Aug. 2, 1938. N. AHLMANN 2,125,263

CEMENT MANUFACTURE

Filed Feb. 9, 1937 2 Sheets-Sheet 1

Fig. 1.

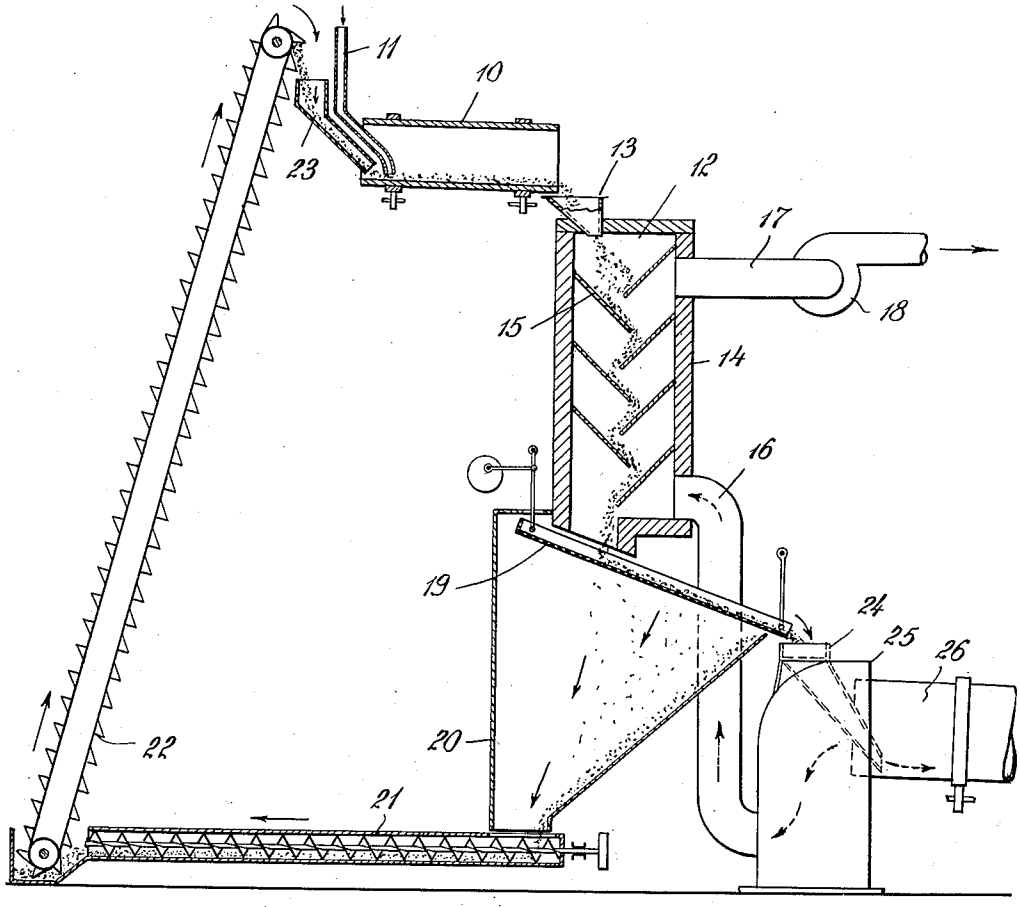

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Fig. 2,

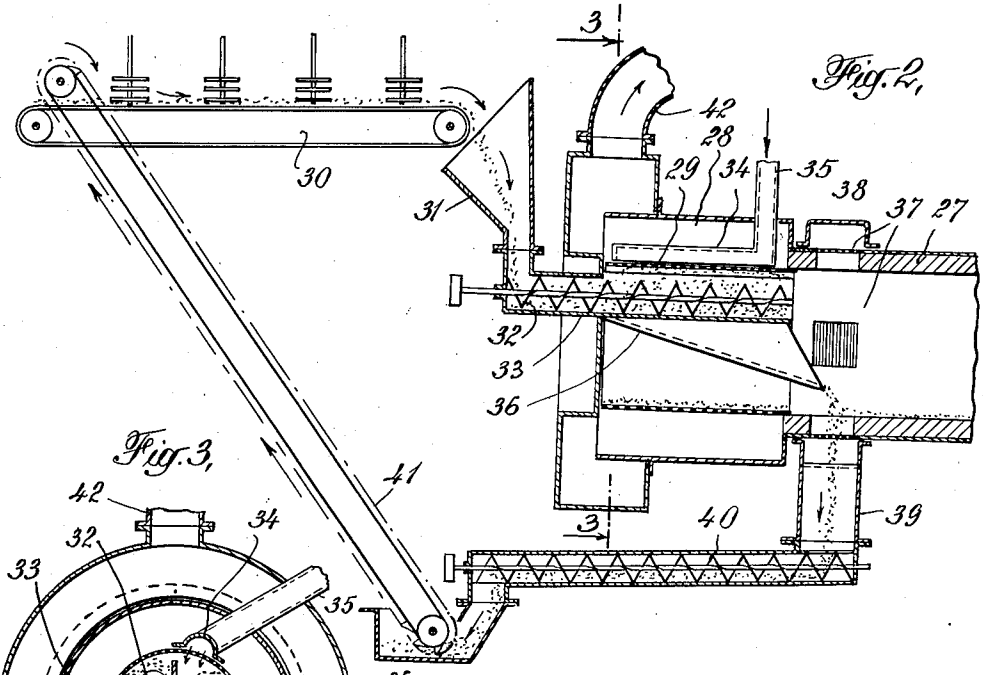


Fig. 3,

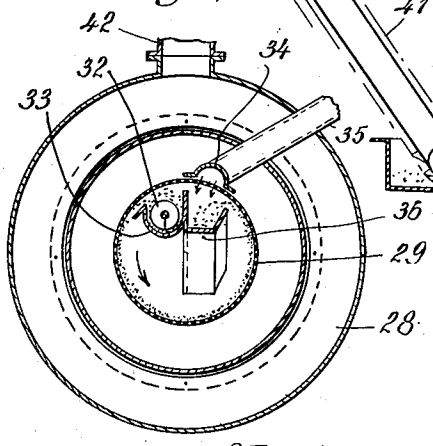


Fig. 4,

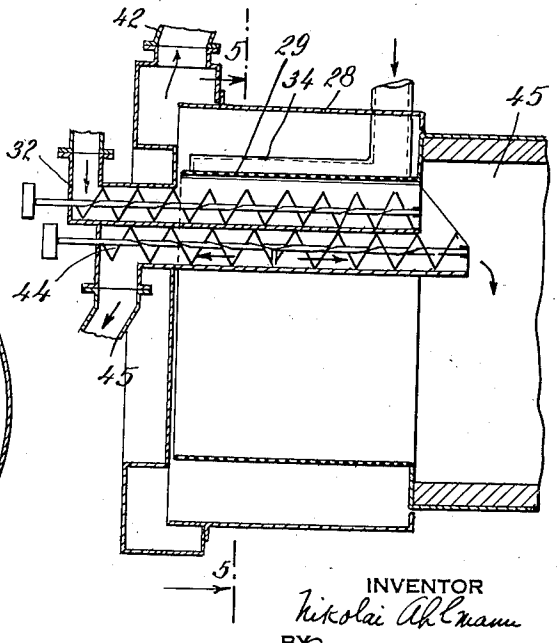
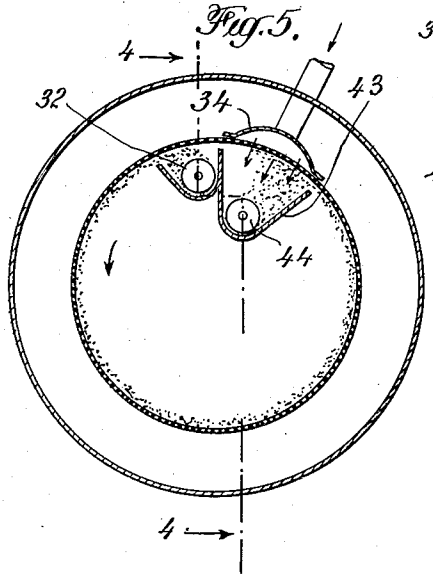


Fig. 5.



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UNITED STATES PATENT OFFICE

2,125,263

CEMENT MANUFACTURE

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Application February 9, 1937, Serial No. 124,821
In Great Britain February 11, 1936

2 Claims. (Cl. 263—53)

This invention relates to the manufacture of cement and is concerned more particularly with a novel method and apparatus for the treatment of the raw material in the form of slurry to place it in condition for calcination, sintering, or both.

In the production of cement, as, for example, by the wet process, the raw material slurry must be dried prior to the burning operation and economy in manufacture requires that the drying be carried on as efficiently as possible. When the raw materials are burned in a rotary kiln, large amounts of waste gases are available for drying purposes, and when the slurry is dried by that heating medium, the surfaces of contact between the slurry and the hot gases should be as large as possible for efficiency and economy. However, those forms of drying apparatus utilizing waste gases, which give the best results with respect to heat economy, have mechanical disadvantages, in that they ordinarily include a considerable amount of heavy movable bodies, such as chains and the like, and in their operation, they also have a substantial power consumption.

The formation of the slurry into nodules, which are then subjected to the action of the hot gases, gives satisfactory results because the total surface of the material to be dried is thereby rendered large and efficient heat exchange can be obtained. However, as raw slurry is ordinarily too wet to be nodulized, it has been necessary heretofore to dry it to some extent before the nodulization takes place, and this drying operation is an expensive one for the reasons above pointed out.

The present invention is, accordingly, directed to the provision of a method and apparatus by which the nodulization and drying of the slurry can be carried on with increased efficiency and economy over those previously obtained. In the practice of the invention, a relatively small quantity of the slurry is dried to the extent necessary to permit its formation into nodules and it is thereafter nodulized and dried. The hot dry nodules are then returned for addition to raw wet slurry to form a mixture suitable for nodulizing, and the nodules so produced are dried. A portion of the dried nodules is then delivered to the kiln for burning, while the remainder is returned and employed for mixture with raw slurry. Thus, once the process is started, it may be continued indefinitely and no drying of the raw materials in the form of slurry is required, except in the preparation of the quantity of nodules first made.

In the application of the invention in actual practice in the drying of cement slurry, the drying is carried on by means of waste gases from the kiln and the nodules and gases may be advantageously brought into contact with one another in a drier interposed between the nodulizing device and the kiln, or, if desired, the drying may take place in the kiln itself, as, for example, in an enlarged chamber at the inlet end of the kiln.

For a better understanding of the invention, reference may be had to the accompanying drawings in which

Figure 1 is a view, partly in elevation and partly in section, showing apparatus suitable for the carrying on of the new method;

Figure 2 is a similar view of another form of apparatus;

Figure 3 is a sectional view on the line 3—3 of Figure 2;

Figure 4 is a sectional view on the line 4—4 of Figure 5, of a modified form of apparatus generally similar to that illustrated in Figure 2; and

Figure 5 is a sectional view on the line 5—5 of Figure 4.

Referring to the drawings, that form of apparatus illustrated in Figure 1 includes a nodulizing device 10 which may be of any suitable construction, as, for example, it may consist of a rotary drum or may be devices similar to those disclosed in the patents to Nielsen No. 1,892,074, December 27, 1932, or Fasting No. 1,980,130, November 6, 1934. The raw slurry is introduced into the nodulizing device through an inlet conduit 11, and the nodules produced in the device are delivered to a drier 12. The nodules may be conveyed to the drier in any suitable manner, as, for example, the device may discharge into a hopper 13 which may be so constructed as to prevent the escape of the gases from the drier.

The drier may be of any suitable type but that illustrated consists of a vertical shaft 14 of any suitable construction containing a plurality of louvres 15 so arranged that the nodules passing down through the shaft are exposed to the action of the hot gases passing upward through the drier. These gases are delivered to the bottom of the shaft through the inlet duct 16 and withdrawn through the outlet duct 17 connected to the suction fan 18. At the bottom of the drier, the nodules are delivered upon a jigging screen 19 by which part of the dried nodules is separated from the remainder. The finer nodules passing through the screen are collected in a hopper 20 and delivered to a conveyor 21 which in turn delivers them to an elevator 22. The

nodules discharged from the elevator enter a hopper 23 from which they are discharged in the nodulizing device to be mixed with the raw slurry entering through the conduit 11. The larger dried nodules are delivered from the screen to a hopper 24 which leads through the hood 25 and discharges the nodules in the upper end of the rotary kiln 26. The gases passing from the kiln enter the hood to which the duct 16 is connected.

In the operation of the apparatus, a quantity of raw wet slurry is dried to place it in condition for nodulization, nodules are formed therefrom, and the nodules are dried. These nodules are not delivered to the kiln, but are used for mixing with raw wet slurry to produce a mixture suitable for nodulizing. The nodulizing operation is then carried on in the usual way, and the nodules formed of the mixture are dried and separated into two portions, one of which is delivered to the kiln and the other of which is returned to the nodulizing apparatus for mixture with the incoming raw slurry. Accordingly, once the process is started, no further drying of the raw materials in the form of slurry is required, and the entire drying operation is carried on with respect to nodular materials. The drying operation is thus highly efficient.

By the use of the screen to separate that part of the dried nodules that is to be returned from the part that is delivered to the kiln, the dust is removed from the kiln feed and the burning process is thus facilitated. Moreover, it is found that the finer nodules and dust are more suitable than the larger nodules for mixing with the raw slurry. Accordingly, if the nodules that are returned to the nodulizing device are too large, they may be pulverized before being delivered to the nodulizing device for mixture with the raw slurry fed thereto.

The proportion of the dried nodules that is returned to the nodulizing device is adjusted to the quantity of raw slurry entering the device, so that the mixture is of a consistency suitable for nodulizing. The quantity of nodules used for the purpose thus depends on the condition of the raw slurry, as, for example, if 162 parts of raw slurry containing 62 parts of water and 100 parts of dry material are supplied to the nodulizing device, it has been found that by the addition of about 182 parts of dry hot fine nodules, a mixture is produced which can be easily nodulized and the nodules formed from the mixture may be readily dried without deterioration in their quality with respect to burning. The nodulizing operation may be controlled in various ways, and preferably, the control is effected by regulating the amount of raw slurry fed to the nodulizing device, since the size of the nodules and the amount of the material that passes through the screen and is thereby returned to the device depend on the relative quantities of dried nodules and raw slurry acted on therein.

While the apparatus illustrated in Figure 1 is suitable for the performance of the new method, it will be understood that changes may be made in the apparatus as desired. For example, instead of using a louvre type drier, a ball drier may be employed. Also, instead of using a drier which is interposed between the nodulizing device and the kiln as a separate piece of apparatus, the drying of the nodules may be carried on in the entrance end of the kiln itself. Constructions of the latter type are illustrated in the remaining figures of the drawings.

In that form of apparatus illustrated in Figure 2, the kiln, generally designated 27, is provided with an enlarged chamber 28 at its inlet end. This chamber includes a cylindrical screen 29 mounted for rotation with the kiln and having its interior in communication with the interior of the kiln. The nodulizing device 30, which is illustrated, is of the type shown in the copending application of Middelboe, Serial No. 73,411, filed April 9, 1936, although any other suitable nodulizing device, such as that illustrated in Figure 1, may be employed. The nodules discharged from the device enter a hopper 31 leading to a conveyor 32 which enters the chamber 28 and extends into the interior of the screen 29. This conveyor lies within a trough 33, the open top of which lies close to the screen 29, and, in the operation of the conveyor, the nodules are discharged upon the interior of the screen by the conveyor and are held in place thereon by the hot gases leaving the kiln and passing outwardly through the screen.

When the nodules have been carried around with the screen through almost a complete rotation thereof, they are brought beneath an inverted trough 34 which lies outside the screen within the chamber 28 and is supplied with air under pressure through a duct 35. The blast of air discharged upon the screen from the trough releases the nodules and they drop into a sloping trough 36 which delivers them into the upper end of the kiln. At this end, the kiln is provided with a plurality of screens 37 spaced angularly about the kiln, the portion of the kiln containing the screens being enclosed within a circumferential chamber 38 from the lower part of which leads a conduit 39. Such of the finer nodules as pass through the screens 37 are delivered through the conduit 39 to a conveyor 40 which leads to an elevator 41 by which the nodules are returned to the nodulizing device where they are mixed with the raw slurry being fed thereto. The hot gases which leave the chamber 28 after passing through the screen 29 are carried off through the duct 42.

The apparatus illustrated in Figure 4 is generally similar to that shown in Figure 2, and includes a drying chamber 28 at the end of the kiln within which is a cylindrical screen 29 rotated by the kiln. The nodules from the nodulizing device are delivered upon the screen and discharged upon the inner surface thereof by a conveyor 32 and are released from the screen by the action of an air blast directed thereon from the trough 34. The nodules released from the screen are collected in a trough 43 which contains a screw conveyor 44, part of the flights of which are right hand and the remainder left hand. Those nodules which enter the forward part of the trough 43 are carried out through the trough to the conduit 45, by which they are delivered to a conveyor 40 and returned by an elevator 41 to the nodulizing device. The remainder of the nodules, which are picked up by the other flights of the screw 44 are delivered directly into the end of the kiln 45. With the construction described, no changes in the kiln itself, such as the provision of the screens 37 and appropriate seals, are required.

In the practice of the new method by any of the forms of apparatus shown, the nodulization of the slurry is effected without preliminary drying thereof, except for such drying as is required to obtain the initial quantity of nodules. The dry nodules returned to the nodulizing device for mixture with the fresh slurry being delivered to the device serve as nuclei in the nodulizing operation, and the advantages of drying the material in

nodular form are obtained without the necessity of any substantial drying of slurry prior to nodulization. While specific forms of nodulizing devices and driers have been shown and described for purposes of explanation, it will be apparent that the utility of the new method is not dependent upon the use of apparatus of any particular type, and those shown are to be understood merely as typical of numerous devices appropriate for the purpose.

I claim:

1. In the manufacture of cement, the method which comprises forming slurry into nodules of sufficient size to be satisfactorily burned in a kiln to produce cement clinker, subjecting such nodules to a drying treatment, passing a part of the said nodules which have been subjected to the drying treatment to a kiln for burning, and mixing another part of the said nodles which have been subjected to the drying treatment with fresh slurry which is too wet to be formed into nodules to form a composite mixture capable of being formed into nodules.

2. In the manufacture of cement, the method which comprises forming slurry into nodules of sufficient size to be satisfactorily burned in a kiln to produce cement clinker, and mixing a portion of the said nodules with fresh slurry which is too wet to be formed into nodules to form a composite mixture capable of being formed into nodules.

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