Product Knowledge Document

Instrument Cluster / Speedometer

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INTRODUCTION

- What is Speedometer?
- Speedometer indicates the speed of the vehicle, over speed warning.
- Working principle : "It works on the principle of eddy current"
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- Application : 1. Indicates the speed of the vehicle.
- 2. Over speed warning.
- 3. Signal to ECU for actuating Air bag
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- Types (i) Straight drive Speedo movements
- (ii) Angular drive Speedo movements

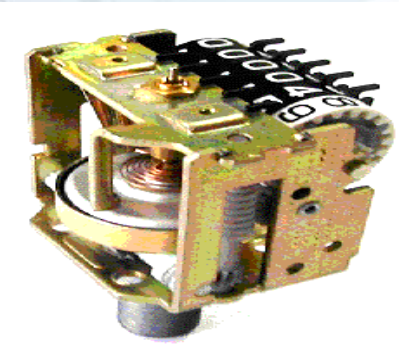

Fig.1. Straight drive Speedo movements

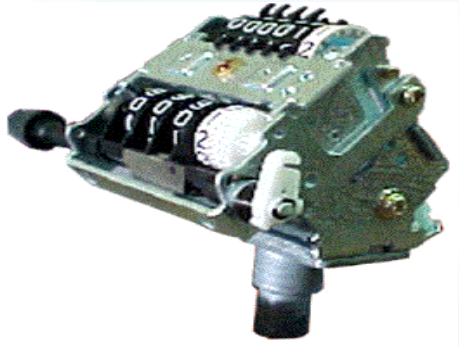

Fig.2. Angular drive Speedo movements

DESCRIPTION

It works on the principle of eddy current. An eddy current movement is used in the mechanical speedometer to measure the speed, this movement uses for the physical phenomenon or the eddy current drag.

A permanent magnet connected to a flexible shaft is surrounded by a moving speed cup and a stationary ring. The magnetic field between magnet and ring passes through the speed cup. There is no mechanical contact between speed cup and magnet. Both can turn independently.

DESCRIPTION

The rotation of the permanent magnet and its magnetic field induces eddy currents in material of the speed cup. Together with the induced magnetic field of the speed cup. The rotating magnetic field of the magnet generates a drag on the speed cup. The rotating magnet thereby transmits a torque to the speed cup without exerting a mechanical contact. This torque increases with the rotational speed of the magnet.

The rotation of the speed cup is opposed by a spiral spring. So that the speed cup can only turn until equilibrium is attained between the drag of the eddy current system and the torque of the return spring.

The angle of rotation of the speed cup corresponds to the pointer position. Which displays the speed on a graduated dial.

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WORKING MECHANISM

A common application of eddy current torque transmission is the Speedo meter. In this device the flexible cable drive rotates a bar magnet through spindle that produces a magnetic field in the gap between the magnet and soft-iron core keeper ring (magnet cover). An aluminum cup (cup drag) fits concentrically in the gap.

These makes the cup drag tends to rotate. Angular deflection of a pointer attached to the axle measure the torque produced by eddy currents. That is exerted on the disk. The torque in turns is proportional to the rotation rate of the Speedo meter cable and hence to speed.

Speed measurement

An eddy current movement is used in the mechanical speedometer to measure the Speed. This movement uses the physical phenomenon of the current drag .A permanent magnet connected to a flexible shaft is surrounded by a moving speed cup and stationary ring. The magnetic field between magnet and ring passes through the speed cup. There is no mechanical contact between speed cup and magnet, both can turn independently

WORKING MECHANISM

The rotating magnetic field of the magnet generates a drag on the speed cup. The rotating magnet thereby transmits a torque to the speed cup without exerting a mechanical contact. This torque increases with the rotational speed of the magnet

FUEL GAUGE

The fuel gauge is used to determine the fuel availability in the fuel tank with the help of level gauge placed in the fuel tank and other end is connected to wiper arm, which moves over a potentiometer winding. Depending upon the position of float in the tank, the resistance value changes. This cause variation in current flow in the coil and deflects the magnet (Electrical) or bimetallic strip (Mechanical) and hence pointer gets deflected thereby indicated the amount of the fuel on a graduated dial.

Working Principle of Speedometer

"It works on the principle of eddy current"

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Working Principle of Speedometer

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The angle of rotation of the speed cup corresponds to the pointer position. Which displays the speed on a graduated dial.

Working Principle of Speedometer

Cross-coil movement is basically Indicating Instrument. It is working under the principle of Electro-magnetic attraction. It's used to indicate fuel level, Radiator temperature, Lubrication oil pressure and air pressure etc., The parameters to be indicated (i.e., Temperature, Fuel level and Pressure) are converted into electrical quantity (change of resistance) according to change of parameters as shown

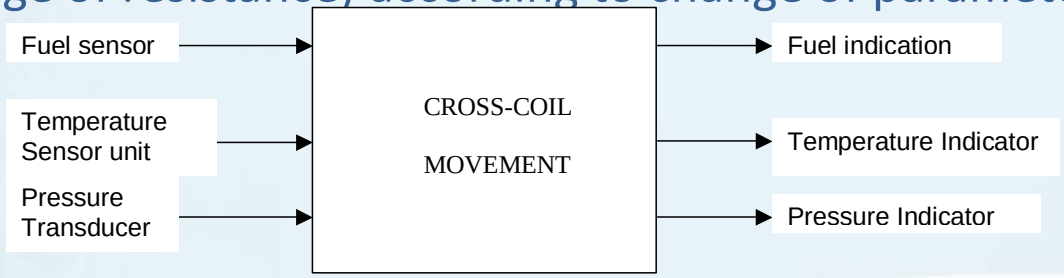


FIG. 4

The above Fig. shows that the cross-coil movement is common for all Indicating Instruments by connecting the suitable sensor. By connecting the suitable Sensor, we can change one type of parameter into another type as desired. (Like galvanic meter is common for both voltmeter and ammeter .

The total current drawn by the system is divided in to two paths in order obtain final resultant force (Electro magnet) for indication. This equivalent resistance is calculated by replacing all coils by its resistance shown in the diagram

Working Principle of Speedometer

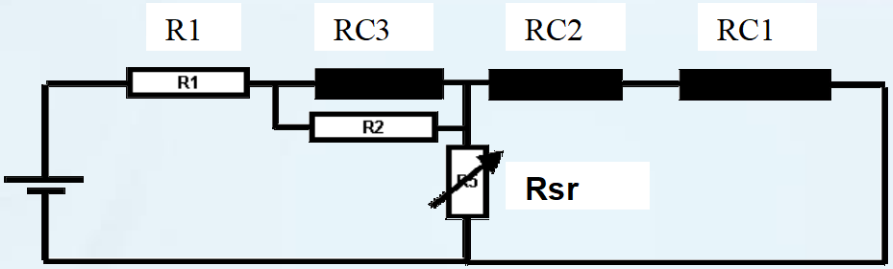


Fig. 16

Fuel Gauge divided in to three stages.

1. Pre Winding 2. Winding 3. Post Winding

MECHANICAL CONSTRUCTION:

Cross-coil consists of the following components, namely:

1. Lower Bobbin
2. Upper Bobbin
3. Permanent Disc Magnet
4. Return Magnet
5. Axle Pointer
6. Ball
7. Silicon oil
8. Terminal

Working Principle of Speedometer

LOWER AND UPPER BOBBIN:

Lower and Upper bobbin are mechanical supports for the purpose of following.

1. To carry winding wire.
2. To keep the Disc magnet with free rotation.
3. To carry the silicon oil for necessary damping.

PERMANENT MAGNET:

It is the bipole magnet, which generate the necessary torque. This torque is used for indication. Due to attraction between permanent Disc magnet and temporary Electro magnet, the deflection torques achieved.

AXLE POINTER:

This carries the magnet and also it carries the pointer for indication, which is pivoted over the “ball” for free frictionless movement.

TERMINALS:

This is used to assemble the movement, and also to pass the current through the coil for necessary working. The top of the terminal carries the ‘Lug Plates’, which are projected to solder the winding wire and resistors.

Working Principle of Speedometer

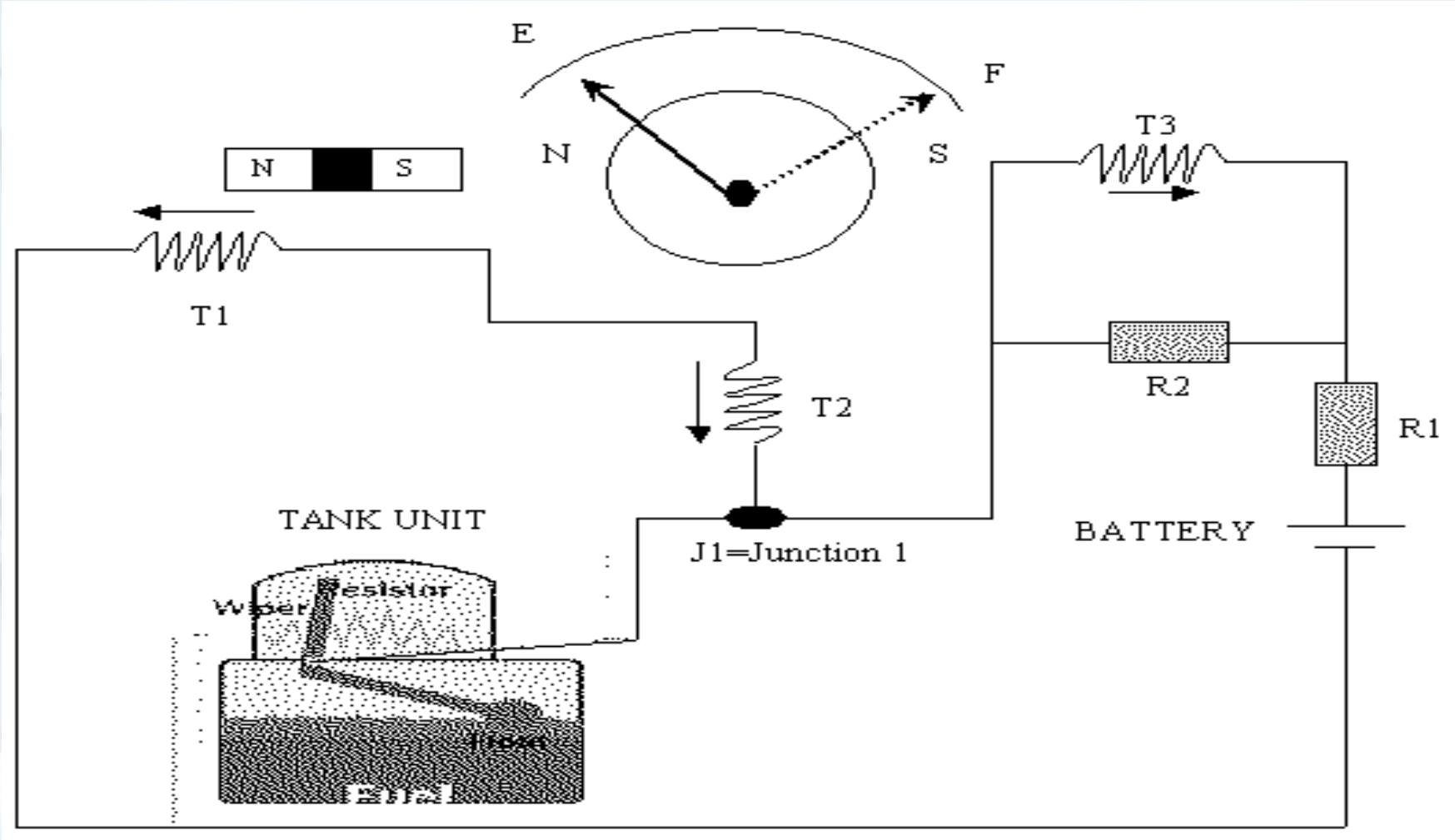
Winding wire

ELECTRICAL CONSTRUCTION:

It consists of three coils (coil 1, coil 2, and coil 3) wounded over the bobbin in series to each other and they are placed magnetically in 90 degrees to each other for getting the necessary torque on the disk (magnet) placed inside the bar.

There is an series resistance R1 (as shown in Fig.) connected to limit the current flow through the coil and one more parallel resistance connected across R2 to achieve the temperature compensation. Tapping will take between coil 2 &3 to connect sensor

Basic Working Principle



Working Principle of Speedometer

"WHEN TANK IS EMPTY"

When supply is given to the cross-coil system the coil C1, C2, C3 will produce Electro-Magnetic Field according to the amount of current flow through it. Current through C1, C2 is decided by the sensor value, which is connected in parallel. Sensor will consume considerable amount of current, which will send to the junction J1 (between C2 &C3). The total amount of current of the battery is divided into two parts. One part goes through the C1 + C2 and another goes through the sensor. If the fuel is low, sensor value resistance value is high, which distributes the coil current (C1, C2, C3) and produce resultant magnetic field.

Working Principle of Speedometer

" WHEN TANK IS FULL"

When the tank is full, that means, the sensor value is changed to 5 ohm. Now, the system gets surrounded by 5 ohm. After that, the system current invoked is as follows:

1. Total current drawn from the battery through coil 3 will increase from the previous value.

2. Current from coil 1 and 2 will get reduce from original value, due to low resistance. Sensor value bypasses all the incoming current. This change in current of all coils will modify the MMF (Magneto Motive Force) .

Drive the pointer at the R position for that we have to do the Range Setting by which axle should also be at R position

SPEEDO MOVEMENT:

Speedo movement is nothing but a device used to measure the speed of the vehicle and odo meter is nothing but a device used to measure the distance traveled in a stipulated time.

The working principle of the speedo movement is based on the eddy current principle. The eddy current principle says that whenever a permanent magnet is revolved a magnetic field will be produced around the magnet area and if we keep an non magnetic conductive material (rotor) it will cut the magnetic lines and an eddy current will be produced. This eddy current will induce the rotor to move in the magnet rotating direction.

SPEEDO MOVEMENT:

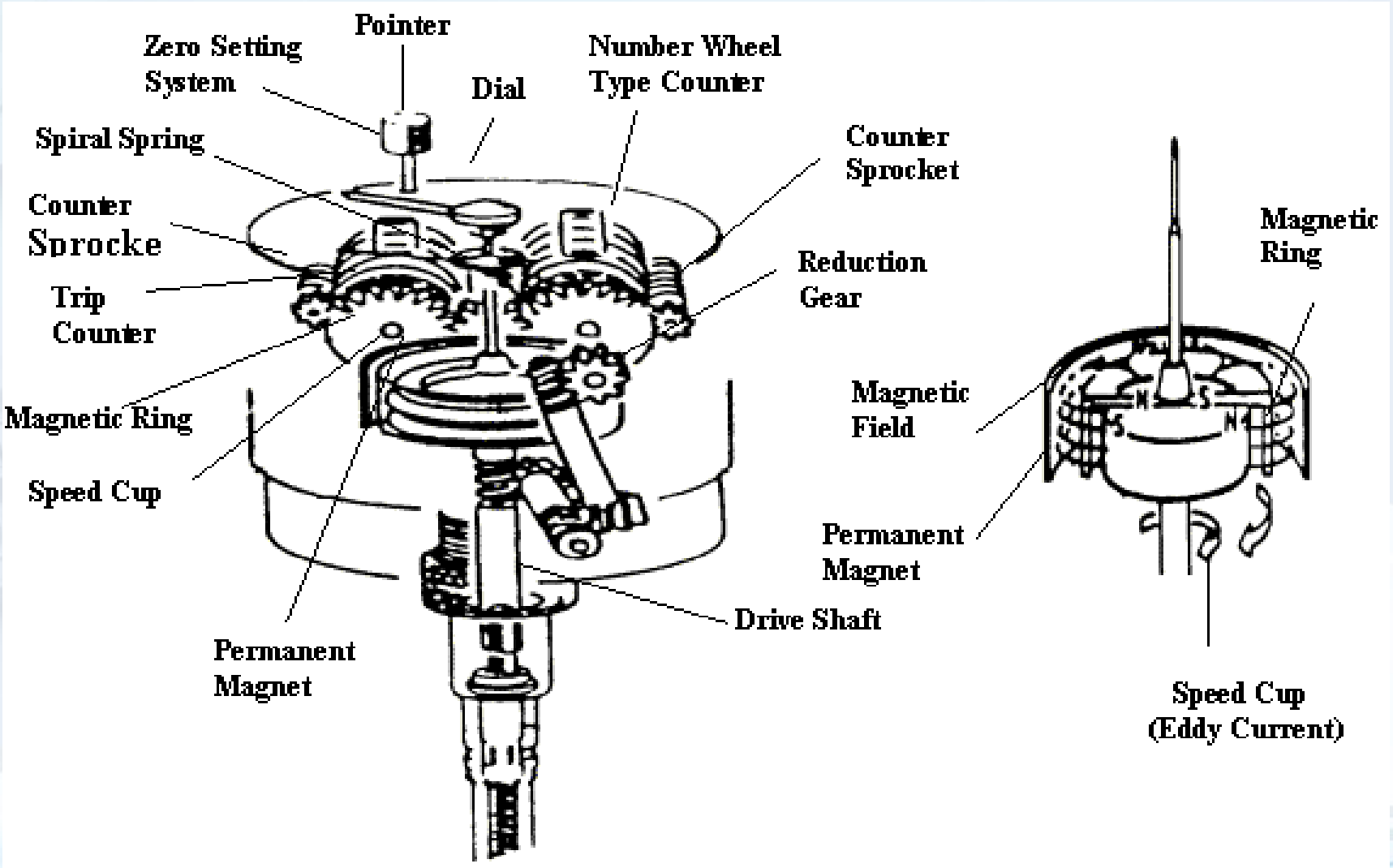
The pointer is fixed in the axle at other end of the rotor. So, when the rotor moves, the pointer also moves.

The pointer sweeps over dial that has been mounted beneath the pointer and above the speedo meter.

The sweep angle would be calibrated according to the customers requirement.

Odo meter working principle is based on the gear and gear engagement.

The speedo meter consists of the following parts.



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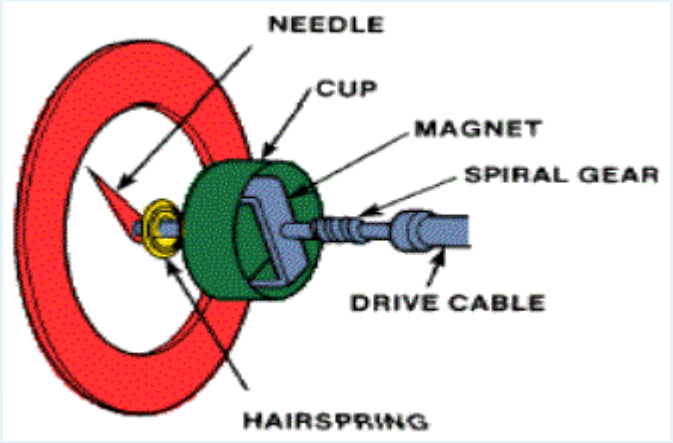

The speedo meter consists of the following parts.

Bearing block:

It is made of zinc alloy and it bears the spindle assy. and sintered bush, under washer and retainer. So, it is called as bearing block. The other name of the bearing block is boss.

The speedo meter consists of the following parts.

Sintered bush:

It is made up of powdered metallurgy. The steel powder is highly compressed into the required shape. The bottom die half is filled with the metallic powder and it is compressed by the hydraulic ram where the top die has been mounted. Then the raw components are baked using the heater. Then the oil is impregnated into the sintered components using high vacuum Pressure chamber. The impregnated oil used as self-lubricant during working condition.

Washer:

Upper washer and under washers are used in the spindle assembly. Washers are made up of spring steel.

Retainer:

It is a brass material and it is being used along with the spindle assembly in the bearing block.

The speedo meter consists of the following parts.

Mainframe:

It is made up of sheet metal. Since it is framing all the small Components it is known as mainframe.

Shafts:

Two worm shafts are being used for the motion transmission from the spindle assembly to the odo assembly. Depending on the position it is used the names have been provided as Horizontal shaft and vertical shafts.

Spindle:

It is made up of free cutting steel material and the vehicle speedometer cable drives it.

The speedo meter consists of the following parts.

Magnet:

It is the main component in the speedo movement and is the permanent type in nature. The comparative value of the magnet should be minimum of 2.2mV.

Magnet cover:

It is used to confine the magnetic lines so that the magnetic field intensity can be improved at the rotor area. As the sweep angle of the speedo movement is directly proportional to the eddy current, the eddy current is directly proportional to the magnetic field density.

Rotor:

It is made up of aluminium so that it is conductive type and not magnetic in nature.

The speedo meter consists of the following parts.

Spiral spring:

It is made up of phosphor bronze. The sweep angle of the speedo systems is inversely proportional to the torque of the spring. Besides controlling the sweep angle of the system it is also bringing the pointer to its home position while the speed of the vehicle decreases/becoming zero.

Damper oil cup:

As the name indicates it is used to hold the damping oil.(High viscosity silicon Oil). It is made up of brass/aluminium.

Damping oil:

To ensure smooth pointer movement and free from small vibration /oscillation the system is provided with damping system. This damping system comprising of damping oil filled in a damper oil cup which is mounted with the rotor axle. Various grade of silicon oils are used depending upon our requirement.

The speedo meter consists of the following parts.

Bush bearing:

It is used to bear the rotor axle and for activation of the damping system. It is made up of brass. A breathing hole has been provided in the bush bearing to remove the air bubbles, which may arise during the assembly or the working condition while driving the vehicle.

Bridge plate:

It holds die casting rotor assembly. It bridges the two walls of the mainframe and known as bridge plate. The other name for this is bracket support.

The speedo meter consists of the following parts.

Hexagonal bush nut:

This nut is used to lock the bush bearing with bridge plate along with the rotor assembly. This is also made up of brass.

Araldite:

It is the adhesive being applied between the hex. nut and the bridge plate. It is the mixture of resin and hardener in the specified ratio (1:1). The purpose of the araldite application is to avoid the hex. nut loosening during the working condition due to heavy vibration.

The speedo meter consists of the following parts.

Field ring:

The magnet cover for speedo movement is known as field ring.

Bearing support:

It is being used in the C2 speedo movement to bear the rotor assembly. It is made up of zinc alloy.

Disc:

This is used along with the bush bearing in the bearing support assembly and it supports the rotor axle. It is made up of phosphor bronze.

Spindle worm:

It is being driven in the C2 spindle to provide the engagement between the horizontal shaft and the spindle.

The speedo meter consists of the following parts.

Odo gear:

This gear is used to drive the odo assembly and it is driven by the idle gear in speedo movement and by vertical shaft in type of speedo movement.

Idle gear:

Idle gear is being used to transmit the motion from the vertical shaft to odo gear. It transmits the motion without manipulating speed.

Odo assembly:

It is the combination of figure wheel and working based on the indexing principle i.e., when the previous figure wheel completes one revolution the next one will be indexed to 1/10th of the revolution.

The speedo meter consists of the following parts.

Rotor axle:

This is made up of free cutting steel and it is die cast with the cup drag. The bottom end of the axle rests on the bush bearing driven inside the spindle or bearing support. At the rear end of the axle the pointer will be fixed.

Speedo movements have been named as F2 and C2 just to distinguish the models. These are the names followed by Nippon Seiki and since we have been ventured with Nippon Seiki we are

following the same culture.

In general the speedo movements have been classified based on the odo assembly position and speed ratio. If the odo assembly presents above the pointer position it is known as Odo top speedo movement and if the odo assembly presents below the pointer position it is known as odo Bottom speedo movement.

THANK YOU

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Are there any Questions?