Sept. 17, 1963 F. OSBORNE 3,104,164

METHOD OF AND APPARATUS FOR PROCESSING SLAG

Filed April 6, 1961

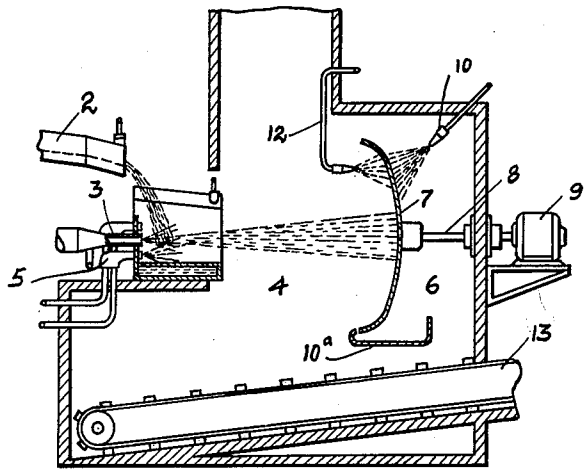


Fig. 1.

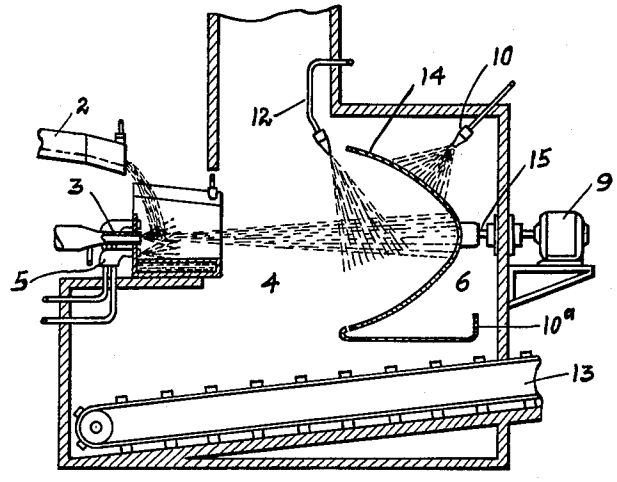


Fig. 2.

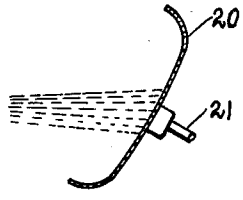


Fig. 3.

INVENTOR.
FRED OSBORNE.

BY
Christy, Parmelee & Stinebower

ATTORNEYS.

United States Patent Office 3,104,164 Patented Sept. 17, 1963

3,104,164
METHOD OF AND APPARATUS FOR PROCESSING SLAG

Fred Osborne, Birmingham, Ala., assignor to S. P. Kinney Engineers, Inc., Carnegie, Pa., a corporation of Pennsylvania

Filed Apr. 6, 1961, Ser. No. 101,170
8 Claims. (Cl. 65—20)

This invention relates to the processing of molten slag or other molten ceramic or glass-like composition to convert it into useable light-weight aggregate, and is for a method of and apparatus for improving the aggregate by expanding and rounding it, and incidentally also improving its surface.

In my prior Patent No. 2,702,407, granted February 22, 1955, for Method of and Apparatus for Producing Light-Weight Slag, there is disclosed a process of converting molten slag into light-weight expanded aggregate in which a falling stream of slag is broken up by a blast of gas, such as steam or air, into pellets which are carried by the blast through a mist of atomized water, the pellets passing through the mist and falling into a pit, part of it still being hot enough to fuse into a clinker. The material removed from the pit is crushed, and the expanded slag fragments are then ready for use as aggregate.

It is a principal object of the present invention to provide a method of and apparatus for shaping the expanded slag or slag-like pellets. It is a further object of the present invention to provide for the cooling of the pellets as and after they have been shaped and before they have been discharged into a collecting pit to prevent them from re-fusing, at least to any considerable extent. A further incidental object of the present invention is to improve the surface properties of the pellets.

My invention may be more fully understood by reference to the accompanying drawings, in which:

FIG. 1 is a somewhat schematic vertical sectional view through an apparatus embodying my invention, and for practising the method of the present invention;

FIG. 2 is a similar view of slightly modified construction; and

FIG. 3 is a fragmentary view in which the rotating element is angularly disposed with reference to a horizontal plane.

Referring to the drawings, the apparatus disclosed in the drawings for pelletizing and expanding the slag is generally similar to that disclosed in my Patent No. 2,702,407 above referred to. 2 designates a water-cooled trough from the lower end of which the slag is discharged in a falling stream in front of a nozzle 3 through which gas, such as air or steam, is directed against the confronting face of the falling stream of slag. The nozzle 3 is of substantially the full width of the falling stream, and its function is to continuously break up the stream into a multiude of fragments or pellets and propel them horizontally through an expanding chamber 4. In passing through the expanding chamber the pellets of slag travel through a mist of atomized water projected from nozzles 5 located in a generally semi-circular arrangement about the gas-discharge nozzle 3. The nozzles 5 are atomizing nozzles, and they create a mist of finely-divided droplets which converge in the zone 4 forwardly of the stream of slag so that the slag does not effectively encounter the mist until it is broken up into pellets and the pellets are travel-

ing horizontally through the expanding zone. In passing through the expanding zone the pellets are brought into a myriad of collisions with tiny drops of water which are insufficient to quench the slag or to a point where it ceases to be plastic or semi-plastic, but which nevertheless produce a controlled expansion in the fragments or pellets of molten slag. The character and quality of the slag can be controlled to some extent by regulating the amount of water which is used, but if too much water is sprayed into the expanding zone, the resulting slag may be weak and friable, so, for the present invention, excessive use of water should be avoided.

Adjacent the discharge end of the expanding zone within an enclosure 6 there is a concaved metal disk 7, the concave surface of which is directed toward the discharge of slag from the expansion zone. This disk is carried on a shaft 8 and is rotated by a driving means such as a motor 9 outside the enclosure 6. The disk 7 has its concaved surface facing the discharge of slag pellets from the expansion zone.

In operation the pellets strike the disk preferably in the central area while the disk is revolving at a speed which depends upon the diameter and contour of the disk, and other conditions best determined by operating the machine under the conditions existing in a particular plant with the particular slag there encountered. The pellets, upon striking the moving surface of the disk, are caused to roll on the surface of the disk and toward the periphery. Since the pellets are still hot, this rolling tends to impart to the pellets a generally spherical shape, and at the same time the texture of the surface of the pellets is smoothed and modified and appears to become slightly glazed. The rear surface of the disk is cooled by one or more water sprays positioned to spray against the back of the disk. Heat is conducted from the surface of the disk through the disk and dissipated in this manner. Water so used may be collected in a drain trough 10*a* for removal from the apparatus without drenching the pellets. Also, if necessary, additional cooling water may be directed through a nozzle 12 against the concave surface of the disk, preferably in the peripheral portion of the disk, so that the pellets of slag will not be too drastically wet or cooled before they have rolled adequately against the surface of the disk. Internal cooling of the disk may of course be provided where necessary.

The pellets are discharged under the action of gravity aided somewhat by centrifugal force from the disk into the interior of the closure 6. They fall into a pit at the bottom of the enclosure. In being rolled against the cooled surface of the concave disk, they are sufficiently cooled before they fall into the pit to an extent where they will not fuse or sinter together, at least to any appreciable extent. They can be removed from the pit by a conveyor such as the endless conveyor indicated at 13.

In FIG. 2 the construction of the apparatus is generally similar to that shown in FIG. 1, and corresponding reference numerals have been used to designate those parts which are common to both figures. However, instead of providing a disk 7 on a shaft 8 driven by a motor 9, there is here disclosed a hollow metal cone having its large opened end facing toward the discharge end of the expansion chamber. This cone is designated 14, and is mounted on a shaft 15 similar to the shaft 8 driven by a motor 16 outside the enclosure 6. By using a deep cone the pellets may be retained for a longer period of

time on the revolving surface. Provision may be made for cooling the exterior of the cone as in FIG. 1, by the use of nozzles **10**, and nozzles **12** may be provided for projecting either a water spray or a blast of cooling air into the interior of the cone. The cone should be of a relatively large diameter so that, as with the disk, the pellets striking the cone will strike in the central area and reduce collision with pellets that have been previously discharged against the rolling the surface and have moved out toward the periphery.

In FIG. 3 the apparatus is otherwise generally the same as that disclosed in the other figures, but in this case the rotating disk or other target has its axis of rotation inclined from a vertical plane, and the disk is oblique to the general direction of travel of the pellets. In this figure, **20** designates a disk similar to 7 carried on a shaft 21, the shaft being inclined from a vertical position, and the disk therefore rotates in a plane which is at an angle to the horizontal plane. If, as here shown, it is inclined upwardly, the pellets may be retained for a longer period of time on a rotating surface, but if the inclination is in an opposite plane, the pellets would be in contact with such a disk but a short time.

It is not contemplated that each pellet shall be formed into a perfect sphere, but that the pellets shall be more or less spherically shaped or rounded, being more like pebbles used as aggregate taken from the beds of rivers or gravel deposits, as distinguished from the sharp edges typical of crushed expanded slag-clinker or rock. At the same time the rolling action of the hot slag on the metal will impart a smoother texture to the surface of the pellets producing a surface more closely approximating a glazed surface, and this is desirable for slag used as aggregate, particularly in concrete building blocks.

According to the present invention, therefore, the slag is first expanded as disclosed in my patent above mentioned, but instead of falling hot into the bottom of a pit where it may accumulate and fuse together, the pellets which have been subjected to the expanded action are rolled over a smooth surface while they are still hot, and in a semi-plastic condition, to produce a generally spherical surface and improve the surface quality. The pellets or fragments of slag, after being thus rolled, are also cooled, or cooled sufficiently that when they are collected in the bottom of the pit they do not again fuse together, at least to any appreciable extent.

In the drawings I have disclosed two different forms of rolling surfaces or targets against which the slag pellets impinge, and on which they are rolled, but this is merely illustrative of my invention and the target may be variously shaped. The speed of the target must be co-related to the kind and volume of slag being processed, and the diameter of the target, and as a general rule it is desirable that the target be of sufficient diameter that the pellets will move out of the area of impact before the rolling is concluded in order to avoid interference with the continuous stream of new pellets moving toward the target. Cooling of the target is important to prevent the slag from adhering thereto and creating proper rolling motion of the slag and have the modification of the surface of the pellets in the manner above described and to effect cooling of the rolled pellets.

I have shown and described certain embodiments of my invention particularly in conjunction with the method disclosed in my prior patent, but it is applicable to any process where pellets in a heat-softened condition and of irregular shape may be impinged against the rotating target. The term "slag" is here used to mean metallurgical slag, such as blast furnace slag, or other molten compositions of ceramic or glass-forming ingredients useful as aggregate.

I claim:

1. The method of converting molten slag into expanded aggregate which comprises continuously dispersing a falling stream of molten slag by a blast of gas into pellets and projecting the pellets through a mist-like spray of water to expand the slag and increase the porosity thereof but from which the pellets emerge at a temperature where they are still somewhat plastic and incandescent, rolling the pellets after they emerge over a cooled surface to surface glaze them and to give them a generally spherical contour and effect further cooling thereof, and collecting the pellets after they have cooled to a temperature below fusing temperature.

2. The method of converting molten slag into expanded aggregate which comprises continuously dispersing a falling stream of molten slag by a blast of gas into pellets and projecting the pellets through a mist-like spray of water to expand the slag and form cellular bodies but from which the pellets emerge at a temperature where they are still somewhat plastic and incandescent, impinging the pellets as they emerge from the spray against the confronting surface of a rotating target in which the pellets are rolled to an eventual point of discharge and at the same time cooled and thereby shape and round the pellets, and glaze their surfaces, and collecting the rolled pellets after they have cooled below the fusing temperature.

3. Apparatus for converting molten slag into expanded aggregate comprising means for converting a flowing stream of molten slag into a falling column, a nozzle for projecting a stream of gas against the column and continuously dispersing it into horizontally-moving pellets, a spray zone through which the pellets are propelled by the blast from said nozzle, means for creating a mist-like spray of water in the spray zone through which the pellets travel for expanding the pellets into cellular bodies, and a rotating target beyond the spray zone against which the pellets impinge and roll upon emerging from the spray zone whereby the pellet surfaces only are made dense.

4. Apparatus for converting molten slag into expanded aggregate as defined in claim 3 in which the target has a concaved surface directed toward the expanding zone, the axis of rotation of the target being generally parallel to the direction of travel of the pellets.

5. Apparatus for converting molten slag into expanded aggregate as defined in claim 3 in which the target has a concaved surface directed toward the expanding zone, the axis of rotation of the target being generally parallel to the direction of travel of the pellets, the concaved surface of the target being of such diameter and its axis of rotation being so located that the majority of the pellets impinge against the central area of the target while the peripheral area is out of the path of the oncoming pellets.

6. Apparatus for converting molten slag into expanded aggregate comprising means for converting a flowing stream of molten slag into a falling column, a nozzle for projecting a stream of gas against the column and continuously dispersing it into horizontally-moving pellets, a spray zone through which the pellets are propelled by the blast from said nozzle, means for creating a mist-like spray of water in the spray zone through which the pellets travel for expanding the pellets to form cellular bodies, a rotating target beyond the spray zone against which the pellets impinge and roll upon emerging from the spray zone, the target being formed of metal, and spray means for cooling the back surface of the target whereby the rolled pellets have only their surfaces compacted.

7. Apparatus for converting molten slag into expanded aggregate comprising means for converting a flowing stream of molten slag into a falling column, a nozzle for projecting a stream of gas against the column and continuously dispersing it into horizontally-moving pellets, a spray zone through which the pellets are propelled by the blast from said nozzle, means for creating a mist-like spray of water in the spray zone through which the pellets travel for expanding the pellets into cellular bodies, a rotating target beyond the spray zone against which the pellets impinge and roll upon emerging from the spray zone whereby only the surfaces of the pellets

are made dense, the target being formed of metal, and spray means for cooling the back surface of the target, the rotating target having its axis of rotation inclined from a vertical plane.

8. Apparatus for converting molten slag into expanded aggregate comprising means for converting a flowing stream of molten slag into a falling column, a nozzle for projecting a stream of gas against the column and continuously dispersing it into horizontally-moving pellets, a spray zone through which the pellets are propelled by the blast from said nozzle, means for creating a mist-like spray of water in the spray zone through which the pellets travel for expanding the pellets to form cellular bodies, a rotating target beyond the spray zone against which the pellets impinge and roll upon emerging from the spray zone whereby only the surfaces of the pellets are compacted, the target being formed of metal, and

spray means for cooling the back surface of the target, the rotating target having its axis of rotation inclined from a vertical plane with the surface of the target impacted by the pellets being inclined with the lower edge being nearest the spray zone.

References Cited in the file of this patent

UNITED STATES PATENTS

721,293	Fuchs	Feb. 24, 1903
1,938,876	Takata	Dec. 12, 1933
2,450,978	Meinzer	Oct. 12, 1948
2,702,407	Osborne	Feb. 22, 1955
2,939,172	Von Reppert	June 7, 1960
2,977,239	Parsons	Mar. 28, 1961
2,978,742	Bliemeister	Apr. 11, 1961
2,987,411	Minnick	June 6, 1961