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(54) Title: MOBILE SORTING UNIT

(57) Abstract: A mobile sorting unit and method separates commingled material by both size and at least one other characteristic, such as mass. The unit may include a platform adapted for mobile transport and a sorting unit supported on the platform. The sorting unit includes an inlet hopper, an oversize separator station for separating oversized material from the commingled material, and an undersize separator station for separating undersize material from the commingled material. A mass separator station is adapted to receive the material exiting the undersize separator station outlet and direct light material toward a light material discharge area and heavy material toward a heavy material discharge area.



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MOBILE SORTING UNIT

Field of the Disclosure

[0001] The present disclosure generally relates to sorting methods and apparatus and, more particularly, to mobile sorting methods and apparatus.

Background of the Disclosure

[0002] Various types of mobile sorting methods and apparatus are known in the art. Such systems are often particularly suited for a specific type of commingled materials, and typically include one and sometimes two screeners mounted on a mobile platform. For example, U.S. Patent No. 6,843,376 to Dube et al. discloses a mobile screening unit having a first screener and a second screener mounted on a mobile support frame. When used to separate composite materials having particles of various sizes, the first screener may separate large size particles from small and medium size particles, while the second screener separates small size particles from the medium size particles. The mobile screening unit of Dube et al. therefore separates incoming material by size into small, medium, and large particles.

[0003] Separating materials solely by size, as taught by Dube et al., is of only limited use. Materials with different characteristics or requirements for re-use (or disposal) may have a similar size, and therefore further sorting, typically by hand, is required to separate the similarly sized materials into the desired material streams. When sorting construction and demolition materials, for example, rock or aggregate may have the same general size dimensions as paper or trash. While these materials may have similar size, their end uses are quite different. Specifically, aggregate may often be re-used on site or at another site as base or fill material, while paper may have a BTU content usable as fuel or trash must be disposed in an appropriate landfill. Consequently, the medium sized products must be further separated for these different end uses.

Brief Description of the Drawings

[0004] Fig. 1 is a perspective view of a mobile sorting unit in accordance with the teachings of the present disclosure;

[0005] Fig. 2 is a side elevation view of the mobile sorting unit of Fig. 1;

[0006] Fig. 3 is a left end view of the mobile sorting unit of Fig. 1;

[0007] Fig. 4 is a right end view of the mobile sorting unit of Fig. 1; and

[0008] Fig. 5 is a plan view of the mobile sorting unit of Fig. 1.

[0009] While the methods and devices described herein are susceptible to various modifications and alternative constructions, certain illustrative embodiments thereof are depicted in the drawings and will be described below in detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed in the drawings. To the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention as defined by the appended claims.

Detailed Description

[0010] Mobile sorting apparatus and methods are disclosed for separating usable material from commingled materials. Portable apparatus may be provided for performing sorting operations on site. The apparatus may include a sorting unit having multiple separator stations for removing materials having a particular characteristic from the commingled materials. For example, the sorting unit may include an oversized separator, an undersized separator, and a mass separator. Each separator station may remove material from the commingled materials that is potentially reusable. Additionally or alternatively, the sorting unit may separate material from the commingled materials that may be returned to or otherwise stored on site, thereby reducing the volume and weight of material that must be transferred off site.

[0011] An exemplary mobile sorting unit 20 is illustrated in Fig. 1. As shown, the mobile sorting unit 20 includes a platform such as trailer 22 having a set of wheels 24 at one end. The trailer 22 preferably includes a hitch 26 and a retractable support 28. The hitch 26 may be of any configuration recognized in the art and capable of attaching to a truck, tractor, or other transport vehicle. The support 28 is movable between a transport position in which a foot of the support is lifted from the ground, and in operational position, in which the foot of the support engages the ground to support one end of the trailer 22, thereby to maintain the trailer in a substantially horizontal position.

[0012] A sorting unit 30 is supported on the trailer 22 and adapted for transport with the trailer. The sorting unit 30 may be permanently or releasably secured to the trailer 22. The trailer 22 and sorting unit 30 may have dimensions (or may be placeable in a transport configuration having dimensions) that meet department of transportation sizes regulations for unrestricted transport along roadways. Preferably, the assembled trailer 22 and sorting unit 30 have dimensions less than approximately 8-1/2 feet wide by 55 feet long by 14 high. The sorting unit 30 separates commingled materials deposited therein according to certain physical characteristics, thereby to sort the commingled material into multiple, potentially reusable materials streams.

[0013] The sorting unit 30 preferably includes an inlet hopper 32 for receiving bulk commingled material. In the exemplary embodiment, a conveyor 34 is located at a base of the hopper 32 and includes a variable speed drive for adjusting the feed rate at which the commingled material enters a first separator station. The hopper 32 includes opposing side walls 33 that flare outwardly from one another, thereby to direct commingled material toward the conveyor 34.

[0014] In the illustrated embodiment, the sorting unit 30 includes an oversized material separator station 36 for removing oversized materials from the commingled materials. The oversized separator station 36 includes an oversize classifying medium 37 that allows smaller material less than a maximum size to pass through the oversize classifying medium while advancing oversized material greater than the maximum size to the oversize discharge area 38. The maximum size is preferably at least 3 inches and typically approximately 5 to 10 inches. Oversized material reaching the oversize discharge area 38 may be transported to a different apparatus or site for further sorting, while material passing through the oversize classifying medium may be advanced to an outlet for further processing in the mobile sorting unit 20.

[0015] In the exemplary embodiment, the oversized material separator station 36 is provided as a vibratory finger screen. The finger screen includes a plurality of longitudinally spaced finger screen sections having spaced fingers projecting therefrom to form a classifying medium 37. The fingers are spaced by a preselected amount sufficient to allow materials up to a preselected size to pass through the fingers as the finger screen is vibrated, such as by vibratory drive 39. The vibratory drive 39 may include a motor having an eccentrically loaded shaft that generates a vibratory force when rotated. Material larger than the preselected size advances along the top of the finger screen section to the oversize discharge

area 38. Material smaller than the preselected size passes through the finger screen sections to the oversize separator outlet 40 (FIG. 2). In the illustrated embodiment, the outlet 40 extends across an entire bottom portion of the finger screen. The space between adjacent fingers and between adjacent finger screen sections may be adjusted as desired to obtain the maximum size. In the current embodiment. Additional details of a suitable finger screen are provided in U.S. Patent No. 5,108,589, which issued to Sherman on April 28, 1992, the entirety of which is incorporated by reference herein. Furthermore, screeners other than a finger screen may be used to separate the oversized material without departing from the present disclosure.

[0016] A first transfer conveyor 42 is provided for receiving and transporting the smaller material passing through the oversize separator station, as best shown in FIG. 2. In the illustrated embodiment, the conveyor 42 has a first end 41 positioned below the oversize separator station outlet 40 and an inclined second end 43. The transfer conveyor 42 is preferably a belt conveyor, however other types of conveyors and apparatus for transferring the material may be used without departing from the scope of this disclosure.

[0017] The sorting unit 30 may further include an undersize separator station 44 for removing fines or other small particles from the commingled materials. The undersize separator station includes an undersize classifying medium 45 that allows material smaller than a minimum size to pass through the undersize classifying medium to an undersize discharge area 46 while advancing material larger than the minimum size to an undersize screener outlet 47. The minimum material size is adjustable, and is preferably less than approximately five inches and typically within a range of approximately 1/8 of an inch to 2 inches.

[0018] In the exemplary embodiment, the undersize separator station 44 is provided as a screener such as the STARGEAR screener marketed by Sherbrooke O.P.M. LTD. of Quebec, Canada. Such a screener includes a plurality of shafts connected by gears to rotate in the same direction. Disks having finger-like projections, which in certain embodiments may appear similar to a star-shape, are attached to and rotated with the shafts to form the classifying medium 45. Gaps between the projections allow undersized material less than the minimum size to pass through to the undersized discharge area while advancing larger material greater than the minimum size to the outlet 47 of the screener. While a star screener is preferred, other types of screeners may be used to separate the undersized material without departing from the scope of this disclosure.

[0019] An undersize material discharge conveyor 50 is provided for receiving undersized material from the undersize discharge area 46 and advancing it to a discharge point, as best shown with reference to FIGS. 1, 3, and 5. The conveyor 50 may be a belt conveyor that is pivotally coupled to the sorting unit 30 or the trailer 22 for rotation between transport and operational positions. In the transport position, a free end 51 of the conveyor 50 is positioned adjacent the sorting unit 30 to reduce the width profile of the mobile sorting unit 20. In the operational position, the free end of the conveyor 50 is rotated outwardly to define a discharge point spaced from the unit 20. The conveyor 50 may be equipped with a magnetic head pulley 52 to separate metallic objects from the material advanced by the conveyor 50.

[0020] A second transfer conveyor 54 is provided for receiving and advancing larger material from the outlet 47 of the undersize separator station 44, as best shown in FIGS. 1 and 2. In the illustrated embodiment, the second transfer conveyor is a belt conveyor having a first end 56 positioned below the outlet 47 and an inclined second end 58. While the second transfer conveyor 54 is preferably a belt conveyor, other types of conveyors and apparatus for transferring the material may be used without departing from the scope of this disclosure.

[0021] The sorting unit 30 includes an additional separator station for separating material according to a characteristic other than size. In the exemplary embodiment, a mass separator station 60 is provided for sorting materials according to density. As noted above, different materials may have roughly the same size and therefore remain commingled after passing through the undersize separator station. These similarly sized materials may have different characteristics that allow for different types of re-use or disposal. By further sorting these materials by another characteristic, such as mass, the sorting unit 30 allows for a greater variety of output materials, which may eliminate subsequent manual or other additional sorting steps that may otherwise be required to fully separate the commingled material.

[0022] In the illustrated embodiment, the mass separator comprises a destoner. An exemplary destoner is disclosed in U.S. Patent No. 4,624,370 which issued to Danner, et al. on November 25, 1986, and is incorporated by reference herein. The destoner includes a trough defining two plateaus 62, 64 interrupted by a drop-out opening 66. Materials are conveyed along the upper plateau 62 and over the drop-out opening 66 by a vibratory force provided by vibratory drive 68, which may be a motor with an eccentrically loaded shaft. An air supply source, such as a fan 70, fluidly communicates with the destoner to provide pressurized air flow which is directed through the drop-out opening 66 at an angle to the

plane of the upper plateau 62 which breaks apart constituents of the material and propels particles of a predetermined density to a landing area on the second plateau 64. The lighter objects landing on the second plateau 64 are transported to a discharge area 72 for further processing or disposal. Heavy materials falling through the drop-out area advance to an outlet 74 of the destoner. While the exemplary embodiment employs a destoner as the mass separator station, other types of apparatus capable of separating materials according to relative mass may be used without departing from the scope of this disclosure.

[0023] A third transfer conveyor 76 (FIG. 1) is positioned to receive heaving material exiting the mass separator station 60 and advance it to a final discharge conveyor 78. In the exemplary embodiment, the third transfer conveyor 76 is a belt conveyor having one end 80 positioned below the outlet 74 of the mass separator station 60 and an opposite end 82 positioned above the final discharge conveyor 78.

[0024] The final discharge conveyor 78 is positioned to receive the heavy material exiting the third transfer conveyor 76 and advance it to a final discharge point, as best illustrated in FIGS. 1, 4 and 5. Similar to the discharge conveyor 50 described above, the final discharge conveyor 78 may be a belt conveyor having a first end 84 pivotally coupled to the trailer 22 or sorting unit 30, so that the conveyor 78 may be placed in either a transport position or an operational position. In the transport position, a second end 86 of the final discharge conveyor 78 is positioned adjacent the sorting unit 30 to reduce the profile width of the mobile sorting unit 20. The second end 86 may be rotated away from the sorting unit 30 in the operational mode to provide a discharge point spaced from the trailer 22. The final discharge conveyor 78 may include a magnetic head pulley 88 for removing metallic material from the material traveling along the conveyor 78.

[0025] A power supply (not shown) may be provided on the trailer 22 to generate power for the motors used to operate the various components of the separator unit. The separator stations may use vibratory, rotary gear, or other drives to provide a force for advancing and separating the material. The feed, transfer, and discharge conveyors may use similar drives to move the conveyor belt or otherwise advance material there along. Each of these drives includes a motor, and the power supply generates power for operating the motors. Additionally or alternatively, the various components of the sorting unit 30 may be powered by an auxiliary power supply, such as a power source provided at the site.

[0026] The mobile sorting unit 20 may be used to separate commingled materials from a variety of sources into one or more reusable materials. When used at construction or demolition sites, for example, the commingled materials may include rock, concrete, dirt, wood, metal, or other materials used in the construction buildings. This material is typically accumulated and stacked on site. Accordingly, the mobile sorting unit 20 may be transported to the site to perform sorting operations.

[0027] When commingled construction and demolition materials are deposited in the inlet hopper 32, the conveyor 34 controls the rate at which the materials are fed into the oversize separator 36. Materials larger than the predetermined maximum size pass do not pass through the oversize separator 36 but instead are removed from the sorting unit 30. Such oversized materials may include large chunks of concrete or stone, wood, or other materials. The smaller material is then advanced to the undersize separator 44, which removes fines or smaller particles. For construction and demolition material, fines typically include dirt, dust, or other similarly sized particles. Such fines may be re-used on site or at another site as fill. The remaining materials are then forwarded to the mass separator 60, which removes lighter particles from the stream. The lighter particles may include paper or other materials that have a BTU content, and therefore may be removed for use as fuel. Alternatively, the lighter materials may be removed for disposal as trash. The remaining heavier materials are typically stone or aggregate which may be reused either on site or at another site.

[0028] The foregoing apparatus and methods provide a mobile means for separating reusable material from commingled materials on site. The system is automated and requires minimal manual labor. The settings of the various separator stations may be adjusted to accommodate different types of commingled materials. Accordingly, the volume and weight of material requiring off site disposal is reduced and reusable material may be transported directly to its final destination rather than first being hauled to a central facility. The commingled material is sorted by size and at least one other characteristic, such as mass, to obtain a more complete separation of the commingled materials.

[0029] While the present invention has been described with reference to specific examples, which are intended to be illustrative only and not to be limiting of the invention, it will be apparent to those of ordinary skill in the art that changes, additions or deletions may be made to the disclosed embodiments without departing from the spirit and scope of the invention.

WHAT IS CLAIMED:

1. A mobile sorting unit for separating reusable material from commingled materials, the mobile sorting unit comprising:
 - a platform adapted for mobile transport; and
 - a sorting unit supported on the platform, the sorting unit including:
 - an inlet hopper for receiving the commingled materials;
 - an oversize separator station adapted to receive the commingled materials from the inlet hopper, the oversize separator station having an oversize classifying medium allowing smaller material less than a maximum size to pass through the oversize classifying medium to an outlet of the oversize separator station while advancing oversized material greater than the maximum size to an oversize discharge area;
 - an undersize separator station adapted to receive the smaller material from the oversize separator station outlet, the undersize separator station having an undersize classifying medium allowing undersized material less than a minimum size to pass through the undersize classifying medium to an undersize discharge area while advancing larger material greater than the minimum size to an outlet of the undersize separator station;
 - a mass separator station adapted to receive the larger material from the undersize separator station outlet, the mass separator directing light material having a pre-determined size and density toward a light material discharge area and directing heavy material having other than the pre-determined size and density toward a heavy material discharge area.
2. The mobile sorting unit of claim 1, in which the reusable material comprises the undersized materials and the heavy material.
3. The mobile sorting unit of claim 1, in which the reusable material further comprises the light material.
4. The mobile sorting unit of claim 1, in which the platform comprises a frame and wheels.

5. The mobile sorting unit of claim 4, in which the platform is sized for roadway transport.

6. The mobile sorting unit of claim 5, in which the frame is adapted for coupling to a vehicle.

7. The mobile sorting unit of claim 1, in which the maximum size in the oversize separator station is no less than approximately 3 inches.

8. The mobile sorting unit of claim 1, in which the minimum size in the undersize separator station is no more than approximately 5 inches.

9. The mobile sorting unit of claim 1, further comprising a ferromagnetic separator station adapted to receive undersized material from the undersize discharge area of the undersize separator station, the ferromagnetic separator station having a magnetic medium for removing ferromagnetic material from the undersized material.

10. The mobile sorting unit of claim 1, further comprising a ferromagnetic separator station adapted to receive heavy material from the heavy material discharge area of the mass separator station, the ferromagnetic separator station having a magnetic medium for removing ferromagnetic material from the undersized material.

11. The mobile sorting unit of claim 1, in which the oversize separator station comprises a vibratory finger screen.

12. The mobile sorting unit of claim 1, in which the undersize separator station comprises a star screen.

13. The mobile sorting unit of claim 1, in which the mass separator station comprises a vibratory separator.
14. The mobile sorting unit of claim 1, in which the inlet hopper comprises an inlet conveyor having an adjustable feed rate.
15. The mobile sorting unit of claim 1, in which the commingled materials comprise materials selected from a group of commingled materials comprising construction materials and demolition materials.
16. The mobile sorting unit of claim 15, in which the oversized material comprises at least one material selected from a group of oversized materials comprising concrete and wood.
17. The mobile sorting unit of claim 15, in which the undersized material comprises at least one material selected from a group of undersized materials comprising dirt and fill.
18. The mobile sorting unit of claim 15, in which at least a portion of the light material comprises fuel.
19. The mobile sorting unit of claim 15, in which the heavy material comprises at least one material selected from a group of heavy materials comprising aggregate and metal.

20. A mobile sorting unit for separating reusable material from commingled materials, comprising:

a platform adapted for mobile transport; and

a sorting unit supported on the platform, the sorting unit including:

an inlet hopper for receiving the commingled materials, the inlet hopper including an inlet conveyor having an adjustable feed rate; and

at least one separator stations selected from a group of separator stations comprising an oversize separator station and an undersize separator station, wherein:

the oversize separator station includes an oversize classifying medium allowing smaller material less than a maximum size to pass through the oversize classifying medium to an outlet of the oversize separator station while advancing oversized material greater than the maximum size to an oversize discharge area; and

the undersize separator station includes an undersize classifying medium allowing undersized material less than a minimum size to pass through the undersize classifying medium to an undersize discharge area while advancing larger material greater than the minimum size to an outlet of the undersize separator station; and

a mass separator station adapted to direct light material having a pre-determined size and density toward a light material discharge area and heavy material having other than the pre-determined size and density toward a heavy material discharge area.

21. A method of sorting reusable material from commingled material on site, the method comprising:

transporting a mobile sorting unit to the remote site;

loading the mobile sorting unit with the commingled materials;

separating oversize material greater than a maximum size from the commingled materials inside the mobile sorting unit;

separating undersize material less than a minimum size from the commingled materials inside the mobile sorting unit; and

separating light material having a predetermined size and density from the commingled materials inside the mobile sorting unit to obtain heavy materials;

wherein the reusable material comprises at least the heavy materials.

20. The method of claim 19, in which the reusable material further comprises the undersize material.

21. The method of claim 19, in which the reusable material is suitable for unclassified storage on site.

22. The method of claim 19, further comprising providing an inlet conveyor adapted to selectively feed at least a portion of the commingled materials at a predetermined rate prior to separating the oversize material, undersize material and light material.

23. The method of claim 19, in which the oversize material separating comprises providing an oversize classifying medium allowing smaller material less than a maximum size to pass through the oversize classifying medium while advancing oversized material greater than the maximum size to an oversize discharge area.

24. The method of claim 19, in which the undersize material separating comprises providing an undersize classifying medium allowing undersized material less than a minimum size to pass through the undersize classifying medium to an undersize discharge area while advancing larger material greater than the minimum size.

25. The method of claim 19, in which the light material separating comprises providing a mass separator that directs light material having a pre-determined size and density toward a light material discharge area and directs heavy material having other than the pre-determined size and density toward a heavy material discharge area.

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FIG. 1

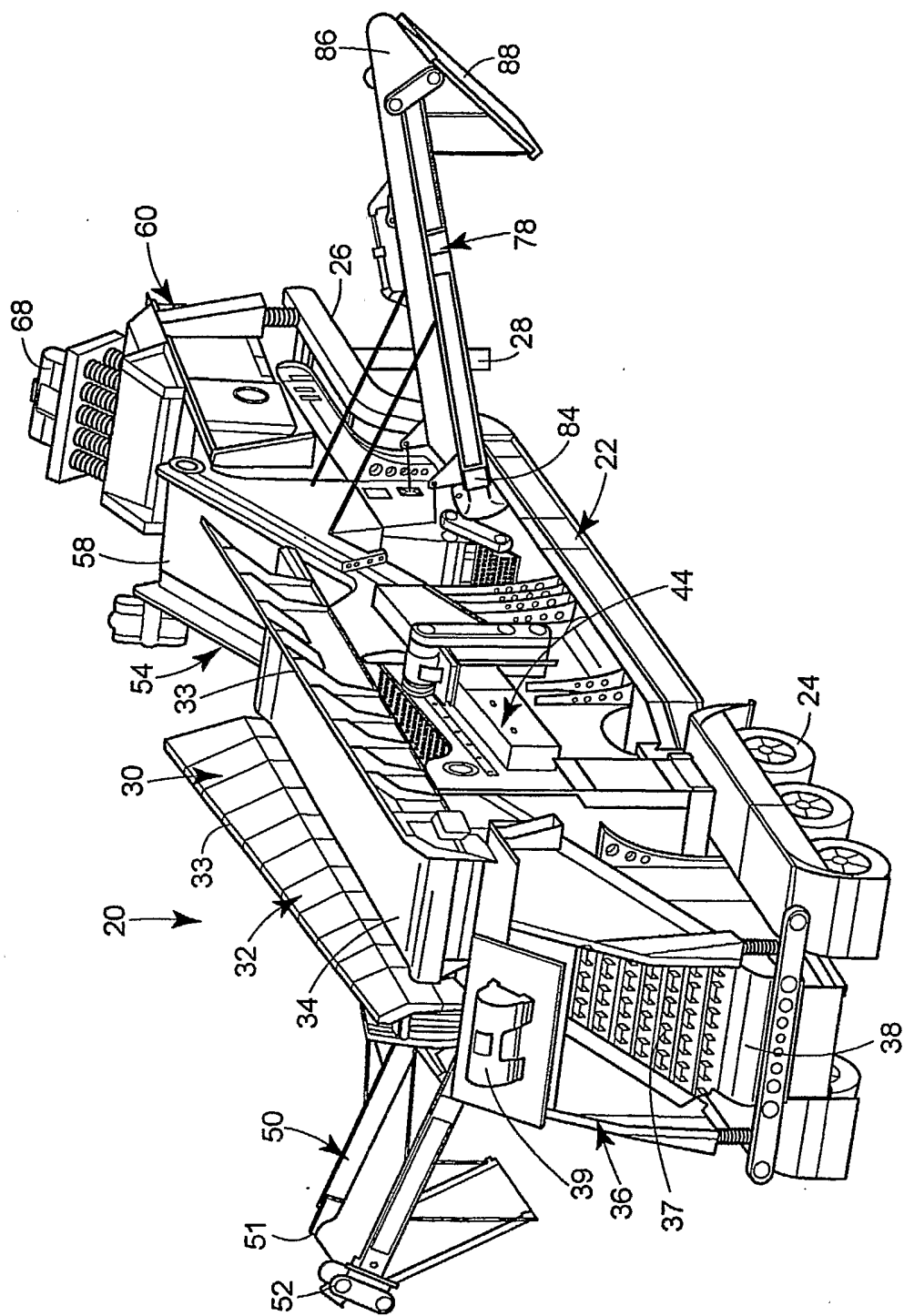
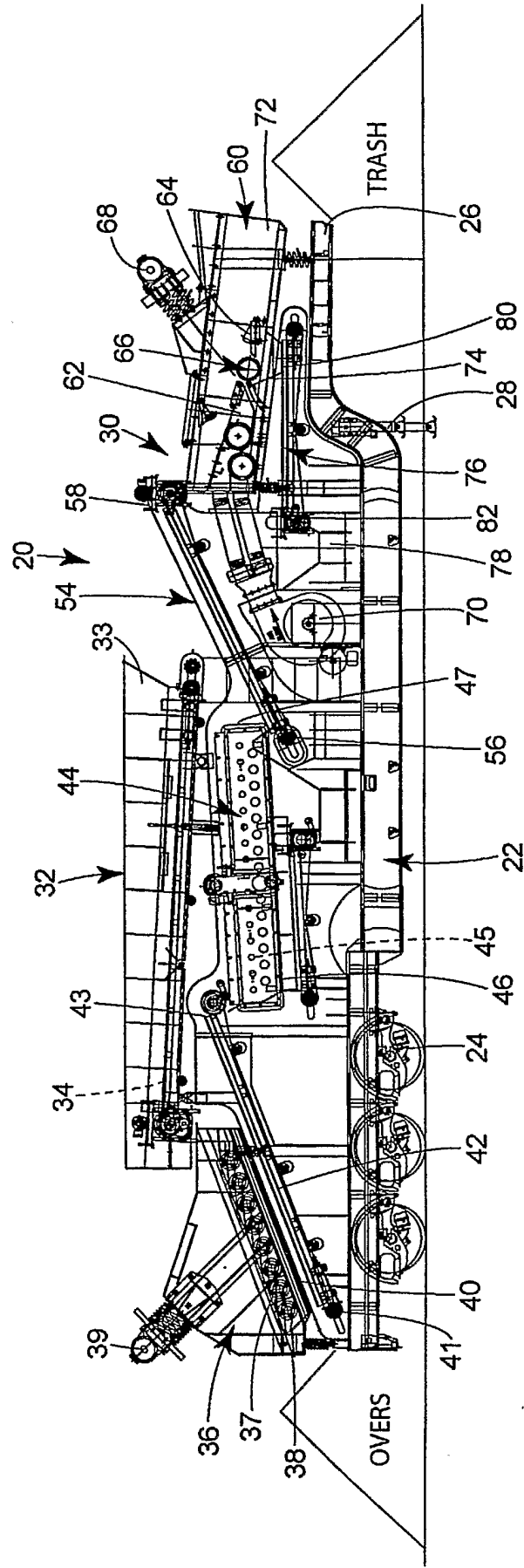


FIG. 2



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FIG. 3

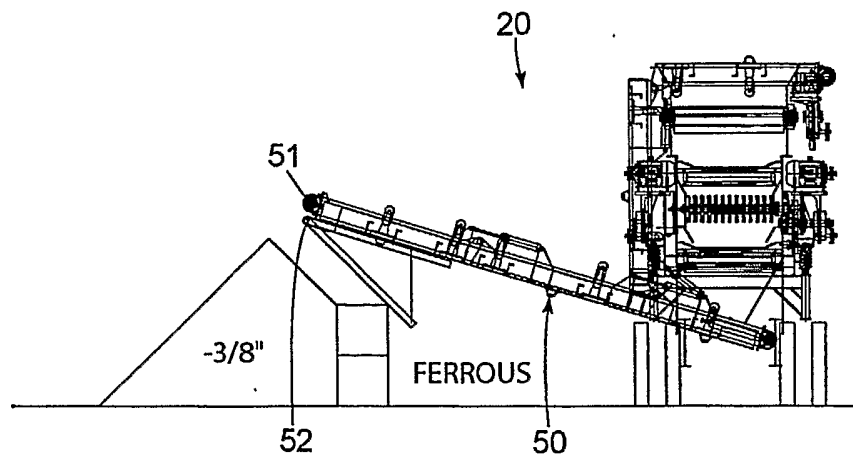


FIG. 4

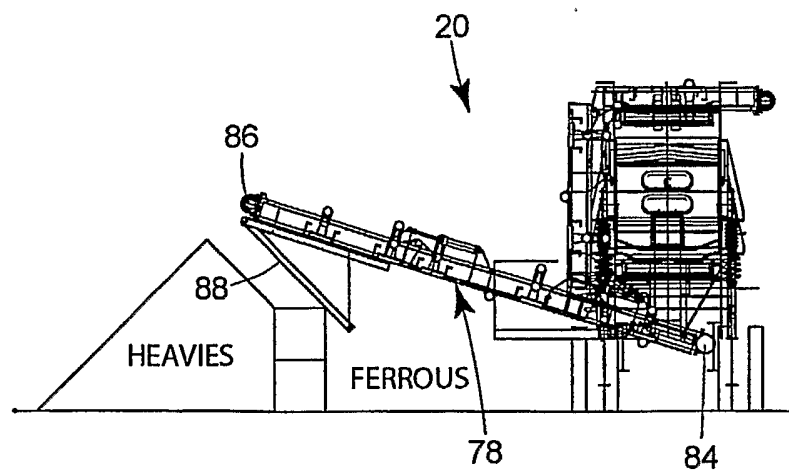


FIG. 5

