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COMPLETE SPECIFICATION.

Improvements in or relating to Moulding Pneumatic Tyres.

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1, do hereby declare the invention, for which we pray that a patent may be granted to me/us, and the method by which it is to be performed, to be particularly described in and by the following statement;—

This invention relates to pneumatic tyres and particularly to apparatus for moulding a pneumatic tyre cover or for providing a used pneumatic tyre cover with a bead-to-bead remould.

Bead-to-bead remoulds are usually carried out in conventional two-part moulds so that for each size of cover to be remoulded a separate mould must be provided. In order, therefore, to cater for a wide range of bead-to-bead remoulds, a considerable number of moulds must be provided. This involves a large initial capital outlay, which has its effect on the price of a tyre remould and, moreover, considerable facilities have also to be provided for handling and storing the moulds.

It is an object of the present invention to provide a single apparatus which is adaptable for moulding or remoulding a range of sizes of pneumatic tyre covers.

According to the invention apparatus for moulding or remoulding pneumatic tyre covers comprises a pair of complementary annular side-plates each having a moulding surface for the bead, sidewall and shoulder portions of a cover, the said surface being adapted to co-operate with tread rings of different diameters, a tread ring having side faces engageable with the said surfaces and heating means associated with the outer periphery of the ring.

Preferably means are provided for enclosing the apparatus in the bead region.

The moulding surfaces are of sufficient extent, measured radially of the side-plates, that a range of tread rings of different diameters may be utilised in conjunction with a single pair of side-plates, the tread rings being engageable with the moulding surfaces at various locations such that more or less of the surfaces are utilised according to the diameter of the ring.

The moulding surfaces may be curved in which case the sides of the tread rings are correspondingly curved so that the sides of each ring form a close fit against the appropriate portions of the said surfaces. Preferably, however, each of the moulding surfaces is formed so that it lies on the surface of the frustum of a cone disposed with its major axis co-axial with the axis of that side-plate upon which the surface is formed.

In order that the profile of the resulting bead-to-bead remould shall be satisfactory throughout the range of covers which can be remoulded when utilising a single pair of side-plates, the profile of the surface provided for moulding the bead and sidewall portions of the covers is of a shape which is a compromise of the profiles normally provided on covers within that range.

Tread rings of differing widths may also be utilised in conjunction with a single pair of side-plates and in conjunction with bead spacing rings engageable with the side-plates adjacent to the bead-moulding surfaces so as to enclose the moulding apparatus in the bead region.

In an alternative construction in accordance with the invention one of the side-plates is provided, adjacent to the bead-moulding surfaces, with an integral co-axial cylindrical portion which extends sufficiently to form a bead-enclosing member and to provide a surface upon which the other side-plate is slidable to adjust the relative positions of the

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sideplates for accommodating covers of various widths.

A single apparatus in accordance with the invention is not limited to the moulding or re-moulding of tyre covers of a single specific bead size.

Apparatus suitable for moulding or re-moulding covers of various bead sizes comprises a pair of side-plates of the kind earlier referred to, each side-plate being formed in two annular sections which are separable along a circular separating line located between the shoulder moulding and the bead moulding surfaces of the side-plate, the outer section fitting closely around the inner section. Inner sections incorporating bead-moulding surfaces of various dimensions may be used in conjunction with a common outer section for the moulding or re-moulding of covers of various bead sizes.

The tread rings may each comprise a rolled annulus of sheet steel having heating means attached thereto and comprising a coil of piping disposed, e.g. helically, around the ring for connecting to a steam supply. Alternatively the tread rings each may comprise an aluminium, magnesium, non-ferrous metal or forged steel ring having a tread matrix either engraved on the inner peripheral surface thereof or formed by die-cast segments attached to the inner peripheral surface of the ring.

Apparatus in accordance with the invention will now be described with reference to the accompanying drawings in which:—

Figure 1 shows, in cross-section, a tyre cover located in moulding apparatus in accordance with the invention.

Figure 2 shows, in cross-section, a tyre cover of larger width and depth but of the same bead size as the cover shown in Figure 1 located in the apparatus illustrated in Figure 1 modified by the addition of a bead spacing ring.

Figure 3 shows, in cross-section, a cover and a modified type of moulding apparatus.

Figure 4 shows, in cross-section, a tyre cover of larger width and depth but of the same bead size as the cover shown in Figure 1, located in apparatus of the type illustrated in Figure 3.

A pair of complementary annular side-plates 1 are provided, (see Fig. 1) each of the plates having a recessed portion 1*a* forming moulding surfaces for the bead, sidewall and shoulder of a tyre. Annular axially extending flanges 1*b* are formed as extensions to the bead moulding surfaces, the side-plates being separated to a width necessary for the size of tyre to be remoulded by means of the flanges 1*b*.

The shoulder moulding surface 1*c* of each plate lies on the surface of the frustum of a shallow cone disposed with its major axis co-axial with the plate, the radial extent of the shoulder moulding surfaces being such that a range of tread rings 7 of different diameters may be used in association with the plates, the rings being engageable with the said surfaces 1*c* at various locations according to the diameter of the ring. Thus when the apparatus is set up for moulding one of the smaller diameter covers within the range, (see Figures 1 and 3) the appropriate tread ring engages the plates at a location such that a considerable amount of the shoulder moulding surface 1*c* on each plate projects beyond the tread ring. On the other hand when the apparatus is set up with a larger diameter ring (See Figures 2 and 4) a larger proportion of shoulder moulding surface 1*c* is utilised.

The tread moulding rings 7 (See Fig. 1) each comprise a rolled annulus 7*a* of double-thickness sheet steel, the inner thickness of sheet steel being provided, if desired, with a plurality of inwardly projecting circumferentially extending corrugations 7*b*.

These corrugations constitute ribs which form a tread matrix. Lateral projections (not illustrated) may be formed on the ribs to provide a pattern. Each side 7*c* of the inner thickness of the sheet metal annulus is inturned and stiffened with an additional hoop of sheet steel (7*d*), the side 7*c* being inclined at such angle that it will lie along and in contact with the shoulder moulding surface 1*c* of the plates 1. The outer thickness of sheet metal is spot-welded to the inner thickness which has a hoop 7*d* spot-welded to each side.

A coil of steam piping 2 is rigidly attached to the outer surface of the ring 7 and provides a heat supply which is effective across the whole width of the ring.

Each of the side-plates has a steam pipe 2*a* arranged on a spiral path co-axial with the axis of the side-plate, the spacing of the convolutions and the thickness of metal between the passage and the moulding surface being arranged so that even curing of the tread shoulders, sidewalls and beads is obtained when a common steam supply is used.

When remoulding a tyre utilising the apparatus just described a tyre cover 4 is provided with a veneer 3 of unvulcanised rubber adhered to its sidewalls and bead portions together with a tread 9 of unvulcanised rubber located in position on its outer periphery.

An inner tube 6 is located within the cover and the cover and tube located inside a tread moulding ring 7 in the usual manner by moving the bead portions of the cover axially apart whereby the external diameter of the tread portion of the tyre will decrease sufficiently to enable the cover to be inserted within the ring 7, the tube 6 is then inflated and the assembly is then located between the

side-plates and axial pressure is applied to the side-plates until the flanges 1*b* contact each other and the hoops 7*d* contact the shoulder moulding surfaces 1*c*.

Steam is then supplied to the steam piping 2 and 2*a* to effect the moulding and curing of the unvulcanised rubber to the cover.

When utilising the apparatus just described in conjunction with Figure 1 for the moulding or remoulding of covers of greater width than the cover illustrated in that Figure, it is necessary to utilise a bead spacing ring of suitable width so as to space apart the side-plates, also to utilise a tread ring of suitable width.

Figure 2 illustrates such an arrangement, the tread ring and the bead spacing ring being indicated by the reference characters 7*e* and 5 respectively.

Figures 3 and 4 illustrate an alternative arrangement in which modification of the apparatus for covers of differing width is effected more simply. The lower side-plate 1 is provided with an integral co-axial cylindrical portion 1*d* which is adapted to extend across the inner peripheral portion of the apparatus so as to enclose the apparatus thereabouts and to project within the bore 1*e* of the other side-plate to make a sliding fit therewith. Adjustment for various widths of covers is therefore possible by relatively sliding the side-plates one upon the other.

Figure 4 illustrates how covers outside the range of a pair of side-plates of the kind just described may yet be accommodated by the provision of an annular extension 10 attached co-axially to the portion 1*d* of the lower side-plate 1 by means of a dowel pin 11 screwed into the portion 1*d*.

In a further modification of the apparatus described above which is not illustrated in the drawings, each of the side-plates is formed in two annular sections which are separable along a circular separating line located between the shoulder moulding and the bead moulding surfaces of the side-plate, the outer section fitting closely and slidably around the inner section. Inner sections incorporating bead moulding surfaces of various dimensions may be used in conjunction with a common outer section for the moulding or re-moulding of covers of various bead sizes.

It will be appreciated from the foregoing descriptions that the most important feature of the invention is that a range of sizes of pneumatic tyre covers may be moulded or remoulded by means of a single pair of side-plates except where covers of various bead sizes are to be accommodated when side-plate sets of the kind described in the preceding paragraph will be required in conjunction with a plurality of tread rings.

Apparatus according to the invention may be used for moulding or remoulding tyres with treads incorporating circumferentially extending traction-augmenting coils, the coils being located in known manner in circumferentially extending grooves formed in the tread matrix.

The apparatus may also be used for top-capping or retreading worn pneumatic tyres instead of providing them with a complete remould.

WHAT we claim is:—

1. Apparatus for moulding or remoulding pneumatic tyre covers comprising a pair of complementary annular side-plates each having a moulding surface for the bead, side-wall and shoulder portions of a cover, the said surface being adapted to co-operate with tread rings of different diameters, a tread ring having side faces engageable with the said surfaces and heating means associated with the outer periphery of the ring.

2. Apparatus according to claim 1 having means associated with the side-plates for enclosing the apparatus in the bead region.

3. Apparatus according to claim 2 wherein the means for enclosing the apparatus in the bead region comprises an axially extending annular portion of each side-plate, said portions serving to locate with and extend beyond the rim-seating portions of the beads of the cover and the said portions lying in abutting relationship in the assembled apparatus.

4. Apparatus according to claim 2 wherein the means for enclosing the apparatus in the bead region comprises a bead spacing ring located between the side-plates and lying in abutting relationship with the side-plates adjacent to the bead moulding surfaces thereof in the assembled apparatus.

5. Apparatus according to claim 2 wherein the means for enclosing the apparatus in the bead region comprises a side-plate having a co-axially extending cylindrical portion and a second side-plate having a bore which is slidable upon the said cylindrical portion.

6. Apparatus according to claim 5 wherein the cylindrical portion is provided with a removable co-axial annular extension.

7. Apparatus according to any of the preceding claims wherein each of the side-plates is formed in two annular co-axial sections one within the other separable along a circular separating line located beyond the bead moulding portion of the side-plate.

8. Apparatus according to any of the preceding claims wherein the surface of each of the side-plates which co-operates with tread rings of different diameters lies on the surface of the frustum of a cone disposed with its major axis co-axial with the axis of that side-plate upon which the surface is formed.

9. Apparatus according to any of the preceding claims wherein the tread ring comprises an annulus of sheet metal having tubular heating piping disposed around its outer periphery.

side-plates and axial pressure is applied to the side-plates until the flanges 1*b* contact each other and the hoops 7*d* contact the shoulder moulding surfaces 1*c*.

Steam is then supplied to the steam piping 2 and 2*a* to effect the moulding and curing of the unvulcanised rubber to the cover.

When utilising the apparatus just described in conjunction with Figure 1 for the moulding or remoulding of covers of greater width than the cover illustrated in that Figure, it is necessary to utilise a bead spacing ring of suitable width so as to space apart the side-plates, also to utilise a tread ring of suitable width.

Figure 2 illustrates such an arrangement, the tread ring and the bead spacing ring being indicated by the reference characters 7*e* and 5 respectively.

Figures 3 and 4 illustrate an alternative arrangement in which modification of the apparatus for covers of differing width is effected more simply. The lower side-plate 1 is provided with an integral co-axial cylindrical portion 1*d* which is adapted to extend across the inner peripheral portion of the apparatus so as to enclose the apparatus thereabouts and to project within the bore 1*e* of the other side-plate to make a sliding fit therewith. Adjustment for various widths of covers is therefore possible by relatively sliding the side-plates one upon the other.

Figure 4 illustrates how covers outside the range of a pair of side-plates of the kind just described may yet be accommodated by the provision of an annular extension 10 attached co-axially to the portion 1*d* of the lower side-plate 1 by means of a dowel pin 11 screwed into the portion 1*d*.

In a further modification of the apparatus described above which is not illustrated in the drawings, each of the side-plates is formed in two annular sections which are separable along a circular separating line located between the shoulder moulding and the bead moulding surfaces of the side-plate, the outer section fitting closely and slidably around the inner section. Inner sections incorporating bead moulding surfaces of various dimensions may be used in conjunction with a common outer section for the moulding or re-moulding of covers of various bead sizes.

It will be appreciated from the foregoing descriptions that the most important feature of the invention is that a range of sizes of pneumatic tyre covers may be moulded or remoulded by means of a single pair of side-plates except where covers of various bead sizes are to be accommodated when side-plate sets of the kind described in the preceding paragraph will be required in conjunction with a plurality of tread rings.

Apparatus according to the invention may be used for moulding or remoulding tyres with treads incorporating circumferentially extending traction-augmenting coils, the coils being located in known manner in circumferentially extending grooves formed in the tread matrix.

The apparatus may also be used for top-capping or retreading worn pneumatic tyres instead of providing them with a complete remould.

WHAT we claim is:—

1. Apparatus for moulding or remoulding pneumatic tyre covers comprising a pair of complementary annular side-plates each having a moulding surface for the bead, side-wall and shoulder portions of a cover, the said surface being adapted to co-operate with tread rings of different diameters, a tread ring having side faces engageable with the said surfaces and heating means associated with the outer periphery of the ring.

2. Apparatus according to claim 1 having means associated with the side-plates for enclosing the apparatus in the bead region.

3. Apparatus according to claim 2 wherein the means for enclosing the apparatus in the bead region comprises an axially extending annular portion of each side-plate, said portions serving to locate with and extend beyond the rim-seating portions of the beads of the cover and the said portions lying in abutting relationship in the assembled apparatus.

4. Apparatus according to claim 2 wherein the means for enclosing the apparatus in the bead region comprises a bead spacing ring located between the side-plates and lying in abutting relationship with the side-plates adjacent to the bead moulding surfaces thereof in the assembled apparatus.

5. Apparatus according to claim 2 wherein the means for enclosing the apparatus in the bead region comprises a side-plate having a co-axially extending cylindrical portion and a second side-plate having a bore which is slidable upon the said cylindrical portion.

6. Apparatus according to claim 5 wherein the cylindrical portion is provided with a removable co-axial annular extension.

7. Apparatus according to any of the preceding claims wherein each of the side-plates is formed in two annular co-axial sections one within the other separable along a circular separating line located beyond the bead moulding portion of the side-plate.

8. Apparatus according to any of the preceding claims wherein the surface of each of the side-plates which co-operates with tread rings of different diameters lies on the surface of the frustum of a cone disposed with its major axis co-axial with the axis of that side-plate upon which the surface is formed.

9. Apparatus according to any of the preceding claims wherein the tread ring comprises an annulus of sheet metal having tubular heating piping disposed around its outer periphery.

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10. Apparatus according to any of the preceding claims wherein each of the side-plates has tubular heating piping attached thereto.

11. Apparatus for moulding or remoulding pneumatic tyre covers constructed and arranged substantially as described herein and shown in Figure 1 of the drawings.

12. Apparatus for moulding or remoulding pneumatic tyre covers constructed and arranged substantially as described herein and shown in Figure 2 of the drawings.

13. Apparatus for moulding or remoulding pneumatic tyre covers constructed and arranged substantially as described herein and shown in Figure 3 of the drawings.

14. Apparatus for moulding or remoulding pneumatic tyre covers constructed and arranged subsequently as described herein and shown in Figure 4 of the drawings.

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PROVISIONAL SPECIFICATION.

Improvements in or relating to Moulding Pneumatic Tyres.

We, DUNLOP RUBBER COMPANY LIMITED, a British Company of 1, Albany Street, London, N.W.1, do hereby declare this invention to be described in the following statement:—

This invention relates to pneumatic tyres and particularly to apparatus for moulding a pneumatic tyre or for providing a used pneumatic tyre with a bead-to-bead remould.

Bead-to-bead remoulds are usually carried out in conventional two-part moulds so that for each size of tyre to be remoulded a separate mould must be provided. In order, therefore, to cater for a wide range of bead-to-bead remoulds, a considerable number of moulds must be provided. This involves a large initial capital outlay, which has its effect on the price of a tyre remould and considerable facilities have also to be provided for handling and storing the moulds.

It is an object of the present invention to provide a single apparatus which is adaptable for moulding or remoulding a range of sizes of pneumatic tyres.

According to the invention apparatus for moulding pneumatic tyres comprises a pair of complementary annular side plates each having a moulding surface for the bead, sidewall and shoulder portions of a tyre, a tread ring having side faces engageable with the plates at or adjacent to the shoulder moulding surface thereof, and heating means associated with the outer periphery of the ring.

The shoulder moulding surfaces are of sufficient extent, measured radially of the side plates that a range of tread rings of different diameters may be utilised in conjunction with a single pair of side plates, the tread rings being engageable with the shoulder moulding surfaces at various location such that more or less of the surfaces are utilised according to the diameter of the ring.

The shoulder moulding surfaces may be curved in which case the sides of the tread rings are correspondingly curved so that the sides of each ring form a fit against the appropriate portions of the shoulder moulding surfaces. Preferably, however, each of the shoulder moulding surfaces is formed so that it lies on the surface of the frustum of a cone disposed with its major axis co-axial with the plate.

In order that the profile of the resulting bead-to-bead remould shall be satisfactory throughout the range of tyres which can be remoulded when utilising a single pair of side plates, the profile of the surface provided for moulding the bead and sidewall portions of the tyres is of a shape which is a compromise of the profiles normally provided on tyres within that range.

Tread rings of differing widths may also be utilised in conjunction with a single pair of side plates and in conjunction with bead spacing rings engageable with the side plates adjacent to the bead moulding surfaces so as to enclose the moulding apparatus in the bead region.

The tread ring may comprise a rolled annulus of sheet steel having heating means attached thereto and comprising a coil of piping disposed, e.g. helically, around the ring for connecting to a steam supply. Alternatively the tread ring may comprise an aluminium, magnesium, non-ferrous metal or forged steel ring having a tread matrix either engraved on the inner peripheral surface thereof or formed by die-cast segments attached to the inner peripheral surface of the ring.

Apparatus in accordance with the invention for bead-to-bead remoulding of a range of pneumatic tyres will now be described.

A pair of complementary annular side plates are provided, each of the plates having a recessed portion forming moulding surfaces for the bead, sidewall and shoulder of a tyre. Annular axially projecting flanges are formed as extensions to the bead moulding surfaces, the side plates being separated to a width necessary for the size of tyre to be remoulded by means of one of a range of bead spacing rings of differing width engageable with the said flanges.

The shoulder moulding surface of each

plate lies on the surface of the frustum of a shallow cone disposed with its major axis co-axial with the plate, the radial extent of the shoulder moulding surfaces being such that a range of tread rings of different diameters may be used in association with the plates, the rings being engageable with the said surfaces at various locations according to the diameter of the ring. Thus when the apparatus is set up for moulding one of the smaller diameter tyres within the range, the appropriate tread ring engages the plates at a location such that a considerable amount of the shoulder moulding surface on each plate projects beyond the tread ring. On the other hand when the apparatus is set up with a larger diameter ring a larger proportion of shoulder moulding surface is utilised.

The tread moulding rings each comprise a rolled annulus of double-thickness sheet steel, the inner thickness of sheet steel being provided, if desired, with a plurality of inwardly projecting circumferentially extending corrugations.

These corrugations constitute ribs which form a tread matrix. Lateral projections may be formed on the ribs to provide a pattern, each side of the inner thickness of sheet metal being inturned at such an angle that it will lie along and in contact with the shoulder moulding surface of the plates. The outer thickness of sheet metal is spot-welded to the inner thickness and has a circumferentially-extending outwardly projecting rib adjacent to each side of the ring.

A coil of steam piping is rigidly attached to the outer surface of each of the rings between the outwardly projecting ribs and forms a heat supply therefor.

Each of the side plates has a steam passage arranged on a spiral path co-axial with the axis of the side plate, the spacing of the convolutions and the thickness of metal between the passage and the moulding surface being arranged so that even curing of the tread shoulders, sidewalls and beads is obtained when a common steam supply is used.

It will be appreciated from the foregoing description that the most important feature of the invention is that a range of sizes of pneumatic tyres may be moulded or remoulded by means of a single pair of side plates in conjunction with a plurality of tread rings.

Whilst the range of tyre sizes which may be moulded with any particular pair of side plates is limited to one particular bead diameter, tread rings suitable for use with one pair of side plates may be utilised with a plurality of other pairs of side plates suitable for a range of different bead diameters.

Apparatus according to the invention may be used for moulding or remoulding tyres with treads incorporating circumferentially extending traction-augmenting coils, the coils being located in known manner in circumferentially extending grooves formed in the tread matrix.

The apparatus may also be used for top-capping or retreading worn pneumatic tyres instead of providing them with a complete remould.

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