

PATENT SPECIFICATION

(11) 1 420 622

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- (21) Application No. 20397/72 (22) Filed 2 May 1972
(21) Application No. 51069/72 (22) Filed 6 Nov. 1972
(23) Complete Specification filed 1 May 1973
(44) Complete Specification published 7 Jan. 1976
(51) INT CL² B60B 25/22/21/02
(52) Index at acceptance B7C 5D3 5H
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(54) WHEEL RIMS

(71) We AVON RUBBER COMPANY LIMITED, of Melksham, Wiltshire, England a British Company do hereby declare the invention, for which we pray that a patent may be granted to 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 wheels for use with pneumatic tyres, and is concerned with the safety aspects of the design of the rims of such wheels and of their combination with pneumatic (usually tubeless) tyres.

A pneumatic tyre has two inextensible beads which are retained on a wheel rim by radially projecting bead-retaining flanges one at each side of the rim and rest on the base of the rim between the flanges. A single piece rim is commonly used, because it can be mass-produced cheaply and for tubeless tyres only requires to be sealed at the valve hole. In order to make it possible for the beads to pass over the bead flanges, a well is provided in the base on the rim, into which parts of both beads can be sunk so that their diametrically opposite parts are raised high enough to pass over a bead-retaining flange. After the tyre is fitted, the well performs no useful function until it is necessary to remove the tyre. This done by a reverse operation, the beads being dislodged into the well.

In normal service the well of the rim presents no problem, but if a tyre failure such as a blowout occurs, it presents a real hazard particularly at the high speeds commonplace today which nowadays is considered to be an unacceptable risk. After a blowout, and loss of pressure, one, or both tyre beads frequently become dislodged by the forces acting on the wheel and tyre and find their way into the well. Once this happens, a tyre bead is able, under the stresses present, to pass over a rim flange, and set up steering reactions that cannot be controlled by the driver.

If the tyre beads could be prevented from going into the well after a blowout, the deflated tyre will remain on the rim, and

improved vehicle control is possible.

There are multi-part types of rim that are taken apart for tyre servicing, and therefore do not require a well, but these are costly, and difficult to seal for tubeless application. The most common type also have the disadvantage that they utilise the air pressure within the tyre to maintain an integral assembly. When this pressure is lost, as in a blowout, the rim frequently falls apart, and sheds its tyre.

There has recently been made public, in the Complete Specification of U.K. Patent No. 1,160,412, a proposal for a deformable one piece rim. The diameter of one of the flanges of a well-less rim is increased, or else a partial well is eliminated, by deforming the rim in a press tool after the tyre has been fitted.

We are approaching the problem from an entirely different direction, one which in our view has many advantages. It depends on providing a well in the rim but obstructing access to the well at times when such access, in the event of tyre deflation, would be dangerous.

Partial or complete obstruction of the well of a rim has been proposed before, usually for entirely different purposes. There are many early patents where inventors have been concerned to shift a well right to one side of the rim in order to allow as much room as possible within the radius of the rim for brake drums. Because they had done this, they had to provide something on which the bead of the tubed tyre could be supported. See, for example the Complete Specifications of U.K. Patent Nos. 304,297 and 248,305. It was also common to wrap a fabric layer or a split ring round the rim within the well of a spoked wheel to prevent the ends of the spokes from chafing the tube of a tubed tyre on the rim (see U.K. Specification No. 248,305). This is still common practice with bicycle wheels today.

A modern example of the former type of proposal is seen in U.S. Specification No. 2,840,133. Here the inventor was faced with

the additional difficulty of how to inflate his tubeless tyre when, by shifting the well right up next to a flange, he had deprived it of its usual initial seat during inflation (i.e. with the heel of the bead on the base of the rim at the flange). His invention was directed at how to inflate a tubeless tyre in this situation, which he solves by having means retaining the tyre bead against which the bead seals inboard of the well for initial inflation, and special air passages from a permanently bridged portion of the well into which an inlet inflation valve opens. When inflation pressure is high enough, the bead flips outwardly over the bridging strip, and seats hard against the flange of the rim. This same action wedges the frustoconical bridging strip into position. There is nothing, apart from the presence of the bead of the tyre, holding the bridging strip in place. It should also be noted that the ends of the strip do not meet and are not connected together.

The invention is concerned with the prevention of the catastrophic loss of steering control which frequently occurs if, when a vehicle tyre deflates or explodes, one or both of the beads of the tyre shift, fall into the well and then escape from the rim. It can be seen that in the arrangement of U.S. Specification No. 2,840,133, for example, as soon as the bead shifts inwardly on deflation, the bridging strip is free to expand and fly off the rim under centrifugal force. Apart from the danger this itself would cause, the well is then uncovered for the bead to fall into.

Each if a bead falls into the well without escaping from the rim there is a loss of concentricity and hence of some steering control.

The present invention therefore provides a wheel rim for receiving a tubeless pneumatic tyre with inextensible beads, having a tyre bead retainer flange at each axial side of the rim and a base, the base of the rim having bead seats, the bead seats being respectively adjacent the said flanges, the bead seats being adapted to receive and seat beads of a tubeless tyre to support loads transmitted between the beads and rim during use, the base of the rim having a well disposed axially between the bead seats and having side walls and a well base, the side walls extending radially inwardly of the base of the rim towards the well base, the well being circumferentially continuous around the rim and being adapted to receive a tyre bead during fitting of a tyre, a removable obstructor for the well to extend circumferentially around the rim, and means for positively retaining the obstructor inextensibly at the well to occupy at least the radially outer portion thereof, the obstructor when so retained being for denying the tyre beads access to any sub-

stantial circumferential length of the well irrespective of the presence, position or condition of inflation of any tyre on the rim. The obstructor, when retained, is effective whether or not a tyre is actually present, and whatever the position of the beads of such a tyre.

The well obstructor thus denies the beads access to the well so that they should not escape from the rim and so that they also tend to remain generally concentric with the axis of rotation of the wheel. Consequently when a blowout occurs there is a greatly reduced chance of the tyre being lost with loss of control, and the beads remaining concentric retain as much as possible of steering control and tend to cause the vehicle to continue to run on the rubber material of the tyre, the latter especially if low aspect tyres are used. This latter has a second effect; the presence of a sandwich of rubber between the rim flange and the road will tend to prevent the flange engaging the road directly. If the vehicle deviates from a straight path and the flanges are not prevented from engaging the road, digging in of the flanges into the road can cause the vehicle to overturn.

In any such arrangement the obstructor can only be removed by a conscious human action. Particularly suitable from the point of view of effectiveness, cheapness and ease of retention, is a band secured in the mouth of the well and retained by a screw or screws against circumferential expansion. The person installing or removing the tyre has merely to push the beads across the rim so that the screw or screws are accessible, and do them up or undo them as the case may be. Especially effective are arrangements where the screw is arranged tangentially across a circumferentially extending gap in the band, so that it can place the band under circumferential tension. The screw is then positioned within the well.

When the well is positioned near a flange it allows, as in the prior art, more room for a brake drum assembly; but also the depth and width of the well may be minimized, and its accessibility for the fitting or removing the obstructor improved.

There is no problem in the present invention in obtaining inflation of a tubeless tyre since the seat for a bead of the tyre during initial inflation is on the rim base adjacent a bead-retaining flange; for this reason it is preferred that the obstructor has a cylindrical outer peripheral surface and the rim base has frusto-conical portions adjacent the flanges. It is thus preferred that although the well is nearer one flange than the other, it is spaced from the nearer flange and that the rim base between that flange and the well is of a diameter such as to allow at least the heel of the bead to be seated

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thereon during initial inflation, i.e. inflation pressure is not required to force the bead over the obstructor. Wheel rims and wheels embodying the invention can be simple to construct and a tyre can be fitted without the use of special tools or apparatus. They should cost little if any more than conventional wheels or rims.

5 The advantages in terms of increased safety are very considerable, especially in present day road conditions, where high speeds are becoming commonplace, and roads are becoming crowded, especially on motorways, where the consequences of a tyre blowout is usually very costly in human lives and material damage.

10 The invention also includes a wheel assembly including a wheel structure having a central hub portion and a wheel rim as previously defined, the well being nearer to one flange than to the other, and a tubeless tyre having bead portions seated against the flanges respectively, the obstructor being positively retained in position in the rim so as to deny the tyre beads access to any substantial circumferential length of the well. Preferably, the axial distance between the said one flange and the well is at least substantially equal to the axial thickness of the sole of the bead.

15 We provide further a method of assembly a wheel and a tubeless pneumatic tyre, the wheel having a rim as defined above, and the method including the steps of using the well to accommodate the beads of the tyre successively as they are passed over a flange of the rim onto the rim, then moving the beads axially clear of the well, placing said well obstructor at the well, securing the obstructor positively and inextensibly at the well, passing one bead of the tyre substantially completely past the obstructor to seat it on its bead seat, and inflating the tyre.

20 When the obstructor comprises a band, the method may include juxtaposing adjacent ends of the band, engaging them together by screw-threaded coupling means and applying tension to the band by rotating the screw-threaded coupling means about an axis directed tangentially of the wheel to lock the obstructor in its position at the well.

25 In the accompanying drawings there are shown various particular forms of embodiment of the present invention, given by way of example only. In the drawings:

30 Figure 1 is a section on a radial plane of a first embodiment of rim,

35 Figure 2 is a section on the line II—II, Figure 1,

40 Figure 3 is a view on the arrow III, Figure 2,

45 Figure 4 is a section one a radial plane of a second embodiment of rim, which is integral with a wheel disc,

50 Figure 5 is a diametrical section of a third

embodiment, showing a separate wheel disc,

Figure 6 is a detail from Figure 5,

Figure 7 is a scrap perspective view of part of the third embodiment,

Figures 8, 9 and 10 show respectively further different well obstructors, the Figures a being elevations and the Figures b top views of the respective securing arrangements, and

Figure 11 shows typical stages of fitting of a tyre and a well obstructor to a rim.

The first embodiment of rim according to the invention is shown in Figures 1 to 3. It is a once-piece rolled steel rim 1 with a base 2 and two bead flanges 3, 4. The base has frustoconical portions 5, having an angle of conicity of about 4° or 5°, adjacent the flanges. Tyre beads 6, 7 in normal use are positioned adjacent the bead flanges and are borne by the frustoconical portions 5. Close to one of the bead flanges 4 is a well 8, which is considerably axially narrower than a conventional, centrally situated well. Its mouth is in the base 2 and is its radially outermost part, its side walls 9, 10 merge into the base 2, the wall 10 merging into one of the frustoconical portions 5 which lie between it and the flange 4. A removable well obstructor 11 can occupy the mouth of the well so that its outer surface is flush with the radially outermost surface of the base 2. The obstructor comprises a split ring of metal of the same gauge as the metal of the remainder of the rim 1.

One wall 10 has an aperture 12 for the insertion of an inflation valve. Each flange has an axially outwardly curving lip 13 at its radially outer portion.

The obstructor 11 is not in position when the tyre is fitted, this being done by putting one part of the beads successively into the well and then passing their diametrically opposite parts over the flange 4 (see also Figure 11). Because of the position of the well closely adjacent to the flange 4 only one bead need be received in it at a time. Then both beads are removed away from the well towards the bead flange 3 and the obstructor 11 is fitted and fastened in position, by fastening means for its ends. As shown in Figures 2 and 3 one end 14 is joggled inwardly and is secured radially inwardly of the other end 16 by a screw 17. The stem of the screw 17 passes through a circumferentially elongate slot 18 in the end 16 and screwthreadedly engages a captive nut 19 secured to the end 14 e.g. by welding. The ring is circumferentially held tight and the screw 17 tightened up so that the ring cannot radially expand. The beads are then moved towards the respective bead flanges, one moving over the obstructor, and the tyre is inflated through a valve provided in the aperture 12. The bead 7 may first seat not against the flange but against a

frustoconical portion 5, as indicated at 7', but inflation will still be possible since this seating is between the edge of obstructor nearest the flange 4 and that flange. To remove the tyre, air is released from it and the bead against the flange 4 is dislodged towards the flange 3, the obstructor 11 unfastened and removed to render the well accessible so that the tyre can be taken off the rim by using the well.

The rolled rim will be attached to a separate wheel disc.

During use of the tyre, should it lose its air, the beads cannot enter the well and the beads are retained concentrically on the rim. It is preferred to use a low-aspect tyre (that is one of about 60% aspect ratio or less) because such a tyre, with a proper choice of the dimensions of the rim and having considerable lateral rigidity in the tread and breaker portion will offer considerable controllability after air-loss, since the tyre will not be able to roll over to any great extent or even by able to shift the beads away from the flanges inwardly of the rim, except under exceptional circumstances. This advantage is not available, at least to such a degree, where tyres are of a higher aspect ratio, unless especially designed with a stiffened sidewall. The aspect ratio of a tyre is the ratio of its radial height to its axial width.

The lips 13 provide a bearing surface for the sidewalls of a deflated tyre (particularly one of low aspect ratio). A sandwich of rubber formed by the collapsed sidewall between these surfaces and the ground will also contribute to preservation of steering control and tend to avoid the digging in of flanges into the road surface, which can cause overturning of the vehicle.

It is also apparent that should the screw 17 not be tightened during fitting it will protrude radially outward and prevent or hinder the tyre bead 7 from being seated adjacent the flange 4 and inflated.

A second embodiment is shown in Figure 4. Here, a rim 20 is integral with a wheel disc 21, which may be relieved for lightness and for the sake of appearance. These may be rolled, pressed, forged or cast parts, in either steel or alloy.

A base 22 of the rim has a central cylindrical (i.e. non-conical) portion with a frustoconical portion 23 merging into it on one axial side. Part of this cylindrical surface is provided by a well obstructor 24, fitted in the mouth of a well 25, the base of which is at the radially outermost part of the wheel disc 21.

The well 25 is, as in the first embodiment, between the mid-circumferential plate P of the rim and one of its flanges. In the present case it is nearer flange 26 than flange 36.

Between the well 25 and the flange 26 there is a frustoconical portion 27 of a minimum radius greater than that of the cylindrical portion of the base 22.

The portions 23 and 27 support beads 28,29 respectively of a tubeless tyre, which, at least when the tyre is inflated, seat against the flanges 26, 36 respectively.

Axially inwardly of the beads when thus seated are respective safety ridges or studs 30,31, formed in the surface of the base of the rim. Ridge or stud 31 lies between the edge of the obstructor 24 nearest the flange 26, and that flange. These ridges or studs are to hinder lateral (axial) movement of the beads when the tyre is deflated, but do not prevent such movement (otherwise the tyre could not be fitted). They are an optional feature only.

The edges of the obstructor 24 are seated in respective annular rebates 35 at the mouth of the well.

An inflation valve 32 of metal or rubber is fitted to an aperture 33 in one wall of the well which is the only aperture in the rim, and one or more apertures 34 pierce the well obstructor 24 to allow passage of air freely from the well to within the tyre, and vice versa.

Various forms of obstructor band suitable for this embodiment will be described more fully in connection with Figures 8 to 10.

In a third embodiment, shown in Figures 5 to 7, a removable wheel rim well obstructor for a rim 40 generally as in the first embodiment is in the form of a steel band 41 which is of a length slightly greater than the circumference of the base 42 of the wheel rim so that its ends overlap when the strip is placed in its operating position. In this operating position its radially inwardly chamfered axial edges 43 rest on the sides of the mouth of an off-centre well 44 of the rim 40. Arrangements for holding together adjacent ends of the band may be as described in the first embodiment or as will be described with reference to Figures 8 to 10. One end of the band has a screw-threaded aperture 46 which receives a screw-threaded element 47 in the form of a hollow stem which is the body of an inflation valve (the non-return parts of which are not shown in the drawings). The other end of the band, lying radially inside the first, has a plain aperture 45. The element 47 holds the two ends of the band 41 together so that it forms a ring and allows it to be secured firmly in place by passing the element 47 radially inwardly through an aperture 48 in the base of the well and providing on it a faceted part 49 with interposition between a nut and the outside of the base of the well of an "O" ring 50 and a gasket 51 to ensure the sealing of the leak path from the inside of the tyre, which exists around the outside of

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the element 47. The radially inward end of the element 47 is screw-threaded at 52 for the reception of a nozzle of an inflation pump in conventional manner.

5 The radially outward end 53 of the element 47 projects, however, radially outwardly from the obstructor and acts as a safety bolt, that is to say, prevents any possibility of a tyre bead indicated at 54, Figure 5, from moving across the wheel rim upon deflation. This will increase further the degree of control available to the driver if there is a sudden deflation since, although the presence of the well obstructor will prevent any bead getting into the well and thus will prevent the tyre from flying off, even the sliding motion of the beads along the rim which is possible when the tyres of comparatively high aspect are used (say 20 70% or more) contributes to loss of control and it is desirable to prevent this. It is also noticeable that the use of the safety element to secure the well obstructor prevents rotation of the well obstructor relative to the wheel rim and, when the safety element is a valve body it ensures that the tyre cannot be inflated until both the well obstructor and the safety element are securely in position.

Figure 5 also shows diagrammatically how 30 the wheel rim 40 may be mounted on a wheel disc indicated at 55 and having a hub portion 56 for securing to a wheel hub, with the well off-set from the disc to an extent where the removable obstructor 41 bears some of the pressure of the tyre bead 54 during normal running of the tyre. The tyre 57 is shown as a low aspect ratio tubeless tyre.

Various forms of obstructor bands are 40 illustrated in Figures 8 to 10. It should be borne in mind that although bands because of their ease of manufacture, comparative cheapness and lightness are preferred as constituting the obstructors the invention includes obstructors which fully occupy the well.

Figures 8a and b shows a band obstructor 60 of which the ends are circumferentially overlapped and secured together by a screw 61 engaging a captive nut 62. This differs from the form of obstructor 11 described earlier only in that there is no allowance for manufacturing tolerance, in that neither aperture through which the screw passes is circumferentially elongate.

Figures 9a and b show a preferred form of band obstructor 63. The ends 64, 65 of the band are both radially intumed to lie opposite each other. A screw 66 extends 60 between the ends, its stem screw threadedly engaging an aperture in end 64 and passable freely through an aperture in end 65. Its head engages the end 65. An elongate slot 67 is provided in the band adjacent the end 65 to allow access of a screwdriver to the head

of the screw 66. Turning the screw draws the ends 64, 65 together tangentially (or allows them to move apart) so that when the obstructor band is positioned in a rim it may be placed under a desired degree of circumferential tension.

Figures 10a and b show another form 68 where a similar tensioning effect may be obtained, but where one band end 69 is intumed radially and one, 70, out-turned radially from a chordal portion 71. In the embodiments shown in Figures 9 and 10 the regions where the obstructors do not fully close the mouth of the well when the obstructor is fixed are not sufficiently large to allow a bead to enter a significant distance into the well. These regions also allow the passage of air freely between the well into the tyre.

In both these last two forms of band, the screw which acts to retain the band in use is housed within the rim well the mouth of which the band is obstructing.

Figure 11 is to illustrate the stages (1) to (5) used to fit a tyre T to a typical rim R embodying the invention and make it ready for inflation. Removal of a tyre involves carrying out the same steps in the reverse order.

In stages (1) to (3), beads B of the tyre are put on by one in the well W while at the diametrically opposite part of the tyre the bead portion there is pushed over the bead-retaining flange of that axial side of the rim. In stage (4) both beads B are pushed to one side of the rim to render the well accessible to the mechanic, and an obstructor is fitted and its retaining means engaged.

Then in stage (5) one bead is passed over the obstructor to engage the base of the rim between the well and the nearer flange, and the tyre is ready for inflation.

WHAT WE CLAIM IS:—

1. A wheel rim for receiving a tubeless pneumatic tyre with inextensible beads, having a tyre bead retainer flange at each axial side of the rim and a base, the base of the rim having bead seats, the bead seats respectively adjacent the said flanges, the bead seats being adapted to receive and seat beads of a tubeless tyre to support loads transmitted between the beads and rim during use, the base of the rim having a well disposed axially between the bead seats and having side walls and a well base, the side walls extending radially inwardly of the base of the rim towards the well base, the well being circumferentially continuous around the rim and being adapted to receive a tyre bead during fitting of a tyre, a removable obstructor for the well to extend circumferentially around the rim, and means for positively retaining the obstructor inextensibly at the well to occupy at least



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the element 47. The radially inward end of the element 47 is screw-threaded at 52 for the reception of a nozzle of an inflation pump in conventional manner.

5 The radially outward end 53 of the element 47 projects, however, radially outwardly from the obstructor and acts as a safety bolt, that is to say, prevents any possibility of a tyre bead indicated at 54, Figure 5, from moving across the wheel rim upon deflation. This will increase further the degree of control available to the driver if there is a sudden deflation since, although the presence of the well obstructor will prevent any bead getting into the well and thus will prevent the tyre from flying off, even the sliding motion of the beads along the rim which is possible when the tyres of comparatively high aspect are used (say 20 70% or more) contributes to loss of control and it is desirable to prevent this. It is also noticeable that the use of the safety element to secure the well obstructor prevents rotation of the well obstructor relative to the wheel rim and, when the safety element is a valve body it ensures that the tyre cannot be inflated until both the well obstructor and the safety element are securely in position.

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the radially outer portion thereof, the obstructor when so retained being for denying the tyre beads access to any substantial circumferential length of the well irrespective of the presence, position or condition of inflation of any tyre on the rim.

2. A wheel rim according to claim 1, wherein the bead seats are frusto-conical, radially outwardly flaring, portions of the base, the obstructor being spaced away from each flange by at least an axial distance equal to the axial width of said frusto-conical portion, the least radius of the bead seats being at least as great as the greatest radius of the obstructor.

3. A wheel rim according to claim 1 or claim 2 wherein the obstructor comprises a band, the means for positively retaining the obstructor being coupling means engageable with juxtaposed ends of the band.

4. A wheel rim according to claim 3 wherein the band has circumferentially spaced ends and is disposed at a radially outer part of the well, the coupling means including a tangentially disposed tightenable screw, the said screw acting between the spaced ends of the band to exert circumferential tension on the band.

5. A wheel rim according to claim 3 or claim 4 wherein the band abuts against each side wall of the well at the mouth of the well.

6. A wheel rim according to claim 1 wherein the obstructor substantially fully occupies the well.

7. A wheel rim according to any one of the preceding claims wherein the well is adjacent one of the bead seats and spaced from the other, the rim having at least one radially outward projection extending circumferentially around the base of the rim immediately adjacent that side of the well which is nearer the adjacent bead seat and axially between the bead seat and the well, to hinder lateral travel of a tyre bead.

8. A wheel rim according to any one of the preceding claims wherein the rim is apertureless except for a valve aperture in the circumferentially continuous well, and there is at least one gap in the obstructor for passing air from the well to radially outside the well.

9. Wheel rims substantially as herein described with reference to and as shown in the accompanying drawings.

10. A wheel assembly including a wheel structure having a central hub portion and a wheel rim as claimed in claim 1 wherein the well is nearer to one flange than to the other, and a tubeless tyre having bead

portions seated against the flanges respectively, the obstructor being positively retained in position in the rim and occupying at least the radially outer portion of the well around substantially the whole circumference of the well so as to deny the tyre beads access to any substantial circumferential length of the well.

11. A wheel assembly according to claim 10 wherein the axial distance between the said one flange and the well is at least substantially equal to the axial thickness of the sole of the bead.

12. A wheel assembly according to claim 10 or claim 11, wherein the axial width of the well is only slightly greater than the axial width of each bead portion of the tyre.

13. A wheel assembly according to claim 10 or claim 11 or claim 12 wherein the obstructor fully occupies the well.

14. Wheel assemblies according to claim 10 substantially as herein described with reference to and as illustrated in the accompanying drawings.

15. A method of assembling a wheel and tubeless pneumatic tyre, the wheel having a rim according to claim 1, which includes the steps of using the well to accommodate the beads of the tyre successively as they are passed over a flange of the rim onto the rim, then moving the beads axially clear of the well, placing said well obstructor at the well, securing the obstructor positively and inextensibly at the well, passing one bead of the tyre substantially completely past the obstructor to seat it on its bead seat and inflating the tyre.

16. A method according to claim 15 wherein the obstructor comprises a band and the method includes juxtaposing adjacent ends of the band and engaging coupling means to them to lock the obstructor in its position at the well.

17. A method according to claim 16 which includes applying circumferential tension to the band by rotating a screw-threaded said coupling means about an axis directed tangentially of the wheel.

18. A method according to claim 15, claim 16 or claim 17 which includes inflating the tyre by initially seating the bead of the tyre which passed over the obstructor against the corresponding bead seat and passing air into the tyre from the well through a gas in the obstructor.

19. A method according to claim 15 substantially as herein described and exemplified with reference to the accompanying drawings.



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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1976.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.



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