We Claim:

1. A hybrid electric drive system (106) comprising:

a hub type electric motor (202) configured to be mounted on a rear wheel (104) of a motorcycle (200) to drive the rear wheel (104) of the motorcycle (200);

an overrunning clutch (204) coupled to both a hub type electric motor (202) through a body of the motor and an IC engine (242) through a chain sprocket mechanism (206) mounted on the rear wheel (104), the overrunning clutch (204) is configured to enable seamless transition between different modes, and transmit IC engine drive and electric motor torque simultaneously to the rear wheel (104) of the motorcycle (200), wherein the overrunning clutch (204) comprises:

an outer hub assembly (260) coupled to the chain sprocket mechanism (206), and is one of the elements configured to transmit the IC engine drive;

an inner hub assembly (262) coupled to the body of the electric motor (202), and is the second element configured to transmit the IC engine drive and seamlessly combine it with the electric motor drive; and

a set of springs and rollers (264, 266) with a recess arrangement (268) that provide the necessary linkage and interaction between the outer hub (260) and the inner hub assembly (262),

wherein,

for an electric mode when the IC engine is shut off and the electric motor is on, the outer hub assembly (260) is stationary and the inner hub assembly (262) gets torque from the electric motor, the rollers (266) get into a position to allow the inner hub assembly (262) to rotate although the outer hub assembly (260) is stationary, and the electric motor drive is transmitted to the rear wheel (104);

for an IC engine mode when the IC engine is on and the electric motor is shut off, the inner hub assembly (262) is not receiving torque from the electric motor and the outer hub assembly (260) receives the torque from the IC engine, the rollers (266) get into a position to allow the outer hub assembly (260) to transmit the torque to the inner hub assembly (262) and the IC engine drive is transmitted to the rear wheel (104), and

for a combined mode, the rollers (266) get into a position same as that of the IC engine mode and allow outer hub assembly (260) to transmit the IC engine torque to the inner hub assembly (262), the inner hub assembly (262) also gets the electric motor torque, the two drives being seamlessly added and transmitted to the rear wheel (104), wherein the overrunning clutch (204) adds and synchronizes the IC engine (242) drive and the hub type electric motor (202) drive in the combined mode;

a control unit (270) is configured to compare torque value of the electric motor (TEM) and the IC engine (TICE) and transmit commands to a motor controller (224) to enable both the IC engine and electric motor torque to be transmitted simultaneously to the rear wheel (104);

a combined accelerator (600) is configured with the electric motor (108) and the IC engine (118) and is designed with a configurable phase lag that allows the electric motor (108) to speed up earlier than the IC engine owing to high initial starting torque of the electric power-train while being driven in the combined mode; and

a rear wheel suspension arrangement is connected to the rear wheel (104) of the motorcycle (200) comprising an arrangement including a set of arrestor plates (252), a pair of shock absorbers (254, 256) and rear fork assembly (232), wherein the set of arrestor plates (252) prevent accidental rotation of motor axle (246) and the rear fork assembly (232) is configured to transmit the electric drive to propel the motorcycle (200).

2. The hybrid electric drive system (106) as claimed in claim 1, wherein the hybrid electric drive system (106) is configured to perform the dual role of allowing drive from each powertrain to be transmitted individually to the rear wheel (104) in the electric mode and the IC engine mode, and adding the drive from the two powertrains and seamlessly transmitting to the rear wheel (104) in the combined mode.

3. The hybrid electric drive system (106) as claimed in claim 1, wherein in the combined mode the IC engine drive is transmitted to the rear wheel (104) from the chain and sprocket mechanism (206) through the overrunning clutch (204), wherein an electric motor torque is added to the inner hub assembly (262) and the combined torque is transmitted to the rear wheel (104) of the motorcycle (200).

4. The hybrid electric drive system (106) as claimed in claim 1, wherein the overrunning clutch (204) is configured to allow either the IC engine (242) or the hub type electric motor

(202) to provide the drive to the rear wheel (104) when the motorcycle (200) is driven in a single mode.

5. The hybrid electric drive system (106) as claimed in claim 1, wherein the inner hub assembly (262) includes a set of circular disc (274) with cylindrical rollers (266) and recess arrangement (268).

6. The hybrid electric drive system (106) as claimed in claim 1, wherein a twist type handle grip (302) is coupled to cylindrical drum (278) that is configured to rotate along with the twist type handle grip (302), wherein the cylindrical drum (278) includes a cable attached to it that gets wound or unwound as the drum turns.

7. The hybrid electric drive system (106) as claimed in claim 1, wherein twisting action of a twist type handle grip (302) is configured to transmit the rider input via a cable to the combined accelerator (600).

8. The hybrid electric drive system (106) as claimed in claim 1, wherein the control unit (270) is configured to measure the IC engine torque (T_{ICE}) and based on torque value, commands the motor controller (224) to deliver the electric motor torque (T_{EM}) that is less than the torque generated by the IC engine ($T_{EM} < T_{ICE}$).

9. The hybrid electric drive system (106) as claimed in claim 1, wherein the motor controller (224) is configured to manage the torque distribution in the combined mode to utilize the resultant torque-speed characteristics of the hybrid drive system (106) more effectively compared to the torque-speed characteristics of the individual IC engine mode and the electric mode.

10. The hybrid electric drive system (106) as claimed in claim 1, wherein the motor controller (224) is placed in the front suspension fork of the motorcycle (200) and its casing assembly is designed to provide adequate mounting capability for the controller and give sufficient protection and ventilation to the controller.

11. The hybrid electric drive system (106) as claimed in claim 1, wherein a set of battery packs (208) are mounted at the rear side of the motorcycle (200) and on either side for preserving the bilateral symmetry of loads for balancing.

12. The hybrid electric drive system (106) as claimed in claim 1, wherein the motorcycle (200) is in the IC engine mode, the hub type electric motor (202) is configured to act as a generator to charge the batteries (208) depending upon the state of charge (SOC) of the battery pack in regeneration mode, where even during braking, irrespective of the mode of operation, the hub type electric motor (202) is configured to act as a generator to charge the batteries depending upon the state of charge (SOC) of the battery pack.

13. A motorcycle (200) comprising:

a hybrid electric drive system (106) that comprises;

a hub type electric motor (202) configured to be mounted on a rear wheel (104) of a motorcycle (200) to drive the rear wheel (104) of the motorcycle (200);

an overrunning clutch (204) coupled to both the hub type electric motor (202) through the body of the motor and an IC engine (242) through a chain sprocket mechanism (206) mounted on the rear wheel (104), and the overrunning clutch (204) is configured to enable seamless transition between different modes, and transmit IC engine drive and electric motor torque simultaneously to the rear wheel (104) of the motorcycle (200), wherein the overrunning clutch (204) comprises:

an outer hub assembly (260) coupled to the chain sprocket mechanism (206), and is one of the elements configured to transmit the IC engine drive;

an inner hub assembly (262) coupled to the body of the electric motor (202), and is the second element configured to transmit the IC engine drive and seamlessly combine it with the electric motor drive; and

a set of springs and rollers (264, 266) with a recess arrangement (268) that provide the necessary linkage and interaction between the outer hub (260) and the inner hub assembly (262),

wherein,

for an electric mode when the IC engine is shut off and the electric motor is on, the outer hub assembly (260) is stationary and the inner hub assembly (262) gets the torque from the electric motor, the rollers (266) get into a position to allow the inner hub assembly (262) to rotate although the outer hub assembly (260) is stationary, and the electric motor drive is transmitted to the rear wheel (104);

for an IC engine mode when the IC engine is on and the electric motor is shut off, the inner hub assembly (262) is not receiving torque

from the electric motor and the outer hub assembly (260) receives the torque from the IC engine, the rollers (266) get into a position to allow the outer hub assembly (260) to transmit the torque to the inner hub assembly (262) and the IC engine drive is transmitted to the rear wheel (104), and

for a combined mode, the rollers (266) get into a position same as that of the IC engine mode and allow outer hub assembly (260) to transmit the IC engine torque to the inner hub assembly (262), the inner hub assembly (262) also gets the electric motor torque, the two drives being seamlessly added and transmitted to the rear wheel (104), wherein the overrunning clutch (204) adds and synchronizes the IC engine (242) drive and the hub type electric motor (202) drive in the combined mode;

a control unit (270) is configured to compare torque value of the electric motor (TEM) and the IC engine (TICE) and transmit commands to a motor controller (224) to enable both the IC engine and electric motor torque to be transmitted simultaneously to the rear wheel (104);

a combined accelerator (600) is configured with the electric motor (108) and the IC engine (118) and is designed with a configurable phase lag that allows the electric motor to speed up earlier than the IC engine owing to high initial starting torque of the electric power-train while being driven in the combined mode; and

a rear wheel suspension arrangement is connected to the rear wheel (104) of the motorcycle (200) comprising an arrangement including a set of arrestor plates (252), a pair of shock absorbers (254, 256) and rear fork assembly (232), wherein the set of arrestor plates (252) prevent accidental rotation of motor axle (246) and the rear fork assembly (232) is configured to transmit the electric drive to propel the motorcycle (200).