Abstract: This invention relates to a vehicle steering system testing apparatus comprising of an anchoring unit fixed rigidly to a flat surface to anchor front end of a vehicle, a hydraulic motor powered with hydraulic source, a steering wheel adapter, a shaft for connecting said hydraulic motor with said steering wheel adapter, said assembly of hydraulic motor and steering wheel adapter with shaft being connected to a steering wheel of said vehicle under test, and an encoder mounted on said hydraulic motor to sense and control the number of steering input turns and method of testing thereof.
STEERING SYSTEM TESTING APPARATUS AND METHOD OF TESTING THEREOF

FIELD OF INVENTION

This invention relates to apparatus used for testing automobile systems and more particularly it relates to apparatus and method of testing steering system.

BACKGROUND OF INVENTION

Steering system test is required to know the interaction of various steering system components with each other. It also provides the possible deterioration in steering component performance over a period of time.

In the conventional test method, on a test fixture, steering system components and actual vehicle parts are assembled partially. The steering system layout dimensions are ensured as per the vehicle layout. For generating steering reaction loads, the steering knuckle is attached with additional bracket to which reaction hydraulic load cylinder is attached. During the steering system test, the steering input turns are applied through the hydraulic motor attached to steering shaft. The steering reaction load is generated by restricting the oil flow out of the reaction cylinder.

The steering system level tests involve the steering system components from steering wheel to road wheel. The system level test on a steering system conducted for determining deterioration in steering system components.
Drawbacks associated with said conventional test method are

- Occurrence of more fluctuations in steering reaction loads.
- Chances of occurrence of unrealistic failures.
- Time required for testing is more.
- Deterioration in steering geometry cannot be analyzed.

OBJECTS OF INVENTION

> The main object of this invention is to provide a Steering system testing apparatus and method of testing thereof by eliminating unwanted artificial force.

➢ Yet another object of this invention is to provide a Steering system testing apparatus and method of testing thereof which requires low set up time.

➢ Yet another object of this invention is to provide a Steering system testing apparatus and method of testing thereof which is simple in construction and cost effective.

BRIEF DESCRIPTION OF THE INVENTION

Steering system testing apparatus in accordance with this invention basically comprises of hydraulic motor, encoder, steering wheel adaptor with shaft, wheel mounting plates, anchoring unit and hydraulic motor mounting means. Wherein said hydraulic motor is connected to steering wheel adapter with shaft, said assembly of hydraulic motor and steering wheel adapter with shaft is connected to
steering wheel of a vehicle under test. Said encoder is mounted on hydraulic motor. Said hydraulic motor is mounted on a hydraulic motor mounting means and is powered by a hydraulic source. Said wheel mounting plates are adopted to put under the front wheels of a vehicle under test. Said anchoring unit is adapted to fix rigidly to the flat surface to anchor front of vehicle.

In the test method, vehicle on road wheels is used directly for conducting the steering system durability test. The vehicle on wheels with complete steering system component assembled is parked on level surface. A hydraulic motor is connected to steering wheel using suitable adapter. The static steering resistance load is generated by loading the vehicle in front to get the front axle weight reaction. The total number of steering turns is controlled using encoder data at steering input. The durability cycle is conducted by turning the hydraulic motor with hydraulic assistance through one complete steering turn from right hand turn to left hand turn back to right hand turn.

The steering wheel is connected to hydraulic motor. The number of motor turns is controlled by encoder data. For generating steering reaction load the vehicle is loaded to simulate front axle weight. The friction at front tyres is ensured by placing the steel plate below each front wheels.

Accordingly, the present invention relates to a vehicle steering system testing apparatus comprising: an anchoring unit fixed rigidly to a flat surface to anchor front end of vehicle; a hydraulic motor powered with hydraulic source; a steering wheel adapter; a shaft for connecting said hydraulic motor with said steering wheel adapter; said assembly of hydraulic motor and steering wheel adapter with shaft is connected to steering wheel of a vehicle under test; an encoder mounted on said hydraulic motor to sense and control the number of steering input turns.
Accordingly, the invention also relates to a method for vehicle steering system testing comprising the steps of: placing said vehicle on wheels with complete steering system component assembled on a flat surface; anchoring front of said vehicle without imposing additional weight component in front axle weight to arrest unwanted vehicle movement as a result of steering inputs; mounting a hydraulic motor on suitable means, said hydraulic motor being adapted to connect with a steering wheel adapter through a shaft; connecting the steering wheel of the vehicle under test with said assembly of hydraulic motor and steering wheel adapter with shaft; mounting an encoder on said hydraulic motor to sense and control the number of steering input turns in clockwise and anti clockwise directions; turning the hydraulic motor through one complete steering turn from right hand turn to left hand turn back to right hand turn to determine the durability cycle of the steering system.

DETAIL DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein the showings are for the purpose of illustrating a preferred embodiment of the invention only, and not for the purpose of limiting the same,

Fig 1. Shows steering system test apparatus fitted to vehicle in accordance with this invention

Referring to fig. 1

Steering system testing apparatus in accordance with this invention comprises of hydraulic motor (4), encoder (7), steering wheel adaptor with shaft (6), wheel mounting plates (9), anchoring unit (3) and hydraulic motor mounting means (10). Wherein said hydraulic motor (4) is connected to steering wheel adapter with shaft (6), said assembly of hydraulic motor and steering wheel adapter with shaft is
connected to steering wheel (5) of a vehicle under test. Said encoder (7) is mounted on hydraulic motor (4). Said hydraulic motor is mounted on a hydraulic motor mounting means (10) and is powered by a hydraulic source. Said wheel mounting plates (9) are adopted to put under the front wheels (11) of a vehicle (1) under test. Said anchoring unit (3) is adapted to fix rigidly to the flat surface (2) to anchor front of vehicle (1).

In this test method, vehicle (1) on road wheels is used directly for conducting the steering system durability test. The said vehicle on wheels with complete steering system component assembled is placed on flat surface (2). The vehicle is anchored by said anchoring unit (3) on said flat surface (2) to arrest unwanted vehicle movement as a result of steering inputs. Also care is taken that the vehicle anchoring is not imposing additional weight component in front axle weight. Said encoder (7) with adapter is connected to sense the number of steering input turns in left hand & right hand directions. The static steering resistance load is generated by providing load (8) at the front of vehicle as per specified front axle weight reaction. The total number of steering turns is controlled using encoder (7) data at steering input. The durability cycle is conducted by turning the hydraulic motor (4) through one complete steering turn from right hand turn to left hand turn and back to right hand turn.

Method of testing steering system in accordance with this invention comprises of

a. Placing the vehicle on flat surface (2) with complete steering system components;

b. Loading the vehicle to prescribed front axle weight by putting dead weights on vehicle floor and/or seat; the front axle weight is measured by placing load cell under front wheels (11); said load cells are removed after completion of measurement;
c. Anchoring said vehicle on said flat surface (2) by means of anchoring unit (3) to arrest unwanted vehicle movement as a result of steering inputs;
d. Connecting assembly of hydraulic motor and steering wheel adapter with shaft to steering wheel (5) of a vehicle under test; said hydraulic motor is mounted on a hydraulic motor mounting means (10) and is powered by a hydraulic source;
e. Mounting encoder (7) on said hydraulic motor (4);
f. Putting the control knob of test controller in manual mode;
g. Measuring input torque performance of the steering system by connecting a torque load cell between hydraulic motor (4) and steering wheel with adapter shaft (6); said torque load cell is disconnected after completion of measurement;
h. Reconnecting assembly of hydraulic motor and steering wheel adapter with shaft to steering wheel (5);
i. Supplying hydraulic fluid to said hydraulic motor (4) with a fluid pressure just sufficient to rotate said steering wheel;
j. Adjusting hydraulic fluid flow for getting preferably 8 to 9 test cycles per minute;
k. Controlling the number of rotations of hydraulic motor in single cycle by using said encoder;
l. Setting the encoder (7) data in the controller for controlling number of turns in clockwise and anti clockwise directions in single cycle;
m. Putting the control knob of test controller in automatic mode;
n. Measuring the number of endurance cycles using a cycle counter of said controller.

The foregoing description is a specific embodiment of the present invention. It should be appreciated that this embodiment is described for purpose of illustration.
only, and that numerous alterations and modifications may be practiced by those skilled in the art without departing from the spirit and scope of the invention. It is intended that all such modifications and alterations be included insofar as they come within the scope of the invention as claimed or the equivalents thereof.
CLAIMS

1. A vehicle steering system testing apparatus comprising:
   an anchoring unit fixed rigidly to a flat surface to anchor front end of a vehicle;
   a hydraulic motor powered with hydraulic source;
   a steering wheel adapter;
   a shaft for connecting said hydraulic motor with said steering wheel adapter;
   said assembly of hydraulic motor and steering wheel adapter with shaft being connected to a steering wheel of said vehicle under test; and
   an encoder mounted on said hydraulic motor to sense and control the number of steering input turns.

2. The apparatus as claimed in claim 1, wherein mounting means are provided to mount said hydraulic motor.

3. The apparatus as claimed in claim 1, wherein wheel-mounting plates are provided under the front wheels of said vehicle under test.

4. The apparatus as claimed in claim 1, wherein a load is provided at the front of said vehicle as per a specified front axle weight reaction to generate static steering resistance load.

5. The apparatus as claimed in claim 1, wherein a cycle counter is provided to measure the number of endurance cycles of the steering system of the vehicle under test.
6. The apparatus as claimed in claim 4, wherein load cells are provided under front wheels to measure front axle weight; and torque load cells are provided between hydraulic motor and steering wheel with adapter shaft to measure input torque performance of the steering system.

7. A method for vehicle steering system testing using the apparatus as claimed in claims 1 to 6 comprising the steps of:
   - placing said vehicle with complete steering system component assembled on a flat surface;
   - anchoring front of said vehicle without imposing additional weight component in front axle weight to arrest unwanted vehicle movement as a result of steering inputs;
   - mounting a hydraulic motor on suitable means, said hydraulic motor being adapted to connect with a steering wheel adapter through a shaft;
   - connecting the steering wheel of the vehicle under test with said assembly of hydraulic motor and steering wheel adapter with shaft;
   - mounting an encoder on said hydraulic motor to sense and control the number of steering input turns in clockwise and anti clockwise directions; and
   - turning the hydraulic motor through one complete steering turn from right hand turn to left hand turn back to right hand turn to determine the durability cycle of the steering system.

8. The method as claimed in claim 7, comprising the step of loading the front of vehicle as per a specified front axle weight reaction to generate static steering resistance load.
9. The method as claimed in claim 7, wherein hydraulic flow to said hydraulic motor is adjusted to obtain preferably 8 to 9 test cycles per minute.

10. The method as claimed in claim 7, includes the step of measuring the front axle weight by placing load cell under front wheels.

11. The method as claimed in claim 7, includes the step of measuring the input torque performance of the steering system by connecting a torque load cell between hydraulic motor and steering wheel with adapter shaft.

12. A vehicle steering system testing apparatus as hereinbefore described with reference to the accompanying drawing.

13. A method for vehicle steering system testing as hereinbefore described with reference to the accompanying drawing.