Scientific Journal of Impact Factor(SJIF): 3.134

e-ISSN(O): 2348-4470
p-ISSN(P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 2,Issue 6, June -2015

MULTI SPEED INDUCTION MOTOR USING POLE AMPLITUDE MODULATION TECHNIQUE WITH VERY LOW CURRENT OUTPUT - ON MULTI SPEED AND ON HIGH HORSE POWER

KULDEEP MEHTA, KUNAL BHATT, SIDDHARTH NASARE, DENISHA MANEK

ABSTRACT: *The development of this motor will provide a new technique in single stator winding in Squirrel Cage Induction Motor. The Pole Amplitude Modulation (PAM) technique is extended version Of Dahlander winding. The use of this technique enables achievement of multi different speeds using one single winding in squirrel cage induction motor. This reduces the cost of motor and also increases the utilization factor of motor. Now a days variable frequency drives are used in market to achieve different speed in a single motor. It injects harmonics and thus it pollutes the input supply. While in PAM we can reduce this draw backs to a certain extent. When VFD is not used, two different motors are used to achieve two different speeds, but by PAM we can achieve multi speeds by a single motor. In PAM technique we used series star and parallel star connection or parallel star and series star connection which is term as constant torque method. So it is quite beneficial to use PAM over all other techniques for achieving multi speeds. Also the current fetching from mains on very high load is very low so it saves the energy most on very high Horse-Power (H.P.) which is best part of this.*

KEYWORDS: Pole amplitude modulation technique, multi speed motor, single layer winding in three phase I.M.

I. "INTRODUCTION"

The availability of a great variety of multi-speed combinations (relatively close together) gives the PAM motor a much wider range of application than that of conventional single- winding, two-speed motors where the ratio of one speed to the other must always be 2:1.(Dahlander connections). But by using the PAM technique it can be built with any number of speed ratios, such as 600/500, 750/600, 750/500, 500/428, 750/428, 230/150, 375/300, 1000/750 or 1500/1000 rpm, to name a few of the many possible combinations. Although it is basically a single-winding, multi-speed squirrel cage motor, the PAM motor features- many outstanding characteristic: It is versatile in application and efficient in operation, especially where less than peak load operation is desired .PAM motor does not have to be engineered with a 2:1 ratio for its two speeds.

II. "WORKING"

A three-phase alternating current in electric machine for alternative pole-number operation, having a symmetrical pole-amplitude modulation. Three-phase stator winding switched to provide the alternative pole-numbers, said pole-number switching being effected by including all coils of each phase-winding in a selected one of two phase-winding parts, said phase-winding parts being connected together alternatively in series and in parallel in order to provide said alternative pole-numbers, and the coils of the phase-windings being grouped to produce a modulation pattern waveform of approximately sinusoidal form with added third-harmonic modulation content, whereby the adjacent harmonic content of the mmf. waveform of the three-phase winding is less for both pole-numbers than for a modulation waveform of sinusoidal form without added third-harmonic modulation content. Connections in the stator winding is not same as all in three phase regular induction motor. They are connected in that way like for slower speed it will work as star connection and for higher speed it will work as a delta connection. Winding can be change by changing the connection, there will be one 6PDT (six pole double throw switch) is provided for changing connections. The PAM motor should be started on its low-speed winding to limit the inrush current. This prolongs motor life by keeping rotor and core temperatures to a minimum. Starting on the low speed is also more desirable for driven equipment considerations

III. "WHY POLE AMPLITUDE MODULATION (P.A.M.)?"

Especially in INDUCTION MOTOR (I.M.) the squirrel cage induction motor being the most widely spread. It however has the basic disadvantage of being inherently a constant speed machine, for the given frequency. Pole amplitude modulation (PAM) is one of the techniques to overcome the disadvantage of constant speed operation of induction motor. Now for different speed achieve we are using constant torque method it mean two different kind of winding one is parallel star and another one is series star. These two connections give 1000 rpm and 1500 rpm on 50 Hz and 4 pole

and 6 pole 36 coils using of mush winding with 7 coil pitch. So it will create alpha 6o degree to each coil and create proper torque to motor. So this is how PAM benefits.

IV. "BACKGROUND OF THE DEVELOPMENT"

The field of development is getting two different kinds of speeds using only one stator winding. Usually when you need two different speeds in squirrel cage induction motor then we have to use two different winding or two different motor. But using pole amplitude modulation we can achieve two different speeds in only single stator winding. When you use two different kind of winding connections in motor than at one speed only one coil is energized and another one is ideal in stator. So that gives low utilization factor of copper in winding. Rather than if we used PAM than we can energized whole the coil (winding) when motor is run on any speed. So it also save the cost of motor in case of use two different motor or in case of use two different winding and also save the copper also which is being use in winding. It saves the energy and gives high utilization factor. The main advantage of this motor is that you can achieve any kind of pole ratio by changing the connection. It mean you can get different kind of speed likewise in pole ratio 4/6pole, 6/8 , 8/10, 10/12, 4/12 so it will give you so many option to select your desire speed in only single stator winding.

V. "HOW CAN IT DIFFER FROM THE OTHER MOTOR?"

For example, There is only one winding is put in 36 slot it mean 36 slot winding gives only one speed like 1500 rpm. So now if someone wants another speed than has to be use another motor or else another winding. Also used of VFD only in two speed become too costly and also it has some other drawbacks which were discuss earlier. So now another choice is put two different winding again it will increase the cost. So how to face this challenge that we consume our cost and also get two different speeds. So PAM gives this kind of advantage to give us by changing the connection in single stator winding, we get two different speed. The use of copper is same as we used in single speed I.M. and also it overcome the drawback of the two different winding. Because when you use two different winding in motor at that time on one speed only one coil get energized and another will ideal so it shows that the use of copper winding is not 100 percentage. But this drawback is overcome by this winding connection. Initially the dimension of the machine was selected through a rigorous set of hand.

VI. "TESTING OF MULTI SPEED INDUCTION MOTOR"

- **Block rotor**
- **Megger test for Testing Induction motor**

Block rotor

Blocked rotor test is conducted on an induction motor. It is also known as short circuit test or locked rotor test or stalled torque test. From this test short circuit current at normal voltage, power factor on short circuit, total leakage reactance, starting torque of the motor can be found. The test is conducted at low voltage because if the applied voltage was normal voltage then the current flowing through the stator windings was high enough to overheat the winding and damage them. The blocked rotor torque test is not performed on a wound rotor motors because the starting torque can be varied as desired. However, blocked rotor current test is conducted on squirrel cage rotor motors.

Megger test

One of the best methods to test electrical insulation condition is a Megger test. It is well known as insulation resistance meter test. The Megger test is a method of testing making use of an Insulation resistance meter that will help to verify the condition of electrical insulation. This is certainly not a new test, and has been in use for a number of years. One of the reasons that it is still such a popular option is because it is non-destructive. The test does have a limit of between 500 and 1000 volts, so it may not always be able to detect some insulation punctures for finding defects and punctures in insulation of things like winding faults and deterioration, moisture present, dust settlement. This method of testing is used widely all over the winding.

RESULT OF MEGGER TEST, BLOCK ROTOR TEST, CURRENT AND POWER ON DIFFERENT V

Voltage (volt)	Current(amp)	Power(watt)	P.F
201.48	1.40	72.90	0.1491
250.82	1.75	89.57	0.1176
300.78	2.13	116.07	0.1045
350	2.52	148.31	0.097
375.25	2.74	168.85	0.0945
400.11	2.95	190.22	0.093
425.45	**3.1825**	213.51	0.091

TABLE 1

Voltage(volts)	Current(amps)	Power(watts)	P.F
200.6	0.73	84.58	0.3315
251.2	0.88	58.89	0.22
300.1	1.04	85.94	0.15
349.8	1.22	94.60	0.12
375.4	1.31	101.29	0.11
399.5	1.41	109.05	0.11
425.8	**1.51**	117.30	0.1051

TABLE 2

TABEL 1: Variable at no load at 1000 RPMTABLE 2: Variable at no load at 1500 RPM

Voltage	Current	Power	P.F
165	6.74	113.64	0.5894

TABLE 3

Voltage	Current	Power	P.F
193.65	7.99	1352.7	0.50

TABLE 4

TABLE 3 AND TABLE 4 shows the result of block rotor test.

AT 1000 rpm value of the current on 425 volt is only 3.1825 for 2.5 hp, which is quite noticeable. Also value of current in at 1500 rpm on 7.5 H.p is only 1.51 amps which shows that at the higher value of load it fetches the less amount of current form main so save the energy most. For both different rpm values the value of current in Block Rotor test is not exceed the 8 amps. The real experiments data shows that the less amount of current requirements on heavy load which is quite energy efficient.

COMPARISON OF TWO SPEED I.M AND SINGLE SPEED I.M.

NOTATIONS	TWO SPEED I.M	SINGLE SPEED I.M
OD,ID,L	210*135*190	210*135*130
POLE	4	4
R.P.M	1500	1500
TOTAL NUM. OF TURNS	138	168
FLUX	**0.46*10^6**	**0.034*10^6**
FLUX DENSITY	**8017.42**	**7773.12**
TOOTH DENSITY	14765.26	15227.029
Yoke density	15698.23	14239.20

TABLE 5

NOTATIONS	TWO SPEED I.M	SINGLE SPEED I.M
OD,ID,L	210*135*170	180*120*120
POLE	6	6
R.P.M	1000	1000
TOTAL NUM. OF TURNS	276	588
FLUX	***0.239*10^6***	***0.098*10^6***
FLUX DENSITY	***6013.07***	***3750***
TOOTH DENSITY	7382.63	6833.09
YOKE DENSITY	11777.38	6525.61

TABLE 6

Here, we can see that in table 5 for 4 pole in both case OD ID and L pole and speed is same but result is different. Total number of turns in stator winding for multi speed is lesser than the single speed I.M. also we can get a higher value of flux flux-density tooth-density and yoke-density. Also remark the table 6 in which for same data we can get the flux flux-density and yoke-density almost double. So by using this data can say that get the good result in multispeed rather than higher speed with minimum of cost and also a with good B-H magnetizing curve.

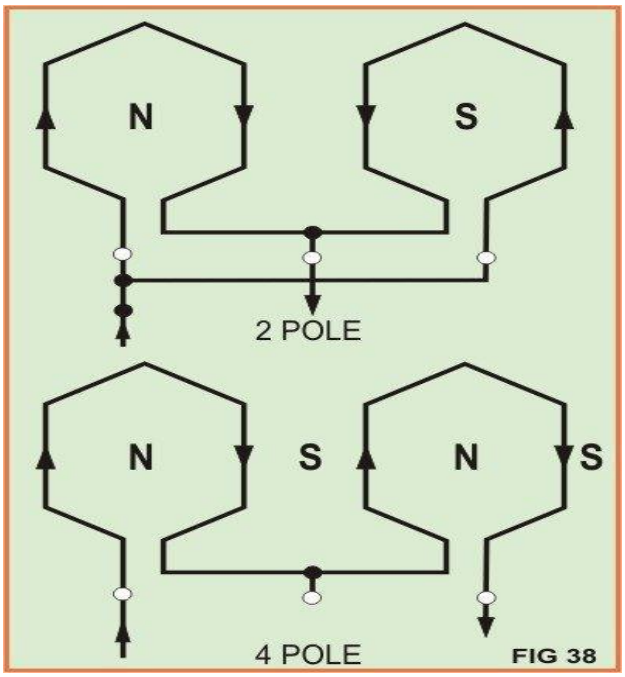


FIGURE 1

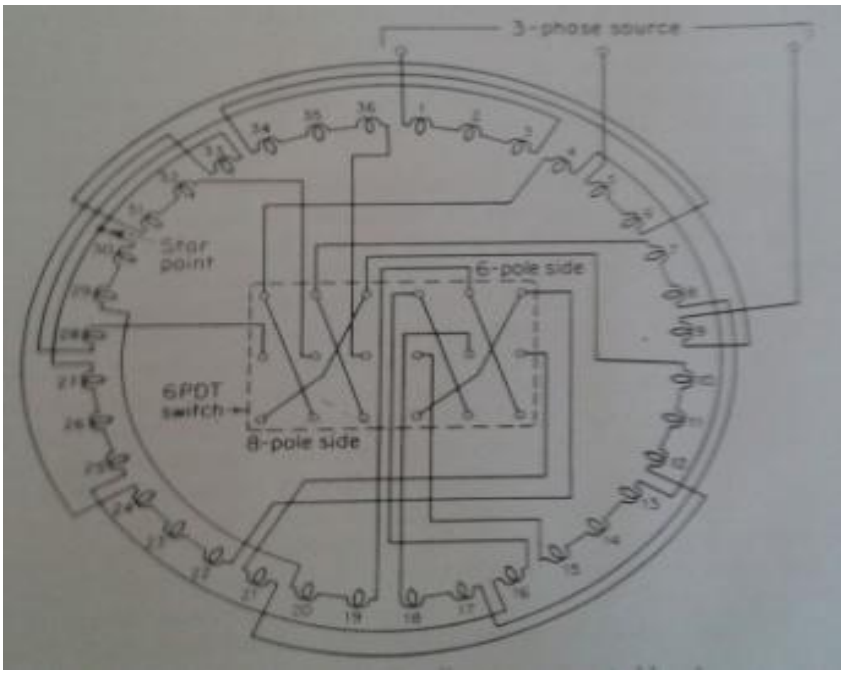
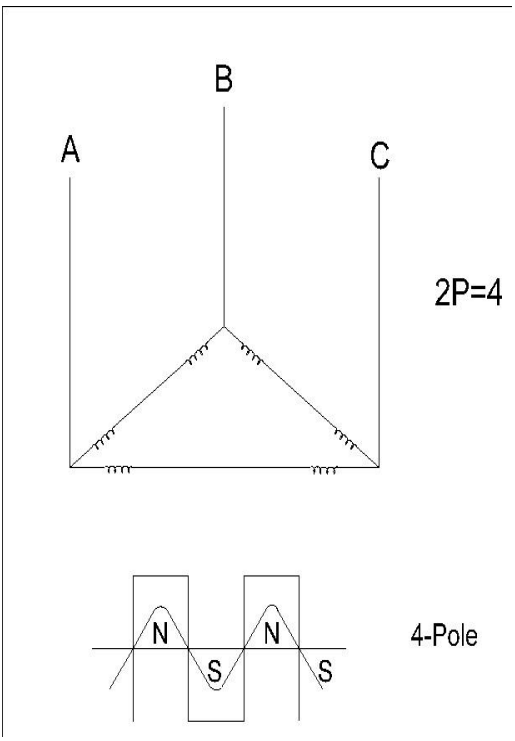
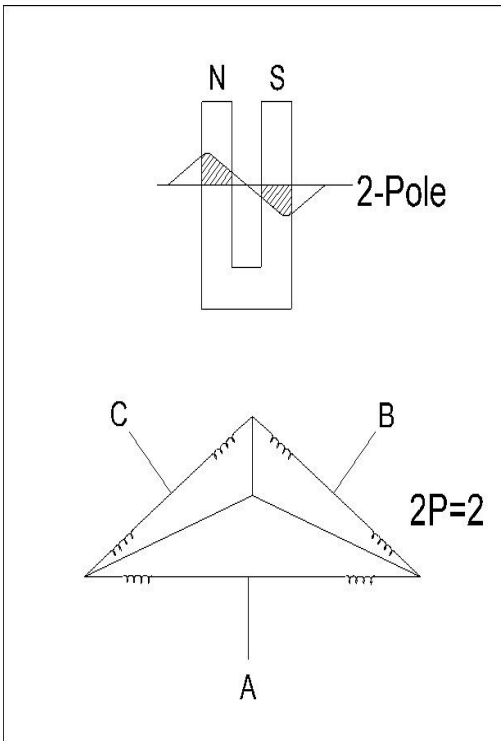


FIGURE 2





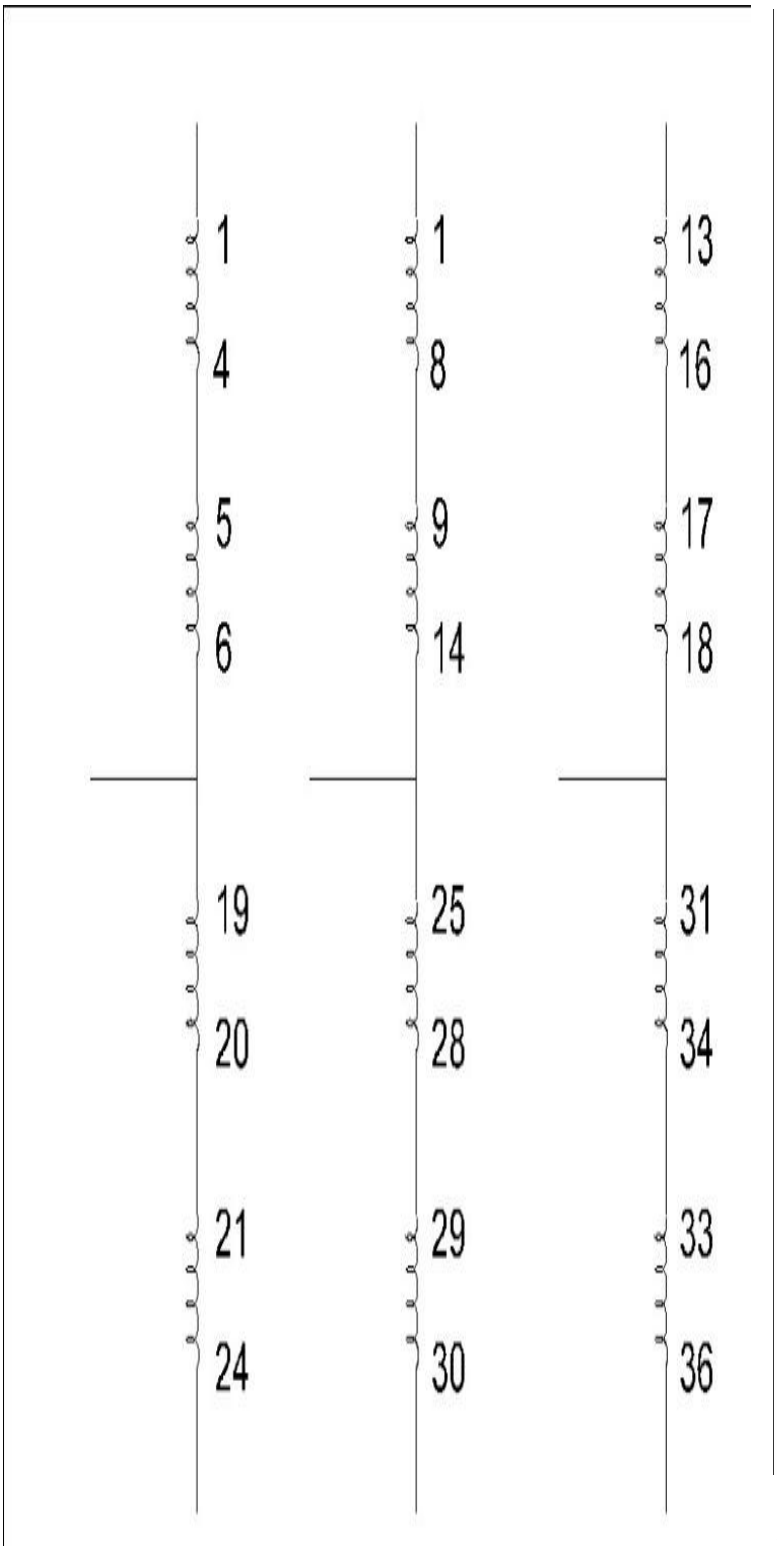


FIGURE 3 (B)

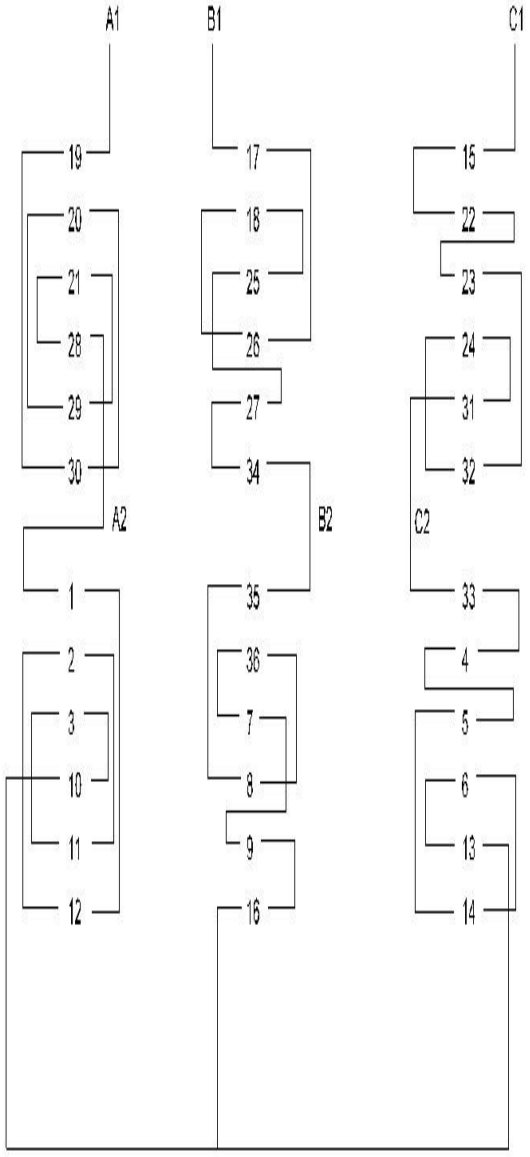
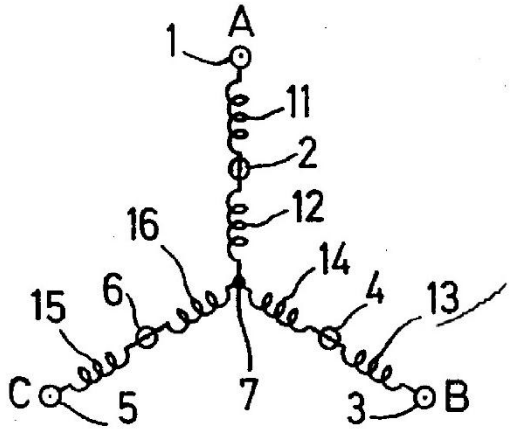


FIGURE 3 (A)

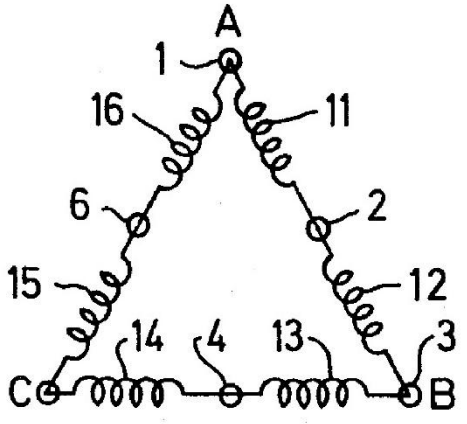
FIGURE 4

FIGURE 5



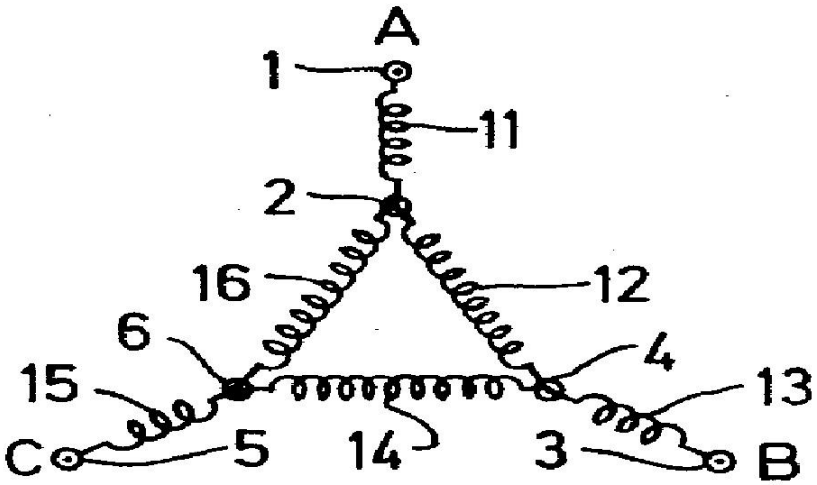
PARALLEL STAR/ SERIES STAR

FIGURE 6(A)



PARALLEL STAR / SERIES DELTA

FIGURE 6 (B)



PARALLEL (STAR/DELTA) /
SERIES -(STAR/DELTA)

FIGURE 6 (C)

VII. "FIGURE EXPLAIN"

FIGURE 1:- You can change the pole numbers by changing the connection in winding, in fig it shows that how 2 pole can convert into 4 pole. By using this technique of connections can get any pole ratio and runs motor on a different speed.

FIGURE 2:- 36 coils are interconnected with each other. For changing the connections 6PDT – six pole double throw switch is provided.by changing switch position pole can be change up to any ratio which is depend upon internal winding.

FIGURE 3:- Fig 3(a) shows that if supply gives the terminal A B C than it will create only two pole when in Fig 3(b) it shows that when supply is given to terminal A B C it will create four pole. This diagram is known as basic Dahlander winding.

FIGURE 4:- real circuit diagram for 4/6 pole for this experiment. It shows that the ending of one coil join with starting with another coil. This diagram is somehow modified in compare of old connection for getting the best result of current on heavy loads. Assume that there is 3 groups are generated in whole connection like A B C. short pitch winding is using over here rather than full pitch because it gives smooth operation and also resultant mmf should be good.

for 1st coil group ending of first coil is directly connected to starting of 4t coil , ending of 4th coil is connected to starting of 5th coil ending of 5th connected to starting of 6th coil and then one more supply is given over there.. Which is open when it works on 4 pole but for 6 pole supply is given over there on open terminals. So this is how you can change pole.

FIGURE 5:- A sample diagram of concentrated winding for four pole/six pole connections in 36 coil. This method is found by G.H Raw cliff, here just sample of pattern show. Somehow this winding connection are more depend on alpha angle and pitch coil.

FIGURE 6:- In fig 6(a) series star and in fig 6(b) series delta shown which is quite old and orthodox technique for I.M winding. In fig 6(c) new connection winding are shown that series (star/delta) and parallel (star/delta) so it's unique and can get maximum amount of different pole ratio.

VIII. "PAM MOTOR BENEFITS AND IT's APPLICATION"

- Power savings at reduced loads
- A practical and effective means of driving a load where a change of speed can provide operating efficiency.
- Initial investment costs are lower than those of a comparable two-speed, two-winding motor.
- As a single-winding machine, the PAM motor is lighter, smaller and more efficient than a two-winding motor of a comparable rating and application. Any pole ratio is possible.
- Inrush currents during starting are greatly reduced when low-speed starting is used.
- Using the PAM motor's low speed to start high inertia loads reduces rotor heating up to 40% and contributes to extended motor life. To run conveyor belts with different speeds, in blowers and driers
- A practical and effective means of driving a load where a change of speed can provide operating efficiency.
- As a single-winding machine, the PAM motor is lighter, smaller and more efficient than a two-winding motor of a comparable rating and application.
- Reduced wear and erosion on the driven equipment (and less noise) during operation at low speed.
- Speeds are changed electronically, not mechanically, which means additional apparatus between the motor and the driven equipment is not required; there is no slip energy loss from speed adjusting couplings.

IX. "Claims"

Up till now few patent had already been register for the same aim but we found all of them not succeed in giving a proper output. As all the patents registered had a few issue with its stack length and all of them fail due to saturation occurred in the motor. But we design a motor with a proper stack length which overcomes such an issue of motor. We achieved the same flux with a new stack length which not only satisfy the economical factor but also stops saturation occurring in the motor and also get a minimum amount of current on higher load which makes different from other and first time try series star and parallel start together for this design.

X. "Conclusion"

By the development of two speed motor in a single stator winding world will not only get a dual speed in a single motor but also any pole ratio in a winding of motor and thus any two speed can be achieved. This motor overcomes the drawback of simple squirrel cage induction motor such as high starting current and problem of poor power factor. It also reduces the problems such as production of harmonic, violation of input supply and heating problem of motor. So it is quite economical to use this motor over the use of single speed motor and over the use of variable frequency drive for achieving speed change in a single motor.

REFERENCES:

BOOK'S BY:

[1] ELECTRICAL MACHINE DIRECT AND ALTERNATING CURRENT BY SISKIND 2nd EDITION
[2] THEORY OF ELECTROMAGNET BY STEVENSON 3RD EDISION USED FOR CALCULATION OF MAGNETICS
[3] ELETRICAL MOTOR BY PHILIPL ALGER 2nd EDITION USED FOR STUDY OF I.M.
[4] USED FOR I.M BEHVIOUR ON DIFFERENT SPEED AND MATRIAL USED IN I.M.
[5] ELETRICAL MOTOR REPAIR BY ROBERT ROSENBERG USED FOR FINDING THE MMF AND HOW TO DESIGN A CIRCUIT
[6] THEORY AND PERFORMANCE OF ELECTRICAL MACHINE BY J.B.GUPTA USED FOR DIFFERENT TEST ON MOTOR
[7] ELECTRICAL MACHINES DESIGN BY A.K.SAWHNEY USED FOR IMPROVE DESIGN OF I.M AND CONNECTIONS OF WINIDNGS
[8] STUDY PATENT OF G.H. RWACLIFF US4260923 A PUBLISH IN 1981

