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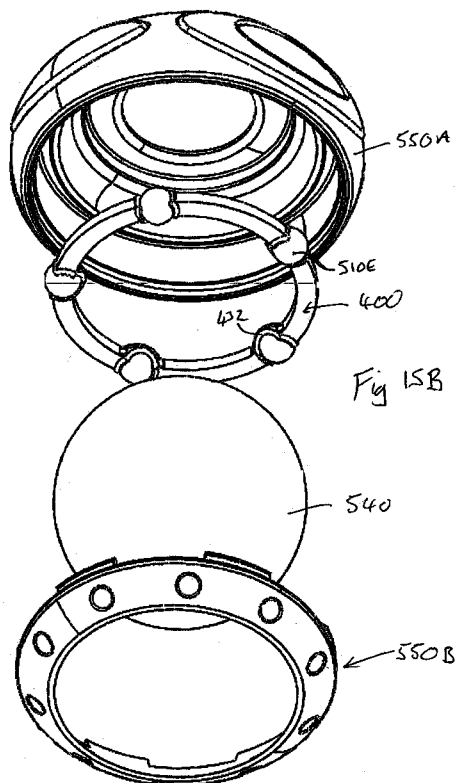
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(54) Title: BEARING APPARATUS



(57) Abstract: An apparatus for allowing a main roller, having at least one surface part which is at least part spherical, to rotate relative to a housing is provided. The apparatus includes the housing, the main roller and a bearing apparatus. The main roller is at least partially located in the housing. The bearing apparatus comprises a plurality of support rollers and a generally annular member, the generally annular member defining a number of openings therein for receiving and retaining the support rollers. At least one surface part of the generally annular member is inclined relative to the plane of the generally annular member.



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BEARING APPARATUS

Field

- 5 The present disclosure relates to a bearing apparatus, and especially, but not exclusively, to a bearing apparatus for use in rotatably coupling a spherical roller to a support.

Background

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Support of a load bearing ball in a housing is utilised in a number of commercially available products, including for example, ball transfer units and casters. A known ball transfer unit comprises a relatively large load-bearing ball which is supported relative to a generally hemispherical cup-shaped support by a large number of relatively small ball bearings, which contact both
15 the load-bearing ball and a generally hemispherical interior surface of the cup. A unit of this type can allow the load-bearing ball to be rotated quite freely, in any direction, at least when the load is directed generally vertically through the load-bearing ball. However, such units may use many tens or even hundreds
20 of ball bearings, retained within the cup-shaped support.

Summary

According to a first aspect of the present disclosure there is provided a bearing
25 apparatus for allowing a main roller having at least one surface part which is at least part spherical to rotate relative to a housing, the bearing apparatus comprising:

- a generally annular member, the member defining a number of openings therein for receiving and retaining respective support rollers,
- 30 - wherein at least one surface part of the generally annular member is inclined relative to the plane of the generally annular member.

The plane of the generally annular member may be regarded as a plane containing orthogonal diameters of the generally annular member, or
35 alternatively a plane in which a cross section of the generally annular member is generally circular. In most, if not all, embodiments this will be a plane which passes through all of the openings (or a plane parallel thereto). Such a plane

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may be referred to herein as a transverse plane of the generally annular member, since it corresponds to a transverse plane of a cylinder or cylindrical shell, a cross section or short length of which may be regarded as an annulus..

5 In an embodiment the generally annular member is a generally annular race.

In an embodiment the generally annular member comprises a main-roller-facing surface portion adapted to face generally towards said rotatable member.

10 In an embodiment at least part of the main-roller-facing surface portion is inclined relative to the plane of the annular race.

In an embodiment at least part of the main-roller-facing surface portion is inclined away from the main-roller-facing direction.

15 In an embodiment at least part of the main-roller-facing surface portion inclines away from the main-roller-facing direction, as said part extends towards the centre of the race.

20 In an embodiment the generally annular member comprises a housing-facing surface portion adapted to face generally towards said housing.

In an embodiment at least part of the housing-facing surface portion is inclined relative to the plane of the generally annular member.

25 In an embodiment each of the openings comprises a hole through the generally annular member.

30 In an embodiment each of the openings comprises an inwardly extending recess provided in a peripheral part of the generally annular member.

In an embodiment each of the openings is at least partially defined by a concave inner surface thereof.

35 In an embodiment each concave inner surface is part spherical in shape.

In an embodiment each of the openings has a transverse size which varies in

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the direction of thickness of the annular member.

In an embodiment the varying transverse size of the openings corresponds to a varying diameter of the openings.

5

In an embodiment each of the openings has a minimum transverse size which is smaller than the diameter of a support roller located therein, in use. In an embodiment this enables the support rollers to be retained in the generally annular member even when the annular member is removed from the housing.

10

In an embodiment at least some of the inclined surface part of the generally annular member is adapted to be substantially parallel to an adjacent part of a spherical or part spherical surface of said rotatable member.

15

In an embodiment the rotatable member is substantially spherical.

In an embodiment the openings are at least partially defined by a radially outer part of the generally annular member.

20

In an embodiment the openings are not enclosed at a radially outer part of the generally annular member.

In an embodiment the generally annular member has a thickness which varies from a greater thickness at a radially outer part of the generally annular member to a smaller thickness at a radially inner part of the generally annular member.

25

In an embodiment only parts of the annular member at or adjacent the openings extend radially inwardly beyond the most radially inward parts of the support rollers.

30

In an embodiment only parts of the annular member at or adjacent the openings are provided with surface parts which are inclined relative to the plane of the generally annular member.

35

According to a second aspect of the present disclosure there is provided apparatus for allowing a main roller, having at least one surface part which is at

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least part spherical, to rotate relative to a housing, the apparatus comprising:
the housing;
the main roller; and
a bearing apparatus;

5 wherein the main roller is at least partially located in the housing; and
wherein the bearing apparatus comprises a plurality of support rollers
and a generally annular member, the generally annular member defining a
number of openings therein for receiving and retaining the support rollers,
wherein at least one surface part of the generally annular member is inclined
10 relative to the plane of the generally annular member.

Providing one or more surface parts of the generally annular member inclined
relative to the plane of the generally annular member can assist in ensuring that
the generally annular member does not interfere with the main roller in use.

15

Providing one or more surface parts of the generally annular member inclined
relative to the plane of the generally annular member can assist in ensuring that
the generally annular member is maintained clear of the main roller in use.

20 Providing one or more surface parts of the generally annular member inclined
relative to the plane of the generally annular member can assist in ensuring that
the generally annular member does not interfere with the housing in use.

25 Providing one or more surface parts of the generally annular member inclined
relative to the plane of the generally annular member can assist in ensuring that
the generally annular member is maintained clear of the housing in use.

In an embodiment the generally annular member is spaced apart from the main
roller, by the support rollers.

30

In an embodiment the generally annular member is spaced apart from the
housing, by the support rollers.

35 In an embodiment, in use, the generally annular member does not contact the
main roller.

In an embodiment, in use, the generally annular member does not contact the

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housing.

In an embodiment the housing has a first end defining an opening through which a part of the main roller extends.

5

In an embodiment the housing has a second end.

In an embodiment the second end of the housing is provided with an opening to expose the main roller.

10

In an embodiment the opening provided at the second end of housing is large enough to provide manual access, through the opening, to the main roller.

In an embodiment the opening provided at the second end of housing is at least 15mm across, in at least one dimension.

15

In an embodiment the opening provided at the second end of housing is substantially circular.

20 In an embodiment the opening provided at the second end of housing is at least 15mm in diameter.

In an embodiment the opening provided at the second end of housing is at least 20mm in diameter.

25

In an embodiment the housing comprises a recessed guide portion for contacting the support rollers.

30 In an embodiment the housing is made from at least two separate housing elements.

In an embodiment the recessed guide portion comprises an internal track provided in the housing.

35 In an embodiment the internal track is defined by one of the housing elements.

In an embodiment the housing elements constitute guide elements and a first

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part of the internal track is defined by a first of the guide elements and a second part of the track is defined by a second of the guide elements.

In an embodiment the first part of the internal track is substantially annular.

5

In an embodiment at least some of the support rollers are retained in the openings so that parts of their surfaces protrude further towards the first end of the housing than does the generally annular member.

10 In an embodiment the apparatus comprises a retaining mechanism for retaining the main roller in a desired position relative to the housing.

In an embodiment the retaining mechanism is provided at or adjacent the first end of the housing.

15

In an embodiment the generally annular member is located substantially between main roller and the second end of the housing.

20 In an embodiment at least some of the support rollers are seated so that parts of their surfaces protrude further towards the second end of the housing than does the generally annular member.

In an embodiment the main roller is generally spherical.

25 In an embodiment the main roller is able to rotate in any direction.

In an embodiment the annular member is able to rotate relative to the housing.

In an embodiment the support rollers are generally spherical.

30

In an embodiment the retaining mechanism comprises a plurality of centring rollers located therein to contact a peripheral portion of the main roller.

35 In an embodiment the retaining mechanism comprises a circular or part circular edge at an opening of the housing.

In an embodiment the circular or part circular edge is deformable to facilitate

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removal of the main roller.

In an embodiment the apparatus further comprises at least one braking mechanism for applying a braking force to the main roller.

5

The braking mechanism may comprise a brake member engageable with the main roller.

10 In an embodiment, the apparatus comprises a drive mechanism for driving the main roller.

The drive mechanism may comprise a driven member engaged or engageable with the main roller to drive the main member.

15 The drive member may be driven by a motor. The drive mechanism may be driven by an electric motor.

In an embodiment the housing is open at its second end.

20 In an embodiment the apparatus is a ball transfer unit.

In an embodiment the main roller is a ground engaging member.

In an embodiment the apparatus is caster.

25

In an embodiment the apparatus is a massage device.

In an embodiment the apparatus is adapted to dispense a liquid.

30 In an embodiment the the generally annular member comprises a number of opening-defining portions which define the openings, and a number of connection portions which connect the opening-defining portions.

35 In an embodiment the opening-defining portions are each provided with at least one surface part of the generally annular member which is inclined relative to the plane of the generally annular member.

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In an embodiment the connection portions are not provided with surface parts of the generally annular member which are inclined relative to the plane of the generally annular member.

- 5 In an embodiment the connection portions are dimensioned and positioned to remain within a volume swept out by the support rollers when the generally annular member and support rollers rotate within the housing.

- 10 In an embodiment the opening provided at the second end of housing is at least 15mm across, in at least one dimension.

- 15 In an embodiment the apparatus comprises first and second housings at respective first and second ends of an elongate main roller. In an embodiment the main roller is a generally cylindrical member having a portion at each end which comprises a part cylindrical surface.

According to a third aspect of the present disclosure there is provided a massage device comprising:

- 20 a ball for contact with a person or animal for assisting in massage;
a housing, wherein the ball is provided at least partially within the housing; and
a plurality of support rollers arranged to provide support between the ball and the housing while allowing the ball to rotate relative to the housing.

- 25 In an embodiment the ball is between 35mm and 80mm in diameter.

In an embodiment the housing has a first end defining an opening through which a part of the ball extends.

- 30 In an embodiment the housing has a second end.

In an embodiment the second end of the housing is provided with an opening to expose the ball.

- 35 In an embodiment the opening provided at the second end of housing is large enough to provide manual access, through the opening, to the ball.

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In an embodiment the opening provided at the second end of housing is at least 15mm across, in at least one dimension.

5 In an embodiment the opening provided at the second end of housing is substantially circular.

In an embodiment the opening provided at the second end of housing is at least 15mm in diameter.

10 In an embodiment the opening provided at the second end of housing is at least 20mm in diameter.

In an embodiment the support rollers are supported within the housing by a generally annular race.

15 In an embodiment the race is in accordance with the first aspect.

In an embodiment the ball is retained in the housing by a retaining portion at or adjacent the first end of the housing.

20 In an embodiment the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by an object via the opening in said second end.

25 In an embodiment the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by at least one finger or thumb of a person via in said second end.

30 In an embodiment the massage device is in accordance with the second aspect.

According to a fourth aspect of the present disclosure there is provided a massage device comprising:

35 a ball for contact with a person or animal for assisting in massage;
a housing, wherein the ball is provided at least partially within the housing; and
wherein the housing has a first end defining an opening through

- 10 -

which a part of the main roller extends and a second end, wherein the second end of the housing is provided with an opening to expose the ball.

5 In an embodiment the opening provided at the second end of housing is large enough to provide manual access, through the opening, to the ball.

In an embodiment the opening provided at the second end of housing is at least 15mm across, in at least one dimension.

10 In an embodiment the opening provided at the second end of housing is substantially circular.

In an embodiment the opening provided at the second end of housing is at least 15mm in diameter.

15 In an embodiment the opening provided at the second end of housing is at least 20mm in diameter.

20 In an embodiment the device further comprises a plurality of support rollers arranged to provide support between the ball and the housing while allowing the ball to rotate relative to the housing.

In an embodiment the support rollers are supported within the housing by a generally annular race.

25 In an embodiment the race is in accordance with the first aspect.

In an embodiment the ball is retained in the housing by a retaining portion at or adjacent the first end of the housing.

30 In an embodiment the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by an object via the opening in said second end.

35 In an embodiment the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by at least one finger or thumb of a person via in said second end.

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In an embodiment the massage device is in accordance with the second and/or third aspect.

- 5 In an embodiment the massage device is provided with a fluid dispenser attached or attachable thereto, for dispensing fluid to the interior of housing.

In an embodiment the fluid dispenser is attached or attachable to the second end of the housing.

10

In an embodiment the massage dispenser is adapted to dispense fluid into the interior of housing through the opening at the second end of the housing.

- 15 In an embodiment the fluid dispenser comprises a compressible container adapted to release fluid upon the application of pressure.

- According to a fifth aspect of the present disclosure there is provided a race for accommodating a plurality of support rollers so that the support rollers can space apart a spherical or part spherical surface of a main roller from a housing in which the main roller is at least partially located, wherein the race is generally annular and provides:
- 20 a plurality of openings for accommodating respective support rollers;
a housing-facing surface; and
a main-roller-facing surface;
- 25 wherein at least part of the a main-roller-facing surface is inclined relative the plane of the generally annular race.

- The plane of the generally a annular race may be defined as a plane containing orthogonal diameters of the generally annular race.

30

It will be appreciated that features and characteristics set out in relation to any one of the above aspects may be incorporated in other aspects.

Brief description of the drawings

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Embodiments will now be described, by way of example only, with reference to the accompanying drawings in which:

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Fig. 1 is a plan view of an embodiment of part of a bearing assembly in accordance with the present disclosure, in the form of a bearing race;

5 Fig. 2 is a cross sectional view on II-II of the bearing race of Fig. 1;

Fig. 3 is a cross sectional view of the bearing race of Fig. 1 showing support rollers retained therein;

10 Fig. 4 is a cross sectional view on IV-IV of the bearing race of Fig. 1;

Fig. 5 is a schematic cross sectional view showing the bearing race of Fig. 1, in use, in a caster or ball transfer unit;

15 Fig. 6 is a plan view of an alternative embodiment of part of a bearing assembly in accordance with the present disclosure, in the form of a bearing race;

Fig. 7 is a cross sectional view on VII-VII of the bearing race of Fig. 6;

20 Fig. 8 is a plan view of a further alternative embodiment of part of a bearing assembly in accordance with the present disclosure, in the form of a bearing race;

Fig. 9 is a cross sectional view on IX-IX of the bearing race of Fig. 8;

25 Fig. 10 is a schematic cross sectional view showing the bearing race of Figs 8 and 9, in use in a roller apparatus;

30 Fig. 11 is a perspective view of an alternative embodiment of part of a bearing assembly in accordance with the present disclosure, in the form of a bearing race, showing a first axial end;

Fig. 12 is a perspective view of the bearing race of Fig. 11, illustrating use with a main roller and support rollers which engage the main roller.

35 Fig. 13 is a perspective view of the bearing race of Fig. 11, showing a second axial end;

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Fig. 14 is a perspective view corresponding to Fig. 13, but also showing support rollers retained in the bearing race;

5 Fig. 15A is a schematic cross sectional view, illustrating use of the bearing race of Fig. 11 in use in a massage device;

Fig. 15B is a perspective exploded view of the massage device illustrated in Fig. 15A;

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Fig. 16 is a side view of the massage device illustrated in Fig.s 15A and 15B;

Fig. 17 is a perspective view of part of a housing of the massage device illustrated in Fig.s 15A, 15B and 16.

15

Fig. 18 is a schematic cross sectional view of an alternative embodiment of a massage device;

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Fig.s 19A to 19G illustrates further variations and embodiments of massage devices;

Fig. 20 illustrates a further embodiment of a massage device; and

25

Fig.s 21A to 21D illustrate schematically, in plan view, alternative ball-bearing/race arrangements.

Description of embodiments

30 With reference to Fig.s 1 to 5 an embodiment of a bearing apparatus in accordance with an aspect of the present disclosure comprises a generally annular race, generally designated 1. The race 1 has a central aperture 5 and defines a number of holes 10A to 10F for receiving and retaining ball bearings. The holes are spaced equally about the race 1, and in this embodiment six
35 holes are provided, although it will be appreciated that other numbers of holes could be provided as desired.

The race 1 has an upper surface 20 and a lower surface 30, as illustrated in

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Fig.s 2 to 4, but it will be appreciated that the terminology 'upper' and 'lower', and corresponding terminology relating to vertical directions or positions, is used for convenience only as the race 1, and apparatus including the race 1, can be used in various orientations according to the use that is being made of it. As illustrated, the lower surface 30 is adapted to face towards a rotatable member, such as a main ball of a caster or ball transfer unit, for example a main roller 40, as illustrated in Fig. 5. Fig. 1 illustrates the lower surface 30 of the race 1.

10 In this embodiment the upper surface 20 is generally flat or planar and is generally coplanar or parallel with the plane of the race 1. The plane of the race may be regarded as the plane of the paper in relation to the race 1 as illustrated in Fig. 1. That is, the plane of the race should be regarded as a plane containing orthogonal diameters of the generally circular or annular race, and
15 can also be regarded as a plane in which a cross section of the generally circular race is generally circular. In Fig. 1 this can also be seen to be a plane which passes through all of the holes 10A to 10F (or a plane parallel thereto). The plane of the race is designated P in Fig. 4, and it should be appreciated that the plane P of the race 1, as indicated in Fig. 4, is orthogonal to the plane
20 of the page. Such a plane may be referred to herein as a transverse plane of the race (or of the generally annular member), since it corresponds to a transverse plane of a cylinder or cylindrical shell, a cross section or short length of which may be regarded as being annular. A corresponding meaning of the plane of the race applies to the other embodiments described herein.

25 The lower surface comprises a surface part 32 which is inclined upwardly towards the centre of the race 1 relative to the (transverse) plane of the race 1. This allows a spherical main roller to be accommodated under the race 1, without an upper part of the spherical main roller engaging an inner lower part
30 of the race 1. In the illustrated embodiment the lower surface further comprises a radially inner part 34, which is generally coplanar or parallel with the (transverse) plane of the race 1, which may provide additional strength, but which may be omitted in various embodiments.

35 The holes 10A to 10F are defined by concave inner surfaces, e.g. 12A. The holes are adapted to receive and retain support rollers, which in this embodiment are in the form of ball bearings, e.g. 38B, 38E, located in

- 15 -

respective holes. The concave inner surfaces, e.g. 12B, of the holes are part spherical and are configured to fit closely around the ball bearings, e.g. 38B, 38E, so that the ball bearings are retained in the holes, but still able to rotate relatively freely. The maximum lateral diameter of the holes is part way through the thickness of the race 1, and openings, e.g. 34E, 35E, of each hole are slightly smaller in the diameter than the diameter of the ball bearing, e.g. 38E to be retained in the hole, so that once inserted into a hole the ball bearing is retained. The race may be made of a material which provides a degree of elasticity, such as a suitable plastic, to facilitate insertion and removal of ball bearings without requiring unduly fine manufacturing tolerances if the load bearing requirements of the race allow, or alternatively (or additionally) a stronger and less deformable material, such as a suitable metal, can be used effectively suitable manufacturing tolerances are utilised.

With particular reference to Fig. 5, it will be appreciated that the shape of the lower surface 30 of the race 1, and in particular provision of the inclined surface part 32, allows a main roller 40 to be provided under the race 1 so that the main roller 40 is engaged by the ball bearings 38B, 38E without an upper part of the spherical main roller engaging an inner lower part of the race 1. As illustrated in Fig. 5, apparatus in which the race 1 is used may comprise a cuplike housing 50. In the embodiment of Fig. 5 the housing 50 comprises a first end 52 which provides an opening from which the main roller 40 projects, and a second closed end 54 (although in alternative embodiments, some of which are described below, an open second end may be provided). An interior wall 56 at the second end 54 provides a circular track 58, which the ball bearings 38B, 38E engage, and in which the ball bearings 38B, 38E run. The housing 50 has a side wall 59, which is generally frustoconical in the illustrated embodiment, but which may be any suitable desired shape, such as, for example, generally cylindrical, or part-spherical. At or adjacent the first end 52, a retaining mechanism 60, for retaining and centring the main roller 40 is provided. This may be a simple edge or lip of the first end of the housing, possibly provided with a seal or cleaning strip (as will be understood from existing ball transfer units) and in Fig. 5 is illustrated schematically as comprising a number of centring bearings 61. In the illustrated, "ball down" orientation the apparatus may be suitable for use as a castor, but it will be appreciated that in an inverted, "ball up" orientation the illustrated apparatus may be suitable for use as a ball transfer unit, possibly with desired changes to

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the shape or other characteristics of the housing 50. Thus Fig.5 should be considered to illustrate not only a caster but also a ball transfer unit.

It will be appreciated that the size of the central aperture 5 (relative to the positions of the holes 10A to 10F) and the angle at which the inclined surface part 32 of the lower surface is inclined, are set so as to provide clearance between the race 1 and a main roller, for example a main roller 40, as illustrated in Fig. 5, and may be adjusted according to the desired position of the race 1 and ball bearings relative to the main roller. For example, in Fig. 5 the race 1 and ball bearings are relatively close to the top of the main roller 40. In one useful embodiment, as illustrated in Fig. 4, the angle of inclination A_1 of the inclined surface part 32 relative to the transverse plane P of the race 1, is between approximately 12 degrees and approximately 17 degrees. However, in a variation it might be desired to have the race 1 and ball bearings nearer a horizontal central plane of the main roller 40, in which case the central aperture 5 would need to be larger, and the angle of inclination of the inclined surface part 32 (relative to the plane of the race 1) would desirably be greater.

It will also be appreciated that mechanisms for controlling the main roller (not illustrated) may be included if desired.

For example, one or more braking mechanisms may be provided to slow or stop rotation of the main roller. This may be useful in enhancing control of loads supported by a caster (e.g. in the context of a shopping trolley) utilising one or more ground engaging main rollers, in controlling movement of objects supported on a ball transfer unit utilising one or more object-supporting main rollers, or in many other applications where it is beneficial to control rotation of a main roller. An embodiment of such a mechanism comprises at least one braking member mounted in the housing, which can engage the main roller to retard or stop its rotation. The braking member may be moveable between an engaging (braking) position and a non-engaging position in which it does not retard or stop rotation of the main roller. An example of a ball down caster including braking mechanisms is disclosed in US Patent No. 2,867,546 (Oppenheimer) the entire disclosure of which is incorporated herein by reference, although it will be appreciated that there are many alternative braking arrangements which could be used. An optional braking mechanism 70 is illustrated schematically in Fig. 5, and comprises a braking surface 71 which

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can be moved so as to engage or be clear of the main roller 40.

In another example, one or more driving mechanisms can be included (additionally or alternatively to one or more braking mechanisms). This may be
5 useful in providing motive force to an object or load supported by a caster (e.g. in the context of a trolley for moving heavy items) utilising one or more ground engaging main rollers, in facilitating movement of objects supported on a ball transfer unit utilising one or more object-supporting main rollers, or in many other applications where it is beneficial to impart drive to main roller. As
10 illustrated schematically in Fig. 5, an embodiment of such a driving mechanism 73 comprises at least one driving member 74 (eg a drive wheel or roller), controllable by a motor 75 or similar, mounted in or on the housing 50. The driving member 74 can engage the main roller 40 and impart drive thereto. In some embodiments it may be preferred that at least three driving members can
15 contact the main roller, so that the direction of rotation of the main roller can be effectively controlled. In one alternative, an axis of rotation of a driving member may be controllable, so that the direction of rotation imparted to the main roller can be controlled. In such an embodiment the driving member may be substantially spherical. The driving member may be controllable to retard or
20 stop the rotation of the main member, and may be mounted so as to be selectively engaged with and/or disengaged from, the main roller, as desired.

It will be appreciated that the examples of a caster and a ball transfer unit are illustrative only, and not exhaustive, since the present disclosure is potentially
25 applicable to a wide range of products and uses. For example, embodiments including a main roller could be used to replace fixed wheels, for example in bi-fold doors in windows (whether or not the roller is required to run in a track). A further use is in relation to a ball in a pointing or input device, such as a computer peripheral, mouse or trackpad, or other apparatus in which
30 measurement of the rotation of a ball is used as a desired input. Other applications may include, but are not limited to: uses in support members for architecture or civil engineering applications, where the bearing arrangement may act as a load distribution mechanism; uses in gear systems which include (or can include) spherical or part spherical members; uses in toys; and in
35 therapeutic products and cosmetic packaging, as will be exemplified below in due course. Further, if a suitable main roller is used, for example a main roller made from a ferromagnetic material, especially a main roller having a number

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of regions with varying magnetic characteristics, drive, braking and/or sensing of the rotation could be performed by suitable electromagnetic components (such as appropriate sensors, coils or electromagnets) without contact with the ball. Of course, contactless sensing of the rotation of the main roller may be
5 achieved by alternative means, such as by optical tracking of a suitable ball, as is known from existing computer input devices.

Fig.s 6 and 7 illustrate an alternative race 100, which has many similarities to the race 1. The similarities will not be described in detail. It will be appreciated
10 that in addition to having an inclined ball-facing or lower surface portion 132, the race 100 also has an inclined upper surface portion 134 at the radially outer part of the upper surface of the race 100. This can assist in avoiding engagement of the radially outer part of the upper surface of the race 100 with an interior wall of a housing, whilst allowing a more compact housing shape to
15 be used. Fig. 6 illustrates a housing-facing surface 120, of the race 100. The housing-facing surface 120 is illustrated as the upper surface of the race 100 in Fig. 7, although it will be appreciated that if the race 100 were used in a different orientation (for example in a ball transfer unit rather than in a caster) this housing-facing surface 120 would not necessarily be the 'upper' surface of
20 the race 100, in use.

Fig.s 8 and 9 illustrate a further alternative race 200, which has many similarities to the race 1 and race 100. The similarities will not be described in detail, although it will be appreciated that the race 200 provides a ball facing
25 (or, in an example orientation, 'lower') surface which comprises a surface part 232 which is inclined upwardly towards the centre of the race 200 relative to the (transverse) plane of the race 200. Unlike the races 1 and 100, in the race 200 the ball bearings are, in use, accommodated in recesses, e.g. 210A, 210B, which are open at the radially outer extreme of the race 200. This can assist in
30 avoiding engagement of the radially outer part of the upper surface of the race 100 with an interior wall of a housing, whilst allowing a more compact housing shape to be used. It will be appreciated that the recesses, e.g. 210A can effectively receive and retain support rollers, such as ball bearings because, in a similar manner to other embodiments, the recesses, e.g. 210A, 210B are
35 formed with part spherical interior wall surfaces, e.g. 212B, which are configured to snugly house, and thereby retain the ball bearings. More specifically, whilst the maximum diameter of each recess is slightly greater than

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the diameter of a ball bearing to be accommodated, any openings of the recesses are smaller in at least one dimension than the diameter of a ball bearing to be accommodated. This allows the ball bearings to be effectively snap-fitted into the recesses, and retained therein. However, the ball bearings
5 are retained in the recesses sufficiently loosely to allow rotation of the ball bearings in use, so that the bearing assembly can function effectively.

Fig. 10 provides a schematic cross sectional view of an apparatus, roller apparatus 300, in which the main roller is not spherical. The main roller 340 is
10 elongate and comprises a cylindrical body 342 with hemispherical ends 344, 346. Each of the hemispherical ends 344, 346, is accommodated and retained in a suitable housing 350A, 350B, which may be identical or similar to the housing 50. The hemispherical ends are engaged by support rollers e.g. 338B, 338E, which are retained by races 301A, 301B, in a manner which will be
15 appreciated from the foregoing description. Although the housings 350A, 350B, may, if desired, be identical or similar to the housing 50, as illustrated the housings 350A, 350B are configured so that tracks, e.g. 358, are of greater diameter proportional to the housing (facilitating a more opposed arrangement of the support rollers e.g. 338B, 338E for greater lateral loadbearing) and the
20 races used are consequently similar to the race 200 to avoid engagement of the radially outer parts of the races 301A, 301B with interior walls of the housings 350A, 350B. The main roller 340 may be of use in supporting an endless conveyor, such as a belt of a belt conveyor, and it will be appreciated that the orientation of the apparatus may be varied from that shown (e.g. may be
25 horizontal rather than vertical) with suitable modification of load bearing parts. The described apparatus is believed to provide benefits over at least some known arrangements for supporting elongate rollers, by providing greater tolerance of the bearing arrangement to relative movement of the ends of the elongate roller. Further, it will be appreciated that the end parts are illustrated
30 as being hemispherical, but variations are possible: for example, the very ends of the main roller could be flattened, since these parts will not, in use, ever engage the support rollers. Further, as illustrated the part-spherical surfaces transition smoothly to the cylindrical body 342, but alternative forms are possible and include provision of one or more stepped, contoured, and/or
35 concave regions between the part-spherical surfaces and the cylindrical body 342. It is desirable that at least the surface parts which engage the support rollers are part-spherical surfaces.

- 20 -

Fig.s 11 to 14 illustrate a further alternative race 400, which has many similarities to the race 300. The similarities will not be described in detail. The race 400 provides a ball facing surface (which, in an example orientation, corresponds to a 'lower' surface) which comprises a surface part 432 which is inclined upwardly towards the centre of the race 400 relative to the (transverse) plane of the race 400. As described in relation to the race 1, in some embodiments, and as illustrated in Fig.s 11 to 14, the angle of the inclined surface part 432 relative to the (transverse) plane of the race 1, is between approximately 12 degrees and approximately 17 degrees. (In variations in which it is desired to have the race and ball bearings nearer a horizontal central plane of the main roller the angle of inclination of the inclined surface part 432 (relative to the plane of the race 400) would desirably be greater.

Unlike the races 1, 100, 200 and 300, in the race 400, along most of its circular length the race 400 does not extend radially inwardly beyond the most radially inward parts of the ball bearings. Only the parts at or adjacent the recesses, e.g. 410A extend radially inwardly beyond the most radially inward parts of the ball bearings. Thus the race 400 may be considered to comprise a plurality of recess defining portions 434 connected by a plurality of connection portions 436, with the connection portions 436 being smaller in cross sectional size than the recesses 410A provided by the recess defining portions 434. The connection portions 436 are substantially in line with the centres of the recesses 410A. When the race 400 and associated ball bearings, e.g. 510B, 510E rotate, the connection portions 436 stay within the area swept out by the ball bearings. Thus the connection portions 436 do not, in use, interfere with either the main roller or the housing, which are spaced apart by the ball bearings. In this embodiment, therefore, the connection portions 436 need not be provided with inclined surface parts in order to avoid interference with the main roller and/or housing.

In use, the recess defining portions 434 extend beyond the ball bearings e.g. 510B, 510E captured and retained by the respective recesses e.g. 410A. The recess defining portions 434 are therefore provided with surface parts 432 which are inclined, upwardly towards the centre of the race 400, relative to the (transverse) plane of the race 400.

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The race 400 can be injection moulded from a suitable plastic. Such an embodiment may be usefully employed for applications in which the race is not required to bear substantial loads.

- 5 Fig.s 15A to 17 illustrate an apparatus in which the race 400 is used, in the form of a massage device 500. The massage device comprises a main roller in the form of a massage ball 540, and further comprises a housing 550, which is made in two parts for ease of manufacture by plastics injection moulding, and which comprises an upper housing part 550A and a lower housing part 550B.
- 10 The housing parts 550A and 550B are adapted to be permanently joined together, for example by snap-fitting, and in this embodiment by snap-fitting of annular or circumferentially distributed interlocking parts 552A, 552B. The upper housing part 550A provides an internal track 558, for engagement by ball bearings e.g. 510B, 510E (also shown in Fig. 14) which are retained in race
- 15 400. The upper housing part 550A also provides a sizeable upper opening 570, at what might be regarded as the second end of the housing, into which the massage ball extends, so that the top of the massage ball is exposed but still below the top of the housing 550. The opening 570 facilitates application of lubricants and topical liquids onto the massage ball, which can enhance
- 20 effectiveness of the massage, and may assist in cleaning of the device 500. The device has been found to be effective for both human and animal, especially equine, massage, and facilitated removal of animal hair is therefore beneficial.
- 25 The massage ball 540 is retained in the housing 550 by provision of a circular lower edge 555 of a skirt part 556 of the lower housing part 550B. The lower edge engages the massage ball just below its widest part. The skirt part 556 is provided with a number of slots 557 (not shown in Fig. 15B), which extend perpendicular to the lower edge 555. The slots 557 facilitate forced
- 30 deformation of the skirt part in order to increase the diameter of the lower edge 555. Thus although the lower edge, in use, securely retains the massage ball 540, the massage ball 540 can be easily removed from the housing by manual application of force to the exposed top of the massage ball. That is, pressure on the top of the massage ball can effectively push the massage ball out of the
- 35 bottom of the housing. This greatly facilitates cleaning of the device.

It will be appreciated that because the ball bearings are retained in the race

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400, even in the absence of the massage ball 540, removal of the ball does not result in freeing, or loss of, the ball bearings, and cleaning of the device is convenient. To assist in avoiding deformation of the recesses (eg 410A) to an extent which might release the ball bearings e.g. 510B, 510E when and if the race 400 is deformed to allow removal of the race 400 from the housing 500, the parts of the race which define the recesses may be relatively stiff (compared to other parts of the race). Desired relative stiffness may be provided by design of the shape and/or configuration and or materials used for the various parts.

Fig. 18 illustrates schematically an alternative embodiment of a massage device 600. The embodiment 600 has many functional and structural similarities to the massage device 500, which will be appreciated by the addressee, and which will not be described in detail, and may utilise the race 400, as illustrated. (It will be appreciated that Fig. 18 and subsequent drawings are schematic only and that, in practicable embodiments, more refined features, such as features akin to corresponding features of the embodiment of Figs 15A to 17, may be incorporated.) The massage device 600 comprises an upper housing part 650A and a lower housing part 650B. The housing parts 650A and 650B are adapted to be permanently joined together, for example by snap-fitting of appropriate interlocking parts (not shown). However, unlike the embodiment 500, in which the internal track 558 is provided entirely by the upper housing part 550A, in the massage device 600 the lower housing part 650B projects into the upper housing part 650A and provides a generally annular lower track part 658B which forms part of an internal track 658, together with an upper track part 658A provided by the upper housing part 650A. In this embodiment, as can be seen in Fig. 18, the lower and upper track parts each provide a contoured concave surface which can be engaged by support rollers (ball bearings, eg 610B, 610E). This configuration can facilitate manufacture, and in particular may require less complex moulding if the parts are made by plastic injection moulding.

As illustrated the massage device 600 is also provided with a dispenser 680 adapted to facilitate application of lubricants and/or other topical liquids onto the massage ball, which can enhance effectiveness of the massage. The capsule fits removeably into opening 670 and can be retained therein during a massage. The dispenser 680 is a container for liquid, adapted to allow liquid to

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be expelled from a cavity 681 provided in the dispenser into the interior of the massage device 600, preferably in response to application of pressure. Thus the dispenser 680 may be regarded as desirably being at least somewhat compressible. In the illustrated embodiment, dispenser 680 comprises a
5 bottom wall 682, which in use is located close to main roller 640, and which is provided with a feed hole 683 therethrough. Dispenser 680 further comprises at least one side wall 684, and an upper portion 686, which closes the top of the dispenser 680 and which may be forced towards the bottom wall 682 in order to force fluid through the feed hole 683. The upper portion 686 is sealed against
10 the side wall 684 to avoid upwards leakage of the fluid. The dispenser 680 may be provided with one or more outwardly projecting members or flange 685, which extends over the edges of the opening 670 to avoid passage of the dispenser 680 too far into the massage device 600. The dispenser 680 may be provided with an internal restoring element, in this embodiment a helical spring
15 687, to assist in restoring the upper portion 686 to its original, uppermost, position. In this embodiment the restoring element is retained on a retaining projection which extends from the upper portion into the cavity. In an alternative embodiment a dispenser may be collapsible, rather than resiliently compressible, but such an alternative is considered to provide less precise
20 control over the dispensing of liquid.

Fig.s 19A to 19G illustrate alternative embodiments, and only the pertinent features will be described. For clarity of illustration of other features no races are shown in Fig.s 19A to 19G (or 20), but appropriately dimensioned races
25 should be considered to be included in the illustrated embodiments, accommodated in a manner similar to the manner in which race 400 is accommodated in the massage device 600.

In massage device 700 of Fig. 19A, an internal track 758 is provided by an
30 upper housing portion 750A providing an upper part of the internal track which has two generally flat (but generally annular) surfaces 758A, 758B which can be contacted by the support rollers. A lower housing portion 750B provides a lower part of the internal track 758 which has a generally flat (but generally annular) surface 758C which can be contacted by the support rollers. This is in
35 contrast to the contoured corresponding surfaces of Fig. 18. Massage device 700 is further configured to provide a number of angularly spaced vents 760, between adjacent surfaces of the upper housing portion 750A and the lower

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housing portion 750B, which may allow debris which would otherwise be trapped within the massage device (until cleaning thereof) to exit.

In massage device 800 of Fig. 19B, an internal track 858 is provided by an upper housing portion 850A providing an upper part of the internal track which has three generally flat (but generally annular) surfaces 858A, 858B, 858C which can be contacted by the support rollers. A lower housing portion 850B provides a lower part of the internal track 858 which has a generally flat (but generally annular) surface 858D which can be contacted by the support rollers. No vents are provided in this embodiment.

In massage device 900 of Fig. 19C, an internal track 958 is provided by an upper housing portion 950A providing an upper part of the internal track which has two generally flat (but generally annular) surfaces 958A, 958B which can be contacted by the support rollers. A lower housing portion 950B provides a lower part of the internal track 958 which has a generally flat (but generally annular) surface 958C which can be contacted by the support rollers. The internal track is expanded laterally outwardly (compared to earlier embodiments) to provide annular void space 960 which may serve to trap debris until cleaning and/or to allow some lateral expansion of the race (provided the configuration of the rest of the device allows this, eg by allowing some downwards movement of the lower housing portion 950B relative to the upper housing portion 950A) which may be desirable under some circumstances. No vents are provided in this embodiment, as this embodiment is envisaged for use in a clean environment in which it is preferred that debris be retained in the device until cleaning.

In massage device 1000 of Fig. 19D, an internal track 1058 is provided by an upper housing portion 1050A providing an upper part of the internal track which has a concave surface 1058A. A lower housing portion 1050B provides a lower part of the internal track 1058 which has a generally flat (but generally annular) surface 958C which can be contacted by the support rollers. Vents 1060 are provided in this embodiment.

Massage device 1100 of Fig. 19E, is similar to massage device 1000 except that lower housing portion 1150B provides a lower part of the internal track 1158 which has a contoured slightly concave surface 1158A which can be

- 25 -

contacted by the support rollers.

Massage device 1200 of Fig. 19F, is similar to massage device 1000 except that no vents are provided in this embodiment.

5

Massage device 1300 of Fig. 19G, is similar to massage device 1100 except that no vents are provided in this embodiment.

It will be appreciated that many more such variations are possible.

10

As stated above, although no races are shown in Fig.s 19A to 19G, appropriately dimensioned races should be considered to be included in the illustrated embodiments, 700, 800, 900, 1000, 1100, 1200, 13000. An appropriate race can maintain angular spacing of the support rollers (ball bearings in these embodiments) while not preventing the support rollers from moving around the internal tracks, and assist in maintaining smooth operation. Further, having the support rollers maintained in a race can assist during assembly, and can maintain the bearings in position when the main roller is removed for cleaning or other maintenance.

20

Fig. 20 illustrates an embodiment of a massage device 1400, similar to the massage device 600 of Fig. 18, but without a dispenser attached. Like the massage device of Fig.s 15A to 17, massage device 1400 is provided with a bottom edge part (circular lower edge 555 in Fig. 15A) to retain the massage ball in the housing. However, the massage device 1400 provides a low friction insert 1455 to provide the lower edge, which may enhance smoothness and feel of the ball action, and/or allow more choice of material for other parts of the housing. Although no race is shown in Fig. 20, an appropriately dimensioned race should be considered to be included.

30

The races of the massage devices may be made by injection moulding and suitable polymers include include ABS, PPSF, PTFE, PA, PP, POM and PC. A low coefficient of friction is desirable, and a value less than 0.4 is desirable.

35

The main rollers may be made from metals or plastics, including, polyester resin, stainless steel, aluminium, ABS, PC, POM, PPSF, PA (nylon).

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Returning to the overall disclosure provided herein, rather than the specifics of massage devices, it will be appreciated that many variations and configurations of support roller arrangement are possible, and Figs 21A to 21D illustrate schematically, in plan view, a small but illustrative number of alternative ball-bearing/race arrangements relative to a spherical main roller. Figs 21A and 21B show arrangements in which a race 1500 is substantially the same diameter as the associated main roller 1510, so that the angle subtended by the centres of the support rollers at the centre of the main roller relative to a horizontal plane (assuming the race 1500 is horizontal) will be relatively small – approximately 30 degrees or less. Further, Figs 21A and 21B illustrate configurations with five and six rollers, respectively.

Figs 21C and 21D show arrangements in which a race 1600 has a substantially smaller diameter than the associated main roller 1610, so that the angle subtended by the centres of the support rollers at the centre of the main roller relative to a horizontal plane will be relatively large – approximately 45 degrees or more. Figs 21C and 21D illustrate configurations with five and six rollers, respectively.

It has been found that, at least under some circumstances, an odd number of support rollers is well suited to linear applications and an even number well suited to applications with more frequent changes of direction.

In general, in arrangements in accordance with the present disclosure, it is preferred that the angle subtended by the centres of the support rollers at the centre of the main roller relative to a horizontal plane is between 5 and 80 degrees. An angle of somewhere between 25 and 60 degrees is often appropriate.

Furthermore, the ratio between the main roller diameter and the support roller diameter bears some consideration. A ratio of between 2:1 and 17:1 is preferred. A ratio of approximately 5:1 to 10:1 works still better, at least under some circumstances, a ratio of 8:1 to 9:1 is often still better, and at least under some circumstances a ratio of 60:7 has been found to be optimal.

In the claims which follow and in the preceding description, except where the context requires otherwise due to express language or necessary implication,

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the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

5

It will be understood to persons skilled in the art of the invention that many modifications may be made without departing from the spirit and scope of the invention.

10

It is to be understood that, if any prior art publication is referred to herein, such reference does not constitute an admission that the publication forms a part of the common general knowledge in the art, in Australia or in any other country.

15

CLAIMS

1. A bearing apparatus for allowing a main roller having at least one surface part which is at least part spherical to rotate relative to a housing, the bearing apparatus comprising a generally annular member, the member defining a number of openings therein for receiving and retaining respective support rollers,
wherein at least one surface part of the generally annular member is inclined relative to the plane of the generally annular member.
2. A bearing apparatus according to claim 1, wherein the generally annular member is a generally annular race.
3. A bearing apparatus according to either preceding claim, wherein the generally annular member comprises a main-roller-facing surface portion adapted to face generally towards said rotatable member and wherein at least part of the main-roller-facing surface portion is inclined relative to the plane of the annular race.
4. A bearing apparatus according to claim 3, wherein at least part of the main-roller-facing surface portion inclines away from the main-roller-facing direction, as said part extends towards the centre of the race, to thereby avoid interference of the race with the main roller.
5. A bearing apparatus according to any preceding claim, wherein the generally annular member comprises a housing-facing surface portion adapted to face generally towards said housing and wherein at least part of the housing-facing surface portion is inclined relative to the plane of the generally annular member.
6. A bearing apparatus according to any preceding claim, wherein each of the openings comprises a hole through the generally annular member.
7. A bearing apparatus according to any preceding claim, wherein each of the openings comprises an inwardly extending recess provided in a peripheral part of the generally annular member.
8. A bearing apparatus according to any preceding claim, wherein each of the

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openings is at least partially defined by a concave inner surface thereof.

9. A bearing apparatus according to claim 8, wherein each concave inner surface is part spherical in shape.

5

10. A bearing apparatus according to any preceding claim, wherein each of the openings has a transverse size which varies in the direction of thickness of the annular member.

10 11. A bearing apparatus according to any preceding claim, wherein each of the openings has a minimum transverse size which is smaller than the diameter of a support roller located therein, in use.

12. A bearing apparatus according to any preceding claim, wherein the
15 generally annular member can retain support rollers in the openings thereof, when the annular member is removed from the housing.

13. A bearing apparatus according to any preceding claim, wherein the
20 openings are at least partially defined by a radially outer part of the generally annular member.

14. A bearing apparatus according to any preceding claim, wherein the
openings are not enclosed by a radially outer part of the generally annular member.

25

15. A bearing apparatus according to any preceding claim, wherein at least part of the generally annular member has a thickness which varies from a greater thickness at a radially outer part of the generally annular member to a smaller thickness at a radially inner part of the generally annular member.

30

16. Apparatus for allowing a main roller, having at least one surface part which is at least part spherical, to rotate relative to a housing, the apparatus comprising:

the housing;
35 the main roller; and
a bearing apparatus;
wherein the main roller is at least partially located in the housing; and

- 30 -

wherein the bearing apparatus comprises a plurality of support rollers and a generally annular member, the generally annular member defining a number of openings therein for receiving and retaining the support rollers, wherein at least one surface part of the generally annular member is inclined
5 relative to the plane of the generally annular member.

17. An apparatus according to claim 16, wherein the housing has a first end defining an opening through which a part of the main roller extends, and wherein the housing has a second end.

10

18. An apparatus according to claim 17, wherein the second end of the housing is provided with an opening to expose the main roller.

19. An apparatus according to claim 18, wherein the opening provided at the
15 second end of housing is large enough to provide manual access, through the opening, to the main roller.

20. An apparatus according to any one of claims 16 to 19, wherein the annular member is able to rotate relative to the housing.

20

21. An apparatus according to claim 20, wherein the generally annular member comprises a number of opening-defining portions which define the openings, and a number of connection portions which connect the opening-defining portions.

25

22. An apparatus according to any one of claims 16 to 21, wherein the housing comprises a recessed guide portion for contacting the support rollers, the recessed guide portion comprising an internal track provided in the housing.

30 23. An apparatus according to claim 22, wherein the housing comprises first and second housing elements which constitute guide elements, and wherein a first part of an internal track is defined by a first guide element and a second part of the internal track is defined by a second guide element.

35 24. An apparatus according to claim 23, wherein the first part of the internal track is substantially annular.

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25. An apparatus according to any of claims 17 to 20, or any of claims 21 to 24 when dependent on any one of claims 17 to 20, wherein at least some of the support rollers are retained in the openings so that parts of their surfaces protrude further towards a first end of the housing than does the generally
5 annular member.

26. An apparatus according to any one of claims 16 to 25, wherein the apparatus comprises a retaining mechanism for retaining the main roller in a desired position relative to the housing.

10 27. An apparatus according to any of claims 16 to 26, further comprising a retaining mechanism for retaining the main roller at least partially within the housing, wherein the retaining mechanism comprises a circular or part circular edge at an opening of the housing, and wherein the circular or part circular edge is deformable to facilitate removal of the main roller.

15 28. An apparatus according to any one of claims 16 to 27, further comprising at least one braking mechanism for applying a braking force to the main roller.

20 29. An apparatus according to any one of claims 16 to 28, also in accordance with any one or more of claims 1 to 16.

30. An apparatus according to any one of claims 16 to 29, being a ball transfer unit.

25 31. An apparatus according to any one of claims 16 to 29, wherein the main roller is a ground engaging member.

32. An apparatus according to any one of claims 16 to 29, being a caster.

30 33. An apparatus according to any one of claims 16 to 29, being a massage device.

34. An apparatus according to claim 33, being adapted to dispense a liquid.

35 35. An apparatus according to any one of claims 16 to 29, comprising first and second housings at respective first and second ends of an elongate main roller.

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36. An apparatus according to claim 35, wherein the elongate main roller is a generally cylindrical member having a portion at each end which comprises a part cylindrical surface

5 37. A massage device comprising:

a ball for contact with a person or animal for assisting in massage;

a housing, wherein the ball is provided at least partially within the housing; and

10 a plurality of support rollers arranged to provide support between the ball and the housing while allowing the ball to rotate relative to the housing.

38. A massage device according to claim 37, wherein the ball is between 35mm and 80mm in diameter.

15 39. A massage device according to claim 37 or 38, wherein the housing has a first end defining an opening through which a part of the ball extends, and a second end.

20 40. A massage device according to claim 39, wherein the second end of the housing is provided with an opening to expose the ball.

41. A massage device according to claim 40, wherein the opening provided at the second end of housing is large enough to provide manual access, through the opening, to the ball.

25 42. A massage device according to claim 40 or 41, wherein the opening provided at the second end of housing is at least 15mm across, in at least one dimension.

30 43. A massage device according to claim 42, wherein the opening provided at the second end of housing is substantially circular and at least 15mm in diameter.

35 44. A massage device according to any of claims 37 to 43, wherein the support rollers are supported within the housing by a generally annular race.

45. A massage device according to any of claims 37 to 44, wherein the

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message device is an apparatus according to any of claims 16 to 29 or 33 to 36.

5 46. A message device according to any of claims 40 to 43, or according to any of claims 44 to 45 when dependent upon any of claims 40 to 43, wherein the ball is retained in the housing by a retaining portion at or adjacent the first end of the housing, and wherein the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing via the opening in said second end.

10 47. A message device according to claim 46, wherein the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by at least one finger or thumb of a person via said second end.

15 48. A message device comprising:
a ball for contact with a person or animal for assisting in massage;
a housing, wherein the ball is provided at least partially within the housing; and
20 wherein the housing has a first end defining an opening through which a part of the main roller extends and a second end, wherein the second end of the housing is provided with an opening to expose the ball.

25 49. A message device according to claim 48, wherein the opening provided at the second end of the housing is large enough to provide manual access, through the opening, to the ball.

30 50. A message device according to claim 48 or 49, wherein the opening provided at the second end of housing is at least 15mm across, in at least one dimension.

51. A message device according to any one of claims 48 to 50, wherein the opening provided at the second end of housing is substantially circular.

35 52. A message device according to any one of claims 48 to 51, further comprising a plurality of support rollers arranged to provide support between the ball and the housing while allowing the ball to rotate relative to the housing.

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53. A massage device according to claim 52, wherein the support rollers are supported within the housing by a generally annular race.

5 54. A massage device according to any of claims 50 to 53 88, wherein the massage device is an apparatus according to any of claims 16 to 29 or 33 to 36.

10 55. A massage device according to any one of claims 48 to 54, wherein the ball is retained in the housing by a retaining portion at or adjacent the first end of the housing.

15 56. A massage device according to claim 55, wherein the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by an object via the opening in said second end.

20 57. A massage device according to claim 55 or 56, wherein the retaining portion is adapted to allow manual release of the ball when the ball is pushed from the second end of the housing by at least one finger or thumb of a person via in said second end.

25 58. A massage device according to any one of claims 48 to 57, further including a fluid dispenser attached or attachable thereto, for dispensing fluid to the interior of the housing.

59. A massage device according to claim 58, wherein the fluid dispenser is attached or attachable to the second end of the housing.

30 60. A massage device according to claim 58 or 59, wherein the dispenser is adapted to dispense fluid into the interior of housing through the opening at the second end of the housing.

35 61. A massage device according to any one of claims 58 to 60, wherein the fluid dispenser comprises a compressible container adapted to release fluid upon the application of pressure.

62. A race for accommodating a plurality of support rollers so that the support

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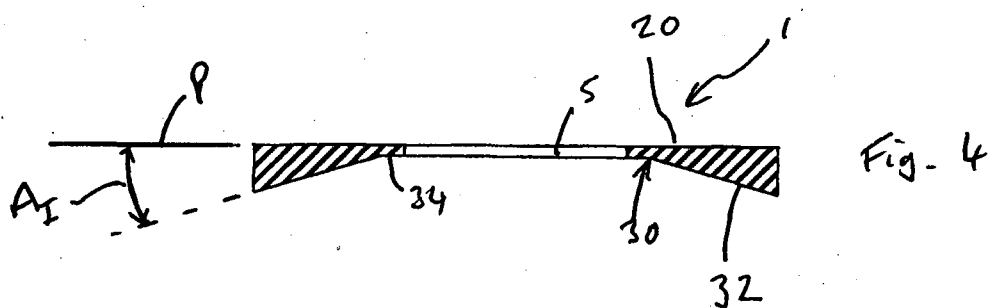
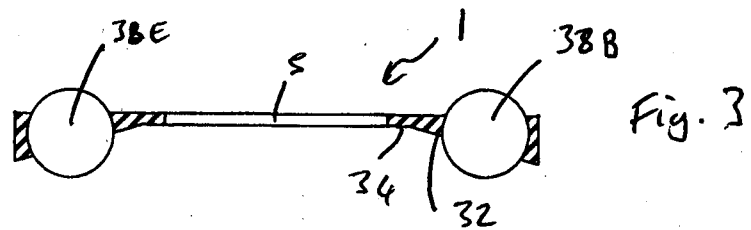
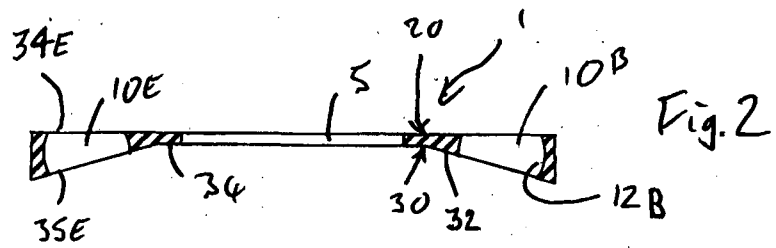
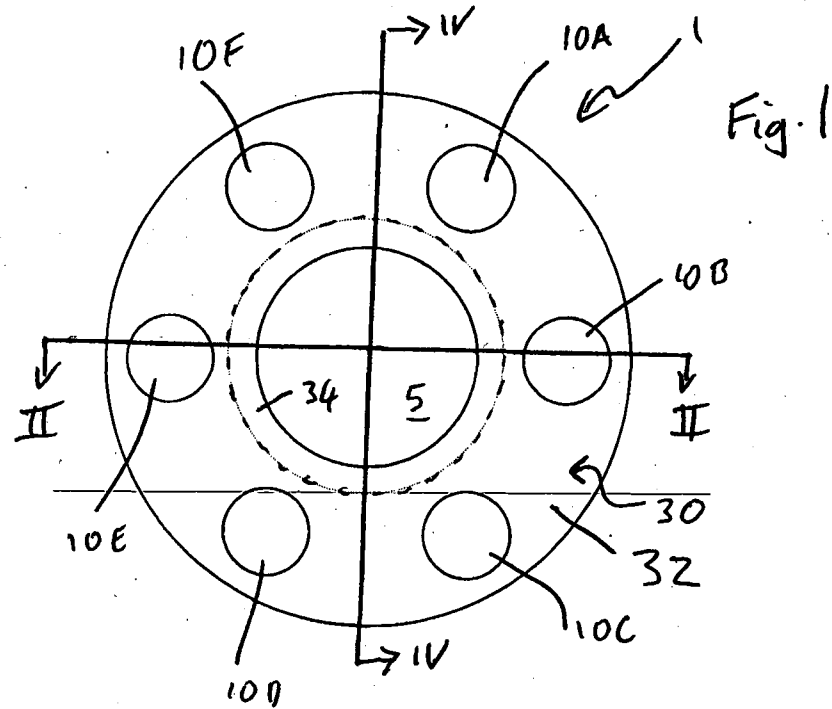
rollers can space apart a spherical or part spherical surface of a main roller from a housing in which the main roller is at least partially located, wherein the race is generally annular and provides:

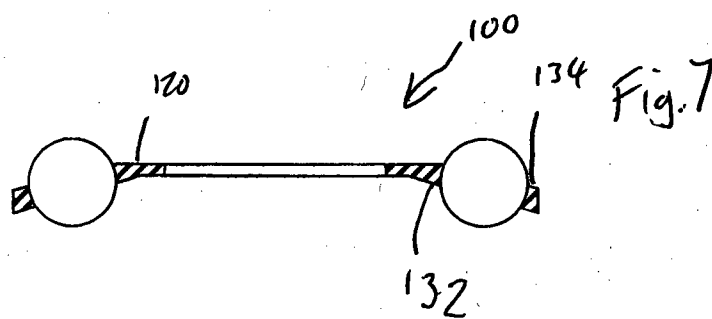
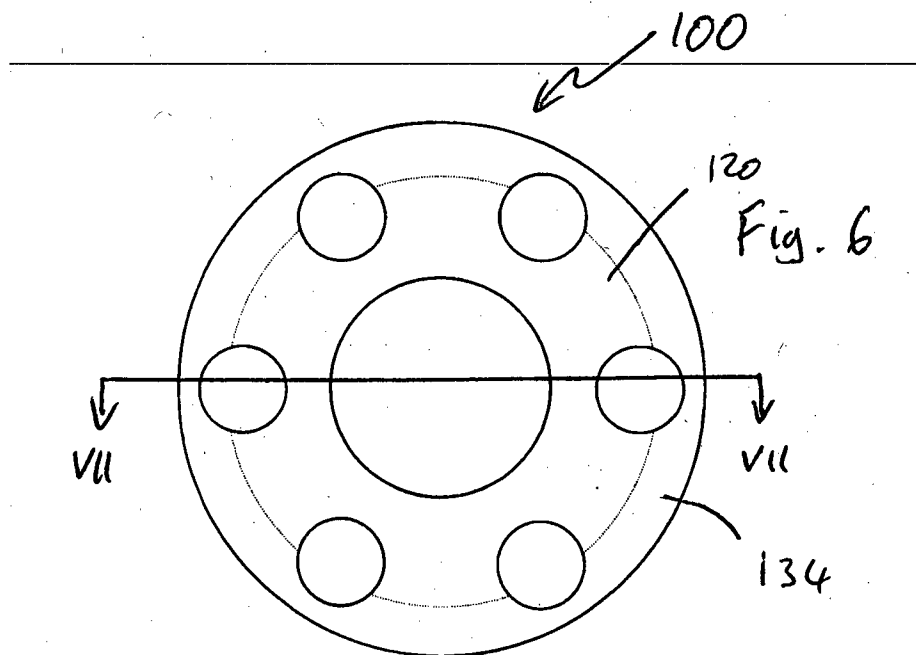
a plurality of openings for accommodating respective support rollers;

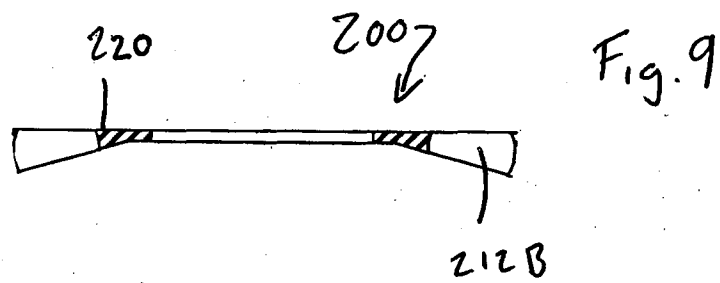
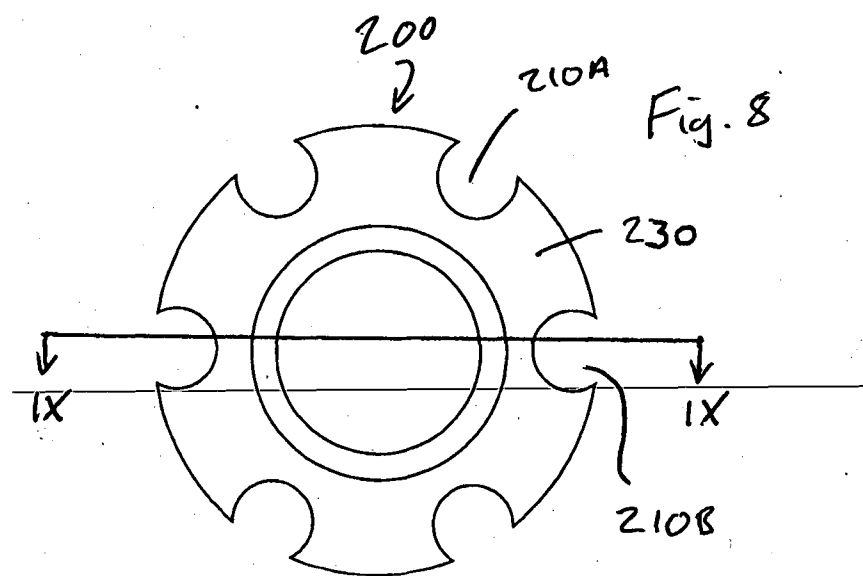
5 a housing-facing surface; and

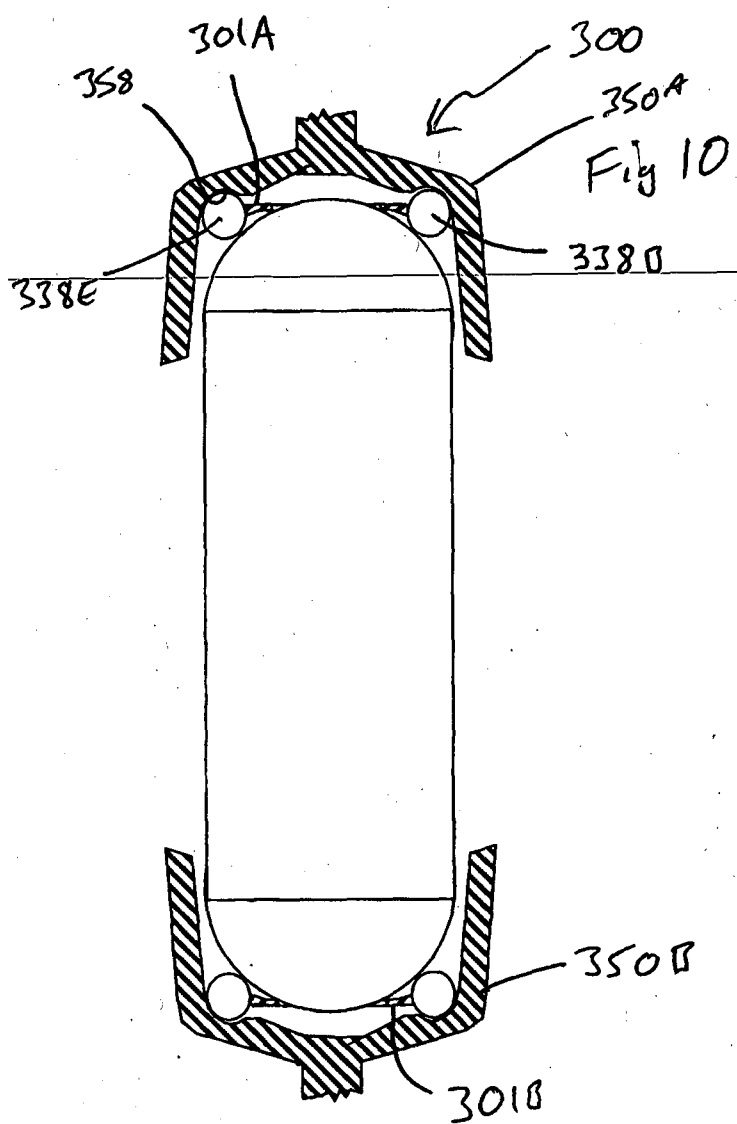
a main-roller-facing surface;

wherein at least part of the a main-roller-facing surface is inclined relative the plane of the generally annular race.









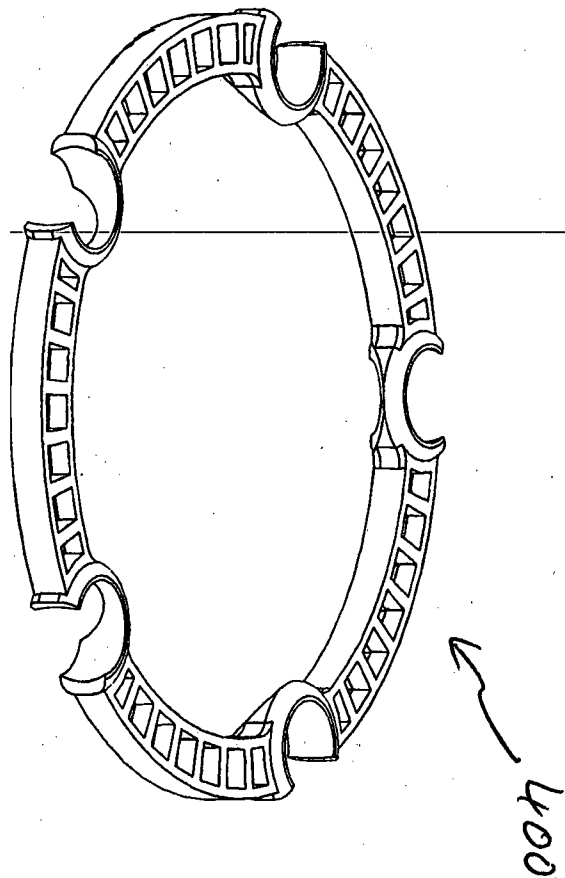


Fig. 11

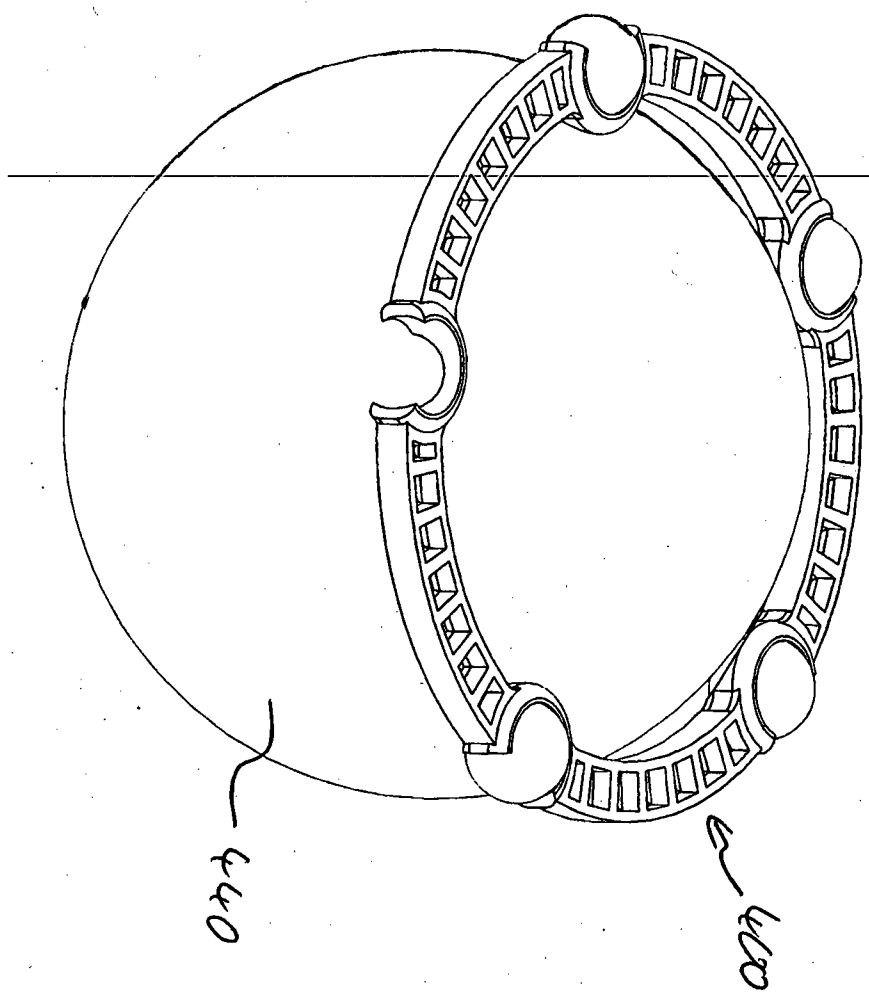


Fig. 12

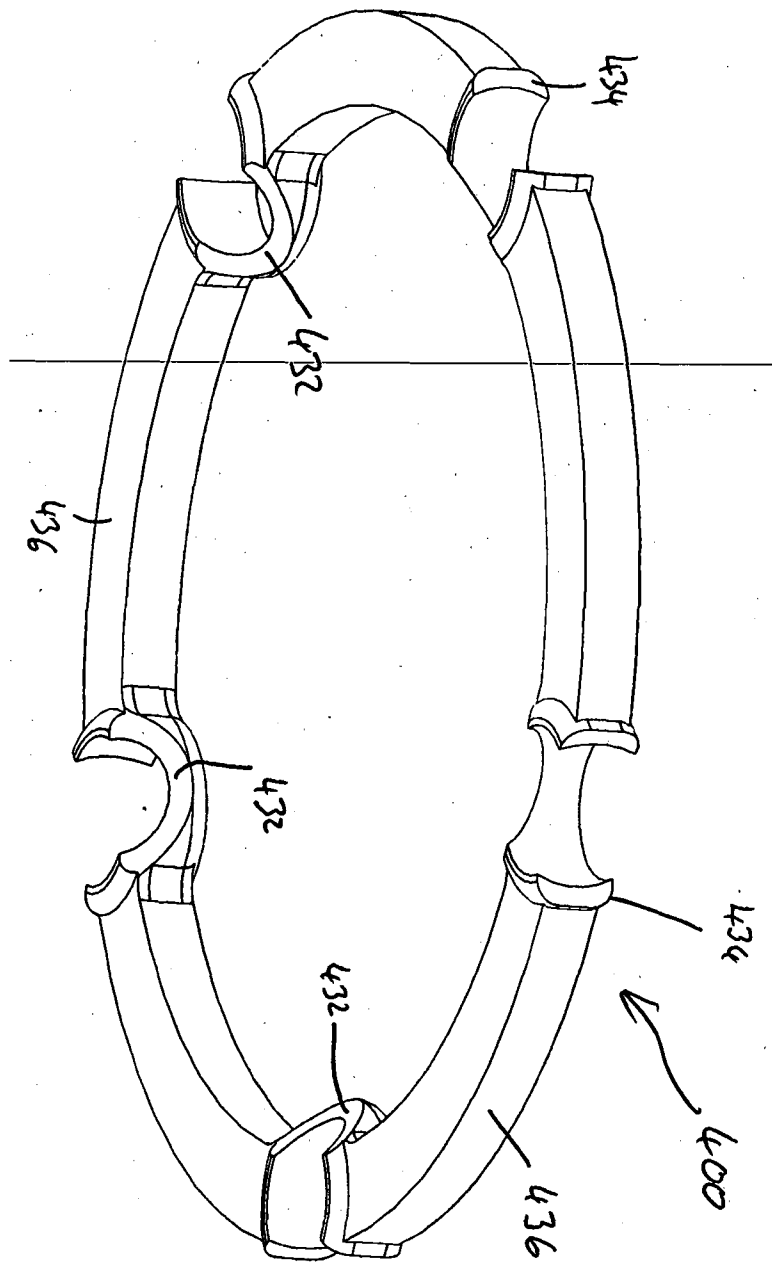
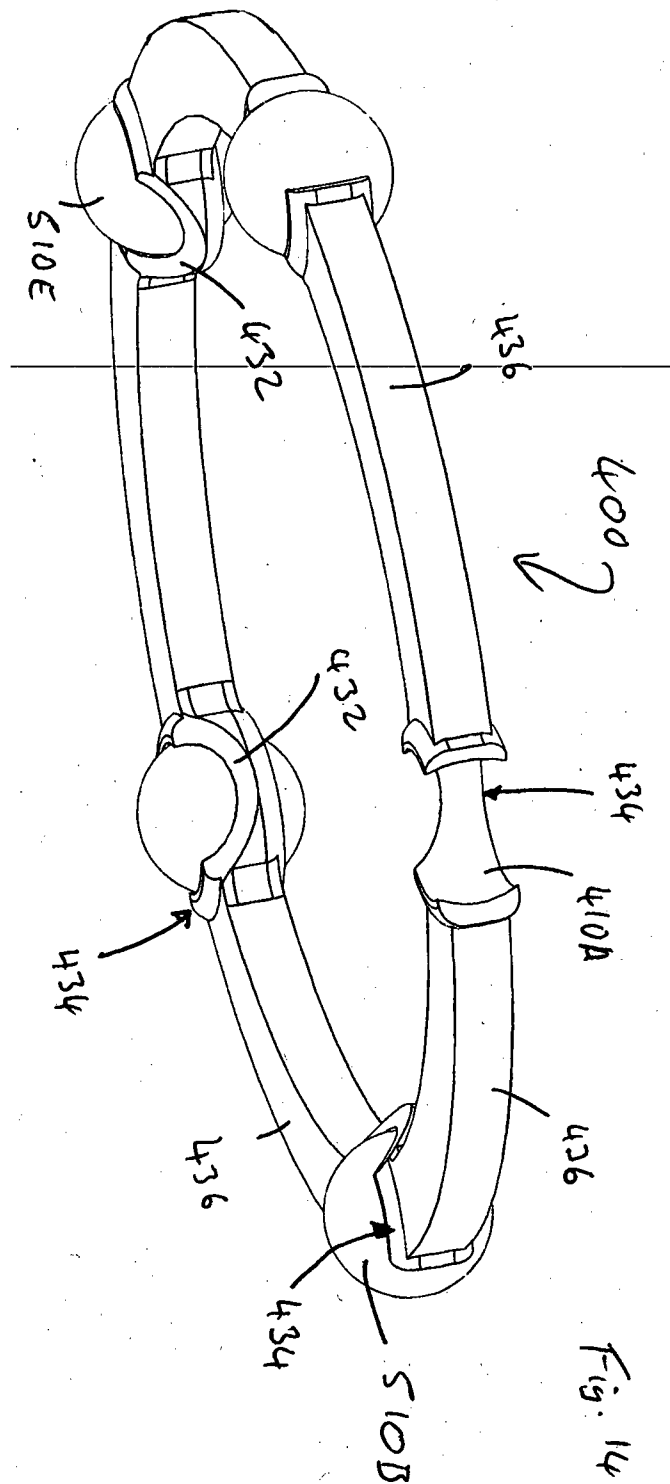
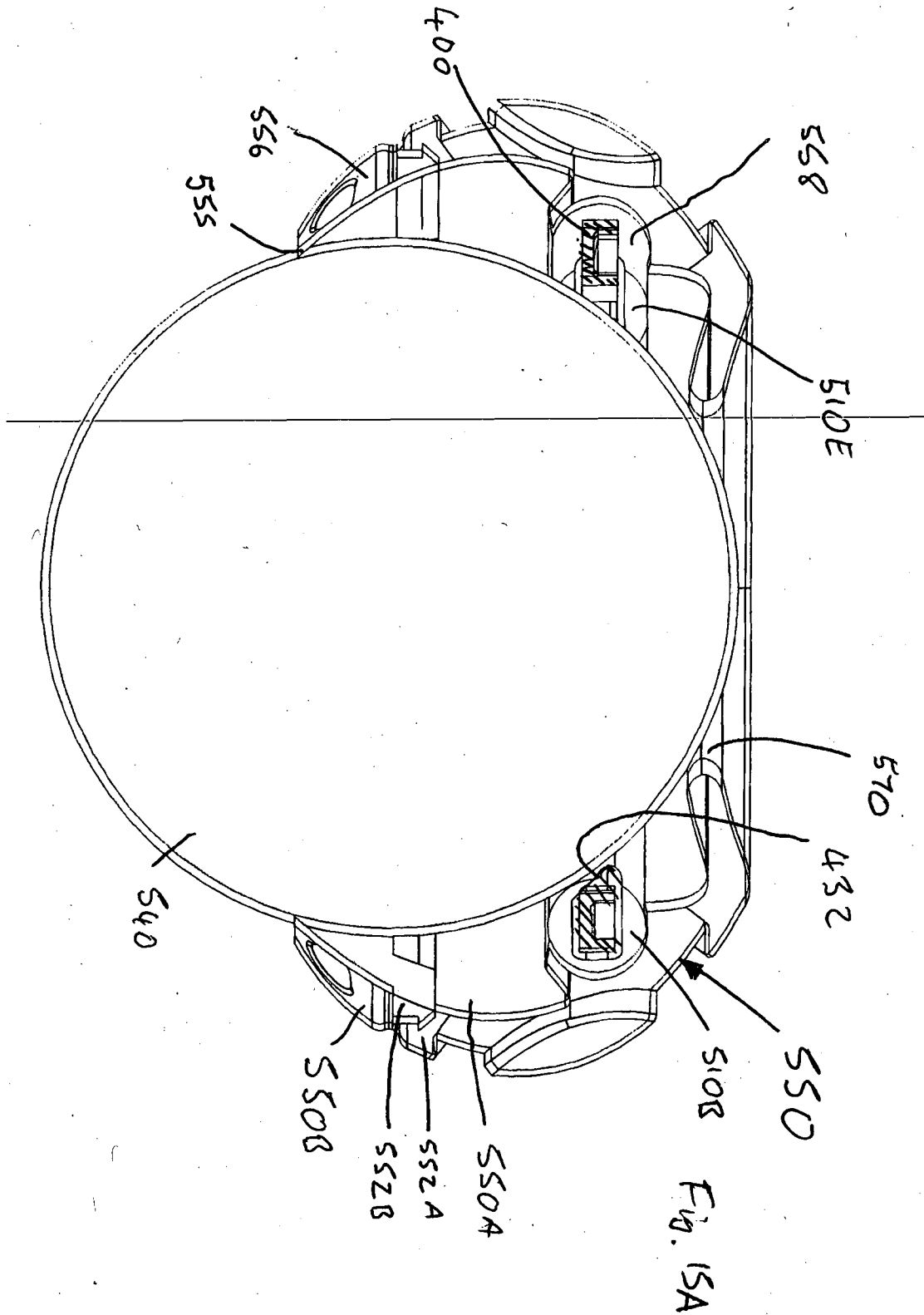


Fig 13





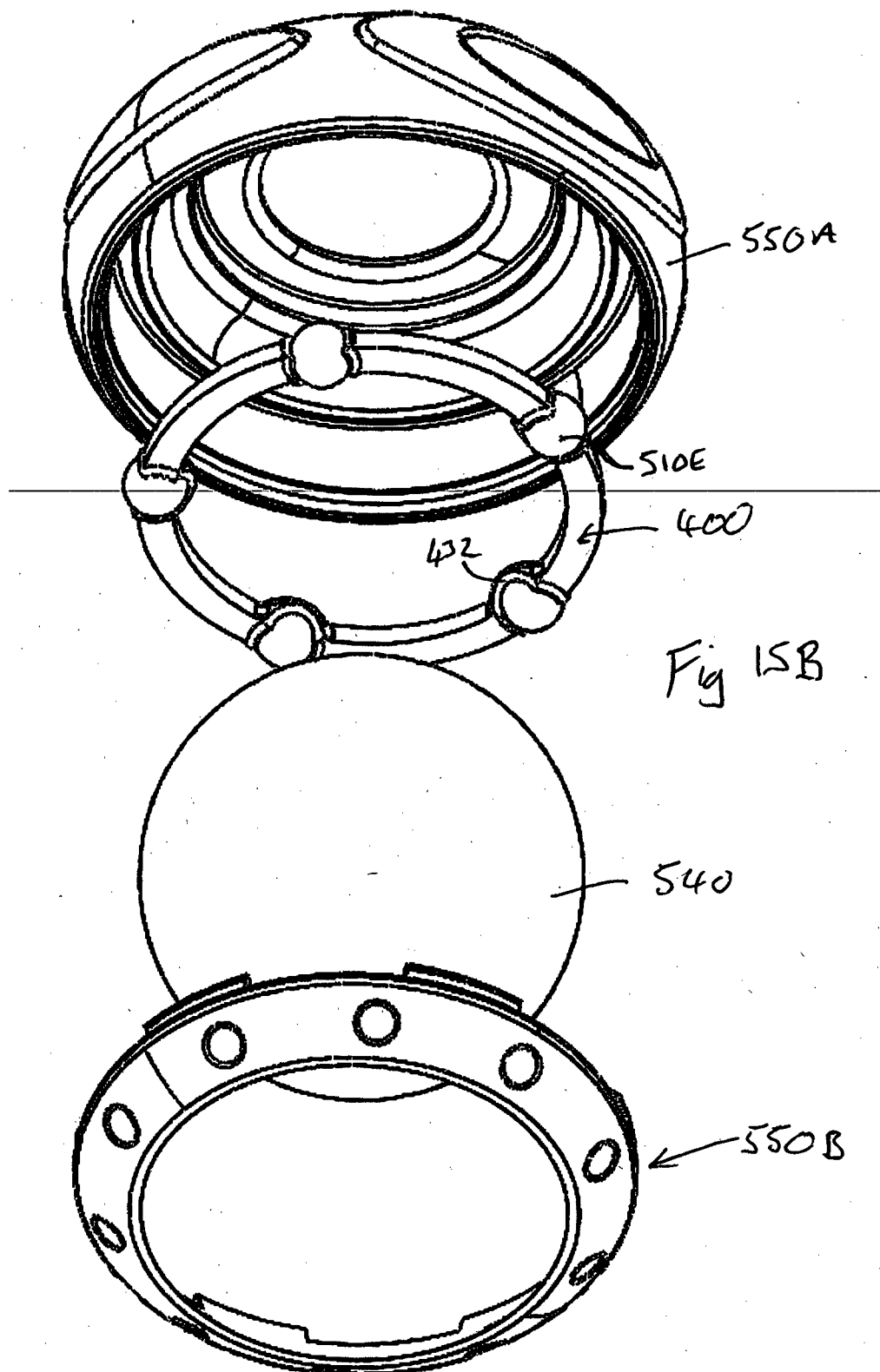
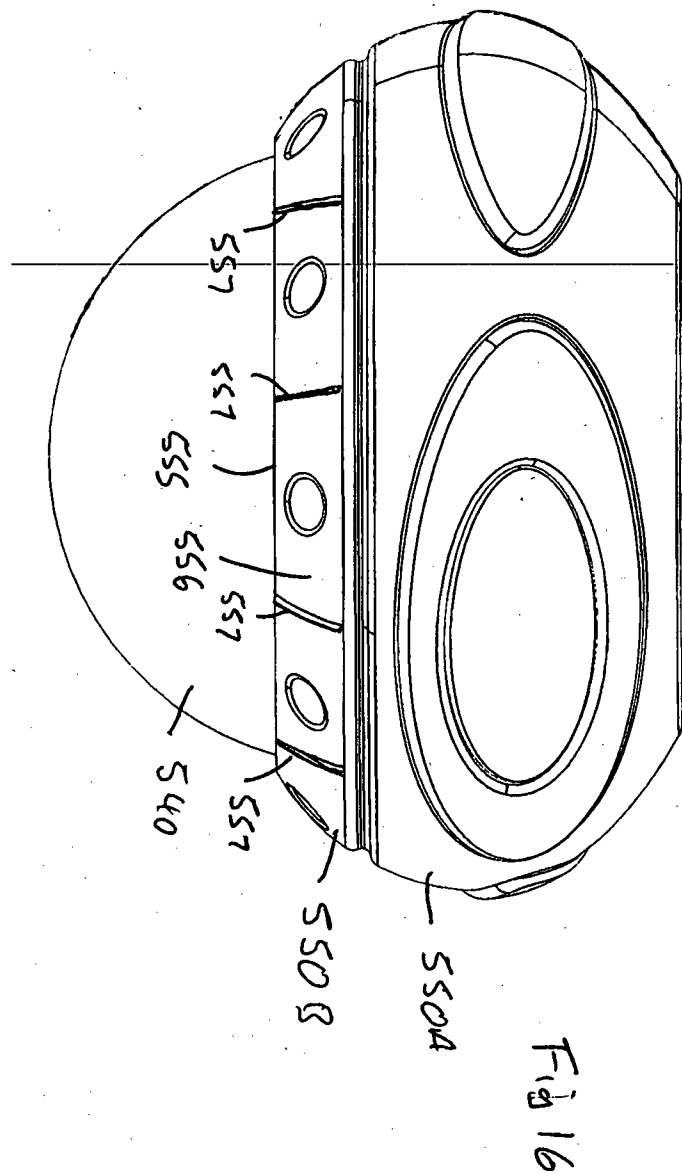
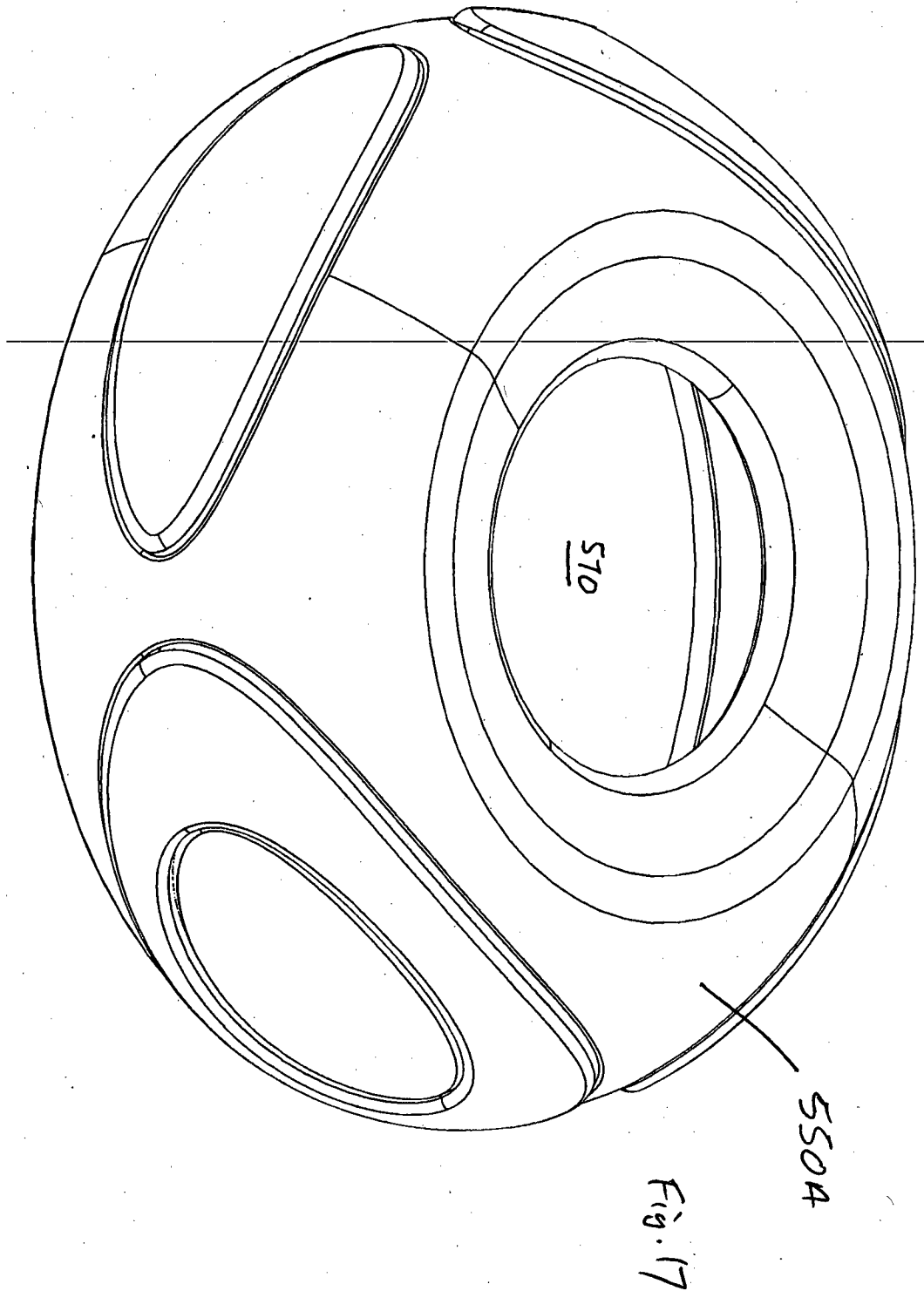
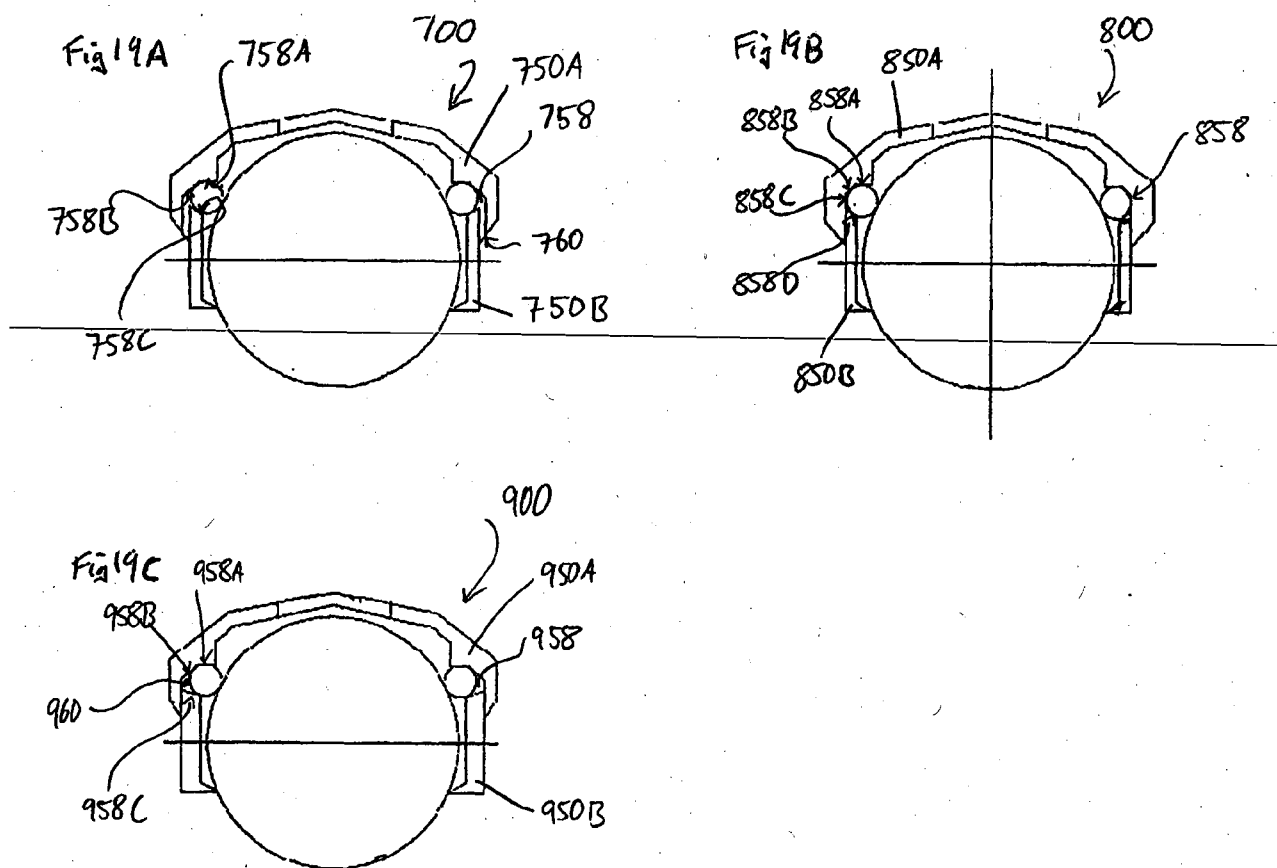
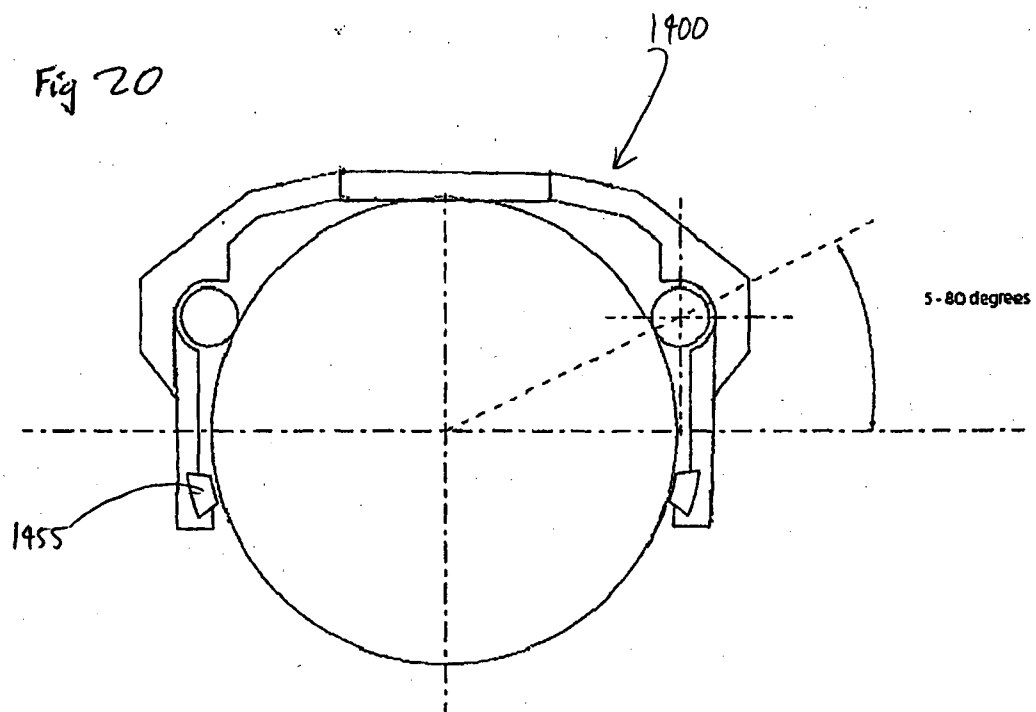
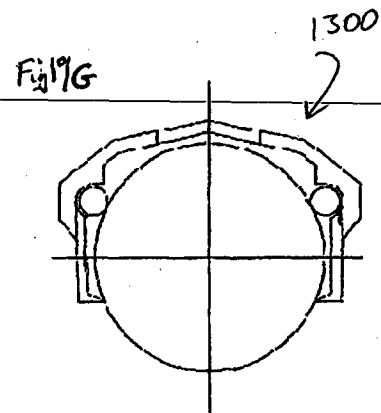
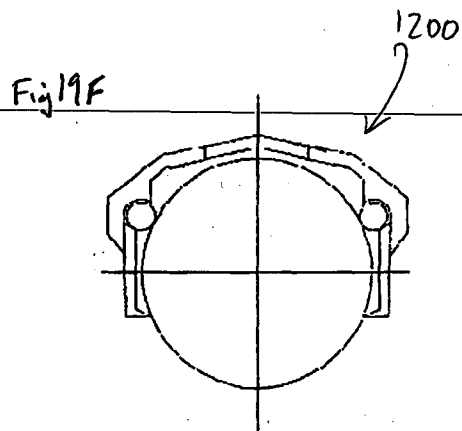
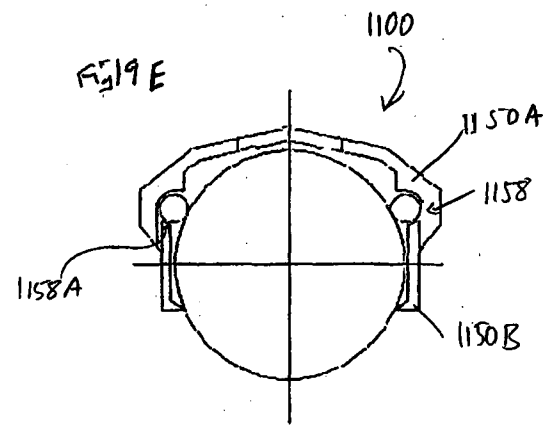
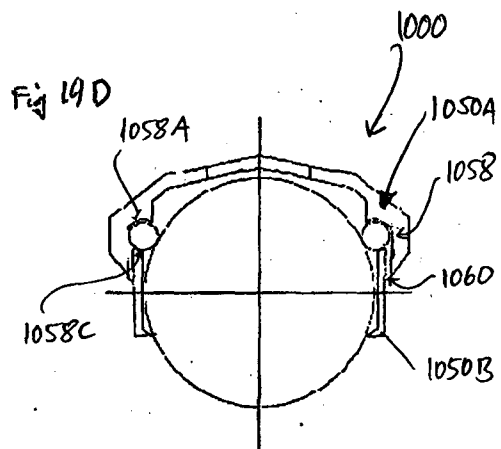


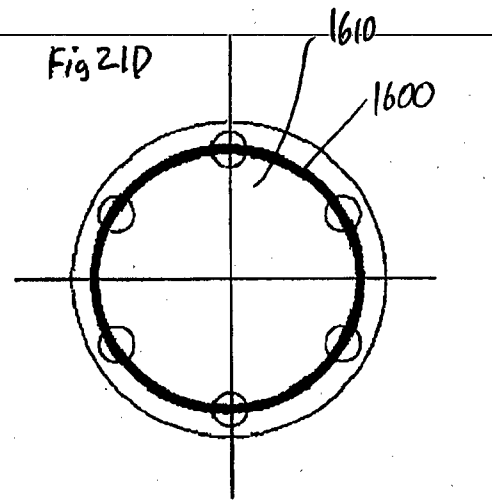
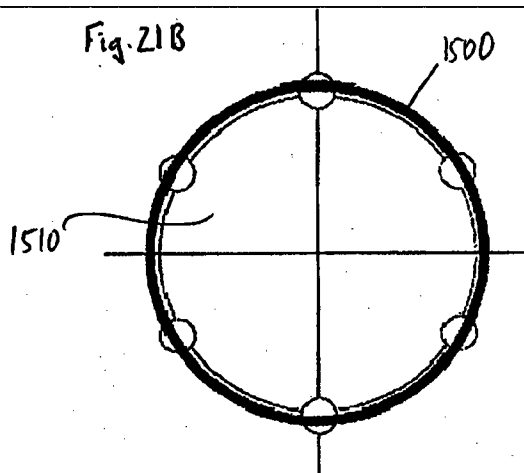
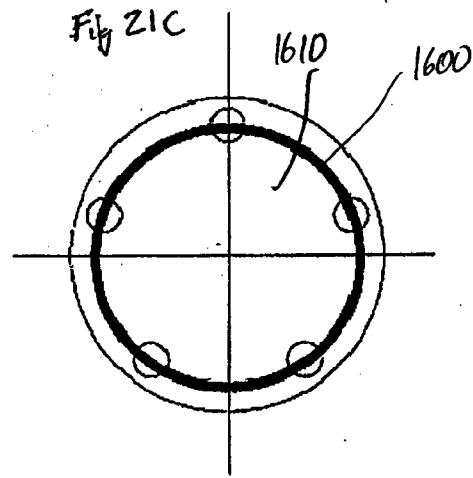
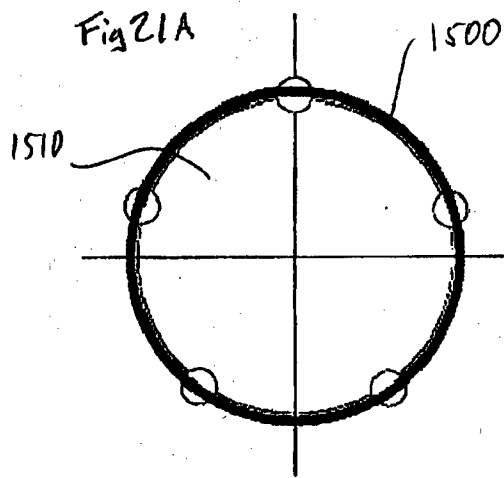
Fig 15B











INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/000866

A. CLASSIFICATION OF SUBJECT MATTER <i>F16C 19/12 (2006.01) A61H 15/00 (2006.01) F16C 33/38 (2006.01)</i>		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
WPI, EPODOC: (i) IPC, ECLA: F16C 33/38, F16 C33/38M1 with keywords: axial, inclined (ii) keywords: massage, ball, bearing (iii) IPC, ECLA: A61H 15/00, F16C 19/12 keywords: bearing, ball		
TotalPatent: IPC: A61H 15/00 and A61H39/04 : JP documents		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search 15 November 2012	Date of mailing of the international search report 15 November 2012	
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au Facsimile No.: +61 2 6283 7999		Authorised officer Asanka Perera AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262832373

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2012/000866
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 6669611 B2 (RAYMOND) 30 December 2003 figures 3, 5 and accompanying description figures 3, 5 and accompanying description	1-27, 29-36, 62 28
X	JP 64-70053 A (YOSHINORI) 15 March 1989 Figure 1 and PAJ English Abstract	1-27, 29-36, 62
Y	US 2687546 A (OPPENHEIMER) 31 August 1954 figures 2, 3 and accompanying description	28
A	US 1936022 A (HUNT) 21 November 1933 The whole document	1-36, 62
A	US 2797685 A (PACKWOOD) 02 July 1957 The whole document	1-36, 62

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-36, 62

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Supplemental Box**Continuation of: Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

Claims 1-15 are directed to a bearing apparatus for allowing a main roller having at least one surface part which is at least part spherical to rotate relative to a housing, the bearing apparatus comprising a generally annular member, the member defining a number of openings therein for receiving and retaining respective support rollers.

Claims 16-36 are directed to an apparatus for allowing a main roller, having at least one surface part which is at least part spherical, to rotate relative to a housing, the apparatus comprising: the housing; the main roller; and a bearing apparatus; wherein the main roller is at least partially located in the housing; and wherein the bearing apparatus comprises a plurality of support rollers and a generally annular member, the generally annular member defining a number of openings therein for receiving and retaining the support rollers

Claim 62 is directed to a race for accommodating a plurality of support rollers so that the support rollers can space apart a spherical or part spherical surface of a main roller from a housing in which the main roller is at least partially located, wherein the race is generally annular and provides: a plurality of openings for accommodating respective support rollers; a housing facing surface; and a main-roller-facing surface. The features of: a generally annular member, the member defining a number of openings therein for receiving and retaining respective support rollers, wherein at least one surface part of the generally annular member is inclined relative to the plane of the generally annular member (claim 1); at least one surface part of the generally annular member is inclined relative to the plane of the generally annular member (claim 16); and at least part of the a main-roller-facing surface is inclined relative the plane of the generally annular race (claim 62) is specific to this group of claims.

Claims 37- 47 are directed to a massage device comprising: a ball for contact with a person or animal for assisting in massage; a housing, wherein the ball is provided at least partially within the housing. The feature of a plurality of support rollers arranged to provide support between the ball and the housing while allowing the ball to rotate relative to the housing is specific to this group of claims.

Claims 48- 61 are directed to a massage device comprising: a ball for contact with a person or animal for assisting in massage; a housing, wherein the ball is provided at least partially within the housing. The feature of the housing having a first end defining an opening through which a part of the main roller extends and a second end, wherein the second end of the housing is provided with an opening to expose the ball is specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art. When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to the claimed inventions between group 1 and groups 2 or 3 the requirements for unity of invention are consequently not satisfied between these pairing of groups a priori.

The only feature common to the claimed inventions groups 2 and 3 above and which provides a technical relationship among them is a massage device comprising: a ball for contact with a person or animal for assisting in massage; a housing, wherein the ball is provided at least partially within the housing.

However this feature does not make a contribution over the prior art because it is disclosed in:
US 2005/0187498 A1 (MILLER) 25 August 2005

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2012/000866**Supplemental Box**

Therefore in the light of this document this common feature cannot be a special technical feature. Therefore there is no special technical feature common to claimed inventions groups 2 and 3 and the requirements for unity of invention are consequently not satisfied between these groups a posteriori.

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2012/000866	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 6669611 B2	30 Dec 2003	CA 2298883 A1	12 Aug 2000
		US 6309331 B1	30 Oct 2001
		US 2002019300 A1	14 Feb 2002
		US 6669611 B2	30 Dec 2003
		WO 03022371 A1	20 Mar 2003
JP 64-70053 A	15 Mar 1989	None	
US 2687546 A	31 Aug 1954	US 2687546 A	31 Aug 1954
US 1936022 A	21 Nov 1933	US 1936022 A	21 Nov 1933
US 2797685 A	02 Jul 1957	US 2797685 A	02 Jul 1957
End of Annex			
<div> Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009) </div>			