

April 14, 1959

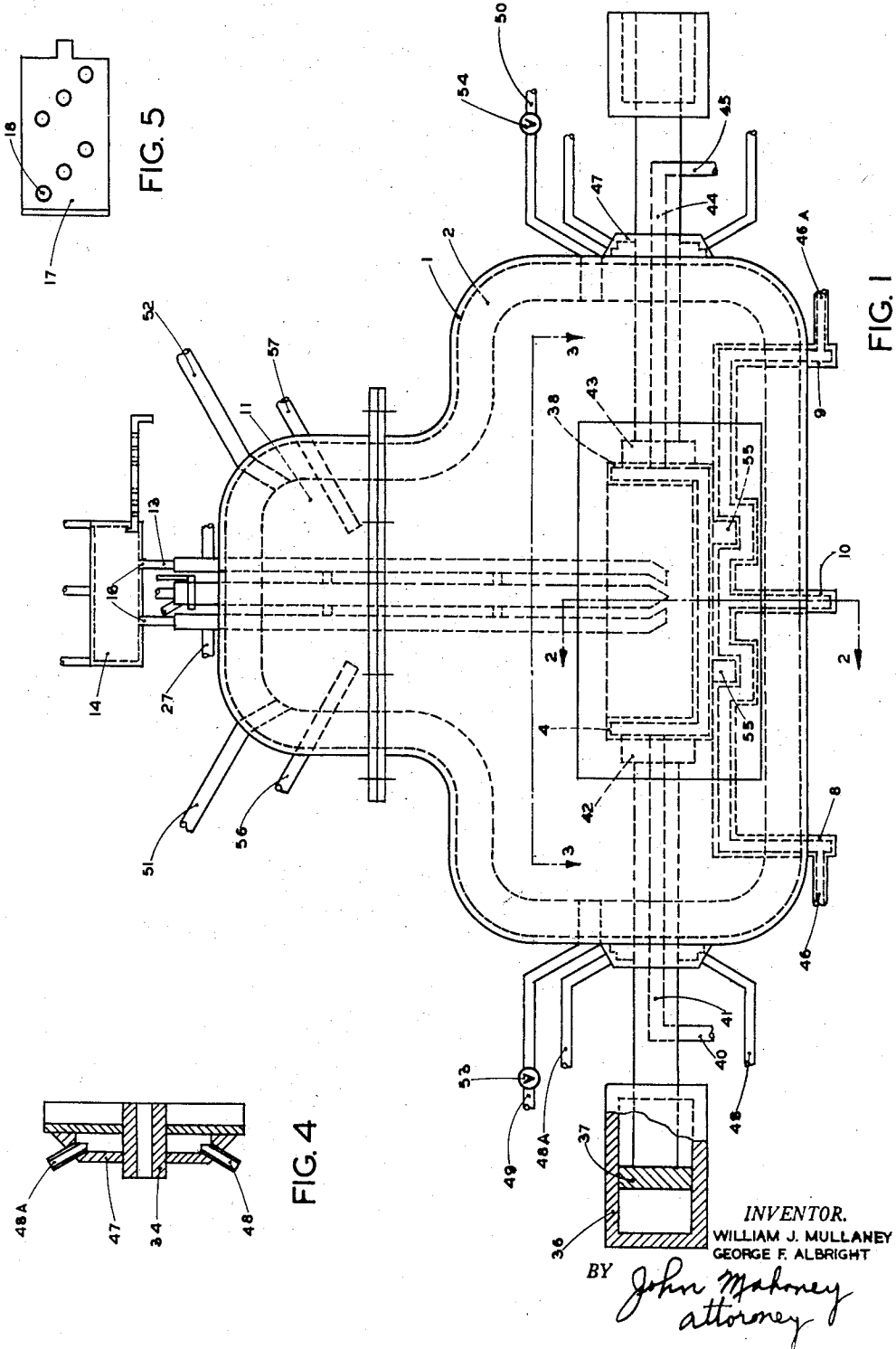
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2,881,489

ELECTRIC ARC FURNACE AND THE PROCESS OF PREPARING CASTINGS

Filed Feb. 17, 1956

3 Sheets-Sheet 1



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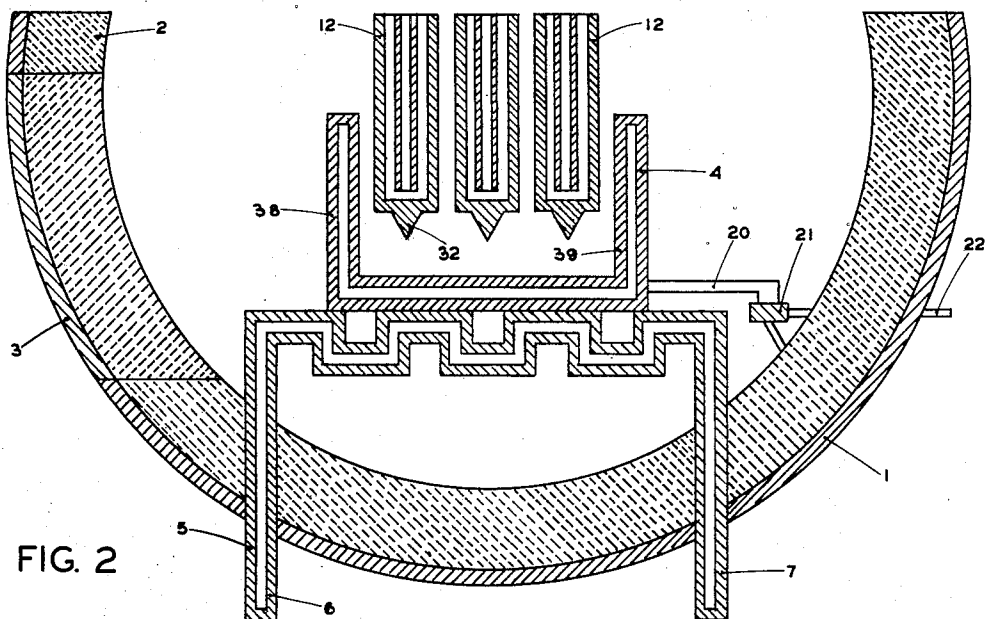


FIG. 2

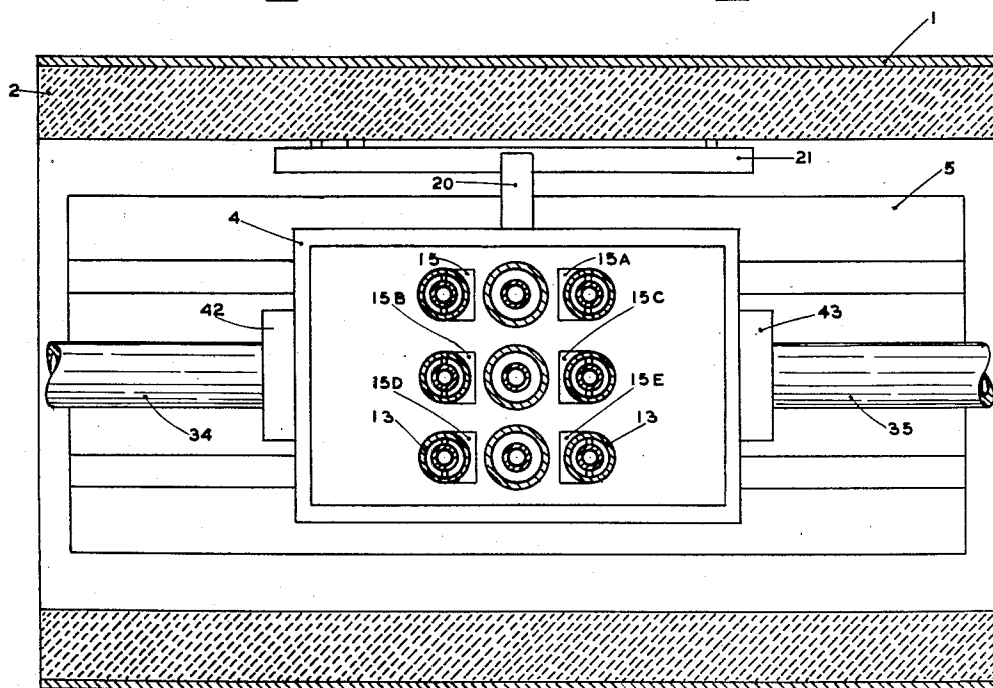


FIG. 3

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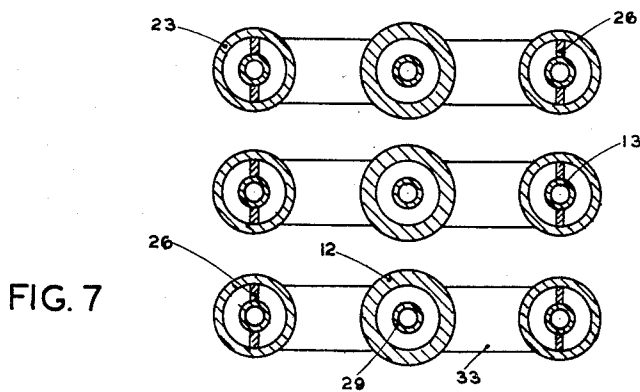
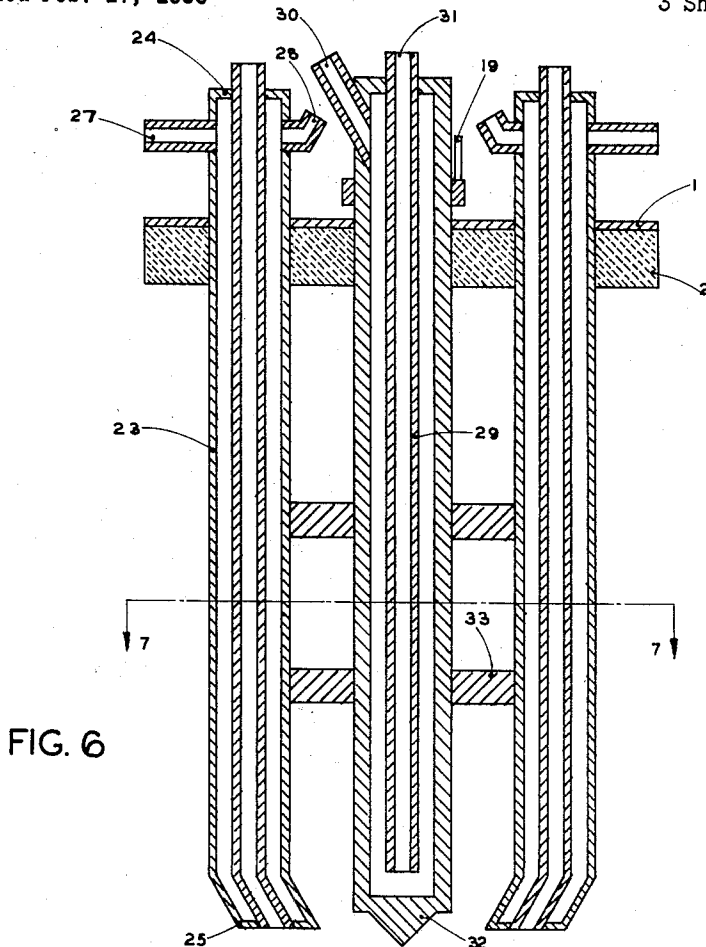
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ELECTRIC ARC FURNACE AND THE PROCESS OF PREPARING CASTINGS

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16 Claims. (Cl. 22—200)

The present invention relates to electric arc vacuum furnaces and more particularly to a furnace in which castings may be formed in any desired shape. It also relates to an improved process of preparing castings while a gas which is inert to or which is substantially inert to the metal or mixture of metals being melted, is passed through the furnace.

In preparing metals having comparatively high melting points, such as titanium, in electrical vacuum arc furnaces, it has been the practice to make castings in cylindrical form. Castings prepared in such manner, however, must be reshaped prior to further processing. In accordance with our invention, improved means are provided for producing castings which are angular in shape, such as square or rectangular, which may be processed without reshaping. In accordance with the invention, means are also provided for continuously passing into and withdrawing from the furnace while the metal is being melted a gas which is inert to the metal for cooling the furnace and removing impurities which are volatilized during the melting operation. The invention is particularly adapted for preparing castings from a metal which is in the form of small or fine particles, such as powdered or pulverulent iron, chromium, tungsten, molybdenum or titanium. It is also possible by the invention to form alloys by utilizing a mixture of two or more powdered or pulverulent metals in such proportions that an alloy will be formed. For instance, by utilizing a mixture of powdered iron, powdered nickel and powdered chromium in the desired proportions, such as approximately 18% chromium and 8% nickel, and the balance iron and minor impurities, alloys of the stainless steel type may be prepared or by utilizing powdered nickel and powdered chromium in the proper proportions, such as approximately 63% nickel and 22% chromium, and the balance powdered iron, alloys of the Nichrome type may be prepared, or by utilizing the proper proportions of iron, chromium, molybdenum and the balance titanium and minor impurities in which each of the metals is in a finely divided state, a titanium base alloy containing approximately 2% iron, 2% chromium, 2% molybdenum, and minor impurities may be prepared. The furnace and the method of the invention is also particularly adapted for the preparation of titanium castings of a square or rectangular shape and of a comparatively high degree of purity from sponge titanium in a finely divided state and the construction and operation of the furnace will be described in connection therewith although it will be understood that the invention is not to be limited thereto.

The invention will be better understood by reference to the accompanying drawings in which:

Fig. 1 is a side elevational view of the improved furnace, showing parts broken away and parts in section;

Fig. 2 is an enlarged cross sectional view taken on a plane passing through the line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a cross sectional view taken on a plane pass-

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ing through the line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is an enlarged detail sectional view of the seal between the piston rod and each end of the furnace;

Fig. 5 is a plan view of a slide movable in the feed hopper;

Fig. 6 is an enlarged vertical sectional view of the feeding columns and electrodes, showing means for cooling the electrodes and feeding columns; and

Fig. 7 is a cross sectional view on a plane passing through the line 7—7 of Fig. 6, looking in the direction of the arrows.

As shown more particularly in Figs. 1, 2 and 3 of the drawings, the furnace is formed of a suitable metal 1 which is lined with a refractory material 2 which will reduce radiation from the furnace to a minimum. The furnace is provided with a door 3 and may be supported on a suitable base, not shown. Arranged within the furnace is a mold or crucible 4 which is angular in shape and which is slidably mounted on a skid 5 having spaced inner and outer walls 6 and 7. While the skid may be supported interiorly of the furnace in any desirable manner, as shown more particularly in Figs. 1 and 2, a plurality of legs are provided which extend downwardly through the wall of the furnace and which are sealed therein by a suitable sealing material. As shown, a pair of legs 8 extend downwardly from each corner at one end of the skid and a second pair of legs 9 extend downwardly from each corner at the opposite end of the skid and if required, additional legs 10 may be provided which extend downwardly from the central portion of the skid.

As shown in Fig. 1, the furnace is provided with a dome 11 having an upper substantially flat surface through which extends one or more electrodes 12 and also extending through the dome are a pair of feed pipes or columns 13 for each electrode. The lower end of each of the feed columns and the lower end of each of the electrodes are maintained in spaced relation to the bottom of the mold in any desirable manner. As shown, the upper ends of the feed columns 13 are connected to a feed hopper 14 which may be maintained in the desired position by any suitable mechanical means, such as a suitable hoist which may be rotated in opposite directions to raise or lower the hopper by a reversible motor through reducing gearing, or a positioner mechanism may be provided which may be operated electrically and since such mechanism is now well known in the art, it has not been shown. The electrodes may be secured to and are movable vertically with the feed columns in a manner to be subsequently described.

The number of feed columns and electrodes which are utilized may of course be varied depending upon the size of the casting desired. Preferably, however, there are two feed columns for each electrode. As shown in Fig. 3 of the drawings, three pairs of feed columns are provided and an electrode is arranged between each pair of feed columns to form a series of rows and the lower end portions 15 and 15A of the feed columns in one row are inclined in opposite directions toward the electrode arranged between them and in a like manner, the lower end portions 15B and 15C of the feed columns in the second row and the lower end portions 15D and 15E of the feed columns in the third row are inclined in opposite directions toward the respective electrode arranged between them.

For feeding metal in small or fine particles to the feed columns, the hopper 14 is provided with a plurality of openings 16, each of which openings leads into a feed pipe 13 and a slide 17 is provided with a plurality of staggered openings 18 which are so arranged that powdered metal is selectively fed through one of the feed

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columns to the mold. The finely divided metal may be fed to the mold by gravity which may be assisted, if desired, by mechanical or pneumatic means, and during the feeding of the metal into the mold, a current from a suitable source of electrical energy is passed through a terminal 19 and electrode 12 and arcs through the powdered metal passing from the outlet orifice of the feed column and thence through solidified metal in the mold to the mold 4 and from the mold through a conductor 20 having one end secured to the mold and its other end in sliding electrical contact with a bar 21. An outlet terminal 22 extends from bar 21 through the wall of the furnace.

During the passage of current through the respective electrodes 12, means are provided for cooling the feed column through which finely divided metal is being fed to the mold, each of which cooling means is connected to the feed column with which it is associated and is movable with it. As shown more particularly in Figs. 6 and 7 of the drawings, a pipe 23 surrounds each of the feed columns and is provided with upper and lower end connections 24 and 25 with the feed column, and baffles 26 are arranged between pipes 23 and feed column 13 and while metal is fed through each feed column, a cooling fluid, such as water, is passed from conduit 27 into the space between baffles 26 and the feed column and is exhausted through a conduit means 28 on the opposite sides of the baffles.

Means are also provided to cool the electrodes 12 through which current is being passed and for this purpose, the lower end of each electrode is closed and a pipe 29 having a lower open end is arranged within the electrode and a cooling fluid, such as water, is passed into the electrode through a pipe 30 and is exhausted through pipe 29 to conduit means 31. Electrode 12 is preferably of the nonconsuming type and may be composed of tungsten or titanium provided with a tip 32 and to enable the electrode to be raised with the hopper, a plurality of spaced bars 33 are secured by suitable means, such as welding, to each electrode and to the respective pipes surrounding the aligned feed columns.

To enable the molten metal to be deposited uniformly in layers within the mold, means are provided for moving the mold in a horizontal direction upon the skid. For this purpose, a pair of rams 34 and 35 are provided, the ram 34 extending through one end of the furnace and ram 35 extending through the opposite end of the furnace. Each of the rams extends into a cylinder 36 and is provided with a piston 37 therein and the rams are selectively moved in opposite directions by suitable hydraulic means well known in the art, thereby moving mold 4 alternately in opposite directions. Slide 17 is so arranged in hopper 14 that when the mold as shown in Fig. 3 of the drawings is moved toward the left, finely divided metal is fed through one of the feeding columns provided with the inclined end portion 15A, 15C or 15E extending in one direction toward its respective electrode whereas when the mold is being moved toward the right, finely divided metal is fed through one of the feed columns 13 having inclined end portion 15, 15B or 15D extending toward its respective electrode. Valves for controlling the flow of the liquid in the hydraulic system may be actuated by limit switches in a manner well known in the art when each of the pistons 37 reaches the desired position in its cylinder 36.

After metal is deposited in the mold from the finely divided metal fed through each feed column on opposite sides of the electrode in the first row as shown in Fig. 3, finely divided metal may be fed alternately through the two feed columns on the opposite sides of the electrode in the second row, and finally, finely divided metal may be alternately fed through the feed columns in the third row during movement of the mold in opposite directions, to provide a uniform layer of metal in the mold, or if desired, and particularly when the furnace

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is utilized in melting metals or alloys having a low melting point, such as iron or alloys thereof, the openings in the slide may be so arranged that finely divided metal will be simultaneously fed to the three feed columns on one side of the row of electrodes while the mold is being moved in one direction and will be simultaneously fed through the feed columns arranged on the opposite side of the electrodes while the mold is being moved in the opposite direction. After the first layer of metal is deposited in the mold, the hopper 14, together with the feed columns 13 and the electrodes 12 may be raised and the process continued until a casting of the desired thickness is obtained.

The mold may be formed of any metal that will not contaminate the metal being cast. In forming castings of powdered titanium, it may for instance be formed of copper or it may be formed of copper with a lining of titanium. During the melting process, means are provided for cooling the mold. For this purpose, the mold is provided with spaced inner and outer walls 38 and 39 through which a cooling fluid, such as water, may be passed in any suitable manner. As shown more particularly in Fig. 1 of the drawings, the cooling fluid passes through an inlet pipe 40 through a conduit 41 in ram 34 and through an aperture in the head 42 of the ram into the space between the walls of the mold and then flows outwardly through an aperture in the head 43 of ram 35 and conduit 44 in the ram 35 to an outlet passage 45.

Means are also provided for cooling the skid 5 and for this purpose an inlet conduit means 46 is provided on one or more of the legs 8 through which a cooling fluid, such as water, is passed, which cooling fluid flows between the walls of the skid and outwardly through a conduit means 46a in one or both of the legs 9 at the opposite end of the skid. If desired, however, the cooling fluid may be passed through conduits in each of the legs at one end of the skid and after the cooling fluid flows between the walls of the skid, is passed outwardly through conduits in each of the legs at the opposite end of the skid.

To prevent the metal which is being melted in the furnace from being contaminated by elements in the atmosphere, such as oxygen, nitrogen, or carbon, means are provided for sealing the portion of the furnace through which rams 34 and 35 extend. For this purpose, a mercury seal is provided in which the mercury is maintained under pressure between the outer wall 1 of the furnace and a cap 47, the inner periphery of which is secured to the outer wall of the furnace by suitable means, such as welding. As shown more particularly in Fig. 4, means including conduit means 48 and 48a which are connected to the inlet and outlet sides of a pump, not shown, are provided for maintaining the mercury under pressure between the wall 1 of the furnace and the cap 47.

Means are also provided for first forming a vacuum within the furnace and then continually passing a gas into and withdrawing it from the furnace which gas is inert to the metal being melted for removing heat from the furnace and any volatile impurities which are formed during the melting operation. For this purpose, a pair of inlet conduit means 49 and 50 are provided which are arranged below the dome of the furnace and a pair of outlet conduit means 51 and 52 are provided which are arranged in the dome of the furnace. When the mold is first inserted into the furnace and door 3 is closed, valves 53 and 54 in the gas inlet pipes 49 and 50, respectively, are closed and the air within the furnace is withdrawn through conduit means 51 and 52 which lead to vacuum pumps, forming a vacuum within the furnace. Valves 53 and 54 are then opened, the vacuum pump leading to conduit means 51 is shut off, and a gas which is inert to the metal being melted is passed

into the furnace through conduit means 49 and 50 and is withdrawn through outlet conduit means 52.

When sponge titanium in a powdered or pulverulent form is being melted in the furnace, after a vacuum is first formed in the furnace, valves 53 and 54 are opened and a gas which is inert to titanium, such as argon or helium, is passed through conduit means 49 and 50 which becomes contaminated with impurities from the titanium and is withdrawn through conduit means 52. The argon or helium which is withdrawn from the furnace may then be passed through a scrubber and if desired may be cooled and again passed into the furnace through conduit means 49 and 50. It will be particularly noted that the outlet conduit means 52 is located in the dome of the furnace and the hot inert gas is being continuously withdrawn which not only serves to cool the furnace but also aids in removing the vaporized impurities which were present in the metal and thus greatly improves the physical properties of the cast metal and this is particularly true when powdered or pulverulent sponge titanium is being melted because titanium is adversely affected by volatile impurities, such as oxygen, hydrogen, and carbon.

When it is desired to remove the casting from the furnace, door 3 which is provided in one side wall of the furnace, is removed and to facilitate the removal of the mold and casting, skid 5 is provided with indentations 55 into which a forked truck may be inserted to remove the casting and mold from the furnace. A new mold may then be inserted through the door opening into the furnace and deposited upon the skid 5. The door which is provided with a suitable sealing material is then replaced and a vacuum is again formed in the furnace by removing the air through outlet conduit means 51 and 52. Valves 53 and 54 are then opened and an inert gas is continuously passed into and withdrawn from the furnace during the melting operation in the manner previously described.

For ascertaining the temperature within the furnace, thermocouples 56 and 57 extending into the furnace may be provided and if desired suitable peep holes which are closed by a suitable transparent material may also be formed in the wall of the furnace for observing the melting operation.

What is claimed is:

1. An electric arc furnace including a furnace wall, an angular shaped mold arranged within the furnace, a pair of feed columns extending through the wall of said furnace and having outlet end portions arranged in the mold at a spaced distance from the bottom thereof, an electrode having an end portion arranged in the mold between the outlet end portions of said feed columns, and the outlet end portion of one of said feed columns being inclined in one direction toward said electrode and the outlet end portion of the other feed column being inclined in the opposite direction toward the electrode, means for alternately moving said mold in opposite directions, means whereby fine metallic particles may be fed into the feed column, the outlet end portion of which is inclined in one direction toward the electrode when said mold is moved in the same direction as the outlet end portion of the feed column is inclined toward the electrode and means whereby fine metal particles may be fed into the other feed column when the mold is moved in the opposite direction, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the mold to melt the metal particles, and means for cooling the mold, the electrode, and the feed columns during the melting operation.

2. An electric arc furnace including a wall, a mold arranged within the furnace having a bottom wall, a hopper for metal particles arranged above said furnace and having a pair of feed columns arranged in spaced relation to each other and extending downwardly through the wall of said furnace, said feed columns having their upper ends

connected to said feed hopper and their lower end portions arranged within said mold and in spaced relation to the bottom wall thereof, an electrode extending through the wall of said furnace and having its lower end portion arranged between said feed columns, means arranged above the mold for connecting said electrode to said feed columns, means for moving said mold in opposite directions relative to said feed columns, means whereby metal particles may be fed into one of said feed columns when the mold is moved in one direction and means whereby metal particles may be fed to the mold through the other feed column when the mold is moved in the opposite direction, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrodes and the metal particles which are fed into the mold to melt the metal particles, means for cooling said mold, electrode, and feed columns during the melting operation, and said hopper, feed columns, and electrode being movable vertically relative to the bottom of the mold so that after a layer of metal is formed in the mold, additional layers of metal may be deposited in the mold to form a casting of the desired thickness.

3. An electric arc furnace including a wall, a mold arranged within the furnace having a bottom wall, a hopper for metal particles arranged above said furnace and having a pair of feed columns arranged in spaced relation to each other and extending downwardly through the wall of said furnace, said feed columns having their upper ends connected to said hopper and their lower end portions arranged within said mold in spaced relation to the bottom wall thereof, an electrode extending through the wall of said furnace between the two feed columns and having its free end portion extending into said mold and the lower end portions of each of said feed columns being inclined toward said electrode, means for moving said mold in opposite directions relative to said feed columns and electrodes, means whereby metal in the form of fine particles may be fed to one of said feed columns when the mold is moved in the same direction as the lower end portion of the feed column is inclined toward the electrode and means whereby fine metal particles may be fed into the other feed column when the mold is moved in the opposite direction, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles which are fed into the mold to melt the metal, means for connecting said electrode to the feed columns, and said hopper, feed columns, and molds being movable vertically upwardly after each layer of metal is deposited in the mold to provide a casting of the desired thickness.

4. An electric arc furnace including a wall, a rectangular-shaped mold arranged within the furnace having a bottom wall, a hopper for metal particles arranged above the furnace and having a series of feed columns arranged in pairs in spaced relation to each other and extending downwardly through the wall of said furnace, each of said feed columns having its upper end connected to the hopper and its lower end portion arranged within said mold in spaced relation to the bottom wall thereof, a plurality of electrodes, each of which is arranged between each pair of feed columns to provide a series of rows consisting of two feed columns and one electrode and the lower end portion of each feed column in each row being inclined toward the electrode arranged therebetween, means for moving said mold in opposite directions relative to said feed columns and electrodes, means whereby metal in the form of fine particles may be fed into at least one of said feed columns which is inclined in one direction toward said electrode when the mold is moved in the same direction as the lower end portion of the feed column is inclined and means whereby fine metal particles may be fed into at least one of the feed columns on the opposite side of said electrodes when the mold is moved in the opposite direction, means for applying sufficient electrical energy to the electrode which is arranged ad-

jacent a column through which metal particles is being fed to provide an arc of sufficient intensity between the electrode and the metal particles to melt the metal, means for connecting said electrodes to the feed columns, and said hopper, feed columns and electrodes being movable vertically upwardly after each layer of metal is formed in the mold to provide a casting of the desired thickness.

5. Apparatus as defined in claim 4 in which means are provided for selectively feeding metal in the form of fine particles to one of the feed columns which is inclined in one direction toward one of the electrodes when the mold is moved in the same direction as the lower end portion of the feed column is inclined and for selectively feeding metal in the form of fine particles to the other feed columns arranged on the opposite side of the electrode when the mold is moved in the opposite direction and for selectively and alternately feeding metal particles to the feed columns on the opposite side of each of the other electrodes while the mold is moved in correspondingly opposite directions and in which means are provided for selectively applying sufficient electrical energy to each electrode to provide an arc of sufficient intensity between each electrode and the metal particles passing in proximity thereto to melt the metal.

6. An electric arc furnace including an outer wall, an angularly-shaped mold arranged within the furnace in sufficiently spaced relation to the furnace wall to permit substantial horizontal movement of the mold within the furnace, said mold including a flat bottom wall and side walls extending upwardly from the bottom wall which side walls provide with the bottom wall an angularly-shaped casting cavity for receiving molten metal, means for providing a passageway through which metal in the form of small particles may be fed into a portion of the cavity of the mold, an electrode, said electrode having its inner end portion extending into the cavity of the mold in spaced relation to the bottom of the mold and in close proximity to the metal particles passing into the mold, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the cavity of the mold to melt the metal particles, means for alternately moving the mold in opposite directions in a horizontal path relative to the electrode and the metal particles while the metal particles are being passed into the cavity of the mold so that during the melting of the metal particles a uniform layer of metal will be deposited upon the bottom wall of the mold and will be retained in place by the side walls of the mold, and means for cooling said mold during the melting operation to form an angularly-shaped flat casting within the mold cavity.

7. A substantially closed electric arc furnace including an outer wall, an angularly-shaped mold arranged within the furnace in spaced relation to the furnace wall, said mold being provided with a flat bottom wall and side walls shaped to provide with the bottom wall an angularly-shaped casting cavity for receiving molten metal, means extending through the wall of the furnace and terminating within the cavity of the mold for providing a passageway through which metal in the form of small particles may be fed into a portion of the cavity of the mold, an electrode having its free end portion arranged in the cavity of the mold in spaced relation to the bottom wall of the mold and in close proximity to the metal particles passing into the mold, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the cavity of the mold to melt the metal particles, means for alternately moving the mold in opposite directions in a horizontal path relative to the electrode and the metal particles passing into the mold cavity during the melting of the metal particles for providing a uniform deposit of metal within the cavity of said mold which metal is retained in place by the side wall means of said mold, means for cooling said mold

during the melting operation to solidify the molten metal deposited in the mold cavity in the form of a flat casting, and means during the melting and casting of the metal particles for continually passing a gas through the furnace which is inert to the metal being liquefied and cast to cool the furnace and to remove from the interior of the furnace impurities from the metal which become volatile during the melting and casting of the metal particles.

8. A substantially closed electric arc furnace including a bottom wall, side walls extending upwardly in a substantially vertical direction from the bottom wall of the furnace to provide a lower chamber and said side walls being then extended upwardly and inwardly and merging at their upper portions to provide a dome for said furnace and an upper chamber which is in communication with but is substantially smaller than the lower chamber, an angularly-shaped mold arranged within the lower chamber of said furnace which mold is in sufficiently spaced relation to the furnace wall to permit substantial horizontal movement of the mold within the furnace, said mold having a flat bottom wall and side walls extending upwardly from its bottom wall to provide a casting cavity, means extending through a wall of said furnace and terminating in the cavity of said mold for providing a passageway through which metal in the form of small particles may be fed into a portion of the cavity of said mold, an electrode, said electrode having its inner end portion extending into the cavity of said mold and being arranged in proximity to the metal particles passing into the cavity of the mold, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the cavity of the mold to melt the metal particles, means for alternately moving the mold in opposite directions in a substantially horizontal path relative to the electrode and the metal particles passing into the mold while the metal particles are being melted to provide a substantially uniform deposit of metal in the cavity of said mold, means for cooling the mold during the melting operation to solidify the molten metal which is formed into a substantially flat casting, inlet means extending through the wall of the lower portion of the furnace through which a gas which is inert to the metal being melted and cast may be passed into the lower chamber of said furnace and outlet means extending through the wall of the dome portion of the furnace through which the inert gas may be withdrawn for cooling the furnace and removing therefrom volatile impurities from the metal particles which volatile impurities are formed during the melting operation.

9. An electric arc furnace comprising side and end walls and an upper wall arranged to provide a substantially enclosed chamber, a rectangularly-shaped mold arranged within the chamber of said furnace which is spaced at a sufficient distance from the walls of said furnace to permit substantial longitudinal movement of the mold within the furnace, said mold having a bottom wall and upwardly extending side and end walls to provide a rectangularly-shaped casting cavity, a feeding column extending through a wall of said furnace and having its free end portion terminating within the cavity of said mold through which metal in the form of small particles may be fed into the cavity of the mold, an electrode having its free end portion extending into the cavity of said mold in proximity to the metal particles passing into the cavity of the mold, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the cavity of the mold to melt the metal particles, said mold being of sufficient length that its end walls are spaced a substantial distance from said electrode and said feeding column when the mold is in a substantially central position within said furnace, means for alternately moving said mold in opposite directions in said furnace while the metal particles are being melted so that a uniform deposit

of metal will be formed within the cavity of the mold, and means for cooling said mold to provide a rectangularly-shaped casting within the cavity of the mold.

10. A substantially closed electric arc furnace including spaced end walls, a stationary skid arranged within said furnace, an angularly-shaped mold arranged within the chamber of said furnace, said mold having a bottom wall slidably mounted on said skid and side and end walls extending upwardly from its bottom wall to provide an angularly-shaped casting cavity, a feeding column extending through said furnace and having its free end portion terminating within the cavity of said mold through which metal in the form of small particles may be fed into the cavity of the mold, an electrode having its free end portion extending into the cavity of said mold in proximity to the metal particles passing into the cavity of said mold, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the cavity of the mold to melt the metal particles, said mold being of sufficient length that its end walls are spaced a substantial distance from said electrode and feeding column when the mold is in a substantially central position between the end walls of said furnace, means for alternately moving said mold in opposite directions on said skid while the metal particles are being melted so that a uniform deposit of metal will be formed in the cavity of the mold, and means for cooling said mold to provide a rectangularly shaped casting within the cavity of the mold.

11. A substantially closed electric arc furnace including spaced end and side walls, a rectangularly shaped stationary skid arranged in said furnace, and one of the side walls of said furnace being provided with a door arranged opposite to said skid, an angularly-shaped mold arranged within said furnace, said mold having a bottom wall slidably mounted on said skid and side and end walls extending upwardly from its bottom wall to provide an angularly-shaped casting cavity, a feeding column extending through one of the walls of said furnace and having its free end portion terminating within the cavity of said mold through which metal in the form of small particles may be fed into the cavity of the mold, an electrode having its free end portion extending into the cavity of said mold in proximity to the metal particles passing into the cavity of the mold, means for applying sufficient electrical energy to said electrode to provide an arc of sufficient intensity between the electrode and the metal particles passing into the cavity of the mold to melt the metal particles, said mold being of sufficient length that its end walls are spaced a substantial distance from said electrode and feeding column when the mold is in a substantially central position between the end walls of said furnace, means for alternately moving said mold in opposite directions on said skid while the metal particles are being melted so that a uniform deposit of metal will be formed in the cavity of the mold, and means for cooling said mold to provide a rectangularly-shaped casting within the cavity of the mold, and said skid being provided with indentations below said mold for receiving a forked truck by means of which the mold may be removed from said skid and furnace and a new mold deposited on the skid when the furnace door is open.

12. The method of preparing angularly-shaped flat castings which comprises inserting within the walls of a substantially closed furnace and in spaced relation to the walls of the furnace a mold having a flat bottom wall and an angularly-shaped casting cavity, feeding metal in the form of small particles into one portion of the cavity of the mold, applying sufficient electrical energy to an electrode having a free end portion arranged in the cavity of the mold in proximity to the metal particles being fed into the cavity of the mold to melt the metal particles, alternately moving said mold in a horizontal path in opposite directions relative to said electrode and

the metal particles being fed into the cavity of the mold to provide a uniform deposit of metal within the cavity of the mold, and cooling the mold to solidify the metal formed therein into an angularly-shaped flat casting.

13. The method as defined in claim 12 including the step of passing through the furnace a gas which is inert to the metal being melted to cool the furnace and to remove from the furnace impurities in the metal particles which volatilize while the particles are being melted.

14. The method as defined in claim 13 in which the small particles which are fed into the cavity of the mold consist essentially of titanium and minor impurities.

15. The method of simultaneously preparing an alloy and casting it into the form of an angularly-shaped casting which comprises inserting within a substantially closed furnace in spaced relation to the walls thereof, a mold having a flat bottom wall and an angularly-shaped casting cavity, feeding into a portion of the mold cavity at least two metals in the form of small particles in such proportions relative to each other than an alloy will be formed when the metals are mixed together in the molten state, applying sufficient electrical energy to an electrode having a free end portion arranged in the cavity of the mold in close proximity to the metal particles being fed into the mold to melt the metal particles, alternately moving said mold in a horizontal path in opposite directions relative to said electrode and the metal particles being fed into the cavity of the mold during the melting operation to form a uniform layer of metal within the angularly-shaped cavity of the mold, and cooling the mold to solidify the metal deposited therein to form a flat angularly-shaped casting.

16. The method of simultaneously preparing a titanium base alloy and casting it into the form of an angularly-shaped flat casting which comprises inserting within and in spaced relation to the walls of a substantially closed furnace, a mold having a flat bottom wall and an angularly-shaped casting cavity, feeding into a portion of the cavity of the mold a mixture comprising a predominant amount of titanium in the form of small particles and a minor amount of at least another metal in the form of small particles in such relative proportion to the titanium particles that it will form an alloy with the titanium when the metals are mixed together in the molten state, applying sufficient electrical energy to an electrode having a free end portion arranged in the cavity of the mold in proximity to the mixture of metal particles being fed into the cavity of the mold to melt the metal particles, alternately moving said mold in opposite directions in a horizontal path relative to said electrode and the mixture of metal particles being fed into the cavity of the mold to provide a uniform deposit of the molten metal within the angularly-shaped cavity of the mold, passing through the furnace during the melting operation a gas which is inert to the metal particles being melted to cool the furnace and to remove from the furnace volatile impurities from the mixture of metal particles while they are being melted within the cavity of the mold, and cooling the mold to solidify the metal deposited therein into an angularly-shaped flat casting.

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