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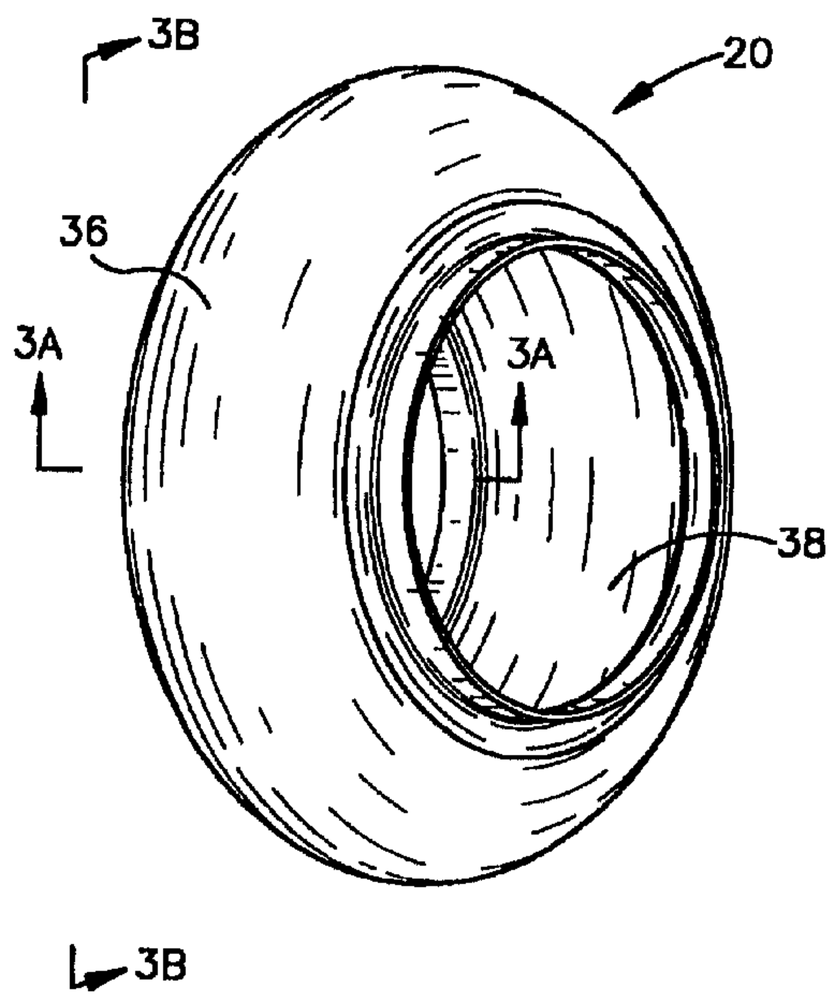
(54) **GOMME INTERIEURE VULCANISEE ET PROCEDE POUR UTILISER LADITE GOMME DANS DES PNEUS**

(54) **VULCANIZED INNERLINER AND METHOD OF UTILIZING THE SAME FOR PNEUMATIC TYRES**



(57) L'invention concerne la fabrication d'un pneu neuf ou rechapé comportant une gomme intérieure vulcanisée sans soudure, ainsi qu'un procédé permettant de fabriquer une gomme intérieure destinée à être utilisée comme intermédiaire de fabrication. La gomme vulcanisée sans soudure, de forme cylindrique ou torique, est fabriquée par différentes techniques de moulage.

(57) The present invention relates to the manufacture of an original or retreaded tire with a vulcanized, splice-free, innerliner and a method of constructing the innerliner as an intermediate article of manufacture. The splice-free, vulcanized innerliner has a cylindrical or toroidal shape and is formed from different molding techniques.

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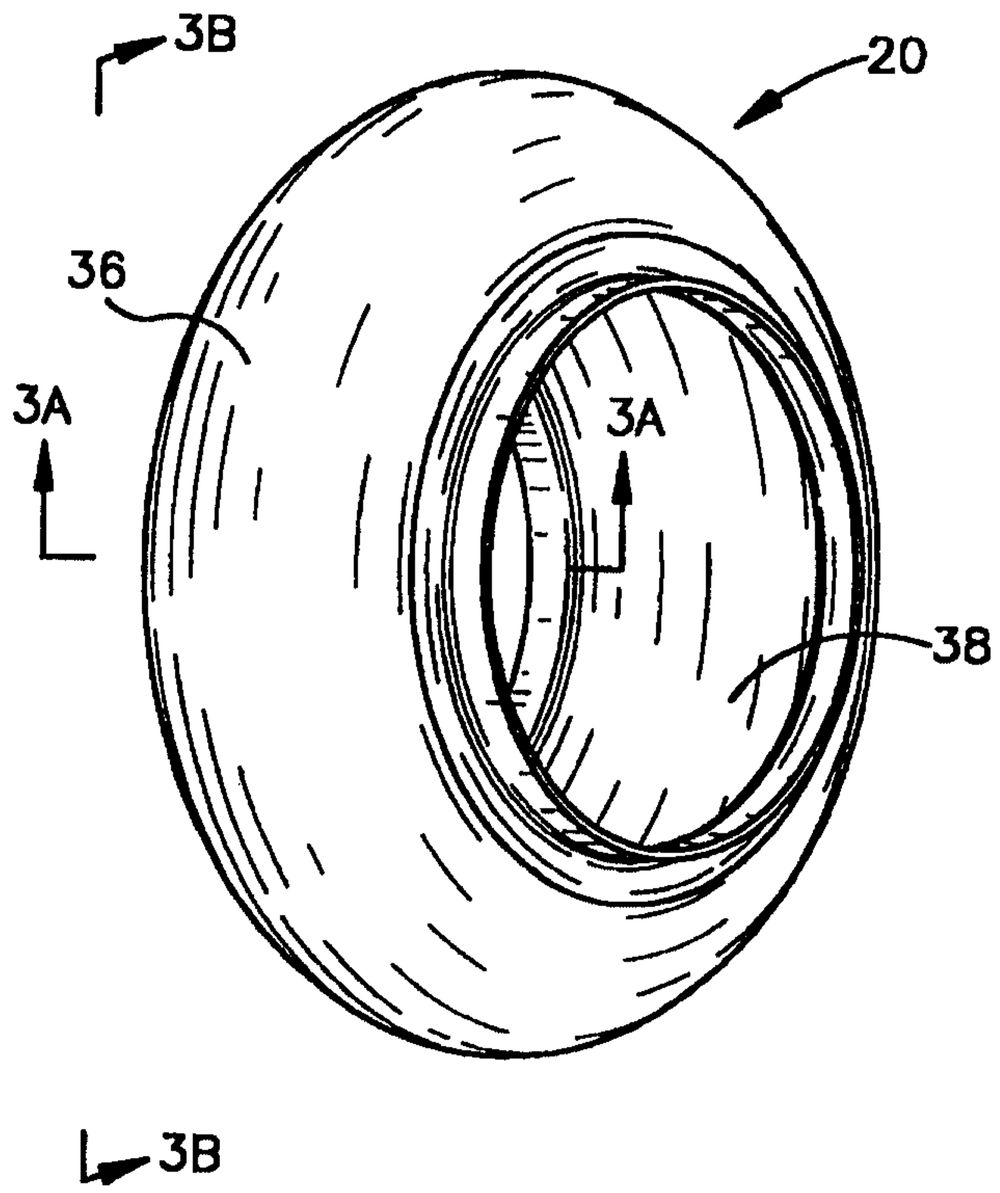
(57) Abstract

The present invention relates to the manufacture of an original or retreaded tire with a vulcanized, splice–free, innerliner and a method of constructing the innerliner as an intermediate article of manufacture. The splice–free, vulcanized innerliner has a cylindrical or toroidal shape and is formed from different molding techniques.



VULCANIZED INNERLINER AND METHOD OF UTILIZING THE SAME FOR PNEUMATIC TYRES

TECHNICAL FIELD

The present invention relates to pneumatic tires and the method of building original and retreaded tires. More particularly, the present invention relates to a vulcanized innerliner and the utilization of the vulcanized innerliner in the manufacture of original and retreaded tires.

BACKGROUND OF THE INVENTION

In the retreading of a tire, the tire is initially prepared by grinding off the existing, unwanted tread and sidewall stock until the tire carcass remains. The tire carcass is examined to determine whether it is either suitable for retreading or too damaged to be retreaded. One common problem, associated with the retreading of tires, is that the innerliner is cracked in the spliced portion so that the inflation air can leak through the crack and into the tire carcass causing the latter to separate or form a blister in the tire plies. A tire carcass with a damaged innerliner is typically discarded even though the tire carcass is otherwise of significant financial value.

To better understand the process of retreading, a brief discussion of tire construction follows. A tubeless, pneumatic tire is typically constructed using a method of tire building wherein the various components, or plies of the tire are applied, as flat stock, upon a rotating tire building drum to form a hollow, toroidal shaped green or uncured tire. In

building a green tire, an innerliner is first wrapped upon the tire building drum followed by the carcass plies containing tire reinforcement. The carcass plies are followed by the beads, apexes, chafers, side walls, belts and tread. The toroidal shaped, green tire assembly is then removed from the tire building drum and placed within a shaping and vulcanizing mold having the shape of the finished tire. The toroidal shaped green tire assembly is heated and expanded radially outward into the mold periphery by injecting pressurized gas or fluid into a curing bladder mounted within the mold and disposed within the green tire assembly. As the curing bladder expands, it forces the tread and sidewalls of the green tire assembly into contact with the heated mold walls to shape and vulcanize the green tire assembly into a fully vulcanized tire. During the radial expansion of the green tire assembly within the shaping and vulcanizing mold, the toroidally shaped plies expand radially outward to dimensions slightly beyond those of the original green tire assembly. Therefore, the bladder is conventionally made of an expandable elastomeric material, usually butyl rubber for resistance to steam.

In the retreading of a tire carcass, as discussed above, the tire to be retreaded is prepared by first grinding off the existing, unwanted tread and sidewall stock until the tire carcass remains. Next, green cushion rubber is applied to the

carcass. Then, a green or cured tread is applied to the tire carcass. Any other damage to the tire carcass and liner is repaired. Severe damage to the liner, such as a crack at the splice cannot be repaired and the carcass must be scrapped. Then the retreaded tire assembly, including the tire carcass, green cushion and tread can be placed in a vulcanizing chamber.

During the production of original tires on an assembly line, the curing bladder within the shaping and vulcanizing mold periodically wears out or fails and requires significant downtime and expensive material and labor costs to install a new curing bladder and put the mold back into operation.

The tire industry has tried to eliminate the need for a curing bladder used in the production of original tires. For example, U.S. 3,143,449 discloses a splice-free, unvulcanized, barrel shaped innerliner for completely sealing the inside of a green tire against the escape of pressurized fluid into the tire body during the vulcanizing operation in a tire vulcanizing mold. This patent fails to teach or suggest the use of a splice-free, pre-vulcanized innerliner for building a new or retread tire. Instead, by eliminating the splice in the tube shaped tire innerliner, the inflation fluid in a bladderless mold was unable to escape through the splice into the body of a green tire being molded and vulcanized in a tire vulcanizing mold and thereby eliminated a cause of blisters and separations

within the completed tire. Moreover, it is believed that while an innerliner formed of an endless splice-free, unvulcanized, tube shaped innerliner will prevent the escape of inflation fluid being injected into the mold forming the tire body, it will not effectively prevent the leakage of pressurized steam, gas or possibly water, currently used to inflate the bladders, from passing through the innerliner and into the tire body while the innerliner is still in a green condition and the tire is being molded in a bladderless mold to the desired shape.

Also pertinent to the present invention, there was disclosed in U.S. Patent No. 4,166,883 ('833) a method of retreading tires with room temperature gas or water instead of the typical use of an inflatable curing bladder and a heated mold against which the tread is pressed. The '833 patent also disclosed a partially cured, or completely cured innerliner that has its ends joined by a beveled splice or secured with a locking strip of uncured or partially cured stock across the two ends when butted together, as conventionally used in tire construction. The inclusion of a partially cured, or completely cured innerliner also allowed for the molding and forming of a green tire by injecting steam or hot water directly against the inner toroidally shaped surface of the green tire, i.e., the surface formed by the innerliner, to expand the green tire into the mold walls to mold the tire and then cure or vulcanize the

tire. The problem with this tire building technique is that the resulting vulcanized tire has a higher probability of a manufacturing flaw in the spliced section of the innerliner as compared with the remaining splice-free tire sections. The spliced, innerliner section, which forms a weaker section of the tire's inner surface, has a higher probability than the remaining inner surface of the innerliner of cracking and forming a passage through which inflation air could leak from the tire and/or propagate a crack within the plies of the tire body.

It is apparent that there is still a need to provide novel methods and structures to manufacturing high quality retreaded and original tires. Moreover, there still exists a need to eliminate a source of tire failure, i.e. cracking in the spliced portion of the innerliner.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide an elastomeric innerliner for a pneumatic tire, the innerliner being as defined in one or more of the appended claims and, as such, having the capability of being constructed to accomplish one or more of the following subsidiary objects.

It is an object of the present invention to provide a splice-free, at least partially cured elastomeric innerliner and a method of constructing the elastomeric innerliner as an

intermediate article of manufacture for use in retreading a tubeless tire.

It is a further object of the present invention to provide a tubeless, pneumatic retreaded tire constructed with a splice-free, elastomeric innerliner that is at least partially cured prior to assembly with the other structural components of the retreaded pneumatic tire.

It is yet a further object of the present invention to provide a splice-free, at least partially cured elastomeric innerliner that is constructed with any of a plurality of molding techniques.

It is still a further object of the present invention to provide a splice-free, elastomeric innerliner that is either partially or fully cured prior to being assembled into an original pneumatic tire assembly.

It is a yet further object of the present invention to provide a splice-free, at least partially cured, cylindrical or toroidal shaped elastomeric innerliner that is assembled into an original pneumatic tire assembly.

It is yet another further object of the present invention to provide a splice-free, elastomeric innerliner that is either partially or fully cured and installed into a previously vulcanized tire assembly.

It is an object of the present invention to provide a splice-free, elastomeric innerliner and a method of constructing the elastomeric innerliner as an intermediate article of manufacture for a tire wherein the splice-free innerliner is at least partially cured and impervious to pressurized gas or fluid to eliminate the need for a curing bladder in the shaping and vulcanization mold.

It is a still further object of the invention to provide a retreaded tire assembly of a tire carcass, a green cushion, a green or vulcanized tire tread and a vulcanized, splice-free innerliner wherein the innerliner can be aligned and secured to the tire carcass.

In accordance with an embodiment of the invention, a splice-free, elastomeric innerliner having a substantially ring-like shape and formed of a vulcanized or partially vulcanized, elastomer member is built into a retreaded tire. The innerliner is constructed in a cylindrical shape, a toroidal shape or some shape therebetween. The splice-free, vulcanized or partially vulcanized innerliner of the invention is assembled into a tire carcass and a green cushion rubber is applied to the carcass followed by a green or cured tread. The entire assembly is preferably placed into a vulcanization chamber maintained at a desired temperature for a period of time at a specified pressure until the retreaded tire is completely vulcanized.

Further according to the invention, the cylindrical shaped innerliner preferably has a contoured profile where the opposite end sections of the innerliner have a narrower wall thickness than the central section of the innerliner. The cylindrical shaped inner liner is stretched into a toroidal shape having a substantially constant wall thickness during the process of constructing the tire.

In another embodiment of the invention, the splice-free, vulcanized or partially vulcanized innerliner having either a cylindrical or toroidal shape is first mounted onto a tire building drum followed by the remainder of the tire components needed to form a completed uncured tire assembly. In still another embodiment of the invention, the uncured tire assembly is first built on a tire building drum without an innerliner and then the splice-free, vulcanized or partially vulcanized innerliner of the invention is built into the otherwise completed uncured tire assembly. In another embodiment of the invention, the splice-free, vulcanized or partially vulcanized innerliner having either a cylindrical or toroidal shape is mounted in a curing mold with a mechanism similar to the clamp rings used to secure curing bladders in place. An uncured tire, built conventionally, but without innerliner, is placed into the curing mold and is cured conventionally, but with the innerliner performing the role of the curing bladder. After curing, excess

material used to clamp the innerliner in place may be trimmed off. In still another embodiment of the invention, the splice-free, vulcanized or partially vulcanized innerliner is built into an already completed vulcanized tire assembly without an innerliner. In each of the above constructions, the resulting tire assembly is placed into a curing mold for shaping and vulcanization, as needed.

Still further, in accordance with the invention, there is disclosed a method of manufacturing an uncured tire assembly with an at least partially vulcanized, splice-free, innerliner member. The uncured tire assembly is placed in a bladderless forming and curing mold. Pressurized gas or liquid is introduced into the tire forming and curing bladderless mold and directed against the innerliner to force the tire against the mold wall so as to mold and vulcanize the tire.

Also according to the invention, the splice-free innerliner can be formed into the cylindrical or toroidal shape from a number of different processes including but not limited to extrusion molding, injection molding, transfer molding, and compression molding. Subsequent to forming the innerliner, it is at least partially vulcanized, sometimes in the process of forming the innerliner.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a fragmentary, perspective view in cross section of a tire incorporating the splice-free, at least partially vulcanized innerliner of the present invention;

Fig. 2 is a fragmentary, perspective view in cross sectional view showing a retreaded tire assembly incorporating the splice-free, at least partially vulcanized innerliner, a carcass, a green cushion, and a green or vulcanized tread;

Fig. 2A is an exploded view illustrating the rib of the innerliner attached within the groove in the carcass;

Fig. 3 is a perspective view of a toroidally shaped, splice-free, at least partially vulcanized innerliner of the invention;

Fig. 3A is a cross-sectional view through line 3A-3A of Fig. 3 showing an enlarged portion of the splice-free, at least partially vulcanized, toroidally shaped innerliner of the invention;

Fig. 3B is a side view through line 3B-3B of Fig.3;

Fig. 4 is a perspective view of a cylindrical shaped, splice-free, at least partially vulcanized innerliner of the invention;

Fig. 4A is a cross-sectional view through line 4A-4A of Fig. 4 showing a side view of the splice-free, at least partially vulcanized, cylindrical shaped innerliner of the invention;

Fig. 5 is a schematic illustration of an extruding system for manufacturing the at least partially vulcanized innerliner of the present invention;

Fig. 6 is a cross sectional view through line 6-6 of Fig. 5 showing the oscillating mandrel of the extruder;

Fig. 6A is a side view through line 6A-6A of Fig. 6;

Fig. 7 is a side view, partly in cross section, of a splice-free, at least partially vulcanized cylindrical shaped innerliner on a rotatable, building drum prior to application of other components and expanding the innerliner into a toroidal shape;

Fig. 8 is a fragmentary, side elevational, broken away cross sectional view showing a completed tire assembly incorporating the splice-free, at least partially vulcanized innerliner of the present invention within a bladderless, tire molding and vulcanizing device; and

Fig. 9 is a plan view of an original unvulcanized tire assembly in accordance with the invention.

DEFINITIONS

A retreaded tire is a vulcanized tire carcass with a new tire tread.

A cured tire is a completely vulcanized tire.

A green tire is an unvulcanized completely assembled tire with the preponderance of components being unvulcanized.

Curing is the vulcanization process.

A partially cured innerliner is vulcanized to at least render the innerliner impervious to pressurized steam, gas, or hot liquid.

DETAILED DESCRIPTION OF THE INVENTION

To best illustrate the present invention, Fig. 1 shows a portion of a typical tire 10 in cross-section in accordance with the invention. The tire 10 can be assembled as a retreaded tire assembly 12, as shown in Fig. 2, by applying a green cushion 14 onto a tire carcass 16 followed by a green or cured tread 18. An at least partially vulcanized innerliner 20 having a generally toroidal shape is mounted within the tire carcass 16. The retreaded tire assembly 12 is then placed into a conventional vulcanization chamber, not shown, and maintained at a desired temperature for a period of time until the tire 10 is vulcanized into the final form as shown in Fig. 1.

The completed tire 10, as shown in Fig. 1, can represent either an original or a retreaded tire that generally includes a rubberized, fabric tire carcass portion 16 terminating in two bead portions 22 and 24, side walls 26 and 28, tread region 30, and a vulcanized or partially vulcanized, splice-free, seam-free innerliner 20, in accordance with the present invention. The innerliner 20 can be constructed in a toroidal shape, as shown in Fig. 3, and then partially or fully vulcanized. The

innerliner 20 can be formed with ribs 32a and 32b preferably extending around and projecting outward of the tire bead portions 22 and 24, respectively, as shown in Figs. 2 and 2A. The ribs 32a and 32b can be press fitted into grooves 34a and 34b formed in the inner facing surface of tire carcass 16, as shown in Figs. 2 and 2A, for aligning and securing innerliner 20 to tire carcass 16. While ribs 32a and 32b are shown aligning and mounting the innerliner 20 to tire carcass 16, it is within the terms of the invention to form the innerliner without ribs 32a and 32b and the tire carcass without corresponding grooves 34a and 34b. In the latter construction, the innerliner 20 can be aligned with respect to the tire carcass 16 by any other mechanical means, such as for example, with an adhesive or a green or unvulcanized rubber laminate sandwiched between the carcass 16 and the innerliner 20. The innerliner 20, as shown in Fig. 3B, can be constructed with end sections 35a and 35b that can each wrap around a bead portion of the tire. It is also within the terms of the invention to form the innerliner without the end sections 35a and 35b if desired.

As shown in Figs. 3, 3A, and 3B, the innerliner 20 of the present invention is formed as a splice-free, at least partially vulcanized innerliner shaped, such as for example, with a ring-like, toroidal shaped wall 36 having a hollow toroidal shaped inner surface 38. With a generally toroidal shaped design, the

wall thickness "t" of innerliner 20 can be substantially uniform since the innerliner is at least partially vulcanized in its approximate, final shape. The innerliner 20, typically manufactured from a sole curable rubber based material, such as for example haloybutyl rubber, can be constructed by a number of different methods such as for example extrusion molding, injection molding, transfer molding, or compression molding.

As shown in Figs. 4 and 4A, the innerliner of the present invention can also be formed of a splice-free, at least partially vulcanized innerliner 40 shaped, such as for example, with a ring-like, cylindrical shaped wall 42 having a hollow cylindrical shaped inner surface 44. With a generally cylindrical shape design, the wall thickness "x" of innerliner 40 can be thicker at its center so that it is substantially uniform after the innerliner is stretched and at least partially vulcanized in its approximate final shape. The innerliner 40 is typically manufactured from a curable rubber based material, such as for example haloybutyl rubber, and can be constructed by a number of different methods such as for example extrusion molding, as shown in Fig. 5 and described hereinbelow.

Referring to Fig. 5, there is shown an example of the manufacture of a vulcanized, seam-free cylindrical innerliner 40 using an exemplary method in connection with the extruding system 50. Rubber or elastomeric innerliner stock is fed into

the feed box 52 of the extruder 54. The extruder screw (not shown) drives the rubber through the extruder barrel 56 to plasticize and warm the rubber and build pressure in the pressure head 57. This pressure forces the rubber through the die opening 58 between a mandrel 60 and the die plate 62 at one end of pressure head 57, as shown in Figs. 6 and 6A, to shape the wall 70 of a continuous cylindrical, rubber tube 72. As shown in Figs. 5 and 6, the mandrel 60 extends through the opening of die plate 62 disposed at one end of pressure head 57 that is mounted to extruder 54 in a conventional manner. The mandrel 60 reciprocates under the control of a computer operated control system (not shown), as shown by arrow 64 in Fig. 6, resulting in the widening and narrowing of the die opening 58 so that the flow of rubber through the die opening becomes correspondingly thicker and thinner, respectively, typically in a sinusoidal cycle. The result is the formation of a continuous, green rubber tube 72 with a contoured profile, as shown in Fig. 5. Typically tube 72 has a wall 70 which alternately becomes thicker and then thinner in response to movement of the mandrel 60 towards and away from the die plate 62. The thicker portion of wall 70 is required so that the wall of the innerliner 40 has a substantially uniform thickness after the innerliner is stretched into its final toroidal shape, as discussed hereinafter. As the continuous tube 72 is extruded,

it passes through a continuous heating oven 80, schematically illustrated in Fig. 5, which at least partially vulcanizes the continuous tube 72. The tube 72 then moves over an annular inner support 82 where it is periodically severed by a knife 84 to form an at least partially vulcanized, ring-like, cylindrically shaped, splice-free innerliner 40 having, at this stage of construction, a contoured profile with the thickness of the wall 70, at opposite end sections 86 and 88 being less than the thickness of the center section 90 of wall 70. It is also within the terms of the invention to form a cylindrically shaped tube 40 with a more constant wall thickness by fixing mandrel 60 relative to die plate 62 thereby holding die opening 58 constant.

In accordance with the invention, the innerliner can be molded into a shape, such as the partially or fully cured toroidally shaped ring, as illustrated in Figs. 3, 3A and 3B, which is preferably dimensioned to be either placed within a tire carcass to be retreaded or built into an original toroidal carcass. To form the splice-free cylindrical innerliner 40 into a splice-free toroidally shaped innerliner, the cylindrical innerliner 40 can be mounted on a building drum 92, as shown in Fig. 7, and gripped at the end portions 86 and 88 by conventional means (not shown). Next, the center section 90 of innerliner 40 is expanded outward by injecting pressurized air

between the drum 92 and the innerliner to shape the innerliner into a toroidal shape, as generally shown in Figs. 3 and 3B. Thus, the otherwise extra rubber used in providing thicker wall sections for the cylindrically shaped innerliner, i.e. to accommodate the stretching of the cylindrically shaped innerliner into its final toroidal shape, is substantially eliminated in the final toroidally shaped innerliner with a substantially constant wall thickness. Thus, the at least partially vulcanized, seamless and splice-less innerliners of the present invention can have a shape ranging between the cylindrical shape of innerliner 40 and the toroidal shape of innerliner 20.

In the example of the innerliner 20 with a hollow toroidal shaped inner surface 38, as shown in Figs. 3, 3A, and 3B, the wall thickness (t), which is substantially constant, is a function of the normal load inflation pressure of the tire 10 in which the innerliner is designed to be incorporated, i.e., the thickness "t" increases as the internal pressure required for the tire increases. The toroidally shaped, elastomeric innerliner 20 can, for example, be constructed with the following wall thickness "t" when employed in tires having the following recommended inflations:

with less than about 30 pounds per square inch (psi) ($21.09\ g/m^2$) inflation, "t" is less than about 2.0 mm;

with less than about 60 psi inflation, "t" is less than about 3.0 mm; and (42.18 g/m^2)

with less than about 100 psi inflation, "t" is less than about 4.0 mm. (70.3 g/m^2)

While the splice-free, at least partially vulcanized innerliner 20 or 40, is described as being novel in its incorporation in the construction of a retreaded tire, it is also within the terms of the invention to use the innerliners 20 or 40 in the construction of an original tire. Referring to Fig. 8, an exemplary description of the construction of a finished tire 10, as illustrated in Fig. 1, is described. A toroidal shaped, original tire assembly 100, as shown in Fig. 9, generally including a tire carcass 16', a tread portion 102 disposed thereabout, and an at least partially cured innerliner 20', is assembled on a tire building drum as conventionally known in the art. Throughout the specification, primed numbers represent structural elements which are substantially identical to structural elements represented by the same unprimed number.

In an exemplary description of the building of a tire assembly 100 on the tire building drum 92, as shown in Fig. 7, the at least partially cured cylindrical innerliner 40 is centered coaxially on the surface of the rotating drum 92. A body ply (not shown) is run onto the drum 92 over innerliner 40, cut and stitched onto itself, as typically applied in the tire

building art. As need, additional carcass plies, followed by the tire beads, apexes, chafers, side walls, belts and a tire tread ply (all not shown), are added. The majority of the carcass materials, with the exception of the innerliner, are comprised of green, uncured rubber and can be stitched together by any conventional techniques and means. For improved clarity of the present invention, the typical carcass plies, tire beads, apexes, chafers, side walls, belts and tread carcass reinforcement are not shown.

The rotation of drum 92 is stopped and the beads 128 and 130 are positioned over the end portions 86 and 88 of the cylindrical innerliner 40, located generally radially outward of the grooves in the bead receiving seats 152 and 154, respectively, as is conventionally done with rotating building drums. The drum 92 is then expanded (not shown) so that the beads 128 and 130 are properly positioned. Then, the ends of the carcass materials are turned up and over the beads by any conventional turn-up means generally known in the art. After the turn-up step, other carcass elements, such as side wall strips can be run onto the drum and stitched in place as needed. Then, the drum is drawn in to drive the beads 128 and 130 toward each other and to reshape the tire assembly from a cylinder to a toroid by inflating the tire assembly. Finally, drum 92 is collapsed and a completed toroidally shaped green tire assembly

100 is removed for shaping and vulcanization into a completed tire 10 in curing press or mold 104, as shown in cross section in Fig. 8, for molding and curing the tire assembly 100 into a vulcanized original tire, such as tire 10 in Fig. 1.

An important aspect of the invention is that mold 104, as shown in Fig. 8, does not require the use of a curing bladder to form the tire 10. The mold 104 is constructed in any conventional manner and does not form a part of the present invention. The mold 104 is shown with a first mold section 106 and a second matching mold section 108. The tire assembly 100, including a tire carcass 16' with a tread portion 102 disposed thereabout and an at least partially cured innerliner 20' aligned and secured within the tire carcass, is placed within the mold cavity 110 so that the tire bead portions 22' and 24' of the carcass 16' are abutted against the mold rings 112 and 114, respectively. Then, circular shaped, elastomeric seals 116 and 118, secured in spaced relation to the outlet end of a curing media inlet member 120, are inserted into the opening between the mold rings 112 and 114. The outer facing surfaces 122 and 124 of the seals 116 and 118, respectively, seal against the section of innerliner 20' adjacent the beads 128 and 130 so that the curing media does not leak between the seals and the innerliner when the curing media is first introduced into the mold 104. The seals 116 and 118 can each be secured at one end

of a support member 132 and 134, respectively, which in turn are connected to each other in spaced relationship at ends 136 and 138 by a member 140. While elastomeric material is described for the construction of seals 116 and 118, it is also within the terms of the invention to use a metal or mechanical sealing system. If desired, the ends 136 and 138 of support members 132 and 134, respectively, are movable with respect to each because of a mechanical connection in member 140. As previously discussed, the innerliner 20' which forms the inner surface of tire assembly 100, has been at least partially cured to render it impervious to pressurized gas, steam, or hot water. The pressurized gas, steam or hot water is introduced into the mold 104 through the center of inlet member 120 to provide sufficient pressure within the tire assembly 100 to force it against the mold wall and the innerliner against the tire carcass 16' so as to form a tread pattern in the tread portion 102 and form any desired identification and indicia marks desired on the tire's surface. The tire assembly 100 then is cured and removed from the mold 104 in the form of a completed original tire 10, as illustrated in Fig. 1.

In accordance with another embodiment of the invention, the innerliner can first be molded into a shape, such as the partially or fully cured toroidally shaped ring 20, as illustrated in Figs. 3 and 3B, which is preferably dimensioned

to substantially match the inner surface of a green tire assembly (not shown) similar to tire assembly 100 of Fig. 9 but without an innerliner. Since the toroidally shaped innerliner 20 does not have to be expanded to mount within the green tire assembly, the wall can be of a uniform gauge. The toroidally shaped, partially vulcanized innerliner 20 can be mounted on a tire building drum, such as drum 92, and gripped at the end portions 35a and 35b. Next, the end portions 35a and 35b of innerliner 20 can be moved in opposite directions to pull the innerliner into a more cylindrical or hour-glass shape with pleats formed in the surface of the innerliner. Next, an uncured tire assembly without an innerliner can be mounted over the drawn out innerliner 20. The end portions 35a and 35b of innerliner 20 can be turned up and over beads 128 and 130 by any conventional turn-up means generally known in the art and then drawn together while the innerliner is inflated to mount the innerliner within the toroidally shaped, uncured tire assembly. Finally, tire building drum 92 is collapsed and the tire assembly is removed for shaping and vulcanization in a curing press or mold 104, as shown in cross section in Fig. 8.

In an alternative embodiment, the innerliner 20, as shown in Fig. 3A, can be provided with elongated slots or ribs (not shown) 160 extending between end portions 35a and 35b on the outwardly facing surface 162 that abuts up against the tire

carcass to allow air to escape from between the innerliner 20' and the tire carcass when they are molded together, as shown in Fig. 8. While elongated slots 160 are illustrated, they are not necessary and are only included in selected applications. Note that the slots 160 will be filled in with the rubber from the abutting ply to close the slots and prevent air from leaking into the space between the innerliner and the tire carcass after the tire is completed, as shown in Fig. 1. It is also within the terms of the invention to provide ribs (not shown) on the outwardly facing surface 162 of innerliner 20 to create a space for the escape of trapped air between the innerliner and the tire carcass. In yet another embodiment, similar slots (not shown) can be provided on the outward facing surface of innerliner 40 shown in Fig. 4, for the same purpose as that described with respect to innerliner 20.

While the splice-less, partially vulcanized innerliner 40 is shown in Figs. 4 and 4A as being constructed with a generally ring-like, cylindrical shape having a wall thickness profile that is thicker in the center portion of the innerliner as compared to the opposite end sections 86 and 88, it is also within the scope of the invention to form the innerliner with any shape between the ring-like, cylindrically shaped innerliner 40, shown in Figs. 4, 4A, and 5, and the ring like, toroidally shaped innerliner 20, shown in Figs. 3 and 3B. The

cylindrically shaped innerliner 40 will ultimately be reshaped to a toroidal shape, not unlike innerliner 20, after the at least partially vulcanized, splice-free innerliner 40 is molded into the tire 10. Since the innerliner for any selected tire will end up with substantially the same shape, it is within the scope of the invention to select the desired shape for the vulcanized innerliner to be anywhere between a cylindrical shaped ring and a toroidal shaped ring.

In accordance with still another embodiment of the invention, the innerliner can first be molded into a toroidal shape 20 or cylindrical shape 40 as illustrated in Fig. 3 and Fig. 4 and partially or fully cured. The innerliner can be mounted in a curing mold with a mechanism (not shown) to clamp the curing bladder in place. The innerliner can have material (not shown), such as tabs extending therefrom, for clamping the innerliner to the mechanism. An uncured tire built conventionally, but without an innerliner, is placed into the curing mold 104 and cured conventionally, but with the innerliner performing the role of the curing bladder. When the completed tire is removed from the curing mold, any excess material used to clamp the liner in place can be trimmed of as needed.

In accordance with still another embodiment of the invention, the innerliner 20 can first be molded into a shape,

such as the toroidal ring illustrated in Figs. 3 and 3B and partially or fully cured. As discussed above, the innerliner 20 can be provided with elongated slots 160 or ribs (not shown), if required. Then, the shaped innerliner 20 is inserted into an already vulcanized tire carcass and tire tread assembly which can be molded and vulcanized in a conventional mold using a bladder. The at least partially cured innerliner can then be attached to the vulcanized tire carcass and tire tread assembly by mechanical means such as for example inserting ribs 32a and 32b into slots 34a and 34b, respectively, as previously discussed and illustrated in Figs. 2 and 2A. It is also within the terms of the invention to secure the innerliner to the carcass by other means such as an adhesive or an unvulcanized rubber laminate sandwiched between the carcass and the innerliner. Next the tire and innerliner assembly is inserted within a bladderless mold, such as mold 104, and finally molded and vulcanized to provide a completed tire.

It is apparent that there has been provided in accordance with this invention a cured or partially cured, splice-free, elastomeric innerliner and a method of constructing the elastomeric innerliner as an intermediate article of manufacture, which splice-free innerliner is at least partially cured and impervious to pressurized gas, water or steam from a different number molding techniques that satisfy the objects,

means and advantages set forth hereinbefore. According to the invention, the seamless, splice-free, elastomeric innerliner is formed of a cured or partially cured, cordless, seamless elastomer member having a shape between a substantially cylindrical and a toroidal shape. The splice-free, at least partially vulcanized innerliner is especially adapted for building into an original or retread tire.

While the invention has been described in combination with embodiments thereof, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing teachings. Accordingly, the invention is intended to embrace all such alternatives, modifications and variations as fall within the spirit and scope of the appended claims.

We claim:

1. An elastomeric innerliner (20,40) as an intermediate article of manufacture for molding into a tire carcass (16) characterized by:

the innerliner (20,40) being formed as a splice-free, at least partially vulcanized, ring-like shaped wall (36,42) of a sole curable rubber based material.

2. The elastomeric innerliner (20) according to claim 1 characterized in that the innerliner (20) is formed with a ring-like, toroidal shaped wall (36).

3. The elastomeric innerliner (40) according to claim 1 characterized in that the innerliner (40) is formed with a ring-like, cylindrical shaped wall (42,70).

4. A method of manufacturing an elastomeric innerliner (20,40) as an intermediate article of manufacture for molding into a tire carcass (16) characterized by the steps of:

molding a splice-free, ring-like shaped wall (36,42) of a sole curable rubber based material; and

at least partially curing the molded, splice-free, ring-like shaped wall (36,42) into the innerliner (20,40).

5. The method of manufacturing an elastomeric innerliner (20,40) according to claim 4 wherein the step of molding is further characterized by the steps of:

extruding elastomeric material into a continuous tube (72) having a contoured profile;

at least partially vulcanizing the continuous tube (72); and

cutting the continuous tube (72) into a ring-like, cylindrically shaped, at least partially vulcanized innerliner (20,40).

6. The method of manufacturing an elastomeric innerliner (20,40) according to claim 5 further characterized by the step of shaping the cylindrically shaped innerliner (20,40) into a toroidally shaped

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innerliner (40) of a sole curable rubber based material.

7. A method of manufacturing a tubeless, pneumatic tire (10) characterized by the steps of:

forming a completely assembled green tire (100) with an at least partially vulcanized, splice-free innerliner (40) of a sole curable rubber based material;

placing the completely assembled green tire (100) into a tire forming and curing mold (104);

introducing pressurized gas or liquid into the tire forming and curing mold (104); and

directing the pressurized gas or liquid against the innerliner (40) to force the tire (100) against the mold for molding and vulcanizing the green tire (100) into tire (10).

8. The method of manufacturing a tubeless, pneumatic tire (10) according to claim 7 further characterized by the step of forming the assembled green tire (100) with a substantially ring-like, toroidal shaped innerliner (40).

9. The method of manufacturing a tubeless, pneumatic tire (10) according to claim 7 further characterized by the step of forming the assembled green tire (100) with a substantially ring-like cylindrical shaped innerliner (40).

10. A method of manufacturing a tubeless, pneumatic tire (10) characterized by the steps of:

forming an otherwise completely assembled green tire without an innerliner;

inserting an at least partially vulcanized, splice-free, innerliner (20) of a sole curable rubber based material into the otherwise completely assembled green tire;

placing the completely assembled green tire and innerliner (20) into a tire forming and curing mold (104);

introducing pressurized gas or liquid into the tire forming and curing mold (104); and

directing the pressurized gas or liquid against the innerliner (20) to force the green tire against the mold to

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mold and vulcanize the green tire and innerliner into a tire (10).

11. The method of manufacturing a tubeless, pneumatic tire (10) according to claim 10 further characterized by the step of inserting an at least partially vulcanized, splice-free, innerliner (40) having a substantially ring-like, toroidal shaped.

12. A method of manufacturing a tubeless, pneumatic tire (10) including the steps of forming an otherwise completely assembled vulcanized tire without an innerliner member, the method characterized by the steps of:

inserting an at least partially vulcanized, splice-free, innerliner member (40) of a sole curable rubber based material into the otherwise completely assembled vulcanized tire;

placing the completely assembled vulcanized tire with the at least partially vulcanized, splice-free, innerliner member into the tire forming and curing mold (104); and

directing the pressurized gas or liquid against the at least partially vulcanized, splice-free, innerliner to force the tire against the mold wall until the tire is completed.

13. The method of manufacturing a tubeless, pneumatic tire (10) according to claim 12 further characterized by the step of inserting an at least partially vulcanized, splice-free, innerliner member having a substantially ring-like, toroidal shape.

14. The method of manufacturing a tubeless, pneumatic tire (10) according to claim 12 characterized by the step of mechanically mounting the innerliner to the otherwise completely assembled vulcanized tire.

15. The method of manufacturing a tubeless, pneumatic tire (10) according to claim 12 including the step of mechanically mounting the innerliner member to the tire forming and curing mold (104) to replace a bladder.

16. A method of retreading a tire including the steps of:

assembling a retreaded tire assembly (12) by placing an at least partially vulcanized, splice-free, innerliner (40) of a sole curable rubber based material on one side of a tire carcass (16) and a green cushion (14) followed by a tread (18) on the opposite side of the carcass; and

maintaining the retreaded tire assembly, innerliner and tread at a desired temperature and pressure for a period of time until the tire (10) is vulcanized.

17. The method of retreading a tire according to claim 16 further characterized by the step of placing an at least partially vulcanized, splice-free, innerliner (40) having a substantially ring-like, toroidal shaped on the tire carcass.

18. The method of retreading a tire according to claim 16 further characterized by the step of mechanically mounting the innerliner (40) to the tire carcass.

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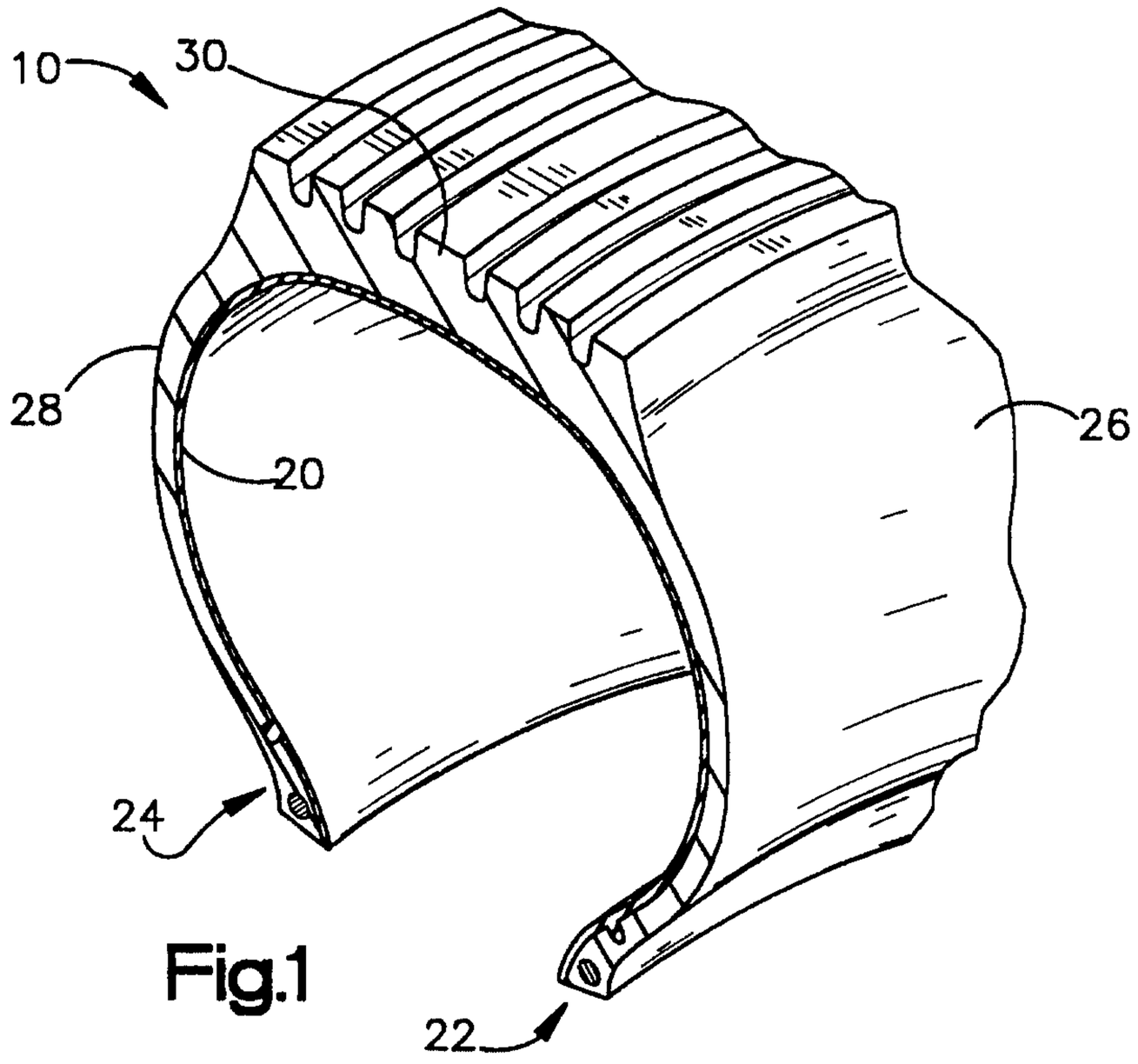


Fig.1

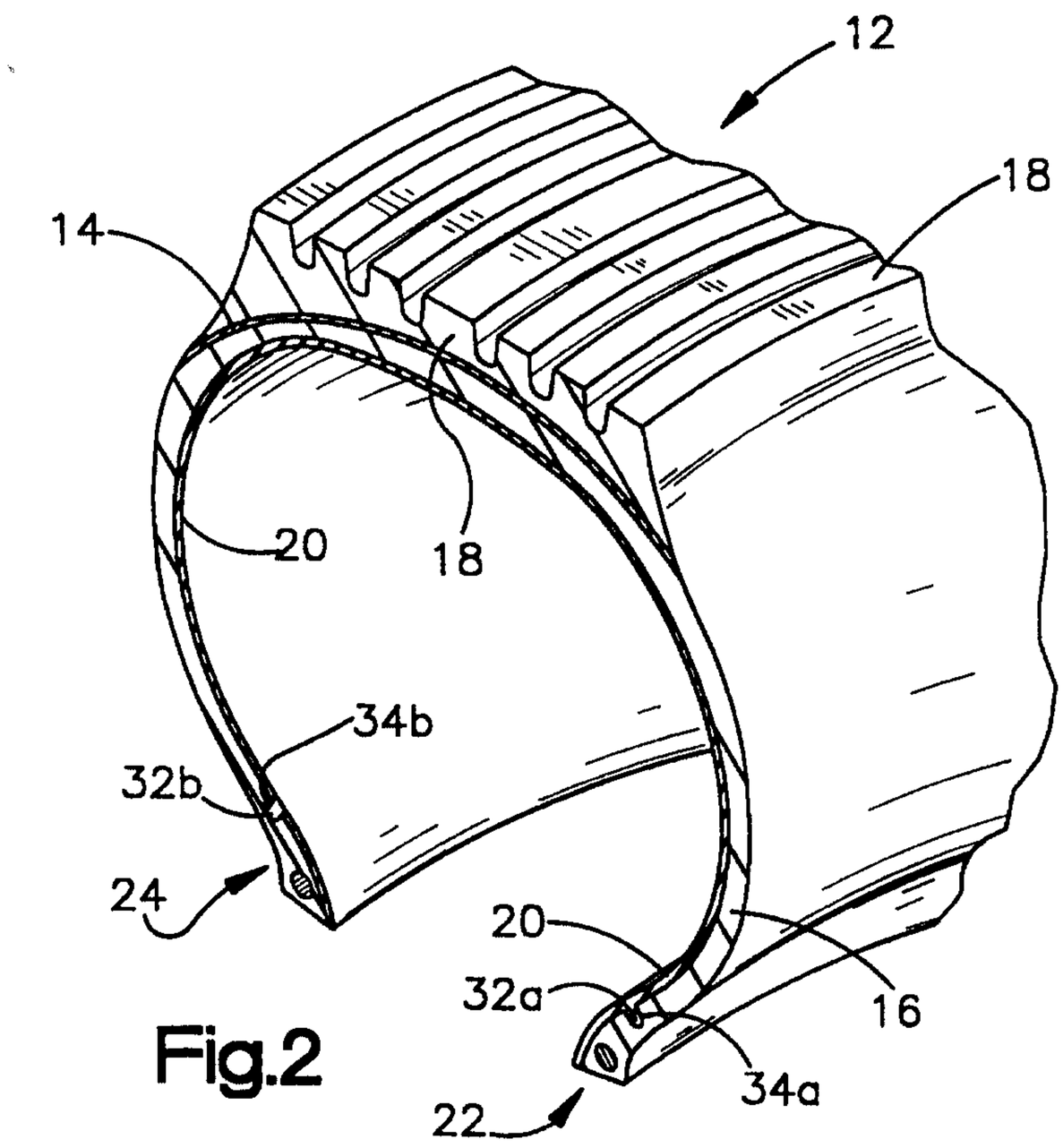


Fig.2

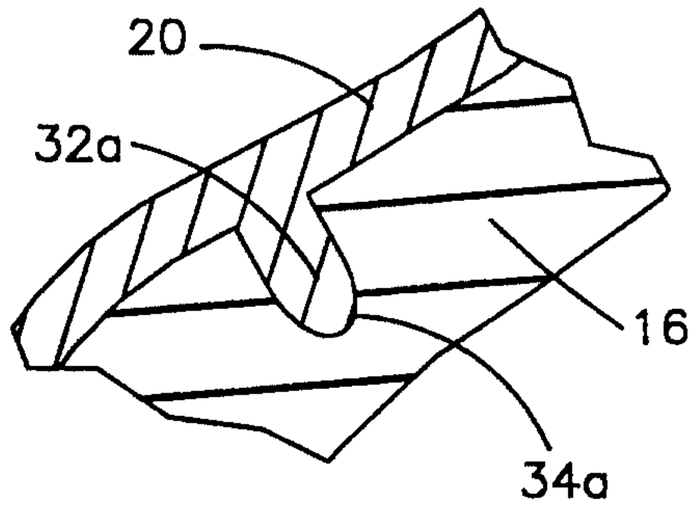


Fig.2A

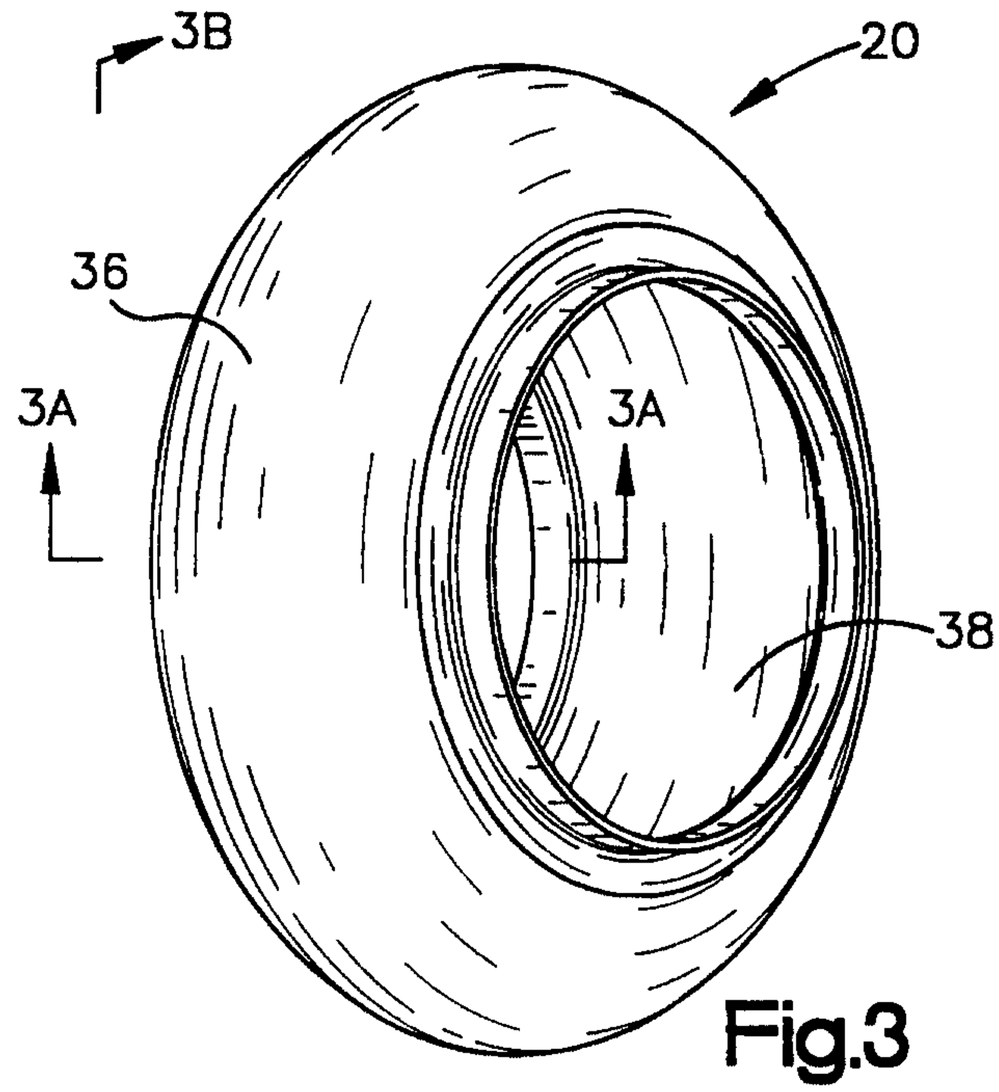


Fig.3

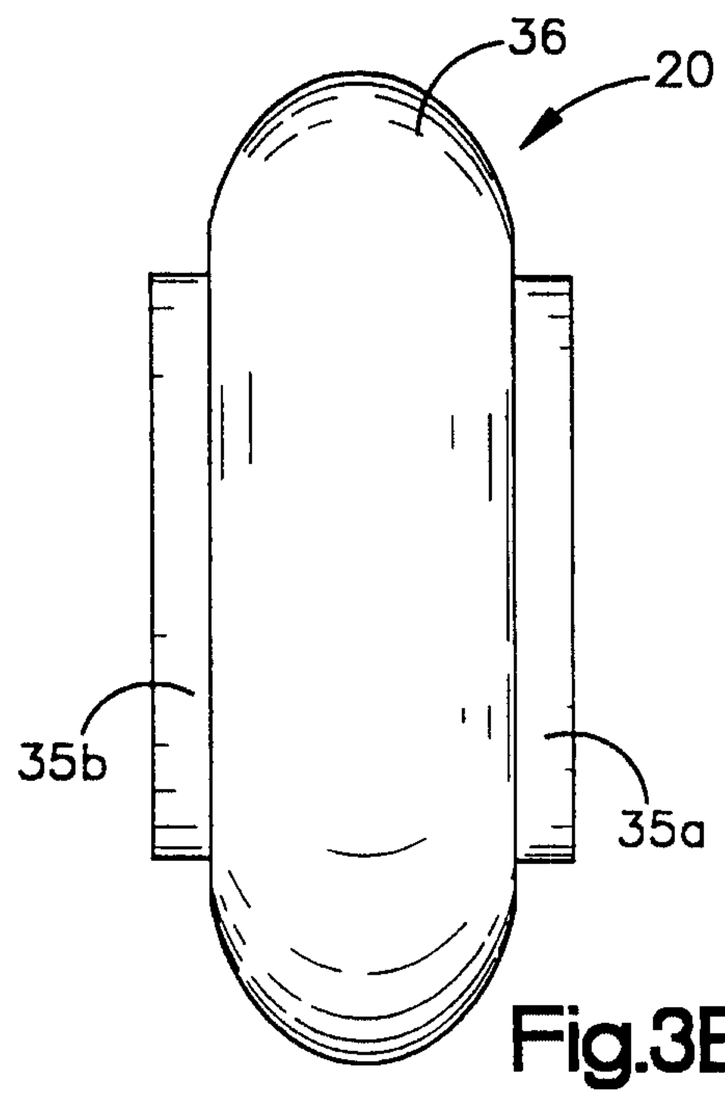


Fig.3B

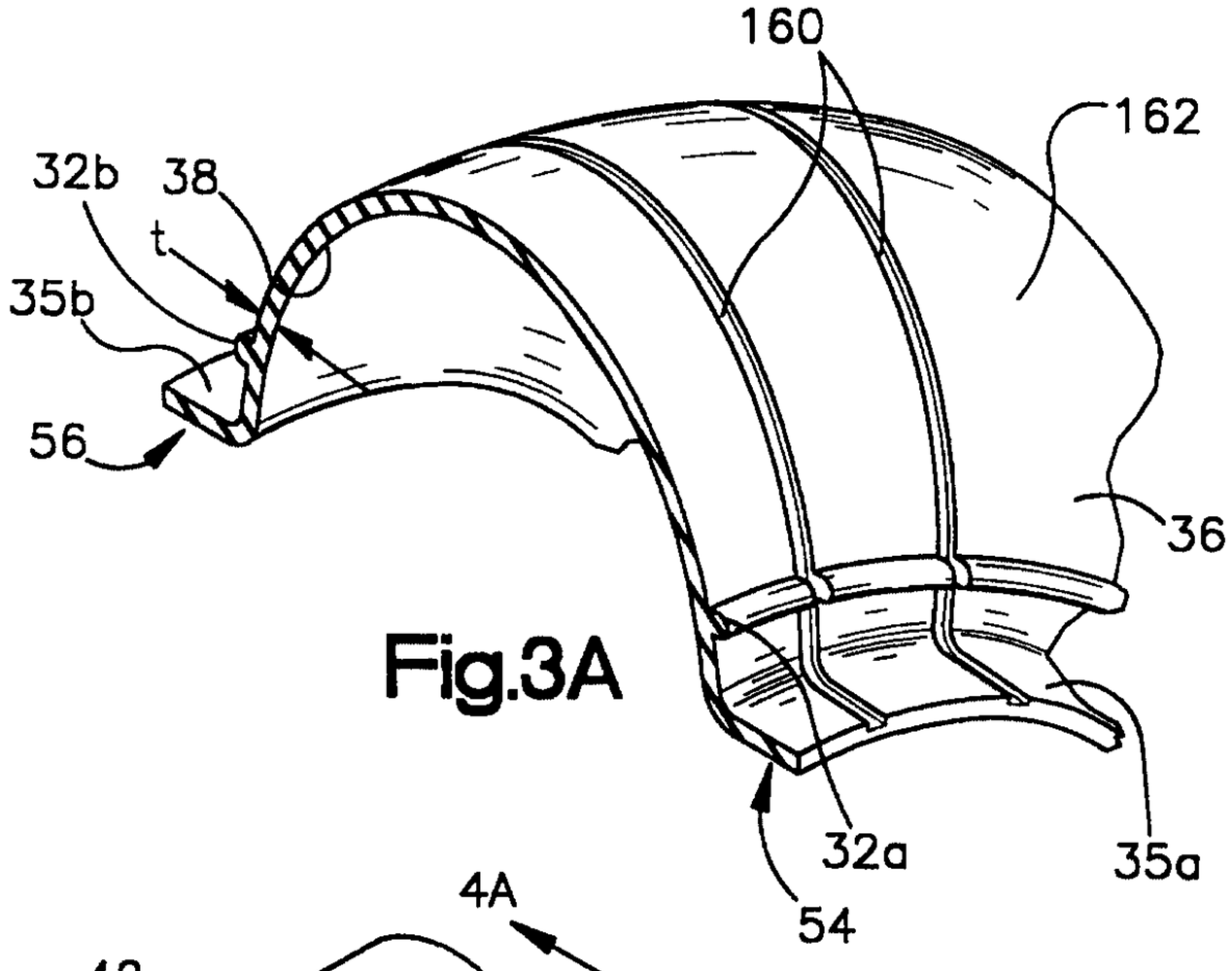


Fig.3A

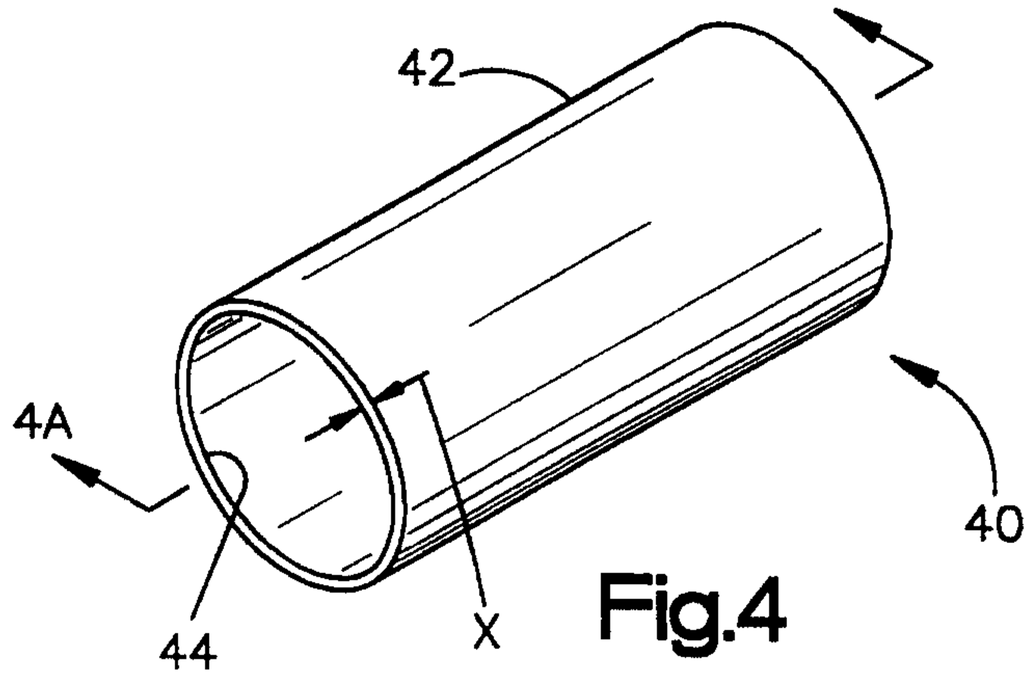


Fig.4

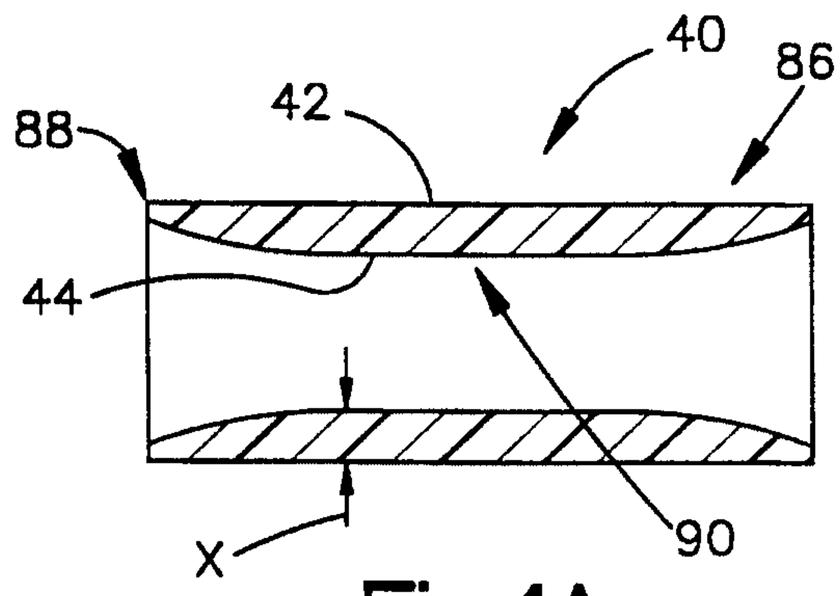


Fig.4A

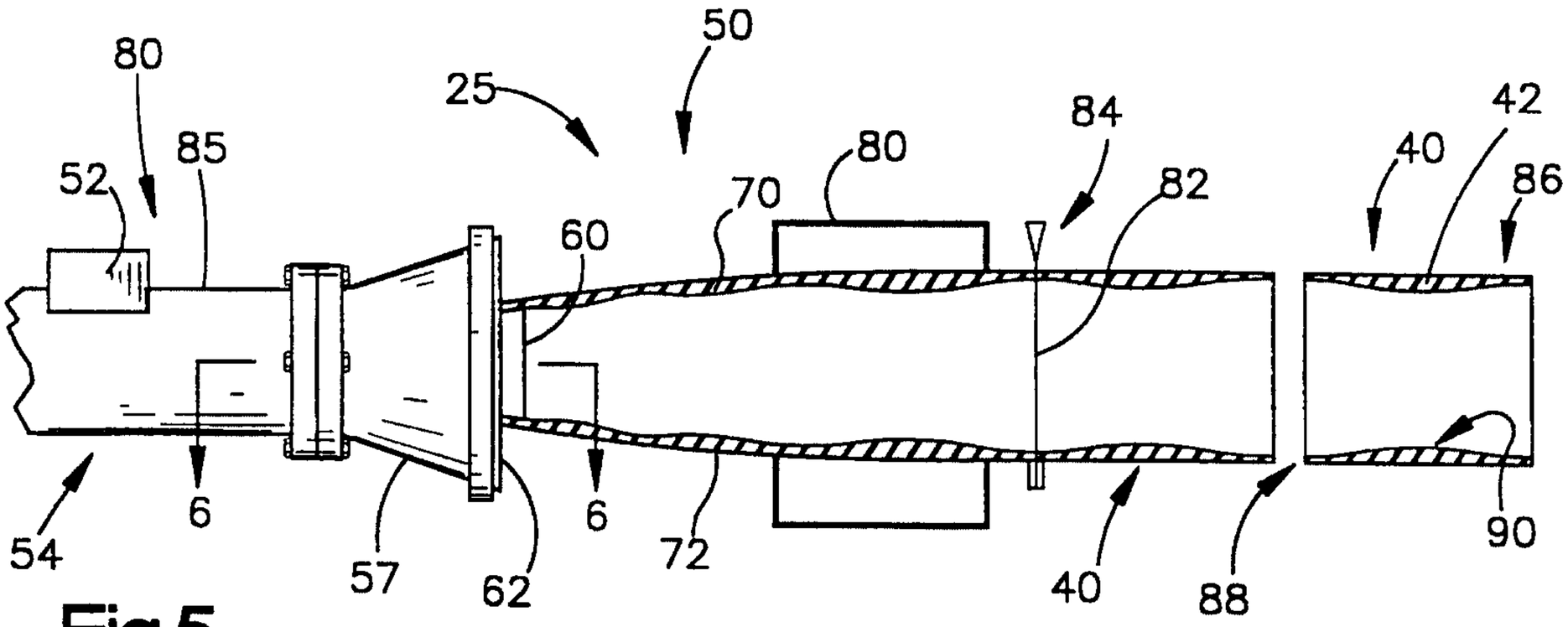


Fig.5

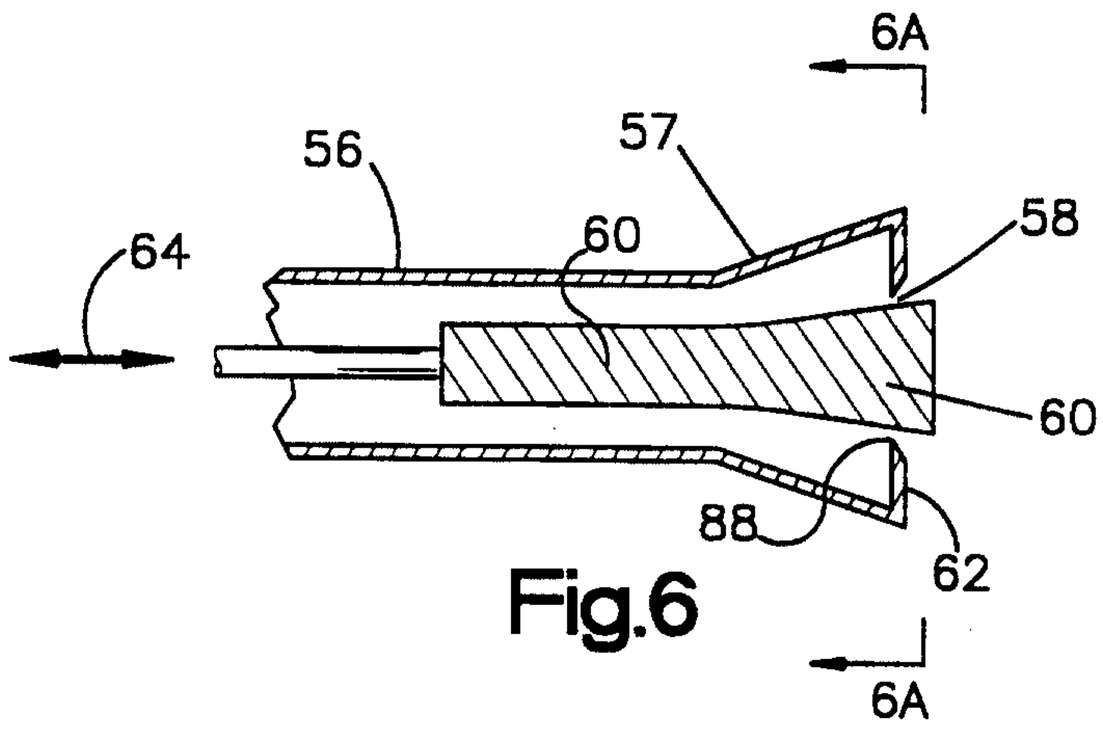


Fig.6

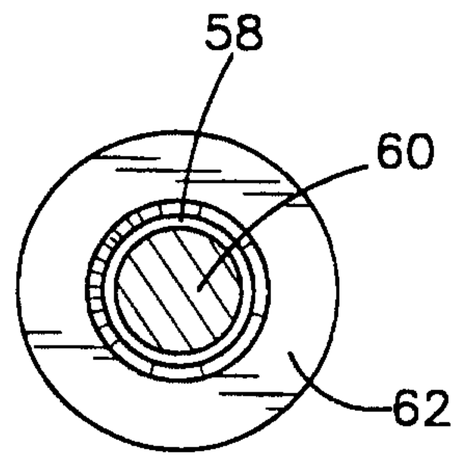


Fig.6A

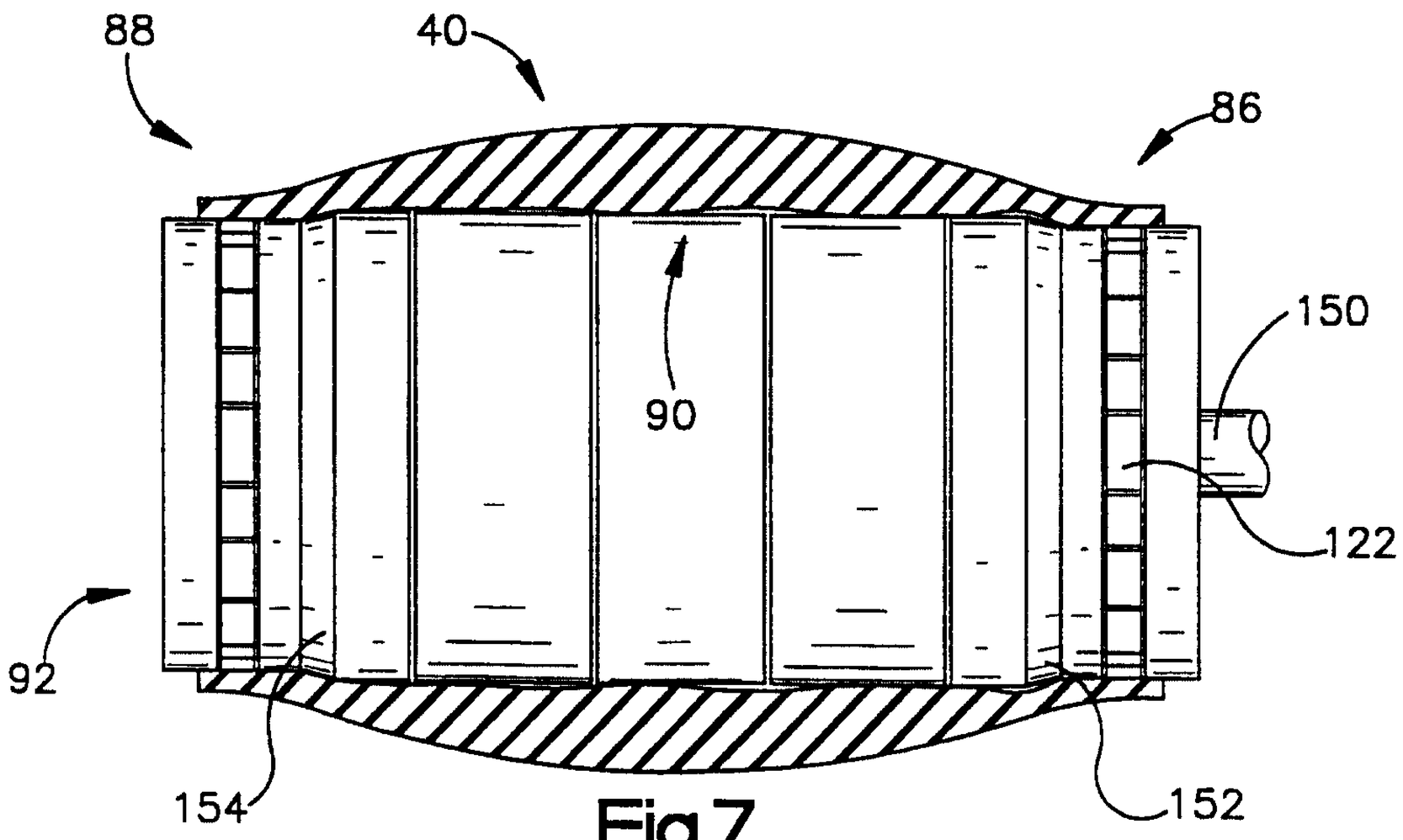
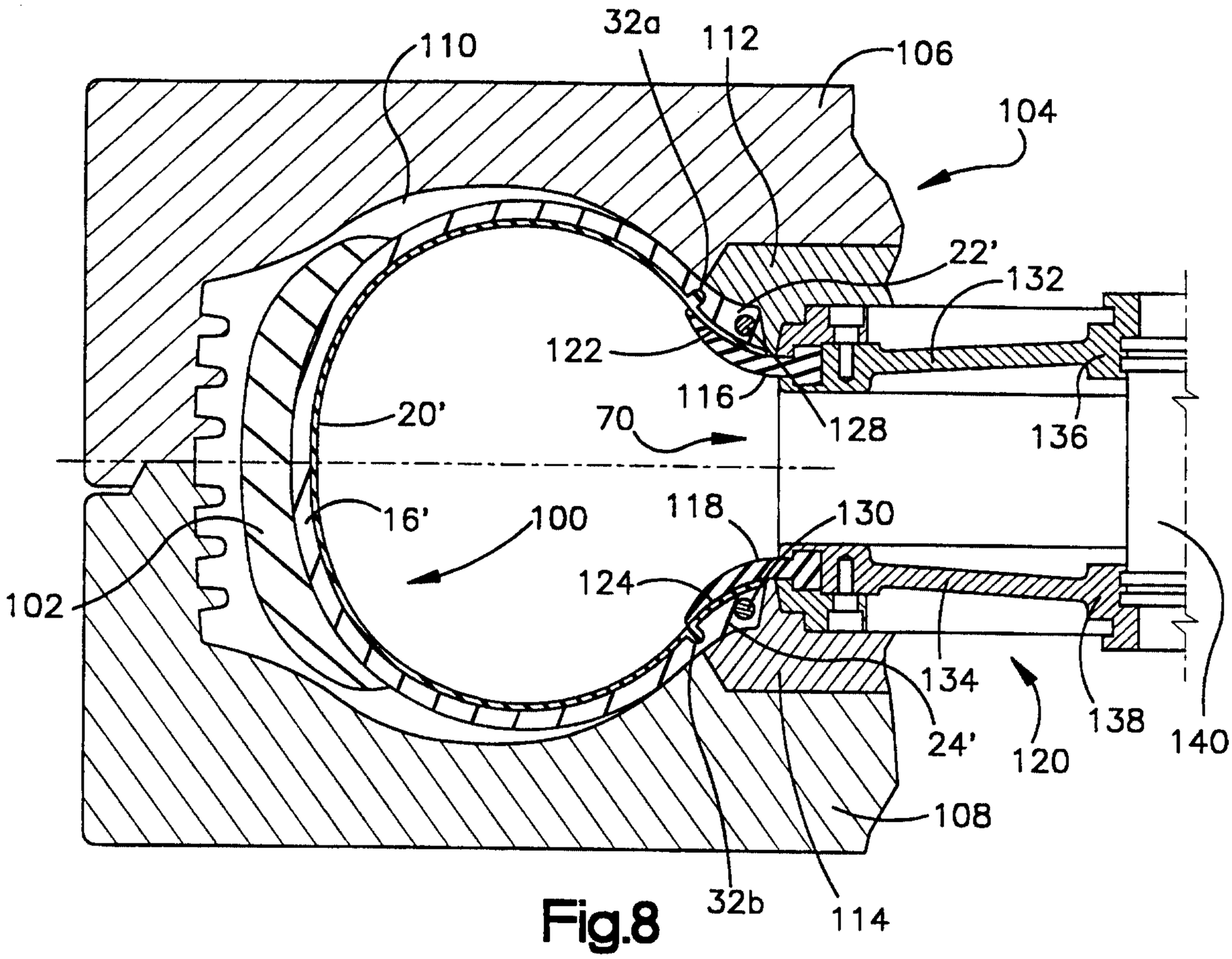


Fig.7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32b
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Fig.8

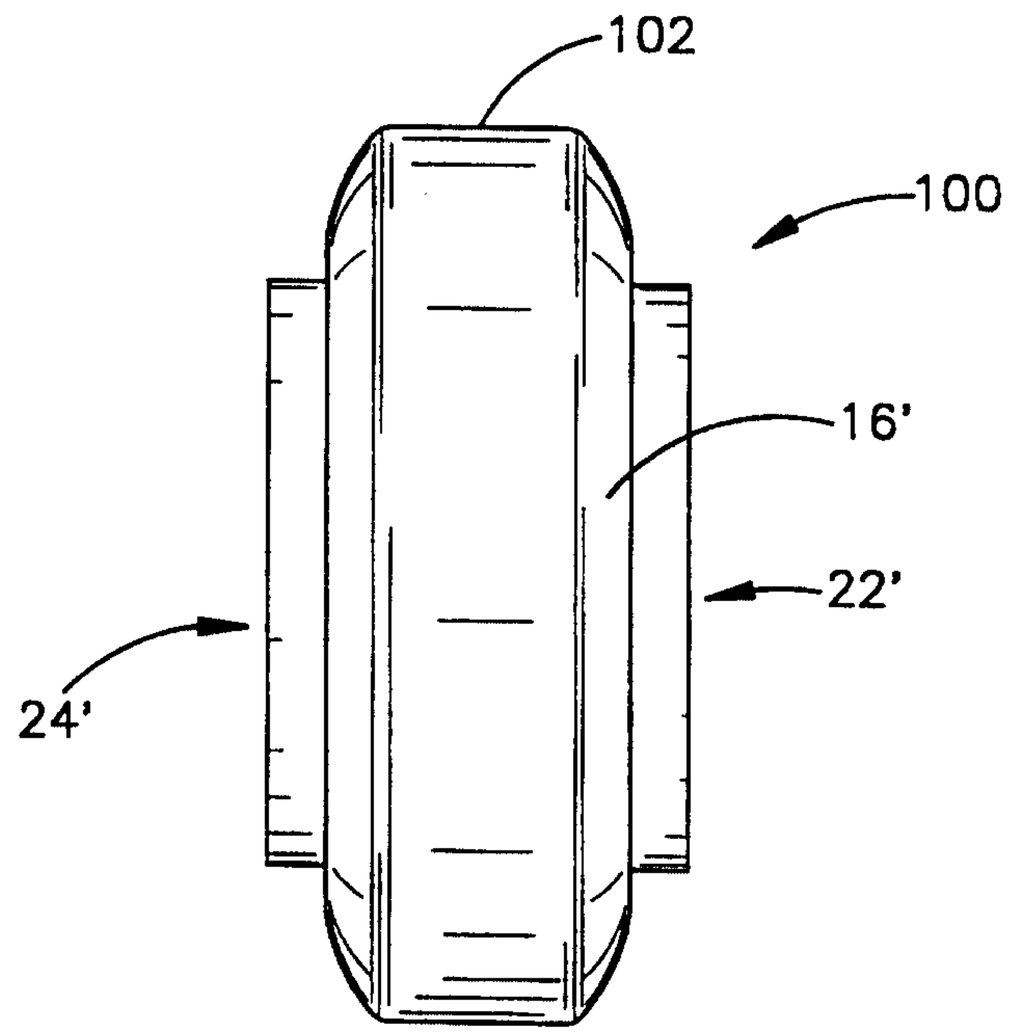
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Fig.9