Induction mater

# Single Phase.

# Induction

A

Date

Page

+-¢

Supply

to

N

current polarity change

I

Voltage,
Same,

Id in forward
direction
$5

Ta

Фъ

→ & direction also
change.

I lux cuts rotor
conductor

and emf will be induced and as it is short circuit Current will also be induced

Ita & developed

torque.

developed forque is same

in both direction

-To

in backward direction

So resultant for que o

is an ac motor

=> Single phase induction motor is

which always

run

1-0 induction motor

when

we

apply

on ac.

1-9

中

is not self starting motor

in Single winding

al

then it will produce flux (field) in

produce flux (field) in

altemating

nature

Date

Page

due to fees flux cuts actor conductor also

reverse (backword) both side

forward

in

hence

is zero

and

it produce equal, and opposite magnitude,

of torque

Starting.

thes

on

rater hence, its

resulfant torque

1-4 induction motor is not self

Ta

कल

im am

main

winding

depend on

NS

phase ande

2

To *a* da om sina

RMF (rotating magnetic

field)

Φajϕт

a

Φт

Φa

la

Φa

auxillary winding

- Developed torque

Td a da Im sind

For I max

=

2=90°

To a imia sina

angle between da and Om

la

im

or

Φa

уфт

soot

2)

2)

3)

ዓ)

5)

Date

Page

As we, have seen, single phase induction motor is not self starting always this use motor, so we one addition winding to start mater, which is called auxillary coinding.

to make 1-¢ J. M two winding So t self starting Some time it

=> Thus we (ϑϱ, is also

Called two phase motor.

=) Now by their connection, 1-4. Induction motor starts

Connection and

in different components, called starting methods.

additional components,

Type of 2+ Induction motor starting method.

Split phase Induction motor
Capacitor start motor capacitor
start capacitor.

shaded

ran motor

pole Indultor motor.

Reluctance start motor.

1)

divide

spoit phase, mojor

I

1-0 Supply

main

coinding

In given

Date Page

Ja

*F.*

centrifugal. soitel

Φa

Do www

xa

Ra

Ny

[ off at 70-7. of its rated speed)

main coinding

auxillary winding)

ФТО

фа

RME

8:00 150005

Rmixm

auszillary winding

Raixa

circuit auxillary winding is

Connected in parallel with

automatic Switch

in

Senes

main coinding

and

I centrifugal Switch) is connected with

auxillary winding:

Soff

Centrifugal Switch operate, when mator cep to

(70-80) 4. of their rated speed

reaches

= Auxillary winding is mainly used to start the

mator

once

)

auxillary

conding

conding to

=) Both winding

(A·W

90°

+

then discometed

motor started Save the power (J22 Ra).

4 LOSS

and Mow)

are placed at

stator

=>

rotor.

Im

190°

শ

A:W

·Jq

Td = Ja Im sind

2

IM

A

Date

Page

=) In auxillary winding, it has high resistance.

(Ra 1), but in main u

in main coinding it is highly

inductive (Xm1)

=>

Mow

A.w

Rq

xa

Rm

xon

Rm dv Xm 1

рар хал

199

.

la ada

२

Em 2am

Td & JaIm Sing

27 621

is ande between two cements (Ja and 3m) 4 is phase angle between it and I

Φ

2 (30-40).

## 2) Capacitor star motor -

=> It is also one of the type of 1-0 Induction motor, by using capacitor, 102, make, more phase difference between two caments (Ja and Imp So that its starting torque improved fuan Split Phase

J

Id a raton sing

のぐ

ta

Im

=>

3.5

by using.

Date

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this capacitor, its starting torque,

more than its for load torque,

to 4 times

Is

Centrifugal switch.

Ta

Xm

~ VS

rotor

Cs

Rm

C=2500F

www.

m

*Xe* z

298C

Ra

Xa

circcait becomes

capacitive

CS. = Starting Capacitor

за

Td 2 JaJmSina

Is

JPA

21

Td. ↑

22 70-80°

water pump)

used

is of range 250 MF used in series with auxillary coinding

⇒>

Here

capacitor

=

Capacitor

and both A ·w

and Mow

are

alse

Centrifugal switch

parallel to each other operately),

when rotor ready

up to (70-80) 1. speed of its full load speed

=> Thus

turs motor is used where we need ligh

Starting torque.

Date Page

application. is

compressure Z

(ii)

pumps

where high starting 7 torque . is

required

3)

да

↑ IS

Nam

Capacitor start Capacitor run

(two capacitor - motor)

motor

CS = capacitor

start

Rom

Ics cr = capacitor

1-4 (US)

Supply

rator

reen

Xm

is

ww

Ra

xo

2) Sig shows the Schematic diagram of a

twoo Value

Capacitor motor. It has a its stator has two windings

main winding (Starting coinding)-

rotor and its stator

fuc

namely

winding

are

placed at so'

in

=>

The

саде

and the auxillary The two comdings

Space..

motor uses two capacitors cg and CR.

The two capacitor are

cef starting.

order

⇒

a

In

connected in parallel

to obfain

a

high starting

torque,

the starting

winding

• large, cument is required for this capacitive

reactance X in

should

be 10w

Since XA = +

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the value of Cs should be large.

256CA

The capacitor cs is short-time rated and is almost always electrolytic

=) During normal operation, the rated line current is smaller than the

Hence the

sto Starting

Current should be large. Since XR=DAG Capacitive reactance should be, large Should be small.

the value of CR

As the motor approaches synchronous speed, the capacitor cs is disconnected by

Switch

Sc.

The capacitor CR is

circuit

time rated

a

centrifugal

permanentl
y

Connected in the

and is called run
capacitor

for continous

capacitor. It is long
menning
.

So it is usually

of oil-filled paper construction.

Since

and the

One. Capacitor Cs is used only at starting
other CR for continous running, this

Capacitor start capacitor

motor is called

oun

motor.

= Fig @ and fig@ show the phason diagrams Z

of a

2- value capacitor motor. At starting

in the circuit and $90

is disconne

both the capacitors.

Shown in pig@·

вода & becomes

cted

ore

when the capacitor cs 90° (electrical) as shown in fig

Q2

Ja

Ja

$390°

big @

*Im*

8=90°

Im

big

Date Page

=> Twoo

and

value. Capacitor motors smooth

running. They

are, quiet

have, have higher

enriciency than motors that run

windin

gs

alone.

on the main

## Applications

Too

value

## Capacitors

maximum

are used for loads.

pull out torque.

of higher inentia requiring. frequent starts

where

and

used

efficiency required are higher. They are

pumping equipment.

ins

air compressors efe.

refrigeration,

Shaded pole, malors

main pole

Date

Page

1-p

scopply

Shading coil

Stater

каде

actor

a

main winding

=> A

A shaded

of

is

a stator and made

cep ода

=)

is bitted

on

Fig. shaded - pole motor with two starter

Poles

pole motor is

induction motor.

Self-starting phase

a

It consists

cage - type rotor. The stator Sailent poles.

Each pole is slotted on side

the smaller port a as showmin

a simple type of

and

a copper ring

Big

above.

This part is

called

the shaded pole.

The

ring

a

Single tum coil and is

known

when

coindin

g field

as

is usually

Shading coil.

alternating Current Rows in the field

I an alternating flux

Core

A

the shaded coil,

is

produced in the portion of this flux links

wity

behaves

which

Secondary of a transformer"

as shor-circouted

Date

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is indecord in the. Shading coil, and

current in it. Jue

A voltage, is indecord this

voltage circalade) induced

cument producees a

flux

called induced

flen which opposen the main flux (come

flup).

=>

the

The Shading coil, tues, causes the flux in

Shaded portion a to lag behind the flux

in the conshaded portion b

=>

of the pole

I the main flux

and

At the same time the shaded pole flux one.

displaced in space.

space displacement is less then go'.

and space displacement

Juis

Since there.

is time

between the two fluxes

+

que

conditions for

Seking up rotating magnetic.

Wield

Produced

=) under, the

a

зорого

are

tue, rotating

fleys

action of starting torque is developed

Application

is developed on tur cage.

The Starting forique developed by motor is very Low.

The lossen Power factor is low, and is low.

also low. for tals reasons, motors are ore a shaded

high and

the eficiency

the shaded pole,

built only in small size of power

or less. For example, – relays,

rating of you

fans of all kinds, hair driers i exhaust fan, eki

Reluctance, start motor

rotory Sailent type

Stator

ropox

1-$ Ac. Supply

Date

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Reluctance Start motor

Hysteresis moter

> seans cet

sens at synchronous

motor

construction [construction Same as 1-4

induction **moter**

Stator

rotor

M · w +Aw

Sailent pole

=>

reluctance torque, is possible only in sailent pole.

Stator winding

ঽ) RMF.

Universal motor

ac or do)

Tac

ᒐ

1-0

Ac.

seepply

CND

Rse

when

Fa

=)

vohen

Ra

ہے

stator.

de Supply

ose

Ac Soupply

rotor

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Connected in
Serios Similar to de
señes motor

Supply (acordes

torque, developed.

ose

+'ve half

-ve half

øse

H

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when

it

fed

when

соожд

with DC Supply

universal motor is fed with Dc supply

DC series motor. In this case,

a as

when the current flows in the field winding,

electromagnetic

field

produces

also flows

an

1

it

The Same cament

in the asmature conductors

current carrying conductor is placed in

the

conductor experience

Jui's mechanical

bield

force.

rotate

1

force

a

a

colon a

magnetic

mechanical

causes the rotor to

Flemming left hand sule, gives us the direction of this force.

when fried with an AC supply

=>

A

the universal

Juis

is

unidirectional torque is

motor is supplied with

produced when

AC power.

because

the

are

connected

field winding

amature winding and the

is series and are in

the same phase. Therefore, whever the polarity

of Ac changes

armature

the

t

the direction of

the current in

and the Held coinding changes simur

I tan cously. The direction of

the

and dincation of armature

magnetic field current reverses so that the direction of the

force experienced by amat ure Conductors remains the

same. Juan, regardless of Ac or Do. Siepply + Supply + universal motors

work on the

Same principle trad

Juces,

DC. Sener motor work on.

proportion of conivesale motor

Date

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1)

They

Men

ad high speed

2)

3)

9)

They

аж

noisy

breshes

5)

Judy have . high Ganting torque,
Compact size, and are light weight.
because of
and
the commutator

Smaller universal motor efficiency is 30%.
cohere
as
larger cuniversal
is
motor
emerena
y
70-754

Application

1) Vaccum cleaners
2)
3)
9)
5)

6)

72

Good

processors

mixes

hair dries

coffee grinder

Clectric Shavers efe.

blowers

8) drilling machines



Servo motor

L

means automatic motor

we

can use

any

major as

servo motor

Servo

mechanism

I

any physical quantity

can be compolled

automatically

W

less essor

ﻉح

Precise coork

٩۶

better acuracy

op

M

Пр

(no feedback),

Open loop system

HP

Gooor

**DJ**

I defector

conpollen

t

motor

Feedbook

closed loop system.

م

encoder position

Sensor

servo

motor

Can

be Acor De

L

↳

potentiometer

Targe

tosition

error

Signa

l

Controller

M

position

Sensor

Date Page

DG

Servo motor

De

Servo motors

are

volves

seperately excited de motors or permanent magnet de motors： Fiq @ shows a schematic separetely excited to servomotor. The diagram of

de

speed of do Servomotor is normally controlled by varrying the

armature voltage

a

The armature of a de sento motor has large resistance so that the torque

-speed characteristics are linear and have a

shown in

ضا

big

large negative slope (torque, reducing with increasing

Speed) as

• The negative slope,

Provide, viscous damping for the servo-drive system.

FigC

shows that the amature mmf and the excitation field mmf are in quadrature in demie.

No

voor

Xa

ww

Ra

mafor

zig@

↑ Armature mmf

KigC

field mmf

Torque . (T)

Val

var

Vaz

Date Page

Vaivan vaz

Speed (N)

kig @

b

=> This provide

a

fast torque, responce because torque and flux becomes decoupled Themefore, astep change, in the, asmature voltage.

or cumsent produce a quick change, in the position on **speed** of the roter.

Ac

servo motors

-=>

AC

Servo

motors

are of two-phase. squirrel Cage induction for low power applications.

ab

1

⇒ fig C shows the schematic diagram of a two phose

servo motor. The stator has two distributed

which are displaced from each other by

Called reference a constant voltage.

one coin

coindings go' electrical degree, one fixed phase, is supplied from

or

voltage source Vm (0° the of

coindin g

The other coinding, called control phase, is supplied coith variable, voltage Same frequency

reference phase

1

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a servo

The control phase is usually supplied from complifier. =)

The speed. and torque of the rotor are controlled by

the phase difference between the control voltage, and the reference. phase voltage

Control phase.

Vactgo

челет

$$Um < 0°$$

High resistance.

соде

rofor

Reference. phase.

Fig Schematic diagram of ac servo mo for

⇒ The torque - speed characteristics for various **confool** are almost linear as shown in fig (11)

vo

наде

л

↑ Torque (t)

spendis

Speed ()

zigh Torque -speed characteristics

Applications

Date Page

Servo motors

are

widely used in redars,

Computers,

robots, machine tools, tracking and guidance systems,

process controllers etc.