Written Pole Motors

An Online Continuing Education Course for Engineers

Course Number: E-3023

Credit: 3 Hours / 3 PDH / 3 CPD

Written-Pole®
Electric Motors

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The term Written-Pole® motor is trademarked by Precise Power Corporation of Bradenton, Fl. All references in this course to Written-Pole motors refer to the trademarked name registered to Precise Power Corporation.

Introduction

In the 1990's, with support from the Electric Power Research Institute (EPRI), the Precise Power Corporation of Bradenton, Florida, developed a new concept in electric motors called the Written Pole® electric motor. This new motor type dramatically reduces starting currents of single phase motors and allows the design of single phase motors up to 100 hp as compared to conventional single phase motors, which are generally limited to units of 15 hp and smaller.

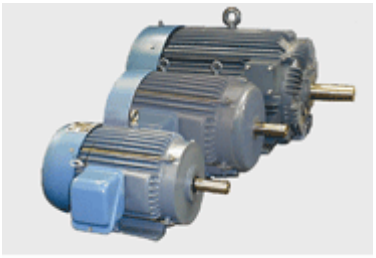

Photo Credit: Precise Power Corp.

Electric motors are the backbone of an electrified society and electric motors are responsible for two-thirds of all electric energy generated in the United States today. Most electric motors are small and only 2% of the motors in the United States are over 5 hp, but they account for over 70% of the energy used to drive electric motors.

The electric distribution system in the United States is comprised of three-phase lines for main feeders and heavily congested areas and single-phase lines for laterals and rural areas. Electric service connections are primarily single phase. This arrangement is ideal for residential and small commercial loads that are predominately lighting, small motors, and miscellaneous appliances. Yet, there are small commercial and agricultural loads that require motors larger than the traditional limits of 10-15 hp. In this case, a three phase power supply is needed to for the three-phase motor load. However, it is often not economical to extend three-phase power into sparsely populated areas.

One fundamental problem with single-phase motors is the very high starting current required to get the motor up to speed. A typical single-phase motor may have starting currents that are six to ten times their normal running current. Newer motors with higher efficiency usually have even higher starting current inrush. This presents a major problem in areas with limited electric supply or in rural areas where only single-phase lines are available. Because of high starting currents, single-phase motors are not generally available in sizes over 15 hp. Many utilities restrict the use of single-phase motors to sizes under 10 hp for ordinary electric motors. High motor starting currents on single-phase lines can cause line voltage dips that can cause problems for other loads.

The motor developed by Precise Power Corporation, known as the Written-Pole® motor, uses an innovative approach of controlling the magnetic field of the motor to reduce the starting current requirements. The result is a motor that has starting current requirements of only about twice the normal running current and, as an added benefit, the motors have efficiencies of 90% or better compared to conventional motors, which have efficiencies of around 85%. The Written-Pole® motor has been developed with inherently low per-unit starting current and they can be applied in single-phase service areas to ratings of over 100 hp without exceeding the starting current limits of many utility systems.

Written-pole motors differ from conventional motors in the way the magnetic field is developed. In a conventional motor, the poles are in fixed positions. In a written-pole motor, a magnetic layer is written in different places on the motor's poles as the rotor turns.

Advantages of Written-Pole® motors include,

- Low starting current
- High operating efficiency
- Excellent torque characteristics
- Unity power factor operation
- Ability to start high-inertia loads
- Ability to re-synchronous under load after pull-out

Because a written-pole motor has much lower starting current than a traditional electric motor, it takes longer to reach full speed. A conventional motor generally reaches full speed in a matter of seconds - it must to prevent overheating – whereas, a written-pole motor may take several minutes to reach full speed. The slow start up speed is beneficial in some applications such as water pumps; since the slow speed can prevent water hammering that is prevalent in water pumping applications with fast ramp up speeds of conventional motors.

In this course we will look at the operation of a typical induction motor, the characteristics of induction motors, the design features of Written-Pole® motors, and a review of the benefits of written-pole motors. First, let's look at the basic operation of an electric motor.

I. Basic Operation of Electric Motors

To understand how an electric motor works, we must first understand the principles of magnetism and electromagnetism. An electromagnet is simply a piece of iron or other ferrous material that has been wound with a conductor through which an electric current can pass. When a current is passed through the conductor the iron is magnetized and acts just like a permanent magnetic.

Consider two electromagnets and one permanent magnet [illegible] he figure below. The top electromagnet is oriented with [illegible] permanent magnet is oriented in [illegible] the bottom elect[illegible] between the cent[illegible] with the south pole [illegible] the north pole of the [illegible]

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In an actual [illegible] gnets are called the *stators*, and the rotating magnet is known as the [illegible] tor is not actually a permanent magnet, but instead is a form of an electromagnet.

The most common type of motor is an induction motor which is based on electromagnetic theory. According to electromagnetic theory, if an electric current is passed through a conductor, which is positioned perpendicular to the direction of a magnetic field, the conductor will experience a mechanical force that will cause it to move in a direction that is perpendicular to the current flowing through the conductor and the direction of the magnetic field.