June 3, 1952 C. V. ORE ET AL 2,598,934

SEPARATOR HAVING FLOW-DIRECTING AND SELF-SEALING DISCHARGE MEANS

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Fig. 1.

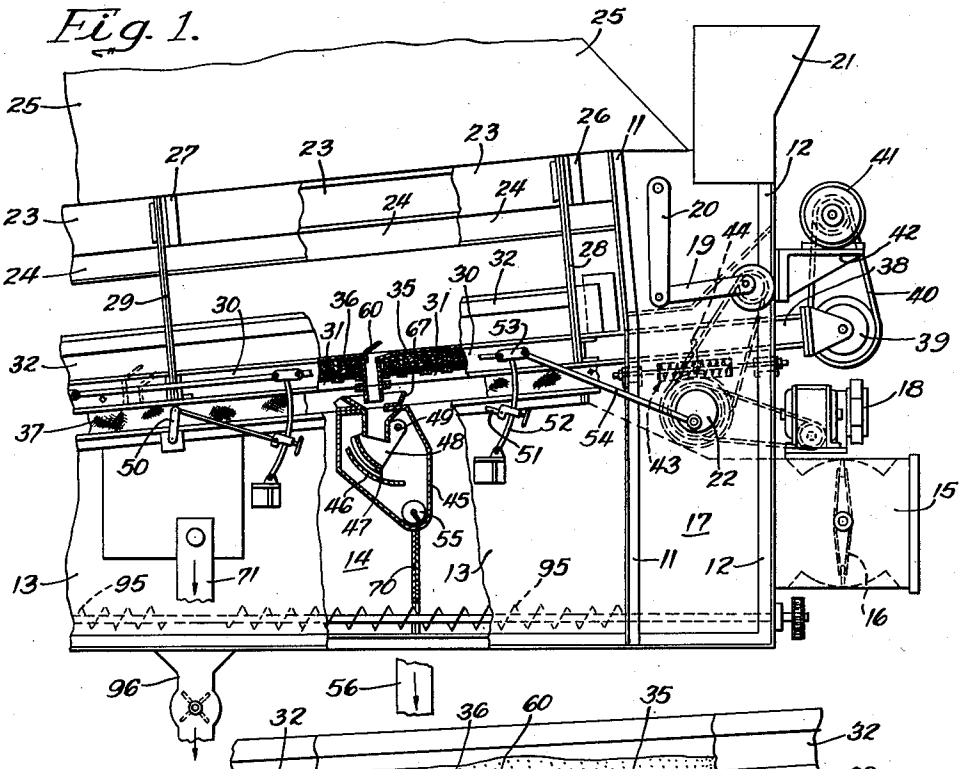


Fig. 2.

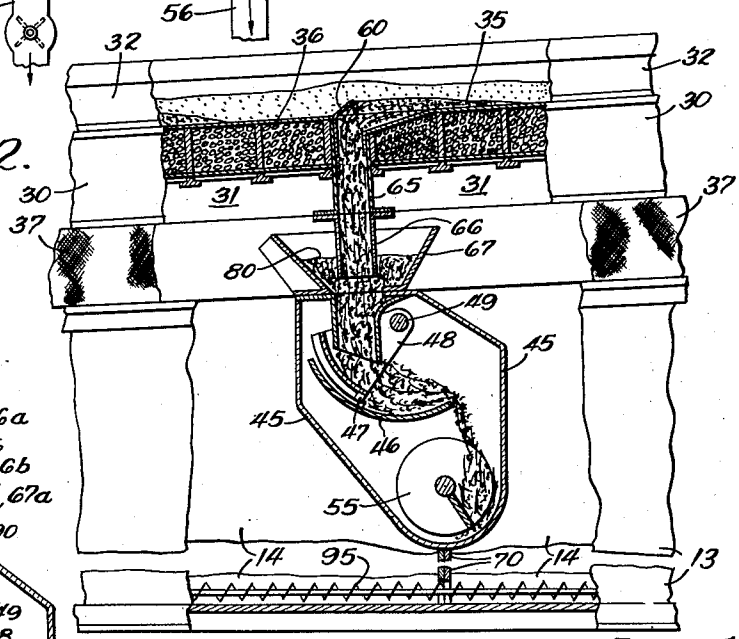
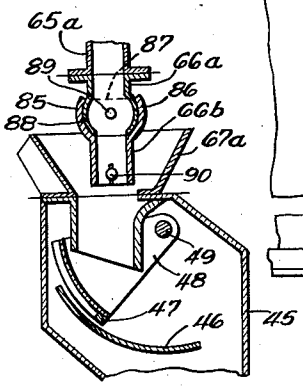


Fig. 3.



Inventors:
Carl V. Ore,
John A. Logan Nicholson
By [signature] Attys.

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SEPARATOR HAVING FLOW-DIRECTING AND SELF-SEALING DISCHARGE MEANS

Carl V. Ore, Harvey, and John A. Logan Nicholson, Odin, Ill., assignors to Roberts and Schaefer Company, Chicago, Ill., a corporation of Illinois

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4 Claims. (Cl. 209—494)

1

This invention is concerned with improvements in pneumatic cleaners or airflow separators of the type disclosed in Patent No. 2,513,960, issued July 4, 1950.

The apparatus shown in the above-mentioned patent comprises an inclined troughlike material-receiving deck formed by a number of longitudinally serially related air-pervious deck sections, means for vibrating the deck, means underneath the deck forming an air box or chamber into which air impulses are injected for escape through the deck sections upwardly into the material bed thereon, and means associated with each deck section for discharging separated material particles therefrom. The raw material, which may be raw coal of relatively small particle size ranging from about ⅜'' down to and including finely comminuted dustlike particles, is fed to the material-receiving deck at the elevated end thereof, moving along its inclined surface formed by the various deck sections and is subjected thereon to the action of the air impulses in the presence of vibrations to effect stratification of its particles in accordance with their specific gravities. Coal, which is the lightest component of the raw feed, orients itself on top of the material bed and the heavier particles, constituting refuse, stratify underneath the coal for removal through the medium of the discharge means associated with the corresponding deck sections.

An object of the invention is to provide new means forming intermediate discharge paths, one associated with each deck section, or with a selected deck section, for removing separated material particles therefrom, the new means being made and arranged so as to simplify the structure of the separator and to improve its performance.

This object is realized by the provision of a chute forming the juncture between adjacent deck sections and projecting downwardly into the air box, the chute being connected rigidly or, if desired, movably, with the corresponding deck sections and vibrating therewith, and a stationary hopper disposed in the air box having an upwardly flaring mouth for receiving the separated material particles from the chute and directing such particles downwardly onto a traylike shelf contained in a discharge chamber which is likewise disposed within the air box. Separated material particles moving downwardly through the chute into the hopper form an air seal around the chute to prevent undesired escape of air from the air box into the discharge mechanism.

Another object is to provide for each intermediate discharge path a new inclined weir which projects adjustably from the material deck at the corresponding intermediate discharge point into the material bed. This weir is inclined in a direction opposite and at an angle to the flow of the material bed on the deck to operate in the manner of a flow-controlling and discharge-discriminating dam which regulates the flow of separated material particles from the corresponding deck section to its associated intermediate discharge means.

2

The objects and features intimated in the foregoing, as well as additional objects and features, will appear from the detailed description of embodiments of the invention, which is rendered below with reference to the accompanying drawings. In these drawings:

Fig. 1 shows a fractional diagrammatic view of an airflow separator with parts broken away and in section to indicate the structure and arrangement of an embodiment of the new flow-controlling and discharge-discriminating weir and an embodiment of the new means associated with the deck and forming the self-sealing path for discharging separated material particles therefrom;

Fig. 2 illustrates the new structures of Fig. 1 diagrammatically in section on an enlarged scale, also showing the manner in which the separated material particles are discharged; and

Fig. 3 represents a diagrammatic fractional sectional view of a modified intermediate discharge structure.

Like parts are indicated by like reference numerals. Known details will be discussed only to the extent required for conveying an understanding of the invention.

As shown in Fig. 1, the airflow separator comprises upright supports 11 and 12 disposed on one side of the structure at the rear end thereof. Supports such as 11 and 12 are also provided on the other side. Similar upright supports (not shown) are arranged at the forward end of the separator, toward the left of the structure shown in Fig. 1, as is particularly disclosed in the previously mentioned patent. Side walls 13 and 14 are disposed between upright supports such as 11 and the corresponding uprights at the forward end of the separator forming an air box or chamber having a rearward extension which terminates in a duct 15 provided with a flutter valve 16. Air is supplied to the duct 15 and is injected into the air chamber in the form of impulses responsive to rotation of the valve 16.

The upright supports 11 and 12 on either side

of the structure are connected with cover plates such as 17, forming rearward extensions of the side walls 13 and 14, respectively. Transversely between these cover plates are disposed certain drive and operating mechanisms including a pulley driven by suitable means such as a belt or chain from the motor and gear reducer 18 and driving a shaft carrying an eccentric for actuating the links 19 and 20 which are part of a mechanism for regulating the supply of raw material particles from the raw feed hopper 21 to the material-receiving deck of the machine. The pulley shaft driven by the motor carries an eccentric 22 which actuates a link system, through the medium of the rod 54, for operating the various intermediate discharge mechanisms yet to be described.

A pair of longitudinally extending inclined top supports 23 are provided, one on each side of the machine, extending forwardly from the upright supports such as 11 toward the forward end where they connect with the corresponding frontal upright supports. Each longitudinal top support 23 may be made in the form of a channel member, with the channel thereof facing transversely inwardly of the structure, and each may be joined with a downwardly and outwardly extending angular member such as 24, forming on each side of the machine a depending shield. A dust hood 25 extends upwardly from the longitudinal top supports 23 for drawing off air from the material deck during the operation of the apparatus.

The longitudinal top supports 23 are provided with brackets 26 and 27, and secured to each of these brackets is a downwardly depending resilient member, e. g., a leaf spring, as indicated at 28 and 29, respectively. These leaf springs support the material-receiving deck.

The deck comprises two longitudinally extending transversely spaced channel members 30 and 31, one on each side of the machine, each disposed with its channel facing outwardly. Each channel member is provided with a number of brackets, one for each leaf spring disposed on the corresponding side, and the free end of each leaf spring is suitably fastened to its associated bracket. The pair of transversely spaced channel members 30 and 31 are thus resiliently suspended from the longitudinal top supports 23. Secured to each channel member 30—31 is an angular member such as 32 extending upwardly and outwardly therefrom to form the side walls of the troughlike material-receiving deck. The downwardly depending shield 24 and the upwardly extending member 32, on either side of the machine, may be connected by canvas or the like.

The channel members 30 and 31 of the deck are transversely interconnected by partitions forming groups of cells, as shown in Figs. 1 and 2. On top of each group of cells is provided a suitable air-pervious covering, and the bottom is formed by valve plates coacting with valve members, as particularly described and referred to in the previously mentioned patent, for admitting air thereinto in a controlled manner. Each cell contains suitable resistance means such as marbles. Each group of cells with its associated air-pervious covering and its valved bottom forms a section of the material-receiving deck. The deck section formed by the rearmost group of cells is indicated by numeral 35, and the next section in forward direction is indicated by numeral 36.

The forward end of the deck section 35 is joined with the rearward end of the deck section 36 by means forming an intermediate discharge chute for directing separated material particles from the deck section 35 downwardly for discharge through the medium of a discharge mechanism which is particularly apparent from Fig. 2. The forward end of the deck section 36 is similarly joined with the rearward end of the next adjacent deck section to form means for removing separated material particles through the medium of a like intermediate discharge mechanism. Each pair of successive deck sections may be similarly joined and provided with means for discharging material particles which have been separated on the preceding deck section.

The novelty in the present invention is particularly directed to the provision of the new flow-controlling and discharge-discriminating weir and to the provision of the new means forming a self-sealing path for the separated material to direct such material into the associated discharge mechanism, and will be particularly described with reference to Fig. 2, after first completing the general description of the structure.

The side walls 13 and 14, defining the air box or chamber in lateral direction, are joined with the channel members 30 and 31, respectively, by canvas bellows 37. Air injected into the air chamber is thus directed underneath the deck sections for upflow through the resistance cells therein and through the associated air-pervious coverings into the material bed moving along the troughlike deck.

A member 38 secured to the deck, and particularly to the channel-shaped supporting members 30 and 31 extends rearwardly therefrom, forming a support for a vibrator 39 which is actuated by a pulley 40 connected with a drive, for example, the motor 41 positioned on a shelf 42 which is mounted on the upright supports 12. Vibrations may thus be imparted to the deck and its various deck sections such as 35 and 36. In order to dampen and control the vibrations, there is provided a resilient balancing mechanism comprising spring means indicated at 43, furnishing a resilient balancing support for the extension 33, and therefore for the deck through the medium of a connecting member 44.

Substantially underneath each intermediate discharge or takeoff, that is, each intermediate discharge extending from the juncture of two adjacent deck sections, is provided a discharge casing or chamber formed by walls 45 which extend transversely within the air chamber or air box defined by the side walls 13 and 14. Within this discharge chamber is provided a transversely extending arcuate traylike member 46 for receiving separated material particles dropping down from the associated intermediate discharge chute. A scraper 47 is disposed within the discharge chamber for oscillation relative to the tray 46 by means of arms 48 secured to a shaft 49. The shaft 49 extends to the outside and is provided with an arm such as 50 (see Fig. 1) which may be oscillated by an arm 51 pivotally linked to it and adjustably linked to an arcuate pivotally mounted member 52 which in turn is linked to a member 53. The latter is connected with the rod 54 which is actuated by the eccentric 22. Accordingly, when the eccentric 22 is rotated by the motor and gear reducer 18, the rod 54 will be pushed back and forth, actuating the link 53 and therewith the arm 52, thus transmitting oscillations through the arm 51 to the link such as 50 and oscillating the shaft 49 and therewith the scraper 47 relative to the tray 46, thereby pushing off measured

amounts of material from the tray 46 onto the screw 55 which discharges the material particles transversely for removal through the chute 56.

Each and every one of the intermediate discharge mechanisms contains the structure briefly outlined above, and the description of one will therefore suffice for all. The previously mentioned patent may be consulted for more detained explanations and references as to the structures of the various mechanisms incorporated in the separator.

Referring now particularly to Fig. 2: The new flow-controlling and discharge-discriminating weir is an angular member indicated by reference numeral 60 which extends transversely of the deck within the side walls formed by the members 32. It is secured to the rearward end of the deck section 36 and is vertically adjustable thereon. The weir may be attached by means of screws engaging the rear end of deck section 36 through slots in the member 60. It will be observed that the weir member is formed to extend at an angle in the direction generally opposite to the flow of the material bed on the deck. It thus acts in the manner of a knife extending angularly into the material bed without causing undesired eddies, thus minimizing frictional forces that may disturb the stratified flow of the bed. The weir is initially adjusted at a proper height so as to dam substantially only that part of the stratified bottom layer of the material bed which should be directed for discharge at this point of the deck. In other words, the weir is so adjusted as to project into the material bed to such an extent that it operates as a discharge-discriminating member; that is to say, it exercises a discharge-discriminating and also a flow-controlling function, damming or banking for discharge only material which should be removed at the corresponding point of the deck.

The discharge path is formed by a chute comprising the downwardly depending section 65 joined with the section 66. Both sections are rectangular in shape, extending transversely of the structure and are part of the deck and vibrating with it. Secured to the discharge chamber or casing 45 on top thereof is a hopper 67 which is stationary with the discharge chamber 45 and therewith stationary with the lower portion of the apparatus. The hopper 67 forms an upwardly flaring mouth surrounding the downwardly extending chute 66.

The operation may be briefly summarized in order to support the understanding of the structure discussed in the foregoing.

Raw material is fed from the hopper 21 by a feed mechanism (not shown) which is actuated by the links 19—20, feeding it in regulated manner onto the elevated rearward end of the deck, that is, onto the rearward portion of the deck section 35. The motor 41 actuates the vibrator 39, thereby vibrating the deck with all its deck sections as a unit. Air impulses are injected into the compartment of the air box or chamber immediately below the first deck section 35 which is disposed to the right of the discharge casing or chamber 45. The casing 45 is connected with the bottom of the structure through a valve mechanism diagrammatically indicated at 70 which may be adjusted so as to admit air into the next compartment for upflow through the air-pervious deck section 36. The forward end of the deck section 36 is joined with the rearward end of the next deck section in the same manner as the forward end of deck section 35 is joined with the rearward end of the deck section 36, to form an intermediate discharge, and this discharge is provided with a similar discharge mechanism which removes separated material through the chute 71. The discharge casing coacting with the second intermediate discharge is likewise provided with a valve mechanism such as 70 for admitting air in controlled manner to the next successive compartment of the air chamber which supplies air impulses to the third deck section of the apparatus. Each succeeding deck section is similarly associated with discharge means of like structure.

The raw material stratifies on the deck under the influence of the mechanical vibrations in the presence of the air impulses injected therethrough, and the raw material particles which stratify at the bottom of the first deck section 35 are drawn off through the intermediate takeoff or discharge particularly shown in Fig. 2. This portion of the material at the bottom of the material bed is banked or dammed, as shown in Fig. 2, by the new weir, the remaining portion of the material bed continuing to flow onto the next deck section 36, with a minimum amount of disturbance and mechanical friction. The separated material particles drop down into the chute 65, continuing to flow downwardly through the chute extension 66 and through the downwardly directed neck in the upper portion of the discharge chamber 45, and accumulate on the tray 46 at an angle of repose which normally would inhibit discharge and would merely result in piling up material above the tray and within the chute portions 65—66. Controlled amounts of materials are scraped off from the tray 46 by the oscillation of the scraper 47 and are discharged onto the screw 55 for removal into the chute 56, as previously mentioned.

The discharge of material from the casing 45 is regulated so as to maintain within the hopper 67 and the chute sections 65—66 an amount of material which always extends upwardly to the bottom layer of the material bed on the deck. In other words, only that amount of material is actually continuously withdrawn by operation of the scraper 47, which is actually separated on the deck section 35. Material particles thus around the lower portion of the downwardly extending chute section 66 within the hopper 67, as indicated by numeral 80, surrounding the lower portion of the chute 66 and thus forming a seal which prevents injection of air from the air chamber into the discharge casing 45.

The structure simplifies the construction of the separator, eliminating special provisions for an air seal which otherwise would be necessary, thereby also simplifying maintenance and reducing to a minimum the need for repair and replacements.

The chute sections 65—66 are rigidly connected with the deck and vibrate therewith. The deck is vibrated at relatively high frequency lying within a range of from about 800 to about 1400 oscillations per minute and at relatively small amplitude which is approximately ⅛", that is to say, about $\frac{1}{16}$" measured from a median center line when the machine is at rest. It must be considered, however, that the correct operation is not instantaneously effective upon starting the machine, but only after the starting period is completed, when the vibration equilibrium is finally reached. Initially upon starting the machine and also shortly before the machine comes to rest,

responsive to turning off the various motors, the oscillations are of considerably greater amplitude. The hopper 67, having the flaring mouth as shown, gives ample room for the initial and for the terminal displacement of the chute section 66 to provide for the initial and terminal oscillations of increased amplitude, and the air seal formed by the material piling up within the hopper 67 around the chute 66 furnishes security against undesired ingress of air from the air chamber into the discharge mechanism.

The modification indicated in Fig. 3 is essentially similar to the one just described, with the exception that the chute section 66 is formed of two parts indicated by reference numerals 66*a* and 66*b*. The portion 66*b* is provided with arcuate side walls 85—86 and with straight end walls, one of which is indicated at 87. The end walls engage the opposite end walls of the chute 66*a*, and the arcuate wall sections 85—86 engage the corresponding curved lower wall portions of the chute 66*a* marked by numeral 88. The connection between the upper arcuate portion of the chute 66*b* with the lower portion of the chute section 66*a* is secured by pivot pins 89. The lower portion of the chute section 66*b* extending into the hopper 67*a* may be secured by pivot pins such as 90, one holding each end wall of the chute section 66*b* pivotally connected with the corresponding end wall of the hopper 67*a*. The end walls 87 of the chute section 66*b* are provided with slots, as shown, for coaction with the associated pivot pins. The remaining structure of the mechanism, corresponds to that discussed in connection with Figs. 1 and 2.

In the modification shown in Fig. 3, the operation is similar to that already described, except that the vibrations of the deck are translated into an angular displacement of the chute section 66*b*, which extends into the hopper 67*a*, because the two chute sections 66*a* and 66*b* are articulated, as shown and described. Accordingly, the chute section 66*b* will be displaced angularly about the pivot point 90, resulting in a downwardly diminishing angular displacement with respect to the material piling up within the hopper 67*a*, the lower portion of the chute 66*b* remaining substantially stationary, at any rate not being subjected to vibrations in rectilinear direction, as is the case in the previously described embodiment. There is, therefore, less disturbance of the material piling around the lower portion of the chute section 66*b* and thus securing a more effective seal against ingress of air from the air box into the discharge mechanism.

Finely comminuted material seeping down through the resistance bed formed by the marbles within the air cells of the various deck sections is removed from the air chamber by means of the screws 95 for discharge through the chute 96.

The previously mentioned patent and the prior art Patents 2,245,942, and Re. 21,682 cited therein may be consulted for details not specifically mentioned or fully explained in the foregoing description.

While the features of the present invention are particularly applicable to airflow separators of the type disclosed in the previously mentioned patent, it is understood that they are not inherently limited thereto, and may find use in different types of separators or like apparatus within the scope and limits of the appended claims. It is likewise understood that the material to be separated need not be coal within the size range discussed, but may be other material, for example, various minerals and ores, and that the size ranges may likewise be different.

Changes may be made within the scope and spirit of the following claims.

We claim:

1. In a pneumatic coal separator of the class described having an air-pervious elongated troughlike coal-separating deck provided with a transversely extending intermediate discharge slot which subdivides said deck to form a pair of adjacent longitudinally successive air-pervious deck sections disposed vibratably on top of a substantially unitary stationary housing forming an air chamber for said deck sections which is common thereto and through which air is delivered under pressure for upward escape through said pair of air-pervious deck sections and having means for vibrating said deck sections as a unit and a stationary discharge casing disposed in said air chamber for receiving separated material particles from said discharge slot, a device for delivering separated material particles from said discharge slot into said discharge casing comprising means rigidly connected with said adjacent deck sections forming a rigid chute leading downwardly from said slot into said air chamber, said rigid chute being vibratable with said deck sections, means forming a chute extension leading downwardly from said rigid chute, and means in said air chamber forming an upwardly and outwardly flaring hopper connected with said discharge casing on top thereof, said chute extension projecting downwardly into said hopper with its free lower end disposed substantially at the narrowest portion thereof, ingress of air from said air chamber into said chute means and into said discharge casing, respectively, being blocked by material particles massing within said hopper around said chute extension which projects thereinto.

2. The structure defined in claim 1, wherein said chute extension is disposed movably relative to said rigid chute.

3. The structure defined in claim 1, wherein said chute extension is rotatably mounted on said rigid chute means.

4. The structure defined in claim 1, wherein the upper end of said chute extension is rotatably connected with the lower end of said rigid chute means and wherein the lower end thereof is pivotally connected with said hopper.

CARL V. ORE.
JOHN A. LOGAN NICHOLSON.

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