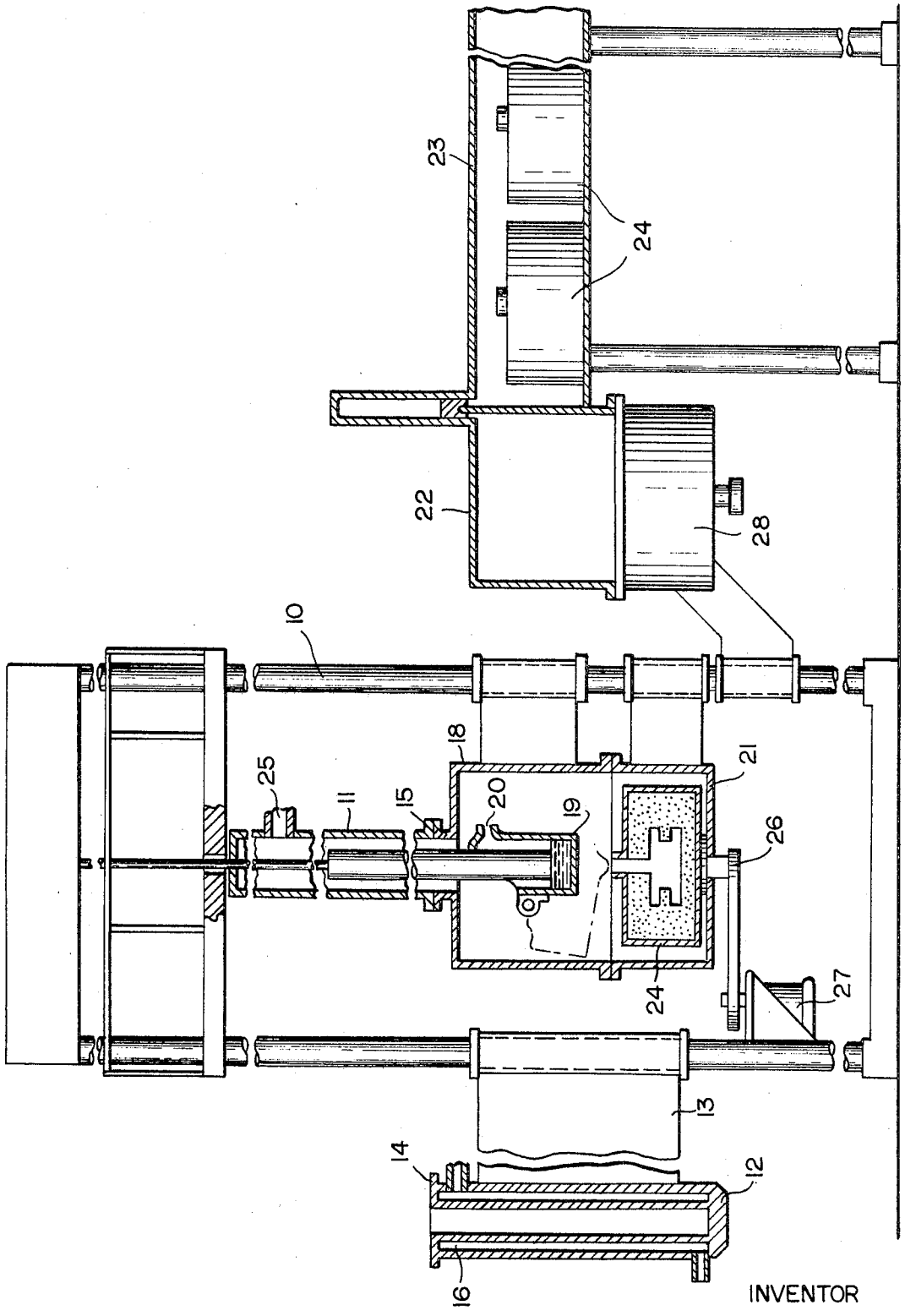
July 7, 1970 A. DUNLOP 3,519,061

APPARATUS FOR USE IN MELTING AND CASTING METALS

Filed July 2, 1968



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United States Patent Office 3,519,061 Patented July 7, 1970

3,519,061

APPARATUS FOR USE IN MELTING AND CASTING METALS

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Filed July 2, 1968, Ser. No. 742,099
Claims priority, application Great Britain, July 4, 1967, 30,755/67
Int. Cl. B22d 27/02, 27/16
U.S. Cl. 164—252 4 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus is provided for melting and casting metals particularly titanium in an inert atmosphere. The apparatus comprises a first chamber into which an electrode such as titanium sponge can be charged and a second chamber where the electrode can be melted to form an ingot. The ingot is then inserted into the first chamber and a third and fourth chamber are attached to the first chamber after removal of the second chamber. The third chamber contains a crucible into which the ingot is melted. The fourth chamber contains a mold into which the molten metal is poured from the crucible. After the first mold has been poured that chamber can be removed and subsequent chambers containing other molds can be moved into position. All of the aforementioned steps are accomplished in an inert atmosphere.

This invention relates to apparatus for use in melting and casting metals, particularly metals (such as titanium and tianium base alloys) which are extremely reactive in molten form and the object of the invention is to provide such apparatus in an improved form.

In accordance with the invention there is provided apparatus for use in melting and casting metals, said apparatus comprising a first chamber into which an electrode can be charged, a second chamber which is adapted to be releasably and sealingly connected to the first chamber and in which an ingot can be formed by melting of the electrode when said second chamber is connected to the first chamber, a third chamber into which a crucible can be charged and which can be releasably and sealingly connected to the firsft chamber when the second chamber is disconnected therefrom, said crucible being arranged to hold molten metal produced by melting of the ingot, a fourth chamber which is adapted to receive a mould and which is adapted to be releasably and sealingly connected to the third chamber, and a furnace or oven in which moulds can be preheated in an inert atmosphere, said fourth chamber being releasably and sealingly connectible to a gas lock at one end of said furnace or oven whereby a mould can be transferred in an inert atmosphere from the furnace or oven to the fourth chamber prior to the latter being releasably and sealingly connected to the third chamber.

Conveniently, the first chamber may be fixedly mounted on a stand or framework whilst the second,: third and fourth chambers are mounted on the stand or framework so as to be each capable of pivoting about a vertical axis relative thereto. Moreover, the fourth chamber may be provided with a rotatable turntable, on which a mould can be placed when it is required to carry out a centrifugal casting operation.

The invention will now be more particularly described with reference to the accompanying drawing which is a sectional elevation showing one example of an apparatus constructed in accordance with the invention.

Referring to the drawing, there is shown therein a stand or framework **10** on which is fixedly mounted a first chamber **11** which is of generally cylindrical configuration, said chamber being arranged so that its longitudinal axis extends in a generally vertical direction. The upper end of said first chamber is formed with an aperture through which extends a feed rod to which the upper end of an electrode can be attached for feeding the electrode into the chamber.

There is also provided a second chamber **12** which is of generally cylindrical configuration and which is mounted on the stand so as to be pivotable about a generally vertical axis, said second chamber being capable of being swung on an arm **13** connected to the stand **10** from a position in whichf it is disposed on one side of said first chamber (as shown in the drawing) to a position in which it is disposed directly beneath the first chamber and aligned therewith. The two adjacent ends of the first and second chambers in the second mentioned position are provided with flanges **14** and **15** which can be clamped together so that the first and second chambers can be releasably and sealingly connected together with the interior of the first chamber, in communication with the interior of the second chamber. The second chamber is adapted to receive or itself forms a crucible having a water jacket **16** for cooling purposes, there being suitable connections for the water supply through the walls of the second chamber.

The first and second chambers (when connected together) are used to produce an ingot **17** by melting an electrode (not shown) which in the case of titanium or a titanium base alloy may be of the kind generally known as a sponge electrode. Said electrode is initially inserted through the first chamber and into the second chamber and an arc is struck between the lower end of the electrode and the crucible placed in the second chamber or the bottom of the second chamber so as to melt the lower end of the electrode. The electrode is then fed into the two chambers at a predetermined rate by conventional feeding apparatus so that an ingot is formed in the second chamber, the ingot being solidified and cooled by the above mentioned water jacket. Then the ingot thus formed is raised into the first chamber, it being understood that the upper end of the ingot will remain attached to the electrode, before the second chamber is disconnected from the first chamber and swung sideways out of alignment with the first chamber.

There is also provided a third chamber **18** which serves to contain a further crucible **19** and which is pivotally mounted on said stand **10** so as to be capable of being swung from a position on the opposite side of the first chamber to the second chamber to a position (as shown in the drawing) in which it is also aligned with the first chamber. The upper end of said third chamber **18** is provided with an aperture through which the aforementioned ingot **17** can be fed whilst means are provided for releasably and sealingly connecting said third chamber to the lower end of the first chamber. In the drawing, the ingot **17** is shown in an intermediate position between the first and third chambers. Said crucible **19** is also provided with a pouring nozzle **20** at the upper end of one side, the crucible being pivoted about the upper end of the opposite side and being capable of being turned about its pivotal axis from the exterior of the third chamber without having to retract the ingot **17**. In use, when the third chamber is connected to the first chamber as above described the previously formed ingot **17** can be fed into the third chamber and an arc struck between its lower end and the crucible **19** (which is conveniently formed of copper and which is cooled) in order to form a pool of molten metal from which castings will subsequently be made.

There is also provided a fourth chamber **21** which is pivotally mounted on the stand **10** below the third cham-

ber **18** and which can be swung between a position in which it is aligned with the third chamber (as shown) so that it can be releasably and sealingly connected thereto (apertures in said third and fourth chambers being provided to establish communication between the interiors of said chambers) and a position in which it is disposed laterally outwardly of the stand so that it can be sealingly and releasably connected to the bottom of a chamber **22** forming a gas lock which is disposed at one end of a furnace or oven **23**. The latter is used for the purpose of preheating moulds **24** into which metal is to be cast and since some moulds may contain carbon it is necessary to ensure that the preheating is carried out in an inert atmosphere which may be provided for example by argon gas or in a vacuum.

Thus in use a series of moulds **24** would be placed in the inert atmosphere in the furnace or oven **23** and when it is desired to transfer a mould into the fourth chamber preparatory to carrying out a casting operation the fourth chamber would be sealingly connected to the bottom of the aforementioned gas lock **22** and the combined space of said gas lock and the fourth chamber flooded with argon gas. The gas lock would then be operated so that one of the moulds **24** in the furnace or oven can be passed through the gas lock and into the fourth chamber after which the latter would be disconnected from the gas lock and swung into a position in which it is sealingly connected to the bottom of the third chamber **18**. The third chamber itself is connected to the lower end of the first chamber and a vacuum pump is then connected by a connection **25** to the assembly of first, third and fourth chambers in order to form a vacuum therein before melting of the ingot **17** into the crucible **19** commences. When the required amount of metal has been melted said crucible is tilted by means operated externally of the third chamber in order that molten metal can be poured by gravity into the mould **24** located in the fourth chamber **21**. If desired said fourth chamber may also incorporate a rotatable turntable **26** so that a centrifugal casting operation can be effected, the turntable being drivable by means of an electric motor **27** which is disconnected from the turntable when the fourth chamber is to be swung to the outer position.

As previously mentioned, the apparatus as above described is particularly suitable for making castings in titanium or titanium base alloys which are extremely reactive when molten and it will be appreciated that the whole casting operation will be performed under controlled and non-reactive conditions. Moreover, if desired the fourth chamber can be duplicated so that two of such chambers are provided and are pivotable on a common axis, one chamber being loaded or unloaded whilst the other chamber is in use. Thus, in the drawing, there is a

fifth chamber **28** (duplicating the fourth chamber) which is shown in the loading position whilst the mould in the fourth chamber is in a position for being filled with molten metal.

What I claim is:

1. Apparatus for use in melting and casting metals, said apparatus comprising a first chamber into which an electrode can be charged, a second chamber which is adapted to be releasably and sealingly connected to the first chamber and in which an ingot can be formed by melting of the electrode when said second chamber is connected to the first chamber, a third chamber into which a crucible can be charged and which can be releasably and sealingly connected to the first chamber when the second chamber is disconnected therefrom, said crucible being arranged to hold molten metal produced by melting of the ingot, a fourth chamber which is adapted to receive a mould and which is adapted to be releasably and sealingly connected to the third chamber, and a furnace or oven in which moulds can be preheated in an inert atmosphere, said fourth chamber being releasably and sealingly connectible to a gas lock at one end of said furnace or oven whereby a mould can be transferred in an inert atmosphere from the furnace or oven to the fourth chamber prior to the latter being releasably and sealingly connected to the third chamber.

2. Apparatus as claimed in claim **1** wherein there is provided a stand or framework, the second, third and fourth chambers each being mounted so as to be pivotable relative to the stand or framework about a vertical axis.

3. Apparatus as claimed in claim **1** wherein the fourth chamber is provided with a rotatable turntable adapted to support a mould for carrying out a centrifugal casting operation.

4. Apparatus as claimed in claim **1** wherein there is provided a fifth chamber which is also adapted to receive a mould and which is adapted to be releasably and sealingly connected to the third chamber, said fifth chamber being arranged so that it can be loaded or unloaded whilst the fourth chamber is in use, and vice-versa.

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U.S. Cl. X.R.

164—52, 121, 258