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Review on Transparent Single Phase Universal Motor

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Abstract:- *The universal or AC commutator motor, widely used in hand tools or domestic appliances, generally uses a two-pole stator with a concentrated winding and an armature with interlocked coils elements. The copper volume and the axial length of the end windings of such conventional structures are then usually very important. In this paper, the authors present a new universal motor structure based on an efficient use of the isotropic magnetic properties of the soft magnetic composites (SMC) and on the concentrated winding technique. The stator core presents a claw pole structure and the armature has a concentrated winding with several coils wound around the same tooth. With this new AC commutator motor structure, a reduction of the total volume by a ratio equal to 200% is obtained when compared to classical universal motor structure with nearly identical performance.*

Key Words: *AC, SMC, Coil, Motor etc.*

I. INTRODUCTION

The universal motor is a type of electric motor that can operate on either AC or DC power and uses an electromagnet as its stator to create its magnetic field. It is a commutated series-wound motor where the stator's field coils are connected in series with the rotor windings through a commutator. It is often referred to as an AC series motor. The universal motor is very similar to a DC series motor in construction, but is modified slightly to allow the motor to operate properly on AC power. This type of electric motor can operate well on AC because the current in both the field coils and the armature (and the resultant magnetic fields) will alternate (reverse polarity) synchronously with the supply. Hence the resulting mechanical force will occur in a consistent direction of rotation, independent of the direction of applied voltage, but determined by the commutator and polarity of the field coils. Universal motors have high starting torque, can run at high speed, and are lightweight and compact. They are commonly used in portable power tools and equipment, as well as many household appliances. They're also relatively easy to control, electromechanically using tapped coils, or electronically. However, the commutator has brushes that wear, so they are much less often used for equipment that is in continuous use. In addition, partly because of the commutator, universal motors are typically very noisy, both acoustically and electromagnetically.

II. CONSTRUCTION

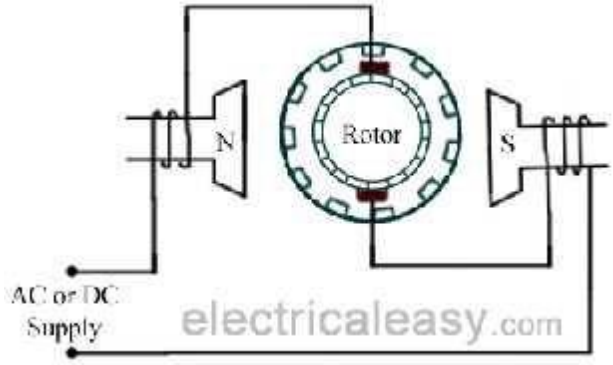
A universal motor is a special type of motor which is designed to run on either DC or single phase AC supply. These motors are generally series wound (armature and field winding are in series), and hence produce high starting torque (See characteristics of DC motors here). That is why, universal motors generally comes built into the device they are meant to drive. Most of the universal motors are designed to operate at higher speeds, exceeding 3500 RPM. They run at lower speed on AC supply than they run on DC supply of same voltage, due to the reactance voltage drop which is present in AC and not in DC. There are two basic types of universal motor :

(i) compensated type (ii) uncompensated type.

Construction of a universal motor is very similar to the construction of a DC machine. It consists of a stator on which field poles are mounted. Field coils are wound on the field poles. However, the whole

magnetic path (stator field circuit and also armature) is laminated. Lamination is necessary to minimize the eddy currents which induce while operating on AC. The rotary armature is of wound type having straight or skewed slots and commutator with brushes resting on it. The commutation on AC is poorer than that for DC. because of the current induced in the armature coils. For that reason brushes used are having high resistance.

III. WORKING



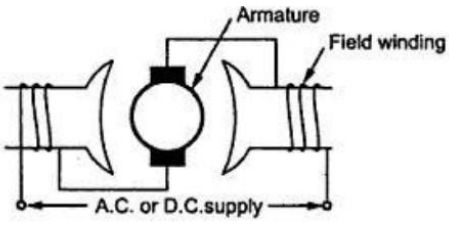
A universal motor works on either DC or single phase AC supply. When the universal motor is fed with a DC supply, it works as a DC series motor. (see working of a DC series motor here). When current flows in the field winding, it produces an electromagnetic field. The same current also flows from the armature conductors. When a current carrying conductor is placed in an electromagnetic field, it experiences a mechanical force. Due to this mechanical force, or torque, the rotor starts to rotate. The direction of this force is given by Fleming's left hand rule. When fed with AC supply, it still produces unidirectional torque.

Because, armature winding and field winding are connected in series, they are in same phase. Hence, as polarity of AC changes periodically, the direction of current in armature and field winding reverses at the same time. Thus, direction of magnetic field and the direction of armature current reverses in such a way that the direction of force experienced by armature conductors remains same. Thus, regardless of AC or DC supply, universal motor works on the same principle that DC series motor works. Speed/load characteristics of a universal motor is similar to that of DC series motor. The speed of a universal motor is low at full load and very high at no load. Usually, gears trains are used to get the required speed on required load. The speed/load characteristics are (for both AC as well as DC supply) are shown in the figure. **Applications of universal motor**

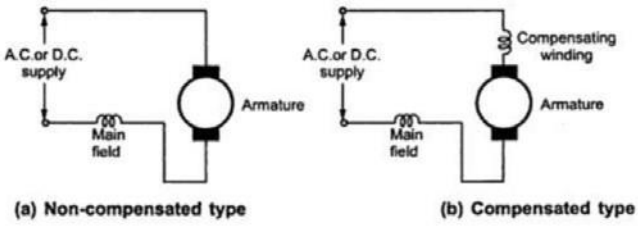
- Universal motors find their use in various home appliances like vacuum cleaners, drink and food mixers, domestic sewing machine etc.
- The higher rating universal motors are used in portable drills, blenders etc.

IV. ROTATION OF UNIVERSAL MOTORS

There are small capacity series motors which can be operated on d.c. supply or single phase alternating supply of same voltage with same characteristics, called universal motors. The general construction of such motor is similar to that of a.c. series motor as discussed in last article. It is manufactured in two types. i) Non compensated, low h.p ii) Compensated type, high h.p. Non compensated type pole has 2 poles, having entire magnetic path as laminated. Armature is wound type similar to the normal d.c. motor



While in compensated type, the motor has distributed field winding consisting of main field and compensating winding. This is some what similar to the stator of split phase single phase induction motor type construction. This also has a wound armature similar to the normal d.c. motor.



Reversal of Rotation of Universal Motors

By reversing the flow of current through the armature or field windings, the direction of rotation can be reversed for salient pole non compensated type universal motor. This is possible by interchanging the terminals on brush holders as shown in the Fig. In case of compensated type, the armature or field loads are interchanged and brushes are shifted against the direction of rotation of motor, to achieve the reversal of direction.

VI. CONCLUSIONS

There are small capacity series motors which can be operated on d.c. supply or single phase alternating supply of same voltage with same characteristics, called universal motors. universal motor is that it's a versatile device capable of running on both AC and DC power sources. It's commonly used in various applications like power tools, vacuum cleaners, and kitchen appliances due to its compact size, high speed, and adjustable torque. However, it's important to note that universal motors can be noisy and less efficient compared to other motor types. universal motor project highlights its effectiveness as a versatile power source suitable for both AC and DC applications. Through experimentation and analysis, the project demonstrated the motor's adaptability, compact design, and capability to deliver high-speed performance with adjustable torque. Despite its advantages, considerations such as noise levels and efficiency should be taken into account for optimal usage in various industries. Overall, the universal motor project contributes to understanding and utilizing this valuable component in a wide range of electrical devices.

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