SYMMETRICAL PHASE CONTROLLERS USING LONG PULSE FOR UNIVERSAL LOADS

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Abstract: This project on Buck Symmetrical phase control, feedback based voltage regulator offers a perfect solution to control and regulate RMS voltage to supply for every electrical utility. This method of RMS voltage regulation supersedes the present methods of voltage regulation by using step down transformers and toroidal variac. This concept gives accuracy and superior methodology of control and regulation of AC wave. In general, this project shall be applied to a wide range of electrical utilities to regulate the supply voltage. In specific application, this concept can be used in Energy Conservation. Overall this is a very important concept primarily to optimize the operational efficiency of the electrical utilities and to conserve the wastage of electricity.

IndexTerms **– ELECTRONICS, PHASE CONTROLLERS , LONG PULSE CONTROL IC.**

I. INTRODUCTION

The existing voltage regulation is achieved by voltage stabilizer. These systems use step down & step up technology by means of a multiple tap transformers and also variac based voltage control technology. These transformers reduce the incoming line voltage in steps of 10 volts or 20 volts. This is purely input voltage sensing regulation system where in output voltage is always varied according to input voltage variations. In this method of voltage regulation, maximum attainable voltage regulation is 15-20%.

In this concept the output voltage is set and kept constant at that level only irrespective of variation in the input voltage. Typically, this system acts as a pointed stabilizer to regulate the load side voltage. Using this concept precise phase control of AC voltage is attained. The regulation is to the extent of 0.5% can be attained when input voltage varies from 200 to 270 VAC. Since the Phase controlled levels are highly flexible.

By this symmetrical phase controlled method the highest possible energy conservation can be attained without reducing the performance of the systems/utilities in electrical applications. This technology shall be used to optimize the performance of various electrical utilities ranging from small lamps to higher capacity fans and motors. When a constant voltage is supplied to these utilities the life span increases as well as unnecessary wastage of energy is eliminated. For example, in case of lamp loads by using this method all the lamps in the load circuit is burnt in regulated voltage and constant illumination. The life of the lamps and accessory components almost doubles when compared to direct usage without this system. The feedback system incorporated in this method helps to maintain the load side RMS voltage constant which in turn conserves maximum energy.

There is wide implicational scope for this design in domestic, commercial and public sectors. In domestic sector a constant supply voltage to load side avoids excess consumption of electricity during late night hours. This will enhance the life span of the lamps as well as reduce the demand on load side by at least 25% for each domestic utility. In overall situation there is a substantial reduction of load demand on distribution transformer. When this situation is imagined in the big cities the energy wastage avoided is phenomenal. In commercial sectors like office establishments, buildings, shopping malls, cinema halls etc., if precisely regulated voltage is supplied then the energy demand of the particular installation also comes down and there by contributes for energy conservation. In public utilities like parking lot, street lights this will go further and the power supplied can be bought down after the utility hours by dimming the lamps further.

II. LITERATURE SURVEY

[1] Andrey V Sidorov proposed AC voltage regulators with or without a transformer. Several research directions by creation of new AC-AC converters are distinguished, such as voltage stabilization, voltage regulation to nominal values and also increasing of voltage with gain greater than unity, reactive power compensators, active filters, voltage dips and overvoltage compensators and soft start of electric motors devices.

[2] Peter Nystrom proposed a comparison of ac voltage regulation technologies. The electrical mains were designed to provide power to linear loads such as light bulbs and heaters. The power they draw from the mains decreases with supply voltage, mitigating some of the consequences of low supply voltage. However, modern power converters used in computing, telecommunications, and industrial equipment are based on the principle of constant power. Because the current draw increases when the supply voltage decreases, this process compounds problems within the distribution systems. Problems with transmission and distribution are primarily found in developing countries, which tend to have an inadequate electrical infrastructure. This problem also exists in industrialized countries, but in a different form. It is typically seen when weak local distribution systems and/or inadequate electrical wiring in some buildings create mains voltage stability problems.

[3] B. Singh, K. Al-Haddad, A Chandra proposed a new control scheme for a parallel 3-phase active filter to eliminate harmonics and to compensate the reactive power of the nonlinear loads. A 3-phase voltage source inverter bridge with a DC bus capacitor is used as an active filter (AF). A hysteresis based carrier less PWM current control is employed to derive the switching signals to the AF. Source reference currents are derived using load currents, DC bus voltage and source voltage. The command currents of the AF are derived using source reference and load currents. A 3-phase diode rectifier with capacitive loading was employed as the nonlinear load.

[4] Dustin Rand, Brad Lehman, Anatoly Shteynberg proposed the difficulties in dimming LED lamps directly from residential phase modulated dimmer switches. In order to explain these difficulties PS pice models for the dimmers are proposed that necessarily include diac characteristics to improve accuracy. A method to dim the LEDs from the residential dimmers is discussed. LEDs can fail with phase modulation dimming.

III. METHODOLOGY

AC voltage controllers (ac line voltage controllers) are employed to vary the RMS value of the alternating voltage applied to a load circuit by introducing two SCR (Thyristor) between the load and a constant voltage AC source. The RMS value of alternating voltage applied to a load circuit is controlled by controlling the triggering angle of the SCRs in the ac voltage controller circuits. In phase control the SCRs are used as switches to connect the load circuit to the input ac supply for a part of every input cycle. That is, the AC supply voltage is chopped using SCRs during a part of each input cycle.

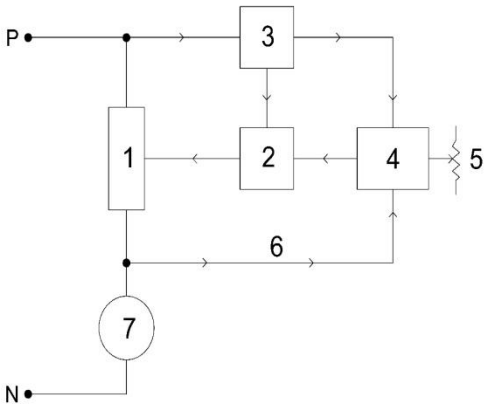
The SCR switch is turned on for a part of every half cycle, so that input supply voltage appears across the load and then turned off during the remaining part of input half cycle to disconnect the ac supply from the load.

By controlling the phase angle or the trigger angle ‘α’ (delay angle), the output RMS voltage across the load can be controlled. The trigger delay angle ‘α’ is defined as the phase angle (the value of ωt) at which the SCR turns on and the load current begins to flow.

IV. HARDWARE REQUIREMENT

1. Thyristor Block.
2. Dual secondary Transformer for Triggering Circuit & power supply.
3. Phase controlling IC.
4. Op-amp for feedback.
5. Other components like Capacitors, Resistors, Diodes, PCB, Connecting Wires, etc.
6. Different loads to test circuit (Incandescent Lamp, Motor, HID Lamp)

V. BLOCK DIAGRAM



The figure shows the block diagram of the module. Each block is explained in brief below:

1. Back to Back Silicon Controlled Rectifier (SCR) Power module 92A
2. Isolated Triggering circuit for SCR power module.
3. DC Power Supply.
4. Control Circuit.
5. Output RMS Voltage Setting.
6. Feed Back Path
7. Load (Inductive/Capacitive/Resistive)

VI. CONCLUSION

For every electrical utility, the RMS voltage to be supplied can be controlled and regulated. It can be applied to a wide range of utilities to regulate the supply voltage and can be used in energy conservation. It optimizes the operational efficiency of the electrical utilities and to minimize the wastage of electricity. Regulation can be decreased to 0.5%.

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