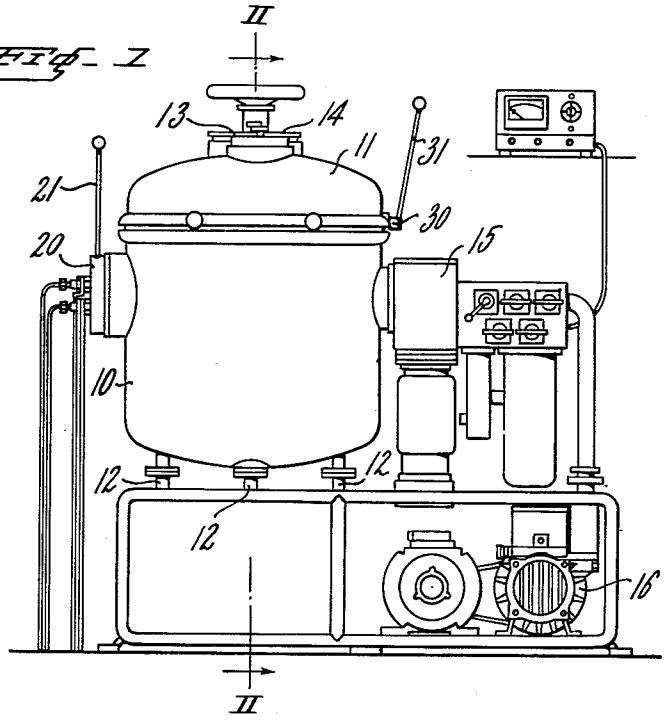
July 19, 1955 O. C. WINKLER 2,713,183

DEVICE FOR MELTING AND CASTING UNDER AIR-EXCLUSION

Filed Nov. 3, 1950 2 Sheets-Sheet 1

Fig. 1



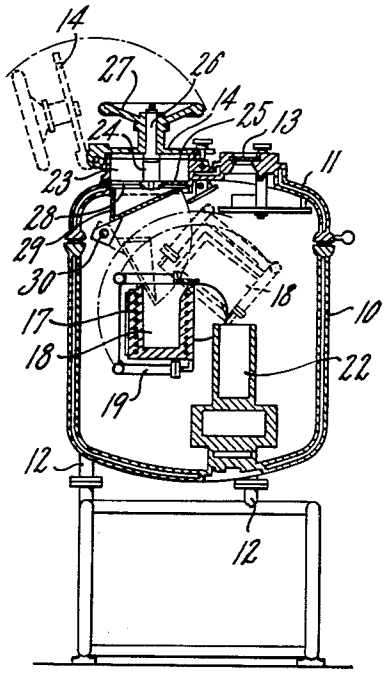


Fig. 2

Fig. 3

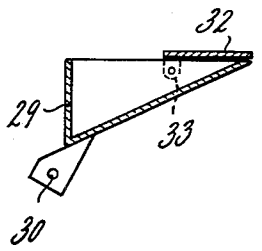


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Fig. 4

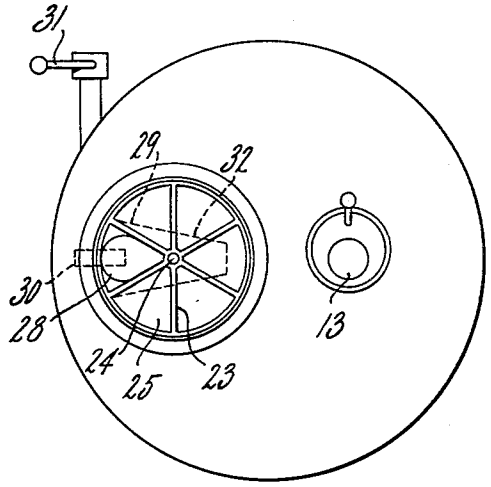
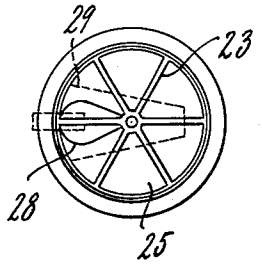


Fig. 5



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DEVICE FOR MELTING AND CASTING UNDER AIR-EXCLUSION

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4 Claims. (Cl. 22—73)

In the production of pure and gas-free materials with exactly defined composition the melting and casting operation thereof must take place under air-exclusion or in a protective gas atmosphere, the melting crucible and the mould being located within a gas-tightly closed and evacuated container. An electric heating device consisting of a resistance element or a high-frequency coil is used for heating the melting crucible. Particularly in heating with high frequency it is as a rule not possible to initially fill the whole charge of the material to be melted into the crucible, in order to prevent jamming of the material in the crucible and to accomplish the melting operation with a favourable electrical efficiency. Experience has shown that when melting with high-frequency at the start only part of the intended crucible charge is to be filled into the melting crucible which charge is then to be pre-melted to a molten bottom, whereupon further material is added gradually, care being taken that the crucible charge, if possible, never solidifies completely.

When melting under air-exclusion, the addition of material during the melting process is, however, rendered much more difficult. The sluicing of material into the highly evacuated container is only possible with the help of complicated appliances necessitating a great technical expenditure and making the safety of the device doubtful. Actually arrangements are known in which a storage receptacle for the material to be melted is provided in the interior of the air-tightly closed container as well as a chute leading from this receptacle to a point above the melting crucible, which chute is capable of being pivoted out of the way. The adjustment of the delivery of the material to be melted then takes place immediately below this receptacle and before the material reaches the chute. The disadvantage of this arrangement lies in the fact that the material to be melted slides down the chute with increasing speed and drops with considerable kinetic energy into the molten charge causing splashing thereof.

The present invention has as its object the elimination of the difficulties and disadvantages described and relates to a device for melting and casting under air-exclusion having an air-tightly closed and evacuated container encasing a melting crucible provided with an electric heating device and at least one mould as well as a delivery element operable from the outside of said container and arranged between a receptacle for the material to be melted and the melting crucible. The device is in particular characterized in that a feeding chute having at least one part tiltable about a horizontal shaft is provided as the delivery element, said feeding chute being located below the receptacle for the material to be melted and with at least the tiltable part above the melting crucible in such a manner that by operating the tiltable part the material to be melted can be fed into the melting crucible successively in any desired timed and quantitative sequence.

Preferably the feeding chute takes the shape of a tiltable shovel secured to a shaft pivotally and gas-tightly mounted in the side wall of the container, said

shaft beinge provided with an operating means located on the outside of the container. Additional means can be provided to reduce the kinetic energy of the material to be fed contained in the feeding chute practically to zero, for which purpose a flap at the feeding end of the feeding chute may, by way of example, be provided, said flap moving into the path of travel of the material to be fed under the influence of its own weight in such a manner that only a narrow slot is created between the chute and the flap out of which slot the material issues on the feeding chute being shaken.

By way of example two embodiments of the object of the present invention are shown in the drawing accompanying and forming part of this specification in which:

Fig. 1 is a front view of the device for melting and casting in a high vacuum.

Fig. 2 a vertical cross-section through the device along line II—II in Fig. 1,

Fig. 3 a partial alternative to Fig. 2 in vertical cross-section,

Fig. 4 a plan view of the container of Figs. 1 and 2 with the flap removed, and

Fig. 5 a plan view of a portion of the container of Fig. 4 showing the receptacle in the course of movement to a different operative position.

The melting and casting device illustrated in Figs. 1 and 2 comprises a container **10** provided with double walling, said container **10** with the interposition of rubber seals being closed off by a lid **11** similarly provided with a double walling. The interspace between said two walls is connected in a cooling water flow by means of the pipe lines **12**. On the top of the lid **11** there is a glass window **13** for the observation of the melting and casting operation as well as a charging orifice capable of being closed gas-tightly by means of a hingeable flap **14**. A high-vacuum diffusion pump **15** of high evacuation capacity is connected to the container **10** at its suction end and to a suitable pre-vacuum pump **16** at the other end.

In the interior of the container **10** there is a vessel or melting crucible **18** embedded in a high-frequency coil **17** said two parts being secured to a horizontal shaft **20** and mounted pivotally and vacuum-tightly in the wall of the container **10** by means of a carrier **19**, said shaft having an operating lever **21** on the outside of said container. The arrangement of the melting crucible **18** is such that on rotation of the shaft **20** said crucible is tilted into the position shown by broken lines in Fig. 2 in which position it is above a mould **22** located vertically in said container and has its spout directed downwardly.

Below the flap **14** a receptacle **23** of circular plan view is arranged in the neck of the charging orifice, said receptacle being radially divided into a multiplicity of segment-like compartments disposed about and secured to a vertical shaft **24**. These compartments are open towards the bottom and rest on a horizontal plate **25** rigidly secured in the neck of the charging orifice, said plate closing said compartments and pivotally carrying said shaft **24**. In the centre of the flap **14** a shaft **26** carrying a hand wheel **27** on the top side of said flap is gas-tightly and also pivotally mounted in such a manner that on said flap being closed said shaft **26** is in line with the shaft **24**. The two ends of the shafts **24** and **26** facing each other have means for their rotational coupling. The horizontal plate **25** has an orifice or aperture **28** corresponding at a time with one of the compartments of the receptacle **23**, a feeding shovel or hopper **29** of triangular vertical cross-section being arranged below said orifice **28**. Said feeding element has an open top disposed beneath said plate **25** and an inclined bottom

secured to a horizontal shaft 30, which is pivotally and gas-tightly mounted in the wall of the container 10 and which shaft 30 has an operating lever 31 on the outside of said container 10, the whole being adapted in such a manner that by rotating the shaft 30 the shovel 29 is tilted into the position shown by broken lines in Fig. 2 in which position said shovel partly projects into the opening of the melting crucible 18.

The material to be melted, such as various metals to be alloyed, are filled into the individual compartments of the receptacle 23 in the desired sequence before evacuation of the container 10 with flap 14 hinged upwardly (Fig. 4), the plate 25 preventing the material from dropping downwardly. Only the material fed into the compartment located above the orifice 28 drops into the shovel 29. After closing the flap 14 the container 10 is evacuated and the high-frequency coil 17 is connected to a high-frequency generator. By tilting the shovel 29 downwardly the material contained therein is fed into the melting crucible 18 where it melts under the influence of the high-frequency field passing through the coil 17. To charge further material the receptacle 23 is rotated by the angular size of one compartment by means of the hand wheel 27 whilst the shovel 29 is hinged upwardly so that the material contained in the next compartment drops through the orifice 28 into the shovel and from there can be fed into the melting crucible 18 by tilting said shovel at will and in any desired quantitative sequence.

Fig. 5 shows the receptacle 23 during movement from the operative position of Fig. 4 to a position wherein another compartment will come into registry with orifice 28.

On tilting said shovel its spout dips relatively far into the crucible so that the material drops into the molten material from a relatively low height whereby splashing of said molten material is avoided.

This condition can be still better ensured by fashioning the shovel according to Fig. 3. At the feeding end of the shovel 29 a flap 32 is provided which is pivotally secured to the side walls of said shovel by means of the lugs 33 and which rests against the feeding end of said shovel under the influence of its own weight. If this shovel is tilted downwardly, the material contained therein cannot simply slide into the melting crucible, but is kept back by the flap 32 lying in the path of travel of the material. Between the shovel and the flap there is only a slot out of which the material drops out on the shovel being shaken. The material to be melted thus leaves the shovel without any initial speed and only drops with the speed of gravity from a low height into the molten material. Because of the small distance between the point of discharge and the molten material the charge has but little potential energy relative to the molten material. The kinetic energy of the material created by the sliding motion of the material on the shovel is reduced practically to zero, i. e., braked by the flap. Splashing of the molten material is thus almost completely eliminated.

Instead of the flap 32 some other means, preferably in the form of baffles, could be provided to reduce the kinetic energy of the trickling material in the shovel almost to zero.

With the device described it is possible to feed the material to be melted in exactly controllable quantities and in the desired sequence by degrees into the melting crucible, the charging and melting process being capable of being controlled by observation through the glass window 13 in exactly the same manner as when melting in the open. Thus the safety of operation of the vacuum melting and casting device is greatly increased and the condition created by which sensitive alloys, by way of example such having components with a strong affinity to residual gases, can be produced with safety.

According to an alternative not shown the device can have means for introducing a protective gas atmosphere into the evacuated interior space of the container.

The feeding element between the receptacle 23 and the melting crucible 18 might also be a chute not having the shape of a shovel provided with at least one part tiltable about a horizontal shaft and arranged above the melting crucible.

What I claim and wish to secure by Letters Patent is:

1. In a furnace having a chamber, a crucible and a mould supported within said chamber; the improvement which comprises an open-bottom receptacle radially divided into a plurality of segmental compartments, said receptacle being disposed within said chamber, plate means closing said open bottom of said receptacle and forming a base for said compartments, said plate means being provided with an aperture, shaft means extending from said receptacle to a location outside of said chamber, means outside said chamber for rotating said shaft means intermittently to thereby register said compartments successively and intermittently with said aperture of said plate means, hopper means disposed beneath said aperture of said plate means in a first position and pivotally mounted for movement to a second position to thereby facilitate discharge of said hopper means into said crucible, said mould being disposed to receive material from said crucible, and means for pivoting said hopper means between said first position and said second position, said pivoting means extending exteriorly of said chamber for actuation from therewithout, whereby material within each of said compartments can be successively discharged therefrom into said hopper means by intermittent rotation of said shaft means, so that said material within said hopper means is thereafter supplied to said crucible by actuation of said pivoting means upon inactuation of said rotating means.

2. In a furnace according to claim 1, wherein said hopper means is triangular in vertical cross-section and has an open top disposed in said first position beneath said plate means and its bottom extending downwardly from said plate means to the pivot point for said hopper means.

3. In a furnace according to claim 2, including a flap adjacent said hopper means extending from said bottom along said open top and partially covering the latter in said first position, and lug means pivotally securing said flap to said hopper means.

4. In a furnace having a crucible supported within a chamber and pivotable for discharge of its contents into a mold; an open-bottom receptacle disposed within said chamber and divided into a plurality of compartments, plate means disposed beneath said open bottom of said receptacle and forming a base for said compartments, said plate means being provided with an aperture, means for displacing said receptacle with respect to said plate means to thereby register said compartments successively and intermittently with said aperture of said plate means, said displacing means extending from said receptacle to a location outside of said chamber, hopper means disposed beneath said aperture of said plate means in a first position and pivotally mounted for movement to a second position to thereby facilitate discharge of said hopper means into said crucible, and means for pivoting said hopper means between said first position and said second position, said pivoting means extending exteriorly of said chamber for actuation from therewithout, whereby material within each of said compartments can be successively discharged therefrom into said hopper means upon intermittent actuation of said displacing means, so that said material within said hopper means is thereafter supplied to said crucible by actuation of said pivoting means upon inactuation of said displacing means.

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5

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