

PATENT SPECIFICATION

(11)

1 510 011

1 510 011

- (21) Application No. 9189/75 (22) Filed 5 March 1975
(23) Complete Specification filed 2 March 1976
(44) Complete Specification published 10 May 1978
(51) INT. CL² B60B 19/14
(52) Index at acceptance
B7C 31
B7B TW
F2A 6D1 6E2 D36
(72) Inventor JAMES DYSON



(54) A GROUND ENGAGING MEMBER FOR MOVABLE STRUCTURES

(71) We, KIRK-DYSON DESIGNS LIMITED, a British Company, of Leafield Estate, Corsham, Wiltshire SN13 9UD, England, 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:—

10 This invention relates to movable structures of the kind (hereinafter called the kind referred to) having supporting ground engaging members such as handtrucks, trolleys, pushchairs and bicycles. In particular, the invention is applicable to handtrucks having a load carrying bin, such as a wheelbarrow.

20 The convention design for a wheelbarrow includes a load carrying bin which is fixedly attached on a frame supported by a single disc-like ground engaging wheel which is attached to the frame forwardly of the centre of gravity of the barrow.

25 Such wheelbarrows have a number of disadvantages. Firstly, the wheelbarrow when fully loaded becomes extremely unstable and is liable to tilt to either side of the single forwardly positioned wheel during forward movement. Secondly, the wheel makes it difficult to manoeuvre the wheelbarrow over broken or uneven ground. Furthermore, the wheel marks a lawn or soft ground especially when the wheelbarrow is loaded.

35 The object of the invention is to provide a movable structure with an improved ground engaging member which avoids the above disadvantages and which in particular enables the movable structure to ride easily over broken ground.

40 In its broadest aspect the invention provides a movable structure of the kind referred to, comprising a frame and a supporting ground engaging member rotatably mounted therein, said member comprising

a ball moulded in one piece with diametrically opposite sockets therein, a bearing assembly mounted in each of said sockets, said frame terminating in a pair of stub shafts each adapted to fit a corresponding bearing assembly, said bearing assemblies each providing a rolling bearing for the corresponding stub shaft and said bearing assemblies each comprising an outer bearing cup mounted in, and non-rotatable relative to, a respective one of said sockets and having an outer peripheral flange engaging the outer surface of said ball, and an inner bearing member mounted on, and non-rotatable relative to, said corresponding stub shaft, said inner bearing member being rotatably mounted in said outer bearing cup.

65 In the preferred embodiment the inner bearing member is cup-shaped and each said bearing assembly also provides a thrust bearing by means of an outer peripheral flange of said inner bearing cup engaging the flange of said outer bearing cup, the inner end of the inner bearing cup being spaced from the inner end of the outer bearing cup when the flanges of said bearing cups are in engagement.

75 The bearing cups are preferably formed of a hard plastics material such as nylon 6, and in the preferred embodiment of the invention the outer surface of the outer bearing cup is formed with cutting fins for engaging the wall of the socket and the inner surface of the inner bearing cup is formed with a web for engaging a slot on the stub shaft.

85 In the preferred embodiment of the invention the ball is moulded in a plastics material. Preferably, the plastics material is a mixture of an ethylene-vinyl acetate (EVA) co-polymer and low density polyethylene, the percentage of EVA in the mixture being in the range of 7½% to 12½%.

The outer surface of the ball forming the

90

ground engaging member is conveniently moulded with suitable tread ribs. In an alternative construction the outer surface of the ball may be moulded with channels defining ribs extending towards the axis of the ball so as to provide circumferential strength to the ball at the point where contact is made with the ground.

The invention will now be described in greater detail with reference to the accompanying drawings, in which:

Figure 1 is a side elevation of a wheelbarrow, fitted with a supporting ball, in accordance with the present invention.

Figure 2 is a sectional view through the frame of the wheelbarrow on the line 2-2 of Figure 1 showing the ball in elevation.

Figure 3 is a sectional view taken on the line 3-3 of Figure 2 showing the mounting of the stub axles in the sockets of the ball.

Figure 4 is a view similar to Figure 2, but showing a modified construction of ball moulded with ribs.

Figure 5 is a detailed view of a rib of the ball of Figure 4 showing the flexing of the rib during use, and

Figures 6 and 7 show alternative constructions of ribs for the ball.

As previously mentioned the invention is concerned with the provision of a movable structure having an improved ground engaging member which is of ball like construction. The invention is applicable to all forms of movable structures normally utilising a wheel such as handtrucks, trolleys, pushchairs and bicycles.

Referring now to Figure 1 of the drawings the ground engaging member is shown applied to a wheelbarrow. The wheelbarrow basically comprises a frame member consisting of two spaced elongated tubular members 10 adapted to support a removable bin 11 therebetween by means of two spaced cross tubes 12 and 13 which interconnect the elongated tubular members 10. The cross tubes 12 and 13 interconnect the elongated members 10 intermediate their ends, the lower front spaced ends 14 of the elongated members 10 forming stub axles to support the ball 15 therebetween and the upper rear spaced ends being adapted to act as handles 16.

The removable bin 11 is preferably a moulding in a plastics material, such as polyethylene which provides a light-weight but strong and rigid construction. The bin is suitably shaped to fit between the elongated tubular members 10 and is provided with moulded transverse lips or lugs to fit onto the cross tubes 12 and 13 interconnecting the longitudinal tubular members 10. The bin 11 is furthermore provided with moulded sections on its external surface for receiving the removable feet 17 or like support members spaced

one on each side of the bin.

The bin is designed so that its deepest part is behind the centre of gravity of the barrow, the bin curving upwardly from its deepest part to a shallow section having a front lip portion 18 located over the ground engaging ball 15. The construction locates the centre of gravity of the barrow just behind the ground engaging ball 15 so as to allow for easy forward tipping.

Referring now to Figures 2 and 3 the ground engaging ball 15 is moulded in one piece from a suitable material such as rubber or plastics. A plastics material such as a mixture of an ethylene-vinyl acetate (EVA) co-polymer and a low density polyethylene is preferred. EVA co-polymers are thermoplastic materials produced by copolymerising vinyl acetate monomer with ethylene monomer. We have discovered that for satisfactory operation the percentage of EVA in the mixture should be in the range of 7½% EVA up to 12½% EVA. If the EVA content is reduced much below 7½% the ball itself becomes too rigid to operate with pneumatic qualities, and becomes a hard structure. It is therefore, not suitable for use over stony or rough ground although it would perform reasonably satisfactorily in soft ground such as sand. If the EVA content is increased beyond 12½% in normal temperatures such as in England, except in the hottest part of the summer, the ball operates satisfactorily up to an EVA content of 25%. However, in hot countries, where the ambient temperature exceeds 20°C, any increase over the 12½% EVA content causes the ball to expand and distort, and for countries where the ambient temperature exceeds 25°C, the EVA must be kept down to 7½%.

The ball 15 is preferably moulded with suitable tread ribs as shown by the reference 19 together with a valve 20 for inflation of the ball. It has been discovered that the ball should be inflated to a pressure of about 6 pounds per square inch. A drop in pressure to below 6 pounds per square inch causes poor performance when the wheelbarrow is heavily laden. Any substantially increase above 6 pounds per square inch can cause the ball to distort when placed in direct sunlight or in temperatures of more than 20°C.

As shown in Figure 3 the ball is also moulded with two diametrically opposite sockets 21 adapted to support the ends of the stub shafts 14 of the longitudinal frame members 10 through the intermediary of suitable bearings. The bearings each comprise a pair of interengaging bearing cups which are injection moulded from nylon 6 which is a nylon having exceptionally good abrasive wear characteristics. The outer

bearing cup 22 fits tightly within the socket 21 and is formed on its outer surface with a plurality of cutting fins 23 which cut into the surface of the socket 21 as the bearing cup is fitted into the socket. The length of the bearing cup 22 is such that it is slightly spaced from the inner end of the socket 21 when its flange 24 abuts against the outer surface of the ball as shown. The outer bearing cup 22 is therefore firmly and non-rotatably fitted within the socket 21.

The bearing cup 22 rotatably receives the inner bearing cup 25 which slides snugly within the outer bearing cup 22 and is formed with a flange 26 which abuts the flange 24 of the outer bearing cup in its operative position. In this position it will be seen that the inner bearing cup 25 has an axial length which is such that its inner end wall 27 is spaced from the inner end wall 28 of the outer bearing cup 22. The inner bearing cup 25 non-rotatably receives the inner end of the stub shaft 14 and to this end of the inner bearing cup is formed with a web 29 which engages with a slot 30 formed in the end of the stub shaft 14.

The design of the bearing as shown in Figure 3 is such that the inner nylon bearing cup 25 rotates within the outer nylon bearing cup 22 and the friction is nylon against nylon, causing no wear upon the ball or the frame of the wheelbarrow. If the frame were to be permitted to bear on the ball, the ball would wear away, and if the stub shafts were to bear on the outer bearing cups, the bearings might wear. It will be appreciated that the bearing forces are against the outer flanges 24 and 26 and within the walls of the bearing cups but not against any of the inside end walls of the bearing cups. If pressure were to occur on the inside end walls of the bearing cups this would cause the sockets to stretch which in turn would put the ball out of spherical. With the design of bearing described above all the side thrust is taken by the flanges 24 and 25 which are then supported by the wall of the ball itself.

An alternative construction of ball is shown in Figure 4. In this construction the ball 15 is moulded with channels 31 defining intermediate ribs 31A which extend towards the rotational axis of the ball and which are provided with tread ribs 19. The provision of the channels 31 is such that it is possible for the ball to act as an inflatable pneumatic member without the necessity of the ball retaining air in a captive capacity. The ribs 31A provide a peripheral beam strength around the circumference of the ball at the point where contact is made with the ground which is sufficient to prevent the ball from collapsing so there is no need to have any pressure

inside the ball. At the same time the ribs 31A have a small amount of flexibility and between each other a concertina effect which is similar to that obtained by the use of a pressure of air inside the ball and this flexibility of the rib walls of the ribs 31A defined by the channels 31 is shown in Figure 5 by the chain lines. The effect of the addition of the ribs 31A is that if the ball is punctured it would not affect the pneumatic performance of the ball. In view of this the ball need no longer have a valve and the construction of Figure 4 need no longer be concerned with the inflation of the ball and the necessity of ensuring that the correct inflation pressure is used.

In the construction of Figure 4 the channels 31 are shown as U-shaped. Figures 6 and 7 show alternative shapes for the channels. In Figure 6 the channels 32 are V-shaped and in Figure 7 the channels 33 are U-shaped with sloping sides. It has been discovered that various ribs have slightly different effects due to the flexing of the ribs in the transverse direction during use.

The ground engaging member in the form of a ball is considerably easier to manufacture than a conventional wheel and has a superior performance to a conventional wheel over soft ground because its spread on the ground covers a wider area causing a lower point load on the ground. The use of a ball is less likely to mark lawns or to sink into mud, earth or sand or other broken ground. The wide spread of the ball compared with a conventional wheel means that less accuracy is required when travelling along a narrow path such as a plank. In addition because the ball is hubless it can travel over objects more easily due to the fact that the ball can absorb the object more deeply so that the resultant angle of climb for the ball to climb over the object is made shallower and therefore, easier.

WHAT WE CLAIM IS:—

1. A movable structure of the kind referred to, comprising a frame and a supporting ground engaging member rotatably mounted therein, said member comprising a ball moulded in one piece with diametrically opposite sockets therein, a bearing assembly mounted in each of said sockets, said frame terminating in a pair of stub shafts each adapted to fit a corresponding bearing assembly, said bearing assemblies each providing a rolling bearing for the corresponding stub shaft and said bearing assemblies each comprising an outer bearing cup mounted in, and non-rotatable relative to, a respective one of said sockets and having an outer peripheral flange engaging the outer surface of



bearing cup 22 fits tightly within the socket 21 and is formed on its outer surface with a plurality of cutting fins 23 which cut into the surface of the socket 21 as the bearing cup is fitted into the socket. The length of the bearing cup 22 is such that it is slightly spaced from the inner end of the socket 21 when its flange 24 abuts against the outer surface of the ball as shown. The outer bearing cup 22 is therefore firmly and non-rotatably fitted within the socket 21.

The bearing cup 22 rotatably receives the inner bearing cup 25 which slides snugly within the outer bearing cup 22 and is formed with a flange 26 which abuts the flange 24 of the outer bearing cup in its operative position. In this position it will be seen that the inner bearing cup 25 has an axial length which is such that its inner end wall 27 is spaced from the inner end wall 28 of the outer bearing cup 22. The inner bearing cup 25 non-rotatably receives the inner end of the stub shaft 14 and to this end of the inner bearing cup is formed with a web 29 which engages with a slot 30 formed in the end of the stub shaft 14.

The design of the bearing as shown in Figure 3 is such that the inner nylon bearing cup 25 rotates within the outer nylon bearing cup 22 and the friction is nylon against nylon, causing no wear upon the ball or the frame of the wheelbarrow. If the frame were to be permitted to bear on the ball, the ball would wear away, and if the stub shafts were to bear on the outer bearing cups, the bearings might wear. It will be appreciated that the bearing forces are against the outer flanges 24 and 26 and within the walls of the bearing cups but not against any of the inside end walls of the bearing cups. If pressure were to occur on the inside end walls of the bearing cups this would cause the sockets to stretch which in turn would put the ball out of spherical. With the design of bearing described above all the side thrust is taken by the flanges 24 and 25 which are then supported by the wall of the ball itself.

An alternative construction of ball is shown in Figure 4. In this construction the ball 15 is moulded with channels 31 defining intermediate ribs 31A which extend towards the rotational axis of the ball and which are provided with tread ribs 19. The provision of the channels 31 is such that it is possible for the ball to act as an inflatable pneumatic member without the necessity of the ball retaining air in a captive capacity. The ribs 31A provide a peripheral beam strength around the circumference of the ball at the point where contact is made with the ground which is sufficient to prevent the ball from collapsing so there is no need to have any pressure

inside the ball. At the same time the ribs 31A have a small amount of flexibility and between each other a concertina effect which is similar to that obtained by the use of a pressure of air inside the ball and this flexibility of the rib walls of the ribs 31A defined by the channels 31 is shown in Figure 5 by the chain lines. The effect of the addition of the ribs 31A is that if the ball is punctured it would not affect the pneumatic performance of the ball. In view of this the ball need no longer have a valve and the construction of Figure 4 need no longer be concerned with the inflation of the ball and the necessity of ensuring that the correct inflation pressure is used.

In the construction of Figure 4 the channels 31 are shown as U-shaped. Figures 6 and 7 show alternative shapes for the channels. In Figure 6 the channels 32 are V-shaped and in Figure 7 the channels 33 are U-shaped with sloping sides. It has been discovered that various ribs have slightly different effects due to the flexing of the ribs in the transverse direction during use.

The ground engaging member in the form of a ball is considerably easier to manufacture than a conventional wheel and has a superior performance to a conventional wheel over soft ground because its spread on the ground covers a wider area causing a lower point load on the ground. The use of a ball is less likely to mark lawns or to sink into mud, earth or sand or other broken ground. The wide spread of the ball compared with a conventional wheel means that less accuracy is required when travelling along a narrow path such as a plank. In addition because the ball is hubless it can travel over objects more easily due to the fact that the ball can absorb the object more deeply so that the resultant angle of climb for the ball to climb over the object is made shallower and therefore, easier.

WHAT WE CLAIM IS:—

1. A movable structure of the kind referred to, comprising a frame and a supporting ground engaging member rotatably mounted therein, said member comprising a ball moulded in one piece with diametrically opposite sockets therein, a bearing assembly mounted in each of said sockets, said frame terminating in a pair of stub shafts each adapted to fit a corresponding bearing assembly, said bearing assemblies each providing a rolling bearing for the corresponding stub shaft and said bearing assemblies each comprising an outer bearing cup mounted in, and non-rotatable relative to, a respective one of said sockets and having an outer peripheral flange engaging the outer surface of



- 5 said ball, and an inner bearing member mounted on, and non-rotatable relative to, said corresponding stub shaft, said inner bearing member being rotatably mounted in said outer bearing cup.
2. A movable structure as claimed in Claim 1, wherein said inner bearing member is cup-shaped and each said bearing assembly also provides a thrust bearing by means of an outer peripheral flange of said inner bearing cup engaging the flange of said outer bearing cup, the inner end of the inner bearing cup being spaced from the inner end of the outer bearing cup when the flanges of said bearing cups are in engagement.
3. A movable structure as claimed in Claim 2, wherein the outer surface of the outer bearing cup is formed with cutting fins for engaging the wall of the socket and the inner surface of the inner bearing cup is formed with a web for engaging a slot on the stub shaft.
4. A movable structure as claimed in either of claims 2 and 3, wherein the bearing cups are moulded from nylon material.
5. A movable structure as claimed in any of the preceding claims, wherein the ball is moulded in a plastics material.

6. A movable structure as claimed in Claim 5, wherein the plastics material is a mixture of EVA and low density polyethylene, the percentage of EVA in the mixture being in the range of 7½ to 12½%.
7. A movable structure as claimed in any of the preceding claims, wherein the outer surface of the ball is moulded with tread ribs.
8. A movable structure as claimed in any one of Claims 1 to 6, wherein the outer surface of the ball is moulded with channels defining ribs extending towards the rotational axis of the ball.
9. A movable structure as claimed in any of the preceding claims, wherein the ball is inflatable.
10. A wheelbarrow having a supporting ground engaging ball member, substantially as described and as shown in Figures 1, 2 and 3; or Figures 1, 4 and 5, or Figures 1, 4 and 5 as modified by Figures 6 or 7 of the accompanying drawings.

For the Applicants:—
F. J. CLEVELAND & COMPANY,
Chartered Patent Agents,
40-43 Chancery Lane,
London, WC2A 1JQ.