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Design of a Low Cost Automatic Servo Controlled Stabilizer with Quick Response to Voltage Variations

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ABSTRACT: This research aims in designing the low cost and the cheapest power conditioning servo controlled automatic voltage stabilizer. The servo controlled stabilizer is widely used in the industrial application to obtain the stable voltage to the electrical equipments. This stabilizer will maintain, monitor, and correct the desired output voltage by adding or subtracting the required amount of voltage to/from the input voltage. This stabilizer will constantly monitor the output voltage and controls the variation in the voltage by movements of a motor. We design the servo controlled automatic voltage stabilizer depending upon the load of the customer. The variable supply voltage conditions are controlled by use of servo stabilizer. Servo controlled automatic voltage stabilizer can controlled all types of loads viz, inductive, resistive, and capacitive loads. Servo stabilizers can be for balanced or for unbalanced input voltages. There are various stabilizer available from 1KVA 1PH to 250KVA 1PH and 3KVA 3PH to 2000KVA 3PH.3PH. The care should be taken that while ordering the servo controlled stabilizer its capacity should be more than twenty percent more than the maximum load.

KEYWORDS: Servo Controlled Stabilizer, Servo Controlled Sensing Card (PCB), Variable Transformer (Variac), Comparator Circuit, Autotransformer.

I. INTRODUCTION

The “servo” is a generic term from Latin Word” servos”-slave used for an automatic control system. This means the mechanism that adjusts itself through feedback during the continued operation of control system. Excessive voltage variations are highly dangerous to the electrical and electronics equipments .In the twenty four hours process plant small variation in the input voltage can cause the heavy loss. Due to this fluctuation heavy financial losses occur. Many sophisticated equipments such as electro-medical, communication equipment, computer and process controlled can damage due to this voltage variation. Servo control is a closed loop control system for electric motor which has a feedback circuit which changes the drive power going to motor according the signal from sensor and the control input signals. The motor used in the servo control is a DC motor although AC servo control motor is also possible. servo control is usable to produce by assembling information collected from other sources .They may involve the control of either velocity or position, high resolution and accuracy, velocity either very low or very high and also can demand high torque in a small package size. Disk drives are the example of the servo system. Because it contains a secured servo system that they spin at desired constant speed by speeding up or slowing down as necessary to keep that desired speed or by measuring their current rotation. Because of the additional component such as feedback devices causes the weakness to the closed loop approach which results to the initial cost and complexity of the control system.

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II. LITERATURE SURVEY

A recent survey indicates that the power quality issues are 50% due to the grounding, neutral to ground voltages, ground current or other ground associated issues and also due to the use of non-linear loads, power-electronics devices and also the unbalanced in the power system. The power quality issue are due to the electronic system failure, automatically system stop for no reasons, failure of equipment during thunderstorm, mis-operation of the piece of the equipment, trip of circuit breaker without overloaded. The use of the dynamic loads causes various problems usually by fluctuation, oscillatory transient, harmonics resonance, voltage or current variations such as voltage dips, voltage variation, interruption swells, notching, noise, distortion, interharmonics, dropout, flicker, voltage fluctuation, over voltage, under voltage, non-linear load, THD, triplets, dirty power etc. The issue of electric power quality are necessary due to the longer interruption operation of a equipment, use of new equipment, use of the new equipment which are more sensitive to power quality variation, the use of a new power quality equipments such as switched mode power supplies and variable speed drops has brought various disturbance into the power supply system.

III. MOTIVATION

Electrical energy has become a basic necessity for our present living conditions. The electrical or electronics instruments such as computer, electro-medical equipments, communication systems and equipments used in many small and large scale industries. The small variation of the voltage can cause the large disturbance to the life and property of the human being. The instrument which is very sensitive to this voltage fluctuation can damage the instrument which leads to the financial loss. The large variation in the voltage can be highly dangerous. So, to get rid of this we design a servo stabilizer which will stabilize this output voltage by variations in the input voltage by the movement of motor. This servo stabilizer will provide the protection against the more sophisticated equipment connected in the power system. The servo stabilizer will maintain, monitor or correct the voltage by adding or subtracting the required amount of voltage to/from the input voltage to get the specified output.

IV. PROBLEM DEFINITION

The servo controlled voltage stabilizer is designed and manufactured as per specification by the skilled engineer. But from the provision of Indian Electricity Act it is required that the voltage should not drop or rise more than four percent. It is reliable product for stable supply. As the load increases which is connected to the distribution transformer, the voltage starts to fluctuate and it became very difficult to the operator to maintain the stable voltage at the output within the updated value. So, because of this fluctuation it became necessary to use servo controlled voltage stabilizer to each and every instrument i.e. for almost every instrument. The performance of any electrical equipment is optimum at its rated voltage. Both over voltage and under voltage produce harmful effects. Under voltage generally reduces efficiency of the instrument whereas over voltage shortens the life of the instrument. So, even domestic appliances like TV Sets, Refrigerators, Computers and others expensive equipments has a need of stabilizer before connecting to the power supply. But it is preferable to employ one event for them, to safeguard against the momentary voltages below 170 V and above 270 V on the mains.

V. OBJECTIVE

This project aims in designing the low cost and the cheapest power-conditioning servo controlled voltage stabilizer to maintain the output voltage constant. The electronics equipment like PH-meter, X-Ray plant, spectrophotometers, recorders are all affected by high main voltage whereas deep freezers, compressors, incubators are affected by low main voltage. The twenty four hour running industries are also affected by fluctuation of voltage. So, it became necessary to design the servo stabilizer to achieve the constant voltage and safeguard the electrical equipments. Energy saving is an added advantage. Our aim is to design a stabilizer which has efficiency more than 97% in comparison with

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other type available in market. Also our aim to design the servo stabilizer for protection against short circuit, overload, over voltage/under voltage and also if the customer having any specific requirements. Many types of stabilizers are available in markets which are manually operated with switch. But it became difficult to operate such stabilizer manually during the peak period. This problem is solved by servo controlled voltage stabilizer more efficiently. With this circuit it is possible to maintain the constant output voltage even if the voltage minimized or maximized. By the requirement of the customer we design a servo stabilizer. To select a servo stabilizer for home/office we have to know about the power fluctuation situation that means what voltage minimum/maximum you are getting from the AC main supply. In brief, we have to select the input voltage window and the power consumption of our appliance.

VI. DESCRIPTION OF PROPOSED WORK

Hardware Circuit Component:

Domain: Electrical Control System & Power Electronics

Core components	: Servo motor, dimmer stat.
Higher Cut-off	: 270V
Lower cut-off	: 170V
Op-Amp	: LM324
Regulator	: LM723
Traic(2)	: BT136
Servo Motor Input Voltage	: 230 V
Servo Motor Torque	: 3 kg-cm
Servo Motor Speed	: 60 rpm
Servo Motor HP	: 0.003hp
Servo Motor Line Current	: 0.125A
Servo Motor Frequency	: 50 Hz, 1 phase
Voltmeter	: 0-300V
Gear Mechanism	: Gear ratio 20:1
Auto Transformer	: 270 V / 5 A

Servo Stabilizers can be for balanced or for unbalanced input voltages. Servo Stabilizer has five major components

- Microcontroller for Voltage monitoring
- Driver Unit
- Motorized variable voltage auto transformer
- Double-wound Buck Boost / Series transformer
- Servo controlled sensing card (PCB)

After determining load of customer and the input voltage band we design our Servo Stabilizer by taking into account the minimum and maximum voltage fluctuation. In servo stabilizer determine output is determined voltage and the same is set by means of servo controlled sensing card (PCB). While ordering Servo Stabilizer its capacity should be 20 percent more than the maximum load. The change in input causes change in the output voltage, the servo controlled sensing card (PCB) give signal to motor fitted on variable voltage auto transformer to either increase or decrease the

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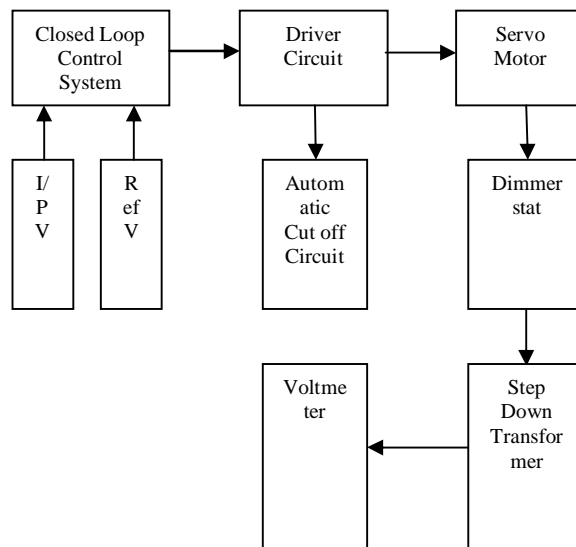
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output voltage to achieve the predetermined output voltage. Autotransformer lays in direct electrical connection between the low and high tension sides. This is the disadvantage of using auto transformer. If primary supplied at the high voltage, then open circuit in the common load results in appearance of dangerous high voltage which is dangerous to human beings operated in the working environment. Therefore, protection should be provided for this. If the ratio transformation k differs far from unit, causes advantage of auto transformer over two winding transformers decreases. The servo controlled voltage stabilizer employ a adjustable precision grade voltage regulator LM723. Wit this circuit with +1 or -1 volt voltage regulation is possible. This circuit operating range of 170V to 250V. In this circuit AC servo motor is used to drive knob of auto transformer, but for higher ratings of servo motor a buck boost transformer can be used. Accordingly the output voltage is boosted or bucked. If the voltage beyond 170V to 250V a protection circuit called under/ over voltage protection is provided to protect the main circuit from damage.

VII. BLOCK DIAGRAM



VIII. APPLICATION

The IEC (International electro technical commission) is an indispensable companion with all the high tech electronic and electrical equipment and machinery required steady state voltage input. It will find fruitful applications in offices, factories, Xerox centres, computer centres, hospitals, EDP centres, scientific laboratories, hotels, process industries ,rubber industries , paper mills , flour mills, tube mills, engineering units, tea estate, cold storages, pharmaceutical units, cement plants , residential bungalows, distilleries and beverages, textile mills, footwear and leather units , rolling mills, oil and vanaspati plants, food processing units. Servo voltage stabilizers are best when it comes to facing the voltage fluctuations due to overload and under load of power. Using these stabilizers can help in preventing many mishaps because of over and under load of power.

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IX. ADVANTAGES

- The stabilizer adds durability to the life of the appliance which is caused by voltage fluctuations.
- Provides better safety and protection.
- It reduces the manufacturing defect of items and increases the production.
- Helps to save overall energy and make the appliances 98% more efficient.
- It improves the quality of the appliances.

X. RESULT

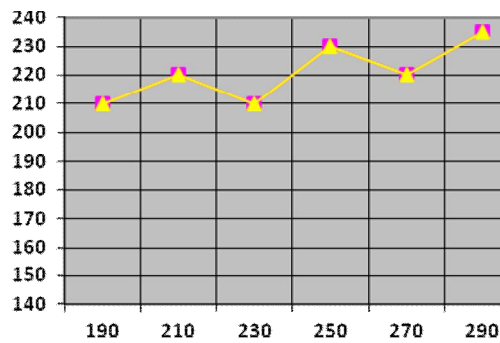


Figure 1 : Input AC Supply Voltage (X Axis) V/s Output Load Voltage (Y Axis)

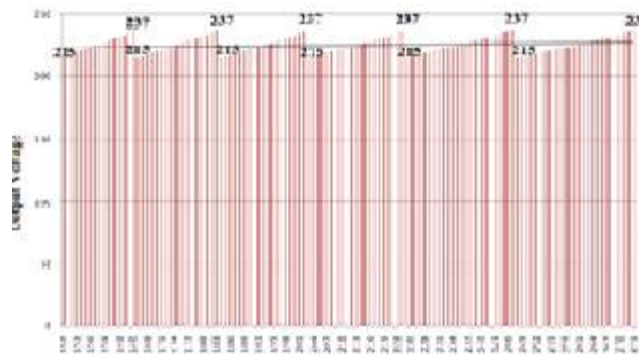


Figure 2 Response Curve; Output Voltage (X Axis) V/s Input Voltage (Y Axis)

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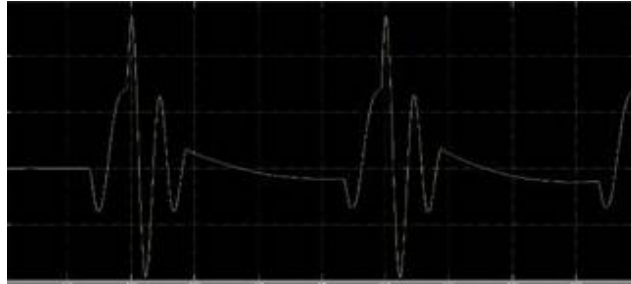


Figure 3 Simulink Waveform of Proposed System

XI. CONCLUSION

According to my research we can implement that, the cost effective developed system is 2500/- in Indian rupees .which is very cost effective in present day scenario. For higher rated servo motors, a buck –boost transformer can be used and in accordance the output voltage is either decreased or increased. It will beat the matter of high and low electricity. Always choose a right sized voltage stabilizer and also try to get them for individual appliances rather than for the whole electricity connection for better functioning of the appliances.

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