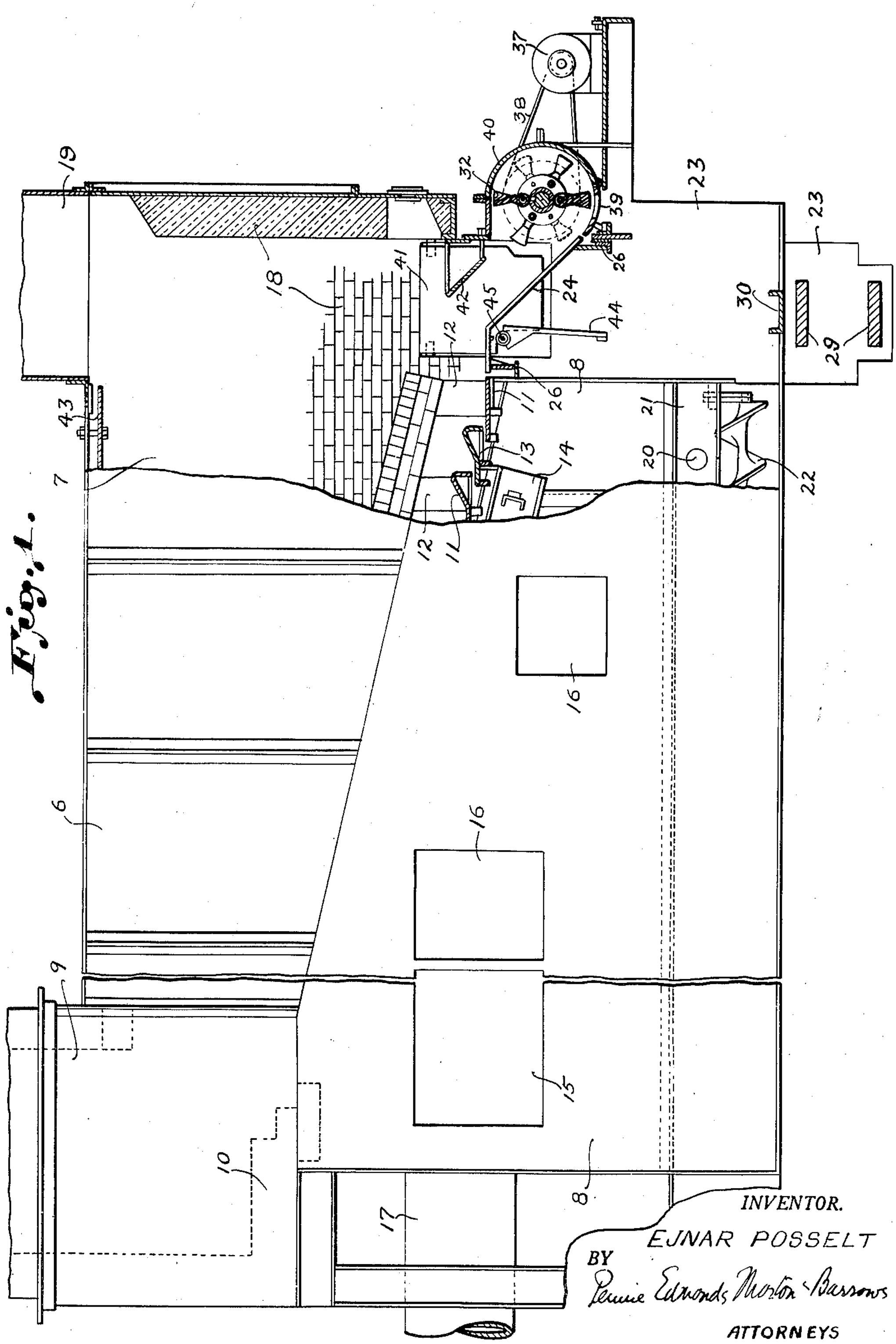
Sept. 2, 1952 E. POSSELT 2,609,149

CLINKER COOLING

Filed May 10, 1949 3 Sheets-Sheet 1

Fig. 1.



INVENTOR.
EJNAR POSSELT
BY Pennie Edmonds Morton & Barrows
ATTORNEYS

Fig. 2.

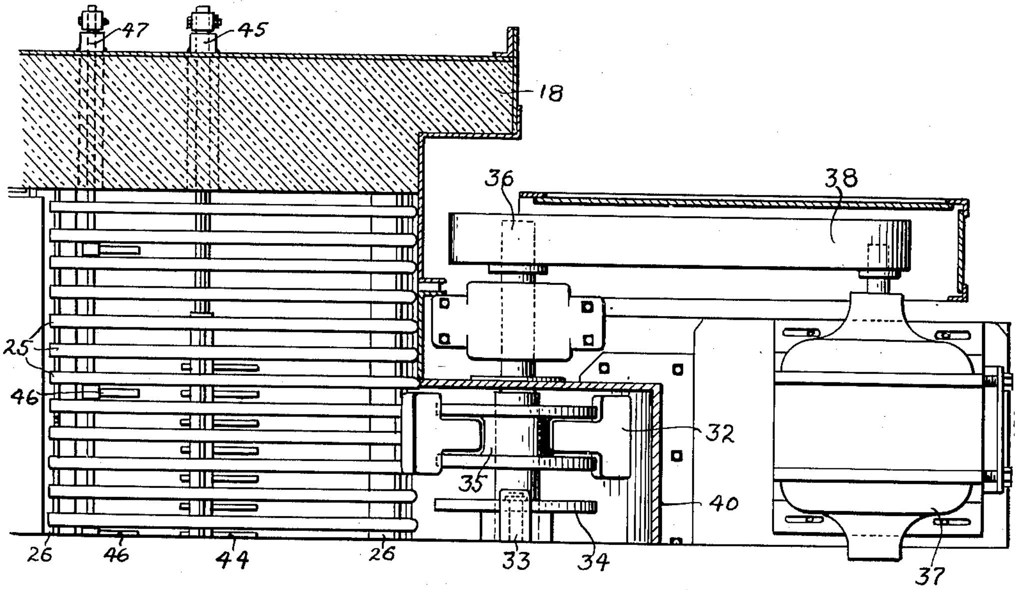
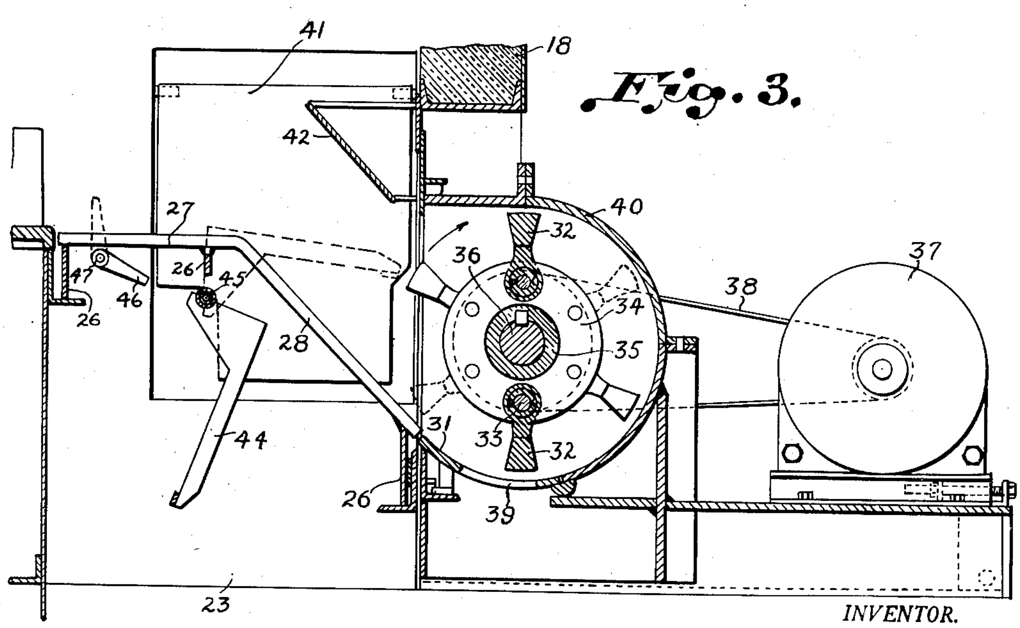


Fig. 3.



INVENTOR.
EJNAR POSSELT
BY
Pennie Edmonds Morton Barrows
ATTORNEYS

CLINKER COOLING

Filed May 10, 1949 3 Sheets-Sheet 3

Fig. 4.

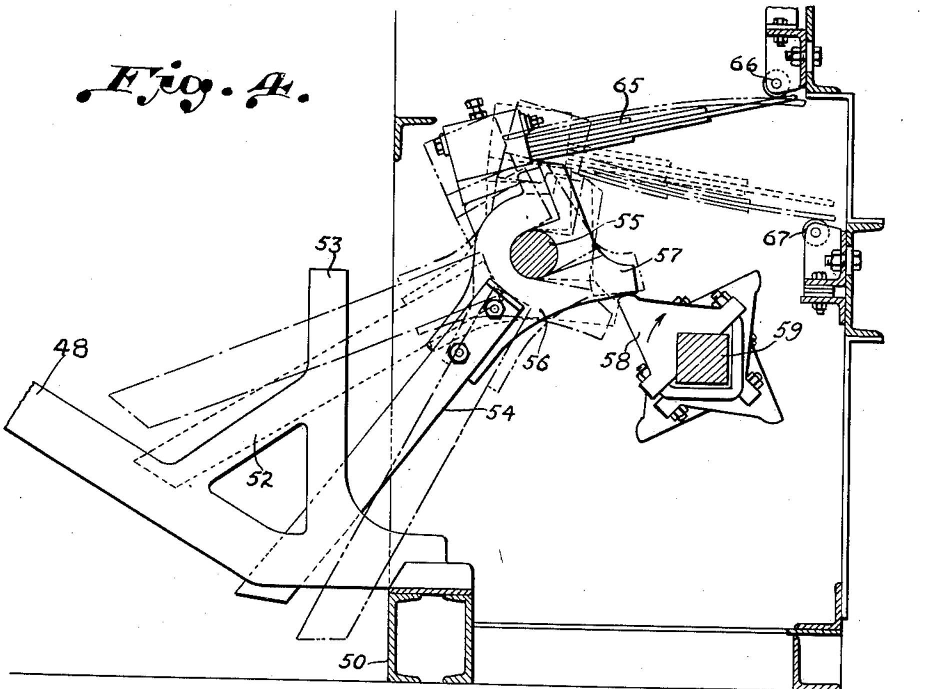
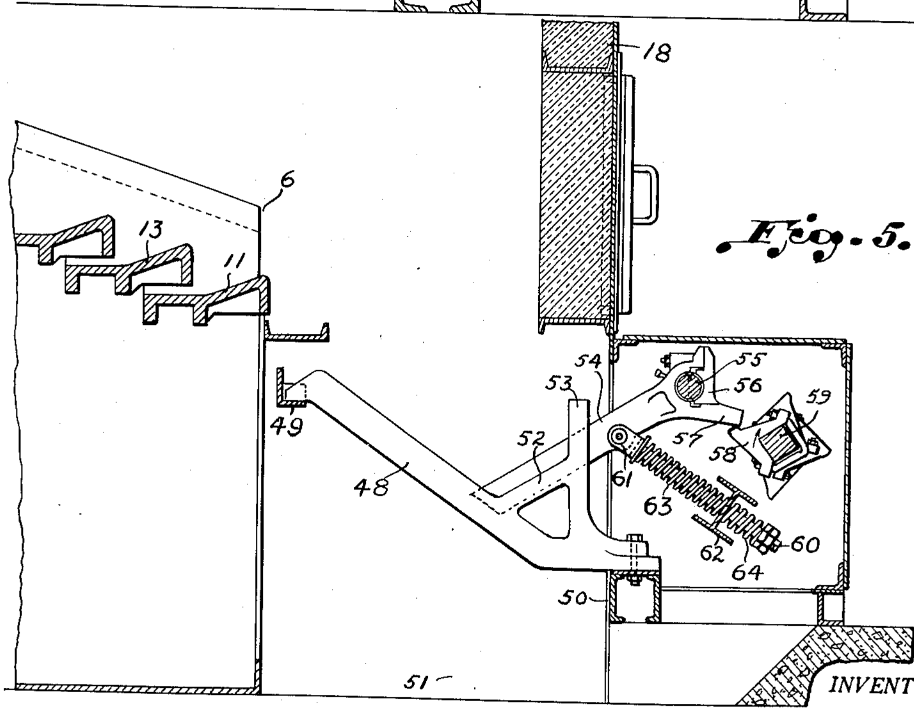


Fig. 5.



INVENTOR.
EJNAR POSSELT

BY
Pennie Edmonds Morton & Barrows
ATTORNEYS.

Patented Sept. 2, 1952

2,609,149

UNITED STATES PATENT OFFICE

2,609,149

CLINKER COOLING

Ejnar Posselt, Pelham Manor, N. Y., assignor to Lone Star Cement Corporation, New York, N. Y., a corporation of Maine

Application May 10, 1949, Serial No. 92,483

13 Claims. (Cl. 241—5)

1

This invention relates to a method of and apparatus for breaking and cooling the coarse portion of a hot material having a substantial range of particle size, such for example, as the clinker of mixed size frequently produced in the manufacture of Portland cement. More particularly, the invention is concerned with a novel method and apparatus for separating large and incompletely cooled pieces of a furnace product following discharge from a cooling apparatus and simultaneously breaking and returning by impact at least a part of the broken material to the cooling operation.

Following the heat treatment of ores and rock products during sintering, roasting, smelting, calcining or clinkering, the continuous furnace or kiln discharge is usually cooled by passage through a cooler in which the entire charge is subjected to the action of an air stream. Such cooling may be carried out in order to effect an "air quenching" of the material by a rapid temperature reduction, to effect a recuperation of sensible heat, or both, or to complete the cooling of material discharged from a recuperator. Many furnace or kiln operations, either inherently, or because of the nature of the material composition, or due to irregular operation, result in a product containing particles of widely varying sizes. In the normal cooling of such material, the relatively fine material is readily cooled due to its large surface area, and the larger particles are often discharged from the cooling apparatus containing substantial quantities of heat. When the equipment is operated to cool the larger pieces to a desired temperature, abnormally large amounts of air, and coolers of excessive capacity, are required. The handling of the larger pieces in subsequent plant operations, and particularly when only partially cooled, is burdensome and necessitates additional equipment and supervision.

One commercial operation, in which such difficulties are encountered, is the manufacture of Portland cement in a rotary kiln, and the method of the present invention is particularly adapted to the treatment of cement clinker so produced. The components present in the raw materials mix fed to the kiln, may be such that excessive clinkering takes place even during the best burning conditions, and the kiln discharge may contain a high proportion of clinker up to 4 to 6" in. diameter, the desired size usually being less than 1 to 2". In other instances, slight variations in the kiln feed mix, or in the burning conditions, will result in large proportions of

2

oversize clinker, even though normal operation on the same material gives a product of the desired small size. Furthermore, large sections of material present in the kiln as coating, or as rings, frequently break loose from the walls of the kiln and are discharged as slabs of substantial proportions.

Cement clinker discharged from a kiln may be cooled in various types of rotary coolers, or with particular advantage may be air quenched and cooled by the methods and apparatus disclosed in such U. S. Patents as Norvig No. 2,041,142, Douglass Nos. 2,137,158 and 2,163,513, and Newhouse No. 2,055,940, in all of which the hot clinker, at a temperature in excess of 2500° F., is cooled by contact with a stream of cooling air, and to which patents reference may be had for a more complete statement of the problems involved in the cooling of Portland cement clinker.

It has heretofore been proposed in Gaffney U. S. Patent No. 2,312,034 to remove from the cooling zone, the fine particles which have been cooled to a desired degree prior to completion of the cooling operation. It has also been proposed to crush oversize clinker as it is discharged from a cooler following a furnace or kiln, but such crushing exposes new hot surfaces which may be red or white hot and must again be cooled in order not to cause difficulty in the conveying equipment which transports the crushed material to storage or to grinding mills. Such an additional cooling operation is a serious disadvantage, since it usually involves a large investment in equipment, particularly in view of the intermittent and variable quantity of crushed material to be treated. According to a more recent proposal, hot oversize clinker is separated from the cooler discharge, delivered to a conventional crushing mechanism, crushed to a desired size, elevated and conveyed to a point above the cooler, and reintroduced into the bed of partially cooled clinker at a predetermined point. Such an arrangement is undesirably expensive and mechanically complicated. Following the steps of crushing and delivery to the base of an elevator, the hot broken material must be elevated and conveyed horizontally, and introduced into the top of the cooler. This requires costly heat resistant crushing, elevating and conveying equipment, and the cost of maintenance, supervision and power are excessive. Furthermore, the arrangement requires additional floor space and head room which are frequently difficult to provide, and special arrangements are necessary at the point of return to the cooler to avoid diversion of heated air.

The present invention is, accordingly, directed to the provision of a method for breaking and cooling the undesired oversize particles discharged from a cooler, which makes use of a principle of operation different from those heretofore employed, and which is not subject to the disadvantages of the prior systems. In the practice of the new method, I cool the mixed size furnace discharge to a degree sufficient to cool the fine particles to a desired temperature, separate the partially cooled large particles, break them by impact and, by the same impact, return a substantial proportion of the broken hot pieces to the initial cooling treatment. By this procedure, I am able to operate the cooling mechanism with maximum efficiency, and to reduce the large particles, by means of impact breaking equipment, to any size required for subsequent crushing and grinding operations, while, at the same time and by the use of the same breaking equipment, the hot broken pieces are projected to a zone in which they will be adequately cooled by contact with the partially cooled fine particles and by being subjected to the same cooling air required in the operation of the cooler.

In operating in accordance with the new method of my invention, I employ a novel form of clinker breaker. Throughout the specification and claims the word "clinker" is used generically to designate hot material which may result from any heat treatment such as sintering, calcining, roasting, smelting or nodulizing operations. The term "furnace" is used broadly to designate the heat treating equipment, preferably of the continuous discharge type, which may be in the form of a rotary or vertical kiln. The novel clinker breaker embodied in the invention may, with advantage, be employed in combination with a suitable cooler and size separator, to yield a product cooled to any desired degree and having any desired maximum particle size.

In order that my invention may be clearly understood, it will be described with reference to the accompanying drawings, in which:

Fig. 1 is a vertical diagrammatic view, partly in section, of a preferred form of apparatus for the practice of the new method, the apparatus as shown including an inclined reciprocating grate cooler;

Fig. 2 is an enlarged top plan view of one-half of the breaker structure of Fig. 1;

Fig. 3 is an enlarged vertical section showing details of construction of the breaker shown in plan in Fig. 2;

Fig. 4 is a vertical view of an alternative type of breaker for practicing the new method; and

Fig. 5 is a vertical view of a second alternative type of breaker for practicing the new method.

Referring to Fig. 1, a clinker cooler 6, such as is disclosed in the referred to Douglass and Gaffney patents, is illustrated diagrammatically. An elongated chamber is divided into upper hot gas chamber 7, and lower plenum chamber 8, by an inclined surface in the form of a grate mechanism having alternate fixed and movable grates, which supports and conveys a bed of material through the cooler. Hot material discharged from the kiln falls directly into the cooler through chute 9 and is distributed horizontally by plate 10. The inclined grate structure, illustrated in detail section at its lower discharge end, comprises horizontal stationary grate plates 11, mounted on side frame wear plates 12, and movable reciprocating plates 13, rigidly supported on movable side frames 14. These side frames, given a horizontal reciprocating motion by a driving mechanism indicated at 15, and supported on wheel mechanisms indicated at 16, cause the alternate movable grates to agitate and advance the inclined bed of hot material through the cooler. Cooling air, supplied to plenum chamber 8 through duct 17, passes upwardly through the bed of material during its travel down the inclined support, and thence into the hot gas chamber 8 usually lined with protective refractory walls 18. A desired proportion of heated air is directed to the kiln through chute 9, to be used as pre-heated secondary combustion air, and the remainder is vented to the atmosphere through stack 19. The cooling air passes vertically through perforations in the individual grate plates, and horizontally through the slight vertical spacings between adjacent grate plates. A limited amount of fine material passes between the grates and into the plenum chamber, and is periodically removed by opening a series of ports 20 in longitudinal housing 21, in which a screw 22 advances the fine material, discharging it into a transverse pit 23.

The bed of cooled material containing hot oversize particles is advanced to a size separator, here shown as a grizzly 24. The individual grizzly bars 25, horizontally spaced to permit the passage of a desired size clinker, for example less than about 2″, are supported by transverse supports 26. The separating bars are preferably constructed, as shown in Fig. 3, to have a generally horizontal section 27 and a steeply sloping section 28. The satisfactorily cooled undersize material passing through the grizzly bars falls into pit 23 and is removed by a belt conveyor 29 protected by guard plate 30. The hot oversize material is pushed across the horizontal section of the separator bars and slides down the steeply sloping section to a throat plate 31. At this point it is broken up into smaller pieces by the impact of rotating swinging hammers 32, and simultaneously impelled in an upwardly sloping direction.

The impact breaker mechanism, as illustrated in Figs. 2 and 3, comprises a plurality of horizontally spaced pairs of free swinging hammers 32, each hammer being suspended on a supporting pin 33, mounted in hammer discs 34. These are connected in pairs by means of hubs 35 to a drive shaft 36, which is rotated by motor 37 through driving means 38. It will be noted that this device is similar in arrangement to a hammer mill but operating in the reverse direction, there being no crusing action between moving hammers and an anvil plate, as in the normal hammer mill. A small proportion of the shattered pieces of clinker will find their way downwardly, and these are discharged through openings 39 into pit 23 to join the cooled fine material passing grizzly 24 and delivered by screw 22. The entire assembly is enclosed in housing 40 and made integral with the cooler walls, thus preventing the escape of fine material or the ingress of air except at the desired points.

A further proportion of the broken clinker is driven between the sloping grizzly bars 28 and falls into the pit with the separated fine fraction. At least a part, however, and with proper design of equipment, a major part of the broken hot clinker, is impelled in direct or deflected trajectories such that it is scattered across the top of the partially cooled bed of material advancing through the cooler, thus subjecting it to further cooling action. Depending on the cleavages, some particles of varying size will be impelled directly up the cooler, while others will be deflected from the side wall protection plates 41. In order to increase the proportion and horizontal travel of the broken pieces entering the cooler, a sloping baffle plate 42 may be positioned, as shown, above the grizzly. This plate serves the further purpose of providing increased breakage of some of the material striking it. To protect the refractory roof from wear, improve particle breakage, and increase deflection up the cooler, a plate 43 may be suspended from the brick roof. At times particles having a size close to that of the grizzly bar spacing become wedged between the sloping bars 28, and are conveniently dislodged by grizzly cleaner arms 44, pivotally mounted on shaft 45 which is manually operated as needed.

In certain burning operations it is desirable to shift the location of the burning zone in the kiln, thereby causing a large ring of clinker to drop and be discharged to the cooler in the form of large slabs. In order that this abnormal load of coarse material will not be delivered to the breaker hammers at one time, a series of quadrant plates 46, mounted on manually operated shaft 47, are provided in order that the operator by raising them through the grizzly bars 27 may control the delivery of the excess of material to the breaker hammers.

Alternative types of mechanism which break the oversize hot clinker by impact and simultaneously return at least a part to the cooler are illustrated in Figs. 4 and 5. Both of these devices may be associated with a cooler in a manner similar to that illustrated in Figs. 1 to 3.

In Fig. 5, sloping grizzly bars 48, supported by cross members 49 and 50 are shown positioned to receive clinker discharged from a reciprocating grate cooler of the type previously described. Clinker having a maximum size less than the grizzly bar spacings will be separated and fall into a pit 51 to be removed by an appropriate conveyor. The oversize slides down the grizzly bars and is stopped by the extensions 52 forming a grid which preferably has a slope complementary to the separating bars. Short vertical extensions 53 further insure that the oversize is held in the desired position to be broken. The breaker mechanism comprises a series of breaker arms or hammer blades 54 arranged to pass between each successive pair of grizzly bar extensions 52. These breaker blades are mounted on a transverse supporting shaft 55 by means of hubs 56, the blades being held in place in the hub in a machined recess. The hubs have suitably shaped projections 57 to permit actuation by cams 58 mounted on a cam drive shaft 59 attached to appropriate driving means. Each breaker arm is moved to its lowest position by a slowly rotating cam and placed under stress by a coil spring arrangement as shown. A spring guide rod 60, pivotally attached to the lower side of the hammer arm at 61, and guided through a hole in the web of an I beam 62, provides support for an impeller spring 63 and a snubber spring 64. In operation, the cam slowly lowers the breaker arm to its point of maximum tension, and suddenly releases it causing it to pass through the space between the grizzly bar extensions and by impact break the large hot clinker held thereon, and at the same time project the broken pieces upwardly with trajectories such that a major portion will be distributed over the grate plates of the cooler. The snubber spring serves to limit the upward travel of the hammer arm to a desired maximum point.

In Fig. 4 is illustrated an alternative spring structure for actuating the hammer arms. The particle size classifier and breaker arm structure are similar to those in Fig. 5 and equivalent parts have been identified by the same reference numerals. In this alternative structure heavy duty leaf springs provide the impact force for the breaker arms. Such a spring 65, is rigidly mounted on the top of hub 56, the upward movement of its free end being limited by the horizontal roller 66 during compression, and its downward movement being stopped by roller 67 which serves as a snubber for the upward movement of the hammer arm. The limits of travel of the breaker blade and of the spring are shown in dotted lines. This structure has the advantage over the device of Fig. 5, in that the spring is farther removed from the hot zone, and thus is not as rapidly affected by the radiant heat from broken clinker. In both modifications illustrated in Figs. 4 and 5, the cams 58 are arranged on the drive shaft to produce a staggered release of the breaker arms.

In general it may be said that the novel apparatus of my invention comprises a separator which discharges sufficiently cool fine sizes and delivers the hot oversize to a support on which it is broken by a properly placed impact means such as swing hammers or hammer blades, and by the impact the broken pieces are projected in a forward direction directly onto the moving bed. Such a device when employed in combination with a cooler for furnace products of mixed particle size eliminates large particles and effects the cooling of all of the material to a desired temperature with maximum efficiency by returning a major proportion of the hot broken pieces to the cooler.

I claim:

1. A clinker separator and breaker which comprises a separating zone having a separator including spaced grizzly bars for receiving partially cooled material of mixed particle size and for separating and discharging the sufficiently cooled fine sizes, means for receiving from the separator and for supporting the larger hot particles, means for impacting separated larger particles with a force sufficient to break them into smaller pieces, said impacting means being constructed and arranged to return by the force of the impact at least a part of the broken pieces through the separating zone back to a point in advance of the separator, and a series of spaced arms fulcrumed on a supporting shaft below the grizzly bars and movable upwardly between the grizzly bars to dislodge clinker wedged between them.

2. A clinker separator and breaker which comprises a separating zone having a separator including spaced grizzly bars for receiving partially cooled material of mixed particle size and for separating and discharging the sufficiently cooled fine sizes, means for receiving from the separator and for supporting the larger hot particles, means for impacting separated larger particles with a force sufficient to break them into smaller pieces, said impacting means being constructed and arranged to return by the force of the impact at least a part of the broken pieces through the separating zone back to a point in advance of the separator, and means for intercepting material above the grizzly bars to regulate the quantity of clinker passing thereover.

3. The clinker separator and breaker of claim

2 in which the means for intercepting the material above the grizzly bars are arms projectable upwardly through the grizzly bars.

4. The method of treating hot furnace products of mixed particle size which comprises cooling the mixture in a cooling zone to produce a desired amount of cooling of the fine particles, separating the cooled fine particles, causing at least a part of the remaining larger particles to move into an impacting zone, impacting the larger particles in said impacting zone with a force sufficient to break them into smaller components, and reversing the direction of movement of at least some of said components and returning them in suspension backward into the cooling zone by the force of the impact to be subjected to further cooling.

5. The method of claim 4 in which the hot furnace products are formed into and are advanced through the cooling zone in a relatively thin bed.

6. The method of claim 5 in which the larger of the components resulting from the impacting are returned to the moving bed at points farther from the discharge end of the cooling zone than the smaller of such components, so that such larger components are subjected to cooling for a greater period of time.

7. The method of claim 5 which includes the further step of projecting the components resulting from the impacting onto a deflecting and impacting surface for further breakage and for deflection onto the moving bed.

8. Apparatus for treating hot materials of mixed particle size comprising a grate structure, means for passing a stream of cooling gas through material on said grate structure, a separator positioned to receive material discharged from the grate structure and to separate cooled fine particles of the material from larger and hotter particles, means for receiving and supporting separated larger and hotter particles in position to be impacted, means for impacting said separated larger and hotter particles with a force sufficient to break them into smaller components, means for advancing the material over said grate structure in the form of a bed and along the separator, with the larger particles passing to the material receiving-and-supporting means, said impacting means being constructed and arranged to reverse the direction of movement of the components of the larger and hotter particles fed to it and to return them, by the force of the impact, and in suspension, over the separator and onto the bed of material on the grate structure for further cooling.

9. The apparatus of claim 8 in which the means for receiving and supporting the larger and hotter particles is a generally horizontal plate, and in which the impacting means includes a rotatable shaft in spaced relation to the

receiving and supporting plate, a plurality of spaced discs rigidly mounted on the shaft, a plurality of free-swinging hammer members pivotally mounted on pins supported by adjacent pairs of discs, with each pair of discs supporting at least two balanced opposing hammers and driving means for rotating the shaft.

10. The apparatus of claim 8 in which the separator includes a plurality of substantially parallel grizzly bars positioned in spaced relationship, each of which has a generally horizontal section to receive material from the cooler and a steeply downwardly sloping section to deliver the separated larger and hotter particles to the means for receiving and supporting said particles in position to be impacted.

11. The apparatus of claim 8 which includes a series of arms fulcrumed below the grizzly bars and spaced on a supporting pivotal shaft for upward passage between the bars to dislodge material wedged between them.

12. The apparatus of claim 8 in which the separator includes a plurality of substantially parallel grizzly bars, the means for receiving and supporting the larger hotter particles includes extensions of the grizzly bars and the impacting means includes breaker blades mounted to be passed between the extensions of the grizzly bars.

13. The apparatus of claim 12 which also includes a hub for each breaker blade fulcrumed on a blade-carrying shaft, leaf springs with bases rigidly mounted on the hubs, means for engaging the free ends of the springs to place them under tension and to limit their recoil, a drive shaft in spaced relation to the said blade-carrying shaft, driving means for rotating the drive shaft, and cam members spaced on the drive shaft to engage projections on the hubs and cooperate with the springs to produce successive thrust and recoil movement of the blades.

EJNAR POSSELT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,660	Lukens et al.	June 27, 1840
433,777	Emerson et al.	Aug. 5, 1890
757,069	Thame	Apr. 12, 1904
1,047,370	Bergquist	Dec. 17, 1912
1,449,510	Holcomb	Mar. 27, 1923
1,959,465	Dryfoos	May 22, 1934
2,163,513	Douglass	June 20, 1939
2,166,403	Haines	July 18, 1939
2,375,487	Newhouse	May 8, 1945

FOREIGN PATENTS

Number	Country	Date
611,020	Germany	Mar. 21, 1935