INDIAN INSTITUTE OF TECHNOLOGY,KANPUR

MANUAL

Experiment No-10

STUDY OF SPEED MEASUREMENT USING PHOTOELECTRIC AND MAGNETIC PICK-UP

TRANSDUCERS AND INSTRUMENTATION

VIRTUAL LAB

Experiment No: - 10

Aim: -   To study of speed measurement –

   a) Photoelectric Pickup
   b) Magnetic Pickup

Apparatus Used: -

- Personal computer.

- Lab view 2009 runtime engine.

- Internet facility for performing(on-line experiment)
  For(off-line experiment) executable file of to experiment can be downloaded through the download link given on the website.

Introduction: -

The method for measuring the rotational speed of a shaft in revolutions per minute (RPM). RPM measurement is important when controlling or monitoring the speed of motors, conveyors, turbines, etc

Various commercial sensors are available to measure the rotate Speeds of the engine categories are optical and magnetic. Magnetic Sensor such a magneto resistive is commonly used in practice to measure angular velocity. These sensors are employed because of its inexpensive, rugged, reliable and no contacting device that need no calibration. A magnetic pickup consists of a permanent magnet, a pole –piece and a sensing coil all encapsulated in a cylindrical case. An object of iron, steel or other magnetic material passing closely by its pole-piece causes distortion of the magnetic flux passing through the sensing coil and pole-Piece which in turn generates a signal voltage. The magnitude of the signal voltage depends on the relative size of the magnetic target.

(a) Photoelectric Sensor:-

Photoelectric sensor usually provides low resolution, due to the low number of pulses measured per revolution. A photoelectric sensor must sense a reflective target on the shaft. If more than one target is used to increase the PPR, then the symmetry from one pulse to the next is likely to be poor.

(b) Magnetic pickup:-

A magnetic pickup consists of a permanent magnet such as an Alnico, wrapped with a coil of a few thousand turns of fine enameled copper wire. The pickup is most often mounted on the body of the instrument, but can be attached to the bridge, neck, as on many electro-acoustic arch top jazz guitars and string basses. The vibration of the nearby soft-magnetic string modulates the magnetic flux linking the coil, there by inducing an alternating current through the coil of wire. The signal is then carried to amplification or recording equipment via a cable. There may also be an internal preamplifier stag described using the concept of a magnetic between the pickup and cable. More generally, the pickup operation can be described using the concept of a magnetic circuit in which the motion of the string varying the magnetic reluctance in the circuit created by the permanent Magnet.

Aim :- (a) To study fo speed measurement using photoelectric Pickup.

Theory: -

A piece of reflecting mark is affixed at a point on the rotating object. The steady light source is focused on the reflecting mark. The light get reflected from the mark which is sensed by a Photodetector.it produces an electrical signal in the form of pulse. The reflected light produces one pulse per revolution.
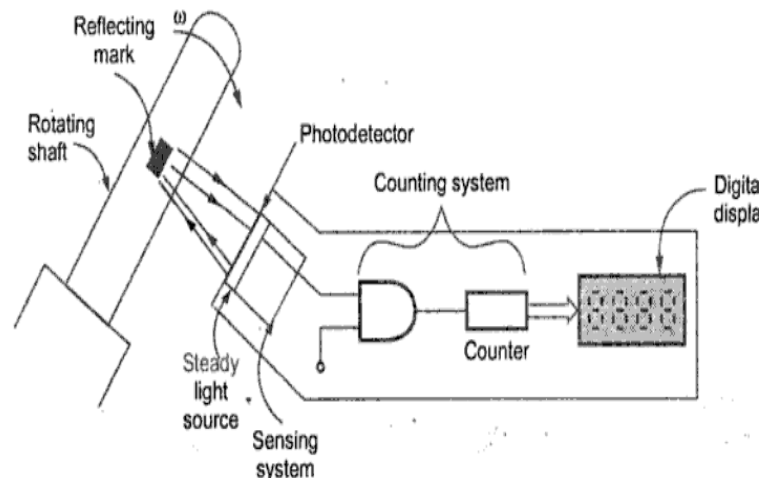

Figure:1 Photoelectric Pickup

The electronic counting system consists of a gate and counter. The gate length Control as one input and a pulse from photodetector as the other input. The gate Pulse and revolution relation is known the counter converts the information into speed. The angular speed value is then gives value to the digital readout where it is displayed on a digital display. This display gives value of angular speed directly in RPM.

Formula Used:-

The speed in r.p.s is given by-

$$n = \frac{pps}{n_s}$$

Where,

n = speed in RPS,

pps = pulses per second,

n_s = number of slots.

Observational table:-

S. No.	Speed(n)	Pulses per second	Number of slots
1.			
2.			
3.			
4.			
5.			

Procedure:-

1. First start the program.
2. The experiment contains two types of transducer for the speed Measurement.
3. Select the speed measurement using Photoelectric Pickup experiment.
4. The model contains a Motor whose speed to be measured and the photoelectric pickup is mounted near to the motor shaft.
5. Change the input voltage of motor through the knob. The motor speed will increase by increasing the motor voltage.
6. The motor speed is detected by photoelectric pickup. The emitting light pulses reflect back depending upon the speed of motor.
7. The graph plots motor speed against time.
8. Finally stop the program.

Result:-

The speed measurement using photoelectric pickup has been studied and the graph Speed versus Time is shown in the graph.

Precaution:-

➢ Follow instructions carefully.
➢ For fetching correct value, wait until the process gets complete.
➢ Runtime engine should be properly installed.

Aim: - (b) To study of speed measurement is using Magnetic Pickup.

Theory: -

It consist of a cylindrical permaent magnet placed behind a soft-iron pole piece . The magnetic pickup sensor is placed is front of the shaft gear,made of ferrous material Whose speed is to be measured. As the gear,rotates, the magnetic flux in the soft-iron pole Becomes high when the tooth of the ferromagnetic gear comes in front of the magnetic pick up,and the flux drops off as the tooth of the gear passed. Thus a voltage is genrated in the coil which is proportional to the rate of change of flux in the pole piece and also proportional to the speed at which the ferromagnetic gear make the flux bulid up. The output voltage waveform varies depending upon the teeth shape of the gear,thickness and spacing and the output voltage amplitude is proportional to the voltage build-up is linearly proportional to the learnce between tip and surface of the gera. The frequency of the voltage build-ups is linearly proportional to RPM.
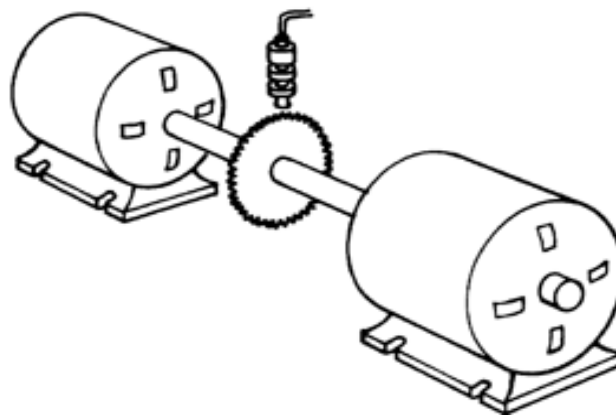

Figure 2: Magnetic Pickup

Formula Used:-

An ac signal is generated by the pickup coil, with the output signal frequency proportional to the engine speed-

$$f = \frac{rpm \times n}{60}$$

Where,

n = no of gear teeth

Magnetic pickup provide an accurate indication or record of equirpment speed (RPM) amd may be used on any type of surface, such as vidrating,rotating or moving surface. They may be

operated under condition when oil,water or non-corrosive liquid are present.they are available in rang from 0 to 25 RPM to 0 to 72000 RPM with calibrated accuracy of ±12% full scale and reproduability of 0.2% full scale.

Observational table:-

S.No.	*rpm*	No of gear teeth	constant
1.			**60**
2.			**60**
3.			**60**
4.			**60**
5.			**60**

Procedure:-

1. First start the program.
2. The experiment contains two types of transducer for the speed Measurement.
3. Select the speed measurement using Magnetic Pickup experiment.
4. The model contains a Motor whose speed to be measured and the Magnetic pickup is mounted near to the motor shaft.
5. Change the input voltage of motor through the knob. The motor speed will increase by increasing the motor voltage.
6. The motor speed is detected by magnetic pickup.
7. The graph plots motor speed against time.
8. Finally stop the program.

Result:-

The speed measurement using Magnetic pickup has been studied and the graph Speed versus Time is plotted in the graph.

Precaution:-

➢ Follow instructions carefully.
➢ For fetching correct value, wait until the process gets complete.
➢ Runtime engine should be properly installed.