(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 September 2014 (18.09.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/140919 A4

(51) International Patent Classification:
F16F 15/12 (2006.01) *F16F 7/00* (2006.01)
B60K 25/00 (2006.01) *F16H 55/48* (2006.01)
F02B 67/06 (2006.01) *F16H 7/18* (2006.01)

(21) International Application Number:
PCT/IB2014/001195

(22) International Filing Date:
15 March 2014 (15.03.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/787,537 15 March 2013 (15.03.2013) US
14/204,148 11 March 2014 (11.03.2014) US

(71) Applicant: **MAGNA POWERTRAIN INC.** [CA/CA]; 50 Casmir Court, Concord, ON L4K 4J5 (CA).

(72) Inventor: **VUKOJUCIC, Dejan**; 24 McNairn Court, Richmond Hills, ON L4C 5X1 (CA).

(74) Agent: **MARQUARDT, Matthew, J.**; Dickinson Wright LLP, 199 Bay Street, Suite 2200, Toronto, Ontario M5L 1G4 (CA).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*
— *with amended claims (Art. 19(1))*

(88) Date of publication of the international search report:
19 February 2015

Date of publication of the amended claims: 9 April 2015

(54) Title: ONE-PIECE INERTIA RING AND METHOD OF MANUFACTURING THE ONE-PIECE INERTIA RING

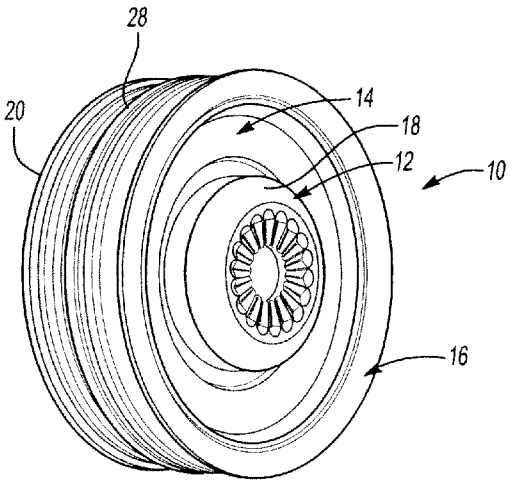

Fig-1

(57) Abstract: A harmonic damper for use in vehicular accessory drive systems. The harmonic damper includes a one-piece inertia ring manufactured from a sheet metal blank using a cold forming process to define a series of interconnected folded ring sections.

WO 2014/140919 A4

AMENDED CLAIMS
received by the International Bureau on 2 January 2015 (02.01.2015)

1. A harmonic damper comprising: a pulley having a hub and a pulley rim interconnected by a web plate;

an inertia ring having an inner surface surrounding the hub and an outer surface; and

an elastomeric ring disposed between an inner surface of the pulley rim and the outer surface of the inertia ring for interconnecting the inertia ring to the pulley;

wherein the inertia ring is configured to include a plurality of interconnected ring sections extending between its inner and outer surfaces, and wherein the inertia ring is cold formed from a metal blank to create the plurality of interconnected ring sections.

2. The harmonic damper of Claim 1 wherein the hub of the pulley is adapted to be connected to a crankshaft of an internal combustion engine, and wherein the pulley rim is adapted to engage an endless drive belt of an accessory drive system for transferring rotary power from the crankshaft to a remote accessory associated with the accessory drive system.

3. The harmonic damper of Claim 1 wherein the inertia ring includes a central mass body portion terminating in a flange section which defines the outer surface, wherein the body portion is ring-shaped has a central aperture defining the inner surface, and wherein the mass body portion is formed from the plurality of the interconnected ring sections.

4. The harmonic damper of Claim 3 wherein the plurality of interconnected ring sections includes a first ring section connected to the flange section by a first fold section to define a first axial interface therebetween, and a second ring section connected to the first ring section by a second fold section to define a second axial interface therebetween, and wherein the first ring section is radially disposed between the flange section and the second ring section such that the first axial interface concentrically surrounds the second axial interface.

5. The harmonic damper of Claim 4 wherein the plurality of interconnected ring sections further includes a third ring section connected to the second ring section by a third fold section to define a third axial interface therebetween, and a fourth ring section connected to the third ring section by a fourth fold section to define a fourth axial interface therebetween, wherein the third ring section is radially disposed between the second ring section and the fourth ring section such that the second axial interface concentrically surrounds the third axial interface and the third axial interface concentrically surrounds the fourth axial interface, and wherein the first and third fold sections extend along a first face surface of the mass body portion and the second and fourth fold sections extend along a second face surface of the mass body portion.

6. The harmonic damper of Claim 5 wherein a width dimension is established between the first and second face surfaces of the mass body portion.

7. The harmonic damper of Claim 5 wherein the first axial interface defines engagement between the flange section and the first ring section.

8. The harmonic damper of Claim 5 wherein said fourth ring section has an inner surface configured to define the central aperture of the mass body portion of the inertia ring.

9. The harmonic damper of Claim 5 wherein said inertia ring further includes a fifth ring section connected to the fourth ring section by a fifth fold section to define a fifth axial interface therebetween, wherein the fifth fold section has an inner surface defining the aperture.

10. The harmonic damper of Claim 4 wherein the inertia ring is cold formed using a folding and stacking process, wherein the second ring section is formed prior to the first ring section, and wherein the first ring section is formed prior to the flange section.

11. A method of assembling a harmonic damper for use in a motor vehicle, comprising:

providing a pulley having a hub portion and a pulley rim portion interconnected by a radial web portion;

providing an inertia ring having a mass body portion and a flange portion;

providing an elastomeric ring;

mounting the mass body portion of the inertia ring to surround the hub portion of the pulley; and

mounting the elastomeric ring between the flange portion of the inertia ring and the pulley rim portion of the pulley;

wherein the flange portion and the mass body portion of the inertia ring are configured to include a plurality of at least three interconnected ring sections fabricated using a cold forming process.

12. The method of Claim 11 wherein the elastomeric ring is disposed between and in engagement with an outer surface of the flange portion of the inertia ring and an inner surface of the pulley rim portion of the pulley.

13. The method of Claim 11 wherein the mass body portion is ring-shaped and has a central aperture defining an inner surface adapted to surround an outer surface of the hub portion.

14. The method of Claim 13 wherein the plurality of interconnected ring sections includes a first ring section connected to the flange portion by a first fold section to define a first axial interface therebetween, and a second ring section connected to the first ring section by a second fold section to define a second axial interface therebetween, and wherein the first ring section is radially disposed between the flange portion and the second ring section such that the first axial interface concentrically surrounds the second axial interface.

15. The method of Claim 14 wherein the plurality of interconnected ring sections further includes a third ring section connected to the second ring section by a third fold section to define a third axial interface therebetween, and a fourth ring section connected to the third ring section by a fourth fold section to define a fourth axial interface therebetween, wherein the third ring section is radially disposed between the second ring section and the fourth ring section such

that the second axial interface concentrically surrounds the third axial interface and the third axial interface concentrically surrounds the fourth axial interface, and wherein the first and third fold sections extend along a first face surface of the mass body portion and the second and fourth fold sections extend along a second face surface of the mass body portion.

16. The method of Claim 15 wherein said inertia ring further includes a fifth ring section connected to the fourth ring section by a fifth fold section to define a fifth axial interface therebetween, wherein the fifth fold section has an inner surface defining a central aperture configured to surround the hub portion of the pulley.

17. A harmonic damper comprising

a drive member having a hub;

an inertia ring having an aperture positioned to surround the hub; and a resilient damper disposed between the drive member and the inertia ring;

wherein the inertia ring includes a mass body portion formed from a plurality of ring sections interconnected by a plurality of fold sections to define a one- piece folded structure.

18. The harmonic damper of Claim 17 wherein the damper is an elastomeric ring disposed between an inner surface of the drive member and an outer surface of the mass body portion of the inertia ring, wherein the plurality of interconnected ring sections and fold sections include a first ring section connected to an outer flange section by a first fold section to define a first axial interface therebetween, and a second ring section connected to the first ring section by a second fold section to define a second axial interface therebetween, and wherein the first ring

section is radially disposed between the flange section and the second ring section such that the first axial interface concentrically surrounds the second axial interface.

19. The harmonic damper of Claim 18 wherein the plurality of interconnected ring sections and fold sections further include a third ring section connected to the second ring section by a third fold section to define a third axial interface therebetween, and a fourth ring section connected to the third ring section by a fourth fold section to define a fourth axial interface therebetween, wherein the third ring section is radially disposed between the second ring section and the fourth ring section such that the second axial interface concentrically surrounds the third axial interface and the third axial interface concentrically surrounds the fourth axial interface, and wherein the first and third fold sections extend along a first face surface of the mass body portion and the second and fourth fold sections extend along a second face surface of the mass body portion.

20. The harmonic damper of Claim 19 wherein the inertia ring further includes a fifth ring section connected to the fourth ring section by a fifth fold section to define a fifth axial interface therebetween, wherein the fifth fold section has an inner surface defining the aperture.