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(21) International Application Number: PCT/FI92/00300 (22) International Filing Date: 6 November 1992 (06.11.92) (30) Priority data: 915274 8 November 1991 (08.11.91) FI (71) Applicants (for all designated States except US): SÖDERBERG, Folke [SE/SE]; Fonaboda, PL 1241, S-711 91 Lindesberg (SE). ALASAUKKO-OJA, Osmo [SE/SE]; Sandströmsgatan 2, S-711 31 Lindesberg (SE). (72) Inventor; and (75) Inventor/Applicant (for US only) : GREUS, Matti [FI/FI]; Pysäkkitie 81, SF-90310 Oulu (FI).		(74) Agent: LAHTI, Helena; Oulun Patenttitoimisto Oy, Torikatu 58-60 A, SF-90120 Oulu (FI). (81) Designated States: CA, CS, FI, HU, NO, PL, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE). Published <i>With international search report.</i> <i>In English translation (filed in Finnish).</i>
(54) Title: APPARATUS FOR REMOVING THE BALLAST OF A RAILWAY WITHOUT DEMOUNTING THE TRACK (57) Abstract The invention relates to an apparatus for removing the ballast of a railway without demounting the track. The apparatus comprises an excavator (12) or the like, which is provided with a boom (13) and own wheels or the like, and an aggregate remover (15). The aggregate remover (15) comprises a body (1) and, in connection with the body (1), an endless circumferential member (2) having at least one transporting member (3) attached thereto, the body (1) being essentially a planar blade or the like and the body (1) being designed to be inserted under the track for rotating the endless circumferential member (2) by means of a drive unit (7) in a plane below the track for removing mineral aggregate out of the ballast layer by means of said at least one transporting member (3) from beneath the track to the side thereof. The aggregate remover (15) is arranged to be operated by means of said excavator (12) or the like, the aggregate remover (15) being arranged to be moved and pushed by means of said boom (13) into the ballast under the track from said side of the track.		

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Apparatus for removing the ballast of a railway without demounting the track

The invention relates to an apparatus for removing the ballast of a railway without demounting the track
5 according to the ingress part of claim 1.

The structural parts of a railway are the track comprising rails and sleepers, the ballast layer, the intermediate layer, the insulating layer and the embankment fill. The purpose of the ballast layer is to hold the track in a
10 specified, geometrically right position and the purpose of ballasting is to obtain a track which is accurately positioned in vertical and lateral directions.

The ballast layer is commonly made of railway ballast. The mineral aggregate used for the ballast must be hard,
15 weather resistant, wear and impact resistant. Railway ballast should not contain any humus, plant remains or any other impurities which might enhance frost lifting.

Although there are strict quality specifications for the ballast, it is obvious that in the course of years there
20 will be deformations due to weathering and soiling which change the geometry of the railway. Freezing contaminations in the ballast cause frostheaves in the railway. For instance, railway level crossings are particularly apt to be damaged by frost and it is the
25 humus and other frost-susceptible material that spoils the ballast. In this case, the ballast must be removed and the ballasting must be done anew to get the track in the right position.

To enable reballasting the old ballast layer must be
30 removed and cleaned by sieving for reutilization. If the

ballast is of poor quality it is preferably utilized as filling material for the embankment or it is carried away. If used ballast is to be used as filling material for the embankment it would be beneficial that the removed ballast
5 could be conveyed to both sides of the track to facilitate reutilization.

Ballast replacement is conventionally performed so that first the track is demounted and put aside after which the old ballast and possibly other structural layers of the
10 railway can be replaced. An apparatus is known which removes the ballast without demounting the track. In this apparatus there is a scraper chain which goes under the track and which scrapes the mineral aggregate of the ballast and transfers it onto a sieve. By means of the
15 sieve, the waste material of the mineral aggregate is separated from the ballast. The ballast is returned under the track and the waste material is carried by a belt-conveyor to one side of the track. The buckets of the scraper chain typically consist of finger-like members
20 which are made of hard metal and which loosen stones from the ballast. The sieve of the apparatus is typically a vibrating sieve.

It is essential of the apparatus of the prior art that the scraper chain and the guide members belonging thereto form
25 a closed unit which goes round the track. The apparatus is mounted to a chassis which moves on the track and it is generally provided with a mechanism for supporting the track. Said apparatus is originally designed as a ballast washing-machine.

30 There are several drawbacks in the operation of the conventional apparatus. In order to mount the scraper chain, a trench must be excavated across the track whereto the first end of the chain is placed to be attached to the

other end of the chain to form an endless member which goes round the track. Normally, the trench must be dug manually. If it is desired to use the removed material as filling material for the embankment, the apparatus of
5 prior art moves all material to one side of the track. Therefrom, the material must then be separately distributed evenly to both sides of the track. When there is a passing train, the apparatus must be moved to a side track which may require that the apparatus must be moved a
10 long way and which naturally causes a delay in the work. The purchase price of the apparatus is very high which means that capital costs have a dominant role compared to the relatively modest work of ballast removing. It should be possible to change the ballast using a much less heavy
15 and a considerably less costly equipment.

The objective of the invention is to eliminate above drawbacks and present an apparatus for removing the ballast of a railway without demounting the track which apparatus has a simple structure and versatile operation.
20 These objectives are obtained by means of an apparatus which is characterized in what is presented in the characterizing part of claim 1. The apparatus comprises an aggregate remover which is operated by such an excavator which is provided with track wheels in addition to
25 conventional wheels or caterpillar tracks. This is advantageous in that the apparatus can be moved both on roads and on railway tracks and, when there is a passing train, the apparatus need not be moved a long way since one can use e.g. the nearest level crossing to move the
30 excavator aside for the time of the passing train. The aggregate remover, which is mounted to the boom of the excavator, is pushed by means of said boom into the ballast below the track from one side of the track. The aggregate remover can be pushed under the track without
35 any trenches and it enables removal of the ballast evenly

to both sides of the track. One aggregate remover is provided with blade-like transporting members which are wider within their lower portion and which carefully move the ballast aside through sliding so that the sleepers are not damaged.

The apparatus according to the invention brings along a considerable saving of time. For instance, it takes only 2-3 hours to change the ballast under a one-track level crossing. The working speed on track is approximately 100 track-m/h and the work requires only a few persons. If necessary, a sieve dipper can be provided in connection with the excavator which then enables one to perform all those stages of operation which are needed in reballasting.

The invention will now be described in the following referring to the enclosed drawings in which

- figure 1 shows an aggregate remover installed to an excavator seen obliquely from above when the remover is being pushed under the track,
- figure 2 shows the aggregate remover installed to an excavator seen from above,
- figure 3 shows an aggregate remover seen from above and partly cross-sectioned,
- figure 4 shows a part of the aggregate remover according to figure 3 seen from the side,
- figure 5 shows a cross-sectioned view of the aggregate remover according to figure 3 with the endless circumferential member removed and seen from the side and
- figure 6 an apparatus according to the invention with the aggregate remover pushed under the track.

In the exemplary case, the apparatus according to the

invention comprises an excavator, having a boom 13 and own wheels, and a mechanism 15 for removing mineral aggregate which hereon will be called the aggregate remover 15. Thus an excavator or the like apparatus, which has conventional operational capabilities and which is provided with normal wheels or track chains, serves as the drive mechanism for the aggregate remover 15. To make use of the aggregate remover 15 possible in a reballasting work that proceeds along the longitudinal direction of the track, the excavator 12 is also provided with track wheels 14, which are made of steel, to move the excavator 12 specifically on the same track whose ballast is being removed. Therefore, the excavator 12 that is used is a normal excavator except that it is provided with track wheels 14 for travel along the track.

The aggregate remover 15 is attached to a fast coupling member on the boom 13 of the excavator. To this fast coupling member, e.g. a sieve dipper can be connected after the ballast removal work by which dipper the ballast removed from beneath the track is cleaned and sieved for reuse.

As to the trajectories of the aggregate remover 15, there are available the same trajectories of motion as there are in a normal operation of the excavator 12. Therefore, it can be moved up, down, forward, backward, left and right, and it can be inclined and rotated at the end of the boom.

The aggregate remover 15 gets its power from the hydraulic system of the excavator. The hoses of the hydraulic motor, which serves as the drive unit 7, are connected to the corresponding hydraulic connectors of the excavator 12 i.e. to the hydraulic inlet and outlet connectors whereby operation of the hydraulic motor can be controlled by a valve in the cab of the excavator 12. If it is desired to

change the direction of rotation of the hydraulic motor, the flow direction of the hydraulic liquid is changed so that the inlet hose becomes the outlet hose and the outlet hose becomes the inlet hose, respectively.

- 5 The aggregate remover 15 comprises primarily a body 1 and, in connection with the body 1, an endless circumferential member 2 having transporting members 3 attached thereto. The body 1 is essentially a planar blade or the like, which is designed to be positioned essentially
10 horizontally under the track. The endless circumferential member 2 is disposed on the outer circumference of the body 1.

The aggregate remover 15 is pushed into the ballast layer under the track from the side of the track essentially in
15 a horizontal plane and the endless circumferential member 2 is rotated in a plane below the track. Transporting members 3 attached to the endless circumferential member 2 dig into the mineral aggregate of the ballast and transport it from beneath the track to the side thereof.

- 20 The aggregate remover 15 transports mineral aggregate of the ballast layer from the middle of the track to the side of the track. The aggregate remover 15 can be turned to operate in a similar way on the other side of the track.

- The endless circumferential member 2 is in the exemplary
25 case a track chain or the like and the transporting member 3 is a blade which projects perpedicularly from the circumferential member 2 and extends vertically. Attached to the circumferential member 2 between the transporting members 3, there are also provided finger-like members 4
30 made of hard metal which are designed to disintegrate possible ice or very tightly compacted mineral aggregate in the ballast.

- The lower part 3' of the transporting member 3 is essentially wider than the upper part 3''. This enables the transporting member 3 to dig into the mineral aggregate so that, during rotation of the endless circumferential member 2, the mineral aggregate of the ballast above the lower portion of the transporting member 3' first falls down and then it is transported, pushed by the transporting member 3, to the side of the track. Transporting members 3 transport mineral aggregate from the ballast layer so that the ballast layer slides down in slices along a slide plane specific to used mineral aggregate to be then transported by the transporting members 3. Therefore, the rotating track chain cannot damage the track structure.
- 15 The circumferential member 2 is arranged to rotate under guidance of a pulley 5 which is mounted in bearings to the body 1 so that the pulley 5 is connected to the drive unit 7 preferably by means of a power transmission assembly 8. As already mentioned earlier, a hydraulic motor serves as the drive unit 7 in the exemplary case. The power transmission assembly 8 comprises a planetary gear which is arranged to control the rotational speed of the endless circumferential member 2. The transmission ratio of the planetary gear is so chosen that the speed of the circumferential member 2 i.e. the track chain can be changed within suitable limits.

The trajectory of the circumferential member 2 is elongated. This has been achieved so that the circumferential member 2 is arranged to rotate under guidance of a second pulley 6 which is mounted in bearings to the body 1. The second pulley 6 is mounted in bearings to a spring-loaded traveller 10 which traveller 10, in case of overload, is constrained to move along guides 11, which are mounted to the body 1 and which are parallel

with the longitudinal direction of the aggregate remover, towards the pulley 5 which is connected to the drive unit 7. This is beneficial in that if it happens that a stone gets between the track chain and the pulley 6 or the pulley 5 the aggregate remover will not be damaged.

The body 1 of the aggregate remover 15 is also provided with suspension means 9 which are advantageously placed closer to the pulley 5, which is connected to the drive unit 7, apart from said drive unit 7.

10 The aggregate remover functions in the following way. The hydraulic motor drives the planetary gear which transmits power to the driven pulley and further to the track chain which performs removal of ballast from beneath the track by means of transporting members. The track chain turns
15 around the sheave pulley and back to the driven pulley. The sheave pulley is spring-loaded and it can move in the traveller 10 towards the driven pulley 5. The pulley assembly of the aggregate remover is protected by protective plates which are part of the body and which are
20 placed on both sides of the track chain. When the operation is transferred to the other side of the track, the rotational direction of the chain is changed so that mineral aggregate moves outwards from beneath the track. That portion of the track whose ballast layer is removed
25 is supported e.g. on jacks or the like. Supporting the track on a right height level can also be performed only when cleaned ballast is being layed under the track.

The invention is not limited to the embodiment described above but can be varied within the limits of the enclosed
30 claims. The aggregate remover is not necessarily elongated and provided with a track chain rotating around two pulleys but it can be designed to have another form.

Claims

1. Apparatus for removing the ballast of a railway without demounting the track, the apparatus comprising an excavator (12) provided with a boom (13) and own wheels or the like and an aggregate remover (15) comprising a body (1) and, in connection with the body (1), an endless circumferential member (2) having at least one transporting member (3) attached thereto, the body (1) being essentially a planar blade or the like and the body (1) being designed to be inserted under the track for rotating the endless circumferential member (2) by means of a drive unit (7) in a plane below the track for removing mineral aggregate out of the ballast layer by means of said at least one transporting member (3) from beneath the track to the side thereof **characterized** in that the aggregate remover (15) is arranged to be operated by means of said excavator (12) or the like, the aggregate remover (15) being arranged to be moved and pushed by means of said boom (13) into the ballast under the track from said side of the track.

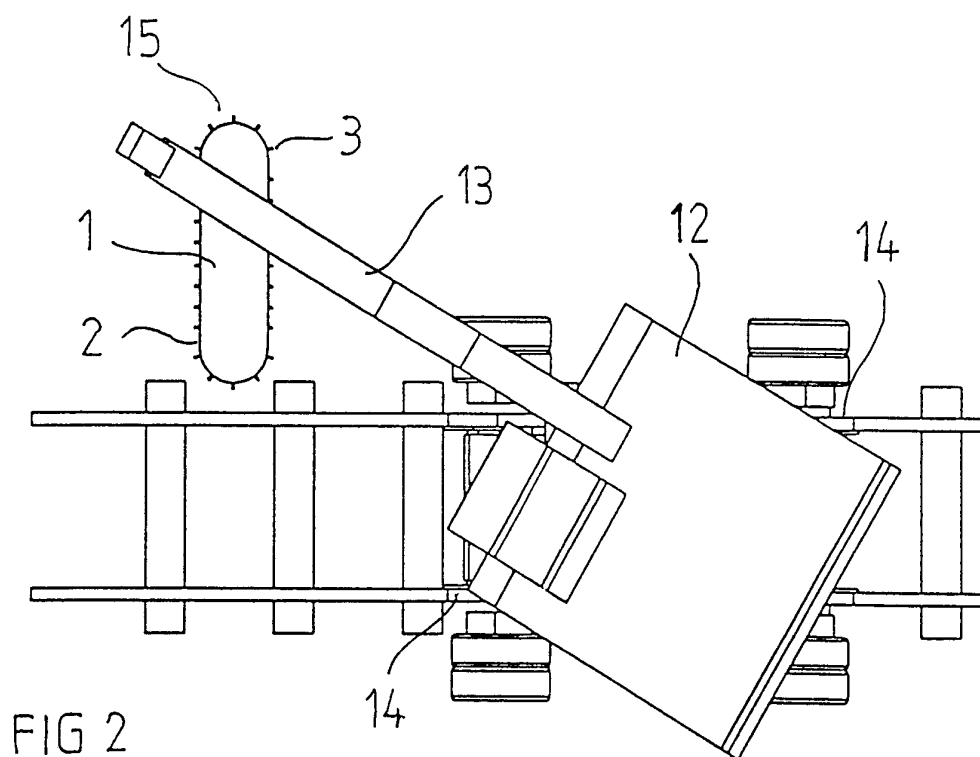
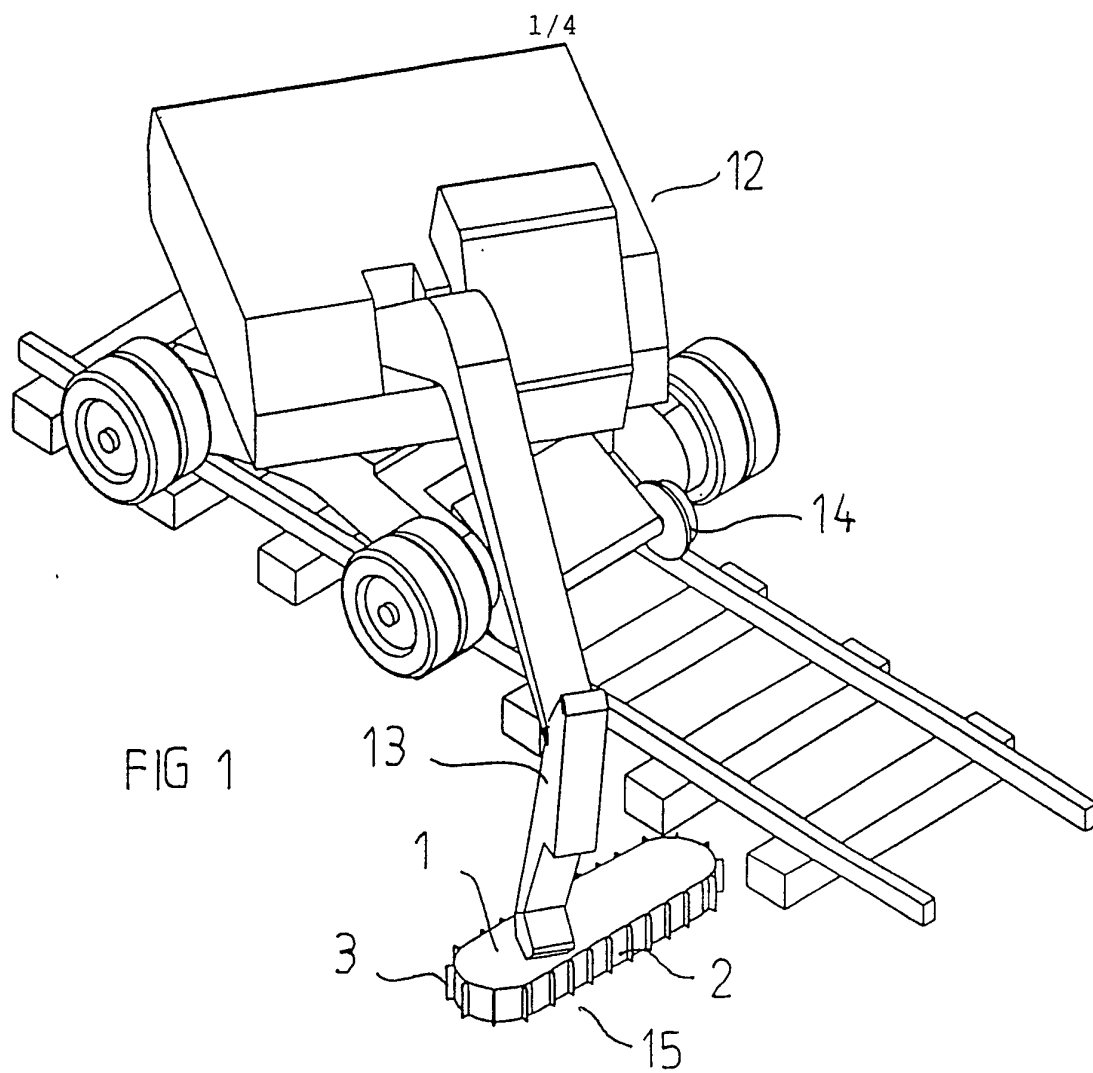
2. Apparatus according to claim 1 **characterized** in that, in order to operate the aggregate remover (15) in a removing work which proceeds in the lengthwise direction of the track, the excavator (12) or the like is additionally provided with track wheels (14) in order to move the excavator (12) or the like particularly along that track whose ballast is to be removed.

3. Apparatus according to claim 1 **characterized** in that the body (1) of the aggregate remover (15) is provided with suspension means (9) for mounting it to the boom of the excavator (12) or the like.

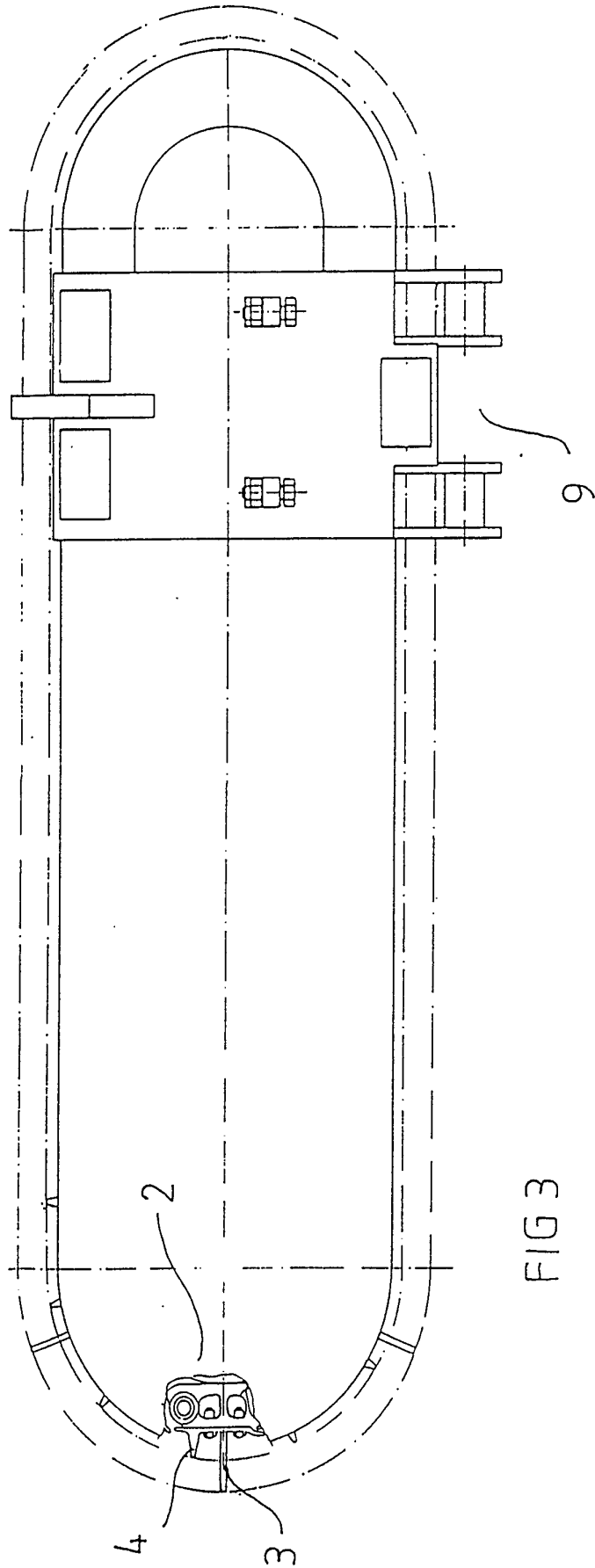
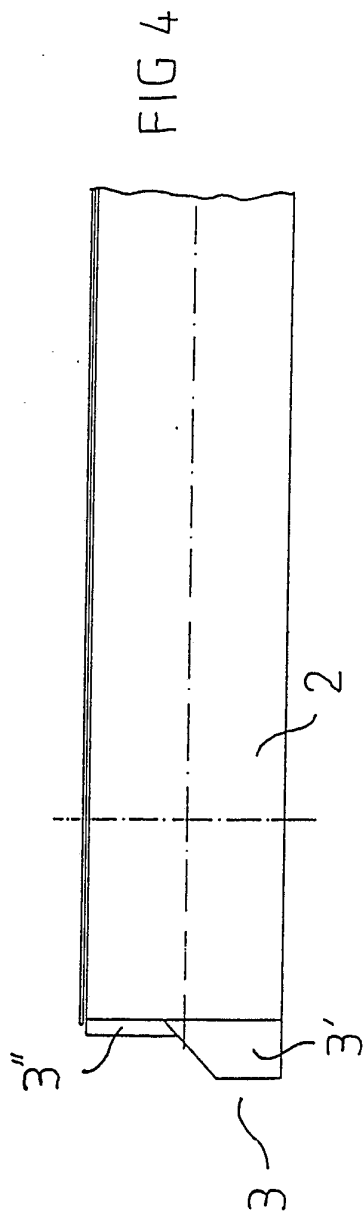
4. Apparatus according to claim 3 wherein the endless circumferential member (2) of the aggregate remover (15) is arranged to rotate under guidance of at least one pulley (5) which is mounted in bearings to the body (1),
5 said at least one pulley (5) being connected to the drive unit (7) preferably by means of a power transmission assembly (8), **characterized** in that the suspension means (9) are placed apart from said drive unit (7).
- 10 5. Apparatus according to claim 4 wherein the endless circumferential member (2) of the aggregate remover (15) is arranged to rotate additionally under guidance of a second pulley (6), which is mounted in bearings to the body (1), along an elongated path **characterized** in that
15 the suspension means (9) are placed closer to said first pulley (5) which is connected to the drive unit (7).
- 20 6. Apparatus according to claim 5 **characterized** in that said second pulley (6) is mounted in bearings to a spring-loaded traveller (10) and that said traveller (10), in case of overload, is constrained to move along guides (11), which are mounted to the body (1) and which are parallel with the longitudinal direction of the aggregate remover, towards the first pulley (5) which is connected to the drive unit (7).
- 25 7. Apparatus according to claim 4 **characterized** in that the drive unit (7) is a hydraulic motor which is in hydraulic connection with said excavator (12) and that the power transmission assembly (8) comprises a planetary gear which is arranged to control the rotational speed of the
30 endless circumferential member (2).
8. Apparatus according to claim 1 wherein the endless circumferential member (2) of the aggregate remover (15) is a track chain which is disposed on the outer perimeter

of the body (1) and in which said at least one transporting member (3) is essentially a vertical blade projecting from the endless circumferential member (2),
characterized in that the lower part (3') of the
5 transporting member (3) is essentially wider than the upper part (3'').

9. Apparatus according to claim 8 **characterized** in that, attached to the endless circumferential member (2) of the aggregate remover (15), there are additionally provided
10 finger-like members (4) which are preferably made of hard metal for breaking ice or the like in the ballast.



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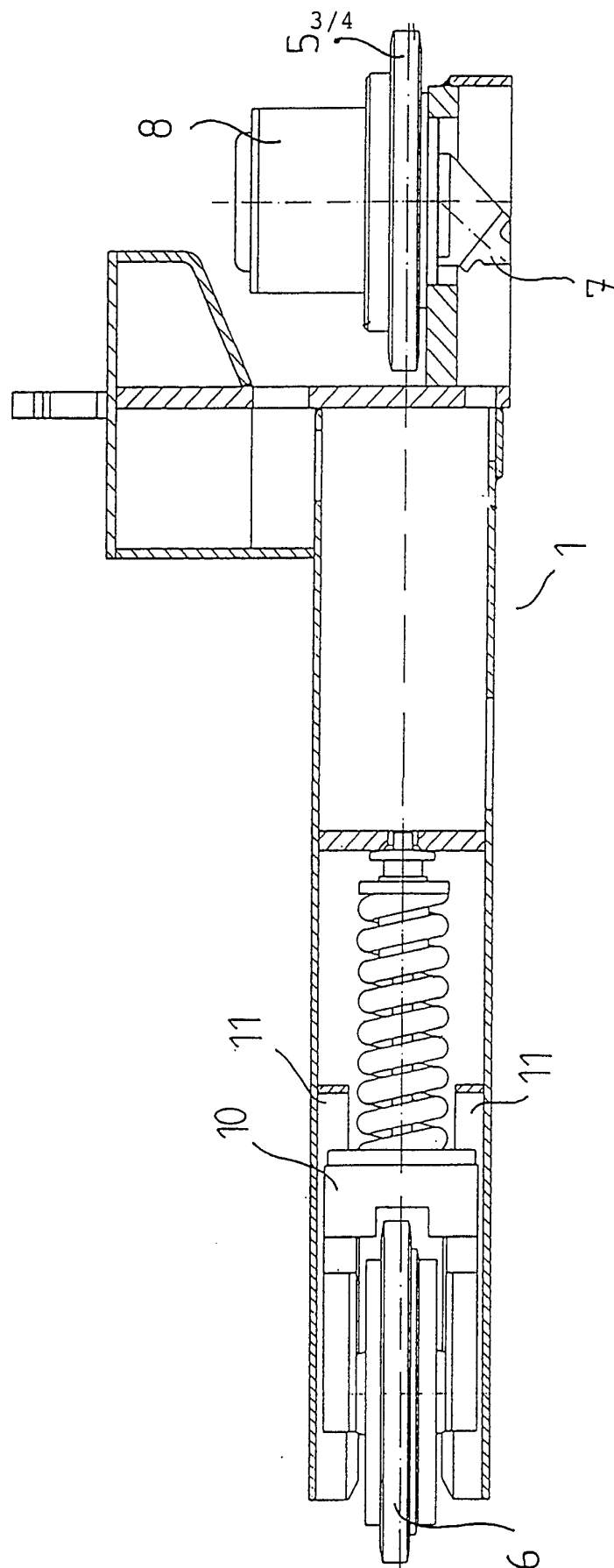
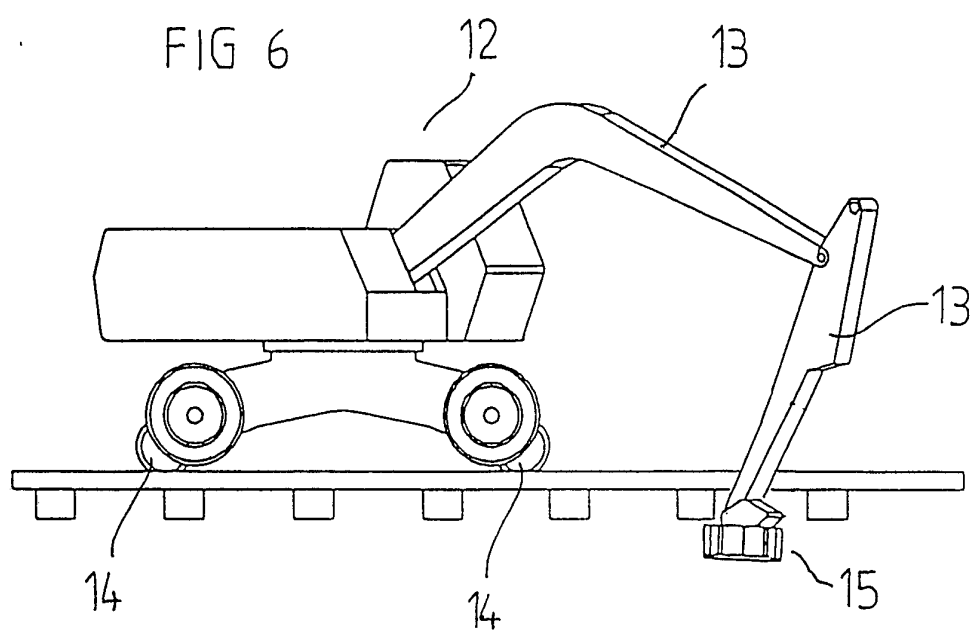


FIG 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 92/00300

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: E01B 27/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: E01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR, A1, 2551781 (SOTRAMEF), 15 March 1985 (15.03.85), page 3, line 11 - line 24; page 5, line 22 - line 27, figures 5,6	1-5,7
A	figure 6 --	6,8,9
X	US, A, 3436848 (R.A. PEPPIN ET AL), 8 April 1969 (08.04.69), page 2, column 4, line 25 - line 30; page 2, column 4, line 60 - line 70; page 1, column 2, line 59 - line 69, page 2, column 3, line 21 - line 26	1-4,7
A	figure 1 --	5,6,8,9

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 2886904 (R. KERSHAW), 19 May 1959 (19.05.59), figure 2 --	1-9
A	DE, C2, 3036007 (FRANZ PLASSER BAHNBAUMASCHINEN-INDUSTRIEGESELLSCHAFT M.B.H), 23 February 1989 (23.02.89), figure 3 -- -----	1-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

29/01/93

International application No.

PCT/FI 92/00300

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
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US-A-	3436848	08/04/69	NONE		
US-A-	2886904	19/05/59	NONE		
DE-C2-	3036007	23/02/89	AT-A,B-	369805	10/02/83
			AU-B-	536350	03/05/84
			AU-A-	6287180	28/05/81
			CA-A-	1158096	06/12/83
			FR-A,B-	2470189	29/05/81
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