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(54) **RAILWAY TRACK SUPPORT SYSTEM**
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Description

[0001] The present invention relates to a method of supporting or stabilizing railway track and, more particularly, a system for stabilizing existing track, for example to remedy or control ground settlement problems.

[0002] Railway track conventionally comprises a pair of spaced rails laid on sleepers which support the passage of a railway vehicle over the rails. The sleepers are typically laid laterally relative to the rails and supported on ballast, such as crushed stone or similar.

[0003] Whilst the combination of subgrade layer materials, ballast and sleepers is generally sufficient to dissipate the compression force of a railway vehicle passing there-over, it is an acknowledged problem that the nature or make-up of the underlying soil can adversely affect the stability and/or longevity of the track. For example, if the underlying soil comprises a so-called 'wet bed', for example which may contain a proportion of peat, it is possible that the ground beneath the track can contract and thereby cause sagging or sinking of the track.

[0004] The above scenario represents one specific example, by which the underlying soil can cause deterioration of the track geometry, and it will be appreciated by the skilled person that other examples exist in which the subgrade, typically comprising a fine-grained, clay-like or silt-like soil, beneath a railway track may be insufficient to support the passage of railway vehicles over time due to soil settlement, compression or other phenomena. Such effects may be attributed to, for example, moisture-density-strength relationships and/or corresponding soil properties such as bearing capacity or compressibility.

[0005] The deterioration of the track by a relatively small degree can lead to speed restrictions being put in place. In more pronounced conditions, the track deterioration can lead to serious safety risks.

[0006] The problems described above are of greater prevalence with increasing speed capabilities of trains. In particular, an increase in the speed of rail vehicles can lead to faster deterioration of the track. Even in relatively minor cases of track dislocation, significant investments made in providing improved trains which are capable of greater speeds can be negated by the need to impose speed restrictions over portions of the rail network.

[0007] Conventional methods of restabilising the track have required complete removal or overhaul of the existing track, including re-laying of ballast and re-aligning the track on the ballast. Some conventional methods include the addition of an adhesive material to the ballast in the hope of preventing future deterioration. Such processes are costly and time consuming and can result in significant downtime of the track, which can cause further associated cost and disruption to railway vehicle operators. Furthermore, even if attempts are made to treat shallow subgrade or improve the performance of the ballast layer, the replacement of the track may then be subjected to further movement of the ground or soil beneath, such that further restabilising of the track may be required in

the future.

[0008] Such a method is disclosed in NL 8 801 026 wherein supporting components are formed by inserting a hollow cylindrical body (3) into the ground and pouring in a hardening mixture. The body is extracted, leaving the mixture to set.

[0009] It is an aim of the present invention to provide a method of stabilising existing railway track which mitigates at least some of the above problems. It may be considered an alternative or additional aim of the invention to provide a system for stabilising existing railway track in situ.

[0010] JP 2006 037413 discloses a ground improvement method which may be used with existing track in situ. Rods 22 are driven between railway sleepers 4 through a layer of ballast 6 to improve an area of ground, and a beam 16 is then installed between the rods 22 and the sleepers 4 to support the track.

[0011] According to the present invention there is provided a method of stabilising railway track as described in the appended claim 1. The method comprises inserting a hollow elongate support into the ground in the vicinity of the railway track, the support being inserted to a depth such that the entire support is below the surface of the ground thereby leaving a void between the support and the surface of the ground; inserting a first cementitious material into the hollow interior of the support; and, inserting a second aggregate material into the void between the support and the ground surface.

[0012] The method may advantageously be performed in situ for an existing railway track. Accordingly, the ground surface may constitute the level of an existing ballast layer, to which the second aggregate material may be augmented. The method may be repeated or duplicated along a length of the railway track. Any, or any combination of, the method steps may be repeated concurrently or sequentially at different locations along the length of the track.

[0013] The cementitious material is typically inserted into the support in situ.

[0014] The present invention is widely applicable to existing railway track, which carries the advantage that the method can be carried out in areas, such as for example, the approach to train stations, where it is impractical to perform conventional track restabilising methods that require reballasting. Furthermore, restabilisation of a length of track can be carried out in stages (i.e. inserting one or a small number of supports at a time) without disruption to track use between those stages.

[0015] The ground may comprise a region of relatively soft or wet subgrade and the method comprises inserting the support into said region. The support may be inserted such that it extends through said subgrade region. The support is of a length between 2m and 8m, which is of an order of magnitude similar to the depth of the subgrade region.

[0016] In one embodiment the method may be performed in a region in which the ground beneath the sub-

grade is typically harder than the softer subgrade region.

[0017] Accordingly the support may allow for the communication of load from the ground surface to the harder region beneath the subgrade. That is to say the support may allow the load on the softer subgrade to be reduced during passage of rail vehicles there-over or else may allow the soft subgrade to be at least partially bypassed or short-circuited in a load bearing capacity.

[0018] According to a preferred embodiment, the support is inserted into the ground at a location inbetween adjacent sleepers of the railway track. Two supports may be inserted at spaced locations in the space between adjacent sleepers. The two supports may be spaced laterally with respect to the direction of the track. One or more supports may be inserted into the ground between successive pairs of adjacent sleepers along a length of track to be supported. The supports may be inserted between successive pairs of sleepers in a regular repeating pattern along the length of track to be supported. For example, supports may be inserted between alternate pairs of sleepers.

[0019] The, or each support, may be inserted into the ground at a location between the opposing rails of the railway track. Additionally or alternatively, one or more supports may be inserted into the ground immediately outside of, or adjacent to, the rails, but, typically, between adjacent sleepers.

[0020] The support may comprise a generally tubular body which may be closed at one end.

[0021] The support may have a first or leading end, which is to be inserted into the ground to a greater depth than a second or trailing end. The first end may be closed. The second end is typically open or else has an opening therein to allow insertion of the cementitious material into the hollow interior of the support.

[0022] The second or trailing end may comprise a head of flange formation. The formation may have a greater width or diameter dimension than the remainder of the support. The formation may comprise a circumferential end wall. The formation may be attached to the support during the method of the invention. For example, the support may be driven into the ground to a first depth such that the second end is above the ground surface, at which point the formation may be attached to the support before driving the support deeper into the ground. A driving force may be applied to the support via the formation, for example via a correspondingly shaped or dimensioned driving tube.

[0023] The support may be a pile.

[0024] One or more openings may be provided in the support. The support may be overfilled with cementitious material such that it passes through the one or more openings into the ground. One or more openings may be provided in a wall (e.g. side wall) of the support. In use, a portion of the cementitious material inserted into the support may seep through the one or more openings. This leaked portion of cementitious material may enter or penetrate the surrounding subgrade or substrata and

thereby enhance the stabilisation thereof.

[0025] The support length may be typically between 2.5 and 7 metres or 3 and 6 metres.

[0026] The aggregate material may comprise a coarse aggregate. The aggregate material may comprise ballast. The aggregate may be loose. The average grain size of the aggregate is typically significantly larger than that of the cementitious material.

[0027] According to one embodiment, the support may be overfilled with cementitious material such that a volume of cementitious material lies above the uppermost end of the support within the void. This may form a cementitious cap on the support. When the aggregate material is inserted into the void, it may advantageously enter into the cementitious material in the void so as to form a region in which both the aggregate and cementitious material are present. Such an intermediate region may be located in a lower region of the void, that is between the support and the uppermost ballast region once complete.

[0028] The cementitious material may be poured into the support using a pipe, such as a so-called Tremie pipe.

[0029] The void may be filled with the aggregate material via a hollow or tubular member. The aggregate may be allowed to fill the void during retraction of the hollow member. The void may be back-filled with aggregate. A driving tube may be used to drive the support into the ground. The aggregate material may be inserted into the void via the hollow driving tube.

[0030] According to a further aspect of the invention there is provided a railway track support system according to the appended claim 14, comprising a plurality of supports submerged in a generally upright orientation below ground level in the vicinity of the railway track, each support having a solidified cementitious material therein and wherein the region between an uppermost end of the support and the ground level on which the railway track is located is substantially filled with aggregate.

[0031] Any of the optional features defined in relation to the structure formed by the method of the first aspect, or else the components or materials used in said method, may also apply to the system of the second aspect.

[0032] The terms "railway" and "sleepers" in UK English, as used herein, may be considered interchangeable with the terms "railroad" and "ties", as used, for example, in American English.

[0033] Practicable embodiments of the invention are described in further detail below with reference to the accompanying drawings, of which;

Figure 1 shows a side view of a section of conventional railway track to be stabilized in accordance with the present invention;

Figure 2 shows a section view through a support and associated railway track during stabilisation according to one embodiment of the invention;

Figure 3 shows an above view of a plurality of the supports shown in Figure 2 located relative to the railway track;

Figure 4 shows a section view of a railway track support system according to one embodiment of the invention; and,

Figure 5 shows a plan view of a section of railway track including the location of the supports for stabilisation of the track according to a further embodiment of the invention.

[0034] The present invention derives from the basic concept that it is possible to adequately stabilise a section of railway track at the onset of track deterioration due to poor subgrade support by piling in the vicinity of the railway track. This can be achieved for example in the window of opportunity when the deterioration of the track has been detected but whilst the track is still safe to use. Such a window of opportunity may occur, for example, when a speed restriction is placed on a section of track to avoid further track degradation.

[0035] Turning firstly to Figures 1 and 3, there are shown portions of conventional railway track 10 comprising a pair of spaced rails 12 supported by laterally arranged sleepers 14 which hold the rails at the desired spacing or gauge. Resilient fasteners 16, or variants thereof, are used to attach a rail 12 to each sleeper 14. Typically two fasteners per rail per sleeper are provided, one on each side of the rail, as can be seen in Figure 3. The rails, sleepers and fasteners are all of conventional design and materials and need not be altered to accommodate the present invention.

[0036] The sleepers 14 are laid upon, and supported by, a bed of ballast 18. The depth and makeup of the ballast may vary from location to location but typically comprises fragmented, crushed or otherwise coarse stone or gravel. A conventional track arrangement comprises both ballast and sub-ballast layers, with the former, upper ballast layer comprising generally larger pieces, whilst the sub-ballast layer typically comprises a particulate material of smaller grain size which supports the upper ballast layer.

[0037] The process carried out according to one embodiment of the invention is described below with reference to the conventional track structure of Figure 1.

[0038] Firstly a volume of ballast 18 is removed from between adjacent sleepers 14. A pile 20, typically formed of steel or another conventional pile material, is oriented vertically above the space between the adjacent sleepers 14 and the rails 12 as shown in Figure 1. The pile 20 is generally tubular in shape and has a closed end 21 and an opposing open end 22. A pile of diameter of between 100 and 250 mm, or, more specifically between 120 and 160 mm may be suitable. In the present embodiment a pile of 140 mm was selected.

[0039] In alternative embodiments, the pile may have

an open end and may be provided with a reinforcing or cutting member, such as a so-called cutting shoe, which may take the form of a collar member arranged for attachment about an open end of the pile.

[0040] The pile length may be any acceptable length for the given pile diameter and strength requirements in use and may be between, for example, 2m and 8 m in length depending on the subgrade at the installation location. In the present example a pile length between 3 and 6 m was used. However other instances of use of the invention will typically involve geotechnical study and/or structural design calculations to determine a suitable length of pile or depth of insertion, which may be outside of the above suggested range.

[0041] The pile 20 is driven into the ground between the sleepers 14 in a generally vertical direction using conventional piling machinery such that the closed end 21 enters the ground first. However in location in which the track is curved in plan and/or banked or otherwise angled relative to horizontal, the pile may be inserted into the ground at an angle to accommodate such features. The angle of insertion may be substantially perpendicular to the angle of the sleepers, or obliquely angled relative thereto as necessary. The pile is driven into the ground initially to a depth such that a portion of the pile, towards the upper end 22 remains exposed above the ground. At this point a flange member 24 is attached, in situ, to the open end 22 of the pile.

[0042] The flange member 24 is shown in Figure 4 and comprises a generally disk shaped member having a central opening 25 therein. The opening 25 is substantially aligned with the longitudinal axis of the pile such that the flange member 24 rests against the open end of the pile. The flange member 24 may have one or more locating formations which are arranged for insertion into the end of the pile to facilitate correct location and subsequent fixing of the flange member to the pile. Once the flange member 24 is rigidly fixed in this manner it provides a head formation at the pile end 22.

[0043] The pile 20 is driven further into the ground using a driving tube 26 as shown in Figure 2. A driving force is applied to the pile 20 via the tube 26. The tube 26 may also be vibrated in order to further assist in the piling process, particularly as the pile passes through the ballast. The pile may subsequently be pushed as it progresses through the subgrade material.

[0044] The driving tube is of diameter greater than that of the pile 20 but less than or equal to the outer diameter of the head formation 24. This causes the formation of a void 28 above the pile 20 as it is inserted into the ground. The void 28 is of a width diameter that is greater than that of the pile 20 and typically substantially equal to the width/diameter of the tube 26 and/or flange 24.

[0045] The pile pierces the subgrade material and is driven until the end 22 achieves a predetermined depth below the ground surface. The predetermined depth, shown as dimension "Y" in Figure 2 may be, for example, 1 m. Additionally or alternatively, the predetermined

depth may be such that the open (upper) end 22 of the pile, and the associated flange 24 is approximately at the lowermost level of the ballast or sub-ballast layer. Additionally or alternatively, the pile may be driven such that its lowermost (closed) end 21 comes into contact with bedrock or a further material layer beneath the subgrade material. It will be appreciated that the exact depth will vary from location to location depending on the ground conditions and the length of pile used. However the upper pile end will typically achieve a depth of between 0.5 and 3 m below ground level.

[0046] The depth to which the pile is driven can be determined based upon the length of the driving tube that is above ground level. Typically the driving tube is sufficiently long that at least a portion thereof is exposed above ground level when the pile reaches its final resting position/depth.

[0047] The larger width of the flange 24 relative to the pile body is advantageous since it drags finer, typically particulate, ballast material with it during insertion of the pile. This is depicted in Figure 2 at 29. This "wedge" of ballast material can assist in stabilising the pile within the subgrade and can also serve to promote load transmission to the pile via the ballast once the railway track is back in service.

[0048] The final resting position of the pile is shown in Figures 2 and 4. Here it can be seen that the open end 22 of the pile lies generally in the region of the interface 30 between the existing ballast (or sub-ballast) 32 and the subgrade 34. Also the lower, closed, end 21 of pile 20 lies approximately in the region of the interface 36 between the subgrade 34 and a further material 38, such as bedrock, or a deeper subgrade material layer, which is typically harder/stronger than the subgrade 34. The subgrade material 34, through which the pile is inserted may constitute a subsoil or substrata layer.

[0049] The pile is then filled with a concrete or grout material via the open end 22. This is achieved by first retracting/raising the driving tube a small distance, such as approximately 100-300 mm, above the flange 24. A Tremie pipe is inserted down the hollow driving tube 26 and the grout is poured into the pile 20 through the opening 25 in the flange.

[0050] A water-cement ratio of approximately 0.45 is used, although an alternative ratio generally in the range 0.4-0.5 may be suitable.

[0051] The pile is overfilled with grout. That is to say grout is poured until the level of grout is above the level of the flange 24 such that the grout fills, or at least partially fills, the space left between the end of the driving tube and the flange. In this embodiment the grout is filled to the level of the lower end of the driving tube. This overfilling with grout provides an "end cap" 27 comprising cementitious material immediately above the pile head. Also, since the retraction of the driving tube 26 may cause partial collapse in the ballast material about the void 28, the end cap region will typically comprise a mix of ballast and grout. This intermediate region is advantageous in

transferring load from the ballast to the pile 20 once set (i.e. when the railway track is in service).

[0052] The grout may also, at least partially, penetrate the wedge 29, further stabilising the pile.

[0053] As part of the filling process, the grout is typically poured to the desired level and then allowed to settle/stabilise for a short time period, such as one or a few minutes. The grout level may then be topped up if it falls in this timeframe.

[0054] The void 28 is then filled with ballast. This is achieved by backfilling, such that the void is filled by pouring of ballast material through the tube, whilst the tube is being retracted. Depending on the makeup of the existing ballast, a finer, sub-ballast material may be inserted first followed by a coarser ballast material to mimic the surrounding ballast structure. The filler material may thus comprise a ballast and granular mix.

[0055] The ballast filler material can in general be distinguished from the grout material in that the ballast is generally loose/dry and of grain size being typically an order of magnitude or more larger than that of the wet grout material.

[0056] Once the tube 26 has been retracted, the ballast 18 between the sleepers 14 can be filled to the desired level, either with the existing (previously removed), or else fresh, ballast.

[0057] The grout then sets forming a strong support for the railway track through the problematic subgrade material 34. Also it can be seen that the resultant end cap region 27 is formed substantially at the interface 30 between the existing ballast and the subgrade 34 layers.

[0058] In Figure 2, there is shown the locations of piles relative to the existing rails 12 and sleepers 14. The piles are inserted in pairs, each pile in the pair being spaced from the other by the longitudinal axis 40 of the track. In particular the piles are symmetrically located on either side of the axis 40. Each pile may be laterally spaced from the axis such that each pile is closer to a rail 12 than to the axis 40. The centre of each pile may be spaced from the corresponding rail by approximately 250-300 mm, typically around 275 mm.

[0059] Each pile is preferably located equidistantly between adjacent sleepers 24.

[0060] Piles are inserted between every other pair of adjacent sleepers 14. However in particularly problematic areas it is possible that piles could be inserted between every pair of sleepers. Conversely, piles may be inserted between pairs of sleepers less frequently in lesser problematic areas. A repeating pattern of "piled" and "un-piled" pairs of sleepers may be created along the length of the track. Further repeating patterns of piles may be used, for example in which pairs of piles arranged as described above are spaced by a single intermediate pile.

[0061] Turning now to Figure 5, there is shown a sequence in which piles may be inserted. The piles 20 are numbered 1 to 8 to show the order in which they are inserted into the ground. In this manner a longitudinal

row (with respect to the track axis 40) of piles 20 are inserted prior to insertion of the adjacent row of piles. Each pile may be installed and filled before inserting the next pile in the sequence. Typically the backfilling with ballast will also be carried out prior to moving on to the next pile. However different sequences and orders of insertion are possible dependent on the available machinery in the interests of achieving installation efficiency provided it does not cause detriment to the support system.

[0062] Figure 4 shows a schematic section through the pile and surrounding ground after the support system has been installed. In use, as a railway vehicle passes over the track 12 above the pile and the temporary applied load is communicated via the sleepers and ballast through the end cap region 27 and the pile itself 20 to the firmer ground 38 beneath. The support system therefore serves to reduce the load applied to the subgrade in use and thus avoid any deterioration or further deterioration of the subgrade.

[0063] Subgrade deformation has been found to be the primary factor in causing geometry deterioration of existing track and so the present invention effectively mitigates against this problem at its root cause and in a manner which does not cause significant disruption to the track. The locating of the piles between the sleepers is considered to be particularly beneficial in supporting the load of a railway vehicle passing there-over. However it is possible in other embodiments that piling may be undertaken at locations adjacent to rather than between the track and/or sleepers. In any embodiment, the support structure left in place by the above described installation process improves the track modulus and/or track stiffness.

[0064] Whilst the above-described implementations of the invention refer to the use of a hollow tubular pile, it will be appreciated that other hollow support profiles may be used which leave at least a partial void behind the leading end of the support upon insertion into the ground. Other hollow supports may include for example box-section piles. Alternatively, piles which are open sided in section but which define a partially enclosed interior space, such as I-section (for example, so-called Universal Beam or Universal Column), H-section or C-section (channel) piles may be used to similar effect. As with the closed end of the tubular pile, such alternative pile shapes may have an end formation or plate for dislodging the subsoil upon insertion so as to leave a void along the length of the inserted pile, which can be subsequently filled with grout. Such an interior or internal void will be bounded by the wall(s) of the pile.

[0065] All such variants of the invention will typically be of an extruded construction, such the section profile is substantially constant along the length of the pile, save for any end formations. Also, all such variants will bound or at least partially bound an internal space between opposing wall portions of the pile.

[0066] In a further development of the invention, the pile may be provided with openings through one or more

walls thereof, such as sidewalls, web or flange walls. Thus when grout is poured into the pile, a volume of grout will flow through the holes and into the surrounding sub-strata. That grout will penetrate the sub-strata to a degree and thereby serve to stabilise the soil immediately surrounding the pile. This may also serve to improve keying between the pile and the subgrade. The openings in the pile will typically open in a substantially lateral direction relative to the longitudinal axis of the pile. The openings are dimensioned to allow leakage of only a fraction of the grout, such as 20% percent or less therethrough. When filling a pile having such openings, the pile will typically be initially overfilled, followed by a wait of extended duration to allow passage of the grout through said openings into the surrounding subsoil, prior to topping up of the grout to the desired level.

Claims

1. A method of stabilising railway track (10) comprising:

inserting an elongate support (20) having a generally hollow interior into the ground in the vicinity of existing railway track (10) in-situ, the support (20) being inserted to a depth such that the entire support (20) is below the surface of the ground thereby leaving a void (28) between the support and the surface of the ground;

inserting a cementitious material into the hollow interior of the support (20);

characterised in that a ballast material (18) is inserted into the void (28) between the support (20) and the ground surface; the support (20) is between 2 and 8 metres in length and is inserted into the ground in a generally upright orientation to a depth such that the support (20) pierces through and substantially spans the depth of a subgrade region (34) once inserted.

2. The method of claim 1, wherein the support (20) is inserted into the ground at a location in a longitudinal direction of the track (10) between the locations of existing sleepers (14) of the railway track (10) and/or between existing rails (12) of the railway track (10).

3. The method of any preceding claim, wherein the support (20) is closed at a first end (21) and open at a second end (22), the first end (21) being inserted into the ground ahead of the second end (22).

4. The method of any preceding claim, wherein the support (20) is provided with an outwardly projecting flange member (24) in the vicinity of a trailing or upper end (22) thereof during insertion.

5. The method of claim 4, wherein the support (20) is driven into the ground by a driving member (26)

which applies a driving force to the support (20) via the flange member (24).

6. The method of any preceding claim wherein the support (20) is overfilled with the cementitious material so as to form a bulb (27) of cementitious material above the upper end of the support (20). 5
7. The method of claim 6, when dependent on claim 5, wherein the driving member (26) is partially retracted such that a lowermost end of the driving member (26) is spaced from an upper end of the support (20) beneath the ground surface by a gap and cementitious material is poured so as to at least partially fill said gap. 10
8. The method of claim 7, wherein the cementitious material in said gap hardens to form a head formation (27) at an upper end of the support (20). 15
9. The method of claim 6 or 7, wherein a quantity of ballast material (18) is also present in said gap. 20
10. The method of any preceding claim, wherein the support (20) is driven into the ground using a hollow driving member (26) and the cementitious material and/or the ballast material (18) is inserted into the void (28) via the hollow interior of the driving member (26). 25
11. The method of any preceding claim, wherein one or more openings are provided in the support (20), preferably in a side wall of the support (20) as well as in an end (21) thereof, and a portion of the cementitious material inserted into the support (20) is allowed to seep through the one or more openings. 30
12. The method of any preceding claim, wherein two of said supports (20) are inserted into the ground at laterally spaced locations with respect to the direction of the track (10) in the space between adjacent sleepers (14). 35
13. The method of any preceding claim, wherein one or more of said supports (20) are inserted into the ground between successive pairs of adjacent sleepers (14). 40
14. A railway track support system, comprising a plurality of supports (20) submerged, in use, in a generally upright orientation below ground level in the vicinity of an existing railway track (10), each support having an uppermost end (22) with a head formation (27) comprising solidified cementitious material thereon; **characterised in that** each support (20) comprises a hollow profile closed at one end (21) and having a solidified cementitious material therein, the supports (20) being between 2 and 8 metres in length and 45

being located at a depth such that they span a sub-grade soil region (34) and the system further comprises aggregate material (18) between the uppermost end of the support (20) and the ground level on which the railway track (10) is located.

15. A railway track support system according to claim 14, wherein each support (20) has a flange portion (24) at its upper end and the head formation (27) comprising solidified cementitious material is on said flange portion (24). 50

Patentansprüche

1. Verfahren zur Stabilisierung von Eisenbahngleisen (10), umfassend:

Einfügen einer länglichen Stütze (20) mit einem generell hohlen Innenraum in den Boden in der Nähe des vorhandenen Eisenbahngleises (10) in situ, wobei die Stütze (20) auf eine Tiefe derart eingesetzt wird, dass sich die ganze Stütze (20) unterhalb der Oberfläche des Bodens befindet, dadurch wird ein Hohlraum (28) zwischen der Stütze und der Oberfläche des Bodens belassen; Einfügen eines zementgebundenen Materials in den Hohlraum der Stütze (20);

dadurch gekennzeichnet, dass ein Ballastmaterial (18) in den Hohlraum (28) zwischen der Stütze (20) und der Bodenoberfläche eingefügt wird, die Stütze (20) zwischen 2 und 8 Meter lang ist und in einer generell aufrechten Orientierung in den Boden derart auf eine Tiefe eingefügt wird, dass die Stütze (20), sobald eingefügt, die Tiefe eines Unterbaubereichs (34) durchdringt und im Wesentlichen überbrückt.

2. Verfahren gemäß Anspruch 1, wobei die Stütze (20) an einer Stelle in den Boden in einer Längsrichtung des Gleises (10) zwischen Positionen von vorhandenen Schwellen (14) des Eisenbahngleises (10) und/oder zwischen vorhandenen Schienen (12) des Eisenbahngleises (10) eingefügt ist. 55
3. Verfahren gemäß einem vorhergehenden Anspruch, wobei die Stütze (20) an einem ersten Ende (21) geschlossen und an einem zweiten Ende (22) offen ist, wobei das erste Ende (21) vor dem zweiten Ende (22) in den Boden eingefügt wird.
4. Verfahren gemäß einem vorhergehenden Anspruch, wobei die Stütze (20) mit einem nach außen vorstehenden Flanschelement (24) in der Nähe eines nachlaufenden oder oberen Endes (22) davon, während des Einfügens, versehen ist.
5. Verfahren gemäß Anspruch 4, wobei die Stütze (20)

von einem Antriebselement (26) in den Boden getrieben wird, das über das Flanschelement (24) eine Antriebskraft auf die Stütze (20) ausübt.

6. Verfahren gemäß einem vorhergehenden Anspruch, wobei die Stütze (20) mit dem zementgebundenen Material überfüllt wird, um ein Wulstprofil (27) aus zementgebundenem Material oberhalb des oberen Endes der Stütze (20) zu bilden. 5
7. Verfahren nach Anspruch 6, wenn von Anspruch 5 abhängig, wobei das Antriebselement (26) teilweise derart zurückgezogen wird, dass ein unterstes Ende des Antriebselements (26) von einem oberen Ende der Stütze (20) unterhalb der Bodenoberfläche durch eine Lücke beabstandet ist und zementgebundenes Material eingefüllt, um die Lücke wenigstens teilweise zu füllen. 10
8. Verfahren nach Anspruch 7, wobei das zementgebundene Material in der Lücke härtet, um eine Kopfformation (27) an einem oberen Ende der Stütze (20) zu bilden. 15
9. Verfahren nach Anspruch 6 oder 7, wobei eine Quantität von Ballastmaterial (18) ebenso in der Lücke vorhanden ist. 20
10. Verfahren gemäß einem vorhergehenden Anspruch, wobei die Stütze (20) unter Verwendung eines hohlen Antriebselements (26) in den Boden getrieben wird und das zementgebundene Material und/oder das Ballastmaterial (18) über den hohlen Innenraum des Antriebselements (26) in den Hohlraum (28) eingefügt wird. 25
11. Verfahren gemäß einem vorhergehenden Anspruch, wobei eine oder mehr Öffnungen in der Stütze (20), vorzugsweise in einer Seitenwand der Stütze (20) sowie in einem Ende (21) davon vorgesehen sind, und einem Teil des in die Stütze (20) eingefügten zementgebundenen Materials erlaubt wird, durch die eine Öffnung oder mehrere Öffnungen zu sickern. 30
12. Verfahren gemäß einem vorhergehenden Anspruch, wobei zwei der Stützen (20) an lateral beabstandeten Positionen in Bezug auf die Richtung des Gleises (10) in den Raum zwischen benachbarten Schwellen (14) in den Boden eingefügt sind. 35
13. Verfahren gemäß einem vorhergehenden Anspruch, wobei die Stützen (20) zwischen aufeinander folgenden Paaren benachbarter Schwellen (14) in den Boden eingefügt sind. 40
14. Eisenbahngleisstützsystem, das eine Vielzahl von Stützen (20) umfasst, die, im Gebrauch, in einer ge- 45

nerell aufrechten Orientierung unterhalb der Bodenebene in der Nähe eines vorhandenen Eisenbahngleises (10) versenkt werden, wobei jede Stütze ein oberstes Ende (22) mit einer Kopfformation (27) aufweist, das verfestigtes zementgebundenes Material darauf umfasst, **dadurch gekennzeichnet, dass** jede Stütze (20) ein an einem Ende (21) geschlossenes Hohlprofil umfasst und ein gefestigtes zementgebundenes Material darin aufweist, wobei die Stützen (20) eine Länge zwischen 2 und 8 Metern aufweisen und bin einer Tiefe derart positioniert sind, dass sie einen Unterbaubodenbereich (34) überbrücken und das System ferner Zuschlagstoffmaterial (18) zwischen dem obersten Ende der Stütze (20) und der Bodenebene umfasst, auf der sich das Eisenbahngleis (10) befindet.

15. Eisenbahngleisstützsystem gemäß Anspruch 14, wobei jede Stütze (20) einen Flanschabschnitt (24) an ihrem oberen Ende aufweist und sich die gefestigte zementgebundene Material umfassende Kopfformation (27) am Flanschabschnitt (24) befindet. 50

Revendications

1. Une méthode de stabilisation d'une voie ferrée (10), comprenant : 55
 - l'insertion, dans le sol, d'un support allongé (20) présentant un intérieur d'une manière générale creux, à proximité de la voie ferrée présente (10) in-situ, le support (20) étant inséré à une profondeur telle que le support entier (20) se trouve sous la surface du sol, de façon à laisser un vide (28) entre le support et la surface du sol ;
 - l'insertion d'une matière cimentaire dans l'intérieur creux du support (20) ;
 - caractérisée en ce qu'**une matière de ballast (18) est insérée dans le vide (28) entre le support (20) et la surface du sol, le support (20) mesurant de 2 à 8 mètres de long, et étant inséré dans le sol, dans une position générale verticale, et à une profondeur telle que, une fois inséré, le support (20) perce la profondeur d'une zone de fondation (34) et la chevauche substantiellement.
2. La méthode selon la revendication 1, le support (20) étant inséré dans le sol en un emplacement dans une direction longitudinale de la voie (10) entre les emplacements des traverses présentes (14) de la voie ferrée (10) et/ou entre des rails présents (12) de la voie ferrée (10).
3. La méthode selon une quelconque des revendications précédentes, le support (20) étant fermé à une première extrémité (21) et ouvert à une deuxième

extrémité (22), la première extrémité (21) étant insérée dans le sol dans une position antérieure par rapport à la deuxième extrémité (22).

4. La méthode selon une quelconque des revendications précédentes, le support (20) étant muni d'une bride saillante vers l'extérieur (24) à proximité de son extrémité postérieure ou supérieure (22) au cours de l'insertion. 5
5. La méthode selon la revendication 4, le support (20) étant enfoncé dans le sol par un élément d'entraînement (26) exerçant sur le support (20) une force d'entraînement par le biais de la bride (24). 10
6. La méthode selon une quelconque des revendications précédentes, le support (20) étant rempli excessivement d'une matière cimentaire, de façon à former un bulbe (27) de matière cimentaire au-dessus de l'extrémité supérieure du support (20). 15 20
7. La méthode selon la revendication 6, lorsqu'elle est tributaire de la revendication 5, l'élément d'entraînement (26) étant partiellement rétracté afin qu'une extrémité inférieure de l'élément d'entraînement (26) soit espacée, par un écart, d'une extrémité supérieure du support (20), sous la surface du sol, et une matière cimentaire étant coulée de façon à remplir tout au moins partiellement ledit écart. 25 30
8. La méthode selon la revendication 7, la matière cimentaire dans ledit écart faisant prise en constituant une formation de tête (27) à une extrémité supérieure du support (20). 35
9. La méthode selon la revendication 6 ou 7, une quantité de matière de ballast (18) étant également présente dans ledit écart. 40
10. La méthode selon une quelconque des revendications précédentes, le support (20) étant enfoncé dans le sol à l'aide d'un élément d'entraînement creux (26) et la matière cimentaire et/ou la matière de ballast (18) étant introduites dans le vide (28) par le biais de l'intérieur creux de l'élément d'entraînement (26). 45
11. La méthode selon une quelconque des revendications précédentes, une ou plusieurs ouvertures étant pratiquées dans le support (20) de préférence dans une paroi latérale du support (20), ainsi que dans une de ses extrémités (21), et en laissant filtrer, par une ou plusieurs ouvertures, une partie de la matière cimentaire introduite dans le support (20). 50 55
12. La méthode selon une quelconque des revendications précédentes, deux desdits supports (20) étant insérés dans le sol dans des emplacements espacés

latéralement relativement au sens de la voie (10) dans l'espace entre des traverses (14) adjacentes.

13. La méthode selon une quelconque des revendications précédentes, un ou plusieurs desdits supports (20) étant insérés dans le sol entre des paires successives de traverses (14) adjacentes.
14. Un système de support de voie ferrée, comprenant une pluralité de supports (20) submergés, en cours d'usage, dans une orientation généralement verticale sous le niveau du sol, à proximité d'une voie ferrée (10) présente, chaque support possédant une extrémité supérieure (22) avec une formation de tête (27) sur laquelle se trouve une matière cimentaire solidifiée, **caractérisé en ce que** chaque support (20) comprend un profil creux fermé à un bout (21) et dans lequel se trouve une matière cimentaire solidifiée, les supports (20) mesurant de 2 à 8 mètres de long, et étant placés à une profondeur telle qu'ils couvrent une zone de fondation (34), et le système comprenant également un agrégat (18) entre l'extrémité supérieure du support (20) et le niveau du sol sur lequel est située la voie ferrée (10).
15. Un système de support de voie ferrée selon la revendication 14, chaque support (20) possédant une bride (24) sur son extrémité supérieure et la formation de tête (27), comprenant une matière cimentaire solidifiée, se trouve sur ladite bride (24).

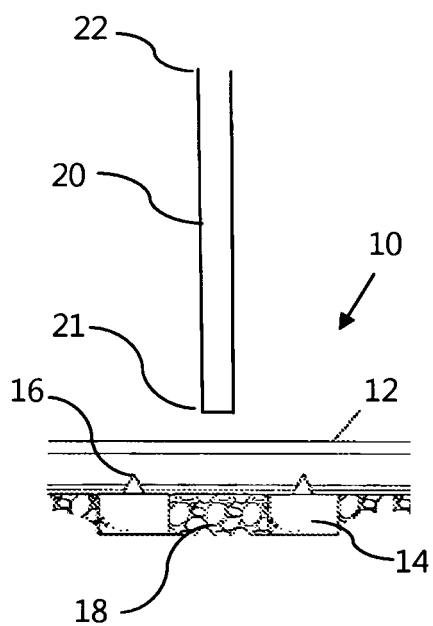


Figure 1

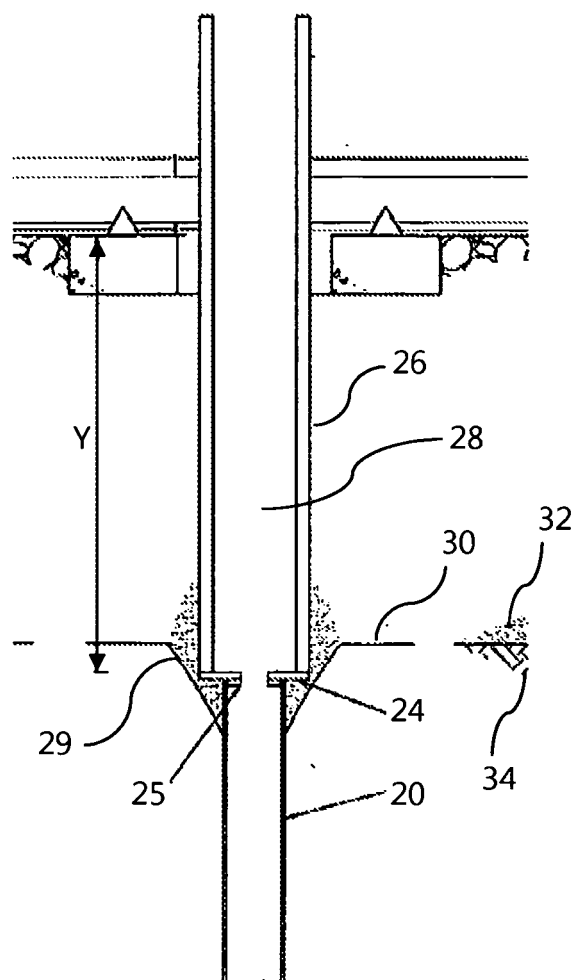


Figure 2

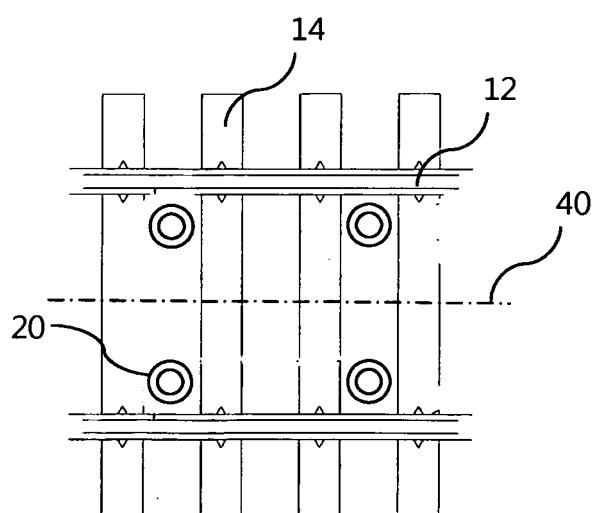


Figure 3

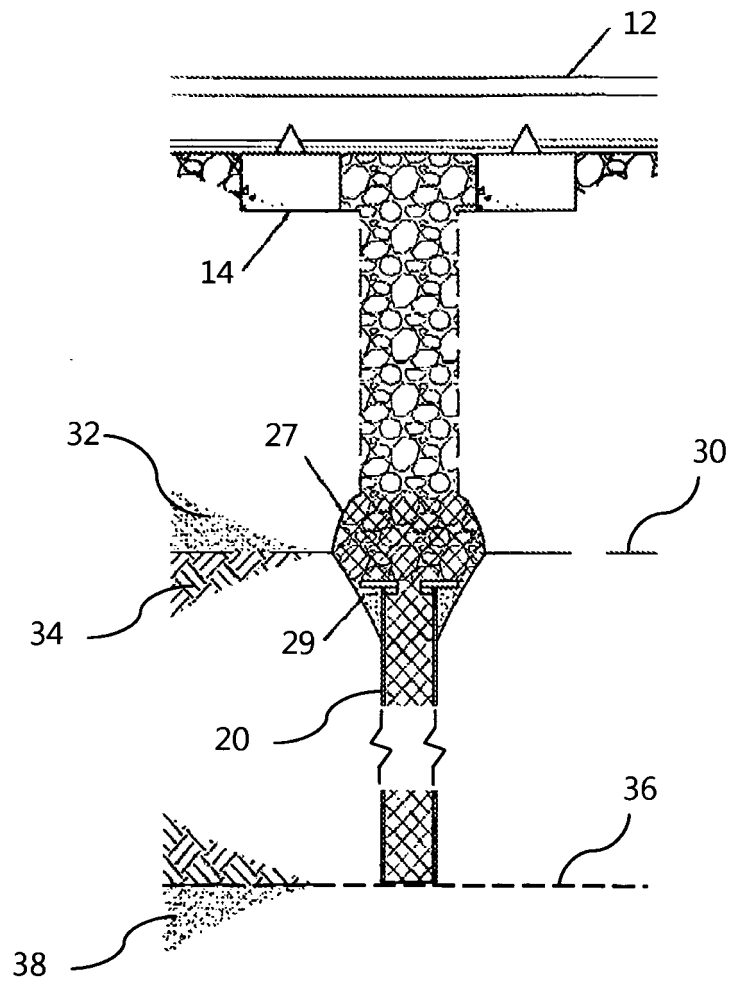


Figure 4

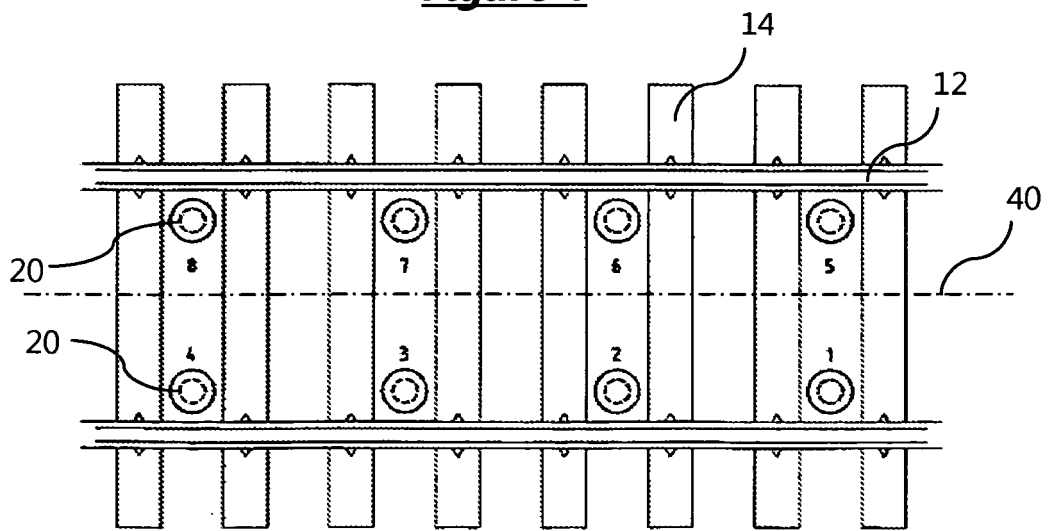


Figure 5

REFERENCES CITED IN THE DESCRIPTION

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