Overheat Protection of Induction Motor

Shweta yadav[1], Shikha Prakash[2]

[1]*Department of Electrical Engineering*
[2]*Department of Electronics and Telecommunication Engineering*

Abstract: *The paper allows us to protect induction motor from overheating. The protection system works in a two stages. In first stage, if the temperature of motor increases than preset value, fan will get automatically started, providing cooling to the system to some extent. In second stage as temperature increases more than the second specified temperature the whole system gets tripped. After cooling of motor, it will restart automatically. The protection arrangement consist of main IC 7107,sensing IC 741 and switching IC 4017.A temperature detector PT 100 detects the temperature of motor and converts the temperature variation into analog voltage pulse[pulsating voltage] form and is fed to sensing IC where it is converted to digital and is directly fed to main IC. The maximum bearable temperature of motor shown in a FND is set by means of SPDT switch as the temperature exceeds the preset value, processing or main IC generate a control signal and directly fed to switching IC and hence recommended switching action is performed providing cooling to the system and hence system get prevented from overheating and after cooling the motor will restart automatically.*

Keywords: *Induction motor, microcontroller, overheating protection, relay*

I. INTRODUCTON

AC induction motors are likely to continue to be reliable sources of fixed speed rotating power. Their successful use in variable speed application is increasing now these days. In order to avoid unsuccessful application especially due to overheating causing the motor life to decrease and other serious damages to the motor such as insulation failure, burning of motor winding and hence continuous production based industries bears various losses in production, therefore the cooling concept is more preferable as it reduces the losses in production and maintaining the continuity in production and hence increasing the efficiency of the machine. Reliable assessment has been done widely to protect the squirrel cage induction motors, here the assessment was done by three methods which were fault tree analysis, event tree analysis, failure mode effect and criticality analysis [1]. Protective delay could be used for thermal modeling to calculate the changes in temperature in real time. There are some harmonics present in this designed system which results in the losses in the motors, so to use the motors in the distorted condition motor derating is required and thus an analysis is done using these factors [2]. The three phase induction motors are also required to be protected from the over-heating, there are variety of procedures to protect from it [3].Classical method has been designed to protect the induction motors from several problems which are single phasing, over current etc [4][5].Microcontroller based system to control the overloading of three phase induction motor has been used[6]. It will detect and indicate the level of voltage along with the faults present in the induction motors [7] which will be beneficial to the people using these motors. It is based on cooling concept deals with the method of protection for preventing the overheating of ac induction motor.

This is an instrumentation based controller. By this method a company holder can convert the thermostat controlling to thermocouple controlling with display. Earlier in this method controlling is done by manual method. In this method a great a great drawback is that in accuracy management. By this method with the help of digital display one can see the temperature which is occurred in motor and one can adjust the temperature under which the motor operate satisfactorily without any problem. If the temperature rises above the specified temperature than the cooling fan is ON automatically for reducing the temperature of motor. After that also if the temperature rise is not controlled by fan and temperature rises continuously than the tripping system disconnect both the motor and fan from the supply. The future aspect of this method is that it can work efficiently in any, which has to be controlled by temperature. Second merit is that it can read the minute variation in the temperature of the temperature. The relay gets operated and can operate the instrument very easily. Here Hall Effect transducers were used to sense the line currents in three phase induction motors, a curve is drawn between current verses time and hence it was observed that the model follows the characteristics [8]. The methodology is discussed in section 2. The working principle is illustrated in section 3. The circuit diagram is explained in section 4.

II. METHODOLOGY

Earlier continuous operation of induction motor in continuous production based industries leads to various problems, in which a major problem of overheating comes into overview. Overheating involves the process of energy transfer in electro-mechanical energy conversion; in the case of rotating machines involves currents in the conductors, and flux in the ferromagnetic parts. Thus there are copper losses in windings and core losses in the ferromagnetic cores. In addition losses occur in end plates and covers on account of leakage flux. The losses appear as heat and therefore the temperature of every affected parts of machine rises above the ambient medium which is normally surrounding air. The heated parts of an electrical machine dissipate heat into the surrounding by conduction and convection assisted by radiation.

In order to avoid such abnormality condition i.e. overheating in contingencies, cooling concept was introduced, to dissipate such heat generated. In cooling concept, the cooling system or the ventilating system tends to take away the heat produced through the presence of ambient air. The temperature rise in a machine can be kept within safe limits by properly designing its cooling system. A higher output can be taken from a given machine frame by having a good cooling system and proper insulating materials.

Earlier fan was used as a remedy, to overcome this abnormal condition. As the maximum bearable temperature of motor exceeds beyond its permissible limit, then overheating arises, and to overcome this, fan started and provide cooling through air to the system to some extent. And as this motor gets cooled, it will restart automatically.

III. WORKING PRINCIPLE

When supply is given to the system, through step-down transformer 230V ac is converted into 120V ac. As it passes through bridge rectifier 12V ac is converted into 12V dc, pulsating in nature. With the help of capacitor, stiff dc o/p is obtained. Stiffed dc o/p is then fed into 7805 voltage regulator, gives 5V dc as a o/p and supplied simultaneously into their integrated circuits i.e. main IC, sensing IC and switching IC.

And hence three modes of operation come into action i.e.

1. Sensing mode
2. Operating mode
3. Switching mode

1. Sensing mode

As motor is continuously operated, temperature goes on increasing. Since supply is directly fed into RTD sensor through switch. As it has the property of converting temperature variation into analog voltage pulse and hence the converted analog voltage pulse is directly fed into sensing IC. And hence operation goes into sensing mode. As sensing IC embodies A/D converter, analog voltage pulse converted into digital, directly fed into main IC.

2. Operating mode

As main IC also embodies 3 D/A converter, 1 sole comparator and 3 oscillators. Digital I/P goes to main IC and is compared through sole comparator with preset value. The o/p is fed to 3 D/A converter where it directly converted into α- numeric form and displays it through FND. This is said to be operating mode. As temperature of motor reaches to specified (preset value) temperature, fan will get automatically start. Here switching mode comes into picture.

3. Switching mode

When the temperature of motor get increases than preset value, a control signal generate in main IC, which goes to switching IC. It goes to switching npn transistor as I/P. As the signal goes to base of npn transistor, it gets biased and its operation shifts to saturation region from cut-off region, relay operate and hence fans start automatically.

As temperature increases gradually and further it reaches to second prescribed temperature of motor, second switching transistor comes into action, transistor biased, operation shifts again from cut-off region to saturation and relay operate and hence the whole system get tripped. And consequently the system can be protected from overheating. And after cooling the motor will get automatically restarted.

IV. CIRCUIT DESCRIPTION

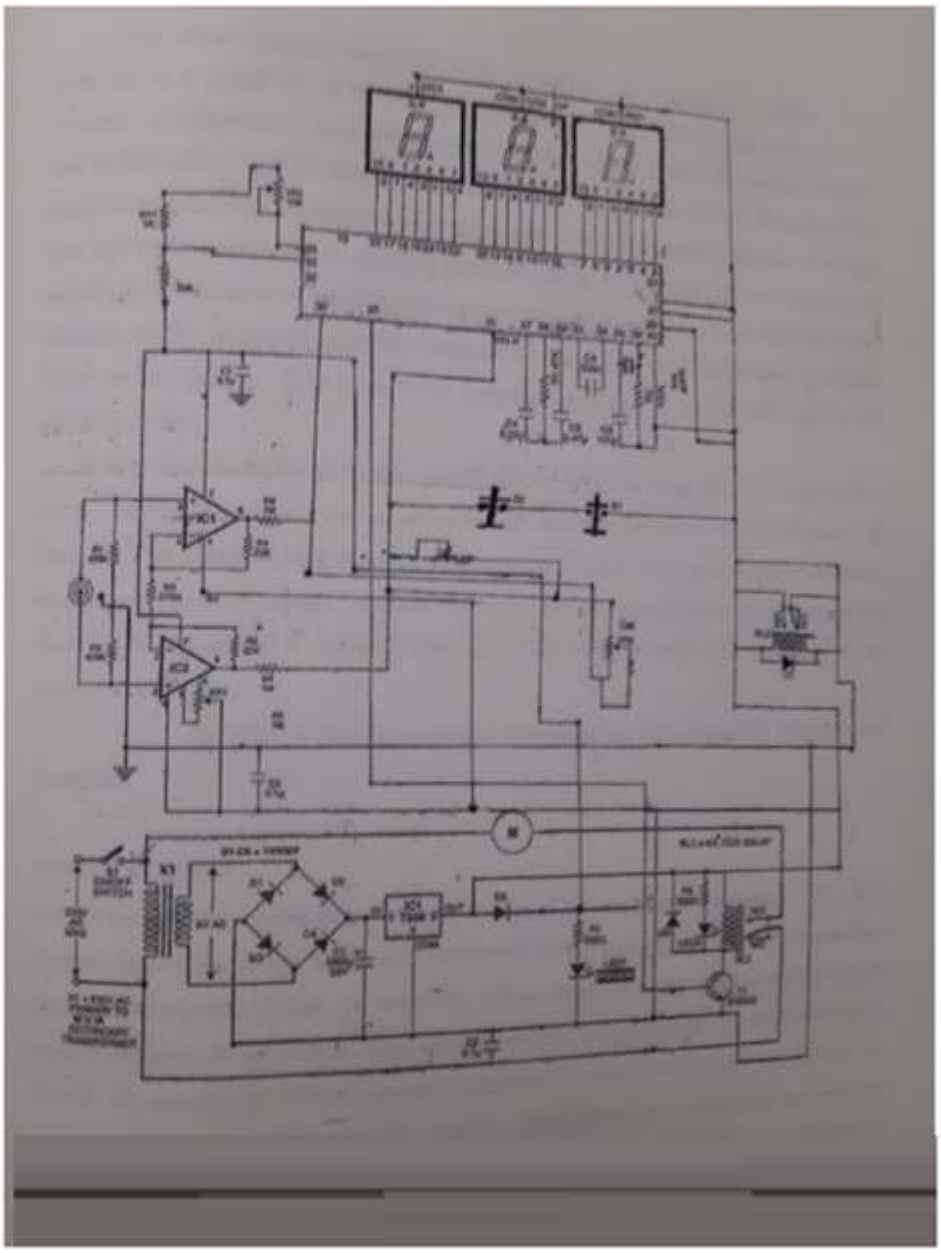

Fig.1: Circuit Diagram

The circuit diagram consists of FND operation as shown in fig.1. Its number is LT542R; it is connected to a digital IC of 40 pins. Its number is L7107. This IC has four A to D converter, a comparator, an oscillator, preamplifier, amplifier etc. The sensor which is used in this method is RTD sensor that is Resistance Temperature Driver. With this RTD temperature according to variation of temperature this RTD sensors converts to voltage form and make a variation by applying positive voltage to it. The IC741 is connected to support the comparator for making the sensitive sensing of temperature so that the minute variation can be read through this temperature controller. This temperature controller works on two modes. First mode is the temperature display mode and the other is the adjusting mode.

In adjusting mode the prescribed mode can be adjusted by pushing a trigger button and by varying the positive and negative voltage which is fed to the increment of the main IC. This variation of the voltage becomes constant at a constant voltage and when temperature rises the voltage variation rises up to that extent and gives a pulse extraction from pin no. 23 of the IC which is then amplified with the help of a transistor for the operation of a relay.

The relay is then connected to the operating instruments for ON and OFF operation. Here three types of power supply is used for continuous operation. +12volt is used to operate the relays which are connected in this system and +5volt is used as a supply for integrated circuit. At first 230volt ac supply is step down with the help of smps transformer to ac 12volt. Then with the help of bridge rectifier it converted into dc 12volt. A capacitor of 1000μF 25 volt is connected in the circuit to store the current and to diminish the ripple generated. The regulator 7805 which is connected in the circuit to produce +5volt. This regulator is connected to the controller IC and it is connected to the RTD sensor for analyzing the variation of temperature.

V. CONCLUSIONS

Ac induction motors are likely to continue to be reliable sources of fixed speed rotating power. Their successful use in variable speed application is increasing. In order to avoid unsuccessful application especially due to overheating. This cooling concept is more preferable.

But as a matter of fact the side effect of overheating of a machine can be prevented through some measures like implementing cooling concept and preventing the causes of overheating due to which continuous production based industries can maintain its production continually. Hence we conclude that the ill effect of overheating can be prevented but its occurrence cannot be stopped.

REFERENCES

[1]. Chafai M., Refoufi L., Bentarzi, H. (2008). Reliability assessment and improvement of large power induction motor winding insulation protection system using predictive analysis. WSEAS Transactions on Circuits and Systems, 7(4), 184-193.

[2]. Khederzadeh, M., Thermal Overload Protection of Induction Motors Under Waveform Distortion. In Proceedings of the 41st International Universities Power Engineering Conference (Vol. 3, pp. 866-870). IEEE, 2006.

[3]. Nilesh M. Wankhade , Chaitalee P. Bhise , Ananta A. Nare ,Manoj R. Thakare, Protection Of Three Phase Induction Motor From Single Phasing And overheating and overspeeding, International Journal of Advance Engineering and Research Development, Volume 5, Special Issue 06, April-2018.

[4]. Priya V. Kale, Amit M. Kale, Nikhil R. Kamdi, Ankita A. Yeotikar, Protection Of Induction Motor Using Classical Method, International Research Journal of Engineering and Technology , Vol. 04 , Issue 01, January -2017

[5]. Avadhoot. S. Thube, Pritam. B. Chavan , Tatyasaheb. Y. Khamgal , Kedarnath. G. Khaire , Deepika B. Srivastava, Three Phase Induction Motor Protection System, International Journal for Research in Applied Science & Engineering Technology , Volume 6 Issue 2, February 2018.

[6]. Dushyant Patil , Siddharth Divekar , Ajit Kumar, Protection of 3 Phase Induction Motor using Microcontroller, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 7, Issue 4, April 2018.

[7]. Pratik K. Hirapara, Keshu L. Divraniya, Bharat S. Gadhavi ,Ketan M. Solanki, Fault Detection, Indication & Protection of Induction Motor by Several Modified Techniques,International Journal of Science Technology and Engineering , Volume 3 ,Issue 09, March 2017.

[8]. K.Pandurangavittal, D.B. Fakruddin,I.Raghavendra Rao, K.Parthasarathy, Microcontroller Based Three-Phase Induction Motor Protection Relay With Operator Selectable Thermal It Curve Feature, Electric Machines & Power Systems, pp. 13-26, 1998.