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SPEED CONTROL OF FAN USING DIAC AND TRIAC

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ABSTRACT

Today our country is facing power crisis and as a power conservation measure the electricity boards insist upon the consumers to save power using appropriate devices like power factor correctors, proportionate power derivative systems etc. The fan regulators can be classified under the proportionate power derivative system as it derives only the required power from the main supply. Thus power is not wasted unnecessarily but is rather conserved. A considerable amount of power can be saved by using the electronic fan regulators. The cost of electronic fan regulators is higher than that of the conventional fan regulators. However, if proper steps are taken to educate the consumers about its long term benefit i.e. energy conservation etc., the market of this product is likely to grow.

KEYWORDS: Diac, Isolation transformer, Speed control, Triac, Universal motor.

INTRODUCTION

Electronic fan regulator is an electronic device consisting diacs, triacs, potentiometric resistance to provide stepless control of fan speed. These regulators can also be used as a speed regulator for many other small motors used in mixer, laboratory solution mixer etc. with appropriate current ratings.

The triac is similar in operation to two thyristors connected in reverse parallel but using a common gate connection. This gives the triac the ability to be triggered into conduction while having a voltage of either polarity across it. In fact it acts rather like a full wave thyristor, either positive or negative gate pulses may be used.Triacs are mainly used in power control to give full wave control. This enables the voltage to be controlled between zero and full power. With simple half wave thyristor circuit the controlled voltage may only be varied between zero and half power as the thyristor only conducts during one half cycle. The triac provides a wider range of control in AC circuits without the need for additional components, e.g. bridge rectifiers or a second thyristor, needed to achieve full wave control with thyristors. The triggering of the triac is also simpler than that required by thyristors in AC circuits, and can normally be achieved using a simple diac circuit.

An isolation transformer is a transformer used to transfer electrical power from a source of alternating current (AC) power to some equipment or device while isolating the powered device from the power source, usually for safety reasons. Isolation transformers provide galvanic isolation and are used to protect against electric shock, to suppress electrical noise in sensitive devices, or to transfer power between two circuits which must not be connected. A transformer sold for isolation is often built with special insulation between primary and secondary, and is specified to withstand a high voltage between windings. Isolation transformers block transmission of the DC component in signals from one circuit to the other, but allow AC components in signals to pass.

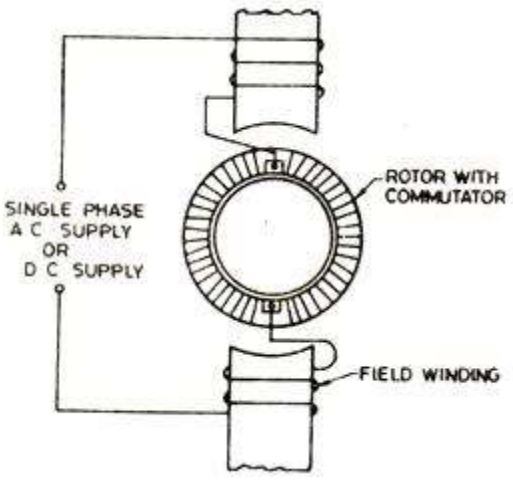

Fig.1 : Isolation Transformer

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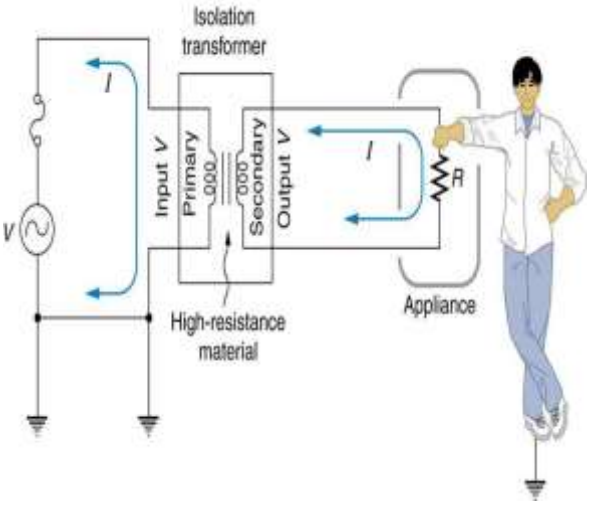

Fig.2 : Importance of Isolation Transformer

The universal motor is so named because it is a type of electric motor that can operate on both AC and DC power. It is a commutated series wound motor where the stator's field coils are connected in series, with the rotor windings through a commutator. It is often referred to as an AC series motor. The universal motor is very similar to a DC series motor in construction, but is modified slightly to allow the motor to operate properly on AC power. This type of electric motor can operate well on AC because the current in both the field coils and the armature (and the resultant magnetic fields) will alternate (reverse polarity) synchronously with the supply. Hence the resulting mechanical force will occur in a consistent direction of rotation, independent of the direction of applied voltage, but determined by the commutator and polarity of the field coils.

Universal motors have high starting torque, can run at high speed, and are light weight and compact. They are commonly used in portable power tools and equipment, as well as many house hold appliances. They are also relatively easy to control, electromechanically using tapped coils.
The diac is a bi-directional trigger diode used mainly in firing triacs and thyristors in AC control circuits. It is a simpler device and consists of a PNP structure (like a transistor without a base). The diac is designed to have a particular break over voltage, typically about 30 volts, and when a voltage less than this is applied in either polarity, the device remains in a high resistance state with only a small leakage current flowing. Once the break over voltage is reached however in either polarity, the device exhibits a negative resistance. When the voltage across the diac exceeds about 30 volts (a typical break over voltage) current flows and an increase in current is accompanied by a drop in the voltage across the diac. Normally, Ohm's law states that an increase in current through a component causes an increase in voltage across that component; however the opposite effect is happening here, therefore the diac exhibits negative resistance at break over.

In electronics and electrical engineering, a fuse is a type of low resistance resistor that acts as a sacrificial device to provide over current protection, of either the load or source circuit. Its essential component is a metal wire or strip that melts when too much current flows through it, interrupting the circuit that it connects. Short circuits, overloading, mismatched loads, or device failure are the prime reasons for excessive current.

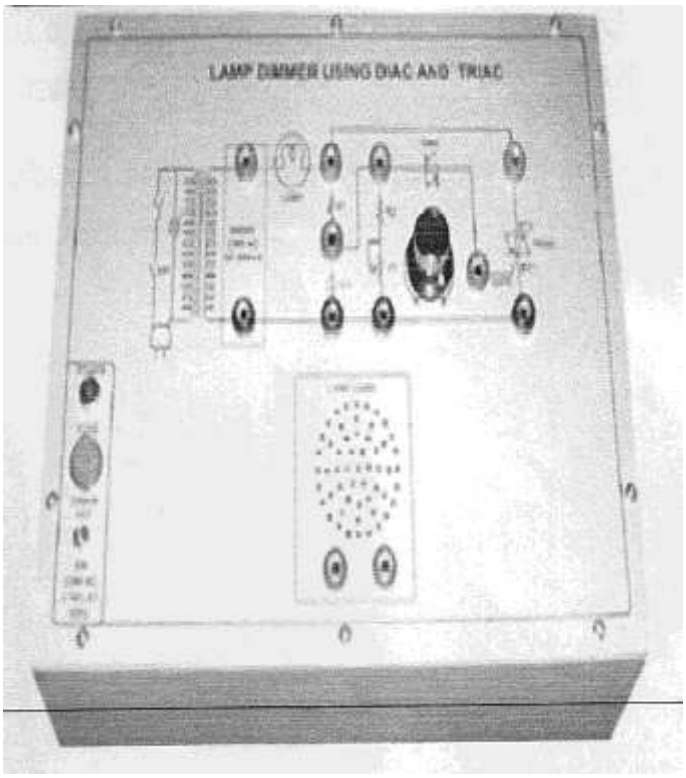

Fig.3 : Instrument Kit

The board consists of the following built-in parts:

- Isolation Transformer 230V A.C., Power 70 watt
- Diac
- Triac
- Potentiometer to control the speed of motor/fan
- A universal motor of 1/12 H.P.
- Adequate no. of other electronic components
- Main ON/OFF switch, fuse and jewel light

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- Adequate no. of patch cords stackable 4mm. spring loaded plug length ½ metre

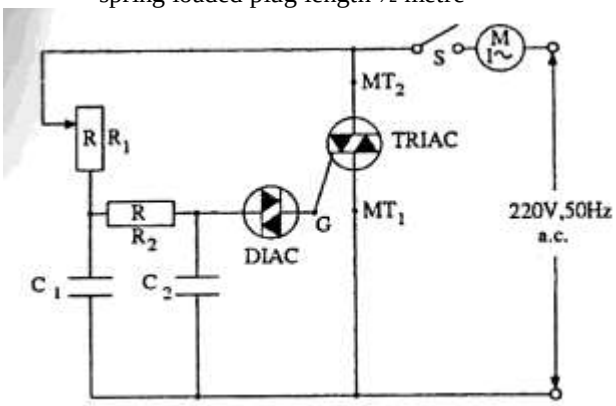

Fig.4 : Circuit Diagram

The unit is operative on 230V +/- 10% at 50Hz A.C. mains. Good quality, reliable terminal/sockets provided at appropriate places on panel for connections/observation of waveforms. The principle used in the electronic fan regulator is the phase control of the A.C. main which is effected by the use of triacs, diacs and RC time constant network.

- Put the power plug to main supply i.e. 230V, 1 phase 50Hz AC line.
- Switch on the set, the display glows.
- Connect the path chords as per diagram attached on the circuit.
- Increase the gate current control pot and record the speed and current.

RESULT

Sl. No.	FIRING ANGLE (DEGREE)	LOAD VOLTAGE (VOLTS)	VOUT (VOLTS)	CURRENT (AMPS)	SPEED (R.P.M.)
1	64.20	100	294.06	0.40	130
2	51.60	110	334.33	0.42	320
3	51.60	120	334.33	0.46	710
4	51.60	130	334.33	0.52	1360
5	38.40	180	363.61	0.62	4500
6	25.8	190	379.48	0.68	6100

CONCLUSION

SCR in conjunction with a four diode bridge and timing network can also be used instead of triacs, although choice of particular arrangement depends on the availability of the reliable semiconductor devices and their price. Fan regulators with diac, triac and RC time constant network are more common in use. We conclude that with the increase in load voltage firing angle decreases and speed increases.

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