Volume 2, Issue 4 April 2016 ISSN NO: 2454 - 7514

North Asian International Research Journal Consortium

North Asian International Research Journal

Of

Science, Engineering and Information Technology

NAIRJC JOURNAL PUBLICATION

North Asian International Research Journal Consortium

Welcome to NAIRJC

ISSN NO: 2454 -7514

North Asian International Research Journal of Science, Engineering & Information Technology is a research journal, published monthly in English, Hindi, Urdu all research papers submitted to the journal will be double-blind peer reviewed referred by members of the editorial board. Readers will include investigator in Universities, Research Institutes Government and Industry with research interest in the general subjects

Editorial Board

Address: - Dr. Ashak Hussain Malik House No. 221 Gangoo, Pulwama, Jammu and Kashmir, India - 192301, Cell: 09086405302, 09906662570, Ph. No: 01933-212815,
Email: nairjc5@gmail.com, nairjc@nairjc.com, info@nairjc.com Website: www.nairjc.com

COMPARATIVE REVIEW OF STEERING MECHANISMS IN TWO WHEELERS

ABHIJEET KHANDAGALE[#1] & VIPIN KHANGAR[#2]

[#1 #2] CAD/CAM, Dept of Mechanical Engineering, G. H. Raisoni College of Engineering, CRPF Gate, Hingna Nagpur.

ABSTRACT: - The paper presents a view into the steering systems used in two wheelers, with the major comparison between Twin Fork Steering and Hub Center Steering. The paper discusses the difference; advantages and disadvantages of using a hub centered steering mechanism over the conventional twin fork system. The idea is to support the use of hub center steering, using a simpler design, which also has been discussed.

I. INTRODUCTION

In the current motorcycle designs, the front wheel is held by the front forks, these twin forks provide the front suspension. Since the front forks are placed at an angle to the ground, the telescopic forks are a bad place to setup the suspension system. Engineers are limited by the size and configuration of these forks to employ changes in the springs and shock absorbers. The hub center steering allows the wheel to rotate left / right on its axle as it steers like a normal bike. The design of HCS enables engineers to modify the front suspension, which has a similar feel of the rear suspension.

Telescopic forks are still far from perfect design, yet they are widely employed front-end suspension for current bikes. The angle of the front forks exerts a large force on the steering head of the frame.[1]Each of the designs have their relative advantages and disadvantages. We have discussed the same in the length of this paper. A proposed design of a new mechanism is also discussed which combines the best of both worlds. The complexity of the hub steering is reduced in the design, which will enable a low cost of production.

II. TWIN FORK STEERING

Telescopic forks are mechanical prismatic joints, thus it is not possible to remove the static friction between the sliding components. The usual result is a poor response to minor road vibration. The up-side-down forks are coated with advanced materials like TiN or carbon composites however the intrinsic properties are still present. [2]High rigidity and heavy unsprung mass if loaded on the front system will minimize the front wheel misalignment. The need of a large and heavy frame, which also is considerably stiff, is due to the road forces that get transmitted through the contact surface between the tire and the road passing through the forks gets magnified into the frame**.** Significant variations in geometry parameters, like caster angle is not permitted by the design layout of this suspension system.

The figure shows the tyre contact patch moves from the steer axis when there is a lateral flex in the forks. This causes wobbles and greatly increases the misalignment, on smooth roads at a given speed, or at any given speed on a bumpy surface. When there is a bump on a side of the wheel, the forks deflect due to the forces generated in the interaction. In a successive event, the forces cause the forks to steer. This happens due to the torque produced about the steering axis. In some cases, it results in a minor handlebar shake, while in several events it can cause an occasional fatal accident. A rigid inline arrangement of the tire contact along the steering axis can reduce the torque at the steering. The suspension system absorbs these bump forces, without a

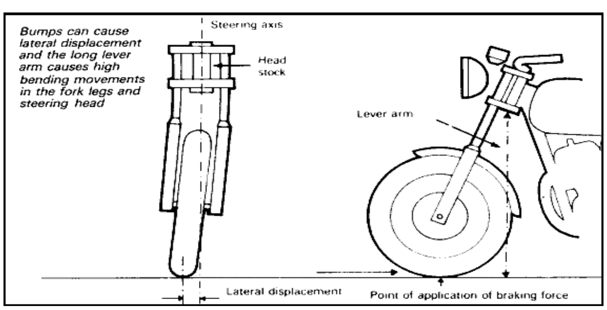


Figure 1-Steering Axis Displacement due to Bumps – Twin Forks

major awareness from the rider. There are several problems which arise due the application of a head-mounted front fork system, but the potential for lateral flex in the system is highly important.[3]

The advantages of having a twin fork system mainly is the less number of components which means a higher rate of production and thus industrially viable. The wishbones can be triangulated, which provides the chassis strength and light weight.[4]

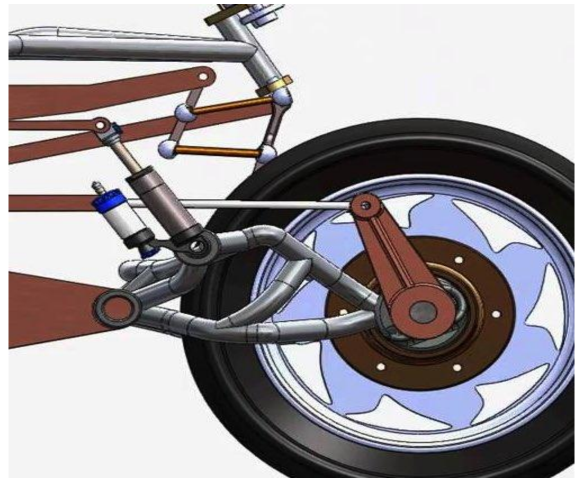
The twin fork system causes the bike to dive forward under the influence of braking forces, which alter the basic steering geometry. Also it reduces the suspension length available to absorb the bumpy road profile and the ability to maintain traction. It is calculated that 42% of the forward force that gets generated while braking, gets directed to the fork legs and absorbed by the springs and fork oil. While excessive brake dive is a matter of concern, the resultant geometry can cause the loss of traction, a certain amount of brake dive reduces the rake and trail of the motorcycle, which allows it to turn more easily.

III. HUB CENTER SYSTEM

The credit for hub center front suspension system designs is borne by Joe Difazio, a British engineer. These systems are the same as the ones used in the Bimota Tesi, and concept-turned production bikes like Vyrus.

The design of an HCS consists of a hub connected to a king-pin which is constrained. This design allows the hub to rotate in the vertical axis direction. A larger diameter clamp (C-shaped) is attached to the hub mounted to king-pin and it rotates in the lateral axis direction. In usual cases, the outer hub is mounted rigidly on the front wheel and the front swing arm connects the king-pin to the frame. In the hub center mechanism, the roles get reversed. The outer clamp is mounted on the swing arm, and the inner king-pin hub is attached to the wheel. The inner hub is constrained in such manner that it can steer but restricts rotation. Also, the king-pin is restrained by rigidly mounting it on the front swing arm; the torque arms connect the mechanism to the frame. The steering axis is defined as geometric vertical axis along the king-pin. This allows engineers to easily alter the steering geometry parameters, which is not possible in the front fork design.[5]The front swing arm the steering geometry values can be tuned to be constant if the inner hub is not rigidly attached. These can also be increased or decreased in relation to the vertical movement of the wheel. The risk of possible flexures and the resulting front wheel misalignments can be reduced by the proximity of the steering axis which is defined by the king-pin and the axis of rotation. [6]

The front swing arm design allows design engineers to employ the suspension with features such as a positive or negative dive as well as progressive dive.



The bike will actually raise during braking with negative dive. There is no longer a need for a sturdy frame around the upper steering column to counter force from the telescopic fork. It maintains a constant stability as there is a minimal change in wheel base throughout suspension motion. [7]Optimum performance can be achieved by controlled adjustment of the separation between suspension and steering control.

The unique steering has its drawbacks - high costs owing to the complexity of the mechanism. The industrial production costs shoot up since only a limited number of components can be manufactured in a shift compared to the traditional setup.[8] The steering poses a new challenge as the supporting chassis limits the steering. An intangible cause is the perception among the conservative users of the traditional motorcycle market that it doesn't look like a ‘real’ bike.

For production bikes with hub center steering, on the consumer end they are overly expensive compared to comparable bikes in the same price range.

IV. OUR DESIGN

The steering knuckle forms a crucial linkage between the stub axle, tie rod and axle housing. Steering knuckle and the axle housing are connected together by using king pin and the other end is attached to the tie rod. Another major part which holds the wheel is the wheel hub; it is fixed over the knuckle using a bearing. The steering knuckle converts linear motion from the tie rod and converts it into angular motion to the stub axle.

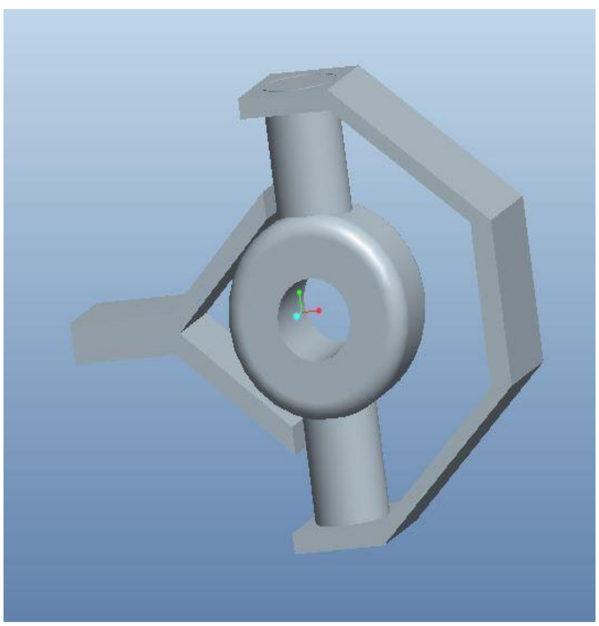


Figure 3 - Current Design of Hub Center Knuckle

Since the inertia of a lighter steering knuckle is less, it results in greater power and less the vibration. The steering knuckle needs to have good yield strength since it carries the power thrust from tie rod to the stub axle; it also needs to be rigid and also as light as possible. Our design employs these characteristics of being light weight and strong. During the motion of the vehicle steering and turning the wheel, subjects the steering knuckle to loads which are both compressive and tension in nature. Since the wheel is in motion, Torsional loads acts on the knuckle due to the wheel rotation.

The inner king-pin hub contains two heavy duty bearings, one for thrust absorption and the other one to aid rolling motion. These bearing are firmly placed inside the hub and restrained by a lock pin. The figure 2 shows the modeled design. The C-clamp is attached to the swing arm, while the king-pin hub is connected to the wheel. A five-bolt wheel hub shaft runs through the hub which is free to rotate.

V. CONCLUSION

While the twin fork design continues to dominate the market, there are several improvements in the design that have been already made. A hub center steering which has higher functional benefits lacks market leadership owing to its complexity. The proposed steering mechanism is aimed at simplifying the hub center steering mechanism. The design process has been selected to reduce the cost and the production complexity of the part.

REFERENCES

[1], [5] Motorcycle Chassis Design: The Theory And Practice; Tony Foale, A. Foale, Published 1984

[2]http://www.carbibles.com/suspension_bible_bikes.html

[3]Analysis Of Alternative Front Suspension Systems For Motorcycles; Basileios Mavroudakis*, Peter Eberhard* IECM, Univ Of Stuttgart, Germany

[4], [6], [7] Foale, Tony (2002). Motorcycle Handling and Chassis Design. Spain: Tony Foale Designs. ISBN 84-933286-3-4.

[8] Wilson, Hugo (1995). The Encyclopedia of the Motorcycle. Dorling-Kindersley. ISBN 0-7513-0206-6.

Publish Research Article

Dear Sir/Mam,

We invite unpublished Research Paper,Summary of Research Project,Theses,Books and Book Review for publication.

Address:- Dr. Ashak Hussain Malik House No-221, Gangoo Pulwama - 192301
Jammu & Kashmir, India
Cell: 09086405302, 09906662570,
Ph No: 01933212815
Email:- nairjc5@gmail.com, nairjc@nairjc.com , info@nairjc.com
Website: www.nairjc.com