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STONE AND HEAVY GRAIN DISCHARGE OUTLET FOR GRAVITY SEPARATORS

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FIG. 1

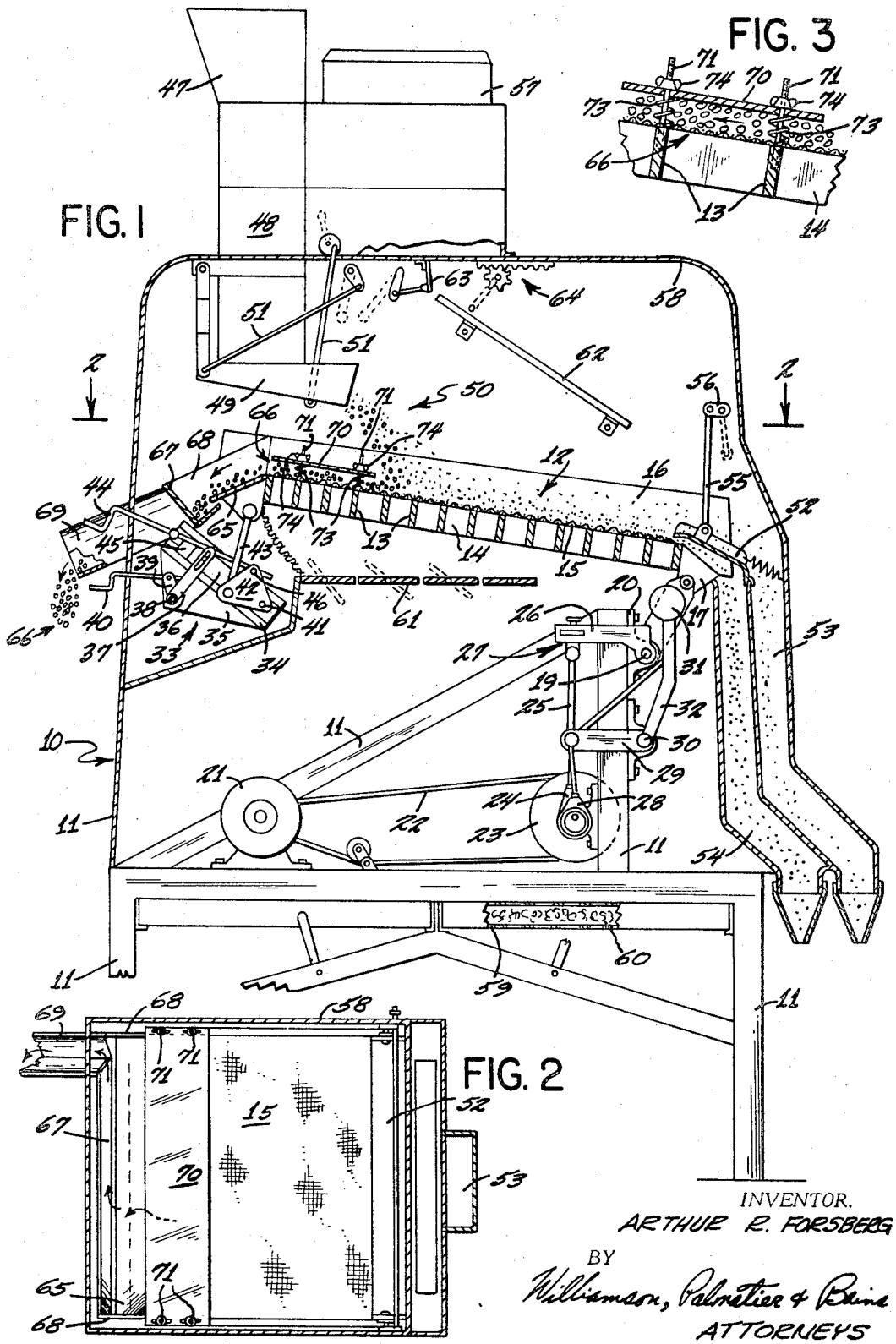


FIG. 3

FIG. 2

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STONE AND HEAVY GRAIN DISCHARGE OUTLET FOR GRAVITY SEPARATORS

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ABSTRACT OF THE DISCLOSURE

A gravity separator with a perforate oscillating deck through which air is drawn separating high density and low density materials, a pressure plate confronting and in closely spaced relation above the rear edge portion and extending entirely across the entire width of the deck.

This invention relates to an improvement in gravity separators and more particularly relates to an improved stone and heavy grain discharge outlet for high speed gravity separators.

Gravity separators of the type disclosed and claimed in my United States Letters Patent 2,928,545 dated Mar. 15, 1960, remove chaff and other like low density particles from grain and further separate high density particles such as stones and heavy or dissimilar grain to arrive at a uniform product free from chaff or other like materials and free from stones and heavy kernels. Gravity separators typically of the vacuum-type carry out the desired separation utilizing an inclined oscillating screen with air flowing from under the screen upwardly through the screen and through the product flowing over the screen. The desired material flows down the inclined screen and the chaff is "blown" upwardly away from the heavier material. The oscillation causes heavy kernels and other high density objects such as stones to flow upwardly on the screen, against the flow of sound grain. The gravity separator must efficiently discharge the heavy undesirable materials without decreasing the capacity of the gravity separator and without wasting sound grain which may flow with the heavy kernels and high density objects which are being separated.

With these comments in mind it is to the elimination of these and other disadvantages to which the present invention is directed along with the inclusion therein of other novel and desirable features.

An object of my invention is to provide a new and improved stone and heavy grain discharge outlet for gravity separators of simple and inexpensive construction and operation.

Another object of my invention is to provide an improved stone and heavy grain discharge outlet which allows the screen to operate at highest capacity with respect to sound grain and which accurately and efficiently separates heavy grain and high density objects from the desired grain without damage to the desired grain and without causing good grain to be discharged and wasted with the heavy undesirable grain or the high density particles.

Still another object of my invention is the provision of an improved stone and heavy grain discharge outlet for gravity separators which is versatile in that a higher or lower degree of accuracy may be achieved with the discharge outlet to provide the proper balance between removal of the contamination, speed of operation and volume of output of sound grain.

A further object of my invention is to provide an improved stone and heavy grain discharge outlet which is adjustable to provide for removal of high density objects from all types of grains as well as to provide removal of heavy, undesirable grains from all types of grains with a minimum of adjustment.

Thes and other objects and advantages of my invention will more fully appear from the following description made in connection with accompanying drawings wherein like reference characters refer to the same or similar parts throughout the several views and in which:

FIG. 1 is a vertical sectional view taken substantially on the longitudinal center line thereof showing the improved stone and heavy grain discharge outlet;

FIG. 2 is a sectional view taken along the lines 2—2 of FIG. 1; and

FIG. 3 is an enlarged vertical sectional view showing details of the improved stone and heavy grain discharge outlet.

One form of the present invention is shown in the drawing and is described herein.

The gravity separator is shown in FIG. 1 and is indicated, in general, by numeral **10**. The gravity separator is supported by a suitable supporting structure indicated at **11**. The gravity separator is provided with a generally horizontal but inclined and perforate material-carrying deck indicated in general by numeral **12** and having a criss-cross gridwork **13** and frame **14** which supports a screen **15** thereon. Side walls **16** are secured to the deck frame **14** and extend upwardly from the screen **15** and on opposite sides thereof for retaining granular material therebetween.

Means are provided for supporting oscillating deck **12** in a generally longitudinal direction. A pair of generally upright but inclined supporting and driving links **17** depend from and are swingably connected with the forward end portion of deck **12** by means of a shaft **18** which is secured to the deck frame **14**. Links **17** are affixedly secured to an oscillatable driving shaft **19** which is journalled in bearings **20**, which bearings are supported by the machine support structure **11**. The oscillatory driving means for deck **12** includes a source of rotary power **21** such as an electric motor which is connected by means of a belt **22** and pulley **23** to a pitman oscillator **24** which has a substantially vertically reciprocable driving rod **25** swingably and adjustably connected to a driving arm **26** which is keyed or otherwise affixedly secured to the drive shaft **19**. The swingable connection between rod **25** and arm **26** is adjustable toward and away from the drive shaft **19** so as to vary the arcuate oscillation of shaft **19** as the connection between rod **25** and arm **26** is moved generally radially toward and away from the shaft **19**. The adjustable connection is indicated, in general at **27**.

Means are provided for counter balancing the movement of the forward end portion of deck **12** in order to provide smooth operation of the driving mechanism. A second Pitman oscillator **28** is connected to a swingable arm **29** which is mounted on a shaft **30** and which is affixedly secured to counter balancing weights **31**, through arm **32**. Oscillator **28** is slightly out of phase with oscillator **24** so that the weight **31** produces a counter balancing effect with respect to the weight exerted by the forward end portion of deck **12**.

Means for supporting the upper or rear end of deck **12** includes means for varying the magnitude of oscillation of the rear end of the deck as the deck is oscillated in a substantially longitudinal direction by the above described driving mechanism. An adjustable deck support or mounting is indicated in general by numeral **33**. Mounting **33** includes a pair of similar guides **34** disposed on opposite sides of the rear end of the deck and below the deck. Guides **34** are suitably supported on the support structure and include mounting plate **35**. A slide member **36** is carried in each of the guides **34** and is slidable in an inclined direction therein. A slotted adjust-

ment link 37 is swingably mounted on the mounting plate 31 by means of a pivot 38 and the arm 37 is affixed to the control arm 39 to which a crank 40 is threadably connected. Crank 40 is journalled in the support structure 11 so as to swing arms 39 and 37 when rotated. A pin is affixed to slide 36 and extends through the slot in the arm 37 for moving the slide when the arm 37 is swung in response to movement of crank 40. It should be understood that each of the slides 36 at the opposite side of the machine is controlled by its respective crank 40. A shaft 41 is rotatably mounted in slide 32 at opposite sides of the machine. Swingable support plates 42 are affixed to shaft 41 adjacent the opposite ends thereof and an upright but inclined support member or link 43 is swingably mounted on the plate 42 and is swingably connected to deck frame 14. A crank is rotatably mounted in bearing 45 which is secured to the upper portion guides 30 and threadably connected at 46 to plate 42. Crank 44 and plate 42 and the swingable connection to the slide 36 provide means for raising and lowering the rear end portion of deck 12 and thereby control the pitch of the deck. Crank 40, the slotted arm and slide 36 provide means for controllably adjusting the inclination of link 43 and thereby control the magnitude of vertical oscillation of the rear end portion of deck 12 as deck 12 is drivably oscillated in a generally longitudinal direction by the driving links 17.

Grain or similar material which is to be separated is conveyed to inlet hopper 47 by suitable conventional means such as a belt conveyor or a screw conveyor, not shown herein. The grain falls by gravity, through feeding chute 48 nto a conventional feeder 49 which discharges a free-falling curtain of granular material indicated, in general, by numeral 50. The curtain of granular material is comprised of high density material such as stone, the desirable grain and chaff or other very light, undesirable material. Feeder or plate 49 may be any of several commercially available feeders and is shown attached to framework 11 by adjustable supporting members 51. Gate or feeder 49 dispenses material across the width of the deck 12 between the upright members or side walls 16. The desired grain and chaff flows downwardly as the deck is inclined and the chaff because it is lighter and is urged upwardly by upwardly flowing air, takes a position above the desired grain. An adjustable skimmer blade 52 skims off the chaff and allows it to fall, by gravity, down chaff outlet chute 53 for disposal. The desired grain, which is heavier than the chaff, passes under the skimmer 52 downwardly through grain chute 54 for reclamation at the end of chute 54. Skimmer blade 52 is adjustably mounted on arm 55 which is attached to the frame 11 at linkage 56.

A vacuum source is attached to conduit 57 and is not shown in the drawing. Deck 12, as well as the forward and rearward drive mechanisms and the feeder mechanism, is enclosed by frame 11 and an auxiliary hood 58 to permit a vacuum to be created surrounding the above mentioned portions of the gravity separator. Openings in the frame 11 are indicated at 59 to permit air flow therethrough. The air flows through a filter 60, upwardly through adjustable vanes 61 and through the screen 15 on deck 12. Since the gridwork 13 is criss-cross and the screen is perforate, air flow is generally upwardly through the grain. The lighter grain or chaff is affected by the upward air flow further separating the chaff from the desirable kernels. The very light material flows through vacuum conduit 57. Additional baffles may be utilized as desired and include baffles 62 and swingable vanes 63 which control the air flow to permit variations in the amount of light material which is removed and the lightness which the material must possess in order to be removed or affected by the air flow upwardly through the grain. The volume of air flow through conduit 57 may be controlled by the rack and pinion gate assembly, indicated in general by numeral 64 thereby affecting the efficiency of the operation and providing a versatile separator in that adjustment for air flow may be made to permit separation of all types and sizes of grain with all kinds of contamination.

High density material such as stones and heavy grain is conveyed upwardly of deck 12 to be discharged. The high density material or stones are conveyed across the width of deck 12 and contact stone discharge guide 65 which is attached to deck 12. Guide 65 is substantially the same width as deck 12 and is attached thereto to permit heavy material, indicated in general by numeral 66, to flow off of deck 12 onto guide 65 and into inclined trough 67. Upright side guide rails 68 are provided on each side of guide 65, directing high density material into inclined trough 67. Of course, trough 67 is of substantially the same width as deck 12 and is constructed of rigid wear resistant material such as steel plate and is rigidly attached to frame 11. The heavy discharge material goes through trough 67 and into trough 69 for disposal as desired. It should be noted that trough 67 and communicating trough 69 are rigidly attached to frame 11 and do not move with oscillating deck 12. However, guide 65 is rigidly attached to deck 12 and reciprocates oscillated. Therefore guide 65 must be affixed to permit blows of discharge material into trough 67 regardless of the oscillation adjustments of deck 12.

A transverse, high density material pressure plate 70 is adjustably mounted on deck 12 for oscillation. Since the criss-cross gridwork 13 is typically constructed of wood, the pressure plate may be secured thereto by threadably mounting studs 71 into the gridwork in inline relation and on each side of the gridwork or frame 13. The pressure plate 70 is positioned confronting screen 15 and is substantially parallel thereto and is in spaced apart relation therewith. Bias or spring means 73 constantly urge pressure plate 70 outwardly away from screen 15 and wing nuts 74 retain pressure plate 70 in a predetermined position relative to screen 15 at all times during oscillation of deck 12. Pressure plate 70 may be constructed of wear resistant steel plate material or even a plastic material such as plexiglass.

Pressure plate 70 is approximately four inches wide and of a length conforming to the width of deck 12. Plate 70 is mounted with its longitudinal dimension transverse to the direction of grain flow. Typically, two mounting studs 71 are used on each end of pressure plate 70, as shown in FIG. 2. However, it should be noted that additional pairs of studs 71 may be utilized across the width of the deck as desired although it has been found unnecessary. Further, pressure plate 70 may be attached to the side, as opposed to the top of the criss-cross gridwork. Plate 70 may be positioned from about ¼ inch up to 1½ inches away from screen 15 as desired. Several variables determine the optimum position of pressure plate 70 relative to screen 15. For example, air flow through the pressure plate relative to the screen. Further, the size of the material which is being separated, as well as the size of the high density material which contaminates the grain being separated, will also determine the proper spacing between pressure plate 70 and screen 15. In general, a high setting such as 1½ inches away from screen 15 results in high density material such a stones and heavier grain to be discharged. As pressure plate 70 is adjusted downwardly, approaching ¼ inch from screen 15, a progressively greater portion of grain is returned onto screen 15 by the action of the air flowing upwardly through the separator, through screen 15, under pressure plate 70 and downwardly and outwardly therefrom causing the grain and other material which may be conveyed or acted upon by the air flowing under plate 70 to be returned onto the screen and reclaimed. Therefore, as pressure plate 70 is positioned closer to plate 15 only stones are allowed to pass upwardly thereunder and preventing heavy grain from flowing outwardly thereunder. As the pressure plate is raised, more of the heavier grain is allowed to pass under plate 70 to be discharged as undesirable.

Typically, mounting means are necessary only on the outer edges of the pressure plate **70**, although it may be desirable to add a stiffening strip across pressure plate **70**, tranverse to the direction of flow of material **50**. Pressure plate **70** is generally positioned parallel to screen **15**. However, experimentation may determine that a slight inclination, forwardly or rearwardly, of pressure plate **70** relative to screen **15** may aid in achieving optimum results.

In operation, a vacuum is supplied at conduit **57** of the gravity separator having my improved stone and heavy grain discharge outlet mounted thereon. An upward movement of air is created with the air flowing from the outside, through the filter **60**, upwardly through adjustable vanes **61**, through the screen **15** as well as through the screen portion **15** which is positioned substantially under pressure plate **70** and then outwardly thereunder and upwardly through conduit **57**. Gate assembly **64**, baffle **62** and **63** and vanes **61** may be adjusted to control the circulation of air and the amount of air flow as desired. These settings may be determined by the contamination within the grain being separated, for example, whether high density contamination is a high percentage of the desired grain or chaff contamination represents the typical contamination in the desired grain. Further, the settings may be determined by the type or specie of grain which is flowing through the separator. After the proper settings have been determined relative to air flow, the amount of grain or other material which is to be separated must be determined. The grain is conveyed into hopper **47** and downwardly through conduit **48** to feeder or gate **49**. Feeder **49** is adjusted to provide a free falling curtain of granular material which is to be separated and through which the constantly moving upward stream of air may pass. Granular material is dispensed onto deck **12** forwardly of transverse pressure plate **70**. Of course, the setting on gate **49** may be changed depending on the size of the grain, the percentage or high density material of the percentage of chaff, as well as the capacity desired. The operator of the machine will quickly determine the optimum setting dependent upon the type of grain which is being separated and the percentages of high or low density contamination in the grain which is being separated. Oscillation of the forward and rearward deck driving assembly must also be adjusted for optimum results.

Having, by experience, determined the proper setting on the air flow mechanism, the forward and rearward deck driving mechanism and the proper setting on the feeding mechanism, pressure plate **70** must be properly positioned relative to the screen **15** to achieve optimum operation of the separator. Material **50** which is discharged into screen **15** may contain high density material such as stones or heavy grain, sound or desirable grain and undesirable chaff. It is desirable to separate out the low density chaff and the high density stones, including some heavy grain. However, the amount of heavy grain to be discharged should include only the very undesirable heavy grain to prevent sound grain from being included and thereby wasted with the undesirable high density material. The action of the upwardly flowing air through the screen **15** and through material which is being separated, causes the sound of desirable grain to flow downwardly along the inclined bed and the chaff also flows downwardly to be separated by the skimmer **52**. However, heavy grain and the other high density material flows upwardly along the inclined screen as the sound material and chaff flows downwardly. At the stone and heavy grain discharge outlet, the setting of plate **70** determines that material which should be discharged to waste and that material which should be urged back onto screen **15** for down flow and subsequent reclamation. Air flow is upwardly through screen **15** under plate **70** and outwardly and upwardly therefrom. Heavy grain which may flow upwardly, when passing under the forward edges of plate **70** is urged downwardly preventing its discharge with the higher density stones. This allows the stones to move upwardly free of grain for discharge thereof. If any grain goes upwardly under transverse pressure plate **70** it typically moves down the incline screen **15** away from the stone discharge outlet as urged downwardly by the air flow from under pressure plate **70**. Pressure plate **70**, of course, oscillates with deck **12** and is positioned away from screen **15** by bias means or spring **73**. A high adjustment on the pressure plate **70** results in an amount of heavy grain being discharged with the stones. The plate may be adjusted downwardly to arrive at the optimum setting at which all stones and high density contamination is separated out and discharged to waste and all the sound grain is urged downwardly onto screen **15** for separation by skimmer **52**. The optimum setting may vary depending upon air flow conditions and the material which is being separated as well as the deck oscillation setting. The material may vary in specie as well as vary in percentage of high density or low density contamination.

From the foregoing it will be seen that I have provided an improved stone and heavy grain discharge outlet for gravity separators which provides high capacity for the high density material which is to be separated from the grain. Further, the efficient removal of the high density material allows a greater volume of grain to be separated within a given separator as well as separating and reclaiming predetermined amounts of heavy grain which would otherwise be wasted when utilizing a stone discharge outlet without the adjustments available with the stones discharge outlet of my invention. Further, I have provided a stone and heavy grain discharge outlet which is quickly and easily adjustable to arrive at optimum operating condition settings efficiently separating out undesirable contamination. My stone and heavy grain discharge outlet oscillates with the deck and guides undesirable material into the outlet trough regardless of the deck oscillation setting or position of the deck at the time of discharge. My unit is so versatile that all grains and the like may be efficiently separated, and adjustment may be made for varying percentages of contamination to achieve maximum contamination removal with minimum sound grain loss.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of my invention.

What is claimed is:

1. A vacuum-type gravity separator comprising

a supporting structure,

a perforate and generally horizontal but inclined material receiving deck having a lower forward end portion upon which grain and like material travels in a forward direction and having an upper rear end portion upon which high density material travels in a rearward direction, the deck having an unobstructed rear edge extending across the entire width of the deck, said deck discharging high density material over said rear edge and all along the length thereof,

means mounting said deck on said supporting structure for oscillatory movement,

a housing on said supporting structure enclosing said deck, said housing having an air discharge spaced above said deck and forwardly of the rear end of said deck, the air discharge adapted to be connected to a source of vacuum pressure whereby air is drawn upwardly through said deck,

driving mechanism on said supporting structure to cause oscillation of said deck,

a transverse pressure plate affixed to said deck at the rear end portion thereof, said pressure plate being positioned in confronting relation with said deck and extending entirely across the width of the deck and spaced therefrom whereby air may be drawn upwardly through said deck into contact with said pressure plate to permit air flow outwardly and upwardly

thereform, thereby urging grain outwardly and forwardly along said deck,

means mounting said pressure plate on said deck,

receiving means adapted to receive high density material discharged from the rear end portion of said deck to permit disposal of the high density material away from the separator, and

a granular material feeding mechanism including a generally horizontal feeder spaced above said pressure plate to cause distribution of material to be separated across the width of said deck in a free falling curtain contacting said deck generally forwardly of said transverse pressure plate and through which air is adapted to pass as air travels upwardly and forwardly from the rear portion of said deck to the air discharge.

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