June 26, 1934. J. S. FASTING 1,964,344

ROTARY KILN

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Fig. 1.

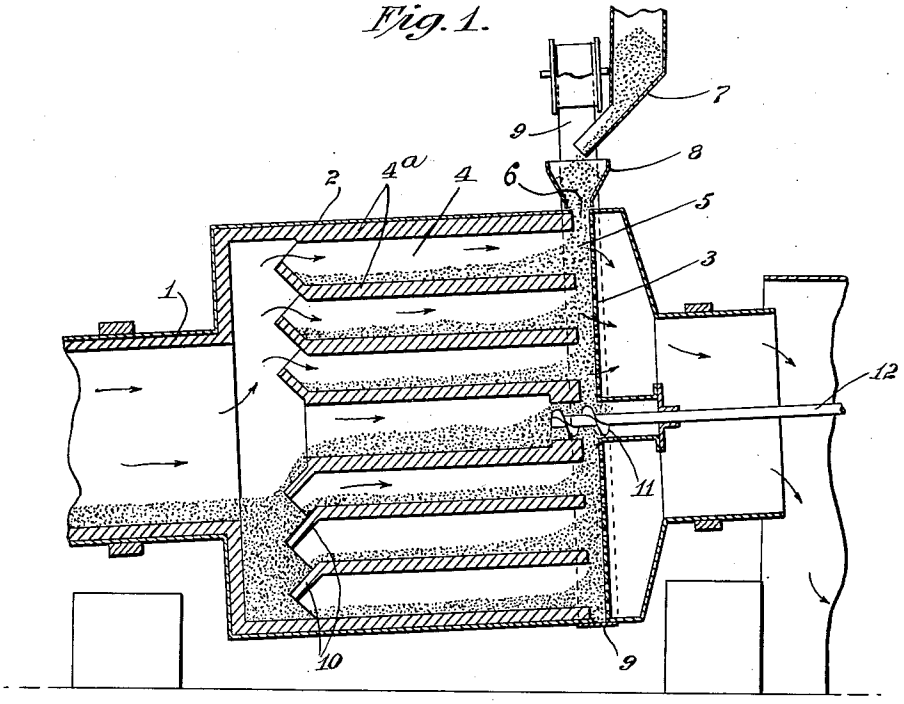

Fig. 2.

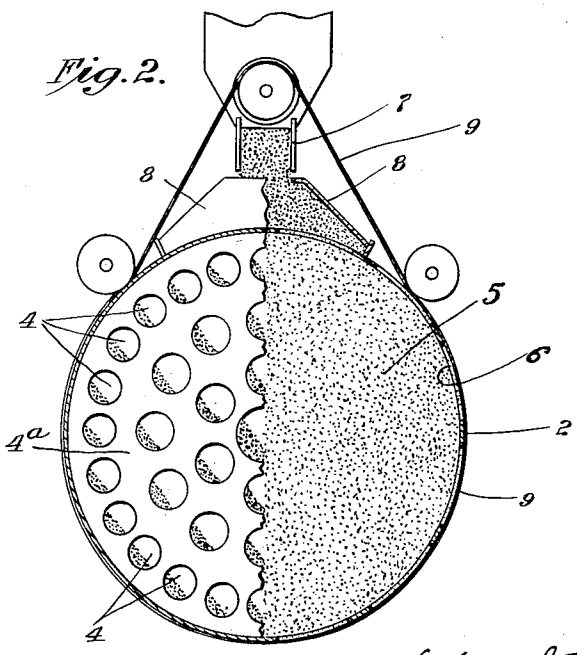

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Fig. 3.

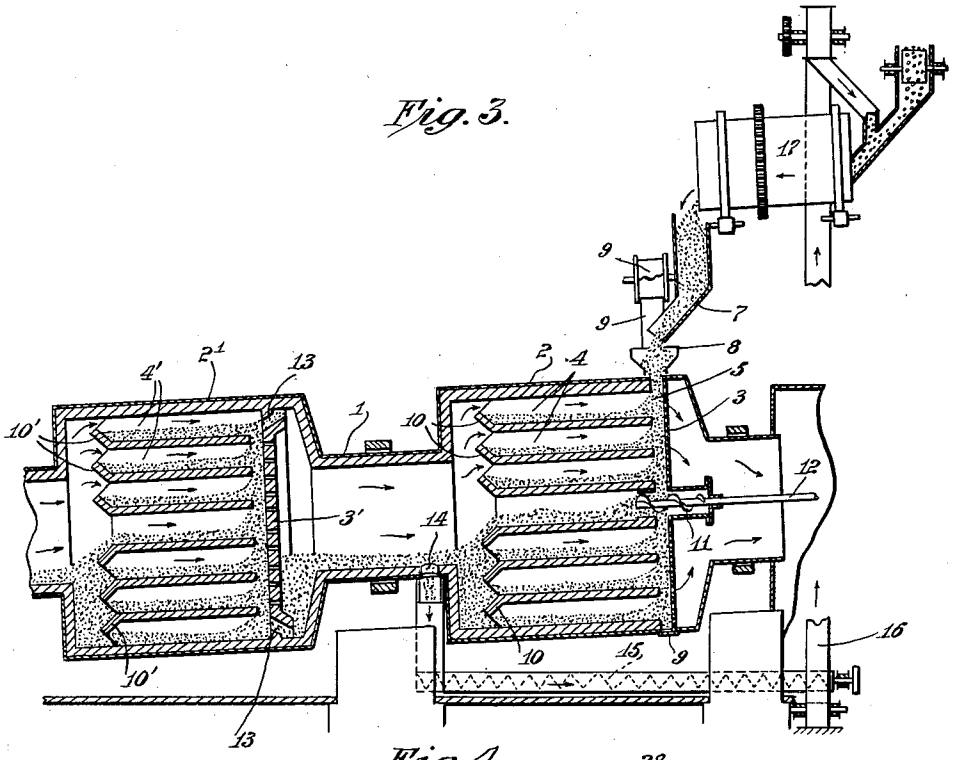

Fig. 4.

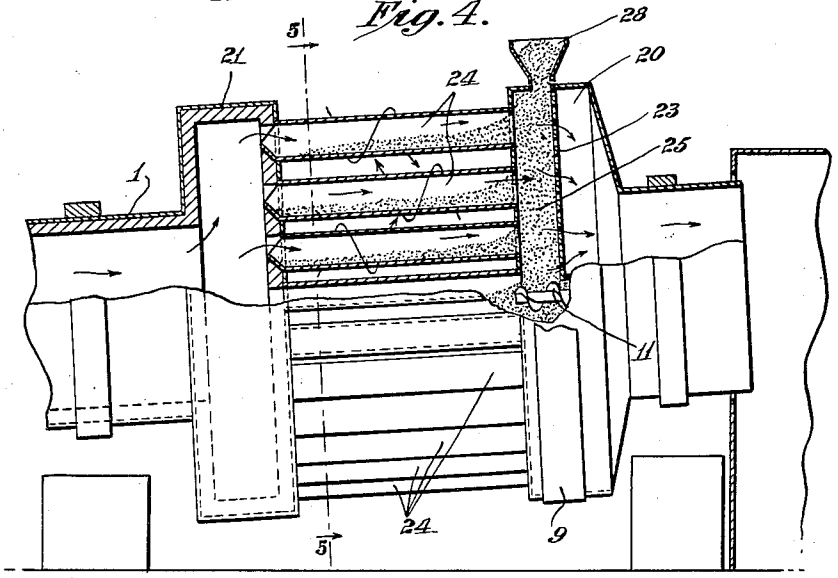

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Fig. 5.

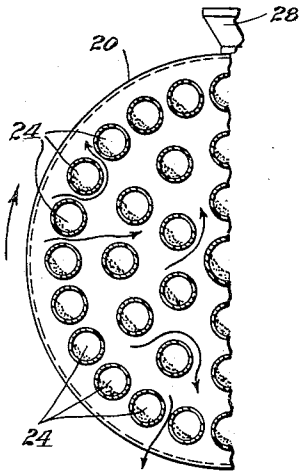


Fig. 7.

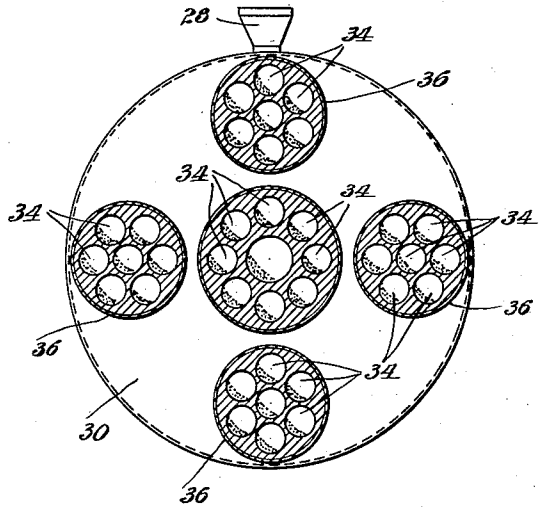
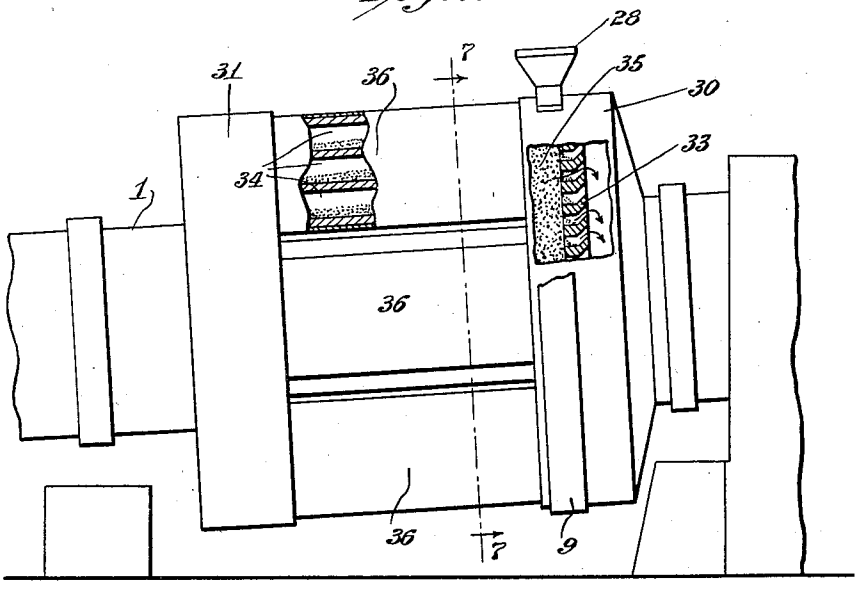


Fig. 6.



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UNITED STATES PATENT OFFICE

1,964,344

ROTARY KILN

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Application June 27, 1933, Serial No. 677,805
In Great Britain June 28, 1932

10 Claims. (Cl. 222—7)

It is well known, particularly in the hydraulic cement industry, that advantageous results follow when the waste gases of a rotary kiln are caused to pass through a layer of the material to be calcined or otherwise treated in the kiln. Not only is the transmission of heat to the material promoted, but the escape of dust is in large measure prevented. It is the object of the present invention to provide an improved structure in which the material to be treated in the kiln is caused to accumulate so as to form a layer through which the hot gases must pass before they escape from the kiln, while the heating of the material may be continued, even to calcination, by exposure of the material to the hot gases in conduits through which the material and the hot gases pass in opposite directions. In accordance with the invention the kiln, in the pre-heating zone and, it may be also, in the calcining zone, is formed of enlarged section, in which are provided axially parallel passages, a gas-permeable partition, transverse to the axis of the kiln, being erected in advance of the inlet ends of such passages and spaced therefrom, whereby there is provided a space between such partition and the inlet ends of the passages into which the material to be treated is delivered, completely filling the same, and from which it is distributed into the several passages. The material with which such transverse space or chamber is charged is preferably in granulated, nodulized or briquetted form. The space or chamber thus formed and the passages are so related that the material accumulates in the space to form a layer through which the hot gases from the kiln pass before escaping through the gas-permeable partition and pass thence to the passages through which it moves onward during the rotation of the kiln, escaping from the passages into the body of the kiln. In practice the whole cross section of the space between the gas-permeable partition and the inlet ends of the passages is kept full of material so that the absorption of heat by the material from the gases progresses effectively. The material naturally piles up somewhat in the inlet ends of the passages, thus adding to the volume of material through which the gas must pass and insuring the complete filling of the reception space. It has been found that the absorption of heat is so good that even when the structure is placed in the calcining zone of the kiln, which is swept by gases at a fairly high temperature, the gas-permeable partition is not heated to such an extent as to cause its destruction. Furthermore, the constant slow flow of material through the passages of the rotating kiln causes constant movement of material throughout the portion of enlarged section, clogging of the material being thus prevented and distribution of the hot gases over the whole of the accumulated layer or wall of material with uniform resistance being insured, with the result that the conditions of heat transmission and the operation of the kiln are uniform throughout.

The material to be treated may be charged into the layer forming reception space in any suitable way and quite conveniently by forming in the kiln wall around such space a series of peripheral openings into the upper-most of which the material is delivered while the lower openings are closed by a band which partially encircles the kiln.

The invention will be more fully explained hereinafter with reference to the accompanying drawings in which it is illustrated, and in which:

Figure 1 is a view in longitudinal sectional elevation of a portion of a kiln in which the invention is incorporated.

Figure 2 is a view in transverse section on two planes, the right hand portion being on a plane of section through the layer forming space, while the left hand portion is on a plane of section through the axially parallel passages.

Figure 3 is a view generally similar to Figure 1, but illustrating the application of the invention to the preheating zone of the kiln and also to the calcining zone.

Figure 4 is a view in longitudinal sectional elevation illustrating a modified embodiment of the invention.

Figure 5 is a partial view in section on the plane indicated by the broken line 5—5 of Figure 4.

Figure 6 is a view in longitudinal elevation, partly broken out and in section, showing a further modification.

Figure 7 is a view in section on the plane indicated by the broken line 7—7 of Figure 6.

In the embodiment of the invention illustrated in Figures 1 and 2 a portion of a rotary kiln of usual construction is shown at 1, to which the material which has been pre-heated or, it may be, calcined, is delivered from a portion 2 of the kiln of enlarged diameter. Within such enlarged portion of the kiln, near its upper or right hand end, is formed a gas-permeable partition 3 which, in this instance, is represented as a metal plate so perforated as to permit the gas to pass through it but without permitting the material to pass. Within the enlarged portion but separated from the partition 3 by a space as shown is a struc-

ture made of heat resistant material 4a in which are formed axially parallel passages 4. The space 5 between the gas-permeable partition 3 and the inlet ends of the passages 4 forms a reception space for the material, which is charged in granulated, nodulized, or briquetted form through a chute 7 into a stationary hopper 8 from which it passes through the upper peripheral openings 6 formed in the wall of the kiln section 2. An endless band 9 embraces the kiln around the space 5, closing the openings in the lower part of the wall while leaving those at the top free to receive material from the hopper 8. Each of the passages 4 may be formed at its outlet end with an inclined lip 10 which serves to prevent the material which has been discharged from the upper passages from passing back into the passages which are lowermost in the rotation of the kiln. A worm conveyor 11, operated by an axial shaft 12, may be provided for the purpose of regulating the movement of material through the several passages 4. The rate at which material is supplied to the space or chamber 5 may be regulated by varying the speed of rotation of the kiln itself, the rate at which the material passes through the passages 4 being proportional to the speed of rotation of the kiln.

In the embodiment of the invention illustrated in Figure 3 the kiln 1 is shown as having not only an enlarged portion 2, which may serve as a pre-heating section, but with a second enlarged portion 2' which may serve as a calcining section. This section is formed in substantially the same manner as is the section 2, having a gas-permeable partition 3', which may be formed of heat resistant material, provided at its periphery with openings 13 through which the material from the intermediate section of the kiln passes into the enlarged portion 2'. The passages 4' may be provided as before with lips 10'. The intermediate portion 1 of the kiln, of normal diameter, may be provided with a peripheral opening 14 through which a portion of the pre-heated and partly calcined material may pass at each revolution of the kiln, to be transferred by a conveyor 15 and elevated by an elevator 16 to be discharged, with other material, into the nodulizing drum 17. The pre-heated nodules so discharged serve as a binder for the raw nodules, particularly when de-watered slurry cake is used as the raw material, for in that case the hot and partly calcined nodules will partly evaporate and partly bind chemically some percentage of water content of the filter cake thus strengthening the nodules formed from wet ground materials.

In the embodiment of the invention illustrated in Figures 4 and 5 the enlarged portion of the kiln is shown as formed of two heads 20 and 21, connected by tubes 24 of metal. The head 20 is provided with a gas-permeable partition 23 which forms between itself and the inlet ends of the tubes or passages 24 a chamber 25 for the reception of material from the hopper 28. The tubes which form the passages 24 are not enclosed within an outer shell and are therefore exposed to the outer air and are cooled by contact therewith and therefore able to resist attack by the hot gases.

As shown in Figures 6 and 7 the passages 34 may be grouped, being formed in heat resisting material within a shell 36, each such group being cooled by the outer air. The passages of each group communicate with the accumulation chamber 35 formed in the head 30 between the inlet ends of the passages 34 and a gas-permeable partition 33 which in this instance is represented as formed of heat resistant material. At their outlet ends the passages 34 discharge material into the head 31 from which it passes into the kiln body 1 as before.

It will be understood that various other changes in construction and arrangement may be made to suit conditions of use or the convenience of the manufacturer and that, except as pointed out in the accompanying claims the invention is not restricted to any of the particular constructions represented in the accompanying drawings.

I claim as my invention:

1. In a rotary kiln for the treatment of cement material and the like, a kiln section having a plurality of axially parallel passages, a gas-permeable partition spaced from the inlet ends of said passages, and means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass.

2. In a rotary kiln for the treatment of cement material and the like, a kiln section having a plurality of axially parallel passages, a gas-permeable partition spaced from the inlet ends of said passages, and means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass, each of such passages having at its discharge end a lip turned toward the periphery of the kiln section to prevent the re-entry of material into the passage.

3. In a rotary kiln for the treatment of cement material and the like, a kiln section having reception and delivery heads, a plurality of axially parallel passages from the reception head to the delivery head, a gas-permeable partition in the reception head spaced from the inlet ends of said passages, and means to charge the space with material to be treated.

4. In a rotary kiln for the treatment of cement material and the like, a kiln section having reception and delivery heads, a plurality of axially parallel passages from the reception head to the delivery head, a gas-permeable partition in the reception head spaced from the inlet ends of said passages, said reception head having a circumferential series of openings therethrough, a band partly embracing the head to close the lower openings, and means to charge said space with material through the upper openings.

5. In a rotary kiln for the treatment of cement material and the like, a kiln section having a plurality of axially parallel passages, a gas-permeable partition spaced from the inlet ends of said passages, means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass, and means to cause the material to move forward from said space.

6. In a rotary kiln for the treatment of cement material and the like, a kiln section having a plurality of axially parallel passages, a gas-permeable partition spaced from the inlet ends of said passages, means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass, and a worn conveyor to force the material forward from said space.

7. In a rotary kiln for the treatment of cement material and the like, a kiln section having a re-

ception head, a delivery head, a plurality of tubes exposed externally to the air and connecting said heads, a gas-permeable partition in the reception head and spaced from the inlet ends of said tubes, and means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass.

8. In a rotary kiln for the treatment of cement material and the like, a kiln section having a reception head, a delivery head, a plurality of tubes exposed externally to the air and connecting said heads, a gas-permeable partition in the reception head and spaced from the inlet ends of said tubes, and means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass, said tubes being arranged in groups with each group enclosed in heat resistant material.

9. In a rotary kiln for the treatment of cement material and the like, a kiln section having a plurality of axially parallel passages, a gas-permeable partition of metal spaced from the inlet ends of said passages, and means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass.

10. In a rotary kiln for the treatment of cement material and the like, a kiln section having a plurality of axially parallel passages, a gas-permeable partition spaced from the inlet ends of said passages and formed of heat resistant material, and means to supply material to be treated to said space between said partition and the inlet ends of the passages to form therein a layer of material through which the hot gases from the kiln may pass.

JOHAN S. FASTING.