(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 223 247 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.07.2002 Bulletin 2002/29

(51) Int Cl.[7]: **E01B 31/18**, H05B 3/00

(21) Application number: **01200076.6**

(22) Date of filing: **11.01.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **Strukton Railinfra b.v.**
3606 AL Maarssen (NL)

(72) Inventors:
- **Braaksma, Egbert**
  3708 GE Zeist (NL)
- **Den Decker, Jozias Andreas Pieter**
  3432 XZ Nieuwegein (NL)

(74) Representative: **Metman, Karel Johannes**
De Vries & Metman
Overschiestraat 180
1062 XK Amsterdam (NL)

(54) Method and apparatus for prestressing rails by electrical heating and method of laying rails

(57) In a method for heating rails by means of electric current, a current source (1) is connected to two rails (B, C), in such a manner that the rails are connected in series. Then a current is led through the rails and the rails are heated to a desired temperature. The heating of the rails (B, C) by means of a series connection is followed by heating of the rails by means of a parallel connection thereof. This method is used for prestressing rails when laying rails in a track, in such a manner that the rails will be at least substantially stressless at a neutral temperature. The invention also comprises an apparatus for heating rails (B, C) by means of electric current, which apparatus includes a current source (1), conductors (2 - 4, 6) as well as connecting elements (5) for connecting said conductors to the rails. Said conductors (2 - 4, 6) and said connecting elements (5) are arranged for successively connecting the current source (1) in series and in parallel to the rails (B, C).

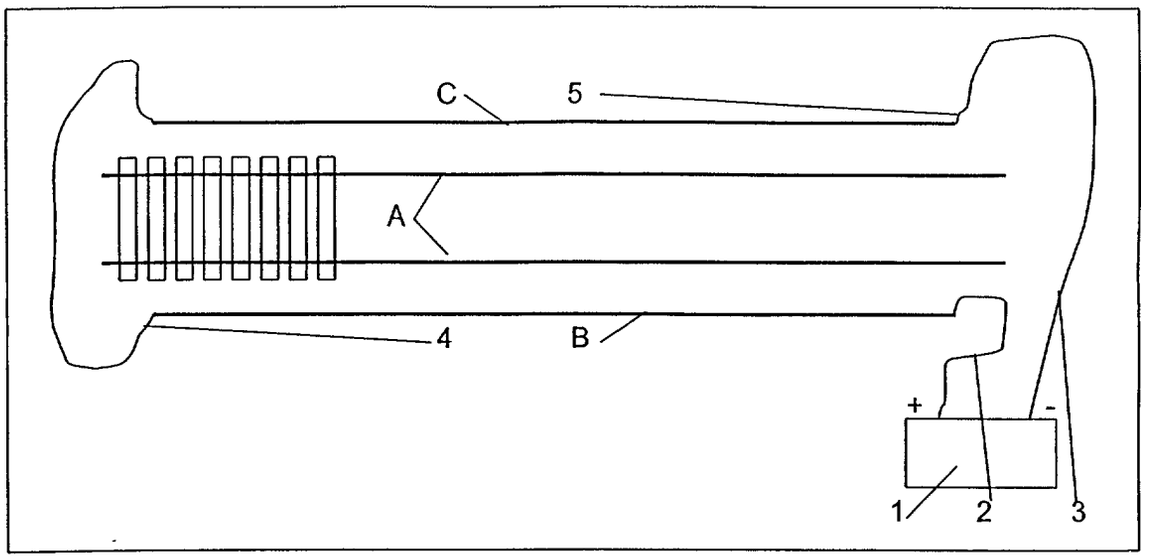

FIG. 1

EP 1 223 247 A1

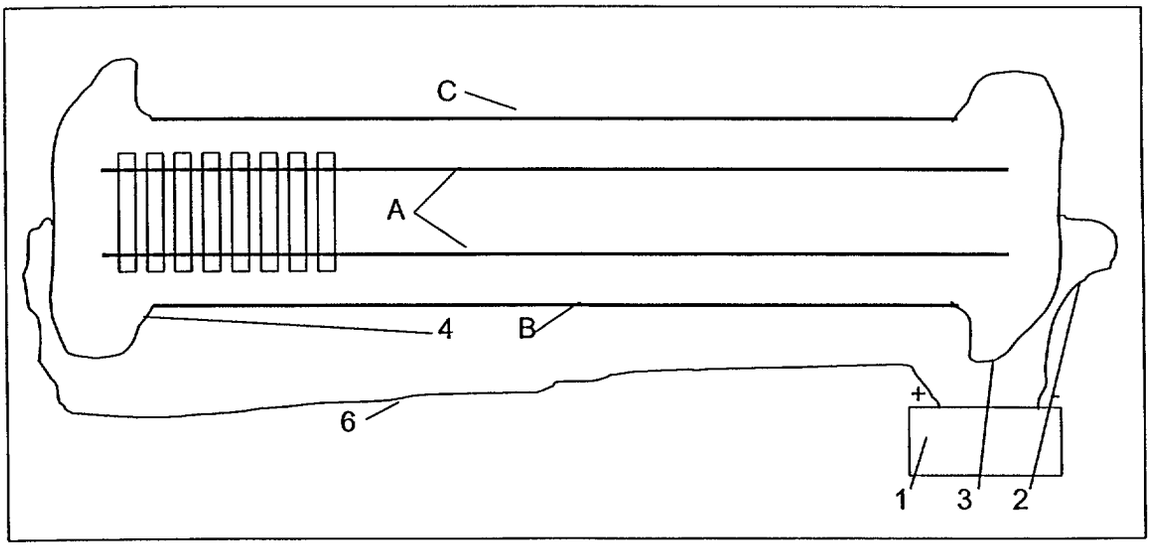

FIG. 2

Description

[0001] The present invention relates to a method and apparatus for heating rails by means of electric current.

[0002] When laying rails, in particular in a jointless track, a prestressing force in longitudinal direction is set up in the rails, which force is so large that the rails are stressless at a specific temperature. This temperature is the so-called neutral temperature, i.e. the temperature of the rail at which no longitudinal forces are present in the rail. Generally this neutral temperature is 25 °C.

[0003] When the temperature of the rails in a track is below the neutral temperature, a tensile stress is created in the rails. At temperatures above the neutral temperature, the tensile stress changes into a compression stress. A compression stress in the rails may lead to lateral buckling of the rails. Said lateral buckling of the rail must be prevented in order to guarantee a safe passage over the rails.

[0004] The prestressing force that is to be created in order to make the rail stressless at the neutral temperature depends on the ambient temperature that prevails when the rails are being laid. The smaller the difference between the temperature during laying and the neutral temperature, the lower the prestressing force that needs to be created. Rails may not be laid at temperatures above the neutral temperature.

[0005] Methods for setting up a prestressing force in rails when laying said rails comprise the prestressing of the rails by means of hydraulic equipment (a continuous process, which cannot be used in arches), and the heating of the rails by means of gas burners (a discontinuous process). The two methods are used after the rails have been placed in their end position in the track and before they are definitively fixed in position. As a consequence of this, said prestressing is an operation which conventionally can only take place next to the placing of the rails.

[0006] A major advantage of heating the rails by means of electric current, in order to heat the rails to the neutral temperature and thus make it possible to lay the rails in stressless condition, is that said heating can take place before the rail in question is fitted, simultaneously with other operations. Further advantages are the continuity of the process, the even distribution of the prestressing force over the rails and the applicability of the method in arches.

[0007] With a prior art method for heating rails by means of electric current, a current source is connected to two rails, in such a manner that the rails are connected in series. Following that, current is led through the rails and, as a result of their resistance, the rails are heated to a desired temperature or a slightly higher temperature.

[0008] One drawback of this prior art method is the fact that heating must be stopped when the rails are being fitted in the track, because mechanical tools are used for the fitting operations, which tools may short-circuit the two rails. In that case, the electric currents will follow an uncontrolled path through the metal tools. For safety reasons and in connection with possible damage, uncontrolledly high currents must not be allowed to pass through the mechanical tools.

[0009] The object of the present invention is to provide a method for heating rails wherein the above drawback is eliminated in an efficient manner.

[0010] In order to accomplish that objective, the method according to the invention is characterized in that the heating of the rails by means of a series connection is followed by heating of the rails by means of a parallel connection thereof.

[0011] When a parallel connection of the rails to the current source is used, there will be practically no voltage difference between the two rails, if at all, as a result of which metal tools can be used without any problem. On the other hand, according to the invention the series connection is maintained during the first stage of the heating process, since only short additional conductors are required thereby, so that the high current intensities are not problematic. Accordingly, the parallel connection is only used for maintaining the temperature that has been generated in the rails while the rails were connected in series, as a result of which the required power is much smaller, so that thinner cables can be used. Thus, it is possible to utilize the advantages of either mode of connection whilst avoiding the drawbacks thereof.

[0012] It is advantageous if the current is controlled in dependence on the temperature, for example by varying the voltage of the current source. Preferably, the measuring of the temperature takes place by measuring the resistance in the circuit.

[0013] The invention furthermore relates to a method for prestressing rails when laying rails in a track, in such a manner that the rails will be at least substantially stressless at a neutral temperature, wherein the rails are heated to said neutral temperature and maintained at said temperature by using the above-described method.

[0014] The invention furthermore relates to an apparatus for heating rails by means of electric current, which apparatus includes a current source, conductors as well as connecting elements for connecting said conductors to the rails, wherein according to the invention said conductors and said connecting elements are arranged for successively connecting the current source in series and in parallel to the rails.

[0015] The invention will now be explained in more detail with reference to the drawing, which shows an exemplary embodiment of the invention.

[0016] Fig. 1 is a schematic top plan view of a railway track with rails to be fitted, which rails are electrically heated in a series connection for the purpose of increasing their temperature.

[0017] Fig. 2 is a view corresponding to Fig. 1, wherein the rails are connected in parallel, however, for the purpose of maintaining the obtained temperature.

[0018] The invention relates to the heating of rails for

the purpose of laying said rails in a railway track. In the illustrated embodiment, the invention is used in replacing the rails of an existing track. It should be understood, however, that the invention can be used with any form of fixing rails to a support.

[0019] In the illustrated embodiment an existing railway track A is shown, the rails of which are to be replaced by new rails B and C, which are laid along railway track A to for that purpose. Rails B, C may have a length of for example a few hundred metres, for example about 500 metres. In that case they consist of a number of lengths of rails of for example 180 metres, which have been connected by welding, which lengths are in turn comprised of for example five rails of 36 metres each, which have been connected by welding by a supplier.

[0020] When the track is being replaced, the rails to be replaced are cut loose from track A and detached from the sleepers. Subsequently the rails of the existing track A are put aside by means of a special machine, and the new rails B, C are placed on the sleepers. The machine thereby rides on the rails to be replaced with its front side and on the newly laid rails B and C with its rear side.

[0021] The new rails B, C must be built into the existing track in such a manner that the tensile stress in the rails will be zero at the neutral temperature. In order to achieve this, rails B and C are heated to said temperature, and during a first stage of the heating process, heating to this temperature takes place in the manner that is shown in Fig. 1.

[0022] Said heating of the rails B and C involves the use of a current source or prestressing unit 1. Said current source 1 preferably consists of a direct current source with an operating voltage of for example 48 Volt. The power of current source 1 can be regulated by varying the voltage while the electric current remains constant. Said current may be as high as thousands of Amp. Current source 1 includes a transformer, which provides the transformation and regulation of the power. The apparatus comprises conductors, in this embodiment in the form of connecting cables 2 and 3 and an interconnecting cable 4, for connecting current source 1 to rails B and C. Said cables 2 - 4 must conduct a strong current, and to that end they have a diameter of for example 700 mm^2. The ends of cables 2, 3 and 4 are provided with cable lugs 5, by means of which a sparkless connection can be made between power cables 2 - 4 and rails B and C.

[0023] In the circuit as shown in Fig. 1, rails B and C are connected in series in the electric circuit with respect to the current source 1. Said electric circuit ensures that the supplied power from the current source is taken up by the two rails B, C. Rails B and C thus obtain a higher temperature as a result of resistance heating. The heating of the rails B and C can take place either quickly or slowly. There is a relationship between the speed at which said heating takes place and the supplied power. Quick heating requires relatively much power, whilst slow heating requires comparatively little power. Since the rails can be preheated whilst other operations are being carried out, it is possible to heat the rails only slowly.

[0024] The moment the new rails B and C must actually be fitted, the temperature of said rails must have been raised to at least substantially the desired value. Said temperature may be equal to the neutral value, but it is also possible that a slightly higher temperature is selected, so that some cooling of rails B and C is allowed.

[0025] During the actual laying of the rails B and C, the temperature of said rails B and C is maintained by the electric heating apparatus in the manner shown in Fig. 2. As said figure shows, current source 1 is now connected to rails B and C in a different manner, such that an electric circuit has been formed, in which rails B and C are connected in parallel. The ends of rails B and C are connected by interconnecting cable 4 and connecting cable 3 to this end, whilst current source 1 is connected to interconnecting cable 4 via an additional parallel cable 6 and to connecting cable 3, which in this case functions as a interconnecting cable, by means of connecting cable 2. When the rails B and C have the same resistance, the circuit current will be distributed evenly over the two rails B and C, and there will be hardly any difference in voltage, if at all, between the two rails, as a result of which the temperature in the two rails can be maintained at an identical value and a short-circuit can be created between rails B and C without any damage being caused to the equipment that creates the short circuit. Preferably, this parallel circuit will be maintained until the fitting of the two rails has been completed. The temperature is maintained at the correct value by direct or indirect measurement of the temperature and control of the power in dependence thereon. The indirect measurement of the temperature can for example take place by measuring (the difference in) the resistance, which is dependent on the temperature in the rails.

[0026] The additional parallel cable 6 must have a great length, for example in the order of the length of the rails B, C that are to be fitted. It is noted that current can also be supplied in a different manner than by means of a connecting cable, for example via an adjacent additional rail or via a hose containing acidified water functioning as a conductor.

[0027] It will be apparent from the foregoing that the invention provides a method and apparatus for heating rails and fitting rails which make it possible to work in an efficient and safe manner.

[0028] The invention is not limited to the embodiment as shown in the drawing, which can be varied in several ways without departing from the scope of the invention as defined in the appended claims. Thus it is also possible, for example, to use an alternating current source.

Claims

1. A method for heating rails by means of electric current, wherein a current source (1) is connected to two rails (B, C), in such a manner that the rails are connected in series, after which a current is led through the rails and the rails are heated to a desired temperature, **characterized in that** the heating of the rails (B, C) by means of a series connection is followed by heating of the rails by means of a parallel connection thereof.

2. A method according to claim 1, wherein the power of the current is controlled in dependence on the temperature.

3. A method according to claim 2, wherein said power is controlled by varying the voltage of the current source.

4. A method according to claim 2 or 3, wherein the temperature is measured by measuring the resistance in the electric circuit.

5. A method for prestressing rails when laying rails in a track, in such a manner that the rails will be at least substantially stressless at a neutral temperature, **characterized in that** the rails are heated to said neutral temperature and maintained at said temperature by using the method according to any one of the preceding claims.

6. Apparatus for heating rails (B, C) by means of electric current, which apparatus includes a current source (1), conductors (2 - 4, 6) as well as connecting elements (5) for connecting said conductors to the rails, **characterized in that** said conductors (2 - 4, 6) and said connecting elements (5) are arranged for successively connecting the current source (1) in series and in parallel to the rails (B, C).

7. Apparatus according to claim 6, wherein one (6) of said conductors (2 - 4, 6) has a length in the order of the length of the rails (B, C) that are to be laid.

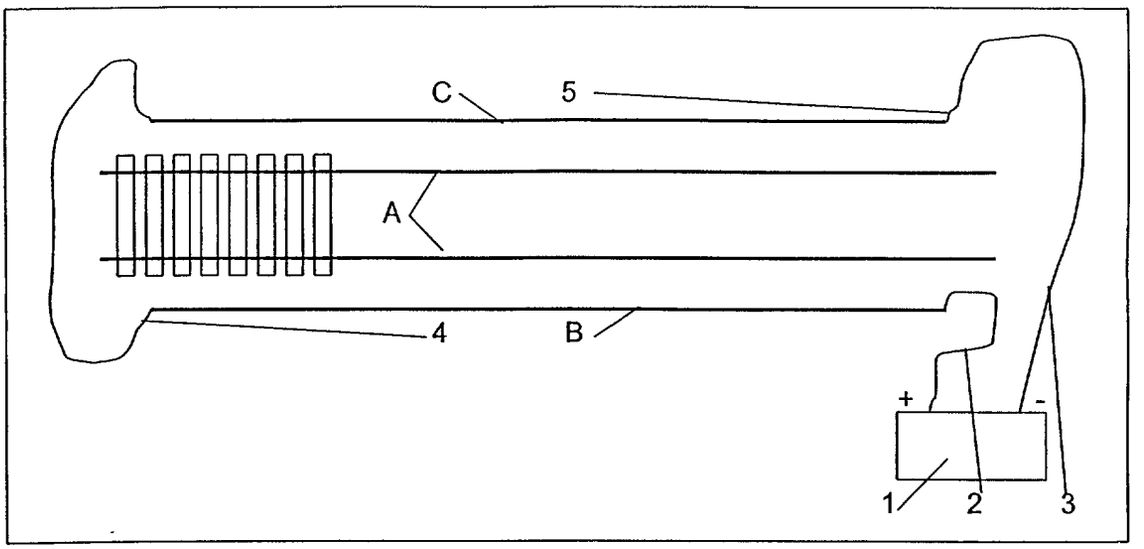

FIG. 1

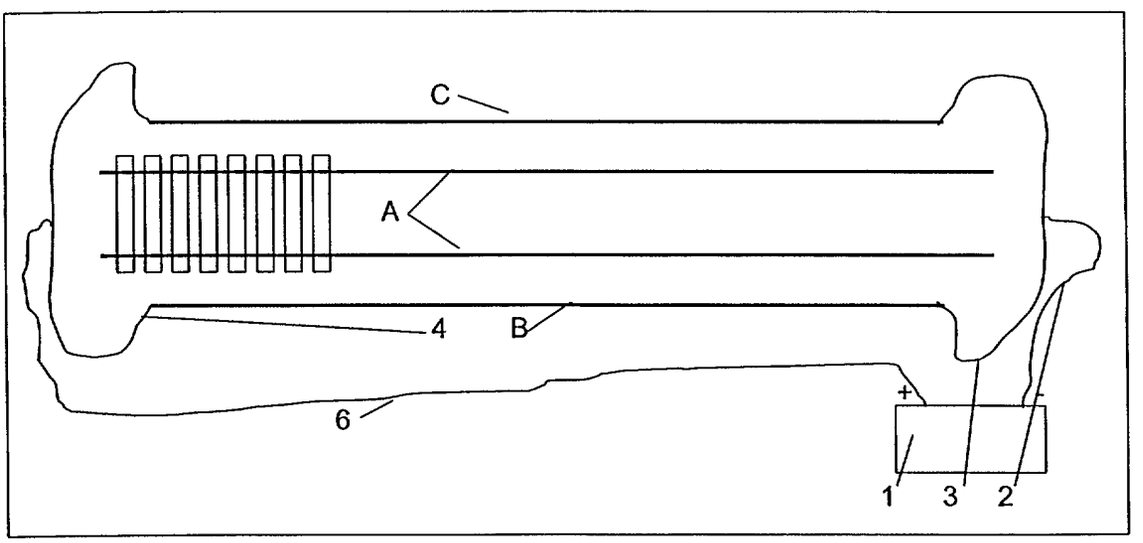

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 20 0076

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 804 793 A (FAROLDI) 8 September 1998 (1998-09-08) * column 3, line 37 - column 4, line 43; figures 1-5 *	1,3,5,6	E01B31/18 H05B3/00
A	GB 2 246 253 A (CERAMASPEED LIMITED) 22 January 1992 (1992-01-22)		

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E01B
H05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 June 2001	Kergueno, J

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 20 0076

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-06-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5804793 A	08-09-1998	IT T0940679 A	26-02-1996
		AT 189019 T	15-02-2000
		AU 696042 B	27-08-1998
		AU 3383695 A	22-03-1996
		DE 69514639 D	24-02-2000
		DE 69514639 T	03-08-2000
		EP 0725860 A	14-08-1996
		FI 961773 A	25-04-1996
		JP 9504586 T	06-05-1997
		CZ 9601493 A	11-12-1996
		WO 9606981 A	07-03-1996
GB 2246253 A	22-01-1992	DE 9107618 U	22-08-1991
		DE 9203267 U	30-04-1992
		GB 2253954 A,B	23-09-1992

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82