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## (54) HEATING MAT

(71) We, MICHELIN & CIE (COMPAGNIE GENERALE DES ETABLISSEMENTS MICHELIN), a French body corporate, of 4 Rue du Terrail, Clermont-Ferrand, Puy-de-Dome, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to heating mats which are used in the repair of pneumatic tyres.

The two side walls of a pneumatic tyre are constituted by a rubber mass in which a reinforcement is enclosed. Although these side walls do not come into contact with the ground, they do sometimes suffer injuries especially when the tyre is used on vehicles which move across country. To repair such damage, rubber patches are vulcanised on to the damaged regions after suitable preparation. The heating necessary for the vulcanisation is provided by a heating mat.

Usually the heating mat has a flat shape and includes an electrical resistance element formed of a metal conductor embedded within a mass of a flexible insulating material which is resistant to heat, for example silicone rubber e.g. that sold under the trade name "Silastene". The electrical resistance element is usually constituted by a chrome-nickel alloy wire. Since this wire is subjected to alternate cycles of prolonged heating and rapid cooling, and to mechanical stresses in placing the heating mat against the injured side wall and keeping it in position, it tends to fracture prematurely. The heating mat does not then operate and this delays the repair of the tyre and lengthens the time when it is out of service.

It is therefore an object of the present invention to provide a heating mat in which this disadvantage is reduced.

According to the invention there is provided a heating mat comprising a flexible insulating mass and a resistance heating element, constituted by a steel cable which terminates in two electrical current supply terminals,

embedded in the flexible flat insulating mass. 50

In order that the heating mat should have the greatest possible flexibility, it is preferable that the steel cable used should be an elastic steel cable. 55

An "elastic steel cable" is a steel cable such as that which is used in the reinforcement of pneumatic tyres and made in accordance with British Specification No. 885,159 having a minimum relative strength of at least 6% at rupture. An example is shown in our French Patent No. 1,188,486. According to that Patent the cable is assembled from component steel wires of for example 0.12, 0.23 or 0.28 mm diameter. 60 65

The use of a steel cable instead of a single wire of chrome-nickel alloy has a number of advantages. It is stronger. The electrical resistance of steel increases with the temperature and so has a self-regulating effect on the power consumption since the resistance of the mat is supplied under a constant electrical voltage. Also steel adheres better than chrome-nickel alloy wire to mixtures having a base of natural or synthetic rubber which are usually used for the production of this kind of heating mat. This good adhesion can be improved still further when the steel cable wires are covered with a brass coating in a manner known per se. 70 75 80

The invention will now be described, by way of example, with reference to the accompanying drawing which is a partially cut away view of a heating mat according to the invention. 85

Mat 1 shown in the drawing has a portion of a flexible insulating mass 2 broken away to show an elastic steel cable constituting the resistance heating element 3. 90

The mat 1 comprises a number of regions. Region 4 contains that part of the cable constituting the heating element 3. Preferably this heating element 3 is arranged in a sinuous line, straight segments 6 of which are parallel to one side of the mat, the mat being of rectangular shape in the example selected. 95

A second region 5 of the mat comprises an elongate aperture 7 extending at right angles

to the straight segments of the heating coil.

Embedded in portion 8 of the mass of the heating mat which defines the aperture 7 relatively to the exterior of the mat is that part 9 of the elastic cable which connects the heating element 3 to an electrical current input terminal 10. This part 9 of the elastic cable thus reinforces the region 8 of the mat in such a manner that this region can be used as a handle for easy carrying or suspension of the mat 1. Furthermore the part 9 of the cable does not restrict the bending of the mat which is necessary to apply the mat against a rubber patch and the side wall of the tyre.

Finally, current terminals 10 and 11 are situated at the end of a third portion 12 of the mat. This is constituted by the prolongation of one of the sides of the rectangle forming the mat 1, this prolongation being of rectangular cross-section. A straight length of cable connects the other end of the heating coil to the terminal 11.

Whereas with known heating mats it is often possible to carry out only 20 to 50 repair operations before failure of the heating element, the heating mats according to the invention make it possible to achieve 800 to 1000 repairs without the elastic resistance cable fracturing.

The following are the characteristics of two specific examples of heating mats of different sizes, constructed in accordance with the present invention.

1. Rectangular mat (620 x 300 mm): coil formed of 32 meters of cable of apparent diameter of 0.9 mm, constituted by 21 wires of brass-covered steel having a diameter of 0.12 mm;

Linear resistance of the cable: 0.866 ohm per meter;

Power consumption: 435 watts with a voltage of 110 volts.

2. Rectangular mat (1100 x 400 mm): coil formed of 75 metres of elastic cable of apparent diameter equal to 2 mm, constituted by 28 brass-covered steel wires of 0.28 mm diameter;

Linear resistance of cable, 0.175 ohm per metre;

Power consumption: 925 watts at 100 volts.

The straight segments of the coil are spaced at a distance of 6 mm and each segment has a length of 380 mm.

#### WHAT WE CLAIM IS:—

1. A heating mat comprising a flexible flat insulating mass and a resistance heating element, constituted by a steel cable which terminates in two electrical current supply terminals, embedded in the flexible flat insulating mass.

2. A heating mat as claimed in Claim 1 in which the steel cable is an elastic steel cable.

3. A heating mat as claimed in Claim 1 or Claim 2 in which the heating element part of the cable is arranged in a sinuously coiled shape within the mass of the mat.

4. A heating mat as claimed in any preceding claim in which the mat is of rectangular shape and the heating cable has straight segments parallel to one of the sides of the mat.

5. A heating mat as claimed in any preceding claim which comprises a region containing that part of the cable which forms the electrical resistance heating element and another region provided with an aperture, that part of the mat defined between the external boundary of the mat and the aperture containing a part of the cable which is intended to connect the electrical resistance heating element to one of the electrical current supply terminals and serving as a handle.

6. A heating mat substantially as herein described with reference to either of the specific examples described in connection with the accompanying drawing.

7. A method of repairing injuries to the side wall of a pneumatic tyre in which a heating mat as claimed in any preceding claim is used to heat and vulcanise a patch on the side wall.

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of  
the Original on a reduced scale*

