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CONVENTION APPLICATION FOR A STANDARD PATENT

We, SUMITOMO RUBBER INDUSTRIES, LTD., of No. 1-1, Tsutsuicho 1-chome, Chuo-ku, Kobe-shi, Hyogo, Japan hereby apply for the grant of a standard patent for an invention entitled:

"PNEUMATIC RADIAL TIRE FOR HEAVY LOAD VEHICLES"

which is described in the accompanying complete specification.

DETAILS OF BASIC APPLICATION

Number of Basic Application: -
214743/1984

Name of Convention Country in which Basic Application was filed: -
Japan

Date of Basic application: -
13 October 1984

Our address for service is: -
C/- Spruson & Ferguson Patent Attorneys
Level 33 St Martins Tower
31 Market Street
Sydney New South Wales Australia

DATED this ELEVENTH day of OCTOBER 1985

SUMITOMO RUBBER INDUSTRIES, LTD.

By: 
N. J. Anderson


TO: THE COMMISSIONER OF PATENTS
AUSTRALIA

SBR:JMC:68F
In a pneumatic radial tire for heavy duty vehicles constructed to effectively suppress railway wear, having a tire tread provided with at least one circumferential groove to divide a tread in widthwise direction and a carcass comprising at least one carcass ply of substantially radially extending rubber coated steel cords and a belt layer for reinforcing a crown portion of said carcass ply, an zigzag angle of the main circumferential grooves with respect to an equatorial line of a tire grow in angle as tread wear out.
The following statement is a full description of this invention, including the best method of performing it known to us.

"PNEUMATIC RADIAL TIRE FOR HEAVY LOAD VEHICLES"

The claims defining the invention are as follows:

1. In a pneumatic radial tire for heavy duty...
BACKGROUND OF THE INVENTION

This invention relates to a pneumatic radial tire for heavy duty vehicles such as trucks, buses and the like, more particularly to a pneumatic radial tire provided with rib shaped tread pattern suitable for travel on paved roads at a high speed, in addition, improving its wear resistant property and effectively reducing uneven wear of tread without sacrificing wet grip performance.

In general, a pneumatic radial tire provided with a reinforcing belt layers which composed of steel cords, in respect of wear resistance, puncture resistance, saving fuel expense, is superior to the conventional bias tire. Because of high rigidity of belt layers between the tread rubber and carcass ply. On the contrary, its riding comfortableness rather falling behind of bias tire as laying belt layers with high rigidity, therefore the development of such radial tire having property as described above tends to advance along with improvement of road. In recent years in our country, in accompany with arrangement and extention of the high-way networks the demand for pneumatic radial tires has been increasing remarkably. In general, a tread patterns of pneumatic radial tires, rib types, lug types, rib-lug types, block
types and rib-block types, etc. are employed according to its usage respectively, particularly, from the viewpoint of traction property, low heat build up property, wet grip performance, a tire for heavy duty trucks and buses preferably employes rib type tread patterns and block type tread patterns.

However the block-type pattern applied to a pneumatic radial tire for heavy vehicles has disadvantage that such block pattern has comparatively smaller area which makes contact with the roads while a tire is in rotation, said blocks pattern has tendency to wear fast due to excessive move of blocks while revolution of tires, furthermore, has tendency to induce uneven wear in the front and the rear of the block, which largely reduce the tire life. Furthermore, in order to be well-furnished as such properties as low heat generation and high wear resistance together with high traction and braking performance enough for the use of the highway at high speed generally, the so-called rib-type tread pattern types being provided with a plurality of continuous zigzag circumferential ribs defined along the widthwise direction of tire by zigzag grooves extending circumferentially of said tread are preferably employed, and although the ribs are generally continuous to the circumferential direction. There are some modification of the rib type tread patterns, for
example, setting some narrower circumferential grooves on said ribs, otherwise, setting comparatively shallower lateral grooves extending to the width direction of the tire thereon, and blocks and ribs are provided together with thereon, so-called rib-block type tread pattern are used too. In any case peculiar abnormal wears occur in the rib edge regions or in the shoulder regions when continuously running over a long distance at a high running speed. The radial tire has a peculiarity of construction provided at its crown portion with circumferential belt layer having a high rigidity. Accordingly, the tire has excellent wear resistance. However, due to the difference of rigidity among themselves of each portion, uneven wear phenomenon apt to be induced. As long as wear life of tires become long, said phenomenon become aggravated to make the worn appearance of the tire worse remarkably.

There are various kinds of abnormal wear associated with tires for the heavy duty vehicles which are classified in the three kinds, that is:

(1) Wear which causes generation of steps extending transversely in the cross-sectional direction of the tire, particularly causes the tread rubber facing both the shoulder portions to wear more readily than tread rubber facing the center portion, which is called uneven shoulder wear.
Wear which causes indentations or steps to be produced across the boundary of a substantially transverse groove which defines a tread pattern is called heel and toe wear. Wear which abnormally occurs at that portion of circumferential ribs defined by a circumferential groove which is adjacent to the circumferential groove, which is called railway wear. It is an object of the invention to prevent especially occurrence of railway wear of the tire in all kinds of those uneven wear. Therefore, the invention will be described in detail about railway wear, which starts from a rib edge portion L of a circumferential rib 5 defined by tread grooves 4 of a tire 1 and gradually spreads in the circumferential direction over a region with a stepwise difference \( \ell \) and a width \( w \) as shown in Fig. 3 when the tire continuously runs straight over a long distance at a high speed.

These abnormal uneven wear not only make the appearance of the tire 1 awkward, but also adversely affect tire performance, especially traction performance, braking performance, and cornering performance, which largely reduce the tire life.

Heretofore, as a countermeasure for above mentioned abnormal wear, some disclosures, for example, Japanese Patent Publication No. 51-15282 (1976) and No. 46-4553 (1971) etc. have been proposed, but hitherto none has led to fully satisfactory
results which can effectively avoid all kinds of uneven wear of the tire.

For example, as described in Japanese Patent Publication No. 51-15202, the cross sectional width of circumferential groove adjacent to the central rib is set up to increase radially, accordingly, the width of central rib radially decreases, and to prevent the stone pick-up, setting a jut portion separated from said rib portions and forming the cross sectional shape of groove like uprises-down shaped V to eliminate the railway wear, which occurs at a side edge portion of a circumferential rib, which has problems on production due to complicated groove shape, moreover, the notches of both sides of groove tend to pick up stones, so to damage the both edges of rib portions, therefore, hitherto none has led to fully satisfactory results which can effectively avoid all kinds of uneven wear of the tire.

SUMMARY OF THE INVENTION

The present invention is intended to provide tires which can solve the above problems of the abnormal wear, especially the railway wear which have never been solved by any prior arts, which largely reduce the tire life, especially of rib type tread pattern.
Fig. 1 is a plane view of an embodiment of the tread pattern in the tire according to the invention;

Fig. 2 is a schematically cross-sectional view of tread construction taken along line A–A of Fig. 1;

Fig. 3 is a partially radial section view of a tire illustrating the occurrence of railway wear;

Fig. 4 is a plane view showing a part of a five rib tread pattern of the prior art tire;

Fig. 4(a) shows the sectional groove shape taken along line A–A in Fig. 4;

Fig. 5(a), (b), (c) and (d) are schematically cross sectional views of tread grooves taken along lines E–E, K–K, L–L, M–M, of Fig. 1 respectively;

Fig. 6 is a plane view of another embodiment of the invention.
DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is intended to provide pneumatic radial tires advantageously adaptable for heavy duty vehicles, which can effectively prevent said railway wear and can prolong the tire life, while keeping the features of rib type pattern.

According to the invention, there is the provision of in a heavy duty pneumatic radial tire constructed to effectively suppress railway wear having a tire tread provided with at least one circumferential groove to divide a tread along the widthwise direction of tire and a carcass of a substantially radial construction composed of at least one rubberized ply layer containing cords embedded therein and a belt superimposed about said carcass for stiff reinforcement beneath a tread and said tread being provided with a plurality of circumferential zig-zag grooves, wherein the angle with respect to a equatorial line and the point height of said circumferential zigzag groove become larger as long as tread wear out.

The invention will now be described in detail with reference to a accompanying drawing about an example according to the present invention, as shown in Fig. 1 and Fig. 2, a heavy duty pneumatic radial tire comprises a carcass 2 of a substantially radial construction composed of at least one rubberized ply layer containing cords
embedded therein and a belt 3 superimposed about said 
carcass for stiff reinforcement beneath a tread 1 and 
the tread 1 is provided with five rows of rib 5 
defined along the widthwise direction of tire by wide 
grooves 4 extending circumferentially of the tread. 

The side edge portion L of the wide ribs 
defined the tread surface by circumferential groove 4 
is substantially parallel with the equatorial line C of 
a tire when a tire is still new. However, as tread wears 
on the straight line L become a zigzag line with a 
constant pitch (P), of which point height (PH) is designed 
to be a range of 0 - 2%. More preferably 0 - 1.5% of 
the tread width (TW) when the tire is new, and to become 
large as tread wear progresses, to a range of 1 - 4%, 
more preferably 2 - 4% of the tread width at maximum value. 
When the point height of the new tire, of which groove 
depth is deepest and tread stiffness on contact area 
with ground is extremely low, is set up to be larger 
than 2% of the tread width, the stiffness of the pointed 
end of the zigzag shaped rib facing to the groove become 
lower than that of the other part, thus abnormal wear 
starts from the pointed end portion of a circumferential 
zigzag rib and gradually spreads in the circumferential 
direction over a region with a stepwise difference & 
and a width ω, accordingly, the said point-height (PH)
of a new tire having a good contact performance with ground
is preferred to be small.

However, the traction performance decreases at the
same time as tread wear progresses and stiffness of
tread surface contacting with ground increases, so in
order to compensate the reduction of said traction
performance, circumferential grooves are set up to increase
its point-height in accompanied with tread wear and a maximum
value of said point height is set up to be a range of
1 - 4% of the tread width (TW), when it is larger than
4%, in spite of increasing the tread contactive performance
owing to service condition, there is a possibility of an
occurrence of said railway wear, on the contrary, when
it is less than 1%, due to decreasing the tread contactive
performance, the traction performance, and many other kind
of tire performances are apt to be decreased. Furthermore,
in order to ease the performance of the worn tires,
especially the wet grip performance, slits (SP) are
disposed on the pointed ends of zigzag grooves as shown
in Fig. 1. Lateral grooves G with the inclination angle β
with respect to the axial direction of tires are disposed
on the pointed ends of the zigzag grooves every two pitch,
and the depth of said lateral groove is set up to be less
than 20% depth of main groove 4, if it is more than 20%,
the continuity of ribs extending to the circumferential
direction is missed, as a countermeasure to prevent a so-called shoulder wear, slits (S) are disposed on both tread edges every pitch (PS), this slit (S) is effective as countermeasures for preventing not only said shoulder wear but also wandering phenomenon, because of making it easy to ride across the railway line and the like by the way of setting slits deeply on buttress side as shown in Fig. 2.

[Effect of the invention]

In order to make clear the effectiveness of the present invention, the comparative test result of one embodiment according to the invention and a prior art tire will be hereafter explained.

One embodiment is a heavy duty pneumatic tire having a size of 10.00 R 20, comprising a carcass of a substantially radial construction composed of at least one rubberized ply layer containing cords embedded therein and a belt superimposed about said carcass for stiff reinforcement beneath a tread and composed of at least three rubberized ply layers each containing metal cords embedded therein, the metal cords of which being crossed with each other at a relatively small angle with respect to the circumferential direction of tire, and said tread being provided with five continuous circumferential ribs each having substantially same width defined along the widthwise
direction of tire by at least four main circumferential grooves (4), as shown in Fig. 1, which is a so-called "five rib pattern", a plurality of lateral shallow grooves (G) are provided on the intermediate ribs (5M) every two pitch of zigzag pattern, said lateral shallow grooves have an inclination angle ($\theta$) of 45° with respect to the axial direction of tire, and a plurality of slits (SP) are disposed on the pointed end portion (Q) of zigzag rib by knife blades with 0.8 mm thickness, the angle of said slits is made parallel to the axial direction of tires, each of cross sectional shape of said slits (SP) and circumferential grooves are shown in Fig. 5 (a), (b), (c), (d) by taking along lines E-E, K-K, L-L, M-M, of Fig. 1 respectively, the point-height (PH) of zigzag grooves of new tire is substantially 0 and its maximum value is 4 mm which is 2.1% of 194 mm of tread width TW.

On the other hand, a control tire for comparative test is a five ribs type pattern as shown in Fig. 4, of which the point height (PH) of the new tire is 10 mm, is 5% of 195 mm of tread width TW and constant even if tread worn down, and this control tire has the same construction as in the embodiment according to the present invention except the tread pattern.

After each of these test tires is run on 100% paved road under an internal pressure of 7.25 kg/cm² and 2700 kg
load per tire over a distance of 40,000 km, depth of railway wear (stepwise difference L) is measured to obtain results as shown in Table 1. In this table, numerical values are expressed by an index on the basis that the control tire is 100.

As apparent from the results of Table 1, the tire according to the invention can effectively and advantageously prevent the railway wear as compared with the control tires. Furthermore, the wet grip performance in the tire according to the invention shows the same test results as the prior art tire.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Present invention</th>
<th>Prior art</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railway wear (L)</td>
<td>46</td>
<td>100</td>
</tr>
<tr>
<td>Wet grip performance (new tire)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Wet grip performance (after 40,000 km run)</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
WHAP-9S-CLAIMED-99:
The claims defining the invention are as follows:—

(1). In a pneumatic radial tire for heavy duty vehicles constructed to effectively suppress railway wear, having a tire tread provided with at least one circumferential groove to divide a tread in widthwise direction and a carcass comprising at least one carcass ply of substantially radially extending rubber coated steel cords and a belt layer for reinforcing a crown portion of said carcass ply, an zigzag angle of the main circumferential grooves with respect to an equatorial line of a tire grow in angle as tread wear out.

(2) The tire according to claim 1, wherein the point height PH of the zigzag of the main circumferential grooves is in the range of 0 to 1.5% width of the tread width TW by the new tire and while it grow in width as tread wear out, its maximum width is in the range of 1% to 4% of the tread width TW.

DATED this ELEVENTH day of OCTOBER 1985
SUMITOMO RUBBER INDUSTRIES, LTD.

Patent Attorneys for the Applicant
SPRUSSON & FERGUSON