AIR-LOCK SYSTEM FOR CONTINUOUSLY OPERATED VERTICAL CEMENT KILNS
Filed April 26, 1950

Inventor
Francis Paul Somogyi,

by
His Attorney
This invention relates to an air-lock system for a continuously operated vertical cement kiln.

In the production of cement, raw material is heated in a kiln of the type referred to above, the material being charged, together with a solid fuel, into the kiln through the top thereof and subsequently discharged therefrom, after heating, 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 a steady supply of air, egress of air through the chute is therefore undesirable and detrimental and should be reduced to a minimum.

In this connection it has been proposed to form an air-lock between the kiln and the discharge end of the chute by pivotally mounting within the chute at least two flap-gates, each flap-gate being opened and closed in succession so that at least one of the flap-gates is always closed. The flap-gates are kept in their closed position by the action of a restoring force, e.g. a balance weight, and they are positively opened by periodically operated actuating means consisting of a cam and lever mechanism which overcomes the closing action of the restoring force.

In practice, however, it can happen that the pressure of the air in the kiln rises above the critical value and overcomes the restoring force of the balance weight, with the result that the flap-gates are blown open allowing air to escape. The above described construction also does not allow of operating the kiln at higher pressures, as a rather heavy balance weight would be required which is inconvenient and undesirable.

Moreover, there is the danger that some bigger particles may come to rest between the flap-gate and the frame of the chute against which the flap-gate bears so that a tight closure is prevented.

According to the present invention the above difficulties are overcome by means of 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 a flap-gate which is mounted in the chute and arranged to be opened positively against the action of a restoring force, by periodically operated actuating means, and which is provided with periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means.

In a preferred construction the flap-gate is locked in the closed position by a lock operating lever arranged periodically to engage a locking lever mounted on the flap-gate spindle. Preferably the flap-gate is connected pivotally to the wall of the chute by means of a spindle to which are connected (a) a closing lever, actuated by a restoring force (e.g. a balance weight) causing the closure of the flap gate (b) an operating lever of a lever and cam mechanism imparting to the flap-gate the opening movement and (c) a locking lever which is adapted to co-act with the free end of a lock operating lever which is urged into its locking position by a restoring force (e.g. a balance weight) and caused to move into the release position by a lever mechanism actuated by means of a cam.

It is advantageous to provide the free end of the lock operating lever with a cam follower and to give the locking lever the form of a cam-way, one part of which cam-way forms the locking face whilst the remaining part forms a riding surface for the lock operating lever during the opening and closing movement of the flap-gate. The lock operating lever is free to rotate around a pivot and the locking face of the cam way has an initial part concentric with the axis of said pivot whilst the distance of the following part from said pivot gradually decreases to produce a wedge action in order to ensure a tight closure of the flap-gate.

By virtue of the above arrangement the flap-gate cannot be blown open by any increase of pressure within the kiln, and the kiln can now be operated at a higher pressure, which gives the best possible operating conditions and at the same time improves the efficiency of the kiln. The new arrangement also ensures a positive closure of the flap-gate during the last part of its closing movement.

Preferably the air-lock system is of the kind described and claimed in my co-pending application Serial No. 158,105, filed April 26, 1950 in which a segmental gate is pivotally mounted in the chute before each flap-gate, each segmental gate being arranged to swing out of a well in the inclined floor to arrest the flow of material before the succeeding flap-gate closes and subsequently to swing back into the well, when the succeeding flap-gate is again open, to allow the flow of material to be resumed.

A preferred embodiment of the invention will now be described by way of example with refer-
2,610,749

3

to the accompanying drawing, the single
figure of which shows diagrammatically, in side
elevation, the lower part of a discharge chute.

In referring now to the drawing of a vertical cement kiln (not shown) has a chute 1 (the lower part
only of which is shown for clarity) disposed at the
bottom thereof. The chute has an inclined floor 2 down which material discharged from the
cement kiln flows, the rear end of the chute being
in communication with the bottom of the kiln.

A segmental gate 3 is pivotally mounted in the
chute near the lower 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. The restoring force for this seg-
mental gate 3 is provided by a balance weight 9
mounted on a closing lever 11 attached to the
pivot shaft or spindle of the gate 3 and lying
in back of the chute. A flap-gate 5 is pivotally
mounted in the chute below the segmental gate
in the direction of flow, and arranged to close
against a seat 6 to prevent egress of air through
the chute. The gates 3 and 5 are positively
operated against a restoring force by means of
linkages 1 and 1a (shown only schematically),
actuated from cams 8 and 8' mounted on a shaft
8a. The restoring force for the gate 5 is pro-
vided by a balance weight 16 mounted on a closing
lever 12 attached to the outside of the spindle
of the gate 5, the weight being so dimensioned
and positioned as to cause the closing of the gate
up to a position where the locking device exerts
its locking pressure. Also attached to the spindles
of the gates 3 and 5 in back of the chute, as
indicated by dotted lines, are arms 7 and 11
respectively to which the linkages 1 and 1a are
pivotally attached in a known manner, which
linkages are similar to the lock opening and re-
leasing means including lever 25 and linkage 21
more fully described hereinafter.

The closing lever 12 for the gate 5 is extended
beyond its pivot on spindle 5', and this extension
has the shape of a quadrant, which forms the
locking lever 13 adapted to co-operate with a locking
lever 16. The quadrant has a cut-out 14 where the lower edge of the lever and the
periphery of the quadrant 13 meet, thus
forming together with the periphery of the quad-
rant a cam way. A bell crank lever is mounted
on a pivot 18 on the outside of the chute and
has one arm which constitutes the lock oper-
ating lever 16, the other arm having a balance
weight 17 mounted thereon and so positioned
that it urges the lock operating lever 16 into en-
gagement with the cut-out 14 after the flap-gate
5 has been closed. The engaging end of the lock
operating lever 16 has a roller 18 mounted there-
on to provide for a rolling engagement between
the locking lever and the cam way of the quad-
rant. The lock operating lever is actuated from
from a cam 19 mounted on the shaft 8a through a
lever 20 and a linkage 21 connected to the en-
gaging end of the lock operating lever 16.

The initial part of the cut-out 14 starting from
the circular edge of the quadrant 13, is concentric
with the pivot 18, but the cut-out 14 gradu-
ally decreases to produce a wedge action in
order to enforce a tight closure of the flap-gate 5.

An additional segmental gate and flap-gate
(not shown) which generally correspond to the
arrangement disclosed in my before mentioned
co-pending application and similarly disposed in the
chute 1 near the upper end (not shown)
thereof, in like relationship and actuated in like
manner to the said additional flap-gates 3 and 5
described above, the gates being provided with a
locking means in like manner to the locking
means for the locking lever 16. The cam
operating lever (not shown) for actuating the upper gates and
the upper locking means are mounted on the shaft 8a and are 180° out of phase with the cams
3, 3' and 13 respectively so that the upper gates
are closed before the lower gates 3 and 5 are open and vice versa.

The upper flap-gate, the upper segmental gate and the gates 3 and 5 each remain closed for
more than half of a complete cycle, i.e. for more
than half a complete revolution of the cam shaft
8a. At the commencement of the second half
cycle the upper gates are already closed and
locked and the flap-gate 5 then commences to open and is again closed a little before the end of
the second half cycle.

The cam, actuating the lock operating lever 16,
is so designed and positioned that this lever is
withdrawn from the locking face of the quadrant
13 a little before the flap-gate 5 commences to open at the beginning of the second half-cycle.

During closing movement of the
flap-gate the roller 18 on the locking lever 16 rides
on the periphery of the quadrant 13 and after the
flap-gate is fully closed the locking lever is
again urged into engagement with the notch 14 by the restoring action of the balance weight 17.
The locking means associated with the upper
gates (not shown) operate in like manner and
therefore need no further description.

The material discharged from the chute 1 is fed
onto a suitable conveyor 22.

Having now particularly described and ascer-
tained 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 oper-
ated vertical cement kiln having a chute with an
inclined floor down which material discharged
from the kiln flows, the said chute comprising a
flap-gate pivotally mounted in the chute, re-
trying means adapted to hold the flap-gate in its
closed position, the flap-gate operating means
acting means for opening the flap-gate against
the action of the restoring means, locking means
adapted to tighten the closure and also to keep
the flap-gate in its closed position between the
periods when it is caused to open by the peri-
dically operated actuating means and lock-releas-
ing means operable in timed relationship with
said actuating means.

2. An air-lock system for a continuously oper-
ated vertical cement kiln having a chute with an
inclined floor down which material discharged
from the kiln flows, the said chute comprising a
flap-gate, a shaft mounted in the chute free
to rotate and connected to the flap-gate, restor-
ing means adapted to hold the flap-gate in its
closed position, periodically operated actuating
means for opening the flap-gate against
the action of the restoring means, periodically oper-
ated locking means adapted to tighten the closure
and also to keep the flap-gate in its closed posi-
tion during the remaining time, the flap-gate being caused to open by the periodically operated actuating
means, said locking means comprising a locking
lever connected to said flap-gate shaft, and a
lock-operating lever adapted to co-act with the
said locking lever.

3. An air-lock system for a continuously oper-
ated vertical cement kiln having a chute with an
inclined floor down which material discharged
5. from the kiln flows, the said chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a closing lever actuated by a restoring means causing the closure of the flap-gate and connected to the shaft of the flap-gate, a cam and lever mechanism including an operating lever for imparting the opening movement to the flap-gate connected to the shaft of the flap-gate, a locking lever connected to the flap-gate, a lock-operating lever, co-acting with said locking lever and having a locking position and a release position, another restoring means urging said lock operating lever into its locking position, and a cam and lever mechanism causing the lock-operating lever to move into the release position.

4. 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 chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a restoring means adapted to hold the flap-gate in its closed position, periodically operated actuating means for opening the flap-gate against the action of the restoring means, periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means, said locking means comprising a locking lever connected to said flap-gate shaft, and a lock-operating lever adapted to co-act with the said locking lever, a cam follower at the free end of said lock-operating lever and a cam-way formed by said locking lever, one part of the cam-way forming a locking face and the remaining part forming a riding surface for the lock-operating lever during the opening and closing movement of the flap-gate.

5. 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 chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a restoring means adapted to hold the flap-gate in its closed position, periodically operated actuating means for opening the flap-gate against the action of the restoring means, periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means, said locking means comprising a locking lever connected to said flap-gate shaft, and a lock-operating lever adapted to co-act with the said locking lever, a cam follower at the free end of said lock-operating lever and a cam-way formed by said locking lever, one part of the cam-way forming a locking face and the remaining part forming a riding surface for the lock-operating lever during the opening and closing movement of the flap-gate.

6. 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 chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a restoring means adapted to hold the flap-gate in its closed position, periodically operated actuating means for opening the flap-gate against the action of the restoring means, periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means, said locking means comprising a locking lever connected to said flap-gate shaft, and a lock-operating lever adapted to co-act with the said locking lever, a cam follower at the free end of said lock-operating lever and a cam-way formed by said locking lever, one part of the cam-way forming a locking face and the remaining part forming a riding surface for the lock-operating lever during the opening and closing movement of the flap-gate, said locking lever has the shape of a quadrant, the lower edge of which forms said locking face of the cam and the periphery of which serves as riding surface for the follower of the lock-operating lever during the opening and closing motion of the flap-gate.

7. 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 chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a restoring lever actuated by a restoring means causing the closure of the flap-gate and connected to the shaft of the flap-gate, a cam and lever mechanism including an operating lever for imparting the opening movement to the flap-gate connected to the shaft of the flap-gate, a locking lever connected to the flap-gate, a lock-operating lever, co-acting with said locking lever having a locking position and a release position, another restoring means urging said lock-operating lever into its locking position, and a cam and lever mechanism causing the lock-operating lever to move into the release position, said lock-operating lever being formed as a bell-crank lever, one end of which being arranged to co-act with said locking lever and the other end being provided with a balance weight urging the bell-crank lever into its locking position.

8. 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 chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a restoring means adapted to hold the flap-gate in its closed position, periodically operated actuating means for opening the flap-gate against the action of the restoring means, periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means, said locking means comprising a locking lever connected to said flap-gate shaft, and a lock-operating lever adapted to co-act with the said locking lever and provided with a cam follower, said locking lever having the shape of a quadrant, one part of the cam-way forming a locking face and the remaining part forming a riding surface for the lock-operating lever during the opening and closing movement of the flap-gate, said periodically operated locking means being so designed that it only causes the locking end of said lock-operating lever to move out of the range of the locking face in order to release the flap-gate, whilst the remaining movement of the lock-operating lever is determined by the movement of its
follower along said riding surface of said locking lever.

9. 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 chute comprising a flap-gate, a shaft mounted in the chute free to rotate and connected to the flap-gate, a restoring means adapted to hold the flap-gate in its closed position, periodically operated actuating means for opening the flap-gate against the action of the restoring means, periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means, said locking means comprising a locking lever connected to said flap-gate shaft, and a lock-operating lever adapted to co-act with the said locking lever, said locking lever having the shape of a cam-way, one part of the cam-way forming a locking face and the remaining part forming a riding surface for the lock-operating lever during the opening and closing movement of the flap-gate, said periodically operated locking means comprising a driving cam and a lever system activated by said cam, said driving cam being so shaped that it causes the lock operating lever to release the flap-gate a short time before the opening movement is imparted to the flap-gate.

10. 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 chute comprising a flap-gate pivotally mounted in the chute, a restoring means adapted to hold the flap-gate in its closed position, periodically operated actuating means for opening the flap-gate against the action of the restoring means, periodically operated locking means adapted to tighten the closure and also to keep the flap-gate in its closed position between the periods when it is caused to open by the periodically operated actuating means, a driving cam imparting motion to said periodically operated actuating means and a driving cam imparting motion to said periodically operated locking means, both said driving cams being arranged on the same shaft.

Francis Paul Somogyi.

REFERENCES CITED

The following references are of record in the file of this patent:

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>28,014</td>
<td>France</td>
<td>July 15, 1924</td>
</tr>
</tbody>
</table>