Available online at www.elixirpublishers.com (Elixir International Journal)

Mechanical Engineering

Elixir Mech. Engg. 85 (2015) 34427-34429

ISSN: 2229-712X

Torque Measurement Equipment for Car Steering

Asawari Patil and Pawan Pingle
Department of Mechanical Engineering, Bharti Vidyapeeth, Katraj, Pune, India.

ARTICLE INFO

Article history:
Received: 10 June 2015;
Received in revised form:
1 August 2015;
Accepted: 11 August 2015;

Keywords
Force measuring equipments,
Steering force,
Automotive.

ABSTRACT
Deterioration of mechanical components in locomotives is evident over kilometers covered. A Number of factors are responsible for this deterioration; wear out of components (Life of Components) over kilometers covered, Reaction due to dust accumulation & change of material properties due to open air weathering. Hence we design a equipment to measure the steering force of automotives.

Introduction

In all the subsystems of a vehicle, the steering system is one of the major ones. The steering is one of the point of human-machine interaction of the vehicle and hence carries a lot of importance any problem in it would make the driving experience unpleasant and hence undesirable this would in turn hamper the reputation of the car model and the manufacturer hence an area of concern. The major problems that arise due to a faulty steering system are the wheels become extremely difficult to turn. The wheels will make the desired turn but the force required will drastically more.

There can be unusual sound signals from the steering while in the process of turning. The steering wheel can vibrate vigorously while idling. These problems are just to name a few and hence may require a recall for rework after the cars are sold to the customers this can be undesirable for the reputation of the manufacturer. With these problems persisting it becomes difficult to judge a car for rework at the plant. There is no particular equipment which can help us decide the same.

The work done in this uses software's, load cells etc to calculate the force in the steering system but no significant work has been done on a equipment that can calculate the approximate force without altering the system and make it more human like. The whole idea behind the equipment designed is not to calculate the exact force but relative force between car models. This project is for test center to check / measure maximum and minimum Torque use to rotate the steering by automatically.

The steering hand wheel torque needed to move the road wheels slowly against various forms of resistance at very low or zero vehicle speed is an important case in the design of a car steering system the torque required to steer the road wheels of a car is a maximum when the car is stationary, the steering geometry and the friction forces in the system influence the torque necessary.

Although it is commonly believed that the torque can be reduced by increasing the offset distance of the tire contact center from the king- pin axis as put forward.

Vehicles equipped with power steering make maneuvering on the road that much easier. Failures of the power-steering system don't usually announce themselves without ample warning, but can certainly be risky. A hard steering can be an outcome of tight fitments while assembly, uneven tire pressures or abnormal frictional forces acting on the linkages or any misalignments, if the power steering fails it reverts the it back to normal mechanical steering and hence becomes difficult to operate causing early fatigue to the driver who is handling the car. Hence a equipment was necessary to measure the torque/force required to steer the wheel

Purpose of project

Design and development of special purpose equipment for measuring the torque/force of the existing steering wheel mounted on the car, neglecting the tyre friction parameter and hence the engine rpm by taking the reading in deal conditions.

Hardware Required

1. VDC electrical motor (BOSCH) 2. Steering wheel structure 3. Hardwire contactor 4. DATA recorder

Description of Task

Automatic Car Steering torque &force measurement fixture is designed to measure the actual torque & steering force of the car. This system covers all working area of mechatronics system. This system consists 30% electronics, 40% electrical and 30% mechanical.

Namely mechanical circuit designing-Mechanical part designing, Mechanical part manufacturing, steering holding frame, Wiper motor holder Electrical-Electrical circuit designing, Electrical assembly designing, Hardwiring, Electrical part listing, Wiring of safety interlocks Electronics- Data logger connection & testing, safety interlocks, integration with line Commissioning – Supervisory controls, Test run.

Description Of the activities carried out

The biggest challenge encountered was how to rotate car wheel without any manual support how to calculate Torque/Force. First work on mechanical fixture to rotate car steering wheel automatically. An existing steering wheel is taken of the same car maker whose torque is to be calculated.

The steering wheel consists of an aluminum frame inside the rubber and plastic coating from the outside. All the material coating of rubber and plastic was removed to get only the steering ring of aluminium. The coating material has lower melting point than the inner aluminum ring, hence application of heat could separate the two.

Tele:
E-mail addresses: asawari261988@gmail.com

Figure 1. Example of a steering wheel with griping rubber covering it

Figure 2. Shows the removal of coating material

Figure 3. Depicts the aluminum ring without coating material

With the help of a clamp we fix this aluminum steering ring on the existing steering wheel on the car which will give us the required fixture for the motor to rotate. To rotate assembly of wheel ring and car steering wheel we need to find a motor which will carry load, small in size and its Torque / current characteristics should be linear so that it will be easy to do further calculation. The wiper motor that is used in the equipment has linear torque to current characteristics. And the motor is connected to the DATA logger which will measure current .It will measure the current when motor is having load, the required torque can be calculated. The DATA logger can be connected to the computer and the Data can be stored in and used ample number of times later.

With the U1250 Series 'data logging capability, we can ensure that every reading gets recorded manually or at intervals specified.

The assembly of all these can be fitted on the wind shield glass without and hassel using vacuum glass holder which will be mounted on the wind shield. These vacuum cups can even bear the weight of all of the assembly while in running condition hence safe to use.

Operation and Process Flow

In this automatic Torque & Force measuring machine we have to go with step by step process:

1. Make the car steering wheel in its actual zero position manually and make wheels aligned straight line.
2. Fix the aluminum ring fixture to the car steering wheel with given clamps.

Clamp the total fixture to car front glass with the help of vacuum glass holder so that at run time of motor fixture should not move or should not vibrate. Fix sensors on wheel shield so that it can sense tire end and center position and give signals to motor to stop ,to get current used by motor to rotate 3 round or till tire sensor signal gets off. Connect power supply. Start the motor first on clock wise direction; let 3 rotation of steering wheel complete and then the tire sensor signal cuts off. The current data is stored in DATA LOGGER device.

Figure 4. Depicts entire assembly

Get print or save it on Computer calculate using the formula:

$$POWER(P) = VOLTAGE(V) \times CURRENT(I)$$

But in above formula I (Current) we have to take difference between Current of motor without load and current of motor with load so, we will get I (current),but we neglect it as its very small.

From Power we can calculate Torque with formula

$$POWER(P) = \frac{2 \times 3.14 \times n(RPM\ OF\ MOTOR) \times T(TORQUE)}{60}$$

$$T(TORQUE\ IN\ N-M) = \frac{POWER(P\ IN\ WATT) \times 60}{2 \times 3.14 \times n(RPM\ OF\ MOTOR)}$$

Finally a Approximate Torque is achieved that is use to rotate Car steering Wheel in its Static or standing position.

Analysis: We can find precision of the equipment by finding out the standard deviation. 50 observations were taken on one subject car without disturbing the setup.

$$MEAN(M) = \frac{\sum f * X}{N} = \frac{519.5}{50} = 10.39 \sim 10.00$$

STANDARD

DEVIATION $\sigma = \sqrt{\frac{\sum fx^2}{N}} = \frac{24.594}{50}$=0.701

Torque calculations with Mean=10

$$POWER(P) = VOLTAGE(V) \times CURRENT(I) = 12 \times (10)$$
$$= 120Watts$$

$$POWER(P) = \frac{2 \times 3.14 \times n(RPM\ OF\ MOTOR) \times T(TORQUE)}{60}$$

$$120 = \frac{2 \times 3.14 \times 60 \times torque}{60}$$

$$torque = 19.1(N-M)$$

Table 1. Frequency distribution of current readings obtained.

Computation Of Standard Deviation For Steering Mechanism							
CURRENT VALUE GROUP(AMPERES)	**FREQUENCY (*f*)**	**MID POINT(X)**	***f*X=***	**MEAN(M)**	**x=m-X**	**x*x**	***f*x*x***
9.0-9.5	3	9.25	27.75	10	0.75	0.562	1.686
9.5-10.0	8	9.75	78	10	0.25	0.062	0.496
10.0-10.5	21	10.25	215.25	10	-0.25	0.062	1.302
10.5-11.0	10	10.75	107.5	10	-0.75	0.562	5.620
11.0-11.5	6	11.25	67.5	10	-1.25	1.562	9.372
11.0-11.5	2	11.75	23.5	10	-1.75	3.062	6.122
TOTAL	50		519.5				24.594

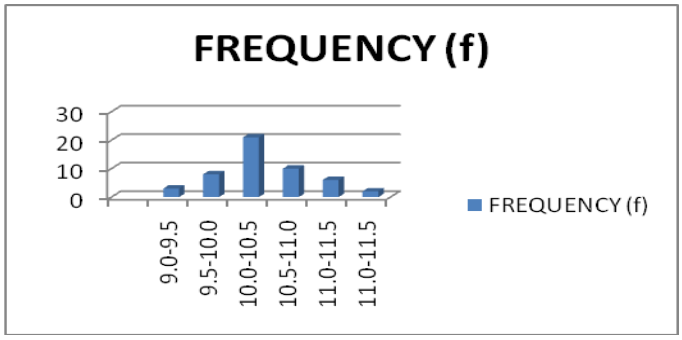

Figure 4. Frequency Distribution graph for the obtained readings

Conclusion

The above setup gives the steering torque reading as 19.1 N-M which is well within range. Has a standard deviation of 0.701 which also signifies good precision.

References

[1] Steven Fox.," Cockpit Control Forces" SAE Technical Paper July, 2010

[2] Ji-Hoon Kim, Jae-Bok Song "Control Logic for an electric power steering system using assist motors "Science Direct April 2002.