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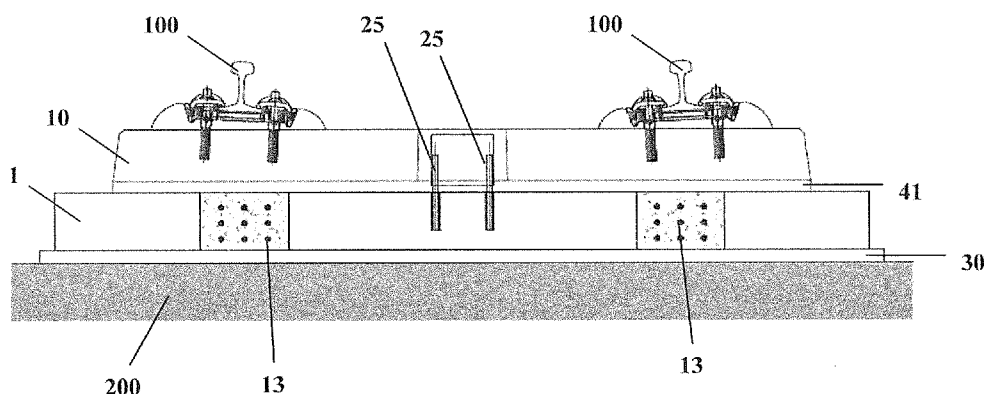
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(54) Title: SLAB TRACK, ARRANGED IN AN OVERLAPPING MANNER ON A SLAB FOUNDATION

**FIG. 1**



(57) Abstract: The application concerns a method for operating the maintenance and/or construction and/or re-construction of a railway line or of a part thereof and comprising the following phases: Arrangement of one or more foundation modules (1), pre-fabricated and transportable to the final place of installation; Arrangement of one or more platforms (10), pre-fabricated and transportable to the final place of installation, said platforms being configured to hold the rails (100) constituting the railway line; Positioning, in the pre-chosen assembly position, of at least one foundation module (1); Overlapping of the platform (10) to the relative foundation module (1); Plano-altimetric adjustment of the platform (10) with respect to the foundation module (1); Fixing of the overlying platform (10) to the underlying module (1), subsequently to said plano-altimetric adjustment phase.



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TITLE**SLAB TRACK, ARRANGED IN AN OVERLAPPING MANNER ON A SLAB  
FOUNDATION**

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Technical field

The technical field of the present invention refers to the maintenance and reconstruction of the railway lines  
10 in general.

In particular, the invention refers to a method that allows to re-instate a railway line in a quick and efficient way, without causing long interruptions of the line itself.

15 Background art

Railway, metro or tramway lines traditionally foresee a track equipment composed of sleepers, anchorage systems and rails on ballasts.

More in particular, the track equipment thus  
20 composed is generally inserted in a ballast as defined in the technical jargon, composed of particular selected road metal. The sleepers lie down and are partially drowned in such road metal, and then the rails are fixed on them. The sleepers can be of wood or concrete.

25 A work of maintenance and/or re-construction of such type of railway, metro or tramway line that foresees the substitution of said type of traditional track equipment with an innovative system without ballast, requires in fact a significant effort, above all in terms of  
30 interruption time of the railway operation.

The reason for this is that it is necessary to dismantle all the structure described before to then re-construct it and, if a new track equipment without ballast wants to be realized, the concrete normally used for these

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types of systems needs long curing times to set and reach the necessary resistance to support the loads generated by the subsequent passage of the rolling stock.

For interventions of this type, the line must be interrupted for a long time with significant inconveniences for the circulation.

#### Disclosure of invention

It is therefore the aim of the present invention to provide an innovative assembly, and relative method of intervention, for the re-construction/maintenance of a railway, metro or tramway line, or of one section thereof, which solves said technical inconveniences.

In particular, it is the aim of the present invention an assembly, and relative method, which allows a quick reactivation of the circulation following a reconstructive intervention that foresees the removal of the ballast.

These and other aims are reached with the present assembly to operate the maintenance and/or construction and/or re-construction of a railway line, or of a part thereof, as per claim 1.

Such assembly comprises:

- One or more foundation modules (1), pre-fabricated and transportable *in loco*;
- 25 - One or more platforms (10), pre-fabricated and transportable *in loco*, said platforms being configured to hold the rails (100) constituting the railway line and being overlappable to the foundation modules (1);
- Adjustment means (30, 30', 31) configured to allow a plano-altimetric adjustment of the platform (10) with respect to the foundation module (1) when, in use, the platform (10) is arranged on the relative foundation module (1);
- 30

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- And wherein, further, first connection means (21, 25, 41) are foreseen, to allow to fix the overlying platform (10) to the underlying module (1) following the plano-altimetric adjustment of the platform (10) on the module  
5 (1).

In this way, all said technical inconveniences are easily solved.

In particular, thanks to the portability and modularity of the foundation plate and of the platform, it  
10 is possible to dismantle the old infrastructure, substituting it now with an arrangement of such components that can be easily transportable *in loco* and adequately assembled quickly.

In this way, the interventions of re-  
15 construction/maintenance result to be quick and reduce to the minimum the interruption times of the circulation.

It is here described also a method for operating the maintenance and/or construction and/or re-construction of a railway line or of a part of it and comprising the  
20 following phases:

- Arrangement of one or more foundation modules (1), pre-fabricated and transportable *in loco*;
- Arrangement of one or more platforms (10), pre-fabricated and transportable *in loco*, said platforms being  
25 configured to hold the rails (100) constituting the railway line;
- Positioning, in the pre-chosen assembly position, of at least one foundation module (1);
- Overlapping of the platform (10) to the relative  
30 foundation module (1);
- Plano-altimetric adjustment of the platform (10) with respect to the foundation module (1);
- Fixing of the overlying platform (10) to the underlying module (1), subsequently to said plano-

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altimetric adjustment phase.

Further advantages can be deduced from the dependent claims.

Brief description of drawings

- 5 Further features and advantages of the present method, according to the invention, will result to be clearer with the description that follows of some embodiments, made to illustrate but not to limit, with reference to the attached drawings, wherein:
- 10 - Figure 1 shows a section in which the components that intervene in the present invention are shown structurally;
- Figure 2 shows an axonometric view of the single foundation module 1;
- Figure 3 shows an example of arrangement in succession  
15 of many foundation modules 1;
- Figure 4 further shows a top view, a section and a lateral view of the single foundation module;
- Figure 5 shows an axonometric view of the pre-compressed platform 10 that lies down on the foundation  
20 module 1 and on which the rails are positioned;
- Figure 6 is a top view of such platform 10;
- Figure 7 shows a connection system of the known art to connect the single rail 100 to the track plate 22;
- Figure 8 shows a section of the platform 10 to  
25 visualize the system of plano-altimetric adjustment;
- Figures from 9 to 11 show macro-phases of application.

Description of some preferred embodiments

For interpretative simplicity, a list of nomenclature is initially introduced, to which the present description  
30 will make reference:

- **Rail:** it is the single bar of rail (numbered, for example, with number 100 in the attached figures);
- **Track:** it is the assembly of the complete infrastructure of track equipment, sleepers, couplings and

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rails;

- **Foundation plate (1):** pre-fabricated module to constitute the foundation;
- **Track plate:** pre-fabricated module with the  
5 fastenings for the rails to position on the foundation plate;
- **Track equipment:** it is the assembly of the parts that compose the track, from above the soil up to the rails;
- **Ballast:** the layer of gravel;
- 10 - **Mortar:** mortar injectable between the foundation plate (1) and the overlying platform (10), called also track plate (10) as indicated above;
- **Sub-base concrete:** it is a casting of concrete that serves as sub-base or laying of the foundations;
- 15 - **Concrete:** it is the compound of cement, sand, aggregates, additives and water;

Figure 1 shows a section of the components necessary to operate a re-set of the line or of a section thereof, in a configuration of completed assembly.

20 They foresee a foundation module 1 (or foundation plate) and an overlying platform 10 (the track plate 10) on which the rails 100 are fixed.

The foundation module 1 lies on an infrastructure 200 that can be, according to the case: compacted soil, 25 viaduct, bridge or cross gallery and on which, as clarified below, the pre-existing old railway structure has been dismantled.

Other components are anyway present, as clarified below in the present description.

30 The foundation module 1 is a pre-fabricated module, preferably of concrete and, generally, of rectangular plan form and of a pre-determined height.

Figure 2 shows such foundation module 1 in an axonometric view to describe it better.

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It foresees two short sides (3, 4) parallel between them and two long sides (2, 5) parallel between them so as to have a rectangular plan form (visible also in figure 4).

5 On the part of the two short sides (3, 4) two openings (11, 12) are obtained by part and passing through the entire thickness with rectangular plan form. From such openings exit the steel reinforcement for the resumption of the casting (in the form of a plurality of bars 13),  
10 which have originally been inserted in the module during the phase of realization in plant thereof.

Alternatively, such openings could also not be necessarily passing through the entire thickness.

Both short sides are therefore provided with such  
15 rectangular openings that face perfectly one another in line when two or more modules are drawn near in succession one with the other, as for example highlighted in figure 3.

The pre-fabricated module described is naturally  
20 transportable *in loco* and its indicative dimensions are about 4,00 m the long side and 2,80 m the short side. The thickness (therefore the height *h* of the sides) can vary in a range between the 20 cm and the 30cm or the 35cm, preferably of about 20 cm. They can therefore be piled up  
25 one on top of the other, they can be moved with specific cranes and transportable *in loco* through specific railway wagons arranged on the lines for such maintenance interventions.

Many modules are therefore constructed in an  
30 identical way so that, as described below, they can be placed in succession one in front of the other so that the openings 11 and 12 obtained in the modules themselves coincide in position, facing one another (see for example figure 3).

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Figure 1 shows a layer 30 on which the foundation module leans. It is a layer of foundation of concrete or gravel-cement mix and will be better described in detail in the description relative to the assembly sequence.

5        Figure 4 shows further top and lateral views of the module in question. It is to be noted that figure 4 (lateral view B) highlights curve V-shaped irons 200' emerging from the upper surface and not visible in the top view. They serve only for the formwork removal and the  
10 movement of the piece and are then cut out when the piece is lain and in a definitive position (for that reason they have been omitted from the top view).

Naturally, they can also be substituted with any other alternative system useful for the movement and are  
15 not considered essential for the present invention.

Going back to the section of figure 1, the overlying platform 10 (called also track plate) is then foreseen. It is preferably of the pre-compressed type.

The platform is reinforced and pre-compressed along  
20 the two main directions in order to render it resistant to the stressing actions and to fatigue phenomena, limiting or even eliminating the crackings and rendering the element long-lasting in time. Generally, the useful life of the structural elements of the system can be estimated  
25 in about sixty years. Rails and plastic or elastomeric elements will follow substitution times depending on the wear due to the loads and the frequency of the railway operation.

The procedures and the techniques of pre-compression  
30 are *per se* well known in the state of the art and in the specific case of the railway platform strands or spring steel wires with pre and post compression will be used.

Figure 5 schematizes the pre-compressed platform 10 in an axonometric view. Also this one is a transportable

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module. Such platform, as shown in figures 5 and 6, can comprise a plurality of supports 22. Such supports 22 are a single body with the platform and on such supports, as said, are fixed the fastenings on which the rails 100 are  
5 then positioned and fixed.

Such supports 22 and the conformation thereof, as for example in figure 5, are not essential for the present invention. In fact, on the track plate the supports indicated with number 22 are only for a type of coupling,  
10 that is of the Vossloh type as clarified below. In that sense, in case other types of coupling are used, these could for example require a flat surface or a different conformation of the supports 22.

In the end, therefore, it is the track plate that  
15 adapts in its conformation to the coupling foreseen, therefore being able to foresee/modify/eliminate the coupling 22 described in figure 5.

Going back to figure 5, just for completeness, this shows the platform on which the rails 100 are already  
20 assembled but it is to be intended that it, naturally, is produced without rails, which are assembled subsequently during the assembly and re-set phase of the line.

Figure 7, only for clarity of description, highlights a standard and well-known connection system to connect the  
25 track to such supports 22, with a system commercialized under the name "Vossloh 300 coupling" but, as said above, other equivalent systems may be used.

Going back to figure 5, the track 10 presents two passing circular holes 21 whose main function, as  
30 clarified below, is that of allowing the injection in pressure or by gravity of the mortar.

The section of figure 1 in fact shows the layer 41 of mortar that creates a thickness between module 1 and platform 10.

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The section of figure 1 further highlights such hole 21 and shows fixing pivots 25 that are inserted through such hole 21 to guarantee a seal to the tangential stresses. Such pivots penetrate up to the underlying foundation module 1 and are arranged, as clarified below, before the pouring of the mortar.

The top view of figure 6 shows very clearly such holes 21 in the number of two per platform.

Adjustment systems are further foreseen to put in a correct geometry the track from the plano-altimetric point of view.

Such adjustment systems are well visible in the lateral view of figure 8.

They are constituted by tropicalized high nuts (which have right away a treatment of the galvanizing type) and bolts on which to act by screwing or unscrewing, with consequent lifting or lowering of the track until its definitive position.

More in particular, figure 8 shows a nut 30 integral to a threaded shank 31 inserted in a passing hole of the platform in such a way that part of the web exits from the opposite part, creating a support.

Inside the channel of passage of the web in the hole of the platform, a further threaded nut 30' is foreseen, and positioned in a fixed way with respect to the platform itself.

In this way, according to the direction of rotation that is impressed to the threaded shank 31 acting on the nut 30 integral to it, an advancement of the web itself is determined with respect to the nut 30', therefore causing a lifting/lowering of the platform 10. If, for example, the right web of figure 8 is left in the position represented and there is action only on the left web, then it is possible to incline at will on one side the entire

-10-

platform 100 with the overlying structure.

As per figure 6 a plurality of such nuts and webs are foreseen arranged on one side and on the opposite side in an obviously symmetrical way.

5       The fixing system of the rails 100 on the supports 22 can be adapted to insert the most common fastenings in commerce and chosen on the basis of the specific needs of the case, as for example those shown in figure 7.

10       Having described the invention in its structural aspects, we now pass onto a description of its application.

With suitable and functioning equipment, and with optimal conditions, it is possible to execute a track of about 80-100m in about 8-9 hours of intervention.

15       The assembly of the track system that is the object of the invention takes place by operating in subsequent phases that in turn can be grouped in three Macro-phases that can be executed also in different moments/days and not necessarily consequent.

20       The Macro-phases comprise, instead, activities that must necessarily be executed in the course of a single interruption since during the execution thereof the circulation is obligatorily interrupted.

Procedurally, the assembly system is the following:

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**MACROPHASE 1: Demolition - Laying - Provisional Alignment and Levelling:**

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**1) Demolition and removal of the section of existing track to be substituted:**

The tracking that delimit the area of intervention are executed, the cut of the rails is executed and therefore, with the help of scrapers, cranes and railway cars are removed in this order: the tracks,

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the sleepers, the ballast of gravel.

**2) Cleaning and preparation of the substructure and casting of the substructure for the foundation:**

5 The soil is brought at level through excavating or landfill and therefore levelled and compacted until the projected quota foreseen is reached, with the use of excavators and vibro-compactors.

10 The casting of a layer of concrete of sub-base or the execution of a layer of a dry gravel-cement mix for a minimum thickness of about 8-10cm is executed. The castings of the concretes can be executed with pumps and pipes also at 150-200m by special means on railway cars placed on the track at an end of the intervention area.

15 Such layer is visible in figure 1 with number 30 and on it lies down precisely the foundation plate 1, which thus remains leant on the support base 200.

20 **3) Laying of the foundation plates:**

With the use of special tracked frame, or directly with mobile cranes, the pre-fabricated foundation plates are collected from the railway cars and therefore lain on the sub-base 30 in concrete or on the gravel-cement mix 30, in sequence, one in front of the other one, paying attention to face the junction openings (11, 12). The laying tolerance will be in the order of the 2-3cm (see for example the arrangement of example of figure 2 and 3).

30

**4) Execution of the connections between foundation plates:**

In the recesses obtained between the openings of each foundation module (that is the spaces defined by the

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coupling of an opening 11 with an opening 12 of a front module, as per figure 3), are inserted further shaped bars, for example of steel, to reinforce and connect between them the various plates. Once the laying of the additional reinforcements has been completed, the castings in concrete are executed until filling all the recesses. In this way, the casting in concrete solidifies and, setting between the irons, guarantees a perfect union of the modules between them.

In this way, the foundation assumes the configuration of a continuous tape of a width of about 2,80m.

**5) Provisional laying of the track plates:**

The tracked portals or the mobile cranes collect from the railway cars the platforms 10 and place them on the surface of the foundation previously executed. The correct laying of each single platform is controlled with topographical instruments that identify the axis of the track in project that will have to coincide with the axis of the platforms in laying.

**6) Positioning and fixing of the rails on the track plates:**

When all the platforms 10 have been applied, the single rails are lifted, which had been previously placed at the sides of the section that is the object of the invention, and they are placed in the seats arranged with the pre-assembled fastenings.

At this point the provisional blocking of the single bars (if not previously welded between them), as well as the tightening of the single fixing points of the fastenings (normally there are  $8+8 = 16$  rail fixing points on each platform) take place.

**7) Coring and insertion of reinforcing cut bars for "stopper" reinforcement:**

While the activities proceed in sequence, the operations of coring can initiate of the underlying foundation through the two holes 21 of a diameter of 30cm present in the track plates, then inserting the reinforcements of steel necessary for the shear stresses, blocking them with structural resin or *beton* (the pivots 25 indicated in the section of figure 1). The subsequent pouring of the mortar will create the underlying layer 41 and will realize a resistant cylinder in the hole 21 called "stopper". The section of figure 1 shows in fact the pivots 25 that are inserted and that are then drowned and therefore fixed definitively through the pouring.

**8) Provisional alignment and levelling of the track:**

Acting with the help of mobile cranes, track-lifting portals and jacks, a provisional adjustment of the track is executed in such a way as to allow the transit at a reduced speed of the trains during the period of re-activated operation.

The track thus adjusted is fixed in position with wedges, thicknesses, dowels and fixing systems of different systems and normally available on the market.

At the ends of the section involved in the substitution will be executed the junction necessary to connect eventual differences in level in quota between the new track and the existing track (which will be the object of the subsequent intervention).

**9) Re-activation of the circulation with reduced speed:**

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The circulation of the trains is re-activated with the imposition of a reduced speed.

## **MACROPHASE 2 : Track Adjustment - Mortar Injection -**

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### **1) Definitive adjustment of the track:**

The track is now placed in the plano-altimetric position of project foreseen, the correct position of the rails is obtained by acting on the special bolts (30, 31) of adjustment (those visible in figure 8) that, by screwing or unscrewing, permit the movement of the platform 10 to which the rails are bound. The adjustment is executed following charts that define the plano-altimetric distances of the rail from topographical pins or with the help of special cars that move on the track and communicate with topographical instruments that, through a software, determine the movements that have to be made to put the track in position.

20

### **2) Injection of the mortar and formation of the "stopper":**

Now that the track is placed in a definitive position the pouring of the mortar takes place, which will fill in the interspace comprised between the extrados of the foundation and the intrados of the track plates (the layer 41). Before making the injection of the mortar lateral caissons will be positioned for the containment of the casting. The injection can be made with the help of pumps and pipes or with special hoppers transported by the tracked portals so as not to weigh on the track that has just been adjusted and leant only on the adjustment bolts. The mortar is poured until the complete filling of the spaces and,

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in correspondence of the holes present in the track plates, reinforced cylinders called "stoppers" will be formed as a consequence.

5    **3)    Provisional support and fixing of the track plates:**

In order to give time to the mortar to set and harden, also during the re-opening of the railway traffic at a reduced speed, temporary special supports are inserted in spaces arranged in the track platform, which have  
10    the task of supporting the load for the passage of the train set without weighing on the fresh mortar. The track thus adjusted is fixed also laterally in position with wedges, thicknesses, dowels and different fixing systems normally available on the  
15    market.

**4)    Re-activation of the circulation at a reduced speed:**

The circulation of the trains is re-activated with the imposition of a reduced speed.

20

**MACROPHASE 3 : Provisional works disassembly - Welding and frosting**

**1)    Provisional works disassembly:**

25

The mortar injected employs about three days to mature completely, and once this period of time has passed all the provisional support and fixing systems can be removed.

30    **2)    Welding and frosting:**

The weldings in the prescribed methods and therefore the frostings are executed.

35    **3)    Re-activation of the circulation with speed of project:**

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The circulation of the trains is re-activated without any speed limit.

In accordance with the present method, it is therefore possible, in a quick way, to make a re-  
5 construction of an old line, therefore to operate a maintenance, a re-conditioning or even to employ such method for a construction from scratch.

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CLAIMS

1. An assembly for operating the maintenance and/or construction and/or re-construction of a railway line or of a part thereof and comprising:
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- One or more foundation modules (1), pre-fabricated and transportable *in loco*;
  - One or more platforms (10), pre-fabricated and transportable *in loco*, said platforms being configured to hold the rails (100) constituting the railway line and being overlappable to the foundation modules (1);
  - Adjustment means (30, 30', 31) configured to allow a plano-altimetric adjustment of the platform (10) with respect to the foundation module (1) when, in use, the platform (10) is arranged on the relative foundation module (1);
  - And wherein, further, first connection means (21, 25, 41) are foreseen, to allow to fix the overlying platform (10) to the underlying module (1) following the plano-altimetric adjustment of the platform (10) on the module (1).
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3. An assembly, as per claim 2, wherein one or more pivots (25) are foreseen, insertable through the hole (21) to penetrate at least in part of the

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underlying foundation module (1).

4. An assembly, as per one or more of the preceding claims, wherein second connection means (11, 12, 13) are foreseen to allow to fix in succession a foundation module (1) to a subsequent foundation module (1).
5. An assembly, as per claim 4, wherein said second connection means (11, 12, 13) comprise at least one opening (11, 12) obtained respectively on two opposite sides (3, 4) of the module, each opening being provided with a plurality of long-shaped hardening elements (13), and a hardening fluid material which is injectable in the seat (11, 12) formed by two openings (11, 12) of two modules (A, B, C) when they are placed in succession one after the other and with the respective openings that face one another.
6. An assembly, as per one or more of the preceding claims, wherein said adjustment means (30, 30', 31) comprise a plurality of long-shaped pivots through which the platform (10) leans on the foundation module (1), resulting spaced from it in such a way as to create a space for the formation of said hardening layer (41).
7. An assembly, as per claim 6, wherein said long-shaped pivots are extractable/retractable from/in said platform (10).
8. A method for operating the maintenance and/or construction and/or re-construction of a railway line or of a part thereof and comprising the following phases:
  - Arrangement of one or more foundation modules (1),

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pre-fabricated and transportable *in loco*;

- Arrangement of one or more platforms (10), pre-fabricated and transportable *in loco*, said platforms being configured to hold the rails (100) constituting the railway line;
  - Positioning, in the pre-chosen assembly position, of at least one foundation module (1);
  - Overlapping of the platform (10) to the relative foundation module (1);
  - Plano-altimetric adjustment of the platform (10) with respect to the foundation module (1);
  - Fixing of the overlying platform (10) to the underlying module (1), subsequently to said plano-altimetric adjustment phase.
9. A method, as per claim 8, wherein a plurality of long-shaped pivots (30, 31) are foreseen that exit from the platform (10) forming support feet that keep the platform lifted with respect to the module, said long-shaped pivots being extractable/retractable with respect to the platform in such a way as to allow said plano-altimetric adjustment.
10. A method, as per claim 8 or 9, wherein said fixing operation foresees the injection of a hardening fluid material which is injected in the space between module and platform that leans on said module through said long-shaped pivots.
11. A method, as per one or more of the preceding claims from 8 to 10, wherein at least one hole (21) is foreseen passing through the entire thickness of the platform (10) and through which a hardening fluid material is poured which forms a layer (41)

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interposed at least in part between platform and module.

12. A method, as per claim 11, wherein the poured fluid material fills, at least partially, also the hole  
5 (21).
13. A method, as per one or more of the preceding claims from 8 to 12, wherein, before the pouring phase, a coring phase is foreseen of one or more holes that penetrate at least in part in the underlying module  
10 (1), said coring holes being obtained in the area of module delimited by the overlying hole (21) of the platform, and wherein, following said coring, the phase of insertion of pivots (25) in said coring holes is foreseen.
- 15 14. A method, as per one or more of the preceding claims from 8 to 13, wherein a preliminary phase of removal of the old railway infrastructure is foreseen.
15. A method, as per one or more of the preceding claims from 8 to 14, wherein before the arrangement of the  
20 foundation module (1) a phase of creation of a laying layer (30) is foreseen on which said foundation module leans, said laying layer (30) being realized with a hardening fluid material.
16. A method, as per one or more of the preceding claims  
25 from 8 to 15, wherein the application of two or more foundation modules in succession and the relative connection of a foundation module to the subsequent one is foreseen.
17. A method, as per claim 16, wherein said connection  
30 foresees the pouring of a hardening fluid material in the relative seats (11, 12) that are generated, when a module is placed in succession to another

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module, through the openings (11, 12) obtained in the modules that face one another.

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FIG. 1

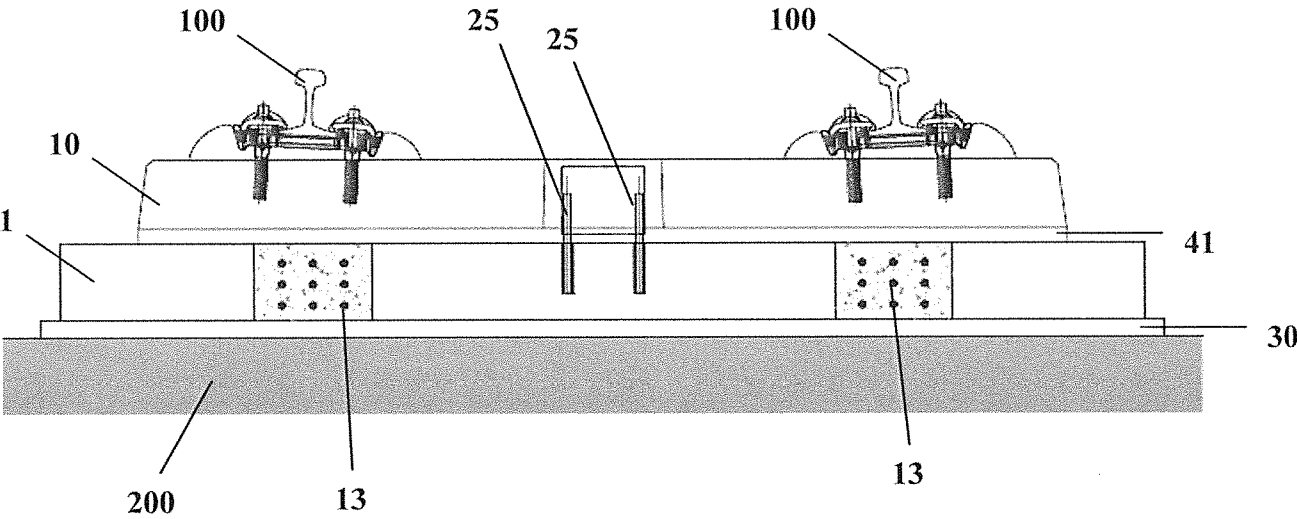


FIG. 2

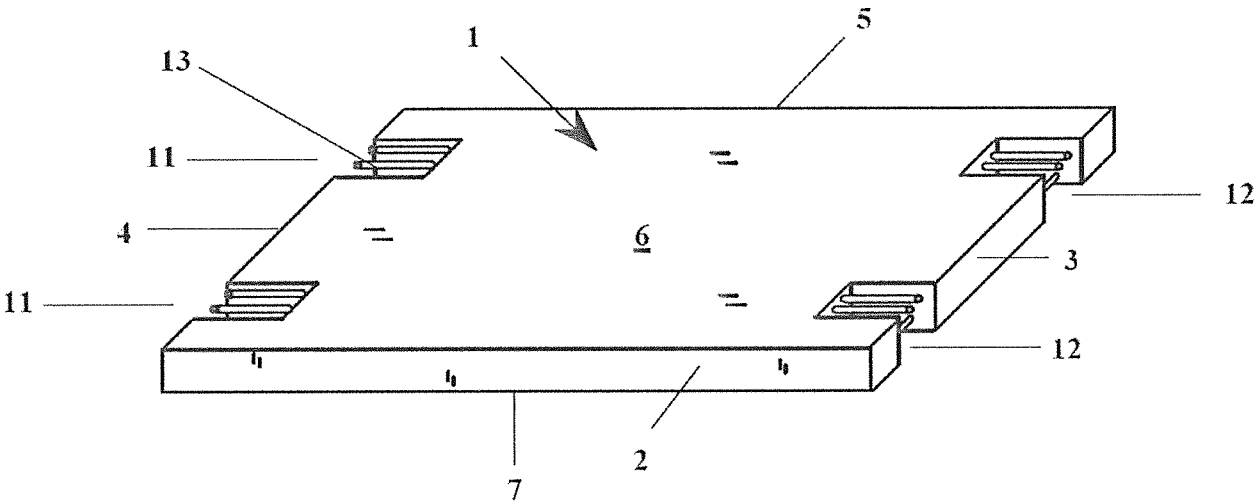
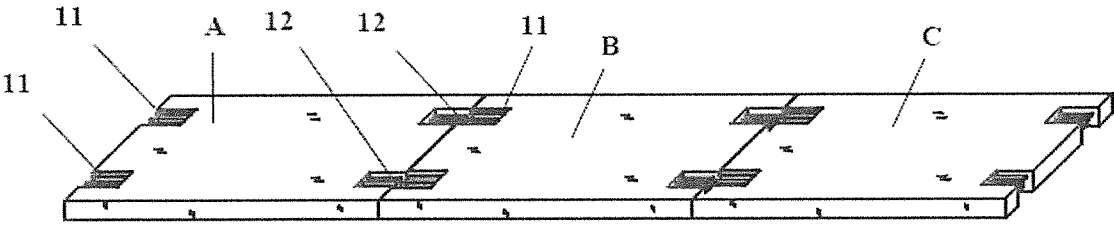
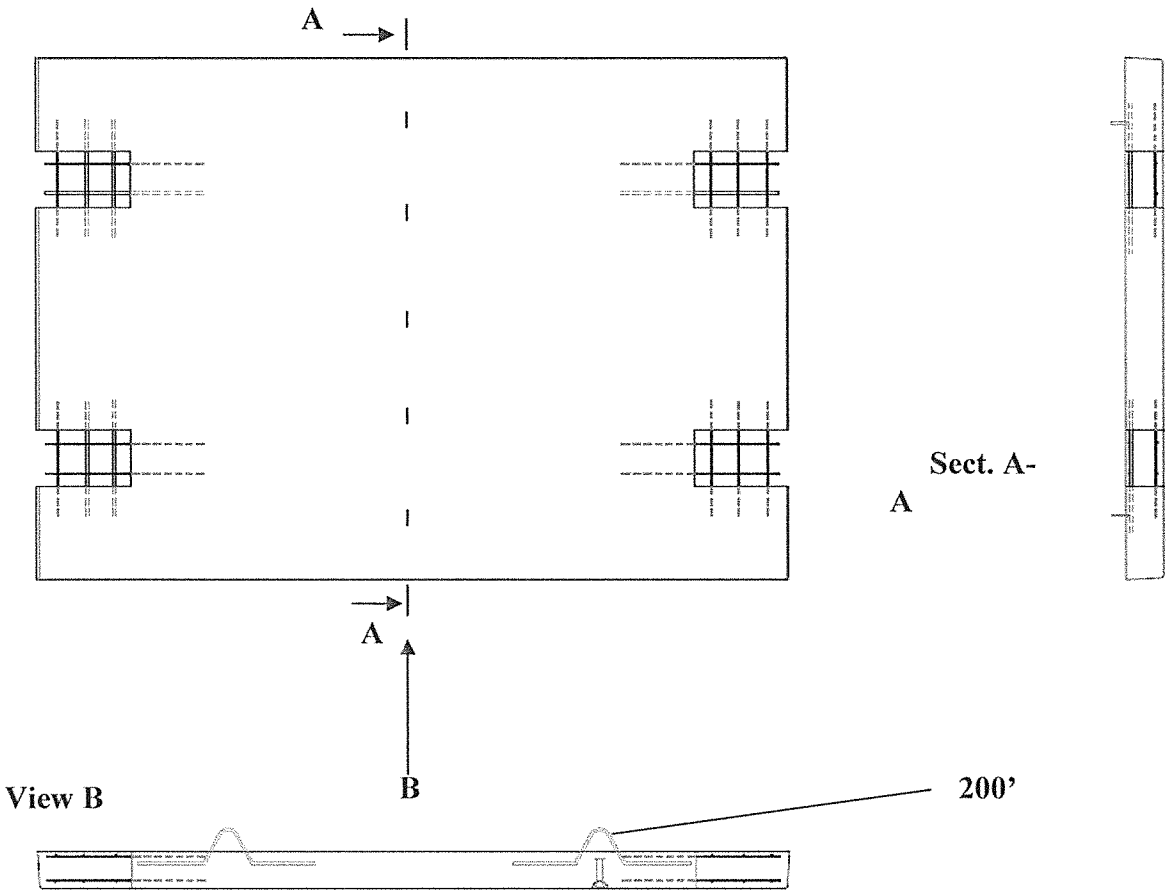


FIG. 3



**FIG. 4**



**FIG. 5**

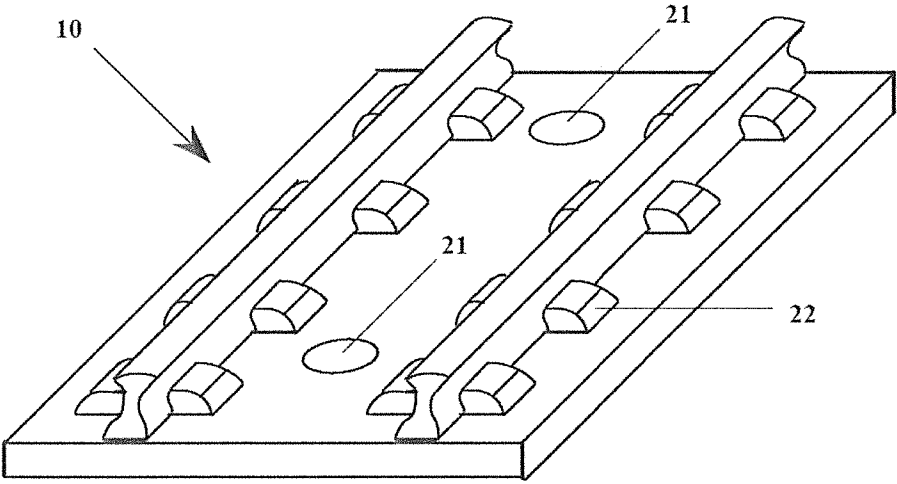


FIG. 6

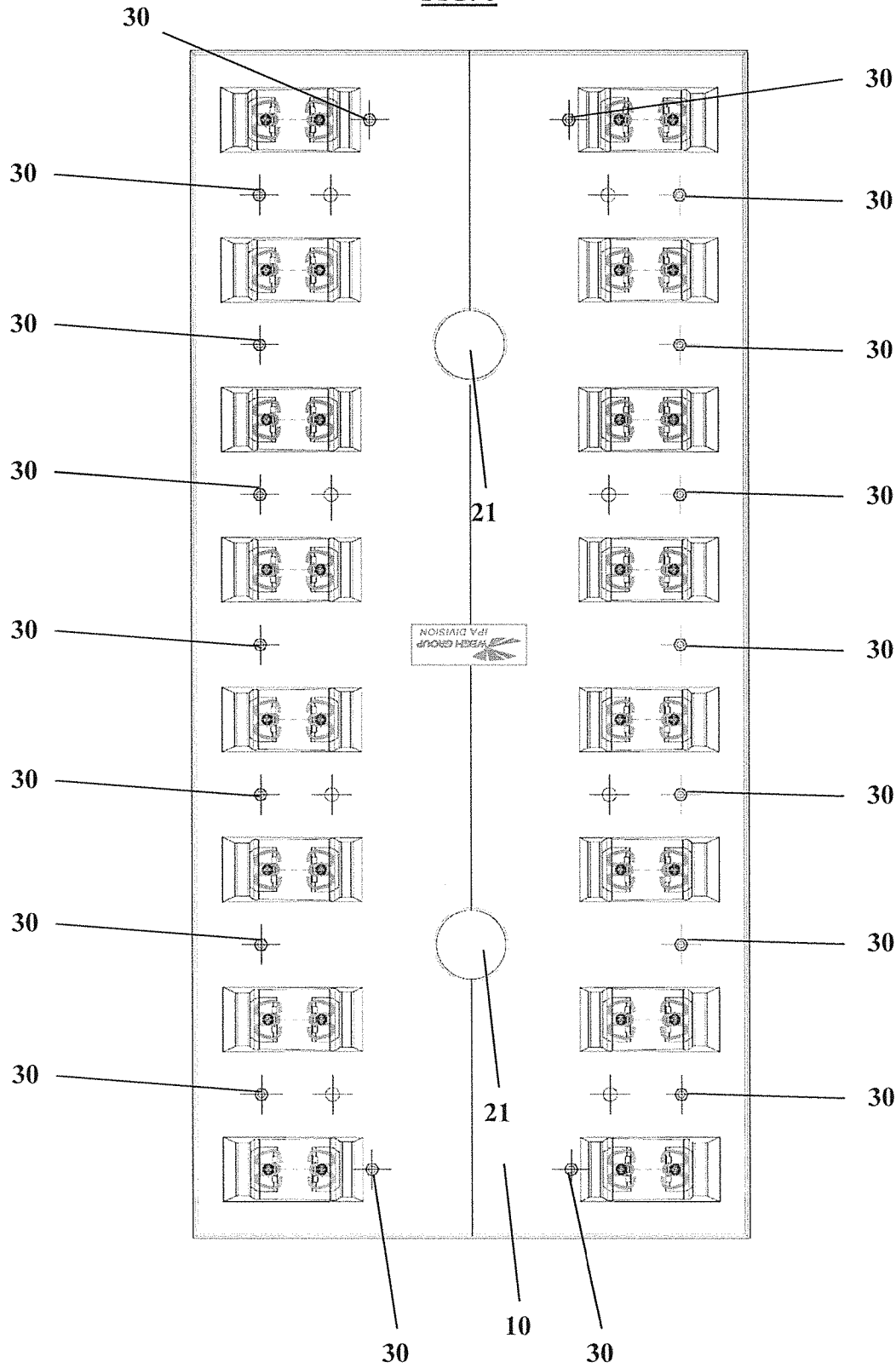


FIG. 7

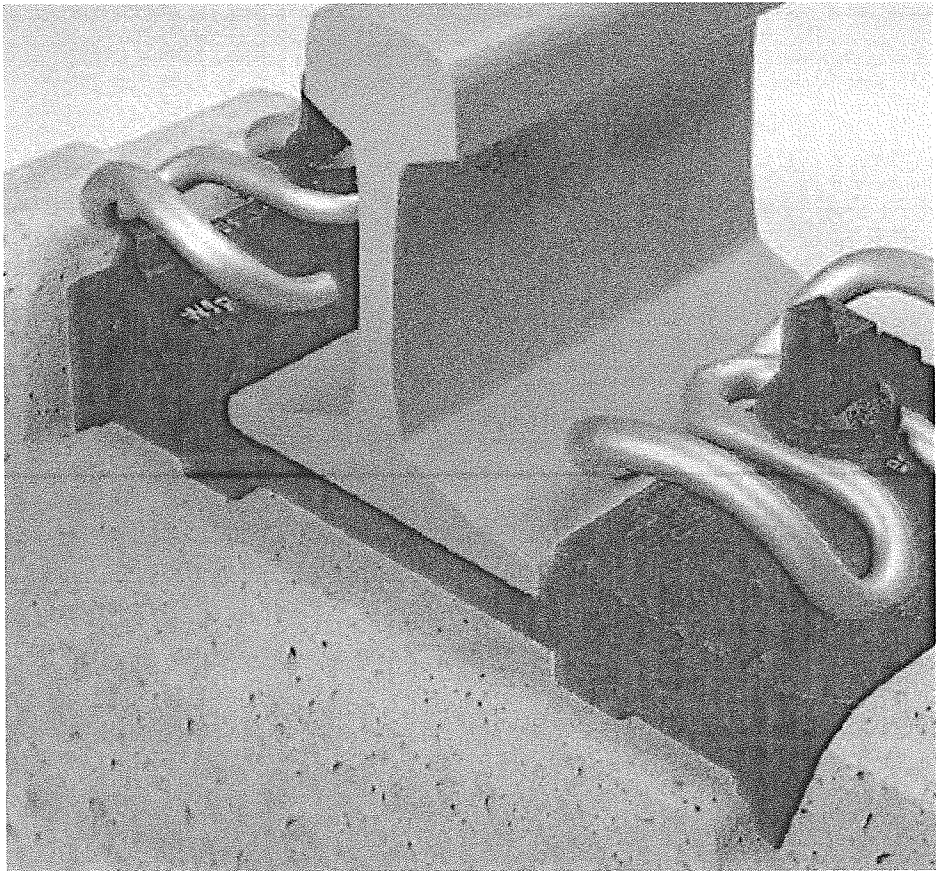
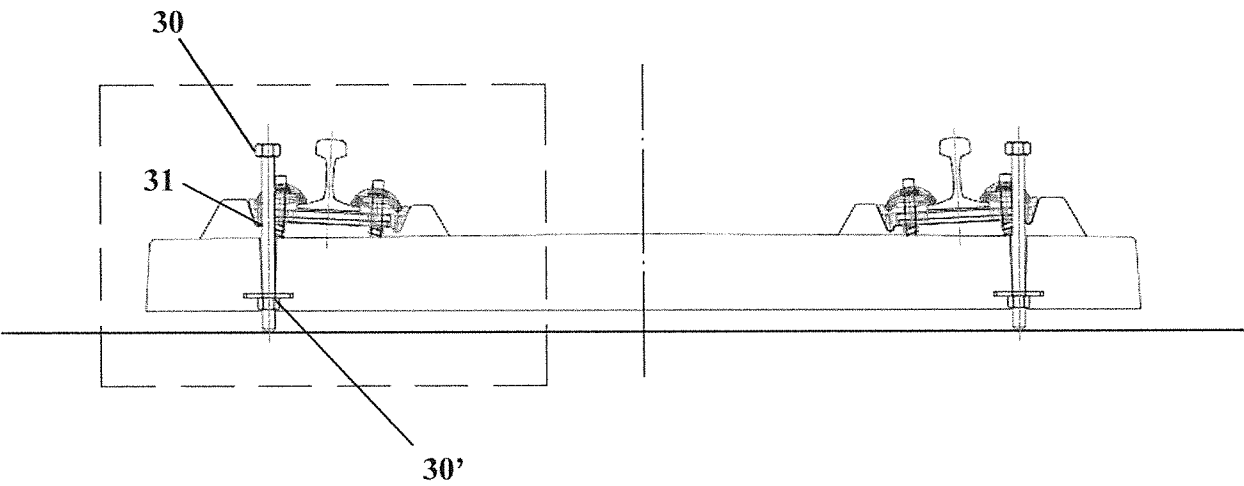


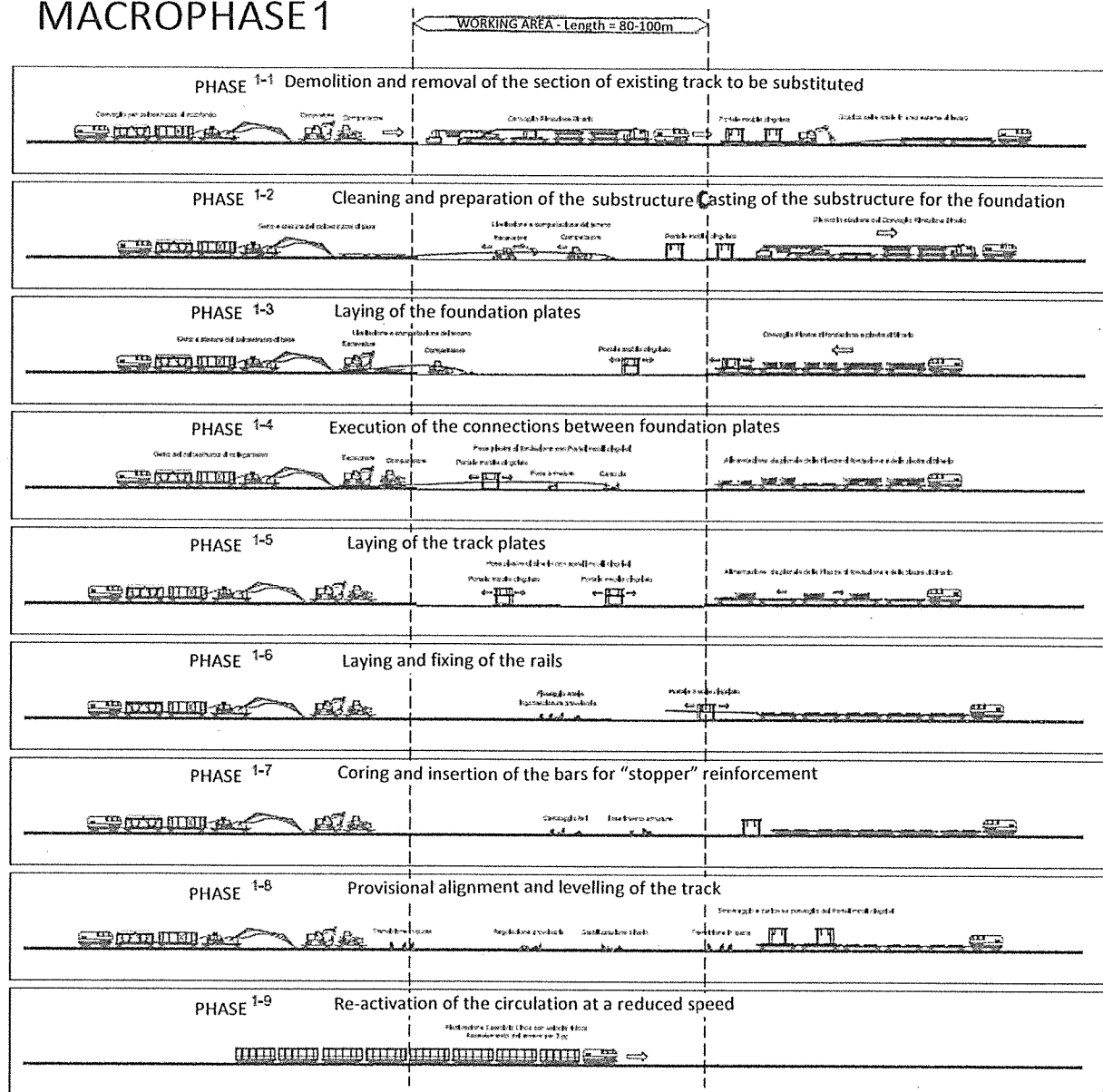
FIG. 8

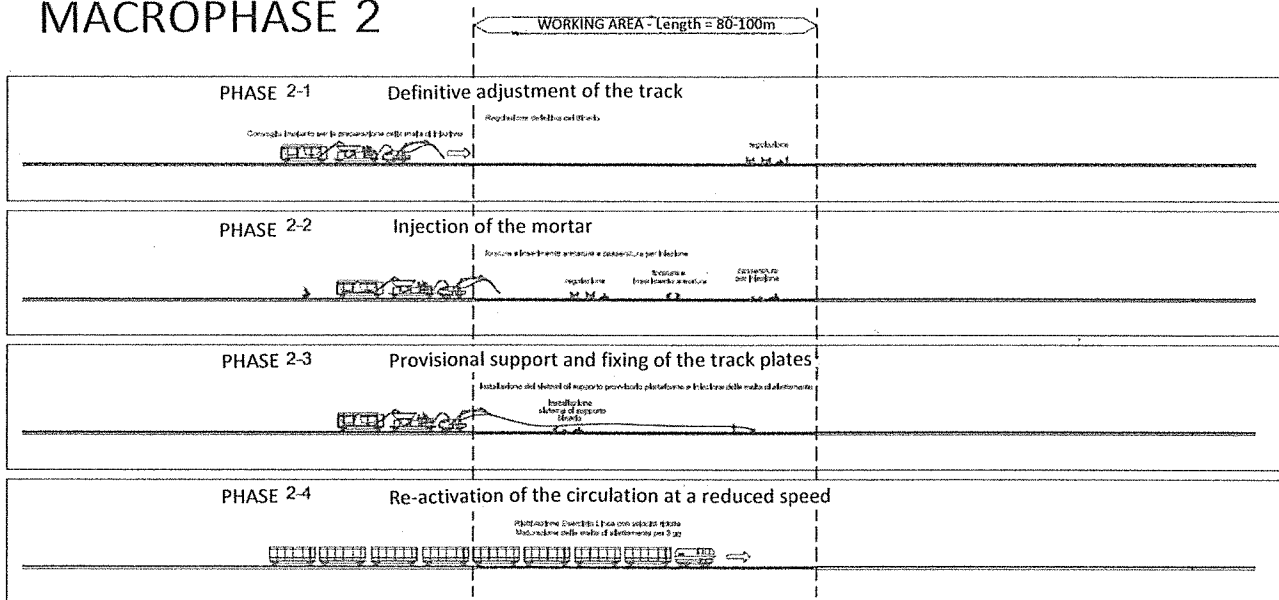
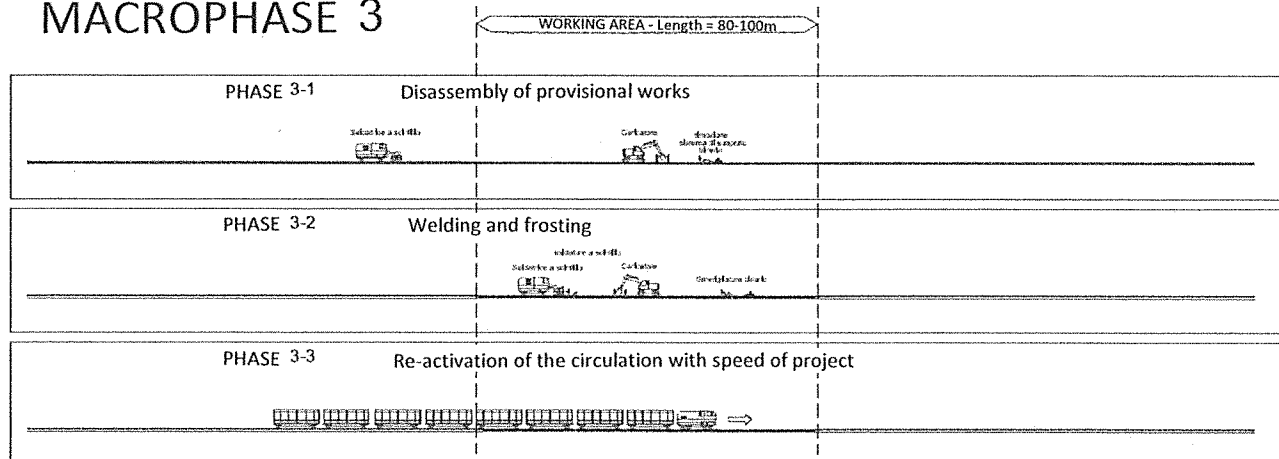


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FIG. 9

## MACROPHASE 1



**FIG. 10****MACROPHASE 2****FIG. 11****MACROPHASE 3**

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/IT2016/000107

A. CLASSIFICATION OF SUBJECT MATTER  
INV. E01B1/00 E01B2/00 E01B29/02 E01B29/04  
ADD.

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)  
E01B

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

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

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                       | Relevant to claim No. |
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| Y         | -----<br>GB 553 086 A (WILLIAM HALL WINSTANLEY)<br>6 May 1943 (1943-05-06)<br>page 2, line 1 - line 4; figure 1<br>----- | 5,17                  |



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

12 January 2017

Date of mailing of the international search report

24/01/2017

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IT2016/000107

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