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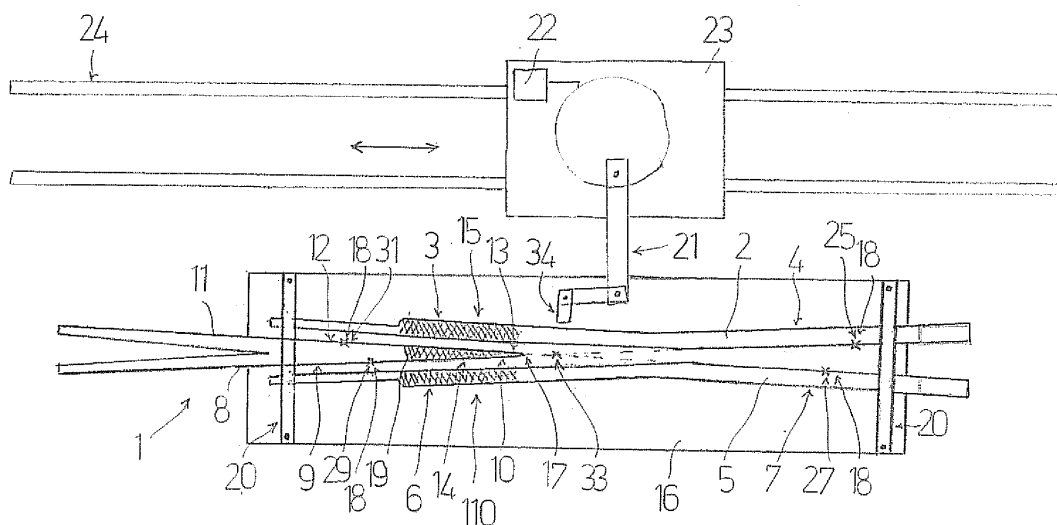
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(54) A method for regenerating a frog of a worn railway switch

(57) 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 of the frog (14); the first wing rail (3), the second wing rail (6) and the point of the frog (14) forming 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.

**FIG 5****EP 2 862 978 A1**

Description

[0001] The present invention relates to the technical sector concerning regeneration of frogs on worn railroad or tramway switches.

[0002] It is known that in a switch the part most subject to wear is the frog, which is formed by a point of the frog, 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 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 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 point (also known as the "material point") of the point 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 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 point, it can be difficult or even impossible to extrapolate the exact position of the actual point: in fact, the effective coordinates of the actual point of a worn switch can even

considerable deviate (for example by a few millimetres) from the theoretical coordinates of the actual point 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 point is not precisely detected, and if the worn area is identifiable, as often happens, at the point of the frog, the material removal steps from the work region and addition of welding material by welding can be imprecise or even wrong.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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 of the frog (14).

[0019] The first wing rail (3), the second wing rail (6) and the point of the frog (14) forming the frog (15) of the portion of worn railroad switch (1).

[0020] 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 point (17) 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 of the frog (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 of the frog (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.

[0021] 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.

[0022] 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).

[0023] 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).

[0024] 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.

[0025] The work plane (16) can be situated in an equipped workshop or area away from the railroad line or tramway.

[0026] 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 coordinates of the actual point (17)) of the portion of worn switch (1) so as to identify, with millimetric precision, the profile and position of the point of the frog (14), 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.

[0027] 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 point (17) of the point of the frog (14) 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.

[0028] 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.

[0029] The step of removing welding material is preferably performed by milling.

[0030] 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.

[0031] 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).

[0032] 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).

[0033] 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 of the frog (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).

[0034] 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.

[0035] 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).

[0036] 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).

[0037] 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).

[0038] 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).

[0039] 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).

[0040] The step of identifying the spatial coordinates of the actual point (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 point (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); this point will correspond to the actual point (17) and the spatial coordinates thereof will be acquired.

[0041] 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

point (17) starting from the theoretical point (33).

[0042] 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 of the frog (14) in proximity of the actual point (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.

[0043] 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 of the frog (14); the first wing rail (3), the second wing rail (6) and the point of the frog (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 point (17) 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 of the frog (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 of the frog (14) 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 of the frog (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

point (17) 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) 5 towards the actual point (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). 10

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 of the frog (14) in proximity of the actual point (17); acquiring a height value of the fifth point (37) of the at least a worn area (19). 15

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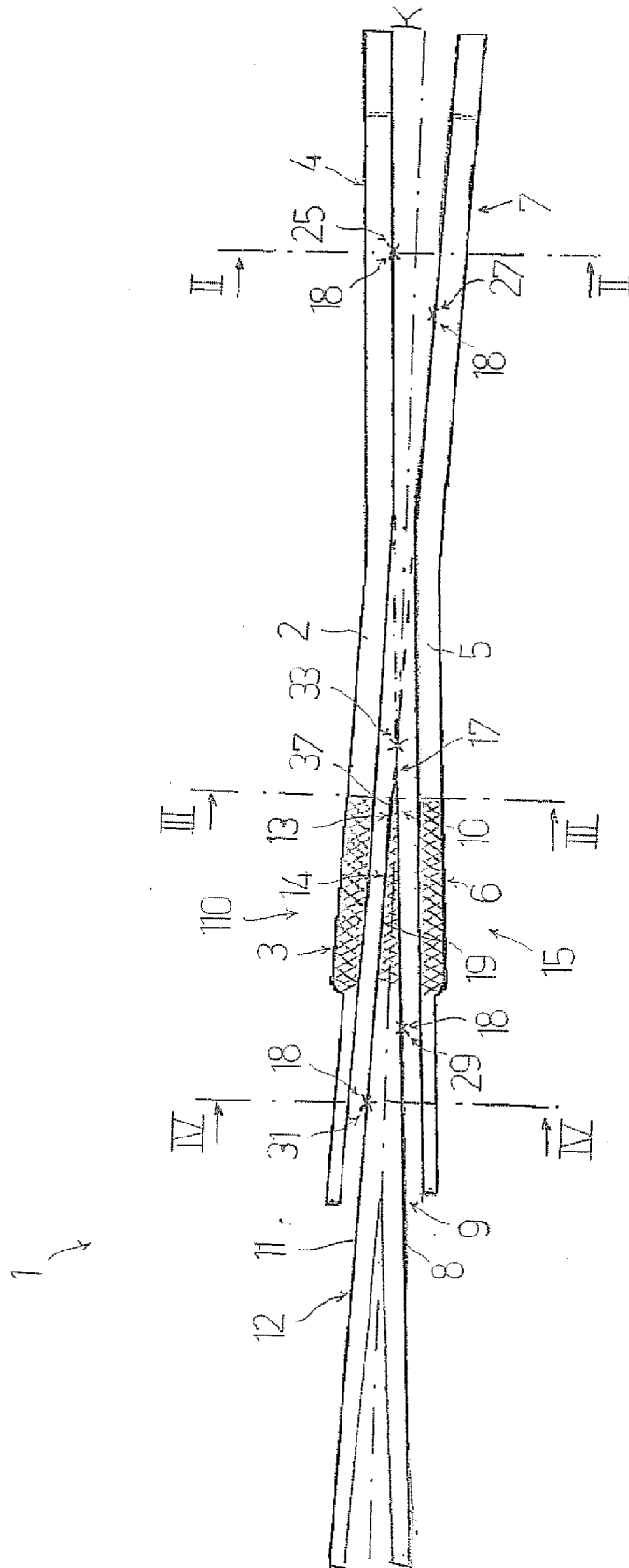


FIG1

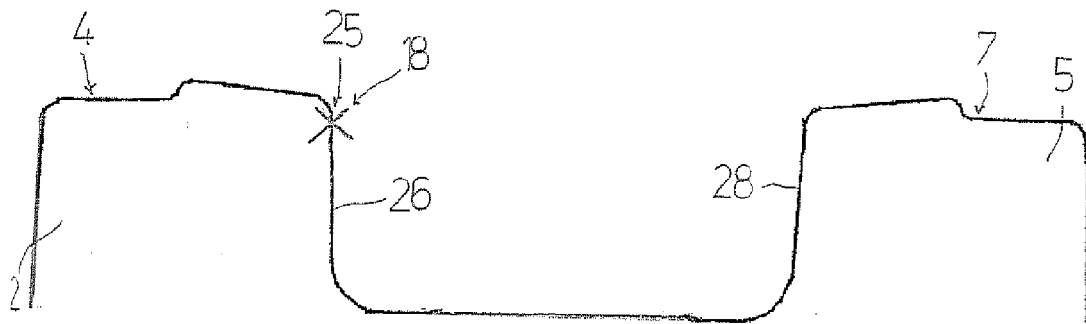


FIG 2

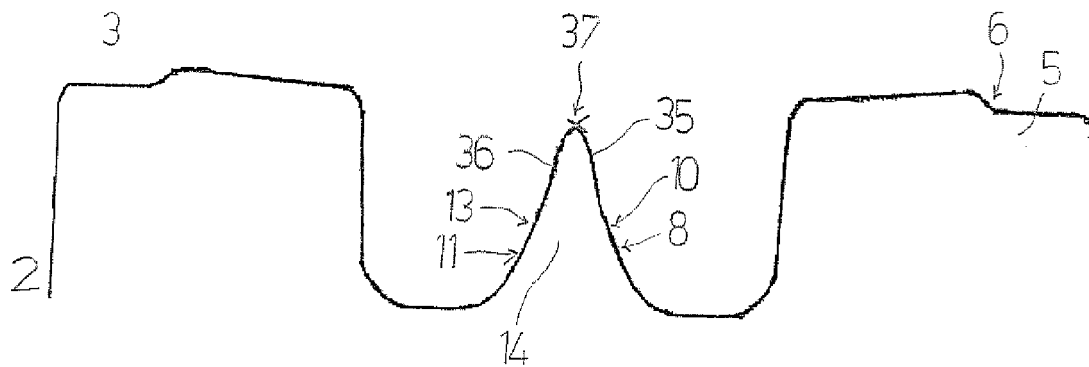


FIG 3

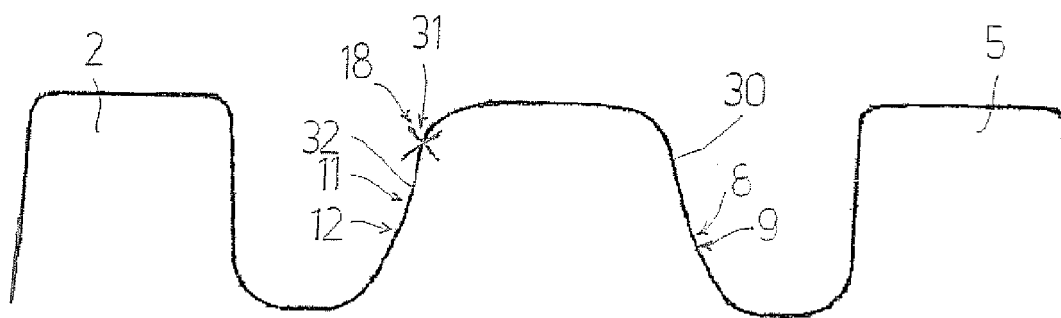


FIG 4

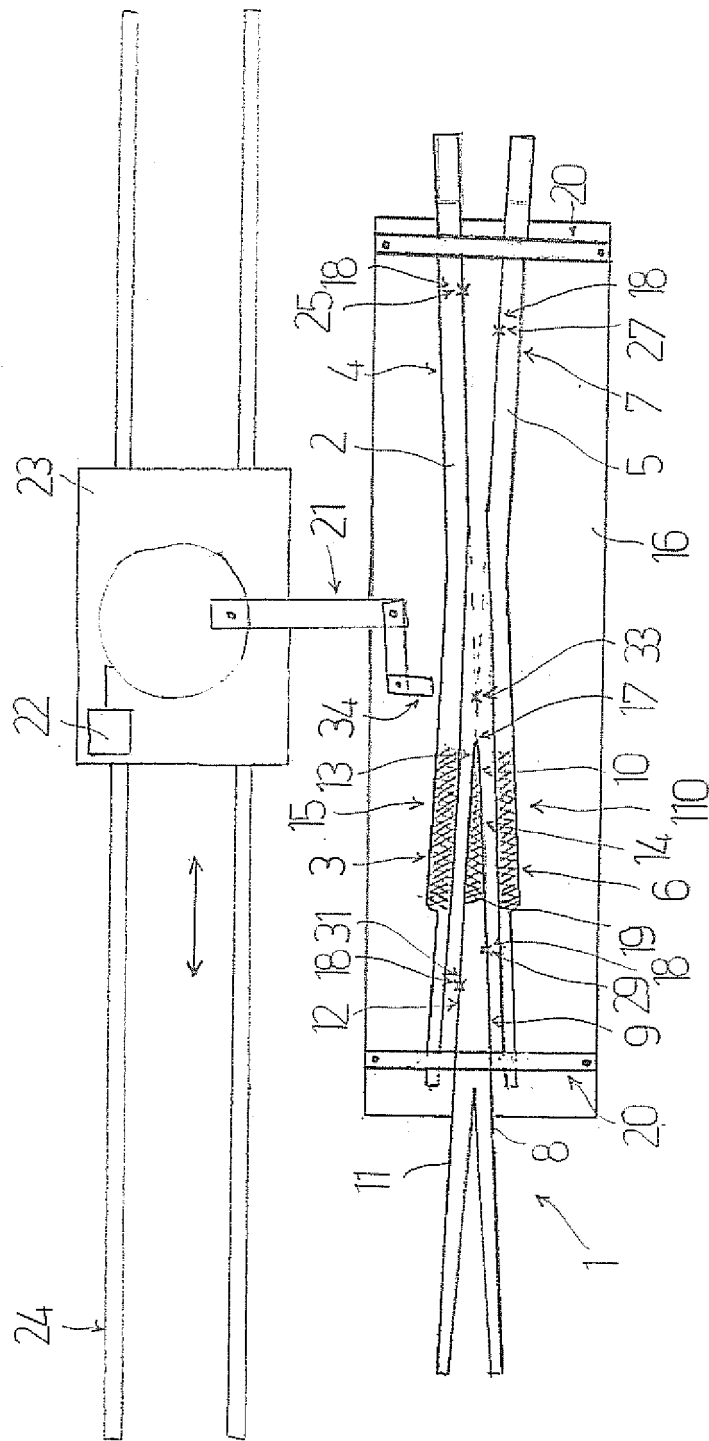


FIG 5



EUROPEAN SEARCH REPORT

Application Number
EP 14 18 9198

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 December 2014	Examiner Lorandi, Lorenzo
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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