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(54) **Title:** END BAR WITH FORCE APPLICATION FOR RETREAD TIRE MOLD

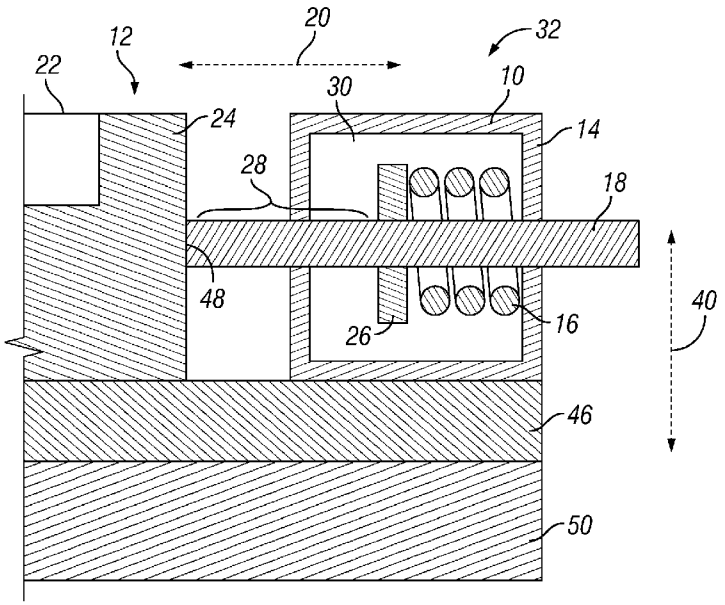


FIG. 5

(57) **Abstract:** An end bar (10) for a retread tire mold (12) is provided that has a spring (16) carried by a frame (14). A pin (18) is present that is urged by the spring (16) in a longitudinal direction. The pin (18) is configured for transferring force from the spring (16) through the pin to a mold sector (24) of the retread tire mold (12) in order to urge mold sectors of the retread tire mold together in the longitudinal direction.

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TITLE

END BAR WITH FORCE APPLICATION FOR RETREAD TIRE MOLD

FIELD OF THE INVENTION

[0001] The present invention relates generally to end bars of molds that are used for the production of retread tire tread. More particularly, the present application involves an end bar that automatically applies compressive forces to the mold sectors of a retread tire mold.

BACKGROUND

[0002] Retreaded tires are those that have a new tread section placed onto a carcass of the tire after the tread section currently on the tire is worn down. To make this replacement, the tread currently on the tire may be removed, and the outer surface of the carcass treated for acceptance of the new tread. A layer of cushion gum can be applied to the surface of the carcass and the new tread section may be applied to this cushion gum layer. The cushion cum layer can be cured in order to cause the new tread section to be attached to the carcass.

[0003] The new tread section can be a cured piece of rubber that is formed by a mold and a press. The mold can be made from a plurality of mold sectors that are arranged against one another into a linear arrangement. Uncured rubber can be placed on top of the mold sectors and a press may be moved in the vertical direction to press the rubber into the mold sectors. The press engages a flat underside of the tread strip, and tread element features are molded into the rubber via corresponding features of the mold sectors. The mold can be heated, and this combination of heat and pressure may cure the rubber into the desired shape.

[0004] When the mold is heated, the tread sectors expand in the vertical, lateral, and longitudinal directions which cause the mold sectors to move, and potentially move relative to one another. Further, pressure applied by the press in the vertical direction may cause longitudinal movement of the mold sectors due to the geometry of the tread forming elements. This pressure may likewise cause relative movement of the mold sectors in the longitudinal direction. Gaps may form in the longitudinal direction between the mold sectors, and these gaps create uniformity issues in the production of the tire tread.

[0005] In order to keep the various mold sectors together in the linear direction so that there are no gaps between the mold sectors, it is known to employ an end bar that has screws at the trim post end of the mold. In this regard, one or more screws are positioned so that they press against the end of the mold sector at the trim post end. The screws may be tightened so that they press the sectors together to eliminate any gaps between the sectors. Although capable of holding the sectors together, the use of screws creates challenges in the production of retread treads. For instance, if the mold is cold and one forgets to loosen the screws from the previous position, the expanding mold sectors may be urged forcefully against the screws causing cracking or other damage to the mold sectors and/or screws. Also, if the mold is cold, it must be heated up into its thermally expanded state before the screws can be tightened to compress the mold sectors against one another. This wait time reduces the efficiency of retread tread production. The use of manually tightened and loosened screws adds to the amount of labor needed to produce the retread tire tread, and increases the chances of mistakes in production. Further, voids between the screws at locations farthest from the mold sectors present areas into which rubber may flow during the pressing and curing process. This rubber can become stuck in the screw arrangement and may fly out unpredictably upon demolding of the retread tread from the mold. As such, there remains room for variation and improvement within the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth more particularly in the remainder of the specification, which makes reference to the appended Figs. in which:

[0007] Fig. 1 is a top view of a retread tire mold with a spacer and an end bar.

[0008] Fig. 2 is a top view of a retread tire mold with a pair of side rails and an end bar.

[0009] Fig. 3 is cross-sectional side view of a retread tire mold with an end bar.

[0010] Fig. 4 is a perspective view of a pin.

[0011] Fig. 5 is a cross-sectional side view of an end bar in engagement with a mold sector.

[0012] Fig. 6 is a side view of an end bar.

[0013] Fig. 7 is a front perspective view of an end bar.

[0014] Fig. 8 is a back perspective view of an end bar.

[0015] Fig. 9 is a back perspective view of an end bar, base plate, and platen.

[0016] Fig. 10 is a back perspective view of an end bar, base plate, and platen.

[0017] Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the invention.

DETAILED DESCRIPTION OF REPRESENTATIVE EMBODIMENTS

[0018] Reference will now be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, and not meant as a limitation of the invention. For example, features illustrated or described as part of one embodiment can be used with another embodiment to yield still a third embodiment. It is intended that the present invention include these and other modifications and variations.

[0019] The present invention provides for an end bar 10 for a retread tire mold 12 that has one or more spring loaded pins 18 that are urged against an end of a mold 22 in order to compress the mold sectors 24 against one another to reduce or eliminate gaps between the aligned mold sectors 24. The spring loaded pins 18 automatically apply force to the mold sectors 24 to cause their compression to one another without the need for manual tightening or loosening of components of the end bar 10. Further, the compressive forces applied by the end bar 10 may commence regardless of whether the mold 22 is cold in an initial state, or heated and thus in an expanded state as the configuration of the spring loaded pins 18 can be made to accommodate the application of compressive force at any location of the mold 22 in the longitudinal direction 20.

[0020] Fig. 1 illustrates a retread tire mold 12 used in the construction of retread tire tread 56 that includes a mold 22 that is formed by a number of mold sectors 24. Although six mold sectors 24 are present, any number of mold sectors 24 could be present to form the mold 22. The mold sectors 24 are typically made of aluminum and have features that form tread elements such as grooves, tread blocks, and sipes of the retread tire tread 56. The mold sectors 24 can be abutted against one another in the longitudinal direction 20 without interlocking, or there may be some interlocking engagements between the mold sectors 24 in some instances. The

mold 22 is arranged so that it is longer in the longitudinal direction 20 than in the lateral direction 36. The retread tire tread 56 is inserted into the mold 22 by first moving the retread tire tread 56 over and past an infeed end 34 of the retread tire mold 12. The retread tire tread 56 is moved up to a trim post end 32 so that the retread tire tread 56 extends from the trim post end 32 back to the infeed end 34 in the longitudinal direction 20.

[0021] The end bar 10 is located at the trim post end 32, but it is to be understood that the end bar 10 could alternatively be located at the infeed end 34 in other exemplary embodiments. In the embodiment shown in Fig. 1, the mold sectors 24 are fixed at the infeed end 34 so that they do not expand past the infeed end 34 but instead only expand towards the trim post end 32. A fixed bar or mechanical connection may be implemented at the infeed end 34 to keep the mold sector 24 at this point fixed. Thermal expansion of the mold 22, along with vertical forces imparted by the press 54, causes the mold sectors 24 to expand in the longitudinal direction 20 towards the trim post end 32. A spacer 44 is present and engages the mold sector 24 that is closest to the end bar 10. The end bar 10 is rigidly attached to a base plate 46 that is under the mold 22. Pins 18 of the end bar 10 engage the spacer 44 and apply force to the spacer 44 to urge the spacer 44 in the longitudinal direction 20 back towards the infeed end 34. As stated, gaps may develop between the various mold sectors 24 through thermal expansion and pressing forces, the force applied by the pins 18 is transferred by the spacer 44 into the mold sector 24 to which it engages and is then in turn transferred through all of the mold sectors 24 all the way back to the infeed end 34. This force presses the mold sectors 24 back against the infeed end 34 so that the mold sectors 24 are compressed against one another and gaps between the mold sectors 24 are either completely eliminated along the entire mold 22 or are at least minimized in size in the longitudinal direction 20. The spacer 44 is not a component of the mold 22 in that there are no tread forming elements in the spacer 44 to form features of the retread tire tread 56. The spacer 44 is used to fill up a void in the longitudinal direction 20 so that the pin 18 can transmit its compressive force to the various mold sectors 24.

[0022] Fig. 2 shows another retread tire mold 12 in which a pair of side rails 52 are present that act against the mold 22 to constrain its movement in the vertical direction 40 and in the lateral direction 36. The side rails 52 may engage portions of the mold sectors 24 that are not engaged by the retread tire tread 56 and do not include elements that form features of the retread tire tread 56. In some instances, the side rails 52 may constrain movement of the mold sectors 24

in the lateral direction 36 but not in the vertical direction 40. The side rails 52 may extend along the entire length of the mold 22 in the longitudinal direction 20, and the pins 18 do not engage the side rails 52. The side rails 52 may be rigidly attached to the base plate 46 or to some other structure in order to resist expansive/movement forces of the mold sectors 24. The side rails 52 in addition to constraining movement of the mold sectors 24 may also constrain movement of the base plate 46 in the lateral direction 36, and in some instances in the vertical direction 40.

[0023] The mold 22 is fixed at the infeed end 34 in that it cannot expand past the infeed end 34 due to a rigidly fixed bar at the infeed end 34, or because the mold sector 24 at the infeed end 34 is rigidly attached to the base plate 46 or otherwise secured in a fixed position. Expansion through thermal and pressing forces will cause the various mold sectors 24 to expand in the longitudinal direction 20 towards the trim post end 32 and this may result in the aforementioned gaps between the mold sectors 24 with resulting molding irregularities in the resulting product. The mold sector 24 at the trim post end 32 will move in the longitudinal direction 20 towards the end bar 10 as it is not constrained by the side rails 52. The end bar 10 is rigidly fixed at the trim post end 32, to the base plate 46 or otherwise, and the pins 18 of the end bar of the end bar 10 directly engage the terminal end of the mold sector 24 that is closest to the end bar 10. The pins 18 apply force to the mold sector 24 at the trim post end 32 that is transferred through the various mold sectors 24 back to the infeed end 34 and this force functions to compress the mold sectors 24 together to eliminate or reduce gaps between adjacent mold sectors 24.

[0024] The pins 18 engage and apply force to the mold sector 24, and do not engage and do not apply force to the base plate 46. Other arrangements of the end bar 10 are possible in which the pins 18 do in fact engage the base plate 46 and apply force thereon. Further, other arrangements are also possible in which the pins 18 do not engage the base plate 46, but force applied by the pins 18 is in fact transferred to the base plate 46. The pins 18 provide the right amount of force to the mold sectors 24 to cause them to compress against one another. Further, the spacing of the pins 18 in the lateral direction 36 allows mold sectors 24 of different widths in the lateral direction 36 to be inserted into and removed from the retread tire mold 12 without having to adjust or remove the end bar 10. If the mold sectors 24 are more narrow than the outboard most pins 18 in the lateral direction 36, these pins 18 simply will not be used but may remain in the retread tire mold 12 as they will be at their normal, at rest positions as they will not

engage the mold sectors 24. Although the pins 18 are shown having fixed positions in the lateral direction 36, it is to be understood that other embodiments of the end bar 10 are possible in which the pins 18 are adjustable in the lateral direction 36 so that they can be moved inboard and outboard as needed to engage or not engage the mold sector 24.

[0025] A cross-sectional side view of the retread tire mold 12 is shown in Fig. 3 in which the mold 22 rests on top of a base plate 46 so that the mold 22 is above the base plate 46 in the vertical direction 40. The base plate 46 in turn rests above a platen 50 such that the base plate 46 is above the platen 50 in the vertical direction 40. The platen 50 is heated with a series of conduits through the platen 50 through which heated water or other fluid will flow to transfer heat into the platen 50 and subsequently through the base plate 46 and into the mold 22 to account for expansion of the mold sectors 24 of the mold 22. The base plate 46 may be rigidly attached to the platen 50 so that these components do not move relative to one another. The end bar 10 is located at the trim post end 32 of the retread tire mold 12 and is rigidly attached to the top of the base plate 46 through welding so that the end bar 10 does not move relative to the base plate 46. The various mold sectors 24 rest on the base plate 46 and extend from the infeed end 34 to the trim post end 32 in the longitudinal direction 20 and are constrained from moving in the longitudinal direction 20 at the infeed end 34. The retread tire tread 56 is located on top of the mold sectors 24 and extends between the ends 32 and 34 in the longitudinal direction 20.

[0026] A press 54 is shown above the retread tire tread 56 in the vertical direction 40. In use, the press 54 will move downward in the vertical direction 40 to engage the top of the retread tire tread 56 and press it into the various mold sectors 24. Heat from the platen 50 is transferred into the mold sectors 24 and subsequently into the retread tire tread 56 which cures the retread tire tread 56 in conjunction with the pressing forces from the press 54. The tread features in the mold sectors 24 form the tread elements of the retread tire tread 56 such as the gooves, tread blocks, and sipes. The resulting retread tire tread 56 is generally linear in shape and can be subsequently applied to a carcass of a tire in a retread operation. The mold sectors 24 are compressed together by the compression forces imparted by the pin 18 of the end bar 10 so that irregularities in the resulting tire tread 56 are not imparted thereon. Any number of pins 18 of the end bar 10 can engage the mold sector 24 and they can be sized and selected to impart any desired amount of compressive force. The pins 18 may be contained within a frame 14 of the end bar 10 so that the only portion of the pins 18 exiting the frame 14 are those between the

frame 14 and the mold sector 24 to which the pins 18 engage in the longitudinal direction 20. The remaining portion of the pins 18 may be within the frame 14 so that no portion of the pins 18 extends rearward of the wall of the frame 14 farthest from the mold 22 in the longitudinal direction 20.

[0027] The pin 18 can be configured in a variety of manners and can be a single piece or may be made of multiple components that are attached to one another. Fig. 4 shows one version of the pin 18 that includes a cylindrical shaft with a head 48 that is the portion of the pin 18 configured for engagement with the spacer 44 or the mold sector 24. The pin 18 also has a flange 26 that is a circular element that extends 360 degrees around the cylindrical shaft of the pin 18. The flange 26 can be located at the midpoint of the circular shaft, or may be at any location in other versions, and in some instances need not extend completely 360 degrees about the circular shaft. The pin 18 has a forward portion 28 that is the section of the pin 18 that extends from the flange 26 to the head 48.

[0028] The pin 18 of Fig. 4 is shown implemented into the end bar 10 of Fig. 5. The end bar 10 includes a frame 14 that is welded onto the top of the base plate 46 and thus stationary with respect to the base plate 46. The pin 18 extends through aligned apertures of front and back portions of the frame 14 so that the pin 18 has portions that are both forward and rearward of the frame 14 in the longitudinal direction 20. In this regard, the pin 18 sticks out of the back of the frame 14, and also sticks out of the front of the frame 14 in certain positions of the pin 18. The pin 18 may also have other positions relative to the frame 14 in which the pin 18 is forward of the frame 14 but not rearward of the frame 14, and in which the pin 18 is rearward of the frame 14 but not forward of the frame 14 in the longitudinal direction 20. The forward portion 28 of the pin 18 is forward of the frame 14 in the longitudinal direction 20, and the head 48 of the pin 18 engages the terminal end of the mold sector 24.

[0029] The frame 14 has walls that define a chamber 30 into which a portion of the pin 18 is disposed. Some of the forward portion 28 may be within the chamber 30, and some of the forward portion 28 may be exterior to chamber 30. The flange 26 of the pin 18 is located within the chamber 30 at all travel locations of the pin 18 relative to the frame 14. The end bar 10 includes a spring 16 that may be completely within the chamber 30, but could be partially within the chamber 30 in other versions of the end bar 10. The spring 16 engages an interior surface of a back wall of the frame 14 and is oriented so that it is compressed and extended in the

longitudinal direction 20. The spring 16 engages on its opposite end the flange 26 and is biased in the longitudinal direction 20 towards the mold 22 so that pin 18 in turn is spring loaded to apply force to the mold 22 in the longitudinal direction 10 towards the mold 22. The spring 16 can be selected to have any spring constant or spring force desired, and its neutral/unbiased position may be anywhere relative to the frame 14. Although a coil spring is illustrated, any type of spring 16 can be employed in accordance with other exemplary embodiments of the end bar 10.

[0030] Fig. 6 shows an alternate embodiment of the end bar 10 that includes a guard 42 positioned over the top of the frame 14 and that extends rearward of the frame 14 in the longitudinal direction 20. The guard 42 also extends downward in the vertical direction 40 from the top of the frame 14 and functions to cover portions of the pins 18 that protrude rearward from the frame 14 in the longitudinal direction 20. During the pressing and curing process, rubber may be pressed to or otherwise flow into areas behind the frame 14 and onto the pins 18 that move rearward of the frame 14 in the longitudinal direction 20 causing a mess and damaging components of the end bar 10. Further, this rubber may be dislodged unpredictably from this area when demolding of the retread tire tread 56 from the mold 22 occurs. The guard 42 shields the pins 18 that are rearward of the frame 14 and prevents rubber from being placed into these areas. Although shown as only minimally extending forward of the frame 14 in the longitudinal direction 20, the guard 42 could extend forward in the longitudinal direction 20 to such an extent that it covers the forward portion 28 and the head 48 in other exemplary embodiments.

[0031] The pin 18 has a head 48 located at the forward end of the pin 18, and this head 48 may be the same as or different from the rest of the pin 18. The head 48 is rectangular in shape and may be screwed into or integrally formed with the shaft of the pin 18 to which it is contiguous. The shaft of the pin 18 need not be the same throughout its length, and as illustrated the forward portion 28 has a larger size in the vertical direction 40 than rearward portions of the pin 18 such as those rearward of the frame 14. Further, the cross-sectional shapes of the pin 18 can be different along its length. For instance, the rearward portion of the pin 18 may have a circular cross-sectional shape, while the forward portion 28 has a rectangular cross-sectional shape. The end bar 10 can have any number of pins 18, and a connecting bar 38 may be present in order to link all of the pins 18 to one another. The connecting bar 38 can be rigidly attached to all of the pins 18.

[0032] Fig. 7 shows an embodiment of the end bar 10 in which the connecting bar 38 spans across all of the pins 18 in the lateral direction 36. All nine of the pins 18 are rigidly attached to the connecting bar 38 and all move in concert with one another so that when one pin 18 moves all of them move in the longitudinal direction 20. The use of multiple pins 18 allows for increased spring forces to be realized by the end bar 10 as each one of the pins 18 can also be associated and urged by its own spring 16 as previously described. If the mold sector 24 is smaller in the lateral direction 36 so that it does not span all of the pins 18 in the lateral direction 36, the spring force from the pins 18 that are outboard from the mold sector 24 will still be incorporated into the overall force applied by the end bar 10 to the mold sectors 24 to compress them against one another. However, it is to be understood that other embodiments are possible in which the connecting bar 38 is not present and in which the pins 18 act independently from one another. In these embodiments if the mold sector 24 was inboard of pins 18 in the lateral direction 36, these pins 18 would not engage the mold sector 24 and would not contribute any compressive force to the mold sectors 24. As such, in use it may be the case that various pins 18 present in the end bar 10 do not engage the mold sectors 24 or spacer 44 and do not act against the mold sectors 24 to compress them when the mold 22 is being used to mold the retread tire tread 56.

[0033] A pair of brackets are present on the end bar 10 below the frame 14 in the vertical direction 40 and are used to connect the end bar 10 to the base plate 46. Bolts or other mechanical fasteners can be used to effect the connection of these brackets to the top of the base plate 46. The brackets extend forward of the frame 14, but could extend rearward of the frame 14 in the longitudinal direction 20 in other embodiments. Fig. 8 shows a back perspective view of an end bar 10 in which the forward portions 28 of the pins 18 are rectangular in cross-sectional shape, and in which the heads 48 are likewise rectangular in cross-sectional shape and are oriented in a manner similar to the forward portions 28. The guard 42 extends behind the rearward ends of the pins 18 to protect them from being coated with rubber. Seals may be present at the aperture in which the pins 18 extend out of the back of the frame 14 in the longitudinal direction 20 to prevent rubber or dust from entering the chamber 30.

[0034] Fig. 9 shows another design of the end bar 10 incorporated into a retread tire mold 12. The platen 50 has a pair of brackets that extend backwards in the longitudinal direction 20 in relation to the orientation of the mold sectors 24 in the retread tire mold 12. The end bar 10 has a

pair of corresponding flanges that are oriented on top of the flanges of the platen 50. Bolts can be disposed between both mated pairs of flanges in order to fasten and rigidly connect the end bar 10 to the platen 50 through the use of corresponding nuts threaded onto the bolts. The end bar 10 can be removably attached to the platen 50 so that when desired it can be removed therefrom. The base plate 46 is held on its end between the platen 50 and the end bar 10 due to the compressive forces generated by the tightening of the bolts at the flanges. The end bar 10 may provide a stop for the base plate 46 so that the base plate 46 cannot move beyond the end bar 10 in the longitudinal direction 20.

[0035] The end bar 10 has a series of holes located on its top surface. The holes extend downward in the vertical direction 40 and bolts can be disposed through these holes and through the base plate 46 in order to further secure the end bar 10 to the base plate 46. In other embodiments, these bolts may likewise extend into the platen 50 to hold the platen 50 to the end bar 10 as well as connecting the platen 50 at these locations to the base plate 46. The embodiment of the end bar in Fig. 10 lacks holes in the upper surface of the end bar 10 because the end bar 10 is directly welded to the base plate 46 to cause the end bar 10 to be permanently attached to the base plate 46. The flange and bolt/nut connection is still present between the end bar 10 and the platen 50 to cause these elements to be removably connected to one another. It is to be understood that a variety of attachment mechanisms and arrangements are possible between the end bar 10 and the various sections of the retread tire mold 12 in accordance with different exemplary embodiments.

[0036] A detector can be incorporated into the end bar 10 in order to ascertain how much the pins 18 have moved from an initial position to the position in which the mold sectors 24 have fully expanded upon reaching their final heating temperatures. A precise expansion time can be ascertained by monitoring the movement of the pins 18. The amount of pin 18 movement may be realized by manual markings on the pins 18 in comparison to a scale or markings on the frame 14 or other element of the retread tire mold 12 to which the pins 18 are moving relative. Alternatively, an automatic sensor can be incorporated into the end bar 10 in order to determine how much the pins 18 move, and a detector that uses such an automatic sensor can be variously configured.

[0037] The use of automatically adjusting pins 18 may help eliminate damage that would otherwise occur to the mold sectors 24 upon application of improper force or upon forgetting to

loosen or remove otherwise constraining elements against the mold sectors 24. By locking the mold sectors 24 into a consistent locked position, autodemolding system pickup if used will be more reliably performed. The spring force applied by the pins 18 is constant at all times as the springs 16 are not changed or acted upon other than by the thermal expansion forces and the pressing forces of the mold sectors 24.

[0038] While the present invention has been described in connection with certain preferred embodiments, it is to be understood that the subject matter encompassed by way of the present invention is not to be limited to those specific embodiments. On the contrary, it is intended for the subject matter of the invention to include all alternatives, modifications and equivalents as can be included within the spirit and scope of the following claims.

CLAIMS

What is claimed is:

1. An end bar for a retread tire mold, comprising:

a frame;

a spring carried by the frame; and

a pin that is urged by the spring in a longitudinal direction, wherein the pin is configured for transferring force from the spring through the pin to a mold sector of the retread tire mold in order to urge mold sectors of the retread tire mold together in the longitudinal direction.

2. The end bar as set forth in claim 1, wherein the pin has a flange, wherein the spring engages the flange, and wherein the pin has a forward portion that extends forward of the flange in the longitudinal direction so as to be configured to be closer to the mold sector in the longitudinal direction.

3. The end bar as set forth in claims 1 or 2, wherein the pin is disposed within a chamber of the frame, and wherein the spring engages the frame.

4. The end bar as set forth in any one of claims 1-3, wherein the frame, the spring, and the pin are all located at a trim post end of the retread tire mold.

5. The end bar as set forth in any one of claims 1-4, wherein at least six of the springs are present and are all carried by the frame, and wherein at least six of the pins are present and are urged by the at least six springs in the longitudinal direction, wherein the at least

six pins are configured for transferring force from the at least six springs through the at least six pins to the mold sector of the retread tire mold in order to urge the mold sectors of the retread tire mold together in the longitudinal direction, wherein the at least six pins are spaced from one another in a lateral direction.

6. The end bar as set forth in claim 5, further comprising a connecting bar that is connected to the at least six pins to link the at least six pins to one another such that spring forces from the at least six springs are all transferred simultaneously to the retread tire mold in order to urge the mold sectors of the retread tire mold together in the longitudinal direction.

7. The end bar as set forth in any one of claims 1-6, wherein the pin extends both forward and rearward of the frame in the longitudinal direction.

8. The end bar as set forth in claim 7, further comprising a guard that is located above the pin in a vertical direction, wherein the guard covers the portion of the pin that is located rearward of the frame in the longitudinal direction.

9. The end bar as set forth in any one of claims 1-8, wherein the pin engages a spacer of the retread tire mold.

10. The end bar as set forth in any one of claims 1-8, wherein the pin engages the mold sector of the retread tire mold that is at an end of the plurality of mold sectors of the retread tire mold.

11. The end bar as set forth in any one of claims 1-10, wherein the frame is welded to a base plate of the retread tire mold.

12. The end bar as set forth in any one of claims 1-11, wherein the pin has a rectangular shaped head that is located at a forward end of the pin in the longitudinal direction.

13. The mold as set forth in any one of claims 1-12, wherein the retread tire mold has a base plate onto which the mold sectors rest, wherein the frame is attached to the base plate, wherein the retread tire mold has a platen onto which the base plate rests, wherein the platen is heated, wherein the mold sectors are arranged in a linear fashion in the longitudinal direction, and wherein the retread tire mold has side rails on either side of the mold sectors in the lateral direction, and wherein the retread tire mold has a press that moves in a vertical direction relative to the mold sectors.

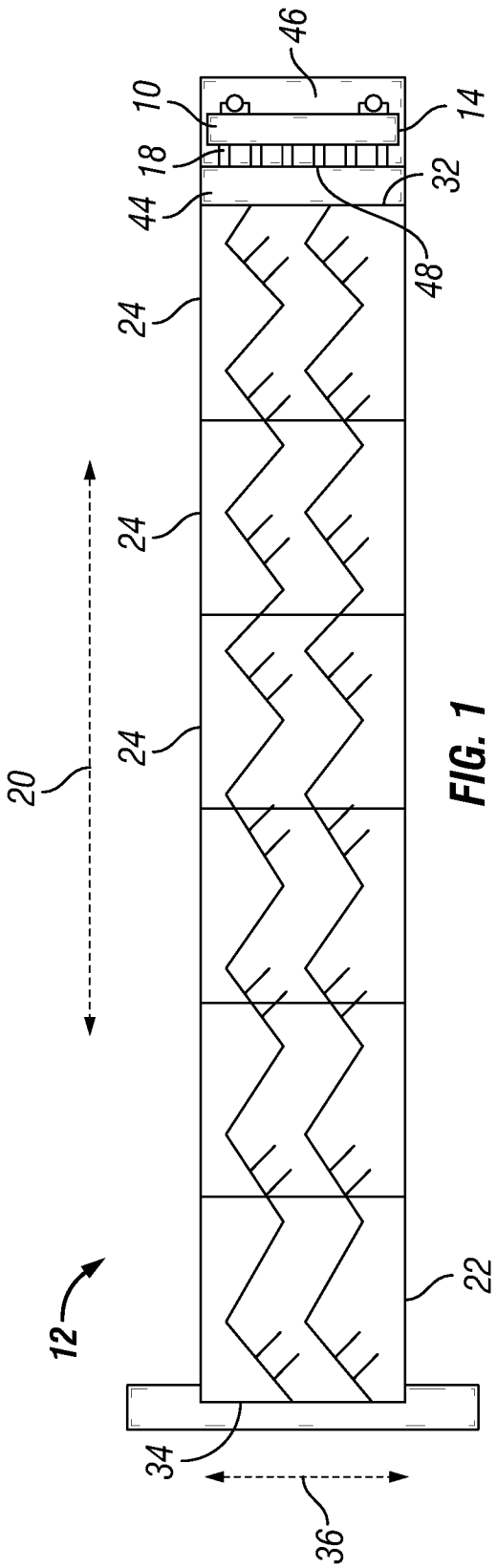

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FIG. 1

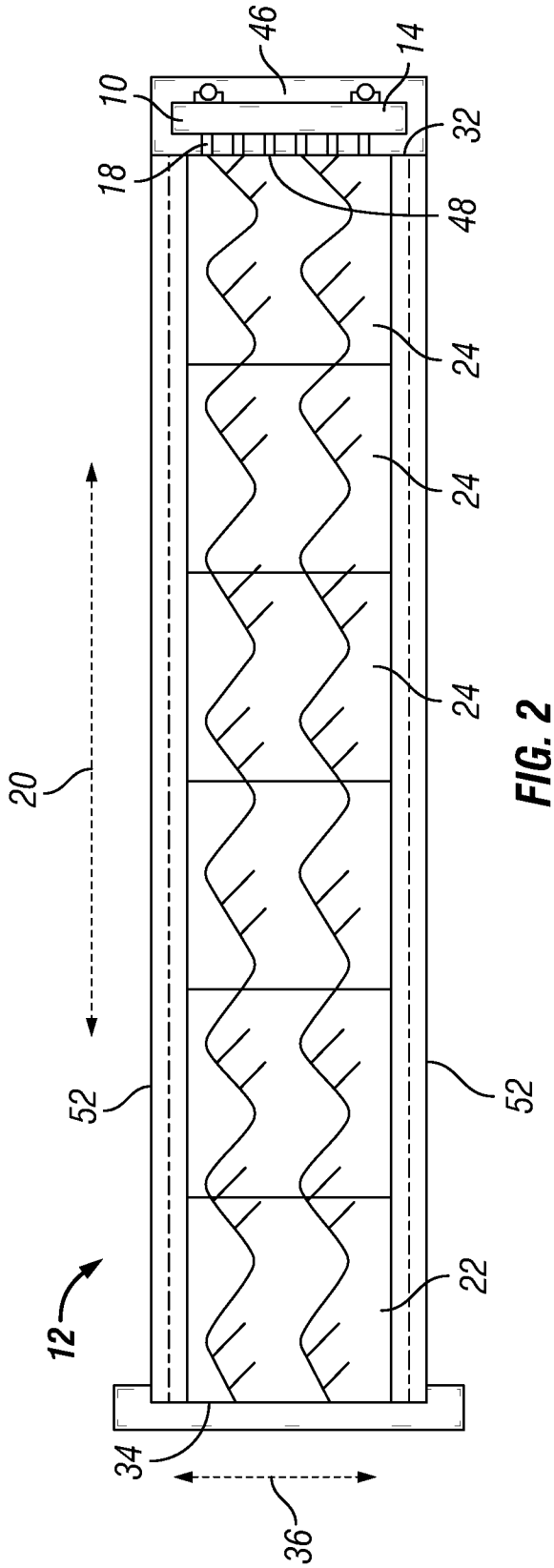

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FIG. 2

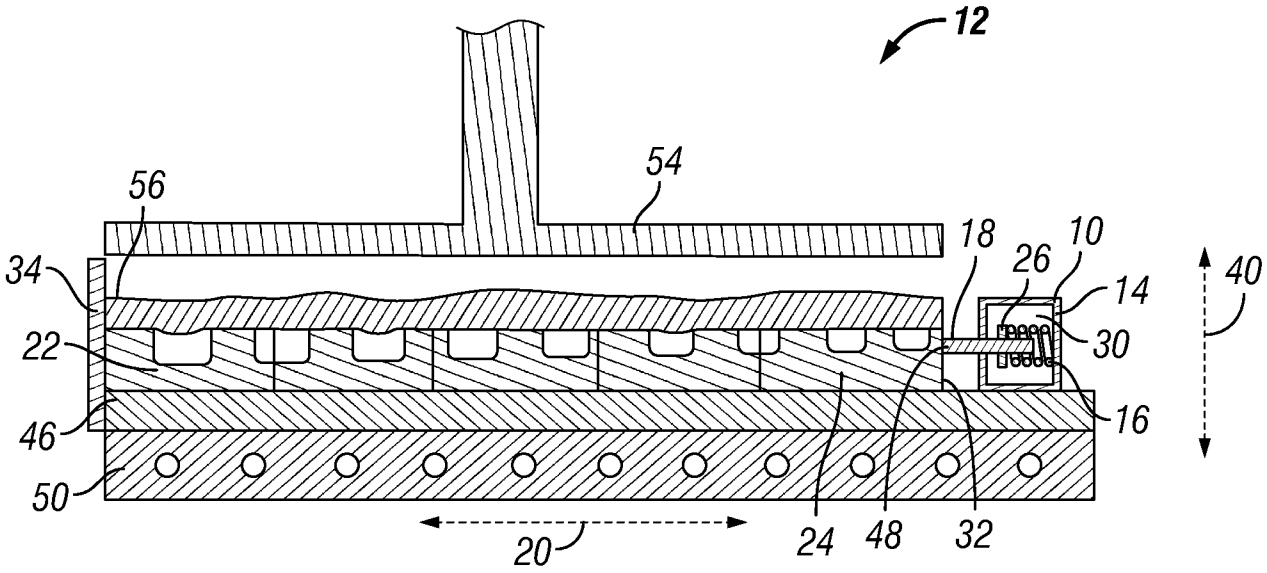


FIG. 3

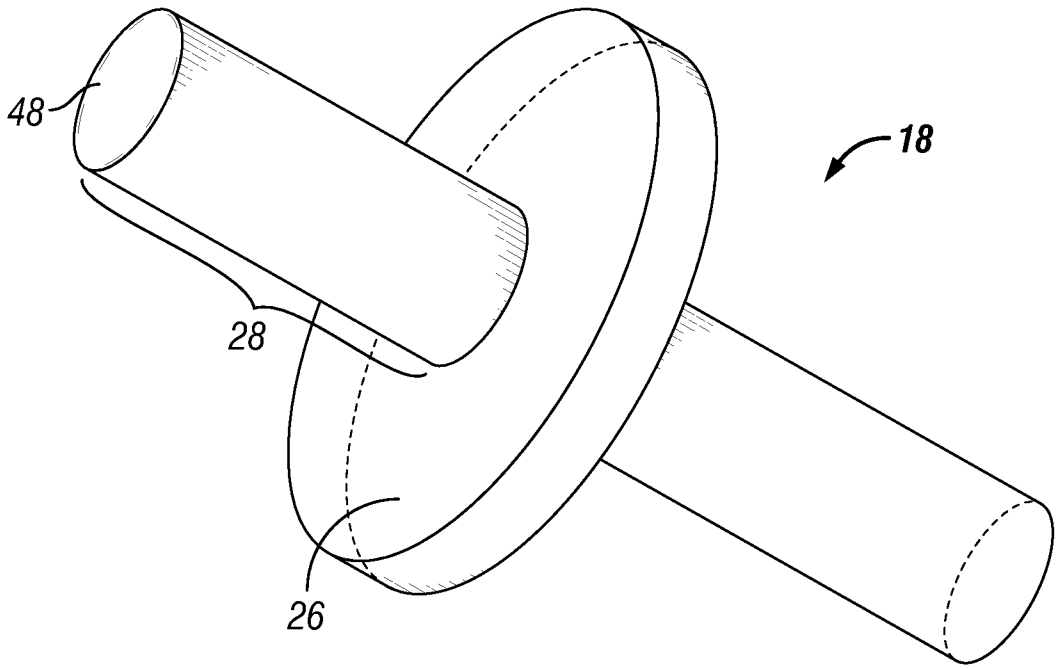


FIG. 4

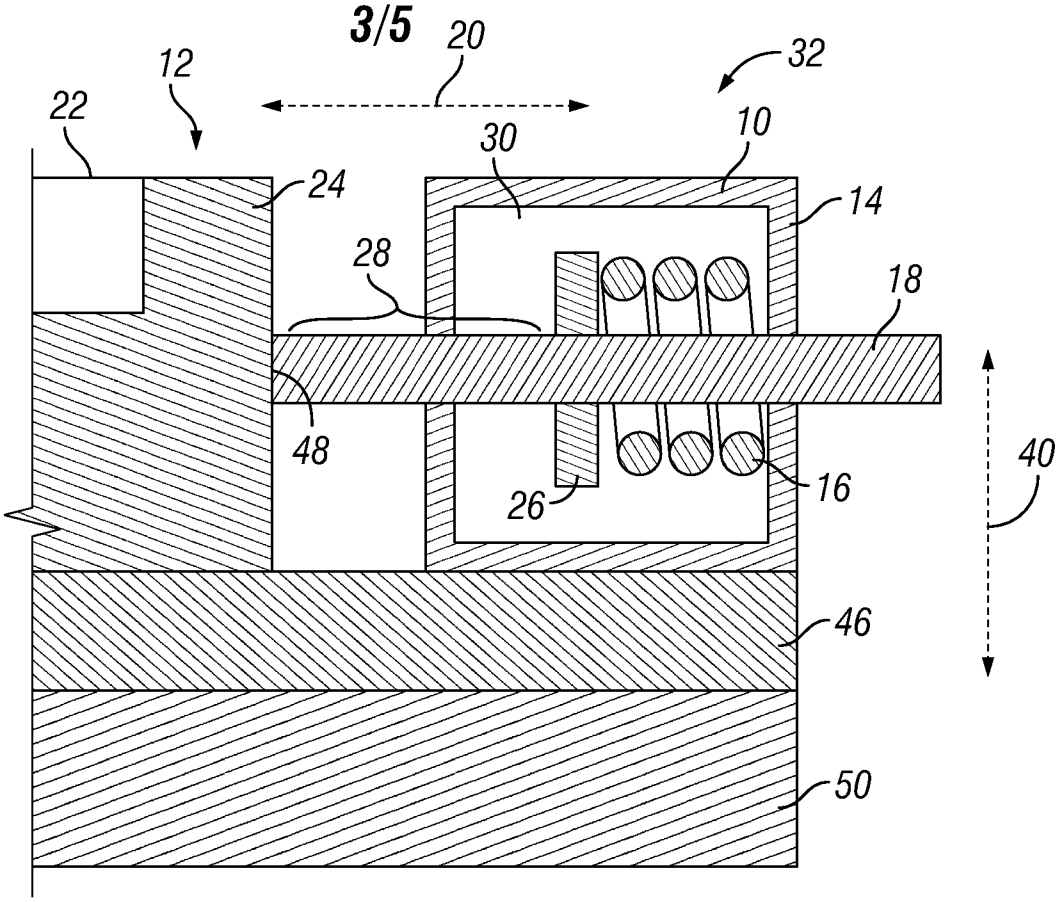

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FIG. 5

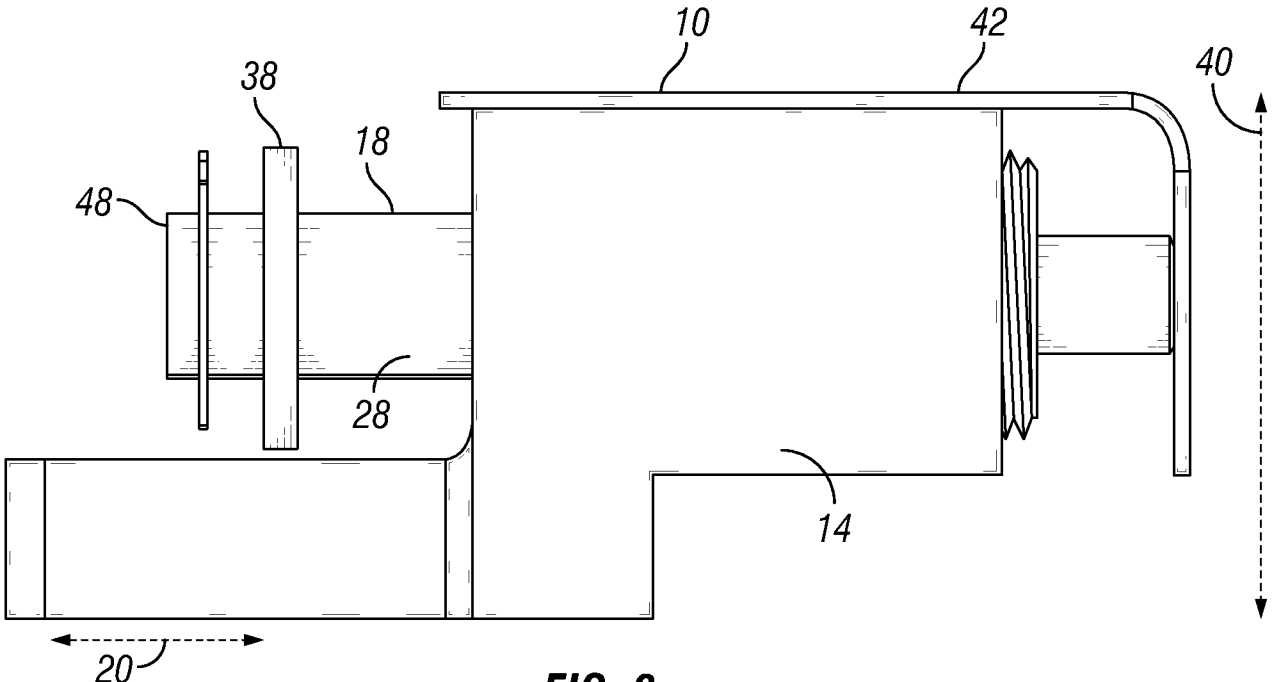

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FIG. 6

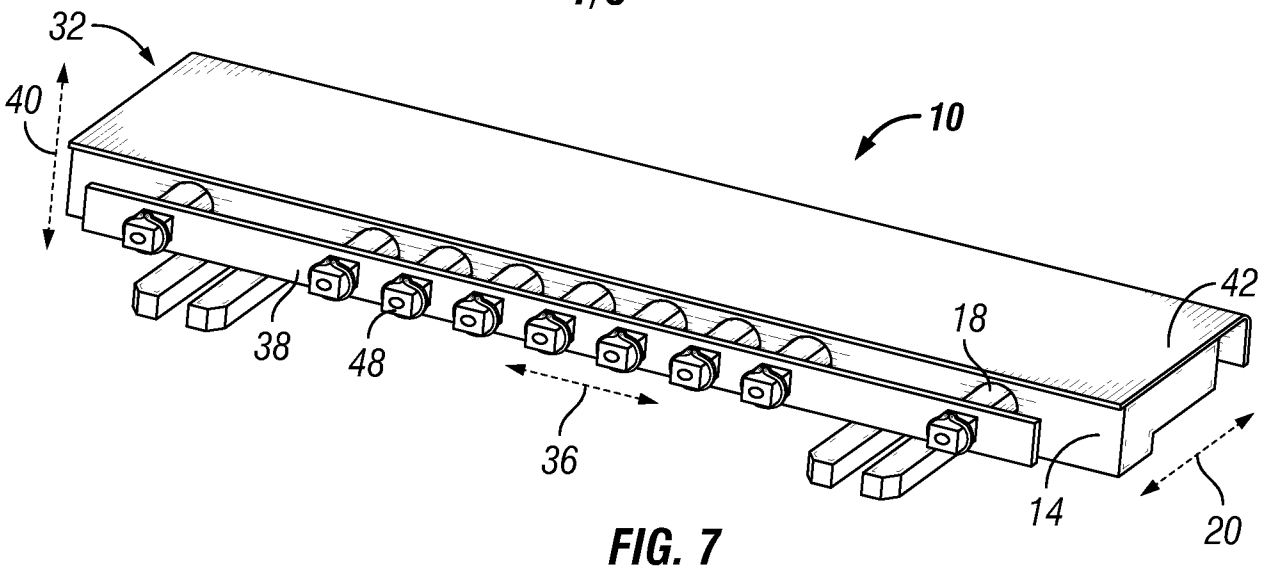


FIG. 7

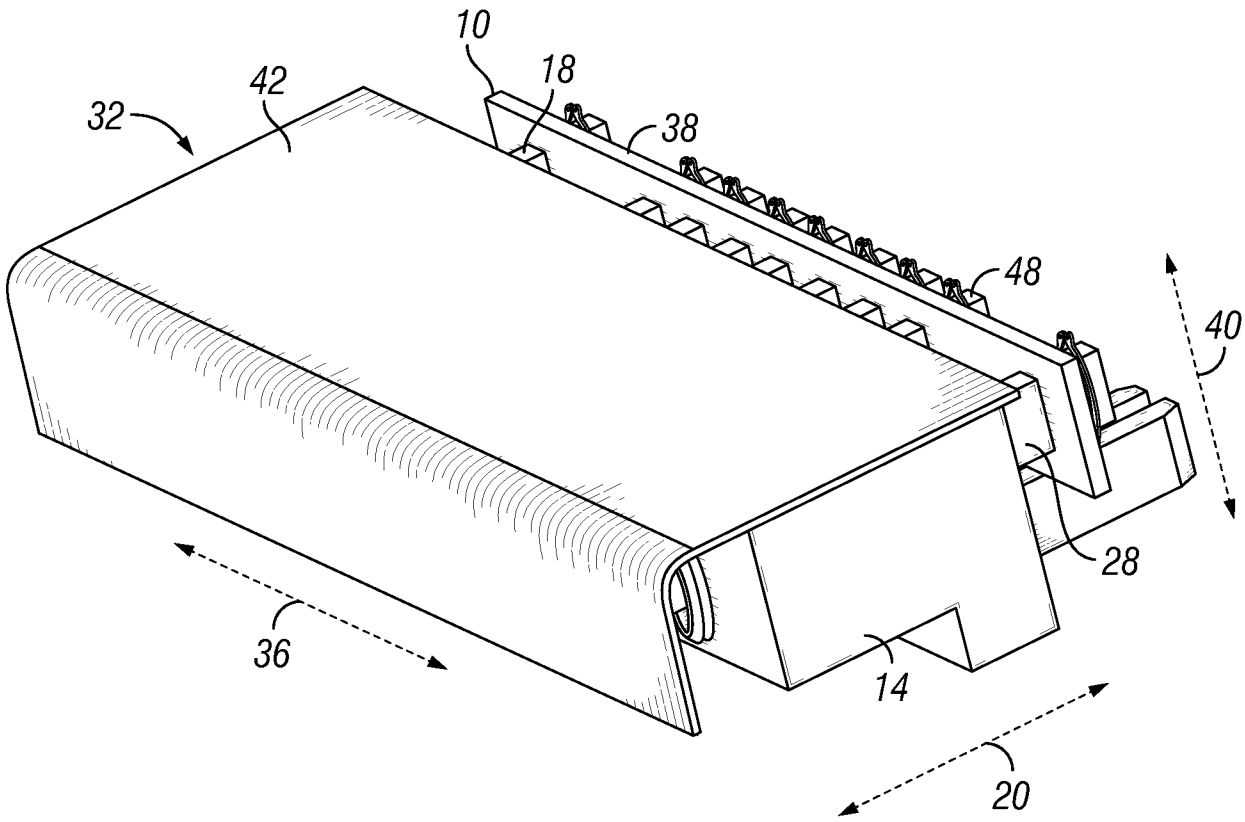


FIG. 8

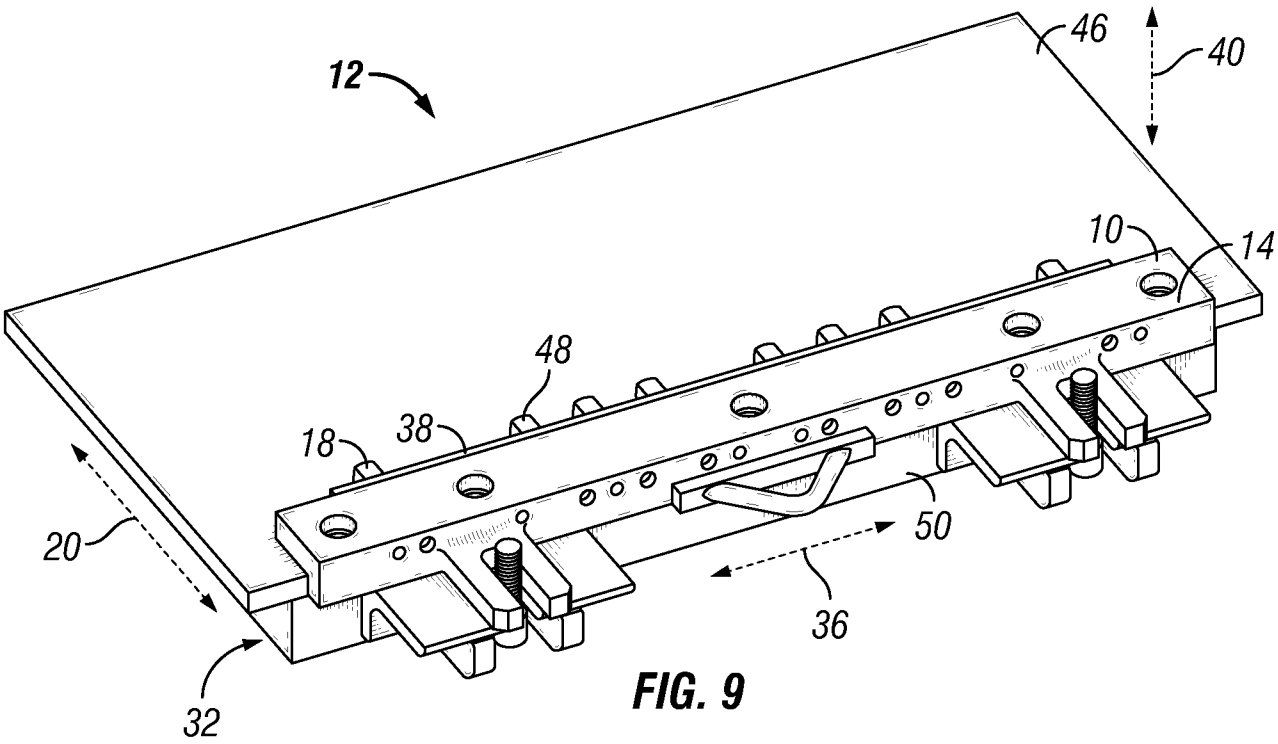


FIG. 9

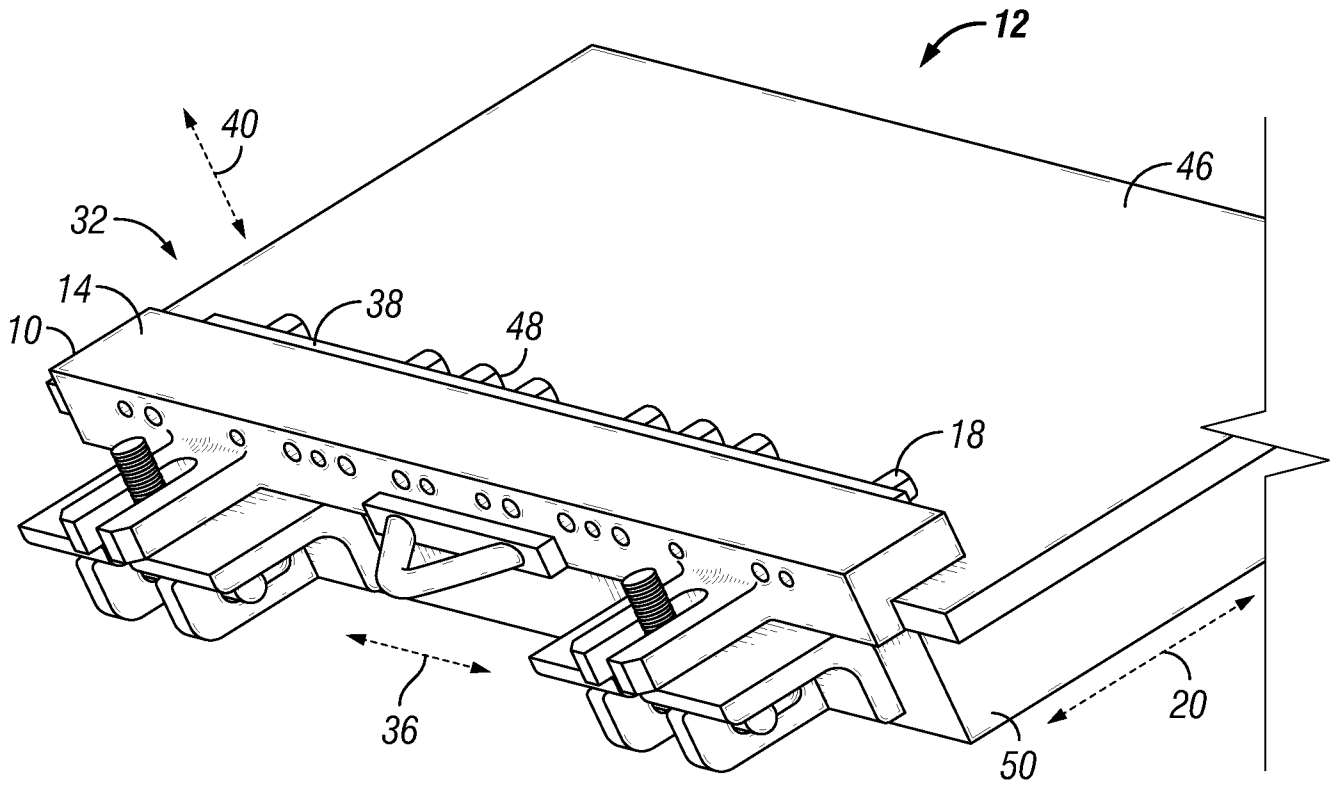


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/023767

A. CLASSIFICATION OF SUBJECT MATTER
INV. B29D30/06
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29D B41B F16B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	GB 929 672 A (LINOTYPE MACHINERY LTD) 26 June 1963 (1963-06-26) page 1, line 52 - page 2, line 57; figures 1,2,4	1 2-12 13
X	GB 17101 A A.D. 1911 (CRABTREE CHARLES HENRY [GB]; CRABTREE ARTHUR EASTWOOD [GB]) 2 May 1912 (1912-05-02) page 2, line 44 - page 3, line 11; figures 1-3,5	1
X	CN 203 114 826 U (HEFEI CHANGHE AUTOMOBILE CO LTD) 7 August 2013 (2013-08-07) abstract; figures 1,2	1
Y A	US 2011/254185 A1 (LIEW KHONG FAH [MY] ET AL) 20 October 2011 (2011-10-20) paragraph [0034]; figures 1,3,4	2-12 13

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 November 2017	23/11/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fregosi, Alberto

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/023767

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2016/347015 A1 (OTTING ROBERT G [US] ET AL) 1 December 2016 (2016-12-01) paragraph [0036]; figures 2,4	1-13
A	US 2007/018349 A1 (PAN CHINGLIN [US] ET AL) 25 January 2007 (2007-01-25) paragraph [0012] - paragraph [0014]; figure 1	1-13

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/023767

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 929672 A	26-06-1963	NONE	
GB 191117101 A	02-05-1912	NONE	
CN 203114826 U	07-08-2013	NONE	
US 2011254185 A1	20-10-2011	AU 2009288937 A1	11-03-2010
		CN 102083603 A	01-06-2011
		EP 2331311 A2	15-06-2011
		KR 20110059621 A	02-06-2011
		US 2011254185 A1	20-10-2011
		WO 2010027251 A2	11-03-2010
US 2016347015 A1	01-12-2016	US 2016347015 A1	01-12-2016
		WO 2016191446 A1	01-12-2016
US 2007018349 A1	25-01-2007	NONE	