US 20060234829A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2006/0234829 A1

(43) Pub. Date: Oct. 19, 2006

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(54) SYSTEM AND METHOD FOR INERTIAL TORQUE REACTION MANAGEMENT

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(21) Appl. No.: **10/907,721**

(22) Filed: **Apr. 13, 2005**

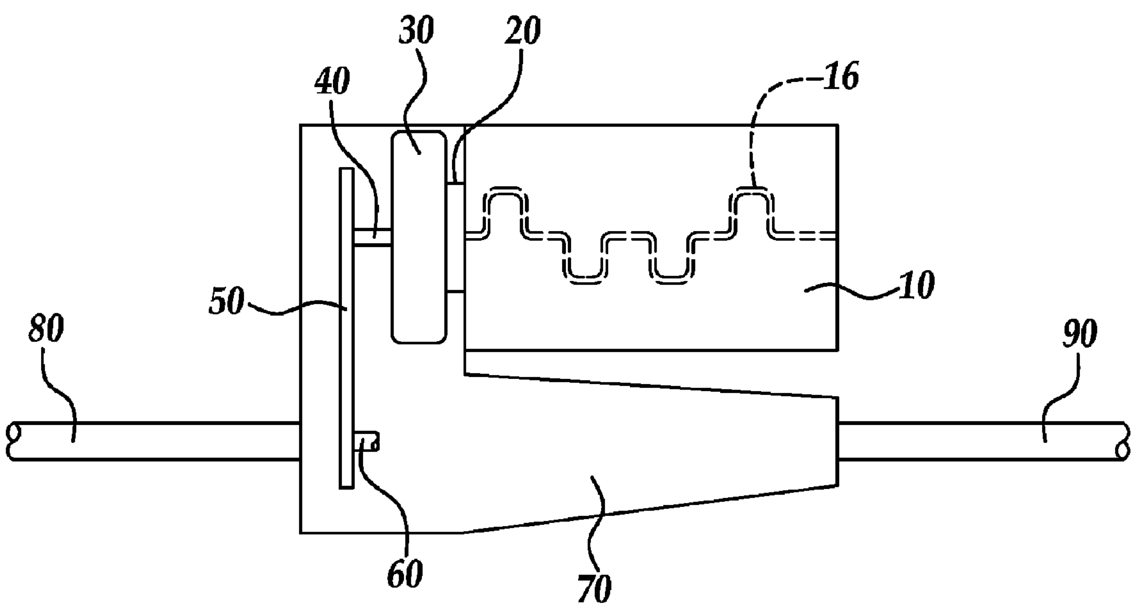
Publication Classification

(51) **Int. Cl.**
F16H 61/38 (2006.01)

(52) **U.S. Cl.** **477/52**

(57) **ABSTRACT**

A system and method for managing inertial torque reactions on stationary powertrain structure rotate at least one selected engine component and at least one selected drive train component in opposite directions so the rotational inertia of the selected drive train component acts in a direction opposite to that of the rotational inertia of the selected engine component to reduce or eliminate the inertial torque reactions on stationary powertrain structure caused by rotational acceleration and deceleration of powertrain components and improves performance with respect to noise, vibration, and harshness (NVH).



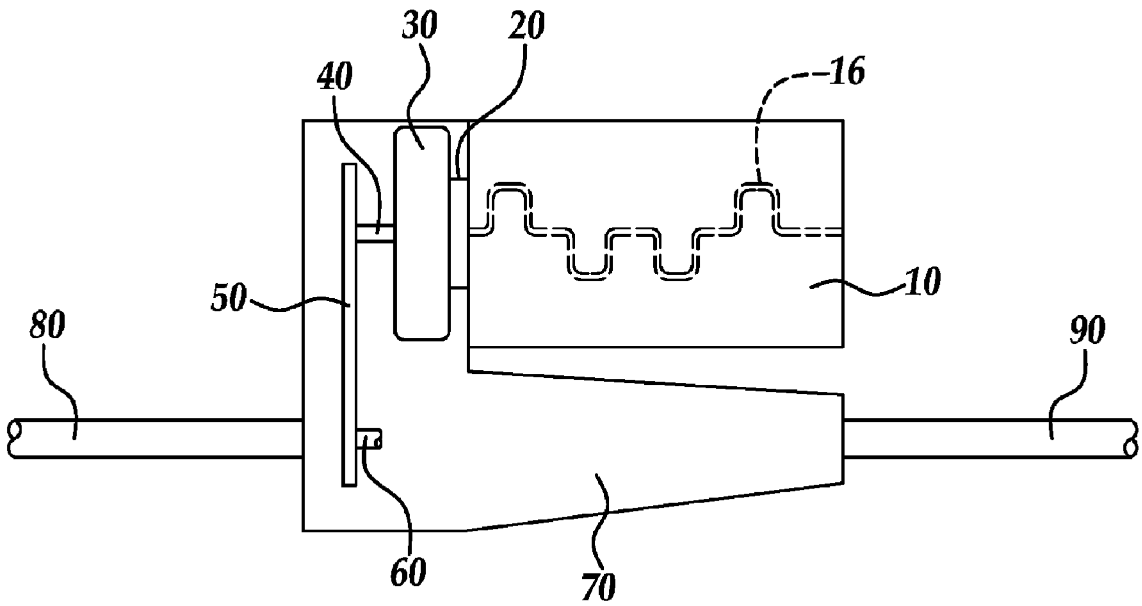


Figure 1

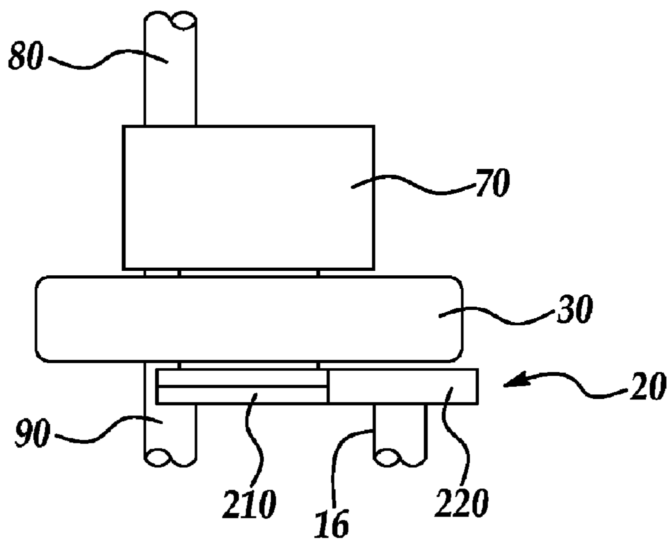


Figure 2

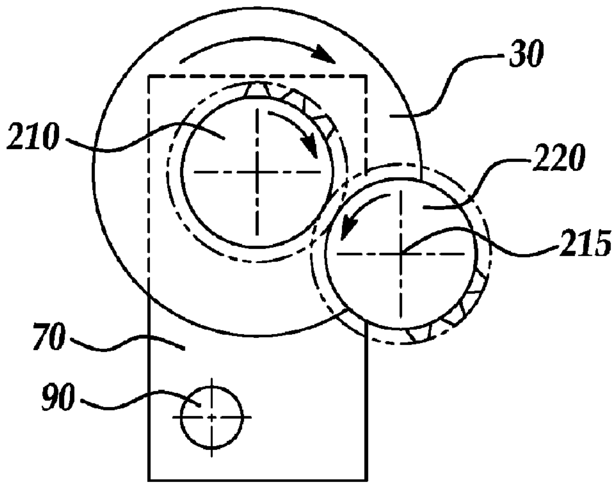


Figure 3

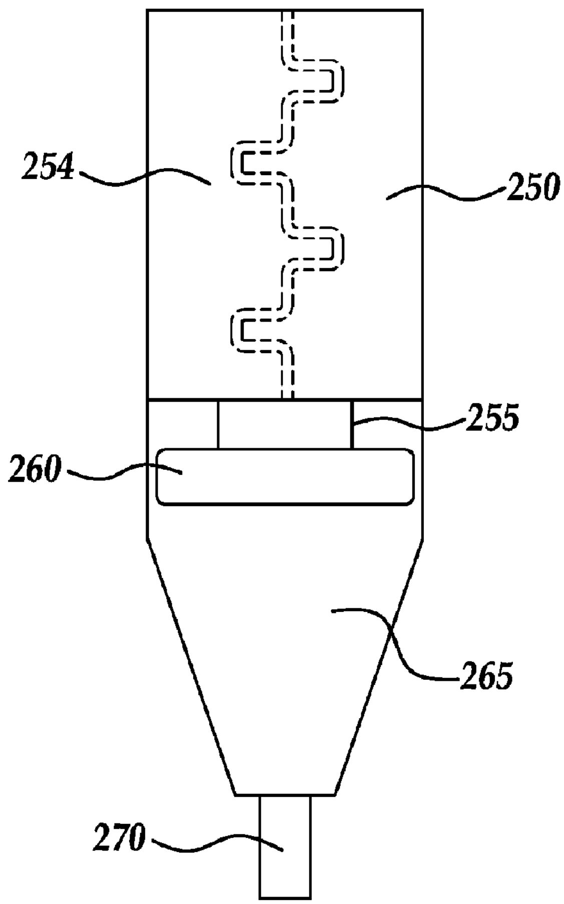
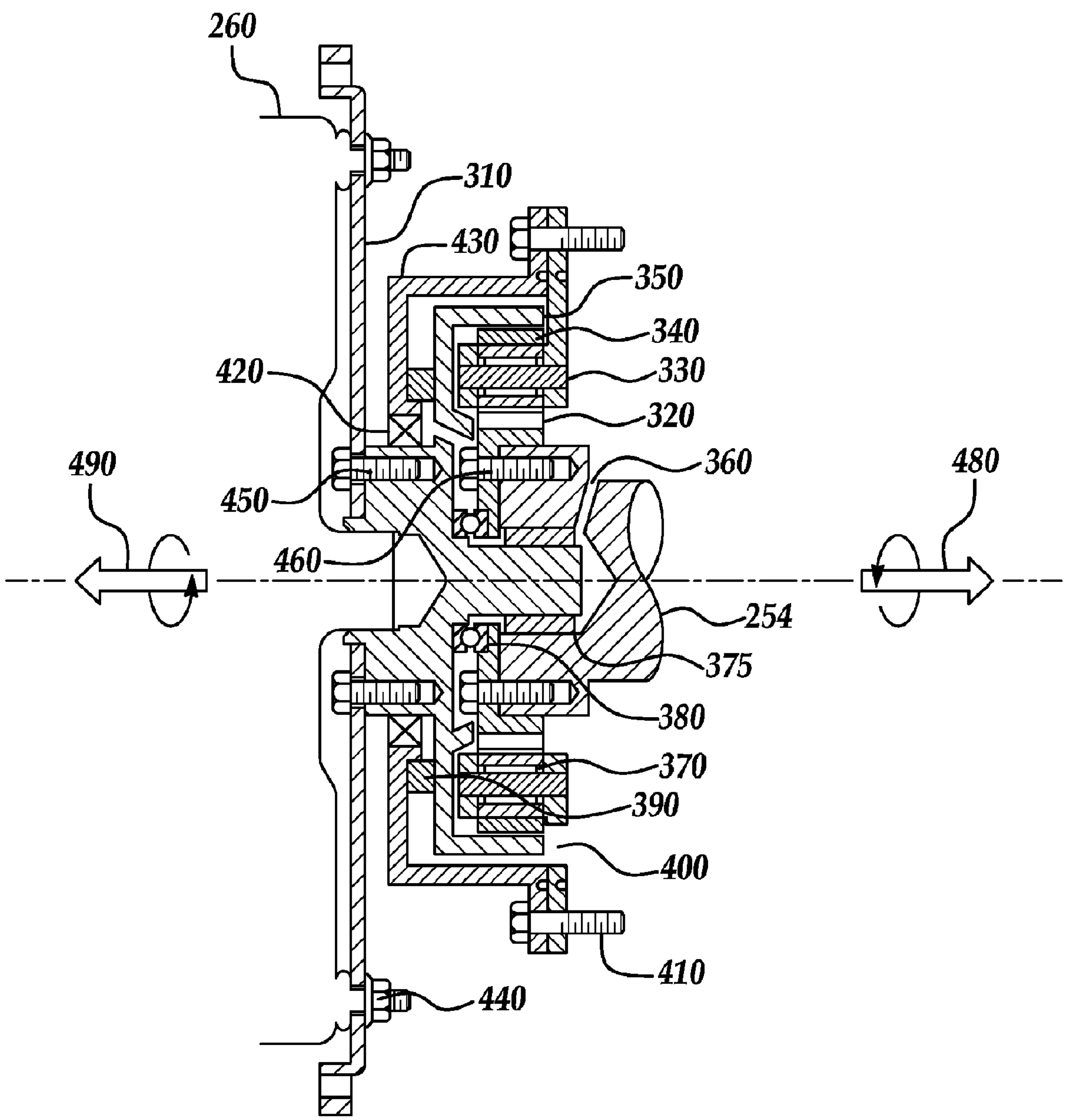


Figure 4


260
310
430
350
340
330
420
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490
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460
254
375
380
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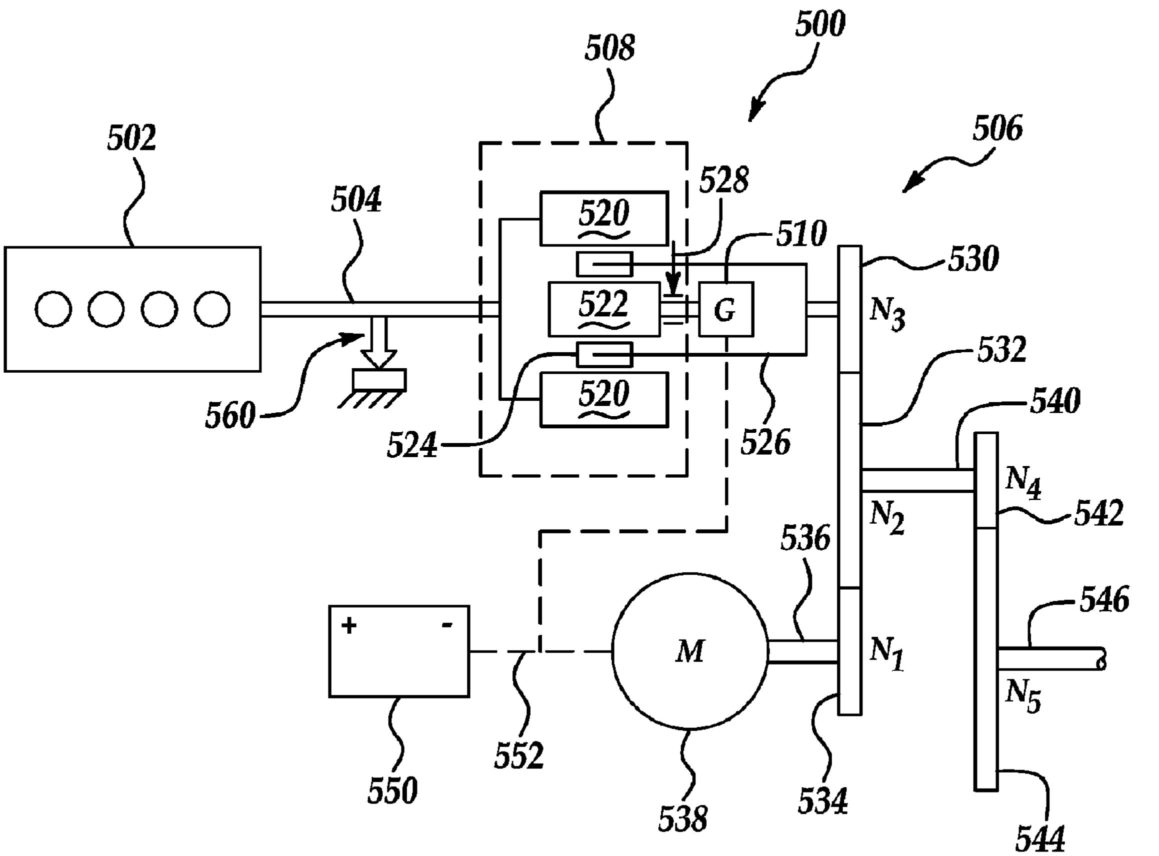
390
400
410
440

Figure 5


500
508
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502
504
528
520
510
530
522
G
N3
520
532
560
524
526
540
N4
542
N2
536
546
+
-
M
N1
N5
550
552
538
534
544

Figure 6

SYSTEM AND METHOD FOR INERTIAL TORQUE REACTION MANAGEMENT

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to systems and methods for managing inertial torque reaction of rotating machines.

[0003] 2. Background Art

[0004] A conventional powertrain has a "stationary" structure that is attached to the vehicle chassis with resilient mounts. In conventional powertrains, rotating inertia of various engine and transmission components including the crankshaft, flywheel, and torque converter of an automatic transmission, for example, is rotated in the same direction, having a compounding effect. When a compression or combustion event of the engine causes an acceleration of the rotating inertia, generally, there is an equal but opposite inertial torque reaction imposed upon the stationary structure. As such, the stationary structure is not truly stationary, but instead, vibrates in opposition to the accelerations of the rotating inertia. This vibration of the stationary structure passes vibration through the resilient mounts into the vehicle chassis, and may result in unwanted noise and vibration within the vehicle passenger compartment.

[0005] Conventional solutions to this vibration issue include controlling the engine operating conditions to minimize the magnitude and frequency range of the inertial torsional vibrations and tuning the powertrain mounts to minimize transmission of vibrations. However, the constraints placed on the engine/powertrain operation may impact the ability to achieve other desirable operating characteristics relative to responsiveness, fuel economy, and/or emissions, for example.

[0006] Other known solutions control one or more counter-rotating elements to reduce or eliminate inertial torque reaction, such as disclosed in U.S. Pat. Nos. 5,551,928, and 5,570,615, for example. While these approaches may reduce the torque reaction on the powertrain structure, the increased mass also increases weight and reduces responsiveness of the system.

SUMMARY OF THE INVENTION

[0007] The present invention includes a system and method for managing inertial torque reaction by rotating inertial powertrain or drivetrain components a direction opposite to the rotation of engine/motor inertial components, to reduce or eliminate torque reaction on stationary powertrain components.

[0008] In one embodiment, the present invention uses a device to provide counter-rotation of one or more engine/motor components relative to rotating transmission or transaxle components to reduce or eliminate the inertial torque reaction otherwise associated with angular acceleration/deceleration of a rotating mass on stationary structure or mounting components. The device may be implemented by a plurality of drive components such as gears, belts, chains and sprockets, or any similar device used to couple an output component of an internal combustion engine to one or more components of the powertrain, such as the torque converter of an automatic transmission or the generator of a hybrid powertrain. The device causes one or more inertial powertrain components to rotate in a direction opposite to that of various engine inertial components, such as a crankshaft. The effective inertia of the counter rotating components may be substantially matched to that of the forward rotating components using a device with an appropriate input/output ratio to create a speed differential between the counter rotating engine/motor components and the forward rotating powertrain components, or by adjusting the mass or component geometry of engine or powertrain components, for example.

[0009] In a transversely mounted internal combustion engine and transaxle, as generally used in, but not limited to, front wheel drive (FWD) vehicles, for example, the crankshaft and the torque converter may be connected using toothed wheels enabling the torque converter and crankshaft to rotate in opposite directions. A separate or integrated device may be used to reduce or eliminate backlash and associated noise, such as a scissors gear, for example. The opposing direction of rotation of the crankshaft and torque converter reduces or eliminates the inertial torque reaction on the stationary powertrain structure to reduce or eliminate unwanted vibration and noise.

[0010] A longitudinally mounted engine and transmission application, as generally used in, but not limited to, rear wheel drive (RWD) vehicles, for example, may incorporate a simple planetary gear set to connect the crankshaft to the torque converter. Such a planetary gear set typically includes a sun gear, a ring gear, and a carrier with a plurality of pinions that are constantly in mesh with the sun and ring gears. In such an arrangement, for example, the carrier may be rendered stationary by using a plurality of fasteners to connect it with the engine/motor block. The sun gear of the planetary gear set may be connected to the crankshaft using any of a variety of methods including using conventional fasteners or alternatively splines with at least one retaining ring. Likewise, the ring gear or the annulus of the planetary gear set may be connected to the engine/motor flex plate using a plurality of fasteners. Such an arrangement allows the ring gear to rotate in a direction opposite to that of the sun gear when the carrier is non-rotating. Thus, at least one drivetrain component, such as the torque converter, will rotate in a direction opposite to that of the crankshaft and create corresponding rotational inertia to reduce or eliminate the inertial torque reaction otherwise associated with a change in angular acceleration/deceleration of rotating components of the engine on the stationary powertrain structure reducing or eliminating associated noise and vibration.

[0011] The present invention provides a number of advantages. For example, the present invention provides systems and methods for managing inertial torque reaction by providing a counter-rotating inertia generated by conventional powertrain components to reduce or eliminate the torque reaction on the powertrain structure and improve performance with respect to noise, vibration, and harshness (NVH). Reversing rotation of conventional powertrain components obviates the need for additional components or mass to generate balancing inertia. This reduces any adverse impact on powertrain weight, responsiveness, and overall performance relative to conventional solutions that add components solely for balancing or canceling torque reactions associated with rotating inertia.

[0012] The present invention may allow variable displacement engines to idle and drive at low engine speeds with fewer than all of the cylinders firing without unacceptable NVH. Also, the reduced or limited inertial torque reaction on the stationary powertrain structure should reduce noise, vibration, and harshness (NVH) with the uneven firing intervals that occur when an 8-cylinder engine operates in a reduced or variable displacement mode with 3, 5, 6, or 7 firing cylinders, for example.

[0013] The above advantage and other advantages and features of the present invention will be readily apparent from the following detailed description of the preferred embodiments when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a top view block diagram illustrating a system or method for managing inertial torque reaction of a transversely mounted powertrain according to one embodiment of the present invention;

[0015] **FIG. 2** is a top view block diagram illustrating another device for coupling a torque converter to an engine or motor in a system or method for managing inertial torque reaction according to the present invention;

[0016] **FIG. 3** is a side view block diagram of the system illustrated in **FIG. 2**;

[0017] **FIG. 4** is a top view block diagram illustrating a system or method for managing inertial torque reaction for a longitudinally mounted powertrain according to one embodiment of the present invention;

[0018] **FIG. 5** is a cross-section of a device for coupling a drivetrain to an engine in a system or method for managing inertial torque reaction according to one embodiment of the present invention; and

[0019] **FIG. 6** is a block diagram illustrating a system or method for managing inertial torque reaction in a hybrid engine/motor powertrain according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0020] As those of ordinary skill in the art will understand, various features of the present invention as illustrated and described with reference to any one of the Figures may be combined with features illustrated in one or more other Figures to produce embodiments of the present invention that are not explicitly illustrated or described. The combinations of features illustrated provide representative embodiments for typical applications. However, various combinations and modifications of the features consistent with the teachings of the present invention may be desired for particular applications or implementations.

[0021] Referring now to **FIG. 1**, a block diagram illustrating a representative embodiment of the present invention in a transversely mounted powertrain application is shown. As those of ordinary skill in the art will appreciate, transversely mounted powertrains are typically used in front wheel drive (FWD) vehicles. However, as described herein, the present invention is not limited to conventional vehicular applications and may be used in various types of powertrains having an internal combustion engine, or other torsional vibration inducing prime mover coupled to a drivetrain that may include a fixed or selectable gearbox, transmission, and/or transaxle to power a machine or vehicle. The present invention is independent of the particular transmission technology and may be used with manual or automatic gear-change or speed-change transmissions, continuously variable transmissions (CVT's), and/or any combination or hybrid. The representative transversely mounted powertrain illustrated in **FIG. 1** includes a multi-cylinder internal combustion engine **10** having a plurality of components that rotate during operation and create rotational inertia with a corresponding torque or moment that acts on stationary structure of an associated vehicle (not shown). Engine **10** generally represents any of a variety of internal combustion engines/motors that may include spark-ignition and compression-ignition engines and other prime movers particularly suited for vehicular applications. As previously described, the present invention may be utilized in various other types of engines and other prime movers that generate a vibrational reaction torque or moment associated with rotational acceleration or deceleration of various engine, motor, and/or transmission/powertrain components and is not limited to vehicular applications or internal combustion engines. Engine **10** typically includes one or more rotating components that may be considered the primary contributors to reaction torque transmitted through engine mounts to a vehicle chassis or other stationary structure due to the magnitude of rotational inertia of the components. For a typical internal combustion engine application, crankshaft **16** is a primary constituent of engine rotational inertia and the resulting reaction torque. Other components (not shown) whose angular acceleration may contribute to the reaction torque include a flywheel, connecting rods, harmonic damper, and camshaft(s), for example.

[0022] A device **20** couples crankshaft **16** of engine **10** to a rotating component of a transaxle or transmission **70**, such as torque converter **30** or flywheel, for example. As illustrated and described in greater detail below, device **20** may be implemented by one or more gears, sprockets, gear sets, belts, or other cooperating components to reverse the direction of rotation of torque converter **30** relative to crankshaft **16**. The actual implementation and positioning of device **20** may depend on various application specific considerations. For example, in transversely mounted powertrain applications, the implementation of device **20** may be dictated by packaging constraints such that the particular implementation does not significantly increase the transverse length of the engine/drivetrain. In various embodiments, device **20** may also increase or decrease rotational speed of torque converter **30** relative to crankshaft **16** to generally match the effective magnitude of rotational inertia produced by rotating components of transmission/transaxle **70** to that of engine **10**. Depending upon the particular application and implementation, the speed differential may be fixed, continuously variable, or selectable from two or more predetermined ratios. For example, the device may be implemented by a gear-change transmission, speed-change transmission, or continuously variable transmission. Applications using a selectable or controllable speed differential may include either a mechanical, electrical, or microprocessor based controller to determine an appropriate speed differential for current operating conditions or a selected operating mode, for example.

[0023] As also illustrated in **FIG. 1**, torque converter **30** is connected to turbine shaft **40**, which is coupled via chain drive **50** to input shaft **60** of transmission or transaxle **70**. Left axle **80** and right axle **90** are connected to corresponding left and right vehicle wheels (not shown), or various auxiliary equipment for non-vehicular applications.

[0024] In operation, torque from engine **10** is carried by crankshaft **16** through coupling device **20** to torque converter **30**, which provides a selective fluid coupling and torque multiplication under various operating conditions to turbine shaft **40**. Chain drive **50** transfers torque from turbine shaft **40** and torque converter **30** through input shaft **60** to transaxle **70**. Left axle **80** and right axle **90** receive power from transmission **70**. Changes in rotational speed of various rotating components of engine **10**, such as crankshaft **16**, for example, result in a corresponding acceleration of rotational inertia and accompanying torque or moment. However, according to the present invention, the counter-rotation of various closely coupled transmission/transaxle or drive train components, such as torque converter **30**, for example, results in a corresponding rotational acceleration of opposite hand or in the opposite direction which produces a torque or moment of opposite sense or direction that tends to reduce or cancel the torque or moment generated by the engine components. As such, the net vibrational torque reaction transmitted to the engine mounts or other stationary powertrain components, such as a vehicle chassis, is reduced or eliminated. The effective magnitudes of the rotational inertias generated by components associated with engine **10** and components associated with transmission or transaxle **70** may be adjusted via component mass and geometry as well as the relative rotational speed, which may be selected or determined by coupling device **20** as described herein.

[0025] A top-view block diagram illustrating a system or method for managing inertial torque reaction according to one embodiment of the present invention is shown in **FIG. 2**. In this embodiment, coupling device **20** is implemented by a spur gear or other toothed wheel **220** connected to an engine crankshaft **16** and in meshing engagement with one or more associated gears **210**, implemented by a scissors gear in this example to reduce or eliminate backlash and associated gear rattle or noise. As best illustrated and described with reference to **FIG. 3**, coupling device **20** reverses rotational direction of torque converter **30** relative to the engine crankshaft. Depending upon the particular application and implementation, another device or a gear set may be used in place of scissors gear **210** to provide counter-rotation of one or more transmission or drive train components and reduce or eliminate backlash and any associated gear noise.

[0026] As shown in **FIG. 2**, scissors gear **210** is connected to torque converter **30**, which, in turn, is fluidly coupled via operation of torque converter **30** to the turbine shaft or input shaft of transmission **70**. The relative speed between the engine crankshaft and torque converter **30** may optionally be controlled or determined by the selected input/output ratio or gear ratio of coupling device **20**. In one embodiment, the gear ratio of device **20** is selected so that torque converter **30** rotates at a speed based on rotational speed of the engine crankshaft to substantially match the effective magnitudes of rotational inertia of the forward rotating transmission components to the rearward rotating engine components. Substantially matching the effective magnitudes of rotational inertia associated with the transmission to the counter-rotating inertia associated with the engine reduces or eliminates any net torque reaction transferred to the stationary powertrain mounts or connections to surrounding structure, such as a vehicle chassis, due to vibrational changes in rotational speed (acceleration/deceleration) of the engine and transmission components. For internal combustion engine applications, each cylinder firing results in a small acceleration of the crankshaft and associated torque reaction that would otherwise be transmitted to the powertrain mounts if not offset by a corresponding acceleration in the opposite-rotating inertia, and its associated torque reaction, according to the present invention.

[0027] **FIG. 3** is a side-view schematic block diagram illustrating a transversely mounted powertrain for a FWD vehicle shown in the top view of **FIG. 2**. In this embodiment, toothed wheel **220** is mounted concentrically on crankshaft axis **215** with its teeth meshing with scissors gear **210** mounted concentrically on the central axis of torque converter **30**. The toothed wheel **220** and scissors gear **210** are meshing in such a way that they always rotate in opposite directions relative to each other. As shown in **FIG. 3**, during operation, toothed wheel **220** mounted to the crankshaft rotates in a counter-clockwise direction about crankshaft axis **215** in the same direction as the crankshaft. Scissors gear **210** is disposed to rotate in a direction opposite to that of toothed wheel **220**. As such, scissors gear **210** rotates in a clockwise direction as shown in **FIG. 3**. Because scissors gear **210** is mounted on torque converter **30**, torque converter **30** also rotates in the same direction as scissors gear **210**. Thus, the meshing engagement of toothed wheel **220** and scissors gear **210** allows torque converter **30** to rotate in a clockwise direction when the crankshaft rotates in a counter-clockwise direction. With this reversal of rotational direction, the rotational accelerations of the inertia of torque converter **30** and associated transmission components act in an opposite direction to the rotational accelerations of the inertia of crankshaft **16** and associated engine components. The rotational acceleration of torque converter **30** acting in a direction opposite to that of crankshaft **16** will reduce or eliminate the resulting net torque reaction on stationary powertrain structure and hence improve performance with respect to noise, vibration, and harshness (NVH).

[0028] **FIG. 4** is a top view schematic block diagram that illustrates another embodiment of the present invention for a longitudinally mounted powertrain, such as used in a typical rear wheel drive (RWD) vehicle, for example. In this embodiment, engine/motor **250** includes a crankshaft or output shaft coupled via device **255** to torque converter **260** of transmission **265** with output shaft **270** connected to a vehicle drive shaft (not shown) or other machinery depending upon the particular application. Torque from engine/motor **250** is carried by crankshaft **254** through coupling device **255** to torque converter **260**. Coupling device **255** reverses the direction of rotation of torque converter **260** relative to crankshaft or engine/motor output shaft **254** so that one or more components of transmission **265**, such as torque converter **260**, provide a counter-rotating inertia to reduce or eliminate any net torque reaction associated with the rotating inertia of various components of engine/motor **250** on or through the stationary powertrain structure. Coupling device **255** may be implemented by any of a number of devices such as two or more meshing gears, a planetary gear set, or similar devices to reverse the direction of rotation. Coupling device **255** may include one or more components to reduce or eliminate backlash and any associated gear noise or rattle, such as a scissors gear, for example. Rotation of torque converter **260** provides a selective fluid coupling and torque multiplication so that power from torque converter **260** is transmitted through transmission **265** to transmission output shaft **270**.

[0029] In addition to reversing the direction of rotation of various transmission components relative to rotating engine components, coupling device **255** may also provide a selected or selectable speed differential between motor/engine output shaft/crankshaft **254** and a transmission input shaft or torque converter **260** to substantially match the effective magnitudes of rotational inertia of rotating drive line and engine components. For applications utilizing a device **255** having a selectable speed differential, a corresponding mechanical, electrical, or microprocessor based actuator/controller may be provided to select one of the available input/output ratios based on an operating mode or current operating conditions, for example. Depending on the component mass and geometry, coupling device **255** may increase or decrease the rotational speed of one or more drive train components relative to one or more engine components. In one embodiment, coupling device **255** reduces the rotational speed of torque converter **260** relative to crankshaft **254** to better match effective rotational inertia magnitudes. However, the actual input/output speed of coupling device **255** will depend upon various application and implementation specific parameters including engine and drive train component geometry, relative mass of components, and relative location of rotating components, for example.

[0030] A cross-section of one embodiment of a device for coupling a prime mover to a drive train in a system or method for managing inertial torque reaction of a powertrain according to the present invention is shown in **FIG. 5**. In this embodiment, the coupling device comprises a planetary gear set to reverse rotational direction and provide a speed differential for a transmission/transaxle torque converter relative to an engine crankshaft. Appropriate construction of the planetary gear set provides a desired speed differential to substantially match effective magnitudes of rotational inertia of engine and drive train components as described herein.

[0031] As shown in **FIG. 5**, engine output shaft or crankshaft **254** is fastened to sun gear **320** using a plurality of fasteners **460**. A plurality of fasteners **410** attach planet carrier **330** to a fixed, non-rotating portion of engine **110** (not shown), such as the engine block, for example. Flex plate **310** is attached to ring gear **350** using a plurality of fasteners **450**. Torque converter **260** is attached to flex plate **310** using a plurality of fasteners **440**. A plurality of planet gears **340** are constantly in mesh with ring gear **350** and sun gear **320**. A plurality of needle bearings **370** supports each planet gear **340**. The planet gears **340** and supporting needle bearings **370** are positioned inside planet carrier **330**. Needle bearings **375** support ring gear **350** inside crankshaft **254** such that relative rotational motion is permitted between ring gear **350** and crankshaft **254**. Thrust bearing **380** and thrust bushing **390** control the axial position of ring gear **350** between rear seal carrier **430** and planet carrier **330**. Oil passage **360** supplies oil from the rear crankshaft main bearing of engine **110** to provide lubrication of the planetary gear set. Oil path **400** allows oil to drain out of the planetary gear set components and be returned to the engine oil sump. Oil seal **420** prevents loss of oil.

[0032] In operation, crankshaft **254** rotates in a first direction indicated generally by arrows **480**. (Arrows **480** and **490** illustrate direction of rotation by use of the right hand rule where rotational direction is indicated by pointing the right-hand thumb in the direction of the straight arrow and closing the hand to make a fist such that the motion of the fingers indicates the direction of rotation.) Because sun gear **320** is attached to crankshaft **254** using a plurality of fasteners **460**, sun gear **320** rotates in the same direction as crankshaft **254**. Planet carrier **330** is rendered stationary by a plurality of fasteners **410** attaching it to a fixed, non-rotating portion of engine **110**. Planet gears **340** are in mesh with sun gear **320** and rotate about their axes in a direction opposite to that of sun gear **320**. Therefore the direction of rotation of planet gears **340**, as generally indicated by arrow **490**, is opposite that of crankshaft **254**. Planet gears **340** are also in mesh with ring gear **350**. The rotation of planet gears **340** forces ring gear **350** to rotate in the same direction, opposite to the crankshaft. Ring gear **350** is connected to flex plate **310** using a plurality of fasteners **450**. As such, flex plate **310** also turns in the same direction as ring gear **350**. Flex plate **310** is connected to torque converter **260** using a plurality of fasteners **440** forcing torque converter **260** to also rotate in the same direction. Thus torque converter **260** rotates in a direction opposite to that of crankshaft **254**. The rotational inertia of torque converter **260** moving in a direction opposite to that of crankshaft **254** will reduce or eliminate the torque reaction induced by any acceleration of rotational inertia of crankshaft **254** on stationary powertrain structure and hence improve performance with respect to noise, vibration, and harshness (NVH).

[0033] A block diagram illustrating a system and method for managing inertial torque reaction according to one embodiment of the present invention in a hybrid powertrain is shown in **FIG. 6**. Hybrid powertrain **500** includes a multiple cylinder internal combustion engine **502** with an output shaft or crankshaft **504** coupled to a drive train **506**. A one-way clutch **560** prevents crankshaft/output shaft **504** from reversing rotational direction. During selected operating modes of the hybrid system when engine **502** is operating to drive generator **510**, device **508** reverses direction of rotation and provides a speed differential between output shaft **504** and generator **510**, which is one of the more significant contributors to rotational inertia of drive train **506**. As such, counter-rotation of generator **510** relative to crankshaft **504** reduces or eliminates any associated net torque reaction on stationary powertrain structure as described herein. In the representative embodiment illustrated in **FIG. 6**, device **508** is implemented by a planetary gear set with engine crankshaft **504** driving ring gear **520**. Sun gear **522** is in constant meshing engagement with a plurality of planet gears **524** supported by carrier **526**. Planet gears **524** are also in meshing engagement with ring gear **520**.

[0034] Carrier **526** of device **508** is coupled via meshing engagement of gears **530**, **532**, and **534** to motor shaft **536** of electric motor **538**. Gear **532** is coupled to intermediate shaft **540**, which is in turn coupled to gear **542**, which is in meshing engagement with output gear **544** coupled to output shaft **546**. A battery **550** or other energy storage device is coupled via electrical connection **552** to motor **538** and generator **510**.

[**0035**] According to the present invention, hybrid powertrain **500** includes one or more operating modes where one or more inertial components of engine **502** and powertrain **506** rotate in opposite directions to provide counter-rotating inertia to reduce or eliminate reaction torque associated with acceleration/deceleration of rotating components. When the vehicle speed is low, so that the rotational speed of planet carrier **526** is substantially less than that of crankshaft **504**, sun gear **522** and generator **510** are forced to rotate in the direction opposite to that of the crankshaft. Depending upon the effective magnitude of rotational inertias of engine components and drive train components, the present invention may also provide a predetermined or selectable speed differential to substantially match effective magnitude of inertias as previously described.

[**0036**] While the best mode for carrying out the invention has been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.

What is claimed is:

1. A method for managing inertial torque reaction in a vehicle having an engine and a drive train, the method comprising:

operating the drive train to rotate inertia in a direction opposite to rotating inertia created by operation of the engine.

2. The method of claim 1 wherein the engine includes a crankshaft and the drive train includes a transmission having at least one inertial component including one of a torque converter and a flywheel and wherein the step of operating the drive train comprises rotating the at least one inertial component in a direction opposite to rotational direction of the crankshaft.

3. The method of claim 1 further comprising coupling the drive train to the engine using a device to reverse direction of rotation of a drive train torque converter relative to an engine crankshaft.

4. The method of claim 3 wherein the step of coupling comprises coupling the torque converter and the crankshaft using a planetary gear set.

5. The method of claim 3 wherein the step of coupling comprises connecting the torque converter to the crankshaft using a plurality of toothed wheels.

6. The method of claim 5 wherein at least one of the toothed wheels comprises a scissors gear.

7. The method of claim 1 further comprising operating the drive train to create rotating inertia having a magnitude substantially equal to rotating inertia of the engine.

8. The method of claim 1 further comprising operating at least one drive train component at a speed differential relative to engine speed, the speed differential being based on rotational inertia magnitude of the engine relative to rotational inertia magnitude of the drive train.

9. The method of claim 1 wherein the step of operating the drive train comprises reducing speed of a transmission torque converter relative to an engine crankshaft.

10. A method for managing inertial torque reaction in a powertrain having a prime mover and a drive train, the method comprising coupling the prime mover to the drive train using a device that reverses direction of rotation of a drive train inertial component relative to direction of rotation of a prime mover output component.

11. The method of claim 10 further comprising operating the drive train inertial component at a speed differential relative to the prime mover output component, the speed differential based on rotational inertia associated with selected components of the prime mover relative to rotational inertia associated with selected components of the drive train.

12. The method of claim 10 wherein the step of coupling comprises coupling a torque converter of the drive train to a crankshaft of the prime mover using a planetary gear set.

13. The method of claim 10 wherein the step of coupling comprises coupling a torque converter of the drive train to a crankshaft of the prime mover using a first gear secured to the crankshaft in meshing engagement with a second gear secured to the torque converter.

14. The method of claim 10 wherein the step of coupling comprises coupling a generator of the drive train to a crankshaft of the prime mover using a planetary gear set.

15. A system for managing inertial torque reaction in a vehicle having a powertrain including a prime mover and a drive train, the system comprising a device for coupling the prime mover to the drive train such that the drive train generates a rotational inertia reaction torque in a direction opposite rotational inertia reaction torque generated by the prime mover.

16. The system of claim 15 wherein the device comprises:

a first gear secured for rotation with an output component of the prime mover; and

a second gear in meshing engagement with the first gear and secured for rotation with an input component of the drive train such that the input component of the drive train rotates in an opposite direction relative to rotation of the output component of the prime mover.

17. The system of claim 15 wherein the device comprises a planetary gear set.

18. The system of claim 15 wherein the device creates a speed differential between rotational speed of an output component of the prime mover and an input component of the drive train.

19. The system of claim 15 wherein the prime mover includes a crankshaft, the drive train includes a transmission having a torque converter, and wherein the device comprises a gear set coupling the crankshaft to the torque converter.

20. The system of claim 15 wherein the prime mover includes a crankshaft, the drive train includes a transmission having a torque converter, and wherein the device reverses direction of rotation of the torque converter relative to direction of rotation of the crankshaft.

21. A system for reducing vibration associated with operation of a vehicle, the system comprising:

a prime mover having an output component that rotates during operation;

a transmission having an input component; and

a device for coupling the output component of the prime mover to the input component of the transmission so that the input component rotates in a direction opposite to the output component of the prime mover.

22. The system of claim 21 wherein the device comprises a plurality of gears.

23. The system of claim 21 wherein the transmission comprises an automatic transmission transversely mounted in the vehicle and wherein the input component comprises a torque converter.

24. The system of claim 21 wherein the transmission comprises an automatic transmission longitudinally mounted in the vehicle and wherein the input component comprises a torque converter.

25. The system of claim 21 wherein device creates a speed differential between rotational speed of the output component of the prime mover and the input component of the transmission.

26. The system of claim 25 wherein the speed differential is based on rotational inertia of the prime mover relative to rotational inertia of the transmission.

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