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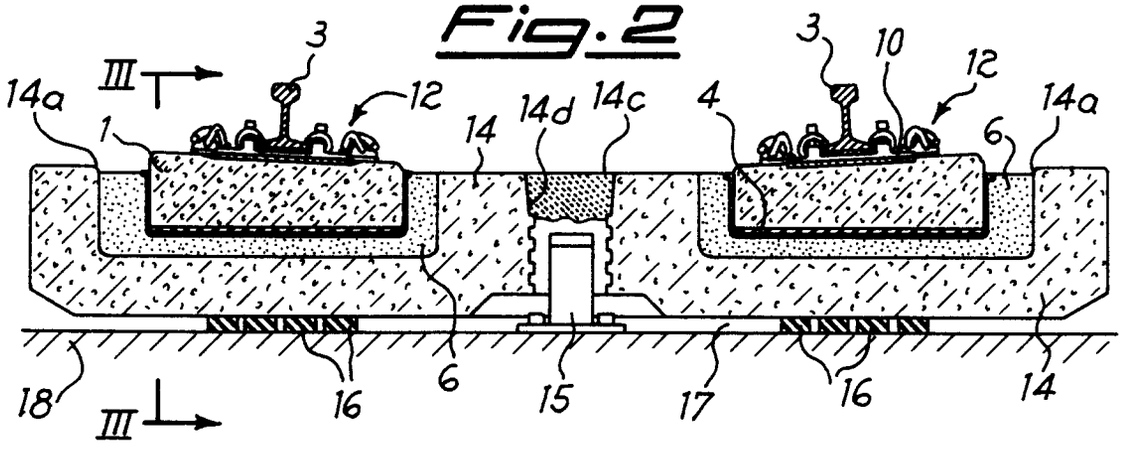
(54) Superstructure assembly with rail support blocks located transversally in longitudinal housings with interposition of flexible components.

(57) A rail superstructure assembly with vibration damping, particularly for railway lines in tunnels, consisting of a prefabricated member (12) comprising a block (1) carrying fasteners (7) for rails (3), made of concrete and enclosed in an envelope (5), open at the top, of rubber or the like, having vibration damping properties, the entire assembly being capable of being inserted via a bed casting (6) into a concrete housing (14) forming part of track bed (3) of the railway line, or at least of one of its lengths, there being provided damping components (4, 16) made of elastomeric material inserted lengthwise between lower surface (1b) of such block (1) and envelope (5) and between housing (14) and rail supporting slab (18), respectively, there being furthermore provided means (14c, 15) for centring the position of housing (14) with respect to the development of the track.

Fig. 2



EP 0 603 927 A2

The object of this invention is a rail superstructure assembly with vibration damping, particularly for railway lines in tunnels, comprising rail support blocks located transversally in appropriate housing seats arranged longitudinally in relation to the rails, with interposition of flexible damping components.

Railway lines running through city centres, as well as metropolitan railway lines, present the problem of transmitting, during the passage of the trains, vibrations which may disturb the structures in proximity to which they run, even proving in some cases hazardous for such structures.

Usually the railway lines rest on ballast which provides a flexible supporting base, capable of damping vibrations to a large extent; however, while such ballast proves satisfactory for non-urban lines, or those located remote from buildings, it is not sufficient for many systems, for example in the case of underground railway lines, such as metropolitan lines, running underneath monuments, ancient buildings or special-purpose buildings, the structure or use of which could be jeopardized by the vibratory movement.

Furthermore, round ballast is subjected to the phenomenon of compaction during use and therefore requires regular maintenance operations, which are particularly demanding and difficult in the case of lines in tunnels with heavy traffic.

There have been proposed cushioned fastening devices or systems of various forms, for example by placing underneath the rail fastenings, or underneath a heavy block to which the said rails are connected, a layer of expanded or flexible material, but such arrangements provide a limited degree of vibration damping which is not always sufficient. There have also been developed rail supporting sleepers of plastic material inserted in a concrete slab resting in turn on a layer of mineral wool or the like, but such arrangements, even though providing a good damping value, have proved too costly and of doubtful durability, it being furthermore virtually impossible to maintain the mineral wool placed below the slab.

The present applicant put forward in a previous patent, IT - 1.190.000, a solution based on the use of a rail superstructure with vibration damping consisting of a prefabricated member comprised of a concrete block carrying rail fastenings enclosed in an envelope of rubber or the like open at the top, with interposition at the sides and bottom of a layer of expanded plastic material having vibration damping properties, firmly adhering to the concrete block and to the rubber envelope, the whole being capable of being incorporated in a concrete casting forming part of the bed of the railway track.

According to a form of implementation of such previous invention, each prefabricated member is independently built into the concrete casting forming part of the track supporting bed; the facing prefabricated members of two parallel rails forming a track may be interconnected by a linking cross-member, preferably consisting of a metal section, capable of ensuring constant spacing and if necessary of being removed after positioning of the prefabricated members and hardening of the casting.

Such previous solutions, however, pose a number of disadvantages including the fact that such member linking the independent blocks protrudes above ground level and poses a danger of obstruction, particularly in the event of leaks in a tunnel; such member is furthermore an obstacle to the variation of the vertical height of the bed with respect to ground level.

In addition to this, the difficulty of reproducing industrially in a constant manner the flexible properties of the plastic filling material renders uncertain the durability in time of its damping action, thereby creating numerous practical problems for industrial implementation and preventive maintenance.

There is therefore posed the technical problem of providing a track supporting structure which will prove particularly effective as regards the damping of vibratory movement brought about by the passage of trains, allowing regulation in a vertical sense of the track geometry while maintaining the upper running surface continuous and free from transverse obstacles so as not to constitute a hazard in the event of leaks, particularly in tunnels.

The structure should furthermore be comprised of the smallest possible number of components to facilitate and make highly repeatable the production and assembly thereof prior to being placed in position on the ground.

Such results are obtained with the present invention, which provides a rail superstructure assembly with vibration damping particularly for railway lines in tunnels, consisting of a prefabricated member comprising a block carrying the rail fasteners, made of concrete and enclosed in an envelope, open at the top, of rubber or the like, having vibration damping properties, the entire assembly being capable of being inserted via a bed casting into a concrete housing forming part of the track bed of the railway line, or at least of one of its lengths, there being provided damping components made of elastomeric material inserted lengthwise between the lower surface of such block and the envelope and between the housing and the rail supporting slab, respectively, there being furthermore provided means for centring the position of the housing with respect to the development of the track. More particularly, it is provided that such envelope shall have inner surfaces with projections capable of facilitating adherence to the concrete

block and that such housing shall comprise at least one pair of seats located crosswise and a multiplicity of seats located lengthwise in order to accommodate the rail supporting blocks.

According to a preferred form of implementation, such means for centring the housing with respect to the track bed consist of a through-hole drilled in the housing and of a pin or the like made integral with the slab in a preset position and capable of being secured at the time of placing on site of the housing by the setting of hardening material.

It is also provided that such hardening material shall become integral with the walls of the hole of the housing, but not with the pin, so as to allow damping action on the flexible components at the bottom. Further details may be obtained from the following description given with reference to the attached drawings, which show:

- In figure 1 : the detail of a block capable of being removed from the rail bed according to the invention, shown in cross-section according to a vertical plane transversal to the rail;
- In figure 2 : the bed according to the invention, shown in crosssection according to plane II-II of fig. 3, and
- In figure 3 : a rail supported in an antivibratory manner with beds according to the invention, shown in cross-section according to plane III-III of figure 2.

As illustrated in the figures, the rail bed according to the invention is comprised of a concrete block 1 to which is attached a rail fastening unit 2 holding rail 3, which block is inserted in an envelope 5 made of rubber or the like.

Envelope 5 is provided, on its inner surface, with projections 5a, for example of annular form, capable of ensuring its adherence to concrete block 1; additionally, between lower surface 1b of concrete block 1 and lower surface 5b of envelope 5 there is interposed a further slab 4 made of flexible material such as rubber or the like in order to increase vibration damping.

The assembly consisting of envelope 5 containing antivibratory material 4 and block 1, equipped with rail fastening unit 2, forms a factory-made prefabricated member 12 which is therefore capable of being rapidly placed on site at the time of construction of the track line, constituting the component for supporting and securing the rails to the ground.

Figures 2 and 3 show that each prefabricated member 12 is inserted in transverse seats 14a of an outer housing 14 made of pre-cast reinforced concrete, block 12 being secured thereto by means of bed casting 6; outer housing 14 rests in turn on a layer 16 of elastomeric damping material, such as microcellular rubber or the like, placed at the bottom of a hollowed-out duct 17 provided in slab 18, comprising the entire seat of the track.

Such housing 14 is furthermore provided in proximity to its middle zone, in a direction transversal to rail 3, with a through-hole 14c having a jagged inner surface 14d and capable of being inserted in a reference component 15 previously made integral with slab 18 in preset positions; once housing 14 is placed in the correct position, established by the matching of hole 14c with centring component 15, the remaining space is filled with hardening material which does not, however, become integral with pin 15, thus imparting to housing 14 the movement necessary to exert damping action on flexible components 16. As shown in figure 3, a certain number of prefabricated members 12 are inserted in a longitudinal direction parallel to rail 3 in corresponding seats 14b within such housing 14, which comes to constitute an appropriate mass suspended from flexible layers 16.

This therefore makes possible a further contribution to the damping of vibrations at all frequencies, in addition to that provided by the individual prefabricated members.

In greater detail, and by way of example, rail fastening unit 2 illustrated in figure 1 is comprised of a metal plate 7 anchored via tie rods 8 embedded in block 1 and provided with springs 9 capable of maintaining a constant tightening pressure with the interposition of a layer of elastomeric damping material 10; to the latter, via flexible tie rods 11, is fixed rail 3.

As shown in the figures, upper surface 1a of block 1 is inclined with respect to lower surface 1b, which is horizontal.

Such structure, together with the inherent properties of the rail fastening unit 2 used, makes it possible to obtain very high damping of the vibratory movement brought about by the passage of the train and transmitted by the rails, while at the same ensuring maintenance under load of the geometry of the track within the permitted tolerances.

The vibration generated by the train is in fact comprised essentially of oscillatory movements in a vertical sense. Such movements are damped both by the compressive strain on slab 4 and by shear strain caused by the firm attachment of block 1 to envelope 5 and of the sidewalls of the latter to casting 6, and therefore to housing 14.

During the passage of the train there is furthermore generated vibration in a horizontal sense, caused by the rocking motion of the vehicles and by imperfections either in the latter's wheels or in

the rails. Such vibrations are damped by the shear strain applied to the transverse lateral portions, as a result of the link existing between material 4, block 1 and envelope 5, and between the latter and casting 6.

The use of a rail fastening, itself provided with damping properties, for example such as that shown in figures 1, 2, makes it possible to obtain a further positive effect for damping purposes; the choice of the best combination should be made case by case, by assessing the costs in relation to the result, that is, with respect to the minimum accepted value of transmitted vibration.

The components according to the invention also provide in each case particular advantages in terms of rapidity and economy of installation, since the moulding of block 1 with the relevant anchor points for the rails, and its enclosure within envelope 5, often involving delicate operations, is done in the factory, in a controlled environment and using the most suitable tooling, which conditions cannot be achieved on site, thus favouring industrial repeatability of the production of the beds according to the invention.

Claims

1. A rail superstructure assembly with vibration damping, particularly for railway lines in tunnels, characterized in that it consists of a prefabricated member (12) comprising a block (1) carrying fasteners (7) for rails (3), made of concrete and enclosed in an envelope (5), open at the top, of rubber or the like, having vibration damping properties, the entire assembly being capable of being inserted via a bed casting (6) into a concrete housing (14) forming part of track bed (3) of the railway line, or at least of one of its lengths, there being provided damping components (4, 16) made of elastomeric material inserted lengthwise between lower surface (1b) of such block (1) and envelope (5) and between housing (14) and rail supporting slab (18), respectively, there being furthermore provided means (14c, 15) for centring the position of housing (14) with respect to the development of the track.

2. A rail superstructure assembly according to claim 1, characterized in that such envelope (5) has inner surfaces (5a) with projections capable of ensuring adherence to block (1).

3. A rail superstructure assembly according to claim 1, characterized in that such housing (14) comprises at least one pair of seats (14a) located crosswise and a multiplicity of seats (14b) located lengthwise to accommodate blocks (1) supporting rail (3).

4. A rail superstructure assembly according to claim 1, characterized in that such means of centring of the housing with respect to the bed of the track consist of a through-hole (14c) drilled in housing (14) and of a pin (15) or the like made integral with slab (18) in preset positions and capable of being secured at the time of placing on site of the housing by the setting of hardening material.

5. A rail superstructure assembly according to claim 1 and 5, characterized in that such hardening material becomes integral with walls (14d) of the hole in container (14) but not with pin (15) so as to allow damping action on flexible components (16) at the bottom.

Fig.1

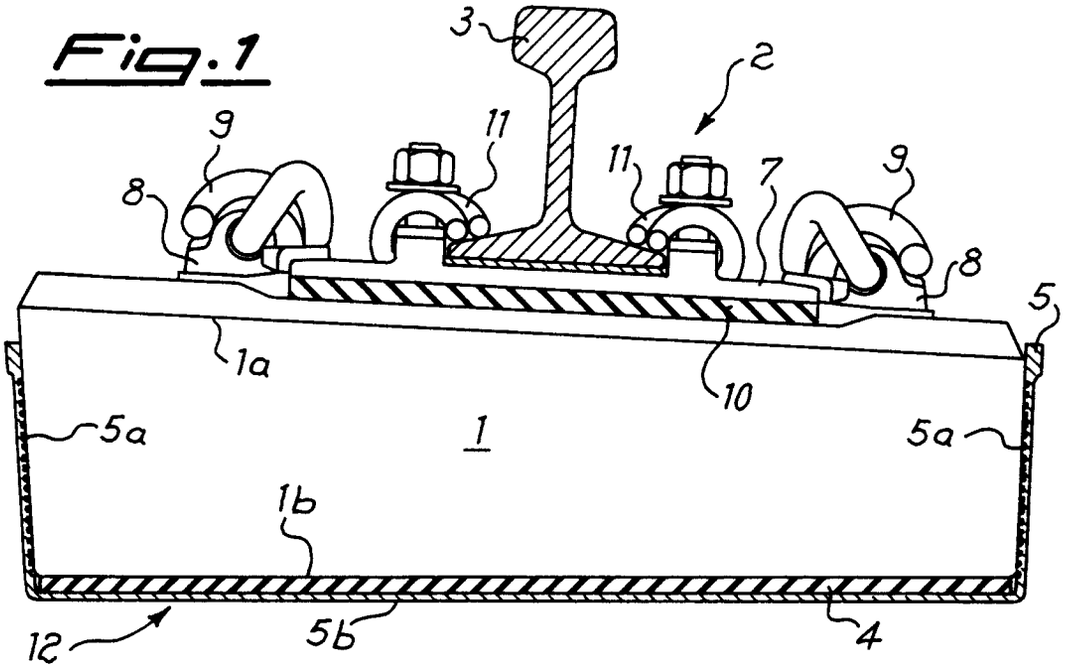
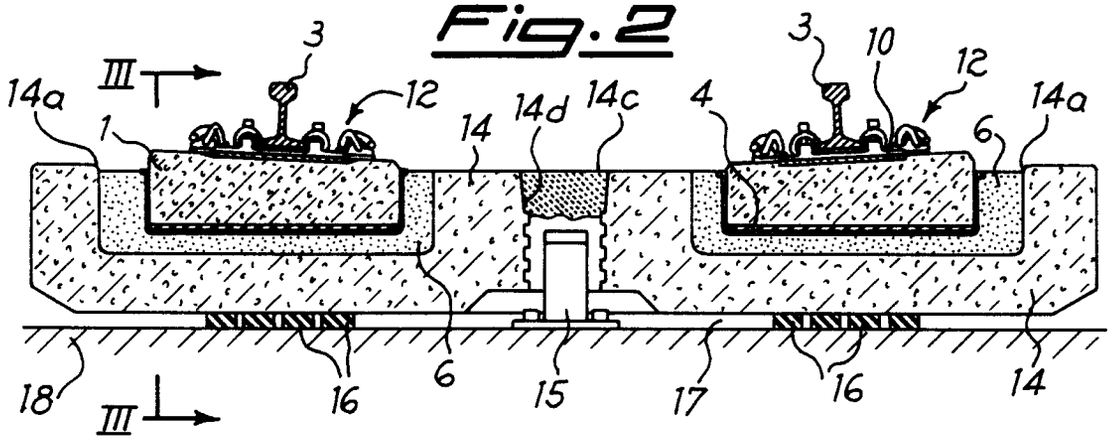


Fig.2



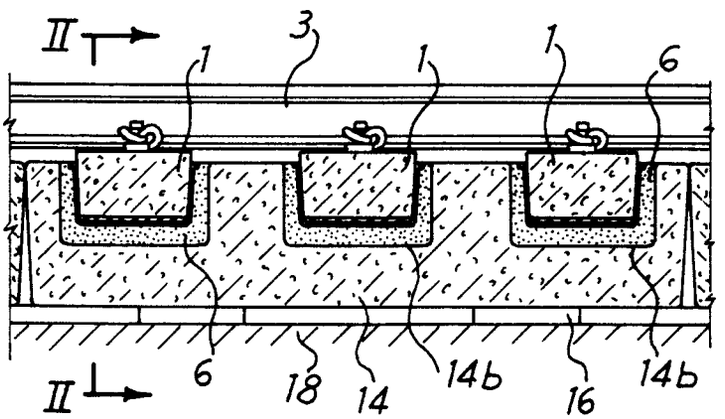


Fig.3