Dec. 2, 1947. J. B. GAFFNEY 2,431,799

COOLER HAVING OVERLAPPING REPLACEABLE GRATES

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Fig. 1.

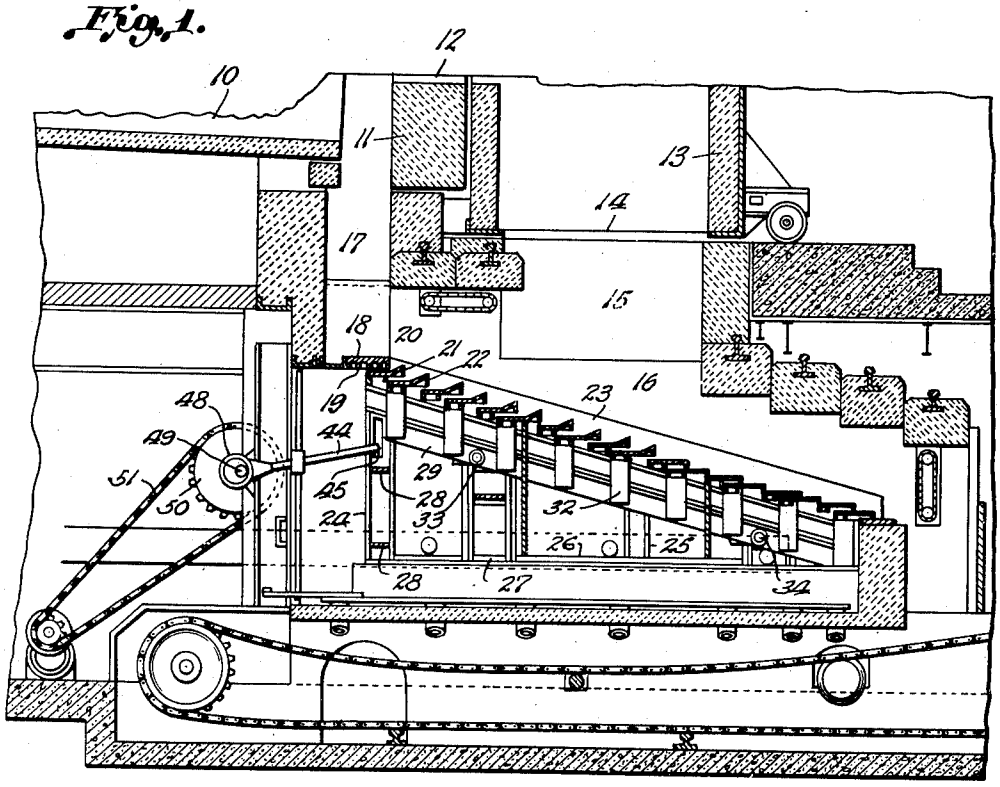


Fig. 5.

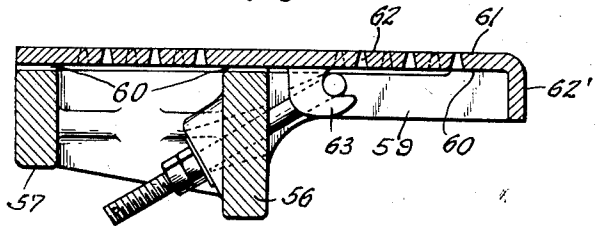
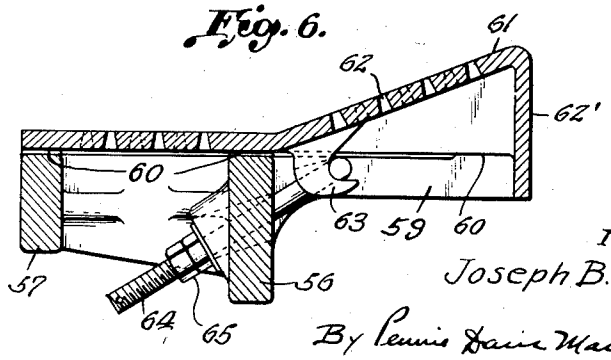


Fig. 6.



INVENTOR.
Joseph B. Gaffney
By Dennis Davis Mannin & Edmonds
ATTORNEYS.

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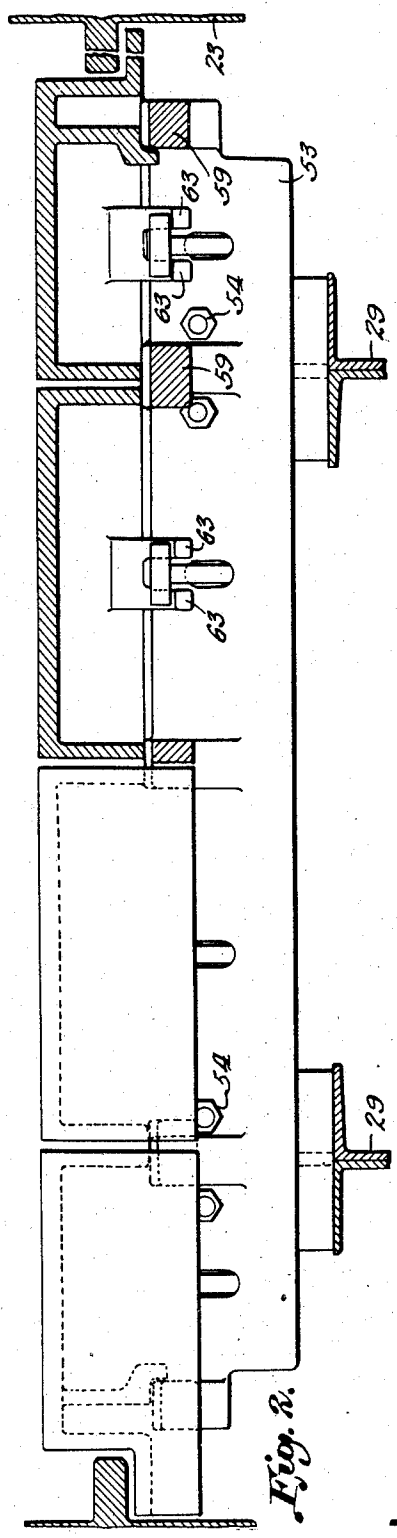


Fig. 2.

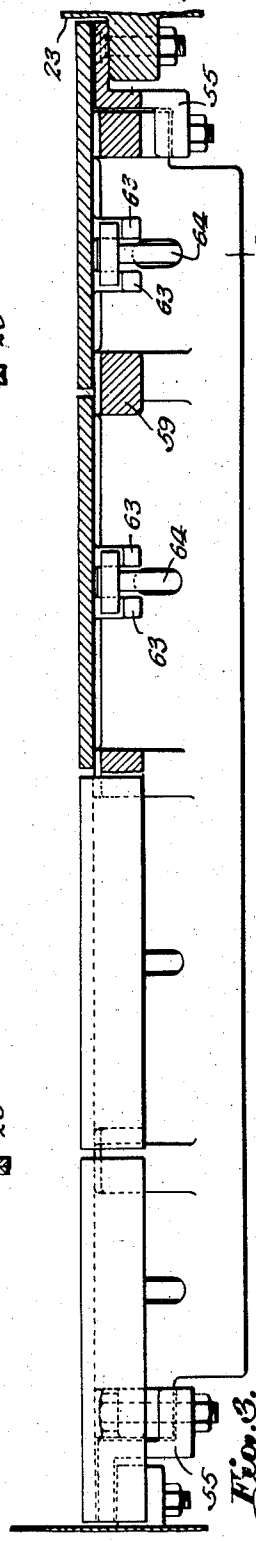


Fig. 3.

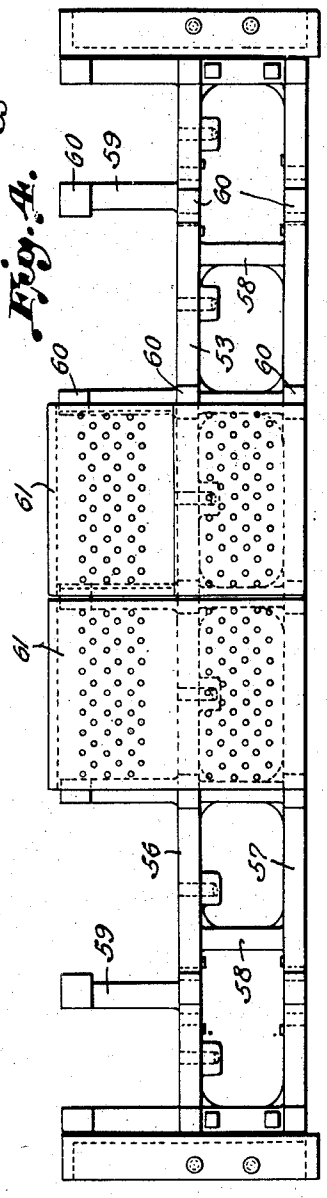


Fig. 4.

INVENTOR.
Joseph B. Gaffney
By Pennie Davis Marvin & Edmonds
ATTORNEYS

Patented Dec. 2, 1947

2,431,799

UNITED STATES PATENT OFFICE

2,431,799

COOLER HAVING OVERLAPPING REPLACEABLE GRATES

Joseph B. Gaffney, Hokendauqua, Pa., assignor to Fuller Company, Catasauqua, Pa., a corporation of Delaware

Application November 8, 1945, Serial No. 627,325

15 Claims. (Cl. 34—164)

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This invention relates to material cooling and more particularly to the rapid air quenching of Portland cement clinker, ore nodules, and lime in varied particle size as issuing from rotary kilns in which the material is burned.

The apparatus of the invention is an improvement upon that of United States Patent No. 2,137,158, granted November 15, 1938, to which reference may be had for a complete statement of the general problem of cooling Portland cement clinker.

The principal cooling elements in the patented structure comprise a series of overlapping, horizontal grates, with fixed grates alternating with laterally movable reciprocating grates. The moving grates serve to agitate the bed continuously and to cause the individual particles of material being cooled to be rolled and overturned as they advance toward the discharge port at the lower end of the grate assembly. The slope formed by the leading edges of the grates is preferably relatively flat and well within the angle of repose of the material so that incoming particles will not roll freely down over the grates, a slope of about 12 degrees being usually provided.

Each grate is provided with a multiplicity of vertical air ports, which are alternately covered and uncovered, as the moving grates are reciprocated, and air is forced through these ports upwardly through the clinker bed. The fixed and moving grates are also vertically spaced, usually about one-quarter of an inch, to provide a horizontal air passage through which air is forced continuously at substantially right angles to the flow through the ports and generally in the direction of advance of the material.

Immediately upon dropping through the chute from the kiln and entering the cooling chamber, the material particles are subjected to blasts of cold air, and as they are continuously agitated and overturned as they advance from grate to grate, the cold blasts of air impinging upon the particles from two directions provide for abrupt and uniform cooling.

The space in the cooling chamber below the grates forms a wind-box supplied by a fan having the capacity to deliver a volume of air at least equal to the kiln requirement of secondary air for combustion and at sufficient pressure, usually about 5 inches of water, to overcome the resistance of the grates and the material stream. The wind-box is preferably provided with transverse baffles forming compartments which may be separately supplied with air in varying quantities so that the necessary volume of air can be forced

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through and between the grates at and adjacent to the entrance to the chamber to reduce the temperature of the material abruptly.

In apparatus of the prior art and incorporating the invention of the above patent, it was found that frequently operation of the apparatus would have to be shut down to replace grates which were cracked or broken. This usually involved shutting down of the kiln also in order to cool the interior of the cooler sufficiently to permit workmen to enter the interior to make the necessary replacements.

The grates of the prior art apparatus were constructed of solid one-piece cast iron or steel rigidly attached to the supporting frames at their ends. In operation of the apparatus, the upper surfaces of the grates are subjected to extremely high temperatures, while at the same time, the lower side is cooled by the air from the wind-box, thus causing relative expansions to develop, which very often resulted in a crack or break. It has been suggested to water cool the grates in an effort to more uniformly distribute the heat. Such additional apparatus as is required to water cool the grates is difficult to operate and, in those installations where such water cooling has been installed, it has failed to prevent the failure of the grates when cooling high temperature material.

The present invention is, accordingly, directed to the provision of a simple grate structure including a light-weight grate which may be used without artificial cooling in a cooler of the type referred to, the grate of the invention being so constructed that it will withstand wide temperature differences on either side thereof without development of stresses sufficient to break or otherwise injure it and which may be replaced with the minimum of effort. The grate structure comprises a plurality of skeletal supports in the form of horizontal vertically spaced spider web members, each member adapted to support a plurality of thin grate sections detachably connected from the under and cool side, thus permitting replacement or adjustment without having to lower the temperature in the cooler.

For a better understanding of the invention, reference may be had to the drawings which are to be taken as illustrative and not as limiting. Fig. 1 is a fragmentary elevation in section of the apparatus, with some of the conventional parts only partially shown. Fig. 2 is a front elevation of a movable grate structure with parts in sections for purpose of illustration. Fig. 3

is a front elevation of a stationary grate structure with parts in section for purpose of illustration. Fig. 4 is a plan view of a grate with several of the grate plates removed for the purpose of clarity. Fig. 5 is a vertical sectional view of one form of the grate structure. Fig. 6 is a vertical sectional view of another form of the grate structure.

A conventional rotary kiln 10 is normally closed and sealed by a refractory-lined hood 11, having a relatively large circular opening 12 communicating with an arch-shaped refractory lined bustle 13. Bustle 13 is somewhat longer than is usual and is provided with an open botton 14 registering with a passage 15 opening into cooling chamber 16.

Hot material as discharged from kiln 10 falls through narrow chute 17 which is displaced transversely toward the rising side of kiln 10. The bottom of chute 17 is closed by shelf 18 which is air-cooled by means of radiating fins 19. After the material particles have accumulated on shelf 18, and have formed a natural angle of repose, the descending particles which follow are distributed by the pile previously formed and pass through entrance 20 of the cooling chamber 16 in which they form an inclined bed resting upon the upper portion of the grate assembly.

The grate assembly and the means for operating it are described in detail in the patent to Douglass No. 2,137,158 and comprises alternately fixed grates 21 and movable grates 22. Fixed grates 21 are rigidly secured to a stationary frame comprising inclined channels 23 secured by upright supports 24 and 25 to lower frame members 26 which rest on ledges 27. Suitable transverse bracing is provided as at 28. Movable grates 22 are mounted on a moving frame comprising inclined side members 29 suitably braced and carrying uprights 32 to which movable grates 22 are secured. Members 29 are movably mounted on axles 33 and 34.

The desired reciprocating motion of the movable frame may be conveniently accomplished by two spaced eccentrics comprising eccentric rods 44 pivotally connected to a horizontal shaft 45 secured to the movable frame members 29. Rods 44 pass through slots in the rear wall of chamber 16 and terminate in straps 48 surrounding the eccentric discs 49. A common crankshaft mounts sprocket wheel 50 driven through chain 51 by a variable speed motor and speed reducer indicated generally at 52. It will be noted that the grates 22 move in parallel horizontal planes between the fixed grates 21 and that the extent of the movement or throw depends upon the eccentricity of the discs 49 on the crank-shaft.

The maximum practical advance of the movable grates is substantially one-half their width, at which point of maximum advance the rear edge of each moving grate is covered by the leading edge of the fixed grate above it, thereby avoiding passage of fine clinker between the grates. It will be understood that the rate of travel of the bed, and consequently its thickness can be varied by changing the speed of the motor 52.

The fixed and movable grates are substantially similar, and may be constructed of iron or steel depending upon the abrasiveness of the material to be treated. Two forms of grate shapes are shown in Figures 5 and 6 which may be used interchangeably depending upon the characteristics of the material to be treated, the form shown in Fig. 6 having a forward raised lip which may be installed for proper operation of the apparatus when treating material having a tendency to cascade down the inclined surface.

Grate supports 53 as shown in Figures 2–4 are identical for both movable and stationary grates. Grate supports 53 for the movable grates are rigidly attached to inclined side members 29 in any desired manner such as bolts 54 and grate supports 53 for the stationary grates are rigidly supported from inclined side members in the form of channels 23 by means of brackets 55. The supports 53 comprise transverse members 56 and 57 having stiffening members 58 therebetween. Fingers 59 extend forwardly of transverse member 56 and the entire spider assembly may be cast as one integral piece if desired. Raised pads 60 are provided at the ends of each finger 59 and also spaced along members 56 and 57 for the purpose of supporting the grates with a minimum of contact with the support for a purpose to be later explained.

Each grate comprises a plurality of thin plates 61 having openings 62 therein through which the cooling air from the wind-box enters the material bed. Forward lips 62′ cast integral with each of the plates 61 are adapted to extend downwardly over the fingers 59 to provide a smooth vertical edge. A pair of hook-like members 63 which may be cast integral with the plates extend downwardly from their bottom side, and hook bolts 64 having T-shaped heads adapted to engage over and to be received by the hook-like members 63 extend through suitable openings in the transverse member 56 and by means of nuts 65 the grate plates may be readily attached to the support.

From the foregoing it will be clear that the grates in their assembled form comprise a plurality of individual thin grate plates having a minimum of contact with the grate support. With such structure, the cooling air from the wind-box in its passage upwardly through the grates sweeps practically the entire under-surface of each grate plate, thus affording a maximum of heat transfer resulting in a more or less uniform temperature in the plate. In use of apparatus of this type, a wide range of temperatures may be encountered in any horizontal section of the material bed undergoing cooling temperature, and great advantage results from the use of the grate of the present invention having sectional supporting plates where each plate may have limited movement for expansion and contraction, thus eliminating undue stresses which apparatus heretofore used frequently resulted in cracks or breaks.

With apparatus of the present invention, in the event of a break in one or more of the grate plates, it is possible to remove the individual plate, in which case the nuts on the T-bolt are backed up and the T-bolt pushed forward until its cross-head drops free of the hook 63. The broken grate then is pushed out of place and the new grate placed in position from the forward side by a repairman entering the cooling chamber, if it is not too hot, or, if the cooling chamber is too hot for that purpose, by lowering the new grate on a wire to its approximate position, after which a repairman underneath the cooling chamber pulls it into proper position, tips the T-bolt up so that the cross-head engages over the hooks thereon, and then tightens up on the nuts to firmly hold the parts in their respective positions. The thinness of each grate plate insures ready heat transfer so that all portions of each plate are heated substantially uniformly,

which lowers the possibility of cracking or breaking to a minimum, and the adaptability of replacement without substantial loss of time causes the new grate to be highly effective for its intended purpose.

I claim:

1. An apparatus for the rapid cooling of heated material comprising a series of spaced over-lapping grates, including fixed grates alternating with movable grates, the upper surface of the grates serving to support a bed of material particles, members at the longitudinal side edges of the series of grates extending longitudinally of the direction in which the series of grates extend, means to impart reciprocating movement to the movable grates to agitate and advance a bed of material thereon, at least some of said grates comprising elongated grate - plate - supporting means extending transversely of the direction in which the series of grates extend and connected at their ends to said members, and at least one grate plate detachably secured to said grate-supporting means.

2. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which a plurality of grate plates slightly spaced from one another are detachably secured along the grate-plate-supporting means.

3. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means is of skeletal structure.

4. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means is of skeletal structure and a plurality of grate plates having air channels extending therethrough are detachably secured to the skeletal supporting structure.

5. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means has relatively small, raised, grate-plate-supporting surfaces spaced from one another both transversely and longitudinally of the direction in which the series of grates extend for supporting the grate plates.

6. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means includes spaced members and said spaced members are provided with relatively small, raised, grate-plate-supporting surfaces spaced from one another both transversely and longitudinally of the direction in which the series of grates extend for supporting the grate plates.

7. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means includes spaced members and fingers extending transversely from one of said spaced members, and said spaced members and the fingers are provided with relatively small, raised, grate-plate-supporting surfaces spaced from one another both transversely and longitudinally of the direction in which the series of grates extend for supporting the grate plates.

8. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means is of a skeletal structure and comprises spaced members, and in which a plurality of grate plates slightly spaced from one another are detachably supported on said spaced members.

9. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate plates are detachably secured to the grate-plate-supporting means by bolt and nut means, the bolt of which extends through an opening in the supporting means.

10. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the grate-plate-supporting means is of a skeletal structure and includes a plurality of spaced members and the grate plates are detachably secured to said spaced members by bolt and nut means, the bolt of which extends through an opening in the grate-plate-supporting means structure.

11. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the detachable securing means includes an extension on said grate plate, a bolt having the head thereof engaging said extension and the shank thereof extending through an opening in the grate-plate-supporting means, and a nut on the distal end of the shank of the bolt which passes through the grate-plate-supporting means.

12. An apparatus for the rapid cooling of heated material as set forth in claim 11 in which the grate-plate-supporting means is of a skeletal structure and comprises spaced members to which the grate plate is secured.

13. An apparatus for the rapid cooling of heated material comprising a series of spaced over-lapping grates, including fixed grates alternating with movable grates, the upper surfaces of the grates serving to support a bed of material particles, means to impart reciprocating movement to the movable grates to agitate and advance a bed of material thereon, at least some of said grates comprising a supporting structure, at least one grate plate having a pair of hook-like members extending therefrom, a T-bolt having the head thereof engaging said hook-like members and the shank thereof extending through an opening in said supporting structure and a nut on the distal end of said shank, whereby the grate plate is detachably secured to said supporting structure.

14. An apparatus for the rapid cooling of heated material as set forth in claim 13 in which the supporting structure is of a skeletal nature.

15. An apparatus for the rapid cooling of heated material as set forth in claim 1 in which the detachable securing means includes an extension on said grate plate, a hook bolt having the hook portion thereof extending over and engaging said extension, and the shank thereof extending through an opening in the grate-plate-supporting means, and a nut on the distal end of the shank of the bolt which extends through the supporting means.

JOSEPH B. GAFFNEY.

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