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E01B 11/26 // E01B 11/54

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(56) Documents Cited:
GB 0505025 A **GB 0214384 A**
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(58) Field of Search:
INT CL^7 **E01B** 11/22 11/24 11/26 11/54
Other: **ONLINE WPI EPODOC JAPIO**

(54) Abstract Title: **Insulated interlocking rail joint**

(57) The joint has first and second rail sections 8,10 having head and supporting portions of substantially the same width. The rail sections 8,10 have an interlocking joint arrangement, such as a multiple dovetail joint, between which an insulating member 36 is sandwiched. The interlocking arrangement allows the rails to be coupled together only in a sliding direction perpendicular to the rail length and provides mechanical resistance to separation of the rails in any other direction. The interlocking arrangement prevents separation of the rails in the rail direction, without any additional connection between the rail sections.

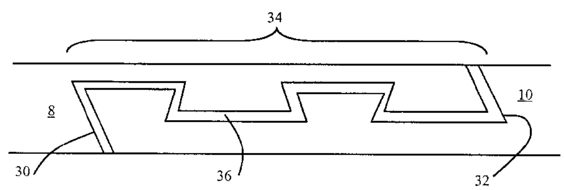

FIG. 3

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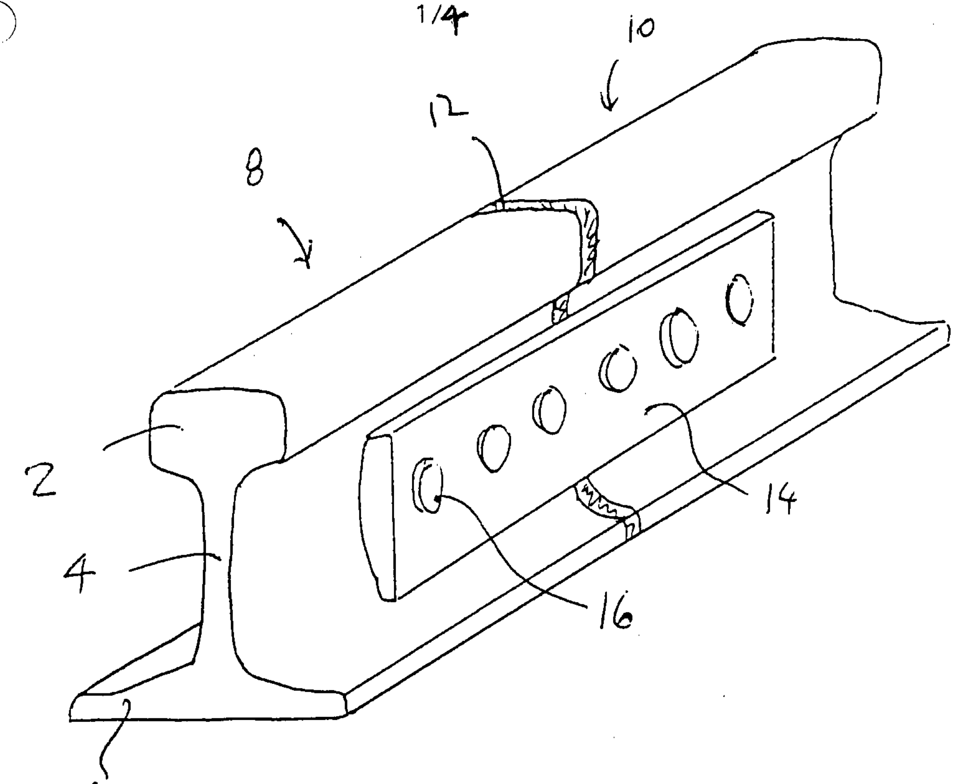

FIG 1

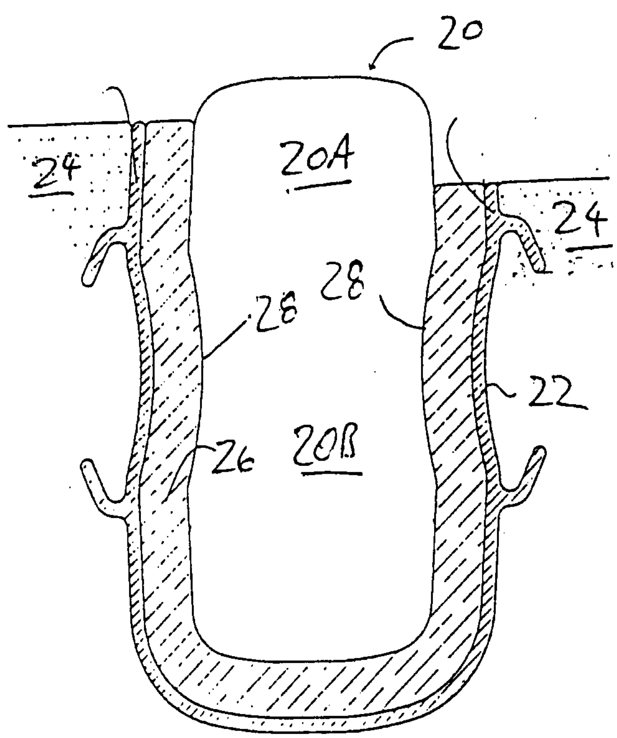

FIG 2

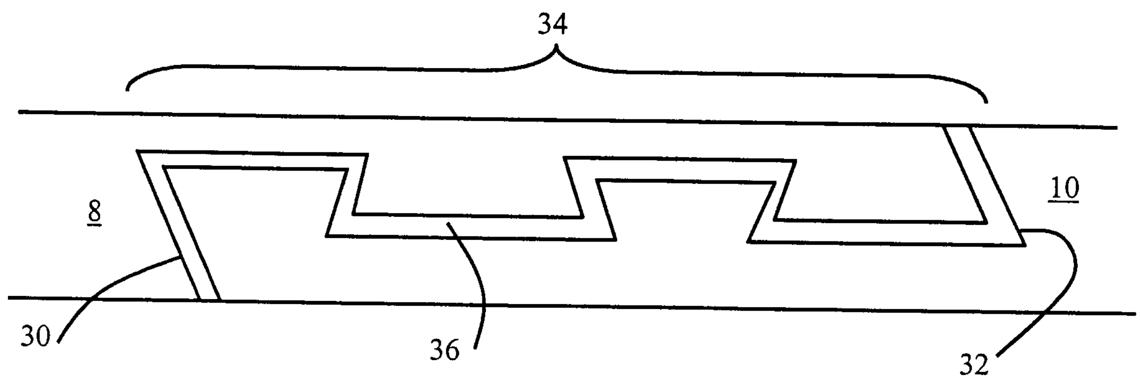

FIG. 3

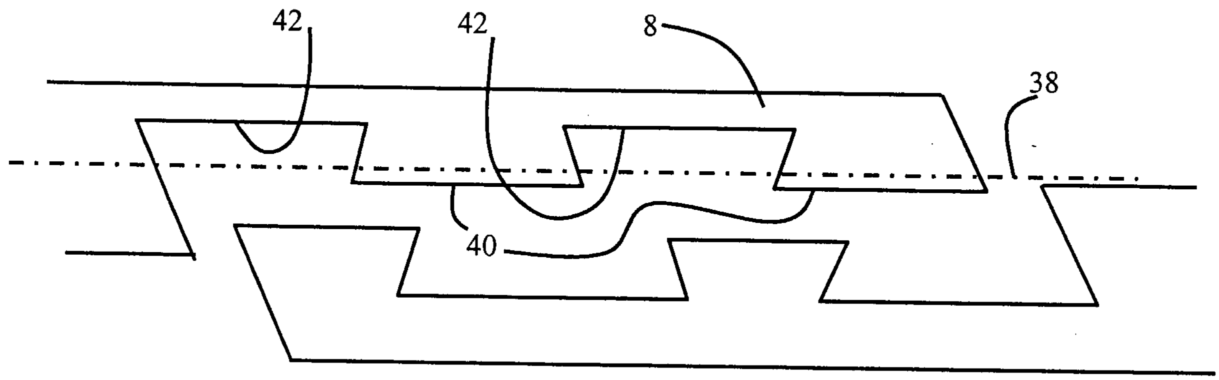

FIG. 4

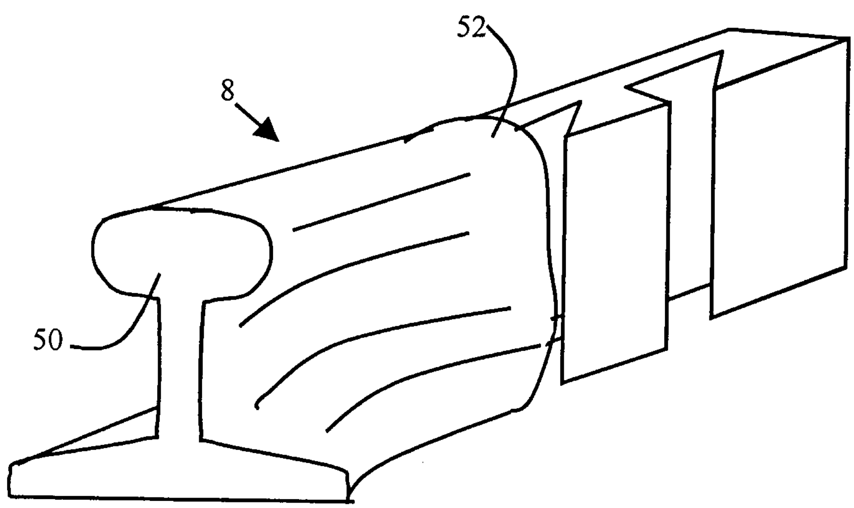

FIG. 7

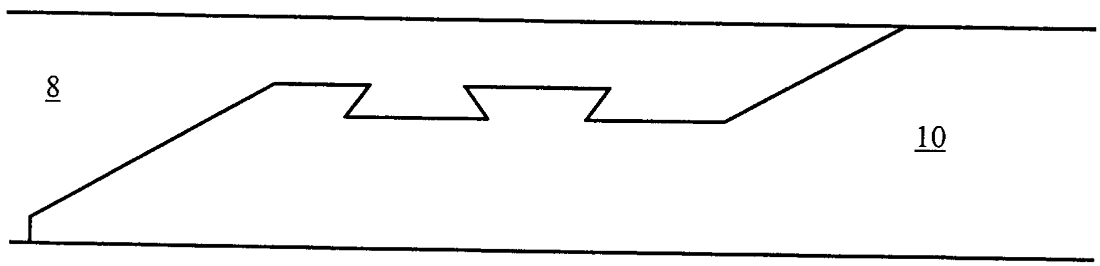

FIG. 5

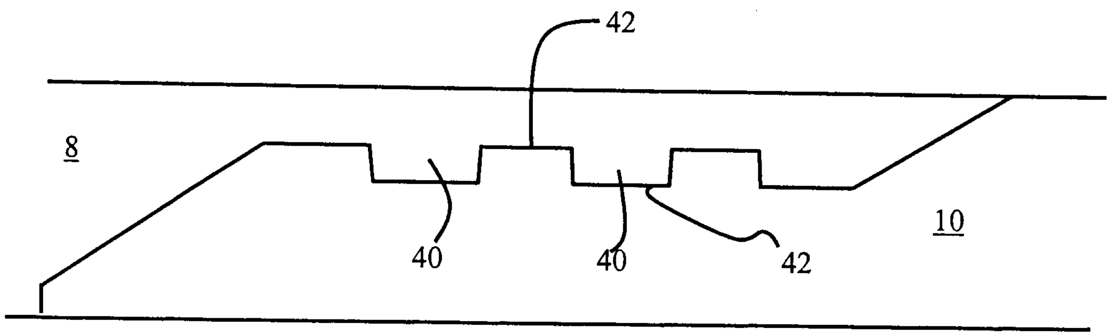

FIG. 6

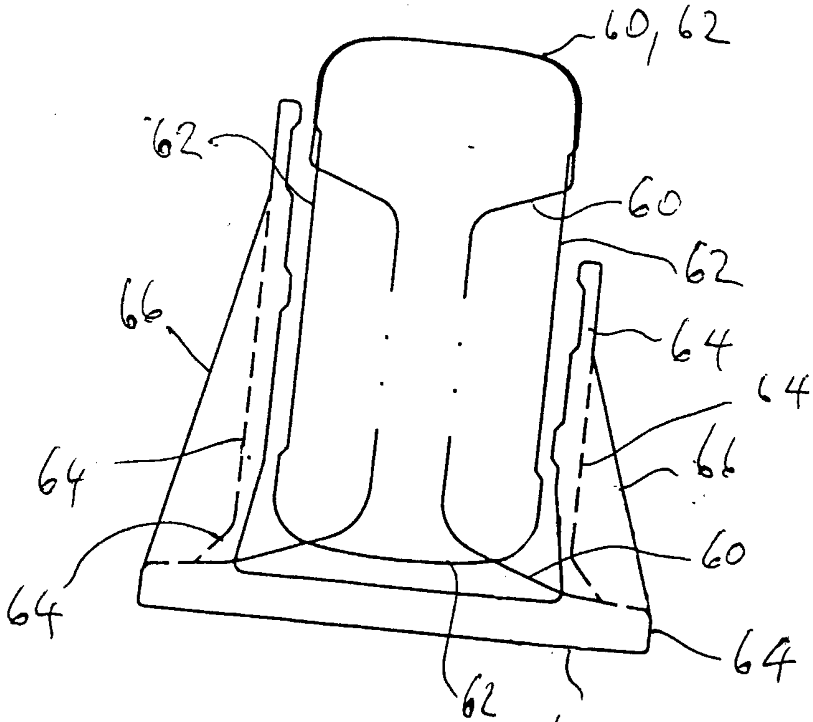

FIG 8

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INSULATED RAIL JOINT

This invention relates to insulated rail joints, for use as part of railway signalling systems, particularly in which the rails of the track are used as conductors for signalling purposes.

Signalling operations are performed based on knowledge of the position of trains on the track. Successive blocks of track can be electrically insulated from each other to enable independent detection of trains to take place in those blocks. This invention is concerned with the insulated railway track joints suitable for such railway signalling systems.

A conventional rail essentially comprises an I-beam, having a head, a narrow web and a base. A conventional insulated rail joint is achieved by cutting two rail sections perpendicularly to the length of the rail. An insulating plate is sandwiched between the two end faces, and the joint is secured using fish plates which are positioned on either side of the thinner web, and which span across the joint. The fish plates on either side are bolted together by bolts passing through both rail sections.

An assembled insulated rail joint is introduced into a rail network by taking a pre-assembled rail joint, and welding the remote ends of the two rail sections into place on site.

The rails are supported at regular intervals by the sleepers, and span the spacing between sleepers. The I-beam structure provides the required vertical strength of the rail across these spans. Insulated rail joints may be located at the position of the sleeper, or between sleepers. However, in either case, the joint is susceptible to wear and damage.

When the joint is suspended between sleepers, there is a tendency for the rails to dip as the train passes over, particularly as forces are transferred rapidly and abruptly from one side of the joint to the other as the train axles pass over. Similarly, there is a tendency for joints to open up when they are located over the sleepers. This leads to accelerated wear, requiring frequent replacement of the insulated joints.

Another problem encountered in the mechanical insulated rail joint is that over time the metal of the rail displaces, and can even result in shorting between adjacent rail blocks, giving rise to track circuit failure.

According to the invention, there is provided an insulated rail joint comprising first and second rail sections, the cross sections of which, in the vicinity of the joint and perpendicular to the rail length, comprise a head portion and a supporting portion, the head and supporting portions having substantially the same width, the first and second rail sections being terminated with a connection face which extends along a portion of the length of the respective rail, the insulated joint being formed by sandwiching an insulating member between the connection faces, wherein the connection faces are arranged to provide coupling of the rails such that the rails can be coupled together in a sliding direction perpendicular to the rail length, the coupling arrangement providing mechanical resistance to separation of the rails in a direction parallel to the rail length.

Extending the joint over a length of rail results in a progressive transfer of force from one rail section to the other as the train passes over the joint. Furthermore, the risk of shorting resulting from deformation of the rail metal is also reduced. The supporting portion of the rail has substantially the same width as the rail head, so that the I-beam section is not used at the insulated joint. The coupling arrangement prevents separation of the rails in the rail direction, without any additional connection between the rail sections.

Preferably, the rails can be coupled together in an interlocking manner in only a single sliding direction, and the coupling arrangement provides mechanical resistance to separation of the rails in any other direction.

Preferably, a shell receives the joint and supports the rail sections along most of the height of both lateral sides of the rail joint. This support, combined with the coupling arrangement, avoids the need for any other mechanical connection, so that the mechanical securing of the rail sections can be solely through the mechanical coupling arrangement.

Each connection face may comprise at least one dovetail projection and at least one dovetail recess. The dovetail projection and the dovetail recess extend perpendicularly to the sliding direction, preferably across a longitudinal centre plane of the rail section. In this way, the dovetail joints are in the centre of the rail, so that the rail joint is essentially symmetrical, and each rail section has sufficient material in the joint for the required mechanical strength and support.

The sliding direction may be vertical, or it may be offset from the vertical.

The ends of the first and second rail sections away from the joint may have cross sections which are different to the cross sections in the vicinity of the joint. Thus, the joint of the invention may be used to replace a worn insulator joint in an existing rail network having different rail cross sections. For example, the cross sections of the ends of the first and second rail sections away from the joint may comprise a head portion, a narrower web portion and a base portion wider than the head portion, thus defining the conventional I-beam rail design. In this case, and with the joint received in a shell, the shell may have attachment portions having dimensions corresponding to the base portion. This enables the replacement joint to be fitted into an existing rail network using the same attachment clips as used for securing the rail base to the sleepers in that system.

Examples of the invention will now be described in detail with reference to the accompanying drawings in which :

Figure 1 shows a known insulated rail joint design for an I-beam type rail;

Figure 2 shows a proposed alternative rail cross section to the more conventional rail shown in Figure 1;

Figure 3 shows an insulated rail joint of the invention, applied to a rail of the type shown in Figure 2;

Figure 4 is an exploded view of the rail joint of Figure 3;

Figure 5 shows a modification to the joint of Figure 3;

Figure 6 shows schematically a second example of insulated rail joint of the invention;

Figure 7 shows how a rail joint of the invention may be integrated into an existing rail network; and

Figure 8 shows how a rail joint of the invention may be secured using sleepers and clips of an existing rail network.

Figure 1 shows a conventional insulated rail joint. As shown, the rail cross section comprises a head 2, a narrow web 4 and a base 6. The base 6 is secured to sleepers by clips (not shown). This conventional rail cross section provides the necessary rigidity for the rail to span across adjacent sleepers, whilst reducing the amount of metal required to form the track. There are various precise definitions of the rail cross section in different rail networks, and these do not need to be described in this text.

Figure 1 shows two sections of rail 8, 10 which have end faces which are perpendicular to the rail length. An insulating plate 12 is sandwiched between these two end faces. A fish plate 14 is provided on each side of the rail and these are bolted together through the two rail sections 8, 10 to form the insulated rail joint. A row of bolts 16 clamp the two rail sections between the two fish plates 14.

Insulated rail joints of this type are prone to heavy wear at the joint, so that the joints require more frequent replacement than other parts of the track. Wear in the joints can also give rise to track circuit failures if a short circuit results between the two rail sections 8, 10.

Figure 2 shows an alternative rail design which has been proposed. The rail 20 is held in a shell 22 set in a bed or slab 24 of concrete. The shell 22 has an inner profile of an open channel to receive the rail 20 whilst also clamping the rail 20 in place. A resilient filler 26 is provided between the shell 22 and the rail 20.

The rail cross section comprises a head portion 20A and a supporting portion 20B. In the example shown in Figure 2, the top of the supporting portion 20B has a pinched part 28. To insert the rail 20 into the shell 22 the wider lower part of the supporting portion 20B has to pass through the pinched region of the fill 26, so that the rail must effectively be sprung into the shell with a snap-action fit.

Despite this pinched part 28 of the rail cross section, the head portion 20A and the supporting portion 20B have substantially the same width. The only differences in width are provided to enable the snap-action fitting of the rail into the shell as described above, and not to provide the I-beam cross section described with reference to Figure 1.

The bed or slab 24 is lower on one side of the rail than on the other side, to allow the passage of the flange of a wheel of the railed vehicle. However, the shell 22 provides support for most of the height of the rail 20 on both sides of the rail. In particular, the shell 22 provides support for at least part of the head portion 20A on both sides of the rail, and over the entire height of the supporting portion 20B on both sides.

The rail design of Figure 2 is described in greater detail in WO 99/63160.

The shell 22 defines a continuous supporting structure for the rail 20, rather than the discontinuous sleeper arrangement of the more conventional rail of Figure 1.

Figure 3 shows an insulated rail joint of the invention, from above, and applied to a rail cross section corresponding to that shown in Figure 2. The joint comprises first and second rail sections 8, 10 each terminated with a respective connection face 30, 32. However, the connection faces 30, 32 do not extend perpendicularly to the rail direction, but instead define an interlocking arrangement which extends along a portion 34 of the length of the two rails 8, 10, for example over a length of 25cm to 75cm. An insulating member 36 is sandwiched between the two connection faces 30, 32.

The joint of Figure 3 is shown expanded in Figure 4. As can be seen more clearly in Figure 4, each rail 8, 10 has a connection portion which extends along the longitudinal axis 38 of the rail and has a series of dovetail joints. This axis may be considered as a vertical plane of symmetry, and the dovetail joints cross this plane, and are thereby centrally located. In Figures 3 and 4, each connection portion has two dovetail sections 40 and two recesses 42 for receiving the dovetails of the other rail. The rails thus interlock with each other to prevent lateral and longitudinal separation and bending moment transfer, and are essentially symmetrical.

To assemble the joint, the two rails are manoeuvred relative to each other in the vertical direction.

A different number of dovetail joints may be used, and furthermore, different interlocking arrangements may be provided. Essentially, the two rails can be slid together in one direction, and the joint then resists separation in at least the longitudinal rail direction through the interlocking arrangement. Any mechanical interlocking arrangement which achieves this function may be used.

Figure 5 shows schematically a modification to the design of Figures 3 and 4 to show that the leading and trailing edges of the connection interface between the rails do not need the reverse angles of Figures 3 and 4. Furthermore, in Figure 5 the dovetail joints of the connection interface are centred not about a centre line of the rail, but are offset from this centre line. In this way, the region of contact of the wheel, which is near the wheel flange, lies on the broader part of the rail. This assists in controlling the wheel transfer from one rail to the other.

The examples of Figures 3 to 5 provide an interlocking arrangement which allows only one direction of separation of the rails. However, the important point is that the shear transfer between the connection faces is increased, and many other shapes of recesses and projection can achieve this. Thus, the connection essentially needs only to prevent rail separation in the rail direction.

Figure 6 shows schematically a second version of rail joint of the invention, in which the connection between the rails can be made in two directions- each perpendicular to the rail length. The rails can be slid together in the vertical direction (as for Figures 3 to 5), but may also be brought together laterally. The connection faces have tongue 40 and groove 42 connections rather than the interlocking dovetail connections of Figures 3 to 5. The joint does not then prevent lateral separation, and this is achieved with the shell of the supporting structure. An interlocking arrangement is, however, preferred as it will reduce the potential for lateral bending in the joint.

The sliding faces of the joints may be provided with rebates, for example horizontal, set into each connection face into which the insulating material will set and which thus provide improved vertical interlocking of the rails. The surfaces may alternatively be striated to achieve the same effect.

By providing the rail sections 8, 10 with connection portions which extend along part of the length of the rails, the load transfer between the two rail sections as the train passes over is progressive. In other words, there is a transitional period during which the load is shared across both rail sections 8, 10.

The interlocking arrangement avoids the need for any securing bolts or fish plates. In the example shown, the rails can be separated by movement in the vertical direction. However, as will be apparent from Figure 2, the rail arrangement itself provides resistance against this movement of the rails.

Bolts, studs or dowels may, however, additionally be provided, if required, and these may be countersunk to lie within the outer envelope of the rail.

The insulating member may be a thermosetting resin or other insulating material capable of bonding the rail sections to carry the required loads. The resin may be poured into place between suitably separated rails. This separation will typically be between 5 and 20mm. This provides electrical insulation as well as providing bonding of the joint together, which gives further resistance to separation of the rails in the sliding direction.

The pad (the fill 26 in Figure 2) may be glued to the outside of the rail in the vicinity of the rail joint to ensure a watertight connection, and prevent a moisture short circuit. This gluing may be over a length beyond the joint itself, for example over 2m or so.

The rail ends will typically be cut from a single rail length using a metal milling process, although any conventional metal shaping process can be used. The joint is shown schematically in Figures 3 to 6, and in practice, the angles will not need to be as sharp as shown.

In the examples shown above, the sliding direction for the joint is the vertical direction. However, other directions may be used. For example, if the sliding direction is the horizontal, then the shell provides lateral resistance to separation of the joint. The disadvantage of this approach is that the progressive transfer of force is lost. Thus, a preferred solution can be to angle the sliding direction of the joint with respect to the vertical, so that separation of the joint is resisted in part by the lateral width of the shell of the rail arrangement and in part by the pinching effect which prevents vertical uplift.

The insulated rail joint of the invention may be used in new rail networks such as that shown in Figure 2. However, the invention may also be applied when replacing worn or damaged insulated joints in existing systems. Figure 7 shows one rail 8 of an insulated rail joint of the invention which is adapted to be applied to an existing rail system, for example using rails of the type shown in Figure 1. For this purpose, the end 50 of the rail section 8 away from the joint has a cross section which is different to the cross section in the vicinity of the joint (namely at 52). Thus, the cross section at 52 corresponds to that shown in Figure 2 whereas the cross section at 50 corresponds to that shown in Figure 1. An insulated rail joint formed from rail sections of the type shown in Figure 5 will be joined before insertion into the existing rail system, and the ends 50 will then be welded in situ to the existing rail. In this example, the existing rail will be secured by clips provided on sleepers, whereas the insulated rail joint uses a shell 22 as explained with reference to Figure 2. To enable the insulated rail joint of the invention to be used for replacement of worn insulated joints of existing systems, an arrangement described with reference to Figure 8 may be employed.

The cross section of the existing rail is indicated at 60 and the cross section of the new rail to be used in the insulated rail joint is indicated at 62. The insulated rail joint is housed in a shell 64 in the manner described above. However, instead of the shell being buried in a concrete slab as shown in Figure 2, the shell 64 is provided with a base having dimensions corresponding to the base of the rail cross section 60. In this way, the shell 64 may be secured to existing sleepers using the conventional clips previously used for securing the rail having cross section 60. Strengthening webs 66 are provided between the locations of the clips. A length of shell 64 is then provided corresponding to the length only of the insulated rail joint. Beyond the joint, the rail undergoes a transition in the manner shown in Figure 7 to enable the joint to be connected to the existing system.

Various modifications will be apparent to those skilled in the art.

CLAIMS

1. An insulated rail joint comprising first and second rail sections, the cross sections of which, in the vicinity of the joint and perpendicular to the rail length, comprise a head portion and a supporting portion, the head and supporting portions having substantially the same width, the first and second rail sections being terminated with a connection face which extends along a portion of the length of the respective rail, the insulated joint being formed by sandwiching an insulating member between the connection faces, wherein the connection faces are arranged to provide coupling of the rails such that the rails can be coupled together in a sliding direction perpendicular to the rail length, the coupling arrangement providing mechanical resistance to separation of the rails in a direction parallel to the rail length.

2. A rail joint as claimed in claim 1, wherein the rails can be coupled together in only a single sliding direction, and the interlocking arrangement provides mechanical resistance to separation of the rails in any other direction.

3. A rail joint as claimed in claim 1 or 2, further comprising a shell, which receives the joint and which supports the rail sections along most of the height of both lateral sides of the rail joint.

4. A rail joint as claimed in claim 3, wherein the mechanical securing of the rail sections is solely through the mechanical coupling arrangement.

5. A rail joint as claimed in any preceding claim, in which each connection face comprises at least one dovetail projection and at least one dovetail recess.

6. A rail joint as claimed in claim 5, wherein the dovetail projection and the dovetail recess extend perpendicularly to the sliding direction across a longitudinal centre plane of the rail section.

7. A rail joint as claimed in any preceding claim, wherein the sliding direction is vertical.

8. A rail joint as claimed in any one of claims 1 to 6, wherein the sliding direction is offset from the vertical.

9. A rail joint as claimed in any preceding claim, in which the ends of the first and second rail sections away from the joint have cross sections which are different to the cross sections in the vicinity of the joint.

10. A rail joint as claimed in claim 9, in which the cross sections of the ends of the first and second rail sections away from the joint comprise a head portion, a narrower web portion and a base portion wider than the head portion.

11. A rail joint as claimed in claim 10, in which the joint is received in a shell, and in which the shell has attachment portions having dimensions corresponding to the base portion.

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Application No:	GB 0222176.0	**Examiner:**	Roger Binding
Claims searched:	1-11	**Date of search:**	29 October 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T):

Int Cl (Ed.7): E01B 11/22, 11/24, 11/26, 11/54

Other: Online WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	EP 1164222 A	(BALFOUR BEATTY)	1-3, 5, 7, 9-11
Y	GB 0505025 A	(BROGDEN)	1, 2, 5, 7, 9
Y	GB 0214384 A	(YOUNGER)	1-3
Y	US 1839360 A	(WEARMOUTH)	1-3, 5, 7, 9-11
Y	US 1798004 A	(SPERANZA)	1-3, 7, 9-11
Y	US 1669289 A	(CUDDY LEWIS)	1, 3, 7, 9-11
Y	US 1656988 A	(PIERCE)	1-3, 5, 7, 9-11

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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