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Comparative Study of Different Types of Voltage Stabilization Schemes

Ranu Kumar[1] and Vijayendra Kumar[2]
[1]B.E (Hons.) 4th year in Electrical & Electronics Engineering, Asia Pacific Institute of Information Technology (APIIT) SD India, Haryana, India
Email: pt1285514@apiit.edu.in
[2]Associate Professor, Department of Electrical & Electronics, Asia Pacific Institute of Information Technology (APIIT) SD India, Haryana, India
Email: vijayendra@apiit.edu.in

***Abstract*—This paper is a study of the electrical device that can be able to sort out the problems of power fluctuation and improve the power quality by using servo mechanisms and comparison between relay and servo type voltage stabilizer. The servo voltage controlled stabilizers can be used in home as well as industries for stability and better voltage regulation and protects it from electrical hazard. The Indian power sector is one of the most diversified in the world. The demand for electricity in the country is growing at a rapid rate. The Indian power sector faces the problem in providing the stable power supply, and it creates the gap between the supply of power and its demand. This may cause heavy financial losses and also losses of industrial equipment. So, to obtain the stability and to overcome from power fluctuation, servo voltage stabilizer is required to be installed. Need of servo voltage stabilizer is increasing with the rise of demand of electrical and electronics devices in the market. This paper consist types of electrical hazard occurs in the industry, effects of this electrical hazard, advantages and applications of servo voltage stabilizer.**

***Index Terms*— Power fluctuation, Servo voltage controlled stabilizer, Equipment, Electrical and Electronic device, Servomechanism, Industries, Electrical hazard.**

I. INTRODUCTION

Based on the study of the power sector scenario of India, there is a huge demand for power in some Indian states due to growing of rapid urbanization and industrialization and the total installed capacity will be around 288,005 MW (Ministry of power, 2016). Wherever, demand is very much higher than supply that results in deficit, poor reliability. There is a need of continuous stable supply of AC power for the entire sophisticated electrical and electronic device installed in the industry. According to the scenario of electricity, voltage fluctuation is common in any electrical supply system. Constant supply of AC power is the backbone of any sophisticated electronic system that works efficiently and smoothly. If the actual voltage is lesser than rated voltage then it may lead to Under-voltage that reduces the efficiency of the electronics equipment and also it can force the system to shut down, and if the voltage gets high then it may lead to over-voltage that effects the machine and decreases the life of electrical and electronics machine.. The main factors of voltage

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fluctuation are the continuous variation of loads and extension of power lines. It will affect the working of equipments and it also cause the accident with operating person of the equipment or machine.
Servo voltage controlled stabilizers will help to overcome from all the above problems and it maintains a constant level of voltage irrespective with the power fluctuation in the power system.

II. Problem Context

For any electronic and electrical system, the requirement of power is regular and need of constant voltage as per rated value of current and voltage for each device. Under-voltage generally reduces efficiency, whereas over-voltage shortens the life. Also a very low voltage can force the system to shut down (Pyone, 2009).The problem of the maintenance of constant voltage covers an extremely large field, from the control of the bus bar voltage of a power station to the supply of constant voltage to small electronic instruments. According to the nature of electricity, voltage fluctuation is common in any electrical supply system. Continuous variation of loads and extension of power lines are the main factors which contribute to the above problem.

III. Electrical Hazards

All electrical and electronics equipment is designed with specified range of input voltages that can be withstand. However if the actual power supply for the equipment is higher than the required, the equipment will consume more power and causes several electrical hazard. A 230V device operating at 240Volts will consume 9% more power, equipment life is reduced by up to 45%. (Claude Lyons, 2007). There are four common types of electrical hazards, they are:

- Surges
- Spike
- Line noise
- Power failure

Steps taken to overcome this electric hazarad:

Voltage stabilizer is required to overcome from the problem of power fluctuation and prevent from electric hazard. There are various types of voltage stabilizer available like relay based, thyristor voltage regulator, servo type voltage stabilizer that helps to stabilize and regulate the voltage as per required for the electric and electronic appliances.

IV. Servo Voltage Stabilizer

Servo stabilizer is a voltage stabilization device, that give stable current (AC) and regulated output voltage where the input power supply voltage changes any time i.e. power fluctuation. It will prevent all the equipments from the different range of voltage either high and low voltage problems. It increases the life of equipments and increases the productivity of machineries and reduces wastage and damage of raw materials by providing stable electric supply. The servo voltage stabilizer consist servo motor unit used to do the voltage correction by servo mechanism concept. As we know servo motor is used because we can easily operate this motor as per the instruction. It can be stop or start at any time. It is not continuously movable motor like DC Motor. We cannot stop the DC motor speed. But servo motor can be controllable at any angle. This type of stabilizer assures stable output power supply, protection from low voltage, high voltage, overload and short circuit.
Figure1 is showing the block diagram of servo voltage controlled stabilizer representing the closed loop path of control system and the step by step procedure to follow. Mainly this block diagram shows the functionality that means how does it works.

V. Comparison In The Working Of Servo Voltage Stabilizer With Relay Type Voltage Stabilizer

Here there is a comparative study on servo type voltage stabilizer and relay based stabilizer which is shown in table I.

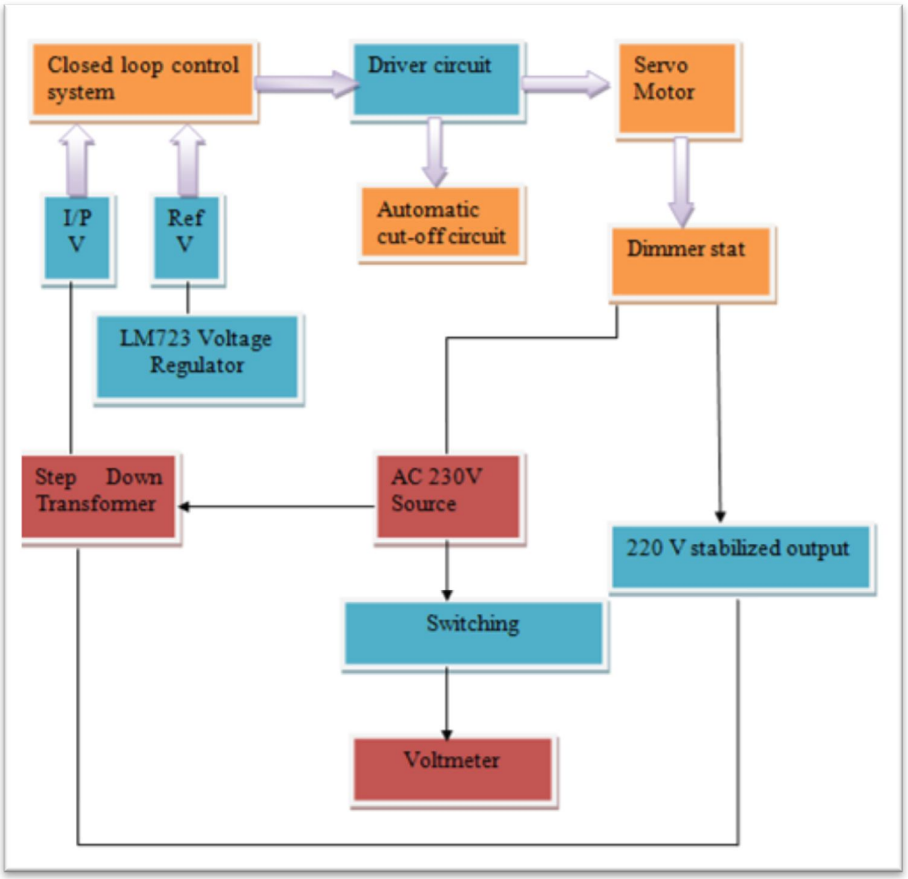

Figure 1. Block diagram of servo voltage stabilizer

TABLE I. COMPARISON BETWEEN SERVO AND RELAY TYPE VOLTAGE STABILIZER

Servo type voltage stabilizer	Relay type voltage stabilizer
• In this servo motor is used for controlling unit of voltage level • Servo motor is good step size resolution for correction of voltage. • It will give balanced output with may be ±1% error. • It is available for high rating more than 1 KVA. • This stabilizer can be used in the industries as well as home. • Cost of servo motor is more than relay. • Level of protection is high. • This stabilizer is used in the communication line.	• In this relay is used for controlling the voltage level. • Relay is not having better size resolution ability. • It will not give stabilized output with accuracy. • It is for low rating. • This stabilizer can be used in the home. • Cost of relay is lesser than servo motor. • Level of protection is low as compared to servo type. • This Stabilizer is used in home or small scale purpose.

VI. ADVANTAGES AND APPLICATIONS OF SERVO VOLTAGE STABILIZER

The servo voltage stabilizer has following advantages:

- Lesser distortion in the output waveform:

Since the number of relays is less as compared to other stabilizers, the time lag due to switching is less compared to others. Also the variac continuously regulates the output voltage without dropping the connection. Hence the distortion in the output is reduced considerably.

- Suitable for large loads:

Servo voltage stabilizer is best suited for large loads at the output. This is because servo voltage stabilizer has large power and current handling capacities as compared to other type of stabilizer.

The applications of servo voltage stabilizer are as follow:

The servo voltage controlled stabilizer can be used at the various places where heavy machines, electronics devices, high power electrical and electronics instrument have been installed the various applications are:

- Industries
- Mall and commercial complex
- Residence and offices.
- Power plant
- Government organizations
- Tele Communication system.
- Control Room
- R & D Institutions
- C.N.C Machine
- Offset printing machine

VII. Proposed Method

Two different models of voltage stabilizer has been designed by taking two different voltage control unit named as

A. Relay Type voltage stabilizer

Relay type voltage stabilizer is designed in proteus for comparative study between relay type voltage stabilizer and servo type voltage stabilizer which one is better as per step size resolution of voltage. So the result after simulating the circuit of relay type stabilizer is shown below:

Case 1: If the input voltage is low that is 204 V then the output voltage will be 220 V

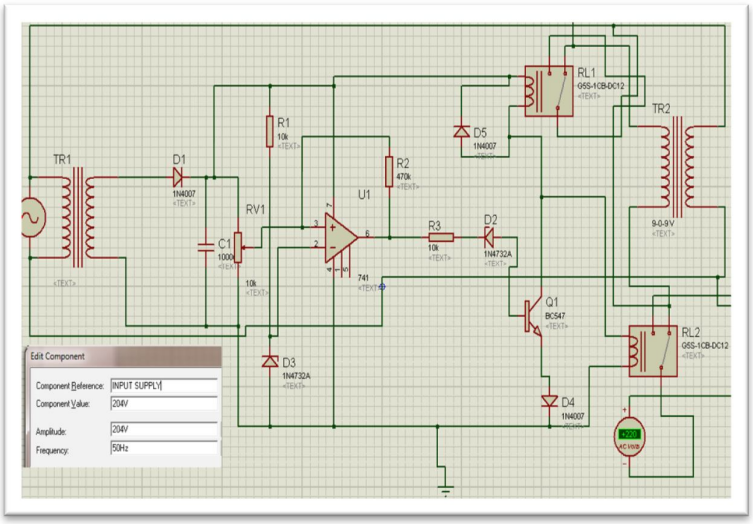

Figure 2. Circuit diagram of relay type voltage stabilizer

B. Servo motor unit

After implementing the circuit on proteus of different unit testing has been done and the results of testing are shown below:

Case 1: When the input voltage i.e. supply voltage will be low then the output of the voltage stabilizer will be 220 V. This voltage is regulated by the servo motor as the step size resolution of servo motor is very good. It can add or subtract the high and low voltage up to 1 volt and achieved the constant voltage by servo mechanism. Servo motor will rotate in the direction of anti clockwise and adjust the voltage. Here Led D2 represents the low voltage at input terminal and it will glow whenever the input voltage is low.

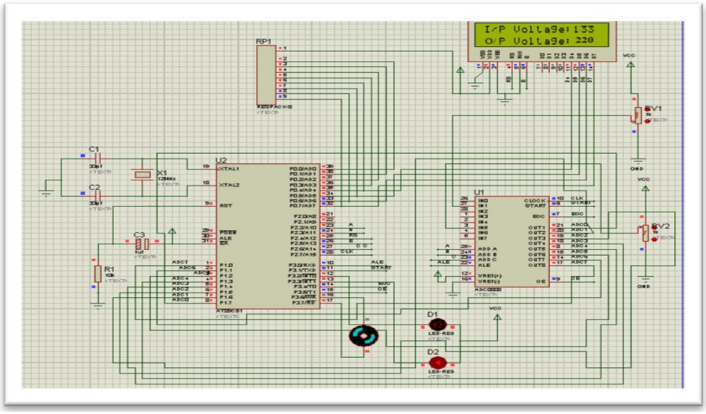

Figure 3. Servo motor control unit

VIII. Conclusion and Future Enhancement

By designing the relay type as well as servo voltage type stabilizer, the efficiency of servo type is improved. Step size resolution of servo motor is good as compared to relay type voltage stabilizer. For good voltage regulation number of relay is more required but in servo motor it's required to use only single unit to resolve the problem of voltage regulation, so servo type voltage stabilizer is better replacement than relay type for any purpose anywhere. A voltage stabilizer is an electrical appliance that can be used to provide constant voltage current to all the electrical and electronics appliances like refrigerators, and power supply at home, and protect it from damage and give long running life. Servo voltage stabilizer is good at a place where large loads have been installed at the output terminal because servo voltage stabilizer is having large power and current handling capacities as compared to other type of stabilizers and its efficiency and voltage regulation and step size resolution of voltage is better.

Fuzzy logic controller may be designed for servo voltage controlled stabilizer in matlab by following the several steps

Step 1: Defining the number of input and output variable in Fuzzy inference system editor

Step 2: Defining the number of sets as by defining the number of membership function as shown in figure below:

Step 3: Defining the rules for all the membership

Step 4: Implementation of fuzzy logic approach in matlab/simulink by designing the servo voltage stabilizer In Matlab

References

[1] Belotti,S. (2015). Ac servo-mechanical voltage stabilizer with electronic control. *belotti.it.* pp.1-2.

[2] Hoque, M. (2014). Design, implementation and performance study of programmable automatic voltage regulator. *Journal of Electrical Systems*. Vol.10. (4). pp. 472- 483.

[3] Laubwald, E. (2015). Servo control system1: DC servomechanisms. *Control systems principles.co.uk.* pp. 1-7.

[4] Mangla, V., Sharma, P. & Kapoor, S. (2015). Servomechanism and its uses. *International Journal of Innovative Research in Technology*. Vol.1. (12). pp. 1067-1069.
[5] Martin, M. (2015). Static voltage stabilizer- Comparison chart between conventional stabilizers and Differential power mode Static voltage stabilizer. pp. 14-15.
[6] Patchett, G. (2010). Voltage stabilizers: Their principle and design. *IEEE Xplore*. Vol.17. pp. 43-49.
[7] Paul, B. (3rd ed.). (2014). *Industrial Electronics and Control Including Programmable Logic Controller*. New Delhi: PHI Learning.
[8] Ponnle, A. (2015). Performance of domestic AC voltage stabilizers in meeting low voltage problems in Nigeria: A case study of 12 Different brands. *International Journal of Engineering and Technology*. Vol.5. (6). pp. 358-367.
[9] Rahman, A. & Lawama, A. (2009). The stabilization of ac voltage: The need for stabilization, its special feature, some design aspects. *International Journal of Recent Trends in Engineering*. Vol.2. (5). pp. 249-253.
[10] Venkatesh, S. & Muthiah, K. (2011). Power Fluctuations- usage of servo voltage stabilizers in industries. *International Journal of Applied Engineering Research*. Vol.2. (1). pp. 283-289.
[11] Wenham, D. (2010). The design of direct voltage and current stabilizers using semiconductor devices. *IEEEXplore*.Vol.106.(18).pp.1384-1389.