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Automatic on Load Voltage Regulation of DC Shunt Generator

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ABSTRACT: The project aims to automize the voltage regulation of DC shunt generator. Automatic on load voltage regulator is a device to decrease the voltage regulation occurring while dc generator is loaded. In the case of a dc shunt generator this drop is further increased by the load condition, the increasing load current increases the corresponding reduction in field current. A microcontroller regularly checks the voltage in dc generator circuit and whenever there is a voltage dip or voltage drop below a certain value, the micro-controller detects and start a motor mechanical system to adjust the excitation of field of dc generator to compensate the voltage drop. The output voltage of a separately excited dc generator drops as the load current increases. The drop in the output voltage is due to the armature resistance and armature reaction drops.

KEYWORDS: Regulation, Onload, Shunt Generator, Field Current, PIC microcontroller, Field Excitation..

I. INTRODUCTION

We have in our Electrical machines laboratory our 15KW, 220V DC Generator coupled to a 18.5KW, 415V, 3, 50Hz Induction motor. The DC supply from theabove Generator set is fed to a 200A, 220V DC panel. The outgoing feeders from the DC panel provide DC supply to various DC motors and motor-generator sets installed in the laboratory. The different characteristics of these machines are determined by operating these under various load conditions.

In the case DC generators, there are chances for the output voltage will not equal to the desired value. This is mainly due to ageing. Due to ageing, the resistance of field winding increases. So field winding losses its capacity to supply required field current. So the field mmf will not sufficient as load needs and desired value of output voltage cannot be achieved. For a DC shunt generator, the field and output voltage are related. So the regulation of output voltage can be achieved by adjusting its field. This can be done by using an automatic on load voltage regulator. To increase the field excitation there must be additional winding in series with existing field winding or another winding in the place of existing winding. Here we use an adjustable rheostat in the place of existing winding. A controller regularly checks the voltage in dc generator circuit and whenever there is a voltage drop or voltage increase beyond a certain value, the controller detects it and starts a motor-mechanical system to adjust the excitation of field of dc generator to compensate the voltage drop or increase.

Over the years it has been observed that when the DC generator is loaded to around 25-30 percentage of its rated capacity, the voltage of the machine falls down and as the load reaches 50 percentage, the machine voltage

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rapidly drops and the machine refuses to handle any load. The problem has been studied in detail and the solution is to have an Automatic Voltage Regulation and this project deals with the same.

II. RELATED WORK

A. Automatic Voltage Regulation of DC Shunt Generators

Regulation involves the adjustment of field excitation. A simple method of voltage regulation by automatic adjustment of field excitation making use of transistor circuitry is discussed. The added advantage of this method is that by the simple adjustment of circuit parameters the characteristics of a compound generator can be achieved. Experimental results prove the effectiveness of the method. From the experimental results obtained and by the considerations of the circuit diagram it is obvious that the method is extremely exible and involves no complications, while it gives very good and consistent results.Considering the economic factors it is evident that thecost of all the elements of the circuit is not even 10 percent of the total cost of compounding a shunt generator constant to achieve the same end, while as compared to other feedback devices it is even cheaper and still more exible.

B. Design and Construction of Automatic VoltageRegulator for Diesel Engine Type Stand-alone Synchronous Generator

The automatic voltage regulator(AVR) is widely used in electric power field to obtain the stability and good regulation of the electric system. The characteristics of alternator output required are constant voltage and constant current. To get the constant output, alternator field excitation is controlled by AVR. The AVR maintains the constant voltage up to certain level of load current independently of generator speed and load. The design and construction of excitation for synchronous generator introduce electronic control technology. The constructed circuit will improve the overall effectiveness of the synchronous generator.This includes the more accurate measurement of voltage and current, as well as improving the response time and system stability. The automatic voltage regulator is designed with electronic control circuit technology using SCR. To study the advanced features of excitation control system and to improve the industrial consumer product with SCR.

C. Automatic voltage regulator using an AC voltage voltage converter

Voltage sags and extended under voltages are one of the main concern of industry today. These voltage sags could cause a high negative impact on productivity, which is certainly an undesirable aspect in industrial and commercial application. Current tap changing transformers are used in distribution system has proven to be inadequate in solving these problem related to line regulation. A solution to this problem is to install an ac voltage-voltage converter that has been developed primarily for voltage sag correlation. This system incorporates high-speed insulated gate bipolar transistor switching technology and was designed to provide the speed and efficiency required by industrial customers. The feasibility of the ac voltage-voltage converter for voltage sag the system will provide the exibility of installation with or without the incorporation of tap changing transformer simulation result shows the operation involved in voltage sag correlation of the ac voltage-voltage converter. A single phase system can be rapidly developed into a three phase converter system based on the exact principal of operation.

III. PROPOSED METHODOLOGY

Now days, there are a number of techniques which are purposefully used and are being build up for voltage regulation.We design “automatic onload voltage regulator” using LCD Display and Keypad.” in which a PIC microcontroller is used for check the output voltage and correspondingly indicated on LCD and a buzzer is on. The Fig (a) shows the block diagram of an “automatic onload voltage regulator.”

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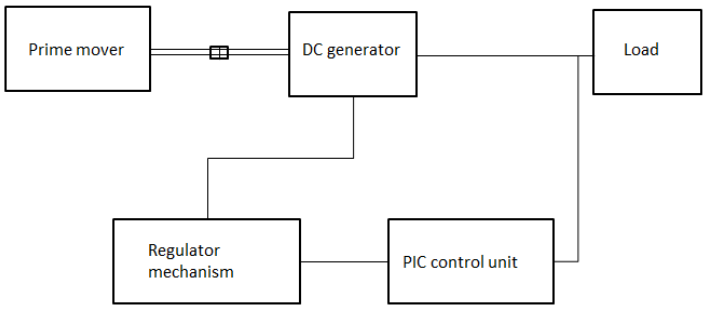

Fig 3.1 Block Diagram of Proposed System

The Hardware components which include,
. PIC Microcontroller

. LCD Display

. Shunt Generator

. Induction motor

. Rheostat

. Motor Driver IC

. Resistors

. Alarm circuit

. Power supply of +12V,+5V

. DC motor

To give a brief description of the project, The fig (a) shows the block diagram of "Solar Powered Grass Cutting Machine". This design contains a microcontroller, regulator mechanism. Adding these elements together, we get our automatic regulator. The goal was to let our control circuit to take the difference of the output voltage and preset voltage, so that correctly detect the variation and adjust the field rheostat mechanism by this work. For inserting a preset voltage value we use Keypad. The programing was done in MP Lab and Proteus by using PIC16F877 IC. Automatic on-load voltage regulator works on the principle of feedback mechanism. Here an Arduino continuously checks the output voltage of a DC shunt generator and makes this voltage to desired value by means of a motor-rheostat assembly.Here resistors are used as voltage divider. They are connected to the output of the DC shunt generator. They convert the output voltage to an equivalent voltage under 5V and give it as the input of PIC. Driver IC is an integrated circuit chip which is used to control motors in autonomous robots. It receives signal from PIC and rotates the DC motor clockwise or anticlock- wise. DC motor is an electrical machine that converts direct current electrical power into mechanical power. Here DC motor is used to produce mechanical power for varying the resistance of field rheostat. DC motor increases or decreases the resistances and therefore the field current also. So it can produce the required field current for the desired output voltage. Here field rheostat act as a separate field winding. Its resistance can be varied according to the need of the field current by means of an PIC-motor assembly. By adjusting the field current we can obtain the desired output voltage.

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IV. RESULTS AND DISCUSSION

A. Overall Hardware Kit

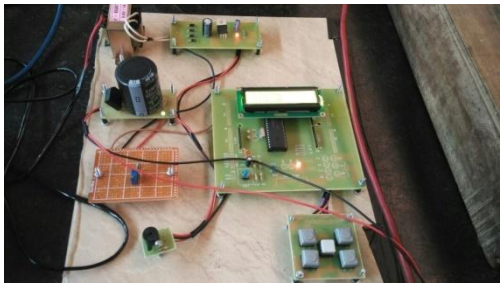

Fig 4(a) shows the overall hardware kit which includes some components like Buzzer, PIC microcontroller and Keypad and a relay circuit used for this project.

B. Experimental circuit diagram

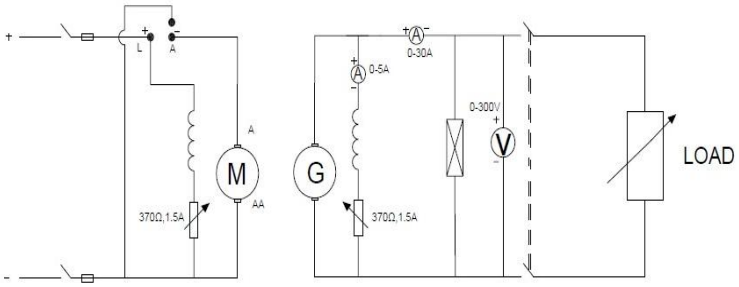

Fig 4(b) shows circuit diagram with the control circuitary shown above. From this we can done the experiment and tabulate the readings for further analysis.

C. Experimental setup in lab

Fig 4(d) shows the experimental setup in the lab.

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D. Contol Circuit

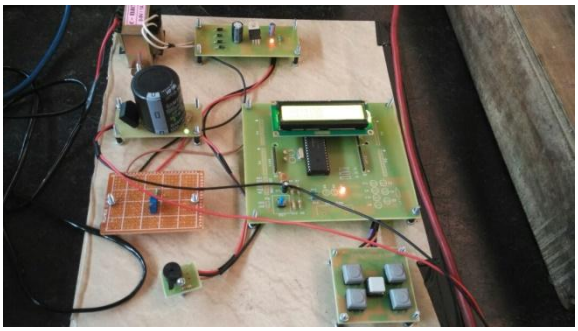

Fig 4(e) shows the control circuit

Automatic onload voltage regulator project was implemented and tested. A experiment is done in the lab and the results are tabulated. From that the length of rheostat to be moved is calculated and from that we designed the motor rheostat with a convenient thread size. It can be controlled by using the proposed control mechanism and by using a fully automatic motor rheostat we can done the regulation automatically with the corresponding voltage variation.

V. CONCLUSION

The purpose of this project was to build a automatic on load voltage regulator. The Automatic on Load Voltage Regulator successfully regulates the output voltage of a DC Shunt Generator depending upon the load it is connected to. It can regulate the voltage up to a specific amount depending on the value of the field rheostat used. Increasing the rating of the rheostat can help to attain better regulation of higher loads. The automatic on load voltage regulator can also connected with a safety mechanism like a tripping circuit to protect the equipments from over current. Thus, it can be further developed for the regulation of voltage as well as overcurrent protection.

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