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PROCESS AND APPARATUS FOR THE CONVERSION
OF MOLTEN METALS OR METAL ALLOYS
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Fig. 1.

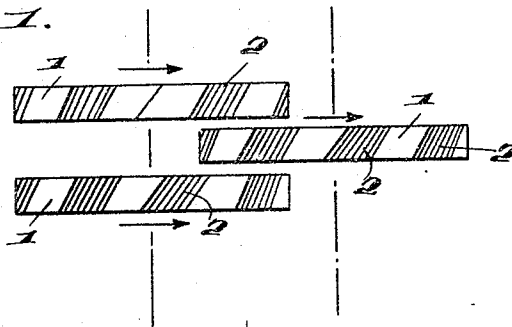


Fig. 2.

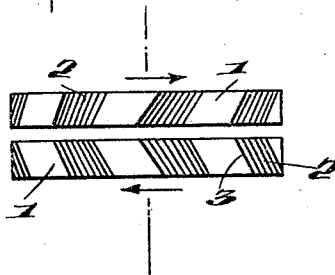


Fig. 3.

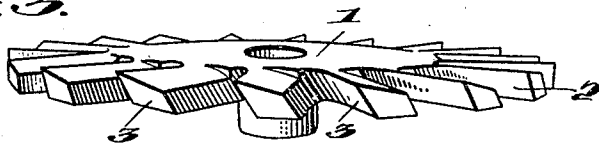
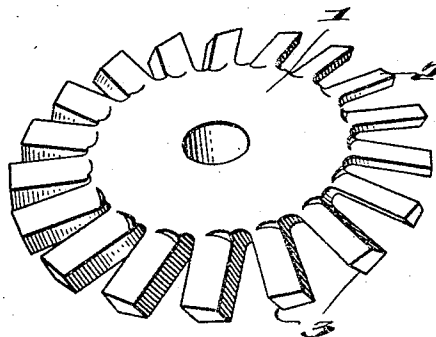


Fig. 4.



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PROCESS AND APPARATUS FOR THE CONVERSION OF MOLTEN METALS OR METAL ALLOYS

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9 Claims. (Cl. 83—91)

My invention relates to a process and an apparatus for the conversion of molten metals or alloys into a finely divided form with the employment of several rapidly rotating elements, particularly discs, as comminuting means.

It is known to convert metals or metal alloys into a finely divided form by impinging the molten substances on the rotating disc whilst cooling water or the like is simultaneously sprayed on the disc. Depending on the speed of rotation of the disc and the kind of cooling the impinged substance is converted into more or less finely divided particles. Thereby a mixture of differently sized grains, i. e., fine and coarse powder, is obtained. This difference in the size of grains requires a new operation step, as the material must be sieved or sifted in order to obtain a metal powder with nearly uniformly sized grains. It has already been proposed to arrange the rotating elements in a stepped or discontinued manner but the powder obtained was yet differently sized and involved a subsequent sieving or sifting if a powder with a special fineness was required.

Object of my invention is a substantial increase in the share of a special narrow area of grain sizes, without any subsequent sieving or sifting operation so that a powder with particles of a definite fineness is obtained. A further object of my invention is the preliminary determination of the narrow area of the desired grain size.

Now I have found that a rather large quantity of nearly equally sized subdivided grain particles may be obtained if at least two rotating elements are employed to comminute the molten good. It has proved expedient to arrange the rotating elements in such manner that the particles propelled off by one rotating disc are impinged on the other disc and finely divided until solidification. Another object of my invention lies in the fact that the rotating elements are independent from each other, moving with different speed against each other.

The scope of my invention may be explained as follows: The molten good impinges on the first rotating element and is comminuted. The smallest particles solidify at once and are propelled off without any further division on the next rotating element. The larger particles which probably due to the heat insulating effect of the enclosing water vapor, impinge in a liquid state on the next rotating element are subject to a further subdivision and will yield to a grain size nearly equal to the smallest particles of the first rotating element. The comminution may be continued till

all droplets are solidified and no new subdivision may take place.

In most cases two superposed rotating elements will be sufficient. The countercurrent speed of the rotating elements is so great that the impact of the centrifuged particles on the second rotating disc is so heavy that no more rotating elements are necessary. The finely grained particles coming from the first rotating element are nearly all solidified, thus forming already the final product. In contrast to the known rotating elements with ribs or the like it is an essential feature of the new invention that the particles are propelled off from the first rotating element are impinging with an increased vehemence on the second rotating disc. The hitherto known rotating elements are provided with different steps, ribs or the like on the same disc and have therefore no relative velocity against each other. The limit of the smallest diameter of the particles is obtained through the rotating speed of the first rotating element.

Now I have found that according to my invention the best yields and most uniform products of equally sized particles will be obtained by rotating elements with openings which overlap in the opened parts. Preferably the rotating elements are constructed as impellers or blade wheels whereby the resilient surfaces of the impellers or blade wheels are placed in such manner that the particles are propelled in the direction of the next rotating elements. It has proved advantageous to design these specially constructed parts with a relatively great strength so that a good and accelerated deduction of heat may take place. This avoids an adherence of the molten good through burning in on the beating blades. I have observed that the rotating elements according to my invention remain perfectly clean after use. Even after a several months' utilization there was no remarkable wear, although one part of the material leaving the first rotating element, impinges in a nearly or wholly solidified state on the next rotating element.

If according to my invention more rotating elements moving with countercurrent or varied speed are used, the yield of an uniform product is far greater than thus obtained with the hitherto known single rapidly rotating disc. The comminution of aluminum, for instance, attains a three times increased yield of finely divided particles (10,000 mesh/qcm.).

To increase the vehemence of impact of the particles coming from the first rotating element, the rotating element may be moved in counter-

current, whereby the second rotating element is arranged in as little a distance as possible below the first rotating element. The countercurrent may be attained in different ways. If the axes of the rotating elements are displaced, the countercurrent will be obtained by rotating of all rotating elements in the same direction. If, however, the superposed rotating elements are concentrically arranged, i. e., coincide, the countercurrent is obtained by the impellers and blade wheels, in case the rotating elements move in countercurrent. Expediently, the rotating elements superpose in their blades or wings. The size of the rotating elements is not prescribed but I prefer to use rotating elements of the same size. If, however, rotating elements are used with different diameters, whereby in a displaced arrangement the second rotating element is greater than the first, the openings of the rotating elements must cover each other. The rotating speed of the elements may be equal or different, according to the respective requirements. The grade of fineness will be obtained by the rotating speed of the first rotating element. If the disc rotates slowly the comminution will yield to coarse grains which, however, will be of substantially the same size.

In order to obtain a perfectly uniform product it is necessary that the material is applied in a molten state and that the casting jet is protected against cooling before it impinges on the first rotating element. Simultaneously with the comminution strong cooling is obtained by application of a cooling medium such as water or the like. Thereby I may proceed, for instance, in such manner that simultaneously with the molten material a cooling liquid is sprayed on the rotating element whereby the rotating element is at the same time also cooled. Through the explosion like evaporation of the cooling liquid the comminution of the molten metal is promoted and a favorable vapor atmosphere is produced. If desired, the walls of the comminution vessel may be cooled also. Instead of or besides a cooling liquid a gas may also be employed. If a gas is used an inert atmosphere will be produced which has proved advantageous with melts of base metals. Nitrogen, carbon dioxide, hydrogen, generator gas, illuminating gas and the like may also be employed as cooling media.

A few embodiments of the invention are illustrated in the annexed diagrammatical drawing.

Figures 1 and 2 show forms of the rotating elements. Figures 3 and 4 show a side view and a plan view of one embodiment of the rotating element.

The rotating elements 1 are placed in as near a distance as possible and are equipped with radially directed propellers, blades 2 or the like. The propellers or blades of the rotating element are moving in countercurrent. The direction of rotation depends upon the arrangement of the rotating elements as a whole. Displaced, the countercurrent is obtained through rotation in the same direction, as in this case the propellers or blades move in contrary direction against each other. If, however, the axes of the rotating elements coincide, the movement of the rotating elements must be contrary to each other in order to obtain a countercurrent effect. The size of axes displacement is to be chosen in such manner that the parts of the rotating elements which are provided with propellers and blades are overlapping (see Fig. 1). The distance between the axes depends upon the size of the rotating ele-

ments whereby the latter may have different or equal diameters.

The impulse of the rotating elements may be utilized anyhow whereby the rotating elements may run with the same or different speed. Thus, for instance, the subsequent rotating elements may have a higher velocity than the first, thereby increasing the impact force.

The casting jet is directed against the part of the first rotating element which is equipped with beating organs. The material is comminuted by the impact force and particles of various sizes are obtained. The smallest particles solidify at once. Owing to their large volume the greater particles remain in a molten state. Impinging on the next rotating element the solidified smaller particles are only propelled off but not subjected to a further comminution. The greater particles are again divided whereby the finer grains solidify immediately. If necessary, more rotating elements may be provided to further comminute the liquid coarser particles on the second rotating element. In this manner a large amount of particles with the same or nearly the same grain size will be obtained. In practice, two rotating elements will be sufficient.

The beating elements 2 may be constructed as shown in Figs. 3 and 4.

The blades 3 of the beating elements show such a direction that the molten material or particles are centrifuged to the next rotating element. The planes may thereby be inclined obliquely. It has proved advantageous to make the beating arms relatively strong and broad in order to avoid a burning in of the molten material. This makes an increased deduction of the heat possible so that the material has no time to adhere. The beating elements may also be tapered against the direction of rotation. This procedure prevents that the molten material is spattered sideways without impinging on the beating areas.

The rotating elements are advantageously provided with a larger quantity of beating elements closely arranged at the periphery of the rotating elements. The propellers and blades may be plane or curved. It is essential only that all the material impinges directly on the blades and is propelled off in the direction of the next rotating element.

What I claim is:

1. A process for the conversion of molten metal into fine particles of substantially uniform size, which comprises impinging a stream of molten metal against a rapidly rotating beating surface and simultaneously impelling the resulting subdivided metal directly against a further rapidly rotating beating and impelling surface, while supplying a stream of cooling liquid to the first rotating surface simultaneously with said stream of molten metal.

2. A process for the conversion of molten metal into fine particles of substantially uniform size, which comprises impinging a stream of molten metal downwardly against a rapidly rotating beating surface and simultaneously impelling the resulting subdivided metal downwardly directly against a further rapidly rotating beating and impelling surface, while supplying a stream of cooling liquid to the first rotating surface simultaneously with said stream of molten metal.

3. A process for the conversion of molten metal into fine particles of substantially uniform size, which comprises impinging a stream of molten metal downwardly against a rapidly rotating

beating surface and simultaneously impelling the resulting subdivided metal downwardly directly against a further rapidly rotating beating and impelling surface moving in a direction counter-current to that of the first beating surface.

4. A process for the conversion of molten metal into fine particles of substantially uniform size, which comprises impinging a stream of molten metal downwardly against a rapidly rotating beating surface and simultaneously impelling the resulting subdivided metal downwardly directly against a further rapidly rotating beating and impelling surface, while supplying a stream of cooling liquid to the first rotating surface simultaneously with said stream of molten metal, and causing the subdivided metal particles to be impelled upon rapidly rotating beating and impelling surfaces until they have solidified.

5. An apparatus for the conversion of molten metal into fine particles of substantially uniform size, which comprises a rotating element for beating and impelling downwardly material supplied from above, means for supplying a stream of molten metal to said rotating element, means for supplying a stream of cooling liquid to said rotating element simultaneously with said stream of molten metal, and a second rotating element for beating material impelled downwardly thereto directly in the path of the metal impelled downwardly by the first rotating element.

6. An apparatus for the conversion of molten metal into fine particles of substantially uniform size, which comprises a rotary element, means for supplying a stream of molten metal to such rotary element, means for supplying a stream of cooling liquid to said rotary element simultaneously with said stream of molten metal, beating means on said rotary element for impelling the metal supplied to the element downwardly, and a second rotary element provided with beating means directly in the path of the metal impelled downwardly by the beating means upon the first rotary element.

7. An apparatus for the conversion of molten metal into fine particles of substantially uniform size, which comprises a series of superposed rotary elements, means for supplying a stream of molten metal downwardly to the uppermost rotary element of such series, means for supplying a stream of cooling liquid to the uppermost rotary element simultaneously with said stream of molten metal, said rotary elements being provided with beating blades which impel the metal being treated downwardly and directly against the beating blades of the rotary element next in the series.

8. An apparatus for the conversion of molten metal into fine particles of substantially uniform size, which comprises a rotary element having impelling blades, means for rotating the rotary element in a predetermined direction, means for supplying a stream of cooling liquid downwardly to said rotary element, and means for supplying cooling liquid to the rotary element simultaneously with said stream of molten metal, said impelling blades impelling downwardly the molten metal supplied to the rotary element upon rotation in said predetermined direction, and a second rotary element having impelling blades directly in the path of the metal impelled downwardly by the impelling blades of said first rotary element.

9. An apparatus for the conversion of molten metal into fine particles of substantially uniform size, which comprises a rotating element for beating and impelling downwardly material supplied from above, means for supplying a stream of molten metal to said rotating element, means for supplying a stream of cooling liquid to said rotating element simultaneously with said stream of molten metal, and a second rotating element for beating material impelled downwardly thereto directly in the path of the metal impelled downwardly by the first rotating element, the beating action of said second rotating element being countercurrent to that of the first element.

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