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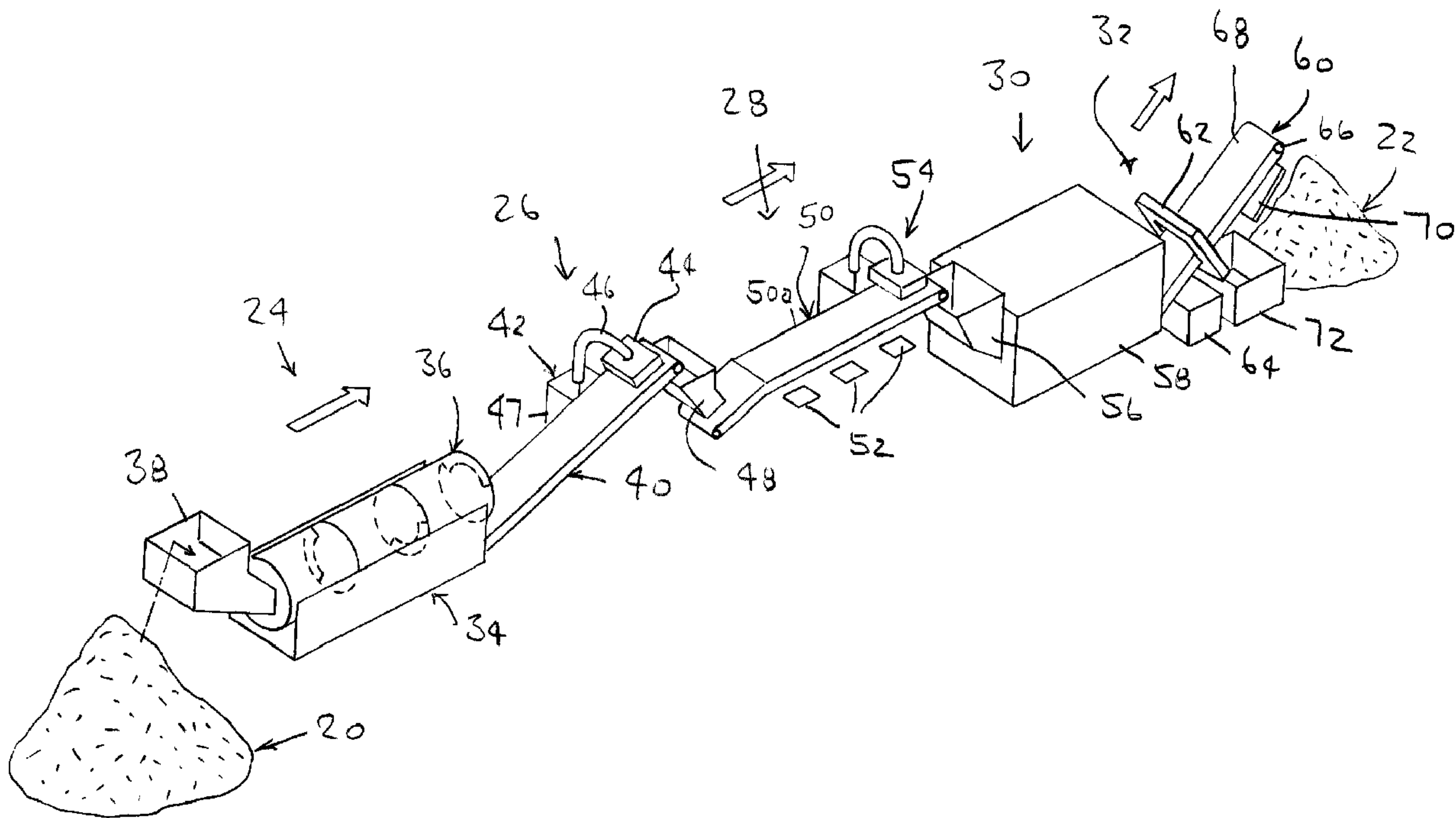
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(54) Titre : TRANSFORMATION DES BARDEAUX D'ASPHALTE
(54) Title: SHINGLE PROCESSING



(57) **Abrégé/Abstract:**

Used asphalt roofing material such as shingles are processed to produce a useful end product in granular form. The method involves causing the used roofing material to travel in a stream through successive processing stations in which the material is first subjected to vibration and/or tumbling to loosen the material and is then ground into said granular form. Lightweight contaminants are removed in an air separator and the material is passed through a hand-picking station for manual removal of large contaminants. Metal contaminants are also removed.

ABSTRACT OF THE DISCLOSURE

Used asphalt roofing material such as shingles are processed to produce a useful end product in granular form. The method involves causing the used roofing material to travel in a stream through successive processing stations in which the material is first subjected to vibration and/or tumbling to
5 loosen the material and is then ground into said granular form. Lightweight contaminants are removed in an air separator and the material is passed through a hand-picking station for manual removal of large contaminants. Metal contaminants are also removed.

Title: SHINGLE PROCESSING**FIELD OF THE INVENTION**

5 [0001] This invention relates generally to the recycling of used asphalt-based roofing materials such as shingles and asphalt flat roofing materials.

BACKGROUND OF THE INVENTION

[0002] In North America, asphalt-based roofing shingles and sheet roofing materials are widely used for roof coverings on buildings, particularly
10 homes. Typically, a building can be re-roofed a number of times by laying new shingles over old shingles, without having to remove all of the old shingles. Ultimately, however, all of the shingles must be removed.

[0003] Waste used shingles represent a significant disposal problem. Typically, the waste shingles are delivered to landfill sites and buried. It has
15 been estimated that landfill sites in Canada receive approximately 300,000 tonnes of used roofing waste each year and that, in the United States, the corresponding amount is about 7,000,000 tonnes. Shingles are not a good landfill commodity because they do not break down in the ground and are impervious to water. They therefore create an unstable landfill situation for
20 material dumped on top of the shingles because water will not drain through.

[0004] Canadian Patent Application No. 2,190,538 of The Warren Paving & Materials Group Limited discloses a method of "processing, storing, blending and utilizing recyclable modified shingle waste asphalt" in the manufacture of hot mix asphalt paving compositions. However, this process
25 is applicable only to new "factory waste" from shingle manufacturing companies. A significant advantage of using new factory waste is that it is free of contaminants. Used shingles that have been removed from a building contain significant contamination due to the presence of nails, paper, plastic, wood and other materials, as well as garbage and other materials that the
30 homeowner may throw into the shingle disposal box that is left on the property during the roofing construction period.

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[0005] United States Patents Nos. 4,706,893 (Brock) and 5,201,472 (Brock) disclose methods and apparatus for manufacturing asphalt paving compositions using recycled asphalt shingles. In the method of the '893 patent, the shingles are comminuted and the resulting particles are fed into an asphalt plant where they are melted and mixed with other components to form an asphalt paving composition. In the method of the '472 patent, a "carrier aggregate" such as sand is added to shredded shingle material to prevent the shredded particles clumping or sticking together during transportation or storage. The shredded material then does not have to be used immediately.

10 **[0006]** Even though the '893 patent refers to the re-cycling of used waste shingles, it is believed that contaminants that would be present in the particulate product in practice would make the product unsuitable for use in asphalt paving compositions. It should be borne in mind that shingles sitting on a roof over time, are subjected to tremendous heat from the sun. That causes melting of the asphalt cement in the shingles and when the shingles are removed, they are not only stuck together, they are bonded to the eaves troughs, soffits, air vents, and the roofing plywood that they are initially attached to. These contaminants are not compatible with hot mix asphalt. Accordingly, it is believed that the inventions disclosed in the Brock patents are suitable for re-cycling new, factory waste shingles only.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is to provide a method of processing used asphalt roofing material such as shingles which results in a product that is useful as a raw material for various applications, for example, the manufacture of asphalt paving compositions.

[0008] In a broad aspect, the invention involves causing the used roofing material to travel in a stream through successive processing stations in which the following steps are performed:

- a) subjecting the traveling material to vibration and/or tumbling to loosen the material;
- b) removing lightweight contaminants in an air separator;

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c) removing metal contaminants;
d) passing the material through a hand-picking station for manual removal of other contaminants; and,
e) grinding the material to form a granular processed roofing material.

5
[0009] As noted above, the granular processed roofing material that results from the method is in itself useful as a raw material in a number of applications, for example, as an additive to asphalt paving compositions, or for forming into sheet material and as a component raw material in the
10 manufacture of other useful construction products.

[0010] The invention is based in part on the recognition that used asphalt roofing material has undergone oxidation by virtue of its exposure to the atmosphere during its initial use as a roofing material, and that this oxidation is effective to prevent agglomeration of the granular material that
15 results from the method of the invention, without the need for additives such as is required pursuant to the teachings of the '472 Brock patent discussed previously.

[0011] The invention also provides an apparatus corresponding to the method referred to above, and a processed roofing material produced by the
20 method.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which illustrate a particular preferred embodiment of the invention by way of example, and in
25 which:

[0013] Fig. 1 is a schematic perspective view of an apparatus for processing used shingles in accordance with a preferred embodiment of the invention;

[0014] Fig. 1a is a perspective view illustrating part of Fig. 1 in more
30 detail;

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[0015] Fig. 2 is a side elevational view corresponding to Fig. 1; and,

[0016] Fig. 3 is a perspective view illustrating a modification of the apparatus shown in Fig. 1.

DESCRIPTION OF PREFERRED EMBODIMENT

5 **[0017]** Referring first to Fig. 1, reference numeral 20 denotes a pile of waste, used shingles ready for processing in accordance with the method of the invention. Reference numeral 22 indicates a pile of processed shingle material that represents the end product of the method. Typically, the "dirty" shingle pile 20 will come directly or indirectly from a disposal company or
10 roofing contractor and would otherwise have been delivered to a landfill site for burying, or as is being presently stockpiled at various landfill sites across Canada and the U.S.A. The pile 22 is a raw material that is useful for various applications, including as an additive in the manufacture of asphalt paving compositions and as a raw material component in the manufacture of a water
15 proofing rolled sheet product and for other construction products.

[0018] As noted previously, the waste shingle material in pile 20 typically contains significant contamination in the form of nails, paper, plastic, wood and other materials. The shingles themselves will have been torn from building roofs and normally will be at least partly broken up and fragmented.

20 **[0019]** The shingle processing apparatus has five main processing stations that are generally denoted by reference numerals 24, 26, 28, 30 and 32. At station 24, the waste material is subjected to vibration and/or tumbling to loosen the material. Lightweight contaminants such as paper and plastic are then removed at station 26 in an air separator. Station 28 is a hand-
25 picking station at which workers (not shown) manually remove and discard other, e.g. heavier contaminants such as large pieces of wood, metal or drywall. At station 30, the material is subjected to grinding which reduces the asphalt material to a granular form. Finally, at station 32, any remaining metal contaminants are removed and the cleaned granular material is discharged to
30 form pile 22. The material is then substantially (typically 99%) free of contaminants.

[0020] As noted previously, shingles exposed to the sun over time tend to melt so that the shingles not only are stuck together but become bonded to other parts of the roof structure. That bond between the shingles and the contaminants is broken by the vibration and/or tumbling action at station 24 so
5 that all of the contaminants can be removed at stations 26 and 32.

[0021] In the particular embodiment illustrated, the vibration and/or tumbling action that is required to loosen the material is provided by a trommel, which is schematically illustrated at 34. Trommel 34 is essentially a conventional piece of equipment, suitable models of which are available from
10 POWERSCREEN, a Terex company of Louisville, Kentucky, U.S.A. and from McClosky Brothers in Peterborough, Ontario, Canada. As is well known, a trommel essentially comprises a cylindrical drum 36 that is driven in rotation. Material is delivered to an input end of the drum and is tumbled and vibrated as the drum rotates,

15 **[0022]** In a conventional trommel, the cylindrical surface of the drum is a series of cylindrical screens disposed end-to-end so that the material moves from one screen to the next as it progresses along the drum. Fines pass through the screens and are collected and stockpiled separately or discarded, while the remaining material is discharged from the output end of the drum.
20 According to the present invention, the screens are replaced by solid (imperforate) cylindrical wall sections so that none of the material is lost from the drum. As shown in the drawings, there are three sections 36a, 36b and 36c which are disposed end-to-end and rotate together.

[0023] Further, it was found that, when a large batch of "dirty" shingles
25 (typically several tonnes) is dumped into the trommel, the material tends not to "volume separate" as it moves through the trommel. The batch of material tends to remain together as it moves along the drum and out of the trommel. This can create a "surging" of material and can result in a significant thickness of material (e.g. up to one foot) being delivered to the picking station 28. This
30 makes it difficult if not impossible for the hand pickers to sort through the material and remove contaminants.

[0024] In order to combat this problem, a series of so-called "surge bars" are provided in the drum to prevent a surge or "plug" of material passing through the drum intact. In the illustrated embodiment, three surge bars are provided and are located one at the discharge end of each of the drum sections 36a, 36b, 36c. In Fig. 1a, the bars are denoted 37a, 37b and 37c. It will be seen that each bar has an arcuate shape and an extent corresponding to about one third of the circumference of the drum, with the respective surge bars being angularly offset from one another by approximately 120°. As such, each surge bar allows approximately one third of the product volume to pass so that the bars collectively prevent a "plug" or "surge" of material from passing through the drum intact.

[0025] It is of course to be understood that the number of sections that make up the drum 36 may vary, as may the number and arrangement of surge bars. Preferably, the bars are removably secured to the drum, e.g. by bolts, so that the bars can be removed and replaced, or additional bars can be added as required.

[0026] The loosened material is discharged from the trommel onto an inclined conveyor 40 that transports the material through an air separator 42. Separator 42 comprises a vacuum hood 44 that is positioned adjacent the upper end of conveyor 40 at a spacing slightly above the upper surface of the conveyor sufficient to provide clearance for the material to pass below the hood, while close enough to pick up light contaminants. A suction conduit 46 connects the hood to a debris collection box 47 adjacent the conveyor.

[0027] Again, the air separator has been shown schematically only. Provision of a suitable air separator is well within the knowledge of a person skilled in the art.

[0028] Material discharged from the upper end of conveyor 40 is delivered into a hopper 48 at the input end of a further conveyor 50 at hand-picking station 28. Conveyor 50 has a horizontal run 50a alongside which workers can conveniently stand adjacent the conveyor as represented by the boxes 52; usually, workers will stand at both sides of the conveyor. The

conveyor is timed to move the material relatively slowly past the workers and allow them time to hand-pick and discard large pieces of wood, metal or other debris.

5 **[0029]** At the discharge end of conveyor 50 is a further air separator 54 that is essentially the same as the separator 42 associated with conveyor 40.

10 **[0030]** Conveyor 50 discharges into a hopper 56 which provides an input to a grinder or crusher 58 at station 30. Again, the grinder is essentially a conventional piece of equipment and has been shown schematically only. The grinder may include a so-called "cutter mill" or a "hammer mill" – either of which rotates in a casing to break up or crush the material. Suitable grinders are a "Beast 3680" ("cutter mill" type) as manufactured by Bandit Industries in Remus, Michigan or a Peterson Pacific Grinder "HC 2400" ("hammer mill" type) as manufactured by Peterson Pacific Corporation in Eugene, Oregon, both U.S.A.

15 **[0031]** In Fig. 2, grinder 58 is shown as including a rotary cutter mill indicated schematically at 58a. A series of water spray nozzles represented at 59 is provided within the grinder to supply cooling water. It has been found that cooling is desirable both to control dust and, at least in warm weather, to prevent significant heat build-up within the grinder, that can impair the ability
20 of the cutter mill to break up the shingles. In other words, cooling has been found to improve the action of the cutter mill. In a practical embodiment, it was found desirable to supply cooling water to the grinder at a rate of approximately 1,000 gallons per hour.

25 **[0032]** Grinder 58 reduces the roofing material to a granular form and discharges the material onto a further inclined conveyor 60 at station 32. Metal contaminants are moved at station 32, first by an eddy current device denoted 62 that surrounds the conveyor and removes non-ferrous waste such as aluminum. Collected non-ferrous waste is delivered into a collection box 64 below the conveyor.

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[0033] At its outer end, conveyor 60 includes a magnetic roller 66 by which ferrous metal is caused to be retained on the belt of the conveyor (denoted 68). As the belt travels around roller 66, the granular roofing material is discharged onto pile 22 and the ferrous metal remains on the belt.

5 Below roller 66, the metal is "skimmed" from the belt by a deflector plate 70 and falls into a ferrous metal collection box 72, as best shown in Fig. 2.

[0034] Collected ferrous and non-ferrous metal contaminants are further recycled, and not landfilled.

[0035] The hand-picking station 28 as shown in Fig. 1 is a single

10 horizontal conveyor with positions for workers to stand on both sides of the conveyor. In some applications, it may be desirable to split the flow of used roofing material into two parallel streams flowing along parallel conveyors with workers positioned along both sides of each conveyor. This helps to spread out the material, considerably reducing "surging" – large poorly distributed

15 mounds of material passing through the picking station.

[0036] Fig. 3 illustrates how this may be accomplished. In that view, the conveyor 40 is shown discharging onto a flow-splitting device 74 which separates the material into two streams indicated by the arrows 76 and 78. Each stream flows into a corresponding hopper 80, 82 through which the

20 material is deposited onto respective picking conveyors 50' and 50". The two conveyors run side-by-side with workers on both sides of each conveyor, and discharge into a common hopper that leads into the 58. The common hopper may be similar to the hopper 56 shown in Figs. 1 and 2.

[0037] To summarize, in accordance with the method of the invention,

25 waste used asphalt material and all of the contaminants that they arrive with is converted into a useful end product known as processed shingle material (PSM) which is in granular form and 85% less than 2.36 mm in size and is substantially (typically 99%) free of contaminants. The particles are partially oxidized, which serves to eliminate clumping and/or agglomeration of the

30 particles. This means that the material can be stored in a stockpile and transported and will remain useable for an extended period of time. The

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processed shingle material itself has been found useful as a raw material for various applications, including as a component raw material in the manufacturing of a rolled waterproofing sheet product and as an additive for road paving compositions. The PSM may be used by itself mixed with other
5 materials such as "crum" rubber from used vehicle tires or different sand and stone aggregates common to the hot melt asphalt manufacturing process, in varying proportions. The result is a blended PSM additive, for use in the manufacturing of hot mix paving asphalt.

[0038] It should finally be noted that the preceding description relates to
10 a particular preferred embodiment of the invention only and that various modifications are possible within the broad scope of the invention. In particular, it is to be noted that the metals removal (shown at station 32) could be performed at a different location in the process, for example, prior to or after the hand-picking station 28. For example, eddy current devices may be
15 located at the discharge end of trommel 36 so that non-ferrous materials are removed before the picking station and before the grinder. Another eddy current device may be located at the discharge end of the picking line. Also, removal of lightweight contaminants could be performed at only one of the two locations shown in the drawings.

[0039] In the illustrated embodiment, the waste used shingle material is
20 batch-loaded into hopper 38, for example using a front-end loader or a hydraulic excavator; depending on the supply of waste material and the frequency of loading, the material may travel through the various processing stations in a substantially continuous stream. Alternatively, a continuous
25 material feed may be provided, e.g. by conveyor.

Claims:

1. A method of processing used asphalt roofing material which comprises causing the used roofing material to travel through successive processing
5 stations in which the following steps are performed:
 - a) subjecting the traveling material to vibration and/or tumbling to loosen the material;
 - b) removing lightweight contaminants in an air separator;
 - c) removing metal contaminants;
 - 10 d) passing the material through a hand-picking station for manual removal of other contaminants; and,
 - e) grinding the material to form a granular processed roofing material.
2. A method as claimed in claim 1, wherein step c) is performed after step
15 e).
3. A method as claimed in claim 2, wherein step c) comprises removing non-ferrous material using an eddy current device and removing ferrous material using a magnetic separator.
4. A method as claimed in claim 1, wherein step d) is performed by
20 dividing the traveling material into two parallel streams from each of which said contaminants may be hand-picked.
5. A method as claimed in claim 1, wherein step a) is performed by causing the material to travel through a trommel.
6. A method as claimed in claim 5, wherein the trommel includes a
25 cylindrical drum comprising a plurality of cylindrical drum sections positioned end-to-end through which the material travels successively, wherein said sections have imperforate walls, and wherein the method further comprises the step of preventing a portion of the material travelling through the drum

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from passing from one section to the next so as to prevent a "plug" of material passing through the drum intact.

7. A method as claimed in claim 1, wherein step e) includes cooling the material with water.

5 8. A method as claimed in claim 7, wherein cooling water is supplied at a rate of approximately 1,000 gallons per hour.

9. An apparatus for processing used roofing material in which the material is caused to travel through successive processing stations, the apparatus comprising:

10 a trommel having an input into which used roofing material is delivered, and an output, the trommel being operable to impart vibration and/or tumbling to the material to loosen the material as the material travels from the input to the output;

15 a first conveyor for receiving material from the output of the trommel and extending to a discharge end;

a second conveyor receiving material from the discharge end of the first conveyor and extending along a path providing a hand-picking station for manual removal of contaminants from the material, the second conveyor having a discharge end;

20 a grinder having an input receiving material from the discharge end of the second conveyor, and an output, the grinder being operable to reduce the material to granular form as the material travels from the input to the output;

25 a third conveyor receiving granular material from the output of the grinder and delivering the granular material to a discharge location at which the material is collected;

at least one air separator associated with one of said first and second conveyors for removing lightweight contaminants from the material; and,

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metal removal means associated with one of said conveyors for removing metal contaminants from the material.

10. An apparatus as claimed in claim 9, wherein said metal removal means is associated with said third conveyor for removing metal contaminants
5 from the material prior to collection.

11. An apparatus as claimed in claim 9, wherein said metal removal means comprises an eddy current device for removing non-ferrous metal and a magnetic separator for removing ferrous metal.

12. An apparatus as claimed in claim 9, wherein said second conveyor
10 comprises a pair of parallel conveyors, and wherein the apparatus further comprises flow divider means at the discharge end of the first conveyor for dividing the flow of material onto the respective parallel conveyors, both of said conveyors delivering material to the input of the grinder, and both conveyors providing access for hand-picking of contaminants from the
15 material traveling along said conveyors.

13. An apparatus as claimed in claim 9, wherein the trommel includes a cylindrical drum comprising a plurality of cylindrical wall sections disposed end-to-end, and wherein the drum includes, between successive sections, an arcuate surge bar that extends inwardly from the wall of the drum and has an
20 arcuate shape and an extent corresponding to a portion of the circumference of the drum for holding back a portion of the volume of the material that would otherwise pass from section to section.

14. An apparatus as claimed in claim 13, wherein the drum comprises three sections with an arcuate surge bar at the downstream end of each
25 section, each bar extending over approximately one third of the circumference of the drum with the respective surge bars angularly offset from one another by approximately 120°.

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15. An apparatus as claimed in claim 9, wherein the grinder further includes means for delivering water to cool the material during grinding.

16. A granular processed roofing material produced by the method of any one of claims 1 to 8.

5 17. A processed roofing material comprising granules having a degree of surface oxidation sufficient to at least substantially prevent agglomeration of said granules, whereby the material is amenable to storage and transportation without agglomeration, the material being substantially free of contaminants not part of the original roofing material.

10 18. A processed roofing material as claimed in claim 17, wherein the material will not agglomerate and is 99% free of contaminants.

15 19. An additive for use in the manufacture of hot melt asphalt comprising a blend of a processed roofing material as claimed in claim 17 or 18, and at least one material selected from the group comprising crum rubber, aggregate and sand.

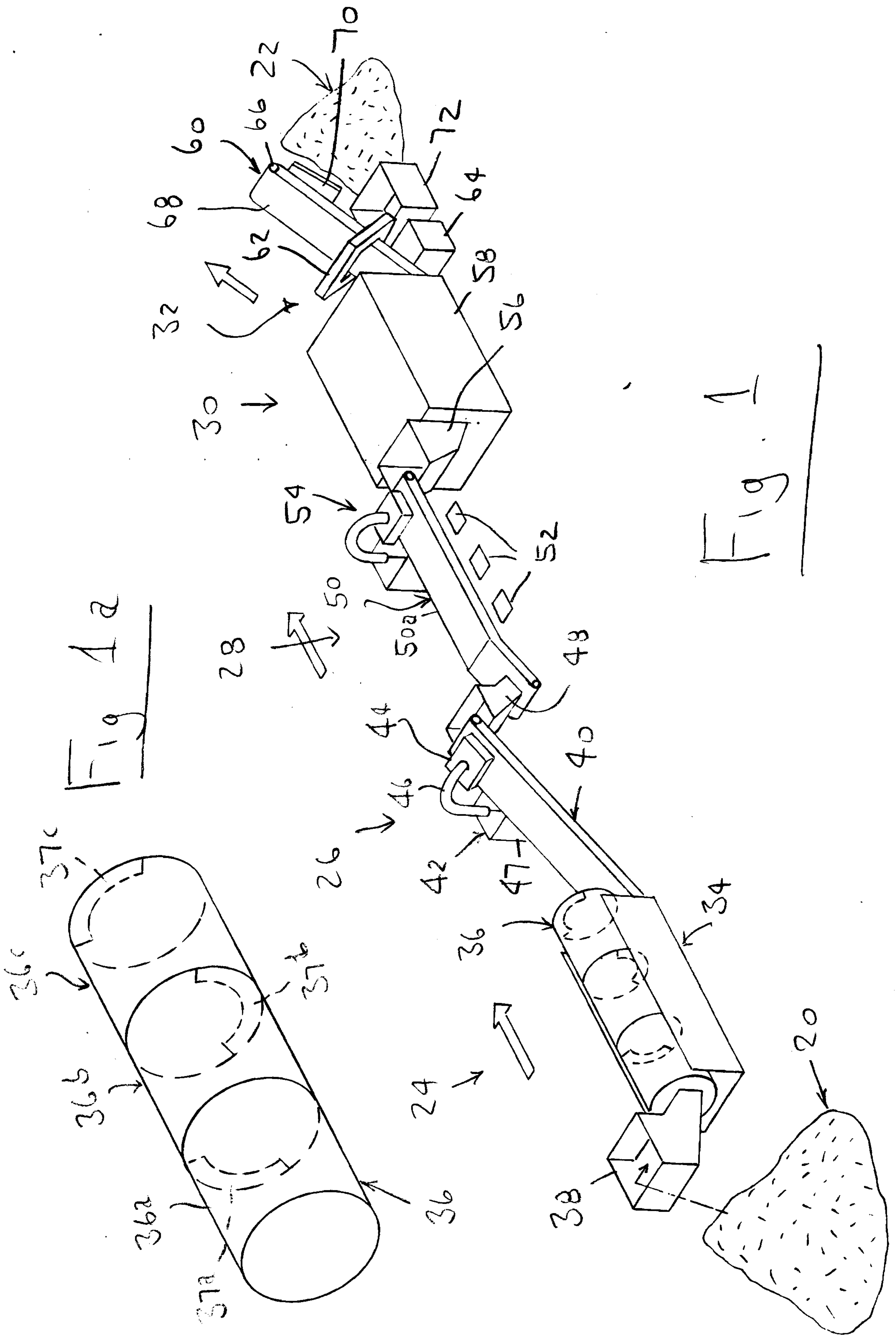


Fig. 1a

Fig. 1

Fig. 2

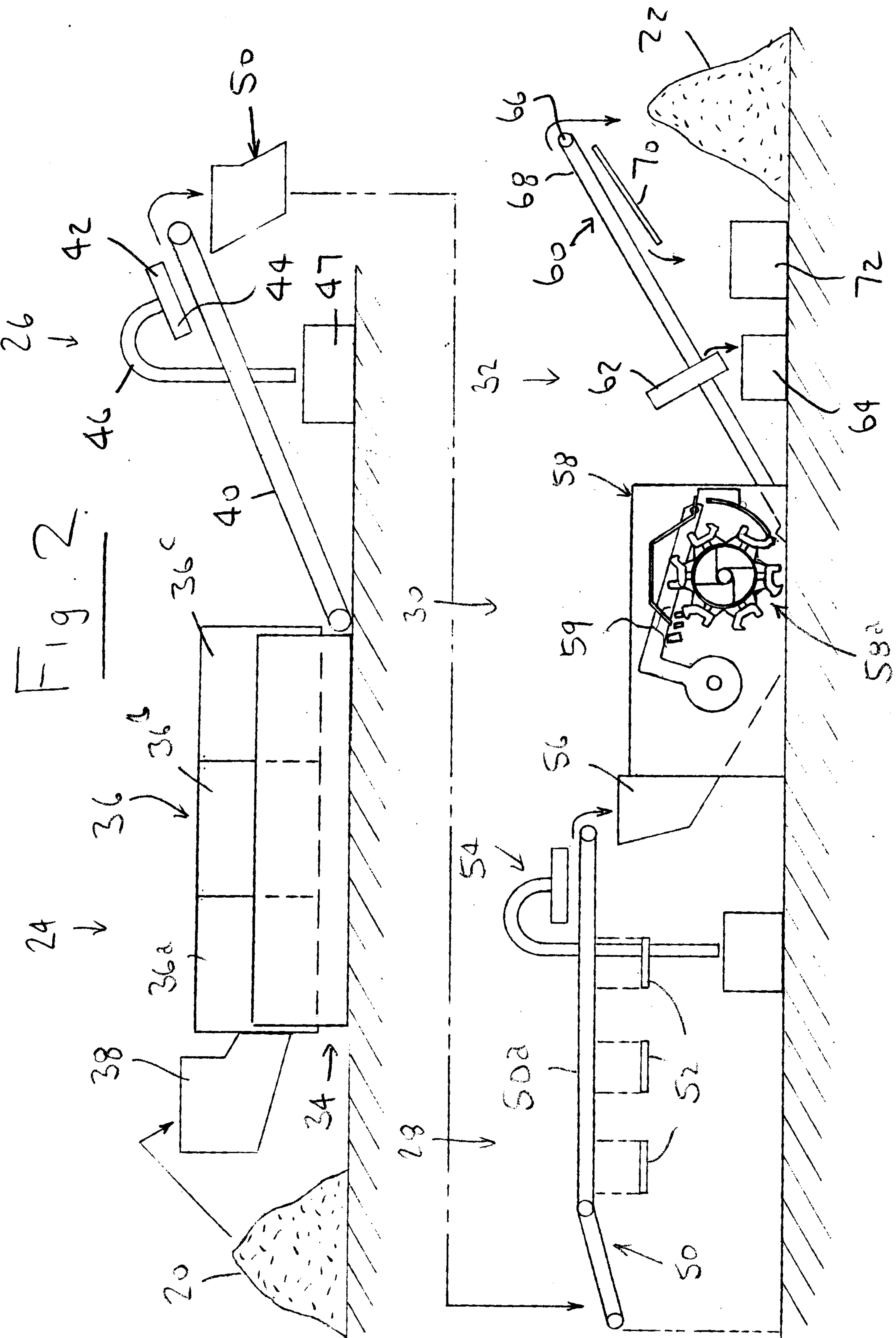


Fig. 3

