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(54) **A method for regenerating a frog of a worn railway switch**

Verfahren zur Erneuerung eines Weichenherzstücks

Procédé de réfection du coeur d'un aiguillage

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Description

DESCRIPTION OF THE INVENTION

[0001] The present invention relates to the technical sector concerning regeneration of frogs on worn railroad or tramway switches, see for example prior art document FR 2 864 118 A1.

[0002] It is known that in a switch the part most subject to wear is the frog, which is formed by a point portion, a first wing rail and a second wing rail. To replace the frog of a worn switch, a portion of the worn switch of a railroad or tramway line is usually sectioned, which worn switch comprises: a first rail comprising a first wing rail and a first length of rail; a second rail comprising a second wing rail and a second length of rail which faces the first length of rail; a third rail comprising a third length of rail and a first end; a fourth rail comprising a fourth length of rail and a second end. The first end of the third rail and the second end of the fourth rail form the point portion of the frog. The portion of worn switch is then removed and is positioned in the railroad or tramway line. The portion of worn switch is eliminated or sent on for recycling of the relative raw materials.

[0003] Alternatively to the replacement of the frog of a worn switch, a method is known for regenerating the frog of a worn switch, carried out directly on the railroad or tramway line, which comprises following steps: identification of the worn area by an operator, using a planarity ruler; marking the worn area, for example using a marking pen; removing material from a work region which comprises the worn area so as to give a surface-signal of any cracks, porosity and inclusions, such as to require a further removal of material using an abrasive miller in the zone involved by the defects; bead-welding using welding robots; roughing using an abrasive miller, so as to remove the excess welding material; finishing grinding using a polishing miller, so as to profile the external flaps of the point portion of the frog and the wing rails; and lastly controlling the linearity of the rolling plane using a planarity ruler.

[0004] The regeneration of the frog requires the interruption of the railroad or tramway line for several hours, which can represent a problem for the circulation of the trains or trams; instead, the replacement of the portion of worn switch with a new portion of switch has a minimal impact on the railroad or tramway circulation, but higher costs.

[0005] It is further specified that a regenerated frog using the above-described method does not have the same working life as a new frog: a comparison reveals that the replacement or further regeneration of a regenerated frog using the known-art method will by necessity occur first with respect to the replacement or regeneration of a new frog.

[0006] The aim of the invention consists in obviating or at least limiting the drawbacks of the prior art as outlined in the foregoing.

[0007] The aim is obtained with a method for regenerating a frog of a worn switch, according to claim 1.

[0008] In the prior art, the removal of material from the work region, carried out before the welding, is finalised to creating a surface which enables the subsequent welding material to gain good adherence: therefore the removal of material from the work region is minimal or at least limited, and is in the order of a few millimetres.

[0009] Also, this removal of material from the work region is carried out manually by an operator with an abrasive miller, and therefore in practice it cannot be either of a particular size or a particular precision.

[0010] In the method of the invention, instead, the step of removing material from the work region is carried out automatically and by milling. The removal of material from the work region before welding can therefore be precisely controlled and can also reach various millimetres of depth; in other words, starting from a theoretic profile of the area, now worn, which there would be if the frog were new, with the milling the theoretical profile can be lowered uniformly by 8-12 mm (where the wear is greater the removal of material from the work region will obviously be less).

[0011] If a roughing and finishing are necessary after the welding, the layer of uniform welding which will be applied in the work region will subsequently be roughed and finished equally uniformly, preferably by milling, so that a frog is obtained having a uniform layer of welded material.

[0012] As the welding material is very hard, greater than the hardness of the material, steel or manganese, of which the frog is made, a regenerated frog can advantageously be obtained having a working life that is even longer than that of a new frog: by way of comparison, the replacement or further regeneration of a regenerated frog, with the present method, can occur subsequently with respect to the replacement or regeneration of a new frog.

[0013] The steps of removal of material from the work region and the addition of welding material are carried out automatically without the intervention of an operator, which enables saving costs and a greater working precision.

[0014] To carry out these steps automatically it is important to precisely identify the position in the space occupied by the frog, identifying the spatial coordinates by a sufficient number of points of the worn portion of switch. Of particular importance, for this purpose, is identifying the spatial coordinates of the actual tip (also known as the "material tip") of the point portion of the frog of the switch, as because of the wear it might be deformed and difficult to identify, even if the model and/or the marque of the worn switch is known. In other words, and by way of example, from the knowledge of the model and/or marque of the worn switch, and therefore of the profile of the point portion of the frog and the wing rail, and from the detecting of the spatial coordinates of some points of the portion of worn switch which do not comprise the

actual tip, it can be difficult or even impossible to extrapolate the exact position of the actual tip: in fact, the effective coordinates of the actual tip of the point portion of the frog of a worn switch can even considerably deviate (for example by a few millimetres) from the theoretical coordinates of the actual tip of the point portion of the frog which can be extrapolated by the knowledge of the spatial coordinates of other points of the portion of worn switch. If the position of the actual tip is not precisely detected, and if the worn area is identifiable, as often happens, at the point portion of the frog, the material removal steps from the work region and addition of welding material by welding can be imprecise or even wrong. The method of the invention can enable obtaining a regenerated frog having an identical profile to the profile of a new frog, and therefore a rolling plane can be obtained which responds to the specific requirements: this is enabled by the carrying-out of automatic steps which therefore do away with the need for manual intervention by an operator.

[0015] The method of the invention advantageously determines a minimum impact on the railroad or tramway circulation: the worn switch, in fact, is sectioned and removed from the railroad or tramway line, making possible the replacement thereof with a new or regenerated switch.

[0016] Specific embodiments of the invention will be described in the following of the present description, in accordance with what is set out in the claims and with the aid of the accompanying tables of drawings, in which:

- figure 1 is a schematic view from above of a portion of worn railroad switch which comprises a frog;
- figures 2, 3, 4 are respectively sections II-II, III-III and IV-IV of the portion of worn switch of figure 1;
- figure 5 schematically illustrates from above the portion of worn switch of figure 1, arranged on a work plane and an arm which is mobile on a guide and bears a tracer point.

[0017] With reference to the accompanying table of drawings, (1) denotes in its entirety a portion of worn switch, comprising: a first rail (2) comprising a first wing rail (3) and a first length of rail (4); a second rail (5) comprising a second wing rail (6) and a second length of rail (7) which faces the first length of rail (4); a third rail (8) comprising a third length of rail (9) and a first end (10); a fourth rail (11) comprising a fourth length of rail (12) and a second end (13), the first end (10) of the third rail (8) and the second end (13) of the fourth rail (11) forming a point portion (14).

[0018] The first wing rail (3), the second wing rail (6) and the point portion (14) forming the frog (15) of the portion of worn railroad switch (1).

[0019] The method for regenerating a frog (15) of a worn switch of the present invention comprises steps of:

sectioning from a railway line or a tramline (not illustrated) a portion of worn railroad switch (1) (figures 1, 5); removing the portion of worn railroad switch (1) from the railway line or tramline; arranging the portion of worn railroad switch (1) on a work plane (16) in a position which is known with a degree of precision, for example a few centimetres (figure 5); identifying spatial coordinates of the actual tip (17) of the point portion (14) of the frog (15) of the portion of worn railroad switch (1) arranged on the work plane (16) and spatial coordinates of other points (18) of the portion of worn railroad switch (1) arranged on the work plane (16) so as to identify a profile and position of the point portion (14), of the first wing rail (3) and of the second wing rail (3) on the work plane (16) (figures 2 and 4); detecting at least a worn area (19) at least in the point portion (14) of the portion of worn railroad switch (1) (figures 1 and 5); removing material, automatically and by means of milling, from a work region (110) which comprises the at least a worn area (19); adding welding material, automatically and by means of welding, in the working region (110) from which material was removed by milling.

[0020] The worn area (19) can be identified, for example, by visual means by use of a planarity ruler (not illustrated) or can be done automatically, as will be more precisely explained in the following.

[0021] The work region (110) comprises worn material that is part of the worn area (19); further, the work region (110) can comprise non-worn material, for example underlying the worn area (19).

[0022] The automatic removal of material by milling preferably removes the worn material that is part of the worn area and contained in the work area (110).

[0023] The portion of worn switch (1) can then be cut (or demounted, if this is the case) and removed from the railroad line or tramway. This portion of worn switch (1) can be replaced with another portion of new switch or can be regenerated to restore railroad or tramway circulation in a short time.

[0024] The work plane (16) can be situated in an equipped workshop or area away from the railroad line or tramway.

[0025] Removable fixing means (20) (for example screws, bolts, plates, etc.) can be included for constraining the worn portion of switch (1) to the work plane (16). There exist various type of switches: therefore, a frog of a switch can be of various dimensions; in addition, the sectioning of a portion of worn switch (1) (for example by cutting or demounting) from a railroad line or tramway is done manually and with a degree of approximation, so that a portion of worn switch (1) can exhibit different dimensions from another portion of worn switch (1) even if the mentioned switches belong to the same type of switches. For this reason, the position assumed by a portion of worn switch (1) on a work plane (16) is known only with a degree of precision of a few centimetres (or millimetres) and it is therefore necessary to detect the spatial coordinates of other points (18) (beyond the spatial co-

ordinates of the actual tip (17)) of the portion of worn switch (1) so as to identify, with millimetric precision, the profile and position of the point portion (14) of the frog, the first wing rail (3) and the second wing rail (6) on the work plane (16). Only in this way is it possible to carry out the automatic removal steps of material from the work region (110) and the applying of welding material as mentioned above.

[0026] Still with reference to the need to know with precision the position assumed by the portion of worn switch (1) on the work plane (16) for the following automatic working steps, as has already been specified in the foregoing, it is particularly important to identify the spatial coordinates of the actual tip (17) of the point portion (14) of the frog (15) of the switch, as due to the wear it might be deformed and difficult to identify even knowing the model and/or the marque of the worn switch and the millimetric position of the switch.

[0027] The method preferably comprises a step of automatically performing a removal of welding material from the working region (110) after welding material has been added.

[0028] The step of removing welding material is preferably performed by milling.

[0029] In this case, all the above-described considerations relating to the advantages deriving from an automatic carrying-out and by means of milling of the removal step of welding material are valid.

[0030] The milling is preferably realised by means of an arm (21), preferably an anthropomorphic arm, which bears a miller (not illustrated) and which is commanded by a control unit (22) (figure 5).

[0031] The arm (21) can be borne by a carriage (23) which slides on guides (24) so that the arm (21) can be mobile parallel to the work plane (16).

[0032] The step of identifying the spatial coordinates of other points (18) of the portion of worn railroad switch (1) preferably comprises steps of: acquiring data relating to a model and/or marque of worn railroad switch of the portion of worn railroad switch so as to obtain the profile of the point portion (14), the first wing rail (3) and the second wing rail (6); identifying the spatial coordinates of a first point (25) on the internal lateral surface (26) of the first length of rail (4) (figures 1 and 2); identifying the spatial coordinates of a second point (27) on the internal lateral surface (28) of the second length of rail (7) (figure 1); identifying the spatial coordinates of a third point (29) on the external lateral surface (30) of the third length of rail (9) (figure 1) or on the external lateral surface (35) of the first end (10) of the third rail (8); identifying the spatial coordinates of a fourth point (31) on the external lateral surface (32) of the fourth length of rail (12) (figures 1 and 4) or on the external lateral surface (36) of the second end (13) of the fourth rail (11); obtaining the spatial coordinates of the theoretical point (33) (figure 1) from knowledge of the spatial coordinates of the first point (25), the second point (27), the third point (29) and the fourth point (31).

[0033] As specified, the position of the portion of worn switch (1) on the work plane (16) is known with a degree of precision of some centimetres. It is therefore possible to identify, even automatically: the internal lateral surface (26) of the first length of rail (4); the internal lateral surface (28) of the second length of rail (7); the external lateral surface (30) of the third length of rail (9) or the external lateral surface (35) of the first end (10) of the third rail (8); and the external lateral surface (32) of the fourth length of rail (12) or on the external lateral surface (36) of the second end (13) of the fourth rail (11). The theoretical point (33) of the frog (15) of the length of worn rail (1) is located on the intersection of a first plane, passing through the first point (25) and the third point (29), with a second plane, passing through the second point (27) and the fourth point (31); calculating the spatial coordinates of the theoretical point (33) is therefore easy and simple.

[0034] From the knowledge of the model and/or marque of the worn switch, the spatial coordinates of the theoretical point (33) and the orientation of the first plane or the second plane it is possible to precisely calculate (in terms of millimetres) the position assumed by the portion of worn switch (1) on the work plane (16).

[0035] The method preferably comprises a step of providing a tracer point (34) (figure 5) which enables acquiring the spatial coordinates of a point that enters into contact with the tracer point (34); and wherein the spatial coordinates of the first point (25), the second point (27), the third point (29) and the fourth point (31) are identified by means of the tracer point (34).

[0036] The above-mentioned arm (21) can for example also bear the tracer point (34), and can also move perpendicularly to the longitudinal axis (K) of the worn portion of switch (1) arranged on the work plane (16) (figure 5).

[0037] If the third point (29) is detected at the external lateral surface (35) of the first end (10) of the third rail (8), it is preferable for the third point (29) not to belong to a worn area (19). This prevents erroneous calculation of the spatial coordinates of the theoretical point (33).

[0038] If the fourth point (31) is detected at the external lateral surface of the second end (13) of the fourth rail (11), it is preferable for the fourth point (31) not to belong to a worn area (19). This avoids erroneous calculation of the spatial coordinates of the theoretical point (33).

[0039] The step of identifying the spatial coordinates of the actual tip (17) of the portion of worn railroad switch (1) arranged on the work plane (16) preferably comprises following steps which occur in succession as follows: bringing the tracer point (34) to the spatial coordinates of a theoretical point (33); displacing the tracer point (34) towards the actual tip (17), along a parallel direction to the longitudinal axis (K) of the portion of worn railroad switch (1) arranged on the work plane (16), until the tracer point (34) enters into contact with a point portion (14) of the portion of worn railroad switch (1); this point will correspond to the actual tip (17) and the spatial coordinates thereof will be acquired.

[0040] Once the portion of worn switch (1) has been positioned on the work plane (16), the orientation of the portion of worn switch (1) is substantially known, which enables knowing the direction in which the tracer point (34) will thereafter be moved so as to reach the actual tip (17) starting from the theoretical point (33).

[0041] The method preferably comprises a step of: bringing the tracer point (34) into contact with a fifth point (37) of the at least a worn area (19) which is at the point portion (14) of the frog (15) in proximity of the actual tip (17); acquiring a height value of the fifth point (37) of the at least a worn area (19) (figure 3). Knowing the height of at least a point of the frog (15) in the worn area (19) enables correct positioning of the miller for the aims of removal of material from the work area (110). Further, knowing the model and/or marque of the worn switch enables identifying the theoretical height of the fifth point (37) if the switcher were new and, therefore, calculating the existence of the worn area (19) or the degree of wear of the worn area (19). This automatic detection avoids the need for a manual intervention on the part of an operator with a planarity ruler.

[0042] The above has been described by way of non-limiting example, and any eventual constructional variants are understood to fall within the protective scope of the present technical solution as claimed in the following.

Claims

1. A method for regenerating a frog of a worn railroad switch, **characterised in that** it comprises steps of:

sectioning from a railway line or a tramline a portion of worn railroad switch (1) which comprises: a first rail (2) comprising a first wing rail (3) and a first length of rail (4); a second rail (5) comprising a second wing rail (6) and a second length of rail (7) which faces the first length of rail (4); a third rail (8) comprising a third length of rail (9) and a first end (10); a fourth rail (11) comprising a fourth length of rail (12) and a second end (13), the first end (10) of the third rail (8) and the second end (13) of the fourth rail (11) forming a point portion (14); the first wing rail (3), the second wing rail (6) and the point portion (14) forming the frog (15) of the portion of worn railroad switch (1); removing the portion of worn railroad switch (1) from the railway line or tramline; arranging the portion of worn railroad switch (1) on a work plane (16) in a position which is known with a degree of precision; identifying spatial coordinates of the actual tip (17) of the point portion (14) of the frog (15) of the portion of worn railroad switch (1) arranged on the work plane (16) and spatial coordinates of other points (18) of the portion of worn railroad

switch (1) arranged on the work plane (16) so as to identify a profile and position of the point portion (14), the first wing rail (3) and the second wing rail (3) on the work plane (16); detecting at least a worn area (19) at least in the point portion (14) of the frog (15) of the portion of worn railroad switch (1); removing material, automatically and by means of milling, from a work region (110) which comprises the at least a worn area (19); adding welding material, automatically and by means of welding, in the work region (110) from which material was removed by milling.

2. The method of the preceding claim, comprising a step of automatically performing a removal of welding material from the working region (110) after welding material has been added.
3. The method of the preceding claim, wherein the step of removing welding material is performed by milling.
4. The method of claim 1 or 2 or 3, wherein the milling is realised by means of an arm (21) which bears a miller and which is commanded by a control unit (22).
5. The method of any one of the preceding claims, wherein the step of identifying the spatial coordinates of other points (18) of the portion of worn railroad switch (1) comprises steps of: acquiring data relating to a model and/or marque of worn railroad switch of the portion of worn railroad switch so as to obtain the profile of the point portion (14), the first wing rail (3) and the second wing rail (6); identifying the spatial coordinates of a first point (25) on the internal lateral surface (26) of the first length of rail (4); identifying the spatial coordinates of a second point (27) on the internal lateral surface (28) of the second length of rail (7); identifying the spatial coordinates of a third point (29) on the external lateral surface (30) of the third length of rail (9) or on the external lateral surface (35) of the first end (10) of the third rail (8); identifying the spatial coordinates of a fourth point (31) on the external lateral surface (32) of the fourth length of rail (12) or on the external lateral surface (36) of the second end (13) of the fourth rail (11); obtaining the spatial coordinates of the theoretical point (33) from knowledge of the spatial coordinates of the first point (25), the second point (27), the third point (29) and the fourth point (31).
6. The method of the preceding claim, comprising a step of providing a tracer point (34) which enables acquiring the spatial coordinates of a point that enters into contact with the tracer point (34); and wherein the spatial coordinates of the first point (25), the second point (27), the third point (29) and the fourth point (31) are identified by means of the tracer point

(34).

7. The method of the preceding claim, wherein the step of identifying the spatial coordinates of the actual tip (17) of the point portion (14) of the frog (15) of the portion of worn railroad switch (1) arranged on the work plane (16) comprises following steps which occur in succession as follows: bringing the tracer point (34) to the spatial coordinates of a theoretical point (33); displacing the tracer point (34) towards the actual tip (17), along a parallel direction to the longitudinal axis (K) of the portion of worn railroad switch (1) arranged on the work plane (16), until the tracer point (34) enters into contact with a point of the portion of worn railroad switch (1).
8. The method of the preceding claim, comprising a step of: bringing the tracer point (34) into contact with a fifth point (37) of the at least a worn area (19) which is at the point portion (14) of the frog (15) in proximity of the actual tip (17); acquiring a height value of the fifth point (37) of the at least a worn area (19).

Patentansprüche

1. Verfahren zur Aufarbeitung eines abgenutzten Weichenherzstücks, **dadurch gekennzeichnet, dass** es die folgenden Schritte beinhaltet:

Abtrennen, von einer Eisenbahnlinie oder einer Straßenbahnlinie, eines abgenutzten Weichenabschnitts (1), der folgendes beinhaltet: eine erste Schiene (2), die eine erste Flügelschiene (3) und einen ersten Schienenlängsabschnitt (4) beinhaltet; eine zweite Schiene (5), die eine zweite Flügelschiene (6) und einen zweiten Schienenlängsabschnitt (7) beinhaltet, der dem ersten Schienenlängsabschnitt (4) zugewandt ist; eine dritte Schiene (8), die einen dritten Schienenlängsabschnitt (9) und ein erstes Ende (10) beinhaltet; eine vierte Schiene (11), die einen vierten Schienenlängsabschnitt (12) und ein zweites Ende (13) beinhaltet, wobei das erste Ende (10) der dritten Schiene (8) und das zweite Ende (13) der vierten Schiene (11) einen Spitzenabschnitt (14) bilden; wobei die erste Flügelschiene (3), die zweite Flügelschiene (6) und der Spitzenabschnitt (14) das Herzstück (15) des abgenutzten Weichenabschnitts (1) bilden;

Entfernen des abgenutzten Weichenabschnitts (1) aus der Eisenbahnlinie oder Straßenbahnlinie;

Anordnen des abgenutzten Weichenabschnitts (1) auf einer Arbeitsfläche (16) in einer Position, die mit einem Genauigkeitsgrad bekannt ist;

Ermitteln von räumlichen Koordinaten der tatsächlichen Spitze (17) des Spitzenabschnitts (14) des Herzstücks (15) des auf der Arbeitsfläche (16) angeordneten abgenutzten Weichenabschnitts (1) und von räumlichen Koordinaten anderer Punkte (18) des auf der Arbeitsfläche (16) angeordneten abgenutzten Weichenabschnitts (1), um ein Profil und eine Position des Spitzenabschnitts (14), der ersten Flügelschiene (3) und der zweiten Flügelschiene (6) auf der Arbeitsfläche (16) zu ermitteln;

Erkennen zumindest eines abgenutzten Bereichs (19) zumindest an dem Spitzenabschnitt (14) des Herzstücks (15) des abgenutzten Weichenabschnitts (1);

Abtragen von Material, automatisch und mittels Fräsverfahren, von einem Arbeitsbereich (110), der zumindest den zumindest einen abgenutzten Bereich (19) enthält;

Auftragen von Schweißmaterial, automatisch und mittels Schweißverfahren, in dem Arbeitsbereich (110) von dem Material durch Fräsen abgetragen wurde.

2. Verfahren nach dem vorhergehenden Anspruch, beinhaltend einen Schritt zum automatischen Durchführen eines Abtragens von Schweißmaterial von dem Arbeitsbereich (110) nach dem Auftragen von Schweißmaterial.
3. Verfahren nach dem vorhergehenden Anspruch, wobei der Schritt des Entferns von Schweißmaterial durch Fräsen ausgeführt wird.
4. Verfahren nach Anspruch 1 oder 2 oder 3, wobei das Fräsen mit Hilfe eines Arms (21) ausgeführt wird, der einen Fräser trägt und von einer Steuereinheit (22) angesteuert wird.
5. Verfahren nach einem der vorhergehenden Ansprüche, wobei der Schritt des Ermittels der räumlichen Koordinaten anderer Punkte (18) des abgenutzten Weichenabschnitts (1) folgende Schritte beinhaltet:

Erfassen der Daten in Bezug auf ein Modell und/oder eine Marke der abgenutzten Weiche des abgenutzten Weichenabschnitts, um das Profil des Spitzenabschnitts (14), der ersten Flügelschiene (3) und der zweiten Flügelschiene (6) zu erhalten; Ermitteln der räumlichen Koordinaten eines ersten Punktes (25) auf der inneren seitlichen Oberfläche (26) des ersten Schienenlängsabschnitts (4); Ermitteln der räumlichen Koordinaten eines zweiten Punktes (27) auf der inneren seitlichen Oberfläche (28) des zweiten Schienenlängsabschnitts (7); Ermitteln der räumlichen Koordinaten eines dritten Punktes (29) auf der äußeren seitlichen Oberfläche (30) des dritten Schienenlängsabschnitts (9)

- oder auf der äußeren seitlichen Oberfläche (35) des ersten Endes (10) der dritten Schiene (8); Ermitteln der räumlichen Koordinaten eines vierten Punktes (31) auf der äußeren seitlichen Oberfläche (32) des vierten Schienenlängsabschnitts (12) oder auf der äußeren seitlichen Oberfläche (36) des zweiten Endes (13) der vierten Schiene (11);
Ermitteln der räumlichen Koordinaten der theoretischen Spitze (33) aus der Kenntnis der räumlichen Koordinaten des ersten Punktes (25), des zweiten Punktes (27), des dritten Punktes (29) und des vierten Punktes (31).
6. Verfahren nach dem vorhergehenden Anspruch, beinhaltend einen Schritt des Bereitstellens eines Tasters (34), der die Aufnahme der räumlichen Koordinaten eines Punktes ermöglicht, der in Berührung mit dem Taster (34) gelangt; und wobei die räumlichen Koordinaten des ersten Punktes (25), des zweiten Punktes (27), des dritten Punktes (29) und des vierten Punktes (31) mit Hilfe des Tasters (34) erkannt werden.
7. Verfahren nach dem vorhergehenden Anspruch, wobei der Schritt des Ermittlens der räumlichen Koordinaten der tatsächlichen Spitze (17) des Spitzenabschnitts (14) des Herzstücks (15) des auf der Arbeitsfläche (16) angeordneten abgenutzten Weichenabschnitts (1) die folgenden Schritte beinhaltet, die in der nachfolgend aufgeführten Reihenfolge ausgeführt werden: Anordnen des Tasters (34) an den räumlichen Koordinaten einer theoretischen Spitze (33); Bewegen des Tasters (34) zu der tatsächlichen Spitze (17) entlang einer Richtung parallel zu der Längsachse (K) des auf der Arbeitsfläche (16) angeordneten abgenutzten Weichenabschnitts (1), bis der Taster (34) mit einem Punkt des abgenutzten Weichenabschnitts (1) in Berührung gelangt.
8. Verfahren nach dem vorhergehenden Anspruch, beinhaltend einen Schritt zum: Anordnen des Tasters (34) in Berührung mit einem fünften Punkt (37) des zumindest einen abgenutzten Bereichs (19), der sich an dem Spitzenabschnitt (14) des Herzstücks (15) in der Nähe der tatsächlichen Spitze (17) befindet; Aufnehmen eines Höhenwertes des fünften Punktes (37) des zumindest einen abgenutzten Bereichs (19).

Revendications

1. Un procédé de réfection du coeur d'un aiguillage usé, **caractérisé en ce qu'il** comprend les phases consistant à:

sectionner d'une voie de chemin de fer ou de tramway une portion d'aiguillage usé (1) qui comprend : un premier rail (2) comprenant une première patte de lièvre (3) et une première longueur de rail (4) ; un deuxième rail (5) comprenant une deuxième patte de lièvre (6) et une deuxième longueur de rail (7) qui fait face à la première longueur de rail (4) ; un troisième rail (8) comprenant une troisième longueur de rail (9) et une première extrémité (10) ; un quatrième rail (11) comprenant une quatrième longueur de rail (12) et une deuxième extrémité (13), la première extrémité (10) du troisième rail (8) et la deuxième extrémité (13) du quatrième rail (11) formant une pointe de coeur (14) ; la première patte de lièvre (3), la deuxième patte de lièvre (6) et la pointe de coeur (14) formant le coeur (15) de la portion d'aiguillage usé (1) ; enlever la portion d'aiguillage usé (1) de la voie de chemin de fer ou de tramway ; placer la portion d'aiguillage usé (1) sur un plan de travail (16) dans une position qui est connue avec un degré de précision ; identifier les coordonnées spatiales de la pointe réelle (17) de la pointe de coeur (14) du coeur (15) de la portion d'aiguillage usé (1) placée sur le plan de travail (16) et les coordonnées spatiales d'autres points (18) de la portion d'aiguillage usé (1) placée sur le plan de travail (16) de manière à identifier un profil et une position de la pointe de coeur (14), de la première patte de lièvre (3) et de la deuxième patte de lièvre (6) sur le plan de travail (16) ; détecter au moins une zone usée (19) au moins dans la pointe de coeur (14) du coeur (15) de la portion d'aiguillage usé (1) ; enlever de la matière, automatiquement et par fraisage, d'une région de travail (110) qui comprend ladite au moins une zone usée (19) ; ajouter du matériau de soudage, automatiquement et par soudage, dans la région de travail (110) de laquelle de la matière a été enlevée par fraisage.

2. Le procédé selon la revendication précédente, comprenant une phase consistant à exécuter automatiquement un enlèvement de matériau de soudage de la région de travail (110) après que du matériau de soudage a été ajouté.
3. Le procédé selon la revendication précédente, dans lequel la phase d'enlèvement du matériau de soudage est exécutée par fraisage.
4. Le procédé selon la revendication 1 ou 2 ou 3, dans lequel le fraisage est réalisé au moyen d'un bras (21) qui porte une fraise et qui est commandé par une unité de contrôle (22).

5. Le procédé selon l'une quelconque des revendications précédentes, dans lequel la phase consistant à identifier les coordonnées spatiales d'autres points (18) de la portion d'aiguillage usé (1) comprend les phases consistant à : acquérir des données concernant un modèle et/ou marque d'aiguillage usé de la portion d'aiguillage usé de manière à obtenir le profil de la pointe de coeur (14), de la première patte de lièvre (3) et de la deuxième patte de lièvre (6) ; identifier les coordonnées spatiales d'un premier point (25) sur la surface latérale intérieure (26) de la première longueur de rail (4) ; identifier les coordonnées spatiales d'un deuxième point (27) sur la surface latérale intérieure (28) de la deuxième longueur de rail (7) ; identifier les coordonnées spatiales d'un troisième point (29) sur la surface latérale extérieure (30) de la troisième longueur de rail (9) ou sur la surface latérale extérieure (35) de la première extrémité (10) du troisième rail (8) ; identifier les coordonnées spatiales d'un quatrième point (31) sur la surface latérale extérieure (32) de la quatrième longueur de rail (12) ou sur la surface latérale extérieure (36) de la deuxième extrémité (13) du quatrième rail (11) ; obtenir les coordonnées spatiales de la pointe mathématique (33) sur la base de la connaissance des coordonnées spatiales du premier point (25), du deuxième point (27), du troisième point (29) et du quatrième point (31).
6. Le procédé selon la revendication précédente, comprenant une phase consistant à prévoir une pointe de palpeur (34) qui permet d'acquérir les coordonnées spatiales d'un point qui entre en contact avec cette même pointe de palpeur (34) ; et dans lequel les coordonnées spatiales du premier point (25), du deuxième point (27), du troisième point (29) et du quatrième point (31) sont identifiées au moyen de la pointe de palpeur (34).
7. Le procédé selon la revendication précédente, dans lequel la phase consistant à identifier les coordonnées spatiales de la pointe réelle (17) de la pointe de coeur (14) du coeur (15) de la portion d'aiguillage usé (1) placée sur le plan de travail (16) comprend les phases suivantes qui ont lieu l'une à la suite de l'autre comme suit : porter la pointe de palpeur (34) au niveau des coordonnées spatiales d'une pointe mathématique (33) ; déplacer la pointe de palpeur (34) vers la pointe réelle (17), le long d'une direction parallèle à l'axe longitudinal (K) de la portion d'aiguillage usé (1) placée sur le plan de travail (16), jusqu'à ce que la pointe de palpeur (34) entre en contact avec un point de la portion d'aiguillage usé (1).
8. Le procédé selon la revendication précédente, comprenant une phase consistant à : porter la pointe de palpeur (34) en contact avec un cinquième point (37)

de ladite au moins une zone usée (19) qui se trouve au niveau de la pointe de coeur (14) du coeur (15) à proximité de la pointe réelle (17) ; acquérir une valeur de hauteur du cinquième point (37) de ladite au moins une zone usée (19).

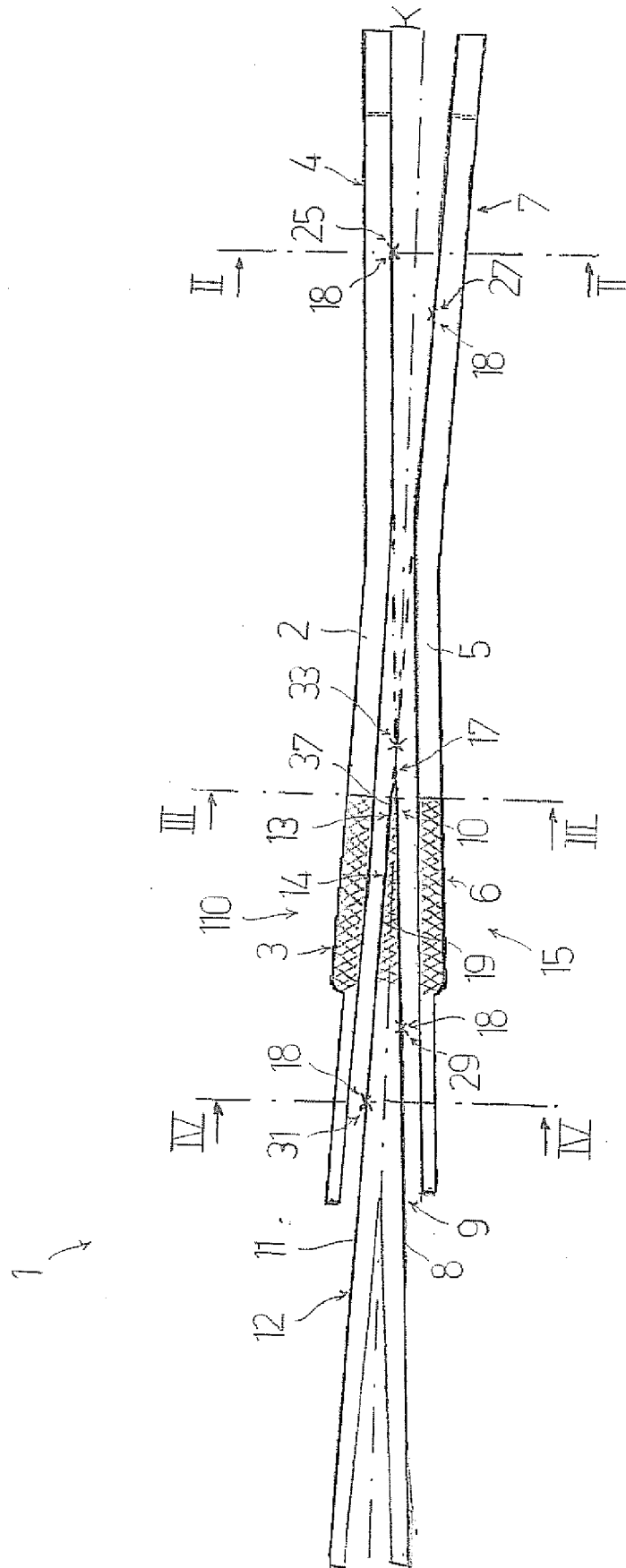


FIG1

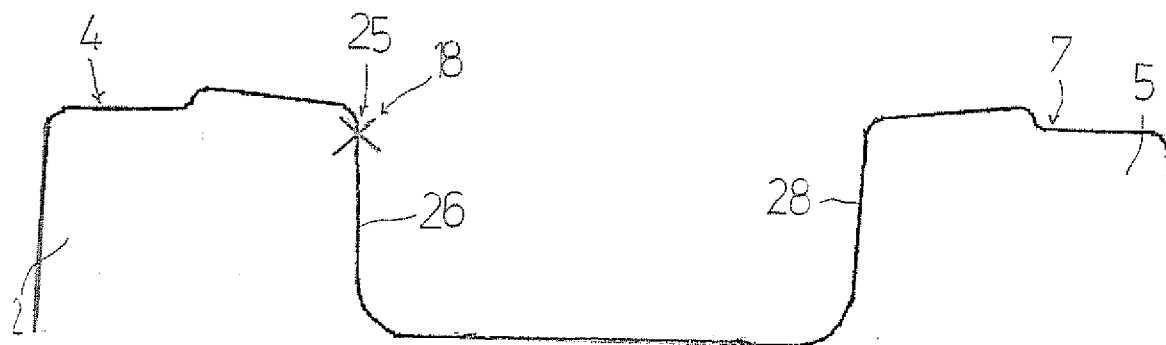


FIG 2

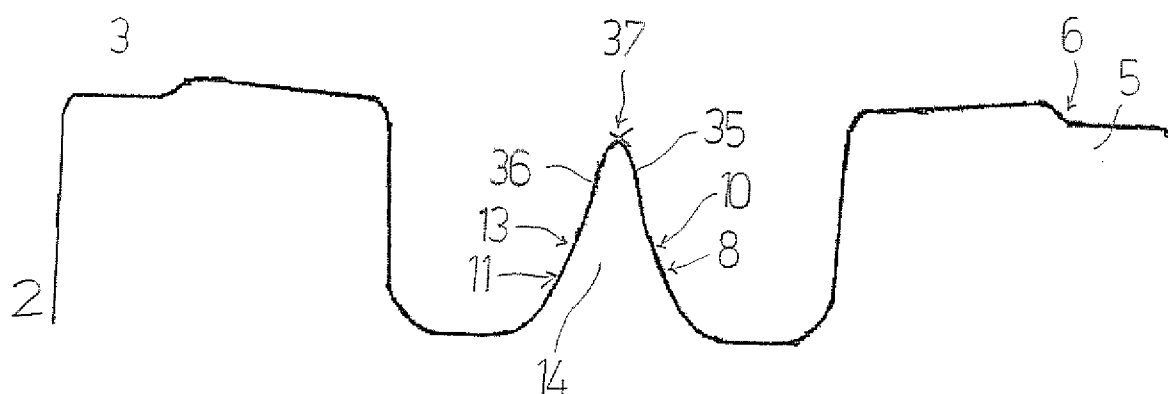


FIG 3

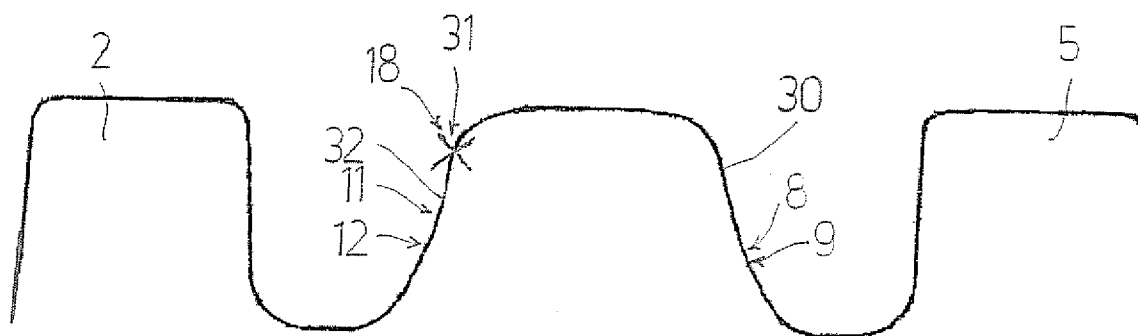
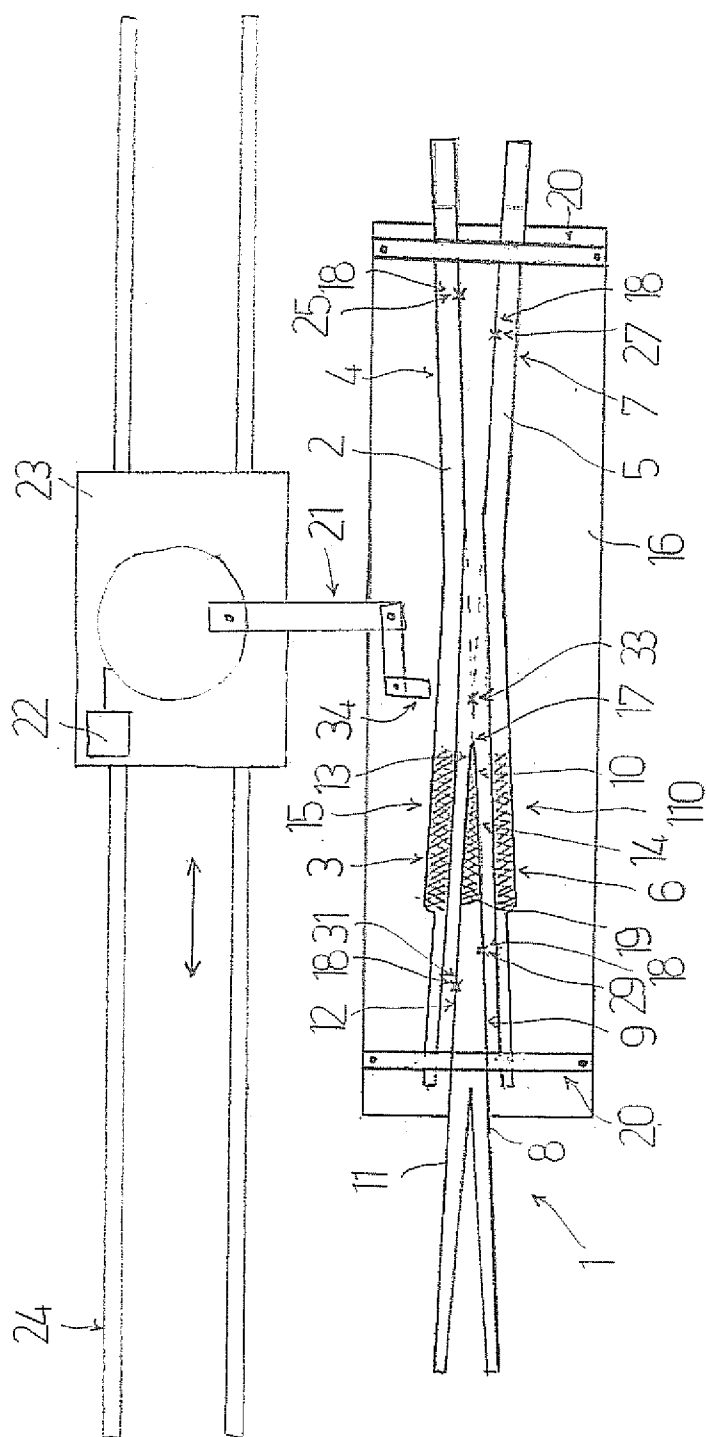


FIG 4



REFERENCES CITED IN THE DESCRIPTION

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EP 2 862 978

ELJÁRÁS KOPOTT VASÚTI KITÉRŐ KERESZTEZÉSI KÖZÉPRÉSZÉNEK FELÚJÍTÁSÁRA

Szabadalmi igénypontok

1. Eljárás kopott vasúti kitérő keresztezési középrészének felújítására, **azzal jellemezve, hogy a következő lépéseket tartalmazza:**

leválasztjuk egy vasútvonalról vagy villamosvonalról a kopott kitérőrészt (1), amely magában foglal: egy első sánt (2), amely egy első könyöksínből (3) és egy első sínszakaszból (4) áll; egy második sánt (5), amely egy második könyöksínből (6) és egy második sínszakaszból (7) áll, amely az első sínszakasszal (4) szemben helyezkedik el; egy harmadik sánt (8), amely egy harmadik sínszakaszból (9) és egy első végből (10) áll; egy negyedik sánt (11), amely egy negyedik sínszakaszból (12) és egy második végből (13) áll, a harmadik sín (8) első vége (10) és a negyedik sín (11) második vége (13) csúcsrészt (14) alkot; az első könyöksín (3), a második könyöksín (6) és a csúcsrész (14) képezi a kopott vasúti kitérőrész (1) keresztezési középrészét (15);

eltávolítjuk a kopott vasúti kitérőrészt (1) a vasútvonalból vagy villamosvonalból;

elhelyezzük a kopott vasúti kitérőrészt (1) egy munkafelületen (16) pontosan ismert helyzetben;

meghatározzuk a munkafelületen (16) elhelyezett kopott vasúti kitérőrész (1) keresztezési középrészén (15) a csúcsrész (14) tényleges csúcsának (17) térbeli koordinátáit és a munkafelületen (16) elhelyezett kopott vasúti kitérőrész (1) más pontjainak (18) térbeli koordinátáit, hogy megállapítsuk a csúcsrész (14), az első könyöksín (3) és a második könyöksín (6) profilját és helyzetét a munkafelületen (16);

észlelünk legalább egy kopott területet (19) a kopott vasúti kitérőrész (1) keresztezési középrészének (15) legalább a csúcsrészén (14);

anyagot távolítunk el, automatikusan és marással, egy munkaterületről (110),

amely magában foglalja a legalább egy kopott területet (19);

hegesztőanyagot hordunk fel, automatikusan és hegesztéssel, a munkaterületen (110), ahonnan marással anyagot távolítottunk el.

2. Az előző igénypont szerinti eljárás, amely tartalmazza azt a lépést, hogy automatikusan hegesztőanyagot távolítottunk el a munkaterületről (110) a hegesztőanyag felhordása után.

3. Az előző igénypont szerinti eljárás, amelyben a hegesztőanyag eltávolításának lépését marással hajtjuk végre.

4. Az 1. vagy 2. vagy 3. igénypont szerinti eljárás, amelyben a marást egy karral (21) végezzük, amely marót hordoz, és amelyet egy vezérlőegység (22) vezérel.

5. Az előző igénypontok bármelyike szerinti eljárás, amelynél az a lépés, amelyben meghatározzuk a kopott vasúti kitérőrész (1) más pontjainak (18) térbeli koordinátáit, a következő lépéseket tartalmazza: adatokat gyűjtünk a kopott vasúti kitérőrész kopott vasúti kitérőjének modelljére és márkájára vonatkozóan, hogy megkapjuk a csúcsrész (14), az első könyöksín (3) és a második könyöksín (6) profilját; meghatározzuk egy első pont (25) térbeli koordinátáit az első sínszakasz (4) belső oldalfelületén (26); meghatározzuk egy második pont (27) térbeli koordinátáit a második sínszakasz (7) belső oldalfelületén (28); meghatározzuk egy harmadik pont (29) térbeli koordinátáit a harmadik sínszakasz (9) külső oldalfelületén (30) vagy a harmadik sín (8) első végének (10) külső oldalfelületén (35); meghatározzuk egy negyedik pont (31) térbeli koordinátáit a negyedik sínszakasz (12) külső oldalfelületén (32) vagy a negyedik sín (11) második végének (13) külső oldalfelületén (36); meghatározzuk az elméleti csúcs (33) térbeli koordinátáit az első pont (25), a második pont (27), a harmadik pont (29) és a negyedik pont (31) térbeli koordinátáinak

ismeretéből.

6. Az előző igénypont szerinti eljárás, amely tartalmazza azt a lépést, hogy egy tapintócsúcsot (34) alkalmazunk, amely lehetővé teszi a tapintócsúccsal (34) érintkezésbe kerülő pont térbeli koordinátáinak felvételét; továbbá az első pont (25), a második pont (27), a harmadik pont (29) és a negyedik pont (31) térbeli koordinátáit a tapintócsúcs (34) segítségével határozzuk meg.

7. Az előző igénypont szerinti eljárás, amelynél az a lépés, amelyben meghatározzuk a munkafelületen (16) elhelyezett kopott vasúti kitérőrész (1) keresztezési középrészén (15) a csúcsrész (14) tényleges csúcsának (17) térbeli koordinátáit, a következő lépéseket tartalmazza a következő sorrendben: a tapintócsúcsot (34) egy elméleti csúcs (33) térbeli koordinátáira állítjuk; a tapintócsúcsot (34) a tényleges csúcs (17) felé mozgatjuk a munkafelületen (16) elhelyezett kopott vasúti kitérőrész (1) hossz-tengelyével (K) párhuzamos irányban, amíg a tapintócsúcs (34) érintkezésbe kerül a kopott vasúti kitérőrész (1) egy pontjával.

8. Az előző igénypont szerinti eljárás, amely tartalmazza a következő lépést: a tapintócsúcsot (34) érintkezésbe hozzuk a legalább egy kopott terület (19) egy ötödik pontjával (37), amely a keresztezési középrész (15) csúcsrészén (14) a tényleges csúcs (17) közelében van; felvesszük a legalább egy kopott terület (19) ötödik pontjának (37) magassági értékét.