United States Patent

[11] 3,602,625

[72] Inventors William J. Duca
Warren;
Mario Tama, Courtland, both of, Ohio

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[22] Filed Apr. 6, 1970
[45] Patented Aug. 31, 1971
[73] Assignee Ajax Magnethermic Corporation
Warren, Ohio

[54] **HORIZONTAL CORELESS INDUCTION FURNACE**
11 Claims, 12 Drawing Figs.

[52] U.S. Cl. 13/27
[51] Int. Cl. H05b 5/00, H05b 5/18
[50] Field of Search 13/26, 27

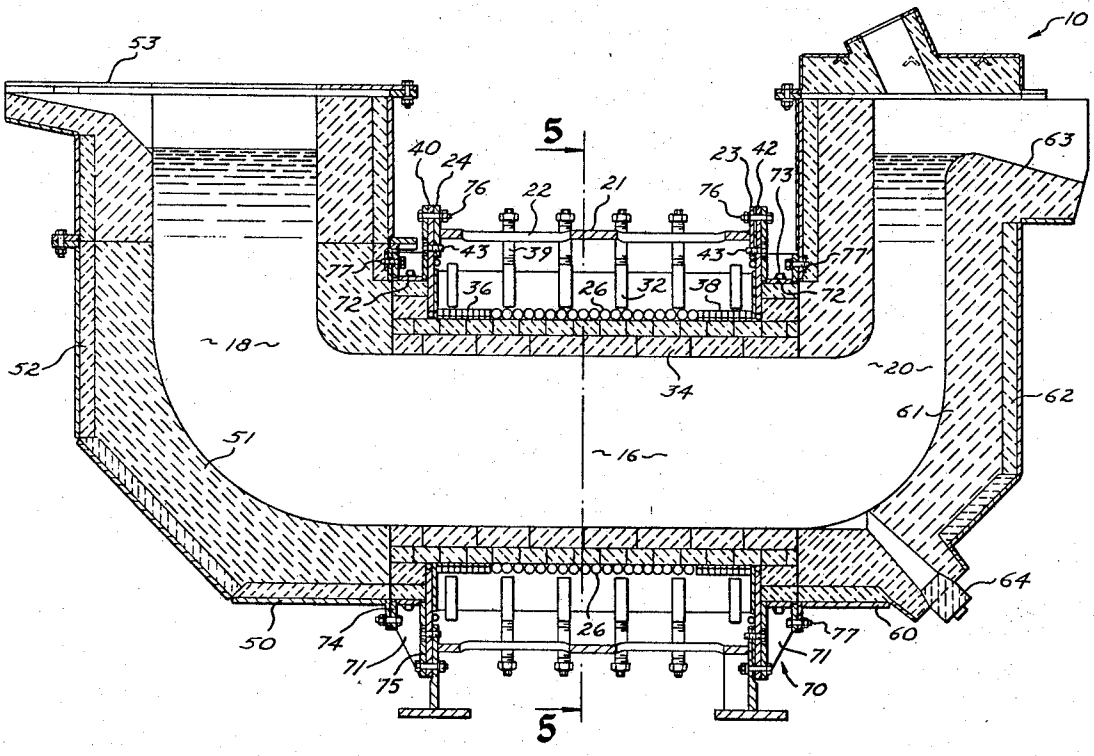
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3,320,348 5/1967 Seulen et al. 13/27
3,483,301 12/1969 Duca 13/26

Primary Examiner—Bernard A. Gilheany
Assistant Examiner—R. N. Envall, Jr.
Attorney—Slough & Slough

ABSTRACT: A coreless sectional induction melting or heating furnace is disclosed, one furnace section being a horizontally disposed heating chamber around which an induction coil is wound, another section being a charging section and a further section being a pour section, said charging section and said pour sections being angled with respect to said horizontally disposed section, spacing means are provided at the output end of the heating section adjacent to an end or ends of the heating coil, wherefore the mating plane between the charging section and the heating section or charging section, pour section and heating section, is disposed outwardly of the coil wrapped portion of the horizontally disposed heating chamber. In the operation of the furnace a head of molten metal is maintained in the charge and pour sections well above the level in the heating chamber.



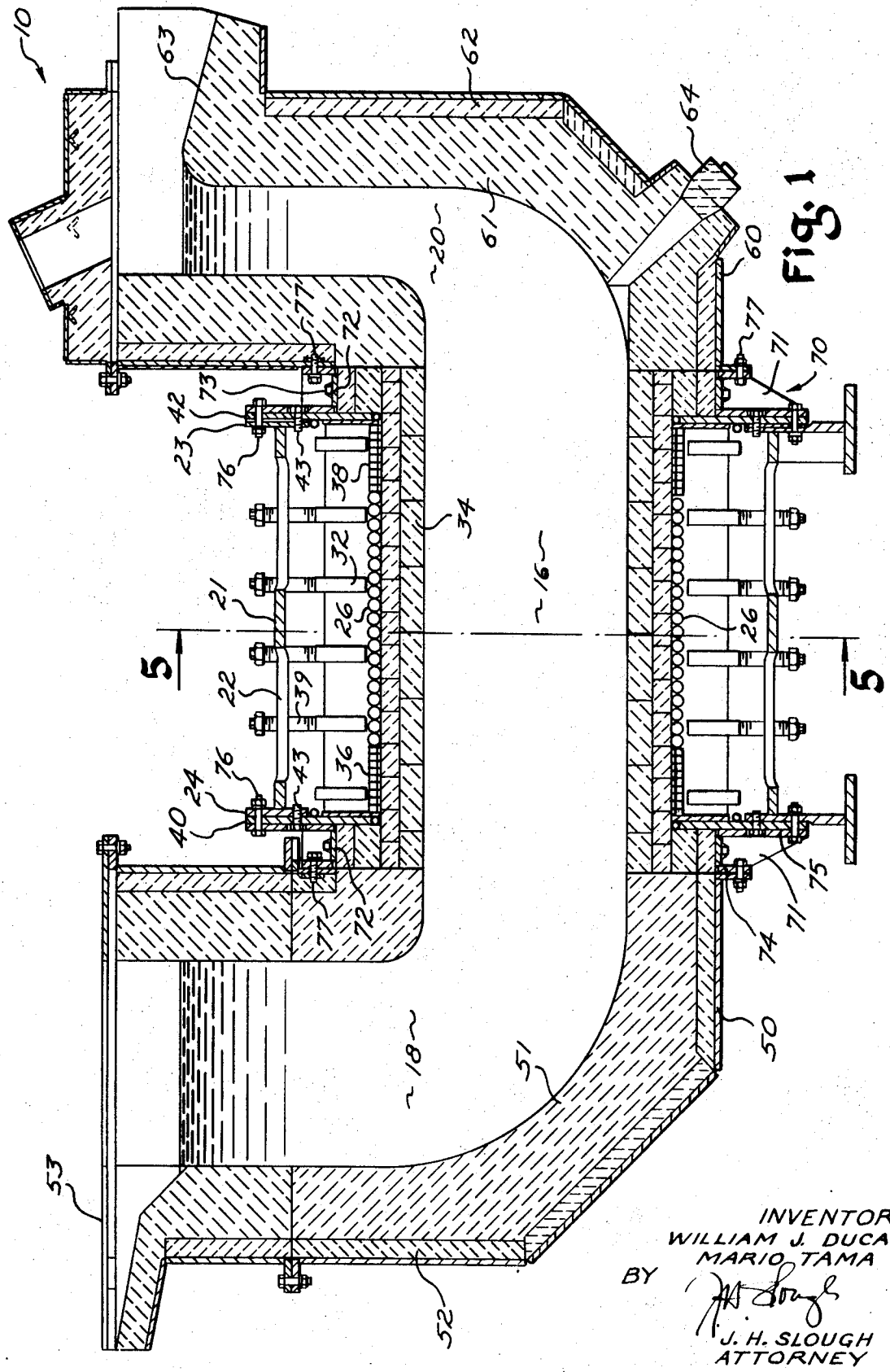


Fig. 1

INVENTORS
WILLIAM J. DUCA
MARIO TAMA
BY
J. H. SLOUGH
ATTORNEY

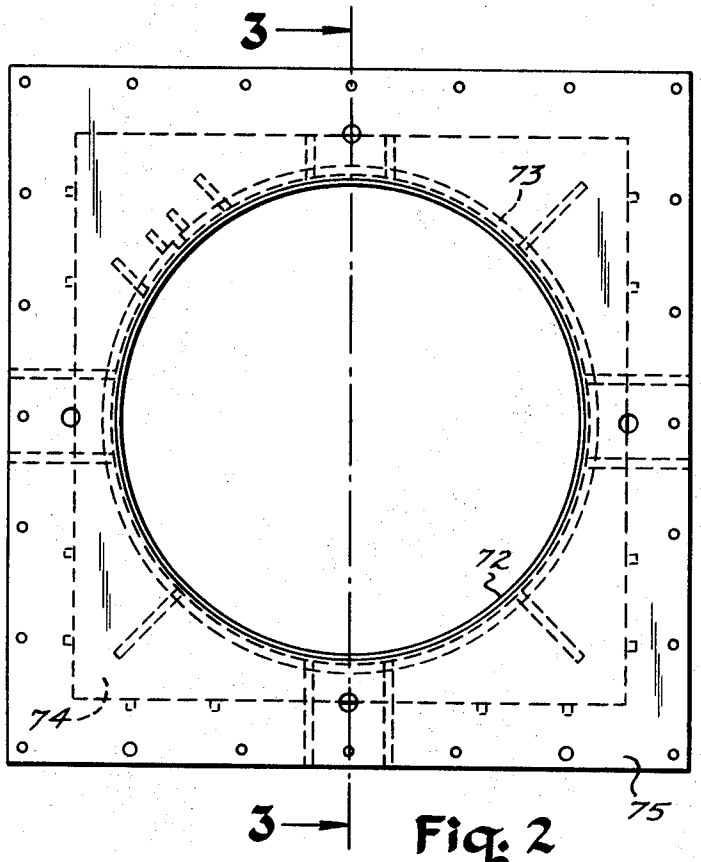


Fig. 2

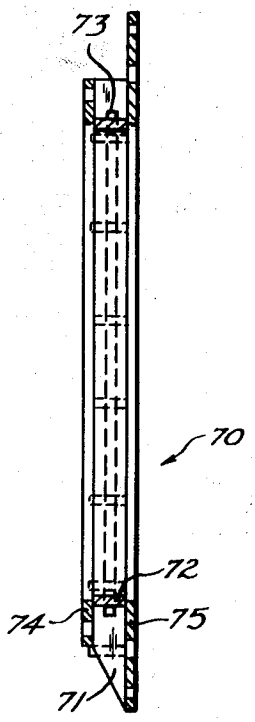


Fig. 3

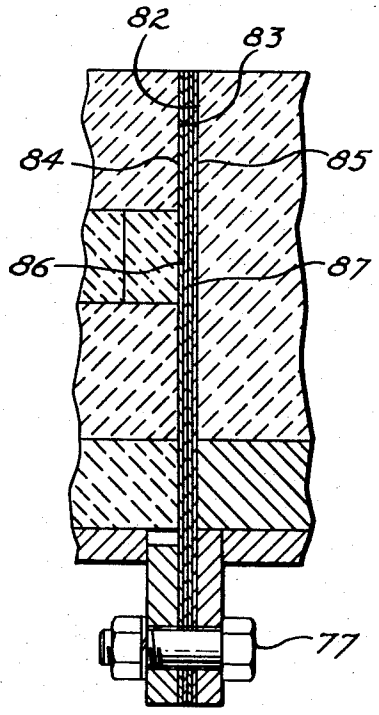


Fig. 4

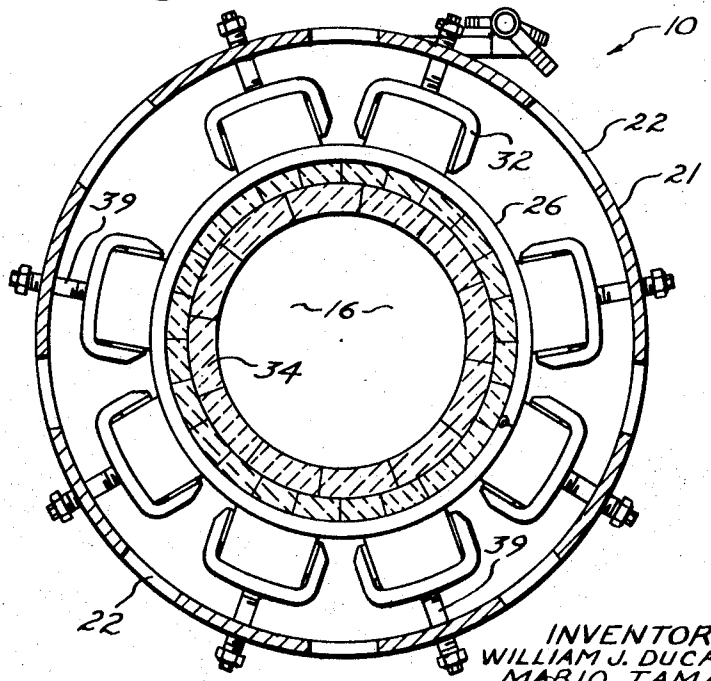


Fig. 5

INVENTORS
WILLIAM J. DUCA
MARIO TAMA
BY
J. H. SLOUGH
ATTORNEY

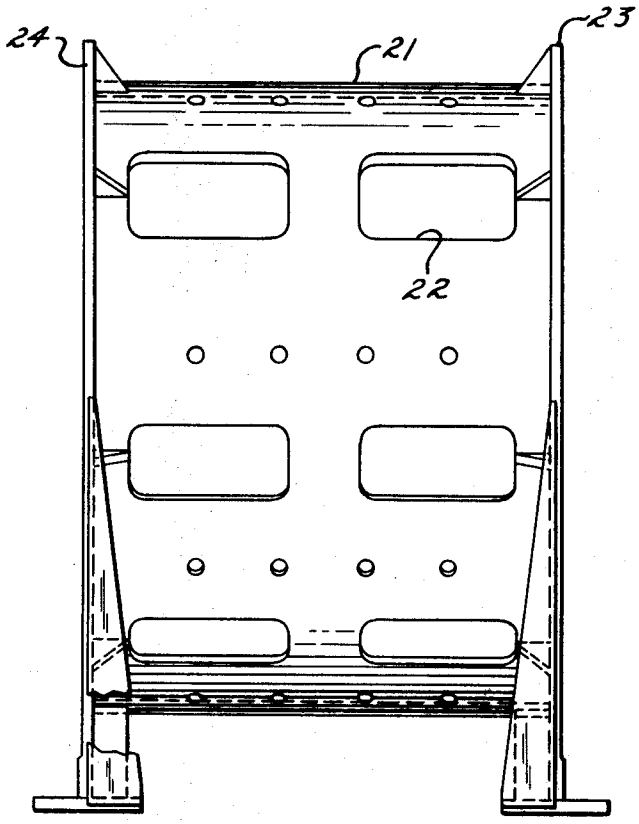


Fig. 6

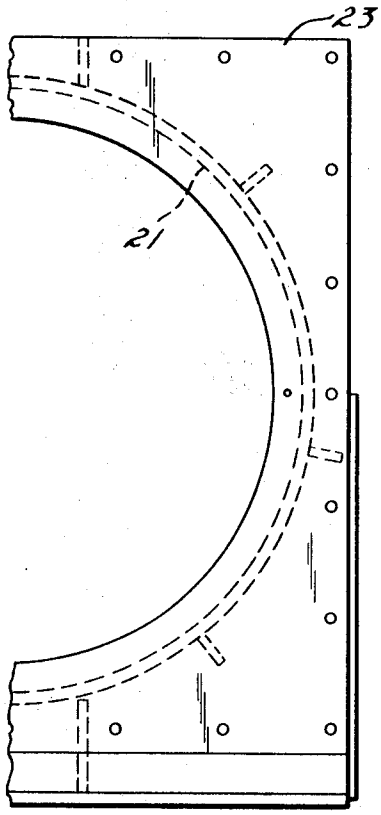


Fig. 7

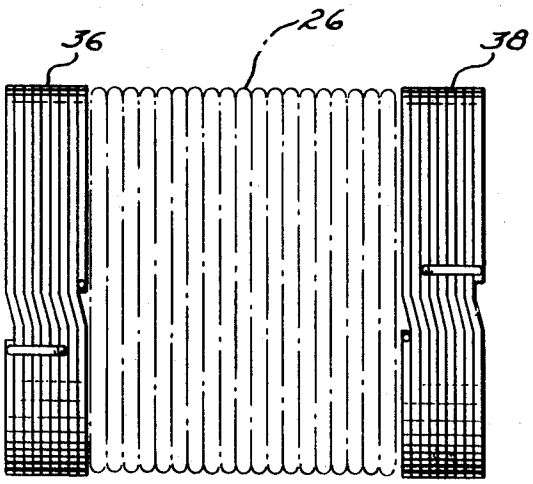


Fig. 8

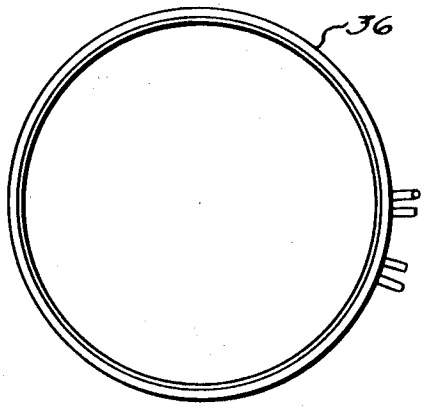


Fig. 9

INVENTORS
WILLIAM J. DUCA
MARIO TAMA
BY
J. H. SLOUGH
ATTORNEY

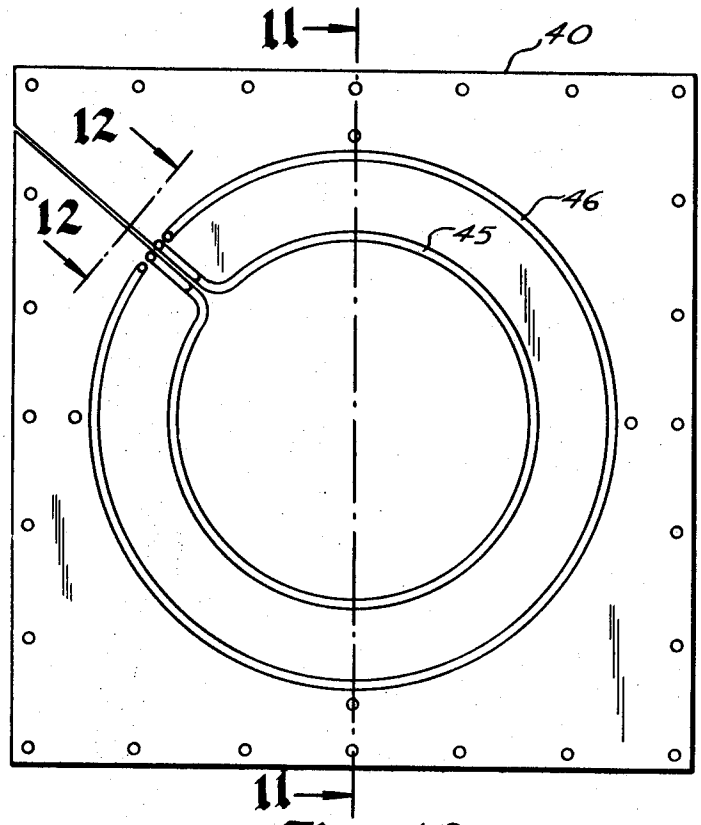


Fig. 10

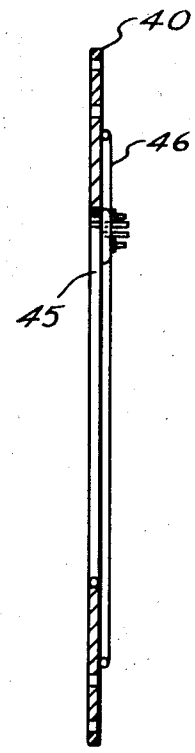


Fig. 11

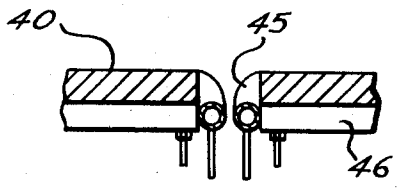


Fig. 12

INVENTORS
WILLIAM J. DUCA
MARIO TAMA

BY

J. H. SLOUGH
ATTORNEY

HORIZONTAL CORELESS INDUCTION FURNACE

This invention relates to an induction furnace for melting and heating metals and relates more particularly to improvements in a horizontal coreless induction furnace of the type set forth, described and claimed in U.S. Letters Pat. No. 3,483,301 patented Dec. 9, 1969.

The horizontal coreless induction furnace of the present invention is constructed in multisection, and consists of a charging section, a heating section and a pouring section facilitating the installation of refractory linings therefor and relining thereof; improved support is provided at the extremities of the heating section and at the mating planes of the sections and proper thermal gradients are provided therefor; cooling means are provided at the outboard end of the induction coil surrounding the horizontally disposed heating section; improved clamping support is provided for said coil; and appropriate different lining material is adapted to be employed in the heating and charge or pour sections.

It is hence an object of this invention to provide a readily assembled and disassembled furnace of the horizontal coreless induction type.

It is a further object of this invention to provide a furnace of the type referred to which comprises improved refractory support and lining with resultant longer life of the lining.

A still further object of this invention is to provide improved clamping means for the induction coil.

Another object of this invention is the provision of cooling means whereby eddy current losses are minimized.

Another object of this invention is to provide safe joints between the furnace sections which eliminate leakage of molten metal at such joints.

Other objects of this invention and the invention itself will become more readily apparent from a purview of the following description, referred to in the appended drawings, in which:

FIG. 1 is a longitudinal section through the furnace of this invention, in the form as disclosed herein;

FIG. 2 is a plan view of a spacer member disposed between sections of the furnace of FIG. 1;

FIG. 3 is a vertical section taken along the line 3—3 of FIG. 2;

FIG. 4 is an enlarged detail of a portion of FIG. 1 in which a joint between the heating section and an end section of the furnace is shown;

FIG. 5 is a transverse section taken along the line 5—5 of FIG. 1;

FIG. 6 is a side elevation of the housing body for the heating section of the furnace;

FIG. 7 is a fragmentary end elevation of substantially one-half of the housing body of FIG. 6;

FIG. 8 is a side elevation of the furnace induction coil, cooling tubes being disclosed adjacent the ends thereof, said induction coil being shown in broken lines;

FIG. 9 is an end elevation of the cooling tubes as seen from the left-hand end of FIG. 8;

FIG. 10 is a plan view of a clamping plate disposed between the spacers of FIGS. 2 and 3 and the heating section of the furnace;

FIG. 11 is a vertical section taken along the lines 11—11 of FIG. 10; and

FIG. 12 is a section taken substantially along the line 12—12 of FIG. 10.

Referring now to the drawings, in all of which like parts are designated by like reference characters, 10 indicates generally the horizontally disposed sectional coreless induction furnace of this invention. It may be suitably adapted for melting or heating any metal or alloy, but is expected to be particularly useful in ferrous metallurgy. Furnaces of this type are used commonly for melting metals and the usual procedure is first heating molten metal inductively in the heating section of the furnace and the heated molten metal in turn melting cold

metal introduced through a charging section. In vertical section as seen in FIG. 1, molten metal is contained in an angled passage. This passage is comprised of a horizontal base portion 16 and angled end portions or sections 18 and 20. The horizontal base section 16 consists of a cylindrical shell 21 having suitable cutouts or openings 22 and supporting end plates 23,24 on either end thereof centrally apertured and normal to the axis of the shell. The base section further comprises magnetic laminations or yokes 32, a multibrick lining 34, an induction heating coil 26 wound around said lining 34, cooling coil sections 36,38 disposed coaxial with and at either end of said heating coil, said cooling coils 36,38 not being supplied with current. It is to be noted that the yokes 32 are rigidly bolted on the shell 20 (FIG. 5) by bolts 39 and that one each of a pair of metallic coil clamping plates 40,42 are superposed on said end plates 23,24. Each plate 40,42 has a cylindrical opening surrounding the lining 34 and is disposed about the heating section at opposite ends of the heating section 16. Note each of the plates 40,42 are secured by bolts 43 to each of the end plates 23,24 of the shell 21 at either end of said shell and the inner periphery of the plates 40,42 exerts compressive support for the induction coil as well as the cooling coils at either end thereof. The support plates 40,42 are adapted to be cooled as by cooling means 45,46 (see FIG. 10) and are further secured by bolts 76 to the channel-shaped outer periphery 71 of generally rectangular in cross section metallic spacer elements 70 interposed between each of said plates 40,42 and an end section. The web 72 of the spacer element is telescoped over an end portion of the multibrick lining and cooling means 73 are disposed centrally of said web. The channel of said spacer has a pair of plates 74,75 of different dimension and the relatively larger plate 75 is provided with a through opening aligned with openings in each of the plates 40,42 and each of the end plates 23,24 to accommodate securing means 76 connecting the plates 40,42, shell 21 and the spacer means. The plate 75 is secured by bolt means 76 to the plate 40,42 and end plate 23,24 of the shell 21 and each of the relatively smaller plates 74 of the spacer members is secured by bolt means 77 to each of the shells 50,60 of the charge and pour sections.

The charging section or reservoir, as shown in FIG. 1 at 18 consists of a shell or casing 50 supporting a lining 51 consisting of a high alumina castable refractory or other brick preferred refractory material, and an outer insulating refractory brick 52. A detachable top 53 is provided for the charging section as shown which may be replaced by a different height top for the purpose of permitting an adjustment in ferrostatic head height in the said reservoir. Similarly the pour or discharge section or reservoir 20 consists of a shell or casing 60 supporting a lining 61 of high alumina castable refractory or other preferred material and an outer insulating refractory brick 62. Said reservoir is provided with a downwardly tapered lip 63 over which molten metal flows as it is discharged from the furnace. A removable plug 64 is associated with the said reservoir communicating with the passage which may be utilized for draining and cleaning the furnace. It is to be noted that the pour section has less capacity than the charge section so as to facilitate the continuous pouring of

As shown in U.S. Letters Pat. No. 3,483,301 referred to above, the reservoirs 18 and 20 are of sufficient height to maintain a substantial head of molten metal above the level of metal in the heating chamber 16 and are in the form shown disposed substantially vertically with respect to the horizontal center heating section.

The mating surfaces or joints provided of the charge section with surfaces of the heating section are shown at 80,81 and at 82,83 of the mating surfaces of the pour section with the heating section. As best shown in FIG. 4, the said mating surfaces are ground smooth and then preferably mudded with a refractory cement (84,85) and plastered with mica paper 86,87 to afford a seal prior to joining the sections together. As shown the cemented mica paper covering the mating surfaces are

bolted together by means of bolt means **77** and further secured to the heating section by means of the spacer means **70**, the support plates **40,42** and the end plates **23,24** of the shell **21**.

It will be obvious that this construction affords adequate refractory support at the extremities of the heating section where the main joints of the furnace are to be made and that this lining support is accomplished by the stainless steel water cooled plates **40,42** which also serve as a coil clamping plate and which cooperate with the water cooled spacer means **70** to provide proper thermal gradients across the joints. It is preferable to slightly prestress the joints at their mating juncture to place the refractory surrounding the same under compression. Further heating of the lining prior to the introduction of the first molten metal places the refractory under further compression.

It will be evident that the sectional furnace of this invention permits the installation of refractory linings in the individual sections prior to assembly.

Although a preferred embodiment of this invention has been described, it will be obvious that other forms thereof will become apparent to one skilled in the art, however the disclosure of the preferred embodiment is not intended to limit the scope of this invention beyond that recited in the following claims:

We claim:

1. A coreless sectional induction furnace for heating or melting metals comprising one section consisting of a horizontally disposed substantially cylindrical heating section, a shell, magnetic laminations and a refractory lining, another section consisting of a charging section having a shell and a refractory lining disposed at one end of said heating section and angled with respect thereto, an induction heating coil wound around said heating section, spacing means disposed at an outboard end of said heating section adjacent to an end of said heating coil, a mating plane between the refractory lining of said charging section and said heating section and angled with respect thereto and a metal discharge means at an opposite end of said heating section.

2. A coreless sectional induction furnace as claimed in claim **1** wherein cooling means are provided at an outboard end of said heating section.

3. A coreless sectional induction furnace as claimed in claim **1** wherein a mating plane is provided between said discharge means and the heating section angled with respect thereto and disposed between a refractory lining of said discharge means and the refractory lining of said heating section.

4. A coreless sectional induction furnace as claimed in claim **1** wherein the metal discharge means comprises a furnace section having a shell and refractory lining.

5. A coreless sectional induction furnace as claimed in claim **1** wherein a coil clamping plate is disposed at either end of said heating section and secured to the shell of said heating section.

6. A coreless sectional induction furnace as claimed in claim **5** wherein cooling means are provided for cooling said coil clamping plates.

7. A coreless sectional induction furnace as claimed in claim **5** wherein spacer means are interposed between said charging section and one of said coil clamping plates disposed at an outboard end of said heating section.

8. A coreless sectional induction furnace as claimed in claim **1** wherein mica plating is interposed between mating surfaces of the refractory lining of the charging section and the heating section, said surfaces being sealed.

9. A coreless sectional induction furnace as claimed in claim **1** wherein said sections are detachably secured together.

10. A coreless sectional induction furnace as claimed in claim **1** wherein a removable plug is provided to drain said furnace.

11. A coreless sectional induction furnace for heating or melting metals comprising one section consisting of a horizontally disposed substantially cylindrical heating section, a shell, magnetic laminations and a refractory lining, another section being a charging section having a shell and a refractory lining disposed at one end of said heating section and angled with respect thereto, a further section being a metal pour section having a shell and refractory lining and disposed at an end of said heating section opposite to said charging section and angled with respect thereto, an induction heating coil wound around said heating section, spacing and cooling means disposed at either outboard end of said heating section adjacent to opposite ends of said heating coil, mating planes between the refractory lining of said charging section and said heating section and the shell of each outboard end of said heating coil and angled with respect thereto, the charging section being adapted to receive a charge of metal and the pour section being adapted to discharge molten metal, said charge and pour sections being of sufficient height to maintain a substantial head of molten metal above the level of metal in said heating section.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,602,625 Dated August 31, 1971

Inventor(s) William J. Duca

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 61, after "of" the following should be inserted ---molten metal from the furnace.---

Signed and sealed this 18th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Acting Commissioner of Patents

FORM PO-1050 (10-69)

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