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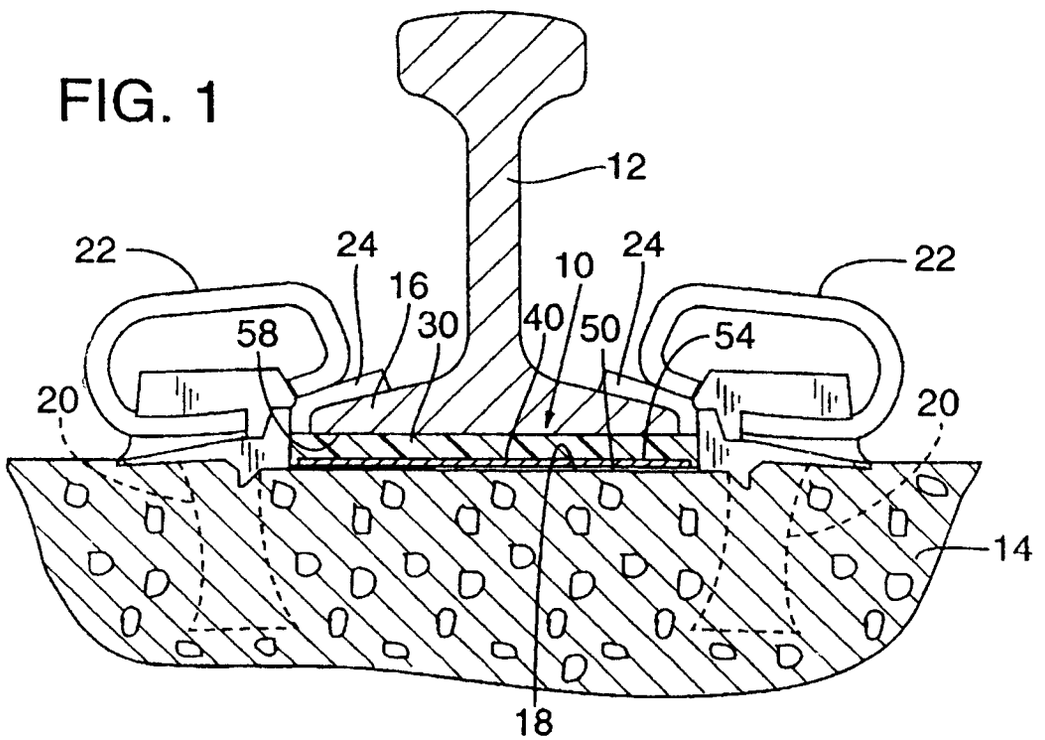
(54) Railroad track, railroad tie and pad for it

(57) A railroad tie (14) or railway sleeper is made from concrete and inlcudes a pad (10) mounted on its upper surface and, in use, receiving and engaging the lower flange (16) or a rail (12). The pad (10) is a composite pad and comprises an elastomeric pad (30) and bonding means (40) bonded together to resist releasable movement between them. The bonding member (40) galvanised, powder-coated, steel plate or a rigid polymeric film or sheet, an acrylic layer. An adhesive layer (18), such as a methacrylate ester, is used for bonding the elastomeric pad (30) and the bonding member (40) to the railroad tie (14). The bond means may be formed as a particular layer (40') bonded to the elastomeric pad (30).

FIG. 1



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Description

Commonly, metal clips or clamps that engage embedded supports are used for securing steel railroad rails to concrete railroad ties, and non-conducting insulators are used to insulate the clips or clamps from the railroad rails. Metal clips or clamps of a type exemplified in Leeves U.S. Patent No. 4,757,945 issued to Pandrol Limited of London, England, and metal clips or clamps of a type exemplified in Young U.S. Patent No. 5,110,046 issued to McKay Australia Limited of Maidstone, Australia, are used widely in North America.

Commonly, when such clips are used, elastomeric pads are disposed between the lower flanges of the railroad rails and the railroad ties for cushioning the railroad rails and for insulating the rails electrically from the ties and from other underlying structures. Although ethylene vinyl acetate (EVA) rubber and other pads have been used widely for many years, polyurethane pads offering superior performance have become available commercially from ITW Irathane (a unit of Illinois Tool Works Inc.) of Hibbing, Minnesota, under its IRATHANE trademark.

Deterioration of the elastomeric pads and erosion of the concrete ties can occur if water infiltrates and freezes between the pads and the ties or if sand, which is used commonly to increase traction on grades, or debris infiltrates therebetween. Such deterioration and erosion problems can be quite severe, particularly under high loadings, in regions where weather conditions vary widely from summer to winter, at sharp curves, and at steep grades. Such deterioration and erosion problems can result in so-called "tie seat abrasion", which if severe can result in a railroad tie being judged unsafe for further service in a railroad track and having to be replaced.

Prior efforts to address such deterioration and erosion problems are disclosed in Buekett U.S. Patent No. 4,925,094. As disclosed therein, a stainless steel or other non-corrodible metal or plastic plate is cast into an upper surface of a concrete tie. A rubber or plastic pad is interposed between the lower flange of a railroad rail and the plate that has been cast into the tie. It appears that the pad merely rests upon the plate and is free to move relative to the cast-in-place plate.

Other efforts to address such deterioration and erosion problems are disclosed in Young U.S. Patent No. 5,110,046. As disclosed therein, either an abrasion-resistant plate of an unspecified material is bonded to the upper surface of a concrete tie by an adhesive layer, epoxy resin adhesives being preferred, or a high density polyethylene (HDPE) closed cell foam is interposed between the abrasion-resistant plate and the upper surface of the concrete tie. In either instance, a rubber, polyurethane, or other elastomeric pad is interposed between the lower flange of a railroad rail and the upper surface of the concrete tie. It appears that the elastomeric pad merely rests upon the plate and is free to move relative to the adhesively bonded or foam-separated plate.

As a matter of related interest, Brown U.S. Patent No. 5,261,599 discloses an elastomeric pad having resiliently deformable sealing portions, which are intended to form a watertight seal between the pad and the upper surface of a railroad tie, such as a concrete tie.

According to this invention a railroad tie is made from concrete and includes a pad mounted on its upper surface, in use, to receive and engage the lower flange of a railroad rail, is characterised in that the pad is a composite pad and comprises an elastomeric pad and bonding means having an upper surface bonded to the lower surface of the elastomeric pad so as to resist relative movement between them, the tie further comprising an adhesive layer bonding the bonding means to its upper surface so as to resist relative movement between them and so as to retard infiltration of sand, water or debris between them.

The bonding means may be a plate like member bonded onto, and/or embedded into the lower surface of the elastomeric pad. The plate like member is preferably made from a galvanised powder-coated steel or a polymeric material such as polycarbonate.

The bonding means may comprise particles or fibres bonded onto the elastomeric material and being partially embedded within its lower surface. In this case the particles or fibres may be granules or fibres made from polycarbonate, acrylic or nylon. The particles may instead be quartz, silica sand, silicon carbide, or aluminium oxide.

The bonding means may comprise a bonding layer which is at least as flexible as the elastomeric pad contacting the lower surface of the bonding pad. In this case the bonding layer may be an acrylic composition, or a polymerization product of a thermoplastic elastomer in methyl methacrylate monomer.

The invention also embraces an elastomeric pad for use in such a railroad tie and the track includes such ties.

The elastomeric pad can be made from any of several compositions depending upon the very specific needs of the application, as determined by the environmental factors, as well as the loadings and frequency of loadings of the specific rail line. The pad can be thus made from a thermoplastic material, such as EVA, polyurethane, or other elastomeric material available. If a bonding member is used, bonding can occur via insert moulding, if the pad is injection moulded, via adhesive bonding, via thermally laminating a suitable material for the bonding member, or via casting a liquid onto the bonding member and polymerizing it in place.

Preferably, the elastomeric pad is a polyurethane pad, and the adhesive layer comprises a methacrylate ester composition. If a bonding member is used, the bonding member may be a galvanized, powder-coated, steel plate, or a rigid, polymeric film or sheet, or an acrylic layer.

If an acrylic layer is used, the acrylic layer may be a product of polymerizing a solution of methyl methacr-

ylate copolymer in n-butyl acrylate monomer, or a product of polymerizing a solution of a thermoplastic elastomer in methyl methacrylate monomer. The solution may have an addition of cumene hydroperoxide to catalyze polymerization or a sprayed coat of a dispersion of benzoyl peroxide in a plasticizer or in water to catalyze polymerization. Alternatively, the acrylic layer may be a product of curing or drying an acrylic emulsion, which may be water-based.

Particular embodiments of this invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a fragmentary, cross-sectional view of a railroad rail having a lower flange, a railroad tie made from concrete, and a composite pad, together with associated clips, supports, and insulators, in a first embodiment;

Figure 2 is a plan view of the first embodiment shown in Figure 1;

Figure 3 is a greatly enlarged, fragmentary sectional view taken along line 3--3 of Figure 2, in a direction indicated by arrows;

Figure 4 is a plan view of an elastomeric pad, as used in an alternative embodiment of this invention;

Figure 5 is a somewhat enlarged, fragmentary sectional view taken along line 5--5 of Figure 4, in a direction indicated by arrows;

Figure 6 is a fragmentary, cross-sectional view of a railroad rail having a lower flange, a railroad tie made from concrete, and a composite pad, together with associated clips, supports, and insulators, in another alternative embodiment of this invention;

Figure 7 is a sectional view analogous to Figure 3 but taken for the alternative embodiment of Figure 6;

Figure 8 is a fragmentary, cross-sectional view of a railroad rail having a lower flange, a railroad tie made from concrete, and a composite pad, together with associated clips, supports, and insulators, in another alternative embodiment of this invention; and,

Figure 9 is a sectional view analogous to Figure 3 but taken for the alternative embodiment of Figure 8.

As shown in Figure 1 in a first embodiment of this invention, a composite pad 10 is mounted between a railroad rail 12 made from steel and a railroad tie 14 made from concrete. As mounted between a lower flange 16 of the railroad rail 12 and an upper surface 18 of the concrete tie 14, the elastomeric pad 10 cushions the railroad rail 12 and insulates the railroad rail 12 electrically from the concrete tie 14.

Two supports 20 are embedded in the concrete tie 14 and extend upwardly from the upper surface 18. Two clamps 22 are provided, each engaging one of the supports 20 and pressing against one side of the lower flange 16 of the railroad rail 12, via an insulator 24 bearing on the composite pad 10, so as to secure the railroad rail 12 to the concrete tie 14.

In the embodiment shown in Figures 1, 2 and 3, the composite pad 10 is configured to coact with the supports 20, clamps 22, and insulators 24, which are outside the scope of this invention. In the embodiment shown in Figures 4 and 5, the composite pad 10 is configured to coact with known supports, clamps, and insulators (not shown) having different configurations. In either embodiment, the composite pad 10 is intended to be adhesively bonded to a railroad tie, such as the concrete tie 14.

In each embodiment of Figures 1 through 5, the composite pad 10 comprises a polyurethane pad 30 and a bonding member 40, which is bonded directly to the elastomeric pad 30 and which is to be adhesively bonded to a railroad tie, such as the concrete tie 14. Preferably, the polyurethane pad 30 is a similar to the polyurethane pads that have become available commercially from ITW Irathane, supra, except that the polyurethane pad 30 is cast onto the bonding member 40 so that the bonding member 40 is bonded directly to the polyurethane pad 30. Preferably, the bonding member 40 is made from steel, galvanized, and powder-coated. Alternatively, the bonding member 40 is made from a polymeric material.

As in each embodiment of Figures 1 through 5, the bonding member 40 may be located in a recess 42 in the polyurethane pad 30. The recess 42 is defined by a marginal lip 44 surrounding an outer edge 46 of the bonding member 40.

Preferably, if the bonding member 40 is made from galvanized steel, the bonding member 40 is powder-coated with a coating composition 48 similar to one of the coating compositions disclosed in U.S. Patent No. 5,441,373. Preferably, the coating composition 48 comprises a polyester resin, as disclosed therein. Alternatively, the coating composition 48 comprises an epoxy or acrylic resin, as disclosed therein.

When the polyurethane pad 30 is cast onto the bonding member 40, the polyurethane pad 30 bonds chemically to the composition 48 coating the galvanized steel of the bonding member 40, whereby the lower surface 52 of the polyurethane pad 30 is bonded directly to the upper surface 54 of the separating pad 40 so as to resist relative movement between the bonding member 40 and the polyurethane pad 30. No separate adhesive is needed, therefore, to bond the polyurethane pad 30 to the bonding member 40.

Moreover, an adhesive layer 50 is used to bond the bonding member 40 to the concrete tie 14, at the lower surface 56 of the bonding member 40 and the upper surface 18 of the concrete tie 14, so as to resist relative movement between the bonding member 40 and the concrete tie 14 and so as to retard infiltration of sand, water, or debris between the bonding member 40 and the concrete tie 14.

Preferably, the adhesive layer 50 in its uncured state is deposited on the upper surface 18 of the concrete tie 14, whereupon the composite pad 10 is pressed onto the adhesive layer 50 so as to spread the adhesive layer 50 until the adhesive layer 50 covers the lower surface 5 6 of the bonding member 40 and the marginal lip 44. It is permissible for some of the adhesive layer 50 to be thus extruded beyond the marginal lip 44. Thereupon, the adhesive layer 50 is allowed to cure, until the bonding member 40 is bonded to the concrete tie 14.

Preferably, the adhesive layer 50 is comprised of a methacrylate ester composition, namely the methacrylate ester composition disclosed in a co-pending European application 95306418.5 published as EP-A-

In the alternative embodiment of Figures 6 and 7, the elastomeric pad 30' is similar to the elastomeric pad 30 noted above, except that the elastomeric pad 30' does not have a recess like the recess 42. A particulate layer 40' is used, which comprises particles 42' bonded directly to the polyurethane pad 30' and which enable the polyurethane pad 30' to be adhesively bonded to the concrete tie 14. Preferably, the polyurethane pad 30' is similar to the polyurethane pads that have become available commercially from ITW Irathane, supra, and is cast in an orientation that is inverted from its orientation in use (see Figure 7) except that the particles 42' of the particulate layer 40' are distributed onto the polyurethane pad 30', after such pad 30' has cured partially but before such pad 30' has cured completely, so that the particles 42' of the particulate layer 40' are bonded directly and chemically to the polyurethane pad 30', so that portions of the bonded particles 42' are embedded in the polyurethane pad 30', and so that portions of the bonded particles 42' are exposed.

Moreover, an adhesive layer 50' is used to bond the bonded particles 42' to the concrete tie 14, at the exposed portions of the bonded particles 42' and the upper surface 18 of the concrete tie 14, so as to resist relative movement between the polyurethane pad 30' and the concrete tie 14 and so as to retard infiltration of sand, water, or debris between the polyurethane pad 30' and the concrete tie 14.

Preferably, the adhesive layer 50' in its uncured state is deposited on the upper surface 18 of the concrete tie 14, whereupon the composite pad 10' comprised of the elastomeric pad 30' and the particulate layer 40' is pressed onto the adhesive layer 50' so as to spread the adhesive layer 50' until the adhesive layer 50' covers the lower surface of the polyurethane pad 30' and the exposed portions of the bonded particles 42'. It is permissible for some of the adhesive layer 50' to be thus extruded beyond the margins of the polyurethane pad 30. Thereupon, the adhesive layer 50' is allowed to cure so that the adhesive layer 50' is bonded not only to the exposed portions of the particles 42' bonded to the polyurethane pad 30' but also to the concrete tie 14, whereby the composite pad 10' comprised of the elastomeric pad 30' and the particulate layer 40' and the concrete tie 14 are bonded to one another via the particulate layer 40' and the adhesive layer 50'.

Bonding between the adhesive layer 50' and the particles 42' of the particulate layer 40' is a combination of chemical bonding and mechanical bonding. Mechanical bonding occurs because of interpenetration of the adhesive layer 50' and the particulate layer 40'. It is not necessary, therefore, to have a strong bond between the polyurethane pad 30' and the adhesive layer 50'.

Polymeric particles, either granules or fibres, or inorganic particles are suitable, so long as the adhesive composition selected for the adhesive layer 50' can be chemically or mechanically bonded to such particles. Thus, polycarbonate, acrylic, or nylon granules or polycarbonate, acrylic, or nylon fibres are suitable. Also, particles of quartz, silica sand, silicon carbide, or aluminum oxide may be so employed. Other polymeric or inorganic particles may prove to be also suitable.

As an example, polycarbonate pulverized to U.S. 20 Mesh may be distributed as granules by being shaken through a sieve or by being sprayed through a powder sprayer. As another example, granules of nylon 12 may be similarly distributed.

Preferably, the adhesive layer 50' is comprised of a methacrylate ester composition, namely the methacrylate ester composition disclosed in the co-pending European application noted above.

Although the methacrylate ester composition discussed in the immediately preceding paragraph does not bond well to polyurethane, such as that used for the polyurethane pad 30', such methacrylate ester composition bonds chemically and mechanically to any of the polymeric particles discussed in the previously preceding paragraphs and at least mechanically to any of the inorganic particles discussed in the previously preceding paragraphs.

In the embodiment of Figures 8 and 9, the composite pad 10" is configured so as to co-act with metal clips or clamps known for securing railroad rails to railroad ties and comprises a polyurethane pad 30" and a bonding layer 40", which is bonded to the polyurethane pad 30" so as to cover the lower surface of the polyurethane pad 30". Preferably, the polyurethane pad 30" is a similar to the polyurethane pads that have become available commercially from ITW Irathane, supra, and is cast in an orientation that is inverted from its orientation in use (see Figure 9) except that a curable composition to provide the bonding layer 40" when cured is applied to the upper surface of the polyurethane pad 30", as cast, before the polyurethane pad 30" has been cured completely, whereupon the curable composition to provide the bonding layer 40" and the polyurethane pad 30" are cured together until cured completely.

Moreover, an adhesive layer 50" is used to bond the composite pad 10" to the concrete tie 14, at the bonding layer 40" and at the upper surface 18 of the concrete tie 14, so as to resist relative movement between the polyurethane pad 30" and the concrete tie 14 and so as to

retard infiltration of sand, water, or debris between the composite pad 10" and the concrete tie 14.

Preferably, the adhesive layer 50" in its uncured state is deposited on the upper surface 18 of the concrete tie 14, whereupon the composite pad 10" is pressed onto the adhesive layer 50" so as to spread the adhesive layer 50 a until the adhesive layer 50" covers the exposed surface of the bonding layer 40" bonded to the polyurethane pad 30". It is permissible for some of the adhesive layer 50" to be thus extruded beyond the margins of the composite pad 10". Thereupon, the adhesive layer 50" is allowed to cure so that the adhesive layer 50" is bonded not only to the bonding layer 40" bonded to the polyurethane pad 30" but also to the concrete tie 14, whereby the composite pad 10" and the concrete tie 14 are bonded to one another via the bonding layer 40" and the adhesive layer 50".

According to one proposed embodiment, the bonding layer 40" comprises an acrylic composition that is a product of polymerizing a 20% (by volume) solution of methyl methacrylate copolymer in n-butyl acrylate monomer. The solution has an addition of 1% (by volume) cumene hydroperoxide to catalyze polymerization and is applied by air spraying, which is preferred, or by coating, printing, or pouring. After the solution is applied to the polyurethane pad 30" while the polyurethane pad 30" is partially cured, the bonding layer 40" is cured (polymerized) by activation of the peroxide during further curing of the polyurethane pad 30 (at 250° F) 120°C until the bonding layer 40" and the polyurethane pad 30" are cured completely.

According to another proposed embodiment, the bonding layer 40" comprises an acrylic composition that is a product of curing or drying a water-based acrylic emulsion, which is cured by drying. Either of two water-based acrylic emulsions available commercially from Johnson Wax of Racine, Wisconsin, under trade designations "Joncryl 74" and "Joncryl SCX 2660" respectively are suitable.

Alternatively, the bonding layer 40" is a product of polymerizing a solution of a thermoplastic elastomer in methyl methacrylate monomer. As an example, the bonding layer may be a product of polymerizing a solution of 20% (by volume) of Kraton D1117 thermoplastic elastomer available commercially from Shell Chemical Co. of Houston, Texas, either with an addition of 1% (by volume) of cumene hydroperoxide to catalyze polymerization, whereupon heat curing is employed, or with a sprayed coat of a dispersion of benzoyl peroxide in a plasticizer or in water to catalyze polymerization, whereupon either ambient curing or heat curing is employed. The dispersion may comprise AFR400 benzoyl peroxide available commercially from Elf Atochem North America, Inc. of Philadelphia, Pennsylvania.

Preferably, the adhesive layer 50" is comprised of a methacrylate ester composition, namely the methacrylate ester composition disclosed in the co-pending European application noted above.

Although the methacrylate ester composition discussed in the immediately preceding paragraph does not bond well to polyurethane, such as that used for the polyurethane pad 30", such methacrylate ester composition bonds well to any of the acrylic compositions specified above.

By this construction, any relative movement between the railroad rail 12 and the concrete tie 14 that is caused by a train rolling over the rail 12 will be between the bottom surface 58 of the rail flange 16 and the top surface 54 of the polyurethane pad 30, 30', or 30", so as to retard infiltration of sand, water, or debris therebetween. Thus, the deterioration and erosion problems discussed above are alleviated, even under high loadings, in regions where weather conditions vary widely from summer to winter, at sharp curves, and at steep grades.

Claims

1. A railroad tie (14) is made from concrete and includes a pad (10) mounted on its upper surface, in use, to receive and engage the lower flange (16) of a railroad rail (12), characterised in that the pad (10) is a composite pad and comprises an elastomeric pad (30) and bonding means (40) having an upper surface bonded to the lower surface of the elastomeric pad (30) so as to resist relative movement between them, the tie (14) further comprising an adhesive layer (18) bonding the bonding means (40) to its upper surface so as to resist relative movement between them and so as to retard infiltration of sand, water or debris between them.

2. A railroad tie according to claim 1, wherein the bonding means is a plate like member (40) bonded onto, and/or embedded into the lower surface of the elastomeric pad (30).

3. A railroad tie according to claim 1 or claim 2, wherein the plate like member (40) is made from a galvanised powder-coated steel or a polymeric material such as polycarbonate.

4. A railroad tie according to claim 1, wherein the bonding means comprises particles or fibres (40') bonded onto the elastomeric material (30) and being partially embedded within its lower surface.

5. A railroad tie according to claim 4, wherein the particles or fibres (40') are granules or fibres made from polycarbonate, acrylic or nylon.

6. A railroad tie according to claim 4, wherein the particules are particles of quartz, silica sand, silicon carbide, or aluminium oxide.

7. A railroad tie according to claim 1, wherein the bonding means (40") comprises a bonding layer (40") which is at least as flexible as the elastomeric pad (30) contacting the lower surface of the bonding pad (30).

8. A railroad tie according to claim 7, wherein the bonding layer (40") is an acrylic composition, or a polymerization product of a thermoplastic elastomer in methyl methacrylate monomer.

9. A railroad tie according to claim 8, wherein the acrylic composition is a product of polymerizing a solution of methyl methacrylate copolymer in n-butylacrylate monomer or is the product of curing or drying a water based acrylic water-based emulsion.

10. A railroad tie according to any one of the preceding claims, in which the adhesive is a methacrylate ester composition.

11. A railroad tie according to any one of the preceding claims, in which the elastomeric pad (30) is a polyurethane pad.

12. A railroad track comprising a railroad rail (12) having a lower flange (16) and a railroad tie (14) in accordance with any one of the preceding claims, the railroad rail (12) being mounted on the railroad tie (14) with its lower flange (16) engaging and resting on the elastomeric pad (30).

13. A composite pad (10) for use in a railroad tie (14) in accordance with any one of the preceding claims, comprising an elastomeric pad (30) and bonding means (40) bonded directly to the surface of the elastomeric pad (30) so as to resist relative movement between the elastomeric pad (30) and the bonding means (40).

FIG. 1

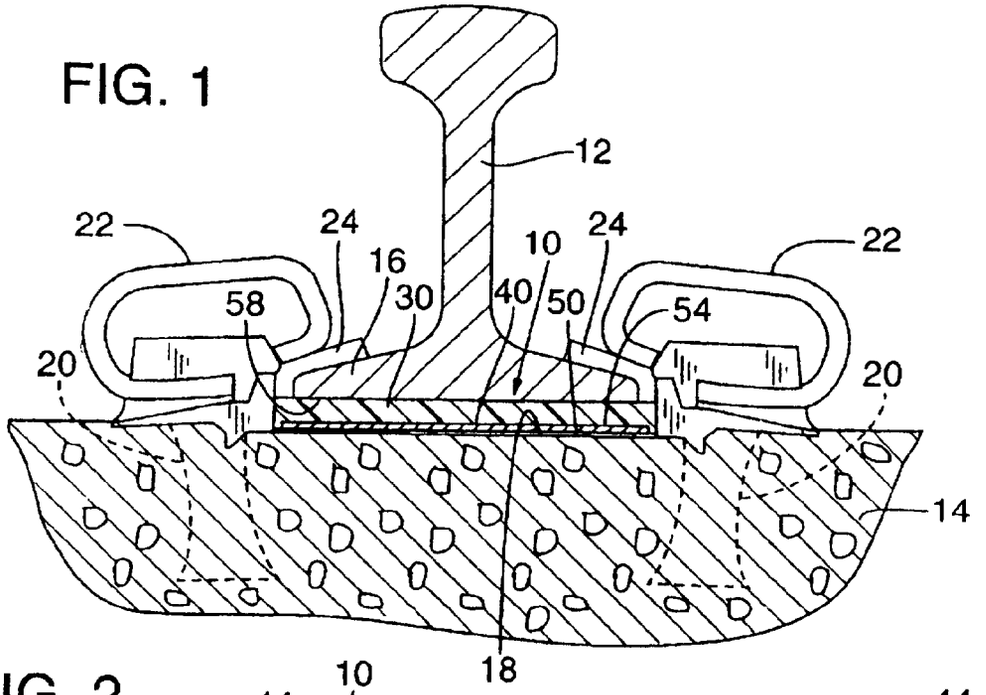


FIG. 2

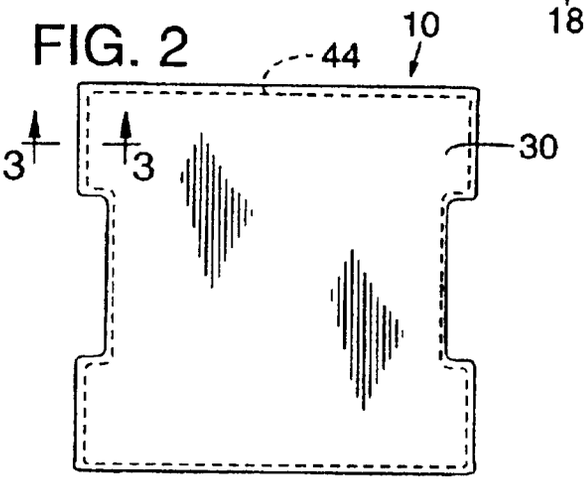


FIG. 4

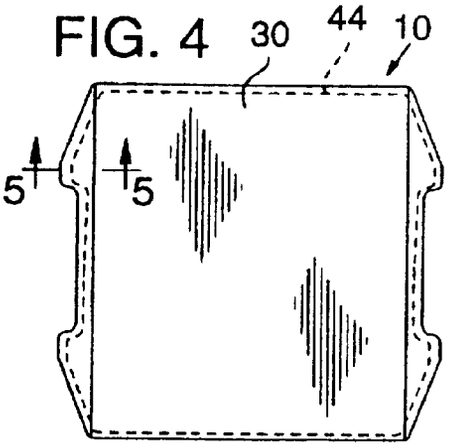


FIG. 3

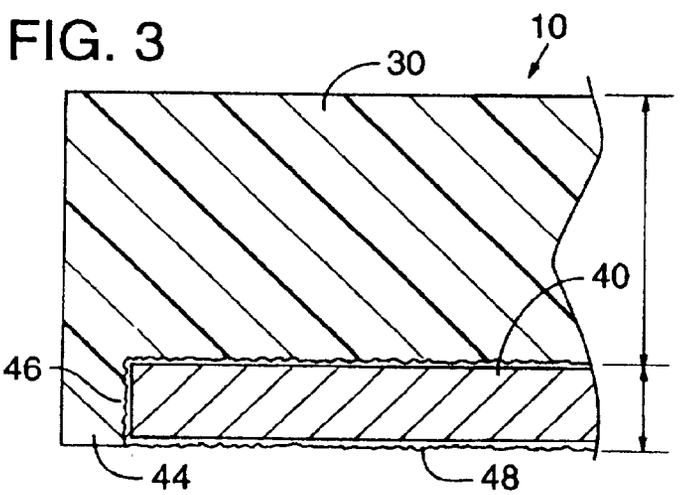


FIG. 5

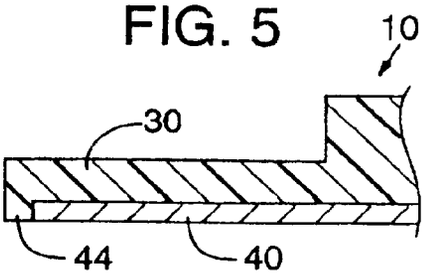


FIG. 6

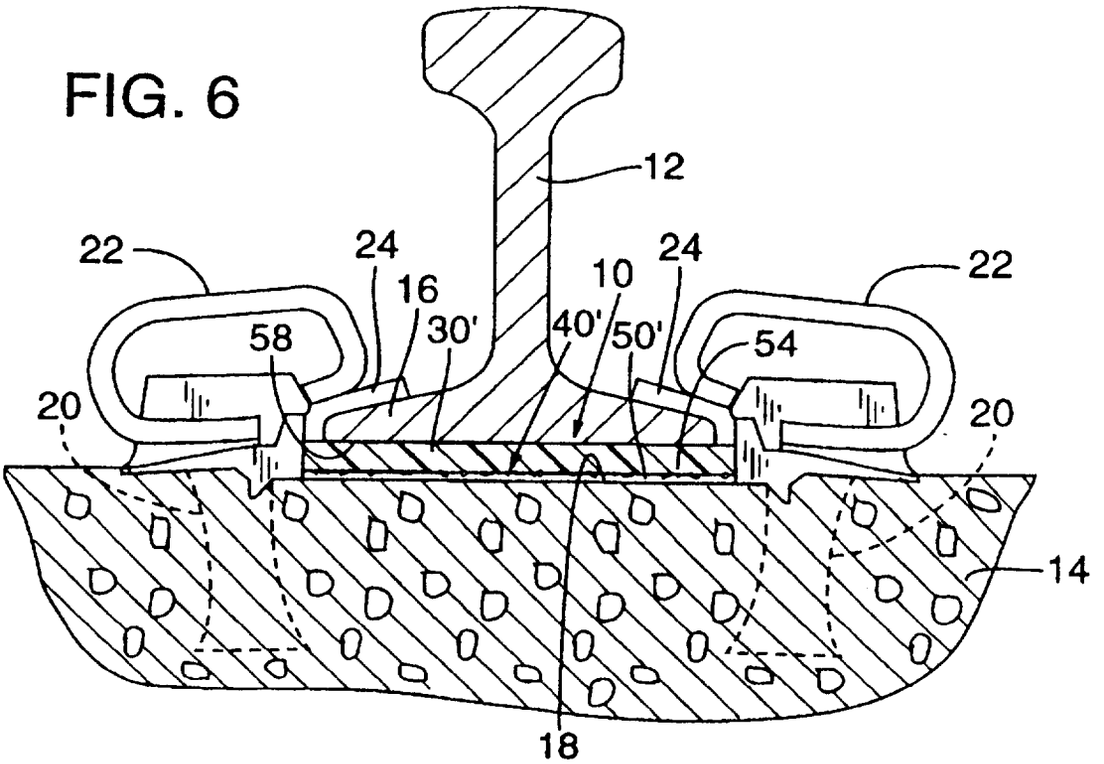


FIG. 7

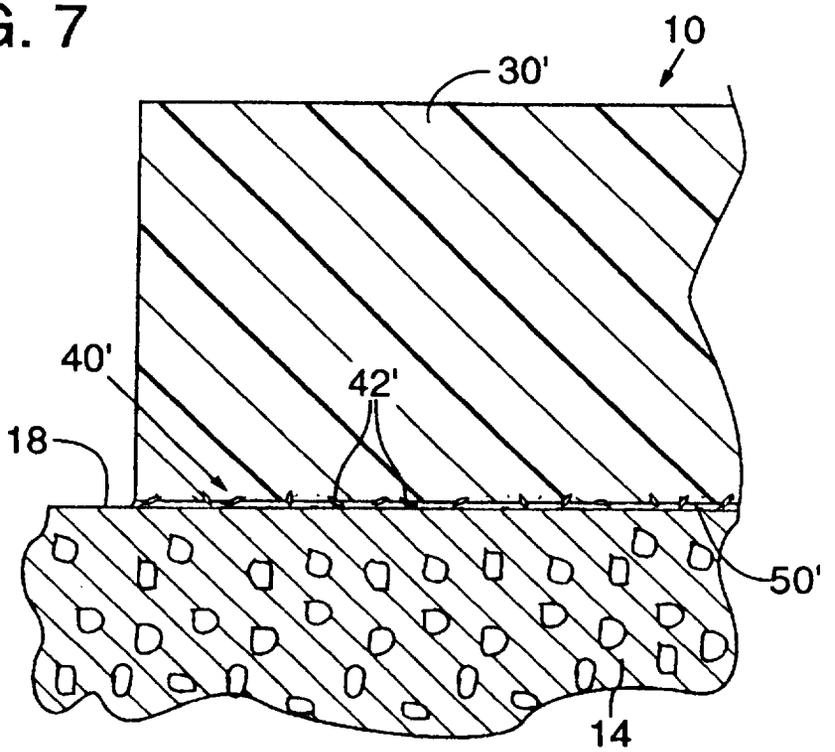


FIG. 8

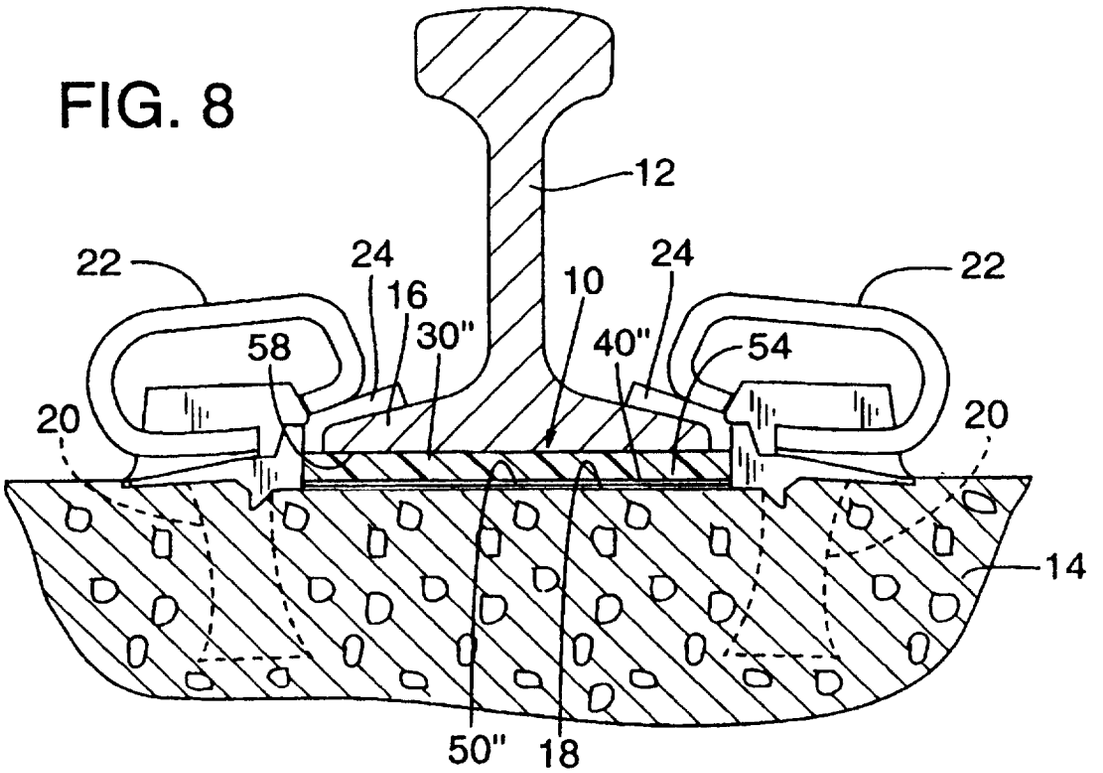
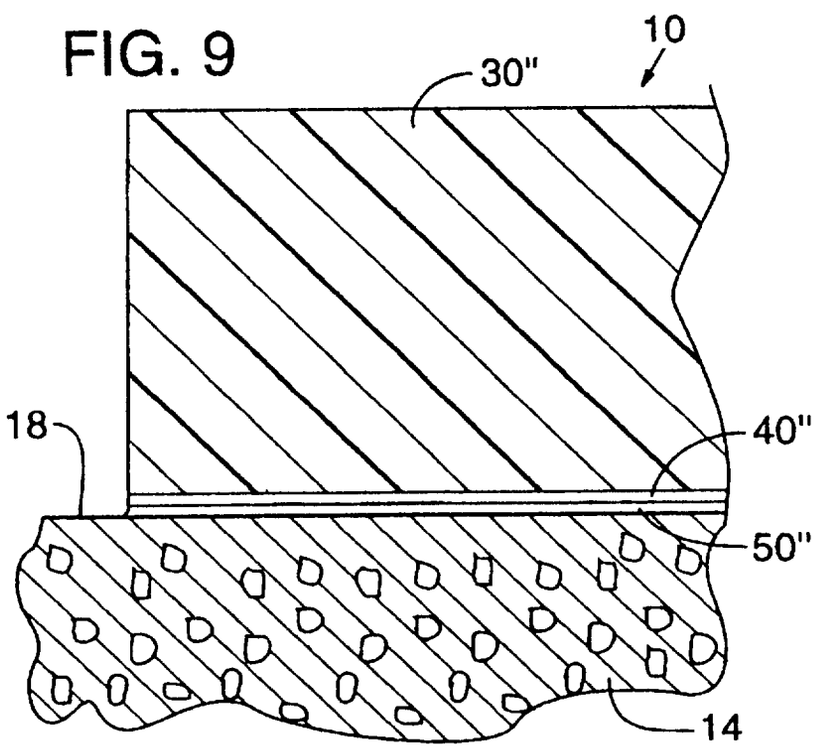


FIG. 9



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 7576

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-26 27 864 (SAUNDERS REEVE ENGINEERING LTD) 13 January 1977 * the whole document *	1-3, 11-13	E01B9/68
A	EP-A-0 541 884 (PORR ALLG BAUGES) 19 May 1993 * column 5, line 46 - column 6; figures 1,5,6 *	1-3,11, 13	
A	EP-A-0 364 756 (BRITISH STEEL PLC ;BRITISH RAILWAYS BOARD (GB)) 25 April 1990 * column 1 - column 3, line 34; figure 1 *	1-3,12, 13	
A,D	US-A-5 110 046 (YOUNG HARTLEY F) 5 May 1992 * the whole document *	1-3,12	
A	US-A-1 772 875 (O'BRIEN) * page 1, line 35 - line 59; figures *	1,2,12, 13	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	GB-A-2 121 461 (PANDROL LTD) 21 December 1983 * page 1, line 19 - page 2, line 80; figures 1-3,7 *	1,2,12, 13	E01B
A	FR-A-2 086 643 (SONNEVILLE) 31 December 1971 * page 2, line 6 - page 3, line 19; figures 1-3 *	1,2,12, 13	
A	GB-A-2 237 833 (PANDROL LTD) 15 May 1991 * page 1 - page 6; figures *	1,2,11, 13	
A	GB-A-777 189 (FABREEKA PRODUCTS COMPANY) * the whole document *	1,4	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	1 February 1996	Paetzel, H-J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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