Sept. 15, 1959 W. V. H. BRUFF 2,904,322

ARRANGEMENT FOR DISCHARGE OF MATERIAL FROM ROTARY KILNS

Filed March 13, 1956

2 Sheets-Sheet 1

Fig. I

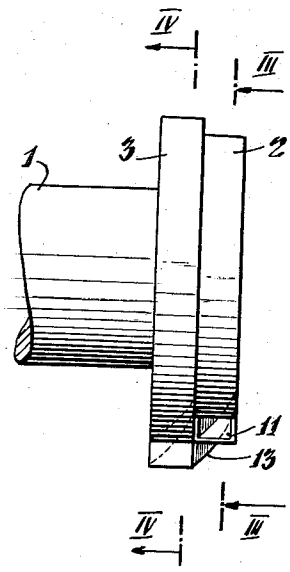


Fig. II

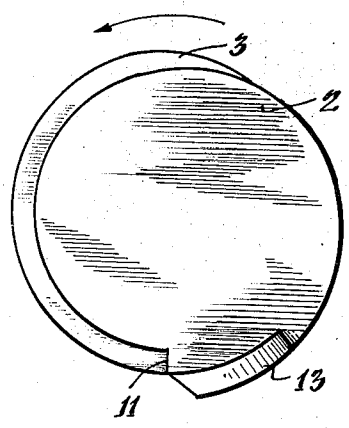


Fig. III

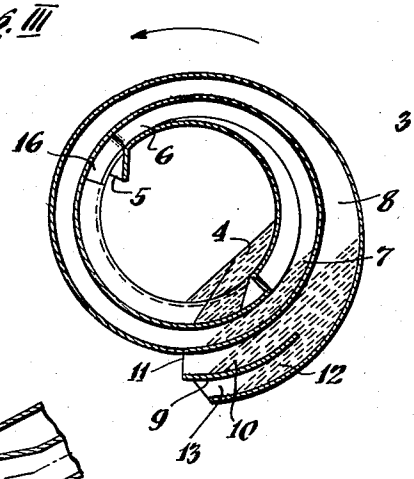


Fig. V

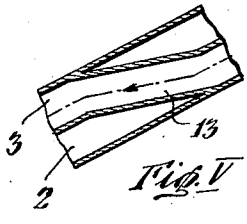


Fig. VI

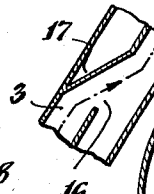
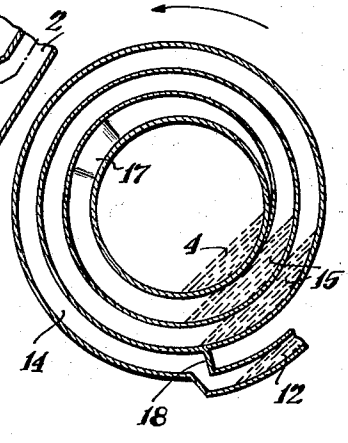


Fig. IV



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ARRANGEMENT FOR DISCHARGE OF MATERIAL FROM ROTARY KILNS

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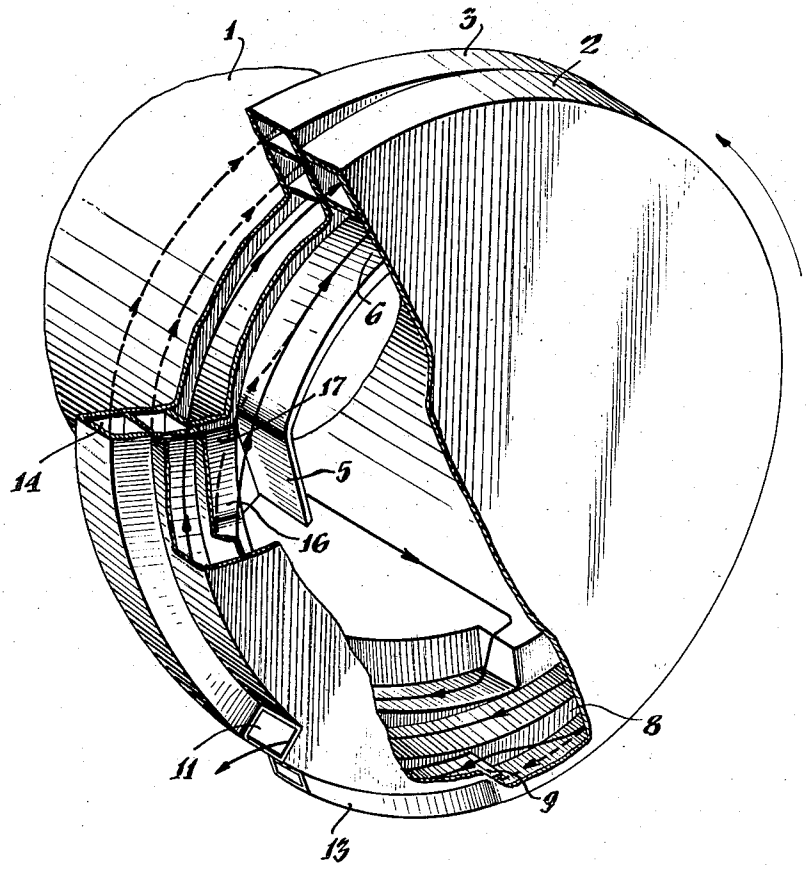
Fig. VII



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United States Patent Office

2,904,322

Patented Sept. 15, 1959

2,904,322

ARRANGEMENT FOR DISCHARGE OF MATERIAL FROM ROTARY KILNS

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Application March 13, 1956, Serial No. 571,177

Claims priority, application Norway March 15, 1955

10 Claims. (Cl. 263—32)

When calcining anthracite it is necessary to maintain a reducing atmosphere in the heating zone in order to avoid combustion of the calcined material. When working with rotary tubular furnaces it is particularly difficult to discharge the calcined material without at the same time letting the atmospheric air into the furnace.

The present application relates to a particular form of apparatus whereby the material can be discharged from the rotary kiln without admission of air. Essentially this comprises a discharge passageway in the form of a coil which is larger than and surrounds the discharge end of the tubular furnace. The entrance to the discharge passageway of the coil is connected with an opening in the surface of the inside of the rotary kiln and the opening may have substantial angular length and may extend along approximately 180° of the inside surface of the kiln. The discharge passageway in the coil is positioned around the outer periphery of the furnace in a spiral and the spiral should have an angular length substantially more than 360°. For example, if the discharge passageway has an angular length of about 540° or more satisfactory results are had. The discharge passageway in the coil is arranged in such direction that material which enters the coil from the furnace will in the course of usual rotation move through the spiral and be discharged at the outer end of the coil.

With this arrangement, if the kiln is at all times producing enough material to fill the cross section area of the discharge passageway of the coil, there will always be a barrier in the coil which will prevent air from feeding back into the interior of the furnace. In practice, however, the quantity discharged from the kiln for each revolution will vary from zero to a maximum depending upon the production of the kiln. I overcome the difficulty that arises from the fact that the production of the kiln may drop below that quantity necessary to fill a section of the discharge passageway of the coil by providing a second coil preferably but not necessarily adjacent the first coil. A connection is made between the first coil and the second coil such that sufficient material will be fed into the second coil to fill its cross section area and the second coil also includes a spiral passageway but in this case I employ a reverse spiral so that as the furnace rotates, the material in the second coil will be fed back into the entrance of the discharge passageway of the first coil. After the material in the second coil has been fed back to an area approximately opposite the entrance to the first coil a crossover channel is provided so that the material from the second coil is again fed into the first coil thereby insuring that enough material will at all times be in the first coil to prevent the inflow of air. One other factor is important. The discharge passageway in the first coil should gradually increase in cross section area towards its outer end and a partition is located centrally in the large outer end to divide the material coming from the coil into two streams. The material which goes on the outside of this partition is the material which is fed back into the second coil

and the material which is on the inside (radially) is discharged from the coil. The increase in size of the discharge passageway should not start within an angular length of 360° of the entrance to the spiral passageway as otherwise the material may not provide an effective air barrier in the coil.

Another important feature of the present structure involves an hour glass-like constriction in the connection between the first and second coils which insures a more uniform flow of material into the second coil and the flow will tend to remain constant even though there may be a momentary interruption in the production of the kiln.

The details of the structure of the present invention may be readily understood by reference to the accompanying drawing in which

Fig. I is a side view of the discharge end of a rotary tubular kiln showing the discharge coils of the present invention in position thereon.

Fig. II shows the kiln and coil viewed towards the end of the kiln;

Fig. III is a section taken on the line III—III of Fig. I through the discharge coil;

Fig. IV is a section taken on line IV—IV of Fig. I;

Fig. V is a sectional view illustrating the connection which feeds material from the first coil positioned at the discharge end of the kiln into the second coil positioned adjacent thereto;

Fig. VI is a sectional view illustrating the connection for returning the material from the second coil into the first coil; and

Fig. VII is an isometric view of the discharge coils of the present invention broken away in part to better illustrate their construction.

As shown in the drawings, 1 is a calcining kiln with a discharge coil 2 and a return coil 3 positioned around the discharge end of the kiln. As best shown in Fig. III discharge coil 2 includes a funnel-shaped entrance 5 which connects with an opening in the inside surface of the kiln and as illustrated in the drawings the angular length of the opening extends along about 180° of the inside surface of the kiln. The funnel-shaped entrance opening 5 leads into a discharge passageway or channel 6 which is wrapped in a spiral surrounding the exterior of the discharge end of the kiln and the spiral lies in a plane transverse the axis of the kiln. The spiral is wrapped to provide a coil of increasing diameter in a direction opposite the direction of rotation of the kiln. The angular length of the passageway is about 570°. With this angular length material passing through the discharge passageway will make at least one and one-half turns around the exterior of the rotary kiln before reaching the outer end of the passageway. The angular length of the discharge passageway is important and I have found that for my purpose of providing a barrier of material against air entering the kiln the angular length of the coil must be substantially greater than 360°.

In Fig. III, 4 is the material inside the kiln. When the kiln revolves in the direction indicated by the arrow a part of the material will pass through the funnel-shaped entrance opening 5 at a point in the minimum diameter of the coil into the channel 6 where the material itself keeps the air out by filling the whole cross section of the channel as indicated by the hatched section 7. At the zone of maximum diameter of the coil the channel 6, as at 8 is somewhat dilated in relation to the channel 6 but the enlargement must not begin within an angular length of 360° of the entrance to the passageway as there would otherwise not be complete closure in all positions of the kiln during rotation. In the preferred form of structure shown in the drawings the enlargement of channel 6 begins at a distance of approximately 405° of

angular length beyond the entrance to channel 6. The enlarged portion 8 of channel 6 is provided with a separating edge or vane 9 which divides the outer discharge opening of channel 6 approximately in half. The material which is skimmed off on the inside of the separating edge leaves the discharge coil at 11 while a constant segment 12 of the material passes outside radially the separating edge and is carried into the entrance opening of the return coil 3 by means of the connecting channel 13 at a zone of maximum diameter of the coil as best shown in Figs. V and VII. The arrow indicates the traveling direction of the material. Even if the kiln at the moment does not produce anything a certain quantity of material will always enter the return coil 3 through the channel 13 because material being emptied from the discharge passageway 6 will move in the outside channel formed by separating vane 9. As illustrated in the drawings the return coil 3 is positioned around the discharge end of kiln 1 immediately adjacent discharge coil 2 and coil 3 has a return passageway or channel which spirals down in from connecting channel 13 to the exterior of the shell of the kiln where as best shown in Figs. VI and VII its discharge opening is connected at a zone of minimum diameter of the coil with entrance 5 of discharge passageway 6 of coil 2. The coiled return passageway 14 of coil 3 is wrapped in a spiral surrounding the exterior of the discharge end of the kiln and lies in a plane transverse the axis of the kiln. The spiral is wrapped to provide a coil of increasing diameter in the direction of rotation of the kiln so that material received from coil 2 at the zone of maximum diameter of the coil will move inwardly toward the shell of the furnace and return to entrance 5 of coil 2 at the zone of minimum diameter. In the preferred form of structure shown, the angular length of coil 3 between connecting channel 13 and entrance 5 of coil 2 is about 720° and in moving through the coil the material makes about two and one-half turns around the exterior of the kiln. The material 12 travels first through the return channel 14 of the coil where it fills up the cross sectional area of channel 14 to form a barrier against air as indicated by the hatched part 15. 16 (see Fig. III) is an opening in the wall separating the two coils. An inclined edge or vane 17 is positioned in opening 16 which leads the return material back to the discharge coil. This inclined edge is shown in Fig. VI which shows a section through both coils and the opening 16 between them. The arrow indicates the traveling direction of the material. It is important to have an hourglass like contraction in the return channel at 18 in Fig. IV. Thereby the quantity of returned material will become approximately constant and independent of the momentary interruption in the production of the kiln.

Fig. VII shows a drawing of the arrangement in perspective where a part of the outer walls is removed. The full drawn arrow indicates the traveling of the material in the discharge coil 2 and the dashed arrow shows the traveling of the return material from the entrance into the return coil 3 through the channel 13 until it returns to the discharge coil through the opening 16.

The two coils need not necessarily be so arranged that one lies behind the other. They may also be arranged outside each other or beside one another and will then have no common separating wall.

It will now be understood that if kiln production should be interrupted the material in coils 2 and 3 will continue to circulate through the coils to maintain barriers of material in both coils against air entering the kiln even though no additional material is fed into the coils from the kiln. For this purpose of continuous circulation of material the separating edge 9 is preferably so positioned in the enlarged outer end of coil 2 that the connecting channel 13 leading over to the intake of coil 3 will have approximately the same cross sectional area as discharge channel 6 and for the same reason the cross sectional area of return channel 14 is preferably made approximately the same as the cross sectional area of channel 6. As shown in the drawings, each of the coiled passageways provide a continuous unobstructed spiral channel through the coils.

It is to be noted that the spiral passageway of coil 3 provides a reservoir of material which feeds into spiral passageway 6 to maintain the air barrier therein when furnace production is interrupted. In order to insure maintaining an air barrier of material in coil 3 and an adequate supply of material to maintain an air barrier in coil 2 the angular length of the spiral return passageway is preferably made more than 720° in length.

What is claimed is:

1. A rotary kiln means for rotating said kiln, a coiled duct forming a passageway wrapped in a spiral surrounding the exterior of the discharge end of the kiln and lying in a plane transverse the axis of the kiln, said coiled duct having an angular length of about 540° with the spiral wrapped to provide a coil of increasing diameter in a direction opposite the direction of rotation of the kiln, said coiled duct having an entrance opening at a point in the minimum diameter of the coil and a discharge opening at a point in the maximum diameter of the coil, means connecting the interior of the kiln with said entrance opening of the duct whereby material from the kiln will enter the duct as the kiln rotates and move through the duct from a zone of minimum diameter of the coil to a zone of maximum diameter of the coil so that the material in passing through the duct will collect in the duct and form a barrier against air entering the kiln from the discharge end.

2. A structure as specified in claim 1 which includes a second coiled duct wrapped in a spiral surrounding the exterior of the discharge end of the kiln and lying in a plane transverse the axis of the kiln with the spiral wrapped to provide a return coil of increasing diameter in the direction of rotation of the kiln, means connecting the discharge opening of said first coiled duct with said second coiled duct at the zone of maximum diameter of both of the coils to feed material from the first coiled duct into the second coiled duct, second separate means connecting said second coiled duct with the entrance opening of said first coiled duct at the zone of minimum diameter of both of the coils to feed material from the second duct into said first duct, said second duct having an angular length of more than 720° so that the material in passing through the second duct will make more than two turns around the exterior of the kiln whereby the material will tend to collect in the second duct and form a barrier to prevent air from entering the kiln and whereby material may be circulated through both ducts to maintain an air barrier therein even though furnace production is interrupted.

3. A rotary kiln means for rotating said kiln, a coiled duct forming a passageway wrapped in a spiral surrounding the exterior of the discharge end of the kiln and lying in a plane transverse the axis of the kiln, said coiled duct having an angular length of substantially more than 360° with the spiral wrapped to provide a coil of increasing diameter in a direction opposite the direction of rotation of the kiln, said coiled duct having an entrance opening at a point in the minimum diameter of the coil and a discharge opening at a point in the maximum diameter of the coil, means connecting the interior of the kiln with said entrance opening of the duct whereby material from the kiln will enter the duct as the kiln rotates and move through the duct from a zone of minimum diameter of the coil to a zone of maximum diameter, a second coiled duct wrapped in a spiral surrounding the exterior of the discharge end of the kiln and lying in a plane transverse the axis of the kiln, with the spiral wrapped to provide a return coil of increasing diameter in the direction of rotation of the kiln, said second coiled duct having an entrance opening at a point in the maximum diameter of the coil and

a discharge opening at a point in the minimum diameter of the coil whereby material entering the second duct will move through the duct from a zone of maximum diameter of the coil to a zone of minimum diameter, second means connecting the discharge opening of said first duct with the entrance opening to said second duct, and third means connecting the discharge opening of said second coiled duct with the entrance opening of the first coiled duct whereby material in passing through the ducts of both coils will tend to collect in the coils and form a barrier against air entering the kiln and whereby the second duct serves as a reservoir for material to be fed into said first duct to maintain a barrier against air in the event that kiln production may be temporarily interrupted.

4. A structure as specified in claim 3 in which the discharge opening of the first coiled duct is provided with a separating wall positioned within the duct, said separating wall being adapted to divide material moving from the discharge duct into two separate streams, one of said streams being discharged to the atmosphere and the second of said streams being discharged into the means which connect the discharge opening of the first coiled duct with the entrance opening of the second coiled duct.

5. A structure as specified in claim 3 in which the first coiled duct is gradually enlarged towards the zone of maximum diameter of the coil, said enlargement bebinning at an angular length of more than 360° from the entrance opening to the duct, the discharge opening of said first coiled duct being provided with a separating edge positioned within the duct, which edge is adapted to divide material moving through the duct into two separate streams, one of said streams being discharged to the atmosphere and the second of said streams being discharged into the means which connect the discharge opening of the first coiled duct with the entrance opening to the second duct.

6. A structure as specified in claim 3 in which the means connecting the discharge opening of the first duct with the entrance opening of the second duct is a conduit having a constriction therein which tends to restrict the flow of material between the two ducts to insure a constant uniform flow of material in the event that production of material in the kiln may be temporarily interrupted.

7. A structure as specified in claim 3 in which the second coiled duct has an angular length greater than 720° so that material passing through the coil will make at least two turns therein before entering the entrance opening of the first duct.

8. A structure as specified in claim 3 in which the cross section area of both coiled ducts is approximately equal.

9. A rotary kiln means for rotating a separate duct forming a passageway associated with said kiln for receiving material from the kiln, an inlet opening at one end of said duct, said duct being wrapped in turns surrounding the discharge end of the kiln with the turns wrapped in a direction opposite the direction of rotation of the kiln relative to said inlet opening so that material fed into the inlet of said duct will move in the duct in a direction opposite the direction of rotation of said kiln, the turns of said duct being positioned coaxial with said kiln, a discharge opening in the second end of said duct, said duct having an angular length of substantially more than 360°, a second separate duct, said second duct being wrapped in turns surrounding the discharge end of the kiln with the turns wrapped in a direction opposite the direction of the turns of the first duct, said second duct having an inlet opening at one end and a discharge opening at the second end thereof arranged at the respective ends of said duct to provide a flow of material from the inlet opening to the discharge opening in a direction opposite the direction of rotation of said kiln, the turns of said second duct being coaxial with said kiln, means connecting the interior of the kiln with the inlet opening of said first duct adapted to feed the material from the kiln into said first duct, second separate means connecting the discharge opening of said first duct with the inlet opening of the second duct, said second means being adapted to supply a portion of the flow from said first duct into said second duct and to supply a portion of the flow from the discharge opening of said first duct to the atmosphere, third separate means for connecting the said discharge opening of the said second duct with the inlet opening of said first duct, whereby material in passing through the ducts of both coils will tend to collect in the coils and form a barrier against air entering the kiln and whereby the second duct serves as a reservoir for material to be fed into said first duct to maintain a barrier against air in the first duct in the event that kiln production may be temporarily interrupted.

10. A structure as specified in claim 9 in which the turns of both of said ducts are arranged in a spiral surrounding the discharge end of the kiln and in which both of the spirals lie in a plane transverse the axis of the kiln.

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