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Wheel for a track-laying vehicle

10 The invention concerns a wheel as set forth in the classifying portion
of claim 1 for a track-laying vehicle. Such a wheel is for example a runner
wheel, a support wheel, a support ring or a direction-changing roller for a
track of the track-laying vehicle.

15 A runner wheel of aluminium or fibre-reinforced resin for light track-
laying vehicles is known from EP 0 159 934 A2. The runner wheel
comprises two circular discs with rings formed thereon. The rings carry
rubber tyres on the outside. The discs form a guide channel for centering
guide teeth of track members of a track of the track-laying vehicle. All
cross-sections of the runner wheel, in particular in the shoulder region,
namely in the junction region of the vertical disc with the peripheral ring,
20 are of a comparatively thin cross-section. When travelling on inclined
slopes, or when passing over obstacles such as lumps of rock the shoulder
region is subjected to a particular loading by virtue of the relatively long
lever of the projecting ring. Those alternating stresses have only a very
slight influence on the service life of a runner wheel consisting of
25 aluminium. A runner wheel comprising fibre-reinforced resin however is in
danger of fracture in that shoulder region. The alternate deformation of the
highly loaded shoulder region, with a heating effect, gives rise to micro-
brittle fractures so that the fibre plastic matrix breaks down and ruptures.
Such a wheel therefore does not attain a long service life.

30 Taking EP 0 159 934 A2 as the basic starting point the object of the
present invention is to provide a wheel of the kind set forth in the opening
part of this specification, which has a long service life while being low in
weight.

According to the invention that object is attained by the features of claim 1. Preferred configurations of the wheel according to the invention are characterised in the appendant claims.

5 The wheel according to the invention has the advantage that considerable reductions in weight are possible in comparison with track-laying vehicle wheels of metal. Besides that reduction in weight, there is the advantage that the inherent damping action of the material in conjunction with the reduced weight means that the transmission of vibration as occurs for example due to the wheel rolling over the track and
10 the track gap which is involved in that respect, to the body or shell of the track-laying vehicle, is reduced. In addition the configuration according to the invention affords the advantage of a comparatively slight heat signature so that it is made more difficult for the wheels and therewith the track-laying vehicle to be detected by heat imaging equipment. Further
15 advantages involve the reduction in the unsprung masses of the track-laying vehicle having wheels according to the invention, making handling easier due to correspondingly reduced component weights, a reduction in stockage and transportation weights and resistance to corrosion.

Polyamide is the appropriate plastic material for the wheel.
20 Polyamide basically enjoys a substantially higher level of strength and impact resistance and is more heat-resistant, in comparison with the known material for runner wheels, namely fibre-reinforced resin.

Polyamide has a tensile modulus of elasticity $> 2000 \text{ N/mm}^2$ and can be used at between -40°C and $+120^\circ\text{C}$. Its notched-bar impact strength in
25 that temperature range is at least 10 kJ/m^2 . Moisture absorption is $< 1\%$ in a standard climate 23/50.

In the case of cast polyamide PA12G the tearing elongation $> 20\%$ at a tearing speed of 5 mm/min .

Partially aromatised polyamide with a 20-50% glass fibre component
30 has a tearing elongation $> 2\%$ at a tearing speed of 50 mm/min .

Further details, features and advantages will be apparent from the description hereinafter of embodiments of the wheel according to the invention, which are shown in the drawing in which:

Figure 1 is a sectional view of a portion of a first embodiment of the wheel for a track-laying vehicle in combination with a portion of a vehicle wheel hub of the track-laying vehicle,

Figure 2 is a view similar to Figure 1 of a second embodiment of the wheel for a track-laying vehicle,

Figure 3 shows a third embodiment of the track-laying vehicle wheel,

Figure 4 shows a front view of a wheel for a track-laying vehicle,

Figure 5 shows a view in section taken along section line V-V in Figure 4 through the track-laying vehicle wheel,

Figure 6 shows a sectional view which is similar in principle to Figure 5 of another embodiment of the wheel for a track-laying vehicle,

Figure 7 shows an embodiment of a wheel with integral hub portion for wheel mounting purposes,

Figure 8 shows a view similar to Figure 7 of a wheel with a hub portion connected thereto for wheel mounting purposes,

Figure 9 shows a view similar to Figures 1 to 3 of yet another embodiment of the wheel for a track-laying vehicle,

Figure 10 shows a sectional view of part of an embodiment of the track-laying wheel similar to the embodiments shown in Figures 1 to 3, with the incorporation of wear protection,

Figure 11 shows a view similar to Figure 10 of another embodiment of the wear protection, and

Figure 12 shows yet another embodiment of the wear protection of a wheel, indicated similarly to Figures 10 and 11.

Figure 1 is a sectional view of a portion of a wheel 10 for a track laying vehicle. The wheel 10 is provided on a wheel hub 12 of which a portion is illustrated. The wheel 10 has a wheel ring 14 comprising two ring portions 16. The wheel ring 14, that is to say the two ring portions 16 of the wheel ring 14, comprise a plastic material. That plastic material is PA. In order to achieve a high level of mechanical strength and resistance to heat, the two ring portions 16 of the wheel ring 14 can be fibre-reinforced.

Each ring portion 16 is divided into a disc 15 of a width 17 and a ring 19 formed in one piece thereon, of a width 21 and a thickness 23. A radius is identified by 25.

Each of the two ring portions 16 is fixedly connected to an associated
5 flange ring 18. This connection can be a connection involving positively locking engagement and/or force-locking engagement and/or intimate joining of the materials involved. The two flange rings 18 are of an L-shaped cross-sectional profile and are fixedly connected to each other and to the vehicle wheel hub 12 by means of connecting elements 20 formed by
10 screws 22 and nuts 24.

The flange rings 18 comprise for example steel or a light metal or light metal alloy.

The two ring portions 16 of the wheel ring 14 of the wheel 10 are provided in such a way that a peripherally extending guide channel 26 is
15 formed between them. The guide channel 26 is delimited by mutually facing guide surfaces 28 of the ring portions 16. The guide surfaces 28 of the ring portions 16 of the wheel ring 14 of the wheel 10 serve to guide the wheel 10 on the guide tooth of the respective track member of the track-laying vehicle.

20 Provided at the outside periphery of the ring portions 16 of the wheel ring 14 is a respective chemically bound runner ring 30. The runner rings 30 comprise for example a rubber or a plastic material or another suitable elastomer material. The runner rings 30 roll over the inside running surface of the corresponding track member.

25 In the embodiment illustrated in Figure 1 the ring portions 16 and the runner rings 30 provided at the outside periphery thereof are of a cross-section of mirror image symmetry, in relation to the guide channel 26. The plane of symmetry is indicated by the dash-dotted line 32.

Figure 2 is a view similar to Figure 1 showing an embodiment of the
30 wheel 10 which differs from the embodiment illustrated in Figure 1 in that the runner rings 30 are integral components of the respective ring portion 16 and the ring 19 of the wheel ring 14 of plastic material.

The same details are denoted in Figure 2 by the same references as in Figure 1 so that there is no need for all those details to be described once again, in connection with Figure 2.

Figure 3 is a diagrammatic view similar to Figures 1 and 2 showing
5 an embodiment of the wheel 10 with a wheel ring 14 comprising two ring portions 16 of plastic material, wherein each of the two ring portions 16 is formed in one piece with the associated flange ring 34. Provided at the outside periphery of one of the two ring portions 16 of plastic material is a runner ring 30, in a similar manner to the embodiment of Figure 1. The ring
10 portion 16 shown at the right represents a variant of the ring portion 16 shown at the left insofar as - corresponding to Figure 2 - the runner ring 30 is an integral component of the wheel ring 14 or the ring 19 respectively.

The flange rings 34 which are integrally connected to the ring portions 16 can be fixed jointly to the vehicle wheel hub 12 by means of
15 supporting ring members 36. The supporting ring members 36 are for example a steel ring with bores for connecting elements 20 which have screws 22 and nuts 24, see Figure 2.

The same details are denoted in Figure 3 by the same references as in Figures 1 and 2 so that there is no need for all those features to be
20 described in detail once again in conjunction with Figure 3.

Figure 4 is a diagrammatic front view on reduced scale of a wheel 10, wherein the wheel ring 14 has spoke-like arms 38, of which only some are illustrated in the drawing. The spoke-like arms 38 alternate with openings 40 in the wheel ring 14, of which also only a few are shown in the
25 drawing. The openings 40 and the arms 38 are uniformly distributed along a pitch circle 42 of the wheel ring 14, as can also be seen in respect of a portion thereof from Figure 5. Such a configuration results in a reduction in the weight of the wheel 10. To increase the stiffness in respect of shape of the wheel 10 or its wheel ring 14 of plastic material, it is for example also
30 possible for the wheel ring 14 to be designed with a corrugated profile in the peripheral direction, as is shown in section in respect of a portion thereof in Figure 6.

Figure 7 is a diagrammatic view in section of a portion of a vehicle wheel hub 12 with a wheel 10. The wheel 10 has a single wheel ring 14 of a plastic material. The wheel ring 14 is of a symmetrical cross-sectional profile. That is indicated by the dash-dotted line of symmetry 44. Provided at the outside periphery of the wheel ring 14, facing towards the vehicle wheel hub 12, are peripherally extending channels 46 which are concentric with respect to the vehicle wheel hub 12 and which serve to receive bearing elements 48. Those bearing elements 48 are for example rolling bearings which form a wheel mounting arrangement 50.

Figure 8 is a diagrammatic view similar to Figure 7 showing a wheel 10 which differs from the embodiment illustrated in Figure 7, in particular insofar as the wheel ring 14 of symmetrical cross-section profile has a hub element 52 which is provided for receiving bearing elements 48 in the form of rolling bearings which form the wheel mounting arrangement 50. The annular hub portion 52 is connected to the wheel ring 14. This connection may be a connection involving positively locking engagement and/or force-locking engagement and/or intimate joining of the materials involved. The hub portion 52 comprises a metal or a metal alloy.

The same details are denoted in Figure 8 by the same references as in Figure 7 so that there is no need for all those features to be described in detail once again in conjunction with Figure 8.

Figure 9 is a view similar to Figures 1 and 2 respectively, showing an embodiment of the wheel 10, wherein the wheel ring 14 has two ring portions 16 which are each of a symmetrical cross-sectional profile. The corresponding line of symmetry is indicated by the associated dash-dotted line 54. In other respects the embodiment of Figure 9 is similar to the embodiment shown in Figure 1, wherein the same features are denoted in Figures 1 and 9 by the same respective references, without being described in detail once again with reference to Figure 9. The symmetrical configuration however is not absolutely necessary.

Figure 10 is a cross-sectional view showing a part of a ring portion 16, similarly to Figures 1 and 3, wherein the corresponding guide surface 28 of the respective ring portion 16 is provided with wear protection 56. In

the embodiment illustrated in Figure 10 the wear protection 56 is formed by a wearing ring 58 which is fixed to the associated guide surface 28. That fixing is effected for example by means of an adhesive 60. Another possibility for example provides that the wearing ring 58 is vulcanised to the ring portion 16. Instead of the wearing ring 58, it is also possible to use ring segments 62 (Figure 11).

Figure 11 is a view similar to Figure 10 showing a part of a ring portion 16 with a wear protection 56 at the associated guide surface 28, being formed by ring segments 62. Each ring segment 62 has at least one fixing projection 64. The fixing projections 64 of the ring segments 62 are cast into the associated ring portion 16 of plastic material. In comparison with a wearing ring 58 (see Figure 10), ring segments 62 have the advantage that they are capable of compensating for differences in thermal expansion, caused by the material involved, as between the material of the respective ring portion 16 and the associated wear protection 56. The ring segments 62 can be replaceably mounted to the ring portion 11.

Figure 12 is a diagrammatic view similar to Figures 10 and 11 showing a ring portion 16 with a wear protection 56 on the associated guide surface 28. The wear protection 56 is formed by a wearing ring 58 which is cast into the associated ring portion 16. The wear protection 56 can also be formed by separate ring segments 62, as have been mentioned hereinbefore with reference to Figure 11.

As in the embodiments of Figures 1, 3 and 9, the ring portion 16 is provided at its outer periphery with a respective runner ring 30.

A summary of the dimensional relationships of the disc 15 and the ring 19 is produced on the basis of the width 17 of the disc 15 = 100%.

Figures	1	2	3	7	8	9
Width 17 of the disc 15 = 100% [mm]	22	22	22	40	40	23
Width 21 of the ring 19 [mm]	40	35	43	50	50	39
Width 21 in % of width 17	181	159	195	125	125	169
Thickness 23 of the ring 19 [mm]	24	24	30	28	28	20
Ratio thickness 23/width 17	1:1.1	1:1.1	1:1.36	1:0.7	1:0.7	1:0.87
Thickness 23 in % of width 17 of the disc 15	110	110	136	70	70	87
Ratio thickness 23/width 21	1:1.67	1:1.45	1:1.43	1:1.78	1:1.78	1:1.95
Width 21 in % of thickness 23	167	145	143	178	178	195

List of references

	10	wheel
	12	vehicle wheel hub (for 10)
5	14	wheel ring (of 10)
	15	disc
	16	ring portions (of 14)
	17	width (of 15)
	18	flange ring (for 16), (base ring)
10	19	ring
	20	connecting elements (between 10 and 12)
	21	width (of 19)
	22	screws (of 20)
	23	thickness (of 19)
15	24	nut (of 20)
	25	radius
	26	guide channel (of 14)
	28	guide surfaces (of 26)
	30	runner ring (on 10)
20	32	dash-dotted line (plane of symmetry)
	34	flange ring (of 16), (base ring)
	36	support ring (on 34)
	38	spoke-like arms (of 10)
	40	openings (in 10)
25	42	pitch circle (for 38, 40)
	44	dash-dotted line (plane of symmetry)
	46	channels (for 48)
	48	bearing elements (for 50), (base ring)
	50	wheel mounting arrangement
30	52	hub element (of 14), (base ring)
	54	dash-dotted line (plane of symmetry)
	56	wear protection (on 28)
	58	wearing ring (of 56)

- 60 adhesive (for 56)
- 62 ring segments (of 56)
- 64 fixing projections (on 62)

CLAIMS

1. A wheel (10) for a track-laying vehicle, which is provided at a vehicle wheel hub (12), wherein
 - 5 the wheel (10) comprises a plastic material, and
 - the wheel (10) is formed from a wheel ring (14) comprising a vertical disc (15) and a peripheral wider ring (19), wherein a radius (25) is provided between the laterally projecting ring (19) and the disc (15), characterised in that
 - 10 the wheel ring (15) comprises polyamide with a tensile modulus of elasticity $> 2000 \text{ N/mm}^2$ and a tearing elongation $> 2\%$, and
 - the wheel ring (14) is of a solid configuration - viewed in cross-section - in the form of an elephant foot, insofar as the width (21) of the ring (19) is 1.0 - 2.5 times its thickness (23), its thickness (23) is 0.5 - 1.5 times the width (17) of the disc (15) and the disc (15) is fixedly connected to a base ring (18, 34, 52) of metal, wherein said base ring (18, 34, 52) is connected to the vehicle wheel hub (12).
 - 15
- 20 2. A wheel according to claim 1 characterised in that the dimensions of the ring (19) in dependence on the width (17 = 100%) of the disc (15) are:

width (21) of the ring (19) from 110 to 210%.
- 25 3. A wheel according to claim 1 characterised in that the polyamide is a cast polyamide PA12G with a tearing elongation $> 20\%$ at a tearing speed of 5 mm/min or a partially aromatised polyamide with a 20 to 50% glass fibre component with a tearing elongation $> 20\%$ at a tearing speed of 50 mm/min.
- 30 4. A wheel according to claim 1 characterised in that the wheel ring (14) has two ring portions (16), between which is formed a peripherally

extending guide channel (26) delimited by mutually facing guide surfaces (28).

5 5. A wheel according to claim 4 characterised in that the guide surfaces (28) are provided with a wear protection (55, 56).

10 6. A wheel according to claim 5 characterised in that the wear protection (56) comprises a wear-resistant composite material embedded in the plastic material or metallic or ceramic substances in the form of fibres or whiskers, or a coating on the wearing region with wear-resistant substances.

15 7. A wheel according to claim 5 characterised in that the wear protection (56) is formed by wearing rings (58) or by ring segments (62) which are fixed to the guide surfaces (28).

8. A wheel according to claim 5 characterised in that the wear protection (56) is formed by coatings on the guide surfaces (28).

20 9. A wheel according to one of the preceding claims characterised in that a respective runner ring (30) is provided at the outside periphery of the rings (19).

25 10. A wheel according to claim 9 characterised in that the runner ring (30) is an integral component of the respective ring (19), or
the runner ring (30) comprises an elastomer material and is fixed to the associated ring (19).