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(54) **A railroad switch and a method of melting snow and ice in railroad switches**

(57) A railroad switch comprising a stock-rail (1), a switch blade (2), slide chairs (3) and a heater (4) designed to melt snow fixed nearby the stock-rail (1) between the slide chairs (3), wherein the heater (4) is not in contact with the stock-rail (1) in the area between the slide chairs (3). In a method of melting snow and ice in railroad switch-

es a heater (4) is fixed nearby the stock-rail (1) between the slide chairs (3), wherein the heater (4) is not in contact with the stock-rail (1) in the area between the slide chairs (3).

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## Description

**[0001]** The object of the invention is a railroad switch and a method of melting out snow and icings in railroad switches. More particularly, the invention relates to a railroad switch comprising stock-rails, switch blades, slide chairs and a heater designed to melt out snow, fixed nearby a stock-rail between slide chairs and a method of melting out snow and icings in railroad switches by means of heaters, especially electric ones. The invention finds a use in the field of railroad infrastructure - in heating railroad switches.

**[0002]** The aim of using the railroad switch heating is to ensure a failure-free operation (i.e. switching) of the railroad switches in winter conditions, during snowfalls, snow being blown in by wind, freezing rain falls and severe frosts. All the above factors which take place in winter may lead shortly to a blockade of the railroad switch, i.e. make its switching impossible. In order to provide the operation of railroad switches in winter, the following important elements of the railroad switch are heated: stock-rails - obligatorily, slide chairs - obligatorily, switch blades - optionally, point locks - optionally, under-lock channels - optionally, movable obtuse crossings - obligatorily.

**[0003]** The following types of heating of railroad switches are presently in use: electric heating of railroad switches, gas heating of railroad switches, water circulation heating of railroad switches, steam heating of railroad switches.

**[0004]** The type, which is most commonly used in railroads worldwide is the electric heating of railroad switches.

**[0005]** The most important part in the process of heating the railroad switches is melting snow out of the space between the stock-rail and the switch blade of the railroad switch as well as from slide chairs. It is achieved by heating the stock-rails (obligatory) and additionally by heating switch blades (optional). The source of the electric heat for heating stock-rails of the railroad switches may be: a resistor heater, a self-limiting heater, an inductive heater.

**[0006]** The heaters can be powered with direct or alternating voltage, the heater power supply voltages range from 3V (in case of inductive heaters) to 460V. Power per 1 linear meter of rail: 200-500W.

**[0007]** Presently, the most widespread are the resistor heaters, most of all road heaters with flat-oval cross-section (fig. 1, prior art).

**[0008]** The concept of heating the stock-rails consists in heating a stock-rail of a railroad switch with an electric heater. The heater which is in direct contact with a stock-rail of a railroad switch transfers heat, especially by conduction (permeation) into the rail stock. Once heated up, the stock-rail of the railroad switch works as a radiator and the heat emitted out of stock-rail melts snow out of the space between the stock-rail and the switch blade.

**[0009]** In the prior art, heaters are fitted to the stock-rail by means of fixing clips, the place of fixing being a variable one. In most of the European railroad directorates, the heater is fixed to the stock-rail foot nearby the neck, from the switch blade side (fig. 1). The advantage of such placement is providing contact between the heater and the slide chair which ensures its good heating.

**[0010]** In some railroad systems, another placement of heaters is found: on the foot on the internal side of the stock-rail (e.g. the Dutch DSB railways), on the neck nearby the stock-rail head on the internal or the external side of the stock-rail (e.g. railways in the Great Britain).

**[0011]** In areas with intensive snowfalls, e.g. mountains, melting snow out of the space between the stock-rail and the switch blade requires the use of additional heaters fixed on the switch blade of the railroad switch. They heat up the switch blade which, once heated up, emits heat which melts out the snow.

**[0012]** In the presently employed solutions, railroad authorities emphasize the need to obtain the best possible contact of the heater with the stock-rail of the railroad switch in order to ensure the best possible transfer of heat to the stock-rail. Due to this reason, the heater rod cross section has a flat-oval shape. Additionally, some railways, e.g. German DB and PKP, have doubled the number of required pressure clips, fixing the heaters to the stock-rail. This has allowed reducing clearances between the heater and the stock-rail, and the heat is better transferred to the rail stock which makes it achieve higher temperatures.

**[0013]** As mentioned above, the purpose of melting snow and icings in the working area of heating the stock-rails is to get the stock-rail of the railroad switch heated up by a source of heat which is the electric heater fixed to the stock-rail. The heat is transferred from the heater to the stock-rail mainly by direct conduction (permeation, conduction, diffusion) of heat. Therefore, it is so important to provide the best possible contact of the heater with the stock-rail of the railroad switch. Additionally, the heat is transferred from the heater to the stock-rail also by radiation and convection, however, to a much smaller degree than by diffusion.

**[0014]** The heated stock-rail works as a radiator, emitting heat, part of which is emitted towards the working area, i.e. into the space between the stock-rail and the switch blade which causes the snow which has been accumulating there to melt out. Partially, the snow between the stock-rail and the switch blade is also melted out by the heat emitted directly from the surface of the heater towards the zone A of the working area. The flow of heat in the zones A (between the chairs) from the heater to the stock-rail is shown on fig. 4 (prior art).

**[0015]** Slide chairs are a critical component which determines the performance of switches in the winter period, even a relatively small amount of snow on their surface can make it impossible for the switch to work. For this reason, they should be maintained in a snowless state. In the presently employed solutions of electric heating of switches in zones

B (at the chairs), the electric heater fixed to the stock-rail is also in contact with the lower surface of the chair which makes it be heated. The heat is transferred from the heater to the chair mainly by direct conduction (permeation, conduction, diffusion) of heat. The chair which is heated up by using this method melts out snow which accumulates on its top slide surface. At the same time, a part of the heat from the heater heats up the stock-rail in the same way as it is the case in the zones A (between the chairs). The flow of heat in the zones B (at the chairs) from the heater to the chair and the stock-rail is shown on fig. 5 (prior art).

**[0016]** The method of melting snow out between the stock-rail and the switch blade where the stock-rail (the rail) is treated as a radiator emitting heat, used in prior art, is loaded with the following drawbacks:

1. Significant losses of heat, emitted by the stock-rail in all directions, only the heat emitted towards to the switch blade of the railroad switch is a useful heat, suitable for melting out snow. The heat emitted in the remaining three directions is a lost heat.
2. High inertia, i.e. a long time of heating up the stock-rail and, as a result of that, a long time needed to melt the snow out from the working space.
3. The only possibility to increase snow melt is to increase the temperature of the stock-rail (the rail) by increasing the power of the heaters. This radically increases the energy consumption of the heating. Excessively high temperatures may negatively affect some components of the railroad switches made of plastic materials, e.g. insulation separators.

**[0017]** Therefore, the object of the present invention is to provide new, improved method of melting snow and icings in railroad switches which would be free from the aforementioned drawbacks, accomplished by installing an electric heater in a proper way in railroad switches. Such solution particularly helps to increase the efficiency of melting snow and icings by multiplying the speed of melting snow and icings in railroad switches even in winter at extremely low temperatures without increasing the temperature of the stock-rail (rail), and furthermore, proper heaters are used to simultaneously reduce losses of the heat emitted from the stock-rail beyond the working space of the heating.

**[0018]** A further object of the invention is to provide a railroad switch enabling the implementation of this method.

**[0019]** A railroad switch comprising a stock-rail, a switch blade, slide chairs and a heater designed to melt out snow, fixed nearby the stock-rail between the slide chairs, is characterised according to the invention in that the heater is not in contact with the stock-rail in the area between the slide chairs.

**[0020]** Preferably, there is a material with thermal insulation properties in the area between the heater and the stock-rail.

**[0021]** Preferably, the heater is installed at the distance from 0.1 mm to 40mm, preferably 2 mm, from the stock-rail.

**[0022]** Preferably, the heater is fixed to the stock-rail nearby the slide chair and comes in contact with the lower surface of the chair.

**[0023]** Preferably, the heater is an electric heater, a gas heater, a water circulation heater or a steam heater.

**[0024]** Preferably, the heater is an electric resistor heater, a self-limiting heater or an inductive heater.

**[0025]** Preferably, the heater comprises a heating rod, preferably with a circular cross section with a diameter ranging from 1mm to 20mm, most preferably with the 8mm diameter.

**[0026]** Preferably, the heater has a radiator, preferably in the form of a plate or wire.

**[0027]** In such case, the radiator preferably has the following dimensions: length from 20mm to 1000mm, preferably from 350mm to 500mm, most preferably 400mm, width: from 20mm to 100mm, preferably from 27mm to 35mm, most preferably 35mm, and thickness: from 0.5mm to 30mm, preferably from 1 mm to 5mm, most preferably 2mm.

**[0028]** The invention also includes a method of melting out snow and icings in railroad switches in which a heater designed to melt out snow, fixed nearby the stock-rail between the slide chairs, is used and heated up, characterised in that the heater is not in contact with the stock-rail in the area between the chairs.

**[0029]** Preferably, a heater with power ranging from 100W/m to 1000W/m, preferably from 250W/m to 330W/m, most preferably 300W/m, is used.

**[0030]** Preferably, an electric heater, a gas heater, a water circulation heater or a steam heater is used.

**[0031]** Preferably, an electric resistor heater, a self-limiting heater or an inductive heater is used.

**[0032]** Preferably, the heater is powered with the electric direct or alternating current with voltage ranging from 3V to 460V, preferably 230V.

**[0033]** The concepts of the strategic components and areas in the railroad switch heating process are understood to be these components or space which must be free from snow and icings in order to enable switching the railroad switch. The strategic components and areas constitute the working area of the heating. The strategic components and areas on the heating process are: the space between the stock-rail and the switch blade - snow lingering in this area can obstruct pressing the switch blade to the stock-rail; the slide chair, particularly the upper surface on which the switch blade moves - the snow lingering on the chair surface is swept and compacted by the switch blade while the railroad switch is being switched which obstructs pressing the blade to the stock-rail; point locks and under-lock channels.

**[0034]** The working area of the stock-rail heating is the space between the stock-rail (rail) and the non-adherent switch

blade of the railroad switch (fig. 2, prior art) which should be free from snow and icings. The working area of the railroad switch stock-rail heating consists of two kinds of snow melting zones (fig. 3, prior art): zones between the slide chairs - hereinafter called the zones A, zones at the slide chairs - hereinafter called the zones B. The number of the zones A and B in the working area of the railroad switch stock-rail heating is variable and depends on the switch type and its length.

[0035] The concept of zone A (the inter-chair) is understood to be the space between: between neighbouring chairs (approx. 2 cm away from each chair) and between the stock-rail, from the neck edge and the railroad switch blade, in the withdrawn state (fig. 8).

### Advantageous Effects of Invention

[0036] Heating of railroad switches in the winter period is an essential element of the railway infrastructure, enabling efficient performance of switches during winter and consequently the possibility to operate railway transportation.

[0037] The use of a non-conductive method of melting snow and icings in railroad switches by means of electric heaters can significantly increase the efficiency of melting snow and icings in railroad switches.

[0038] As the first tests carried out in railroad switches during the 2010/11 winter proved, the time of melting the snow lingering between the stock-rail and the switch blade by means of a non-conductive heater was approximately three times shorter than the time of melting by means of the heater which had been used so far.

[0039] Thanks to much higher efficiency of the new solution, it is also possible to reduce the power of the heaters installed in railroad switches. Considering the scale of railway directorates, this can result in considerable savings. For example, in the PKP PLK SA network, the power of heaters in railroad switches amounts to approx. 120MW; in the German DB railways, this power amounts to over 400MW.

[0040] The invention will now be described in greater detail in preferred embodiments, with references to the attached drawings, in which:

Fig. 1 (prior art) presents the typical method of electric heating of the stock-rails of the railroad switches which is employed in the European railway directorates;

Fig. 2 (prior art) presents the working area of heating of the railroad switch stock-rails;

Fig. 3 (prior art) presents the zones of melting snow in the working area of heating of the railroad switch stock-rails where A means the zone A, i.e. the space between the stock-rail and the railroad switch blade, between the slide chairs, whereas B means the zones B situated between the stock-rail and the railroad switch blade, above the slide chairs;

Fig. 4 (prior art) presents the flow of heat from the heater to the stock-rail and the directions of the heat emission from the stock-rail in the zone A (the inter-chair one). On the drawing, the grey arrows represent the directions of the heat flow from the heater in the stock-rail, the black arrows - the useful heat emitted from the stock-rail and the heater, the white arrows - the useless (lost) heat emitted from the stock-rail;

Fig. 5 (prior art) presents the flow of heat from the heater to the slide chair and the stock-rail as well as the directions of the heat emission from the stock-rail in the zone B (at the slide chair). On the drawing, the grey arrows represent the directions of the heat flow in the stock-rail, the black arrows - the useful heat emitted from the slide chair and the stock-rail, the white arrows - the useless (lost) heat emitted from the stock-rails;

Fig. 6 presents the flow of heat in the non-conductive method of melting snow and icings according to the invention in the zones A. On the drawing, the black arrows represent the useful heat emitted from the stock-rail and the heater;

Fig. 7 presents the change of the heat distribution while the snow is melted by non-conductive heating (on the right) as compared to the heating which has been employed so far (on the left); Fig. 7A - The heating used so far - a heater adjoining the stock-rail (rail), Fig. 7B - The non-conductive heating - the heater without contact with the stock-rail (rail). On the drawing, the arrow I represents the heat flow from the heater to the stock-rail, in the heating used so far mainly by conduction (permeation), in the non-conductive heating only by radiation; the arrows II and III represent the useful heat emitted from the stock-rail and the heater, melting out snow; the arrows IV and V represent the useless (lost) heat;

Fig. 8 presents the borders of the zones A (the inter-chair ones) in the railroad switches;

Fig. 9 presents an exemplary non-conductive heater without a radiator, used in the railroad switch according to the

invention;

Fig. 10 presents an exemplary non-conductive heater with a full aluminium 35 mm radiator, used in the railroad switch according to the invention;

Fig. 11 presents an exemplary non-conductive heater with a radiator made of aluminium wire, used in the railroad switch according to the invention;

Fig. 12 presents an exemplary shape and dimensions of a non-conductive heater with an aluminium 35mm radiator used in the railroad switch according to the invention;

Fig. 13 presents the comparison of the results of melting snow by the traditional heater (on the left) and the new generation heater with a 35mm radiator (on the right), used in the railroad switch according to the invention, in the ambient temperature:  $-7^{\circ}\text{C}$ . The non-conductive heater with a radiator has melted the entire snow out of the working space. The visible remains of the snow linger below the switch blade and do not affect the performance of the railroad switch. Prostki station, 25 January 2012;

Fig. 14 presents the comparison of the results of melting snow by the traditional heater (on the left) and the new generation heater with a 35mm wire radiator (on the right) used in the railroad switch according to the invention, in the ambient temperature  $-9^{\circ}\text{C}$ , in conditions of a very strong wind and snow storm. The non-conductive heater with a radiator has melted the entire snow out of the working space. The visible remains of the snow linger below the switch blade and do not affect the performance of the railroad switch. Prostki station, 02 February 2012;

Fig. 15 presents the comparison of the results of melting snow by the traditional heater (on the left) and the new generation heater with a 27mm wire radiator (on the right) used in the railroad switch according to the invention, in the ambient temperature of  $-23^{\circ}\text{C}$ . Prostki station, 2 February 2012. The visible difference of temperatures on the stock-rail head:  $+18^{\circ}\text{C}$  for a standard heater and  $0^{\circ}\text{C}$  for the tested non-conductive heater used in the railroad switch according to the invention, whereas

Fig. 16 presents the comparison of the results of melting snow by the traditional heater (on the left) and the new generation heater with a 35mm radiator (on the right) used in the railroad switch according to the invention - a general view of the railroad switch.

**[0041]** The following references were used on the drawing: 1 - stock-rail (rail), 2 - switch blade, 3 - slide chairs, 4 - heater, 5 - clips fixing the heater to the stock-rail, 6 - snow to be melted out, 6a - snow to be melted out in the working space, 6b - snow to be melted out on the slide chair surface, 7 - free space (an air slot or a thermal insulation material), 8 - heater rod, 9 - power cable, 10 - coupling, 11 - radiator, 12 - stock-rail foot.

**[0042]** The solutions known from the prior art are presented on fig. 1 - fig. 5.

#### Preferable Embodiments of Invention

**[0043]** The operational test runs of non-conductive heaters for electrical heating of railroad switches were performed at the PKP PLK S.A. station in Prostki (line: Bialystok - Elk) in the 2011/12 winter season. The tests were carried out by the Railway Institute by order of the manufacturer of heaters. At Prostki station, the electric non-conductive heaters, with radiators and without radiators, were tested. The examples of the heaters tested at Prostki station are presented on fig. 9 - 16. Both making prototypes of the heaters according to the invention and the tests performed were of confidential nature and do not constitute a disclosure of the present invention to the public.

**[0044]** The design of the tubular heater used in the embodiments is the same as that of the heaters used so far to heat up railroad switches except that the non-conductive heater used in the railroad switch according to the invention differs from the known heaters used so far for its circular cross-section of the rod.

**[0045]** The common feature of the non-conductive heaters presented below is the lack of contact between the heater and the railroad switch blade (the distance is approx. 2 mm) and multiplied heating surface of the heaters as compared to the heaters used so far (fig.). The multiplication of the heating surface was being achieved in two ways: by extending the heater rod and bending it in an appropriate way (fig. 9) or by using radiators permanently fixed to the heater rod (fig. 10 and 11). In the tested heaters, radiators were made of aluminium. Yet, various dimensions and shapes of the radiators were tested.

Example 1

**[0046]** An example of the heaters tested at Prostki station is a non-conductive heater without a radiator installed in the railroad switch according to the invention, presented on fig. 9.

**[0047]** The exemplary electric heater 4 consists of a tubular heating rod 8, a triple wire power cable 9 and a rubber coupling 10, non-demountable and non-disconnectable, connecting the heater rod 8 with the cable 9. The heater 4 featuring the design as shown above is fixed in a contactless way with the stock-rail 1 of the railroad switch according to the invention, in the space between the stock-rail 1 and the switch blade 2 between the slide chairs 3 (i.e. in the zone A, that is, in the heating working area) and above the foot of the stock-rail 12, at the distance of 2 mm from the stock-rail, by means of clips 5 fixing that heater 4 to the stock-rail 1. According to the invention, the tubular heating rod 8 with a circular cross section, the diameter of 8 mm and the length of 1300 mm is used. In the railroad switch according to the invention, the heater 4 with the following electric specifications was used: power supply voltage - 230V DC (alternating current), power - 400 W, power/linear meter - 308W/m, insulation rating - I. The multiplication of the heating surface of the present heater 4 was achieved by extending the heater rod 8 and bending it in an appropriate way. Exemplary bendings of the heater rod are presented on fig. 9.

**[0048]** Following the completion of tests in the ambient temperature of -11 °C, it turned out that after 3 hours of heating, the heater melted out approx. 2/3 of snow in the space between the stock-rail and the switch blade. At the same time, the old type heater only melted an approx. 5 ÷ 6cm diameter tunnel around the heater.

Example 2

**[0049]** Another example of the heaters tested at Prostki station on 25 February 2012 is a non-conductive heater with a radiator installed in the railroad switch according to the invention presented on fig. 10 and fig. 13. The heater used for the test was the heater 4 featuring the same design and electrical specifications as presented in the above example 1; however, the heater 4 additionally contained a full aluminium 35 mm radiator, permanently fixed to the heating rod 8, in order to multiply the heating surface of this heater 4.

**[0050]** The tested non-conductive heater with a full aluminium 35mm radiator is built of aluminium radiators having the dimensions of 400 mm x 35 mm x 2 mm, the heating surface included covering 400 mm x 35 mm. The heater 4 is fixed to the stock-rail in such a way as to prevent the radiator from being in contact with the stock-rail 1 of the railroad switch. The radiator is suspended above the foot of the stock-rail 12 within the distance of approx. 2mm. The shape, design and dimensions of non-conductive heater with the aluminium 35mm radiator are presented on fig. 12.

**[0051]** After the completion of the tests in the ambient temperature of -7°C, it turned out that the non-conductive heater with the 35mm wide radiator is a heater featuring a very good efficiency in melting out snow in the working space between the stock-rail 1 and the switch blade 2 of the railroad switch which is presented on fig. 13 on which the snow melting efficiency of the standard 330W/m heater, known from the prior art, was compared to that of the tested non-conductive heater with the 35mm radiator (308W/m) in the railroad switch according to the invention. As it is seen on fig. 13, the multiplication of the snow melting speed was successfully achieved. In the ambient temperature -7°C, after 190 minutes of heating, the non-conductive heater with the 35 mm melted out the entire snow from the working space. The snow remains which are visible on fig. 13, lingering below the lower surface of the switch blade 2 do not affect the performance of the railroad switch.

Example 3

**[0052]** Another example of the heaters tested at Prostki station on 2 February 2012, installed in the railroad switch according to the invention, is a non-conductive heater with an full aluminium 27 mm radiator, presented on fig. 15, featuring the same design and electrical specifications as presented above.

**[0053]** This heater was tested also during severe frosts, in the ambient temperature of -23°C and it turned out that the snow melting efficiency of the non-conductive heater with the full aluminium 27 mm radiator is radically higher than that of the known standard radiator which was shown on fig. 15, which presents the results of snow melting done by the known heater and the heater with the 27 mm radiator used according to the invention in a railroad switch.

**[0054]** In these conditions, after 100 minutes of heating, the standard heater was only capable of melting out a small sized tunnel in snow at the heater, with the diameter only as small as 3 - 4 cm. After 240 minutes of heating, the snow crevasse at the stock-rail 1 melted out by the standard heater was 0 to 0.8 cm whereas in case of the heater with the radiator, used according to the invention, the area free from snow was 8 to 12 cm, the difference being severalfold. The below chart 1 presents for the benchmarking purpose the visible difference of temperatures on the stock-rail head of the standard heater and the heater before turning on the heating, after 100 minutes and after 240 minutes of heating by means of two heaters.

## Example 4

**[0055]** Another example of the heater 4, tested at Prostki station on 2 February 2012, is a non-conductive heater with a radiator installed in the railroad switch according to the invention, presented on fig. 11 and fig. 14. The heater used for the test was the heater 4 featuring the same design and electrical specifications as presented above; however, it additionally contained a radiator in the form of aluminium wire wound up to a 35mm wide coil, permanently fixed to the heating rod 8, in order to multiply the heating surface of this heater 4.

**[0056]** This heater was tested also during severe frosts, in the ambient temperature of  $-9^{\circ}\text{C}$ , in conditions of a very strong wind and snow storm, and it turned out that the heater 4 with the 35 mm wire radiator, used according to the invention, melted out the entire snow from the working space, whereas the snow remains, visible on fig. 14, lingering below the switch blade 2 after 180 minutes of heating, do not affect the performance of the railroad switch.

**[0057]** The present test proved that the snow melting efficiency of the non-conductive heater 4 with the 35 mm wire radiator is higher than that of the known standard heater shown on fig. 14 which presents, for benchmarking purposes, the results of snow melting by the known heater and the heater with the 35 mm wire radiator used in the railroad switch according to the invention, in the temperature of  $-9^{\circ}\text{C}$ , in conditions of a very strong wind and during snow storm.

**[0058]** Furthermore, it is also possible to melt snow and icings in the railroad switch according to the invention with the use of gas heaters (emitters), which will be an obvious option for a professional within a specific area and will not affect the preferable effect of the invention in the form of better melting of snow and icings in railroad switches.

**[0059]** The results of operational tests are as follows: In the 2011/12 winter season, the Railway Institute carried out operational tests of non-conductive heaters. The tests consisted in comparing the snow melting efficiency of non-conductive heaters and the heaters used so far. The tests were carried out at the PKP PLK SA Prostki station (line: Bialystok - Elk) in the RKpd-S49 R 190 slip type railroad switch. Various types of the non-conductive heaters were tested.

**[0060]** The results of these tests have fully proven the assumptions of the tested new non-conductive heaters which much faster melted snow from the space between the stock-rail and the switch blade. As the benchmarking of snow melting efficiency presented on fig. 13, 14 and 15 shows, in some cases the snow melting speed was successfully multiplied.

**[0061]** After the completion of the first tests, a non-conductive heater 4 with the 35 mm wide radiator was selected for further tests as the heater having the highest good efficiency in melting out snow from the working space between the stock-rail 1 and the switch blade 2 of the railroad switch.

**[0062]** The results of these tests have fully proven the assumptions of the new heaters, the tested non-conductive heaters radically faster melted snow from the space between the stock-rail 1 and the switch blade 2.

**[0063]** The comparison of the temperature increase on the stock-rail head, presented in Table 1, looks interesting.

Table 1

Temperature (T) at the stock-rail head with heating by the standard heater and the non-conductive heater according to the invention with the 27 mm radiator. Refers to fig.15.				
	Standard 330W/m heater		Heater according to the invention with a 308W/m radiator	
Time of heating	T of the head	$\Delta T$	T of the head	$\Delta T$
0	$-10^{\circ}\text{C}$	-	$-14^{\circ}\text{C}$	-
100 minutes	$+9^{\circ}\text{C}$	$19^{\circ}$	$0^{\circ}\text{C}$	$14^{\circ}$
240 minutes	$+18^{\circ}\text{C}$	$28^{\circ}$	$0^{\circ}\text{C}$	$14^{\circ}$

**[0064]** The comparison of the above temperatures against the melting efficiency of particular heaters presented on fig. 15 shows clearly that even a significant increase of the stock-rail temperature does not accelerate the snow melting process in the space between the stock-rail and the switch blade. The factor determining the snow melting speed is the heating surface of the heater and its temperature. The heating surface of the standard heater is approx.  $12\text{mm} \times L_g$  where  $L_g$  is the heater rod length, for the heater with a radiator according to the invention it amounts to  $35\text{mm} \times L_r$  where  $L_r$  is the length of the radiator. So, comparing the heating surface of the radiator with the dimensions of  $35\text{mm} \times 400\text{mm}$  and a part of the heater with the length of 40cm, that is,  $12\text{mm} \times 400\text{mm}$ , you see that the heating surface of the heater with a radiator according to the invention is almost three times (2,92 times) larger than the heating surface of the standard heater. The temperatures determined for the surface of the heater and the radiator, for the discussed case presented on fig. 15 amounted to:

- for the standard heater - from 66°C (at the clips) to 121°C (between the clips),
- for the 35mm radiator of the non-conductive heater according to the invention - from 171 °C to 202°C.

**[0065]** The relatively low temperatures obtained on the surface of the standard heater result from the high amount of heat collected by the railroad switch stock-rail with which the heater is in contact along its entire length. On the other hand, according to the invention, the lack of contact between the heater and the radiator results in higher temperatures on its surface. At the same time, the almost three times larger heating surface of the non-conductive heater with a radiator is the cause of the much higher snows melting efficiency.

**[0066]** The results of the operational tests of the non-conductive heaters proved their assumptions to be correct. The new type of the heater melts out snow from the space between the stock-rail and the switch blade much faster than the heaters used so far, even despite the little bit lesser power of the new heaters. At the same time, the stock-rail of the railroad switch according to the invention heated with non-conductive heaters gets heated up to much lower temperatures than while using standard heaters. It is preferable since overheating of the railroad switches during long-lasting heating negatively affects some of their components, e.g. insulating washers made of plastic. Depending on the priorities, the non-conductive heating of railroad switches according to the invention can be used to increase the efficiency of melting out snow and icings or to reduce the power of heaters or to accomplish both of these purposes.

**[0067]** According to the invention, the non-conductive method of melting out snow and icings in the railroad switches can be used in the prevailing majority of railroad switches, newly manufactured and used so far by railways all over the world.

## Claims

1. A railroad switch comprising a stock-rail, a switch blade, slide chairs and a heater designed to melt out snow, fixed nearby the stock-rail between the slide chairs, **characterised in that** the heater (4) is not in contact with the stock-rail (1) in the area between the slide chairs (3).
2. The railroad switch according to claim 1, **characterised in that** there is a material with thermal insulation properties in the area between the heater (4) and the stock-rail (1).
3. The railroad switch according to claim 1 or 2, **characterised in that** the heater (4) is installed at the distance from 0.1 mm to 40mm, preferably 2 mm, from the stock-rail (1).
4. The railroad switch according to any of the preceding claims, **characterised in that** the heater (4) is fixed to the stock-rail (1) nearby the slide chair (3) and comes in contact with the lower surface of the chair (3).
5. The railroad switch according to any of the preceding claims, **characterised in that** the heater (4) is an electric heater, a gas heater, a circulation water heater or a steam heater.
6. The railroad switch according to claim 5, **characterised in that** the heater (4) is an electric resistor heater, a self-limiting heater or an inductive heater.
7. The railroad switch according to any of the preceding claims, **characterised in that** the heater (4) comprises a heating rod (8), preferably with a circular cross section, with a diameter ranging from 1 mm to 20mm, most preferably with the 8mm diameter.
8. The railroad switch according to any of the preceding claims, **characterised in that** the heater (4) has a radiator (11), preferably in the form of a plate or wire.
9. The railroad switch according to claim 8, **characterised in that** the radiator (11) has the following dimensions: length from 20mm to 1000mm, preferably from 350mm to 500mm, most preferably 400mm, width: from 20mm to 100mm, preferably from 27mm to 35mm, most preferably 35mm, and thickness: from 0.5mm to 30mm, preferably from 1 mm to 5mm, most preferably 2mm.
10. A method of melting out snow and icings in railroad switches, in which a heater designed to melt out snow, fixed nearby the stock-rail between the slide chairs, is used and heated up, **characterised in that** the heater (4) is not in contact with the stock-rail (1) in the area between the slide chairs (3).



11. The method according to claim 10, **characterised in that** a heater with power ranging from 100W/m to 1000W/m, preferably from 250W/m to 330W/m, most preferably 300W/m, is used.

5 12. The method according to claim 10 or 11, **characterised in that** an electric heater, a gas heater, a circulation water heater or a steam heater is used.

13. The method according to claim 12, **characterised in that** an electric resistor heater, a self-limiting heater or an inductive heater is used.

10 14. The method according to claim 13, **characterised in that** the heater is powered with the direct or alternating current with voltage ranging from 3V to 460V, preferably 230V.

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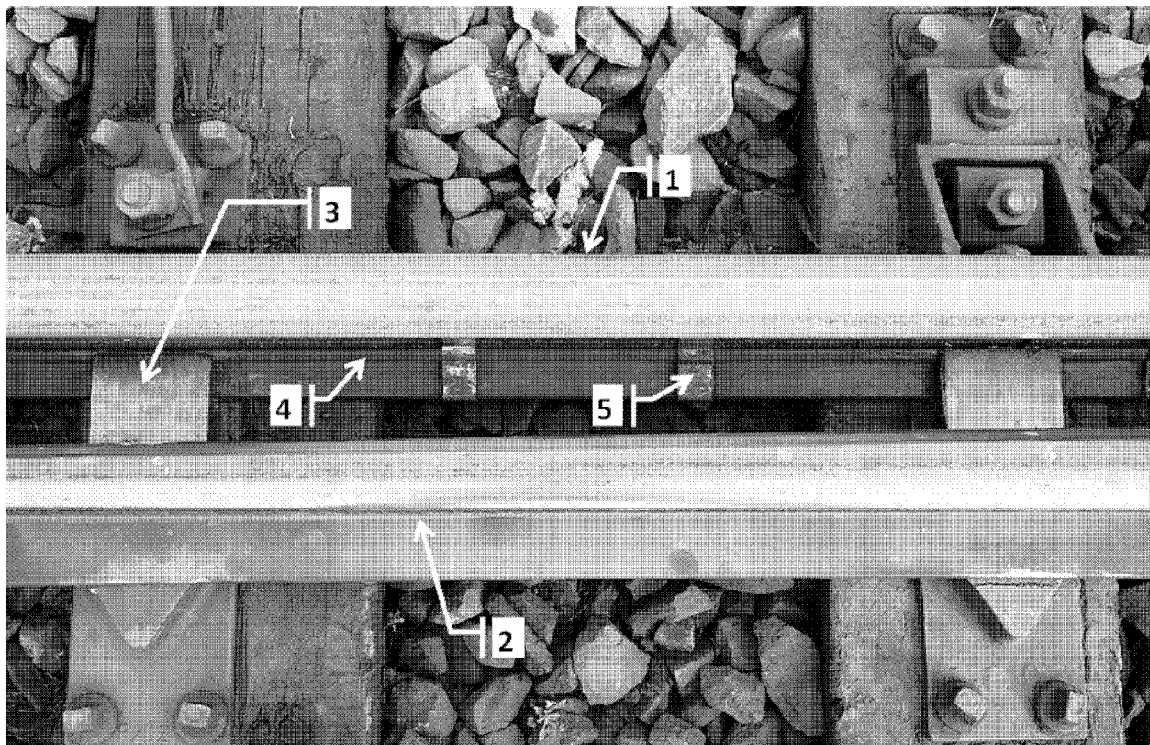


Fig. 1 (prior art)

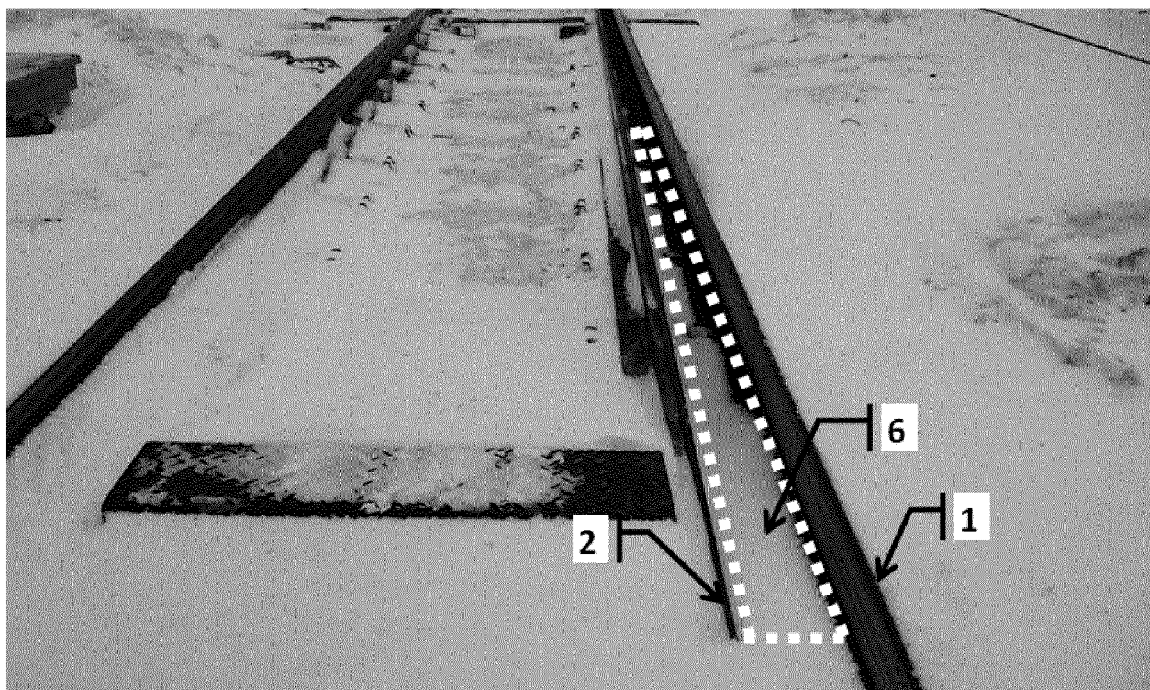


Fig. 2 (prior art)

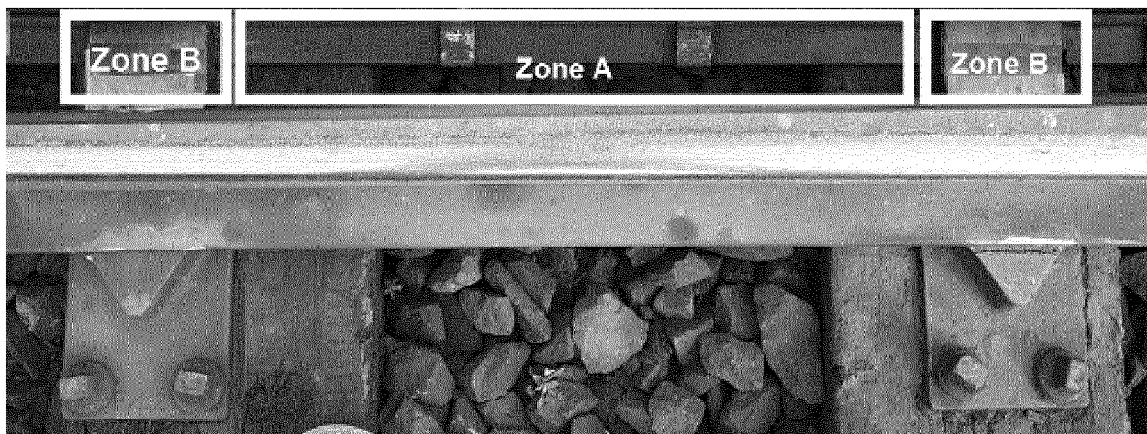


Fig. 3 (prior art)

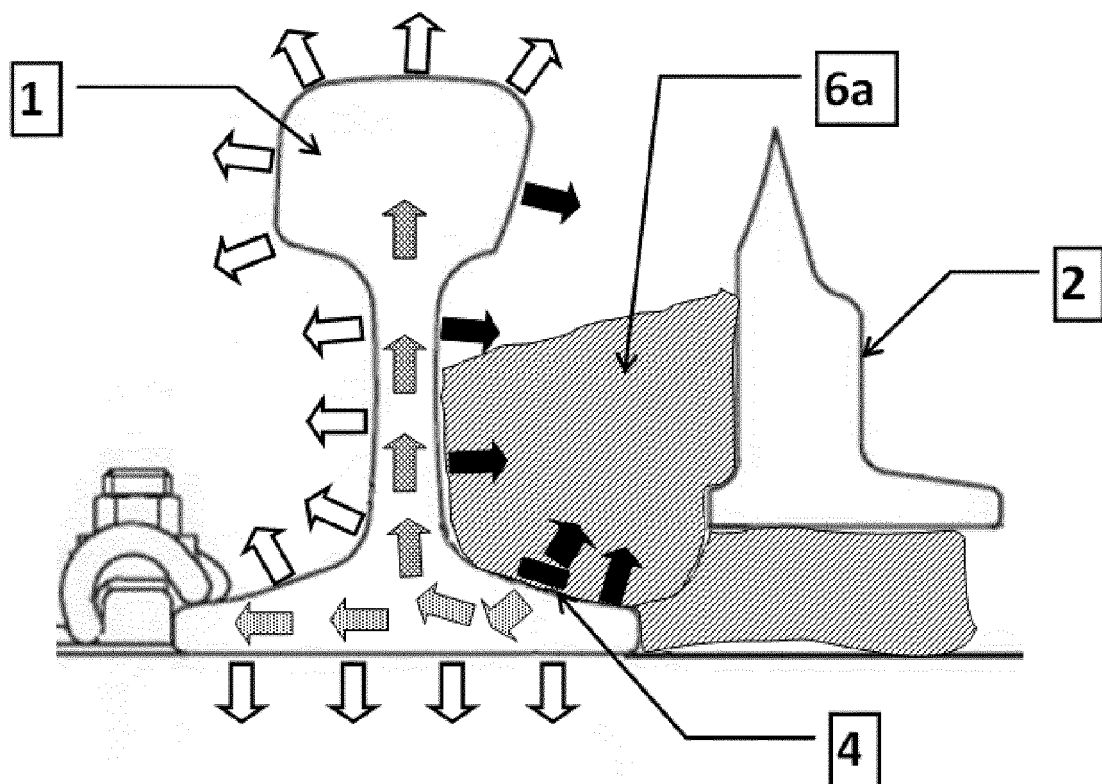


Fig. 4 (prior art)

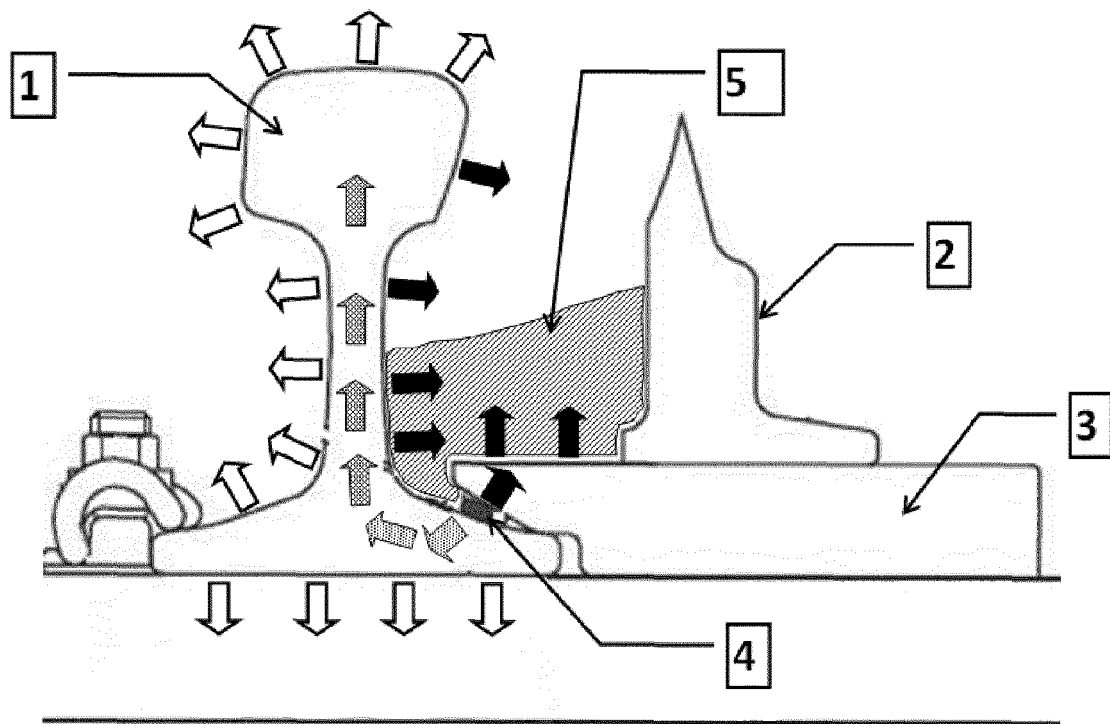


Fig. 5 (prior art)

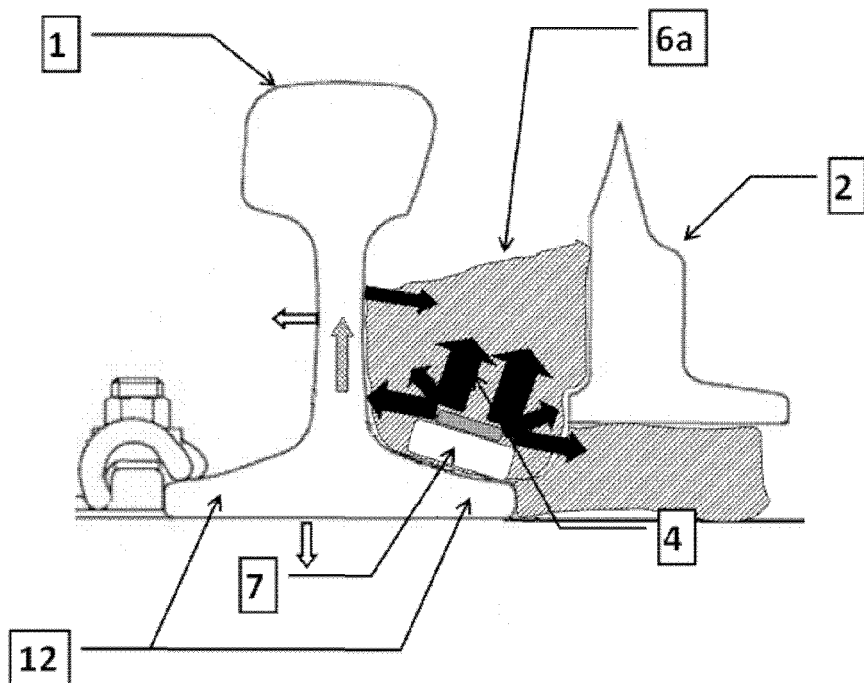


Fig. 6

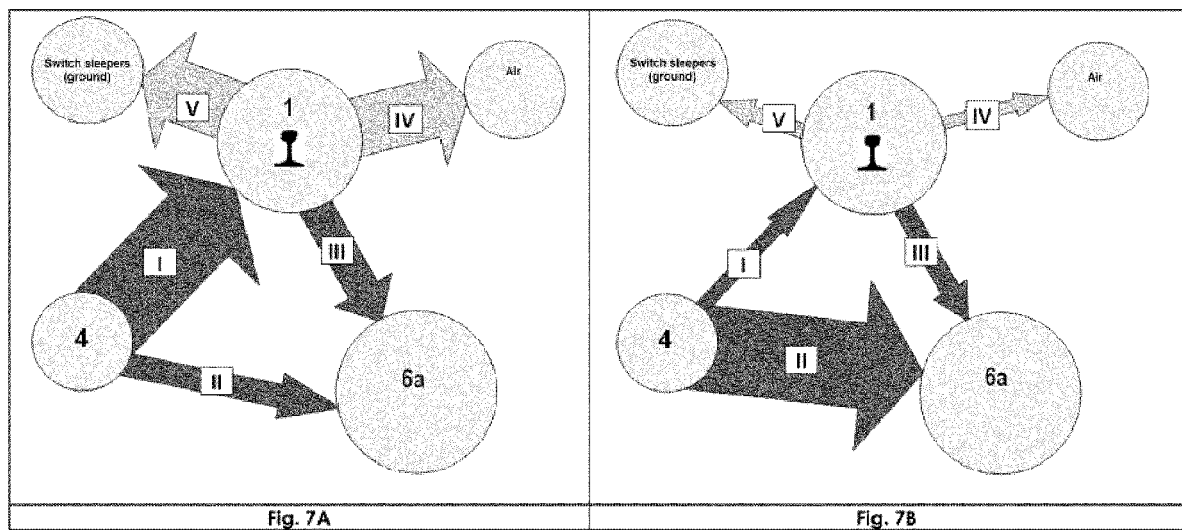


Fig. 7

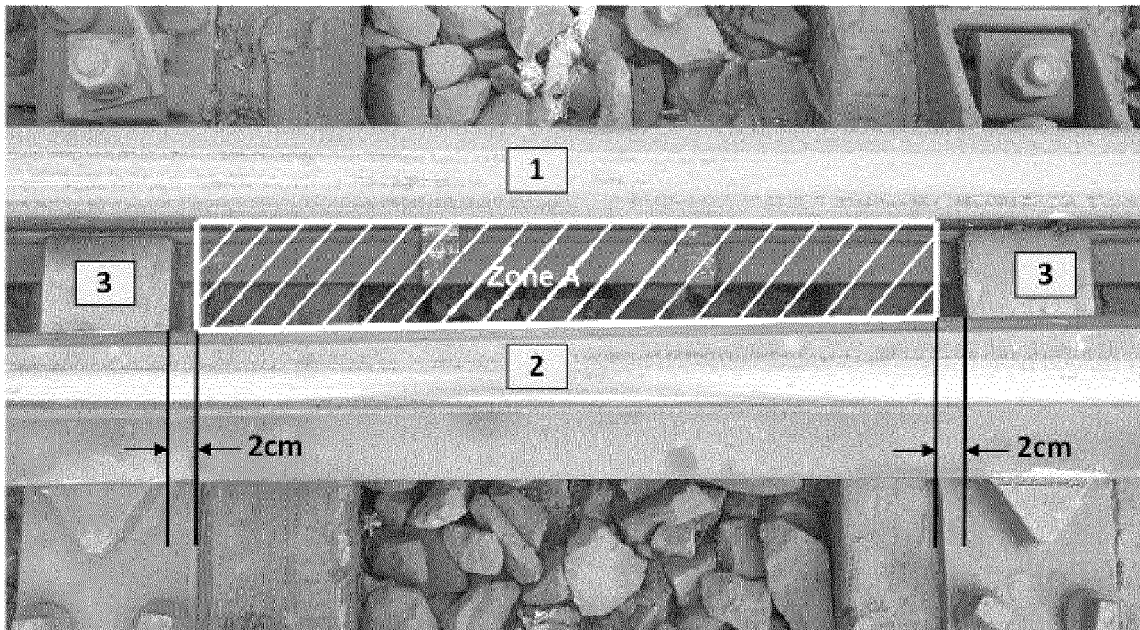


Fig. 8

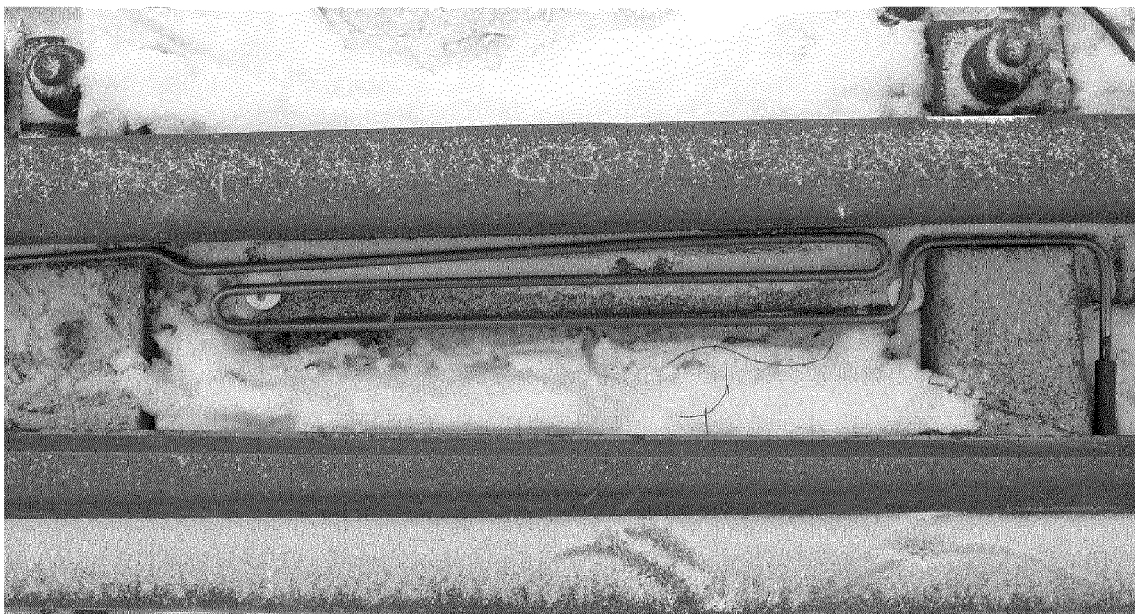


Fig. 9



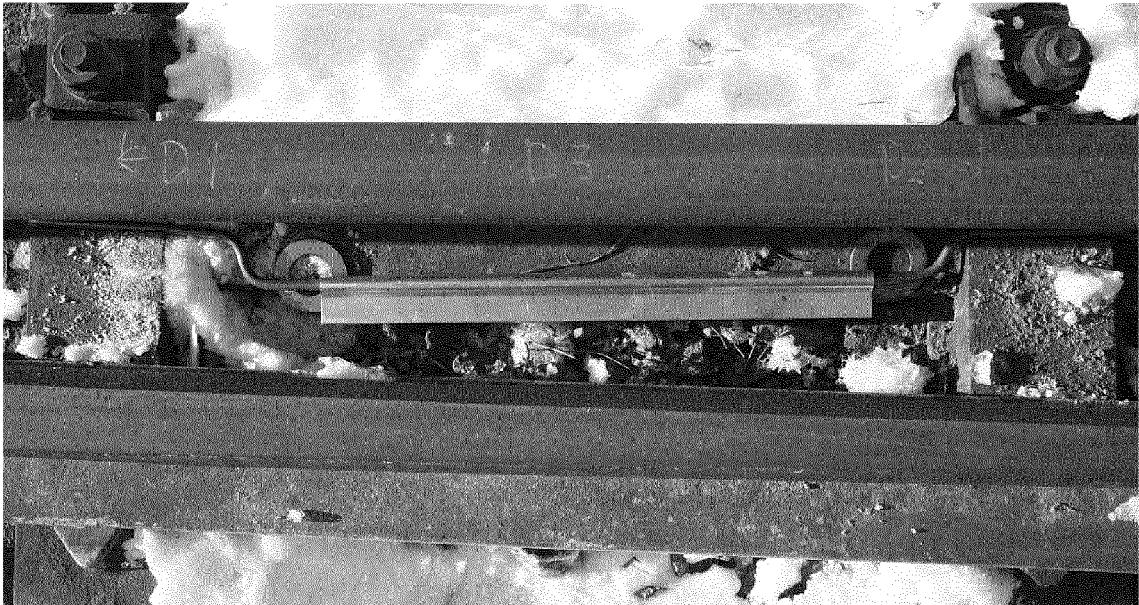


Fig.10

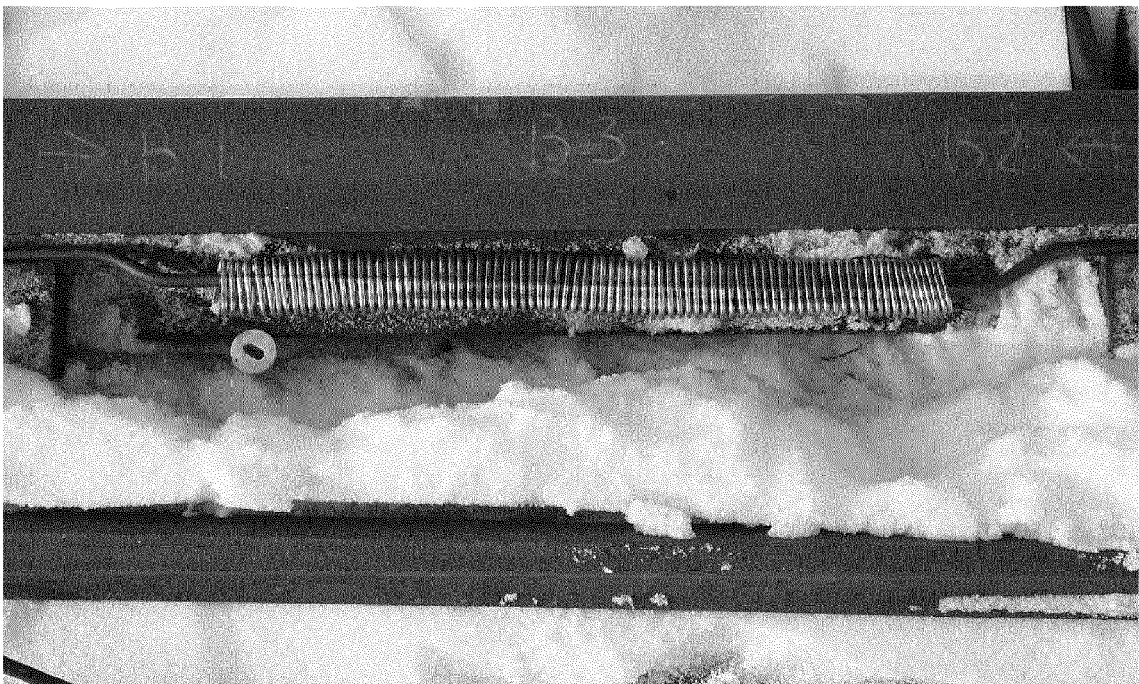


Fig. 11

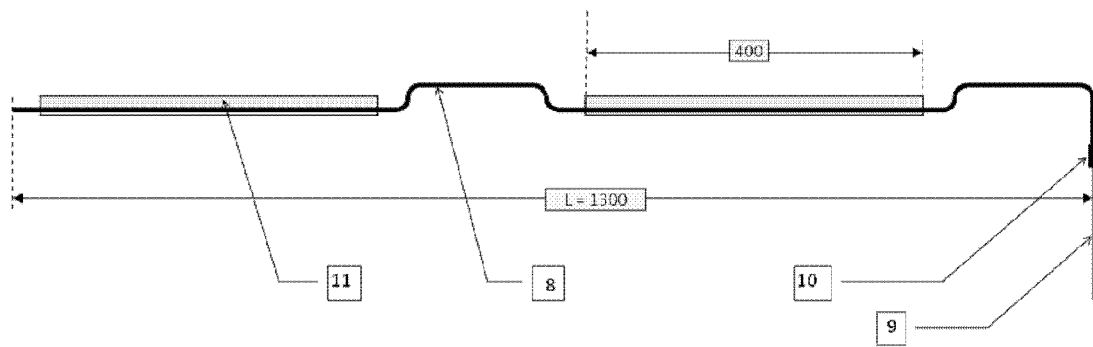


Fig. 12



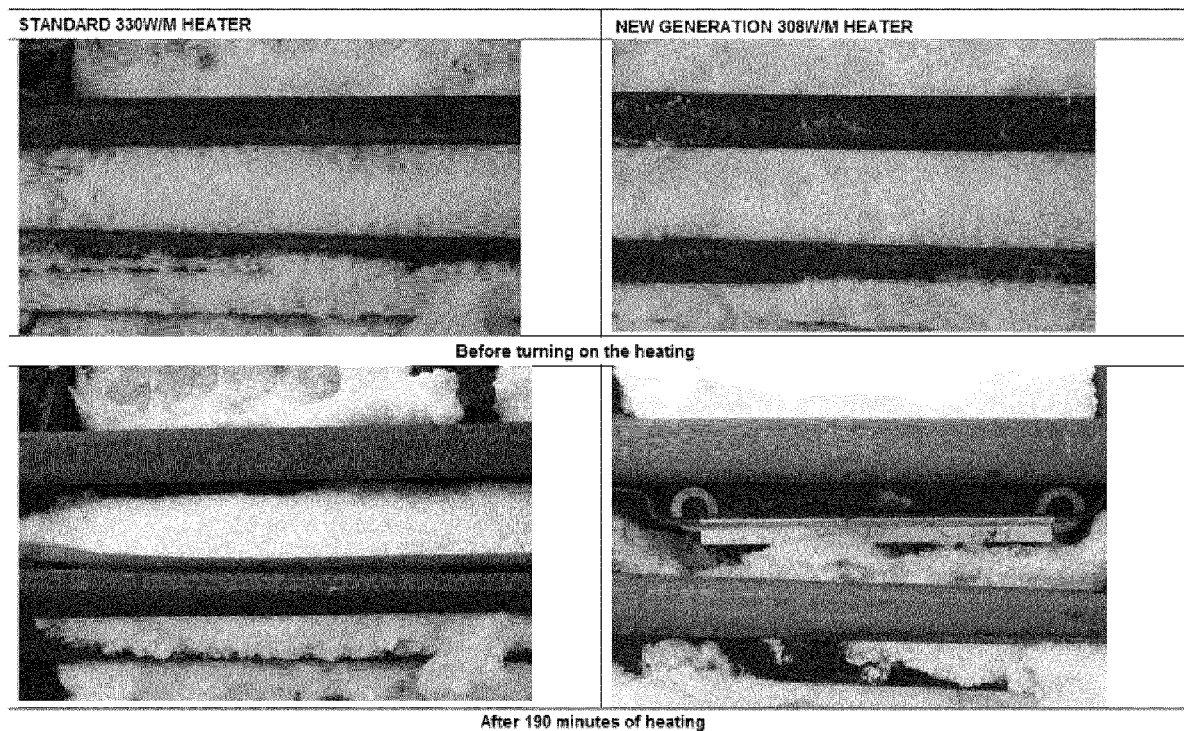


Fig. 13

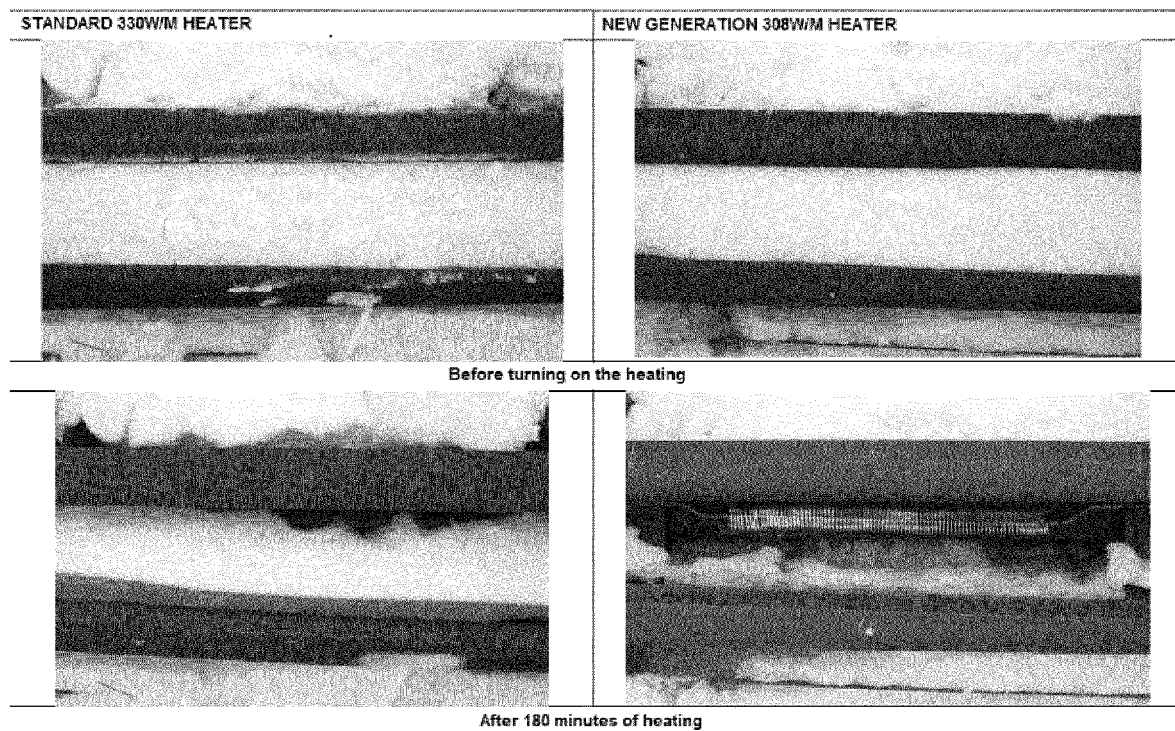


Fig. 14

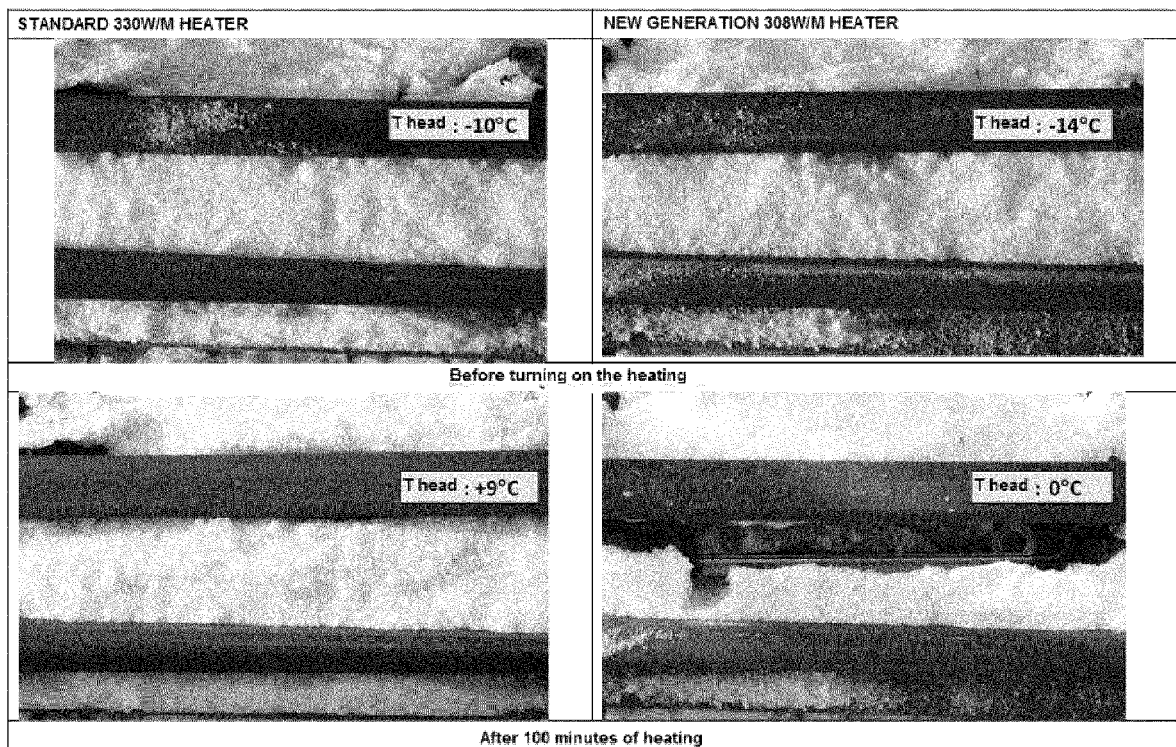


Fig. 15

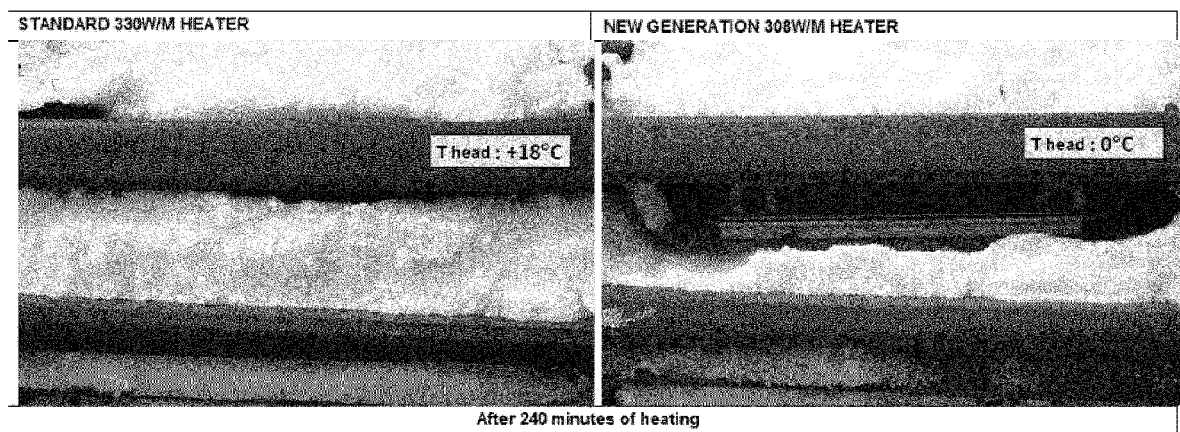


Fig. 15. cont

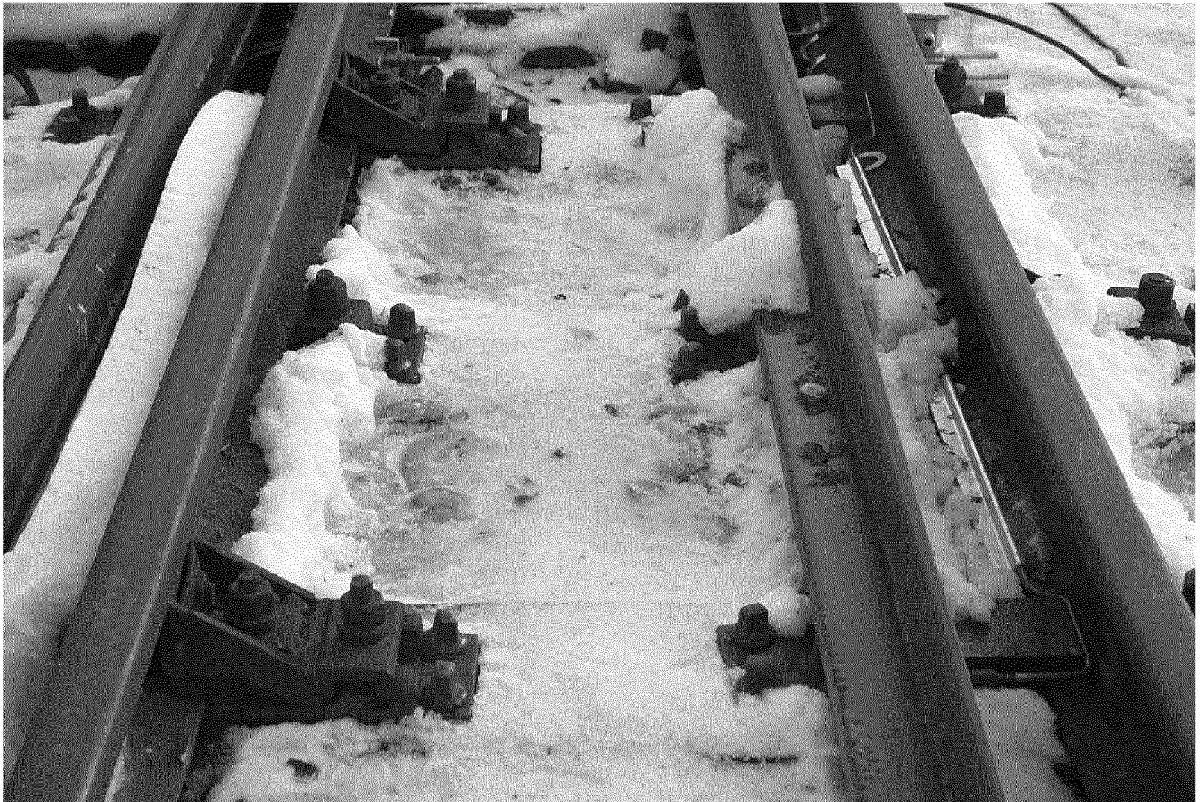


Fig. 16



## EUROPEAN SEARCH REPORT

Application Number  
EP 12 46 1526

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* page 3, lines 25-28; claim 1; figures 1-5 *	2,3	
X	US 3 264 472 A (SIMMONS LAWRENCE C) 2 August 1966 (1966-08-02)	1,5, 7-12,14	
A	* column 3, line 27 - column 4, line 25; figures 1-5 *	2,3,6,13	
X	US 2 654 826 A (SPURLIN MARCUS A) 6 October 1953 (1953-10-06)	1,5, 7-12,14	
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	* abstract; figures 1,2A, 2B, 3C,3D *		
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 November 2012	Examiner Fernandez, Eva
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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The members are as contained in the European Patent Office EDP file on  
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26-11-2012

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