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(54) **Tire building drum.**

(57) The invention relates to a tire building drum comprising a drum shaft and a circumferential surface for receiving a tire component, wherein the circumferential surface is defined by segments which are radially movable between a contracted position in which the circumferential surface has a first radius and an expanded position in which the circumferential surface has a second, greater radius, wherein the tire building drum comprises cover plates, wherein each segment is provided with a first section having a first support surface for supporting the tire component and a second section with a second support surface for supporting the cover plate, wherein each second section is movable relative to its respective first section from a recessed position in which the second support surface is recessed with respect to first radius and an extended position in which the second support surface is raised towards the second radius.

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Tire building drum

BACKGROUND

The invention relates to a tire building drum with a circumferential surface with a variable radius.

US 3,932,256 A discloses a tire building drum having a large number of segments, which can move radially to expand and to contract the drum. The drum is further provided with cover plates for spanning the gaps between the segments in the expanded state of the drum. Each cover plate has a fixed longitudinal edge rigidly affixed to one of said segments and a free longitudinal edge overlying the other of said segments, the plate having an arched contour that, when free from an externally applied load, is support by one of the pair of segments only. The other of the pair of segments has cover plate support surface that is declined inwardly to underlie and to support said free edge when a load is applied to said cover plate.

JP 2009-274392 A discloses a similar expandable tire building drum, also having a plurality of segments and cover plates for spanning the gaps between the segments. Each cover plate is coupled to one of the segments via a spring loaded hinge, that is arranged to bias the cover plates onto a recessed cover plate support surface of an adjacent one of the segments. The cover plates are given a warp such that the free ends are always in contact with the cover plate support surface.

It is noted that in both prior arts, the cover plates and the segments are optimally adjusted for the

radius of the circumference of the drum in the contracted state. However, in the expanded state, the circumference of the drum has a larger radius. As a result, the circumference of the drum will show a plurality of dips at the location where the cover plates rest on the adjacent segments. In addition, when the drum is expanded, the segments move apart and each cover plate moves in the circumferential direction of the drum with the segment to which it is fixed, thereby at least partly exposing the underlying cover plate support surface of the adjacent segment. As the exposed cover plate support surface is declined or recessed inwardly with respect to the base surface of the segment to accommodate the cover plate in the contracted state, a dip or waving pattern in the circumferential surface is created at the location of the cover plate support surface in the expanded state. These dips or waving patterns seriously affect the consistency of the tire component supported thereon, which ultimately affects the overall quality of the tire.

It is an object of the present invention to provide a tire building drum with a circumferential surface with a variable radius, wherein the consistency of the circumferential surface can be improved.

SUMMARY OF THE INVENTION

According to a first aspect, the invention provides a tire building drum comprising a drum shaft and a circumferential surface concentric to the drum shaft for receiving a tire component, wherein the circumferential surface is defined by segments which are movable in a radial direction with respect to the drum shaft between a contracted position in which the circumferential surface has a first radius and an expanded position in which the segments are spaced apart and in which the circumferential surface has a second, greater radius, wherein the tire

building drum comprises cover plates for spanning the spaced apart segments, wherein each segment is provided with a first section having a first support surface for supporting the tire component and a second section with a second support surface for supporting the cover plate of an adjacent one of the segments, wherein, with the movement of the segments from the contracted position to the expanded position, each second section is movable relative to its respective first section from a recessed position to an extended position, respectively, wherein, in the recessed position, the second support surface is recessed with respect to first radius towards the drum shaft and wherein, in the extended position, the second support surface is raised from the recessed position towards the second radius.

The second support surface, in the extended position, can contribute to a more round and/or more consistent circumferential surface of the tire building drum. In particular, waving patterns or dips in the circumferential surface of the tire building drum at the location of the second support surfaces or the cover plates supported thereon, can be reduced or even eliminated.

In an embodiment each segment is provided with a coupling section between the first section and the second section, wherein the coupling section defines a segment axis extending parallel to the drum shaft, wherein the second section is arranged to be rotated or bent relative to the first section between the recessed position and the extended position about the segment axis. The movement of the second section relative to the first section can thus take place about the segment axis parallel to the circumferential surface of the drum, thereby ensuring that the second support surface can be consistently moved relative to the first support surface over the entire width of the circumferential surface in the axial direction of the drum shaft.

In an embodiment the coupling section comprises a

hinge, a film hinge or an integral hinge. The film hinge or integral hinge can provide a smooth transition from the first section to the second section via the coupling section, which can improve the consistency of the circumferential surface of the tire building drum at the coupling section.

In a preferred embodiment thereof the first section, the second section and the coupling section are integrally formed, preferably out of a flexible synthetic material. The sections can thus be manufactured as a simple yet functional single piece of material.

In an embodiment each segment is provided with a slit cooperating with the coupling section to facilitate the bending or rotation of the second section relative to the first section. The slit can locally weaken the segment to allow flexing of the material at the coupling section. The slit can furthermore provide the necessary clearance to allow the relative movement of the second section with respect to the first section.

In an embodiment the tire building drum further comprises a guide assembly or actuator assembly that is operationally coupled to each of the second sections for guiding or actuating the relative movement of the second sections with respect to their respective first sections. The guide assembly can provide a passive guidance of the second sections during an active radial movement of the segments, while the alternative actuator assembly can provide an actively driven relative movement of the second sections during the radial movement of the segments.

In an embodiment the guide assembly or actuator assembly is operationally placed between each second section and its respective first section. The operational coupling can be either a direct coupling or an indirect coupling, e.g. through a mechanism.

In an embodiment the tire building drum comprises a drive system coupled to each of the first sections for driving the radial movement of the segments between the

contracted position and the expanded position relative to the drum shaft, wherein the guide assembly comprises a plurality of arms, each of which is coupled to a respective one of the second sections and a guide plate for guiding the plurality of arms relative to the drum shaft, wherein the guide plate is provided with a plurality of slots extending under an offset with the radial direction, wherein the each of the arms is slidably received in a respective one of the slots for movement along a non-radial path, wherein the difference between the radial movement imposed by the drive system on the first segments and the non-radial movement imposed by the guide plate on the plurality of arms is arranged to cause the movement of the second sections relative to their respective first sections. The combination of the arms and the slots can provide a simple yet effective way of guiding each individual second section with only passive components and/or a minimum of components.

In an embodiment each cover plate comprises a proximal end that is coupled to the first section of a respective one of the segments, an opposite distal end that is arranged to rest on the second support surface of an adjacent one of the segments and a third support surface extending between the proximal end and the distal end for supporting the tire component between the spaced apart segments, wherein the distal end of said cover plate is movable relative to its respective first section to follow the movement of the second support surface of the adjacent one of the segments when the second section of said adjacent one of the segments is moved from the recessed position to the extended position. The distal end of the cover plate can thus be brought into abutment with the second support surface in either the recessed or the extend position, thereby maintaining a substantially closed circumferential surface of the tire building drum. The second section can further impose a rotation on the distal end of the cover plate with respect to its proximal end,

which rotation at least partly compensates for the opposite rotation or dip that would be imposed on the distal end by the change in the relative spaced apart positions of the two adjacent segments alone.

In an embodiment said cover plate comprises a coupling between the proximal end and the distal end, wherein the coupling element defines a cover plate axis extending parallel to the drum shaft, wherein the distal end is arranged to be rotated or bent relative to the proximal end between about the cover plate axis. The movement of the distal end relative to the proximal end can thus take place about the cover plate axis parallel to the circumferential surface of the drum, thereby ensuring that the distal end can be consistently moved relative to the proximal end over the entire width of the circumferential surface in the axial direction of the drum shaft.

In an embodiment the coupling element comprises a hinge, a film hinge or an integral hinge. The film hinge or integral hinge can provide a smooth transition from the proximal end to the distal end via the coupling element, which can improve the consistency of the circumferential surface of the tire building drum at the coupling element.

In an embodiment the proximal end, the distal end and the coupling element are integrally formed, preferably out of spring steel. The cover plate can thus be manufactured as a simple yet functional single piece of material.

In an embodiment each cover plate is provided with a slit cooperating with the coupling element to facilitate the bending or rotation of the distal end relative to the proximal end. The slit can locally weaken the cover plate to allow flexing of the material at the coupling element. The slit can furthermore provide the necessary clearance to allow the relative movement of the distal end with respect to the proximal end.

In an embodiment, in the recessed position, the second support surface is arranged to support the cover

plate in a first support position with its third support surface extending substantially along or at the first radius and wherein, in the extended position, the second support surface is arranged to support the cover plate in a second support position with its third support surface extending substantially along or at the second radius. Thus, in both the recessed position and the extended position, the third support surface can be supported along the respective first and second radius, respectively. In particular, the radius of the third support surface can be adjusted depending on the recessed or extended position of the second section on which it is supported. At both radii, the third support surface can be made to approximate the circumference of the circumferential surface of the tire building drum as close as possible, to make said circumferential surface as round or consistent as possible.

In an embodiment the movement of the second section from the recessed position to the extended position, the second section is arranged for lifting the distal end of the cover plate supported thereon towards the second circumference. The lifting can at least partly compensate for the opposite rotation or dip that would be imposed on the distal end by the change in the relative spaced apart positions of the two adjacent segments.

In an embodiment the first support surfaces and the third support surface form a combined support surface with an average radius which in the contracted position of the segments is equal to or substantially equal to the first radius and in the expanded position of the segments is equal to or substantially equal to the second radius. The radius of the combined support surface can thus be adjusted accordingly with the change of the radii of the circumferential surface when the segments are radially moved. At both radii, the combined support surface can thus be made to approximate the circumference of the circumferential surface of the tire building drum as close as possible, to make said circumferential surface as round

or consistent as possible.

In an embodiment the cover plates, in the contracted position of the segments, at least partially cover the second support surface on which they are supported, wherein an increasing part of said second support surface is exposed when the segments are moved towards the expanded position, wherein each second section, in the extended position, is moved towards the second radius such that the exposed part of the second support surface extends substantially along or at the second radius. The second support surface can thus form part of the circumferential surface of the tire building drum for supporting the tire components. By raising the second support surface towards the second radius, dips or waving patterns at the transition between the second support surface and the cover plate supported thereon and/or at the transition between the second support surface and the respective first support surface can be reduced or even eliminated, thereby increasing the consistency of the circumferential surface of the tire building drum.

In an embodiment the exposed part of the second support surface is arranged for directly supporting the tire component. The exposed part of the second support surface can thus actively contribute to the function of the circumferential surface of the tire building drum.

In an embodiment the first support surfaces, the second support surfaces and the third support surface, in the expanded position of the segments form a combined support surface with an average radius which is equal to or substantially equal to the second radius. The radius of the combined support surface can thus be adjusted accordingly with the change of the radii of the circumferential surface when the segments are radially moved. At both radii, the combined support surface can thus be made to approximate the circumference of the circumferential surface of the tire building drum as close as possible, to make said circumferential surface as round or consistent as possible.

According to a second aspect, the invention provides a method for varying the radius of the circumferential surface of the aforementioned tire building drum, wherein the method comprises the step of moving each second section relative to its respective first section, simultaneously with the movement of the segments from the contracted position to the expanded position, from the recessed position to the extended position.

Again, the second support surface, in the extended position, can contribute to a more round and/or more consistent circumferential surface of the tire building drum. In particular, waving patterns or dips in the circumferential surface of the tire building drum at the location of the second support surfaces or the cover plates supported thereon, can be reduced or even eliminated.

The various aspects and features described and shown in the specification can be applied, individually, wherever possible. These individual aspects, in particular the aspects and features described in the attached dependent claims, can be made subject of divisional patent applications.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be elucidated on the basis of an exemplary embodiment shown in the attached schematic drawings, in which:

figure 1 shows a partial side view of the tire building drum with a plurality of segments according to the invention, wherein the segments are in a contracted position;

figure 2 shows a partial side view of the tire building drum according to figure 1, wherein the segments are in an expanded position;

figures 3 and 4 shows two views in perspective of

one of the segments of the tire building drum according to figures 1 and 2;

figures 5A and 5B show a cross section of the tire building drum according to the line V-V in figure 1, with the segments in the contracted position according to figure 1 and the expanded position according to figure 2, respectively;

figure 6A shows a detail of the tire building drum according to the circle VI A in figure 1;

figure 6B shows a detail of the tire building drum according to the circle VI B in figure 2;

figure 6C shows a comparative overlay of the segments as shown in figures 6A and 6B;

figure 7 shows an alternative segment for use in the tire building drum according to figure 1; and

figure 8 shows a further alternative segment for use in the tire building drum according to figure 1.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1, 2, 5A and 5B show partial views of a tire building drum 1 according to an exemplary embodiment of the invention. It will be clear that the tire building drum 1 continues outside the boundaries of the drawings and that the partial view is representative for the entire circumference of the tire building drum 1. The tire building drum 1 is arranged to be contracted and expanded in its radial direction. The tire building drum 1 is typically used to receive tire components, in particular breaker and tread packages, for tire building. The tire building drum 1 may however also be used for other tire components and packages for tire building.

As shown in figures 5A and 5B, the tire building drum 1 comprises a drum shaft 2 that defines an axial direction A and a central rotation axis S about which the tire building drum 1 is arranged to be rotated by a rotary

drive (not shown). The tire building drum 1 further comprises a drive system 3 and a plurality of segments 4 operationally coupled to said drive system 3. The plurality of segments 4 are evenly distributed in the circumferential direction of the tire building drum 1 to define or form a circumferential surface 10 of the tire building drum 1, for receiving the tire components. The drive system 3 is arranged for moving the plurality of segments 4 in the radial direction of the tire building drum 1 between a radially contracted position as shown in figures 1 and 5A and a radially expanded position as shown in figures 2 and 5B. In the radially contracted position of the plurality of segments 4 the circumferential surface 10 of the tire building drum 1 has a first circumference C1 with a first radius R1, while in the radially expanded position of the plurality of segments 4 the circumferential surface 10 of the tire building drum 1 has a second, greater circumference C2 with a second, greater radius R2.

In an exemplary embodiment, the drive system 3 drives a plurality of first wedge members 31, e.g. centrally from within the drum shaft 2 (not shown). The first wedge members 31 are arranged on the drum shaft 2 to be slidable in the axial direction A of the drum shaft 2. The first wedge members 31 are provided with run-on or wedge surfaces which are inclined in one of the axial directions A of the tire building drum 1. Figures 5A and 5B only show a cross section of one of the first wedge members 31 interacting with one of the segments 4. It will be clear to one skilled in the art that the other of the first wedge members 31 are evenly distributed in the circumferential direction of the tire building drum 1, one underneath each of the plurality of segments 4, for interacting with each of those segments 4 and that all of these first wedge members 31 are driven simultaneously and equally by the drive system 3 in the axial direction A of the tire building drum 1.

Figures 5A and 5B further shows one of the

segments 4, which is representative for each segment 4 of the plurality of segments 4. Each segment 4 comprises a second wedge member 40 which is inclined in the same direction as the first wedge members 31 and which is arranged to be slidably arranged, in the direction of inclination, on the first wedge members 31. The segments 4 are axially fixed with respect to the drum shaft 2 in a manner which will be described later. Operation of the drive system 3 is converted by the inclined sliding of the first wedge members 31 with respect to the second wedge member 40 into a radially outward or inward translation of the second wedge members 40 with respect to the drum shaft 2. The first wedge members 31 thus effectively force the second wedge members 40 radially outwards.

Figures 3 and 4 show the representative one segment 4 separately from the tire building drum 1. The segment 4 comprises a first section 41 which is fixedly supported on the second wedge member 40 at the radially outer side of the segment 4 and a second section 42 which extends at one side of the first section 41 in the circumferential direction of the tire building drum 1. The second section 42 is arranged to be movable in a first direction of rotation M with respect to its respective first section 41 from a recessed position to an extended position in a manner which will be described in more detail hereafter. The first section 41 is provided with a first support surface 43 that faces radially outwards and that forms and/or defines a part of the external circumferential surface 10 of the tire building drum 1. As such, the first support surface 43 is arranged to be in direct contact with and/or for directly supporting the tire components. The first support surface 43 is arranged to be at, to extend along, to match, to be concentric to or to approximate the first circumference C1 in the contracted position of the segment 4. Preferably, the first support surface 43 has been given a curvature that is substantially coincident with the first circumference C1. Alternatively, the first

support surface 43 can be a relatively flat surface having a tangent that is substantially the same as the average tangent of the circumference C1 at the first support surface 43. The second section 42 is provided with a second support surface 44 that is arranged to extend at a variable angle or inclination with respect the first circumference C1 of the tire building drum 1 or with respect to a tangent or a plane of the first circumference C1 at the transition from the first section 41 to the second section 42.

The segment 4 is further provided with a coupling section 45, in this exemplary embodiment in the form of a film hinge or an integral hinge, which couples the second section 42 to the first section 41. The coupling section 45 couples the second section 42 to the first section 41 so as to be bendable, articulated or flexible in the first direction of rotation M about a segment axis E, extending between the first section 41 and the second section 42, parallel to the rotational axis S of the tire building drum 1. In particular, the first section 41, the second section 42 and the coupling section 45 are integrally formed out of one piece of flexible synthetic material. In an alternative, equally functional embodiment of the segment 104, as shown in figure 7, the coupling section 145 is formed by an actual, separate hinge. The coupling section 45 is arranged in between the first support surface 43 and the second support surface 44 and preferably provides or forms a smooth transition between the first support surface 43 and the second support surface 44. At the side of the coupling section 45 facing towards the drum shaft 2, the first section 41 and the second section 42 are spaced apart or provided with a slit 46 to accommodate radially inward flexing, bending, articulation or rotation of the second section 42 with respect to the first section 41. In particular, the slit 46 locally weakens the segment 4 at the coupling section 45 to increase its flexibility and/or provides clearance for the second section 42 to move towards the first section 41 about the segment axis E.

As shown in figures 3 and 4, the tire building drum 1 is provided with a guide assembly 5 for guiding the relative movement of the second section 42 with respect to the first section 41. The guide assembly 5 is operationally placed between or coupled to the first section 41 and the second section 42, for relatively moving the second section 42 with respect to the first section 41.

In this exemplary embodiment, the guide assembly 5 comprises a set 50 of a first push/pull rod or first arm 51 and a second push/pull rod or second arm 52. Each arm 51, 52 is provided with an elongate body 53 which, at one end, is coupled or fixed to the second section 42 and at the opposite end, is provided with a guide wheel 54. As best seen in figures 1, 2, 5A and 5B, the guide assembly 5 further comprises a first radially extending, disc shaped guide plate 55 and a second radially extending, disc shaped guide plate 56 arranged at and coupled to opposite ends of the drum shaft 2 in the axial direction A of the tire building drum 1. The guide plates 55, 56 are provided with slots 57 for receiving and guiding the guide wheels 54 of the respective arms 51, 52. The slots 57 extend in a non-radial direction or under an angle with the radial direction of movement of the respective segments 4. Because of the angle, the prolongations of the slots 57 do not intersect with the rotational axis S of the drum shaft 2. The slots 57 thus impose a path of movement on the guide wheels 54 and the arms 51, 52 associated therewith, such that the second section 42 coupled to the arms 51, 52 are moved in a different direction that is offset with respect to the radial movement of the segments 4. Thus, when the segments 4 are moved in the radial direction between their contracted positions and their expanded positions, the non-radial path followed by the guide wheels 54 in the slots 57 imposes a rotational movement A on the second section 42 with respect to the first section 41 about the segment axis E. In this exemplary embodiment, the offset of the non-radial direction of the slots 57 with respect to the radial

direction of the segments 4 is in a range of approximately three to twelve degrees, and preferably in the range of approximately seven to ten degrees.

Alternatively, the tire building drum 1 is provided with an actuator assembly 205 as shown in figure 8 that replaces the guide assembly 5. The actuator assembly 205 is provided with actuators 250 for actively actuating the required relative movements of the second sections 42 with respect to the first sections 41. The actuator 250 is preferably a linear actuator, e.g. pneumatic pistons or an electric linear drives, which is operationally placed between the first section 41 and its respective second section 42, either directly between the first section 41 and its respective second section 42 as shown in figure 8 or indirectly via a coupling or mechanism (not shown) at or near the drum shaft 2, for actuating the required relative movements.

As shown in figures 1 and 2, and in more detail in figures 6A and 6B, the tire building drum 1 is provided with a plurality of cover elements or cover plates 6. In particular, it can be observed that, in the contracted position, the segments 4 are in close proximity to each other in the circumferential direction of the tire building drum 1. Each first section 41 of one of the segments 4 is at a short distance or in abutting contact with the second section 42 of a directly neighboring or adjacent one of the segments 4. However, when the segments 4 are moved to the expanded position as shown in figure 2, the segments 4 are spaced apart in the circumferential direction of the tire building drum 1. The cover plates 6 are arranged to cover, bridge or span the gaps between said spaced apart segments 4 in order to maintain a closed or substantially closed circumferential surface 10 of the tire building drum 1 during the radial movement of the segments 4.

As best seen in figures 3 and 4, each of the cover plates 6 comprises a proximal end 61 that is coupled to the first section 41 of a respective one of the segments

4 and an opposite distal end or free end 62 that is arranged project from the one segment 4 to rest on or overlay the second support surface 44 of an adjacent one of the segments 4. Each cover plate 6 further comprises a third support surface 63 extending between the proximal end 61 and the distal end 62 of the cover plate 61 for directly contacting and/or directly supporting the tire components. The third support surface 63 has been given a slight curvature and/or tapers in the direction from the proximal end 61 towards the distal end 62, while the bottom surface of the cover plate 61, facing radially inwards, is substantially flat and is arranged to rest on and/or slide over the second support surface 44 of the adjacent one of the segments 4. As shown in figure 4, the first section 41 of the one segment 4 is provided with a mounting surface 48 that is recessed with respect to the first support surface 43 over a distance that is substantially equal to the thickness of the cover plate 6 at the proximal end 61. In this manner, the cover plate 6 can be mounted onto the mounting surface 48 of the first section 41 with its third support surface 63 flush with the first support surface 43. The cover plate 61 is thinnest at the distal end 62 such that, at the transition from the cover plate 61 to the second support surface 44, the cover plate 61 can be laid down as flat as possible on the second support surface 44 and/or the transition is as smooth as possible to the second support surface 44.

The cover plate 6 is arranged to be at least partly flexible, bendable or rotatable in a second direction of rotation N with respect to the first section 41 to which it is mounted, to passively follow the radial movement of the adjacent one or neighboring one of the segments 4 when the segments 4 are radially moved from the contracted position to the expanded position. In particular, it is the distal end 62 of the cover plate 6 that is movable with respect to the first section 41 to which the cover plate 6 is mounted, so as to follow the

second support surface 44 on which the distal end 62 is placed, during the radial movement of the segments 4. Preferably, the cover plate 6 has a neutral or natural or relaxed curvature that has a radius that is slightly smaller than the first radius R1, such that the distal end 62 is always biased to move towards and into forced abutment onto the second support surface 44.

To allow relative movement of the distal end 62 with respect to the proximal end 61, the cover plate 6 is further provided with a coupling element 64, in this exemplary embodiment in the form of an film hinge or integral hinge, arranged between the proximal end 61 and the distal end 63, preferably at the position where the cover plate 6 protrudes freely from the first section 41 to which it is fixed. One skilled in the art will appreciate that coupling element 64 in the cover plate 6 is essentially of the same structure as the coupling section 45 in the segment 4. In an alternative, equally functional embodiment of the cover plate 104, as shown in figure 7, the coupling element 164 is formed by an actual, separate hinge. The coupling element 64 defines a cover plate axis F about which the distal end 62 is flexible, rotatable or bendable in a radially inward or radially outward direction. The coupling element 64 is preferably smoothly integrated in the third support surface 63. At the side of the coupling element 64 facing towards the drum shaft 2, a slit 65 is provided in the cover plate 6 to accommodate radially inward flexing, bending, articulation or rotation of the distal end 62 with respect to the proximal end 61. In particular, the slit 65 locally weakens the cover plate 6 at the coupling section 64 to increase its flexibility and/or provides clearance for the distal end 62 to move towards the proximal end 61 about the cover plate axis F.

As a result of the relative movement of the distal end 62 with respect to the proximal end 61, the curvature or radius of the third support surface 63 in between can be varied as well. The third support surface 63

is initially arranged to be at, to extend along, to match, to be concentric to or to approximate the first circumference C1 in the contracted position of the segment 4, for optimally being in direct contact and/or for directly supporting the tire components between the spaced apart segments 4. Preferably, the third support surface 63 has been given a curvature that is substantially coincident with the first circumference C1, or at least has a tangent that is substantially the same as the tangent of the circumference C1 at the third support surface 63.

The cover plates 6 are preferably manufactured from a flexible and resilient spring steel. This material allows for the cover plates 6 to firmly support the weight of the tire components, at the thickness as shown, even when the segments 4 are fully spaced apart, while still allowing for some flexibility or bending of the cover plate 6 about the cover plate axis F.

Figures 6A and 6B show details of the aforementioned tire building drum 1 in operation.

Figure 6A shows the tire building drum 1 with the segments 4 in the contracted position. Each first support surface 43 extends along or is at the first circumference C1 and the first radius R1. Each second support surface 44 is arranged to be at least partially spaced apart from the first radius R1 and the first circumference C1 towards the drum shaft 2. The rest space between the second support surfaces 44 and the first circumference C1 substantially corresponds to the cross sectional shape of the cover plates 6 of the respective adjacent segments 4 such that the cover plates 6 may be received on top of the second support surfaces 44 without it intersecting or protruding with respect to the first circumference C1. In particular, it can be observed that angle of inclination of the second support surface 44 in the recessed position is substantially the same as the angle of the tapering bottom surface of the cover plate 6 supported thereon. A substantial part of said cover plates 6 is received and

supported on top of the respective second support surfaces 44 in a first support position, in which third support surfaces 63 of the cover plates 6 extend along or are at the first circumference C1 and the first radius R1. The second support surfaces 44 are almost completely shielded or covered by the respective cover plates 6 supported thereon. In particular, the third support surfaces 63 are in the radially outer or external position with respect to the respective second support surfaces 44, while the second support surfaces 44 are in the radially inner or internal position. The first support surfaces 43 and the third support surfaces 63 thus form or define a first combined support surface forming a substantial part of or the entire circumferential surface 10 of the tire building drum 1 for supporting the tire components. The first combined support surface extends along, approximates or is at the first radius R1 of the first circumference C1 and preferably approximates a perfect circle.

Figure 6B shows the tire building drum 1 with the segments 4 in the expanded position. The first support surfaces 43 are now moved into a position along or at the second circumference C2 and the second radius R2. The second sections 42 have been moved by the actuator assembly or the guide assembly 5 relative to their respective first sections 41 about the respective segment axes E, into a position in which the second support surfaces 44 extend at least partially along or at the second circumference C2 and the second radius R2. Simultaneously, each of the cover plates 6 of the respective adjacent segments 4 have been moved together with said adjacent segment 4 in the circumferential direction of the tire building drum 1 away from the respective second sections 42 on which they are supported, thereby exposing an increasing part of the respective second support surfaces 44. The second support surfaces 44 now partly define the external circumferential surface 10 of the tire building drum 1 onto which the tire components are supported. Together, the first support

surfaces 43, the second support surfaces 44 and the third support surfaces 63 form or define a second combined support surface forming a substantial part of or the entire circumferential surface 10 of the tire building drum 1 for supporting the tire components. The second combined support surface extends along, approximates or is at the second radius R2 of the second circumference C2 and preferably approximates a perfect circle. Thus, in the expanded position of the segments 4, the second support surface 44 now directly supports the tire components as part of the circumferential surface 10.

Furthermore, it is noted that the raising of the second support surface 44 with respect to the distal end 62 of the cover plate 6 that is supported thereon at least partly compensates for the tapering or the decrease in the thickness of the distal end 62 of the cover plate 6, and thus the gradually decreasing radius of said distal end 62 as it moves together with the adjacent segment 4 over the second support surface 44 of the one segment 4 onto which it is supported. In the second support position, the cover plate 6 thus has not solely followed the radial movement of the segment 4 onto which it is supported, but its distal end 62 has been raised or lifted slightly in the radially outward direction by the second support surface 44 onto which it is supported, towards the second circumference C2 and the second radius R2. This prevents that the third support surface 63 of the cover plate 6 generates a dip or waving pattern with respect to the first support surface 43 of the adjacent segment 4 at the position where it rests on the second support surface 44 of the adjacent segment 4. Thus, the combined second support surface as shown in figure 6B can be more round or circular compared to a situation where the distal end 62 of the cover plate 6 would solely follow the radial movement of the adjacent segment 4.

Figure 6C shows a comparative overlay of one of the segments 4 in both the contracted position and the

expanded position as shown in figures 6A and 6B, respectively. This clearly illustrates the differences in orientation of the second section 42 with respect to the first section 41 of the segment 4 and of the distal end 62 with respect to the proximal end 61 of the associated cover plate 6.

In this exemplary embodiment, the natural or relaxed condition of the segment 4 is the condition in which the second section 42 is in the extended position with respect to the first section 41. The second section 42 is thus pulled inwards by the arms 51, 52 towards the drum shaft 2, into a flexed condition. It has been found that this reduces the chances of fatigue of the material of the segment 4, in particular at or near the coupling section 45 thereof. In particular, cracks in the externally facing first support surface 43 and/or second support surface 44 can be prevented, which could potentially cause irregularities in the consistency of the tire components supported thereon.

It is to be understood that the above description is included to illustrate the operation of the preferred embodiments and is not meant to limit the scope of the invention. From the above discussion, many variations will be apparent to one skilled in the art that would yet be encompassed by the spirit and scope of the present invention.

In summary the invention relates to a tire building drum comprising a drum shaft and a circumferential surface for receiving a tire component, wherein the circumferential surface is defined by segments which are radially movable between a contracted position in which the circumferential surface has a first radius and an expanded position in which the circumferential surface has a second, greater radius, wherein the tire building drum comprises cover plates, wherein each segment is provided with a first section having a first support surface for supporting the tire component and a second section with a second support

surface for supporting the cover plate, wherein each second section is movable relative to its respective first section from a recessed position in which the second support surface is recessed with respect to first radius and an extended position in which the second support surface is raised towards the second radius.

C O N C L U S I E S

1. Bandenbouwtrommel omvattend een trommelas en een omtreksoppervlak concentrisch aan de trommelas voor het ontvangen van een bandcomponent, waarbij het omtreksoppervlak bepaald is door segmenten welke beweegbaar zijn in een radiale richting ten opzichte van de trommelas tussen een samengetrokken positie waarin het omtreksoppervlak een eerste radius heeft en een geëxpandeerde positie waarin de segmenten op afstand van elkaar gelegen zijn en waarin het omtreksoppervlak een tweede, grotere radius heeft, waarbij de bandenbouwtrommel afdekplaten omvat voor het overspannen van de op afstand van elkaar gelegen segmenten, waarbij elk segment is voorzien van een eerste sectie dat een eerste ondersteuningsoppervlak heeft voor het ondersteunen van de bandcomponent en een tweede sectie met een tweede ondersteuningsoppervlak voor het ondersteunen van de afdekplaat van één van de naastgelegen segmenten, waarbij elke tweede sectie, met de beweging van de segmenten vanuit de samengetrokken positie naar de geëxpandeerde positie, beweegbaar is relatief ten opzichte van de respectievelijke eerste sectie daarvan vanuit respectievelijk een teruggelegen positie naar een uitgezette positie, waarbij, in de teruggelegen positie, het tweede ondersteuningsoppervlak teruggelegen is ten opzichte van de eerste radius in de richting van de trommelas en waarbij, in de uitgezette positie, het tweede ondersteuningsoppervlak opgetild is vanuit de teruggelegen positie in de richting van de tweede radius.

2. Bandenbouwtrommel volgens conclusie 1, waarbij elk segment is voorzien van een koppelsectie tussen de eerste sectie en de tweede sectie, waarbij de

koppelsectie een segment hartlijn bepaald die zich evenwijdig uitstrekt aan de trommelas, waarbij de tweede sectie is ingericht voor het roteren of buigen relatief ten opzichte van de eerste sectie tussen de teruggelegen positie en de uitgezette positie rond de segment hartlijn.

3. Bandenbouwtrommel volgens conclusie 2, waarbij de koppelsectie een scharnier, een film scharnier of een integraal scharnier omvat.

4. Bandenbouwtrommel volgens conclusie 2 of 3, waarbij de eerste sectie, de tweede sectie en de koppelsectie integraal gevormd zijn, bij voorkeur uit een flexibel synthetisch materiaal.

5. Bandenbouwtrommel volgens één der conclusies 2, 3 of 4, waarbij elk segment is voorzien van een snede die samenwerkt met de koppelsectie voor het faciliteren van het buigen of roteren van de tweede sectie relatief ten opzichte van de eerste sectie.

6. Bandenbouwtrommel volgens één der voorgaande conclusies, verder omvattend een geleidingssamenstel of actuator samenstel dat operationeel gekoppeld is met elke van de tweede secties voor het geleiden of actueren van de relatieve beweging van de tweede secties ten opzichte van hun respectievelijke eerste secties.

7. Bandenbouwtrommel volgens conclusie 6, waarbij het geleidingssamenstel of actuator samenstel operationeel geplaatst is tussen elke tweede sectie en de respectievelijke eerste sectie daarvan.

8. Bandenbouwtrommel volgens conclusie 6 of 7, waarbij de bandenbouwtrommel een aandrijfsysteem omvat dat gekoppeld is met elk van de eerste secties voor het aandrijven van de radiale beweging van de segmenten tussen de samengetrokken positie en de geëxpandeerde positie relatief ten opzichte van de trommelas, waarbij het geleidingssamenstel een meervoud van armen omvat, waarvan elk is gekoppeld met een respectievelijke tweede sectie en een geleidingsplaat voor het geleiden van het meervoud van

armen relatief ten opzichte van de trommelas, waarbij de geleidingsplaat is voorzien van een meervoud van gleuven die zich onder een offset uitstrekken ten opzichte van de radiale richting, waarbij elk van de armen schuifbaar ontvangen is in een respectievelijke gleuf voor beweging langs een niet-radiale baan, waarbij het verschil tussen de radiale beweging die wordt opgelegd door het aandrijfsysteem op de eerste segmenten en de niet-radiale beweging die wordt opgelegd door de geleidingsplaat aan het meervoud van armen is ingericht voor het veroorzaken van de beweging van de tweede secties relatief ten opzichte van hun respectievelijke eerste secties.

9. Bandenbouwtrommel volgens één der voorgaande conclusies, waarbij elke afdekplaat een proximaal uiteinde omvat dat gekoppeld is met de eerste sectie van een respectievelijk segment, een tegengesteld distaal uiteinde dat is ingericht om te rusten op het tweede ondersteuningsoppervlak van één van de naastgelegen segmenten en een derde ondersteuningsoppervlak dat zich uitstrekt tussen het proximale uiteinde en het distale uiteinde voor het ondersteunen van de bandcomponent tussen de op afstand van elkaar gelegen segmenten, waarbij het distale uiteinde van de afdekplaat relatief beweegbaar is ten opzichte van de respectievelijke eerste sectie daarvan voor het volgen van de beweging van het tweede ondersteuningsoppervlak van het naastgelegen segment wanneer de tweede sectie van het naastgelegen segment bewogen wordt vanuit de teruggelegen positie naar de uitgezette positie.

10. Bandenbouwtrommel volgens conclusie 9, waarbij de afdekplaat een koppeling omvat tussen het proximale uiteinde en het distale uiteinde, waarbij het koppelelement een afdekplaat hartlijn bepaald die zich evenwijdig aan de trommelas uitstrekt, waarbij het distale uiteinde is ingericht teneinde te roteren of te buigen relatief ten opzichte van het proximale uiteinde tussen

rond de afdekplaat hartlijn.

11. Bandenbouwtrommel volgens conclusie 10, waarbij het koppelelement een scharnier, een film scharnier of een integraal scharnier omvat.

12. Bandenbouwtrommel volgens conclusie 10 of 11, waarbij het proximale uiteinde, het distale uiteinde en het koppelelement integraal gevormd zijn, bij voorkeur uit veerstaal.

13. Bandenbouwtrommel volgens één der conclusies 10, 11 of 12, waarbij elke afdekplaat is voorzien van een snede die samenwerkt met het koppelelement teneinde het buigen of roteren van het distale uiteinde ten opzichte van het proximale uiteinde te faciliteren.

14. Bandenbouwtrommel volgens één der conclusies 9-13, waarbij, in de teruggelegen positie, het tweede ondersteuningsoppervlak is ingericht voor het ondersteunen van de afdekplaat in een eerste ondersteuningspositie met het derde ondersteuningsoppervlak daarvan zich uitstrekkend in hoofdzaak langs of bij de eerste radius en waarbij, in de uitgezette positie, het tweede ondersteuningsoppervlak is ingericht voor het ondersteunen van de afdekplaat in een tweede ondersteuningspositie met het derde ondersteuningsoppervlak daarvan zich uitstrekkend in hoofdzaak langs of bij de tweede radius.

15. Bandenbouwtrommel volgens conclusie 14, waarbij de tweede sectie, met de beweging van de tweede sectie vanuit de teruggelegen positie naar de uitgezette positie, is ingericht voor het optillen van het distale uiteinde van de afdekplaat die daarop wordt ondersteund in de richting van de tweede omtrek.

16. Bandenbouwtrommel volgens één der voorgaande conclusies, waarbij de eerste ondersteuningsoppervlakken en het derde ondersteuningsoppervlak een gecombineerd ondersteuningsoppervlak vormt met een gemiddelde radius welke in de samengetrokken positie van de segmenten gelijk is of in hoofdzaak gelijk is aan de eerste radius en in de

uitgezette positie van de segmenten gelijks is aan of in hoofdzaak gelijk is aan de tweede radius.

17. Bandenbouwtrommel volgens één der voorgaande conclusies, waarbij de afdekplaten, in de samengetrokken positie van de segmenten, ten minste gedeeltelijk het tweede ondersteuningsoppervlak afdekken waarop zij ondersteund zijn, waarbij een toenemend gedeelte van het tweede ondersteuningsoppervlak blootgelegd wordt wanneer de segmenten bewogen worden naar de geëxpandeerde positie, waarbij elke tweede sectie, in de uitgezette positie, bewogen is in de richting van de tweede radius zodanig dat het blootgelegde deel van het tweede ondersteuningsoppervlak zich in hoofdzaak langs of bij de tweede radius uitstrekt.

18. Bandenbouwtrommel volgens conclusie 17, waarbij het blootgelegde deel van het tweede ondersteuningsoppervlak is ingericht voor het direct ondersteunen van de bandcomponent.

19. Bandenbouwtrommel volgens conclusie 17 of 18, waarbij de eerste ondersteuningsoppervlakken, de tweede ondersteuningsoppervlakken en het derde ondersteuningsoppervlak, in de geëxpandeerde positie van de segmenten een gecombineerd ondersteuningsoppervlak vormen met een gemiddelde radius die gelijk is of in hoofdzaak gelijk is aan de tweede radius.

20. Werkwijze voor het varieren van de radius van het omtreksoppervlak van een bandenbouwtrommel volgens één der conclusies 1-19, waarbij de werkwijze de stap omvat van het relatief bewegen van elke tweede sectie ten opzichte van de respectievelijke eerste sectie daarvan, gelijktijdig met de beweging van de segmenten vanuit de samengetrokken positie naar de geëxpandeerde positie, vanuit de teruggelegen positie naar de uitgezette positie.

-o-o-o-o-o-o-o-o-

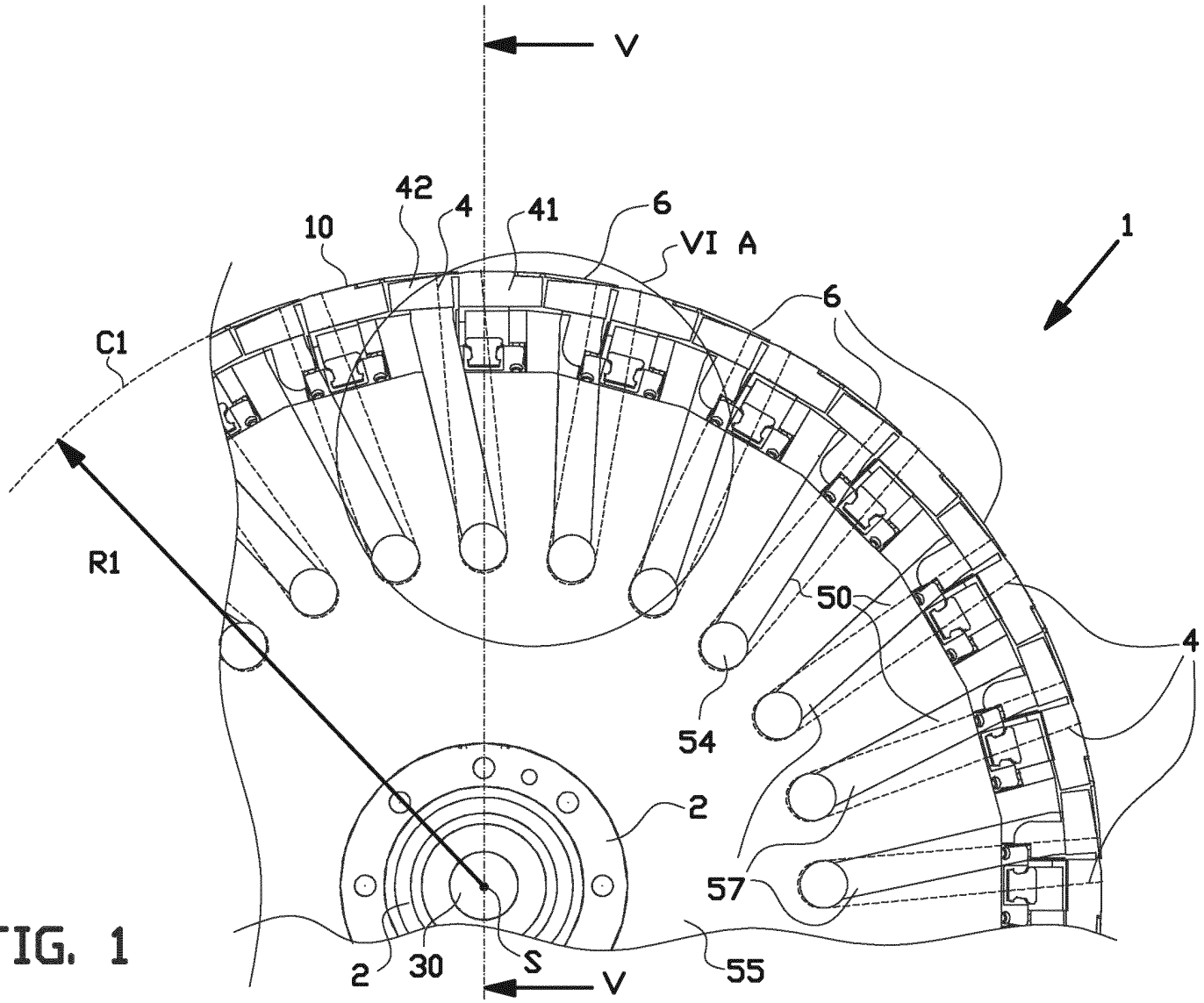

FIG. 1

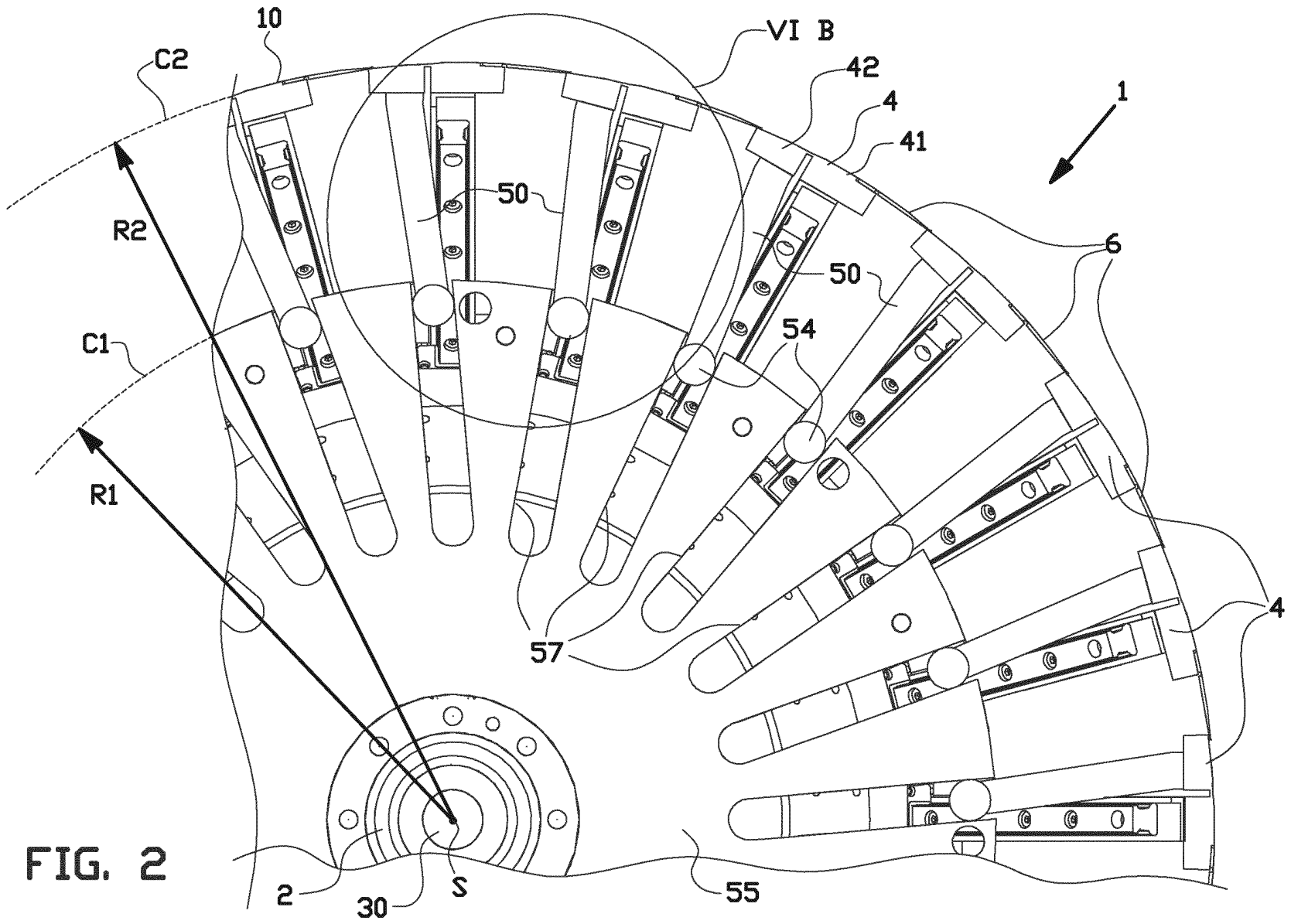

FIG. 2

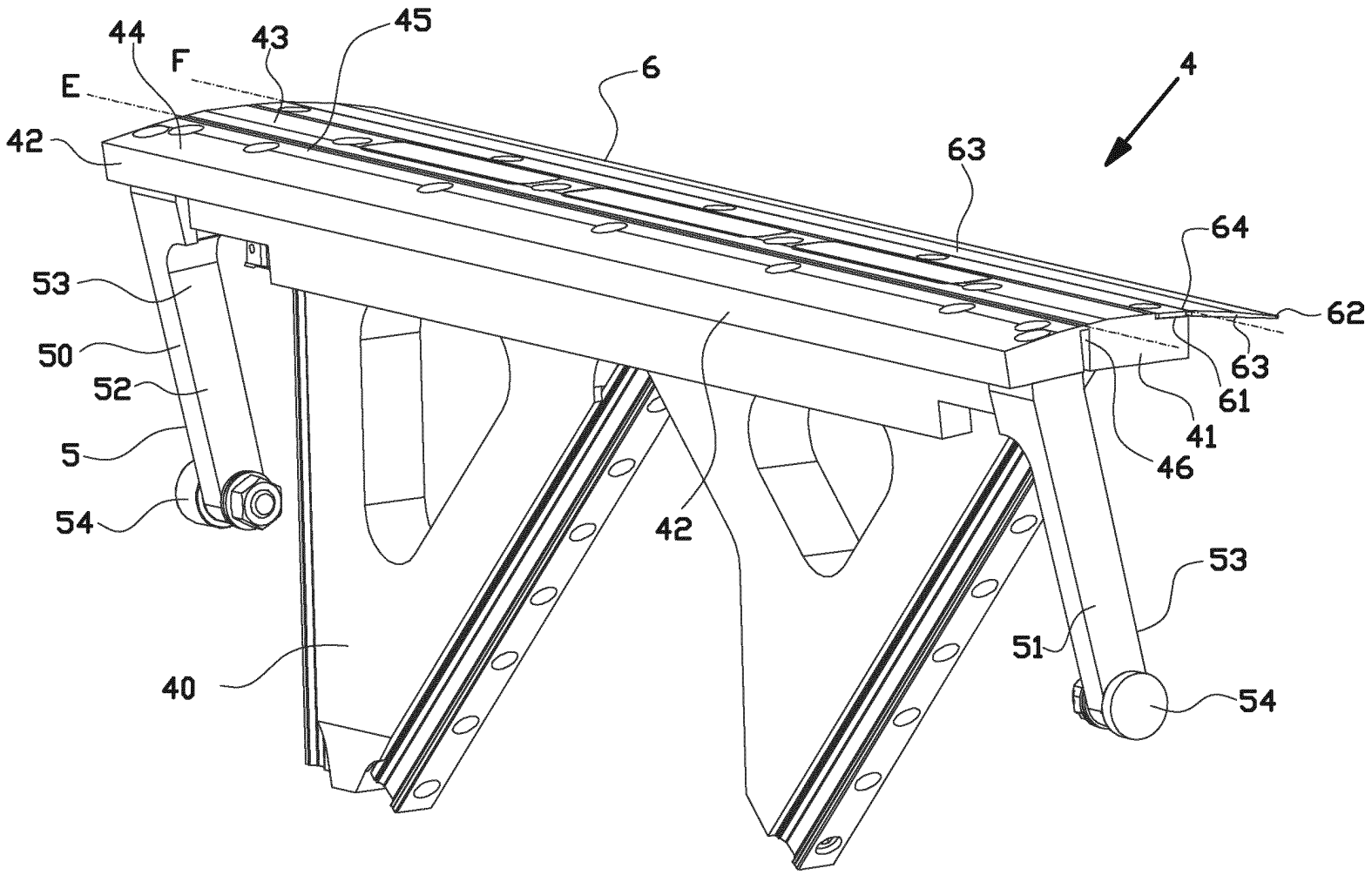

FIG. 3

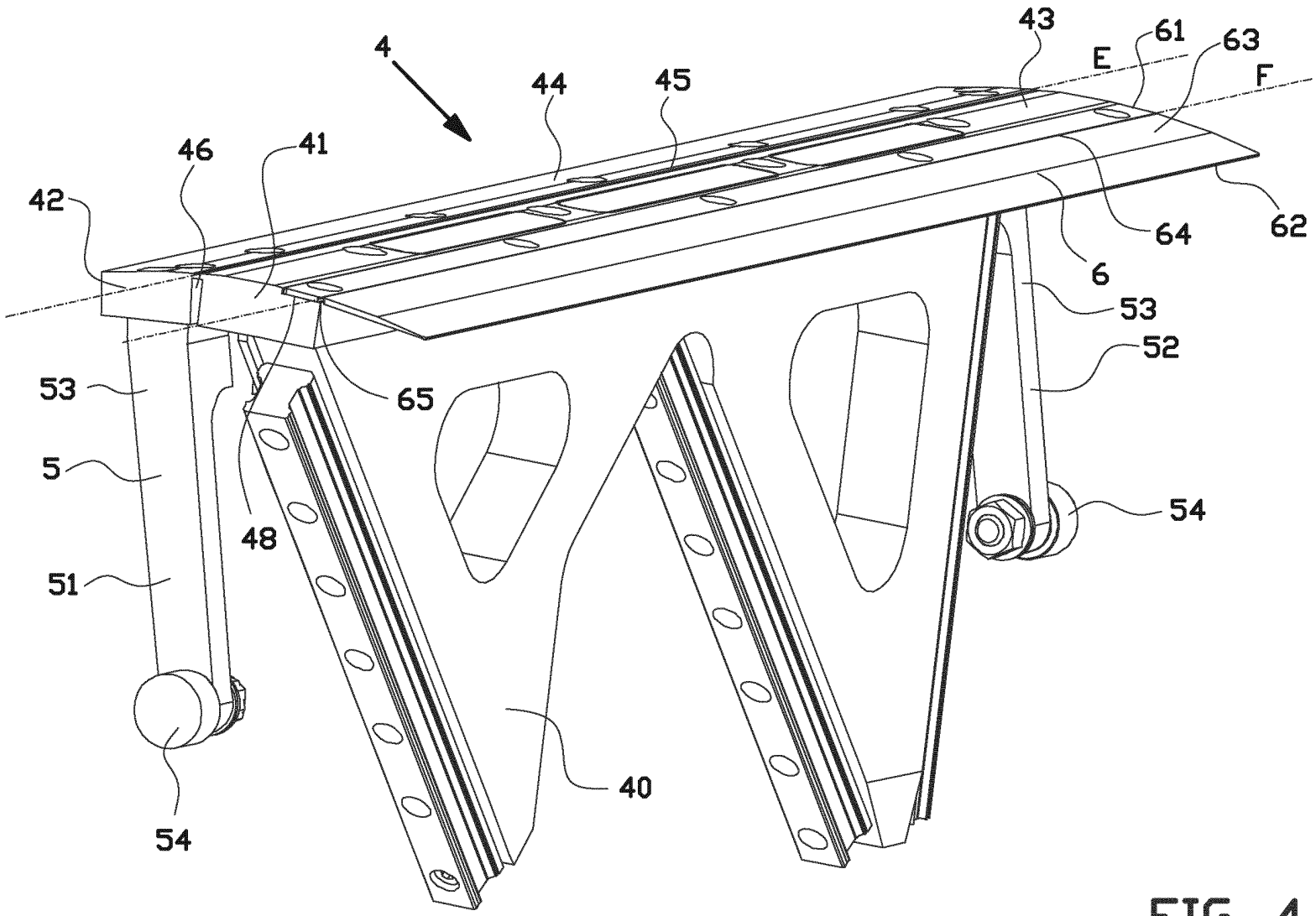

FIG. 4

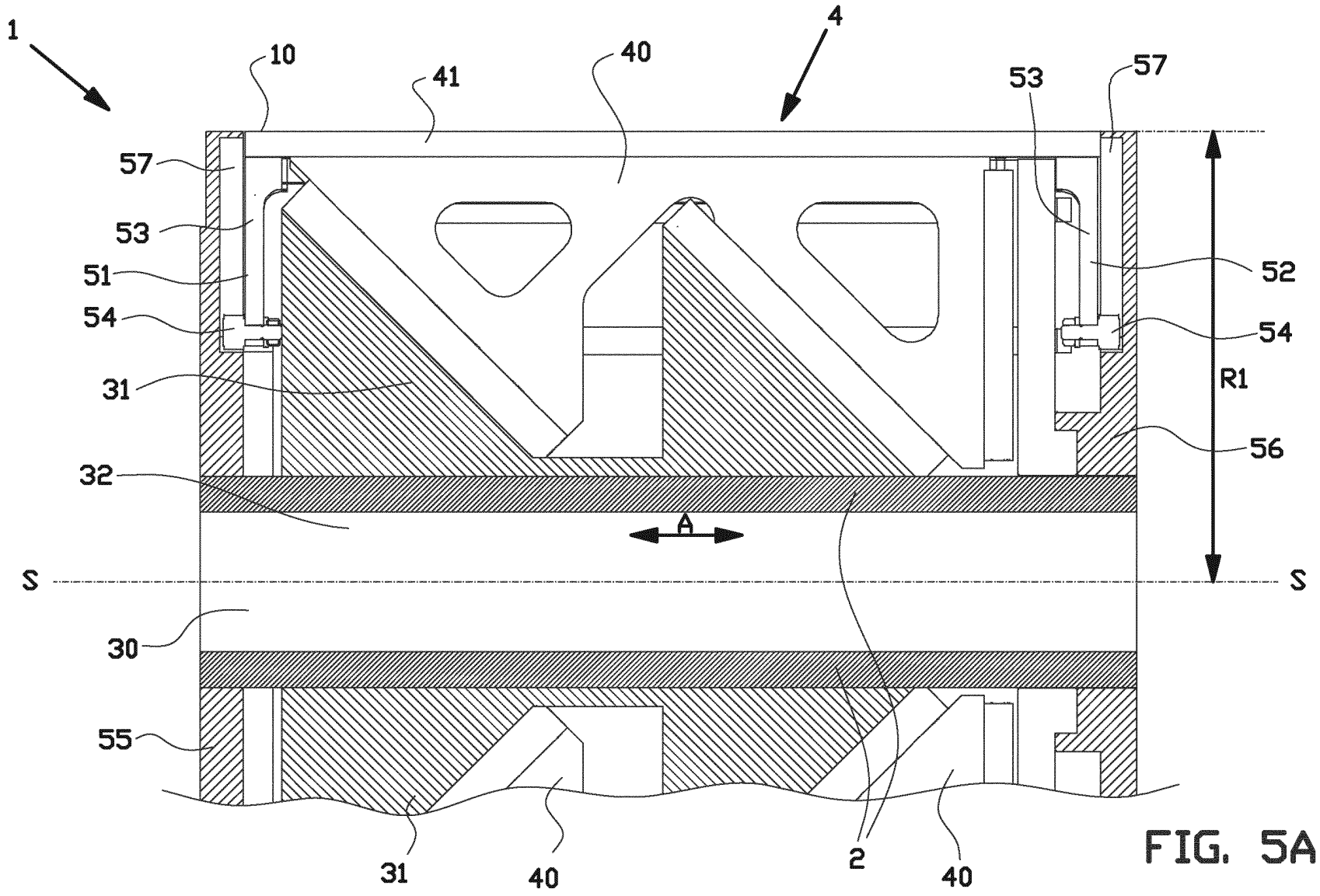

FIG. 5A

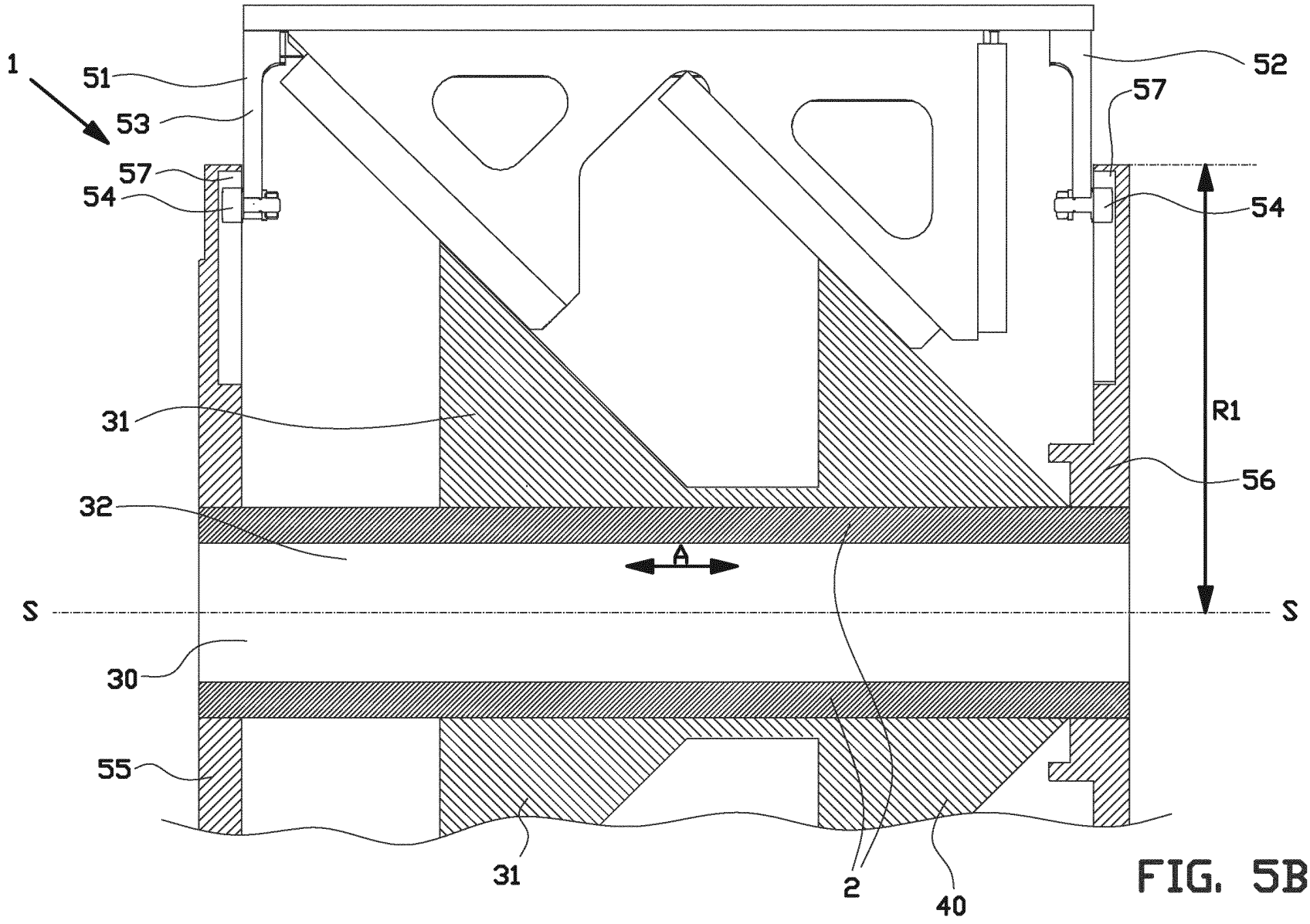

FIG. 5B

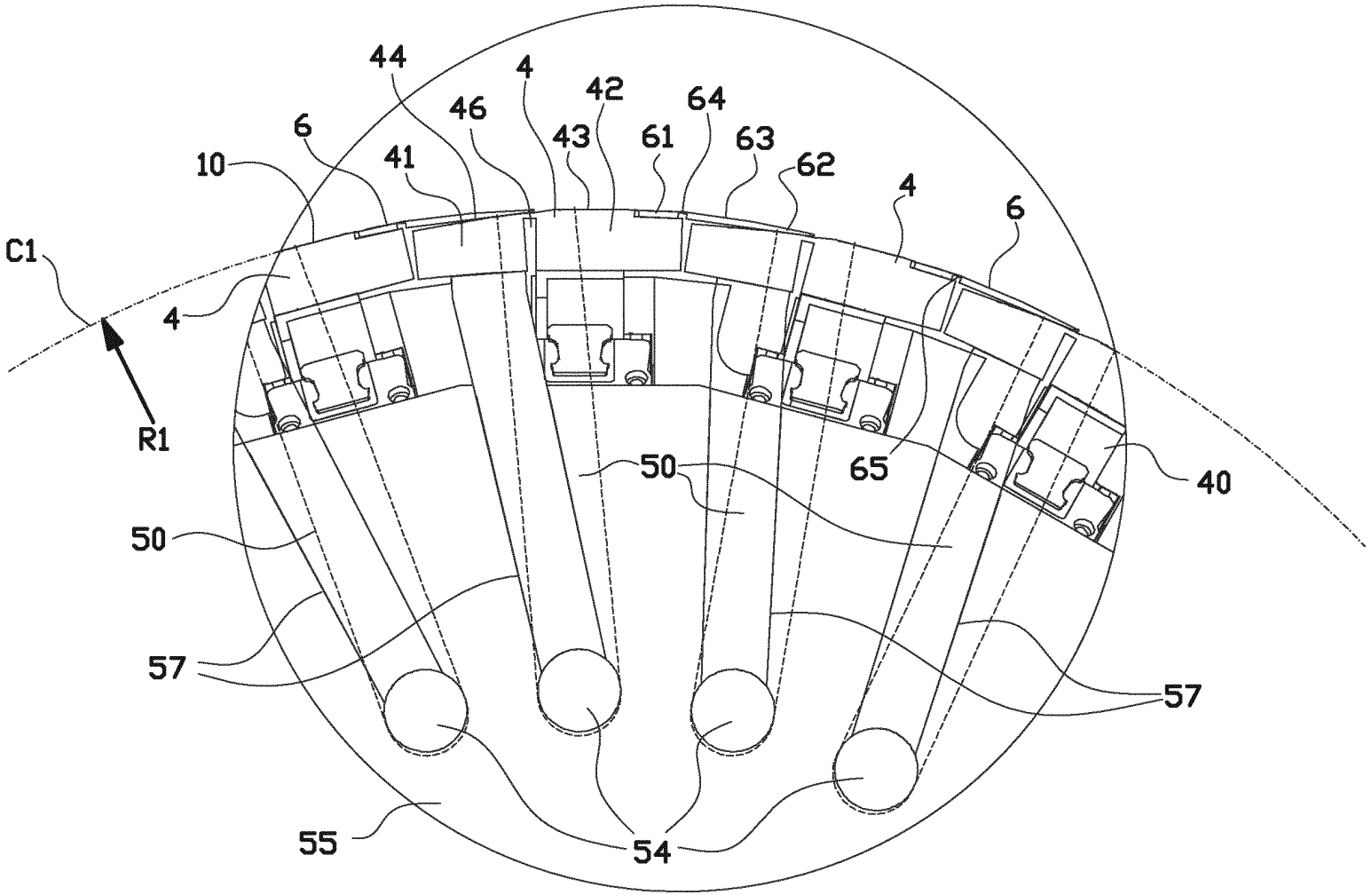

FIG. 6A

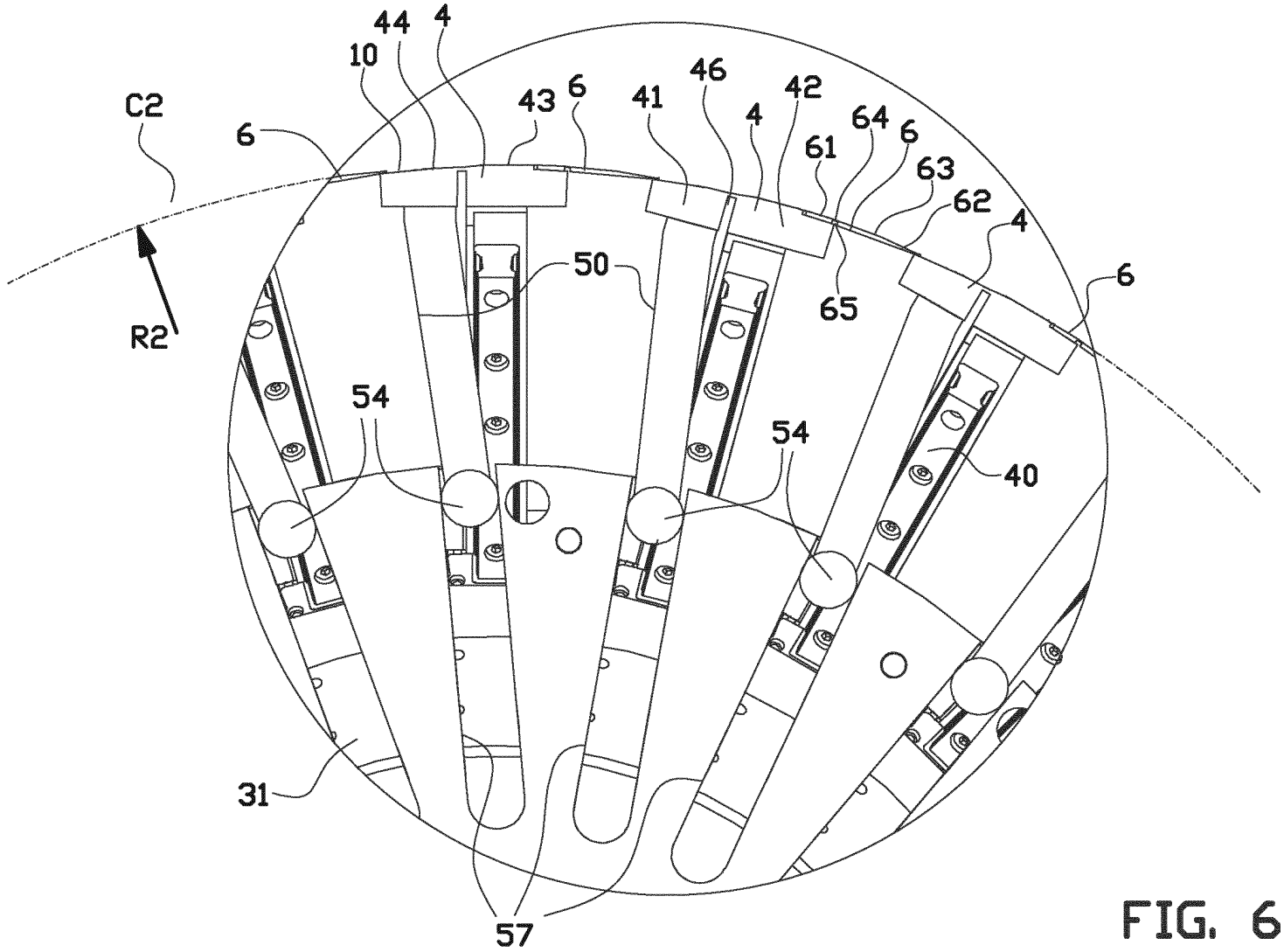

FIG. 6B

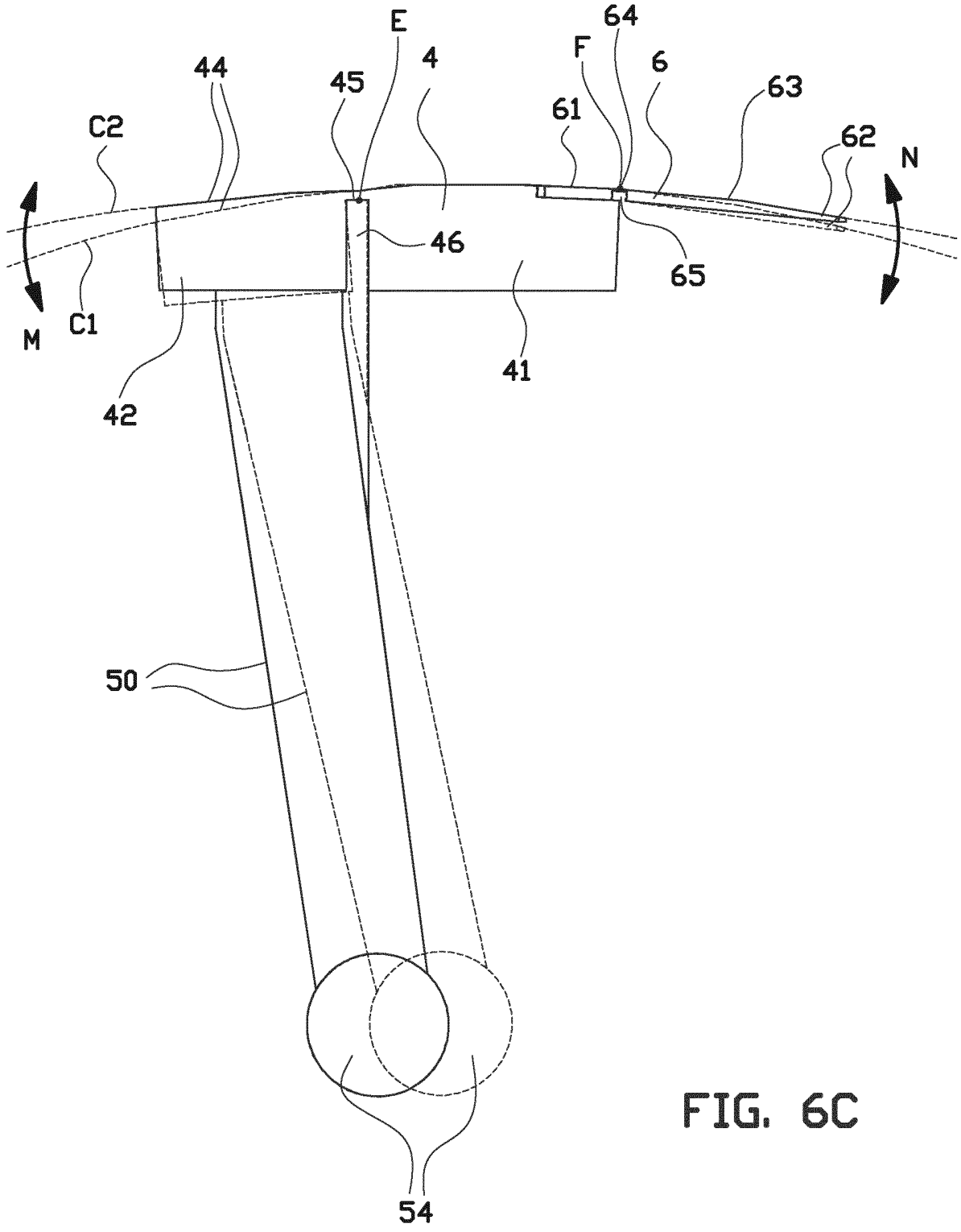

FIG. 6C

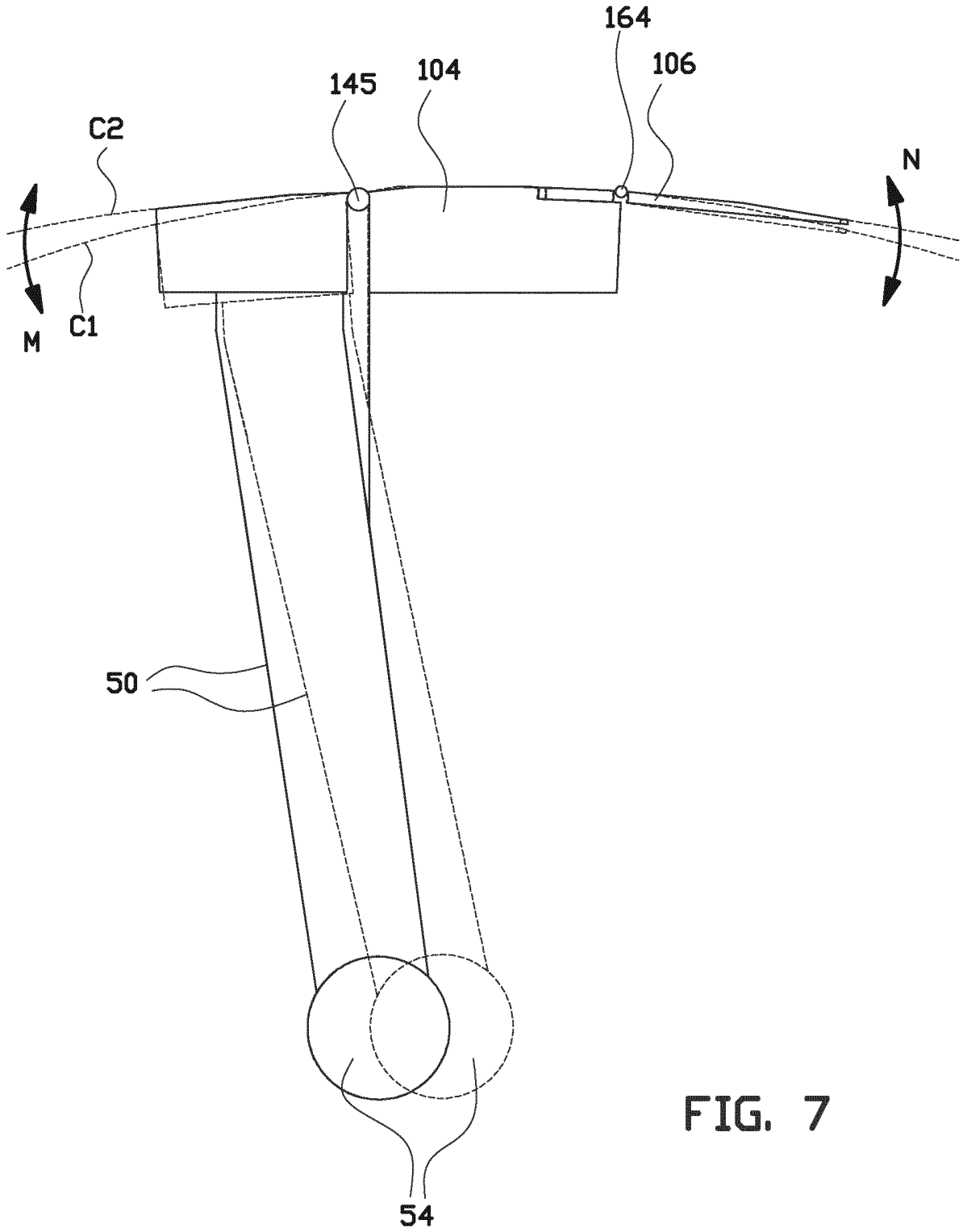

FIG. 7

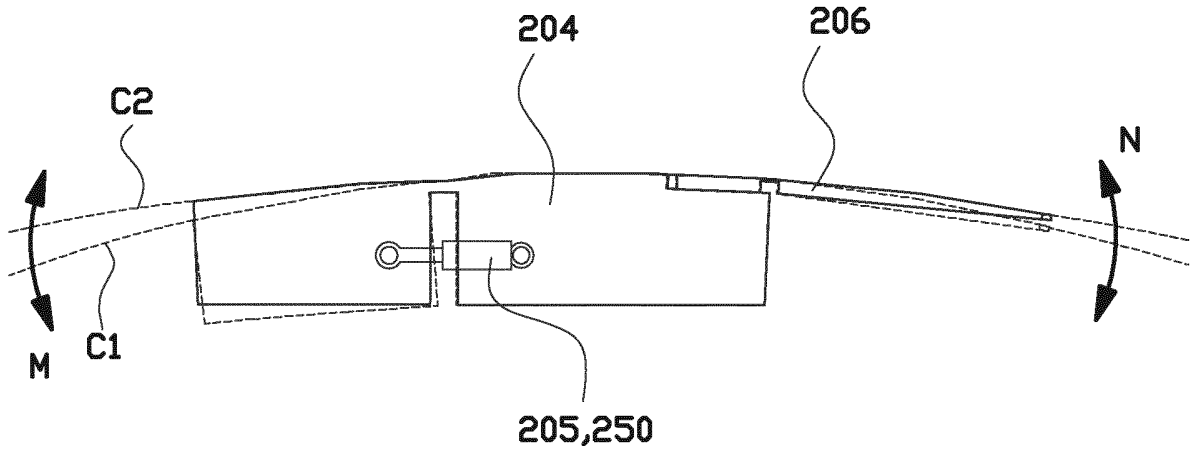

FIG. 8

A B S T R A C T

The invention relates to a tire building drum comprising a drum shaft and a circumferential surface for receiving a tire component, wherein the circumferential surface is defined by segments which are radially movable between a contracted position in which the circumferential surface has a first radius and an expanded position in which the circumferential surface has a second, greater radius, wherein the tire building drum comprises cover plates, wherein each segment is provided with a first section having a first support surface for supporting the tire component and a second section with a second support surface for supporting the cover plate, wherein each second section is movable relative to its respective first section from a recessed position in which the second support surface is recessed with respect to first radius and an extended position in which the second support surface is raised towards the second radius.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	NLP195327A
Nederlands aanvraag nr. **2013045**	Indieningsdatum **20-06-2014**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **VMI Holland B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **11-10-2014**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN62920**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

B29D30/24

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**B29D**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III. ☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES** (opmerkingen op aanvullingsblad)

IV. ☐ **GEBREK AAN EENHEID VAN UITVINDING** (opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2013045

A. CLASSIFICATIE VAN HET ONDERWERP
INV. B29D30/24
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
B29D

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 6 013 147 A (BYERLEY MARK S [US]) 11 januari 2000 (2000-01-11) * kolom 4, regel 48 - kolom 9, regel 47; figuren 1,2,8-13 * * kolom 6, regel 42 - kolom 7, regel 27; figuren 8,12,13 *	1-3,6-8, 20

A	US 5 203 947 A (BOEKER PAT A [JP]) 20 april 1993 (1993-04-20) * kolom 2, regel 48 - kolom 4, regel 55; figuren 1-7 *	1-20

A,D	US 3 932 256 A (TOUCHETTE JOHN W) 13 januari 1976 (1976-01-13) in de aanvraag genoemd * kolom 2, regel 7 - kolom 6, regel 8; figuren 1-3 *	1-20

	-/--	

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
27 maart 2015	
Naam en adres van de instantie European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	**De bevoegde ambtenaar** Fregosi, Alberto

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2013045

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
A,D	JP 2009 274392 A (SUMITOMO RUBBER IND) 26 november 2009 (2009-11-26) in de aanvraag genoemd * samenvatting; figuren 1-5 *	1-20
A	US 4 923 554 A (OZAWA CHIAKI [JP]) 8 mei 1990 (1990-05-08) * kolom 3, regel 39 - kolom 5, regel 24; figuren 1-3 *	1-20

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2013045

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 6013147 A	11-01-2000	BR 9903051 A	09-10-2001
		CA 2274336 A1	21-01-2000
		US 6013147 A	11-01-2000
US 5203947 A	20-04-1993	JP 3193417 B2	30-07-2001
		JP H0596650 A	20-04-1993
		US 5203947 A	20-04-1993
US 3932256 A	13-01-1976	JP S5147070 A	22-04-1976
		US 3932256 A	13-01-1976
JP 2009274392 A	26-11-2009	CN 101579930 A	18-11-2009
		JP 4510907 B2	28-07-2010
		JP 2009274392 A	26-11-2009
US 4923554 A	08-05-1990	JP H01157838 A	21-06-1989
		US 4923554 A	08-05-1990

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN62920	20.06.2014		NL2013045

International Patent Classification (IPC)
INV. B29D30/24

Applicant
VMI Holland B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

	Examiner
	Fregosi, Alberto

Application number

WRITTEN OPINION

NL2013045

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	4, 5, 9-19
	No:	Claims	1-3, 6-8, 20
Inventive step	Yes:	Claims	
	No:	Claims	1-20
Industrial applicability	Yes:	Claims	1-20
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Prior art

Reference is made to the following documents:

D1: US 6013147 - A;

D2: US 5203947 - A;

D3: US 3932256 - A;

D4: JP 2009274392 - A;

D5: US 4923554 - A.

2. Claims **1, 20** - Lack of Novelty

2.1 Document **D1** (US 6013147 - A) discloses (the signs in parentheses referring to this document):

a tire building drum (12) comprising:

(a) - a drum shaft (16) and a circumferential surface (20) concentric to the drum shaft for receiving a tire component;

(b) - wherein the circumferential surface is defined by segments (22) which are movable in a radial direction with respect to the drum shaft between a contracted position in which the circumferential surface has a first radius and an expanded position in which the segments are spaced apart and in which the circumferential surface has a second, greater radius;

(c) - wherein the tire building drum (12) comprises cover plates (32) for spanning the spaced apart segments (22) [see figures 1, 2, 8 and the relevant passages of the description];

(b1) - wherein each segment (22) is provided with a first section (34, 44) having a first support surface for supporting the tire component and a second section (30) with a second support surface for supporting the cover plate (32) of an adjacent one of the segments [see figures 1, 2, 8 and the relevant passages of the description];

(b2) - wherein, with the movement of the segments from the contracted position to the expanded position, each second section (30) is movable relative to its respective first section (34, 44) from a recessed position to an extended position, respectively;

(b3) - wherein, in the recessed position, the second support surface (30) is recessed with respect to first radius towards the drum shaft (16) and wherein, in the extended position, the second support surface (30) is raised from the recessed position towards the second radius [see figure 11 and the relevant passages of the description].

2.2 It is remarked that "the second side section **32** of each segment **22**" of **D1**, although similar to "the first side section **30** of each segment **22**", is considered as corresponding to the "cover plates 6" as defined in claim **1** of the present application.

Claim **1** is therefore not novel.

2.3 Document **D1** also discloses (the signs in parentheses referring to this document):

a method for varying the radius of the circumferential surface of the tire building drum (12) [as defined in claim **1**], wherein the method comprises the step of moving each second section (30) relative to its respective first section (34, 44), simultaneously with the movement of the segments (22) from the contracted position to the expanded position, from the recessed position to the extended position.

See: column 6, line 42 - column 7, line 27 and figures 8, 12, 13.

Claim **20** is therefore not novel.

3. Dependent claims **2-19** - Lack of Novelty and /or Inventive Step

3.1 Dependent claims **2** to **19** do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step, since these features appear to be

disclosed or suggested in the available prior art (documents **D1** to **D5**) or are simply considered as part of the common knowledge of the person skilled in the art of tyre manufacturing.