Abstract: The subject matter described herein relates to a transmission system (108) of a hybrid two wheeled vehicle (100). The transmission system 108 includes a pair of drive members (202, 302, 206, 304) and a driven member (212, 306). One of the drive members (202, 302) is attached to an internal combustion engine of the vehicle (100) while the other drive member (206, 304) is attached to the electric motor (210) of the vehicle (100). The driven member (212, 306), on the other hand, is attached to a drive wheel (106) of the vehicle (100) through a gearbox (220). A common transmission member (214, 308) is employed to facilitate transfer of power from the drive members (202, 302, 206, 304) to the driven member (212, 306).
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TRANSMISSION SYSTEM FOR HYBRID TWO WHEELED VEHICLE

TECHNICAL FIELD

The subject matter described herein, in general, relates to a hybrid two wheeled vehicle and in particular, relates to a transmission system for a hybrid two wheeled vehicle.

BACKGROUND

Conventionally, two wheeled vehicles are driven by an internal combustion engine. However, due to the depletion of crude oil reserves along with the rise in fuel prices and increased sensitivity to limit hydrocarbon emissions, it has become desirable to find alternate ways and/or solutions to achieve better fuel economy. One way to achieve the aforesaid is through an electrically driven vehicle. However, such a vehicle has greater body weight and shorter range or running distance per charge as compared to the conventional vehicles. Such drawbacks are overcome by hybrid vehicles.

Hybrid vehicles with two power sources are known in the art. A hybrid two wheeled vehicle employs two power sources i.e. an electric motor and an internal combustion engine. Usually, the internal combustion engine is the main source of power while the electric motor provides secondary power to the hybrid vehicle. In operation, the internal combustion engine and the electric motor can be used in combination with each other or can be used independently. As a result, the pollution caused by a hybrid vehicle is considerably lesser as compared to conventional vehicles that use only internal combustion engines as the power source.
Generally, in a hybrid two wheeled vehicle, the electric motor is disposed near a
gear box of the vehicle. This results in shifting of the center of gravity (CG) of the
vehicle from the center line, making it difficult to handle the vehicle. Further, the electric
motor in the hybrid two wheeled vehicle is normally located near the rear wheel of the
vehicle, which may cause water ingress into the electric motor and consequently lead to
failure of the electric motor. Such a phenomenon is more predominant in step through
two wheelers, which have small wheels and therefore less ground clearance.

Further, in a hybrid two wheeled vehicle, a transmission system is typically employed to transfer power from the engine as well as the electric motor to the rear wheel
of the vehicle. A type of transmission system commonly used in hybrid two wheeled
vehicles is continuously variable transmission (CVT), which includes a pair of variable
diameter pulleys and V belts. The transmission ratio in the CVT is changed by varying
the diameters of the pulleys. However, during operation, there is a possibility of the belt
slipping over the pulleys as the belt moves inwards or outwards on the pulleys. This
results in transmission losses and consequently leads to lower efficiency. Moreover, CVT
produces a lot of noise as the belts move over differently sized pulleys, which is not
desirable.

There is, thus, a need for achieving better transmission efficiency and good
drivability in a hybrid two wheeled vehicle that provides better fuel economy and lower
emissions in operation.

SUMMARY

The subject matter described herein is directed to a transmission system for a
hybrid two wheeled vehicle. The transmission system includes a first power source
having a first output shaft, a first drive member attached to the first output shaft, a second power source having a second output shaft, a second drive member attached to the second output shaft, a driven member for driving a drive wheel of the vehicle, and a power transmitting member. The power transmitting member of the present subject matter is a common power transmitting member for transmitting power from at least one of the first drive member and the second drive member to the driven member.

In one embodiment, the first drive member, the second drive member, and the driven member are pulleys whereas the power transmitting member is a belt.

In another embodiment, the first drive member, the second drive member, and the driven member are sprockets whereas the power transmitting member is a chain.

The transmission system of the present subject matter eliminates any offset in the centre of gravity (CG) of the hybrid two wheeled vehicle with respect to the centerline of the vehicle. This ensures easy handling of the hybrid two wheeled vehicle, thereby improving drivability of the vehicle. Moreover, mounting of the electric motor on the upper side of the transmission case minimizes water ingress into the electric motor, consequently resulting in prolonged life of the electric motor.

These and other features, aspects, and advantages of the present subject matter will become better understood with reference to the following description and appended claims. This summary is provided to introduce a selection of concepts in a simplified form. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.
BRIEF DESCRIPTION OF DRAWINGS

The above and other features, aspects, and advantages of the subject matter will become better understood with regard to the following description, appended claims, and accompanying drawings where:

**Fig.1** illustrates a side view of a hybrid two wheeled vehicle.

**Fig. 2a** and **2b** illustrate a side view and a top view of a transmission system of the hybrid two wheeled vehicle of **Fig. 1** in accordance with one embodiment of the present subject matter.

**Fig. 3a** and **3b** illustrate a side view and a top view of a transmission system of the hybrid two wheeled vehicle of **Fig. 1** in accordance with another embodiment of the present subject matter.

**Fig. 4a** and **4b** illustrate a side view and a top view of the transmission system of the hybrid two wheeled vehicle of **Fig. 1** in accordance with yet another embodiment of the present subject matter.

DETAILED DESCRIPTION

A transmission system for a hybrid two wheeled vehicle is described herein. According to one aspect of the present subject matter, the transmission system includes a first drive member, a second drive member and a driven member disposed in a transmission case.

The first drive member is connected to a crankshaft of an internal combustion engine whereas the second drive member is connected to the output shaft of an electric motor. The torque from the engine and the electric motor is transferred to the first drive
member and the second drive member respectively, which in turn transfer the torque to
the driven member through a transmission member.

Fig. 1 illustrates a side view of a hybrid two wheeled vehicle 100. For example
and by no way limiting the scope of the subject matter, the hybrid two wheeled vehicle
100 is a step through motorcycle. The hybrid two wheeled vehicle 100 of the present
subject matter is configured to accommodate two persons, a rider and a pillion. The
hybrid two wheeled vehicle 100 includes a seat 102, a front wheel 104, a rear wheel 106,
an internal combustion engine, a fuel tank, an electric motor, a battery to power the
electric motor, and a transmission system 108 to transmit power from the engine and the
motor to the rear wheel 106 of the hybrid two wheeled vehicle 100. In one preferred
embodiment, the transmission system 108 is provided on the left side of the hybrid two
wheeled vehicle 100.

Fig. 2a and 2b illustrate a side view and a top view of a transmission system 108
of the hybrid two wheeled vehicle 100 in accordance with one embodiment of the present
subject matter. The transmission system 108 of the present subject matter includes a belt
and pulley arrangement enclosed in a transmission case 200. As shown herein, the
transmission system 108 includes a first drive member 202 attached to the crankshaft 204
of the internal combustion engine, a second drive member 206 attached to an output shaft
208 of the electric motor 210, and a driven member 212 attached to a drive wheel of the
vehicle 100. In the present embodiment, the drive wheel is the rear wheel 106 of the
vehicle 100. Similarly, the first drive member 202, the second drive member 206 and the
driven member 212 are pulleys and are linked to each other through a common power
transmitting member, such as a belt 214. The belt 214 wraps around the first drive
member 202, the second drive member 206, and the driven member 212.
The transmission system further includes an idler 216 that is disposed between the second drive member 206 and the driven member 212 for increasing the wrap angle of the belt 214. The provision of the idler 216 avoids slipping of the belt 214.

A tensioner 218 is disposed between the driven member 212 and the first drive member 202 to provide adequate tension to the belt 214. The position of the tensioner 218 in the transmission case 200 can be adjusted in order to provide appropriate tension to the belt 214.

During operation, the idler 216 and the tensioner 218 rotate in the same direction with respect to each other. However, the idler 216 and the tensioner 218 rotate in opposite direction with respect to the first drive member 202, the second drive member 206 and the driven member 212.

Further, the second drive member 206 is disposed above the center line 219 of the vehicle 100 and thus any possibility of the CG getting offset from the center line 219 of the vehicle can be avoided.

When the clutch of the vehicle is engaged, the rotational motion of the crankshaft 204 is transferred to the first drive member 202. The belt 214 transfers the motion from the first drive member 202 to the driven member 212. The driven member 212 in turn transfers the motion to the rear wheel 106 of the vehicle 100 through a gear box 220.

The electric motor 210, on the other hand, transfers the rotational motion to the driven member 212 through the second drive member 206. The output shaft 208 of the electric motor 210 is connected to the second drive member 206. In the present embodiment, the second drive member 206 is disposed above the center line 219 of the vehicle 100. The hybrid two wheeled vehicle 100 can be operated in three modes namely internal combustion engine mode, electric motor mode, and hybrid mode.
In the first mode or the internal combustion engine mode, only the internal combustion engine (not shown in the figure) operates and the electric motor 210 is idle or is in "off state. In the second mode or the electric motor mode, only the electric motor 210 provides the driving torque while the internal combustion engine is idle. In the third mode or the hybrid mode, both the internal combustion engine and the electric motor 210 provide driving torque to the driven member 212.

The operation of the hybrid two wheeled vehicle 100 is further illustrated with the help of Fig. 2a and the Fig. 2b.

In the first mode, the engagement of clutch facilitates the transmission of torque from the crankshaft 204 to the first drive member 202. The belt 214 is wraps around the first drive member 202 and in turn transfers torque to the driven member 212. In this mode, the electric motor 210 is idle or is in "off state and the second drive member 206 rotates freely over the output shaft 208 of the electric motor 210. The torque from the driven pulley 212 is transferred to the rear wheel 106 through the gear box 220. This mode is preferably employed during riding conditions wherein average speed of the hybrid two wheeled vehicle 100 is high.

In the second mode, the electric motor 210 is in "on" state and transmits a torque to the second drive member 206. The belt 214, disposed over the second drive member 206, transfers the torque to the driven member 212. The torque transferred to the driven member 212 rotates the rear wheel 106 through the gear box 220. At this stage, the clutch is disengaged so that there is no torque transfer from the crankshaft 204 to the first drive member 202. The belt 214 disposed around the first drive member 202 rotates freely over the first drive member 202. This mode is preferably employed in conditions wherein average load and speed requirements of the hybrid two wheeled vehicle 100 are low.
In the third mode, both the engine and the electric motor 210 transmit power to the rear wheel 106. The engagement of the clutch facilitates the transmission of torque from the crankshaft 204 to the first drive member 202. At the same time, the electric motor 210 is also in its "on" state and transmits torque to the second drive member 206. The belt 214 transmits the combined torque from the first drive member 202 and the second drive member 206 to the driven member 212. This mode is preferably employed during high torque requirement i.e. when the vehicle 100 is climbing a hill.

The hybrid two wheeled vehicle 100 can be switched from one mode to the other either manually or automatically.

The subject matter described above can be embodied in many other ways as would be clear to a person skilled in the art. For example, in one embodiment, the first drive member 202, the second drive member 206, and the driven member 212 are sprockets and are linked to each other through a common power transmitting member, such as a chain.

Fig. 3a and 3b illustrate a side view and a top view of a transmission system 300 of the hybrid two wheeled vehicle 100 in accordance with another embodiment of the present subject matter. In the present embodiment, the first drive member 302, the second drive member 304 and the driven member 306 are sprockets and are provided on the same level. The second drive member 304 is mounted between the first drive member 302 and the driven member 306. The torque from the crankshaft 204 and the electric motor 210 is transferred to the first drive member 302 and the second drive member 304 respectively. The first drive member 302 and the second drive member 304 in turn transfer this torque, either alone or together, to the driven member 306 through a common transmission member, such as a chain 308.
Fig. 4a and 4b illustrate a side view and a top view of the transmission system 400 of a hybrid two wheeled vehicle 100 in accordance with yet another embodiment of the present subject matter. In the present embodiment, the electric motor 210 is mounted on the driven member 212. During the internal combustion engine mode, the electric motor 210 is disengaged through a one way clutch (not shown in figures).

The subject matter described above can have different advantages including those mentioned below. The transmission system eliminates any offset in the centre of gravity (CG) of the hybrid two wheeled vehicle with respect to the center line 219 of the vehicle. This ensures easy handling of the hybrid two wheeled vehicle, thereby improving drivability of the vehicle. Moreover, mounting of the electric motor on the upper side of the transmission case minimizes water ingress into the electric motor, consequently resulting in prolonged life of the electric motor.

Further, due to the use of a fixed transmission system, the possibility of slip of transmission member in the drive and driven members is substantially reduced. This reduces the transmission losses substantially, thereby leading to the enhanced efficiency of the vehicle. This results in better fuel economy and low emissions in the hybrid two wheeled vehicle.

Although the subject matter has been described in considerable detail with reference to certain preferred embodiments thereof, other embodiments are possible. As such, the spirit and scope of the appended claims should not be limited to the description of the preferred embodiment contained therein.
IAVeclaim:

1. A transmission system (108) for a hybrid two wheeled vehicle (100), said transmission system (108) comprising:
   a. a first power source having a first output shaft (204);
   b. a first drive member (202, 302) attached to said first output shaft (204);
   c. a second power source (210) having a second output shaft (208);
   d. a second drive member (206, 304) attached to said second output shaft (208);
   e. a driven member (212, 306); and
   f. a power transmitting member (214, 308);
   characterized in that
   said power transmitting member (214, 308) is a common power transmitting member for said first drive member (202), said second drive member (206) and said driven member (212) for transmitting power from at least one of said first drive member (202) and said second drive member (206) to said driven member (212).

2. The transmission system (108) as claimed in claim 1, wherein said first drive member (202, 302), said second drive member (206, 304) and said driven member (212, 306) are pulleys, and wherein said power transmitting member (214, 308) is a belt.

3. The transmission system (108) as claimed in claim 1, wherein said first drive member (202, 302), said second drive member (206, 304) and said driven member (212, 306) are sprockets, and wherein said power transmitting member (214, 308) is a chain.
4. The transmission system (108) as claimed in claim 1, wherein said power transmitting member wraps around said first drive member (202, 302), said second drive member (206, 304) and said driven member (212, 306).

5. The transmission system (108) as claimed in claim 1 further comprises an idler (216) for increasing the wrap angle of said power transmitting member (214, 308) over said first drive member (202, 302), said second drive member (206, 304) and said driven member (212, 306).

6. The transmission system (108) as claimed in claim 1 further comprises a tensioner (218) to provide a specified tension in said power transmitting member (214, 308).

7. The transmission system (108) as claimed in claim 6, wherein said tensioner (218) is adjustable.

8. The transmission system (108) as claimed in claim 1, wherein said driven member (212, 306) is attached to a drive wheel (106) of said vehicle (100) through a gear box (220).

9. The transmission system (108) as claimed in claim 1, wherein said first power source is an internal combustion engine and said second power source is an electric motor (210).

10. The transmission system (108) as claimed in claim 1, wherein said second power source (210) is disposed above the center line (219) of said vehicle (100).