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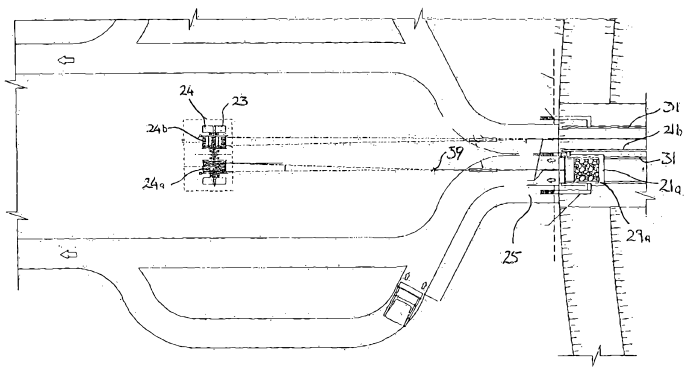

(57) Abstract: A haulage system (11) for hauling vehicles between the bottom and top of a mining pit, the haulage system (11) comprises a loading platform (27) located at the pit floor (15), and a dispatch platform (25) located adjacent the rim (19) of the pit. The haulage system (11) also comprises a first hauling apparatus (21a), a second hauling apparatus (21b) and a hauling means (23). Each hauling apparatus (21a, 21b) comprises a carrier (29) adapted to support and convey a vehicle such as a truck, a track (31) extending between the dispatch platform (25) and the loading platform (27) and adapted to guide and support the carrier (29), a sheave (35) located below the dispatch platform (25), and cable means (33) attached between the hauling means (23) and the carrier (29) via the sheave (35). The hauling means (23) comprises a double drum winder (24) fixedly disposed at the top of the pit at a distance from the pit's rim (19), whereby the first apparatus (21a) and second apparatus (21b) counterbalance each other and work in opposed fashion such that as the carrier (29) of one apparatus (21a, 21b) ascends its respective track (31) and reaches the dispatch platform (25), the carrier (29) of the other apparatus (21b, 21a) simultaneously descends its respective track (31) and reaches the loading platform (27).

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Haulage System for Pit Mining

Field of the Invention

This invention relates to a haulage system for use in pit mining. The haulage system assists in the transport of material from the pit.

Background Art

The increasing depth and mining rates in new and developing open pit mining operations has led to the consideration of alternative options to the conventional removal of ore/waste out of open pits. Currently, material is removed from the pit by diesel truck haulage. These vehicles travel along roadways typically incorporated along the pit walls, or by separate ramps into the pit. When designing these roadways, numerous factors, such as gradients and width, must be taken into consideration. As the pits increase in depth, the constraints, which dictate the design of the roadway, become increasingly difficult to meet.

Any type of trucking operation out of a pit results in considerable operating and maintenance expenses, high road maintenance, dust suppression problems, safety issues, the problem of congestion, particularly in tight conical pits, and the considerable time taken for a return journey. Furthermore, the truck haul roads into/out of the pit need to be sufficiently wide to accommodate two trucks passing in opposite direction of travel. These roads could be 30 metres wide – the wider the road, the flatter the overall slope of the pit wall must be in order to support the road. The flatter the slope of the pit wall, the greater the pit opening needs to be, requiring the removal of a greater amount of waste material before the ore can be accessed. This can make a significant difference to the economies of large deep pits.

Trucks do, however, provide flexibility and are needed at the operating faces to collect rock from within the pit.

To date, the alternatives to a roadway system include the partial electrification of the haulage trucks using overhead conductors, in-pit crushing of ore/waste and the possibility of hoisting the ore up the slope of the pit.

The use of in pit crushers and conveyors also have inherent difficulties. The type of in-pit crusher suitable for crushing hard rock at run-of-pit size and with crushing rates of say 4000 tonnes per hour, at present means selection of a large gyratory type of crusher. Major disadvantages of the in-pit crushing/conveying systems include:

- Installations are extremely heavy;
- High initial installation cost and subsequent relocation cost of the hard rock crusher and conveyors;
- High wear on a series of very large and long conveyor belts, particularly by dense and very sharp rocks, resulting in high maintenance and belt replacement costs;
- Susceptibility of in-pit crushers and conveyors to damage from blasting.
- High operating costs caused by crushing all the waste.
- Batching of ore and waste crushing and conveying with resulting pit scheduling problems.
- Redesign of the pit layout necessary to accommodate the conveyors. This results in a greater strip ratio and overpass or underpass systems to allow conveyors to cross haul roads, or diversion of the haul roads.

Several systems have also been proposed whereby a counter balanced carrier traverses directly up the pit wall. These systems, however, require substantial infrastructure to be positioned adjacent the rim of the pit opening, and may compromise the integrity of the pit's rim. One of these systems is disclosed in WO 99/05396 Dames & Moore Pty Ltd.

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The preceding discussion of the background to the invention is intended only to facilitate an understanding of the present invention. It should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was part of the common general knowledge as at the priority date of this application.

It is an object of the present invention to provide an alternative pit haulage system which overcomes one or more of the disadvantages of the prior art or provides an alternative to the prior art.

Disclosure of Invention

The present invention provides a haulage system for hauling vehicles between a first level and a second level of a mining pit, the haulage system comprises:

at least one carrier adapted to support and convey a vehicle such as a truck;

at least one loading platform located at the first level, and at least one dispatch platform located at the second level;

at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the at least one carrier;

at least one sheave means located below the dispatch platform;

hauling means comprising at least one winder fixedly disposed away from the pit walls, and

cable means attached between the at least one winder and the at least one carrier, the cable means being supported by the sheave means

whereby a vehicle laden with material is received upon the at least one carrier via the loading platform, the winder is activated to haul the at least one carrier up the at least one track until the carrier reaches the dispatch platform

whereupon the vehicle drives off the at least one carrier on to the dispatch platform.

Preferably the first level is the bottom of the pit. Preferably the second level is the top of the pit. The first level may be at a position intermediate the top and bottom of the pit. Similarly the second level may be at a position intermediate the top and bottom of the pit.

Preferably the at least one winder is fixedly disposed at the top of the pit at a distance from the pit's rim

Preferably the carrier provides a substantially flat support member upon which the vehicle is supported when on the carrier. Preferably the support member is pivotally mounted.

Preferably the hauling system has a sensor means such that as the carrier travels along the at least one track the sensor means detects any change in gradient and activates a levelling means which levels the support member such that the support member is maintained in a substantially horizontal orientation regardless of the variances in gradient over which the at least one track extends.

As the support member is pivotally mounted on the carrier, the support member can move to accommodate changes in the gradient of the pit wall. As the carrier traverses the at least one track, the at least one track may be laid over a pit wall which has different gradients. In order to ensure the support member remains substantially horizontal, the support member is able to rotate relative to the carrier to ensure it remains substantially horizontal.

The carrier may comprise means to prevent the accidental removal of the truck therefrom.

Preferably, the at least one track is in the form of a railway.

Preferably the at least one track extends below the loading platform a sufficient distance such that the support member of the carrier aligns with the top of the loading platform when the carrier is at a lower most position, wherein the vehicle may be received upon.

Preferably the at least one track extends to the top of the pit wall such that the support member of the carrier aligns with the dispatch platform when the carrier is at an upper most position, wherein the vehicle may drive off the carrier.

Preferably the sheave means comprises a sheave located below the dispatch platform. The position of the sheave enables forces created during the hauling of the carrier to be distributed in a manner which minimises the forces exerted upon the rim which may compromise the stability of the rim.

Preferably, the sheave is positioned such that a portion of its periphery substantially aligns with or extends beyond the surface of the pit wall.

Preferably the winder, sheave and cable means are located centrally with respect to the extent of the at least one track of the railway.

Preferably the dispatch platform has a recess which accommodates the cable means and provides clear passage for the cable means extending between the winder and the sheave.

Preferably the sheave is sufficiently spaced from the winder to provide the required fleet angles of said cable means onto said winder.

Preferably cable means is in the form of a set of cables attached to the winder and the carrier. The set of cables may comprise three cables.

Preferably the hauling means is in the form of a winder drum.

Preferably the winder drum is grooved such that the cable means is guided on to the winder drum and seated in the grooves. The winder drum may be of sufficient

size such that when the carrier is aligned with the dispatch platform the cable means is in a single layer on the winder drum.

Preferably the hauling system comprises a first carrier and a second carrier, each being associated with its own at least one track, sheave means, winder and cable means which is in the form of a cable.

Preferably the winders associated with the first carrier and the second carrier are incorporated as a double winder drum. The double winder drum may have separate portions which support the respective cable of the respective carrier. Preferably the cable of the first carrier is wound upon the double winder drum in an opposed manner to the cable of the second carrier, such that as the double drum winder rotates, the cable of one carrier is wound onto the drum whilst the cable of the other carrier is wound off the drum. With this arrangement one carrier ascends whilst the other simultaneously descends into the pit counterbalancing each other.

In another arrangement, the winders associated with the first and second carriers may comprise separate winders electrically coupled together for operation in unison. Typically, the winders counter-rotate in unison.

The present invention further provides a haulage system for hauling vehicles between a first level and a second level of a mining pit, the haulage system comprises a loading platform located at the first level, and a dispatch platform located at the second level, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each hauling apparatus comprising:

a carrier adapted to support and convey a vehicle such as a truck;

at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the carrier;

a sheave located below the dispatch platform;

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hauling means comprising a winder fixedly disposed at the top of the pit at a distance from the pit's rim, and

cable means attached between the winder and the carrier via the sheave

whereby the first apparatus and second apparatus counterbalance each other and work in opposed fashion such that as the carrier of one apparatus ascends its respective at least one track and reaches the dispatch platform, the carrier of the other apparatus simultaneously descends its respective at least one track and reaches the loading platform.

In this arrangement, the affect of the counterbalance results in the haulage system only requiring to move the load in the ascending vehicle, as the weight of the truck ascending (minus the load) is counterbalanced by the weight of the truck descending.

Preferably the first level is the bottom of the pit. Preferably the second level is the top of the pit. In other aspects either or both of these levels may be intermediate the top and bottom of the pit.

The present invention further provides a haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus, a second hauling apparatus and a hauling means, each hauling apparatus comprising:

a carrier adapted to support and convey a vehicle such as a truck;

at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the carrier;

a sheave located below the dispatch platform; and

cable means attached between the hauling means and the carrier via the sheave

the hauling means comprising a double drum winder fixedly disposed at the top of the pit at a distance from the pit's rim, whereby the first apparatus and second apparatus counterbalance each other and work in opposed fashion such that as the carrier of one apparatus ascends its respective at least one track and reaches the dispatch platform, the carrier of the other apparatus simultaneously descends its respective at least one track and reaches the loading platform.

Preferably during operation the cable means of one of the apparatus winds around one end of the double winder drum whilst the cable means of the other apparatus unwinds from the other end of the double winder drum. Alternatively, the two cable means may wind around separate winders, the winders being electrically coupled together for counter-rotation in unison.

The present invention further provides a haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises:

a first and second carrier, each adapted to support and convey a vehicle such as a truck;

a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit

a first and a second set of tracks extending between said dispatch platform and said loading platform, each set of tracks being adapted to guide and support the respective carrier;

a first and second sheave located below the dispatch platform, each being located centrally with respect to its respective track;

hauling means comprising a first winder drum and second winder drum fixedly disposed at the top of the pit at a distance from the pit's rim, and

a first and second cable means, each attached between the respective winder and carrier

whereby, when a first vehicle laden with ore is driven onto the loading platform and onto the first carrier, a second vehicle is driven onto the dispatch platform and onto the second carrier, the hauling means is activated to transport the carriers along their respective tracks, as this is occurring the first winder drum and second winder drum rotate, the first winder drum receiving cable whilst the second winder drum unwinds the cable, the first carrier reaches the dispatch platform as the second carrier reaches the loading platform whereupon both vehicles leave their respective carriers.

Preferably, the first winder drum and second winder drum are integral with each other in the form of a double winder drum.

Preferably, the cable of the first carrier is wound on the double winder drum in an opposed manner to the cable associated with the second carrier.

The present invention further provides a haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each apparatus comprising a carrier adapted to support and convey a vehicle such as a truck, at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the carrier, hauling means comprising a winder fixedly disposed at the top of the pit, and cable means attached between the winder and the carrier via a sheave characterized in that the sheave is located below the dispatch platform such that forces exerted through the sheave have minimal effect on the integrity of the pit's rim.

The present invention further provides a haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located

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adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each apparatus comprising a carrier adapted to support and convey a vehicle such as a truck, at least one track extending between said dispatch platform and said loading platform adapted to support and guide the carrier, hauling means comprising a winder fixedly disposed at the top of the pit, and cable means attached between the winder and the carrier via a sheave characterized in that cable means is provide by a plurality of cables.

The plurality of cables may comprise three cables.

The present invention further provides a haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each apparatus comprising a carrier adapted to support and convey a vehicle such as a truck, at least one track extending between said dispatch platform and said loading platform adapted to support and guide the carrier, hauling means comprising a winder fixedly disposed at the top of the pit, and cable means attached between the winder and the carrier via a sheave characterized in that the winder of each apparatus are integral with each other and is in the form of a grooved double winder drum, the drum is of sufficient size such that when the cables are wound onto the drum the cables are in a single layer.

Preferably the carrier of the aforementioned haulage systems provides a substantially flat support member upon which the truck is supported when on the carrier. Preferably the support member is pivotally mounted upon the carrier.

Preferably the haulage system has a sensor means such that as the carrier travels along the at least one track the sensor means senses any change in gradient and activates a levelling means which levels the support member such that the support member is maintained in a substantially horizontal orientation regardless of the variances in gradient over which the at least one track extends.

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In accordance with a further aspect of the present invention there is provided a method for conveying material excavated from within a pit mine to the outer peripheral surface of the mine, including:

loading a truck disposed within the pit with excavated material from within the pit, and positioning it via a loading platform onto a carrier;

hauling said carrier supporting said truck along an inclined track extending along a pit wall;

dispatching said truck from the carrier when the carrier aligns with a dispatch platform at the top of said pit;

loading another truck onto the carrier; and

returning the further truck to the loading platform along said track.

The method may further comprise the step of positioning an empty truck via the dispatch platform onto a further carrier simultaneous with the positioning of the loaded truck via the loading platform onto the carrier, whereby the carriers are operatively connected such that as the loaded truck ascends the at least one track, the further carrier and empty truck descends and acts as a counter-balance.

The method may further comprise the step of adjusting a support member of the carrier, upon which the truck is supported, such that the support member remains in a substantially horizontal orientation regardless of the gradient over which the carrier passes.

Brief Description of Drawings

The invention will be better understood in the light of the following description of one specific embodiment thereof. The description is made with reference to the accompanying drawings, wherein:

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Fig 1 is a schematic plan of the rim and top portion of a pit employing a haulage system according to an embodiment of the present invention;

Figure 2 is a side view of a carrier of the haulage system supporting a truck located at a dispatch platform;

Figure 3 is a rear view of figure 2; and

Figure 4 is a view of a hauling means of the haulage system.

Best Mode(s) for Carrying Out the Invention

The embodiment of the present invention is directed towards a haulage system 11 disposed at one side of an open pit mine 13 and a method for conveying material excavated from within the pit mine to the outer peripheral surface thereof using the haulage system 11. The open pit mine 13 comprises a pit floor 15, a pit wall 17 and a pit rim 19 located around the periphery of the pit opening.

The haulage system 11 described in the embodiment delivers run-of-pit ore and waste from a selected position at the floor of the pit 15. The haulage system 11 is preferably installed such that the ore carried to the top only needs to travel minimal distance to the crusher.

The haulage system 11 enables certain advantageous features to be incorporated into the design of a pit whereby the pit is of a certain size. These advantages could not be realized by smaller types of operations due to the productivity difference between small and large pits. Thus, the system 11 is best applied in those pits handling large tonnage.

The haulage system 11 is designed to be installed preferably once the mine has reached its maximum depth.

The haulage system 11 generally comprises a first hauling apparatus 21a and a second hauling apparatus 21b, a dispatch platform 25 adjacent the pit's rim 19, a loading platform 17 located on the pit floor 15, and hauling means 23.

The hauling means 23 comprises a double drum winder 24 disposed a distance from the pit's rim 19 as shown in figure 1. The double drum winder 24 comprises two portions, an over wind drum 24a and an under wind drum 24b.

The first hauling apparatus 21a and second hauling apparatus 21b are in side-by-side relation.

Each hauling apparatus 21a, 21b comprises a carrier 29 positioned upon and movable with respect to at least one track, which in this embodiment is in the form of a railway 31. The railway 31 extends between the dispatch platform 25 and loading platform 27, and is adapted to support and guide the carrier 11.

Referring to figure 2, each carrier 29 comprises a flat support member 30 adapted to receive and support a truck. The support member 30 remains substantially horizontal as it travels between the two platforms. This enables the haulage system to accommodate different gradients as the carrier traverses the pit wall.

The support member 30 is pivotally mounted so that it may be adjusted as the carrier 29 travels over different gradients such that the support member 30 remains in a substantially horizontal orientation. To achieve this, the hauling system 11 has a sensor means 32 (not shown) such that as the carrier 29 travels along the railway 31 the sensor means 32 monitors and detects any change in gradient. Where the gradient changes, the sensor means 32 activates a levelling means 34 (not shown) which adjusts the support member 30 such that the support member 30 is maintained in a substantially horizontal orientation, accommodating the variances in gradient over which the railway 31 extends.

The levelling means 34 may be in the form of a hydraulic system having cylinders placed at either end of the support member 30. In order to adjust the level of the support member 30, a hydraulic fluid may be pumped from one cylinder to another until the support member 30 is horizontal.

Other means to adjust the support member 30 as are obvious to the person skilled in the art are also available. For instance the support member 30 may be

caused to level by mechanical means, such as a change in the railway 31, a projection or other means. In other embodiments, the railway 31 may have a first section over a first gradient and a second section over a second gradient with means to ensure a smooth transition of the support member 30 as it encounters the change in gradient, in addition to levelling means to ensure the support member remains horizontal.

Each carrier 29 also comprise means to prevent the unintended removal of the truck from the carrier 29.

Each hauling apparatus 21 further comprises cable means, in the form of a set of three cables 33, extending from the carrier 29 to the double drum winder 24, with the set of cables 33a from the first apparatus 21a orientated to wind on and off the over wind drum 24a whilst the set of cables 33b from the second apparatus 21b are orientated to wind on and off the under wind drum 24b. In this embodiment, the cables 33 each comprise steel wire rope.

Each hauling apparatus 21 also comprises a sheave 35 positioned between the double drum winder 24 and the carrier 29, and which is adapted to support the respective set of cables 33. Each sheave 35 is mounted in a recess formed in the dispatch platform 25. Each sheave 35 is below the upper surface of the dispatch platform 25 and has a portion 37 of its periphery extending beyond the pit wall 17, as best shown in figure 3. In this position the forces acting upon each sheave 35 are distributed inwardly in a direction generally approximated by arrow 'A'. This position minimises the forces at the rim 19 which would otherwise compromise the stability of the rim 17.

Furthermore, as no head frame is required to support the sheave 35, the infrastructure required at the pit's rim is greatly reduced. This not only assists in maintaining the integrity of the rim 19 but also allows easy transfer of the trucks on and off the dispatch platform 25 on to the carrier 29 without requiring excessive support structures.

Each sheave 35 and set of cables 33 are centrally orientated with respect to each railway 31, whilst the over wind drum 24a aligns with the first hauling apparatus 21a and the under wind drum 24b aligns with the second hauling apparatus 21b.

The double wind drum 24 is orientated with respect to each sheave 35a, 35b so as to attain the required fleet angles. To assist the over wind drum 24a a deflection sheave 39 is centrally positioned with respect to the sheave 35a, at a distance between the drum 24a and the sheave 35.

Each drum 24a, 24b is grooved such that the set of cables 33 is guided by and seated in a groove when wound on the drum. Each drum 24a, 24b is also of sufficient width such that the cables can be completely wound onto the respective drum in a single layer when the respective carrier 29 is at the dispatch platform 25.

In the present embodiment, the configuration of the haulage system 11 allows the pair of carriers 29 to operate in balance. That is, each carrier 29 is connected to one end of the set of cables 33, whilst the other end is connected to the corresponding sides of the double winder drum 24, with the set of cables 33a associated with the first haulage apparatus 21a being wound around the wind drum 24 in an opposite direction to cables 33b of the second hauling apparatus 21b. The configuration of the double drum winder 24, cables 33, and the carriers 29 are therefore arranged in such a manner that when the double drum winder 24 is operated, one side of the double drum winder 24a winds the cables 33a thereon, whilst the other unwinds the cables 33b therefrom, and vice versa.

When one side of the double drum winder 24a is wound to one extreme, the carrier 29 of the first hauling apparatus 21a is disposed at the dispatch platform 25, allowing a fully laden truck to drive off the carrier 29 before another empty truck boards the carrier 29. As this occurs, the carrier 29 of the second hauling apparatus 21b is simultaneously disposed at the loading platform 27 for unloading an empty truck and allowing a fully laden truck to drive onto the carrier 29.

When the double drum winder 24 is wound to the other extreme, the position of the carriers 29 is reversed. In this manner, the winder 24 is always under a consistent load from a fully laden truck on one carrier 29 and an empty truck on the other carrier 29. The carrier 29 of one hauling apparatus 21 counter-balances to a degree the carrier 29 of the other hauling apparatus, and hence the hauling system 11 is only required to move an effective weight of the pay load contained in the ascending laden truck.

A suitable area is provided at the loading platform 27 for the trucks to manoeuvre on and off the carrier 29. The bottom end of each railway 31 therefore extends below the loading platform 27 such that the support member 30 of the carrier 29 is able to align with the loading platform 27 and allow the truck to drive on/off the platform.

As previously described a group of three wire cables 33a and 33b are attached to each carrier 29 to allow it to be pulled up the side of the pit 13 by the double drum winder 24 from the loading platform 27 to the dispatch platform 25, at which the truck may drive off the carrier 29 before another one is received thereon. Use of three cables 33a per carrier 29 provide for a far higher standard of safety compared with one or two cables of the same size. Whilst this system is described as particularly having three cables 33 extending between each carrier 29 and winder drum 24 the system would equally work well with any number of suitable cables. Typically, the stronger the arrangement of cables 33 used in the system the greater is the safety factor.

In another variation, each hauling apparatus 21 may be associated with its own loading platform 27 and dispatching platform 25.

Other important advantages of the haulage system of the present embodiment are:

(1) As the system uses carriers to hoist the trucks, the system can handle the same size ore as conventional truck haulage.

(2) There are multi cables per conveyance to provide a high factor of safety as specified in all mining regulations applied to mine hoisting systems.

(3) As there is minimal traction force reaction between the carrier and the track, there is no slippage of the carrier relative to the track, and there will be little wear.

(4) The likelihood of rocks falling out of a truck traversing the pit wall are greatly reduced than in conventional hauling means as the truck remains substantially horizontal during the ascent to the top.

(5) Smaller roads into and out of the pit may only be required. These roads may only be required to traffic smaller vehicles.

The haulage system described in the present embodiment has many advantages compared with existing haulage systems for material excavated from a pit. When compared with trucking out of a pit the present embodiment has the following advantages:

(1) Large operating cost savings.

(2) Removal of truck haulage and congestion.

(3) Very significant energy cost savings. As the two carriers are in balance, the only work done is lifting the payload itself. In present systems the truck has to lift both the payload and the truck itself out of the pit on each cycle.

(4) The haulage system allows the use of electricity as the sole power source, rather than diesel fuel. Electricity generation is likely to cause significantly less carbon emissions to reduce the greenhouse effect, compared with individual diesel trucks. This will contribute to carbon credits for the country of operation.

(5) Removes the safety hazard associated with drivers operating trucks on long monotonous journeys up and down the pit, where any short period of inattention can have disastrous consequences.

(6) The introduction of a pit haulage system will result in a significant reduction of waste removal as the pit will be able to have steeper sides as a result of eliminating double width haul roads, which are designed to have shallow gradients.

(7) Reduction in truck fleet with savings in capital costs and corresponding operating and maintenance savings in manpower and cost.

(8) Reduction of haul road maintenance and dust suppression.

(9) Independent of slippery road conditions in wet weather or icy conditions.

When compared with in-pit crushing and conveying waste techniques, the present system has the following advantages:

(1) Capital cost saving by elimination of large in-pit crushers and the inclined conveyor installation out of the pit.

(2) Elimination of the operating and maintenance costs associated with crushing all the waste.

(3) Reduction in pit traffic and congestion which is caused by haulage of material mined at a lower level to where the crusher is positioned - crusher relocation is not flexible.

(4) Virtual elimination of blast damage to in-pit equipment.

(5) Obviates problem of batch crushing and conveying ore and waste, or the alternative of trucking ore out of the pit and crushing waste only.

(6) Elimination of conveyors out of the pit which cause greater excavation and in many cases flatter pit sides, together with diversion of haul roads, all of which can significantly increase pit development costs.

The automatic haulage system 11 of the present invention presents major advantages in efficiency once the vertical depth of the pit has been reached. Indeed, the greater the vertical depth of the pit, the greater are the benefits of adopting the haulage system 11 of the present invention compared with truck haulage.

It should be appreciated that the scope of the present invention is not limited to the specific embodiment described herein. Accordingly, changes and modifications to the embodiment that are in accordance with standard engineering design and which do not depart from the spirit of the invention are considered to fall within the scope of the invention.

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

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The Claims Defining the Invention are as Follows

1. A haulage system for hauling vehicles between a first level and a second level of a mining pit, the haulage system comprises:

at least one carrier adapted to support and convey a vehicle such as a truck;

at least one loading platform located at the first level, and at least one dispatch platform located at the second level;

at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the at least one carrier;

at least one sheave means located below the dispatch platform;

hauling means comprising at least one winder fixedly disposed away from the pit walls, and

cable means attached between the at least one winder and the at least one carrier, the cable means being supported by the sheave means;

whereby a vehicle laden with ore is received upon the at least one carrier via the loading platform, the winder is activated to haul the at least one carrier up the at least one track until the carrier reaches the dispatch platform whereupon the vehicle drives off the at least one carrier on to the dispatch platform.

2. The haulage system according to claim 1 wherein the first level is the bottom of the pit, and the second level is the top of the pit.

3. The haulage system according to claim 1 or 2 wherein the at least one winder is fixedly disposed at the top of the pit at a distance from the pit's rim.

4. The haulage system according to any one of the preceding claims wherein the carrier provides a substantially flat support member upon which the vehicle is supported when on the carrier the support member being pivotally mounted.

5. The haulage system according to claim 4 wherein the hauling system has a sensor means such that as the carrier travels along the at least one track the sensor means detects variations in gradient and activates a levelling means which levels the support member such that the support member is maintained in a substantially horizontal orientation regardless of the variances in gradient over which the at least one track extends.

6. The haulage system according to any one of the preceding claims wherein the at least one track is in the form of a railway.

7. The haulage system according to any one of claims 4 to 6 wherein the at least one track extends below the loading platform a sufficient distance such that the support member of the carrier aligns with the top of the loading platform when the carrier is at a lower most position, wherein the vehicle can be positioned thereupon, the at least one track extends to the top of the pit wall such that the support member of the carrier aligns with the dispatch platform when the carrier is at an upper most position, wherein the vehicle can be dispatched therefrom.

8. The haulage system according to any one of the preceding claims wherein the sheave means comprises a sheave located below the dispatch platform, the sheave is positioned such that a portion of its periphery substantially aligns with or extends beyond the surface of the pit wall.

9. The haulage system according to claim 8 wherein the winder, sheave and cable means are located centrally with respect to the extent of the at least one tracks of the railway, whereby the dispatch platform has a recess which accommodates the cable means and provides clear passage for the cable means extending between the winder and the sheave, the sheave being sufficiently spaced from the winder to provide the required fleet angles of said cable means onto said winder.

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10. The haulage system according to any one of the preceding claims wherein the hauling means is in the form of a winder drum, the winder drum is grooved such that the cable means is guided on to the winder drum and seated in the grooves.

11. The haulage system according to any one of the preceding claims wherein the system comprises a first carrier and a second carrier, each being associated with its own at least one track, sheave means, winder and cable means, which is in the form of a cable.

12. The haulage system according to claim 11 wherein the winder of the first carrier and the winder of the second carrier are integral and are in the form of a double winder drum, the double winder drum has separate portions which support the respective cable of the respective carrier.

13. The haulage system according to claim 12 wherein the cable of the first carrier is wound upon the double winder drum in an opposed manner to the cable of the second carrier, such that as the double winder drum rotates, the cable of one carrier is wound onto the drum, whilst the cable of the other carrier is would off the drum.

14. A haulage system for hauling vehicles between a first level and a second level of a mining pit, the haulage system comprises a loading platform located at the first level, and a dispatch platform located at the second level, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each hauling apparatus comprising:

a carrier adapted to support and convey a vehicle such as a truck;

at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the carrier;

a sheave located below the dispatch platform;

hauling means comprising a winder fixedly disposed at the top of the pit at a distance from the pit's rim, and

cable means attached between the winder and the carrier via the sheave

whereby the first apparatus and second apparatus counterbalance each other and work in opposed fashion such that as the carrier of one apparatus ascends its respective at least one track and reaches the dispatch platform, the carrier of the other apparatus simultaneously descends its respective at least one track and reaches the loading platform.

15. The haulage system according to claim 14 wherein the first level is the bottom of the pit and the second level is the top of the pit.

16. A haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus, a second hauling apparatus and a hauling means, each hauling apparatus comprising:

a carrier adapted to support and convey a vehicle such as a truck;

at least one track extending between said dispatch platform and said loading platform and adapted to guide and support the carrier;

a sheave located below the dispatch platform; and

cable means attached between the hauling means and the carrier via the sheave

the hauling means comprising a double drum winder fixedly disposed at the top of the pit at a distance from the pit's rim, whereby the first apparatus and second apparatus counterbalance each other and work in opposed fashion such that as the carrier of one apparatus ascends its respective at least one track and reaches the dispatch platform, the carrier of the other apparatus

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simultaneously descends its respective at least one track and reaches the loading platform.

17. The haulage system according to claim 16 wherein during operation the cable means of one of the apparatus winds around one end of the double winder drum whilst the cable means of the other apparatus unwinds from the other end of the double winder drum.

18. A haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises:

a first and second carrier, each adapted to support and convey a vehicle such as a truck;

a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit

a first and a second set of tracks extending between said dispatch platform and said loading platform, each set of tracks being adapted to guide and support the respective carrier;

a first and second sheave located below the dispatch platform, each being located centrally with respect to its respective at least one track;

hauling means comprising a first winder drum and second winder drum fixedly disposed at the top of the pit at a distance from the pit's rim, and

a first and second cable means, each attached between the respective winder and carrier

whereby, when a first vehicle laden with ore is driven onto the loading platform and onto the first carrier, a second vehicle is driven onto the dispatch platform and onto the second carrier, the hauling means is activated to transport the carriers along their respective tracks, as this is occurring the first winder drum and second winder drum rotate, the first winder drum receiving cable whilst the

second winder drum unwinds the cable, the first carrier reaches the dispatch platform as the second carrier reaches the loading platform whereupon both vehicles leave their respective carriers.

19. The haulage system according to claim 18 wherein the first winder drum and second winder drum are integral with each other in the form of a double winder drum, whereby the cable associated with the first carrier and the cable associated with the second carrier are wound on the double winder drum in an opposed manner to each other.

20. A haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each apparatus comprising a carrier adapted to support and convey a vehicle such as a truck, a track extending between said dispatch platform and said loading platform and adapted to guide and support the carrier, hauling means comprising a winder fixedly disposed at the top of the pit, and cable means attached between the winder and the carrier via a sheave characterized in that the sheave is located below the dispatch platform such that forces exerted through the sheave have minimal effect on the integrity of the pit's rim.

21. A haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each apparatus comprising a carrier adapted to support and convey a vehicle such as a truck, at least one track extending between said dispatch platform and said loading platform adapted to support and guide the carrier, hauling means comprising a winder fixedly disposed at the top of the pit, and cable means attached between the winder and the carrier via a sheave characterized in that cable means is provide by a plurality of cables.

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22.A haulage system for hauling vehicles between the bottom and top of a mining pit, the haulage system comprises a loading platform located at the bottom of the pit, and a dispatch platform located adjacent the rim of the pit, the haulage system also comprises a first hauling apparatus and a second hauling apparatus, each apparatus comprising a carrier adapted to support and convey a vehicle such as a truck, at least one track extending between said dispatch platform and said loading platform adapted to support and guide the carrier, hauling means comprising a winder fixedly disposed at the top of the pit, and cable means attached between the winder and the carrier via a sheave characterized in that the winder of each apparatus are integral with each other and is in the form of a grooved double winder drum and is of sufficient size such that when the cables are wound onto the drum the cables are in a single layer.

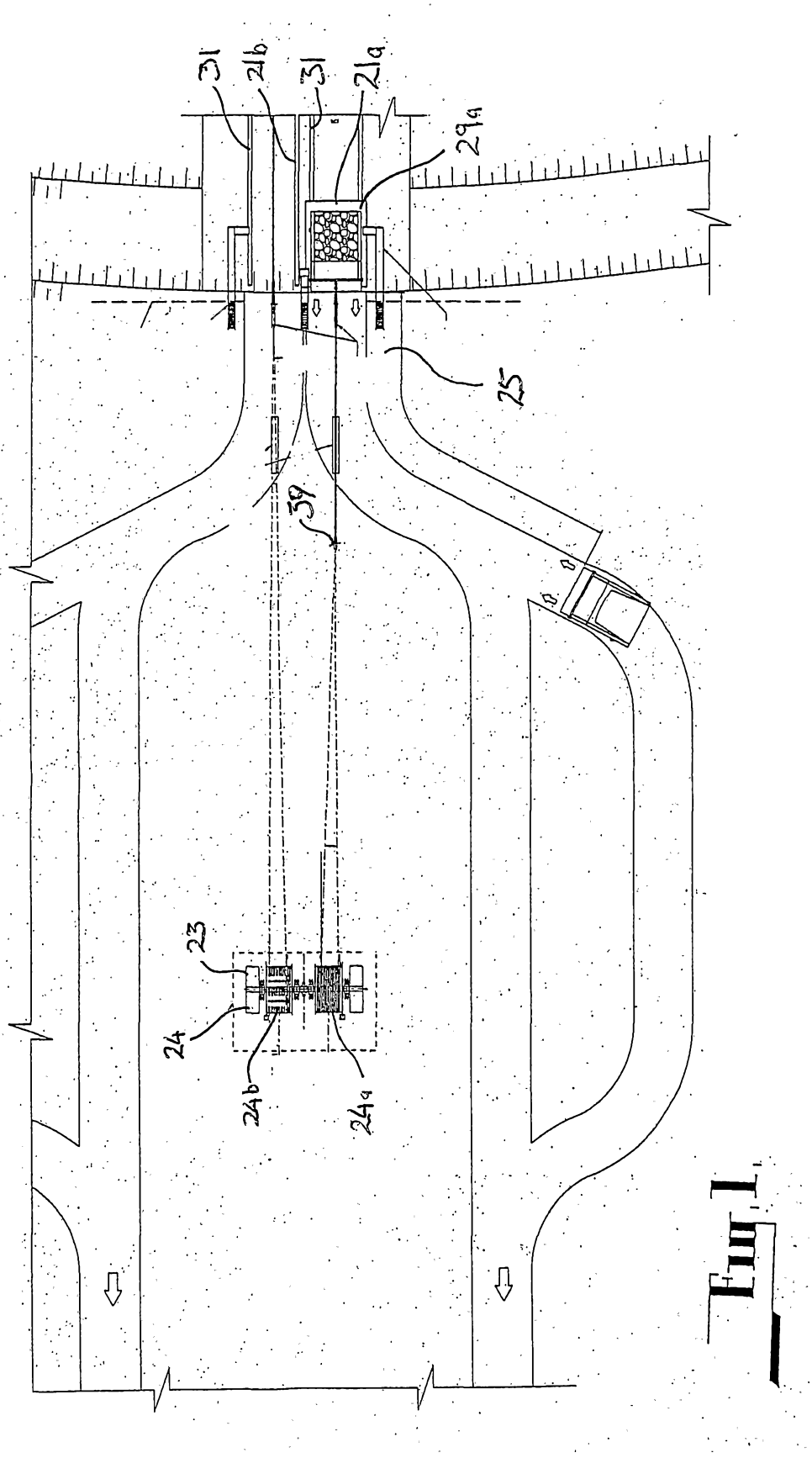

Fig. 1

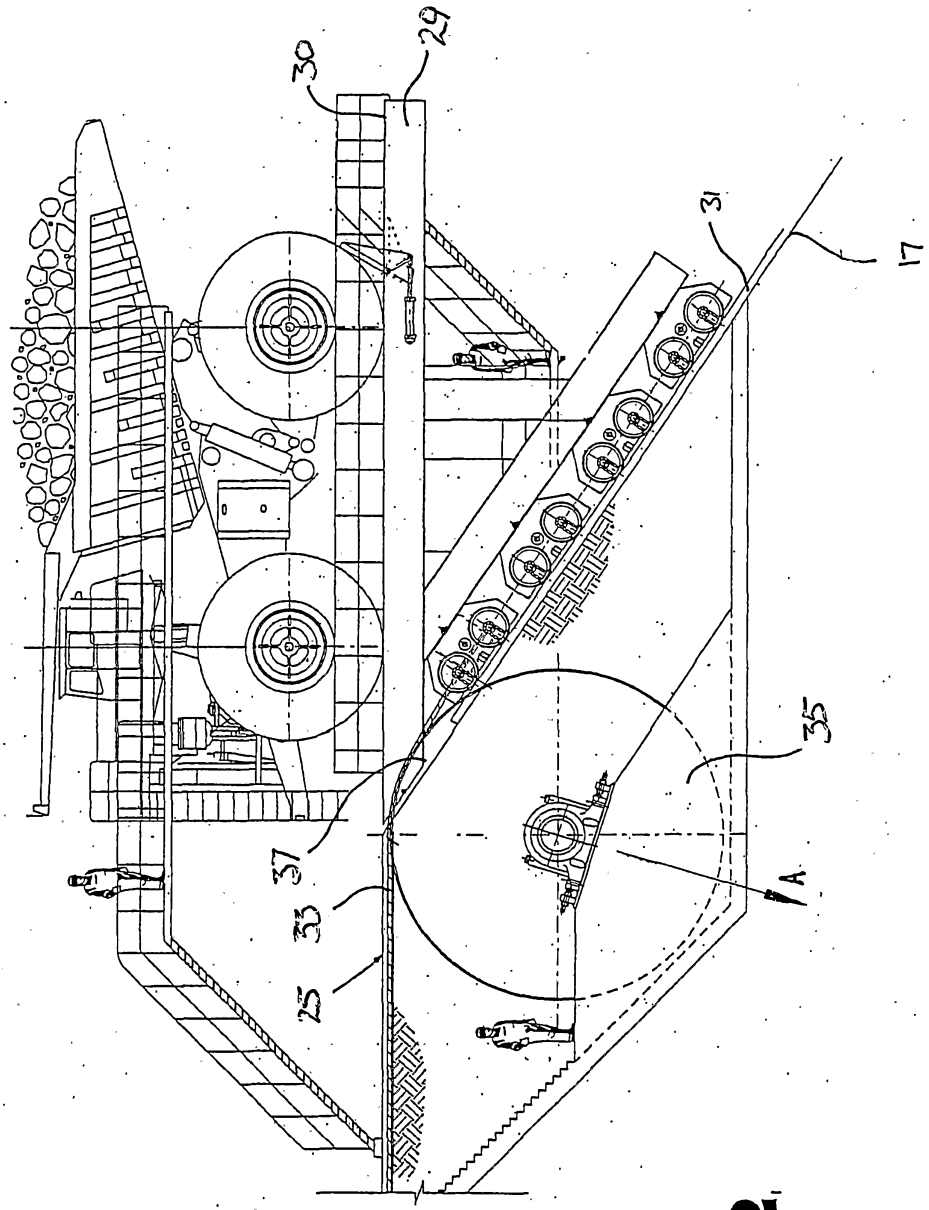

Fig. 2

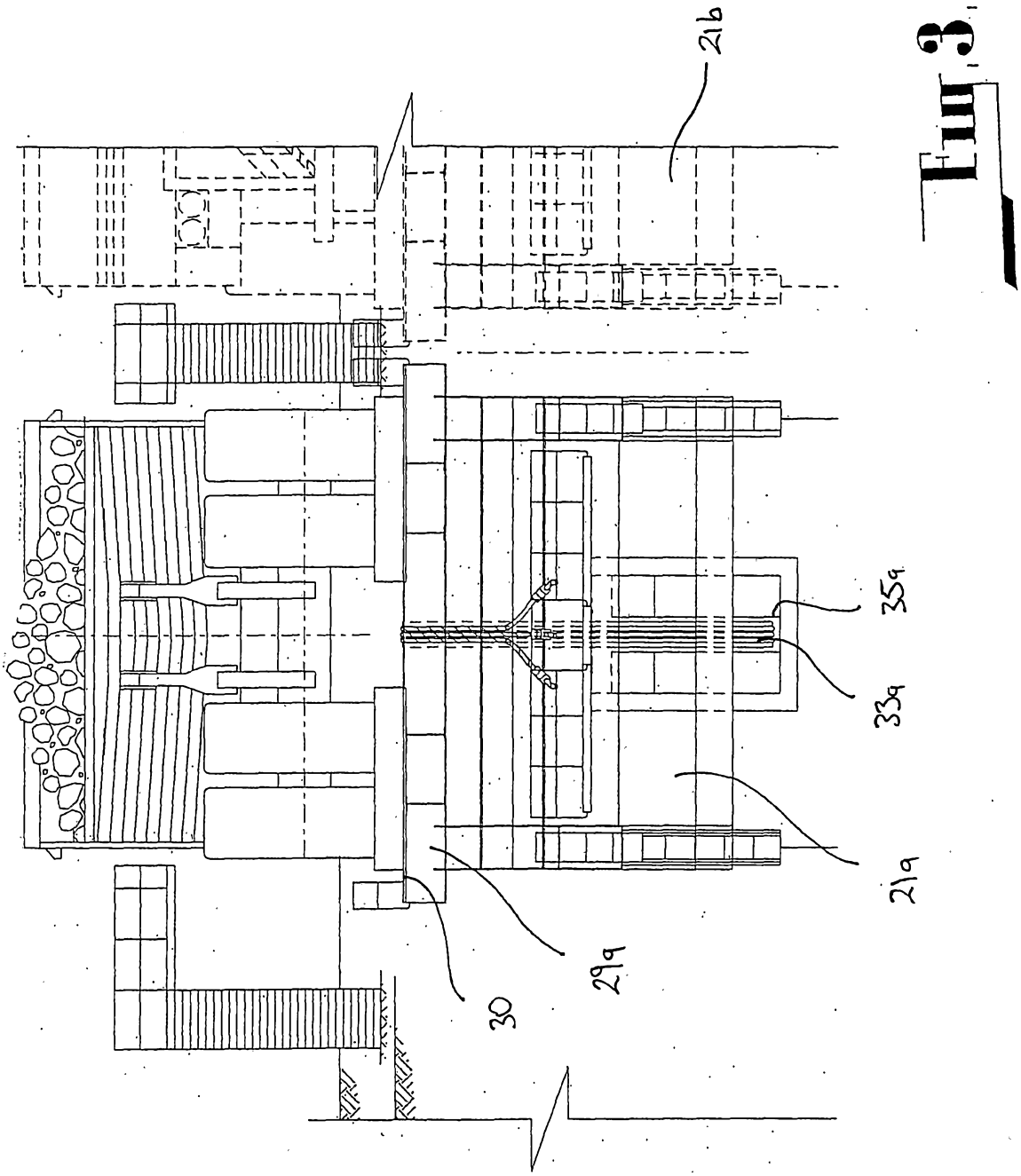

Fig. 3

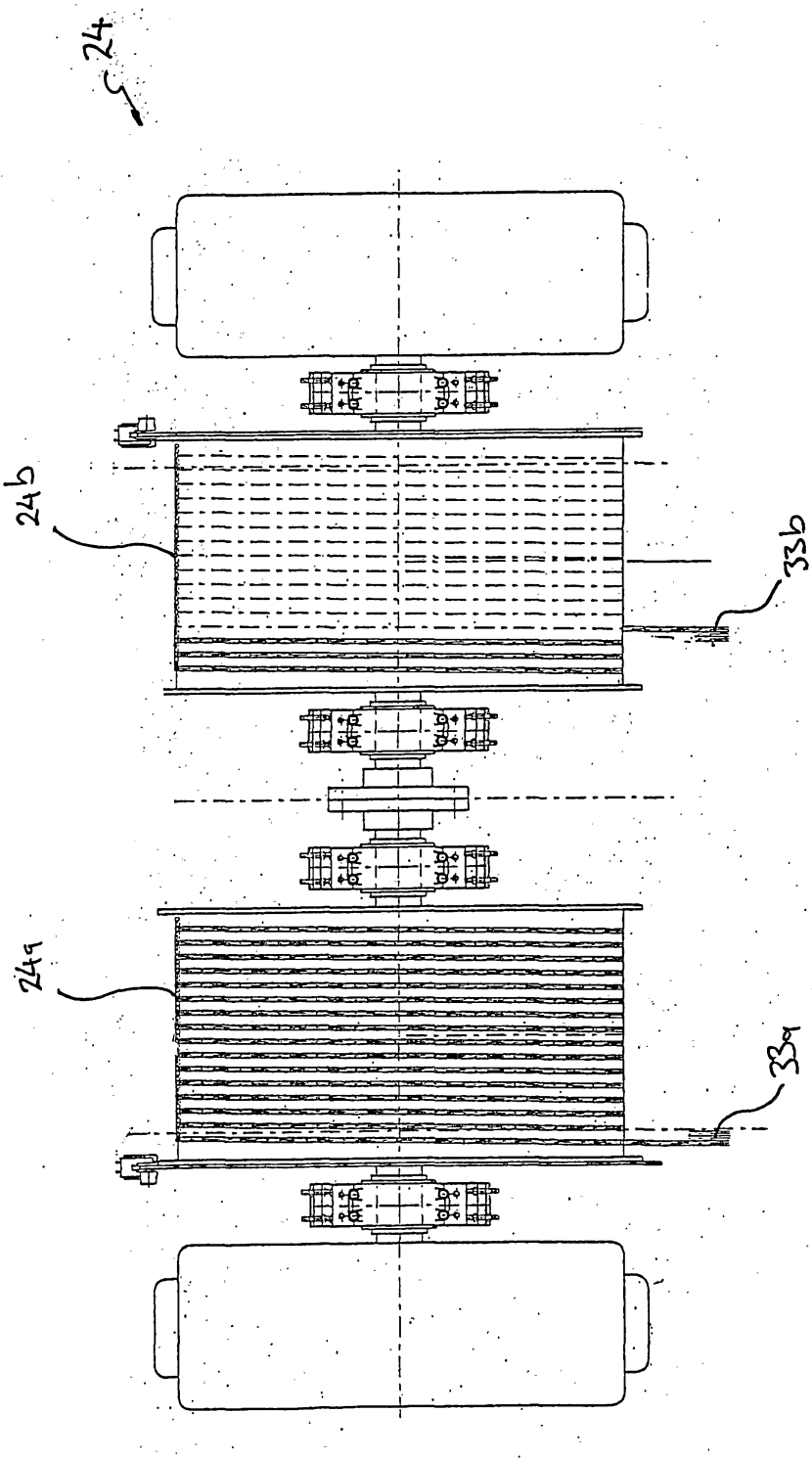

Fig 4