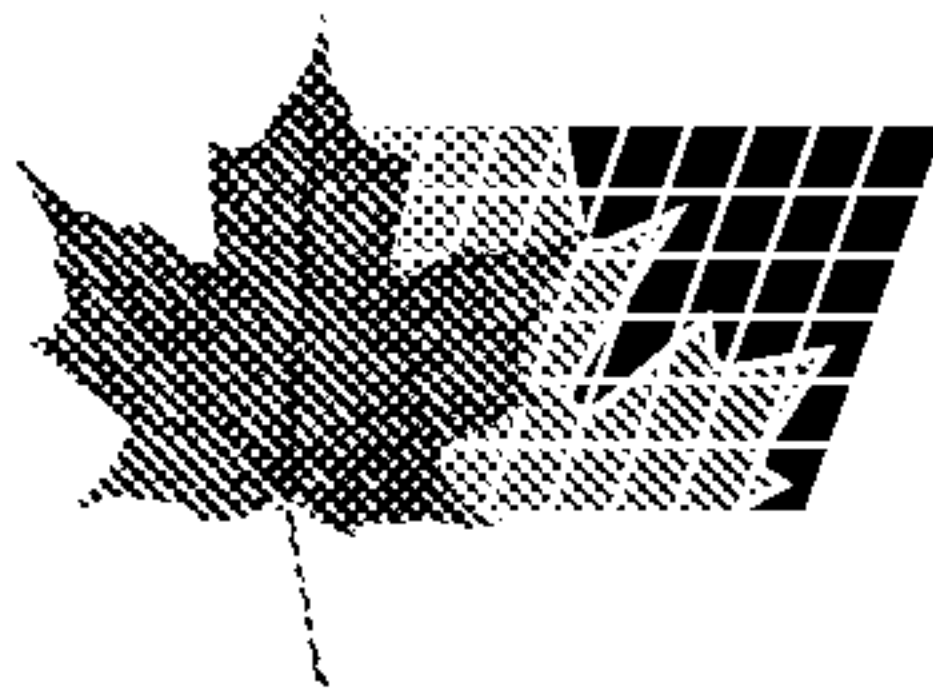




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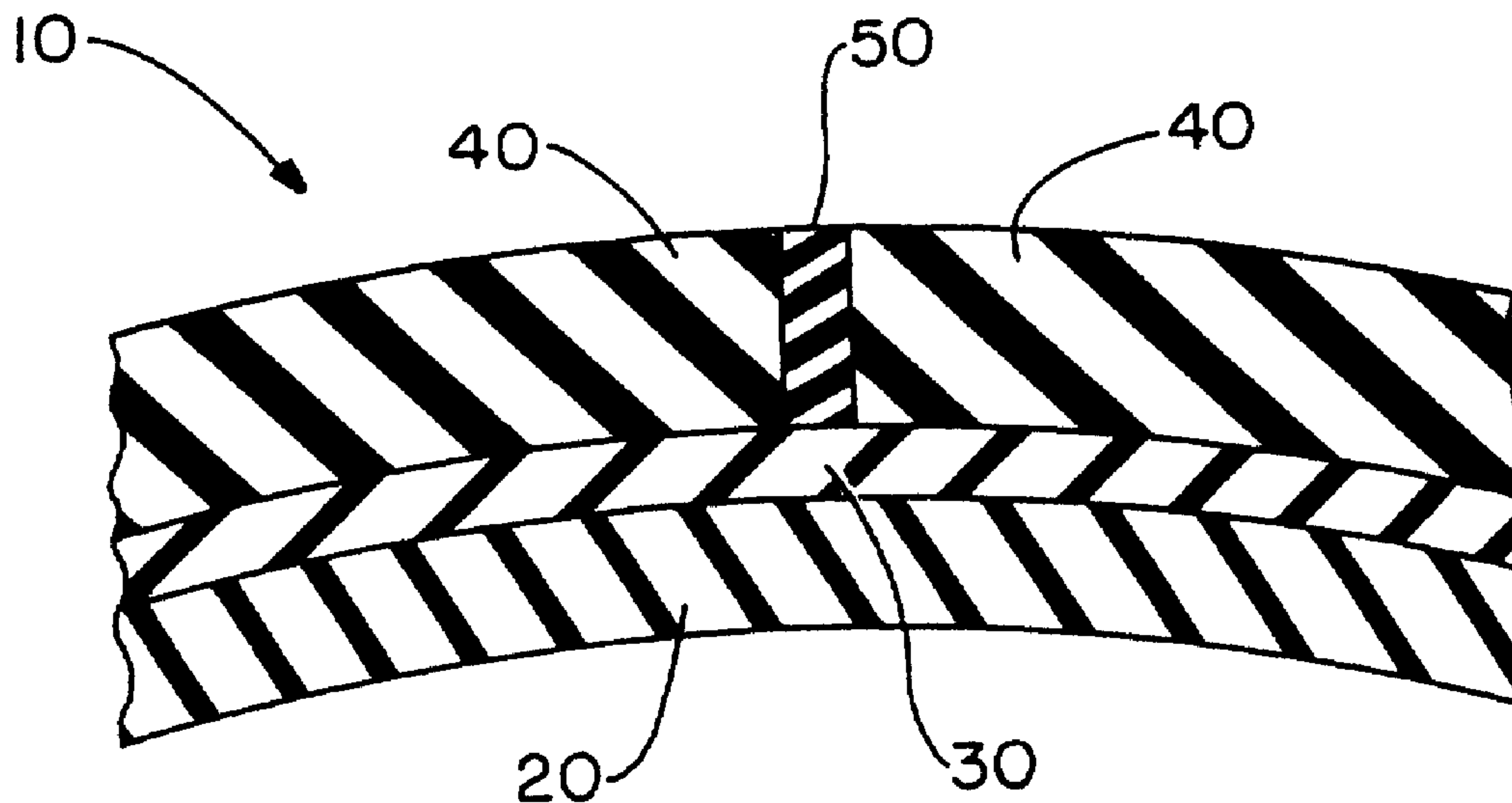
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(54) EPISSURE DE PNEU RECHAPE EXTRUDABLE

(54) EXTRUDABLE RETREAD TIRE SPLICING



(57) Retreaded tires are made using a hot extruded splice strip of either natural rubber or a high-synthetic rubber to directly adhere the ends of a precured tire tread together. The retreaded tire, which also contains an uncured cushion strip between the tire tread and a buffed carcass, is then heated to cure the tread splice as well as the tire cushion.

Abstract Of The Disclosure

EXTRUDABLE RETREAD TIRE SPLICING

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EXTRUDABLE RETREAD TIRE SPLICINGField Of Invention

5 Tire splices for retread tires are made by applying a hot, natural rubber or high-synthetic rubber extrudate directly between the ends of a cured tire tread.

Background Of The Invention

10 Heretofore, for making a retread tire, tire splices have been formed by applying an adhesive to the ends of the cured tire tread. Calendered natural rubber was then added between the tread ends and subsequently cured. Such procedure is well known to
15 those having skill in such art.

U.S. Patent No. 5,503,940 to Majumdar, et al. relates to using a calendered high-synthetic rubber compounds which was applied to the ends of the cured tire treads without any adhesive.

20

Summary Of The Invention

It is an aspect of the present invention in a retread tire to utilize a hot extrudate to splice together the ends of a typically cured tire tread
25 which is applied to a buffed casing. The hot extrudate tire splice can either contain a high percentage of natural rubber, or preferably a high percentage of synthetic rubber which is applied to the ends of a cured tire tread.

Brief Description Of The Drawing

FIGURE 1 is a partial side elevation of a schematic cross section of a retread tire having a tire splice according to the present invention.

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Detailed Description Of The Invention

Referring to FIGURE 1, a retread tire generally indicated by the numeral (10), contains carcass layer (20), which generally contains various belts and plies therein. For example, carcass (20) can contain one or more steel belts as well as one or more plies made of rayon, polyester, fiberglass, nylon, and the like. The plies can either extend in a bias direction or in a radial direction.

15

Tire cushion (30) is located on top of tire carcass (20) and generally adhered thereto. The tire cushion (30) is cured with the tire splice. The tire cushion (30) can be made of a high percentage or amount of natural rubber, or generally any type of high percentage or amount of synthetic rubber, or blends thereof. Suitable types of synthetic rubbers include those made from conjugated dienes having generally from about 4 to about 12 carbon atoms and, preferably from about 4 to about 8 carbon atoms such as butadiene, isoprene, from conjugated dienes having from 4 to 12 carbon atoms with monomers of vinyl substituted aromatics having from 8 to 12 carbon atoms such as styrene, alpha-methylstyrene, and the like. Examples of suitable synthetic rubbers include polybutadiene, polyisoprene, styrene-butadiene rubber, and the like. Such rubbers are well known to the art

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and to the literature and can be compounded with conventional amounts of various additives such as oil, fillers such as carbon black, clay, and the like, processing aids, zinc oxide, stearic acid, sulfur, various accelerators, antioxidants, antiozinates, and the like. A highly preferred high tack compound based on a high percentage synthetic rubber compound is described in U.S. Patent No. 5,503,940 and is hereby fully incorporated. By the term "high tack" it is meant that the rubber, or cushion substrate, provides a sticky composition which provides for a physical union of one vulcanized substrate to a second vulcanized substrate until both substrates can be vulcanized to each other.

The tire cushion compound of the '940 patent not only has high tack, but is referred to as a high percentage synthetic rubber compound, inasmuch as it contains generally at least 40% by weight, desirably at least 50% by weight, and preferably at least 55% by weight of synthetic rubber which is blended with natural rubber. As set forth in the '940 patent, the synthetic rubber contains at least one bis-imide therein and generally also contains one or more compatible tackifying agents known to the art and to the literature. Such tackifying agents generally include rosin and its derivatives, as well as various hydrocarbon resins, which are set forth in the '940 patent and hereby fully incorporated. A preferred type of such a tackifier are the various phenol-formaldehyde resins. Alternatively, the tire cushion compound can be a high percentage natural rubber

meaning that it generally contains at least 90% by weight, desirably at least 95% by weight, and preferably 100% by weight of natural rubber therein based upon the total weight of all rubbers.

5 Any suitable or desired type of rubber can be utilized for tire tread (40), such as natural rubber, synthetic rubber such as that made from conjugated dienes having from 4 to 12 carbon atoms, copolymers made from conjugated dienes having from 4 to 12 carbon
10 atoms and vinyl substitute aromatics having from 8 to 12 carbon atoms. While tire tread (40) can be uncured, preferably it is cured.

 Heretofore, tire splice (50) was generally a thin strip of calendered and uncured natural rubber.
15 However, before it was applied between the ends of cured tire tread (40), an adhesive was applied then thereto. Then, the thin calendered natural rubber was applied between the tread ends and cured.

 According to the present invention, tire splice
20 (50) is an extrudate which is applied, while still hot or warm, between the ends of the cured tire tread and cured. That is, the ends of the tire tread are free of adhesive other than said extrudate. An example of a suitable extruder is a cold feed hand-held extruder
25 having a circular die manufactured by the Bosch Company of Germany, which was modified with a detachable slit die. The extrudate is generally applied to only one end of a tire tread. The remaining end is then pushed against the extrudate to
30 form a seal or splice between the two tread ends.

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The spliced extrudate compound can be the same as a tire cushion (30) as set forth hereinabove and, thus, is fully incorporated by reference. That is, the splice extrudate can be either a high percentage synthetic rubber and, thus, generally contains at least 40% by weight, desirably at least 50% by weight, and preferably at least 55% by weight of synthetic rubber which is blended with natural rubber. Alternatively, the splice extrudate compound can be a high percentage natural rubber containing at least 90% by weight, desirably at least 95% by weight, and preferably 100% by weight of natural rubber therein based upon the total weight of all rubbers. A preferred spliced extrudate compound is a high tack, high percentage synthetic rubber such as that set forth in U.S. Patent No. 5,503,940 which is hereby fully incorporated by reference. This rubber contains a bis-imide compound as well as various tackifiers therein such as rosin, hydrocarbon resins, phenol-formaldehyde resins, and the like.

Once the extruded spliced rubber such as natural rubber, or a blend of natural rubber with a high amount or percentage of synthetic rubber, has been added to the splice area, it is cured. Curing is obtained by heating the retread tire for a sufficient time at a suitable temperature to crosslink the tire splice, as well as the tire cushion if the same has not been cured. Suitable curing times and temperatures can vary such as temperatures from about 210°F (99°C) to about 310°F (155°C) at times of from about 1 to about 4 hours, and the like. Optionally,

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before curing, metal staples or other suitable devices can be utilized to maintain the two tire tread ends in position until cure is completed, where upon they are removed. The tire splice compound contains
5 conventional amounts of conventional additives such as various oils, for example naphthenic, aliphatic, etc., fillers such as carbon black, clay, etc., various processing aids, zinc oxide, stearic acid, sulfur, various accelerators, antioxidants, antiozonants, and
10 the like. According to the present invention, the ends of the tire tread do not have any cement applied thereto which generally contains VOC (volatile organic compounds) such as solvents and, thus, is undesirable.

The tire splice compound, upon cure, generally
15 has adhesion of at least 100 pounds per linear inch (18 kg/cm) with either end of the tire tread.

The invention will be better understood by reference to the following examples which serve to illustrate but not to limit the present invention.
20

EXAMPLES

Four identical types of worn tires were buffed. To two of the tires was applied a calendered natural
25 rubber cushion and to the remaining two tires was applied an extruded high percentage synthetic rubber. The compositions of the cushions are set forth in Table I. In order to obtain a true comparison of properties, the ends of the tread were coated with
30 cement for both the extruded splice and the calendered splice examples. However, as noted above, the ends of

the tire tread do not require a cement or an adhesive, which contain solvent and hence VOC (*vide infra*). According to the present invention, and the extrudate is thus directly applied to the tire tread ends having
5 no adhesive thereon.

Table II contains the makeup of the four tires with regard to the type of cushion and type of splice as well as test data. The formulation of the natural rubber splice and the synthetic rubber splice is the
10 same as the formulation set forth in Table I. The calendered rubbers had a thickness of 1.7 mm and were applied to one end of a cured tread which was subsequently joined to the other end of the cured tread and secured together to form the tire splice.

15 The natural rubber spliced material was cut into one-inch (2.5 cm) wide strips. Two such strips were combined and passed through a Haake System 90, one-inch (2.5 cm) diameter single-screw Rheomix rubber extruder attached with a one-quarter-inch (0.64 cm)
20 diameter die. The set temperature was 77°C. The rope feed formed, thereby, had a diameter of 0.26 inches (0.64 cm) and was extruded at the rate of 26.4 inches (67 cm) per minute.

The high percentage synthetic rubber material was
25 passed through a Haake System 90 1-inch (2.5 cm) diameter single-screw Rheomix rubber extruder attached with a one-quarter-inch (0.64 cm) diameter die. The set temperature was 77°C. The rope feed formed, thereby, had a diameter of 0.27 inches (0.69 cm) and
30 was extruded at the rate of 29.5 (75 cm) inches per minute.

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Both the extruded natural rubber as well as the extruded high percentage synthetic rubber rope feeds were applied directly onto a precured tread splice of a tire, as indicated in FIGURE 1, utilizing a modified hand-held extruder having slit die geometry of 1.0x10 mm.

TABLE I

	Synthetic Cushion	All NR Cushion
High Cis Polybutadiene	60.00	
Natural Rubber	40.00	100.00
Carbon Black	50.00	40.00
Tackifiers	8.00	8.50
Processing Oils	6.50	11.00
Antiox/Antioz	1.50	3.00
Perkalink® 900	1.50	
Peptizer		0.30

In addition to the above ingredients, conventional rubber additives such as zinc oxide, fatty acids, retarders, insoluble sulfur, and accelerators were added to the above formulation. The accelerators include one or more of the following; sulfenamides, thiazoles, guanidines, thiurams, or dithiocarbamates.

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TABLE II

	Invention	Control	Control	Invention
Tire Cushion	Calendered Natural Rubber	Calendered Natural Rubber	Extruded High-Synthetic	Extruded High-Synthetic Rubber ⁴
Splice Material	Extruded Natural Rubber ⁴	Calendered Natural Rubber	Calendered Natural Rubber	Extruded High-Synthetic *
Dynamic Heat Rise - Radial Medium Truck Tire Test				
	Finish	Finish	Finish	Finish
Temp-CR ¹ °C	99	99	94	100
Temp - ISSR ² °C	110	108	102	109
Temp-OSSR ³ °C	107	108	102	107
Dynamic High Speed - Radial Medium Drive Tire Test				
Run till step #	6	7	6	6
Min/kph	45/130	15/140	40/130	31/130
km	523	588	515	494
Step to 121+ °C	4	4	5	4

1. CR = crown temperature
2. ISSR = inside serial side rib temperature
3. OSSR = outside serial side rib temperature
4. Used slit die having geometry of 1.0x10 mm

TABLE III

Number	Slit Die Geometry (mm)	Extrudate Thickness (mm)
1	1.9 x 10	3.8
2	1.0 x 10	1.3

5 The tire splice rubber as well as the tire cushion rubber of Table II were cured by placing the tire inside a rubber envelope which was then placed inside a pressurized autoclave at 260°F (127°C) for about 150 minutes.

10 As apparent from the test data of Table II, the results of utilizing an extruded high percentage synthetic rubber or natural rubber for the spliced material are indistinguishable from the control examples which utilized calendered natural rubber.

15 In a separate experiment, the thickness of extrudate as a function of die geometry was determined and are shown in Table III. Clearly the 1.0x10 mm die is preferred to 1.9x10 mm die for experimental tire building as the extrudate thickness was closer to that of calendered strip - 1.7 mm (*vide supra*). Both the hot extruded natural rubber and the high percentage synthetic rubber extruded through 1.0x10 mm die were highly tacky and was able to hold precured tread splices together without the need of any splice cement.

25 The present invention and process can be utilized to splice generally any type of tires including aircraft tires, vehicle tires and especially truck tires. The present invention has many advantages

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inasmuch as it eliminates the need of applying an
adhesive, and/or calendering the splice strip which is
time consuming, and hence reduces the cost of making
tires. It also eliminates the need to utilize
5 solvent-based adhesives as well as eliminates the need
of plastic film to roll the calendered spliced rubber.

While in accordance with the patent statutes the
best mode and preferred embodiment has been set forth,
the scope of the invention is not limited thereto, but
10 rather by the scope of the attached claims.

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WHAT IS CLAIMED IS:

1. A process for splicing a retread tire,
comprising the steps of:
5 extruding a rubber splice composition;
applying said extruded rubber splice composition
directly to a spliced area between two tire tread
ends; and
heating and curing said rubber splice
10 composition.
2. A process according to Claim 1 wherein said
tire tread ends are free of any adhesive other than
said extruded rubber splice composition.
- 15 3. A process according to Claim 1 wherein said
tire tread is cured.
4. A process according to Claim 1 wherein said
20 spliced rubber compound is a high percentage natural
rubber, or a high percentage synthetic rubber-natural
rubber blend, or combinations thereof, having high
tack before cure.
- 25 5. A process according to Claim 1 wherein said
high percentage natural rubber or said high percentage
synthetic rubber-natural rubber blend contains
tackifiers.
- 30 6. A process according to Claim 5 including
applying said splice rubber to one tire tread end and

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pushing the remaining tire tread end into contact with said splice rubber before heating and curing.

5 7. A process according to Claim 6 wherein said rubber splice is a said blend containing synthetic rubber, and wherein the amount of said synthetic rubber is at least 40% by weight based upon a total weight of said synthetic rubber and said natural rubber.

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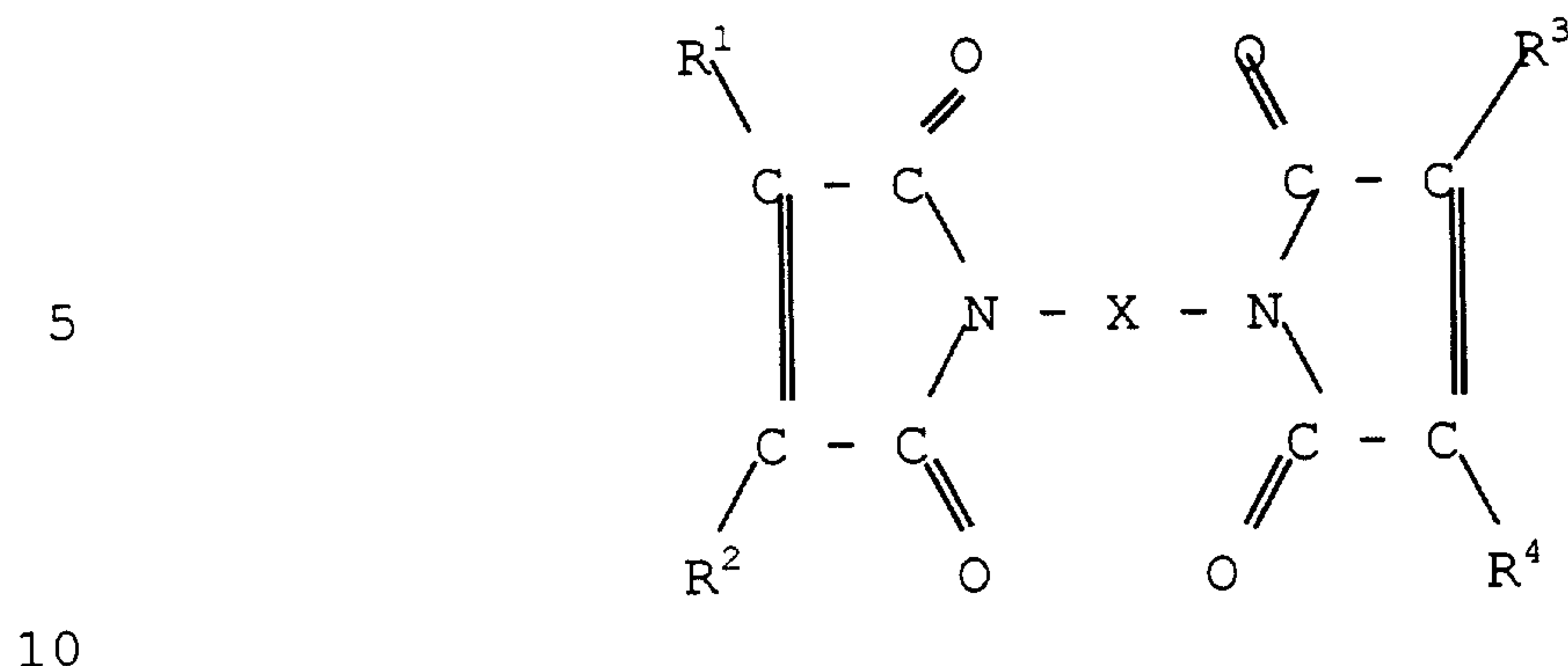
8. A process according to Claim 7 wherein said synthetic rubber contains a bis-imide compound.

15 9. A process according to Claim 2 wherein said spliced rubber splice composition is a high tack synthetic rubber-natural rubber blend.

20 10. A process according to Claim 9 wherein said high percentage synthetic rubber contains at least 55% by weight based of said synthetic rubber based upon the total weight of said synthetic rubber and said natural rubber, and wherein said blend contains a bis-imide compound.

25 11. A process according to Claim 10 wherein said bis-amide compound has the formula

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where R¹, R², R³, and R⁴, independently, are hydrogen, an alkyl group having from 1 to 5 carbon atoms, a phenyl group, an alkylphenyl group having 7 to 10 carbon atoms or a halogen substituted alkyl group having from 1 to 5 carbon atoms, a halogen substituted phenyl group, or a halogen substituted alkylphenylene group having a total of from 7 to 10 carbon atoms, and where X is an alkylene group having from 1 to 5 carbon atoms, a phenylene group, an alkylphenylene or alkylenephenyl group having 7 to 10 carbon atoms or a halogen substituted alkylene group having from 1 to 5 carbon atoms, a halogen substituted phenylene group, or a halogen substituted alkylphenylene or alkylenephenyl group having a total of from 7 to 10 carbon atoms, and wherein the amount of said bis-imide compound is from about 0.1 to about 10 parts by weight per 100 parts by weight of said cushion vulcanizable elastomer.

30 12. A process for splicing a rubber article comprising the steps of:

extruding a splice rubber into an area between two rubber articles, and heating and curing said rubber splice.

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13. A process according to Claim 12 wherein said tire tread ends are free of any adhesive other than said splice rubber.

5 14. A process according to Claim 13 wherein said spliced rubber compound is a high percentage natural rubber, or a high percentage synthetic rubber-natural rubber blend, or combinations thereof, having high tack before cure.

10 15. A process according to Claim 11 wherein said high percentage natural rubber or said high percentage synthetic rubber-natural rubber blend contains tackifiers.

15 16. A process according to Claim 15 wherein said rubber splice is a said blend containing synthetic rubber, and wherein the amount of said synthetic rubber is at least 40% by weight based upon a total
20 weight of said synthetic rubber and said natural rubber, and wherein said synthetic rubber contains a bis-imide compound.

25 17. A process according to Claim 16 wherein said high percentage synthetic rubber contains at least 55% by weight of said synthetic rubber.

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