# 2. LITERATURE SURVEY

## 2.1 HISTORY

In the 1890s, electric bicycles were documented within various U.S. patents. For example, on 31 December 1895, Ogden Bolton Jr. Was granted U.S. Patent 552,271 for a battery-powered bicycle with “6-pole brush-and-commutator direct current (DC) hub motor mounted in the rear wheel.” There were no gears and the motor could draw up to 100 amperes (A) from a 10-volt battery. Two years later, in 1897, Hosea W. Libby of Boston invented an electric bicycle (U.S. Patent 596,272) that was propelled by a “double electric motor.” The motor was designed within the hub of the crank set axle. This model was later re-invented and imitated in the late 1990s by Giant Lafree electric bicycles.

By 1898 a rear wheel drive electric bicycle, which used a driving belt along the outside edge of the wheel was patented by Mathew J. Steffens. Also, the 1899 U.S. Patent 627,066 by John Schrempf depicted a rear wheel friction “roller-wheel” style drive electric bicycle. Schlep’s invention was later re-examined and expanded in 1969 by G.A. Wood Jr. with his U.S. Patent 3,431,994. Wood’s device used 4 fractional horsepower motors; connected through a series of gears.

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Page 3 of 40

Torque sensors and power controls were developed in the late 1990s. For example, Takada Yutky of Japan filed a patent in 1997 for such a device. In 1992 Vector Services Limited offered and sold an electric bicycle dubbed Zike. The bicycle included Nickel-cadmium batteries that were built into a frame member and included an 850 g permanent-magnet motor. Despite the Zike, in 1992 hardly any commercial electric bicycles were available. Production grew from 1993 to 2004 by an estimated 35%. By contrast, according to Gardner, in 1995 regular bicycle production decreased from its peak 107 million units. Some of the less expensive electric bicycles used bulky lead acid batteries, whereas newer models generally used NiMH, NiCd and/or Li-ion batteries which offered lighter, denser capacity batteries. Performance varied; however, in general there was an increase in range and speed.

In a parallel hybrid motorized bicycle, such as the aforementioned1897 invention by Hosea W. Libbey, human and motor inputs are mechanically coupled either in the bottom bracket, the rear or the front wheel, whereas in a (mechanical) series hybrid cycle, The motor used is of 50 rpm and provides 5A current and is of 120 watts. This makes the cycle to provide speed of 20km/hr and runs till 60 km approximately. It can take load of 115Kg. When the motor is connected to the controller and the speed is regulated from initial position to maximum position the cycle achieves its speed from slow to fast Sprocket connected to the wheel shaft of the motor has 33 teeth and sprocket connected to the shaft of the t has 11 teeth so if the motor revolves one time then the wheel will rotate 4 time. These will lead to increase the speed of the cycle. During the downhill the supply from the battery can be disconnected still the cycle can rotate freely and at the same time power can be generated from dynamo which can used to give supply to headlight and taillight or to charge the battery. The controller has four heat sinks in it which protects the circuit from overheating.

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Page 7 of 40

| | |
|---|---|
| Force | = 115Kg |

Therefore PMDC Motor can take the load up to ***115Kg*** weight.


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Page 12 of 40

Fig 3.2.3 Construction of PMDC motor

Permanent magnet DC brushed motors (PMDC motors) consist of permanent magnets, located in the stator, and windings, located in the rotor. The ends of the winding coils are connected to commutator segments that make slipping contact with the water. The specific gravity of the electrolyte is lowered during charging, there is reversal of the chemical reaction and the specific gravity of the electrolyte rises. The specific gravity is a good indication of the state of charge of a battery. The chemical reactions that take place during charging and discharging are as follows.

| Charged | | | Discharged | | |
|---|---|---|---|---|---|
| Positive Plate | Electrolyte | Negative Plate | Positive Plate | Electrolyte | Negative Plate |
| Pbo + | 2H SO + | pb ==== | pbso + | 2H O + | pbso |
| (Lead Peroxide) | (Sulphuric acid) | (Spongy lead) | (Lead sulphate) | (Water) | (Lead sulphate) |

Chemical Reaction

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Page 15 of 40

From the above equation, it is evident that the discharge is carried to the last point. However, in practice, the battery is never charged beyond a certain point because of two reasons. First, lead sulphate occupies a greater volume that lead peroxide and hence excessive sulphation is liable to setup mechanical stresses in the positive plates, thereby causing shedding of active material and tracking of the plates. Secondly, the excessive sulphation does not permit the sulphate to get reconverted fully back to the active material during charging.

**Chemical action:**

Sulphuric acid is a combination of hydrogen and sulphate ions. When the cell discharges, lead peroxide from the positive electrode combines with hydrogen ions to form water and with sulphate ions to form lead sulphate.

## MINIATURE CIRCUIT BREAKER


Fig 3.2.10 Miniature circuit breaker

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Page 26 of 40

**Operation**

All circuit breakers have common features in their operation, although details vary substantially depending on the voltage class, current rating and type of the circuit breaker. The circuit breaker must detect a fault condition; in low-voltage circuit breakers this is usually done within the breaker enclosure. Circuit breakers for large currents or high voltages are usually arranged with pilot devices to sense a fault current and to operate the trip opening mechanism. The trip solenoid that releases the latch is usually energized by a separate battery, although some high-voltage circuit breakers are self-contained with current transformers, protection relays, and an internal control power source.

Once a fault is detected, contacts within the circuit breaker must open to interrupt the circuit; some mechanically-stored energy (using something such as springs or compressed air) contained within the breaker is used to separate the contacts, although some of the energy ired may be obtained from the fault current itself. Small circuit breakers may be manually operated; larger units have solenoids to trip the mechanism, and electric motors to restore energy to the springs.

## BATTERY


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Page 34 of 40