AIR-LOCK SYSTEM FOR A CONTINUOUSLY OPERATED VERTICAL CEMENT KILN

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Application April 26, 1950, Serial No. 158,105
Claims priority, application Great Britain July 15, 1949
3 Claims. (Cl. 214—17)

This invention relates to an air-lock system for a continuously operated vertical cement kiln. In conventional cement kilns the raw material is charged together with solid fuel into the kiln through the top thereof and the treated material is withdrawn at the bottom through a chute, the receiving end of which is in communication with the bottom of the kiln. Air for the combustion of the solid fuel is supplied to the kiln at the bottom thereof at a pressure above that of the surrounding atmosphere. Since successful and efficient operation of the kiln depends to a large extent on the air conditions prevailing within the kiln, egress of air through the chute is undesirable and detrimental and should be reduced to a minimum.

In this connection it is known to form an air-lock between the kiln and the discharge end of the chute, by pivoting at least two flap-gates within the chute, the gates being arranged to open and close in succession so that at least one gate is always closed.

In practice however, difficulty is experienced in completely closing the gates, against the continuous flow of material, due to material becoming wedged between the gate and its seat. Because of this, air is allowed to escape therethrough at a relatively high velocity, carrying with it a large amount of dust which causes considerable wear not only in the chute itself but to the machined surfaces of the gates. Furthermore, the machined surfaces of the gates are also subjected to considerable abrasion due to being in contact with the flow of material. In consequence, the efficiency of the kiln is impaired and heavy expenditure incurred in making good the wear caused by the above adverse conditions.

According to the present invention there is provided an air-lock system for a continuously operated vertical cement kiln having a chute with an inclined floor down which material discharged from the kiln flows, the said system comprising at least two flap-gates adapted to close air-tightly the chute and arranged to open and close in succession so that one flap-gate at least is always closed to prevent egress of air through the chute, and an additional gate provided in front of each flap-gate and adapted to be moved into the closed position before the associated flap-gate closes in order to arrest the flow of material and to allow the load-free closing of said flap-gates and to be moved into the open position after or together with the opening movement of the associated flap-gate to keep the material out of contact with said flap-gates during the closing movement of said flap-gates and to allow the flow of material to be resumed while both the said additional gate and its associated flap-gate are open.

By virtue of the above arrangement the flap-gates can be closed more easily and a substantially satisfactory air-lock ensured. Furthermore, abrasion of the flap-gates and wear in the chute itself is considerably reduced whereby a substantial saving in time and material is effected and the efficiency of the kiln is improved.

The additional gate may be conveniently designed as a segmental gate pivotally mounted in the chute and adapted to swing out of a well in the inclined floor and to move across the chute to arrest the flow of material. Preferably each flap-gate is protected by a depending trap-plate against which the associated segmental gate closes when it swings out of the well.

A preferred embodiment of the invention will now be described by way of example with reference to the accompanying drawing in which:

Fig. 1 shows a vertical cross-section through a discharge chute for a vertical cement kiln provided with an air-lock system according to the invention, and

Fig. 2 is a fragmentary detail plan view showing the actuating shaft for the gates.

Referring now to the drawing, a vertical cement kiln (not shown) has a chute 1 disposed at the bottom thereof. The chute has an inclined floor 2 down which material discharged from the kiln flows, the receiving end of the chute being in communication with the bottom of the kiln. A segmental gate 3 is pivotally mounted in the chute 1 near the upper end thereof and arranged to swing out of a well 4 in the floor 2 to arrest the flow of material and subsequently to swing back into the well to allow the flow of material to be resumed. Leading edges 3c of the radial sides of the segmental gate 3 in the closed position, abut the underside of a depending pivotal trap-plate 5 hinged to the chute 1 by hinge straps 6. A flap-gate 7 is associated with the segmental gate 3 and is pivotally mounted in the chute below the segmental gate 3 in the direction of flow of material down the chute, and arranged to close against a seat 8 in order to prevent egress of air therethrough. A second segmental gate 9, a pivotal trap-plate 10 hinged to the chute by hinge straps 11, and a second flap-gate 12 associated to the segmental gate 9 are disposed in the chute near the lower end thereof in like relationship and in a similar manner to the segmental gate 3, the trap-plate 5 and the flap-gate 7 described above. In the latter case the segmental gate 9 is arranged to swing out of and into a well 14 in the floor 2 and the leading edges 9c of the radial sides of the segmental gate 9, in the closed position, abut the under-side of the depending trap-plate 10 whilst the flap-gate 12 is arranged to close against a seat 13. The trap-plates 5 and 10 serve to protect the flap-gates 7 and 12 respectively from being damaged by large pieces of material passing down the chute, the trap-plates being so arranged to arrest such large pieces of material and to guide them through the flap-gates at a substantially reduced speed.

The segmental gates 3 and 9 and the flap-gates 7 and 12 are each counter-balanced by weights 15, 16, 17 and 18 respectively, each weight being so positioned as to assist in closing the gate with which it is associated and thereafter to hold the gate against its seat.

The material discharged from the kiln through the chute 1 is fed to a suitable conveyor 19.

The gates 3, 7, 9, 12 are each independently actuated by a cam mechanism through crank levers 20, 21, 22 and 23 respectively connected by links 24, 25, 26, 27 to cam-shaped levers 28, 29, 30, 31 mounted on a common spindle 32. The cam-shaped levers are actuated from a revolving actuating shaft 33 by rollers mounted eccentrically of the shaft between spaced discs on the shaft. For the sake of clarity the drawing shows only the roller 34 co-operating with the cam-shaped lever 29.

Referring to Fig. 2 of the drawing, it will be seen that the roller 34 is mounted between discs 35, 36 on the actuating shaft 33.

The gates 3, 7, 9, 12 each remain closed for more than half a complete working cycle, i.e. for more than half a complete revolution of the actuating shaft 33. At the commencement of each cycle the flap-gate 7 begins to open and is again a little closed before the end of the
first half-cycle. The segmental gate 3 begins to open a little after the flap-gate 7 and closes before the flap-gate 7. The flow of material to flap-gate 7 is therefore, not resumed until the flap-gate is already partly open, and the flow of material is again arrested before the flap-gate 7 closes, so that material does not come into contact with the flap-gate 7. In an analogous manner the flap-gate 12 commences to open at the beginning of the second half-cycle and is again fully closed a little before the edge of the second half-cycle, whilst the segmental gate 9 begins to open a little after the flap-gate 12 and is again fully closed a little before the flap-gate 12. The segmental gates 3 and 9 thus shield the flap-gates 7 and 12 from contact with the material.

In the instantaneous position shown in the drawing it will be observed that the segmental gate 9 and the flap-gate 12 are closed, the flap-gate 7 is in the open position and about to commence its closing movement whilst the segmental gate 3 is already part-way closed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. An air-lock system for a continuously operated vertical cement kiln having a chute with an inclined floor down which the material discharged from the kiln flows, the said system comprising two flap-gates mounted in the chute, operating means adapted to open and to close said flap-gates in succession so that one flap-gate at least is always closed to prevent egress of air through the chute, an additional gate provided in front of each flap-gate, and operating means adapted to move each additional gate into the closed position before the associated flap-gate closes in order to arrest the flow of material and to allow the load-free closing of said flap-gates, and to move said additional gate into the open position after or together with the opening movement of the associated flap-gate to keep the material out of contact with said flap-gates during the closing movement of said flap-gates and to allow the flow of material to be resumed whilst both the said additional gate and its associated flap-gate are open.

2. An air-lock system for a continuously operated vertical cement kiln having a chute with an inclined floor down which the material discharged from the kiln flows, the said system comprising two flap-gates mounted in the chute, operating means adapted to open and to close said flap-gates in succession so that one flap-gate at least is always closed to prevent egress of air through the chute, an additional gate pivotally mounted in the chute in front of each flap-gate and having the form of a cylinder segment, and operating means adapted to move each additional gate into the closed position before the associated flap-gate closes in order to arrest the flow of material and to allow the load-free closing of said flap-gates, and to move said additional gate into the open position after or together with the opening movement of the associated flap-gate to keep the material out of contact with said flap-gates during the closing movement of said flap-gates and to allow the flow of material to be resumed whilst both the said additional gate and its associated flap-gate are open, and an inclined pivotal trap-plate in front of each flap-gate, each trap-plate being so arranged that the leading edge of said additional gate bears in its closed position against the free edge of said trap-plate.

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