July 9, 1946. C. R. SELIGER 2,403,463

ART OF REDUCING METALS

Filed June 12, 1942

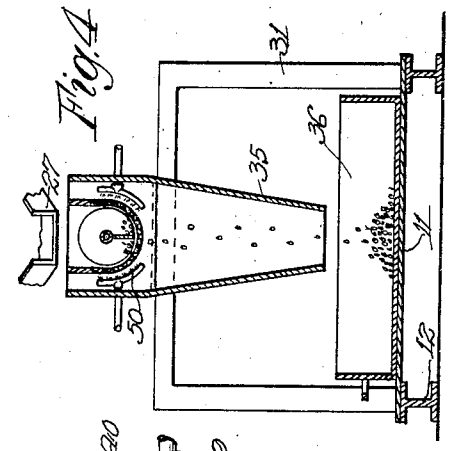


Fig. 4

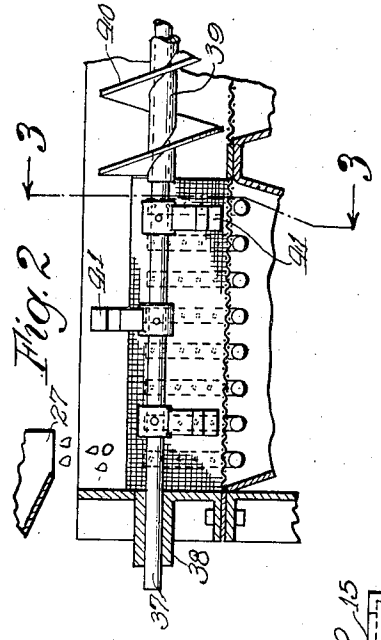


Fig. 2

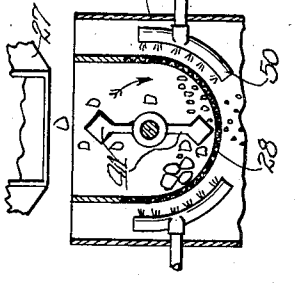


Fig. 3

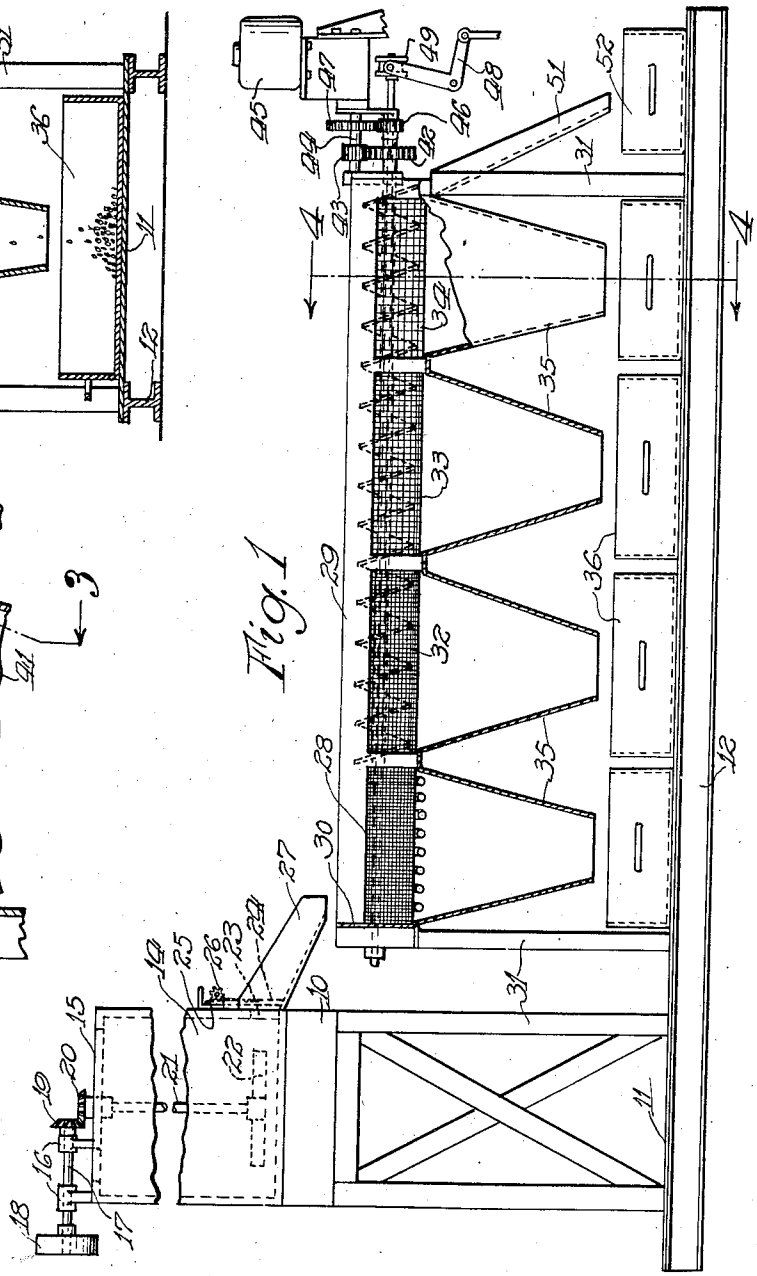


Fig. 1

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ART OF REDUCING METALS

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15 Claims. (Cl. 83—91)

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The invention relates to the art of reducing metals to granular form and particularly to granules having internal lubrication.

The invention concerns metals such as aluminum, antimony, copper, iron, lead, magnesium, tin, and zinc.

It is an object of the invention to produce in an efficient and inexpensive way metal granules which have a porous structure.

A further object of the invention constitutes the provision of metal granules capable of retaining a lubricant both externally and internally, so that when a mass of such granules is compressed into solid form, the product is permeated with a lubricant and has external lubrication.

A further object constitutes the steps of melting the metal, mixing it with a lubricant or lubricants, and subsequently reducing the metal to crystalline particles with irregular surfaces and cellular structure, so that the lubricant is occluded in the particles and the irregular surface cause effective adherence of lubrication externally applied thereto.

It is a still further object to melt metal and subject the molten metal to a mechanical reduction, so as to produce particles of scoriaceous structure, whereby material applied thereto becomes firmly adherent thereto.

With these and other objects in view which will become apparent from a perusal of the invention, the latter comprises the novel steps of a method described in the following specification, particularly pointed out in the claims forming a part hereof and illustrated in the accompanying drawing in which

Fig. 1 is a side view of an apparatus adapted to carry out the method.

Fig. 2 is a longitudinal section through a portion of the apparatus.

Fig. 3 is a section on the line 3—3 of Fig. 2, and

Fig. 4 is a section on the line 4—4 of Fig. 1.

In carrying out my invention, I first melt the metal and then permit it to cool slowly. A solid lubricant, such as graphite, mica, talc, chalk, or oxide of zinc or stearic acid is added to the metal while in molten condition and having doughy consistency.

It is understood that the particular lubricant selected varies with particular requirements. If preferred, colloidal graphite or lubricating oils may be used, depending upon the melting point of the particular metal and the use to which it is put.

For iron and copper colloidal graphite is used

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which is retained in the molten metal because oxygen is excluded.

The lubricant which is added to the molten metal is employed in quantities from three to six parts by weight of lubricant for each one hundred parts by weight of metal.

The molten metal, while cooling off slowly, is subjected to stirring whereby all of the layers of the molten mass are repeatedly brought to the top and exposed to surface oxidation.

Cooling of the molten mass is permitted to a temperature below the melting point of the metal, at which stage the metal assumes semi-fluid or doughy consistency. Any impurities appearing on the surface are removed before the stirring is carried out.

A heated foraminous plate having openings ranging from 2 to 6 mm. is utilized to force the doughy mass therethrough, under continuous impacts whereby crystalline particles of scoriaceous structure result.

I have found that such impacts may be effected by the use of a sledge hammer of about 20 lbs. of weight which is held by the operator and brought down on the doughy mass spread on the heated foraminous plate and is then reciprocated under pressure sufficient to disintegrate the mass through the openings in the plate. This procedure is repeated until all of the mass has been forced through the plate. The best results are obtained when the hammer engages the doughy mass with an edge to obtain a sharp impact.

In commercial application, the apparatus more or less diagrammatically shown in the accompanying drawing is utilized, in which 10 designates a support on which an electric furnace is placed. The support 10 rests on a platform 11 placed on I-beams 12. An electric heating furnace 14 is placed on the support 10 and is provided with a top 15 having openings for the admission of air and for affording access to the top surface of the molten metal in said furnace, to remove impurities.

The top 15 is provided with a pair of bearings 16 in which a shaft 17 is journaled having at one end a pulley 18 and provided at the other end with a bevel gear 19 in mesh with a mating gear 20 on a vertical shaft 21 journaled in the top 15.

The shaft 21 extends to a point short of the bottom of the furnace and has a plurality of blades 22 which stir the molten metal upon rotation of the shaft.

The furnace is provided with an outlet 23 normally closed by a gate valve 24 having a rack 25 in mesh with a pinion 26.

Upon rotation of the pinion 26 the gate valve may be raised to permit the discharge of the doughy metal by a spout 27 to a screen 28 shaped like a trough.

The screen is mounted in a box frame having side walls 29 and end walls 30 and placed on supports 31.

A plurality of screens 32, 33 and 34 are mounted in said box frame with progressively coarser mesh. Hoppers 35 depend from each screen section to discharge screenings into receptacles 36 placed on the platform 11.

A longitudinal shaft 37 is journaled in bearings 38 at the end walls and extends through a hollow shaft 39 which is provided with a screw conveyor 40.

The portion of the shaft 37 within the screen 28 has a plurality of hammers or strikers 41 shaped to engage the material with a sharp edge.

The shaft 39 has a gear 42 in mesh with a pinion 43 on a shaft 44 to which power is imparted from a motor 45.

A pinion 46 is splined on the shaft 37 and meshes with a gear 47 on the shaft 44 so that the shaft 37 rotates with greater speed than the hollow shaft 39. A bell crank lever 48 engages a pulley 49 fast on the shaft 37 to impart reciprocating movement to the shaft 37.

The screen 28 is heated by a plurality of gas burners 50.

In use the metal is molten in the furnace and any impurities appearing on top of the molten mass are removed through the open top 15. The molten metal is stirred and permitted to cool to a temperature from 50° to 100° below its melting temperature to obtain doughy consistency.

Thereupon the gate valve is opened and the doughly metal discharged by the spout 27 to the screen. The shaft 37 being rotated and reciprocated subjects the doughy metal to impacts and friction whereby the metal is formed into granules of cellular structure.

The fine granules pass through the screen 28 while the coarser granules are carried to the right, as viewed in Fig. 1, by the screw conveyor and according to size, pass respectively through the screens 32, 33 and 34, and collect in the receptacle 36 placed therebeneath.

Very coarse granules reach the end spout 51 and are discharged in an end receptacle 52.

Thereafter the granules are placed under high pressure and thereby formed into a homogeneous mass. The pressure fluctuates between ten thousand and one hundred thousand pounds of pressure per square inch, depending on the metal or combination of metals used.

In some cases the metal granules are placed in molds, subjected to high pressure, and subsequently sintered. The best results were obtained when sintering was carried out for a period of approximately twenty minutes.

After sintering, the mass is quenched in an oil or water bath. The granules may be mixed with external lubrication prior to being subjected to compression so that a filler of lubrication is provided between the granules and due to compression, absorption of the lubricant by the granules is caused.

While the invention is described in its preferred embodiment, numerous changes and modifications may be made without detracting from the spirit of the invention.

I, therefore, do not limit myself to the details or the particular sequence of steps enumerated, but claim my invention as broadly as the state of the art permits.

I claim:

1. The method of reducing iron to particle form, including the steps of melting said iron, permitting said iron to cool to a semi-liquid doughy consistency in the temperature ranging substantially from 50° to 100° F. from its melting point while being puddled, maintaining the iron at that range of temperature while forcing the semi-liquid iron by impacts through a heated foraminous plate, and cooling the particle to solidification.

2. The method of producing iron granules permeated by a lubricant, including the steps of melting the iron, adding thereto colloidal graphite, while puddling the metal, permitting the metal to cool to a doughy semi-liquid consistency in the temperature ranging substantially from 50° to 100° F. from its melting point, maintaining the iron at that range of temperature while forcing the metal through a foraminous plate under impacts, and cooling the granules to solidification.

3. The method of producing iron granules permeated by a lubricant, including the steps of melting the iron, adding thereto colloidal graphite, while puddling the metal, permitting the metal to cool to a doughy semi-liquid consistency in the temperature ranging substantially from 50° to 100° F. from its melting point, maintaining the iron at that range of temperature while forcing the metal through a heated foraminous plate under impacts and friction, and cooling the granules to solidification.

4. The method as set forth in claim 1 applied to the reduction of copper.

5. The method as set forth in claim 2 applied to the reduction of copper.

6. The method as set forth in claim 1 as applied to aluminum.

7. The method as set forth in claim 2 as applied to aluminum.

8. The method as set forth in claim 1 as applied to lead.

9. The method as set forth in claim 1 as applied to magnesium.

10. The method as set forth in claim 1 as applied to tin.

11. The method as set forth in claim 1 as applied to zinc.

12. The method as set forth in claim 2 as applied to lead.

13. The method as set forth in claim 2 as applied to magnesium.

14. The method as set forth in claim 2 as applied to tin.

15. The method as set forth in claim 2 as applied to zinc.

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