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(54) Ballast removing device

(57) A crawler mounted ballast remover (10), for example for excavating samples of railway ballast comprises a fan unit (17) operable to draw ballast into a hopper (15) via a hose and nozzle (24,25). Also disclosed is a method of coring a ballast layer, which both minimizes ballast removal and the tendency for a trial pit to collapse.

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Description

[0001] This invention concerns a device and method for removing ballast, in particular removing ballast from a railway track bed.

[0002] As is well known, rail ballast comprises fragments of rock or stone, typically having a mean dimension of about 50 mm. A layer of ballast of around 300-500 mm is laid on a prepared sub-soil base, and supports rail sleepers and other track bed equipment. The sleepers and other equipment are often partially or wholly buried in the ballast.

[0003] Difficulties arise when relatively small volumes of ballast require removal, for example for down hole inspection of the track bed. Manual removal is the usual solution, using forks and shovels, but this is very disadvantageous for a number of reasons. Firstly the work is physically demanding because ballast is heavy and very difficult to move owing to the interlocking nature of the stone fragments. Several track workers are usually required. Secondly a considerable volume of material is often removed unnecessarily, because of the tendency of the ballast to fall into the excavation. This disturbance of material may obscure the fault which is being investigated. Thirdly the excavation may dislodge ballast around the inspection area, which may potentially result in new track bed faults which are unrelated to the fault under inspection. Furthermore, it is often necessary to take a representative sample of ballast from a trial pit. This is difficult because ballast becomes very dirty with time, especially at the bottom of the pit.

[0004] Percussive coring techniques are frequently used for sampling from ballast and underlying sub-soil, but the coring devices are of small diameter and cannot be used for providing representative samples of ballast. Moreover, the samples cannot be inspected on site, so the inspection engineer does not have the benefit of being able to make an instant assessment of track bed condition.

[0005] What is required is an improved means of localized ballast removal, and an improved method for localized ballast removal.

[0006] According to a first aspect of the invention, there is provided a ballast removal apparatus comprising a chassis mounted on twin crawler tracks and having a power pack and hopper assembly thereon, the hopper assembly having a hopper, an inlet for the hopper and a fan adapted to form a partial vacuum in the hopper via said inlet, said power pack being adapted to drive said crawler tracks and fan on demand, and in use said fan being operable to draw ballast into the hopper via said inlet.

[0007] In the preferred embodiment the inlet comprises a flexible hose having a nozzle at the distal end, and provided with closure means. The nozzle may comprise a relatively rigid pipe having an internal diameter of about 100 mm. In one embodiment the hopper is provided with two inlets adjacent opposite sides thereof.

[0008] Preferably the hopper assembly comprises a substantially box-like hopper having vertical axis fan mounted on the top thereof, said inlet being provided in a side wall of the hopper, and said fan having an upwardly facing exhaust. The exhaust is preferably located in the top of the hopper. Preferably the crawler tracks have a track less than or equal to the width of said box-like hopper.

[0009] The power pack is preferably a transversely mounted internal combustion engine and hydraulic pump, being mounted at one end of the chassis and having a length and height less than the corresponding dimensions of the box-like hopper.

[0010] Preferably the hopper assembly is horizontally hinged at the other end of the chassis and is tiltable by a hydraulic ram provided on the chassis so as to permit the contents thereof to be emptied under gravity. For this purpose one or more doors may be provided in the end wall of the hopper, preferably with a horizontally disposed top hinge.

[0011] According to a second aspect of the invention, there is provided a method of forming a vertical inspection void in rail ballast, and comprising the steps of:

driving a tubular auger through the ballast whilst vacuuming ballast from the

interior thereof via a vacuum nozzle within the auger;

at a predetermined depth, removing the vacuum nozzle;

inserting a close fitting liner within the auger, said liner being adapted to permit viewing of the auger through the wall thereof;

and removing the auger.

[0012] The liner permits down-hole inspection of the ballast strata whilst substantially preventing collapse of the wall of the vertical void. The method permits partial or full excavation through the ballast layer, and may also be used for deeper excavation through the sub-soil bed beneath the ballast.

[0013] In one embodiment the liner is a clear tube formed from a short length of flexible plastic (e.g. acrylic plastic) which can be overlapped at the sides for easy insertion, yet will expand to closely engage the internal wall of the auger. The tube may be corrugated in the vertical direction to facilitate bending and to minimize surface friction on the auger. The corrugations may also interlock to maintain the clear tube at a diameter just less than the internal diameter of the auger.

[0014] As an alternative, the liner may consist of a wire cage having a mesh size sufficiently small to prevent ballast falling into the interior thereof. The cage may be of e.g. 3 mm bar defining a square mesh having a mean bar spacing of 40 mm.

[0015] Other features of the invention will be apparent from the following description of a preferred embodiment shown by way of example only in the accompanying drawings in which:-

Fig. 1 is a device according to the invention in schematic side elevation.

Fig. 2 is an end elevation corresponding to Fig. 1.

Fig. 3 corresponds to Fig. 1, and shows a hopper in a discharge position, and

Fig. 4 illustrates a vacuum hose for use with the invention

[0016] With reference to the drawings, a ballast suction apparatus 10 comprises a chassis 11 is supported on twin crawler tracks 12, and has mounted thereon a hydraulic power pack 13, and a hopper unit 14.

[0017] The chassis 11 is typically a straight ladder section frame adapted to support the power pack 13 at one end. This power pack typically consists of a diesel i.c. engine coupled to a hydraulic pump, and is self-contained with fuel tank, battery and other ancillaries. In the preferred embodiment the engine is rated at 28 HP, and pump output is 66 litres per minute at 110 bar.

[0018] The twin crawler tracks 12 are powered by independent hydraulic motors (not shown), and allow the apparatus 10 to move forward and back, and to turn, under operator control. Typically an operator may walk alongside the apparatus 10 and control movement thereof via a hand held control unit and umbilical.

[0019] The hopper unit 14 comprises a substantially closed steel hopper 15 of about $1m^3$ capacity, and a vertical axis fan assembly 16 powered by a hydraulic motor 17. The hopper has two stub pipe inlets 18, and a vertical exhaust outlet 19 having a grid-like guard. In use the fan rotates to form a partial vacuum in the hopper 15.

[0020] Horizontally hinged doors 20 are provided at each end of the hopper 14; as illustrated the doors are in the closed condition in which the respective openings are sealed sufficiently to maintain the partial vacuum in the hopper. Hydraulic connectors 21 are schematically illustrated.

[0021] As best shown in Fig. 3, the hopper is pivoted to the chassis adjacent the end opposite the power pack 13, and can be raised and lowered on demand by a suitable hydraulic actuator 22 which is mounted on the chassis. A mechanical latch may be provided to retain the hopper in the lowered and/or raised conditions.

[0022] Fig. 4 shows a suitable vacuum hose comprising a rigid nozzle 24 and flexible pipe 25 for coupling to a stub inlet 18. The nozzle may typically be about 1500 mm long, and the hose 3000-4000 mm.

[0023] In use the power pack and hydraulically operable components (tracks 12, fan assembly 16 and actuator 22) can all be controlled via a control panel, which consists of a series of levers located on top of the power pack.

[0024] In use the apparatus 10 is used to suck ballast into the hopper 15 via a flexible hose attached to one of two stub inlets 18. When not in use a stub inlet (or the hose attached thereto) is closed by a suitable gate valve or equivalent, thus giving increased suction at the other inlet. Two stub inlets 18 are provided so as to give access to both sides of the apparatus without the use of long hoses, but more or less can be provided, as required. Typically the apparatus is used to excavate a small volume of ballast to facilitate inspection of a railway track bed, or to ease removal and replacement of equipment in the track bed.

[0025] Ballast is replaced by raising the hopper, as illustrated in Fig. 3, and opening the lower door 20 (as illustrated in dotted outline) to permit the contents of the hopper to fall under gravity into the excavated area. The other door 20 (adjacent the power pack) is provided to give access to the interior of the hopper for the purpose of dislodging the contents. Both doors may be provided with latches to hold them in the open condition.

[0026] The hopper may include vertically arranged baffle walls in the base thereof so as to allow ballast to accumulate in pre-defined compartments. Such an arrangement is useful if a portion of ballast is to be removed for subsequent testing or analysis. A separate door into such compartment(s) may be provided to ease removal of the sample(s).

[0027] The vacuum arrangement of the invention allows small quantities of ballast to be removed in the particular area of interest, and with a considerably reduced risk of disturbance of adjacent ballast. Thus for example, the area around a sleeper or other track bed component may be removed in a localized manner so as to permit removal and replacement thereof. The area around and under the component is substantially undisturbed, and accordingly replacement is significantly easier.

[0028] In the case of track bed inspection, an excavation is required in order to assess the nature and depth of ballast and sub-soil or other base. The present invention permits a hole to be created for inspection purposes, but collapse thereof is almost inevitable as excavation continues.

[0029] A second aspect of the invention concerns a novel method of down-hole inspection using the vacuum device already described. For this purpose a tubular auger somewhat larger in diameter than the vacuum nozzle is screwed into the track bed on a generally vertical axis through a distance of about 50-80 mm. The auger has simple teeth at the ballast engaging end, for example castellations which serve to dislodge ballast into the interior. At the outer end the auger has hand holds to permit arcuate movement thereof by track operatives. The auger may be for example 1000-1500 mm tall and 150-200 mm outside diameter - the auger may be cut from a handy piece of steel pipe. The auger is typically heavy enough to sink under its own weight if aided by arcuate move-

ment.

[0030] Once screwed into the ballast, the vacuum nozzle is used to suck out loose ballast in the interior of the auger, following which the auger is screwed further into the ballast. A crow bar or other tool may be required to loosen up the central core of ballast, which may have become very compact with time. This procedure continues, as an almost continuous operation, until the auger is at the required depth, or has penetrated through the ballast layer.

[0031] The vacuum nozzle is removed, and for example a close-fitting clear tube is inserted within the auger to full depth. The auger is then removed. A small amount of ballast will collapse into the tubular void formed as the auger is pulled out, but the clear tube will maintain the integrity of the inspection hole, and permit down-hole inspection of the ballast through the wall thereof. The clear tube may for example be constituted by a short length of corrugated acrylic plastic, the corrugations running vertically and allowing a tube to be formed and inserted. An open wire cage is a suitable alternative.

[0032] If necessary a sub-soil sample can be taken through the bottom of the hole, for example by driving one or more coring tubes into the sub-soil, and removing the cores for inspection.

[0033] A particular advantage of a hydraulic power pack on the vacuum device is that a hydraulic power take-off may be provided whereby a pneumatic breaker may be used to drive through hard or very compacted surfaces, prior to vacuuming, or to drive aforementioned coring tubes.

[0034] The device of the invention is particularly manoeuvrable, due to the crawler mechanism and can cross rough and steep ground, and turn in its own length. Furthermore the device is small, and optimally is sized to fit within a large van of the size adapted to take a standard pallet through the rear doors. Exit from the van is via removable ramps, which can also be used to mount the device on a rail trolley or other rail mounted vehicle. Typical overall dimensions are: length 1.32 m, width 1.14 m, height 1.1 m, track overall length 1.4 m, centre to centre width of tracks 0.87 m.

[0035] The crawler tracks are within the standard rail gauge, which in the United Kingdom is about 1.33m. In the case of a broader gauge, the crawler tracks could be more widely spaced.

[0036] The device may be mounted on a flat-bed rail trolley or carriage.

[0037] The skilled man will appreciate that various detail features of the invention may be changed or adapted to suit circumstances of use whilst without rendering the apparatus or method outside the scope of this patent application.

Claims

1. A ballast removal apparatus (10) comprising a chassis (11) mounted on twin crawler tracks (12) and having a power pack (13) and hopper assembly (14) thereon, the hopper assembly having a hopper (15), an inlet (18) for the hopper and a fan (16) adapted to form a partial vacuum in the hopper via said inlet, said power pack (13) being adapted to drive said crawler tracks (12) and/or fan (16) on demand, and in use said fan (16) being operable to draw ballast into the hopper (15) via said inlet (18).

2. Apparatus according to claim 1 wherein said inlet (18) comprises a flexible hose (25) having a nozzle (24) at the distal end, and is provided with closure means.

3. Apparatus according to claim 2 wherein said nozzle comprises a relatively rigid pipe having an internal diameter of about 100 mm.

4. Apparatus according to any preceding claim wherein said hopper assembly (14) comprises a substantially box-like hopper (15), and said fan (16) is mounted on the top of said hopper and has a vertical axis, said inlet being provided in a side wall of the hopper, and said fan having an upwardly facing exhaust.

5. Apparatus according to claim 4 wherein said exhaust is located in the top of the hopper.

6. Apparatus according to any preceding claim wherein said hopper (15) is provided with two inlets (18) respectively adjacent opposite sides thereof.

7. Apparatus according to any preceding claim wherein said crawler tracks have a track less than or equal to the width of said hopper (15).

8. Apparatus according to any preceding claim wherein said power pack (13) comprises a transversely mounted internal combustion engine and hydraulic pump, mounted at one end of said chassis (11) and having a length and height less than the corresponding dimensions of said hopper (15).

9. Apparatus according to any preceding claim wherein said hopper assembly (14) is horizontally hinged at one end of said chassis (11) and is tiltable by a hydraulic ram (22) provided on the chassis (11) so as to permit the contents thereof to be emptied under gravity.

10. Apparatus according to claim 9 and having one or more doors provided in an end wall of the hopper, and having a horizontally disposed top hinge.

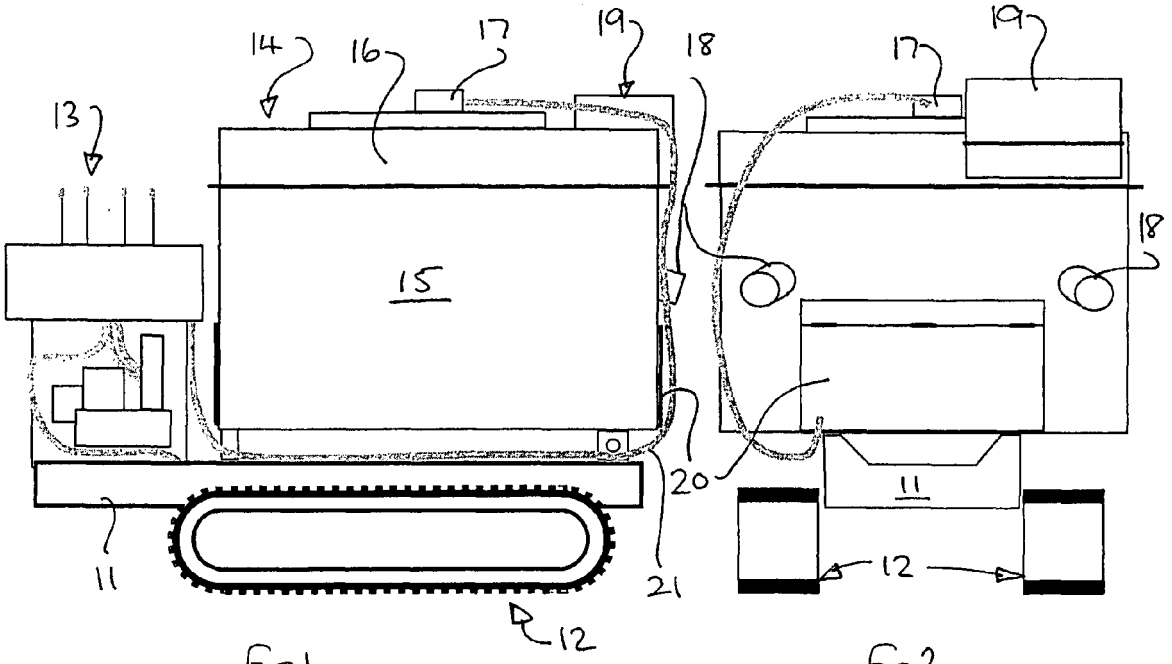

Fig1

Fig2

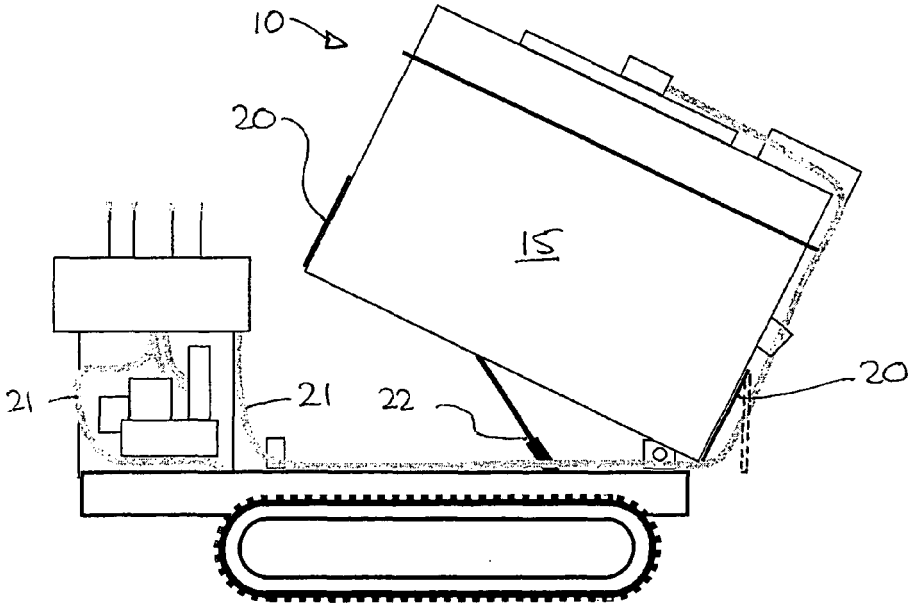

Fig3

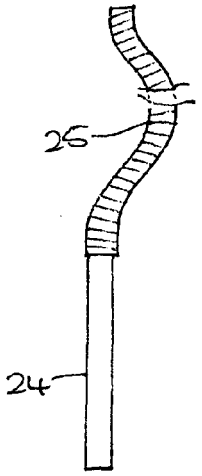

Fig4