(12) UK Patent Application (19) GB (11) 2 383 067 (13) A

(43) Date of A Publication 18.06.2003

(21) Application No 0129708.4

(22) Date of Filing 12.12.2001

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(51) INT CL[7]
E01B 11/24

(52) UK CL (Edition V)
E1G GEA G302 G308

(56) Documents Cited
GB 0703598 A **GB 0537711 A**
GB 0448201 A **GB 0276445 A**
GB 0250867 A **GB 0214384 A**
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(58) Field of Search
UK CL (Edition T) **E1G** GEA
INT CL[7] **E01B** 11/24
Other: **ONLINE WPI EPODOC JAPIO**

(54) Abstract Title
Rail joint

(57) The joint is for first and second rails with cross section having head and support parts of equal width. Each rail 8, 10 in the vicinity of the joint has a length of substantially only one lateral side of the rail, and lateral sides are butted together such that the outer shape of the cross section of the rail joint is substantially identical to the outer shape of the cross section of the rails adjacent the joint. This provides a joint which extends over a length of the rail so that force transfer from one rail to the other is progressive. The rail ends 8, 10 can couple by means of a longitudinal tongue and groove joint 30, 31 to prevent lateral separation, optionally with bolts. Alternatively, the rail ends 8, 10 have curved form end faces (Fig. 4).

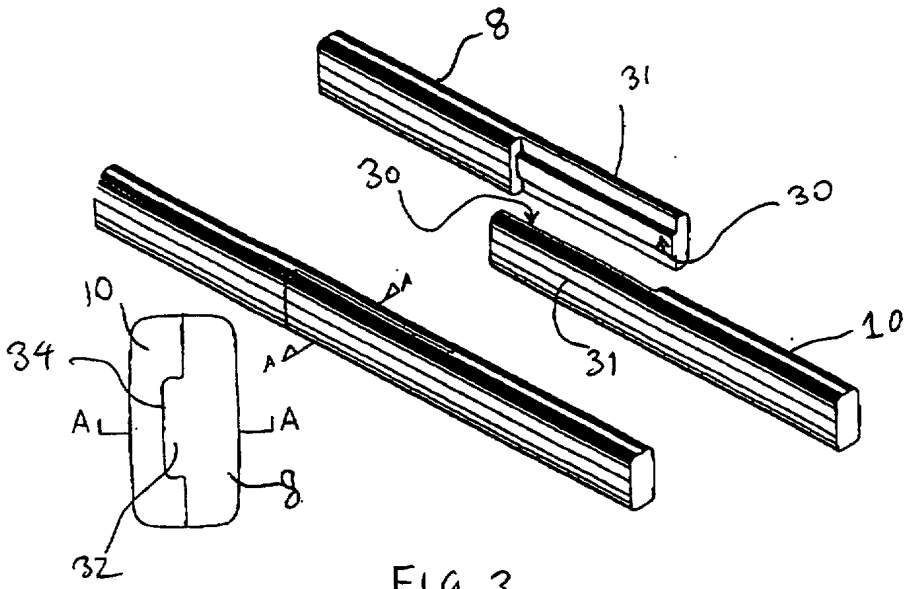

Fig. 3

GB 2 383 067 A

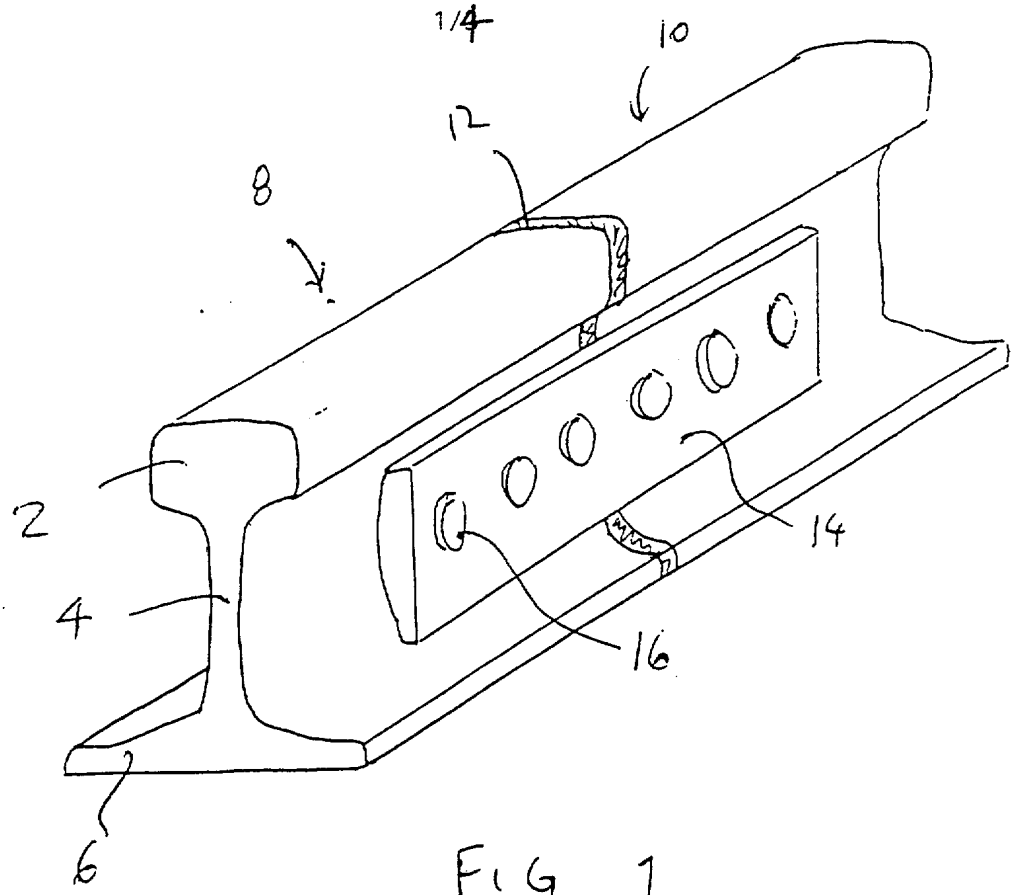

Fig 1

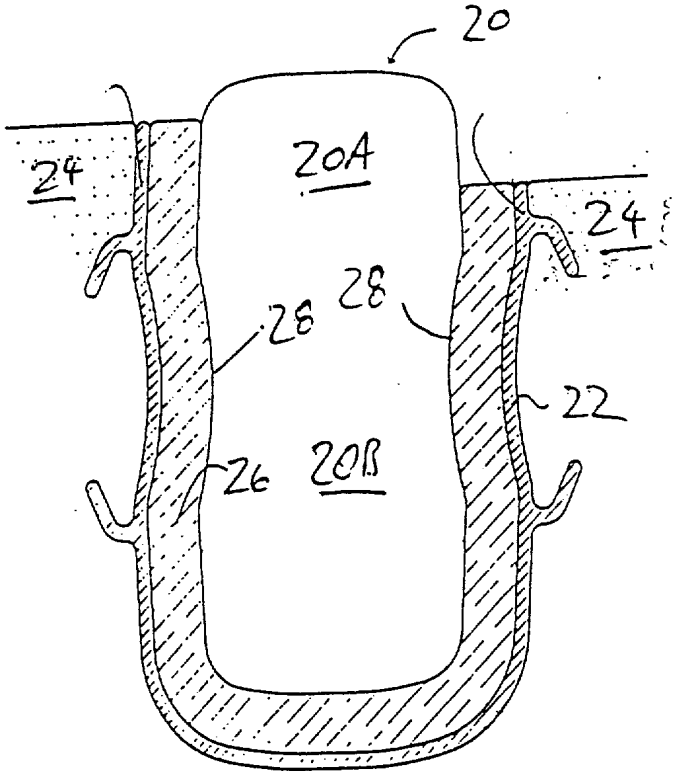

Fig 2

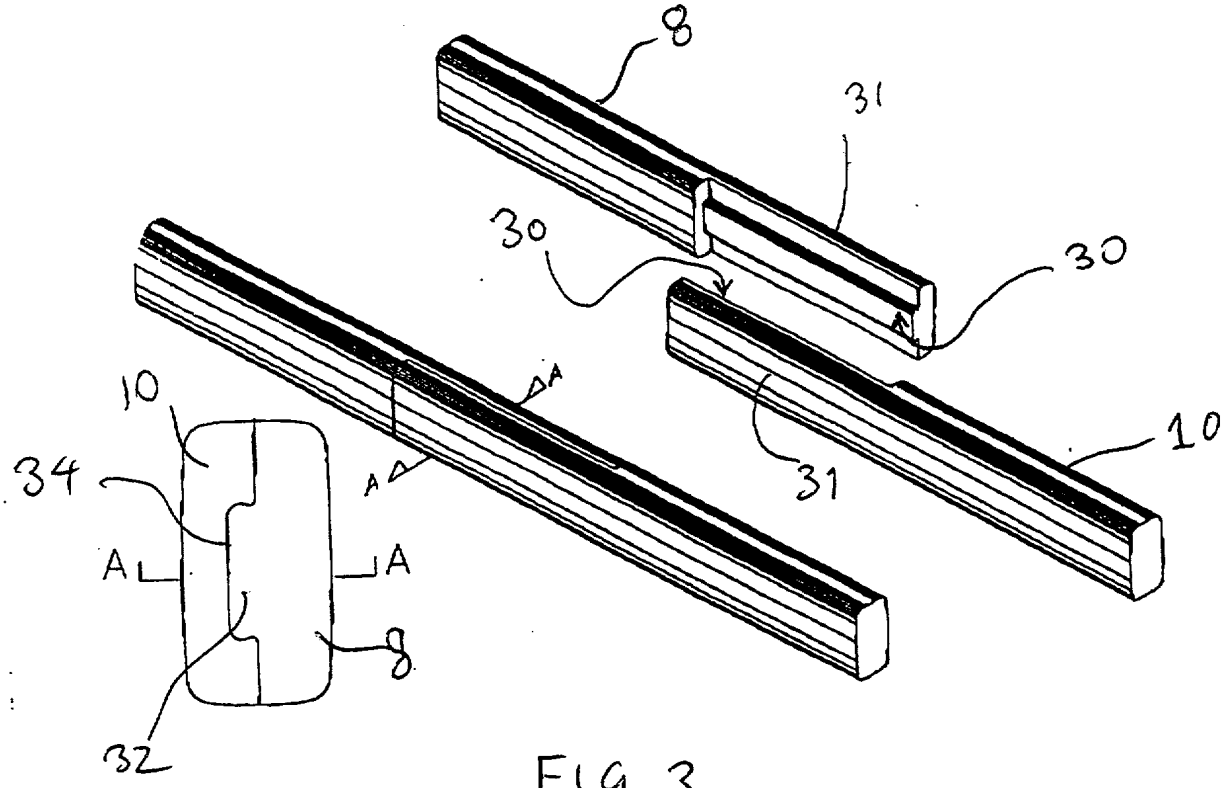
8
31
30
30
10
31
10
34
A
A
A
A
8
32

FIG. 3

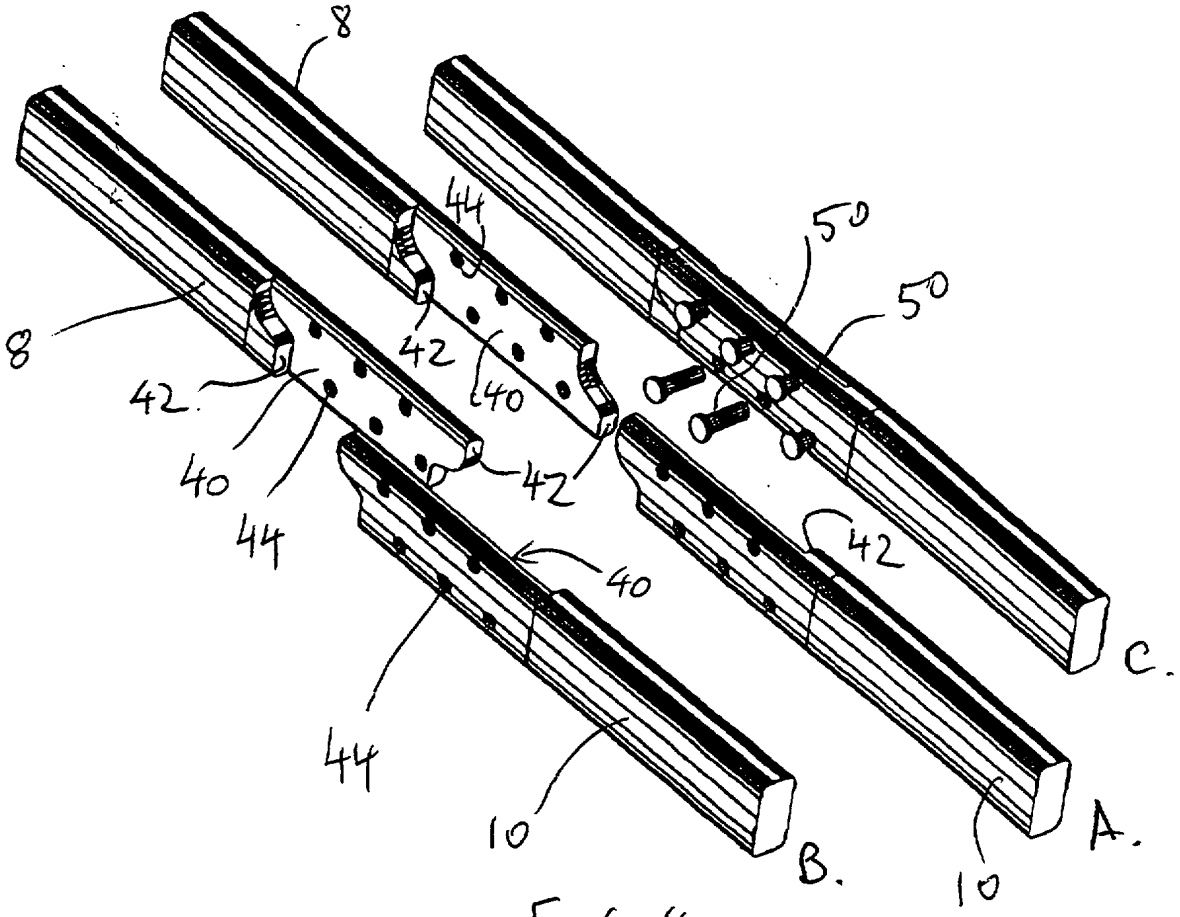
8
8
44
50
50
42
40
42
42
40
44
42
40
44
10
B.
10
C.
A.

FIG 4

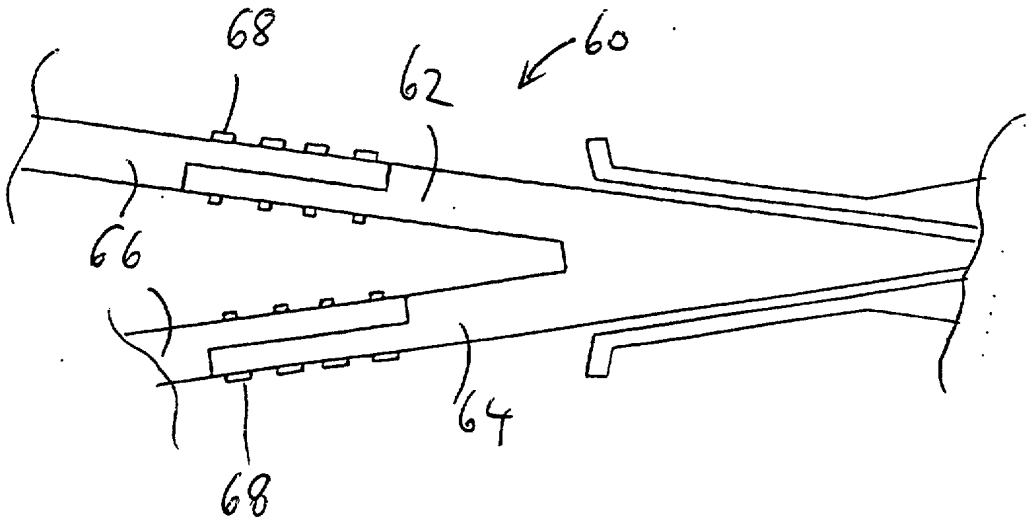

FIG 5

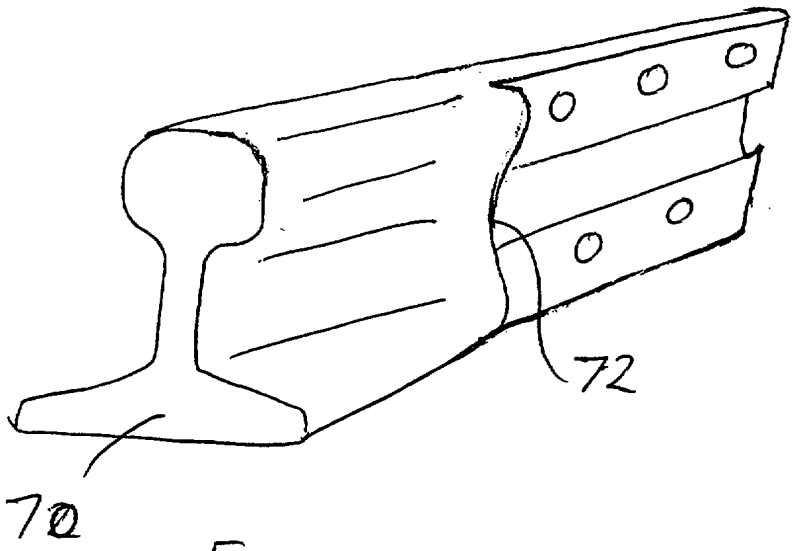

FIG 6

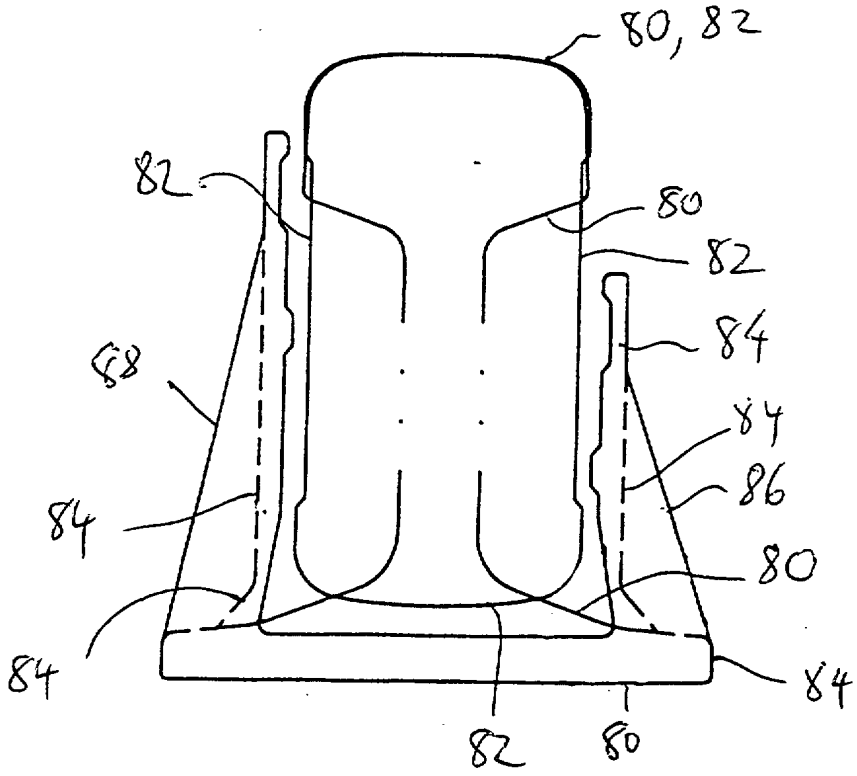

FIG 7

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RAIL JOINT

This invention relates to joints between rails of a railway system.

A conventional rail essentially comprises an I-beam, having a head, a narrow web and a base. When rail sections are to be joined to form a continuous rail, this is conventionally carried out by welding rail sections end-to-end. Welding is conventionally used for all rail connections where a continuous rail is required.

In some rail systems, successive blocks of track are electrically insulated from each other to enable sections of rail to be used as signalling conductors, permitting detection of trains to take place independently in different blocks. A conventional insulated rail joint for this purpose 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.

For these reasons, mechanical coupling of rail sections is only conventionally used for insulated rail joints, whereas welding is used for all other joints. For example, a crossing can be manufactured as a separate cast component, which is installed by welding the (four) rail leg ends of the crossing to rail sections on-site. The metal composition used for the cast crossing is different to the rail composition, and the welding operation may not therefore be straightforward, for example a chromium welding operation may be required.

There is therefore a need for a mechanical coupling suitable for connecting rail sections so that welding can be avoided in some circumstances.

According to the invention, there is provided a 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, wherein the first and second rail sections are terminated with terminating portions comprising a length of substantially only one lateral side of the rail, the terminating portions being butted together and contacting each other in the joint such that the outer shape of the cross section of the rail joint is substantially identical to the outer shape of the cross section of the rail sections adjacent the joint.

This rail joint defines the end of two rail sections as one lateral half of a rail, and joins these halves together. This provides a joint which extends over a length of the rail so that force transfer from one rail to the other is progressive.

The terminating portions may have a planar face portion parallel with the longitudinal rail axis and along a central plane of the rail, the planar faces being butted together in the joint. These planar faces can then be brought together laterally, and may then be connected with bolts or other connectors.

The terminating portions may instead have a face portion parallel with the longitudinal rail axis and along a central plane of the rail, wherein the face of one rail section is provided with a recess and the face of the other rail section is provided with a projection, the faces being butted together in the joint with the projection engaged in

the recess. This provides an interlocking connection of the rail sections. Preferably, the engagement of the projection in the recess is such that lateral separation of the rail sections is prevented. This avoids the need for any other connectors.

However, the first and second sections may nevertheless be secured together by transverse members extending through the two terminating portions. These transverse members are preferably arranged in first and second rows, with the members in one row being staggered with respect to the members in the other row. This connection arrangement provides additional strength in the joint.

Each rail section may terminated with two end faces, one for each lateral side of the rail, and the end faces are not purely vertical but are instead shaped to provide additional resistance to bending in the joint.

The rail joint may 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. The joint may thus be used in embedded rail systems. The first and second sections can then be secured together by transverse pins, with axial movement of the pins being restricted by the shell.

The ends of one 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. In this way, a transition rail may be used in the joint, so that the joint can be used in conventional rail systems, which do not have the required rail cross section for the joint.

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 a first example of rail joint of the invention;

Figure 4 shows a second example of rail joint of the invention;

Figure 5 shows use of the rail joint of the invention to connect rails to a crossing;

Figure 6 shows a transition rail enabling the joint of the invention to be used in combination with conventional I-beam rails; and

Figure 7 shows how the joint of the invention can be integrated into existing rail systems using I-beam rails.

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. Mechanical connection of this type is therefore only conventionally used when welding is not possible, for example because of the need for an insulating spacer in an insulated rail joint.

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.

The invention provides a connection for rail sections which generally have substantially constant width, namely rail sections which do not provide the substantially thinner web portion.

Figure 3 shows a first rail joint of the invention. The joint comprises first and second rail sections 8, 10 each terminated with a connection face 30. The connection faces 30 do not extend perpendicularly to the rail direction, but instead extend along the longitudinal axis of the rail sections. Each rail section, within the joint, has a thickness approximately equal to half the thickness of the rail head. Thus, the first and second rail sections are terminated with terminating portions 31 comprising a length of rail which comprises only one lateral half of the normal rail shape. These two lateral halves are butted together and contact each other in the joint, so that the outer shape of the rail is maintained in the joint.

By providing a rail joint which extends along a length of the two rails forming the joint, 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.

In the example of Figure 3, one rail section 8 is provided with a projection 32 and the other rail section 10 is provided with a recess 34, so that the cross section of the rail in the vicinity of the joint has a tongue and groove joint in the manner of a jigsaw, which prevents the rails from being separated laterally. This avoids the need for any connecting bolts or other fasteners. Instead, the rail sections are joined by sliding the rails together in a direction parallel to the rail axes.

The first and second rail sections 8, 10 of Figure 3 can additionally be secured together using bolts, but there is no need for any fish plates as the joint runs parallel to the rail length. In addition, if the rail joint is to be housed in a shell 22 as shown in Figure 2, counter sunk transverse bolts may be provided to maintain the outer contour of the rail, to enable the rail joint to be placed in the shell 22. Instead, the rail sections 8, 10 may be secured together by transverse pins/dowels if the shell arrangement provides the required lateral retention of the rail. The shell will then prevent axial movement of the pins/dowels so that bolts are not required.

Structural adhesive may be used in the joint, and if bolts are used, they preferably use locking nuts.

Figure 4 shows a second example of rail joint of the invention, in which fastening pins are used, and in which the rail sections have flat connection faces instead of the C-type interlocking arrangement of Figure 3.

Two different designs are shown in Figure 4. In each case, the first and second rail sections 8,10 are provided with a planar connection face 40 extending along the direction of rail. This face extends vertically through the centre of the rail. In the vicinity of the joint, only one lateral half of the rail section is again provided, so that each rail section has is longer on one lateral side than on the other lateral side. Both lateral halves of the rail sections are terminated with a shaped end face 42 instead of a

flat end face perpendicular to the rail axis. The end faces 42 mate with each other and effectively provide a joint at an angle to the vertical, which reduces the tendency for dipping in the joint.

In one arrangement (Figure 4A), the end two faces 42 of each rail are parallel to each other, whereas in another arrangement (Figure 4B) the two end faces of each rail are mirror images of each other with respect to the vertical.

A plurality of through holes 44 are provided for transverse connecting bolts or pins. A greater height is available for positioning of the bolts or pins than in the fish plate of Figure 1. The through holes are preferably arranged in two rows as shown in Figure 4, with the holes in one row being staggered with respect to the holes in the other row. In this way, additional resistance to bending in the vertical plane is provided. In particular, the two levels of bolts provide a stronger beam effect allowing the joint to supported greater loads and/or provide increased life.

The number of pins (or bolts, studs, dowels) will vary depending on the application. The number and dimensions will be sufficient to withstand all anticipated forces from rail vehicle impacts and compressive forces, as well as all torsional forces anticipated to be exerted on stressed running rails. If pins or dowels are used, they may be retained in place by the surrounding structure (such as the channel in Figure 2) or else clips may be provided for this purpose.

As shown in Figure 4C, the rail joint can be connected using pins 50 which engage frictionally with the through holes 44. This provides a simple mechanical connection.

One particular application of the rail joint of the invention is to provide connection to a crossing. The crossing 60 shown in Figure 5 will normally be cast (rather than rolled as will be the rails) and will be made from a dissimilar metal composition to the rail. The joint of the invention avoids the need for welding. The leg ends 62, 64 of the crossing are machined to the selected profile providing the mating surface for connection to a suitably terminated rail 66. Figure 5 shows connecting pins 68, although these may be bolts or flush dowels.

The invention enables a rail joint to be formed where welding may be difficult or dangerous. The joint also does not require the full conventional rail depth, and the connection has improved joint strength to a fish plate-type conventional (insulated) rail joint. The joint reduces rail end dipping in conventional transverse rail joints.

The joint of the invention is formed from shaped rail ends, and therefore uses rail quality steel, avoiding the use of cast iron fish plates.

The joint of the invention requires rail sections which do not have a thin web, particularly as the joint relies upon the removal from the rail ends of one lateral half of the rail. The joint is therefore suited for embedded rail cross sections, such as in Figure 2. However, the invention may also be applied when replacing worn or damaged joints in existing systems.

In this case, transition rails may be used, such as shown in Figure 6. One end 70 of the rail section away from the joint has a cross section which is different to the cross section 72 in the vicinity of the joint. Thus, the cross section at 72 corresponds to that shown in Figure 2 whereas the cross section at 70 corresponds to that shown in Figure 1. The transition rail enables a crossing to be used with the non-welded joint of the invention, which is then coupled to a conventional rail network. The conventional rail end 72 is then welded to the next rail section in conventional manner.

When the rail joint is used in a rail system having conventional I-beam rails, it is also possible to use the conventional clip fastening arrangement for securing the joint to conventional sleepers. The arrangement described with reference to Figure 7 may be employed for this purpose.

The cross section of the existing rail is indicated at 80 and the cross section of the new rail to be used in the rail joint is indicated at 82. The insulated rail joint is housed in a shell 84 in the manner described above. However, instead of the shell being buried in a concrete slab as shown in Figure 2, the shell 84 is provided with a base having dimensions corresponding to the base of the rail cross section 80. In this way, the shell 84 may be secured to existing sleepers using the conventional clips previously used for securing the rail having cross section 80. Strengthening webs 86 are

provided between the locations of the clips. A length of shell 84 is then provided corresponding to the length only of the rail joint. Beyond the joint, the rail undergoes a transition in the manner shown in Figure 6 to enable the joint to be connected to the existing system.

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

CLAIMS

1. A 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, wherein the first and second rail sections are terminated with terminating portions comprising a length of substantially only one lateral side of the rail, the terminating portions being butted together and contacting each other in the joint such that the outer shape of the cross section of the rail joint is substantially identical to the outer shape of the cross section of the rail sections adjacent the joint.

2. A rail joint as claimed in claim 1, wherein the terminating portions have a planar face portion parallel with the longitudinal rail axis, the planar faces being butted together in the joint.

3. A rail joint as claimed in claim 1, wherein terminating portions have a face portion parallel with the longitudinal rail axis, wherein the face of one rail section is provided with a recess and the face of the other rail section is provided with a projection, the faces being butted together in the joint with the projection engaged in the recess.

4. A rail joint as claimed in claim 3, wherein the engagement of the projection in the recess is such that lateral separation of the rail sections is prevented.

5. A rail joint as claimed in any preceding claim, wherein the first and second sections are secured together by transverse members extending through the two terminating portions, the transverse members being arranged in first and second rows, with the members in one row being staggered with respect to the members in the other row.

6. A rail joint as claimed in any preceding claim, wherein each rail section is terminated with two non-vertical end faces, one for each lateral side of the rail.

7. A rail joint as claimed in any preceding claim, 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.

8. A rail joint as claimed in claim 7, in which the first and second sections are secured together by countersunk transverse bolts.

9. A rail joint as claimed in claim 7, in which the first and second sections are secured together by transverse pins, axial movement of the pins being restricted by the shell.

10. 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.

11. A rail joint as claimed in claim 10, 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.

Application No: GB 0129708.4 **Examiner:** Roger Binding
Claims searched: 1-11 **Date of search:** 4 February 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): E1G (GEA)

Int Cl (Ed.7): E01B 11/24

Other: Online WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 0703598 A	(HENSON), see Figs 2 & 5.	11
Y	GB 0537711 A	(FELIX)	4
X	GB 0448201 A	(BROGDEN), see Figs 1 to 7.	X - 1, 2
X	GB 0276445 A	(COOPER)	X - 1, 2
X, Y	GB 0250867 A	(HOLLIDAY), note especially page 1, lines 71 to 81.	X - 1, 2, 6, 10 Y - 11
X, Y	GB 0214384 A	(WYLIE)	X - 1-3 Y - 4
XE	EP 1164222 A1	(BALFOUR BEATTY)	1, 2, 5, 7-11

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