

Feb. 1, 1966

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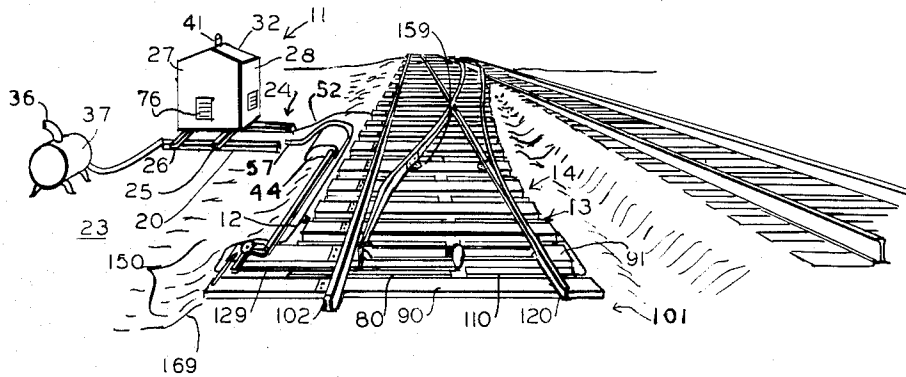
3,233,097

RAILROAD SWITCH HEATERS AND PROCESS OF OPERATION THEREOF

Filed March 5, 1964

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FIG. 1



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FIG. 3

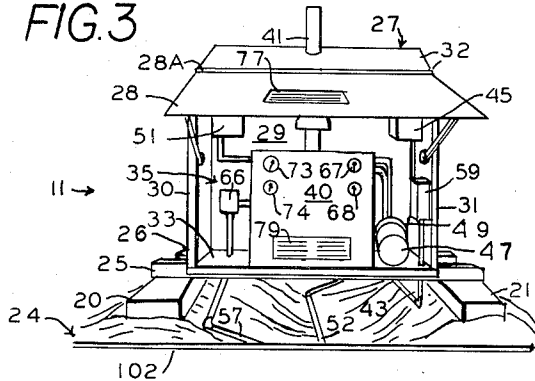


FIG. 4

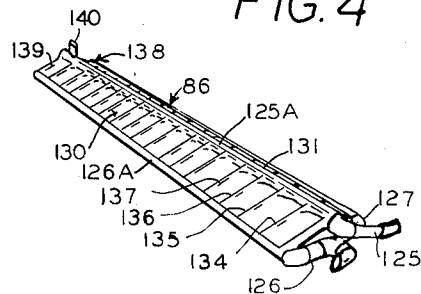


FIG. 5

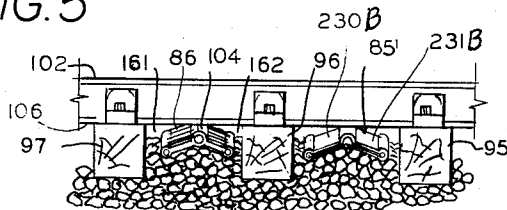


FIG. 6

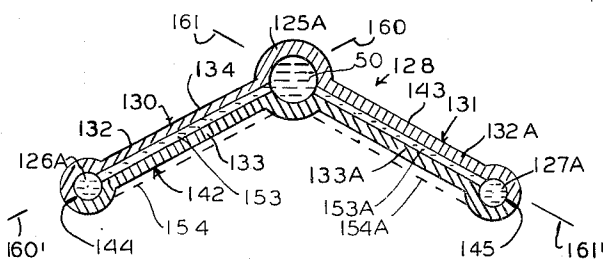
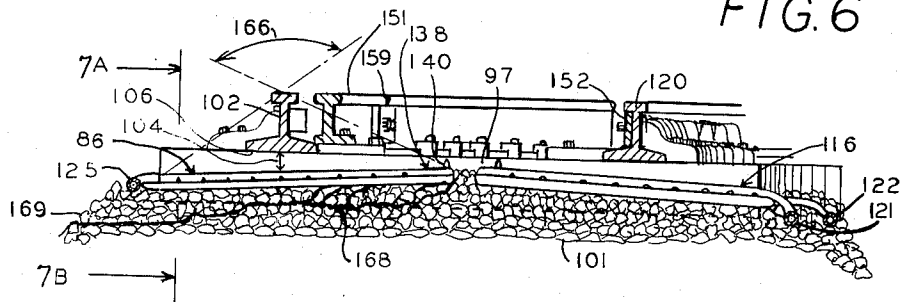


FIG. 7

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FIG. 7A

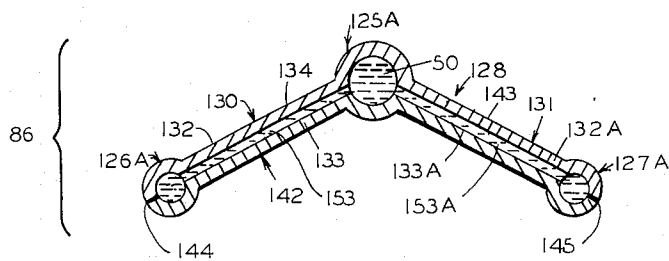
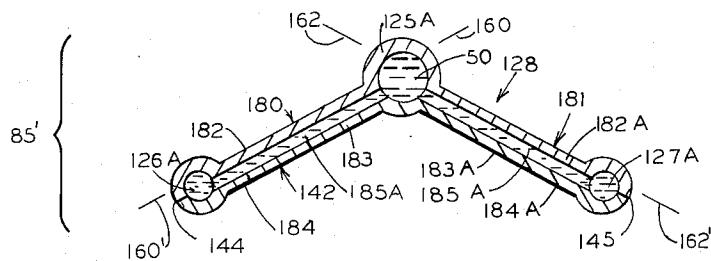


FIG. 7B



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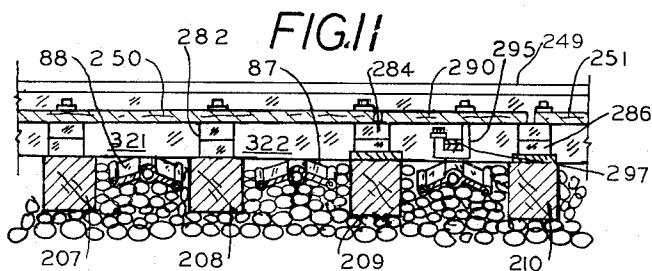
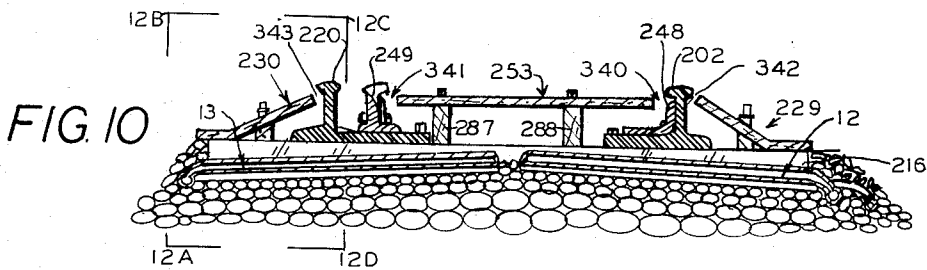
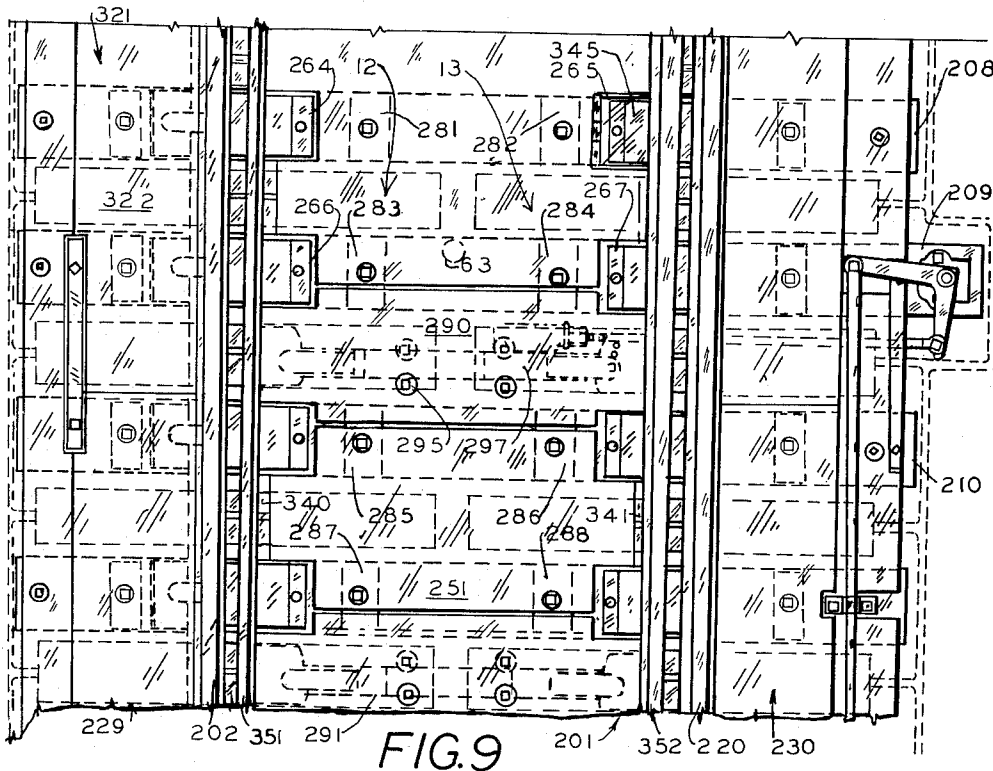
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RAILROAD SWITCH HEATERS AND PROCESS OF OPERATION THEREOF

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FIG. 8

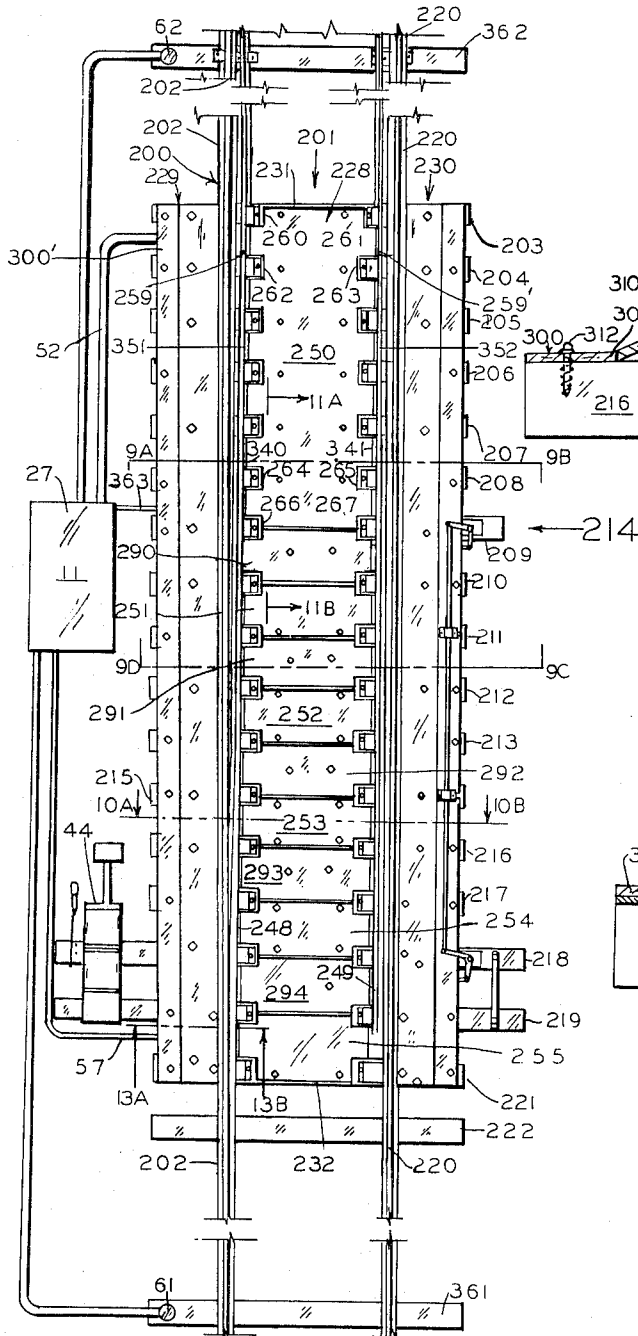


FIG. 12

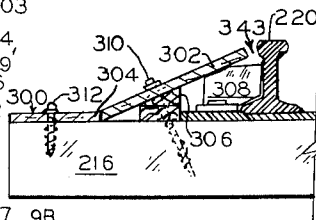
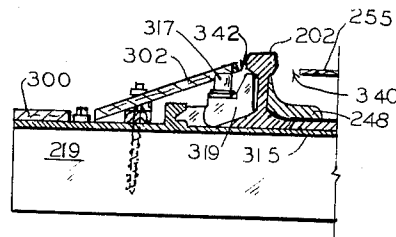


FIG. 13



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3,233,097 RAILROAD SWITCH HEATERS AND PROCESS OF OPERATION THEREOF

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Filed Mar. 5, 1964, Ser. No. 350,150

14 Claims. (Cl. 246-428)

This invention relates to improvements in apparatuses to keep railroad switches and rails clear of interference by snow and ice during inclement cold weather and to improvements in the process of operation thereof. This is a continuation-in-part of my co-pending application Serial No. 163,195, filed December 29, 1961, now abandoned.

One object of this invention is to provide railroad switch heaters of improved efficiency, capacity, and reliability of operation, and a process for their operation.

Another object of this invention is to provide railroad switch heaters of improved ease of installation.

Another object of this invention is to provide railroad switch and rail heaters of improved ease, economy, and reliability of maintenance.

Yet another object of this invention is to provide a process for drying as well as heating railroad switch sections and thereby maintaining such switches in operative condition, notwithstanding wet and cold weather conditions.

Other objects of this invention will become apparent to those skilled in the art on study of the below specification, of which specification the accompanying drawings form a part. In describing the invention reference will be made to the drawings showing preferred embodiments of my invention. In these drawings, wherein like numbers refer to same parts in all figures:

FIGURE 1 is an overall perspective view of one installation according to this invention;

FIGURE 2 is a diagrammatic top view of the railroad track and track heater portion of an installation as in FIGURE 1;

FIGURE 3 is a diagrammatic perspective view of the fluid heater subassembly portion of the installation shown in FIGURE 1;

FIGURE 4 is an enlarged perspective view of a rail heater element 86, of the apparatus of FIGURE 1, according to this invention;

FIGURE 5 is a sectional view taken along plane 5A-5B of FIGURE 6;

FIGURE 6 is a vertical sectional view taken along plane 6A-6B of FIGURE 2;

FIGURE 7A is an enlarged vertical cross-sectional view of one embodiment of a rail heater element of this invention as viewed along section 7A-7B of FIGURE 6;

FIGURE 7B is a similar view of another embodiment of this invention;

FIGURE 8 is an overall plan view of an improved embodiment of switch heater according to this invention;

FIGURE 9 is an enlarged view of the portion indicated as 9A-9B-9C-9D in FIGURE 8;

FIGURE 10 is a sectional view along the section 10A-10B in FIGURE 8;

FIGURE 11 is a transverse sectional view along the plane 11A-11B of FIGURE 8;

FIGURE 12 is an enlarged view of portion 12A-12B-12C-12D of FIGURE 10; and

FIGURE 13 is an enlarged view similar to FIGURE 12 along the section 13A-13B of FIGURE 8.

An installation according to this invention comprises a fluid heater subassembly 11, a left rail heating subassembly 12, and a right rail heating subassembly 13. The ends of subassemblies 12 and 13 are firmly attached to each other, as by welding in place, as below described, in the

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field at the switch section of railroad track and roadbed to be serviced by the installation, such section being generally shown as 14. The ends of the subassemblies 12 and 13 are also similarly attached to the fluid heater subassembly 11, as below described.

The fluid heater subassembly 11 sits on concrete piers 20 and 21 which are firmly fixed in and rest on the ground 23 at a location 24, as shown in FIGURE 1, sufficiently distant from the track switch section 14 to avoid any interference with the traffic thereover. Longitudinal girders 25 and 26 rest on, and are firmly attached to, said piers as by anchor bolts. These girders are level and firmly attached to and support the horizontal bottom of a frame housing 27. The frame of said housing supports side walls 28 and 29, end walls 30 and 31, a roof 32 and a floor 33. The frame pivotally supports each vertical side wall as 28 on a corresponding horizontally extending hinge, as 28A. The housing thus provides an enclosed interior space 35. Access to the space as for adjustment and maintenance is provided by the pivotal rotation of the vertical side walls about the aforesaid hinges, as 28A.

A source of butane gas 36 supplies a reservoir 37 which feeds a gas burner 39 in a fluid heater 40 in housing 27. The combustion gases formed by the burner 39 pass by a flue 41 out of the housing 27. The walls of the housing 27 are made of steel sheeting in the preferred embodiment and are louvered as shown at 76 and 77; the gas burner chamber is louvered as shown at 79 for ingress of the air to the burner.

A source of electric power, line 43, which is the same source as actuates the switch mechanism 44, charges an electric battery 45 inside the space 35. The battery "floats" on the line 43 and serves for a source of energy of operation during temporary failure of the electric power source. The battery and/or the electric power source drives a variable speed electric motor 47 connected to a pump 49. Pump 49 drives a liquid heat transfer fluid, 50, of low melting point, as "DOWTHERM E" (trademark of Dow Chemical Co. of Midland, Michigan for O-Dichlorobenzene stabilized for heat transfer use, having a freezing point of -22°C . and a boiling point at 760 mm. Hg pressure absolute of 179.5°C .) in the preferred embodiment, through sub-assemblies 11, 12, and 13. Such fluid enters pump 49 from reservoir 51 for such fluid and from fluid heater inlet line 52 and passes from said pump into the coils 55 of the fluid heater 40. There such fluid is brought into effective heat exchange with the hot combustion gases formed by the gas burner 39. The heated fluid passes out from the heater 40 by fluid heater discharge line 57.

The operation of pump 49 is controlled from a conventional control box 59, which is supported in housing 27 on the frame thereof. The pump is, as below described, actuated by exterior sensing elements 61 and 62 and 63. Pressure sensitive elements as 65 and 66, sensitive to the pressure of the heat transfer fluid in the fluid inlet and outlet lines respectively and connected to indicating instruments 67 and 68 respectively, and temperature sensitive elements 71 and 72 in the inlet and outlet lines 52 and 57 respectively connected to temperature indicating instruments therefor, as 73 and 74, are also connected to the control box 59 for purposes as below described.

The left rail heating sub-assembly 12 comprises a series of like rail heater elements as 80-88. These elements are located between, and slightly spaced away from, the ties as 90-99 and below and out of mechanical contact with the nearest (left railroad track rail 102 of section 14. Each heater element as 80-88 is located on top of the surface of the railway roadbed 101 although out of direct mechanical contact with such nearest rail. Each of the ties as 90-99 is spaced from its neighboring ties

with from 10 to 12 inches space therebetween as shown for ties 95, 96, and 97 in FIGURE 5. The ties are each about 7 inches high and from 9 to 11 inches wide. The top of each heating element, as shown for element 86 in FIGURES 5 and 6, is spaced from the bottom edge, as 106, of each corresponding rail, as 102, where such rail passes directly over said heating element, by a distance, 104, which distance, in the preferred embodiment, is about 2 inches and in the range of 1 to 3 inches.

The discharge line 57 is connected to and feeds the inlet end 103 of the rail heater distribution sub-assembly 12. The fluid heater inlet line 52 is connected to, and is fed from, the outlet end line 105 of assembly 12.

A right rail heating sub-assembly 13 comprises a series of rail heater elements as 110 to 118. These elements have the same structure as elements 80-88. They rest on top of the railway roadbed 101 between and slightly spaced away from the ties as 90-99 and below and spaced away from, i.e., out of mechanical contact with, the right hand railroad rail 120. As shown in FIGURE 2, the inlet line 121 of sub-assembly 13 is connected to the inlet end 103 of sub-assembly 12 and outlet line 122 of sub-assembly 13 is connected to outlet end line 105 of sub-assembly 12.

In the preferred embodiment, the rail heater distribution elements 80-88 and 110-118 each comprise, as shown for element 86 in detail, a "hot" or inlet conduit 125 and "cold" or outlet conduits 126 and 127 formed of standard steel pipe and a pressed steel heat transfer unit 128. The unit 128 comprises an inlet conduit 125A of $\frac{3}{4}$ " I.D. and outlet conduits 126A and 127A of $\frac{1}{2}$ " I.D. A web member 130 extends from conduit 125A to 126A and a web member 131 similarly extends from conduit 125A to 127A. Each web member, as 130, is formed of two plates of 14 gauge pressed steel, as 132 and 133. Each upper plate, as 132, is generally flat but pressed to form therein a series of upward projections, with downwardly open grooves, 134, 135, 136, and 137, each of $\frac{1}{8}$ " internal radius: each lower plate as 133 is flat and welded to the corresponding upper plate near the edge of each of these grooves. Thereby a definite channel as 153 and 153A is formed on the interior surface of each of these grooves and serves to connect conduit 125A to conduits 126A and 127A. The grooves, as 134, 135, 136, and 137 are spaced apart 6 inches in the preferred embodiment along the entire length of the unit 128, except however at the central end, 138, a larger $\frac{1}{2}$ inch I.D. conduit 139 is provided to connect the ends of conduits 125A and 126A for directing some of the heating fluid along the entire length of the unit 128. A vent 140 is provided at the central end 138 of the conduit 125A to permit venting of vapor or air during installation of the parts of the system. Such vent is locked or screwed shut after applying sufficient pressure of fluid to the system to remove unwanted gas and the fluid system is then closed. The channels, as 153, in each groove as 134, 135, 136, and 137 provide for improved heat transfer from the heat transfer fluid 50 inside the pipes and conduits as 125, 125A, 126, and 126A, to the web as 130 and the large surface thereof, and thence, to the associated rails as 102; web 131 has a corresponding structure to interconnect conduits 125A and 127A. The unit 128 is made of a lower member 142 comprising corresponding lower plates 133 and 133A and the lower portion of conduits 125A, 126A, and 127A, all made of 14 gauge pressed steel. The upper unit 143, also of 14 gauge pressed steel, is composed of the upper portions of conduits 125A, 126A, 127A and of corresponding upper plates 132 and 132A. The members 142 and 143 are joined together along their adjoining edges by continuous welds 144 and 145 to form the complete and leakproof conduits 125A, 126A, and 127A. Conduits 125 and 125A are joined by welding as are conduits 126 to 126A and 127 to 127A respectively. Each of the rail heating elements as 86 are about 9 inches wide and 2 inches in

total height (from top of conduit 125A to bottom of 126A and 127A) in the preferred embodiment; this allows their use in the usual 10 to 12 inches space between adjacent railroad ties and provides for placement of these heating elements above the level of the roadbed riprap and spaced from one to three inches below the bottom level of the nearest rail where such rail passes over said element. This provides an excellent radiation situation for transfer of heat from the heating elements as 80-88 and 110-118 to the rails without interfering with the switch mechanism moving parts, as 129. The heating elements 80-88 and 110-118 are out of mechanical contact with the rail; the piping as 121 and 122 and 103 and 105 bringing the heating fluid to and from the heating plates is also out of contact with the rails and the ties and is supported on the relative stable railroad track roadbed. Accordingly, the heating system elements according to this invention are subjected to a minimum amount of vibration. The welding of the joints above described to provide the assembly of the above described sub-assemblies also prevents leakage of the heat transfer fluid and serves to provide an apparatus and installation which is very sturdily constructed and thoroughly able to resist the vibration which occurs in the operation of the railway track bed while avoiding that occurring in the railroad rails. The heater, in the preferred embodiment, puts out about 147,000 B.t.u. per hour and provides for a discharge temperature of fluid of 225° F. in line 57 at about 15 p.s.i. gauge pressure while pump 49 has $\frac{1}{2}$ H.P. and discharges $7\frac{1}{2}$ gallons per minute at a 12-foot head. The series connection of the rail heating elements as 80-88 (inlet of second element to outlet of first element, inlet of third element to outlet of second element, etc.) provides that the heating fluid in its hottest condition, i.e., coming most directly from the heater discharge line 57, passes, in the preferred embodiment, to the bottom of the most critical zone in the switch section, i.e., zone 150 below the tips 148 and 149 of the movable tongues 151, 152 of the switch.

In a preferred embodiment of this invention the rails 102 and 120 are standard 8 inch high rails spaced 60 inches apart from each other and 3 inches wide at their top, and the ties as 96 and 97 are each 9 feet long, so that there is a two-foot lateral extension of the ties as 90-99 beyond the rails 102 and 120.

The plates as 130 and 131 in left hand sub-assembly 12 extend from 2 feet to the left of the left rail 102 to within 1 to 2 inches of the center of the distance between rails 102 and 120. The plates in the right hand sub-assembly 13 extend from about 2 feet to the right of rail 120 to between 1 and 2 inches from the center of the distance between rails 102 and 120. Elements 110-118 are shown in FIGURE 2 as connected in parallel across line 121 and 122 for purpose of illustration rather than in series as shown for unit sub-assembly 12. In the preferred embodiment the rail heater elements of both sub-assembly units, left hand and right hand, such as 12 and 13, are connected in series across lines 52 and 57 as shown in FIGURE 2 for the sub-assembly 12, and web plates, as 130, 131, are continuous sheets.

External temperature sensing element 61 is located on tie 100 between track rails 102 and 120 a distance of several ties from the nearest heater plate element as 90 and 110. External thermal sensing element 62 is similarly located on tie 100', which tie is located a similar distance along the track from the other end of sub-assemblies 12 and 13. Such temperature sensing elements form a part of sub-assembly 11 and are connected to control box 59 to cause pump motor 47 to begin operation and heater 39 to heat the fluid 50 in boiler coils 55 when the outside or ambient temperature falls to a predetermined level—as 35° F. in the preferred embodiment. An external sensing element 63 is located between the rails 102 and 120 and out of contact with any heater element, as 90-98 or 110-118, and is located on top of a tie as

95 between heater elements, as shown in FIGURE 2; it cuts off fluid heater 39 when the temperature of air sensed by said element is above 90° F. Internal sensing elements 71 and 72 increase the speed of motor 47 and the pump-rate of fluid 50 whenever the temperature of the return fluid in pipe 52 is more than 30° F. lower than in the discharge line 57. A safety valve (not shown) cuts off the heater 39 when the pressure in the discharge line 57 exceeds 50 p.s.i.g. or falls to zero and cuts back the heater slightly when the discharge line pressure is over 25 p.s.i.g.

In operation lines 57, 103, 121, 105, and 122 conduct the heated heat transfer fluid in a closed circuit including the inlet and outlet pipes as 125 and 126 of each of the heater elements as 80-88 and 110-118 and the fluid heater 40.

Each of the heater elements as 80-88 and 110-118 are located on the top of the railroad roadbed riprap so that the transfer of heat by radiation from said elements to the rails thereover will not be diminished by overlying material. The porous layer of gravel or riprap of the roadbed below those plates serves as a heat reservoir for purposes below described.

In the preferred embodiment the hottest fluid is passed directly to the zone 150, where tips 148 and 149 of the movable tongue or turnout rails 151 and 152 of the switch 14 are located. This provides for most effectively heating the zone whereat such tips of the tongue or turnout rails are situated and so avoids any interference with the proper operation of such movable elements by snow or ice or frost settling on or between such rails. This is particularly important in order to avoid derailment problems which may occur because of the accumulation of snow and ice between such moving parts in this particularly sensitive zone.

The left hand sub-assembly 12 is assembled as a unit in the shop and put in place in the switch section 14. Such sub-assembly extends for 18 ties in the preferred embodiment. More generally, such sub-assembly (as 12 or 13) extends from one (as 90) or two ties past the movable end as 148, 149 of the movable tongue or turnout rails 151, 152 of a switch to one or two ties past the pivots, as 159 and 159' for such turnout rails. The installation of sub-assemblies 12 and 13 of this invention thus provides a pair of rail heating elements as 80-88 and 110-118 between each of the ties along the length of track between which the movable portion of the switch section—i.e., turnout rails as 151, 152—is located, which length of track is serviced by the installation of this invention rather than the particular number of heating elements and ties shown diagrammatically in FIGURE 2.

For installation, the apparatus of this invention merely requires moving of enough ballast from the roadbed 101 to insert the heating elements under, but out of contact with, one of the rails and thereafter putting one sub-assembly, such as 12, in place as above shown. This is followed or accompanied by putting the other such assembly, as 13, in place; thereafter the joints between these sub-assemblies at points 154, 155, 156, and 157 may be welded together. The sub-assembly 11 is assembled as a unit, i.e., prefabricated in a shop and moved to place on top of the piers 20 and 21 on the girders 25 and 26. The fluid discharge and fluid inlet pipes 52 and 57 are then joined to the pipes 103 and 105 at joints 156 and 157.

The porosity of the ballast forming the roadbed 101 below the heating element cooperates with the above discussed structure: it serves, not only as a reservoir of heated material but also to provide passage for the melted snow coming from the top of the track as a fluid; the porous ballast in roadbed 101 is composed of 1-2 and ¾"-1½" crushed stone (nominal size of square opening, in inches, as in Taggart, Handbook of Mineral Dressing, J. Wiley & Sons, N.Y., 1944, pp. 3-107) in the preferred embodiment: It acts as a heated volume of

material of substantial heat capacity and also provides channels wherethrough the water resulting from snow melted under the influence of the high temperature and large surface area of the heating elements as 80-88 (and 110-118) may flow below the level of the ties. This provides for rapid and lateral discharge or escape of the snow or ice melted by the sub-assemblies 12 and 13 from the roadbed 101 and thus avoids any build-up of ice formation as might otherwise interfere with the operation of the switching element if such ice were allowed to accumulate below (and thereafter, above) the level of the ties. The space 161, 162 between the elements as 86 and the ties as 96 and 97 adjacent thereto allows for runoff from the sloped tops of each element, as 86, of water produced from the melted snow. Thereby drainage away from as well as melting action on snow and/or sleet on the ties and all the surfaces of the rails 102 and 120 and switch parts, e.g., 151, 152, and 159, are provided. The temperature of the rail heater element is maintained by the above described temperature sensing elements and burner and pump controls at a sufficiently high level (225° F.-185° F.) to evaporate whatever water would remain in contact with those elements whenever the ambient temperature falls to any given temperature, e.g., 35° F. and the pump is run at such a speed as to permit only a predetermined temperature drop between lines 52 and 57 and thereby provides for the evaporation of water on and under the track section 14 and, thereby, for the removal therefrom after the snow or ice initially contacting same has been melted.

According to this invention the solid angle 166 "seen" from the section 14 (as at 150) of rails 102 and 120 to heater elements as 86 and 116, is about 140°; this provides excellent heat transfer from the physically near (2 inches from bottom edge 106 to top of heating element, as 86) heater elements of the sub-assemblies 12 and 13 to the rails by radiation while mechanically such rail heater elements as 80-88 and 110-118 are not subject to direct mechanical vibration from the rails as 102 and 120, and 151 and 152 from trains passing thereover.

Also, by the apparatus of this invention, when the ambient temperature drops, as sensed by distant (from sub-assemblies 12 and 13) elements 61 or 62, the heater 11 and sub-assemblies 12 and 13 render the entire porous roadbed mass 101 in their vicinity warm and thus establish a heat reservoir in the roadbed 101 in the zone below the switch section 14 to minimize any subsequent accumulation of ice and water in such zone; then, when frost, snow, or sleet subsequently occur, the ice or snow resulting from such weather which is melted has, in the preferred embodiment, a warm porous zone of the roadbed 101 through which to discharge the liquid resulting from melting of such snow and ice or sleet above the level of roadbed 101 by the action of sub-assemblies 11, 12, and 13 as above described.

Because the rails as 102 and 120 may get quite cold due to radiation on a cold, clear night, moisture in the atmosphere frequently settles on and forms ice between the rails as 102, 120 and the points 148 and 149 of the movable tongue or turnout rails as 151 and 152 of a switch, as 14: Such ice interferes with the operation of such switches. The apparatus of this invention, however, being set to start when the ambient air temperature falls to about 35° F., prevents ice forming on such structures and from so interfering with the operation of such switch. In the preferred embodiment above described, this apparatus provides a large heat capacity—147,000 B.t.u. per hour boiler output—for the 30 foot length of track section 14, serviced by this installation and this apparatus provides for the delivery of substantially all of such heat energy to the rails and also to below the level of the rails to provide channels as 168 in the porous roadbed 101. The water which results from the melting of the snow and ice coming to a switch section during inclement

cold weather may be removed by such channels to the sides, as 169, of the railway roadbed 101. When the roadbed is not so porous, another structure of apparatus within the scope of this invention, as below described, provides for discharge of the water resulting from melting of such ice and/or snow and/or sleet laterally of the rails of the section serviced by the installation of this invention.

During an experiment when there was weather of 0° F. to -3° F. for 12 hours and 35 m.p.h. winds there was only a 22° F. drop from the discharge line 57 to inlet line 52 and using the installation of the above described preferred embodiment for the 18 ties in the 30-foot long switch section 14, sub-assemblies 12 and 13 extending 9 inches length-wise beyond the ends of the movable turnout rails as 151 and 152, such section was preserved totally without any ice formation thereon notwithstanding the deposit in the immediate vicinity of said track section of 3 inches of snow. Also, during a ¾ inch fall of snow in 3 hours at an average temperature of 4° F. the above section was maintained free of any accumulation of ice and moisture. The snow was observed to be melted and discharged from the tracks and ties and units as 128 substantially as soon as such snow contacted same.

This invention also includes the process above described of maintaining a railroad track and switch section (as 14) free of encumbrance by ice and snow, said process comprising the steps of heating said movable rails and portions of the fixed rails adjacent thereto by the transfer of heat thereto by radiation from heated elements out of mechanical contact with said rails and located below said rails and between said ties, said elements providing about 900 sq. inches of surface upwardly directed and located below each 20 inches of length of said pair of rails, while said elements are concurrently heating the porous roadbed below said heating elements and so distribute up to about 5,000 B.t.u. per hour per foot of length of track as needed from said heating elements to said track rails and roadbed therebelow to discharge melted snow and ice substantially (2 feet in the preferred embodiment, as the units as 86 extend as far laterally of the rails thereabove as do the ties, as 96, 97) laterally of said rails.

As above described, the heating elements are heated by fluid at about 225° F. so that, in the preferred embodiment and procedure, said heating element surfaces are maintained above or at the boiling temperature of water. This effects and expedites evaporation of water from the ties and rails above said heating elements, from the heating elements, and from the interstices of the porous roadbed below said heating elements and so avoids accumulations of moisture on said surfaces as might subsequently solidify and interfere with the operation of the switch.

While according to the preferred embodiment of this invention above described, a porous roadbed is used, it is within the scope of this invention that the apparatus consisting of subassemblies 11 (which includes the associated sensing elements as 61, 62, and 63) 12, and 13 be used with a relatively non-porous roadbed such as one made of tightly packed sand. For use in such circumstance, the upper surfaces as 130 and 131 of unit 128 in each heating element as 80-83 and 110-118 are modified from as above described in reference to the embodiment shown in FIGURE 7A to a structure as shown for web plate elements 180 and 181 in heating element 85' shown in FIGURE 5 and FIGURE 7B. Each upper surface 182 and 182A of web plate elements 180 and 181 is flat rather than ribbed by upwardly projecting grooves as 134, 135, 136, and 137 as shown for element 86. In the embodiment shown as item 85' of FIGURES 5 and 7B, a series of downwardly projecting grooved extensions as 184 (corresponding to mirror images of items as 134) and 184A (corresponding to mirror images of items as 134A) each with an upwardly open channel or groove

185 (in 184) and 185A (in 184A) respectively are provided in the lower web plates 183 and 183A of such modified unit 128 in lieu of the above described component of the lower web plates (133 and 133A) of unit 128 so that downwardly projecting grooves and passages (functioning generally as 153 and 153A provided in upper plate 132) are then provided by plates 180 and 181 and chambers 185 and 185A predominantly in the lower web plates. The upper surfaces of web plates 180, and 181 are then located in plates as 160-160' and 162-162' respectively as shown in FIGURE 7B; planes 160-160' and 161-161' pass through the centers of the cylindrical conduits 126A and 127A respectively. The sloped position of the heating elements as 86 and 116 in FIGURE 6 (which position is also typical of the position of similar elements 80-83 and 110-118) provides that the central portion, as 138 of each heating element, as 86 and also 85', is higher than the lateral portion of each such element (such lateral portion being connected to the inlet and outlet pipes therefor, as 125, 126, 127). Each such element, as 85', also passes underneath the associated rail, as 102, with one to three inches space between said rail and said element where said element passes directly below said rail.

This sloped position of the top surfaces of the web plates as 180 and 181 provides, in each such heating element, for drainage of water resulting from the melting of snow and/or ice or sleet thereon and discharge thereof laterally of the rails (as 102 or 120) associated therewith by passage of such water along the laterally downwardly sloped troughs formed by the sloped upper flat surface as 180 and conduit 126A and along the laterally downwardly sloped trough formed by the sloped top surface of the web plate 181 and the conduit 127A; elements as 85' extend as far laterally as do elements as 86, namely as far as the ties on either side of such heating element. Otherwise the installation of sub-assemblies 11, 12, and 13 when used with a non-porous roadbed is the same as above described with a porous roadbed. The elements as 85' may be used with a porous roadbed as well as with a non-porous roadbed.

The units of the apparatus of this invention have been described for a switch unit 14 of 18 ties length from a first tie, as 90, located past the ends of the movable tongue or turnout rails as 151, 152 to the last tie of such section, as 99, located on the other side of the points about which such movable turnout rails pivot, as 159, 159', and the distance from said first tie to said last tie is 30 feet. The installation and process of this invention are, however, intended to be used where the switch length is shorter (e.g. of 6 to 7 ties and about 12 feet length) as well as longer. With such shorter or longer switches a heater or unit as 40 may be of lesser or greater output in order to provide, as above described, up to 5,000 B.t.u. per hour per foot of length of track, e.g. about 150,000 B.t.u. per hour output for a 30-foot long installation and about 60,000 B.t.u. per hour output for a 12-foot long installation with the heating units as 80-83 and 110-116 or units such as 85' in subassemblies as 12 and 13 providing about 900 square inches of surface (9 inch width x about 100 inches total length) for each 20-inch length of track (i.e. 20 inches of total length of the pair of track rails as 120 and 102 and ties therebetween) such heating elements being, as above described for the preferred embodiment, located close to (from one to three inches distant where the rails pass above each of the heating elements) yet spaced away from the rails to be heated by each said heating element, and said heating elements provided with fluid in the same manner as above described for the preferred embodiment and at the same heat intensity—i.e., 225° F. as above described for the preferred embodiment.

While Dowtherm E is described as used in the preferred embodiment, other heat transfer fluids of low melting point and high boiling point such as ethylene glycol

(M.P., -17°C. ; B.P., 197°C.) stabilized for heat transfer use in a metal system as herein provided, or air may also be used as fluid 50 herein.

It is also within the scope of this invention that a thermopile actuated by the heat of burner 39 may be connected to box 59 and battery 45 to provide the electrical energy required to drive the motor 47 if the source of electrical energy 43 should fail. Such arrangement provides that the installation of this invention would be entirely self-contained, without dependence on outside energy, for long periods of time in the event of the failure of the electrical energy source 43. Also within the scope of this invention such a thermopile may replace the source 43.

The temperature-sensing elements 61, 62 and 63 which are each conventional temperature-sensing instruments, are indicated by the standard representation for an instrument locally mounted as set out at page 336 of Eckman, "Industrial Instrumentation," John Wiley & Sons, New York, 1950, although, specifically, a Model V-1 Thermostat of the Berling Instrument Company, South Orange, New Jersey, may be used, the Minneapolis Honeywell Model L4008C Thermostat 0°F. – 70°F. range is preferred; the thermostat is adjusted so that the contacts thereof are closed when the ambient air temperature descends to 35°F. and remains closed at all temperatures therebelow.

The control box 59, shown in the drawings as a square, is a conventional controller well known per se, such as a Honeywell R7087D Resistance Thermometer Controller, and, in the preferred embodiment, a Minneapolis Honeywell Model RA-816A; the box is set to de-energize the burner when the fluid temperature rises above 400°F. and to re-energize the burner when the fluid temperature drops to 360°F.

The gas burner 39 is a conventional burner well known per se; in the preferred embodiment above described, a Carlin Model 400N-3 pedestal mounted with a J2CB-100 single-stage fuel unit and a $\frac{1}{8}$ H.P., 120 volt, 60 cycle motor. The single-stage fuel unit has a built-in strainer and pressure-regulating valve. The motor has a safety overload valve. The burner has the usual wire electrode which, in the preferred embodiment is a conventional wire and porcelain electrode assembly, Carlin part No. 423 in the preferred embodiment. The strainer is provided in the fluid-circulating system to keep impurities from affecting the pump operation. The $\frac{1}{8}$ H.P. motor operates a fan.

The pressure-sensitive instrument 65 is a conventional pressure-sensitive element. In the embodiment of FIGURES 1-5, a McDonnell No. 69 fluid cutoff is used.

The temperature-sensitive element 72 also is a conventional temperature-sensitive element well known per se; in the embodiment shown in FIGURE 2, a Minneapolis Honeywell T654-A or Mercoid DA-35 is used, such element is adjusted so that its contacts open when the heat-transfer fluid reaches a temperature of 400°F. and recloses when the fluid temperature drops to 360°F. in the preferred embodiment.

The switch heater installation according to the embodiment of my invention on the track section shown as 214 in FIGURE 8 has the same general structure and components as shown for section 14 above discussed, and additionally, has a shield, 201; that shield in co-operation with the heating panels provides an insulating and heating air volume above the ties as well as above the spaces in the roadbed between the successive ties, said spaces being usually referred to as the cribs. The shield is, in the preferred embodiment, made of a heat-insulating material, such as $\frac{3}{4}$ -inch plywood. The switch heater shown in FIGURES 8-13 comprises the fluid heater subassembly 11, the left rail heating subassembly 12, and the right-hand rail heating subassembly 13 as above described. The ends of subassemblies 12 and 13 are firmly attached to each other, as by welding in

place, as above described, in the field at the switch section of railroad track and roadbed to be serviced by the installation, such section being generally shown as 214. The ends of the subassemblies 12 and 13 are also similarly attached to the fluid heater subassembly 11 by lines 52 and 57 as above described and actuated by the elements 61 and 62 and 63 as above described for the apparatus of FIGURE 1.

The particular switch embodiment shown in FIGURE 8 in plan view is a No. 20 Turnout Switch described at pages 169 and 170 of the Atchison, Topeka and Santa Fe Railway System "Rules—Maintenance of Way and Structures," Operating Department 1960, drawing C.E.S. No. 5890, sheets 1 and 2, and provided with heating panels and shields according to this invention.

According to the embodiment of this invention as shown in FIGURES 8-13, the shield generally indicated as 201 provided over the ties of the railroad switch section 214 comprises three parallel series of contiguous $\frac{3}{4}$ -inch thick wooden plates supported in whole or in part upon or attached to each of the ties between the track rails and laterally of the rails. This shield extends from one heel edge 231, at one side of the heel of the switch to a point edge, 232, one tie removed from the crib in which the control arm for the points 248 and 249 of the switch 200 is located. The section 214 comprises switch 200, its ties and the control structure therefor.

The shield 201 comprises a central portion 228, a left-hand lateral portion 229, and a right lateral portion 230.

The central portion 228 of shield 201 located between the rails 202 and 220 of switch 200 comprises fixed portions 250-255 and movable portions 290-294.

The fixed portions as 250-255 are attached to, and supported on, fixed spacing elements; those spacing elements are attached to the conventional ties of section 214, shown as 203-213, 215-219 and 221-222. The fixed shield portions are each $\frac{3}{4}$ -inch thick, imperforate, horizontal, flat plywood sheets of low thermal conductivity that cover over the central portion of each tie and extend on either side thereof to within $1\frac{1}{2}$ inches of the inner side of the head of each adjacent rail, as 351 and 352, whichever is nearer. The rails are conventionally spaced apart 4-feet $8\frac{1}{2}$ inches, the maximum width of the portion 228 is 4-feet $5\frac{1}{2}$ inches. The top of the plywood sheet is level with the bottom of the head of the rails and spaced away therefrom by a left central air escape space 340 and a right central air escape space 341. The fixed portions 250-255 are each provided with lateral road maintenance access openings, as 260-267, for inspection and maintenance of spikes and chairs holding the rails and tongues to the ties. Spacing elements as 281-288 are built up from nominal 2" x 4" lumber to a 3-inch x 7-inch horizontal section size with the 7-inch side parallel to the length of rails 202 and 220. These elements are bolted to the tie therebelow (or the gage plate in case of ties 218 and 219) to provide vertical support for the horizontal shield portion thereabove and to space such horizontal portion with the top thereof at the level of the bottom of the heads of the rails supported on such tie. Elements 281-288 also serve to fix the shield so that the lateral edge thereof will be spaced sufficiently far enough across the air escape space 340 or 341 from the nearest rail or tongue point to avoid contact with a railway car wheel flange riding on such rail structure. The distance across the spaces 340 and 341 in the preferred embodiment herein discussed is $1\frac{1}{2}$ inches each.

The movable shield portions 290-294 are each formed of flat, horizontal plywood the same as used for the portions 250-255. The portions 290-294 are each, as shown for portion 290 in FIGURE 11, centrally of its length located and drawn downward by a $\frac{1}{2}$ -inch diameter steel J-bolt, as 295; the J-bolt is supported at its lower end on the movable control rod 297, which rod is actuated by the conventional switch mechanism as 44. The heel and point ends of the movable portion 290 are slidably sup-

ported on the top surface of the adjacent fixed supports 283, 284, 285 and 286. The bottom of each of the movable shield portions, as 290, and the top of the stationary supports therefor, (as 283-285 for 290) are greased to facilitate ready motion of the slidable portions past such support.

The lateral shield portions 229 and 230 are each formed of an imperforate lateral portion, as 300 in the right hand portion formed, in a preferred embodiment, of 8-inch wide, 3/4-inch thick plywood and a 16-inch wide sloped, central portion as 302', similar to 302 above described but on the left hand portion 229 also formed of 3/4-inch imperforate plywood sheet, which extends from the inner edge 304 of portion 300 to within 1/2-inch of the head of the adjacent rail and with the bottom surface of the portion 302 at the level of the bottom of the head of the adjacent rail leaving a right lateral air escape space 343 between rail 220 and shield portion 230. The portion 302 is also held in place by a support 306 fixed to the tie and may rest on a rail brace, as 308. The bolt 310 fixes portion 302 to its support as 306 and tie as 216, and bolt 312 ties the plate as 300 to its tie as 216. The relations of the plates to the tie are the same in other ties except where gage plates are used, as on ties 218 and 219. There the steel gage plate 315 is bolted to tie 219 and the panel 302 is provided with a hole to clear and adjust the nut 317 of the chair or brace 319 for the rail 202.

The supports 281, 282, etc., are so spaced and located as to provide that the hot air generated by the heating panels of subassemblies 12 and 13, such as 81-88, will travel from one crib space, as 321, to the other crib space, as 322, over the intervening tie, as 208 and equalize the temperatures thereof.

The 3/4-inch, 5-ply plywood, outside grade, used for the shield 201 and its component panels provides a small heat transfer as well as electrical insulating element between the rails. The heat insulating and imperforate characteristics of shield 201 provide that the heat generated by the heating panels of subassemblies 12 and 13 provides a stack effect and convection currents of heated air which cause a drying as well as heating current of air to pass through the air escape spaces past the heads of the adjacent rails, which rails are thereby kept warm as well as dry. Such convection currents also pass through the interstices between the rails at the points of said rails and serve to keep them dry.

The portions 229 and 230 of the shield on the outside, or lateral, portions of the rails are supported on the ties therefor and, as above described for the central portions, provide for passage of the hot air developed by the panels of subassemblies 11, 12 and 13 from one crib space to the other laterally of the rails. There is a 1/2-inch left lateral air escape space 342 between the central portion of the sloped, left lateral panel, 229, and the head of the adjacent rail 202. In cooperation with the subassemblies 11, 12 and 13 a heating and drying current of air passes through that narrow air escape zone as well as corresponding zone 343 to the right of rail 220. The space between each tie and the central portion as 302 provides for passage of hot air from one crib space to the other over the lateral portion of such tie, as well as permitting a heating action by convection as well as radiation. The porous roadbed permits air to enter the space above the vicinity of the heating panels from the sides of the shield (and ties) and, after being heated, to rise to the air escape spaces. The shield directs the flow of heated air to the zones at which such heated air most efficiently dries the rails where needed.

The shield 201 in the preferred embodiment extends longitudinally from the two ties to the rear of the pivots 259 and 259' to two ties beyond the tips 248 and 249 of the turnout rails 351 and 352. The function structure and operation of the control elements 61, 62 and 63 and of the fluid heater subassembly and components in its hous-

ing 27 are the same as above described for the embodiment of FIGURE 1 and the operation of those elements are the same as above described for the embodiment of FIGURE 1. The elements 61 and 62 are located on ties 361 and 362 each five ties away from the ends of the shield; i.e., element 61 is located on tie 361 five ties beyond point edge 232 of shield 201, and element 62 is located five ties beyond heel edge 231 of shield 201. In the embodiment of FIGURES 8-13 element 63 is located on tie 209 and connected to subassembly 11 by line 363.

The above structure of shield 201 and subassemblies 11, 12 and 13 provides for a roof composed of the shield elements 228, 229 and 230 with orifices with definite but limited areas provided for the escape of the air heated by the heating panels such as 81-88. With the operation of the heating subassembly 11 actuated by control elements 61, 62 and 63 as above described the structure of the embodiment shown in FIGURES 8-13 provides a substantial upward flow of hot and dry gas (air). Such heated air passes upwardly from the heated panels of subassemblies 12 and 13 below the central portion 228 of the shield 201 through the left and right central air escape spaces 340 and 341 and from the portions of subassemblies 12 and 13 lateral of the rails upwardly through the lateral air escape spaces 342 and 343. Thereby the heated air from the upper surfaces of subassemblies 12 and 13 is directed at and past the heads of the switch rails and tongues. This flow of hot, dry gas provides for an effective drying action as well as heating action on those rails and tongues. This drying action prevents damaging effects of ice and/or snow. It is a feature of this invention that the large surface area of the panels of subassemblies 11 and 12 provides for a large output of heat as above described to the zone between the heating panels as 86 and the shield portions as 228, 229 and 230 thereabove as well as to the roadbed below the heating panels. This structure and operation produces a certain "stack" effect which is greatly magnified by that the exit orifices thereof, 340, 341, 342 and 343 have an area (horizontally measured) substantially smaller than that of the heating surface; i.e., the heating surface substantially covers the entire horizontal area of the roadbed between the ties while the central exit orifices 340 and 341 are only about 1 1/2 inches wide between the head of the rail and the outside edge of the shield, and spaces 342 and 343 are only 1/2-inch wide. This provides for development of definite convection currents whereby warm and dried air continuously passes upward in contact with the head of the rails by convection. Such stream of air has an upward velocity of at least a quarter of a foot per second and as high as four feet per second during operation of the apparatus of FIGURE 8 when the ambient temperature is at 0° F.

This relatively low intensity of temperature in the panels of subassemblies 12 and 13, i.e., below 400° F., without any additional fans, produces a substantial drying action on the rails through the convection action of the air heated by these panels and constrained to travel in a limited zone immediately adjacent the railheads. This dry, warm air stream removes moisture from, as well as prevents its collection on such rails and structures. This drying of the rails by a passage of dry and hot air therepast according to the apparatus and process of this invention is a continued operation which is efficiently and economically carried out by the apparatuses of this invention without damage to the wood structure of the railbed, and without violent temperature stresses to the metal parts and at a relatively steady state and is performed without any moving parts.

The orifices provided by the access openings 261-267 over the spikes and tie plates provide for a drying and maintaining of those elements in dry condition through these cold and wet spells and thereby avoiding the temperature stresses concomitant on low temperatures and alternate wet and dry conditions whereat the coefficient

of expansion between the wood and metal may be dissimilar. Nevertheless, it is within the scope of the invention that the pockets 260, 261, 262 and 263 herein provided in the embodiment of FIGURE 8 above described for purposes of inspection may be covered by hinge doors as 345 which are transparent in order to facilitate the inspection of the items therebelow, as spikes or bolts and allow the ready manipulation of such items as required; although for economic purposes of construction the structure above described provides a new and useful apparatus per se, the use of hinged doors over the access spaces provides additional economy and efficiency.

This invention thus includes a process of maintaining railroad track section free of encumbrance by ice and snow, (said track comprising a pair of rails, ties and a roadbed, said rails being in contact with atmospheric air and supported on said ties, said ties supported on said roadbed), comprising the steps of continuously sensing the temperature of the atmospheric air as by elements 61 and 62 at a distance from said rails of said section and supplying heat to a heat conductive surface as the panels of subassemblies 12 and 13 and maintaining said surfaces at a temperature between 185° F. and 400° F., supplying said heat at the rate of 5,000 B.t.u. per hour per foot of length of said section by the subassembly 11. The heating surfaces are below the level of the bottom and top of said rails to provide a "stack" effect for development of convection currents. The heating surfaces provide at least 500 square inches of upwardly directed surface per foot of length of said section; the body of air under the shield contacts the said heated surface of the panel and the shield confines said body of heated air above all of the heated panel surfaces except those below the air outlet orifices which confine the heated air to pass upwardly only in the 1/2 to 1 1/2 inch wide air outlet orifices adjacent the rails. The heating and convection currents provided serve to pass said heated air in a stream of from 1/2 to 1 1/2 inches width upwardly at a speed of 1/2 to 4 feet per second in contact with and past said rails when the temperature of the atmospheric air at a distance from said section falls below 35° F.

Although, in accordance with the provision of the patent statutes, this invention has been described as embodied in concrete form and the principle of the invention has been described in the best modes in which it is now contemplated applying such principle, it will be understood that the constructions and operations shown and described are merely illustrative and that the invention is not limited thereto since alterations and modifications will readily suggest themselves to persons skilled in the art without departing from the true spirit of the invention or from the scope of the annexed claims.

I claim:

1. Apparatus for heating a railroad track switch section comprising rails, ties, and a railbed therebelow, said apparatus comprising

- (a) a source of heated fluid automatically controlled to discharge heated fluid, said source comprising in operative connection, a fluid heater, a fluid heat transfer medium, a pump for said fluid, and a chamber wherein the heater heats transfer medium, a temperature sensing element exposed to ambient air temperature and operatively connected to said burner, said temperature sensing element being operatively connected to fluid heater for increasing the rate of heating of said heat transfer fluid in said fluid heater at a predetermined ambient air temperature range.
- (b) railway track heating elements located between and spaced away from the ties of said railway track and below and out of contact with said rails, said heating elements each having an inlet chamber running along the length thereof and an outlet chamber connected to said inlet chamber and running along said length, said chambers being spaced apart from

each other, fluid conduit means connecting the outlet of said fluid heater to the inlets of said heating elements, and a thermally conductive plate firmly connected to said inlet and outlet chambers, said track heating elements covering the major portion of the upwardly directed area between the ties, and

- (c) a railroad railbed underneath each of said heating elements, and said temperature sensing element being distant from said source of heat and from said railroad track heating elements.

2. Apparatus as in claim 1 wherein the heating elements have an upwardly directed surface of above 500 square inches for each foot of track and said fluid heater provides 5,000 B.t.u. per hour per each foot of said track to each of said heating elements.

3. Apparatus for heating a railroad track switch section comprising rails, ties, and a railbed therebelow said apparatus comprising

- (a) a source of heated heat transfer fluid automatically controlled to discharge said fluid above the boiling point of water, said source comprising a gas burner, a source of combustible gas, coils for a heat transfer medium fluid and a chamber wherein combustion gases of said burner may contact the said coils for and containing said heat transfer medium, a temperature sensing element exposed to ambient air temperature and operatively connected to said burner, said temperature sensing element being operatively connected to said heater for increasing the combustion rate in said burner and increasing the rate of heating said heat transfer fluid in said coils,

- (b) pairs of railway track heating elements located between and spaced away from the ties of said railway track and below and out of contact with said rails, each heating element presenting an upper surface with an upwardly directed surface area of over 200 square inches for each linear 16 inches of railway track, said track heating elements having an inlet chamber running the length thereof and an outlet chamber running the length thereof, thermally conductive plates firmly connected to each of said inlet and outlet chambers, said plates extending from laterally of each of said railway rails to near the center of the space between said railway track rails, the other of said pair of heating elements extending laterally from the other side of the opposite rail to close to the center of the distance between said two rails and within a few inches of said first heating element, said track heating elements having a surface which covers from 75 to 90 percentum of the upwardly directed total area between the ties adjacent thereto, conduits connecting said inlet chamber and outlet chamber in each heating element and in contact with each said thermally conductive plate, fluid conduit means connecting the outlet of said heating coils to the inlet of each of said heating elements,

- (c) a porous railroad railbed underneath each of said heating elements for discharge of fluid from the zone above said heating element plate, and

- (d) said temperature sensing element being distant from said source of heat and from said railroad track heating elements.

4. Apparatus as in claim 3 for heating a railroad track switch section comprising movable tongues wherein said heating elements are connected in series, and the heating elements most directly connected to the outlet of said source of heat are underneath the tongues of the switch element.

5. Apparatus as in claim 4 wherein the heating fluid used has a melting point below 5° F. and has a boiling point, at 15 lbs. p.s.i.a. pressure in excess of 212° F.

6. Apparatus as in claim 3 wherein the heating source transfers 100,000 B.t.u. per hour to the heating elements, said heating elements having above 100 square feet of upwardly directed thermally conductive surface exposed to

said rails at a level which is a distance of more than 1 inch and less than 6 inches from the bottom of each said rail in said track, for each 30-foot length of said length of section.

7. Apparatus for heating a railroad track switch section comprising rails, ties, and railbed therebelow, said apparatus comprising

(a) a source of heated fluid automatically controlled to discharge heated fluid, said source comprising in operative connection, a fluid heater, a fluid heat transfer medium, a pump for said fluid, and a chamber wherein the heater heats transfer medium, a temperature sensing element exposed to ambient air temperature and operatively connected to said burner, said temperature sensing element being operatively connected to said fluid heater for increasing the rate of heating of said heat transfer fluid in said fluid heater at a predetermined ambient temperature range,

(b) railway track heating elements located between and spaced away from the ties of said railway track and below and out of contact with said rails, said track heating elements covering the major portion of the upwardly directed area between the ties, an imperforate sheet element supported above said heating elements extending over substantially the entire area covered by said heating elements, an elongated opening in said sheet element, the edges of which run parallel to said rails and slightly spaced away therefrom, and

(c) a railroad railbed underneath each of said heating elements, and said temperature sensing element being distant from said source of heat and from said railroad track heating elements.

8. Apparatus as in claim 2 also including at a level below the top of the rails and above the portion of said ties between the rails and above the track heating elements an imperforate central sheet of low thermal conductivity located between the rails of the track and extending from one rail to the other with a narrow air outlet orifice between the lateral edges of said sheet and the adjacent rails and an imperforate lateral sheet of low thermal conductivity with edges extending along the length of each of the outer portion of each of the ties lateral of each rail, the heating elements extending lateral of the rails and the lateral sheets extending from above the heating element to an edges close to but spaced slightly away from the rails and forming an air outlet orifice lateral of each rail.

9. Apparatus as in claim 6 also including at a level below the top of the rails and above the portion of said ties between the rails and above the track heating elements an imperforate central sheet of low thermal conductivity located between the rails of the track and extending from one rail to the other with a narrow air outlet orifice between the lateral edges of said sheet and the adjacent rails and imperforate lateral sheets of low thermal conductivity located over and extending along the length of each of the outer portion of each of the ties lateral of each rail, the heating elements extending lateral of the rails and the lateral sheets extending from a lateral edge thereof above a lateral portion of the heating element to an inner edge close to but spaced slightly away from the rails and there forming an air outlet orifice lateral of each rail, an air inlet orifice at the lateral edge of said lateral sheets opening to the upper surface of said track heating elements and to said narrow air outlet orifices between the lateral sheet and said rails and said spaces between said central sheet and said rails, said air outlet orifices being higher than said inlet orifice.

10. Process of maintaining a railroad track section free of encumbrance by ice and snow, said track comprising a pair of rails, ties and a roadbed, said rails being in contact with atmospheric air and supported on said ties, said ties supported on said roadbed, said process comprising the steps of continuously sensing the temperature of the atmospheric air at a distance from said rails and supplying

heat to a heat conductive surface and maintaining said surface at a temperature between 185° F. and 400° F., supplying said heat at the rate of 5,000 B.t.u. per hour per foot of length of said section, said surface being below the level of the top said rails, said surface providing at least 500 square inches of upwardly directed surface per foot of length of said section, contacting a body of air with said heated surface, confining said body of heated air above the major portion of said heated surface and passing said heated air in a stream of from ½ to 1½ inches width upwardly in contact with and past said rails when the temperature of the atmospheric air at a distance from said section falls below 35° F.

11. Process of maintaining a railroad switch track section free of encumbrance by ice and snow, said railroad track section comprising a pair of fixed and movable rails, ties, and a porous roadbed, said rails each having an inner side surface and an outer side surface, a bottom surface and a top surface, said bottom surface of each said rail being supported on said ties, said ties being spaced apart from each other and supported on said roadbed and extending laterally of said ties and between said rails, said section being in contact with atmospheric air, said process comprising the steps of continuously sensing the temperature of the atmospheric air at a distance from said railroad track section and, when the temperature of the atmospheric air at a distance from said section falls below a predetermined temperature, heating a volume of heat transfer fluid at a heat source and cycling said heated fluid from said heat source to substantially equal amounts of upwardly directed area of heat transfer surfaces on the inner and outer sides of said rails and spaced away from said rails, transferring heat from said fluid to said heat transfer surfaces by conduction and maintaining said heat transfer surfaces at a predetermined elevated temperature range between 185° F. and 400° F. and transferring heat to the inner side and outer side surfaces of said rails from said heated surfaces by convection and radiation and returning said heat transfer fluid from said surfaces to said heat source and blocking upward passage of warmed air from below said heated surfaces between said ties over the major and central portion of the upwardly directed area between adjacent ties and heating the roadbed below the rails and providing warmed channels therein for passage of water therethrough.

12. Process as in claim 11 wherein snow falls on said section and the heated surfaces occupy 75 to 90 percent of the upwardly directed area between the adjacent ties and the temperature of the heated surfaces is maintained at 212 to 225° F. and said predetermined temperature is 35° F. and wherein the heated fluid transfers up to 5,000 B.t.u. per hour per foot of length of said section, said snow is melted to water and said resultant water is discharged from said roadbed laterally of said rails whereby said roadbed and ties and rails are maintained in dry condition free of ice and moisture and the process includes the step of discontinuing the heating of the heat transfer fluid when the temperature of atmospheric air in contact with said section is a predetermined amount higher than said predetermined temperature.

13. Process of maintaining a railroad track section free of encumbrance by ice and snow, said railroad track section comprising a pair of fixed rails and a pair of movable rails, ties and roadbed, said rails being in contact with atmospheric air and supported on said ties, said ties supported on said roadbed, said rails each having an inner side surface, an outer side surface, a bottom surface and a top surface, said process comprising the steps of continuously sensing the temperature of the atmospheric air at a distance from said section and, when the temperature of said atmospheric air at said distance from said section falls to a predetermined level, supplying heat at a fluid heating zone to a heat transfer medium and transferring said heated heat transfer medium to substantially equal amounts of upwardly directed areas of heat transfer

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surfaces on the inner and outer sides of said rails, heating said surfaces by said medium and maintaining said heat transfer surfaces at a temperature range between 185° F. and 400° F., transferring heat to both inner and outer sides of said rails by radiation and contacting air with said heated surfaces and thereby heating said air, confining said heated air to prevent free upward passage thereof from between the rails and laterally thereof above the major portion of said heated surfaces for passing said heated air upwardly from said heated surfaces only in narrow streams on both sides of said rails, each said narrow stream being in contact with and elongated parallel to a side surface of one of said rails and said process also comprising the step of discontinuing the supply of heat to the heat transfer medium when the temperature of air at said distance reaches a predetermined value higher than said first predetermined temperature.

14. Process as in claim 13 wherein when snow is falling toward said section and said heat transfer fluid moves in a closed cycle from said fluid heating zone to said heat transfer surfaces and back to said heating zone, the predetermined level of the temperature of said atmospheric

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air at said distance from said section is 35° F., said upwardly flowing streams of heated air have a range of width of one half to one and one half inches and the heat source transfers up to 5,000 B.t.u. per hour per foot of length of said section to said fluid and the heated surfaces provide upward of 500 square inches of upwardly directed heating surface per foot of track length arrayed over the central 75% to 90% of the upwardly directed area between adjacent ties whereby said ties and rails are maintained in dry condition.

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