

[54] **CRYSTAL MELTING APPARATUS
FASHIONED TO ELIMINATE BUBBLES
ENTRAPPED IN THE MELT**

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[58] **Field of Search**..... 23/273 SP, 301 SP

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[57] **ABSTRACT**

An improved melting apparatus, preferably a zone melting apparatus, wherein the surface of a current traversed body has the form of a bowl or pot in the melting region wherein a substance to be melted and the body surface are contacted. This apparatus aids in the elimination of entrapped bubbles in the melted and subsequently solidified substance.

7 Claims, 5 Drawing Figures

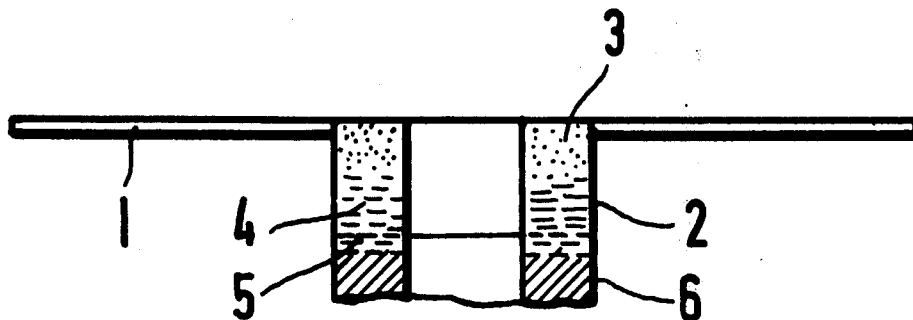


FIG. 1

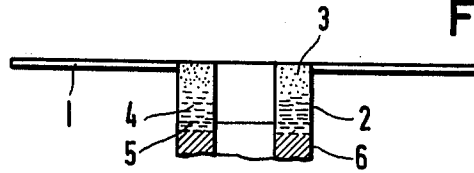


FIG. 2

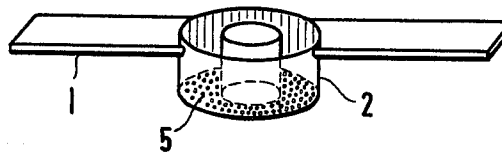


FIG. 3

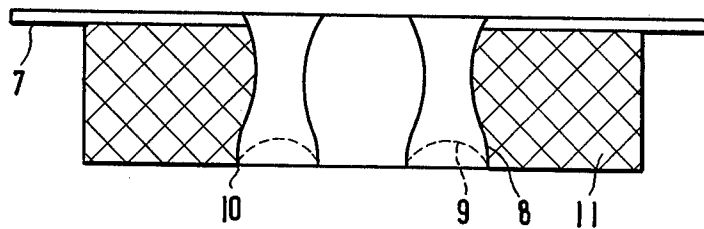


FIG. 4

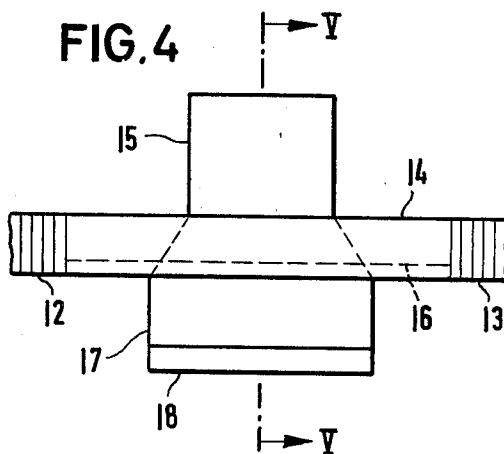
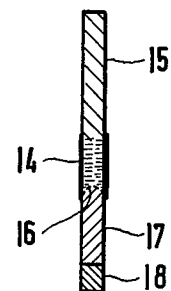


FIG. 5



CRYSTAL MELTING APPARATUS FASHIONED TO ELIMINATE BUBBLES ENTRAPPED IN THE MELT

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for melting substances, particularly zone melting, with an electrically conducting and current-traversed body, wherein there is applied to the surface of the body the substance to be melted and the surface has at least one downwardly extending opening.

It is a known practice in zone melting to press a bar of the substance to be melted against a perforated strip of precious metal which is heated by electric current to deliver the heat for melting. The substance which is melted by contacting the precious metal strip escapes through small openings on the underside of the precious metal strip. The liquid substance reunites on the underside of the strip into a continuous melt zone. From the melt zone there is a slow lowering of a support to solidify or crystallize the liquid substance. The working speed of this known system is relatively low, since the contact surface of the heated precious metal strip is relatively small. Further, the bar being melted must not be moved too rapidly, because there exists the danger that the molten material will swell off to the sides. A particular disadvantage as a result, is that the liquid layer above the current-traversed precious metal strip in the melt zone can be only relatively thin. Therefore, there exists the danger, especially when the substance is a sintered bar, that gas bubbles included in the melt will migrate through the openings in the precious metal strip and will be frozen in or trapped on the under side of the substance on solidification.

SUMMARY OF THE INVENTION

An object of this invention is to avoid the disadvantages of the known apparatus and to provide a melting apparatus, preferably for zone melting, which has a high working speed, avoids the entrapment of gas bubbles and which can work complicated cross section forms.

The object underlying this invention is solved by having the surface of the body in the melting region in the form of a bowl or of a pot, which is open at the top.

When the surface of the surface-traversed body has a bowl or pot-form construction, the contact surface between the heating body and the body to be melted is increased. As a result heat transfer is increased and a higher melting speed is made possible. When the pot has a sufficient depth it is possible, to melt powder-form substances which are frequently inexpensively available as waste. The described prior art process cannot utilize these powdered wastes.

The cross section of the pot form can be formed arbitrarily so that it is possible to produce bars of any desired cross section form in the zone melting process. The cross section can also, for example, be annular if the production of a pipe is desired. For the production of plates the cross section can have the form of an elongated rectangle.

The bottom of the pot can also be of sieve form. This allows a uniform passage of molten material over the entire melt surface. In this manner, spheres can also be produced where a support is not present underneath the sieve-form bottom and the liquid drips out of the

sieve openings. The drops then rapidly coalesce into spheres because of their surface tension.

Another preferred embodiment of the invention consists in the bottom of the pot being formed by a strip, known per se, which is heated by an electric current flux with the side walls of the pot extending upward from the surface of the strip. This construction is simple, when the side walls of the vessel must not give off heat, and, therefore, must not be heated. The side walls can then, for example, have the form of a ring of a material that does not conduct electric current and heat. In this case, the ring is simply placed on the surface of the strip.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be further explained with the aid of the drawings wherein:

FIG. 1 shows in section, an apparatus according to the invention for the production of a pipe;

FIG. 2 shows the apparatus according to FIG. 1 in perspective;

FIG. 3 is a modification of FIG. 1, wherein the walls of the pot have a different construction;

FIG. 4 illustrates the zone melting of a plate; and

FIG. 5 is a section taken along section line V—V of FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1, a strip 1 is connected through its ends to a current source (not represented). Strip 1 serves to supply electric current to a central annular pot 2 filled with particles 3 of a substance to be melted. When the current is switched on, the walls of the pot 2, which have a suitable electric resistance, are heated, and the particles 3 are melted thereby forming a melt zone 4. The bottom 5 of the pot 2 is perforated, so that molten material can pass through the holes in the bottom. Beneath the bottom 5 there is a pipe 6 of resolidified material. Pipe 6 is represented in part and supports the melt zone 4. The pipe 6 is lowered in any manner known in zone melting in relation to the melting rate or the solidification rate.

In addition, pot 2 can be provided with heat insulation in order to maintain a high efficiency. Instead of the particles 3, usually inexpensively obtained, a sintered tubular bar can also be introduced from above.

FIG. 2 shows the apparatus according to FIG. 1 in perspective, without the contents in the pot 2 and the pipe 6 positioned under it. The strip 1 can also be conveniently positioned too, at the midpoint of the side wall of the pot 2 or in the zone of the bottom 5. Through its position on the pot the current distribution can be adjusted thereby adjusting the heat generation in the pot 2.

FIG. 3 shows a particularly preferred embodiment of the apparatus of the invention. A pot 8, with a relatively great height, is positioned in the central region of a strip 7. As a result, particularly through the constricted cross section in the middle zone, there is produced a particularly great height in the melt zone, in which bubbles can move upward. This results in a bubble-free material emerging from the bottom 9 of the pot 8. The bottom 9 is again perforated. A special feature of bottom 9 is its upward domed positioned, or convex form (otherwise, it is like the annular bottom 5 in FIG. 2). The upward positioned dome yields on the lateral borders sharp edges 10, which produce a clean flow of

the material from the pot and produce a pipe with a smooth wall.

The great height in the melt zone in the apparatus illustrated in FIG. 3 makes possible, the admixing of additional substances into the melt in order to lower the melting point of the melt. Therefore, it is possible to form substances into crystal bodies which are otherwise stable only considerably below the melting point.

In the apparatus according to FIG. 3, the pot 8 is laterally insulated against heat loss by an insulation 11. For equalization, the bar drawn from FIG. 3 can be rotated like a sintered bar that is being melted.

FIG. 4 shows an apparatus, where there is arranged between two electrodes 12 and 13 an elongated, substantially rectangular pot 14, narrow, in cross section. The bottom of the pot (see section V—V in FIG. 5) is arched upward like the pot 8 in FIG. 3. A plate 15 is introduced from above into the pot 14 and melted. There is thus formed inside the pot 14, a melt zone, and the molten material forces its way out through the perforated bottom 16. Underneath the pot 14 there is formed a plate 17 consisting of solidified material grown from a monocrystal bar 18 and is, therefore, also material grown from a monocrystal bar 18 and is, therefore, also monocrystalline. The plate 17 is slowly lowered in correlation to the melting rate in the pot 14. The sharp edges formed between the bottom 16 and the side walls of the pot 14 provide for a good release of the melt from the bottom of the pot 16 in the border zone and, as a result, an exactly dimensioned and true plate 17.

I claim:

1. An apparatus for zone melting a substance comprising in combination:

- a substantially planar, strip member having an opening therethrough;
- side walls extending transversely from said strip member and enclosing said opening;
- a sieve member secured to said side walls, said side walls and sieve member defining a pot-shaped cavity for receipt of said substance; and
- means for passing a current through said strip member, side walls and sieve member to resistantly heat said side walls and sieve member, said side walls,

sieve member and current-passing means cooperating to define means for conductively heating said substance to produce a zone of molten substance within said pot-shaped cavity, said substance being in direct physical contact with said side walls and sieve member, said molten substance passing through said sieve member and said pot-shaped cavity to be subsequently solidified, whereby gas bubbles in said zone are permitted to move upwardly to substantially avoid the entrapment of said bubbles in said subsequently solidified substance.

2. An apparatus as claimed in claim 1 wherein said sieve member is dome-shaped and converges in sharp edges with said side walls.

3. An apparatus as claimed in claim 1 wherein said opening is annular.

4. In an apparatus for purifying a substance including a substantially planar, strip member having a perforated region and means for passing a current through said strip member to heat said perforated region, said substance being placed in direct physical contact with said perforated region whereby said substance melts, passes through said perforated region and is subsequently solidified, the improvement comprising side walls for said perforated region extending transversely from said strip member and enclosing said perforated region to define a pot-shaped cavity for receipt of said substance, said side walls being heated by said current, said strip member, side walls, and current means cooperatively defining means for conductively heating said substance to produce a zone of molten substances within said pot-shaped cavity, whereby gas bubbles in said zone are permitted to migrate upwardly to avoid the entrapment of said gas bubbles in said subsequently solidified substance.

5. An improvement as claimed in claim 4 wherein said perforated region is an annular region.

6. An improvement as claimed in claim 4 wherein said perforated region is an elongated, rectangular region.

7. An improvement as claimed in claim 4 wherein said side walls are insulated.

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