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Kyle

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[54] **FLOW INVERTER FOR GRAIN DRIERS**

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Related U.S. Application Data

[63] Continuation of Ser. No. 835,955, June 24, 1969, abandoned.

[52] **U.S. Cl.** **34/167,** 34/174

[51] **Int. Cl.** **F26b 17/12**

[58] **Field of Search** 34/28, 29, 161, 168, 34/169, 171–176; 259/180; 302/28; 193/14, 29

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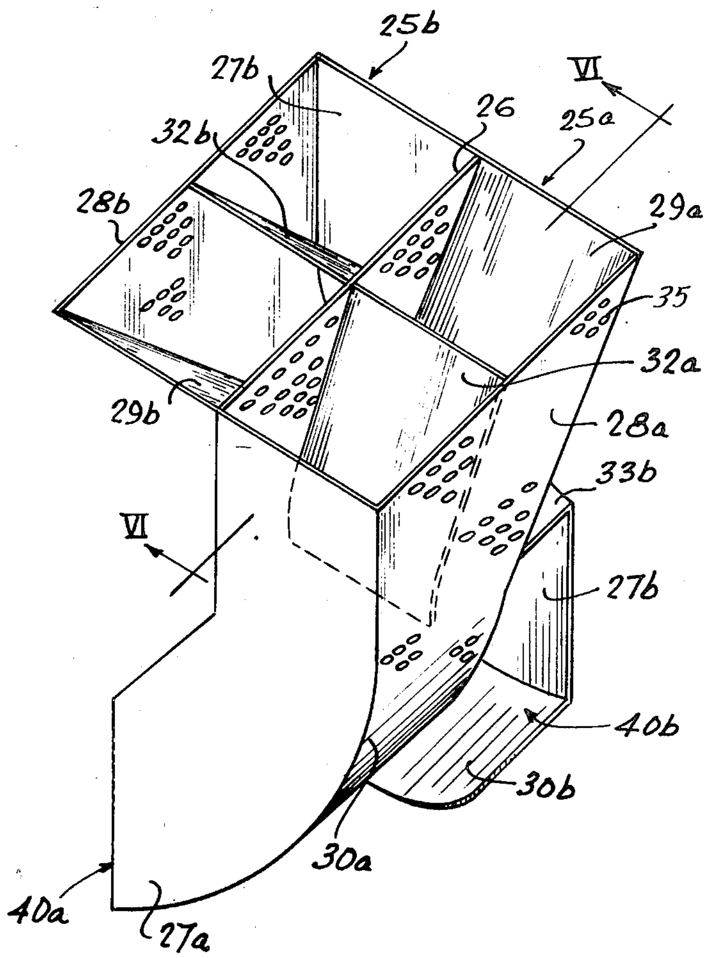
[57] **ABSTRACT**

Flow inverter for use in a gravity flow grain drier of the type having drying chambers with perforated walls through which drying air passes. The flow inverter has two flow directing portions for separating portions of the flow of grain adjacent the air inlet wall and adjacent the air outlet wall respectively and simultaneously smoothly deflecting the separated portions laterally angularly into chutes which direct the portion separated from the flow adjacent the air inlet wall downstream adjacent the air outlet wall and direct the portion of the flow adjacent the air outlet wall downstream adjacent the air inlet wall.

12 Claims, 6 Drawing Figures



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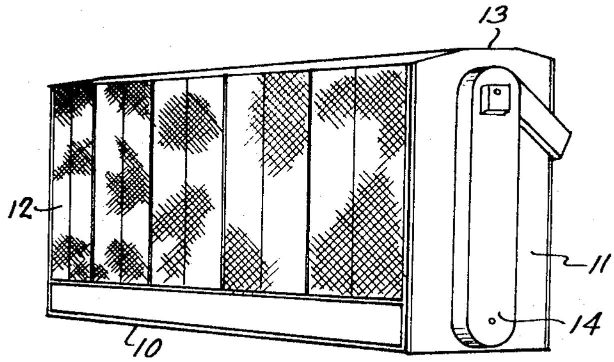

Fig. 1.

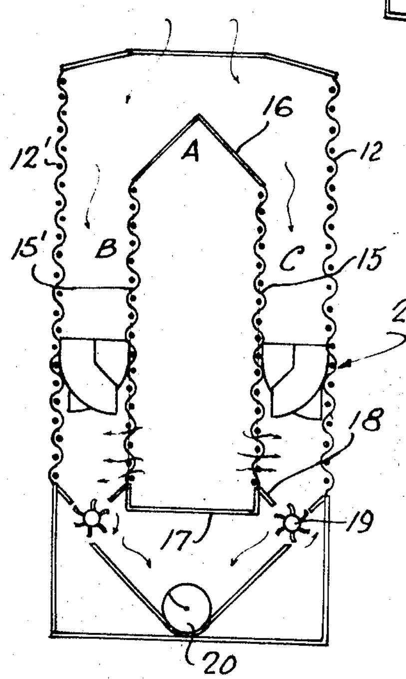

Fig. 2.

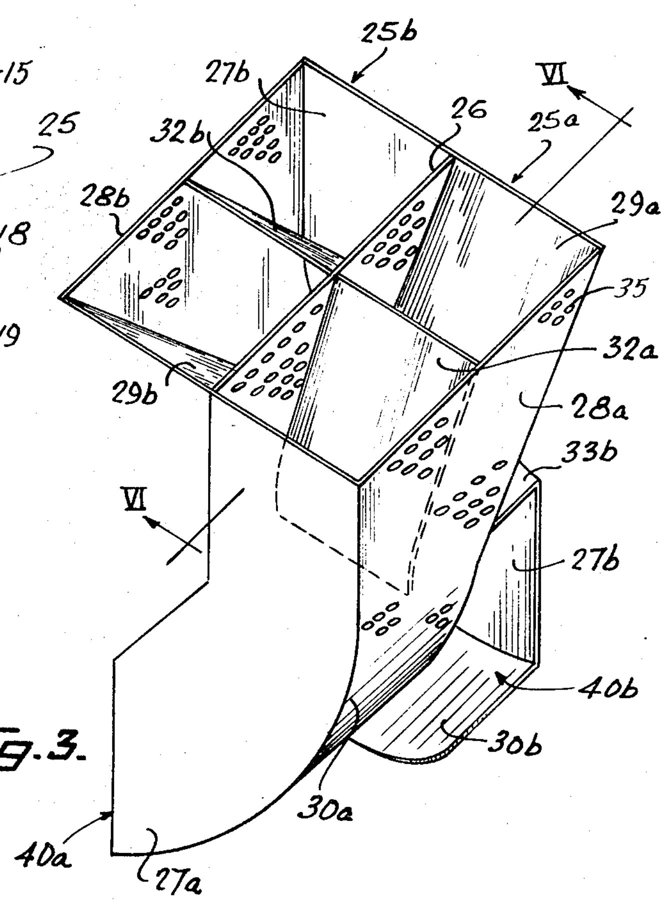

Fig. 3.

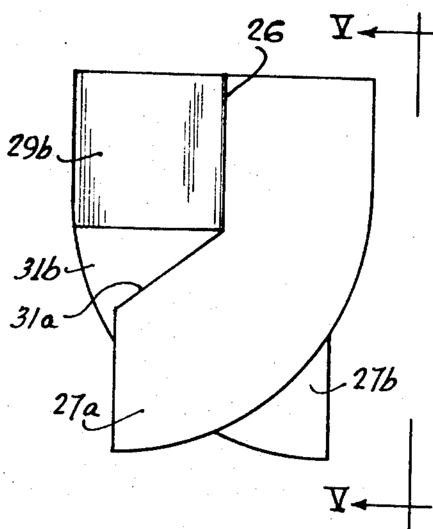

Fig. 4.

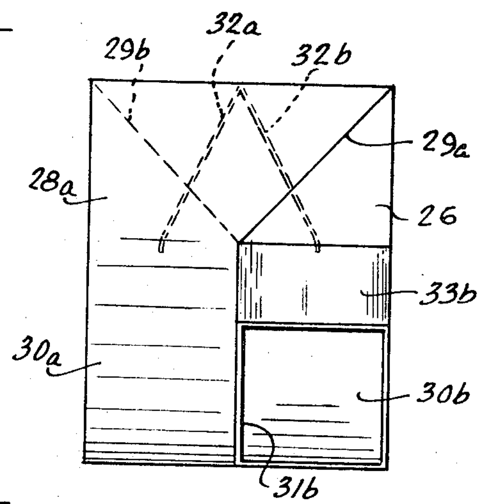

Fig. 5.

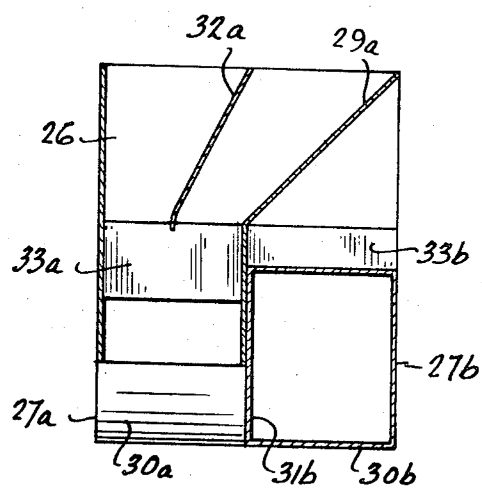

Fig. 6.

FLOW INVERTER FOR GRAIN DRIERS

This invention is a continuation of Ser. No. 835,955, filed June 24, 1969, now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a flow inverter for use in grain driers, particularly for gravity type grain driers having drying chambers with perforated walls.

2. Description of the Prior Art

The need to accelerate the rate of drying grain has led to the development of specialized grain drying equipment. One form of grain drying device that has received wide acceptance is a gravity flow drying chamber. The basic components of this device are perforated walls between which the grain to be dried is deposited, means to heat air and means to force the heated air into the chamber through one of the walls, through the grain between the walls and out through the other wall. The grain continuously moves down through the chamber and the rate of flow of the grain is controlled by means of a metering device in the bottom of the chamber. While devices of this type currently on the market represent a great advancement over the natural drying processes previously employed, they are far from being perfect.

Wet grain is a very difficult material to handle, being of a soft and soggy nature, and it tends to solidify under the pressure of the overlying mass when deposited in a drying chamber. In this condition, the fluid properties of the grain are extremely irregular. A major problem in drying chambers results from the fact that as grain dries its fluid properties increase over those of wet grain. Thus, the warm dry air entering one wall of the chamber picks up moisture from the grain adjacent that wall and as this air moves across the chamber through the grain, it becomes cooler and more moisture laden so that its ability to dry the grain decreases as it progresses across the chamber. The result of this is that a drying front moves slowly across the bin.

Because of this slowly moving drying front, all of the grain in the drying chamber is dried only after a very long residence time. This can be aided somewhat by increasing the temperature and flow rate of air but this requires the use of large quantities of fuel and, moreover, by the time the grain adjacent the air exit wall becomes dry, the grain adjacent the air inlet wall may be overdry, resulting in economic weight loss or even scorching or charring beyond the point of utility.

Various attempts have been made in the prior art to overcome the problems of the flow characteristics of the drying grain including baffles to break up the flow. However, once grain has begun to flow it develops momentum tending to keep it moving. The result is that flow channels appear behind the drying front while the wetter grain ahead of the front tends to remain still. Thus, the relatively dry grain tends to merely flow over these baffles in flow channels without properly mixing with the grain which is still wet.

SUMMARY OF THE INVENTION

I have now been able to overcome these difficulties by inserting flow inverters into the drying chambers of gravity flow grain driers.

My flow inverter comprises a housing unit which is adapted to be fitted within a grain drying chamber and conforms to the inner surfaces thereof. The housing comprises a first flow directing portion for separating a portion of the flow of grain adjacent the air inlet wall and simultaneously smoothly deflecting the separated portion laterally angularly into a first channel means. This first channel means is operatively joined with the first flow directing portion to direct the separated and deflected portion of grain into the conduit downstream adjacent the air outlet wall. The housing further comprises a second flow directing portion for separating a portion of the flow adjacent the air outlet wall and simultaneously smoothly deflecting this separated portion laterally angularly into a second channel means. This second channel means is operatively joined with the second flow directing portion to direct the separated deflected portion into the conduit downstream adjacent the air inlet wall.

My flow inverter has the great advantage of being able to positively divide the flow through the drying chamber in the region of the drying front so that the relatively wet grain ahead of the drying front is moved into direct contact with the hot dry air entering through the air inlet wall while the already dry grain behind the front is moved into the area of the air outlet wall. The grain moved adjacent the air outlet wall, because it is already dry, is in a free flowing state so that the air passing through which has picked up moisture from the wet grain will flow through the dry grain with relative ease without again saturating this grain with moisture. The result is that the grain emerging from the bottom of the grain drying chamber is of a relatively uniform dryness.

Since most commercial driers contain an elongated drying chamber, a series of the inverters are normally placed side by side along the length of the column. For instance, in a chamber one foot wide and eight feet long, eight one foot square inverters may be inserted.

The two flow directing portions can be equal in size so that the flow of grain in the drying chamber can be divided in half. This has the particular advantage of simplifying construction.

However, it is also possible to have the flow directing portions of unequal size so that more of the flow of grain is directed in one direction than the other. This can be varied depending on the position of the inverter in the drying chamber. Usually the inverter is positioned in the chamber approximately two thirds of the way down from the top.

According to yet another embodiment of my invention, the flow can be divided into two portions adjacent the air inlet and outlet walls respectively, as well as a third portion between these which is not diverted but allowed to continue straight down the center of the chamber. With this arrangement the driest grain adjacent the air inlet wall is diverted adjacent the air outlet wall, the wettest grain adjacent the air outlet wall is diverted adjacent the air inlet wall and the central portion of the grain which is of intermediate dryness continues down the center of the drying chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

Certain preferred embodiments of my invention are illustrated by the attached drawings in which:

FIG. 1 is a perspective view of a grain drying device of the type in which the flow inverter of this invention is employed;

FIG. 2 represents diagrammatically, a cross-section of the drying device of FIG. 1 and shows the location of the flow inverter of this invention relative to the drying device as a whole;

FIG. 3 is a perspective view of my new flow inverter;

FIG. 4 is an end elevation of the flow inverter shown in FIG. 3;

FIG. 5 is a side elevation of the flow inverter of FIG. 3 and

FIG. 6 is a sectional view along line 6—6 in FIG. 3.

With reference to FIGS. 1 and 2, the numeral 10 indicates a support frame of a grain drying device. Extending upwardly from the frame 10 are end walls 11 and side walls 12, the side walls being perforated to permit passage of air therethrough.

As can be seen from FIG. 2, the dryer has an internal plenum chamber A formed from perforated side walls 15, flow dividing top 16 and bottom 17. Two vertical drying chambers B and C are defined by walls 12', 15' and 12,15 respectively. By means which is not shown and is not a part of the present invention, heated air is forced into the plenum chamber A. From chamber A this air flows through walls 15 and 15' into drying chambers B and C, through the grain contained therein and out through walls 12 and 12'.

The grain to be dried is fed into the dryer by known means through opening 13 and flows over plenum chamber top 16 into drying chambers B and C. The grain is supported in thee chambers by baffles 18 and continuously passes out of the bottom of the chambers at a controlled rate by means of metering devices 19 and into auger 20. The auger 20 delivers the grain into elevator housing 14.

Referring now to FIGS. 3 to 6, it will be seen that each flow inverter unit is divided into two parts 25*a* and 25*b* by means of vertical flow dividing wall 26. A pair of vertical end walls 27*a* and 27*b* are joined to wall 26 and a pair of vertical side walls 28*a* and 28*b* are joined to end walls 27*a* and 27*b*.

Inwardly inclined end panels 29*a* and 29*b* positioned between walls 28*a* and 26 and between walls 28*b* and 26 respectively, form the bottoms of flow deflecting portions.

These flow deflecting portions merge into grain carrying chutes 40*a* and 40*b*. The chutes are composed of smoothly curved bottom walls 30*a* and 30*b*, inner side panels 31*a* and 31*b*, inclined top panels 33*a* and 33*b* and extensions of end walls 27*a* and 27*b*. Bottom walls 30*a* and 30*b* smoothly merge into vertical side walls 28*a* and 28*b* respectively, while top panels 33*a* and 33*b* angularly join dividing wall 26. End walls 27*a* and 27*b* serve as end walls for both the flow deflecting portions and the chutes. The inner side panels 31*a* and 31*b* are angularly joined to inwardly inclined end panels 29*a* and 29*b* respectively.

Preferably these inner side panels 31*a* and 31*b* do not extend beyond chute bottom walls 30*b* and 30*a* respectively. This can be clearly seen from FIG. 3 where panel 31*b* does not appear beyond the bottom 30*a* of chute 40*a*. The purpose of this is to allow the grain to flow off the side as it emerges from the chute 40*b* and into the space behind chute 40*a*.

In order to cut down on bridging, particularly of the wet grain, on the inclined surfaces 29*a* and 29*b*, additional inclined baffles 32*a* and 32*b* can be inserted.

The inverter can be fabricated as an integral unit with a single dividing wall 26 or each half 25*a* and 25*b* can be fabricated separately with its own wall 26. These two halves are then simply joined together so that wall 26 becomes a double wall.

My inverter can be fabricated from many different sheet materials, e.g. sheet metal. Preferably the panels normal to the direction of air flow have perforations 35 so that the air can flow through and drying will continue without interruption during the flow inversion.

While the embodiment described above represents the simplest and least expensive embodiment of my flow inverter, it will be appreciated that various other physical embodiments are possible. Thus, for instance, the side of the inverter receiving dry grain can have a pair of chutes carrying the grain to the air outlet side while the side receiving wet grain can have a single large chute which passes between the two small chutes for dry grain.

What is claimed is:

1. A flow inverter for use in a grain drier of the type having spaced vertically extending perforated air inlet and outlet walls defining a vertical grain drying chamber downwardly through which the grain flows, said flow inverter comprising

a. first and second pairs of opposed end walls,

b. at least one flow separating vertical wall extending between the end walls to form a first transverse mouth to be positioned adjacent one of the air inlet and outlet walls and a second transverse mouth to be positioned adjacent the other of the air inlet and outlet walls, said first and second mouths being coextensive,

c. one end wall of the first pair of end walls extending angularly downwardly from the first mouth towards the opposed end wall of the first pair to form first channel means extending downwardly from said first mouth, for laterally deflecting a portion of the flow of grain entering said first mouth,

d. second channel means forming a continuation of said first channel means and directed when positioned towards said other of the air inlet and outlet walls for directing upstream flow from adjacent said one of the air inlet and outlet walls to downstream flow adjacent said other of the air inlet and outlet walls,

e. one end wall of the second pair of end walls opposed to said one end wall of said first pair extending angularly downwardly from the second mouth towards the opposed end wall of the second pair to form third channel means extending downwardly from said second mouth for laterally deflecting a portion of flow of grain entering said second mouth, and

f. fourth channel means forming a continuation of said third channel means and directed when positioned towards said one of the air inlet and outlet walls for directing upstream flow from adjacent said other of the air inlet and outlet walls to downstream flow adjacent said one of the air inlet and outlet walls.

2. A flow inverter according to claim 1 wherein the first and second mouths are separated by means of a single vertical wall.

3. A flow inverter according to claim 1 wherein baffles are angularly positioned in said first and second mouths to assist the flow of grain.

4. A flow inverter according to claim 1 wherein said second and fourth channel means include smoothly curved chutes.

5. A flow inverter according to claim 1 wherein surfaces transverse to the direction of air flow through the drier are perforated.

6. A flow inverter in combination with a grain drier comprising spaced vertically extending perforated air inlet and outlet walls defining a vertical grain drying chamber downwardly through which the grain flows, said flow inverter comprising a first flow separating and concentrating means positioned adjacent the air inlet wall for separating a first portion of the flow of grain adjacent the air inlet wall, concentrating it transversely and downwardly in a path generally parallel to said air inlet wall and simultaneously smoothly deflecting the separated concentrated flow portion into a first channel means, said first channel means operatively joined with said first flow separating and concentrating portion to direct the separated deflected portion downstream adjacent the air outlet wall and to permit said first portion of grain flow to expand adjacent said air outlet wall to substantially the same transverse dimensions which it had prior to being separated, and said flow inverter further comprising a second flow separating and concentrating means coextensive with said first flow separating and concentrating means and positioned adjacent the air outlet wall for separating a second portion of the flow of grain adjacent the air outlet wall, concentrating it transversely and downwardly in a path generally parallel to said air outlet wall and simultaneously smoothly deflecting the separated concentrated flow portion into a second channel means, said second channel means operatively joined with said second flow separating and concentrating portion to direct the separated deflected portion downstream adjacent the air inlet wall and to permit said second portion of grain flow to expand adjacent said air outlet wall to substantially the same transverse dimensions which it had prior to being separated.

7. A device according to claim 6 wherein the grain drying chamber is elongated transverse to the direction of air flow and a series of said flow inverter units are positioned side by side along the transverse length of the chamber.

8. A device according to claim 6 wherein said flow separating and concentrating means include angularly positioned baffles to assist the flow therein.

9. A device according to claim 8 wherein said channel means are in the form of smoothly curved chutes.

10. A device according to claim 8 wherein surfaces normal to the direction of air flow through the drier are perforated.

11. A flow inverter device in combination with a grain dryer comprising a vertically extending perforated air inlet wall and a vertically extending perforated air outlet wall spaced from said air inlet wall, said walls defining a vertical grain drying chamber therebetween, said flow inverter comprising

a. a pair of side walls and a pair of end walls having upper edges defining an upper opening, said side walls being adjacent said air inlet and outlet walls,

b. at least one flow separating vertical wall extending between the end walls to divide said opening into a first mouth adjacent the air inlet wall and a second mouth adjacent the air outlet wall,

c. a first flow deflector extending angularly downwardly from the upper edge of one of said end walls towards the other end wall to form first channel means extending downwardly from said first mouth, said first and second mouths being coextensive,

d. second channel means forming a continuation of said first channel means and directed towards said air outlet wall for directing upstream flow from adjacent the air inlet wall, to downstream flow adjacent the air outlet wall,

e. a second flow deflector extending angularly downwardly from the upper edge of said other end wall towards said one end wall to form a third channel means extending downwardly from said second mouth, and

f. fourth channel means forming a continuation of said third channel means directed towards said air inlet wall for directing upstream flow from adjacent the air outlet wall to downstream flow adjacent the air inlet wall.

12. Method of drying grain comprising the steps of flowing the grain through a drying zone, passing drying air thorugh the drying zone transverse to the general direction of flow of grain, said air entering along a first side wall of said zone and exiting along a second side wall of said zone, separating a first portion of flow of said grain adjacent said first side wall, concentrating it transversely to said general direction of flow in a path substantially parallel to said first side wall and then deflecting it transversely to said general direction of flow in a path oblique to said second side wall, and separating a second portion of flow of said grain between said first portion of flow of grain and said second side wall, the transverse dimensions of said first and second portions of flow being coextensive, concentrating it transversely to said general direction of flow in a path substantially parallel to said second side wall and then deflecting it transversely to said general direction of flow in a path oblique to said first side wall, said first and second portions of flow being allowed to expand to substantially the same respective transverse dimensions which they had prior to said separating and concentrating steps.

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