The gear reduction starter engineering essay

A starter motor is a high-torque motor for tuning the gear on the engine flywheel. Starter motor is also known as starting motor or a starter. The function of starter is to reduce the starting current by inititlly high resistance. In RLC series circuit resistance, inductance and capacitance are connected in series. Starter is used to protect the motor from overload. If the starter is 3ph to avoid single phasing and it is used to reduce the strating current.

In motor starter both Otto cycle and Diesel cycle internal-combustion engine require the pistons to be moving before the ignition phase of cycle. This means that the engine must be set in motion by an external force before it can power itself.

A hard crank was used to start engines, but it was inconvenient, difficult, and dangerous to start an engine. Care had to be taken to retard the spark in order to prevent backfiring with advance spark setting. The engine could kick back, pulling the crank with it, because the overrun safety mechanism works in one direction only.

In this case users were advised to cup their fingers under the crank and pull up, it felt neutral for operators to grasp the handle with the fingers on one side, the thumb on the order. Even a simple backfire can break thumb or it is also seen that it could end with a broken wrist.

The electric starter ensured that anyone could easily start and run an internal combustion engine car, and this made it the design of choice for the car buyers.

ELECTRIC STARTER

The electric starter is a permanent-magnet or a series parallel wound direct current electric motor with a solenoid switch mounted on it. Current from the starting battery is applied to the solenoid through a key operated switch which pushes out the drive pinion on the starter drive shaft.

The solenoid also closes high current contacts for the starter motor, which begins to turn. Once the engine starts, the key operated switch is opened, a spring in the solenoid assembly pulls the pinion gear away from the ring gear and the starter motor stops. The starter’s pinion is clutched to its drive shift through an overrunning sparg clutch which permits the engine to transmit drive only in one direction. This is why the drive is transmitted through the pinion to the flywheel ring gear , but if the pinion remains engaged, the pinion will spin independently of its driveshift. This prevents the engine driving the starter for such backdrive would cause the starter to spin so fast as to fly apart. That is why a standard starter motor is only designed for intermittent use which would preclude its use as a generator.

This system of pinion arrangement was used in early 1960’s after that a new system was introduced and named as Bendix Drive.

The Bendix system places the starter drive pinion on a driveshift. When the starter motor starts turning, the inertia of the drive pinion causes it to ride forward and thus engage with the ring gear. When the engine starts, backdrive from the ring drive causes the ring gear to exceed pinion to rotative speed of a starter, at which point the drive pinion is forced back down the helical shaft and thus out of mesh with the ring gear.

The drive unit is spun at a releasing the latch and permitting the overdriven drive unit to be spun of engagement. In this matter unwanted starter disengagement is avoided before a successful engine start.

GEAR-REDUCTION STARTERS

In 1962, Chrysler introduced a starter incorporating a geartrian between the motor and the driveshaft. Rolls Royce had introduced a conceptually similar starter in 1964 but Chrysler was the first to bring volume-production unit in the market. The motor shaft was integrally cut gear teeth forming a drive gear which mesh with a larger adjacent driven gear to provide a gear reduction. This permits the use of higher speed, lower current and lighter motor assembly while increasing cranking torque.

The Chrysler starter made a unique, readily identifiable sound when cranking the engine. This starter formed the design basis for the offset gear reduction starters now employed by the vehicles on the road. Light aircraft engines also made extensive use of this kind of starter because of its light weight that offered an advantage to the aircraft companies.

Ford also issued a nonstandard starter, a direct drive ” moveable pole shoe ” design that provided cost reduction rather than electrical benefits. This type of solenoid eliminated the starter. There are some steps that we have to follow while operating the ford starter:-

The operator closed the key-operated starting switch.

A small electric current flowed through the starter relay cord , closing the contacts and sending a large current to the starter motor assembly.

One of the pole shoes hinged in the front, swang into position. This moved a pinion gear to engage the flywheel ring gear.

The starter motor cranked the engine until it started.

The operator released the key-operated starting switch, cutting power to the starter motor assembly.

A spring retracted the pole shoe and with it the pinion gear.

This starter was used on ford vehicles from 1973 through 1990, when a gear reduction unit conceptually similar to Chrysler unit replaced it.

PNEUMATIC STARTER

Some gas turbine engines and Diesel engines ues a pneumatic self starter. The system consists of geared turbines , an air compressor and a pressure tank. Compressed air released from the tank is used to spin the turbine, and through a set of reduction gears, engages the ring gear on the flywheel, much like an electric engine. On larger diesel engines found in large shore installations and especially on ships, a pneumatic starting gear is used. Theair motor is generally powered by compressed air. The air motor is made up of center drum about the size of a soup can with more than four slots cut into it which allows the vanes to placed radically on the drum to form chambers sround the drum. The drum is offset inside a ring casing so that the inlet airfor starting is admitted at the area where the drum and the vanes form a small chamber compared to others.

Some small diesel engines such as ones found on tugboat and lifeboat use hydraulic starters in which the air is replaced with a hydraulic motor. The engine should not be shut down while running unless the hydraulic accumulators for the starting motor are recharged. Else there is a manual hand pump to slowly pump up the accumulators.

On large diesel engines and almost all diesel generators used the prime movers of the ships will use compressed air acting directly on the cylinder head. This is not ideal for the small diesel engines as it provides too much cooling on starting. The actual compressed air is provided form a large reservoir that feeds into a header located along the engine. As soon as the air starts the valve starts opening and the compressed air is admitted and the engine will being turning as it can be used on 2-cycle or 4-cycle engines and on reversing engines. On large 2-stroke engines less than one revolution of the crank shaft is needed for starting.

This is why the heavy trucks use air breaks and the system gives the double duty by supplying compressed air to the break system. Pneumatic starters have the advantage of delivering high torque.

ELECTRIC MOTOR

The electric motor converts electric energy into mechanical energy. Electric motor operates through interacting magnetic fields and current carrying conductors to generate force. Electric motors are found in applications as diverse as industrial fans, blowers and pumps. They may be powered by electric current or by alternating current from a central electrical distribution grid. The smallest motor is found in electric wrist watches. Medium size

motor of highly standardized dimensions and characteristics provide convenient mechanical power for industrial uses. The very largest electric motors are used for propulsion of large ships.

The physical principle of production of mechanical force by the interaction of an electric current and a magnetic field was known as early as 1821. Electric motors of increasing efficiency were constructed throughout the 19th century, but commercial exploitation of electric motors on a large scale required efficient electric generators and electrical distribution networks.

Device used with AC electric motor to temporarily reduce the load and the torque in the powertrain of the motor during start is known as electric motor. Mechanical stress is also reduced by the electric motor.

INDUCTION MOTOR

There are different types of asynchronous AC motors and one of them is induction motor. When power is supplied to the rotating device by the means of electromagnetic induction. There are several ways to supply power to the rotor. In a Dc motor this power is supplied to the armature directly from a DC source. Sometimes an induction motor is also called a rotating transformer. This is because the stator is essentially the primarily side of the transformer.

TYPES OF STARTER MOTOR

Direct on-line starter

Star delta starter

Automatic star delta starter

Auto transformer starter

Steps starter

Motor soft starter

Differences in some of starter motor are as follows

1. Difference between Direct on-line starter and Star delta starter

A direct on-line(DOL) starter connects the motor terminal directly to the power supply. Hence, the motor is subjected to the full voltage of power supply. Consequently high starting current flows through the motor. This type of starting is suitable for small motors below 3. 75kw. reduced voltage starters are employed with motors above 3. 75kw. Although DOL motor starters are available for motors less than kV. Supply reliability and reserve power generation dictates the use of reduced voltage or not.

2. Differences between Star delta starter and Automatic star delta starter

To reduce the starting current of an induction motor the voltage across the motor needs to be reduced. This can be done by autotransformer starter, star-delta starter or resistor starter. These days VVVF used extensively for speed control serves this purpose also. Whenever you start a big heavy electric motor, you need to start it slowly to prevent the rotor overheating and drowning an enormous current.

Future prospective

Methods are changed in building the starter motor. Many new technologies continue to be introduced in new cars and trucks.

General improved methods are:-

better engine peak efficiency potential

losses are reduced at light load from throttling

weight, drag and rolling resistance is also reduced

Mid-term engine technology is introduced on the market.

Most promising development is cam-less valve actuation which offers potential to reduce throttling loss to near zero.

New technologies introduced in the market are quite expensive but are very beneficial for the ecological balance.