Lubricant Flow Control and Monitoring of Bearings in Turbine System

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Abstract— As the appetite for electricity by modern society continues to grow, so does the desire of power plant managers to increase the reliability of their plants. The main piece of equipment used by power plants to produce electricity is the turbine; if it does not run, the plant does not produce electricity. In recent years, there has been significant attention given to lubricant flow control to bearing. This paper will focus on lubricant flow control through bearing based on temperature of bearing. The flow is controlled by microcontroller it reads lubricant temperature. This project deals with the flow control, Pressure monitoring for lube oil pumps according to the variations in temperature of the system.

Key words: Turbine System, Lubricant Flow Control and Monitoring of Bearings

I. Introduction

To satisfy the ever-increasing demands for electricity, all power plant operators are interested in improving the output and reliability of their plants. They accomplish this primarily by ensuring that the power-generating turbine operates as frequently and efficiently as possible. Many of the issues that result in turbine downtime are lubricant-related; making it is imperative that power plant management and maintenance groups work together to develop a turbine lubrication reliability program for their plants. Of the different types of turbines used for electricity production, steam turbines are among the most common. While there are similarities between the different turbine types and the lubricants used to lubricate them, there are specific differences. A steam turbine reliability program should be multifaceted, including functions such as lubricant selection, lubricant condition monitoring, lubricant storage and lubricant supplier service. Recent evidence from field performance and research studies suggest that it is possible to overcome many steam turbine lubrication issues through selection of a well-formulated turbine lubricant, accompanied by an entire program to ensure successful service of the lubricant.

II. Existing System

The existing system is only eligible for circulating the lubricant oil. It functions as the entire lubricating system maintenance and monitoring of the flow. The existing system is a simplified monitoring and not taken to account about the control and temperature of bearings of the turbine system and its level of flow.

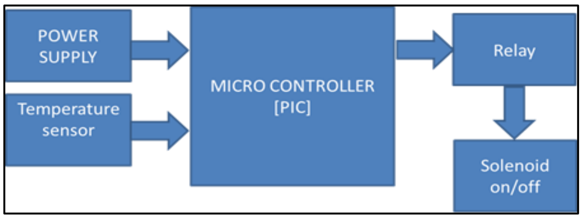

Fig. 1: Existing System

III. Proposed System

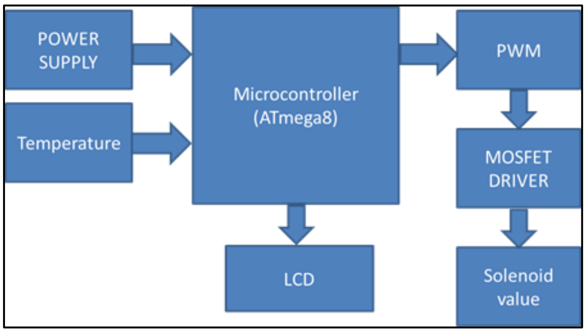

Fig. 1: Proposed System

The modern steam turbine and generator are carefully designed pieces of equipment constructed of well selected materials. Its satisfactory performance and useful life in service depend, among other things, on the maintenance of proper lubrication. This is one of the best insurances against turbine outage. In this proposed system we implementing PWM MOSFET driver to control the flow level depending on temperature level lubricant flow is controlled by this methodology there is no wastage of lubricant.

IV. Hardware Requirements

A. Power Supply

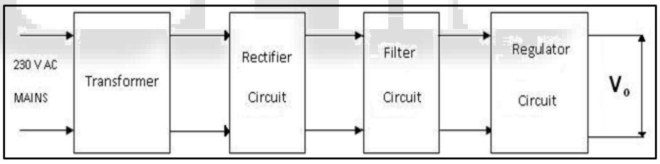

Fig. 3: Power Supply

Power Supply is an important part of a circuit. It provides required supply to different blocks of the circuit from input 230V AC. The main blocks include transformer, rectifier circuit, filter circuit, and regulator circuit. For our project we require + 5 Volt and +12 Volts supply. +5 Volts is given to Micro-controller board.

B. Microcontroller-ATMEGA8

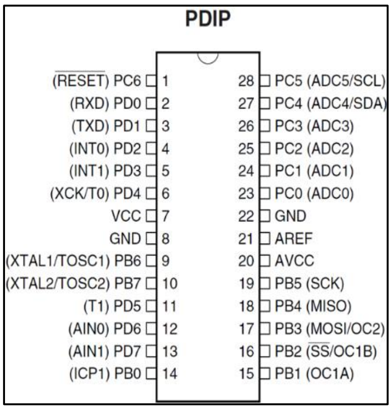

Fig. 4: Microcontroller-ATMEGA8

1) The ATmega8 provides the following features

8 Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 512 bytes of EEPROM, 1 Kbyte of SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte oriented Two wire Serial Interface, a 6-channel ADC (eight channels in TQFP and QFN/MLF packages) with 10-bit accuracy, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM; Timer/Counters, SPI port, and interrupt system to continue functioning. The Power down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next Interrupt or Hardware Reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption. The ATmega8 is supported with a full suite of program and system development tools, including C compilers, macro assemblers, program simulators, and evaluation kits.

C. Temperature Sensor LM35

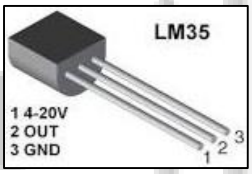

Fig. 5: LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a -55° to +150°C temperature range, while the LM35C is rated for a -40° to +110°C range (-10° with improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package. The LM35D is also available in an 8-lead surface mount small outline package and a plastic TO-220 package.

D. Solenoid Valve

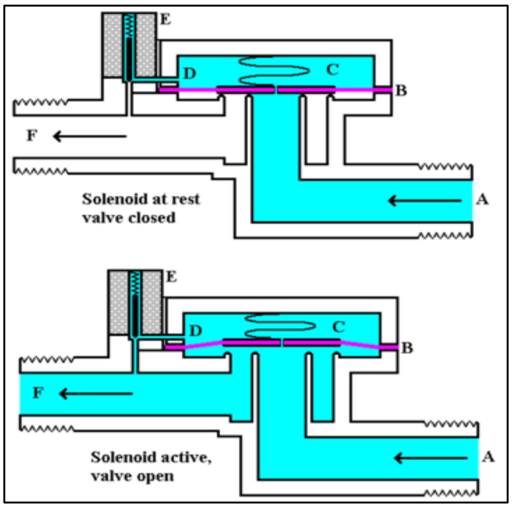

Fig. 6: Solenoid Valve

1) Input side
2) Diaphragm
3) Pressure chamber
4) Pressure relief conduit
5) Solenoid
6) Output side

The diagram to the right shows the design of a basic valve. At the top figure is the valve in its closed state. The water under pressure enters at A. B is an elastic diaphragm and above it is a weak spring pushing it down. The function of this spring is irrelevant for now as the valve would stay closed even without it. The diaphragm has a pinhole through its center which allows a very small amount of water to flow through it. This water fills the cavity C on the other side of the diaphragm so that pressure is equal on both sides of the diaphragm; however the compressed spring supplies a net downward force. The spring is weak and is only able to close the inlet because water pressure is equalized on both sides of the diaphragm. In the previous configuration the small conduit D was blocked by a pin which is the armature of the solenoid E and which is pushed down by a spring. If the solenoid is activated by drawing the pin upwards via magnetic force from the solenoid current, the water in chamber C will flow through this conduit D to the output side of the valve. The pressure in chamber C will drop and the incoming pressure will lift the diaphragm thus opening the main valve. Water now flows directly from A to F.

V. SOFTWARE TECHNIQUES

A. Code Vision AVR

The AVR is a modified Harvard architecture8-bitRISC single chip microcontroller which was developed by Atmel in 1996. The AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

B. Program Memory

Program instructions are stored in volatile flash. Although the MCUs are 8-bit, each instruction takes one or two 16-bit words. The size of the program memory is usually indicated in the naming of the device itself (e.g., the ATmega64x line has 64 kB of flash while the ATmega32x line has

32 kB).There is no provision for off-chip program memory; all code executed by the AVR core must reside in the on-chip flash. However, this limitation does not apply to the AT94 FPSLIC AVR/FPGA chips.

C. Embedded C

Embedded C is used for microcontroller programming. There is a large and growing international demand for programmers with 'embedded' skills, and many desktop developers are starting to move into this important area. Because most embedded projects have severe cost constraints.

D. Programming Interfaces

There are many means to load program code into an AVR chip. The methods to program AVR chips vary from AVR family to family.

E. ISP

The In-system programming (ISP) programming method is functionally performed through SPI, plus some twiddling of the Reset line. As long as the SPI pins of the AVR aren't connected to anything disruptive, the AVR chip can stay soldered on a PCB while reprogramming. All that's needed is a 6-pin connector and programming adapter. This is the most common way to develop with an AVR.

The Atmel AVR ISP mkII device connects to a computer's USB port and performs in-system programming using Atmel's software.

F. Program Execution

Atmel's AVRs have a two stage, single level pipeline design. This means the next machine instruction is fetched as the current one is executing. Most instructions take just one or two clock cycles, making AVRs relatively fast among the eight-bit microcontrollers.

The AVR family of processors was designed with the efficient execution of compiledC code in mind and has several built-in pointers for the task.

VI. Conclusion

Aside from turbine blade failures, the most common turbine reliability issues are bearing and control system failures, which often can be traced back to lubrication-related issues. Therefore, we are overcoming the obstacles in lubricant flow level and temperature related problems in lubrication of turbine system by controlling the flow level of lube oil around the bearings.

Reference

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