APPARATUS FOR STITCHING THE PLYS TO FORM THE CARCASS OF LARGE-SIZE (E.G. TRUCK AND TRACTOR-SIZE) PNEUMATIC TIRES

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APPARATUS FOR STITCHING THE PLYES TO FORM THE CARCASS OF LARGE-SIZE (E. G. TRUCK AND TRACTOR-SIZE) PNEUMATIC TIRES

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1 This invention relates to the stitching apparatus of machines for building truck and tractor-sized tires, by which is meant the apparatus in such machines for stitching together the various plies of rubber and rubberized fabric of which the carcass of the tire is built up.

Carcasses for tires are normally built by laying various plies of cord fabric and of unvulcanized rubber onto a revolving building drum. The various plies must then be "stitched," i.e., they must be compressed against the drum surface, in order to cause them to adhere to one another and to remove any air trapped between them.

In truck and tractor-sized tire building equipment now in use, the stitching operations are performed by means of a pair of discs, which are moved symmetrically with one another from the center of length of the building drum outwardly thereof and parallel to the axis of the drum while this latter is rotated, and a second pair of discs which are moved around the cross-sectional contour of the ends of the drum. Thus, to perform the stitching operations, two separate appliances are required, each of which is provided with a pair of discs, and which appliances are arranged one beneath the drum and the other on the side thereof opposite to the side at which the operator stands, the whole available space around the drum being thereby taken up. The above mentioned appliances are hand-controlled and the arrangement of the controls is such that the operator has to leave his position and move to the side of the machine in order to accomplish the various stitching operations.

One object of the present invention is to provide a single appliance in which the whole sequence of the stitching operations is carried out by means of a single pair of discs, the appliance being fitted behind the building drum in order to leave the whole space therebelow available for the fitting of further ty re building appliances.

A further object of the invention is to provide an appliance wherein all of the stitching operations are effected mechanically and the controls are all arranged within easy reach of the operator, who can therefore control all of the appliances from a fixed position relative to the machine.

A further object is to provide an appliance wherein all of the stitching operations are performed by symmetrical movements on both sides of the drum simultaneously, thereby enabling the operator to control them by watching the carcass from one side thereof only.

The whole stitching process has been thoroughly analysed in order to establish exactly what motions are required from the discs during the various manufacturing stages. As shown by Figure 1 of the accompanying drawings, the stitching process can be divided into two phases, as follows:

1st phase.—In this phase the discs, starting from the centre line (i.e., the transverse medial plane of the drum) at A—A', move parallel to the rotational axis of the drum until they reach the positions B and B', disposed symmetrically about the centre line.

2nd phase.—In this phase the discs perform the following movements:

(a) A rotation through 90° around the centres X and X' (thus moving from B and B' to C and C');
(b) A rectilinear motion normal to the axis of the building drum (from C and C' to D and D');
(c) A rotation through 45° around the centres Y and Y' (from D and D' to E and E');
(d) A rectilinear motion parallel to the building drum axis (from E and E' to F and F').

To perform the stitching operations as above described with only one pair of discs it is essential that the discs shall be bringable into contact with one another (position A—A' of Figure 1) and also that they shall be rotatable each around an imaginary vertical axis passing through the centre of curvature of the cross-sectional contour of the radially outer shoulder of the drum at the corresponding end thereof. This latter requirement tends, however, to be in conflict with the former one, for the mechanical devices that would be required in order to make possible such a rotation of the discs would need to be fitted beneath the arms supporting the discs and in such positions they would interfere with each other when the discs were brought into contact with one another (position A—A').

In a stitching apparatus in accordance with this invention, this problem has been solved by connecting the disc-supporting arms with two housings slidably fitted on a saddle, by means of a lever assembly forming a system of parallelogram linkages. The mechanical elements from which the arms derive their swivelling movement are fitted within the housings and the drive is transmitted to the arms by means of the lever assemblies, a detailed description of which will be given hereinafter.

Such an arrangement allows the driving elements for the discs to be conveniently spaced apart from one another, thereby enabling the arms to be drawn closer and closer together, un-
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till the respective discs thereon are brought finally into contact with one another.

For the foregoing it will be understood that the invention may be said to relate to apparatus for "stitching" the plies of cord fabric and rubber to form the carcass of a large-size (e.g., truck or tractor-size) pneumatic tyre during fabricating thereon a rotatable building drum, the plies to be stitched being wrapped around the drum and the stitching operation being performed by means of freely rotatable discs which bear at the periphery thereof and with rolling contact upon the outermost ply on the drum as the latter with the plies in position thereon rotates, while being traversed across said outermost ply, so as to cause the plies to adhere to one another and at the same time to drive out any air that may be entrapped between them.

It will be seen that the invention is applicable to apparatus wherein the building drum has at each end thereof, in the axial section of the drum, a rounded shoulder tangential to the outer periphery of the drum and the end face thereof, around which shoulder the plies are laid during or prior to the stitching operation. With the invention the stitching operation is performed by two discs only, which are traversable simultaneously and symmetrically with respect to the transverse medial plane of the drum, first lengthwise of the drum, parallel to the rotational axis thereof, from a starting position immediately adjacent said transverse medial plane to a position, in the case of each disc, coincident with the point of tangency of the rounded shoulder aforesaid with the outer periphery of the drum. In a second stage of the traverse movement the discs are traversed around said shoulder, performing in this second stage of traverse movement an arcuate movement about an imaginary axis passing through the centre of curvature of the shoulder (in the axial section of the drum). The discs are traversable in this second stage by a drive transmitted through a pair of lever assemblies which during the first stage of the traverse movement are movable bodily with the discs and without relative motion of the levers of the assemblies and during the second stage of the traverse movement are stationnary and operating as the result of relative articulatory movement of the levers to rotate the discs about said imaginary axes.

As hereinafter described, the second stage of traverse movement of the discs is or may be followed by further stages, namely the stages hereinafter referred to as the third, fourth and fifth stages.

The features and also the principle and manner of operation of an apparatus in accordance with the present invention will now be further described with reference to the drawings already referred to, which illustrate a preferred embodiment of the invention by way of example.

In the drawings:
Figure 1 shows diagrammatically the different positions to which the discs have to be brought during the course of the stitching operation;
Figure 2 is partly a side view and partly a cross-section of the complete stitching apparatus;
Figure 3 is a plan view partly in section of the complete apparatus;
Figure 4 is a plan view of one of the lever assemblies of the apparatus, showing the corresponding discs fitted thereon. In this figure the levers are shown in the positions they occupy when the disc is in the position in which its plane is perpendicular to the axis of the building drum (positions A and A' and B and B' of Figure 1);
Figure 5 is a corresponding kinematic diagram of the same lever assembly, the levers being shown in the positions in which they appear in Figure 4;
Figure 6 is also a kinematic diagram of the lever assembly of Figure 4, but showing the levers in the positions they occupy after a rotation of the disc through 45°;
Figure 7 is a further plan view of the lever assembly of Figure 4, showing the levers in the positions they occupy after a rotation of the disc through 135° (positions E and E', also F and F' of Figure 1); and
Figure 8 is a corresponding kinematic diagram of the same lever assembly, the levers being shown in the positions in which they appear in Figure 7.
Figure 9 is a wiring diagram of the electric control arrangement for controlling the apparatus, whilst Figure 10 is a plan view of the apparatus showing the location of the limit switches used in the control arrangement.

Like reference characters are applied to like parts in the several figures.

Referring to Figures 2, 3 and 4, the machine comprises a fixed base 1 wherein a saddle 2 is guided for sliding movement along the base towards and away from the drum. This saddle is driven by a threaded spindle 3, engaging a nut 3a and driven by a motor unit 4 incorporating a speed reduction gear, through sprockets 5, 6 and a chain 7. Two housings 8, 9, slidably guided on the saddle 2 and located symmetrically with respect to the centre line thereof and therefore to the transverse medial plane of the drum 17 since this is disposed symmetrically with respect to the saddle, are driven by a screw 10 carrying two threads, one of left hand and the other of right hand, engaged respectively with a pair of nuts 11, 12, and the screw is driven by a second motor unit 13 incorporating a speed reduction gear through sprockets 14, 15 and a chain 16. The housings 8, 9, by sliding along the saddle 2, allow the first stage of the stitching process to be properly accomplished, said first stage involving traverse of the discs through the intermediate positions A and A' to positions B and B' (Figure 1). The two sets of mechanical elements associated respectively with the housings 8, 9 then swing the corresponding discs around their imaginary vertical axes in the manner previously described.

Since the two housings 8, 9 are identical, one only will be described in what follows, namely the housing 9, a cross-section of which is shown in Figure 2.

Within this housing is a cylindrical drum 17 rotatable around its own axis and carrying on its periphery a worm wheel 18. This worm wheel engages a worm 19 keyed onto a shaft 20 driven by a third motor unit 21 incorporating a speed reduction gear, through sprockets 22, 23 and a chain 24. Two pins 25, 26 project from opposite faces of the drum 17. These pins are coaxial and their common axis is disposed eccentrically with respect to the axis of the drum 17. A lever 27 is keyed at one end thereof onto the pin 25. At the opposite end the lever carries a pin 28 wherein the adjacent (outer) end of one arm of a two-arm lever 29 is pivoted. Lever 29, which as shown (see Figures 4 and 7) is in part U-shaped, the U having a tail-like extension pro-
jecting from it to the right (in Figures 4 and 7), is pivoted at the free extremity of the tail-like extension on a pin 30 carried on a member 31 and the outer end of the other arm of the lever is pivoted on a pin 32 carried on a lever 33 rotatable around a pivot 34 secured to the housing 9. Two arms 35, 36 fast with a cylindrical boss 37 are pivoted respectively on the pins 26, 27. The arm 35 is formed with an extension 38, one end of which is pivotally mounted on a pin 39 carried on the lever 33. A pivot 40 on the member 31 is rotatable in the cylindrical boss 37. An arm 42 provided at one end thereof with a conical disc 43 is pivoted on a pin 44 carried on the member 31. A piston 45 is reciprocable within a cylinder 44 formed integral with the arm 42 and a piston rod 46 pivotally connected at one end thereof to the piston 45 is also pivotally connected at the opposite end to the member 31 through a pivot pin 47 therein.

The working of the apparatus in the two phases of the stitching process as referred to above can be readily appreciated from the preceding statements. The disc 43 (see Figures 1 and 2) has to move during the first phase from position A to position B, the opposite disc moving symmetrically with it from position A’ to position B’. By allowing compressed air to enter the cylinder 44, the disc 43 is forced against the building drum with a force that can be adjusted as necessary by suitably proportioning the air pressure. Then, by starting the motor unit 13, the housings 8 and 9 are moved along the saddle by reason of rotation of the screw 10, with the result that the two discs are similarly moved along the drum, from said positions A and A’ to positions B and B’. As soon as the disc have reached the positions B and B’, the motor unit 13 is stopped, being so stopped automatically by means of an adjustable limit-switch.

The first phase of the stitching process is now completed. Before turning, however, to describe the second phase, it will be convenient to describe the form and working of the lever assemblies and also the manner of operation of the elements associated with the housings 8 and 9 by which these assemblies and therefore the discs are driven.

As already stated, all motions of the discs are symmetrical and simultaneous. It will therefore be sufficient to consider the motion of one disc and correspondingly one lever assembly only.

Starting from position B (see Figure 1), the disc 43 has to rotate around the imaginary vertical axis passing through the centre of curvature X of the cross-sectional contour of the radially outer shoulder of the drum at the corresponding end thereof as hereinafore set forth. The rotation of the disc 43 is derived however from the rotation of the drum 17 around its own axis, which axis does not pass through said centre of curvature X. As hereinafore stated, therefore, the lever assembly by which the disc 43 is supported and through which it is driven, is designed to transmit the drive from drum 17 to disc 43 in such a manner as to allow the disc to rotate around the imaginary vertical axis passing through X.

Figure 4 shows the positions taken by the various parts of the lever assembly when the disc 43 has attained the position B. The levers are connected in such a manner as to form four parallelogram linkages (see Figures 5, 6 and 8), one of which has four “real” sides, another three “real” sides and one “imaginary” side, and each of the remaining two two “real” sides and two “imaginary” ones. These parallelograms can be identified in Figures 5, 6 and 8 by means of the following diagrams:

**Parallelogram 1**

Z to 28: “Imaginary” side
34 to 32: “Real” side
Z to 34: “Imaginary” side
28 to 32: “Real” side

**Parallelogram 2**

Z to 25: “Real” side
29 to 34: “Real” side
Z to 34: “Imaginary” side
25 to 39: “Real” side

**Parallelogram 3**

25 to 23: “Real” side
40 to 30: “Real” side
25 to 40: “Real” side
23 to 38: “Real” side

**Parallelogram 4**

Z to 25: “Real” side
X to 40: “Imaginary” side
Z to X: “Imaginary” side
25 to 49: “Real” side

By the four parallelograms 1, 2, 3, 4 a system is formed wherein, as in a pantograph, all pivots have to follow predetermined paths. The said system also comprises two fixed points, i.e., the centre Z of drum 17 and the centre of the pivot 34 on the housing 9. When the drum 17 rotates, all of the levers are caused to travel along strictly pre-established paths.

In Figures 4 to 8 the disc 43 is shown in the position which it would occupy if the building drum were not present; as is readily seen from Figures 5, 6 and 8, the disc 43, while remaining with its diametral plane always perpendicular to the surface of the building drum, rotates around a vertical axis passing through the axis X.

With the drum present, the periphery of the disc 43 cannot coincide with the axis X but instead lies on the outer surface of the plies, the arm 42 carrying the disc 43 being inclined at an appropriate angle. The disc 43 thus rotates bodily around the axis X with its diametral plane always perpendicular to the outer surface of the plies.

The stability of the system is positively ensured by the fact that the parallelograms 1 and 2 have two fixed points in common, viz. the fixed points Z and 34. Since the disc 43 has to accomplish a total rotation of 153°, these parallelograms will take alternately a position wherein the angles between the levers are equal to zero, which position is obviously highly unstable. However, the apparatus has been designed in such a manner that, when one of the parallelograms is closed, the other one is open and vice versa, the stability of the system being thereby positively ensured.

In fact, the angle formed between the pairs of sides 39 to 34, 34 to 32 and 25 to 28 is invariable, since the centres 34, 35, 32 and Z, 25, 28 are rigidly connected. As can be seen from Figures 4 and 7, the centres 34, 35, 32 are carried on the lever 32, while the centres Z and 25 are carried on the drum 17, the centre 28 being carried on the lever 27 keyed to the pivot 25.

It follows, therefore, that if the parallelogram 2 is closed, as in the starting position (Figure 5), the parallelogram 1 must be open. Figure 6 shows an intermediate position of the parts of
the lever assembly, the disc 43 having been rotated through 45°. In this position, the parallelogram 1 is closed and the parallelogram 2 open.

The traverse movement of the discs is performed in five successive stages. The first of these, namely from position A or A' to position B or B' (Figure 1), has already been described. The remaining four, namely the stages hereinbefore referred to as the "second," "third," "fourth" and "fifth" stages, will now be described as follows:

Second stage.—Rotation of disc through 90° around the centre X or X', from B or B' to C or C'.

As previously stated, the disc 43 rotates around the axis X or X' in consequence of the rotation of drum 17. This drum, in turn, derives its motion from worm 19 meshing with worm wheel 18 and keyed on shaft 20 driven by motor unit 21. After a rotation through 90° has been accomplished by the disc, motor unit 21 is automatically stopped by an adjustable limit switch, with the result that the disc is thus stopped at position C or C' (Figure 1).

Third stage.—Rectilinear motion of disc along a path perpendicular to the drum axis, from position C or C' to D or D'.

The motion during this stage is produced as the result of movement of the saddle 2 along the guides on the base 1 in the direction towards the rotational axis of the building drum. Motor unit 4 rotates the threaded spindle 3 and causes it to screw into the nut 4c. The entire unit comprising the saddle and the whole of the parts thereon is thereby moved towards the building drum. Upon the disc 43 reaching position D or D', motor unit 4 is automatically stopped, by the action of an adjustable limit switch as hereinafter more particularly described.

Fourth stage.—Rotation of disc through 45° around centre Y or Y' from D or D' to E or E'.

The motion of the saddle 3 by which the disc 43 was brought from position C or C' to position D or D' produced also a displacement of the axis X or X' to the position Y or Y', due of course to the fact that said axis is in stationary relation to the saddle. The motion of the disc from position D or D' to E or E' is the result of rotation of the disc through 45° about the axis X or X' now at position Y or Y', under drive from motor unit 21, said rotation being accompanied by movement of the pivoted arm 42 carrying the disc about its axis of pivot 41 (Figure 2) in the direction towards the axis X or X' now at position Y or Y', the disc moving, in consequence of said movement of the arm 41, in its own plane and under thrust from the compressed air piston and cylinder device 44, which causes it at all times to maintain pressure contact with the piles of fabric on the drum, with the result that it follows faithfully the axial-section contour of the drum as it is traversed therealong from position A or A' to position F or F'.

Fifth stage.—Rectilinear motion of disc along a path parallel to the building drum axis, from position E or E' to F or F'.

The motion during this stage is derived from a combination of a further step of forward movement of the saddle 2 in the direction towards the rotational axis of the drum to a position in which the axis X or X' is brought to a further displaced position YY or YY', with a further movement of the pivoted arm 42 about the axis 41 in the direction towards the axis X or X', i.e. as this undergoes its movement from position Y or Y' to YY or YY', until further movement of the arm 42 being controlled by the axial-section contour of the building drum, with the result that the disc is caused to travel inwardly of the drum and along a path parallel to the rotational axis thereof from position E or E' to position F or F' as the saddle pursues its further step of movement in the direction towards the drum.

To control and to co-ordinate the motions of the various elements of the machine, by which the paths followed by the stitching discs are established in the manner above described, an electrical control and adjustment installation, provided with remote-control switches, is employed in the machine.

This installation includes the requisite motors and mechanical controls, as well as the corresponding wiring, as shown in Figures 9 and 10.

Referring to these figures, the saddle 2 is driven by the motor unit 4 (Figure 10), the operation of which is controlled by remote-control switches 96 for the forward stroke and 91 for the return stroke (Figure 9).

Limit switches 96, 90, 91, 92 mounted upon the base 4, serve to adjust the limits of the forward stroke, while the return stroke limits are adjusted by means of other limit switches 910, 911 also mounted upon the base.

The two housings 8, 9 (Figure 10) are driven by the motor unit 13, under the control of remote-control switches 70, 11 and their travel is controlled in the two directions by limit switches 709, 710.

The discs are driven by the motor unit 21 under the control of remote-control switches 86, 81, while the angle of rotation of the discs (i.e. about the axes X, X') is controlled by limit switches 980, 810.

A third limit switch 983, actuated by the rotational motion of the arms 42 about the axis X or X', serves to cause the saddle 2—after motor unit 4 has been stopped by the action of the corresponding limit switch 901—to accomplish a further forward movement, controlled as regards extent by the limit switch 902, but only after the arms have accomplished a pre-established rotation of 90°.

A special compounding switch C,8, having eight positions, enables the motor units 4 and 21 to be driven each of them separately and in either direction or in any of four combinations, namely (1) both in coupled drive clockwise, (2) both in coupled drive anti-clockwise, (3) one clockwise and the other anti-clockwise in coupled drive, (4) the reverse of combination (3). In this way the rotation of the disc-carrying arms 42 about the axis X or X' and the rectilinear motion of the saddle 2 can be effected either independently or contemporaneously.

The limit-switch 785 is designed to prevent the arms from being rotated when the housings 8, 9 are not in their end-of-stroke positions. In effect, it allows the transmission of the drive current to be applied to compounding switch C,8 only after it has been driven.

The electro-pneumatic valves for controlling the motion of the arms 42 are driven by the switch marked "Foot Air Switch" (see Figure 9); such a motion is required to bring the discs near to the building drum.
After having thus described the component parts of the electrical installation, the operation of these parts while the various successive stages of traverse movement of the stitching discs are being performed will now be described as follows:

First stage of traverse movement

By depressing the push button marked "stitching" the switch EVA is lifted and through two contacts EVA thereof (one of which is normally closed), the electro-pneumatic valves for the control of the air inlet and the air exhaust are actuated, thus controlling the piston and cylinder devices 44 by means of which the discs 43 are forced against the building drum.

At the same time, the switch EVA, by a third contact EVA, is also automatically closed and, through the time-relay EVAT, the motor unit 13 is started. By the motor unit 13, the discs are moved from position A or A' to position B or B', whereby the stitching operation in a direction parallel to the drum axis is accomplished, i.e., as regards the portion of the wrapping of plies on the drum extending axially thereof from the traverse medial plane of the drum to the positions B and B' of traverse of the stitching discs therealong. The limit switch 700 is actuated by the housings 8, 9 on attaining their end-of-stroke positions, whereby the current to remote-control switches EVA and 70 is cut off, and current is applied to compounding switch C.8, which is thus enabled to control the motor unit 21 for the rotation of discs about the axes X and X'. The fourth contact of switch EVA (which is the lowermost of the four as shown in the figure) serves to permit the movement of the discs in a direction parallel to the axis of the building drum, there being during this stage of the traverse movement of the discs no air under pressure in the piston 45 of cylinder 44.

Second stage of traverse movement.—Rotation of discs through 90° around axes X and X'

The compounding switch C.8 is moved to the left, thus closing the contact through which current flows to remote-control switch 80 for the motor unit 21. By suitably adjusting the compounding switch, the discs can be caused to accomplish the rotation required to pass from position B or B' to position C or C'.

Third stage of traverse movement.—Rectilinear motion of discs in a direction perpendicular to drum axis

The compounding switch C.8 is moved downward, whereby current is caused to flow to remote-control switch 80 controlling the forward operation of motor unit 4. Saddle 2 moves forward in consequence thereof and the discs are determined by the limit switch 901, thus displacing the discs from the position C or C' to the position D or D'.

Fourth stage of traverse movement.—Rotation of discs through 45° around axes X and X' at positions Y and Y'

The compound switch C.8 is moved to the left, whereby, as in the preceding stage of traverse movement, current is applied to remote-control switch 80, with the result that motor unit 21 is started and the discs are rotated until attaining the end of their rotation (around axes X and X' at positions Y and Y') motion as determined by the limit switch 300.

Fifth stage of traverse movement.—Rectilinear motion of discs in a direction parallel to drum axis

The compounding switch C.8 is moved downward, diagonally to the left, and the foot air pedal then depressed. This results in the remote-control switch 90 of motor unit 4, and the electro-pneumatic valves for the drive of the piston by which the arms 42 are rotated about their pivotal axes 41, being simultaneously operated. The foregoing operation is made possible by the combination of two motions, already described (see "fifth stage" above). The motion of the motor unit 4 is limited by the limit switch 902.

The electrical installation also includes the push-buttons marked "Forward" and "Reverse," to bring the saddle 2 to respectively the work and rest positions, and the push-buttons marked "Open" and "Close" for the control of the rectilinear movement of the housings and the parts carried thereon in a direction parallel to the drum axis during the idle motions.

The remaining positions of the compounding switch C.8 are allocated to the bringing of the discs and the housings back to their initial (start) positions.

What we claim as our invention and desire to secure by Letters Patent of the United States is:

1. An apparatus for stitching the carcasses of large-size pneumatic tires on a building drum which has at each end thereof, in the axial section of the drum, a rounded shoulder tangential to the outer periphery of the drum and the end face thereof, around which the shoulders are laid prior to stitching, two rotatable stitching discs, progressive traversing means for traversing said discs in a direction parallel to the rotational axis of the drum simultaneously and symmetrically with respect to the traverse medial plane of the drum, the limits of movement of said traversing means corresponding to a starting position of the discs immediately adjacent said traverse medial plane and a finishing position of each disc coincident with the point at which said rounded shoulder commences, further traversing means for traversing said discs around said shoulder whilst said discs perform an axial movement about the center of curvature of the shoulder, said further traversing means comprising a pair of lever assemblies and two pivoted arms each mounted on a lever assembly and carrying at their free end one said disc, said lever assemblies moving bodily with the discs during the first traverse movement of the discs and without relative motion of the levers of the assemblies, and, during the second traverse movement, being stationary and operative as the result of relative articulatory movement of the levers to rotate the disc about its center of curvature.

2. An apparatus as claimed in claim 1, wherein each disc is carried upon the free end of an arm pivotally mounted upon one of the levers of the corresponding lever assembly for swinging movement relatively thereto in directions towards and away from the surface of the drum, which arm is yieldingly urged in the direction towards the said surface by means adapted to apply pressure to the arm for the maintenance of the disc thereon in operative rolling contact with the plies of fabric on the drum.

3. An apparatus as claimed in claim 1, comprising means for moving said discs in a direction parallel to the end face of the drum, and towards the rotational axis thereof, the discs being moved
bodily with the corresponding lever assembly without relative articulatory movement of the levers thereof.

4. An apparatus as claimed in claim 1 comprising a pair of worms, a pair of worm wheels each in engagement with one of said worms, a saddle movable in a direction at right-angles to the axis of the building drum, and a pair of housings each supporting one of said worm wheels such that a saddle for movement together with the respective lever assemblies along a path parallel to the rotational axis of the building drum, said lever assemblies being mounted upon the respective housings in driving connection with the worm wheels therein.

5. An apparatus as claimed in claim 1 comprising at least one limit switch for automatically stopping the operation of said first traversing means at said finishing position and at least one further limit switch for preventing the commencement of operation of said further traversing means before completion of the operation of said first traversing means.

6. In an apparatus for stitching the plies of a tire casing after the plies have been applied to a rotatable tire-building drum having curved corners at each end of said drum, a base fixed relative to said drum, a saddle movable bodily towards and away from the axis of said drum, two housings movable on said saddle in a direction parallel to the axis of said drum, said housings being movable in opposite directions symmetrically with respect to a plane vertical to said axis and equidistant from each end of said drum, two rotatable members each mounted on one of said housings and rotatable about vertical axes perpendicular to the axes of said drum, two stitching members; two stitching members comprising arms for supporting said stitching members, so that they are adapted to be brought into contact with said plies at points lying in a horizontal plane passing through the rotational axis of said drum, two sets of parallelogram linkages each coupling one of said supporting arms to one of said rotatable members for accurate movement of the stitching member about the center of curvature of one of said curved corners, said linkages lying in a horizontal plane below said drum whereby said stitching members can be brought together adjacent the vertical plane which is equidistant from the ends of the drum, and two pneumatically operated thrust members each coupled between a supporting arm and the parallelogram linkage associated therewith for urging the stitching member carried by the supporting member into engagement with the plies on the building drum.

7. An apparatus according to claim 6 wherein two corners of one parallelogram linkage of each set are also corners of at least one of the other parallelogram linkages of that set and the members pivoted to said corners and converging to the same point form an invariable angle between them such that as one linkage closes the other opens.

8. An apparatus according to claim 7 wherein said two corners are fixed relative to the housing on which the set of linkages is mounted.

9. An apparatus according to claim 6 wherein at least one lever forming one member of one parallelogram linkage and which is attached to its corresponding rotatable member is fixed to at least one corresponding lever spaced apart vertically therefrom, whereby said sets of linkages are reinforced against bending moments resulting from the reaction of the thrust of said stitching members on the drum.

10. An apparatus for stitching the carcass plies of large-size pneumatic tires during fabrication thereof, on a rotatable building drum having a curved shoulder at each end thereof, comprising a base having guides thereon, a horizontal saddle disposed parallel to the rotational axis of the drum and slideable perpendicularly to the said guides, an electric motor for traversing the saddle along the guides whereby the saddle can be advanced towards the drum axis or retracted therefrom, two housings slidably mounted on the saddle in positions disposed symmetrically on either side of the transverse medial plane of the drum, for traverse movement simultaneously and in opposite directions, also in a symmetrical manner with respect to said medial plane, along a path extending parallel to the drum axis, a second electric motor for traversing the housings along said path, each of said housings carrying a worm wheel, a shaft mounted in said saddle, two worms mounted on said shaft and each engaging one of said worm wheels, a third electric motor for driving the shaft, two lever assemblies each forming a system of parallelogram linkages and extending in opposite directions with one of said worm wheels respectively, two stitching discs, two pivoted upwardly extending arms each carrying at one end thereof one of said stitching discs, each of said arms being coupled to one of said lever assemblies for bodily rotation of the associated disc around the center of curvature of the curved shoulder at the corresponding end of the building drum by movement of said lever assemblies, and means urging the periphery of each disc into contact with the plies on the building drum.

11. An apparatus as claimed in claim 10 wherein each lever assembly comprises four parallelogram linkages, two of which have two fixed pivots in common and the levers pivot to said fixed pivots forming invariable angles between them, whereby when one of the said parallelogram linkages is open, the other during rotation of the pivot arms carrying the stitching discs, is closed, all the levers of the latter mentioned parallelogram linkage being in this condition thereof in line with one another.

12. An apparatus as claimed in claim 10 comprising a plurality of switches each connected in the circuit of one of said electric motors for interrupting the circuit thereof upon a predetermined movement of the members traversed by the motor; each limit switch being slidably mounted on guides for adjustment thereof along by means of screw controls, whereby the operative strokes of the switches are selectively adjustable to accommodate a change of building drum for another of different size.
arms each pivoted at one end to one parallelogram linkage and carrying a stitching member at the other end, whereby each stitching member is rotatable bodily about the center of curvature of one of said curved corners by rotation of its associated rotatable member, and is movable towards and into contact with the other stitching member by the opposite symmetrical movement of said housings, and thrust means urging said stitching member into engagement with the plies on said building drum.

14. An apparatus according to claim 13, wherein two corners of one parallelogram linkage of each set are also corners of the other parallelogram linkage of that set, whereby one linkage closes as the other opens.

15. An apparatus according to claim 14, wherein said two corners are fixed relative to the housing on which the set of linkages is mounted.

16. An apparatus according to claim 13, wherein at least one lever forming one member of one parallelogram linkage and which is attached to its corresponding rotatable member is fixed to at least one corresponding lever spaced apart vertically therefrom, whereby said sets of linkages are reinforced against bending moments resulting from the reaction of the thrust of said stitching members on the drum.

17. An apparatus according to claim 13 wherein each set of parallelogram linkages comprises a lever which is at least in part U-shaped, and has pivot holes at each extremity of the U-shaped part, said pivot holes constituting corners of a parallelogram linkage, and two further linkages are each pivoted to one of said pivot holes and form members of a further parallelogram linkage, one of said linkages carrying a further pivot hole constituting a corner of the further parallelogram linkage, which hole, during movement of this last-mentioned lever, crosses the line joining the two pivot holes at the extremity of the U-shaped part.

18. In an apparatus for stitching the plies of a tire casing after the plies have been applied to a rotatable tire-building drum having curved corners at each end of said drum, a base fixed relative to said drum, a saddle movable bodily towards and away from the axis of said drum, two housings movable on said saddle in a direction parallel to the axis of said drum, said housings being movable in opposite directions symmetrically with respect to a plane perpendicular to said axis and equidistant from each end of said drum, two stitching members each movable with one of said housings into engagement with each other and movable by said housings away from one another to effect stitching along the side of the drum, said stitching members also being movable towards or away from the axis of said drum by corresponding movement of said saddle; means for urging the periphery of said stitching members in a direction perpendicular to the surface of said drum and into engagement with the plies on said building drum, two rotatable members each mounted on one of said housings, two arms each supporting one of the stitching members, and rotated by said rotatable members, and two parallelogram linkages for transmitting the rotatable movement of said rotatable members to said supporting arms, and so arranged that said stitching members can come into contact with one another, said linkages each being coupled to one of said rotatable members for effecting accurate movement of a stitching member about the center of curvature of one of said curved corners whilst said stitching member is urged in a direction perpendicular to the tangent at the point of contact of the stitching member with the plies placed around the curved corner.

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