inductor 4 without spilling metal and without the necessity of adding molten metal to the furnace for the starting of the new inductor unit. Inductor units 5 and 6 continue to operate and serve to maintain the temperature of the metal left in the drum while a faulty unit 4 is being replaced.

For the exchange of inductor unit 6 the furnace must be rotated in a counterclockwise manner in the position shown in Figs. 6, 9, 13.

In this position the conditions concerning the molten charge are the same as in the position shown in Fig. 5 except that the hole 50 is now above the level of the inductor. Hence, when replacing unit 6 it is necessary to first pour out sufficient metal from the furnace to lower the metal level to that shown in Fig. 9.

The change of the center inductor unit 5 is more difficult; however, the position shown in Figs. 7, 10, 15 satisfies these requirements.

Upon draining this unit there is sufficient metal in the drum for the operation of inductor unit 6. Depending upon the physical size and proportions of the furnace, inductor unit 5 may or may not be filled by the metal remaining in the drum. However, solid metal may be added to the furnace and melted by unit 6 until sufficient metal is in the furnace to flood unit 5 and get it into operation.

In the following the sequence of the furnace operations for changing the inductor units and for emptying the metal from the same and from the furnace will now be described with reference to Figs. 11 to 17.

It should be noted that the angle between the inductor units is chosen to be 50°. The directions along which arm 40 of lever 27 extends in its various operating positions are indicated by α and β, since, as later explained, a change of the position of lever 27 must be executed for the installment of certain operating positions. The inductor units are also here indicated by numerals 4, 5 and 6.

Fig. 11 indicates the normal working position of the furnace also shown on Figs. 2 and 4.

Cylinder 28 has its ram retracted and, therefore, does not influence the operation of the equipment. Cylinder 31 attached to the one end of arm 40 has its ram extended to engage notch 44. Lever 27 is thus locked to the drum and cylinder 23 may be used to rotate the furnace, if desired, in either direction. Arm 40 points towards α.

If cylinder 23 is operated to turn arm 40 of lever 27 for 38 degress in a clockwise direction the position of Fig. 12 is reached for the replacement of inductor unit 4. Arm 40 still locked in notch 44 points towards α; the ram of cylinder 28 remains unlocked from notch 46. By the downward slope of the melting loop towards the hearth, see Fig. 8, the metal can be emptied from the loop before the replacement of the inductor unit is undertaken. By this clockwise rotation also the spout opening has been lowered delivering metal from the furnace.

By a counterclockwise rotation from the initial position of Figs. 11, 2, 4 through an angle of 49° the furnace arrives in the position shown in Fig. 13 which position is also shown in Figs. 6 and 9. This is the position for the exchange of inductor unit 6. Cylinder 28 is still unlocked.

This rotation also raises opening 50 and allows metal to be charged into the furnace without overflowing into the spout; in this position inductor unit 6 has a slope towards the hearth of 2½°.

In order to change inductor unit 5 the furnace is first brought into the position of Fig. 12, whereby notch 46 appears on top of cylinder 28; the ram of this cylinder is actuated and engages the notch. The ram of small cylinder 41 is retracted from notch 44 and lever 27 is now free from engagement with the drum. The drum is stopped from moving by the ram of cylinder 28. In this position the ram 26 may be retracted. The lever 27 is now rotated in a counterclockwise direction into the position of Fig. 14, where the ram of cylinder 41 on arm 40 may now be used to engage notch 45 and the arm 40 points towards β.

The ram of cylinder 28 is now retracted from notch 46. The drum is again capable of being rotated by lever 27 and ram 26. The ram 26 is now extended and the furnace is rotated in a clockwise direction. If the rotation is stopped at 49° from position of Fig. 2 or 5, the position of Fig. 15 is reached and the inductor unit 5 is now on the left of the vertical center line and will have a downward slope of 2½° towards the center of the furnace. This is sufficient to drain it of molten metal and thus allow it to be removed.

If the rotation is continued as far as possible this will bring inductor unit 6 in the position of Fig. 16 and slightly above the horizontal center line. In this position all inductors are empty and the furnace is drained completely.

To return the furnace into its normal position of Fig. 11 or 4 ram 26 is fully retracted, the drum is locked by the ram of cylinder 28 engaging notch 46, ram of cylinder 41 is retracted freeing arm 27; ram 26 is extended, the ram of cylinder 41 is engaged in notch 44 and cylinder 28 is disconnected releasing the furnace drum. The furnace is in the position of Fig. 12 and is easily returned to the normal operating position of Figs. 11 or 4.

The equipment for rotating or tilting the instant drum-type furnace in its various operating positions is described and shown in the specification and drawings by way of example only and the equipment as well as its various parts may be replaced by equivalent means without departing from the spirit of this invention as recited in the appended claims.

What we claim is:

1. In a drum-type induction furnace for molten metals a base, a metal holding chamber, a refractory lined casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace and to rotate the same into its operating positions.

2. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said

inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, means supported on said base and means attached to said casing to rotatably support the furnace and means supported on said base and connected with said casing to rotate the furnace into its operating positions.

3. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, circular tracks attached to the circumference of said casing and rollers on said base to rotatably support said tracks and means supported on said base and connected with said casing to rotate the furnace in three positions for the exchange of the inductor units and in a position for the total discharge of the molten metal.

4. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace and means to rotate the same in its operating positions said means including a hydraulic cylinder rotatably supported on said base, a ram in said cylinder, at least two notches provided at the circumference of said casing and means for effecting the operative engagement of the cylinder ram with said notches.

5. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace on said base and means to rotate the furnace in its operating positions said means including a hydraulic cylinder rotatably mounted on said base, a ram in said cylinder, at least two notches provided at the circumference of said casing, a double arm lever rotatably carried on said casing, the end of the one arm being rotatably connected with the ram of said hydraulic cylinder and a hydraulic ram attached to the end of the second arm for engagement with said notches.

6. In a furnace according to claim 5 the angle of inclination between two adjacent inductor units being about 50° and the arms of the double arm lever enclosing therebetween an angle of about 134°.

7. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace on said base and means to rotate the furnace in its operating positions, said means including a hydraulic cylinder rotatably mounted on said base, two notches provided at the circumference of said casing, a double arm lever rotatably carried in the center of said casing, one of said arms being rotatably connected with the ram of said hydraulic cylinder and means to effect the engagement of the second lever arm with either one of said two notches.

8. In a furnace according to claim 7 means to hold the furnace casing in a fixed position during the change of engagement of the second lever arm from one to the second notch.

9. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor units attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of one of said inductor units extending through a vertical center plane of the furnace and the melting loops of the other lateral inductor units extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace on said base, means to rotate the furnace in its operating positions said means including a hydraulic cylinder, a ram in said cylinder means to rotatably support the one end of said cylinder on said base, three notches provided at the circumference of said casing, means to effect the engagement of said ram in either of two of said notches, a double arm lever rotatably carried in the center of said casing, one lever arm being connected with said ram, a ram attached to the second lever arm for engagement with said two notches and a ram located on said base for engagement with said third notch to hold the furnace casing in a fixed position during the change of engagement of said lever with one to the other of said two notches.

10. In a drum-type induction furnace for molten metals a base, a metal holding chamber, a refractory lined casing housing said chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loops of the inductor units of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace and to rotate the same into its operating positions.

11. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loops of the inductor units of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, means supported on said base and means attached to said casing to rotatably support the furnace and means supported on said base and connected with said casing to rotate the furnace into its operating positions.

12. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of the inductor units of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, circular tracks attached to the circumference of said casing and rollers on said base to rotatably support said tracks and means supported on said base and connected with said casing to rotate the furnace in three positions for the exchange of the inductor units and in a position for the total discharge of the molten metal.

13. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loops of the inductor unit of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace and means to rotate the same in its operating positions said means including a hydraulic cylinder rotatably supported on said base, a ram in said cylinder, at least two notches provided at the circumference of said casing and means for effecting the operative engagement of the cylinder ram with said notches.

14. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loops of the inductor units of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace on said base and means to rotate the furnace in its operating positions said means including a hydraulic cylinder rotatably mounted on said base, a ram in said cylinder, at least two notches provided at the circumference of said casing, a double arm lever rotatably carried on said casing, the end of the one arm being rotatably connected with the ram of said hydraulic cylinder and a hydraulic ram attached to the end of the second arm for engagement with said notches.

15. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in the said inductor units connected with said molten metal holding chamber, the melting loops of the inductor units of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace on said base and means to rotate the furnace in its operating positions, said means including a hydraulic cylinder rotatably mounted on said base, two notches provided at the circumference of said casing, a double arm lever rotatably carried in the center of said casing, one of said arms being rotatably connected with the ram of said hydraulic cylinder and means to effect the engagement of the second lever arm with either one of said two notches.

16. In a drum-type induction furnace for molten metals a base, a cylindrical metal holding chamber, a refractory lined cylindrical casing housing said chamber, inductor unit rows attached to the circumference of said casing below its horizontal center plane, a secondary melting loop in said inductor units connected with said molten metal holding chamber, the melting loop of the inductor units of the center row extending through a vertical center plane of the furnace and the melting loops of the inductor units of the lateral rows extending through a plane forming an acute angle with said vertical center plane, means to rotatably support the furnace on said base, means to rotate the furnace in its operating positions said means including a hydraulic cylinder, a ram in said cylinder, means to rotatably support the one end of said cylinder on said base, three notches provided at the circumference of said casing, means to effect the engagement of said ram with either of two of said notches, a double arm lever rotatably carried in the center of said casing, one lever arm being connected with said ram, a ram attached to the second lever arm for engagement with said two notches and a ram located on said base for engagement with said third notch to hold the furnace casing in a fixed position during the change of engagement of said lever with one to the other of said two notches.

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