According to a first 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 being supported by the device support and including: first and second railway-rail clamping elements to horizontally and longitudinally align the opposing railway rails when gripped by the first and second railway-rail clamping elements, at least one of the first and second railway-rail clamping elements being movably supported by the device support; and vertical lifting means for moving each railway-rail clamping element vertically to align the opposing railway rails, the vertical lifting means comprising first and second lifting elements supported by the device support, at least one of the first and second lifting elements being movably supported by the device support, the first and second lifting elements each comprising at least one lifting head which includes a pair of opposed pivotable lifting armatures, and a pivot point of each pivotable lifting armature being proximate a lifting grip end of the pivotable lifting armature; urging means for moving at least one railway-rail clamping element towards the other clamping element to bring 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.

The provision of a device which can align railway rails in three mutually perpendicular directions during an induction welding process ensures that a strong, smooth and stable weld is formed, without resulting in significant stresses in the railway rails during the process. Providing a strong clamping force allows for aligned longitudinal urging of the railway rails towards one another to be effected, whilst the lifting means also permits vertical alignment of the rails during the process.

The or each lifting head may be optionally associated with a linear actuator to effect a pivoting motion of the or each lifting head. The first and second lifting elements may be respectively co-located with the first and second railway-rail clamping elements to form first and second clamping and lifting modules. Optionally the vertical lifting means is adapted to engage with a head of the said railway rails.

The construction of the lifting means ensures that the railway rails are aligned during the induction welding process in a vertical direction, which would not otherwise be achievable were the induction welding to take place directly on the ground.

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 an aspect not in accordance with the present 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 further 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

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, the vertical lifting means comprising 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), the first and second lifting elements (18) each comprising at least one lifting head (48) which includes a pair of opposed pivotable lifting armatures (64), and a pivot point of each pivotable lifting armature (64) being proximate a lifting grip end (70) of the pivotable lifting armature (64);

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 or each lifting head (48) is associated with a linear actuator (50) to effect a pivoting motion of the or each lifting head (48).

3. A railway rail induction-welding device (10) as claimed in claim 1 or 2, 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).

4. 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.

5. 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).

6. A railway rail induction-welding device (10) as claimed in claim 5, wherein the at least one clamping head (44) includes a pair of opposed pivotable clamping armatures (52).

7. A railway rail induction-welding device (10) as claimed in claim 6, wherein a pivot point of each pivotable clamping armature (52) is proximate a clamping grip end (58) of the pivotable clamping armature (52).

8. A railway rail induction-welding device (10) as claimed in claim 6 or claim 7, 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).

9. A railway rail induction-welding device (10) as claimed in any one of claims 5 to 8, 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).

10. 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.

11. 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.

12. 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.

13. 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.

14. 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).

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

16. A vehicle comprising a railway rail induction-welding device (10) as claimed in any one of claims 1 to 13.

17. A vehicle as claimed in claim 16, wherein the vehicle is a road-rail vehicle.

18. 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 13;

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.

19. A method as claimed in claim 18, wherein during step c], the two facing ends are forced into contact with one another to form a direct weld between the railway rails.

20. A method as claimed in claim 18, 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.

21. 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.