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(54) **Underground track replacement in tube tunnels**

(57) The invention is concerned with a method of replacing, in an existing underground, the original track within the tunnel. The old track is removed and from outside the tunnel via a station entrance, separate, prefabricated elongated elements (4) are supplied and installed to bear a running rail (1). Coupling elements (5) are supplied from outside the tunnel and are mounted to the elements (4) to keep them at a mutual distance. The elements (4) contain recesses (6) and the elements (4) are positioned such that the recesses (6) receive the typical radial coupling flanges of the tunnel sections that project inwards from the tunnel wall, such that the elements (4) bear with a large surface area on the tunnel wall.

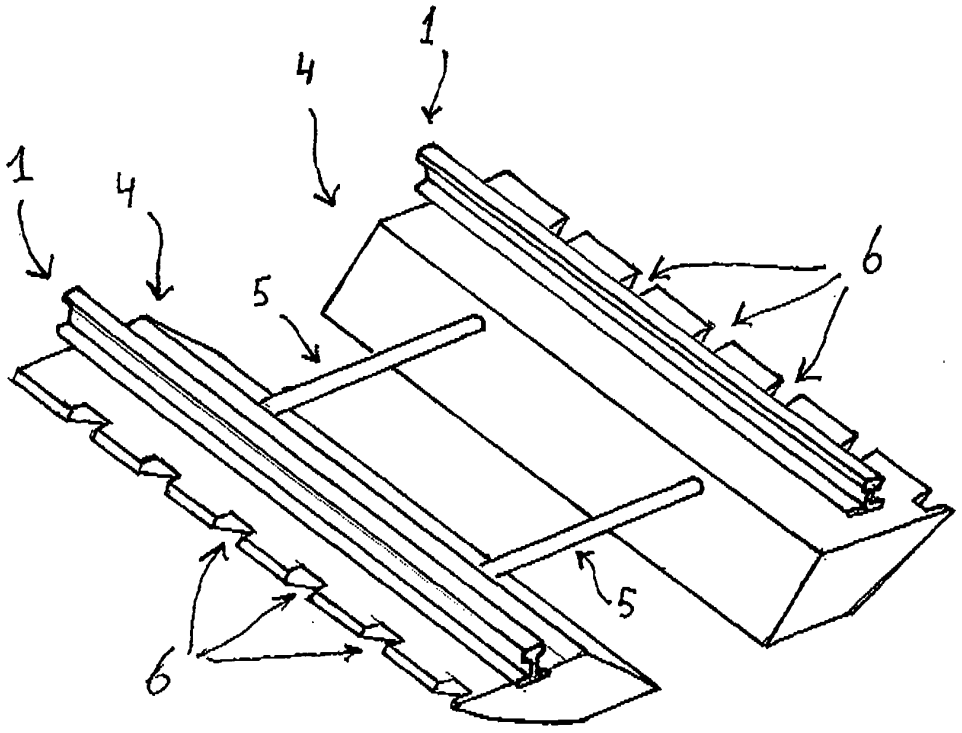

Fig. 2

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Description

[0001] This invention is specifically directed to the London Underground, however it is also applicable to other underground railways.

[0002] Typical for this field is that logistics are very complicated as a lack of space and power limits the use of heavy equipment and access to the track is generally limited to the station entrances. Work on the track is basically limited to two periods. One is during the nightly hours between the last and the first train services, approximating 3.5 "Engineering Hours". The other is during weekend closures ("Possessions") of parts of a line, approximating 52 hours. Using prior art techniques, track replacement reaches about 1 metre during Engineering Hours and 60 metres during Possession.

[0003] The object of the invention is versatile and e.g. one or more of the following aspects: to considerably increase the speed of track replacement; decrease the work load (e.g. lower noise and dust levels, less manual breakout and handling); improve the track quality/durability; reduction of forces and vibration levels caused by the train wheel-rail interface (for vibration e.g. 20 dB), yielding improved passenger comfort by lowering noise- and vibration levels; decreasing the frequency of corrugation. With the invention 90 metres track replacement is e.g. feasible during Possession.

[0004] In a non-limiting way, the invention will further be elaborated in relation to the London Underground, the oldest major system typically consisting of cast iron tunnel sections and rail supported on wooden sleepers, embedded in an unreinforced concrete base, small tunnel diameters (approximately 3.5 or 3.8 m) and many horizontal and vertical curvatures (radius as small as 90 m) . Most of the tunnel tubes were constructed by digging through clay layers using a shield method and contain a single track. A single track consists of four rails: two running and two conductor. The track should be electrically insulated from the tunnel sections.

[0005] According to the invention, the original track within the tunnel is replaced by removing the old track and supplying from outside the tunnel separate, prefabricated elongated elements (hereafter called slabs) and installing them such that they extend in longitudinal direction of the tunnel and at a mutual, substantially constant distance and then mounting on top of each slab a rail such that the rails are located in substantially the location of the rails of the original track.

[0006] During removal of the original track, existing sleepers and concrete will typically be removed- A slab typically will measure between about 2 and 6 metres. Thus, a plurality will be installed head to tail for a left or right rail of the track. The slab can be made of casting, curable material such as (reinforced) concrete or material yielding similar properties like a mixture of fibres and binder. A rail will be discretely (i.e. at regular intervals such as the Pandrol Vanguard system) or continuously supported (such as an embedded rail) by the slab.

[0007] The invention is now further illustrated by way of example only while refering to the drawing which shows in:

Fig. 1 a cross section of an underground railway track;
Fig. 2 a perspective view of the renewed track.

[0008] Fig. 1 shows the mutual position of the left and right running rail 1, supporting the running wheels of the train, and centrally there between the negative conductor rail 2 and aside the positive conductor rail 3 for the power supply of the train.

[0009] Fig. 2 shows a single set of prefabricated slabs 4 as installed in an underground, more or less cylindrical tunnel tube (not shown) extending parallel to the running rails 1 and bearing them on top. The slabs 4 have a mutual distance that is bridged by cross wise extending elongated coupling elements, in this example rods 5, distributed lengthwise of the rails 1. The ends of these rods are fixed to the relevant slab 4 and function as spacers such that the slabs 4 are kept in the correct mutual position, also during operation.

[0010] The slabs are of solid material, properly designed to bear the loads of a passing train with passengers. They are in a convenient way fixed to the tunnel tube wall, e.g. by bolts and/or embedded in on site cast concrete or grout.

[0011] The slabs contain at their sides facing the tunnel wall circumferentially extending recesses 6 distributed lengthwise of the rails 1 and designed to receive the typical radial coupling flanges of the cast iron tunnel sections that project inwards from the tunnel wall. Thus, the slabs are able to bear with a large surface area on the tunnel wall.

[0012] During track renewal a plurality of separate slabs 4 for the right and left rail 1 are installed head to tail, possibly leaving a gap between their ends, such that at least two slabs in mutual elongation are installed. Thereafter the spacers 5 are mounted and the slabs are fixed to the tunnel wall. Then the running rails 1 and supply rails 2, 3 are mounted. The ends of the renewed track is connected to the ends of the undisturbed track upstream and downstream and train traffic can resume.

[0013] Typically, the length of a single piece rail covers the length of more than one or two slabs 4.

[0014] Slabs 4 can be installed sequentially. In an alternative slabs 4 can be installed simultaneously, e.g. in pairs of two, one for each rail 1 of the track. A wheeled crane can e.g. ride longitudinally of the track in the space between the co-extensive slabs 4 to install a next single or pair of separate slabs 4.

[0015] The invention also covers other variants, such as without the recesses 6 or spacers 5. As an alternative, the running rails 1 are installed first, to be in their final operating position. Then, the slabs 4 are inserted below the running rails 1 and clipped to said running rails 1 to be in their final position for operational use. After installing

the slabs 4, the spacers 5 are positioned and fixed to the slabs 4. Finally the embedding material is cast and cured. This procedure saves installation time since merely the running rails 1 need alignment and are used as a reference for installing the slabs 4.

Claims

1. A method of replacing, in an existing underground, the original track within the tunnel by removing the old track and supplying from outside the tunnel, preferably via a station entrance, separate, prefabricated elongated elements (4) with a length preferably between about 2 and 6 metres, and installing them such that they extend in longitudinal direction of the tunnel and at a mutual, substantially constant distance and assembling an element (4) and a rail (1) such that preferably the rails are located in substantially the location of the rails of the original track.

2. The method according to claim 1, wherein existing sleepers and concrete are removed and/or the elements (4) are fixed to the tunnel tube wall, e.g. by bolts and/or imbedded in on site cast material.

3. The method according to claim 1 or 2, wherein prefabricated coupling elements (5) are supplied from outside the tunnel, preferably via a station entrance, and are mounted to the elements (4) to keep them at a mutual distance by cross wise extending and distributed lengthwise of the rails (1) and/or the elements (4) are designed to bear the loads of a passing train.

4. The method according to claim 1, 2 or 3, wherein the elements (4) contain at their sides facing the tunnel wall circumferentially extending recesses (6) distributed lengthwise of the rails (1) and the elements (4) are positioned such that the recesses (6) receive irregularities of the tunnel wall, such as the typical radial coupling flanges of the tunnel sections that project inwards from the tunnel wall, such that the elements (4) bear with a large surface area on the tunnel wall,

5. The method according to any of the preceding claims, wherein a plurality of separate elements (4) for the right and left rail (1) are installed head to tail, possibly leaving a gap between their ends, such that at least two elements (4) in mutual elongation are installed and/or the length of a single piece rail (1) covers the length of more than one or two elements (4).

6. The method according to any of the preceding claims, wherein the elements (4) are installed, thereafter the spacers (5) are mounted and thereafter the elements (4) are fixed to the tunnel wall, while the running rail (1) and/or supply rail (2, 3) are mounted prior to or after installing the elements (4).

7. The method according to any of the preceding claims, wherein the ends of the renewed track is connected to the ends of the undisturbed track upstream and downstream, such that train traffic can resume.

8. The method according to any of the preceding claims, wherein the elements (4) are installed sequentially or simultaneously, e.g. in pairs of two, one for each rail (1) of the track and/or
wherein two running and two conductor rails are mounted.

9. The method according to any of the preceding claims, wherein a wheeled crane rides longitudinally of the track in-the space between the co-extensive elements (4) to install a next single or pair of separate elements (4), and/or the rail (1) is mounted such that will be discretely (i.e. at regular intervals such as the Pandrol Vanguard system) or continuously supported (such as an embedded rail) by the element.

10. The method according to any of the preceding claims, wherein the running rails (1) are installed first, to be in their final operating position, then, the elements (4) are inserted below the running rails (1) and clipped to said running rails (1) to be in their final position for operational use, then the spacers (5) are positioned and fixed to the elements (4), then embedding material is cast and cured.

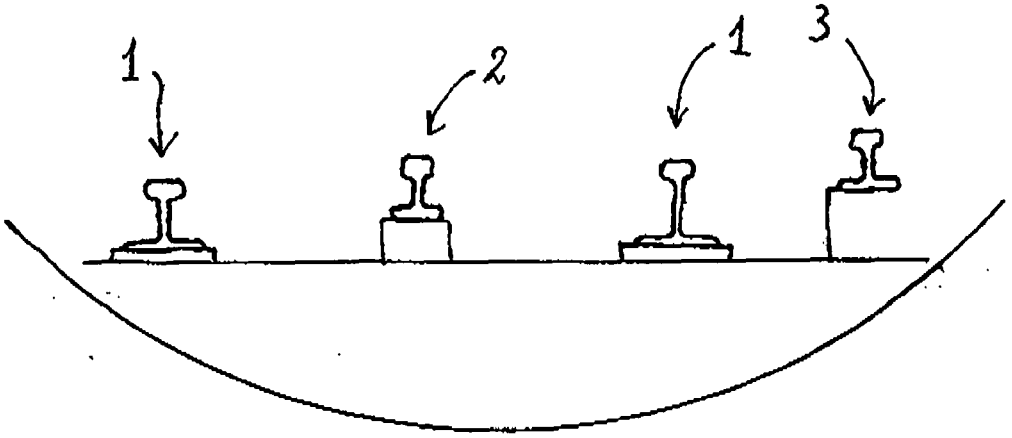

Fig. 1

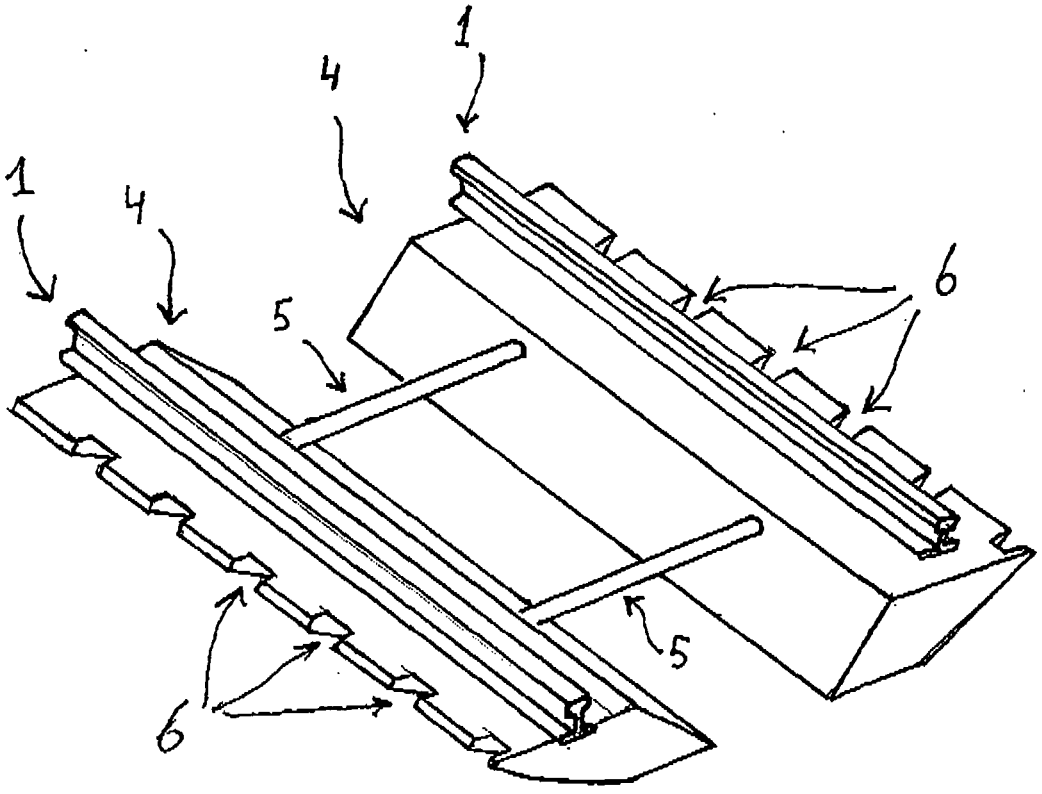

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 06 02 1325

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 666 599 A (SUD OUEST TRAVAUX [FR]) 13 March 1992 (1992-03-13) * claims 1-3; figures 1-5 *	1,2,7,9	INV. E01B2/00
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A	US 4 616 395 A (FARESE VIRGIL A [US] ET AL) 14 October 1986 (1986-10-14) * figures 1-5 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

E01B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 January 2007	Fernandez, Eva

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 02 1325

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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25-01-2007

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