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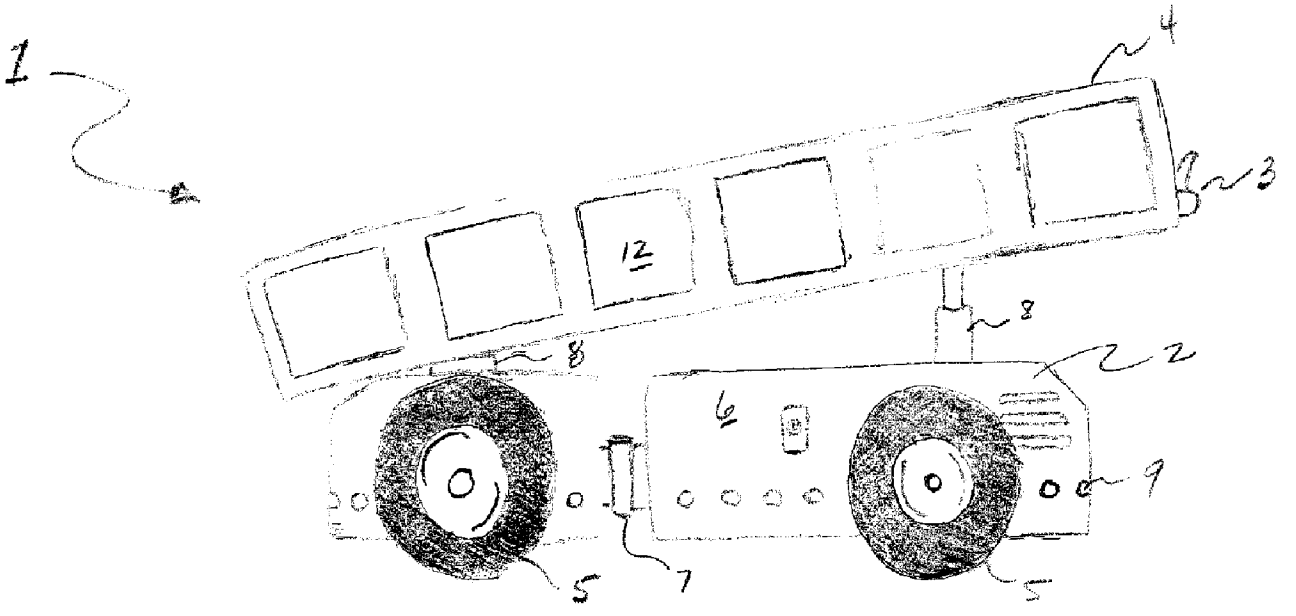
(71) Demandeur/Applicant:
MORRISON, DOUGLAS, CA

(72) Inventeur/Inventor:
MORRISON, DOUGLAS, CA

(74) Agent: GOWLING WLG (CANADA) LLP

(54) Titre : VEHICULE ET PROCEDE POUR DEPLACER DU MINERAI GROSSIER SOUTERRAIN
(54) Title: VEHICLE AND PROCESS FOR MOVING COARSE ORE UNDERGROUND



(57) Abrégé/Abstract:
Disclosed are vehicles used in transporting coarse ore in a mine and systems using the same. The vehicles include a drive mechanism for moving the vehicle along a surface; an inclinable conveyor positioned atop the drive mechanism for moving the coarse ore from a loading position to a discharge position; and vertically extending walls positioned along the longitudinal sides of the conveyor. The loading position of the conveyor being offset from the vertically extending walls and the discharge position of the

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(57) Abrégé(suite)/Abstract(continued):
conveyor extends beyond the vertically extending walls so that one vehicle can be positioned with respect to another to form a continuous walled conveyor. The vehicles and systems described herein do not require rails, so they can be manoeuvered within a mine to form a network from the mine face to a coarse ore unloading area.

ABSTRACT

Disclosed are vehicles used in transporting coarse ore in a mine and systems using the same. The vehicles include a drive mechanism for moving the vehicle along a surface; an inclinable conveyor positioned atop the drive mechanism for moving the coarse ore from a loading position to a discharge position; and vertically extending walls positioned along the longitudinal sides of the conveyor. The loading position of the conveyor being offset from the vertically extending walls and the discharge position of the conveyor extends beyond the vertically extending walls so that one vehicle can be positioned with respect to another to form a continuous walled conveyor. The vehicles and systems described herein do not require rails, so they can be manoeuvered within a mine to form a network from the mine face to a coarse ore unloading area.

VEHICLE AND PROCESS FOR MOVING COARSE ORE UNDERGROUND

FIELD OF THE INVENTION

[0001] The present invention generally relates to mining. More specifically, the invention relates to a transport vehicle, system and process for moving coarse ore in a mine.

BACKGROUND OF THE INVENTION

[0002] The transportation of coarse ore in any mine relies on the movement of ore-carrying equipment to carry it to the primary crusher. This equipment includes load, haul, dump (LHD) machines, dump trucks, shuttle cars and similarly purposed machinery. Since these machines must make trips back and forth from the mine face to the unloading area, the overall production rate of the mine can be limited as a result of the time it takes to move the coarse ore from the face. Moreover, since these machines return to the mine face from the unloading area empty, the machines are at most only 50% fuel-efficient, which adds significantly to the overall cost of the mining operation.

[0003] Conveyor belt systems have been developed to move material in soft-rock mines such as coal or salt when the ore is relatively low-density and low abrasiveness. In hard-rock metal mines where the ore is high-density and highly abrasive, however, conveyor systems are often restricted to moving crushed rock, which is significantly more uniform in size and causes less wear than coarse ore. In addition, the conveyor belts used in mines are often fixed installations or require a rail system and they are well-suited to the straight line geometry of coal and salt mines. The more permanent nature of these types of installations, as well as the raw nature of coarse ore compared to crushed rock, does not allow these systems to be used in the movement of coarse ore in hard-rock metal mines from the mine face to the crusher, for example, when the geometry of the ore sources and the tunnels or drifts through which the ore must pass are highly variable.

[0004] There is a need for vehicles, systems and processes that are robust enough to move coarse ore throughout the mine, which are more continuous in operation and adaptable to the ever-changing landscape and geometry of an active hard-rock metal mining operation.

SUMMARY OF THE INVENTION

[0005] According to an aspect of the present invention, there is provided a vehicle for transporting coarse ore in a mine. The vehicle having a drive mechanism for moving the vehicle along a surface; an inclinable conveyor positioned atop the drive mechanism for moving the coarse ore from a loading position to a discharge position; and vertically extending walls positioned along the longitudinal sides of the conveyor, creating a steel trough. The loading position of the conveyor being offset from the vertically extending walls and the discharge position of the conveyor extending beyond the vertically extending walls.

[0006] In one embodiment, the drive mechanism is electrically powered.

[0007] In another embodiment, the drive mechanism is sectioned and each section is connected by an articulating connection.

[0008] In a further embodiment, the drive mechanism is remotely or autonomously controlled.

[0009] In a still further embodiment, location and hazard sensors are positioned on the vehicle to allow for the vehicle to be autonomous.

[0010] In yet a further embodiment, the inclinable conveyor is mounted to the drive mechanism via posts.

[0011] In yet another embodiment, the posts are adjustable to allow the distance between inclinable conveyor and the drive mechanism to be adjusted.

[0012] In one embodiment, the conveyor is a chain conveyor. The chains driving guides that move the coarse ore from the loading position to the discharge position. In some cases, the chain conveyor is powered by a separate engine from the drive mechanism.

[0013] According to another aspect of the present invention, there is provided a trackless system for transporting coarse ore from a mine face. The system having: a network of vehicles as described above. The vehicles being arranged so that the discharge position of one conveyor is positioned near the loading position of a second conveyor.

[0014] According to a further aspect of the present invention, there is provided a method of transporting coarse ore from a mine face. The method comprising the steps of: loading coarse ore onto the conveyor of the vehicle as described above; moving the coarse ore from the loading position to the discharge position of the conveyor; and discharging the coarse ore from the conveyor into a storage area.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] These and other features, aspects and advantages of the present invention will become better understood with regard to the following description and accompanying drawings wherein:

[0016] FIG. 1 shows a vehicle according to an embodiment of the invention;

[0017] FIG. 2 is a top plan view of a conveyor according to an embodiment of the invention;

[0018] FIG. 3 shows a series of vehicles in operation according to an embodiment of the invention; and

[0019] FIG. 4 shows a network of vehicles aligned in a mine according to an embodiment of the invention.

DESCRIPTION OF THE INVENTION

[0020] The following description is of one particular embodiment by way of example only and without limitation to the combination necessary for carrying the invention into effect.

[0021] The vehicle and system disclosed herein are designed for the movement of coarse ore or material. Coarse ore is generated during the mining process after drilling and/or blasting at the mine face. Unlike ore that has been passed through a crusher, coarse ore is irregular in shape and size, often weighing significantly more than ore after comminution. As such, mining equipment used to move crushed ore is insufficient to move coarse ore.

[0022] As shown in FIG. 1, a vehicle (1) is provided for transporting coarse ore in a mine. The vehicle (1) contains a drive mechanism (2) for moving the vehicle (1) along a surface. Atop the drive mechanism (2), an inclinable conveyor (3) is provided for moving the coarse ore from a loading position to a discharge position. The inclinable conveyor (3) having vertically extending walls (4) positioned along the longitudinal sides of the conveyor (3).

[0023] The drive mechanism (2) of the vehicle (1) allows the vehicle (1) to manoeuver throughout a mine without the use of rails or being towed by another vehicle. As such, the drive mechanism (2) will typically have wheels (5) or tracks, which are powered by a drive shaft and motor, to allow the vehicle (1) to move freely within a mine. In an effort to reduce the pollution in a mine, the drive mechanism (2) can be electrically powered via a bank of rechargeable batteries. However, it will be understood that the drive mechanism (2) can be powered by conventional fossil fuels, or a hybrid system comprising electricity and fossil fuel.

[0024] The body (6) of the drive mechanism (1) can take many different forms, such as that shown in FIG. 1, where the body of the drive mechanism (1) is split into two sections that are connected by an

articulating connection (7). This particular arrangement will provide increased manoeuverability within the mine.

[0025] In a preferred, but not limiting, embodiment, the drive mechanism (2) does not contain manual controls for an operator, i.e. steering wheel, manual accelerator and brakes, but instead can be driven remotely or autonomously using pre-programmed commands, remote controlled instructions and/or artificial intelligence. In the case where the vehicle is controlled by remote control, a receiver is incorporated into the drive mechanism (2) so that input from a remote location can be received and converted into movement of the vehicle (1). The remote transmitter can be in the form of a handheld device or centralized control room.

[0026] When the drive mechanism (2) allows the vehicle (1) to be driven autonomously, sensors (9), such as proximity sensors using lasers and radar, for example, are incorporated into the various components of the vehicle (1) so that the environment of the vehicle can be detected, understood and mapped. For example, proximity to other vehicles, workers, obstacles and the mine can be determined through the sensors (9). This information is relayed to a central processing unit that uses the information about the environment to control movement of the vehicle (1).

[0027] A hybrid system where the drive mechanism (2) is designed to be remotely controlled at times and to operate autonomously at times can be provided to allow the vehicle (1) to move throughout the mine via remote control, whereas alignment with other vehicles (1) or other mining machines can take place autonomously.

[0028] In addition to allowing the vehicle (1) to move around a mine, the drive mechanism (2) also provides a platform for the conveyor (3) to be mounted to via posts (8). In one embodiment, the conveyor (3) can be mounted to the drive mechanism (2) via adjustable posts (8) so that the distance between the conveyor (3) and drive mechanism (2) can be adjusted. This includes independently adjusting the distance between

each end of the conveyor (3) and the drive mechanism (2) so that the angle of incline of the conveyor (3) can be controlled based on the application. In some embodiments, the adjustable posts (8) are either hydraulic or pneumatic cylinders (8) positioned in the vicinity of the ends of the conveyor (3) to control the distance between the conveyor (3) and the drive mechanism (2). In other embodiments, the distance between the conveyor (3) and the drive mechanism (2) can be fixed via the posts (8), including providing a fixed angle of incline for the conveyor (3).

[0029] When the drive mechanism (2) is articulated, as shown in FIG. 1, the posts (8) may be movable with respect to drive mechanism (2), which will prevent the conveyor (3) from becoming twisted while the vehicle (1) moves around corners in the mine. For example, the posts (8) can be positioned within or on a track on the drive mechanism (2) so that the posts (8) can move independently of the drive mechanism (2).

[0030] In one embodiment, the width of the vehicle (1) will be no more than half, preferably no more than 40%, the width of the access tunnels or drifts of the mine. For example, when the access tunnels or drifts of the mine are a standard 5 metres wide, the preferred width of vehicle (1) would be between 2-3 metres wide, preferably approximately 2 metres wide, and approximately 5 metres long, with the drive mechanism (2) being approximately 3.5 metres long. Similarly, when the access tunnels or drifts of the mine are 6 metres wide, the width of the vehicle (1) should be approximately 2.4 metres wide. A vehicle (1) of these dimensions is easily manoeuvrable within a conventional mine. Moreover, the dimensions of such a vehicle (1) will allow for two vehicles to pass each other in an access tunnel or drift, or at any time operate in tandem side-by-side.

[0031] As mentioned above, a conveyor (3) is positioned atop the drive mechanism (2). The conveyor (3) moves coarse ore from a loading position (10) to a discharge position (11). As shown in FIGs 1 and 2, vertically extending walls (12) are positioned along the longitudinal

sides of the conveyor (3) to prevent spillage of the coarse ore off the sides of the conveyor (3). These walls (12) can be removably or permanently attached to the vehicle (1), or can be independent units that are positioned near the vehicle (1) and conveyor (3) to prevent spillage from the conveyor (3). Preferably, the walls (12) will be made from steel to limit the damage caused by repeated impact with the coarse ore.

[0032] In order for one or more vehicles (1) to be linked together, as described below, it is preferable that the loading position (10) of the conveyor (3) is offset from the walls (12) and the discharge position (11) of the conveyor (3) extends beyond the walls (12). This arrangement allows for the conveyor (3) of a first vehicle (1) to overlap with the conveyor (3) of a second vehicle (1), thus providing a continuous conveyor system to be constructed that also has a continuous wall to limit spillage along length of the conveyor(s).

[0033] The conveyor (3) should be an industrial conveyor capable of moving ore that is random in both size and shape, and thus random in terms of weight. For example, a chain conveyor can be used to move the coarse ore. In this embodiment, the chain conveyor will include continuous chains (13) running the length of each side of the conveyor (3). The chains (13) can be rotated by one or more spindles positioned beneath the conveyor (3). The spindles are driven by the same motor used for the drive mechanism (2) or can be powered by a separate motor. As a built-in safety precaution, a switch can be installed to prevent the motor(s) from operating both the conveyor and drive mechanism at the same time. In order to keep emissions to a minimum in the mine, the use of electric motors can be used to move the spindles. For the purposes of the present discussion, "motors" can be run on electricity and/or combustion. Electric motors can be powered via onboard batteries or can be plugged in directly to a power source when the vehicle is stationary. The onboard batteries can be recharged when the vehicle is stationary by plugging the unit directly into a power grid or a supercharger.

[0034] The chains (13) drive guides (14), such as steel plates or scoops, that are interspaced along the chains (13). The guides (14) drag the coarse ore along the conveyor (3) from the loading position (10) to the discharge position (11).

[0035] In operation, multiple vehicles (1) will be arranged to form a network (as shown in FIG. 4) to transfer the coarse ore (15) from a mine face (16) to a dumping location (17), such as a rock crusher, conventional train haulage system, or storage bin. Typically, the system described herein is used in conjunction with a machine capable of transferring raw material (18), such as a continuous loader. Although continuous loaders are known in the art, the dimensions of these vehicles typically do not lend themselves to optimal production levels within the system described herein. For example, in order to permit movement of the continuous loader within the access tunnel or drift, when the vehicles (1) are in place, the width of the continuous loader should be less than half the width of the access tunnel or drift. Based on a standard 5 metre wide access tunnel or drift, the smallest commercial available continuous loader that would work within this environment is 2.2 metres wide. However, since conventional continuous loaders are usually operated with a side car, the actual width of the conveyor is typically 1 metre. If the width of conveyors (3) of vehicles (1) are typically between 1.6 to 1.8 metres wide, then the overall production rate of the system will be limited by a continuous loader with a conveyor being 1 metre wide. Therefore, a continuous loader having a conveyor with a width that is equal to but not greater than the width of the conveyor (3) of vehicle (1) is preferred, and ensures that the largest piece of material discharged from the loader will not block the conveyors. To maximize loading capability, the continuous loader has a feeder pan that is 2 metres in width when in transport mode (i.e. when driving to the mine face), but can expand to 3 metres in width when in operation (i.e. when moving rock from the face of the mine).

[0036] As shown in FIG. 3, the coarse ore (15) is deposited, preferably from a continuous loader as described above, onto the loading

position of the conveyor of the first vehicle (1') in the network. The guides (14) of the conveyor (3) drag the coarse ore (15) to the discharge position of the conveyor (3), which results in the coarse ore (15) being deposited onto the loading position of the conveyor (3) of the second vehicle (1'') in the network. This sequence is continued until the coarse ore (15) enters the last vehicle in the network, represented by 1''' in FIG. 3. The coarse ore (15) from the last vehicle (1''') is discharged into the dumping location (17) for further processing.

[0037] As shown in FIG. 4, multiple vehicles (1) can be used to form the network that can stretch throughout the mine, including navigating around corners and obstacles. When the vehicles (1) are electrically powered, they can use the energy stored in onboard batteries to move into position within the mine, but when parked and transporting the coarse ore (15), each vehicle can be plugged into a stationary power source (19) to recharge the batteries and supply power to the motor responsible for moving the conveyor (3).

[0038] The vehicles (1) used within this system are typically positioned along one side of the access tunnel or drift (i.e. not in the middle of access tunnel or drift). This arrangement allows for additional vehicles, such as the vehicles described herein, and workers to pass-by the aligned vehicles (1) of the system. Moreover, this arrangement allows for disabled vehicles (1) to be quickly, and efficiently, removed and replaced from the system.

[0039] In order to allow for material transfer across a drift intersection, from a source drift to an adjacent drift, a transfer chute may be provided. The transfer chute is suspended at the end of the source drift and directs the flow of material from the elevated discharge position (11) of one vehicle (1) to the loading position (10) of a second vehicle (1'). The transfer chute is walled to prevent material from falling from the chute onto the ground below. The transfer of material in the chute occurs via gravity, by providing the chute at a slight decline from the loading area to the discharge area. The transfer can

be aided by replacing the floor of the chute with rollers. The use of a transfer chute to bridge these gaps in the drifts allows for access to the drifts without having to stop production.

[0040] It will be understood that numerous modifications thereto will appear to those skilled in the art. Accordingly, the above description and accompanying drawings should be taken as illustrative of the invention and not in a limiting sense. It will further be understood that it is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains and as may be applied to the essential features herein before set forth, and as follows in the scope of the appended claims.

CLAIMS

1. A vehicle for transporting coarse ore in a mine, said vehicle comprising:

a drive mechanism for moving the vehicle along a surface;

an inclinable conveyor positioned atop the drive mechanism for moving the coarse ore from a loading position to a discharge position; and

vertically extending walls positioned along the longitudinal sides of the conveyor,

wherein the loading position of the conveyor is offset from the vertically extending walls and the discharge position of the conveyor extends beyond the vertically extending walls.

2. The vehicle of claim 1, wherein the drive mechanism is electrically powered.

3. The vehicle of claim 1, wherein the drive mechanism is sectioned and each section is connected by an articulating connection.

4. The vehicle of claim 1, wherein the drive mechanism is remotely or autonomously controlled.

5. The vehicle of claim 4, wherein location and hazard sensors are positioned on the vehicle to allow for the vehicle to be autonomous.

6. The vehicle of claim 1, wherein the inclinable conveyor is mounted to the drive mechanism via posts.

7. The vehicle of claim 6, wherein the posts are adjustable to allow the distance between inclinable conveyor and the drive mechanism to be adjusted.

8. The vehicle of claim 1, wherein the conveyor is a chain conveyor.

9. The vehicle of claim 8, wherein the chains drive guides that move the coarse ore from the loading position to the discharge position.

10. The vehicle of claim 8, wherein the chain conveyor is powered by a separate engine from the drive mechanism.

11. A trackless system for transporting coarse ore from a mine face, the system comprising:

a network of vehicles as defined in any one of claims 1 to 10,

wherein the vehicles are arranged so that the discharge position of one conveyor is positioned near the loading position of a second conveyor.

12. A method of transporting coarse ore from a mine face comprising the steps of:

loading coarse ore onto the conveyor of the vehicle as defined in any one of claims 1 to 10;

moving the coarse ore from the loading position to the discharge position of the conveyor; and

discharging the coarse ore from the conveyor into a storage area.

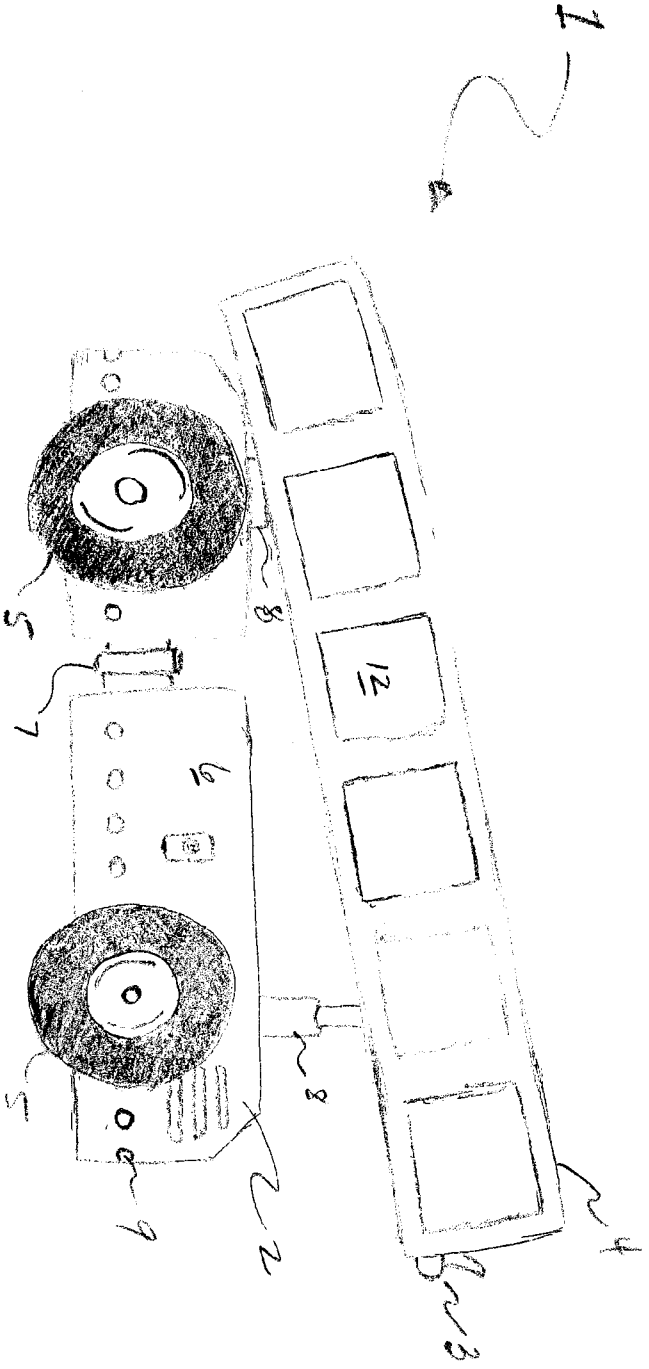


FIG. 1

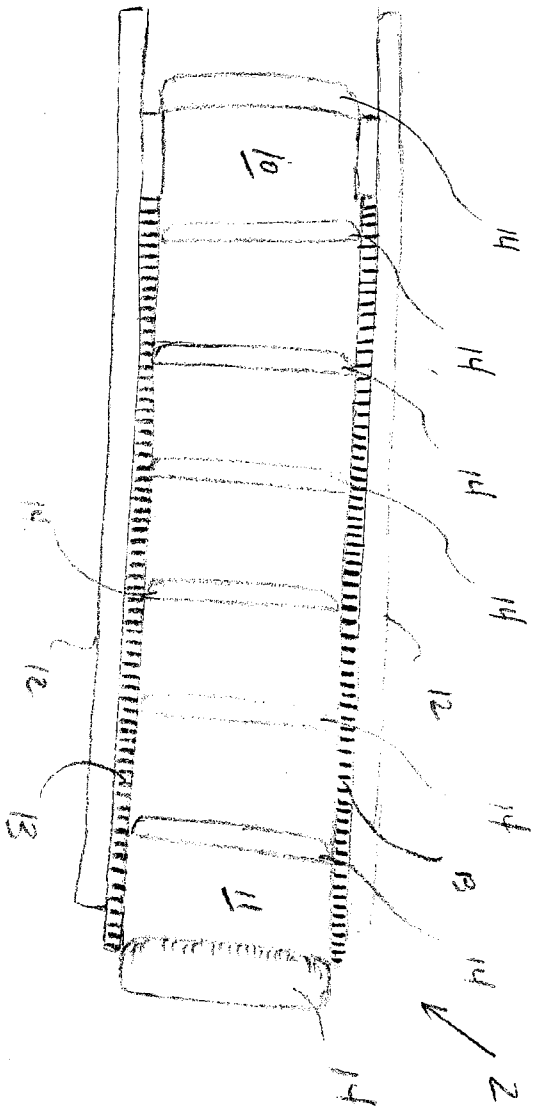


FIG. 2

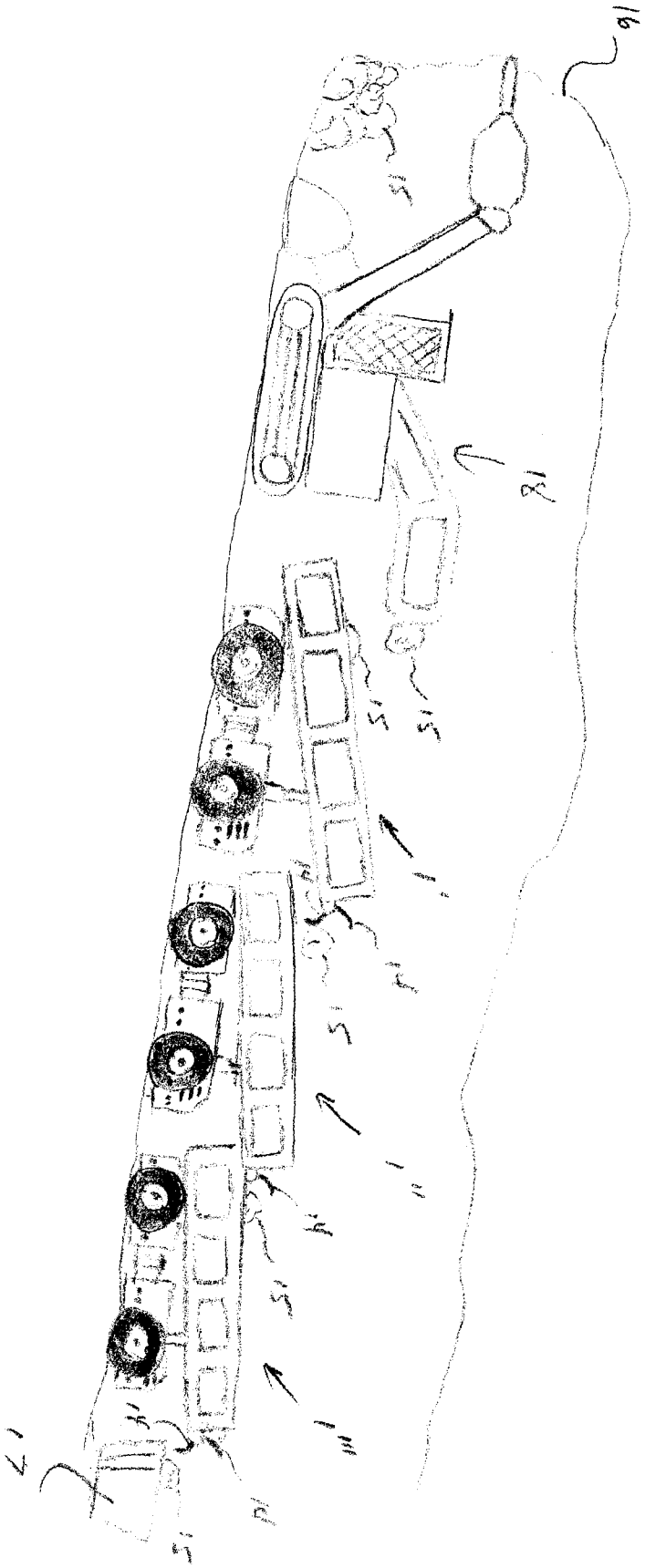


Fig. 3

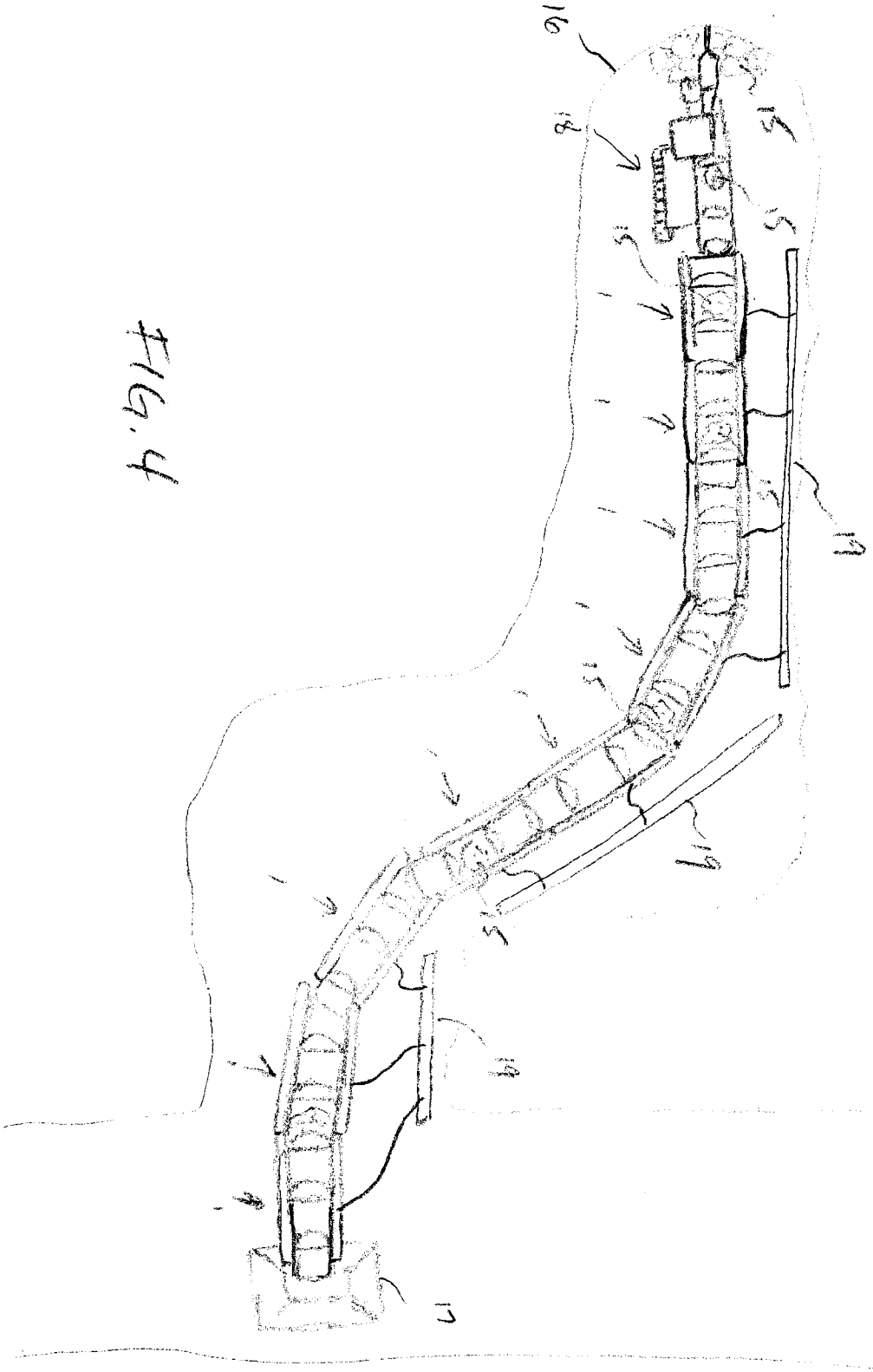
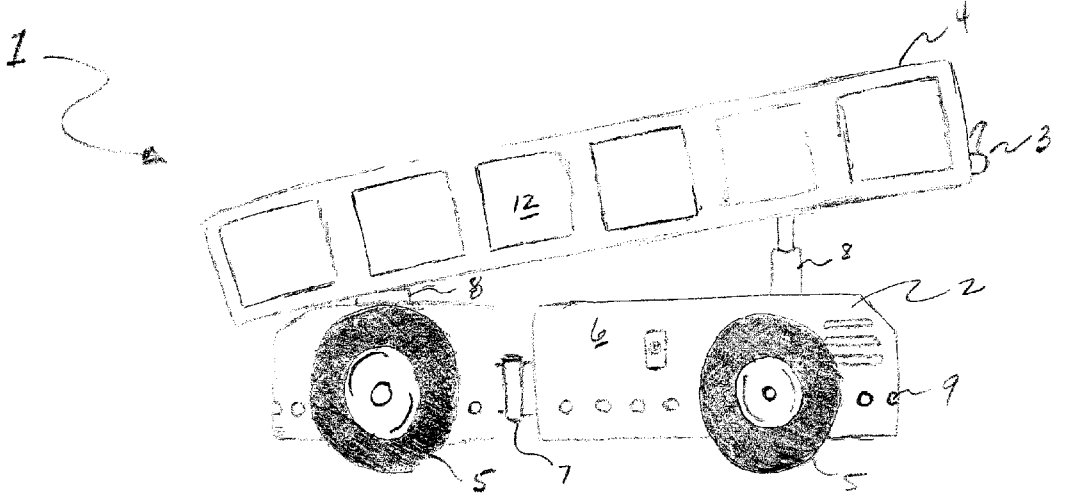


Fig. 4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