Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

Unit 31: Electrical Systems and Fault Finding

Unit Workbook 2

in a series of 4 for this unit

Learning Outcome 2

Electrical Motors and Generators

INTRODUCTION

Construction, application, characteristics, and testing

Types of electric motors and generators

Practical applications

Generation methods

Starting methods

Voltages, power, speed, torque, inertia

EMI, efficiency

Cooling and protection devices

Contents

Topics Covered: -

Applications, construction, characteristics, and testing

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Applications, construction, characteristics, and testing

Applications

The purpose of an electrical motor is to convert electrical energy into mechanical energy. Some common uses of electrical motors are;

- Electric car
- Washing machine
- Cooling fan
- Refrigerator or freezer
- Microwave oven
- Drive for a conveyor belt
- Robotics

The purpose of an electrical generator is the opposite to that of a motor i.e. to convert mechanical energy into electrical energy. Some common uses of generators are;

- Dynamo on a bicycle
- Power station turbines
- Fossil fuelled cars
- Diesel trains
- Vessels
- Roadworks tool power

An illustration of the motor and generator concepts is shown in figure 1.

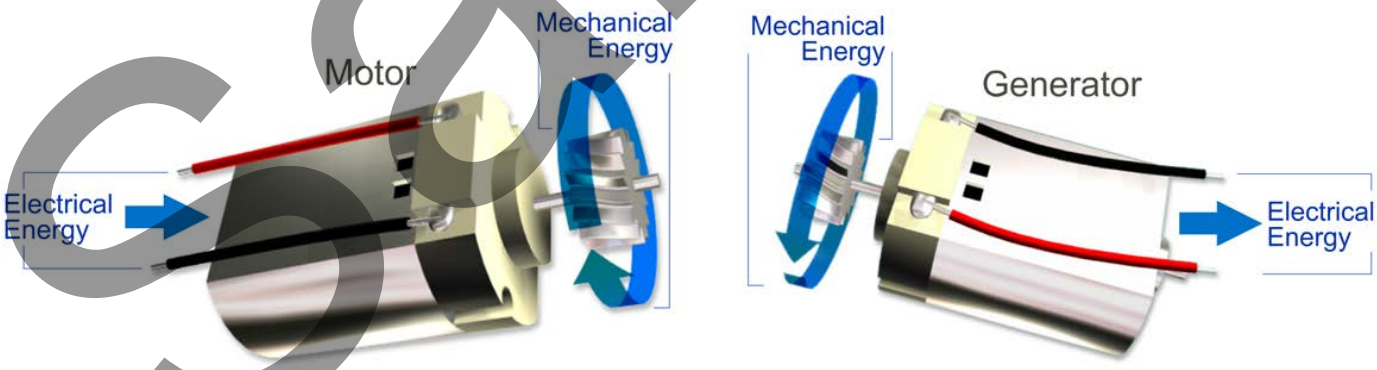

Figure 1 *The motor and generator concepts*

Construction

The two basic components common to both motors and generators are;

- Rotor – the spinning part at the centre
- Stator – fixed part which surrounds the rotor

Other components of motors and generators are;

- Bearings – these provide physical support for the rotor
- Air gap – the space between the rotor and stator
- Windings – usually copper coil placed around both the stator and rotor
- Magnets – these can be found in either or both the stator and rotor
- Slip rings and brushes – present on some types

The overall construction principle for a generator and motor is shown in figure 2.

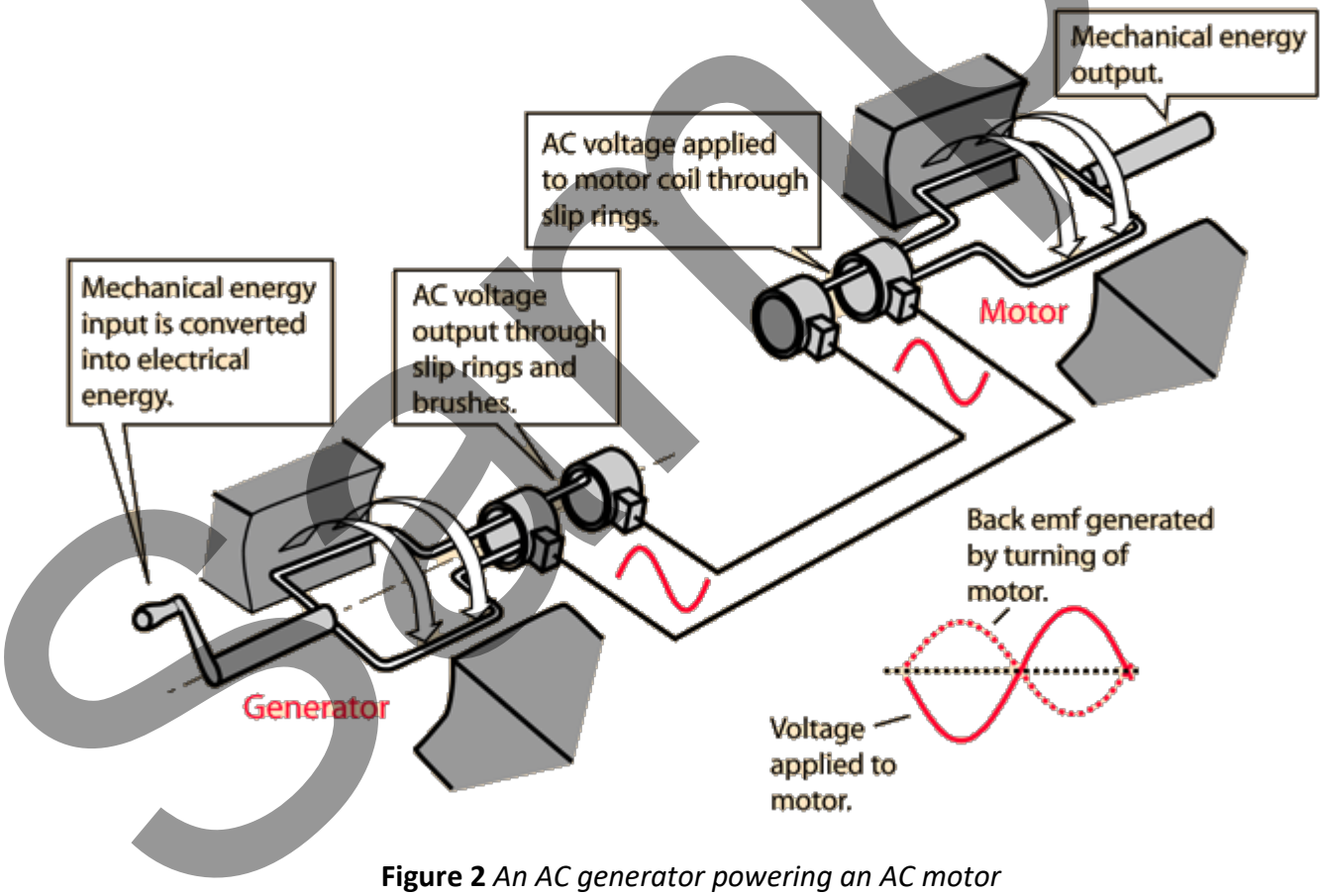

Figure 2 *An AC generator powering an AC motor*

Characteristics

Motors and generators can be made to operate on an AC or DC principle. The basic idea behind any motor or generator is that current-carrying coils which move within magnetic fields will experience a force, as shown in figure 3.

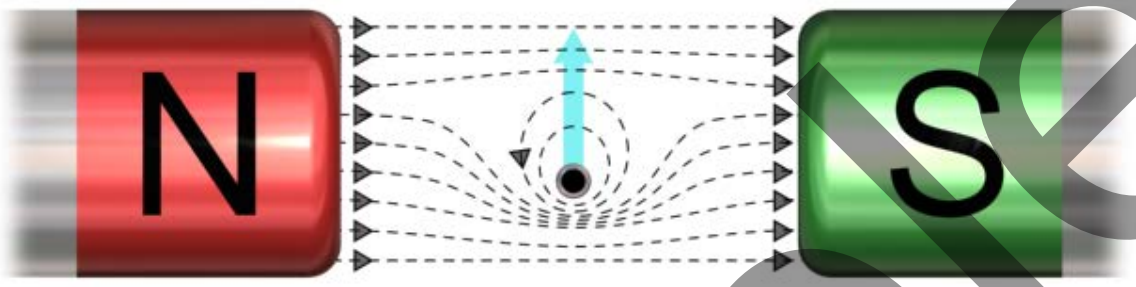

Figure 3 *Force on a current-carrying conductor within a magnetic field*

Any conductor which carries current will radiate a magnetic field. Placing such a conductor inside a larger magnetic field, perhaps constructed from permanent magnets, as shown in figure 3, will result in the conductor experiencing a force and thus movement.

Should we twist the conductor into the form of a loop then we have one turn of a coil, as shown in figure 4. Now the current will flow in opposite directions on either side of the coil. The magnetic forces then tend to work in opposite directions, producing a twisting force (torque) on the coil about its centre.

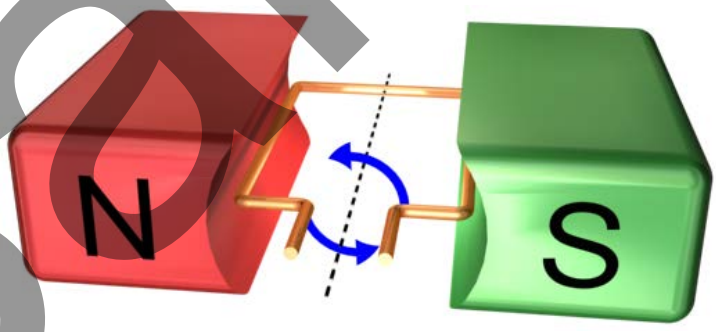

Figure 4 *Force on a current-carrying coil within a magnetic field*

Testing

Testing of motors and generators may be undertaken with a digital or analogue multimeter, clamp meter, temperature sensor, Megger or oscilloscope.