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(54) Material recycling apparatus

(57) A material recycling apparatus (10) and an associated method. The material recycling apparatus comprises a mobile chassis (20) upon which is mounted a hopper (30) for receiving material to be recycled; a separator (40) arranged to receive material from the hopper (30) and to select correctly-sized material; a mixer (50) arranged to receive the correctly-sized material and to combine the correctly-sized material with one or more additives to create mixed material, and to discharge the material.

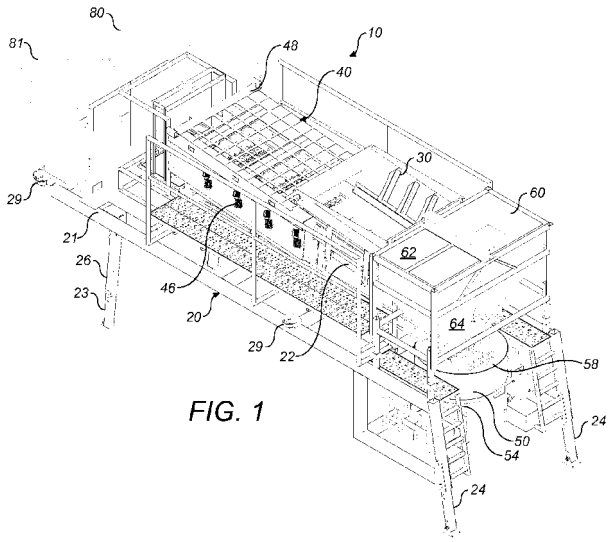

FIG. 1

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Description

BACKGROUND

Technical Field

[0001] The invention relates to a material recycling apparatus, and an associated method of recycling material. Specifically, but not exclusively, the invention relates to recycling material excavated from trenches, often known as trench arisings, into usable fill for trench reinstatement.

Description of Related Art

[0002] In the past, trenches have most commonly been reinstated using virgin material excavated directly from quarries. Virgin material has the advantage of being well-known, trusted and generally reliable. Also, various grades of virgin material are available to suit particular applications. For example, high grade material is needed for roadways due to higher loads when compared to pavements or walkways, or sometimes even minor roadways, for example. Lower grade material can be used for pavements or walkways, or more minor roadways.

[0003] Recently, recycled aggregate has been used as infill to reinstate trenches. The recycled aggregate is produced at a recycling centre and is transported to each trench, as necessary.

[0004] Excavated trench arisings are sometimes returned to the recycling centre for processing into recycled aggregate. In this way, the amount of virgin material required is reduced and the disposal cost of trench arisings is reduced or sometimes eliminated.

[0005] However, there is a commercial desire to make trench reinstatement cheaper, easier, quicker and more environmentally sustainable.

[0006] An aim of the invention is to attempt to solve one or more of the above problems.

SUMMARY OF THE INVENTION

[0007] According to the present invention there is provided an apparatus and method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

[0008] According to a first aspect of the invention there is provided a material recycling apparatus comprising; a mobile chassis, upon which is mounted: a hopper for receiving material to be recycled; a separator arranged to receive material from the hopper and to select correctly-sized material; a mixer arranged to receive the correctly-sized material, to combine the correctly-sized material with one or more additives to create mixed material, and to discharge the mixed material.

[0009] In this way, the material recycling apparatus is easily taken to and installed adjacent a trench excavation. Therefore, transport costs are reduced, fewer teams of people need be employed to reinstate the trench, and trench reinstatement is quicker and more environmentally sustainable.

[0010] Preferably, the mobile chassis is arranged to be loadable onto a tipper truck in use. For this purpose, the mobile chassis may comprise one or more of the following: a pair of front stabilising jacks which are removable in use, or adjustable to lie parallel with the chassis, and which are located in a front half of the mobile chassis; a pair of rollers positioned at a front end of the mobile chassis to aid loading of the mobile chassis onto the tipper truck; and a pair of guide wheels positioned at a side of the mobile chassis and arranged to guide the mobile chassis along side walls of the tipper truck. Preferably, the front stabilising jacks are coupled to the mobile chassis using a pin, and when coupled the front stabilising jacks are held captive by a jack coupling so as not to move substantially in any direction.

[0011] Alternatively, the mobile chassis is a lorry.

[0012] Preferably, the hopper is a hopper conveyor, and the hopper conveyor is arranged to convey material to the separator, in use.

[0013] Preferably, the separator comprises a plurality of shafts each having a plurality of star wheels. Preferably, there are between twelve and forty star wheels on each shaft. Preferably, there are eighteen star wheels on each shaft. Preferably, there are between four and eighteen shafts. Preferably, there are between six and ten shafts. Preferably, there are eight shafts. Preferably, the plurality of shafts are arranged to be perpendicular to a longitudinal direction of the chassis. Preferably, the star wheels on each shaft are spaced apart, and star wheels on each shaft are arranged to line up with the corresponding spaces between star wheels on adjacent shafts.

[0014] Preferably, the mixer is sunk into the chassis to receive material selected by the separator in use. Preferably, the mixer comprises at least one sensor for detecting a state of material in the mixer, in use. Preferably, the at least one sensor is a load sensor and the apparatus is arranged to pause at least the separator when the mixer is determined to be full. Preferably, the at least one sensor is a conductivity sensor and the apparatus is arranged to indicate that a predetermined mix has been achieved based on a measurement by the conductivity sensor. Preferably, the mixer comprises both the load sensor and the conductivity sensor. Preferably, the at least one sensor is a permittivity sensor and the apparatus is arranged to indicate that a predetermined mix has been achieved based on a measurement by the permittivity sensor. Preferably, the mixer comprises the load sensor and the permittivity sensor. Preferably, the mixer comprises the conductivity sensor and permittivity sensor.

[0015] Preferably, the apparatus comprises one or more means for adding the one or more additives to the mixer. Preferably, the apparatus comprises one or more additive hoppers, each of which is positioned above the

mixer. Preferably, the apparatus is arranged to add additives from the additive hoppers automatically to achieve an optimum mix. Preferably, the additive hoppers comprise at least one of a drying agent, a binding agent, virgin material and water.

[0016] Preferably, the apparatus comprises a loading mechanism for loading material into the hopper. Preferably, the loading mechanism is a grab crane or a vacuum excavator.

[0017] Preferably, the apparatus comprises a waste hopper which is positioned to receive over-sized material from the separator.

[0018] Alternatively, the apparatus comprises a crusher which is positioned to receive over-sized material from the separator. Preferably, the apparatus is arranged to move crushed material from the crusher to the hopper.

[0019] According to another aspect of the invention, there is provided a method of recycling trench arisings on site, the method comprising: loading trench arisings into a material recycling apparatus located adjacent the trench, separating the trench arisings into correctly-sized material, conveying the correctly-sized material to a mixer, mixing the correctly-sized material with one or more additives to create mixed material, and discharging the mixed material.

[0020] Preferably, the method comprises separating the trench arisings using a star screen.

[0021] Preferably, the method comprises mixing the correctly-sized material with one or more additives until a predetermined grade of mixed material is achieved. Preferably, the method comprises sensing at least one of the conductivity and permittivity of the mixed material to achieve the predetermined grade. Preferably, the additives are one or more of: a drying agent, a binding agent, virgin material and water.

[0022] Preferably, the method comprises measuring a load of the mixer and pausing at least the separating process if the mixer is determined to be full.

[0023] Other preferred features of the method may be inferred from the apparatus or the description of the example embodiments and are not repeated for brevity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] For a better understanding of the invention, and to show how example embodiments may be carried into effect, reference will now be made to the accompanying drawings in which:

Fig. 1 is a perspective view of a material recycling apparatus according to a first embodiment of the invention;

Fig. 2 is a plan view of the material recycling apparatus of Fig. 1;

Fig. 3 is a side view of the material recycling apparatus of Fig.1;

Fig. 4 is a front view of the material recycling apparatus of Fig. 1;

Fig. 5 is a rear view of the material recycling apparatus of Fig. 1;

Fig. 6 is a perspective view of the material recycling apparatus of Fig. 1 loaded on a truck;

Fig. 7 is a side view of a material recycling apparatus according to a second embodiment of the invention in which the apparatus is shown in a forward configuration;

Fig. 8 is a plan view of the material recycling apparatus of Fig. 7;

Fig. 9 is a side view of a material recycling apparatus according to a third embodiment of the invention in which the material recycling apparatus is shown in a rearward configuration; and

Fig. 10 is a plan view of the material recycling apparatus of Fig. 9.

DETAILED DESCRIPTION OF THE EXAMPLE EMBODIMENTS

[0025] Three embodiments of the invention are now described with reference to the figures.

[0026] A first embodiment of the invention is described with reference to Figs. 1 to 5.

[0027] Fig.1 is a perspective view of a material recycling apparatus 10. Reference is also made to Figures. 2-5 which show plan, side, front and rear views of the apparatus 10 shown in Fig.1.

[0028] The material recycling apparatus 10 comprises a mobile chassis 20, a hopper 30, a separator 40, a mixer 50 and additive hoppers 60, 62 and 64.

[0029] The mobile chassis 20 is arranged to support the hopper 30, separator 40, mixer 50 and additive hoppers 60, 62 and 64 thereon. The mobile chassis 20 is arranged to be driven by a vehicle to a location adjacent trench excavation workings.

[0030] The chassis 20 comprises a platform 21 upon which is mounted a frame assembly 22. The frame assembly 22 is arranged to secure the hopper 30 and separator 40 to the chassis 20. The chassis 20 also comprises front stabilising jacks 23 located approximately a fifth of the length of the chassis 20 from a front end of the chassis 20. The chassis 20 also comprises rear stabilising jacks 24 located at a rear end of the chassis 20. The front stabilising jacks 23 and the rear stabilising jacks 24 are retractable and may be deployed to a number of heights using a pin and hole arrangement.

[0031] Referring especially to Fig. 3, which is a side view, the front stabilising jacks 23 are removably attached to jack couplings 25 located on an underside of

the chassis 20. The front stabilising jacks 23 are attached to the jack couplings using a pin 26. When coupled, the front stabilising jacks 23 are held captive by the jack coupling 25 and pin 26 so as not to be able to move substantially in any direction.

[0032] The hopper 30 is arranged in use to receive trench arisings from an excavated trench. The hopper 30 is a hopper conveyor and comprises a conveyor 32 (see Fig. 2) which transports trench arisings from the hopper 30 in use to the separator 40. The conveyor 32 is arranged at an incline of approximately 5 degrees to the horizontal so that the trench arisings travel upwards to the separator 40.

[0033] The separator 40 is located between the hopper 30 and the front of the mobile chassis 20 and is used to select material of a correct size to create infill for trench reinstatement. Referring especially to Fig. 2, which is a plan view, the separator 40 is a star screen and comprises a plurality of star wheels 42 arranged on a plurality of shafts 44, in this example eighteen star wheels 42 mounted on each of eight shafts 44. Each shaft 44 is powered by a motor 46. The shafts 44 are arranged to be perpendicular to a longitudinal direction of the chassis 20. The star wheels 42 are mounted on the shafts 44 and adjacent star wheels 42 on each respective shaft 44 are spaced apart by a boss (not shown) which is moulded as part of each respective star wheel 42. The star wheels 42 on one shaft 44 are arranged to line up with the corresponding bosses on the adjacent shaft 44. The star wheels 42 on adjacent shafts are arranged so that their respective outer circumferences are aligned. In other words, there is no overlap between star wheels 42 in adjacent shafts 44. Each shaft 44 is mounted so as to rotate on bearings and each shaft can be driven independently. The star wheels 42 are arranged to rotate so that their uppermost point is moving in the direction of material flow over the stars. A safety barrier 48 is provided above the separator 40. The separator 40 is also arranged at an incline of approximately 5 degrees to the horizontal so that the trench arisings travel upwards towards the front of the mobile chassis 20.

[0034] The mixer 50 is a 300 litre pan mixer but any other suitably sized mixer could be used. The mixer 50 is sunk into the chassis 20 at a rear end and is supported by a lower portion 27 of the chassis 20. The mixer 50 has two pairs of rotating arms for agitating the material contained within to prevent consolidation. The lower portion 27 comprises a compressor air tank 52 and compressor 54 which are arranged to drive the rotating arms.

[0035] The three additive hoppers 60, 62 and 64 are positioned above the mixer 50, between the hopper 30 and the rear end of the mobile chassis 20. Of course, in some circumstances it may not be necessary to use additives, but in most cases additives will be necessary to treat the material in the mixer in order to make it suitable as infill. Additives include binding and drying agents, as well as virgin or previously recycled material to improve the quality of the finished infill or to add bulk where necessary. Water may also be used as an additive to create a more flowable material, which is quicker to use and which requires less compaction. The additive hoppers 60, 62 and 64 are mounted on an additive hopper frame assembly 66 constructed above the mixer 50. The mixer 50 comprises instrumentation and a control system, as will be described later, to determine an optimum mix.

[0036] A generator 80 is provided at the front end of the chassis 20 to provide power to the apparatus 10 so that it may stand alone. A control box 81 is provided on the generator to control operation of the material recycling apparatus 10.

[0037] Additionally, the separator 40 has a separator conveyor 49 arranged underneath the star wheels 42 to catch correctly-sized material and convey the correctly-sized material to the mixer 50. Material which does not pass through the rotating star wheels 42 is transported along an upper surface of the separator 40 to a waste skip or crusher (not shown). The mobile chassis 20 is constructed to be modular so that the components are easily removed and replaced. For example, the waste skip may be replaced directly with the crusher without further modification. The separator conveyor 49 is arranged to transport correctly-sized material in a direction opposite to the hopper conveyor 32, or upper conveyor 32.

[0038] Fig.2 shows one of a pair of front rollers 28 arranged at the front of the chassis 20. Fig.3 which shows a side view, illustrates that a pair of front rollers 28 are positioned at the front of the chassis 20. The front rollers 28 aid the chassis 20, and hence the apparatus 10, to be loaded onto the back of a lorry or truck, in particular a tipper truck.

[0039] Fig.6 is a perspective view of the apparatus 10 loaded onto a tipper truck 100. The tipper truck 100 has side walls 110 which substantially prevent the chassis 20 from moving in a sideways direction. For the purposes of loading the chassis 20 onto the tipper truck 100, guide wheels 29 are provided on each side of the chassis 20. Guide wheels 29 are located at respective front corners of the chassis 20. Another pair of guide wheels 29 are located further back towards the rear end of the chassis 20. The front rollers 28 are positioned to have a horizontal axis of rotation, and the guide wheels 29 are positioned to have a vertical axis of rotation. The front stabilising jacks 23 are removable, or are operated to become rotatable to lie parallel with the chassis 20 when loaded onto the tipper truck 100.

[0040] The tipper truck 100 also comprises a loading mechanism 120, in this example a grab crane. However, any type of loading mechanism could be used such as a vacuum excavator.

[0041] Operation of the material recycling apparatus 10 is now described.

[0042] Firstly, a trench is excavated resulting in trench arisings. Then, the loading mechanism 120 is used to gather some of the trench arisings and deposit the trench arisings in the hopper 30.

[0043] The conveyor 32 transports the trench arisings from the hopper 30 towards the front of the material recycling apparatus 10 and onto the separator 40. The separator 40 does not allow over-sized material to pass therethrough onto the separator conveyor 49 located below. Instead, over-sized material is transported towards the front of the material recycling apparatus 10 until falling into the waste skip or crusher. An advantage of using a crusher is that further recycling of oversized material may be achieved, with the output of the crusher being fed back into the hopper 30, either by the loading mechanism 120 or other suitable means. A crusher is most advantageously used when lots of oversized material is expected or noticed.

[0044] The correctly-sized material falls through the separator 40 onto the separator conveyor 49 and is transported toward the rear of the material recycling apparatus 10 to the mixer 50. At this stage, it should be noticed that the separator 40 also acts to break-up material into smaller pieces. This is done by the action of the rotating star wheels 42. The consequence of this is that wet excavated material, especially clay, is more likely to be broken-up into correctly-sized material. Also, wet material is not likely to jam the separator 40 due to the design of the star wheels 42.

[0045] The correctly-sized material enters the mixer 50 and the control system causes the material to be mixed with certain additives from the additive hoppers 60, 62 and 64 until the correct grade of material is achieved.

[0046] Determining the correct grade of material may be accomplished by using a conductivity test on the material. A conductivity measurement has been found to be indicative of the quality of the material and can indicate the result that the material will achieve in testing known to those skilled in the art, such as Clegg testing. For example, the conductivity of the material may be indicative of wetness and compactness or compactability. The wetter the material, and the more compact the material, the lower the conductivity. For infill to be robust and long-lasting, then the wetness and compactness should be at an optimum level. For example, if the material is not compacted enough, the infill can settle and descent in the trench over time leading to an expensive repair process. If the material is too wet, or too dry, then the infill can sag over time.

[0047] In addition, or alternatively, a permittivity test may be used to determine the dielectric property of the material, which is also indicative of material suitability for trench reinstatements.

[0048] Sensors 58 are provided in the mixer 50 to determine conductivity and permittivity. The apparatus 10, via the control system, is arranged to cause additives from the additive hoppers 60, 62, 64 to be added to the mixer 50 as necessary to achieve an optimum mix. Alternatively, a human operator could add material from the additive hoppers 60,62,64 until an optimum mix is achieved, indicated by a visual or audible output on the apparatus 10. Also, load sensors 54 are also used to determine when the mixer is full and are used to disable the separator 40 together with hopper conveyor 32 and separator conveyor 49 until material is discharged from the mixer 50.

[0049] In this example embodiment, the mobile recycling apparatus 10 is approximately 2160 millimetres wide and 6000 millimetres long, but any other suitable dimensions may be employed in order that the material recycling apparatus 10 is loadable onto a vehicle, such as a tipper truck 100.

[0050] The combination of features above gives rise to a material recycling apparatus 10 which can be taken to an excavation site and used adjacent an excavation works. The material recycling apparatus 10 is a standalone apparatus in that it provides its own power via generator 80 and can turn excavated material into infill easily and cheaply, removing transportation costs and providing a source of infill which is more reliable. Reliability is improved because the infill is tested on-site and need not be transported or stored prior to use. Transportation and storage can affect the quality of grade infill to such an extent that expensive repair operations to trench reinstatements are subsequently required. The star wheels 42 operate very quietly and ensure that minimal disruption is caused to people neighbouring the apparatus 10.

[0051] A second embodiment of the invention is now described with reference to Figs. 7 and 8.

[0052] Fig. 7 is a side view of a material recycling apparatus 200 which is permanently mounted on a lorry 210 in a forward-facing configuration. Fig. 8 is a plan view of the material recycling apparatus 200 shown in Fig. 7.

[0053] The material recycling apparatus 200 comprises a hopper 230, a separator 240 and a mixer 250. In addition, a waste skip 290 is also provided.

[0054] The hopper 230 operates in the same way as the hopper 30 of the first embodiment and is located towards the rear of the lorry 210. Material is provided, via a hopper conveyor 232, to the separator 240 which is configured in the same way as the separator 40 of the first embodiment. The waste skip 290 is provided to catch over-sized material.

[0055] The mixer 250 is positioned directly below the separator 240 and a chute 256 is positioned above the mixer 250 to channel correctly-sized material into the mixer 250. Also provided is a separator conveyor 249 which is used in conjunction with the chute 256 to transport correctly-sized material from the separator 240 into the mixer 250.

[0056] In this second embodiment, additives are added to the mixer by hand via guides 260 and 262. The mixer 250 is arranged to discharge infill onto an infill discharge conveyor 258 which transports the infill from the mixer 250 to the rear of the lorry 210. Again, sensors may be provided to detect conductivity and load in the same way as the first embodiment.

[0057] The lorry 210, in this example, also comprises a grab crane, or loading mechanism 220.

[0058] Operation of the material recycling apparatus 200 is now described.

[0059] Firstly a trench is excavated resulting in trench arisings. Then, the lifting mechanism 220 is used to gather some of the trench arisings and deposit the trench arisings in the hopper 230.

[0060] The hopper conveyor 232 transports the trench arisings from the hopper 230 towards the front of the material recycling apparatus 200 and onto the separator 240. The separator 240 does not allow over-sized material to pass therethrough into the mixer 250 via the separator conveyor 249 and chute 256. Over-sized material is transported towards the front of the material recycling apparatus 200 until the over-sized material falls into the waste skip 290 or crusher (not shown) if installed. The separator 240 also acts to break-up material into smaller pieces, as described in the first embodiment.

[0061] The correctly-sized material enters the mixer 50 and is mixed with certain additives by a user, until the correct grade of material is achieved.

[0062] Determining the correct grade of material may be accomplished by using a conductivity test on the material. The conductivity measurement has been found to be indicative of the quality of the material and can indicate the result that the material will achieve in testing known to those skilled in the art, such as Clegg testing. For example, the conductivity of the material may by indicative of wetness and compactness or compactability. The wetter the material and the more compact the material, the lower the conductivity. For infill to be robust and long lasting, then the wetness and compactness should be at an optimal level. For example, if the material is not compacted enough, the infill can sag over time leading to an expensive repair process. If the material is too wet, or too dry, then the infill can sag over time.

[0063] In addition, or alternatively, a permittivity test may be used to determine the dielectric property of the material, which is also indicative of material suitability for trench reinstatements.

[0064] Sensors 252 are provided in the mixer to determine conductivity and permittivity. Also, load sensors 254 are used to determine when the mixer is full and are used to disable the separator 240 together with the hopper conveyor 232 and a separator conveyor 249 until material is discharged from the mixer 250.

[0065] The material, or mixed-material to be used as infill, is transported to the rear of the lorry 210 by the infill discharge conveyor 258.

[0066] A third embodiment of the invention is now described with reference to Figs. 9 and 10.

[0067] Fig. 9 is a side view of the material recycling apparatus 300 shown in a rearward facing configuration.

[0068] The material recycling apparatus 300 at Fig. 9 comprises the same components as the material recycling apparatus 200 of Fig. 7.

[0069] However, the material recycling apparatus 300 is configured differently to the material recycling apparatus 200 of Figs. 7 and 8. Here, in the third embodiment, the hopper 230 is positioned towards a front of the lorry 210. Trench arisings are transported towards a rear of the lorry 210 into the separator 240. The waste skip 290 is provided at a rear end of the lorry 210. The infill discharge conveyor 258 is shorter in length and is arranged to carry the infill to the rear end of the lorry 210.

[0070] Operation of the material recycling apparatus 300 of the third embodiment is identical to that of the second embodiment, taking into account the variation in configuration.

[0071] For completeness, Fig. 10 is a plan view of the material recycling apparatus 300 shown in Fig. 9.

[0072] Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

[0073] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0074] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0075] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0076] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A material recycling apparatus (10) comprising a mobile chassis (20), upon which is mounted:

   a hopper (30) for receiving material to be recycled;

   a separator (40) arranged to receive material from the hopper (30) and to select correctly-sized material; and

   a mixer (50) arranged to receive the correctly-sized material, to combine the correctly-sized material with one or more additives to create

mixed material, and to discharge the mixed material.

2. The apparatus (10) of claim 1, wherein the mobile chassis (20) is arranged to be loadable onto a tipper truck (100) in use.

3. The apparatus (10) of claim 1, wherein the mobile chassis (20) is a lorry (200).

4. The apparatus (10) of any preceding claim, wherein the hopper (30) is a hopper conveyor, and the hopper conveyor is arranged to convey material to the separator, in use.

5. The apparatus (10) of any preceding claim, wherein the separator comprises a plurality of shafts each having a plurality of star wheels (42).

6. The apparatus (10) of any preceding claim, wherein the mixer (50) comprises at least one sensor (58) for detecting a state of material in the mixer (50), in use.

7. The apparatus (10) of claim 6, wherein the at least one sensor (58) is one of a conductivity sensor and a permittivity sensor and the apparatus (10) is arranged to indicate that a predetermined mix has been achieved based on a measurement by the sensor.

8. The apparatus (10) of any preceding claim, wherein the apparatus (10) comprises one or more means for adding the one or more additives to the mixer (50), and the additives comprise at least one of a drying agent, a binding agent, virgin material and water.

9. A method of recycling trench arisings on site, the method comprising:

loading trench arisings into a material recycling apparatus (10) located adjacent the trench;
separating the trench arisings into correctly-sized material;
conveying the correctly-sized material to a mixer (50);
mixing the correctly-sized material with one or more additives to create mixed material and
discharging the mixed material.

10. The method of claim 9, wherein the method comprises separating the trench arisings using a star screen.

11. The method of claim 9 or 10, wherein the method comprises mixing the correctly-sized material with one or more additives until a predetermined grade of mixed material is achieved.

12. The method of claim 11, wherein the method comprises sensing at least one of the conductivity and permittivity of the mixed material to achieve the predetermined grade.

13. The method of any of claims 9 to 12, wherein the additives are one or more of: a drying agent, a binding agent, virgin material and water.

14. The method of any of claims 9 to 13, wherein the method comprises measuring a load of the mixer (50) and pausing at least the separating process if the mixer (50) is determined to be full.

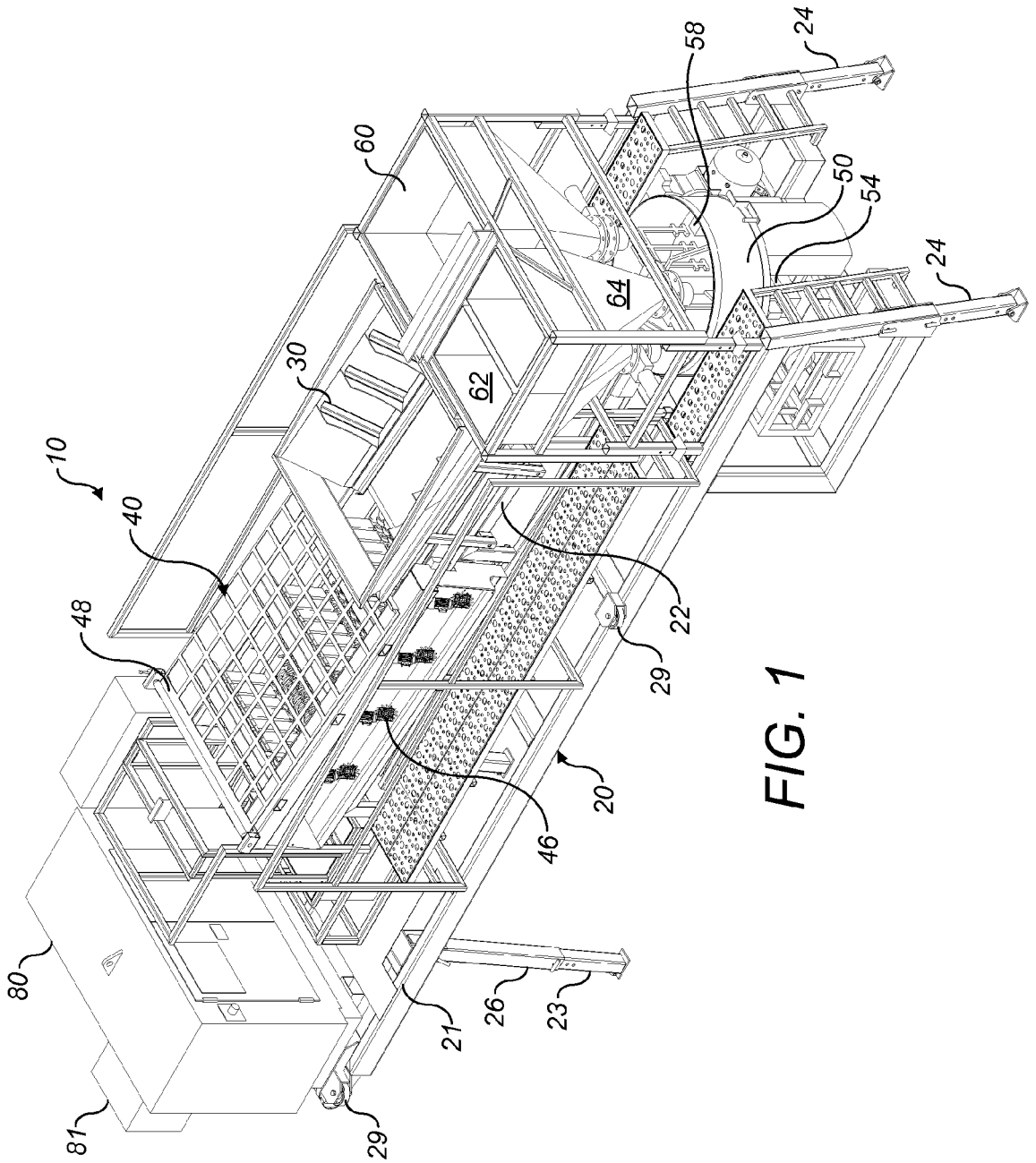

FIG. 1

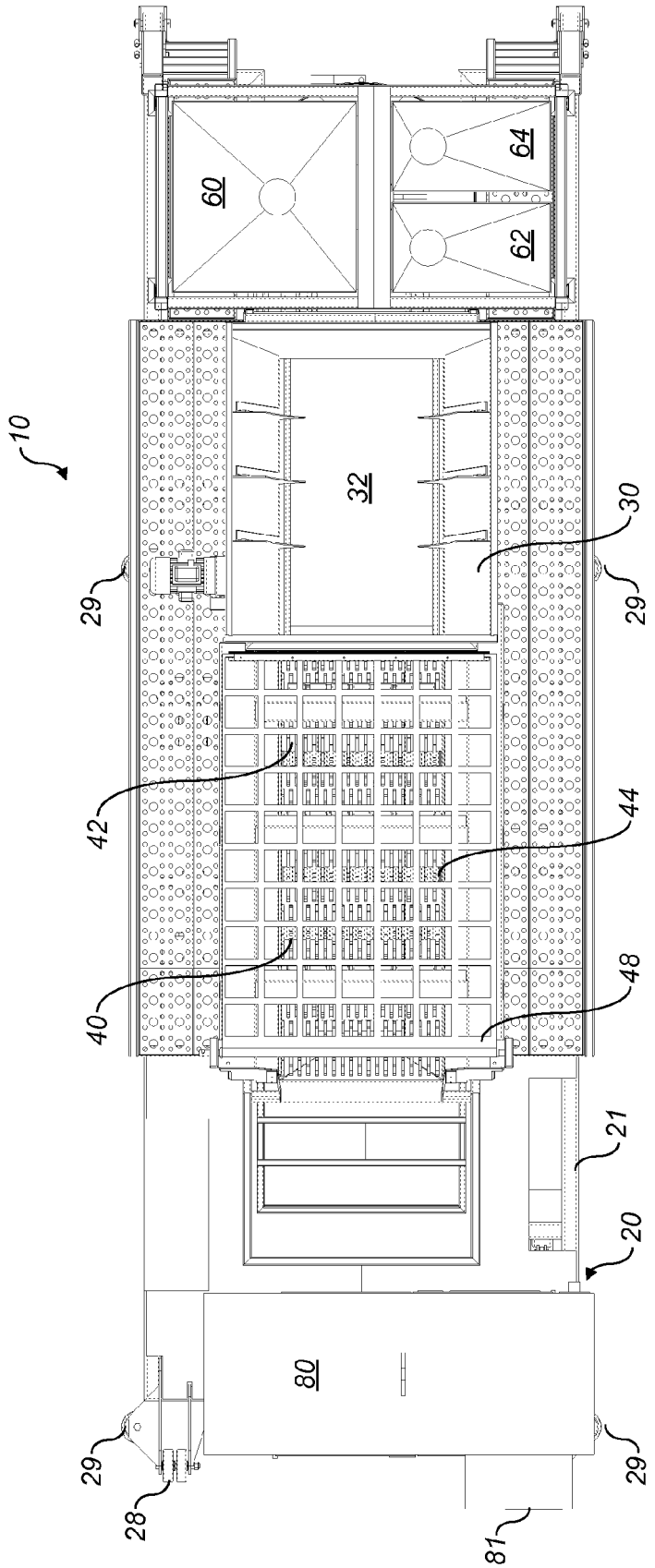

FIG. 2

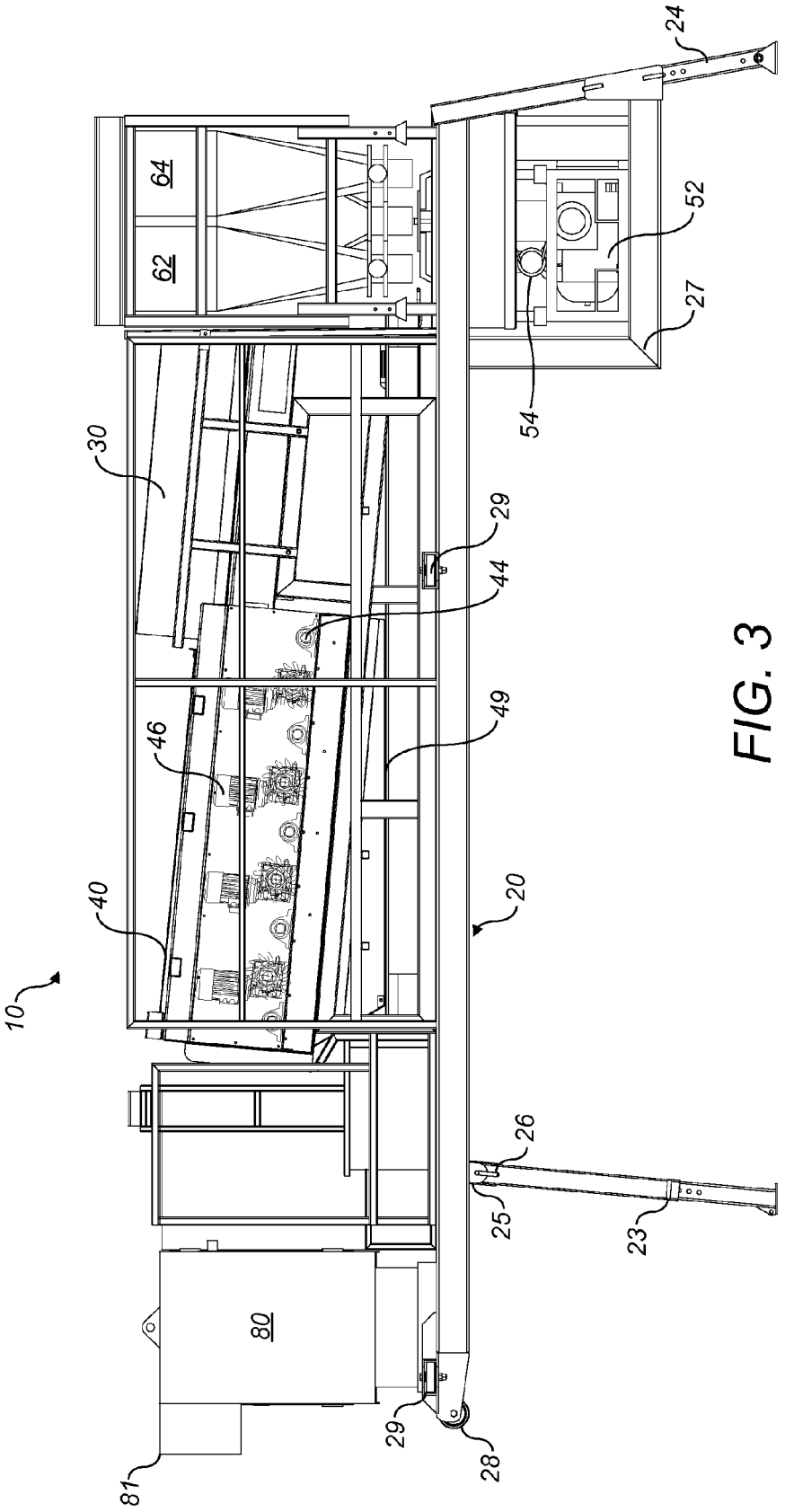

FIG. 3

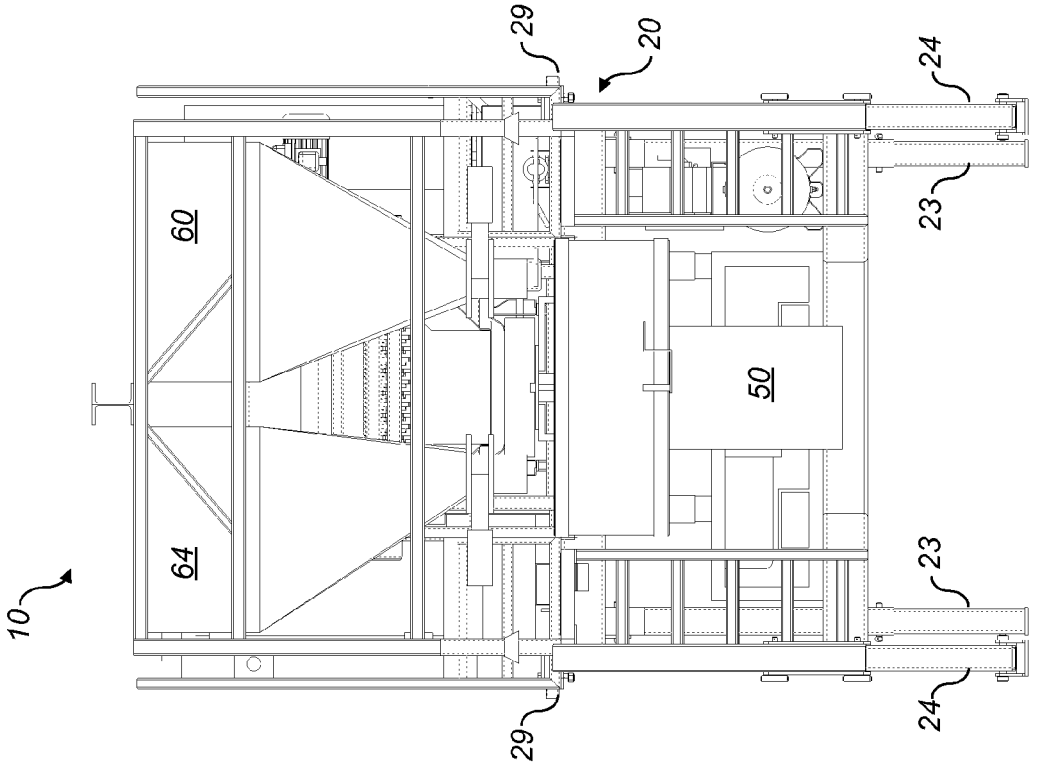
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FIG. 5

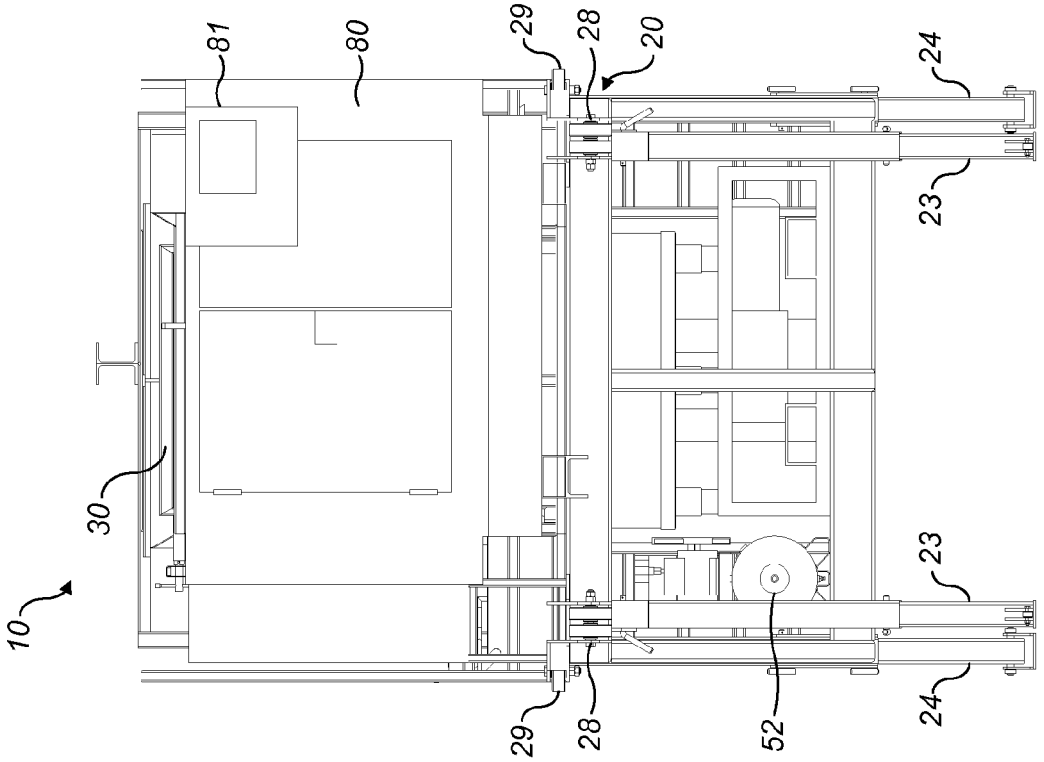
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FIG. 4

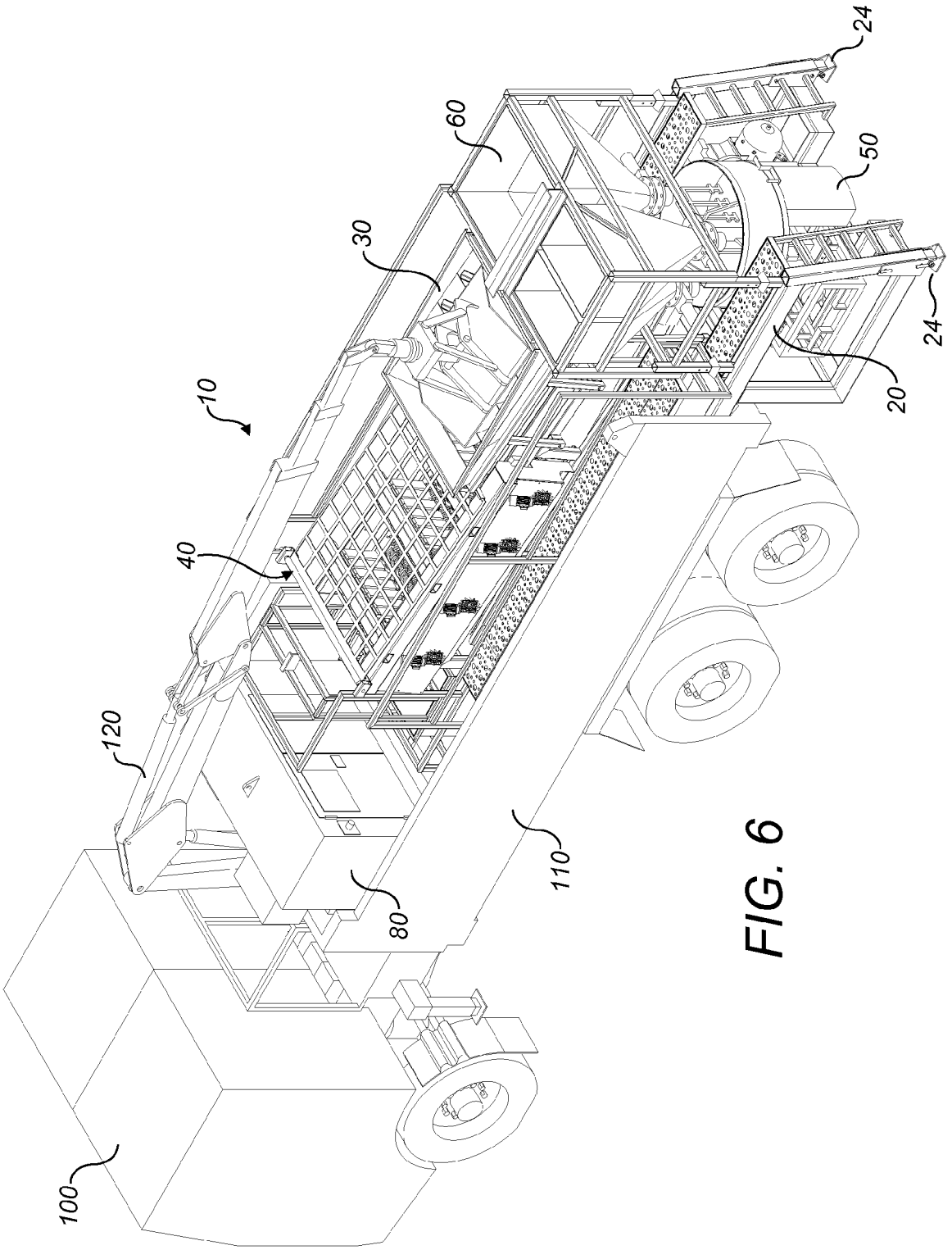

FIG. 6

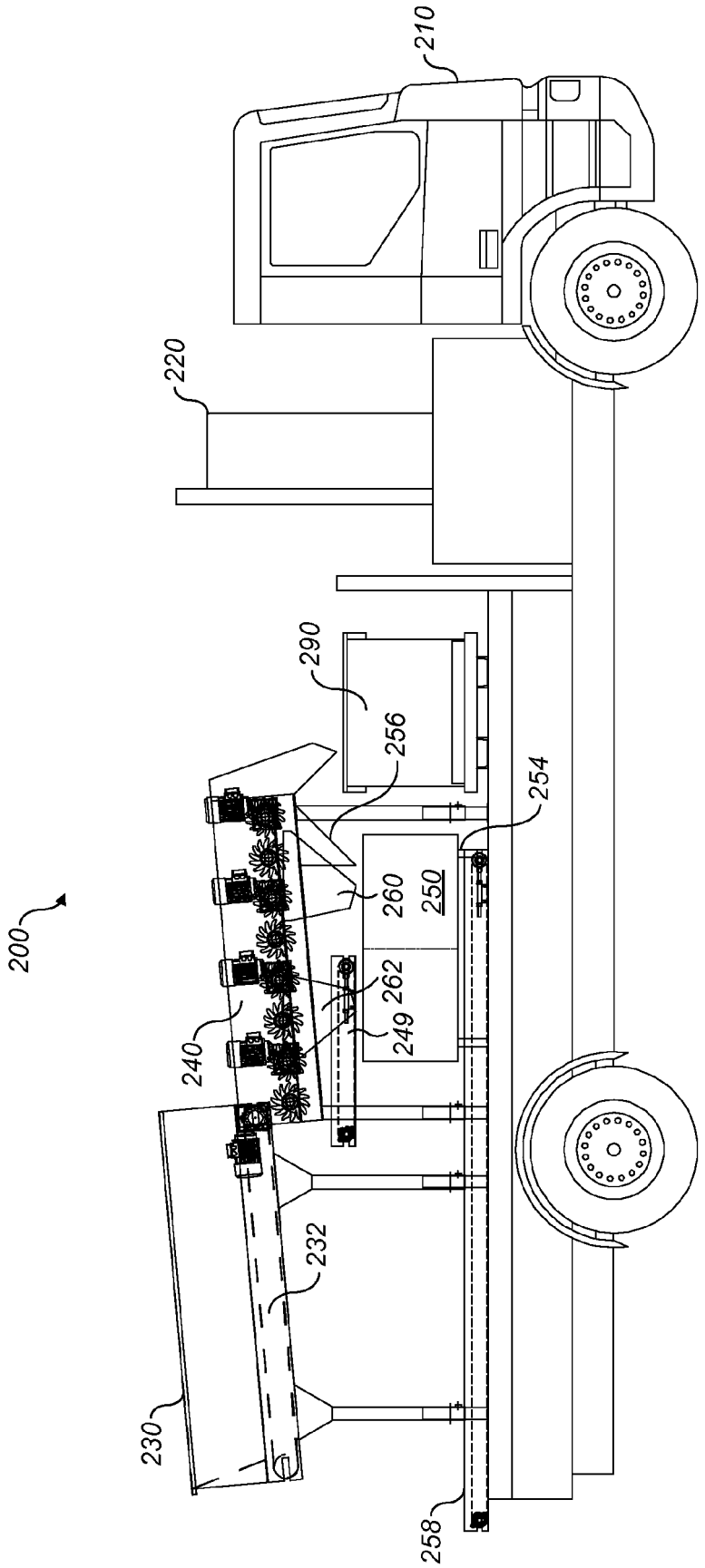

FIG. 7

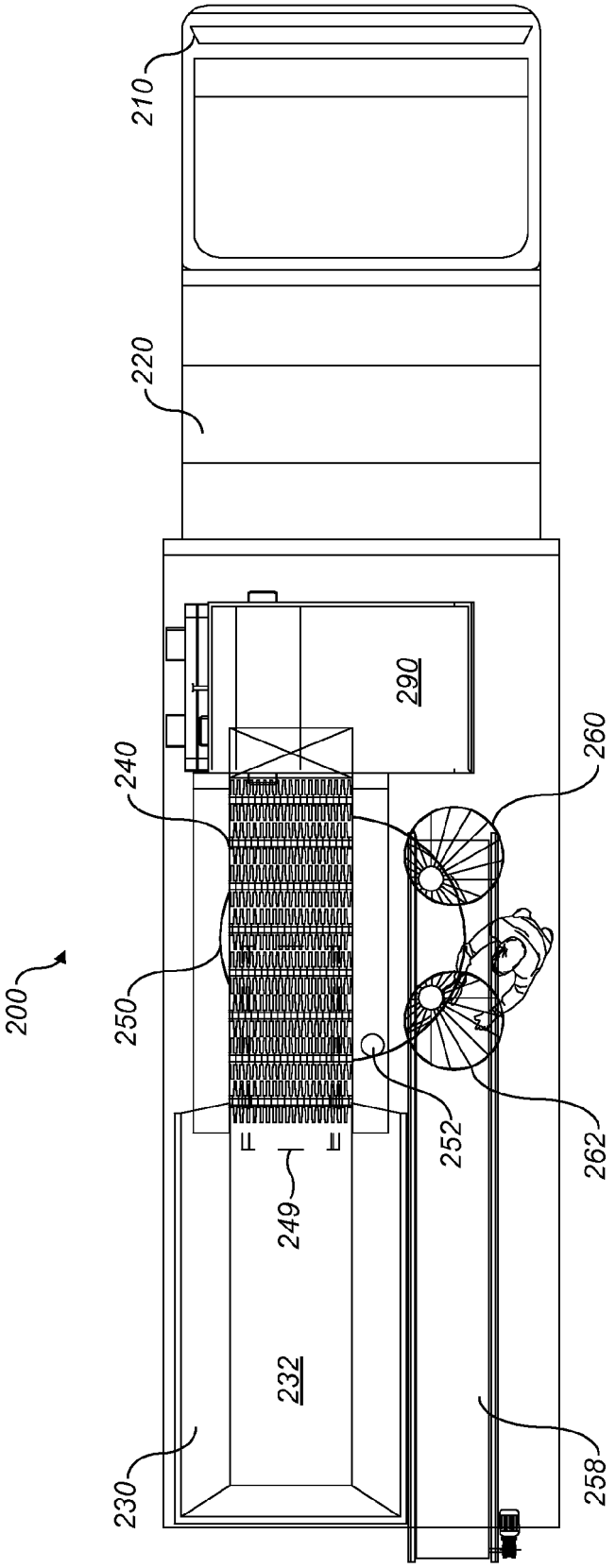

FIG. 8

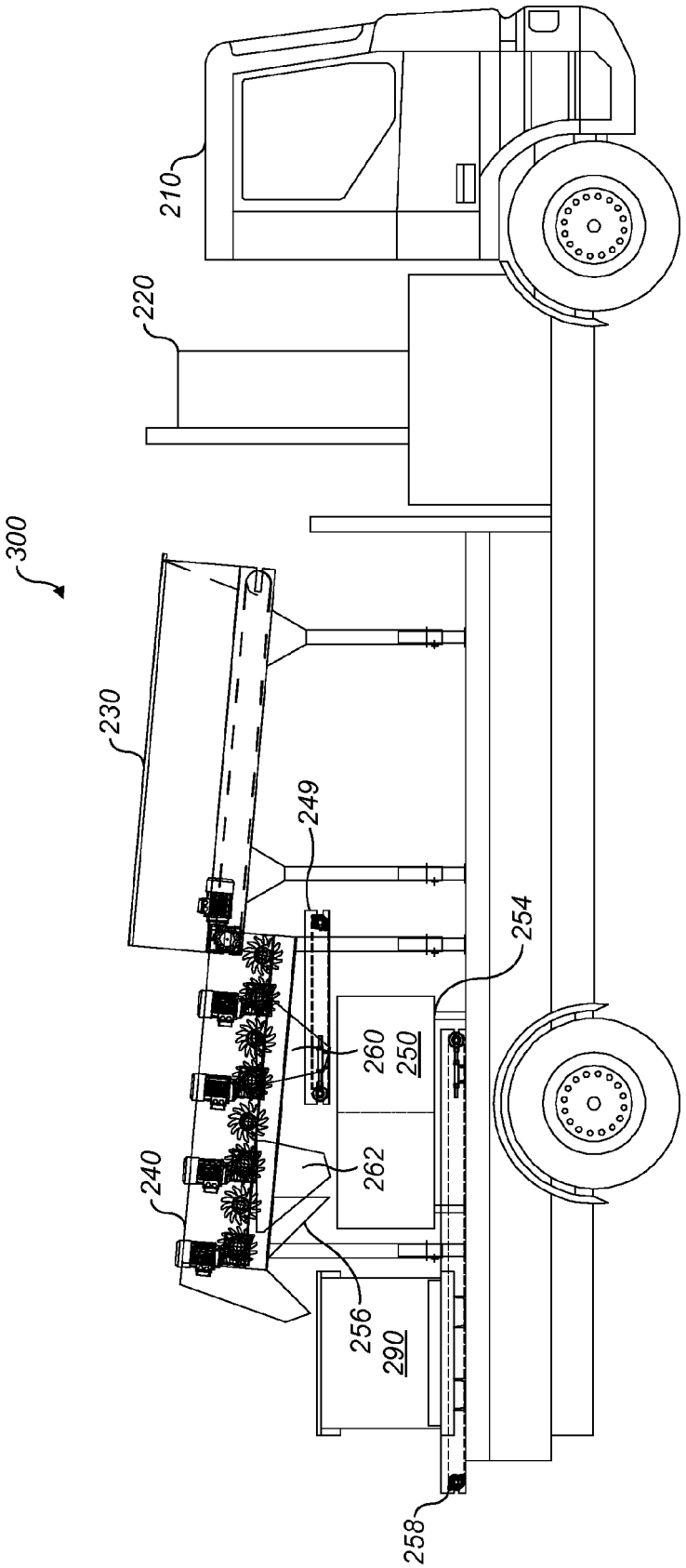

FIG. 9

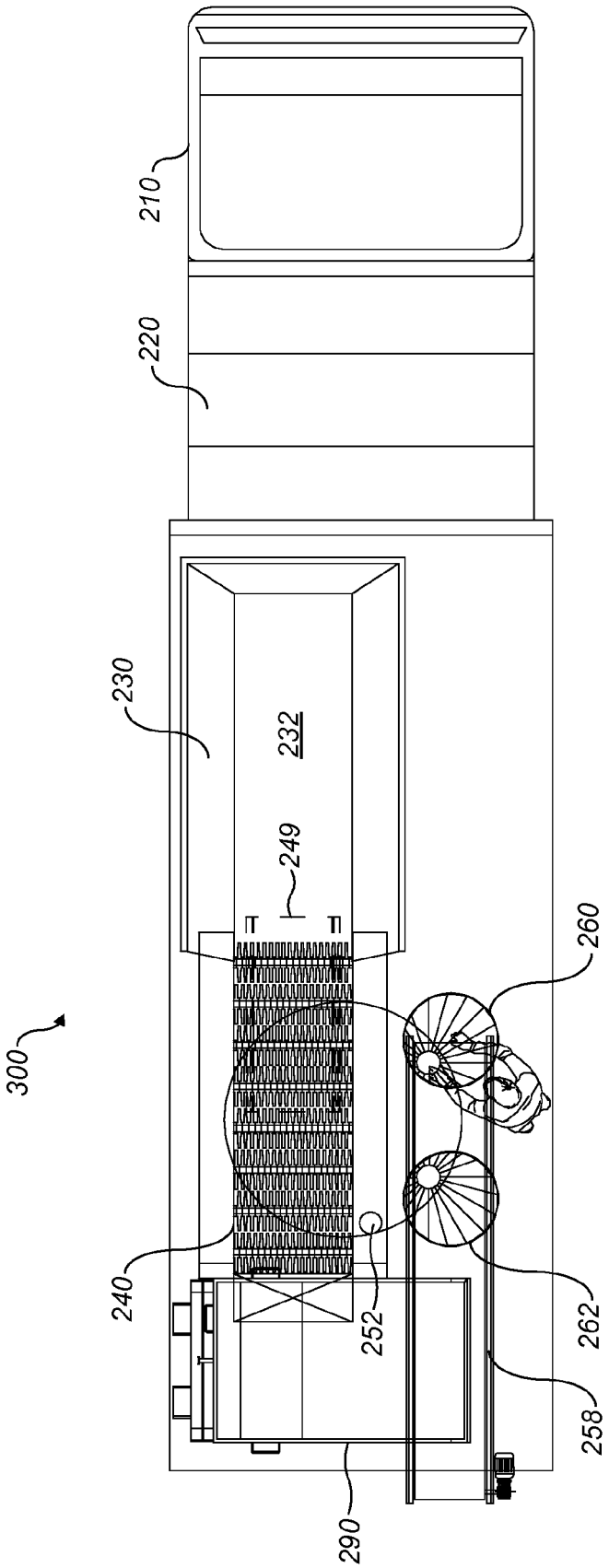

FIG. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 11 15 5888

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 June 2011	Bultot, Coralie

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