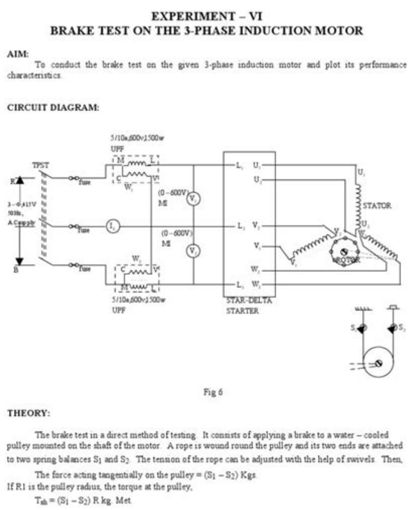
brake test on 3 phase induction motor lab manual



EXPERIMENT – VI
BRAKE TEST ON THE 3-PHASE INDUCTION MOTOR

AIM:
To conduct the brake test on the given 3-phase induction motor and plot its performance characteristics.

CIRCUIT DIAGRAM:

Fig 6

THEORY:

The brake test in a direct method of testing. It consists of applying a brake to a water – cooled pulley mounted on the shaft of the motor. A rope is wound round the pulley and its two ends are attached to two spring balances S_1 and S_2. The tension of the rope can be adjusted with the help of swivels. Then,

The force acting tangentially on the pulley = $(S_1 - S_2)$ Kgs.
If R1 is the pulley radius, the torque at the pulley,
$T_{sh} = (S_1 - S_2)$ R kg. Met.

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Book Descriptions:

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A be lt and brake drum arrangement as shown in the c ircuit diagram can load the mo tor. Torque Output power Vs power factor Output power Vs Efficiency Output power Vs %slip.RESUL T Performance characteris ti cs of 3phase squirrel cage induc ti on motor is examine by direct loading. VIVA QUESTIONS 1.Explain what is meant by a 3phase induction motor 2.Write the classification of 3phase induction motor 3.State the steps to draw the equivalent circuit of 3phase induction motor 4.State the condition for maximum torque of 3phase induction motor 5.Give the different methods of speed control of I.M. 6.How do you calculate slip speed 7.State the condition when induction motor acts as induction generator 8.Give the other name for induction generator The effect of ch ange of applied voltage on the above mentioned quantities a re ex plained as follows a Effect on Speed Speed remains practically constant unti ll very low voltage are reached. Unless heavil y load ed, the speed of an induction motor is affected v ery li ttle by fluctuations of voltage. b Effect on Stator Curren t As applied voltage is increased, stator current rises gradually on account of the increa se in magnetising current required to produce the stator flux. The component of the stator current which provides the ampere turns balancing the rotor ampere turns will steadil y diminish as the rotor cu rrent de crease with the increase i n rotor speed. The increase in the magne tising component is however, more than sufficient to ba lance this decrease. At ve ry low voltages the induction is so low that almost the whole o f the stator current is employed in ba lancing the rotor current. At normal voltag e the rotor current requires onl y a small proportion of the stator currents to balance them. The higher saturation of the magnetic circuit requires a much stron ger magnetising current to maintain the air gap flux.http://www.klostercompany.com/userfiles/cpe-30433-manual.xml

- **brake test on 3 phase induction motor lab manual, brake test on 3 phase slip ring induction motor lab manual, brake test on 3 phase squirrel cage induction motor lab manual, brake test on 3 phase induction motor lab manual pdf, brake test on 3 phase induction motor lab manual download, brake test on 3 phase induction motor lab manual free, brake test on 3 phase induction motor lab manual test.**

c E ffect on P ower Factor As explained above, the magnetising component of the stator current becomes larger as the voltage increase. Thus, there is a continuous incre ase in the power factor angle and hence a fall in power factor. Frictional losses of the motor are practically constant as the sp eed do es not change with voltage. The loss component of the stator current, IW is due to f rictional losses and iron losses. As voltage is increased, iron loss component and magnetising component of stator current will increase. The increase in magnetising current will be more than the increase in ironloss component of s tator current. Thus there will be a fall in power factor as the volt age is increased. d Effect on Power Input Noload powe r input is spent in overc oming both iron and frictional losses. As stated earlier, frictional losses are nearly constant at all voltages until the In fi g, by ex trapolating the power input curve to the left until it cuts the ordinate of zero voltage, when there can be no ironloss, it is possible to make a rough esti mate of the power spent in friction and windage. The effect of change of stator input voltage on the above mentioned quantities are shown graphically. FORMULAE USED Open circuit test No load power factor Cos. In this test rotor is blocked. 3. After that make the connection to measure the stator re sistance as per the circuit Diagram VIVA QUESTIONS 1.Explain what is meant by a 3phase induction motor 2.Write the classification of 3phase induction motor 3.State the steps to draw the equivalent circuit of 3phase induction motor 4.State the condition for maximum torque of 3phase induction motor 5.Give the different methods of speed control of I.M. 6.How do you calculate slip speed 7.State the condition when induction motor acts as induction generator 8.Give the other name for induction generator. P R 1 N X 1 230 V, 1 , 50Hz AC Supply Equivalent circui t of 1.http://www.clubforeducation.com/FCKeditor/userfiles/cpe-2-manual.xml

APPARATUS REQUIRED THEORY Slip ring induction mot or is a t y pe of induction mot or in which the rotor is provided with 3 phase double la yer distributed winding consistin g of coils as used in alternators. The rotor is wound for as man y poles as the numb er o f stator poles and is alwa ys w ound 3 phase even when the stator is wound two phase. The three phase are starred internall y. Th e other three winding terminals are brou ght out and connected to three insulated slip rings mounted on then shaft with brushes resting on th em. These brushes are further externall y connected to a three phase star connected rheostat. When running under normal conditions the slip ring s are automatically short circuited by means of a metal collar which is push ed along the shaft and connections all the rings together. Next the brushes are automatical l y lifted from the slip rings to reduce the frictional losses and the wear and tear. In the wound rotor t y pe the rotor slots accommodate an insul ated winding similar to that used on the stator. The rotor winding is unifo rmly distributed and is usuall y con nected in star. The three leads from the star connection ate then connected to three sli p rings of collector rings mounted on but insulated from the shaft. Carbo n brushes pr essing on the slip rings allow external resistors to be inserted in series with the rotor winding for speed and starting torque control. Actually the wo und t y p e rotor of induction motor costs more and requires increased maintenance it is therefore only used where i The driven load requires speed control Since the rotor is wound with polyphase windings and carrier slip rings it is called slip rin g induction motor or wound rotor CIRCUIT DIAGRAM PROCEDURE 1. Make the connections as per circuit diagram. 2. Ensure variac Auto Transformer position in zero ou tput voltage and switch on 3. Tabular Column. Expected Graphs 1. % Efficiency Vs Output Power 2. Speed Vs Output Power in 3. Torque Vs Output Power 4.

Loa d Current Vs BHP. THEORY When single pha se supply is applie d across one single phase winding on the stator of a single phase induction motor, the nature of the field produced is alternating and such the rotor will not develop any sta rting torque. It has however been observed that once the m otor is given an initial rotation it continues to rot ate. In a singlephase motor, to provide starting torque, an additional winding is provided, which is called the auxiliary winding. T he main and the auxiliary winding s are connected in pa rallel across a sing lephase supply. The impedance of the two windings are made defer ent so t hat currents flowing throug h the se windings will have a tim e phase diff ere nce a Need of a Capacitor in the Auxiliary Winding Circuit A singlephase motor h aving a main winding and an auxiliar y windin g fed from a single phase suppl y can be co nsidered as equivalent to a two phase motor having a single phase supply. Since the two windings a re not identical, the two cur rents Im and Ia will have a time phase displacement. Now if by an y means the timephase displacement between the two currents, Im and Ia flowing through the two windings can be made 900, a s ingle phase mot or will behave ex actly li ke a two phase motor.If a capacitor is to be used only for achieving high starting torque, then the auxiliary winding can be switched off when the motor picks up speed. This is done b y reversing the two terminal connections o f the auxiliary or main winding across the supply. The leads of the main and auxiliary windings c an be differentiated from each other if lead marks are not labelled by measuring resistances of the two windings.G et t he power sup ply from the control panel. 2. Close the DP ST sw it ch. 3. Adjust the au totransform er to the rat ed vo lt age of 1phas e induc ti on motor. Note the readings of a mm eter, vo ltm et er and wa ttm eter. 4. Br ing au t otransform er to mi n im u m vo lt ag e po sition.

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Sw it ch of the suppl y. BLO CK ED ROTOR TEST PR EC AU TIO N 1. Keep the DP ST sw it ch i n open pos iti on. 2. Auto transform er should be at mi n im um position. 3. Before sw it ch ing on t he suppl y, som e load is app li ed i n the brake drum, so that ro tor does not ro tat e. PR O C ED URE 1.

Connec ti ons are made as per the circuit diagram. 2. G et the po wer supply from the control panel. 3. Close the DP ST sw it ch 4. Auto transform er is ad just ed to rat ed current of 1phas e induc ti on motor. 5. Readings of a mm eter, voltmet er and wa ttm et er are noted down. 6. Br ing au totransform er to it s mi n im um vo lt age po s iti on and sw it ch off the suppl y, after re moving the load. O BS ERVATION TABLE NOLOAD TE ST SI NO Vo lt age vo lt Io Amp Wo Wa tt BLO CK ED ROTOR TE ST SI NO Vo lt age vo lt Io Amp Wo Wa tt VIVA QUESTIONS 1. State the conditions, under which noload test is performed 2. Which theory is commonly used for the analysis of induction motor 3. What is the slip of forward and backward rotors 4. What is the phase displacement in space between the two windings 5. How the phase splitting can be increa sed between the two wi ndings 6. How is the starting winding disconnected from the supply PR O C ED U RE 1. Connec ti ons are given as per the circuit diagram. 2. The induc ti on motor is st ar t ed on no l oad by u sing transform er st ar ter. VIVA QUESTIONS 1. State the conditions, under which noload test is performed 2. Which theory is commonly used for the analysis of induction motor 3. What is the slip of forward and backward rot ors PROCEDURE SEPERATION OF LOSSES 1. Connections are given as per the circuit diagram. 2. The 3 A.C supply is given by closing the TPST switch. 3. The induction motor is starte d gradually by appl y in g voltage through th e 3 autotransformer. 4. At rated voltage, power input Wo is measured by using wattmeter and no load current Io and voltage Vo are noted. 5.

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Voltage is gradually reduced till the motor continues to run. 6. For each voltage, readings of ammeter, voltmeter and wattmeter are noted. MEASUREMENT OF STATOR RESISTANCE Rs 1. Connections are given as per the circuit diagram. 2. The D.C supply is given through a DPST switch. APPARATUS REQUIRED THEORY The regulation of a s ynchronous generator Alternator is th e rise in volt age at the terminals when the load is reduced from full load rated value to zero, speed and field current remaining constant. The voltage regulation depends upon the power fa ctor of the load. Tabular Column Tabular Column CIRCUIT DIAGRAM iii .Record the line to line voltage E and the filed current If. Make sure that the speed remains constant through the whole test. 6. Take the readings upto 110 % of the rated voltage of the alternator. 7. Stop the motor and connect as in fig.2 for the short circ uit test of the alternator Close the 3 switch and gradua ll y increase the excitation. Record the field current If and the armature current Ia. Take readings upto 120 % of the rated generator current. 9. Switch the alternator exciter off. S top the motor and make connection as given in fig.3 for measurement of DC resistance of the armature. 10. Adjust the DC powe r supply so that the cu rrent flowing through the alternator winding does not exceed the rated value. C alculate only the saturated value. 3. Calculate, analytica ll y, the voltage regulation of the generator for the following loading conditions One. Rated load, unity power factor Two. Rated load, 0.8 lagging p.f Three. Rated load, 0.8 leading p.f Use equations 3 and 4. H ence, it gives more accurate results. It is a graphical method to find out the regulation of the given three phase alternator. The experimental data required is No load Curve and the ZPF curve, also called the wattles load characteristic curve. It is a curve of terminal volt age against the ex citation, when the armature is delivering full load current at zero power factor.

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The construction of the graph to obtain regulation using the zpf method is as follows 1. Take a point b on the zpf curve as shown. 2. Draw bk equa l to bo o is the origin. Ob’ is the field current at rated armature current under shortcircuits conditions. 3. Through k, draw kc parallel to oc’ to meet OCC at c. 4. Drop a perpendicular from c to meet bk at a. The abc is called the Potier triangle. 5. The length ac gives the leakage reactance drop, I a X al and ab is the armature reaction mmf at rated current, X p. For cylindrical rotor m achine, Potier reactance X p is approximately equal to leakage reactance, X al. In salientpole machine, X p may be larger than 3 times of X al This is called the dark lamp synchr onization of alternator with the supply source. VIVA QUESTIONS 1.Define regulation of an alternator 2.Why emf method is called as pessimistic metrhod 3.What is the disadvantage of emf method 4.What is meant by synchronous impedance 5.Is synchronous impedance constant with respec t to Excitation 6.What is the other name for mmf method. As such the operation of synchronous motor is described below under three modes of excitation. Normal excitation the armature current is min imum at a particular value of fi eld current. The operating power factor is unity and thus the motor is like a resistive load. Under excitation when the field current is decreased the armature curre nt increases and the power factor is lagging and the motor is like an inductive load. Over excitation when field current is increase d the armature current also increases, the power factor is leading and the motor is like a capacitive motor. VIVA QUESTIONS Q.1.Where the synchronous machines find maximum application Q 2. What is generated voltage and frequenc y of sy nch ronous generator Q3. Why damper windings are used in s ynchronous machines Q4. Under what circumstances synchronous machine is used as industrial machine Q5. What are the typical character istics of synchronous machines Q6.

What are various excitations under which sy nchronous machine is operated Q7. What is meant by V curve of synchronous machine Q8. Which type of prime movers are used for synchronous machines APPARATUS REQUIRED Synchronising Panel For Parallel Operation Of A.C. Genera tors THEORY Before a synchronous generator c an be put to share the l oad, it should be properly c onnected in parallel with the commo n bus bar. I nterconnection of the terminals of a generator w ith th e terminals of another or a bus bar, to which a large number of s y nchronous generator are already connected is called sy nchroni zing Condition For Para ll el Co nnection Or Syn chronisation For satisfactory parallel c onnection of alternat ors, the following three conditions must be fulfilled a The generated voltage of the i ncoming alternator to be connected in parallel with a bus bar should be equal to the busbar v ol tage. b Frequency of the generated voltage of the i ncoming alternator should be equal to the bus bar frequency. c Phase sequence of the voltage of the incoming alternator should be t he same as that of the busbar. Generated voltage of the incoming alter nato r can be adjusted by adjusting the field excitation. Frequency of the incoming alternator can be controlled and m ade equal to bus bar frequency by controlling the speed of the primemov er driving the alternator. Phase sequenc e of the a lternator and the busbar can be checked by a phase sequence indicator. Three l amps L1, L2 and L3 are to be c onnected as shown in the figure. With the sy nc hronous generator driven at rate d speed if all the lamps glow together and become dark together then the phase sequence of the incoming alternator in the sam e as that of t he busbar. For this purpose the two commonly used methods are described as follows. Two lamps are cross connected with the busbar. In thi s method the brightness of the lamps will vary in sequence.

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A particular sequence will indicate if the incoming alternator is running too fast or too slow. Prefe ct s y nchronizing will occur when lamp L1 is dark while lamps L2 and L3 are equally bright. When the speed and voltage have b een adjusted, the switch of the incoming synchronous machine can be closed only when lamp L1 is d ark while lamps L2 and L3 are equa ll y bri ght. If the frequency of the i ncoming alternator is higher than the bus bar freq uency, the ph asors R2 Y2 B2 representing the alternator voltages wil l be rot ating faster than the phasors R1 Y1 B1 representing the bus bar voltages. At the inst ant when R1 is in phase with R 2, lamp L1 will be dark and the other two lamps will be equally bright. Aft er one third of the cycle, B2 will be in phase with Y2. Since the lamp L 2 is connected across B2 and Y2, it will be dark. After another on e third of a cycle, lamp L 3 will be dark. Thus if the frequenc y of the incoming alternator is higher, the lamps will bec ome dark in the sequence L1 L2 L3. The speed of the alternator will, therefore have to be slowly adjusted so that the l amp L1 is dark and lamps l2 and L3 are bright. At this instant, the switch can be closed. The incoming machine thus gets connected in parallel with the busbar. In this three lamp method, in addition to knowing the exact inst ant of closing of synchronising switch, it is also know whether the incoming alternators frequency is less or more than the busbar frequency. B SYNCHRONISING BY USING A SYNCHOSCOPE A Synchroscope determines the instant of synchronism more accuratel y than the three lamp method. A pointer connected to the rotor will rotate if there is a difference in frequencies of the incoming alternator and bus bar Anticlockwise rotation of the rotor point er indicates that the frequency of the incoming alternator is slower, whereas clockwise rotation of the pointer indicates that the frequenc y is higher than the bus bar frequenc y.

The speed of the primemover driving the alter nator will, ther efore, have to be adjusted such that, when the frequencies are equal the pointer is stationary. The alternator can be switched on the bus bar by closing the switch, S at this ins t ant. The primemover of the alternator is a DC M otor, w hose speed c an be adjusted by the rheost a t provided in its field circuit. The generated voltage of the alternator is adjusted equal to the bus bar voltage by varying the field current of a lternator with t he rheostat provided in its field circuit. Synchronising switchboard consisting of these set of lamps each set with 2 lamps in series and a switch forms the proper li nk be tween the in coming alternator and th e busbar. Check the phase sequence of both the alternators by usin g phase sequence indic ator. The phase sequence of b oth the alternators should be same. As per the connections of the set of lamps, one set which is directly conn ected between the same phase shoul d be dark and at the same instant, the order two set of lamps, which are cross connected should be bright. 6. S witch on the TPST knife switch in UPWARDS direction. Now the three set of lamps will flicker. In case flickering is fast, adjust slowly t he speed of both the DC Motors, so that the frequency becomes equal. Check the equalit y of two voltages of alternator. Under such a condition, the set of lamps will go in and out very slowly. At this point switch on the MCB for s y nchroscope and when its pointer is in the middle the two alternators are s ynchronized Thus both the alternators are now supplying common voltage to the bus bar. 7. W atch for the correct i nstant of S y nchronisation which is denoted b y s ynchroscope pointer in the middle with the sy n chronising switch in hand and close this switch in the down ward direction, when the directly connected set of lamps is dark and the other two set of lamps are equally bright, thus synchronising the inc oming alternator with the busbar. 8.

S witch off the s y nchron ising switch, busbar s witch and then the DC mains to stop the DC motor and the alternator. RESULT Parallel operation of two three pha se alternators has been performed. VIVA QUESTIONS Q.1.Where the synchronous machines find maximum application Q 2. What is generated voltage and frequency of sy n chronous generator Q3. Why damper windings are used in s y nchronous machines Q4. Under what circumstances synchronous machine is used as industrial machine Q5. What are the typical character istics of synchrono us machines. Discover everything Scribd has to offer, including books and audiobooks from major publishers. Start Free Trial Cancel anytime. Report this Document Download Now save Save Brake Test on the 3Phase Induction Motor For Later 63% 19 63% found this document useful 19 votes 35K views 2 pages Brake Test on the 3Phase Induction Motor Uploaded by Aravind Babu Description Full description save Save Brake Test on the 3Phase Induction Motor For Later 63% 63% found this document useful, Mark this document as useful 37% 37% found this document not useful, Mark this document as not useful Embed Share Print Download Now Jump to Page You are on page 1 of 2 Search inside document Browse Books Site Directory Site Language English Change Language English Change Language. It consists of applying a brake to a water cooled pulley mounted on the shaft of the motor. A rope is wound round the pulley and its two ends are attached to two spring balances S1 and S2. The tension of the rope can be adjusted with the help of swivels. The motor input can be measured directly as in the circuit diagram 6. For finding the performance characteristics, the speed of the motor can also be measured by a tachometer. Note the readings of all meters. Gradually increase the load by tightening the rope and note down the readings of all meters and tabulate the results as shown below.

The output and input of the motors, Efficiency, Torque and slip can be calculated and the performance characteristic.How is the supply voltage related to the starting Torque. In what respects slipping I.M. superior to squirrel cage. What is the value of rotor resistance, which give maximum starting torque. Using Field Oriented Control. The speed control of the singlephase induction. Speed control of SinglePhase induction motor Documents Modelling and Simulating a ThreePhase Induction. To browse Academia.edu and the wider internet faster and more securely, please take a few seconds to upgrade your browser. You can download the paper by clicking the button above. The rotor is either a wound type or consists of copper The threephase current drawn by the stator from The magnetic According to Lenzs Law, the EMFs must oppose the But on account of losses, the speed The field of the DC generator is excited separately. Loading the When the motor drives a load, it has to exert more torque. Since torque is proportional to the product of flux and current, with increasing load the relative speed slip between the rotor The basic difference is that the The noload current of the motor is sometimes as high as 30 % to 40 % of the fullload Show connections with Analog Power Wattmeters and with Power Quality Meters The switch settings on the two banks should be similar. If they cant If your power meter has a current clamp Adjust the output of the threephase variac to be 208 V between phases before turning on the motor. Record the terminal AC voltage V t, the With each load value, record the reading of V t, I a, W 1, W 2, V dc the speed N and Measure the resistance between two of the drive terminals of The NEMA code letters on the motor Make certain that you write down the NEM A code and the horsepower rating of the machine.

Start the Flukeview software on the computer and If not, look at the device manager to determine the port that it is connected Enter 1 second for the time of measurement. The parameter labeled maximum current is really the current per division of the display. Set the probe and meter to be able to When you are ready, push start on the meter and then the start button for the motor. The meter The meter should display the currenttime curve. Use the Fluxview software It is best to capture the data into an excel spread sheet so that you can manipulate the plot for best viewing. Can you explain them. For the electric car company, see Tesla, Inc. In TEFC motors, interior heat losses are dissipated indirectly through enclosure fins, mostly by forced air convection. Many such motors have a symmetric armature, and the frame may be reversed to place the electrical connection box not shown on the opposite side. Singlephase induction motors are used extensively for smaller loads, such as household appliances like fans. Although traditionally used in fixedspeed service, induction motors are increasingly being used with variablefrequency drives VFD in variablespeed service. VFDs offer especially important energy savings opportunities for existing and prospective induction motors in variabletorque centrifugal fan, pump and compressor load applications. Squirrel cage induction motors are very widely used in both fixedspeed and variablefrequency drive applications.Tesla applied for US patents in October and November 1887 and was granted some of these patents in May 1888.Whereas a synchronous motors rotor turns at the same rate as the stator field, an induction motors rotor rotates at a somewhat slower speed than the stator field. The induction motor stators magnetic field is therefore changing or rotating relative to the rotor.The direction of the magnetic field created will be such as to oppose the change in current through the rotor windings, in agreement with Lenzs Law.

The cause of induced current in the rotor windings is the rotating stator magnetic field, so to oppose the change in rotorwinding currents the rotor will start to rotate in the direction of the rotating stator magnetic field. The rotor accelerates until the magnitude of induced rotor current and torque balances the applied mechanical load on the rotation of the rotor. Since rotation at synchronous speed would result in no induced rotor current, an induction motor always operates slightly slower than synchronous speed.As the speed of the rotor drops below synchronous speed, the rotation rate of the magnetic field in the rotor increases, inducing more current in the windings and creating more torque. Under load, the speed drops and the slip increases enough to create sufficient torque to turn the load.The generating mode for induction motors is complicated by the need to excite the rotor, which begins with only residual magnetization. In some cases, that residual magnetization is enough to selfexcite the motor under load. Therefore, it is necessary to either snap the motor and connect it momentarily to a live grid or to add capacitors charged initially by residual magnetism and providing the required reactive power during operation. Similar is the operation of the induction motor in parallel with a synchronous motor serving as a power factor compensator. A feature in the generator mode in parallel to the grid is that the rotor speed is higher than in the driving mode.As the load torque increases beyond breakdown torque the motor stalls.A single phase induction motor requires separate starting circuitry to provide a rotating field to the motor. The normal running windings within such a singlephase motor can cause the rotor to turn in either direction, so the starting circuit determines the operating direction.The current induced in this turn lags behind the supply current, creating a delayed magnetic field around the shaded part of the pole face.

This imparts sufficient rotational field energy to start the motor. These motors are typically used in applications such as desk fans and record players, as the required starting torque is low, and the low efficiency is tolerable relative to the reduced cost of the motor and starting method compared to other AC motor designs.In capacitorstart designs, the second winding is disconnected once the motor is up to speed, usually either by a centrifugal switch acting on weights on the motor shaft or a thermistor which heats up and increases its resistance, reducing the current through the second winding to an insignificant level. The capacitorrun designs keep the second winding on when running, improving torque. A resistance start design uses a starter inserted in series with the startup winding, creating reactance.The current distribution within the rotor bars varies depending on the frequency of the induced current. At standstill, the rotor current is the same frequency as the stator current, and tends to travel at the outermost parts of the cage rotor bars by skin effect . The different bar shapes can give usefully different speedtorque characteristics as well as some control over the inrush current at startup.Applications such as electric overhead cranes used DC drives or wound rotor motors WRIM with slip rings for rotor circuit connection to variable external resistance allowing considerable range of speed control.This system was once widely used in threephase AC railway locomotives, such as FS Class E.333.The most common efficient way to control asynchronous motor speed of many loads is with VFDs.Scalar control is suitable for application where the load is constant.Note the interleaving of the pole windings and the resulting quadrupole field. To optimize the distribution of the magnetic field, windings are distributed in slots around the stator, with the magnetic field having the same number of north and south poles.

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