ISSN (Online): 2349-7084
GLOBAL IMPACT FACTOR 0.238
ISRA JIF 0.351

INTERNATIONAL JOURNAL OF COMPUTER ENGINEERING IN RESEARCH TRENDS
VOLUME 2, ISSUE 5, MAY 2015, PP 329-334

Power Steering in Automobiles and Review the Allocation Procedure

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Abstract: The purpose of power steering is to reduce the driver's effort at the steering wheel. Steering wheel that the spooked hand wheel at the top of the steering column of an automobile which actuates the steering gear.

Such a system is used in heavy commercial vehicle and therefore, application of power steering in car, is the biggest question today is. Because as per norms of power steering, whose vehicle unladen weight is more than 1500 kgs , may affect as the proper norms. However, introducing of power steering in car, in terms of prefect steering is to a problem by means of dragging, while sudden applied of brake.

Power steering mechanism employs Electrical Devices, Compressed Air and Hydraulic pressure. There are two types of power steering, i.e. integral and linkage. The integral type, the power steering systems forms part of the steering gear, where as linkage type, it forms part of the steering linkage.

Key words: Dragging, Electrical Device, Effect of steering mechanism, electronics device, Horse Power, Power Steering, Steering Linkage

1.INTRODUCTION

The power steering is consisting by a fluid reservoir, hydraulic pump, hydraulic ram, hydraulic control valve, steering shaft, steering box and steering wheel.

Steering wheel is made of steel rod ring welded together on a hub with help of 2, 3, or 4 spokes. In our country steering wheels have a fixed position, but in foreign countries in some vehicles these wheels locked in any position to suit the driver.

Hydraulic pump, mechanism worked completely or partially by force transmitted through liquid. Steering shaft is made by good quality steel and help to rotate properly.

The need of greater steering angle that, it is seen that the inside wheel is required to turn to a greater angle than the outer wheel.

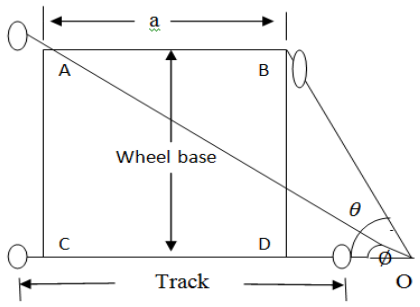

Fig: 1.1. Condition for true rolling:

$\emptyset$ → angle of outside lock.
θ → angle of inside lock.

AB = CD = CO – DO = AC$\emptyset$ – BD Cot θ
Therefore, Cot $\emptyset$ – Cot θ = $\frac{AB}{AC}$ = $\frac{a}{b}$,
Therefore, Cot $\emptyset$ – Cot θ = $\frac{a}{b}$

The above equation gives the fundamental condition to be satisfied and as per experimental study for car, this formula is not helping due to sudden applied of brake, as a result, dragging i.e. car pull one side.

2. LITERACY REVIEW:

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2.1. ACKERMANN STEERING MECHANISM:

Two different steering mechanisms are used: [1] Davis Steering System,
[2] Ackermann Steering Mechanism,

However, Ackerman steering mechanism is generally used in all the vehicles. The Ackermann steering gear is much simpler than Davis and consists of a four-bar chain having turning pairs only. Steering arm AB and CD make equal angles with the front wheel axis. ACBD forms a four bar mechanism the links of which are proportional that the fundamental condition for true rolling is satisfied.

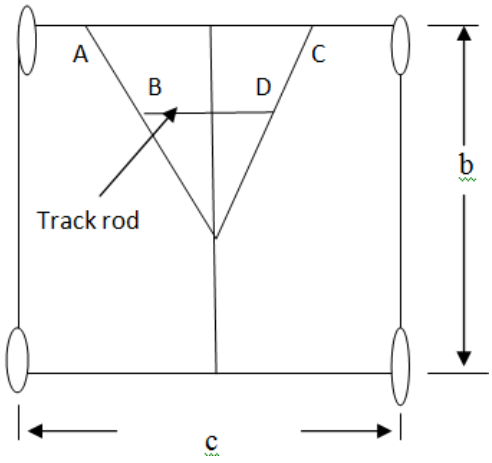

Fig: 2(a)

The principal states when a vehicle takes a bend, its wheels should make round the same centre. In other words, the front wheels must relation to each other and the axis of front wheels should meet the axis of rear wheels at a point. This point known as the instantaneous centre (O).

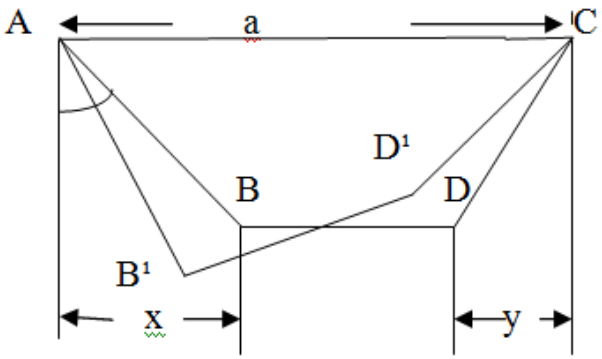

Fig:2.(b)

Let the steering wheel's given a clockwise rotation right hand side turn of the vehicle the new position of linkage. Neglecting the slight inclination of the track rod, the movement of B and D in the direction parallel to the axle beam AC will be the same. Let B^1D^1 be the correct steering position and z denote the steering arm radius.

Then, Sin $(\propto + \emptyset) = \frac{x+y}{z}$

And, Sin $(\propto - \emptyset) = \frac{x-y}{z}$

Therefore, Sin $(\propto + \theta)$+ Sin $(\propto - \emptyset)$,

$= \frac{2x}{y}$

$= 2 \sin\propto$.

The variable O and Ø can b calculated for correct steering with help of above equation.

3. METHODOLOGY :

While a driver, drive the car by the manual steering, the driver suppliers all the steering force and therefore, there are some disadvantages to manual steering. Automobile usually do not have full power steering. They have power assisted steering, which is called power steering. Power steering systems have used compressed air, electrical devices and hydraulic pressure.

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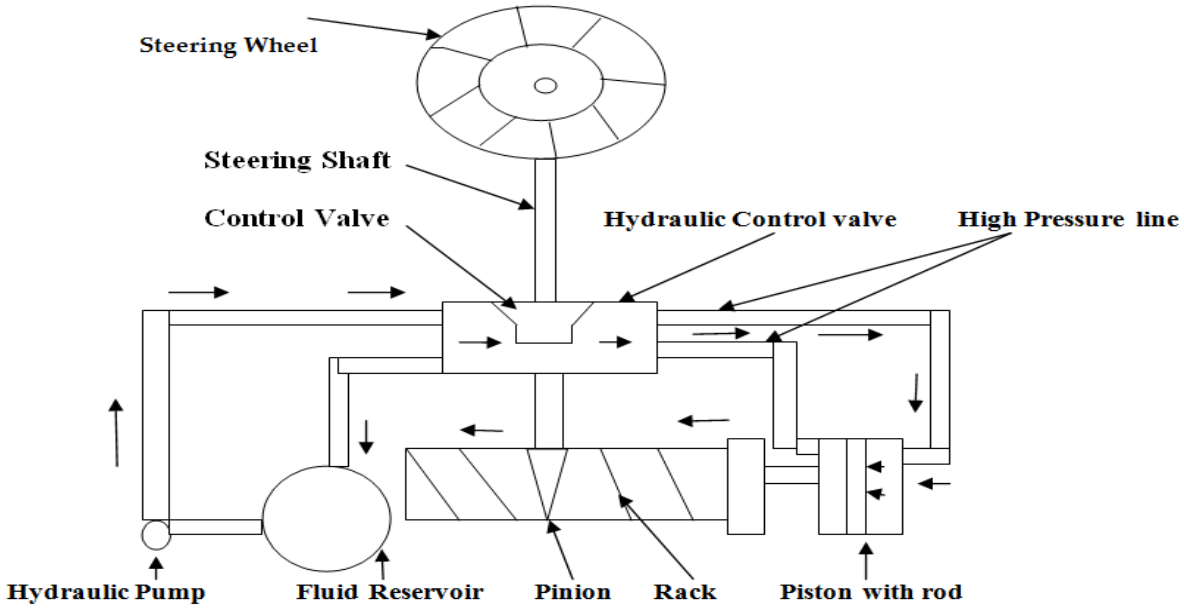

Fig. 3(a) Power Steering

The engine driven hydraulic pump feeds the fluid under pressure forms the fluid reservoir to the hydraulic feed lines. A hydraulic control valve situated below the steering senses the input pressure at the steering wheel and converts it into pressure changes into the hydraulic arm. As soon as the driver turns the steering wheel, the steering arm moves the control valve such that one of the parts closes whilst the other opens.

In terms of turning radius, when a vehicle a turn without experiencing any lateral slip , all the wheels rotate about a common centre along different turning circle.

Turning circle radius of the outer front wheel = $\frac{b}{\sin\theta}$ + (c-a/2).

Turning circle radius of the inner front wheel = b/Sin θ – (c-a/2).

Turning circle radius of the outer rear wheel
= b Cot Ø + (c-a/2).

Turning circle radius of the inner rear wheel
= b Cot θ = (c-a/2).

For example: (A vehicle with wheel base = 2·14 and front wheel track = 1· 22 m is provided with Ackermann steering system. The distance from the centre plane of each front wheel to the nearest king pin axis is 0·11 m. while taking a turn, the inner front wheel is deflected through a maximum angle of 42´ .Calculate the corresponding deflection of the outer front wheel, assuring that all vehicles are in true rolling motion. Also find the turning radius of the outer front wheel and inner rear wheel).

Solution:

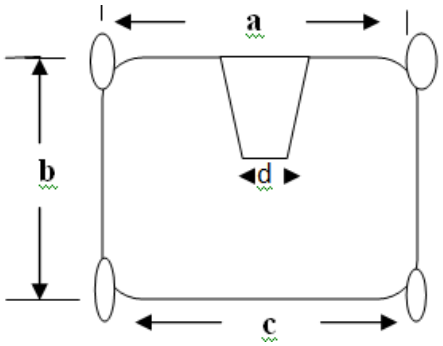

Fig:3(b)

For correct steering,
Cot Ø – Cot θ = a/b,
Cot Ø – Cot 42º = 1.00/2.17,
∴ Cot Ø = 1.00/2.14 + Cot 42º,
= 0.467 + 1.11
= 1.571,
∴ Ø = 32.4º.

Turning circle radius of the outer front wheel = 1/SinØ + (c-a/2),
= 2/in 32.4 ° + (1.22 – 1.00/2),
= 2.14/.536 + 0.11,
= 3.99 + .11,
= 4.10 m.

Turning circle radius of the inner rear wheel = b Cot θ = (c-a/2),

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= 2.14 Cot 42º - 0.11
= 2.14 × 1.110 – 0.11,
= 2.38 – 0.11,
= 2.27 m.

4. RESULT AND DISCUSSION:

Steering gear ratio means, the number of turns of the steering wheel to one turn of pitman arm. If the turning of the steering wheel through 360°, the angular movement of the steering arms is 360°: 36° (10 : 1).

Vehicle having low horse power (hp) use steering ratio between 10:1 to 12:1, and Medium horse power is 13:1 to 16:1 and heavy vehicles is 15:1 to 25:1.

The power steering systems used in automobiles is basically a modified of manual steering linkage are little changed from the manual steering systems. The main electrical device that is power booster has been added to assist the driver.

As per the basic operation of power steering systems, the booster is set into operation when the steering shaft is turned. Than after the steering effort exceeds a certain force, the booster takes over and provides most of the force required for steering.

For example, some cars have power assistance when the force applied at the steering wheel is more than about 4 pounds (17 N). The force varies with the make and the model of the car and the most cars it ranges from 1.5 to 7 pounds (7 to 31 N).

Today is the biggest question, electronics device of power steering special reference to car, is depending on horse power as well as aerodynamic body design. If it is not properly adjusted, the sudden application of brake may cause accident by dragging. i.e. car pull to one side , because while the driver is going to brake applied, this force is increasing by 8 times of as per horse power. For example, one vehicle has 100 hp, after the braking applied is going to reached 800 hp.

Brake horse power that, the net power obtained at the shaft termed s brake horse power and is measured by a rope brake arrangement.

b. h. p. = $2\pi NT/4500$,

Where, N = r. p. m. of crankshaft.

T = Torque

= (W-S)D/2 kg.m.

b.h.p. = $\dfrac{\pi DN(W-S)}{4500}$

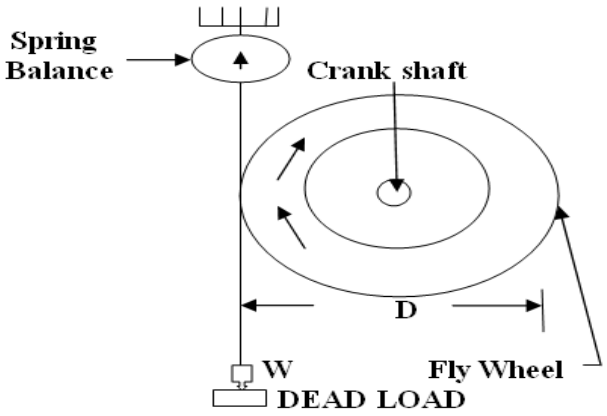

Fig: 4.1

5. TYPE OF DATA:

Tata heavy vehicles are difficult to steer because they have large cross section tyres, having large contact area and heavy load calls for more effort by the driver to turn the steering wheel. Therefore, TATA used Z. F. Hydraulic power steering, which is more comfort towards turn by steering wheel. Because, controlling the vehicles as well as controlling of power steering, this Z. F. hydraulic power steering, the driver's effort is substantially reduced while he can easily get the 'feel' of the road.

Tata Z F hydraulic power steering is consisting by:

[1] Z F valve and Nuts,
[2] Z F van type pump,
[3] Integral Micronics filter,
[4] Hydraulic tank,
[5] Connection hose pipe, etc.

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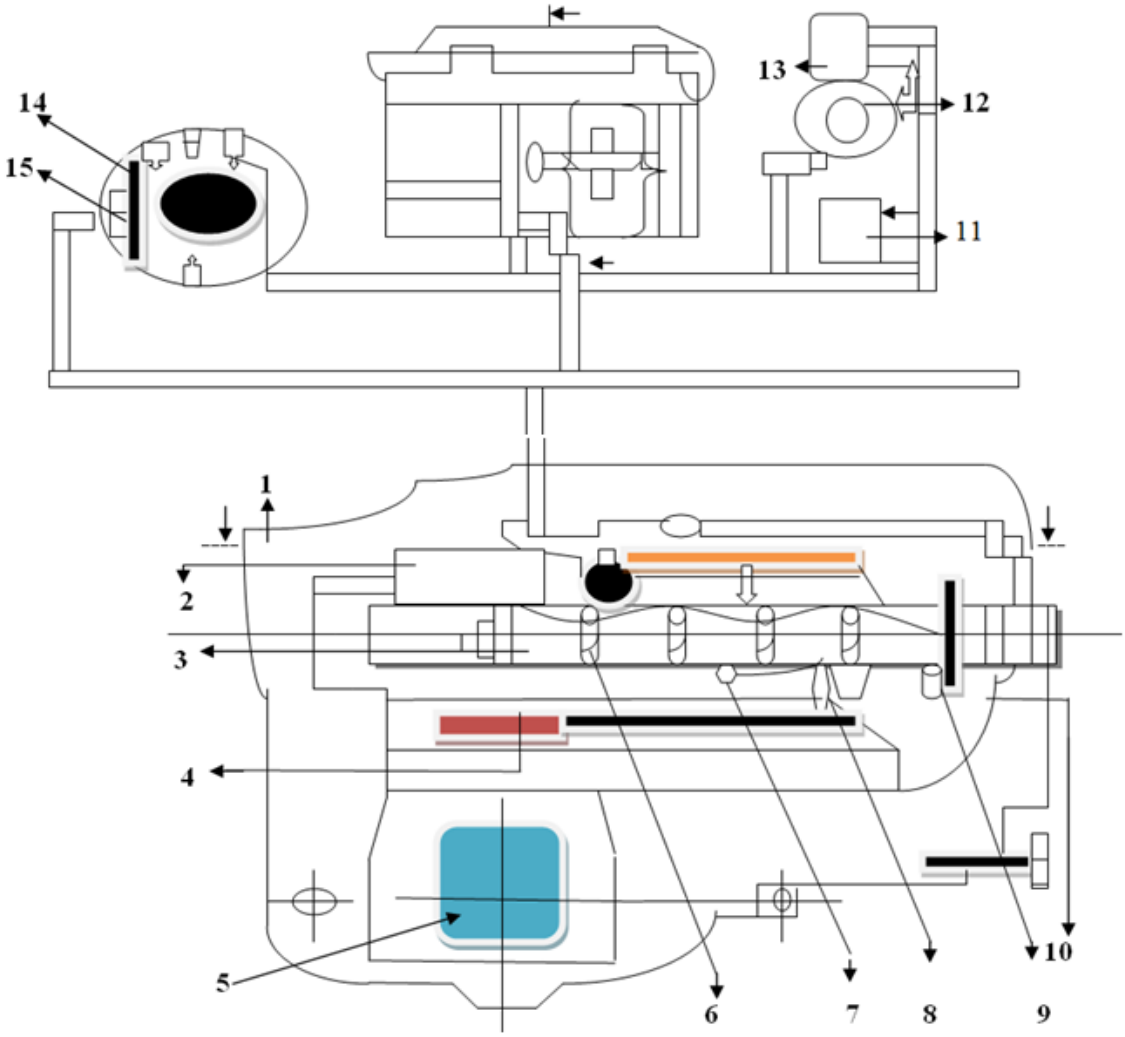

Fig. 5(a) Power steering sectional views:

Thread Rig,
1. Piston,
2. Bar.
3. Baoding Bar,
4. Sector Shaft,
5. Valve,
6. Steering Nut,
7. Thread Rig,
10. Regulator Control Valve bearing
11. Pressure Relief Valve,
12. Full Control valve with Band Pipe
13. Oil Reservoir,
14. Rear Piston,
15. Valve Pullet, etc.

Tata Z P Hydraulic power steering (Fig. 5(a) is small size and located inside the steering housing. Control valve is operated by smoothly and valve is properly done matching between oil level and power steering. As per study it was found that the in between contact each other up to 130 times. The figures 5(a), shows that sectional view of valve and nut power steering and vane pipe is joint and steering is in neutral position.

1. For the Tata power steering the following three points are most important:
2. Pressure line to be located in between pump and steering gear box,
3. Return line to be located in between steering gear box and oil tank,

4. Section line to be located in between oil reservoir and oil pump, etc.

6. CONCLUSION:

The power steering system, a continuously operating pump provides hydraulic pressure when needed. However, steering geometry, it is a simple lay out of the steering systems. The relation between the valves of wheel alignment, castor, camber and king pin inclination.

Steering geometry, usually called front wheel alignment, is not only checking of toe and adjusting of steering linkage, but the following items are of steering geometry since these all play an important role for easy and safe driving.

1] Camber angle,
2] Ackerman Steering,
3] Toe-in,
4] Toe-out,
5] King pin inclination,
6] Caster angle, etc.

7. ACKNOWLEDGEMENT:

The author as Engineering Graduate, MBA along with Ph.D. in Automobile Engineering from International University, Washington, USA/2001 and Published numbers of research paper/projects completed i.e.

UGC sponsored national seminar: 87 Nos.
NAAC sponsored national seminar: 05 Nos.
CTE International Conference: 05 Nos
Guwahati University/Dibrugarh University/Assam University/ Tezpur : 32 Nos.
University/ Assam Agricultural university/UST, Shillong/ Institution of Engineers, SCERT etc National/International seminar/ Conference.
5. SAE International Conference/Exposition i.e. USA/France : 07 Nos.
6. Recipient of BOLT Award/ Gold Medal etc: 05 Awards
7. Publication of Books : 07 nos.

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