United States Patent [19]

Hubach

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[45] **Aug. 14, 1973**

[54] **COMBINATION SCALPER CLEANER**

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[21] Appl. No.: **165,929**

Related U.S. Application Data

[63] Continuation-in-part of Ser. Nos. 795,260, Jan. 30, 1969, Pat. No. 3,680,697, and Ser. No. 130,311, April 1, 1971, Pat. No. 3,688,902.

[52] **U.S. Cl.** **209/240,** 209/267, 209/317

[51] **Int. Cl.** **B07b 1/36**

[58] **Field of Search** 209/315-317, 240, 239, 267, 311, 254, 243, 244, 241, 245, 313, 318, 320, 236, 237, 371-374, 329

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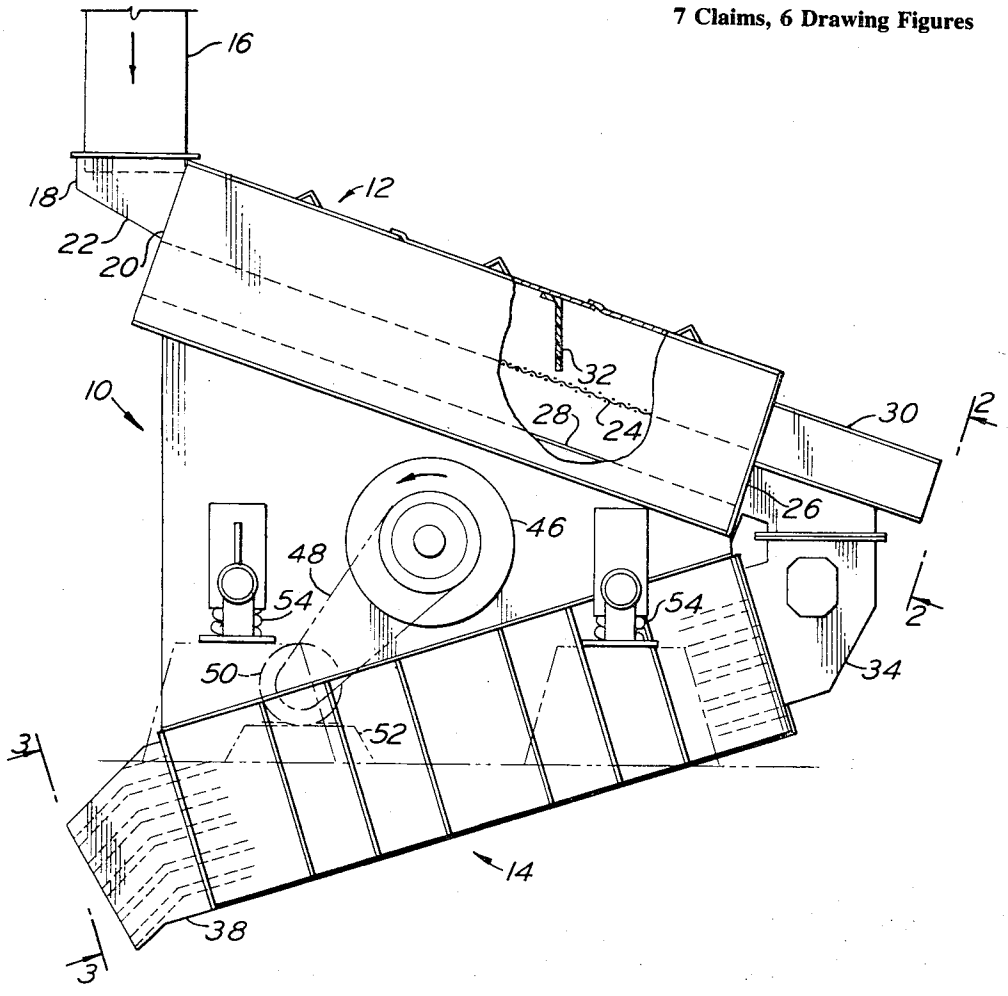
[57] **ABSTRACT**

Grain cleaning apparatus providing a flow path for grain including, in sequence, a scalper and a cleaner. First ducting means is connected to a hopper on the inlet side of the scalper and a second ducting means is connected to the outlet portion of the scalper to conduct grain from the scalper to the grain cleaner. The scalping unit separates grain from impurities which are larger than the grain. The grain cleaning unit separates grain from impurities smaller than said grain. The scalping unit and the grain cleaning unit are rigidly connected together to operate as a unit in vibratory motion to shake the grain on industrial screens in both units. The inlet hopper and the outlet of the grain cleaning unit are in vertical alignment to allow the insertion of the grain cleaning apparatus into an existing vertical ducting arrangement without need for extensive revision or restructuring of an existing building or ducting network.

7 Claims, 6 Drawing Figures



Patented Aug. 14, 1973 **3,752,315**

3 Sheets-Sheet 1

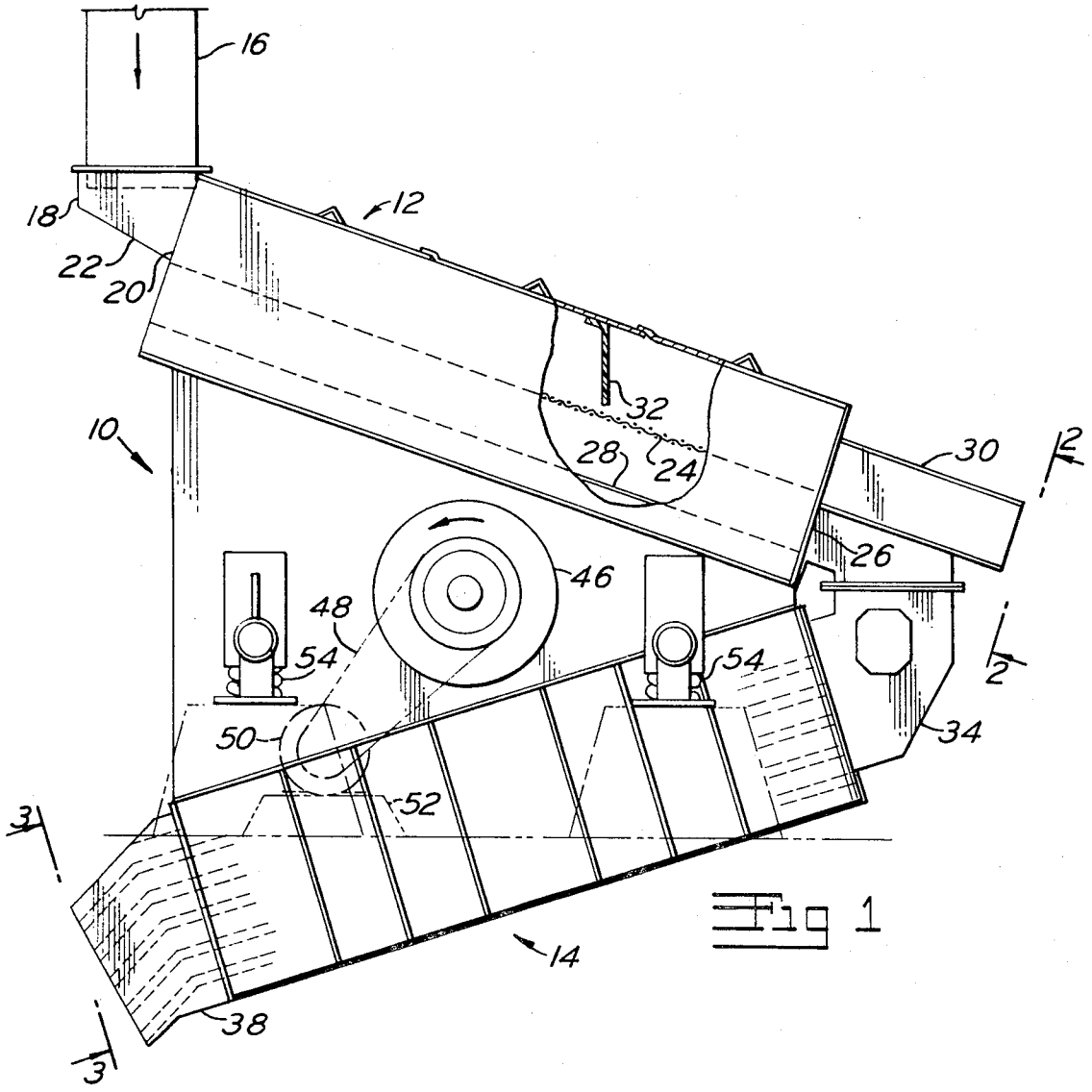


Fig 1

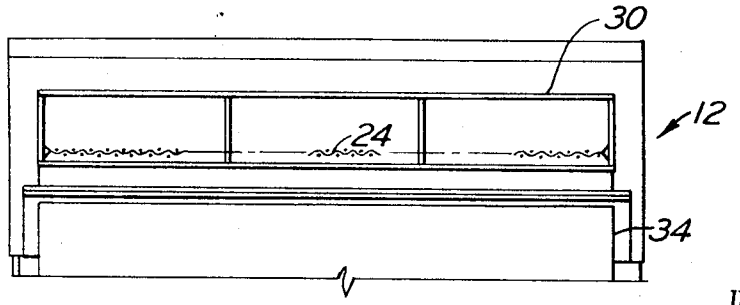


Fig 2

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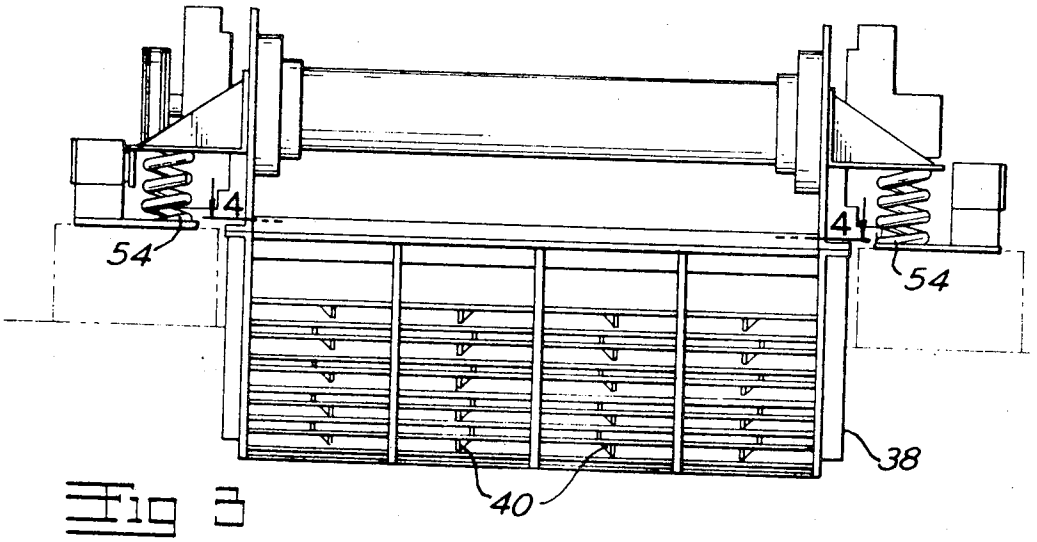

Fig 3

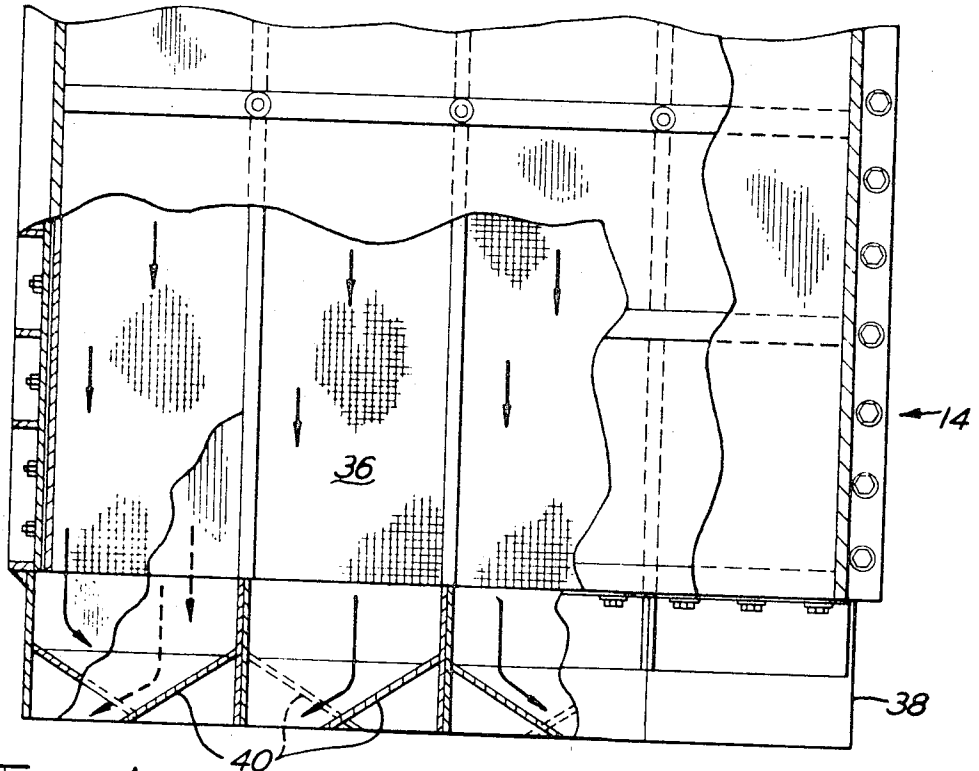

Fig 4

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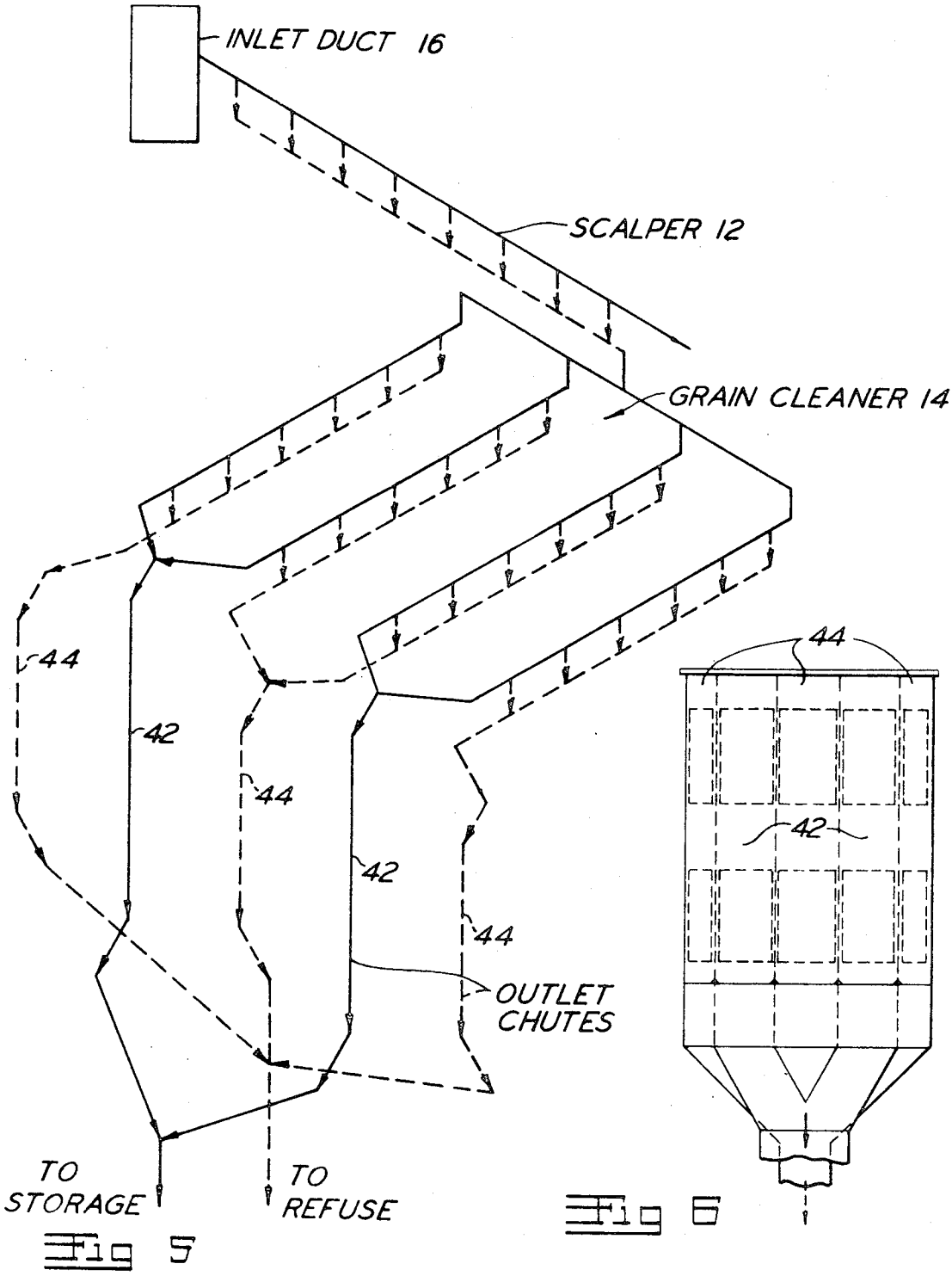

Fig 5

Fig 6

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COMBINATION SCALPER CLEANER

BACKGROUND OF THE INVENTION

This is a continuation in part of my copending application, Ser. No. 795,260 filed Jan. 30, 1969 entitled Grain Cleaner, now U.S. Pat. No. 3,680,697; and my copending application, Ser. No. 130,311, filed Apr. 1, 1971 entitled Grain Cleaner, now U.S. Pat. No. 3,688,902.

Conventional grain cleaning apparatus used in large grain storage elevators includes a scalping unit which separates large impurities from the grain such as pods, shucks and corn cobs as may not have been separated in the pre-storage operations. After the grain is separated from the larger impurities, it is conducted to a grain separator which serves to separate the grain from smaller impurities. A detailed explanation of the structure used to separate grain from fines is set out in my copending applications, Ser. Nos. 795,260 and 130,311, as identified above.

Unfortunately, the smaller grain storage elevators find the purchase of these two large pieces of equipment burdensome from an economic standpoint and in addition the equipment is not in continual use. For this reason the inventor has designed a combined scalping and grain cleaning apparatus mounted on one vibrating axle and constructed so that there is a continual feed of grain from the scalper to the grain cleaner during the grain cleaning operation. In this manner, the owners of small grain storage elevators are able to purchase a single piece of apparatus which they may put in continual use which takes the place of two units previously used. Admittedly, the cleaning rate of the new combined apparatus is less than with the separate units but the need in the industry is for a single, compact and combined piece of apparatus, not heretofore available.

It is desirable to structure and orient the device whereby it can be mounted in existing ducting patterns. Often the grain elevator will have a special building adjacent thereto which includes vertical duct work. In the instant invention, the feed hopper to the scalper or first grain cleaning unit is vertically aligned with the outlet manifold from the second grain cleaning unit. In this way, a section of the existing ducting can be removed and the grain cleaning unit inserted without substantial change. The only added feature would be the special set of channels and discharge chutes necessary for collecting the separated grain and fines into different single ducts so that the grain can be routed to appropriate storage areas and the fines can be routed to refuse dumps or other places, as desired.

BRIEF DESCRIPTION OF THE INVENTION

A first duct discharges grain into a hopper connected to the inlet to the scalper. The grain spreads on an inclined screen within the scalper as it flows toward the outlet end. A flexible shroud extending across the flow path above the screen retards the speed of the flowing grain.

Impurities larger than the grain remain above the screen and are discharged from the scalper to be conveyed to a refuse pile. Grain and smaller impurities fall through the screen onto a pan; the material on the pan exits through a second duct and is dumped into an inlet manifold.

Adjustable gates in the inlet manifold apportion uniform streams of grain to a plurality of stacked and inclined screening decks within a grain cleaner. The screening decks separate grain from fines or impurities smaller than the grain. Separated fines and impurities are routed through an outlet manifold and connected chutes which lead to the desired facilities for the grain or fines.

It is important that the scalper and grain cleaner be rigidly locked together with their screens oppositely inclined, thus, to operate as a compact unit with a single vibrating means. Additionally, it is important that the hopper of the scalper and the outlet manifold of the grain cleaner be mounted in vertical alignment; if this is true the compact unit can be inserted into existing vertical duct work without substantial modification of the ducting or the building.

Objects of the invention will become obvious from a detailed reading of the specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of the unitary grain cleaning apparatus of this invention.

FIG. 2 is an end view taken along line 2—2 of FIG. 1.

FIG. 3 is an end view taken along line 3—3 of FIG. 1.

FIG. 4 is a plan view, partially in section, showing the screening and outlet manifold structure of the second grain cleaning unit of FIG. 1.

FIG. 5 is a diagrammatic view of the flow path of the grain and impurities.

FIG. 6 is an elevational view of the vertically extending outlet chutes.

PREFERRED EMBODIMENT

This invention is concerned with a unitary structure **10** combining a scalper **12** with a grain cleaning unit **14.**

The scalper or first grain cleaning unit **12** serves the purpose of separating large impurities such as corn cobs, shucks and pods from grain and the second grain cleaning unit **14** serves the purpose of separating grain from impurities which are smaller than the grain.

For convenience the invention will be described in the flow sequence of the grain in its path from the beginning of the cleaning operation to the end.

The grain is fed from a first ducting means **16** into a hopper **18.** There are important angular and size relationships between the first ducting **16** and the hopper **18.** For example, it is necessary for proper operation that the cross-sectional area of the ducting **16** be smaller than the cross-sectional area of the inlet **20** to the first grain cleaning unit **12.** In addition, it is necessary that the bottom **22** of the hopper **18** be inclined at an angle with respet to the direction of flow of grain being discharged from ducting **16.** This angle should not be more than **120°** when measured between the centerline of discharge duct **16** and the downstream projection of hopper bottom **22.** The reasons for the necessary angular and size relationships will be explained subsequently.

The first grain cleaning unit or scalper **12** consists of a box with a screen **24** therein. The grain and impurities are discharged into the grain cleaning unit **12** from the hopper **18** such that all of the material is initially above the screen. The screen **24** extends along a plane passing from a point just below the inlet **20** to a point above an outlet **26,** the outlet accommodating the separated

grain discharged from the first grain cleaning unit. As the grain passes along the screen **24** the smaller units will fall through and be retained on a pan **28** which conducts the same to the discharge outlet **26.** Larger impurities are retained above the screen **24** and conducted to a discharge spout **30** from which the "scalps" may be collected and carted to the refuse dump or taken to any place desired.

In the experimental phase of perfecting the invention, it was discovered that the grain would not spread adequately on the screen **24** where the hopper **18** was choked with grain. However, it was found that where the grain was allowed to fall freely such that it would strike the hopper bottom **22,** it would tend to rebound and spread horizontally. Thus, a much better distribution of grain was obtained and accordingly, more efficient grain separation resulted.

It was additionally discovered that where the chute **16** discharges grain substantially parallel to the bottom **22** of the hopper, the result is very little grain separation. In fact, almost all of the grain and impurities will flow along the screen **24** and out the spout **30** if the angle between the bottom **22** of the hopper and the direction of flow of the grain from ducting **16** is greater than 120°. In other words, there must be a change in the direction of flow of at least 60° to prevent excess grain from improperly going into the refuse pile with the oversized impurities.

In addition to the change in flow direction, it was found beneficial to include a rubber shroud **32** within the scalper, which shroud helps retard the flow of the material above the screen **24.** In the preferred embodiment, the first grain cleaning means **12** is approximately 6 feet long. The rubber shroud **32** is located about two-thirds of the distance from the inlet **20** or approximately two feet from the outlet **26.** When the shroud is too close to the inlet **20** the grain may tend to back up as water behind a dam. Such excessively retarded flow does not allow proper separation to occur. Alternatively, when the shroud **32** is too close to the outlet spouting **30,** grain flowing down the screen **24** is not retarded adequately and extra grain is sometimes lost.

To be specific, it was experimentally determined that for proper separation, the grain cannot be excessively retarded in its flow through scalper **12** and it must strike the bottom **22** of the hopper in free fall to spread properly. The structure which gives these necessary results are (1) chute **16** which is smaller in cross-sectional area than inlet **20,** (2) the angular deflection of grain by the bottom **22** and (3) the proper spacing of the shroud **32** along the flow path to give the right flow retardation. This last being in the range 1 – 2 feet from the outlet **26** of a scalper **12** which is about 6 feet in length. Further, the shroud **32** should hang loosely to within about 1 inch of the screen. Unless these parameters are maintained, the efficiency of the operation is adversely affected.

Separated grain flowing on the pan **28** moves out of the scalper **12** through outlet **26** and into a second ducting means **34.** Within the second ducting means are a plurality of gates (not shown) for regulating the flow of grain to a plurality of screening decks **36** within the second grain cleaning means **14.**

The regulating gates within the second ducting means **34** are illustrated in FIG. **2** of my copending application. Ser. No. 795,260 filed Jan. 30, 1969. The same are described in some detail on page 8, line 17 through page 9, line 12 and said description is specifically incorporated in this application by reference. Within that application there is also described in much more detail, the structure of the screening decks and the outlet manifold **38** and the same is incorporated herein by reference.

The plurality of gates provides uniform flow above each of a plurality of screens and the whole grains are retained above the screen while the undersized grains and smaller impurities fall through onto a pan. In the preferred embodiment, there are ten stacked screening decks within the unit **14.**

The outlet manifold **38** includes a plurality of baffles **40** for deflecting the separated grain or fines, as the case may be, into a plurality of vertically aligned discharge ports which dump the material into outlet chutes **42** or **44,** the fines being in chutes **42** and the grain being in chutes **44.** The material will fall by gravity within the chutes until it acquires a certain momentum at which point there will be an angular deflection in the chute which will deflect the material to one side or the other such that all of the grain can be collected into a single duct and all of the fines collected into a different single duct. Thus, the separated grain and fines may be separately collected and transported to an appropriate repository.

It will be noted that the two grain separating units **12** and **14** are locked together by rigid side panels to be vibrated by a single vibrating means consisting of an eccentric **46,** a drive belt **48** and a motor **50.** The drive belt **48** is driven by the motor **50** which is locked in position on a substrate **52.**

The unitary grain cleaning apparatus is supported on a plurality of springs **54** in a conventional manner and consequently the eccentric **46** vibrates the unit **10.** A problem arose because of the fact that the unit **10** moves up and down and the motor **50** does not. It was discovered that the motor should be located in an arc subtended by two lines intersecting at the axis of the eccentric **46** and extending at an angle 30° above and 30° below a horizontal line passing through the same axis. With the motor above or below this desired arc, the belt **48** will occasionally jump out of the grooves in the pulley during the vibrating operation.

It will be noted that the centerline of the first ducting means **16** is coaxial with the centerline of the third ducting means or chutes **42** and **44.** This is not by accident. In small grain elevators such as this machine is designed to accommodate, existing vertical ducting will already be in existence in the shed or building adjacent the elevator. This apparatus was designed to fit into position within that vertical ducting network by merely removing a section of the ducting and replacing it with the grain separating unit and the outlet chutes **42** and **44.** In this manner, the existing buildings will not have to be redesigned and a minimum of new ducting will be necessary.

In my copending patent applications previously identified, the parameters of properly cleaning grain have been described in some detail which involve a particular acceleration imparted by the eccentric **46,** the spacing between the pan screens, etc. The apparatus of this particular invention was designed with those parameters incorporated. Accordingly, the eccentric **46** is caused to rotate counterclockwise and the screening decks within the unit **14** are inclined at an angle in the

range 15° to 20° with the preferred angle being about 17°. With this particular kind of rotation the screens in the unit **14** supporting the grain will be jerked out of supporting position and pulled rearwardly. On their upstroke they will again engage the grain at a point further down the screen toward the outlet manifold **38**. This is not true of the first grain cleaning unit **12** because it is oppositely inclined from the unit **14**. Thus, the particular direction of the rotation of the eccentric will tend to push the grain above screen **24** upstream toward the hopper **18**. Accordingly, a combination of parameters were adjusted and correlated, including the distance of the rubber shroud **32** from the inlet **20**, the angle of the bottom of the hopper **22**, the angle between the inlet and outlet sections of the hopper and the angle of the screen **24**. All of the other elements have previously been described except for the angle of screen **24**, and it is found to be effective at an angle with respect to the horizontal in the range 16° to 20°, with the preferred angle being about 18°.

Having thus described the invention, I claim,

1. A grain cleaning apparatus providing a grain flow path in sequence comprising, a vertically extending duct flexibly connected to an opening in a hopper, said hopper being connected to the inlet of a first separating means, the first separating means serving to separate grain and fines from larger sizes of impurities, an inlet manifold means for (a) conducting the grain and fines from the outlet of the first separating means to the inlet of a second separating means and (b) providing equal flows of grain to each of a plurality of superposed screening decks within said second separating means, said second separating means serving to separate the grain from the fines, and outlet manifold means connected to the outlet end of said second separating means for (A) collecting and channeling the grain into vertically extending chutes and (B) collecting and channeling the fines into other vertically extending chutes, the hopper and both separating means and manifolds all being reciprocated as a unit by a vibrator,

the duct being of smaller cross-sectional area than the hopper opening and being positioned to drop grain vertically onto the bottom of said hopper,

the bottom of said hopper serving to change the direction of flow of vertically falling grain and being inclined at an angle to the vertical, wherein the included angle between a vertical line and the hopper bottom is 120° or less,

a screen within said first separating means positioned above a pan and inclined downwardly from the hopper at an angle to the horizontal in the range 16°–20°, the screen having apertures therethrough of a size not larger than the largest desirable grain size, thereby allowing grain and fines to fall through the screen onto the pan while larger sized impurities remain above the screen and are discharged from the outlet end of the first separating means as refuse,

a flexible shroud hanging loosely from the inside top of the first separating means to within about an inch of the screen to retard the flow of grain, said shroud extending transversely across the path of the grain about 2/3 the length of the screen from the hopper to the inlet manifold,

grain and fines from the pan being dispensed from the first separating means into said inlet mainfold means, said inlet manifold means including structural means for dividing the dispensed grain and fines into equal portions for each of a plurality of screening decks within the second separating means,

the screening decks each comprising a screen above a non-porous pan, the fines passing through the screens while the grain is retained on the screens,

the screening decks being inclined downwardly from the inlet manifold at an angle to the horizontal in the range 15°–20°,

the screens in the first and second separating means being inclined downwardly in opposite directions,

the separated fines and grain being dispensed from said second separating means into an outlet manifold means which includes structural means for channeling the fines and grain into separate vertically extending chutes,

the chutes being vertically aligned with the duct.

2. The apparatus of claim **1** wherein the first separating means is about 6 feet in length and the shroud is spaced between four and 5 feet from the hopper.

3. The apparatus of claim **2** wherein the screening decks are inclined at an angle of about 17°.

4. The apparatus of claim **3** wherein the screen in the first separating means is inclined at an angle of about 18°.

5. The apparatus of claim **2** wherein the screen in the first separating means is inclined at an angle of about 18°.

6. The apparatus of claim **1** wherein the screen in the first separating means is inclined at an angle of about 18°.

7. The apparatus of claim **1** wherein the screening decks are inclined at an angle of about 17°.

* * * * *