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METHOD AND APPARATUS FOR UTILIZING WASTE HEAT

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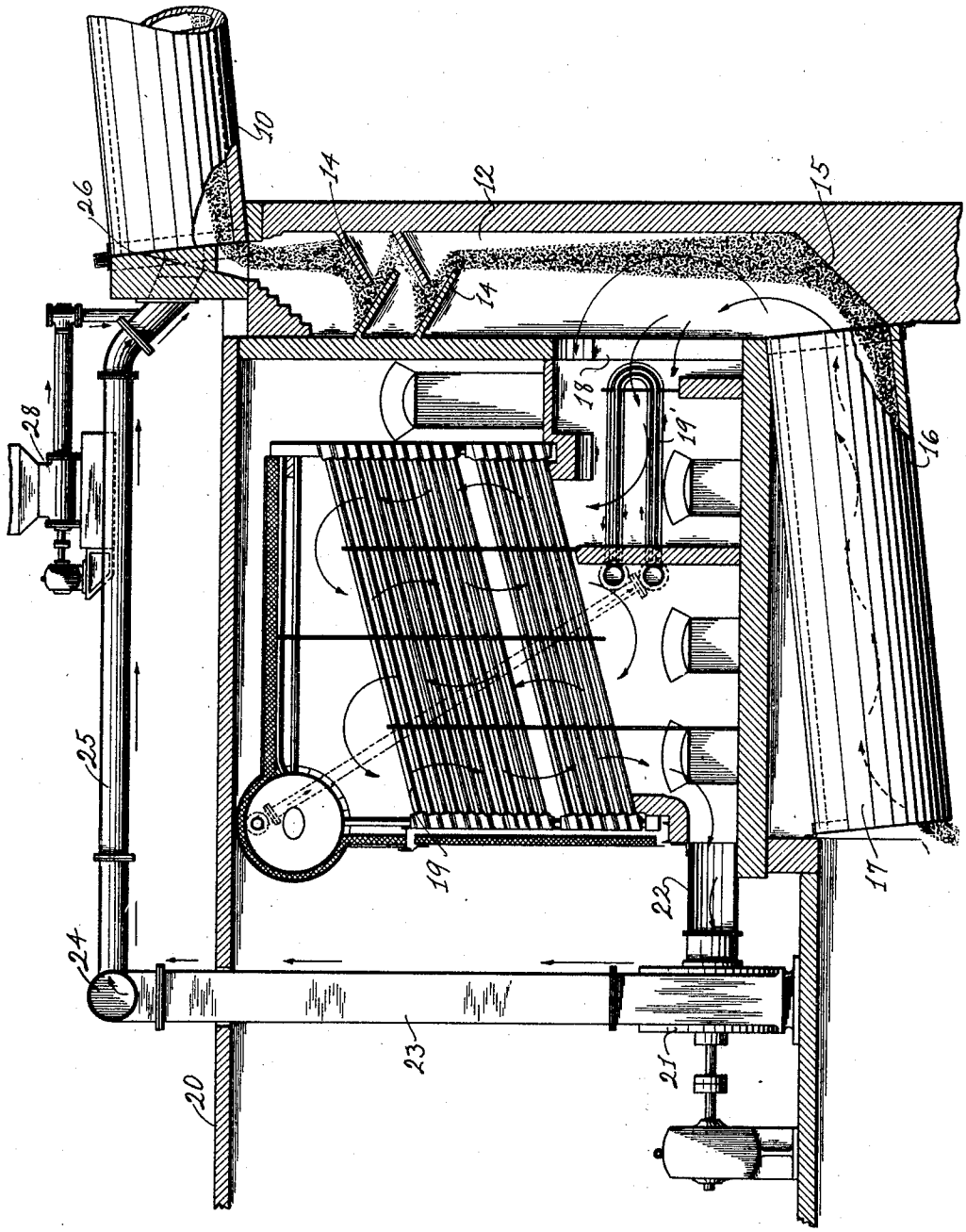

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METHOD AND APPARATUS FOR UTILIZING WASTE HEAT

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My present invention relates to means and methods applicable to the utilization of heat from hot cement clinker and the like, and will be best understood from the following description and accompanying drawings showing illustrative apparatus for carrying out the process or processes contemplated under my invention.

The drawing shows in the only figure a diagrammatic representation of a vertical cross-section through a cement kiln and heat utilizing means.

Like reference characters indicate like parts in the drawing.

In the construction shown, the glowing hot calcined material or clinker from the chamber of one of a number of rotary cement kilns 10 is progressively discharged into the upper end of a vertical passageway or chute 12. The fall of the clinker is checked at the top of the chute by a series of staggered inclined shelves or baffles 14, each extending more than halfway across the chute from the opposite sides. The accumulation of clinker moving downwardly on the baffles forms, in effect, a partition of gas seal, separating the space in the upper part of the chute 12 from that in the lower part of the chute 12, where air is tending to rise because of draft or forced pressure in the zone of combustion in the kiln 10 above.

An inclined surface 15 receives the clinker falling in the chute 12 and deflects it in a horizontal direction to enter an inclined rotary cooler 16. In the cooler, the hot clinker is rotated and tumbled to bring it into intimate contact with the cold air current entering the opening 17 at the lower end. The cooled clinker is discharged through the opening 17 to a place of storage to wait for the final grinding process.

Air is drawn upwardly, as noted, through the rotary cylinder 16 and the chute 12, to cool the hot clinker which is moving in the opposite direction. The air is thereby heated. It is drawn from the chute 12 through an opening 18 in the side of the chute and enters a boiler 19. The boiler 19 is located, as shown, above the rotary cooler or coolers 16 and below the kiln room floor 20. The boiler may be of any size or any type, a water tube boiler being shown. It may be located in any position conveniently associated with the chute 12 and the rotary cylinder 16. Preferably, however, it is located above the cooler with the opening 18 from the chute 12 at the lower part of the boiler setting. If a superheater is used, it may be placed, as shown at 19′, directly opposite the opening 18 so that it may be contacted with the hot air before it has been cooled by contact with the boiler heating surface.

The air is drawn through and from the boiler by the suction of a fan 21 acting at the end of a flue pipe 22. The air delivered by the fan is conducted by a main pipe 23 to a manifold or header pipe 24. This manifold is tapped to deliver the air through an air pressure pipe 25 to a burner nozzle 26 which discharges fuel and the partially cooled air from the boiler into a kiln 10. Any portion or all of the air from the boiler may be thus used.

A powdered fuel feeding device 28 is connected to the pipe 25 and discharges fuel into the pipe 25 adjacent the nozzle 26. The fuel connection enters the pipe 25 at a sufficient distance from the nozzle to insure a good mixing of the fuel in the air blast. The flame from the nozzle 26 enters the kiln to burn and calcine or clinker the cement mixture fed into the kiln at its other and higher end.

By the counterflow arrangement by which the air is made to flow in a direction opposite to that of the heated material, the greatest efficiency of heat transfer is provided and, at the same time, the temperature of the air entering the boiler setting is relatively high because, just before entering the boiler setting, it contacts with hot material which has not been previously cooled by having cold air drawn over or through it.

It will be obvious that various modifications may be made in the construction of the heat reclaiming device or in the steps of the process without departing from the spirit of this invention.

I claim:

1. The method of reclaiming heat from hot

divided solid non-combustible material comprising the steps of heating air by moving the same through a falling stream of the hot material, passing the heated air over boiler heating surface, mixing the partially cooled air from the boiler without again contacting it with the hot material with finely divided fuel and burning the mixture in the production of an additional quantity of said hot material.

2. The method of reclaiming heat from hot divided solid non-combustible material comprising the steps of discharging the hot material into a downwardly directed passageway and through an outlet therefrom while simultaneously drawing air upwardly from said outlet through said passageway and from said passageway through a heat reclaiming means, mixing the air with finely divided fuel and burning the mixture to heat an additional quantity of the material.

3. Apparatus for the recovery of heat from cement clinker or the like comprising, in combination, a downwardly directed passageway arranged to receive the clinker discharged from a kiln, an outlet from said passageway at the lowest part thereof, a boiler, an outlet from said passageway to said boiler, means for moving air in through said first-mentioned outlet and through the falling shower of clinker and said second mentioned outlet over the heating surface of the boiler.

4. Apparatus for the recovery of heat from cement clinker or the like comprising, in combination, a downwardly directed passageway arranged to receive the clinker discharged from a kiln, an outlet from said passageway at the lowest part thereof, a boiler, an outlet from said passageway to said boiler, means for moving air in through said first-mentioned outlet and said second mentioned outlet through the falling shower of clinker and over the heating surface of the boiler, and means for mixing at least a portion of the partially cooled air with finely divided fuel and injecting and burning the mixture in a kiln.

5. Apparatus for the recovery of heat from cement clinker or the like comprising, in combination, a vertically disposed passageway arranged to receive the clinker discharged from a kiln, an outlet from said passageway at the lowest part thereof, baffles arranged adjacent the top of the passageway to check the flow of the clinker and to seal against gas flow at the top of the passageway, the lower portion of said passageway being free, and means to move air through said outlet and through the free portion of said passageway to cool the falling clinker.

6. Heat interchanging apparatus, comprising a kiln arranged to continuously discharge hot clinker from one end, a downwardly directed passageway for receiving the discharge from said kiln, said passageway having an outlet for clinker at the lower end thereof and a second outlet between said first outlet and the upper end of said passageway, a boiler communicating with said second outlet, means to move air into the passageway through said clinker outlet and from said second outlet over the heating surface of the boiler, and means arranged to mix fuel with the partially cooled air from the boiler heating surface and inject and burn the mixture in the kiln.

7. In combination, a cement kiln, a downwardly directed clinker cooler, a passageway for conveying hot clinker from the kiln to the cooler, a boiler associated with said kiln and cooler, and means to move air over the hot clinker while it is freely falling in said cooler, then through said passageway and over the heating surface of the boiler.

8. In combination, a cement kiln having a fuel burner, a downwardly extending clinker cooler, a passageway for conveying hot clinker from the kiln to the cooler, a boiler associated with said kiln and cooler, means to move air over the hot clinker while it is freely falling in said cooler, then through said passageway and over the heating surface of the boiler, and means to deliver the partially cooled air from said heating surface to said burner.

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