arranged to engage with and simultaneously clamp and lift a railway rail inserted into the frame via the at least one clamping head and the at least one lifting head.

A module for a railway rail induction-welding device can be produced as a unit, allowing it to be installed directly into the device, and making manufacture, maintenance and repair of the device more straightforward. The provision of a combined clamping and lifting unit also serves to enforce the alignment of each railway rail from a single module, reducing the likelihood of miscalibration or misalignment of the device.

Preferably, the at least one clamping head includes a pair of opposed pivotable clamping armatures. A pivot point of each pivotable clamping armature is proximate to a clamping grip end of the pivotable clamping armature, and the at least one lifting head includes a pair of opposed pivotable lifting armatures, in which case a pivot point of each pivotable lifting armature is proximate a lifting grip end of the pivotable lifting armature. Optionally, the at least one clamping head and the at least one lifting head may be provided in an alternating configuration.

The construction of the clamping and lifting heads is such that the clearance required for actuation is minimal, typically, a change in width of the clamping and lifting heads upon activation is preferably less than 200mm. This allows the railway rail induction-welding device to be utilised in constricted areas of track, such as in the vicinity of railway rail interchange or switching junctions.

According to a third aspect of the invention, there is provided a vehicle comprising a railway rail induction-welding device preferably in accordance with the first aspect of the invention. Preferably, the vehicle may be a road-rail vehicle.

A vehicle having both rail and road transitory capability can beneficially utilise the existing rail network in order to perform repairs to existing rails, whilst also being completely suited to the assembly of new stretches of railway track where none has previously been lain.

According to a fourth aspect of the invention, there is provided a method of inductively welding opposing railway rails together, the method comprising the steps of: a] moving two facing ends of opposing railway rails into alignment in three mutually perpendicular directions; b] applying electromagnetic induction to the two facing ends to reach a welding temperature; and c] longitudinally forcing the two facing ends of the aligned railway rails towards one another to inductively weld the railway rails together.

The alignment of railway rails during a welding process is critical for the minimising of stresses or strains on the metal of the rails following welding. The described method therefore allows such forces to be minimised as a result of the weld due to the accurate alignment of the railway rails.

Preferably, during step c], the two facing ends may be forced into contact with one another to form a direct weld between the railway rails. Alternatively, before step b], a sacrificial piece of railway rail is positioned between the opposing railway rails, and during step c], the two facing ends of the railway rails are forced into contact with the sacrificial piece of railway rail to form an indirect weld between the railway rails.

The present invention can advantageously be used not only to join adjacent railway rails directly, but also by using a piece of sacrificial track which is completely melted during the welding process. This improves the flexibility of the induction welding process in a variety of contexts.

According to a fifth aspect of the invention, there may be provided an induction-welding device comprising: a device support; first and second clamping elements to align opposing objects when gripped by the first and second clamping elements, at least one of the first and second clamping elements being movably supported by the device support; and vertical lifting means for moving each clamping element vertically to align the opposing objects; urging means for moving at least one clamping element towards the other clamping element to bring aligned opposing objects towards each other; and an induction heating device on the device support and interposed or interposable between the first and second clamping elements to inductively weld the opposing objects together.

According to a sixth aspect of the invention, there is provided a railway rail induction-welding device comprising: a device support; a railway rail alignment means for aligning opposing railway rails in three mutually perpendicular directions, the railway rail alignment means including first and second clamping and lifting modules supported by the device support; the first clamping and lifting module comprising a first railway-rail clamping element and a first lifting element, and the second clamping and lifting module comprising a second railway-rail clamping element and a second lifting element, a plurality of clamping heads is provided for each of the first and second clamping elements; the first and second railway-rail clamping elements configured to horizontally and longitudinally align the opposing railway rails when gripped by the first and second railway-rail clamping elements; and the first and second lifting elements for vertically aligning the opposing railway rails; urging means for moving at least one clamping and lifting module towards

the other clamping and lifting module to bring the aligned opposing railway rails towards each other; and an induction heating device on the device support and interposed or interposable between the first and second railway-rail clamping elements to inductively weld the opposing railway rails together; characterised in that a plurality of lifting heads is provided for each of the first and second lifting elements, the lifting heads being engageable with the said opposing railway rails, and the clamping heads and the lifting heads of each of the clamping and lifting modules being provided in an alternating configuration.

The invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective representation of one embodiment of a railway rail induction-welding device in accordance with the first aspect of the invention;

Figure 2 is a side-on representation of the railway rail induction-welding device of Figure 1;

Figure 3 is an end-on representation of the railway rail induction-welding device of Figure 1;

Figure 4 is a plan view from below of the railway rail induction-welding device of Figure 1;

Figure 5 is a perspective representation of the railway rail induction-welding device of Figure 1, including a device housing;

Figure 6 is a perspective representation of one embodiment of a railway rail clamping and lifting module in accordance with the second aspect of the invention, for use as part of the railway rail induction-welding device of Figure 1;

Figure 7 is an end-on view of the railway rail clamping and lifting module of Figure 6;

Figure 8 is a side-on view of the railway rail clamping and lifting module of Figure 6;

Figure 9 is a perspective representation of one embodiment of a clamping head as utilised in the railway rail clamping and lifting module of Figure 6;

Figure 10 is an end-on view of the clamping head of Figure 9, indicating a position of a railway rail to be clamped;

Figure 11 is a perspective representation of one embodiment of a lifting head as utilised in the railway rail clamping and lifting module of Figure 6; and

Figure 12 is an end-on view of the lifting head of Figure 11, indicating a position of a railway rail to be lifted.

Claims

1. A railway rail induction-welding device (10) comprising:

a device support (12);

a railway rail alignment means for aligning opposing railway rails in three mutually perpendicular directions, the railway rail alignment means being supported by the device support (12) and including:

first and second railway-rail clamping elements (16) to horizontally and longitudinally align the opposing railway rails when gripped by the first and second railway-rail clamping elements (16), at least one of the first and second railway-rail clamping elements (16) being movably supported by the device support (12); and

vertical lifting means for moving each railway-rail clamping element (16) vertically to align the opposing railway rails;

urging means for moving at least one railway-rail clamping element (16) towards the other clamping element (16) to bring aligned opposing railway rails towards each other; and

an induction heating device (24) on the device support (12) and interposed or interposable between the first and second railway-rail clamping elements (16) to inductively weld the opposing railway rails together.

2. A railway rail induction-welding device (10) as claimed in claim 1, wherein the vertical lifting means comprises first and second lifting elements (18) supported by the device support (12), at least one of the first and second lifting elements (18) being movably supported by the device support (12).

3. A railway rail induction-welding device (10) as claimed in claim 2, wherein the first and second lifting elements (18) each comprise at least one lifting head (48).

4. A railway rail induction-welding device (10) as claimed in claim 3, wherein the at least one lifting head (48) includes a pair of opposed pivotable lifting armatures (64).

5. A railway rail induction-welding device (10) as claimed in claim 4, wherein a pivot point of each pivotable lifting armature (64) is proximate a lifting grip end (70) of the pivotable lifting armature (64).

6. A railway rail induction-welding device (10) as claimed in claim 4 or claim 5, wherein the or each lifting head (48) is associated with a linear actuator (50) to effect a pivoting motion of the or each lifting head (48).

7. A railway rail induction-welding device (10) as claimed in any one of claims 2 to 6, wherein the first and second lifting elements (18) are respectively co-located with the first and second railway-rail clamping elements (16) to form first and second clamping and lifting modules (14a, 14b).

8. A railway rail induction-welding device (10) as claimed in any one of the preceding claims, wherein the vertical lifting means is adapted to engage with a head of the said railway rails.

9. A railway rail induction-welding device (10) as claimed in any one of the preceding claims, wherein the first and second clamping elements (16) each comprise at least one clamping head (44).

10. A railway rail induction-welding device (10) as claimed in claim 9, wherein the at least one clamping head (44) includes a pair of opposed pivotable clamping armatures (52).

11. A railway rail induction-welding device (10) as claimed in claim 10, wherein a pivot point of each pivotable clamping armature (52) is proximate a clamping grip end (58) of the pivotable clamping armature (52).

12. A railway rail induction-welding device (10) as claimed in claim 10 or claim 11, wherein the or each clamping head (44) is associated with a linear actuator (46) to effect a pivoting motion of the or each clamping head (44).

13. A railway rail induction-welding device (10) as claimed in any one of claims 9 to 12, when also dependent upon any one of claims 3 to 6, wherein a plurality of said clamping heads (44) is provided for each of the first and second clamping elements (16) and/or a plurality of said lifting heads (48) is provided for each of the first and second lifting elements (18), the or each clamping

head (44) being provided in an alternating configuration with the or each lifting head (48) of the first and second lifting elements respectively (18).

14. A railway rail induction-welding device (10) as claimed in any one of the preceding claims, wherein the first and second clamping elements (16) are adapted to engage with a web of the said opposing railway rails.

15. A railway rail induction-welding device (10) as claimed in any one of the preceding claims, wherein the urging means comprises at least one actuatable forge cylinder (22) arrange to actuate the first or second clamping element (16) towards the other.

16. A railway rail induction-welding device (10) as claimed in any one of the preceding claims, further comprising an actuatable shear die (28) which is adapted to remove upset material following inductive welding of the opposing railway rails.

17. A railway rail induction-welding device (10) as claimed in any one of the preceding claims, further comprising a device housing (38), and a support actuator (36), the support actuator (36) being in engagement with the device housing (38) and device support (12) to permit pivoting of the device support (12) for maintenance.

18. A railway rail clamping and lifting module (14a, 14b) for a railway rail induction-welding device (10) as claimed in any one of the preceding claims, the railway rail clamping and lifting module (14a, 14b) comprising:

a module frame (40);

at least one clamping head (44) supported by the module frame (40), the at least one clamping head (44) including a pair of opposed pivotable clamping armatures (52), a pivot point of each pivotable clamping armature (52) being proximate a clamping grip end (58) of the pivotable clamping armature (52); and

at least one lifting head (48) supported by the module frame (40), the at least one lifting head (48) including a pair of opposed pivotable lifting armatures (64), a pivot point of each pivotable lifting armature (64) being proximate a lifting grip end (70) of the pivotable lifting armature (64);

the railway rail clamping and lifting module (14a, 14b) being arranged to engage with and simultaneously clamp and lift a railway rail inserted into the frame via the at least one clamping head (44) and the at least one lifting head (48).

19. A railway rail clamping and lifting module (14a, 14b) as claimed in claim 18, wherein the at least one clamping head (44) and the at least one lifting head (48) are provided in an alternating configuration.

20. A vehicle comprising a railway rail induction-welding device (10) as claimed in any one of claims 1 to 17.

21. A vehicle as claimed in claim 20, wherein the vehicle is a road-rail vehicle.

22. A method of inductively welding opposing railway rails together, the method comprising the steps of:

a] moving two facing ends of opposing railway rails into alignment in three mutually perpendicular directions using a railway rail induction-welding device (10) as claimed in any one of claims 1 to 17;

b] applying electromagnetic induction to the two facing ends to reach a welding temperature; and

c] longitudinally forcing the two facing ends of the aligned railway rails towards one another to inductively weld the railway rails together.

23. A method as claimed in claim 22, wherein during step c], the two facing ends are forced into contact with one another to form a direct weld between the railway rails.

24. A method as claimed in claim 22, wherein before step b], a sacrificial piece of railway rail is positioned between the opposing railway rails, and during step c], the two facing ends of the railway rails are forced into contact with the sacrificial piece of railway rail to form an indirect weld between the railway rails.

25. An induction-welding device (10) comprising:

a device support (12);

first and second clamping elements (16) to align opposing objects when gripped by the first and second clamping elements (16), at least one of the first and second clamping elements (16) being movably supported by the device support (12); and

vertical lifting means for moving each clamping element (16) vertically to align the opposing objects;

urging means for moving at least one clamping element (16) towards the other clamping element (16) to bring aligned opposing objects towards each other; and

an induction heating device (24) on the device support (12) and interposed or interposable between the first and second clamping elements (16) to inductively weld the opposing objects together.

26. A railway rail induction-welding device (10) comprising:

a device support (12);

a railway rail alignment means for aligning opposing railway rails in three mutually perpendicular directions, the railway rail alignment means including first and second clamping and lifting modules (14a, 14b) supported by the device support (12);

the first clamping and lifting module (14a) comprising a first railway-rail clamping element (16) and a first lifting element (18), and the second clamping and lifting module (14b) comprising a second railway-rail clamping element (16) and a second lifting element (18), a plurality of clamping heads (44) is provided for each of the first and second clamping elements (16);

the first and second railway-rail clamping elements (16) configured to horizontally and longitudinally align the opposing railway rails when gripped by the first and second railway-rail clamping elements (16); and

the first and second lifting elements (18) for vertically aligning the opposing railway rails;

urging means for moving at least one clamping and lifting module (14a) towards the other clamping and lifting module (14b) to bring the aligned opposing railway rails towards each other; and

an induction heating device (24) on the device support (12) and interposed or interposable between the first and second railway-rail clamping elements (16) to inductively weld the opposing railway rails together;

characterised in that a plurality of lifting heads (48) is provided for each of the first and second lifting elements (18), the lifting heads (48) being engageable with the said opposing railway rails, and the clamping heads (44) and the lifting heads (48) of each of the clamping and lifting modules (14a, 14b) being provided in an alternating configuration.