CAPACITOR MOTORS.

By including a capacitor in series with the starting winding the current in this winding may be arranged to lead the applied voltage. With a suitably designed winding and correctly chosen value of capacitance the amount of lead may be so adjusted that the current in the starting winding is 90 degrees out of phase with the current in the running winding. This gives an all round improvement in the performance. The vector representation of the currents is shown in Fig. 6.

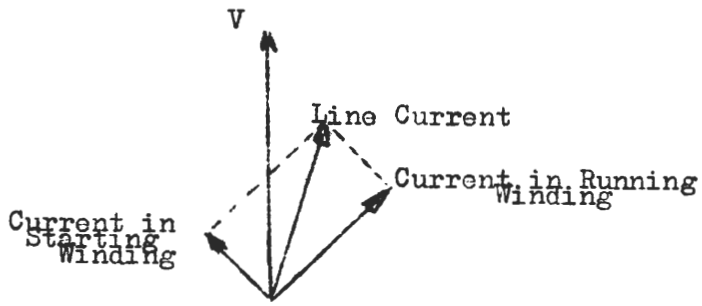


Fig.6.

To maintain this phase relatioship the capacitance must vary with the speed of the motor and with the load applied to the motor; this is a condition which cannot be satisfied in practice. Hence, a compromise has to be made in the design according to the requirements of the specific characteristics of the appliance to be driven by the motor. This accounts for the existence of three general types of capacitor motor.

Capacitor Start Motor.

This is similar in general construction, size, and mechanical detail to a split-phase motor of similar output, the most notable difference in its appearance lies in the presnce of the large capacitor

usually fixed to the outside of the body of the motor.

The size of this capacitor is large, values of 30/40 μF being quite common for one-sixth and one-quarter horse power motors. Modern reliable electrolytic capacitors are used with both plates "formed".

Starting torques up to four times full load torque are possible with the further advantage of a smaller starting current than that taken by the split-phase machine.

Immediately full speed has been attained the capacitor and starting winding are cut out by the action of a centrifugal switch. This means that during normal running the variation in speed with load, power factor, efficiency, overload capacity, and temperature rise are similar to that of the split-phase motor.of similar size.

The basic ciruit is shown in FIg. 7, and its torque-speed characteristic in Fig.8

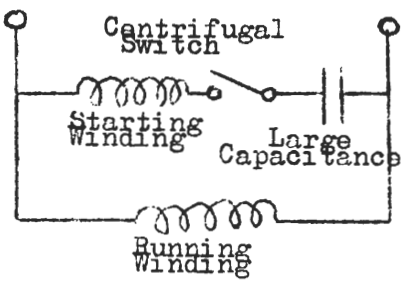
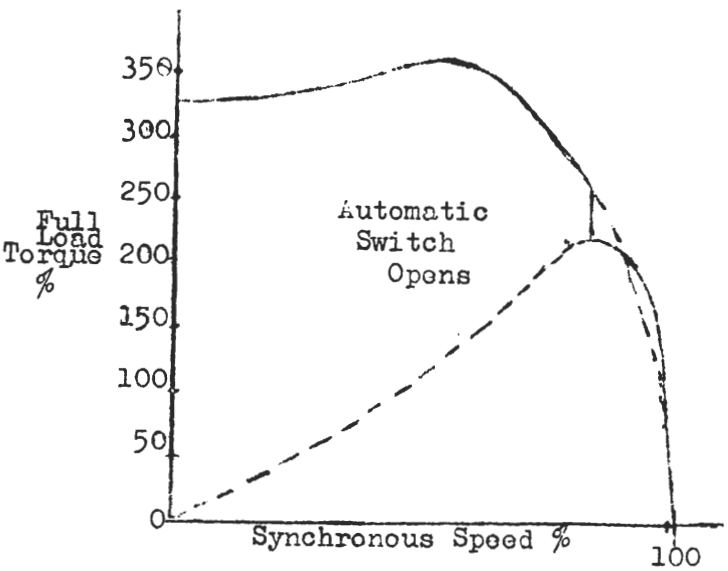


Fig.7.



Torque speed curve of 1/6 H.P. 220/250V. 50c/s Motor.

Fig.8.

Reversal of Capacitor Start Motors.

This is achieved in the same way as in the split-phase motor simply by reversing the direction of current flow in one winding only.

However, unlike the split-phase motor the starting and the running windings are often similar, hence a single-pole two-way switch suffice as shown in Fig.9.

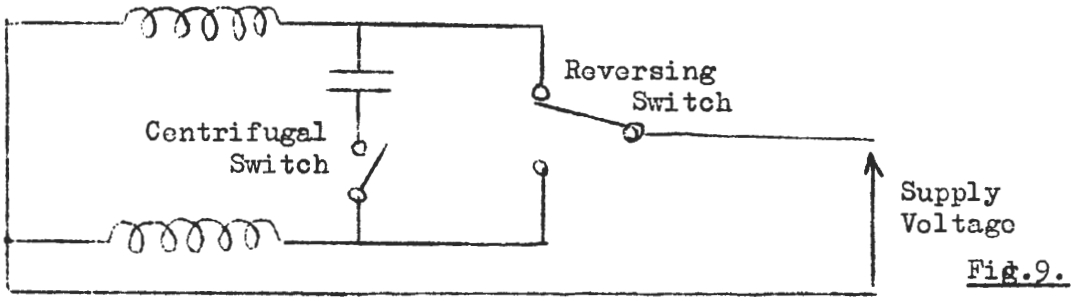


Fig.9.

Capacitor Run Motor.(Permanent Split Capacitor Motor.)

In this motor the capacitor remains permanently in the circuit as depicted in Fig.10.

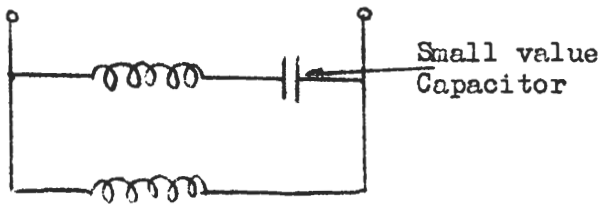


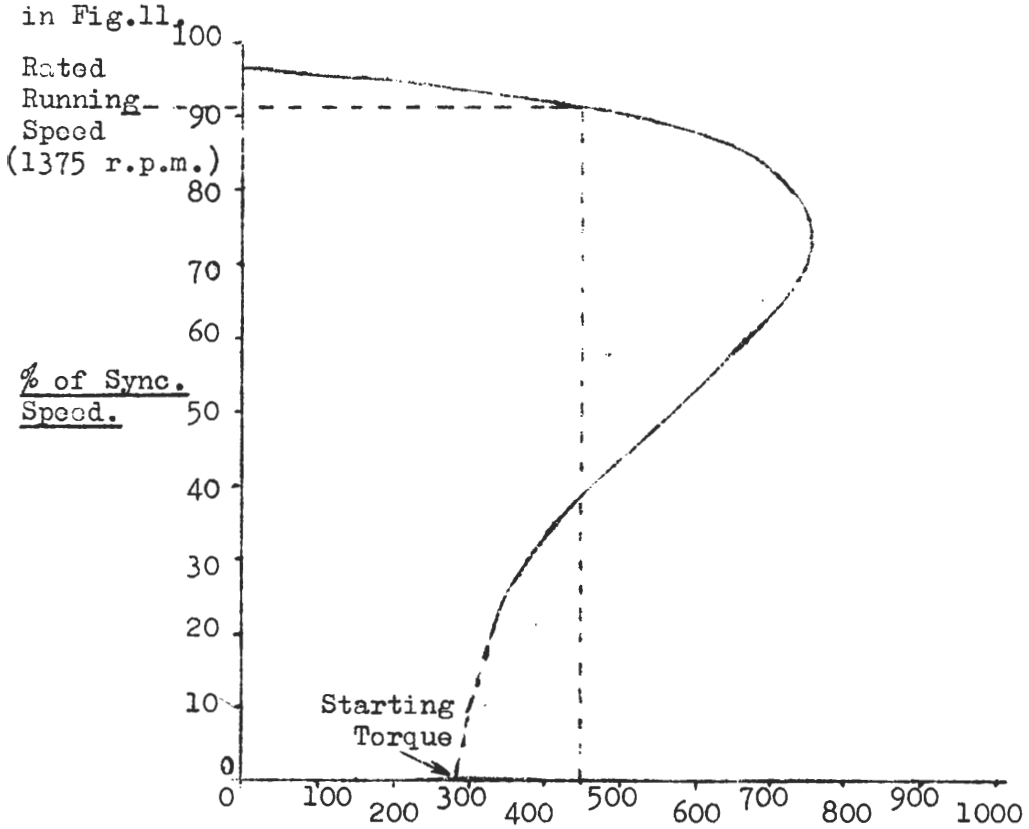
Fig.10

Electrolytic capacitors are generally rated as being suitable for 20 or 30 starts per hour and are therefore not suitable for continuous operation. In this motor the capacitor is of the paper insulated type and small in value; in the small size motors order of one or two microfarads.

This type of motor combines the advantages of extreme simplicity and reliability with high efficiency and silence in running. Its only disadvantage is its low starting torque which ranges from 50 to 100 per cent of full load in the small sizes, and is less in larger motors.

A further advantage is that its speed can be appreciably reduced by inserting resistance or reactance in series with the windings.

The torque-speed curve of a capacitor run induction motor is shown in Fig.11.



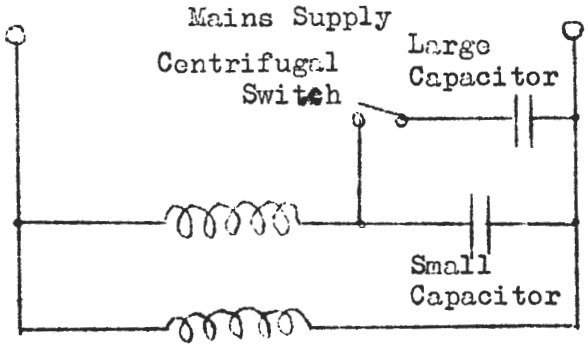
Speed-torque curve of Capacitor Run Induction Motor. (approx. 1/100 H.P.)

Fig.11

Capacitor Start and Run Motor.

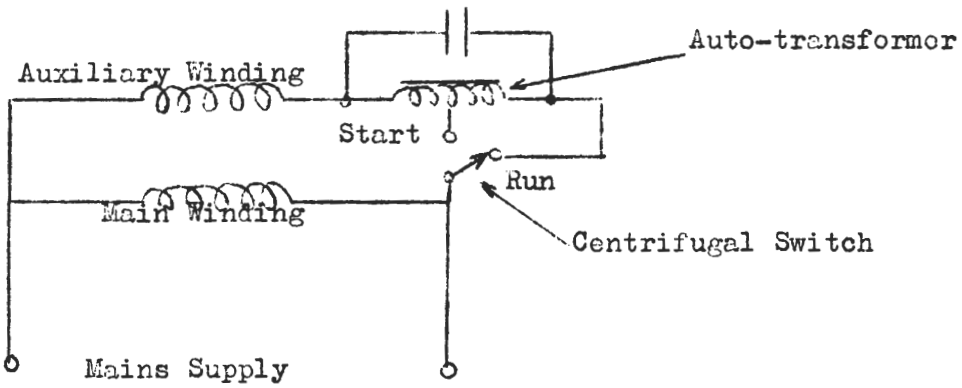
This motor combines the characteristics of the two types already mentioned and has a better running performance than any other type of single-phase motor. It gives a high starting torque, it is efficient and very silent in running. It has a high overload capacity and a high power-factor. The cost is higher because two capacitors have to be provided or one capacitor and an auto-transformer.

The connection diagram is given in Fig.12



Capacitor Start and Run Motor.

Fig.12.



Capacitor Motor with Auto-transformer.

Fig.13

In Fig.13 a capacitor run motor is shown used with an auto-transformer which, in the start position of the switch, is so connected as to step up the voltage across the capacitor such that its effective value is four to nine times its capacitance in the running position of the switch. The centrifugal switch in this motor is a two-way type with three contacts instead of the usual two-way two-contact pattern.

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