MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A
CONVENTION APPLICATION FOR A PATENT

(a) insert full name(s) of applicant(s).

(b) insert address(es) of applicant(s)

of (b) Leverkusen, Germany

(c) insert title of invention.

"A WOUND TYRE"

which is described in the accompanying complete specification. This application is a convention application and is based on the application or applications for a patent or patents or similar protection made in the following country or countries on the following date or dates:

in (d) GERMANY on (e) 29.8.79 No. (f) 34.9.36.8...

in (d) .......... on (e) .......... No. (f) ..........

in (d) .......... on (e) .......... No. (f) ..........

in (d) .......... on (e) .......... No. (f) ..........

in (d) .......... on (e) .......... No. (f) ..........

in (d) .......... on (e) .......... No. (f) ..........

Our address for service is care of ARTHUR S. CAVE & CO., Patent and Trade Mark Attorneys, 1 Alfred Street, Sydney, New South Wales, Australia 2000.

Dated this (g) 26th .............. day of August .............. 1980

(h) BAYER AKTIENGESELLSCHAFT

By Its Patent Attorneys,

ARTHUR S. CAVE & CO.

G. F. CHODZIESNER.

The Commissioner of Patents,
COMMONWEALTH OF AUSTRALIA
ARThUR S. CAVE & CO.
PATENT AND TRADE MARK ATTORNEYS
SYDNEY

A.S.C.-2
DECLARATION IN SUPPORT OF A CONVENTION APPLICATION UNDER PART XVI FOR A PATENT OR PATENT OF ADDITION

In support of the Convention application made for a patent for an invention entitled
(a) A Wound Tyre

The applicant for a patent is
(b) Joachim Gremm
Erwin Dill
(c) Bayer Aktiengesellschaft, D 5090 Leverkusen, Germany

I we/we solemnly and sincerely declare as follows:

1. I am/we are the applicant(s) for the patent of addition

(OR, IN THE CASE OF AN APPLICATION BY A BODY CORPORATE.)

1. I am/we are authorised by the applicant for the patent of addition to make this declaration on its behalf.

2. The basic application(s) as defined by Section 141 of the Act was/were made in the following country or countries on the following dates namely:

   (d) Germany on (e) August 29, 1978 No. (f) P 29 34 936,8
   by (g) Bayer Aktiengesellschaft

3. I am/we are the actual inventor(s) of the invention referred to in the basic application

(OR, WHERE A PERSON OTHER THAN THE INVENTOR IS THE APPLICANT)

   (h) 1) Jakob Ippen 2) Friedel Stützgen

of (i) 1) Schleiermacher Strasse 17, D 5090 Leverkusen 1, Germany
2) Albrecht-Duerer-Strasse 94, D 5024 Pulheim, Germany
both of German nationality

We/are the actual inventor(s) of the invention and the facts upon which the Company is entitled to make the application are as follows:

   (k) The company is the Assignee of the said invention

   from the said inventors

4. The basic application(s) referred to in paragraph 2 of this Declaration was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

Declared at Leverkusen this 16th day of July 1980

The Commissioner of Patents,
COMMONWEALTH OF AUSTRALIA
ARTHUR S. CAVE & CO.
PATENT AND TRADE MARK ATTORNEYS
SYDNEY

(Signature of Declarant)
1. A tyre comprising an air-tight internal panel, a carcass, a wire cap, a hump strip, a belt, a tread, a shoulder portion, a wire core and a lateral portion, wherein the carcass and internal panel are formed by a carcass fabric embedded in a rubber mixture and an air-tight rubber panel extending over the entire length, which encircles the tyre at least twice and on which an at least double encircling coil having textile threads which cross over at a known angle to the direction of travel in at least three layers is built-up using high modulus—possessing mixture to form the belt.
Short Title:

Int. Cl:

Application Number:
Lodged:

Complete Specification-Lodged:

Accepted:
Lapsed:
Published:

Priority:

Related Art:

TO BE COMPLETED BY APPLICANT

Name of Applicant: BAYER AKTIENGESELLSCHAFT

Address of Applicant: Leverkusen, Germany

Actual Inventor: (1) JAKOB IPPEN (2) FRIEDEL STUTTGEN

Address for Service: ARTHUR S. CAVE & CO., Patent and Trade Mark
Attorneys, 1 Alfred Street, Sydney, New South Wales, Australia, 2000.

Complete Specification for the invention entitled:
"A WOUND TYRE"

The following statement is a full description of this invention, including the best method of performing it known to me:

-1-

ASC-49
The invention relates to a tyre consisting of an air-tight inner panel, a carcass, a wire cap, hump strips, a belt, a tread, a shoulder portion and a side portion.

The conventional vehicle tyre is produced mainly by hand from very many differing components.

The quality of the tyre depends, in particular, on the dexterity and care of the tyre builder. These highly stressed vehicle components are consequently accompanied by an incalculable risk which is very serious since it endangers life and limb. Moreover, the manual work makes the labour costs very high.

The process cannot be automated economically due to the plurality of operating stages resulting from a plurality of differing components. In addition, the fitting of steel belts is very expensive and demands special care. Another feature of the steel belt is that the adhesion between rubber and metal decreases in proportion to the ageing of the tyre. Problems are also caused by rust formation due to the friction between the steel threads moving against each other known as "fretting".

There has been no lack of attempts to mechanise the work. Thus, for example, a tyre with encircling textile belts was experimentally produced and tested in conjunction with normal radial carcasses.

However, trials have shown that a tyre of this type is poor in response and has unsatisfactory lateral guidance. In particular, the tyre failed during overtaking procedures as the driving behaviour was unstable.

An object of the invention is to find a tyre for a vehicle with an associated apparatus which demands less operations but, nevertheless, meets higher requirements with respect to drive comfort, durability and drive stability.
According to the present invention there is provided a tyre comprising an air-tight internal panel, a carcass, a wire cap, a hump strip, a belt, a tread, a shoulder portion, a wire core and a lateral portion, wherein the carcass and internal panel are formed by a carcass fabric embedded in a rubber mixture and an air-tight rubber panel extending over the entire length, which encircles the tyre at least twice and on which an at least double encircling coil having textile threads which cross over at a known angle to the direction of travel in at least three layers is built-up using high moduluspossessing mixture to form the belt.

It is surprising to a skilled man that, in the case of a carcass which is coated over its entire length with an air-tight internal panel, the structure is not disturbed in the air-tight region even when greatly stressed under mechanical and thermal influences, despite the multiply encircling coil, as would be the case in the formerly used internal panel. Another advantage which should be mentioned is that the textile threads, which run obliquely to the direction of travel and wound up twice at least with right and left gradient, in conjunction with the mixture possessing a high modulus (i.e. tensile strength \( \geq 6 \) MPa at 100% elongation) impart to the tyre all the driving properties which have to be met nowadays in the mass production of "tyres".

The multiple coils with a web demand fewer operations and are easier to automate because of their more precise guidance. The number of starting points is also reduced thus producing fewer weak points, and this increases the safety of the tyre. The textile threads are more economical and are lighter in weight than a conventional steel belt, this being advantageous in the case of rapidly rotating wheels.

In a particular embodiment, the beginning and end of the carcass fabric lie approximately on top of each other.
Shifting of the ends of the carcass fabric which in the circumferential direction should amount to between -5 and +10 mm relative to the fitting position of the joins on top of each other, does not have an undesirable effect on the properties of running true and strength. These possible tolerances considerably simplify the difficult production involving the plastic-elastic product.

In another embodiment, the rubber panel projects from at least 10 to 20 mm over the carcass layer.

In contrast to the conventional step-wise widening of the individual layers which invariably only ever allows the winding of one layer, the carcass edges are surprisingly perfectly embedded if the internal panel projects, and sufficient protection from damage to these endangered points is thus achieved.

In another embodiment, the air-tight rubber panel has a density at 80°C of from 22 to 42.10^{-8} 1/24 h m^{-2}, preferably of from 30 - 35.10^{-8} 1/24 h m^{-2} (DIN 53536). Because of the doubled layer of the air-tight rubber panel, substantially fewer demands have to be met with respect to the tightness of the individual layer than in the case of the conventional single-layered internal panel, yet the safety of the tyre with regard to air loss increases.

Suitable rubbers for the production of the air-tight mixture include natural and synthetic rubbers and mixtures thereof. Particularly suitable synthetic rubbers include styrene-butadiene rubber and butadiene rubber such as, for example, cis-1,4-polybutadiene.

The air-tight mixture is produced from conventional rubber mixtures which contain, in addition to the known vulcanising agents, accelerators and anti-agers, for example, the following constituents per 100 parts by weight of rubber: from 30 - 50 parts by weight carbon.
black, from 5 to 15 parts by weight of silica and from
0.5 to 4 parts by weight of an adhesive combination
composed, for example, of resorcinol and stearic acid
in a ratio of 2:1.

In a recommended embodiment, the belt consists of
two separate coils each with two turns, the textile
threads of each coil forming a specific angle to the
direction of travel and to the other coil.

The doubled turns per coil simplify automatic
operation. If the points of contact of the two coils
are arranged opposite each other, a triple layer of
threads is also produced at the points of contact, thus
making the tyre very safe.

The reinforcement for the carcass can be produced
from any desired rayon, polyamide, polyester, aramide
or carbon fibre. Cords which only stretch slightly
such as, for example, those of rayon, polyamide, glass,
aramide or carbon fibres have to be used for the belt.

In a possible embodiment, the belt additionally
contains two steel belt layers which are covered on one
side or both sides with high modulus possessing mixture.
With heavy duty tyres, the required properties of a
heavy duty tyre can be achieved by the incorporation of
additional steel belt layers with layers of high modu-
lus possessing mixture arranged above and below, the
small number of steel belts making the tyre cheaper
and more economical.

In one embodiment, the tyre has an air pressure
of between 1 and 10 bar, preferably between 2 and 4 bar
for passenger cars and between 7 and 10 bar for lorries.

The tyre design according to the invention allows
a high air pressure which leads to low rolling resis-
tance and nevertheless has equally good spring comfort
as corresponding steel belt tyres due to the overall
softer belt assembly.

Le A 19.924  - 5 -
In a preferred embodiment, the high modulus-possessing mixture contains from 20 to 40 parts by weight of reinforcing resin per 100 parts by weight of rubber.

Elastomers of this type are distinguished in that they have high degrees of hardness (Shore A hardness 85 to 95) and a tensile value having a tensile strength of from 6 to 15 MPa at 100% elongation. Moreover, they can readily be processed.

Suitable rubbers for the production of the high modulus-possessing mixture include natural and synthetic rubber and mixtures thereof. Particularly suitable synthetic rubbers include styrene butadiene rubber and butadiene rubber such as for example, cis-1,4-polybutadiene. Rubbers containing urethane or urea groups are also suitable.

The high modulus-possessing mixture is obtained from rubber mixtures containing, in addition to the conventional vulcanisers, accelerators, agers and fillers, from 20 to 40, preferably from 25 to 35 parts by weight of silica and reinforcing resin per 100 parts by weight of rubber. Suitable reinforcing resins include, for example, phenolic-based novolaks such as, for example, phenol formaldehyde resins which can also be used in the form of their reaction products with boric acid, boron trioxide or boric acid alkyl ester as well as unsaturated fatty acids obtained according to German Offenlegungsschrift No. 2 557 613. Novolaks which are modified by conventional additives such as, for example, cashew oil are preferably used as reinforcing resins. It is also possible to use glass fibres instead of the reinforcing resin or in conjunction with it.

In an embodiment of the method, the individual operations are carried out on consecutively arranged units of a production machine, prefabricated layers of carcass with internal panel or belt with high modulus-
possessing mixture automatically being supplied and wound for the coils in several layers.

Due to the passage, the materials can be supplied automatically into the individual units, thus saving manual work in this mass-produced article. At the same time, the application processes are reduced by the multiple coil, thus increasing the safety of production and shortening the production time.

Embodiments of the invention are illustrated in the accompanying drawings and described in more detail below.

Figure 1 shows a section through a passenger car tyre.

Figure 2 shows a section through a passenger car tyre.

Figure 3 shows a section through a passenger car tyre.

Figure 4 shows a section through a lorry tyre.

Figure 5 shows a plan view of the production plant.

Figure 6 shows an elevation of the production plant.

In Figure 1, reference numeral 1 denotes an air-tight rubber panel, 2 a carcass, 3 a high modulus-possessing rubber mixture, 5 an encircling belt, 6 a tread, 7 a shoulder portion, 8 a lateral portion, 9 a hump strip, 10 a wire cap and 11 a steel cord core.

In Figure 2, 1 denotes air-tight rubber panel, 2 carcass, 3 high modulus-possessing rubber mixture, 5 encircling belt, 6 tread, 7 shoulder portion, 8 lateral portion, 9 hump strip, 10 wire cap and 11 steel cord core.

In Figure 3, 1 denotes air-tight rubber panel, 2 carcass, 5 wound belt with high modulus-possessing mixture and angle of inclination to the right, 12 wound belt with high modulus-possessing mixture and angle of inclination to the left, 6 tread, 7 shoulder portion, 8 lateral portion, 9 hump strip, 10 wire cap, 11 wire core.

Le A 19 924 - 7 -
In Figure 4, 1 denotes a rubber panel, 2 carcass, 13 high modulus-possessing mixture in the belt region, 14 high modulus-possessing mixture in the foot strip, 15 a steel belt with angle of inclination to the right, 16 a steel belt with angle of inclination to the left, 17 a hump strip of high modulus-possessing mixture, 18 a wire core of high modulus-possessing mixture, 19 a steel wire core, 20 a steel core sheath of high modulus-possessing mixture.

Figures 5 and 6 show a drive block 21 which is rotatable about a vertical axis and is provided with four units 22, 23, 24, 25 each consisting of a drivable construction drum 26 with vacuum openings 27 for applying the web, a folding skin 28 for fixing the wire cores and elements 29 which can be moved in the radial direction by expansion skin for cambering purposes.

The first unit 22 is provided with a servicer 30 for a doubled carcass and a servicer 31 for the wire caps. The second unit 23 has a magnetic core inserting device 32 which can be driven via the drum. The third unit 24 is provided with a servicer 33 for the hump strip and lateral portions. The fourth unit has a contact roller 34, a stripper 35 and a conveyor belt 36 for the blank.

Beside it, another drive block 37 is erected which is rotatable about a vertical axis and has two units 38, 39, each of which is equipped with a belt servicer 40 and tread servicer 41 as well as contact rollers 42, 43.

The fourth unit 25 of the first drive block 21 and the second unit 39 of the second drive block 37 lie opposite each other and are joined together by means of a conveyor 44 for the transfer of the tyre superstructure to the substructure.

To produce a tyre, a casing which has been cut to length and which is provided with an air-tight coating over its entire length is supplied to the drum on unit
22 by means of the production device 40 and rolled. Wire caps are similarly deposited by means of servicer 31, cut to length and rolled. After travelling into the next unit 23, the wire core is automatically inserted by means of a magnetic core insertion device 32. The core is subsequently clamped and the ply turn-up effected. In the next operation, after travelling to unit 24, the hump strip and the lateral portion are supplied via servicer 33, cut to length and rolled. The drum then pivots into position 25 in order to receive the belt later on.

In parallel with the previous operations, the belt layer, including the high modulus-containing mixture, is supplied to the drum via servicer 40, cut to length and rolled in unit 38. The drum then pivots to unit 39 where the tread and the shoulder portion are supplied via servicer 41 deposited and rolled.

The conveyor 44 takes up the component from unit 39 and conveys it to unit 25 above the carcass. The carcass is cambered until contact is established with the belt. The blank tyre is rolled by means of rollers 34 and ejected onto the conveyor belt 36 by means of the tyre stripper 35.

**Example**

Conventional mixtures can be used for the tyre in addition to the formulations mentioned below by way of example.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural rubber</td>
<td>80.0</td>
</tr>
<tr>
<td>cis-1,4-polybutadiene</td>
<td>20.0</td>
</tr>
<tr>
<td>Carbon black N-559</td>
<td>40.0</td>
</tr>
<tr>
<td>active precipitated silica</td>
<td>8.0</td>
</tr>
<tr>
<td>zinc oxide</td>
<td>10.0</td>
</tr>
<tr>
<td>aromatic mineral oil</td>
<td>3.0</td>
</tr>
<tr>
<td>alkylphenol resin</td>
<td>2.0</td>
</tr>
</tbody>
</table>
N-isopropyl-N-phenyl-p-phenylene-
diamine 1.8 parts by weight
2,2,4-trimethyl-1,2-dihydro-
quinoline 1.2
stearic acid 0.75
5 resorcinol/stearic acid 2:1 1.2
hexamethylenetetraamine 0.75
benzothiazyl-2-cyclohexylsul-
phene amide 0.7
dibenzothiazyl disulphide 0.3
10 sulphur batch (53.2%) 6.25
        175.95

Mixture plasticity/80°C
Defo hardness/Defo elasticity 475/14
15 tensile strength (MPa) 20.3
breaking elongation (%) 460
tensile value at 300% elongation
(MPa) 11.7
Tear propagation resistance according
to Pohle (N) 250
20 hardness at 20/70°C (Shore A) 60/60
impact elasticity at 20/70°C (%) 64/70
gas permeability at 80°C 32.2·10⁻⁸

The high modulus-possessing mixture is produced
from
Natural rubber 75.0
cis-1,4-polybutadiene 25.0
carbon black N-347 40.0
30 active precipitated silica 30.0
modified novolak 30.0
stearic acid 3.0
N-isopropyl-N-phenyl-p-phenylene-
diamine 2.5
2,2,4-trimethyl-1,2-dihydroquinoline 1.5
35 zinc oxide 5.0
secondary amine 2.5
hexamethylenetetraamine (80%) 4.5
<table>
<thead>
<tr>
<th>Mixture plasticity/80%</th>
<th>2250/11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defo hardness/Defo elasticity</td>
<td>2250/11</td>
</tr>
<tr>
<td>tensile strength (MPa)</td>
<td>14.1</td>
</tr>
<tr>
<td>breaking elongation (%)</td>
<td>270</td>
</tr>
<tr>
<td>tensile value at 100% elongation (MPa)</td>
<td>6.5</td>
</tr>
<tr>
<td>tear propagation resistance according to Pohle (N)</td>
<td>180</td>
</tr>
<tr>
<td>hardness at 20°C (Shore A)</td>
<td>89</td>
</tr>
</tbody>
</table>
The claims defining the invention are as follows:

1. A tyre comprising an air-tight internal panel, a carcass, a wire cap, a hump strip, a belt, a tread, a shoulder portion, a wire core and a lateral portion, wherein the carcass and internal panel are formed by a carcass fabric embedded in a rubber mixture and an air-tight rubber panel extending over the entire length, which encircles the tyre at least twice and on which an at least double encircling coil having textile threads which cross over at a known angle to the direction of travel in at least three layers is built-up using high modulus-possessing mixture to form the belt.

2. A tyre according to claim 1, wherein the beginning and the end of the carcass fabric lie approximately on top of one another.

3. A tyre according to claim 1 or 2 wherein the air-tight rubber panel projects over the carcass layer by from at least 10 to 20 mm.

4. A tyre according to any of claims 1 to 3, wherein the air tight rubber panel has a tightness of from 22 to 42.10^{-8} 1/24 h m^2 at 80°C.

5. A tyre according to claim 4, wherein the air-tight rubber panel has a tightness of from 30 to 35.10^{-8} 1/24 h m^2 at 80°C.

6. A tyre according to claim 1 to 5, wherein the belt is composed of two separate coils with two turns each the textile threads forming a specific angle with the direction of travel and to the other coil for each coil.

7. A tyre according to any of claims 1 to 6, wherein the steel belt layers are additionally arranged in the belt and are covered on one or both sides with high modulus-possessing mixture.

8. A tyre according to any of claims 1 to 7, wherein
the tyre has an air pressure of from 1 to 10 bar.

9. A tyre according to claim 8 for a passenger car wherein the tyre air-pressure is from 2 to 4 bar.

10. A tyre according to claim 8 for a lorry wherein the tyre air-pressure is from 7 to 10 bar.

11. A tyre according to any of claims 1 to 10, wherein the high modulus-possessing mixture contains from 20 to 40 parts by weight of reinforcing resin for each 100 parts by weight of rubber.

12. A tyre substantially as herein described and illustrated in any one of Figures 1 to 4 of the accompanying drawings.

13. A tyre according to any preceding claim formed with reference to a method of production of a tyre according to any preceding claim, wherein a substructure comprising a carcass which is sealed against escape of air is placed on a first drum, on which wire cores are fixed on the substructure by fording over the casing after applying a wire cap and then provided with a hump strip and lateral portion; a superstructure comprising a belt and tread is produced on a second drum and is then pushed via the first drum which produces an internal bond between the substructure and the superstructure while cambering the carcass and rolling the superstructure, and the individual operations are carried out on consecutively arranged units of a production machine, prefabricated layers comprising carcass with internal panel or belt with high modulus-possessing mixture being automatically supplied and wound to produce the coil in several layers.

DATED this 26th day of August, 1980.

BAYER AKTIENGESELLSCHAFT,
By Its Patent Attorneys,
ARTHUR S. CAVE & CO.