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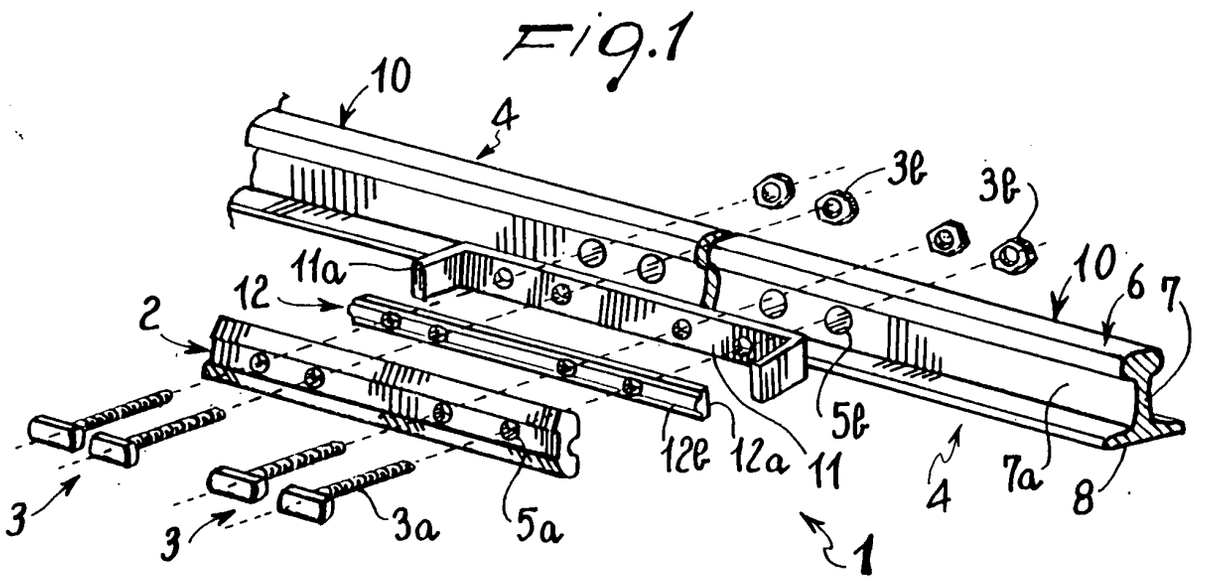
(54) Apparatus and process for electrically joining rail sections

(57) It is provided at least one fish-plate (2) adapted to directly engage ends of rails (4) disposed close to each other and to delimit at least one space (9) together with said rails, mechanical means (3) for tightening the fish-plate (2) to the rails (4) and electrical connection elements comprising at least one conductive element (11) placed in the space (9) between the fish-plate (2) and the rails (4) and susceptible of engagement with the rails (4) by the same mechanical tightening system to be used for the fish-plate (2), between the conductive element (11) and the fish-plate (2) being also interposed an elastically deformable pressure body (12) to enable the mechanical tightening intensity of the fish-plate (2) to be at least partly independent of the tightening intensity of the conductive element (11).

Fig.1



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Description

[0001] The invention relates to an apparatus and a process for joining together consecutive rails or rail sections, being in particular part of the tracks of a railway line, under conditions of electrical continuity, as defined in the preamble of claim 1.

[0002] It is known that tracks for railway lines — as well as for tramlines, carriages, bridge cranes, etc. — consist of aligned rails, or parts thereof (rail sections) connected with each other along two parallel lines.

[0003] Union between the ends of two consecutive rails and/or rail sections can be obtained in two ways: by welding with the aluminothermic method or the electric flash method, or by application of appropriate fish-plates, tightened by screw elements known as "fish-bolts".

[0004] While the aluminothermic or electric flash welding, where possible, is the best solution to give an electrical and mechanical continuity to rails, under many situations use of junctions utilising said fish-plates is required.

[0005] For example this happens during the works for track renewal, in the so-called expansion-compensating junctions, in temporary junctions, sometimes in the railway parks and in secondary tracks, etc.

[0006] Union between two consecutive rails, in particular on railway lines, does not only require a mechanical continuity, but an efficient electrical continuity is to be obtained as well between the same.

[0007] In the case of junctions with fish-plates, there is a separation between the rails, also to allow thermal expansions, and therefore the electrical continuity is to be obtained by means of special devices, because the fish-plates alone are unable to ensure it.

[0008] In fact, the fish-plates only have the task of making junctions of the mechanical type and usually are bad electricity conductors and sometimes they are even electrically insulated.

[0009] The solution that is generally adopted to obtain a satisfactory electrical continuity is that of connecting the immediately consecutive ends of the rails or rail sections by means of copper cables or plaits of appropriate section.

[0010] The two ends of the copper plaits are fastened to the two rails upstream and downstream of each fish-plate through several different devices.

[0011] For example, the ends of the copper plaits are inserted into hollow copper cylinders, in turn inserted in appropriate holes formed in the rails close to the region in engagement with the fish-plate; or the plait ends are directly locked by forced fitting in said holes through wedge-shaped pins (named "olive"). In accordance with another method the plait ends are fastened to terminals that are anchored and tightened to the rail flange.

[0012] Other devices are possible and new solutions are always under consideration, since effectiveness, functional capacity and reliability of the electric connection practically depend on said devices.

[0013] By way of example the technical solutions highlighted in the European patents EP 0328946, EP 0338466, EP 0878034 are mentioned, all of them concerning systems for fastening plaits or cables to mutually consecutive rails.

[0014] In short, use of fish-plates to make two consecutive rails or rail sections integral with each other is in many cases substantially required, but the combined use of fish-plates and electric connections by means of plaits, cables or the like is often unsatisfactory under different points of view.

[0015] In particular, said combination involves use of many elements that must be manufactured, made available and individually applied, this being time-consuming and requiring use of many resources and a lot of manpower.

[0016] In addition, the electric connections mentioned above are bulky as they make it difficult to carry out the track-ridging operations with semiautomatic earthmoving machines (graders, ridgers, forming machines), said machines often cutting the connections themselves or causing separation of same from the rails.

[0017] Then a complete exposure of the copper cables and plaits to the weather and generally to the external environment inevitably giving rise to formation of oxides, can cause a decay in the initial electrical conductivity, which decay often cannot be detected immediately.

[0018] Generally, said means for ensuring the electrical continuity which are made of a great number of elements are also unsatisfactory in terms of sturdiness, duration and assembling and servicing times.

[0019] Under this situation, the technical task underlying the present invention is to devise an apparatus and a process capable of substantially obviating the mentioned drawbacks.

[0020] Within the scope of this technical task it is an important aim of the invention to devise an apparatus and a process particularly adapted for application to a railway line, in the presence of use of fish-plates to join consecutive rails together.

[0021] The mentioned technical task is achieved by an apparatus and a process for joining consecutive rails or rail sections under conditions of electrical continuity, as claimed in the appended independent claims.

[0022] Preferred embodiments are detailed in the dependent claims.

[0023] Description of a preferred embodiment of the invention is now taken hereinafter with the aid of the accompanying drawings, in which:

- **Fig. 1** is a perspective exploded view of the apparatus in accordance with the invention, placed close to two rails to be joined to each other; and
- **Fig. 2** is a section view of the apparatus in accordance with the invention, applied to an end of a rail.

[0024] With reference to the drawings, the apparatus in accordance with the invention is generally identified by reference numeral **1**.

[0025] It comprises, in a manner known by itself, at least one fish-plate **2** to be assembled with rails **4** through mechanical tightening means **3**, preferably consisting of the so-called fishbolts. The fishbolts are screw elements comprising a threaded bar **3a** and a nut **3b**.

[0026] Shown in Fig. 1 is the simplest embodiment, with a single fish-plate 2, whereas in Fig. 2 a standard embodiment is shown which consists of two fish-plates 2 tightening the ends of two rails 4 on opposite sides through fishbolts 3. In addition, shown in Fig. 1 are four fishbolts passing through holes **5a** and **5b** formed through the fish-plates 2 and rails 4, respectively.

[0027] The illustrated rails 4 are of the type used in railway lines. Each of them, seen in section, has a widened upper portion called head **6**, on which the vehicle wheels rest, an intermediate thin portion that is particularly extended in height, called web, **7** and a widened lower portion called flange **8**.

[0028] The web 7 has two side faces **7a** of a substantially vertical extension forming, as a whole, the surface portion of rails 4 substantially having the greatest width.

[0029] The head 6 and flange 8 have surface sections mutually converging towards the web side faces 7a to which they are contiguous.

[0030] In particular, on each side of rails 4 seen in section it is possible to distinguish an upper convergence section **6a,** on head 6, and a lower convergence section **8a,** on flange 8.

[0031] The fish-plates 2 are provided to be wedge-like fitted between the convergence sections 6a, 8a, thereby establishing a direct and forced contact therewith, while keeping a position spaced apart from web 7.

[0032] Practically the fish-plates 2 and web 7 delimit spaces 9 therebetween, as shown in Fig. 2.

[0033] The immediately consecutive rails 4 are usually in side by side relationship, while maintaining a small space, called laying clearance, allowing thermal expansion in a longitudinal direction; for electrically connecting the consecutive rails 4 with each other, in spite of said space, provision is made for electrical connection elements placed close to the fish-plates 2.

[0034] These electrical connection elements comprise at least one conductive element **11** or two conductive elements 11, each of which is disposed in a space 9 and is in engagement with rails 4, in contact relationship therewith through mechanical tightening of the fish-plates 2.

[0035] In more detail, each conductive element 11 consists of a thin plate made of copper for example or another conductive material, such sized and positioned that it engages at least one major portion of a side face 7a of web 7 by contact. Then tabs **11a** of the same material as the thin plate are disposed at the sides of the thin plate 11 itself and they project and are bent to a T-shaped configuration so as to embrace a fish-plate 2 on opposite sides.

[0036] Preferably interposed between one conductive element 11 and the relevant fish-plate 1 is at least one pressure body **12**.

[0037] As shown in Fig. 2 the pressure body 12 has a first work surface **12a** the shape of which matches that of the thin plate 11 and a second work surface **12b** the shape of which matches that of the fish-plate 2.

[0038] The pressure body 12 is preferably elastically deformable and is made of plastic material or an appropriate elastomer material.

[0039] Both the thin plate 11 and pressure body 12 are provided with holes adapted to be brought into alignment with said holes 5a and 5b formed in the fish-plate 2 and rails 4 respectively, to enable passage of fishbolts 3.

[0040] In addition a conductive compound also having an antioxidant effect can be interposed between the conductive element 11 and rails 4.

[0041] Use of the apparatus is as follows.

[0042] The fish-plates 2 and conductive elements 11 can be mounted on rails 4 by aligning said holes and inserting the fishbolts 3 thereinto.

[0043] The pressure bodies 12 too can be inserted together with the conductive elements 11 after arrangement of the respective holes to a position in alignment with the holes in rails 4.

[0044] Assembling is promoted by the presence of the tabs 11 a at the sides of the conductive elements 11, said tabs embracing and positioning all the elements that must be fastened by means of said fishbolts 3.

[0045] Said fishbolts 3 are screwed down by dynamometric wrenches so as to obtain the most appropriate tightening action from the point of view of the mechanical engagement of the fishbolts 2 on the convergence sections 6a, 8a of consecutive rails 4.

[0046] Due to said tightening, the conductive elements 11 adhere under pressure to the side faces 7a of webs 7, so as to ensure an excellent electrical continuity.

[0047] When, as in the preferred case herein illustrated, the pressure bodies 12 exist and are made of elastically deformable material, locking under pressure of the conductive elements 11 does not interfere with the mechanical locking of the consecutive rails 4 and does not condition it.

[0048] In fact the resiliency of the pressure bodies 12 allows the mechanical-tightening parameters to be freely varied within wide margins.

[0049] The invention teaches a new process for giving electrical continuity to consecutive rails, or parts thereof (rail sections) being part of a railway line in which said rails are joined together by fish-plates.

[0050] This process involves the steps of inserting at least one conductive element between the rails and fish-plates during the assembling step and pressing said conductive element by means of the same tightening action carried out on the fish-plates.

[0051] It is then also provided that the mechanical rail

tightening be at least partly independent, in terms of intensity, of the pressure exerted on the conductive element.

[0052] In fact a direct contact of the fish-plates with the rails at said convergence sections is arranged, with formation of a free space between the rail web and the fish-plates. In this space both the conductive element and at least one substantially elastic pressure body are inserted. The pressure body is placed between the conductive element and the respective fish-plate and elastic deformation of same is caused so that mechanical tightening between the fish-plates and rails is not hindered.

[0053] The invention allows important advantages to be achieved.

[0054] In fact, due to the high contact surface, an excellent electrical continuity is obtained and also, due to the protected position of the conductive elements, a more reduced decay of the electrical continuity value in time.

[0055] Since the conductive elements once assembled are not accessible, possible damages resulting from use of heavy duty machinery for the operations concerning track maintenance are avoided.

[0056] The devised technical solution is also simple, of quick and easy application and reduced costs. In particular assembling can be also carried out by unskilled staff provided with the only instruments currently used for tightening of the fishbolts. Practically, it is only sufficient to lock the fish-plates in a suitable manner: in the presence of said elastically deformable pressure bodies, the contact under pressure of the conductive element is in any case optimal. In addition squashing of the conductive element does not hinder the mechanical tightening of the fish-plates.

[0057] As a result of the above, the intervention time when two rails or parts thereof are required to be connected is surely more reduced than with the prior art systems. The devised technical solution is also advantageous under other important aspects such as safety of the whole railway line: in fact in case of strong untightening or breakage — due to accidental reasons — of the fish-plates joining the rails, and therefore in case of risk of separation of the rails themselves, also a reduction or breaking of the electric signal occurs due to a concurrent detachment of the conductive elements.

[0058] It is therefore possible to check the unimpaired state of the mechanical junctions between the rails at least partly, through simple controls carried out on the intensity of the electric signal.

[0059] It is then to be pointed out that contact between the rail web and the conductive element is maintained substantially clean by the vibrations due to passage of the trains.

[0060] These vibrations in fact, as a result of the presence of said elastically deformable pressure body elastically pressing the conductor element against the rails, give rise to a small repeated forced rubbing between the faced surfaces of the rails and of the conductive element.

[0061] Said small rubbing actions carried out under strong pressures cause removal of possible deposits of oxide or other substances that can reduce current passage. Practically, the structure as made appears to be "self-cleaning".

[0062] The invention is susceptible of modifications and variations.

[0063] For example, the conductive elements can be differently shaped and sized and can also appear like a network, a grid or a plurality of copper plaits.

[0064] The pressure bodies too can be differently structured and also combined in a substantially stable manner with the conductive elements.

[0065] For example, the conductive elements may consist of a plurality of elements in engagement by restrained fixing with the pressure bodies and projecting therefrom.

Claims

1. An apparatus to join consecutive rails or rail sections together under conditions of electrical continuity, comprising: at least one fish-plate (2) adapted to engage ends of rails (4) or rail sections disposed close to each other, mechanical-tightening means (3) for said fish-plate (2) and electrical-connection elements extending between said rails (4), **characterised in that** said electrical-connection elements comprise at least one conductive element (11) placed between said fish-plate (2) and said rails (4), and **in that** engagement of said conductive element (11) with said rails (4) takes place through mechanical tightening of said fish-plate (2).

2. An apparatus as claimed in claim 1, wherein at least one elastically-deformable pressure body (12) is interposed between said conductive element (11) and fish-plate (2).

3. An apparatus as claimed in claim 1, wherein said rails comprise a widened upper portion called head (6), a widened lower portion called flange (8) and a thin intermediate portion called web (7), and wherein said conductive element (11) is placed in contact with said web (7).

4. An apparatus as claimed in claim 3, wherein said fish-plate (2) directly engages said rails (4) at said head (6) and said flange (8) and delimits a space (9) together with said web (7), said conductive element (11) being inserted in said space (9).

5. An apparatus as claimed in claim 4, wherein in said space (9) between said conductive element (11) and fish-plate (2) at least one elastically-deformable pressure element (12) is inserted.

6. An apparatus as claimed in claim 5, wherein said pressure body (12) has a first work surface (12a) matching said conductive element (11) and a second work surface (12b) the shape of which substantially matches said fish-plate (2).

7. An apparatus as claimed in claim 1, wherein said conductive element (11) is substantially a thin plate.

8. An apparatus as claimed in claim 7, wherein said thin plate at its ends has projecting tabs (11 a) that are such bent as to embrace a respective fish-plate (2) on opposite sides thereof.

9. An apparatus as claimed in claim 2, wherein said mechanical-tightening means (3) comprises a plurality of screw elements and wherein said conductive element (11), pressure body (12) and fish-plate (2) have a plurality of holes adapted to be mutually aligned to allow passage of said screw elements.

10. A process for joining consecutive rails or rail sections together under conditions of electrical continuity, in the presence of at least one fish-plate adapted to join rails consecutive to each other and of mechanical means for tightening said fish-plate to said rails, the process being **characterised in that** it consists in inserting at least one conductive element between said rails and fish-plate, and in pressing said conductive element on said rails by mechanical tightening of said fish-plate.

11. A process as claimed in claim 10, wherein said fish-plate is set in a manner adapted to directly engage said rails and to define a space therewith, and wherein said conductive element is inserted in said space.

12. A process as claimed in claim 11, wherein the intensity of the mechanical tightening of said fish-plate to said rails and the tightening intensity of said conductive element, housed in said space, to said rails are made at least partly independent of each other by interposition of an elastically deformable pressure body between said conductive element and fish-plate.

Fig.1

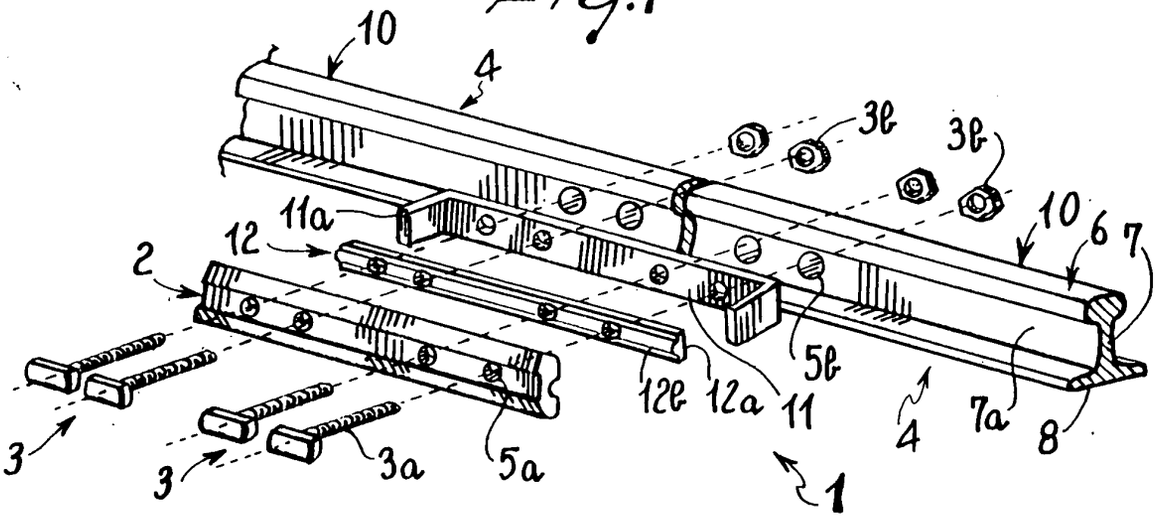
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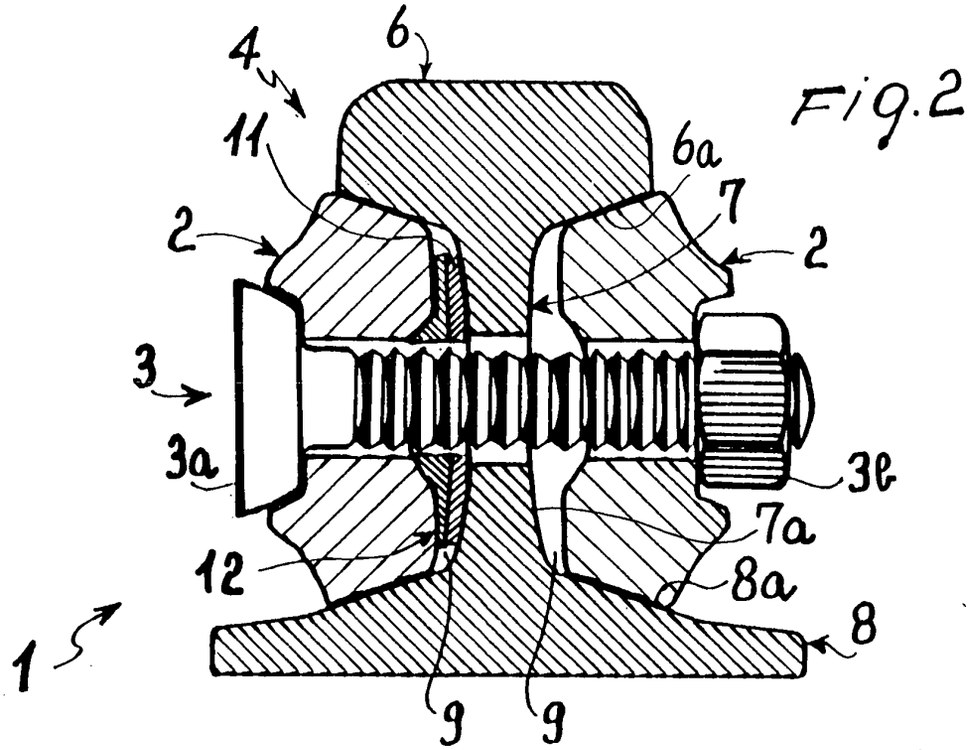
Fig.2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