May 23, 1939. J. F. ERVIN 2,159,433

METHOD OF DISINTEGRATING METAL INTO SHOTTING

Filed Jan. 5, 1938

Fig.1.

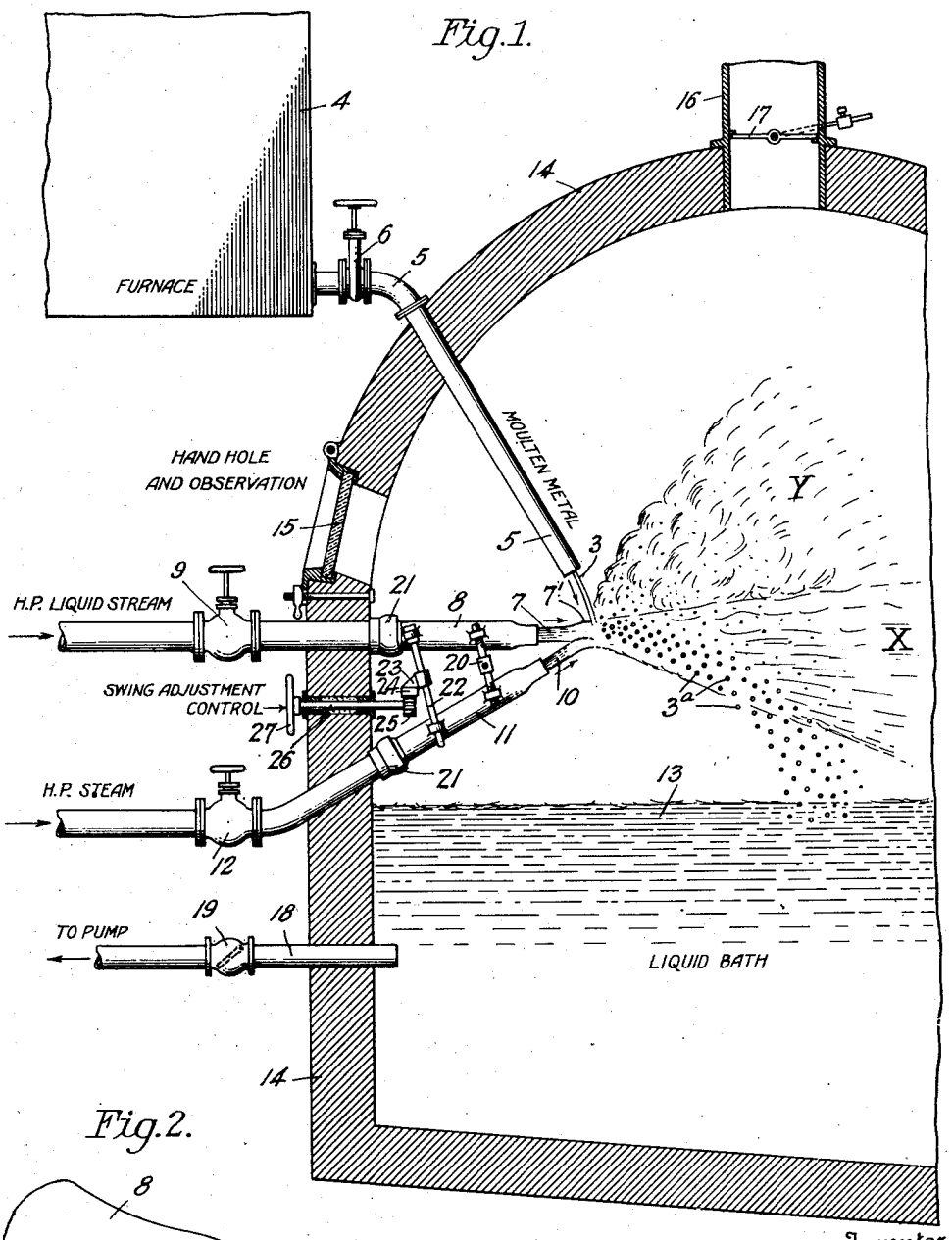
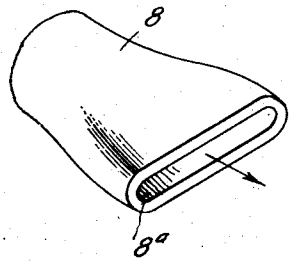


Fig.2.



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Patented May 23, 1939 2,159,433

UNITED STATES PATENT OFFICE

2,159,433

METHOD OF DISINTEGRATING METAL INTO SHOTTING

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Application January 5, 1938, Serial No. 183,539

12 Claims. (Cl. 82—91)

This invention relates to methods and means of disintegrating molten metal in the production of metal spherulate or shot, having reference more particularly to the break-up or dissection of special hard-composition alloys into vary-sized globules or grit intended for use as metallic abrasive and blast cleaning, cutting or polishing material and the like.

The object is to provide an improved method, or process, and applicative means for disintegrating or "shotting" the metal with improved results not only in the disintegration accomplishment, or action itself, but also in the nature or state of the material produced.

One of the principal aims in this objective is to attain a more quiescent, regular and steady break-up or dissection of the metal so that the spherulate or grit particles produced will be more perfectly formed and more uniform or less diversified in size, thereby reducing the amount of pure fragmentation and dissipation into mere dust.

Another primary purpose is to accomplish or perform the disintegration free of oxidation influence or result upon the metal and in such a medium and manner as to substantially eliminate if not entirely exclude the possibility of such deleterent action occurring either during or immediately following the break-up of the metal.

Incident to the first of these aims, it is also intended as an important factor to afford a control, within possible limits, of the rate, force and degree or sizing of the disintegration, so as thereby to produce the globular particles of the desired character and to maintain a proper uniformity in their formation.

Further included aims and purposes of incident nature will be evidenced hereinafter.

Complete understanding of the invention and what it seeks to accomplish will be facilitated by first explaining that in the ordinary production of metal shot or grit, a downward flowing stream of the metal is struck by a jet of steam directed thereagainst with high-pressure size or force. This steam jet disintegrates the metal into small globular particles thrown off from the point of impact and simultaneously solidifying as they drop into a quenching pool of water below, from which they are later taken when fully cooled and hardened.

A newer process, which improves upon the other, consists in discharging a stream of the metal downward upon a flat stream of water projected under high-pressure force. Said water stream similarly disintegrates the metal and tends to supportively roll the formed particles thereon as they drop into a quenching water pool beneath, from which they are later gathered when properly cooled and hardened.

Both of these methods are effectual in producing shot and substantially improve upon the prior method of simply dropping molten globules from a height into water. However, the disintegrating action in both is quite violent, due to the kinetic energy of the steam or water in striking the hot molten stream, and an explosive effect occurs at the impact point of the two streams. The formed metal particles are scattered widely with a vigorous impellation and are diversified in size a great deal more than is desirable. Much of it is pure fragmentation, or ragged lumping, and more is mere dust in fineness. Moreover, the openness to possible oxidation of the metal is objectionable, as this results in defect in the product, especially if it is to be used as a blast cleaning or polishing medium.

The present invention combines the two said earlier methods, together with a substituted element in one of the same, and results in an improvement upon both. To a considerable extent the above stated objections and imperfections of the production are thereby reduced although they admittedly are not eliminated and it is probable that they cannot be eliminated entirely. In addition, the invention includes an effective provision against the possibility of oxidation and so affords a marked improvement over each of the earlier methods described.

The full particulars as well as the general concept and special advantages of the invention will be understood from the following description made with reference to the attached drawing, illustrating one practical embodiment of the same in a somewhat elementary form.

In said drawing:

Fig. 1 is a fragmented side-elevational representation of an apparatus for applying or carrying the claimed method into effect; and

Fig. 2 is a fragmentary perspective end-view of one of said apparatus parts.

In the claimed invention a stream 3 of the molten metal is fed downward from its melting furnace 4 as through a discharge pipe or nozzle 5. This stream is of a size or thickness proper for the size of shotting or grit desired to be produced, and is controlled as by a regulating or shut-off valve 6 placed in its feed or discharge line. It is intended to be continuous through an operating or production period and may of course be so maintained for as long as desired, or as

long as its supply continues from the furnace. The best results also require it to be maintained steady and uniform without "pulsation" or variation in size or force of downward flow.

Under said metal stream, so that the former discharges thereonto, a flat or flattened stream 7 of liquid is projected horizontally under high pressure force as through a nozzle 8 having feed-line connection with a high-pressure or pump source (not shown). This latter stream consists of a liquid other than water and of a non-volatile oil or oily character, such for instance as an oil emulsion. Its nature is such that, as distinguished from water, both its flow and its action upon the metal stream dropping upon it are smoother and its tendency to break up and vaporize under heat is less or slower. One of various possible liquids found to be very satisfactory for the purpose comprises an oil-fat emulsion having a flash-point of 167° C., a fire point of 243° C. and a specific heat of 0.25° C., with a specific gravity of 1.4. Said liquid is spouted forth in a flattened stream of definite or substantial thickness by a tipping of the nozzle end with an elongate discharge opening 8ª as illustrated in Fig. 2. A valve 9 inserted in its feed line from the pressure source provides for the control of its flow.

Below said liquid stream, another stream or jet 10 of a gaseous fluid such as steam is directed upwardly, also under high-pressure force, and in the same general direction, as through a nozzle 11 having feed-line connection with a high-pressure forcing source or boiler (not shown). This third-named stream is arranged to strike the liquid stream immediately under or very nearly under the point of the metal stream's discharge thereonto, at an upward inclination of approximately 30 degrees which is however of course variable. It thereby tends and serves not only to support said liquid stream below said point and subsequently beyond the same, but also to raise the surface of said stream at that point so as to give it a mound or knob-like formation 7', such as represented. A valve 12 in its feed line from the forcing source or boiler controls the flow of said gaseous stream or jet, which may if desired be flattened out like the liquid stream.

The three described streams are brought together preferably quite close to or only slightly beyond their feeding conduit ends. In some instances it might be desirable to bring them together almost immediately beyond said ends to a single point, but ordinarily a definite distancing beyond is preferred. Advantageously, the metal stream 3 drops a mere four to five inches from its nozzle 5 onto the liquid stream; the liquid stream 7 under-meets said metal stream approximately four inches from its nozzle 8; and the gaseous stream 10 strikes said liquid stream approximately the same distance from its nozzle 11, immediately below or perhaps a quarter of an inch in advance of the liquid stream's contact with the metal stream.

As the said three streams come together, the metal stream is disintegrated in much the same way as by a steam or liquid stream alone. However, the oil or oily character of the liquid stream is much more quiet and smooth in its action upon the hot molten metal and the disintegration takes place with less violent and explosive effect and with greater regularity and uniformity of result. The metal strikes and enters into the liquid with subdued response to its break-up and quenching effect, and the "shotting" or rending into globular particles is produced with less fragmentation, dissipation and diversification in size. The liquid also tends somewhat to roll the formed and simultaneously solidified particles so as to make them more perfectly spherical. During this action, the gaseous stream or the like of steam supportively augments and sustains the liquid stream, raising its surface at the point (7') of metal contact so as to present a mound upon which the break into particles will occur, and carrying it a farther distance forward than would otherwise be the case. The said gaseous stream also tends to pierce the liquid and contribute its quenching qualities thereto, surrounding the whole operation with vapor as the liquid disperses and the globular particles drop therethrough.

The formed particles thus produced drop into a further quenching pool 13 of the liquid, or the same as the liquid, or containing the liquid, in a receptive space below, where they are cooled and hardened and are later gathered and thereafter dried by a special process or treatment preventing oxidation and giving them a desired finish.

The disintegrating action may be regulated and perfected or refined to a considerable degree by a proper control of the respective stream flows. That is, the extent (size and volume) and uniformity of disintegration may be maintained or varied by suitable adjustment or changed adjustment of the respective valves 6, 9 and 12 controlling the flow of these streams. A uniform flow of each in relation to the other of course produces the best and most perfect result. Any appreciable variation in the flows is liable to change the character of the shotting. For instance, if the stream of metal begins to "pulsate" or thin out to a trickle from a reduced supply, the disintegration will become irregular and fragmented or reduced to approximate dust. The flow should be kept steady for regular and uniform result, so that as the metal stream may vary one way or the other, its controlling valve should be re-set to preserve its regular continued flow. Similarly, the liquid and gaseous streams may require new adjustment to preserve unaltered flow. On the other hand, a regulation to change the character of the disintegration may be made by readjusting any one or all three of said valves, or by altering the pressures of the liquid and gaseous fluid streams.

In the last mentioned connection, the liquid stream is supplied under pressure up to 50 or more pounds from the pump source, and the gaseous fluid or steam stream is supplied under pressure up to 80 or more pounds from the boiler or other forcing source.

In this instance the operation is performed within the confined space of a closed chamber represented by the dome structure 14. This chamber desirably has an observation and hand-hole window 15 through which the operation may be viewed and access may be had to the nozzle parts. It also has a stack 16, controlled by a suitable valve 17, through which air and present gas may be expelled. The said controlling valve is closed to the outer atmosphere and is adapted to open when the inner chamber pressure exceeds the amount for which it is set. Said chamber is excluded of air and other possible oxidizing gas before the operation is started, as by opening up the gaseous fluid or steam discharge to expel and displace the same with its vapor.

Continued supply of the steam or gaseous fluid, along with the functioning of said valve, during the operation, maintains the chamber with an inner predetermined pressure greater than atmospheric, with said gaseous or steam vapor filling the entire inner space above the liquid pool 13 contained in its bottom. This inner greater-than-atmospheric pressure may amount to one or two pounds above atmospheric, or to as much as three or more "atmospheres", depending upon conditions and the results to be obtained. Ordinarily, operation will be conducted under an internal pressure of perhaps three or four pounds above atmospheric and said operation is performed free of possible oxidation influence upon the metal by complete exclusion of air.

The liquid pool 13 contained in the bottom of said chamber is, as previously stated, the same as the liquid supplied in the liquid stream 7, or contains the same liquid in strata, and may therefore be drawn off to the supply source for reuse, although a straining and refinement or reconditioning is first advisable, due to the soiling by dust from the metal and to the dilution by steam from the jetting in a disintegrating operation. For such purpose a draw-off pipe 18 is shown in proposed connection with the liquid-stream supply or some other pump source, the same being provided with a valve 19 by which to control the flow therethrough.

In operation, the liquid stream is started before the metal stream is released to discharge thereonto, it being assumed that air has first been excluded from the region as above described. The steam or gaseous fluid stream, already in operation from the air excluding operation or newly brought into play, is adjusted to cooperate supplementally with it in the proper way so that the two work smoothly together. The metal stream is then released in proper flow and the disintegration immediately begins.

As the smooth oily stream is met by the hot metal flow, it breaks the same up into small globular particles which are carried along briefly with it with something of a rolling or turning motion, while at the same time dropping toward the liquid pool below. Some of the metal of course flys off with a certain explosiveness diversely and some of it breaks into pure fragments or dissipates into mere dust, but less of this intense action occurs than in the case of a mere water or steam stream alone. The greater number of the particles form in the stream and all are enveloped either in said stream or in the vapor of the gaseous fluid or steam which augments it. Many of them are conveyed well forward by the supporting effect of the fluid gas or steam stream.

Simultaneously, the said gaseous fluid or steam stream raises the surface of the liquid stream where the metal flow contacts it and penetrates into or blends with the liquid stream to sustain and augment the quenching action of the former upon the solidified particles dropping to harden in the liquid pool below. The action of the two streams in operation upon the metal is represented within the chamber 14 of the drawing, wherein 3a indicates the formed metal globules falling to place while other dots indicate other particles thrown off divergently; X indicates the combined liquid and gaseous fluid or steam flow; and Y indicates the area of vapor arising from the hot metal contact therewith.

For better control and regulation, the liquid and steam gaseous fluid nozzles 8 and 11 may advantageously be connected and adapted to swing in fixed relation to each other as by means illustratively represented. In the present arrangement, tie-bolts 20 of turn-buckle or opposing screw form couple said nozzles together adjustably at opposite sides and each swings upon a ball and socket joint connection 21 to its feeding line pipe. On opposite sides of the nozzles also brace-rods 22 are provided, with a slide or slippage movement through one of them. These brace-rods have arms 23 supporting a slightly arcuated rack 24 horizontally between the nozzles and a pinion 25 on the end of a turn-shaft 26 actuates said pinion against said rack to swing the nozzles a slight distance toward either side. The turn-shaft extends through a packing to the outside of the chamber and a hand-wheel 27 on its end provides for its manipulation. Thus the nozzles are maintained in the adjusted relation and are enabled to be swung in unison horizontally so as to follow and properly retain their ejecting streams under the metal stream should the latter waver or shift to either side.

The advantages of this method and the means provided to carry it into effect will be appreciated by those familiar with the difficulties and imperfections of "shotting" or the production of metal spherulate and grit by the methods already known and in use. While it is not claimed that this new method attains perfect results or eliminates all of the objections and defects or inadequacies of prior methods, it is claimed to produce improved results and to substantially reduce and moderate said objections and defects.

It will be understood that the invention may be modified or varied in its practice and that the applicative means disclosed may be embodied in quite different constructions without departing from the full scope and concept of the invention. For instance, the liquid stream, other than water, of the character defined may be used alone or without the stream of gaseous fluid or steam, or the gaseous fluid stream might be reduced proportionally greatly in its force. Under certain conditions also the gaseous fluid stream with steam alone or without the liquid stream might be used. The confining chamber might in a case of the liquid stream use alone be eliminated, although in the case of the steam stream use alone it would have to be employed under an inner pressure exceeding atmospheric substantially or by a few pounds greater than that necessary merely to exclude air as set forth in a prior application by this same inventor co-pending herewith. Obviously various changes in the actual apparatus and arrangement of parts for conducting or accomplishing the method can be made with full equivalency in result. Therefore, the appended claims are not intended to limit the invention to the actual practice and the actual means described and shown.

The use hereinbefore of the word "steam" in conjunction or synonymous connection with the term "gaseous fluid" is intended only to indicate steam as the preferred medium or example of gaseous fluids usable for the purposes of this invention. The term "gaseous fluid" as used hereinafter in the claims is intended to cover not only steam but also those other vaporous gases or fluids of a gaseous nature, other than air, which may be similarly used as a substitute or the equivalent thereof for the same purpose and result. Therefore, the said term will be understood to be used neither with the intention of claiming more than the actual invention involved, nor with

the intention of being limited to the stated example of steam alone.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging a molten stream of the metal onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, and supporting said liquid stream by a stream of gaseous fluid directed at an angle upwardly thereagainst also with pressure force.

2. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging a molten stream of the metal downwardly onto a stream of liquid other than water and of an oil or oily character projected horizontally thereunder with high-pressure force, and directing angularly up against said stream under the point of the metal stream discharge thereonto a supporting stream of gaseous vapor projected likewise with high-pressure force.

3. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging a molten stream of the metal downward onto a stream of liquid other than water and of an oil-emulsion character projected horizontally thereunder under pressure force, and directing upwardly against said stream under approximately the point of the metal stream discharge thereonto and in the same flow direction a stream of gaseous fluid projected also under pressure force.

4. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging a molten stream of the metal onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, and supporting said liquid stream by a stream of gaseous fluid such as steam directed at an angle upwardly thereagainst also with pressure force, the surrounding space being meanwhile evacuated of air and other oxidizing gas.

5. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging a molten stream of the metal onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, and supporting said liquid stream by a stream of gaseous vapor such as steam directed at an angle upwardly thereagainst also with pressure force, the surrounding space being meanwhile evacuated of air and other oxidizing gas and a medium of vaporous gas being maintained in said space enveloping the three streams.

6. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging a molten stream of the metal onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, and supporting said liquid stream by a stream of gaseous vapor such as steam directed angularly upward thereagainst in the same general direction thereto also with pressure force, the surrounding space being meanwhile evacuated of air and said space being filled with the vapor of the medium from the gaseous vapor stream.

7. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging within an air excluded space a molten stream of the metal onto a stream of liquid other than water and of an oil or oily character projected horizontally thereunder with high-pressure force, directing angularly up against said stream under the point of the metal stream discharge thereonto in the same general direction thereof a supporting stream of a gaseous fluid such as steam projected likewise with high-pressure force, and filling said space with vapor from said gaseous fluid stream.

8. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging within a chamber excluded of air a molten stream of the metal onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, supporting said liquid stream by a stream of a gaseous fluid of the character of steam directed angularly upward thereagainst in the same general direction also with pressure force, and maintaining the air excluded from said space during the contacting operation of the three streams.

9. The improved method of disintegrating metal in production of metal shot or grit, which consists in first excluding air from a closed chamber space, discharging a molten stream of the metal within said space onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, supporting said liquid stream by a stream of gaseous fluid such as steam directed at an angle upwardly thereagainst in substantially the same general direction also with pressure force, and maintaining the air exclusion from the said space during the time said three streams are projected into contact with each other.

10. The improved method of disintegrating metal in production of metal shot or grit, which consists in discharging within a closed air excluded chamber space a molten stream of the metal downwardly onto a stream of liquid other than water and of an oil or oily character projected horizontally thereunder by pressure force, the said stream being flattened by nozzling through an elongate discharge from its force supply line and said closed chamber being maintained air excluded.

11. The improved method of disintegrating metal in production of metal shot or grit, which consists in first expelling air from a closed chamber space by a medium of internal pressure greater than atmospheric, discharging a molten stream of the metal within said space onto a stream of liquid other than water and of an oil or oily character projected with pressure force thereunder, supporting said liquid stream by a stream of gaseous fluid such as steam directed upwardly thereagainst at an angle in the same general flow direction also with pressure force, and maintaining within said closed chamber space a pressure substantially greater than atmospheric by the said internal pressure medium so as to continually exclude air during the time said three streams are projected into contact with each other, the said internal pressure medium consisting of gaseous fluid from the said gaseous fluid stream.

12. In an apparatus for disintegrating metal in the production of metal shot or grit according to the method herein described, means providing a closed chamber space and having a controlled outlet for the displacement of one

gaseous medium by another therewithin, means for discharging a molten stream of the metal downwardly into said space from a source of supply above, means for discharging a force pressure stream of liquid horizontally under the stream of downwardly discharging metal, means for discharging a force pressure stream of steam upwardly against the liquid stream under approximately the point at which the metal stream discharges thereonto, means for controlling and regulating the three stream flows independently, and means maintaining said liquid and steam stream discharges in fixed relation to each other but adapting them to be swung in unison in opposite side-wise directions exteriorally of the chamber, said chamber having in its bottom a pool of or the same as the liquid supplied in said liquid stream.

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