DESIGN OF FLOATING HANDLEBAR SUSPENSION

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Abstract

An alternative to the conventional telescopic fork type front suspension used in bicycles is the Floating handle bar suspension which replaces the two springs that are used in the Telescopic forks by a single open coiled spring of a greater wire diameter and stiffness thereby eliminating the need of telescopic forks. In our study we determine the spring that is to be used to produce the required suspension effect. The newly designed spring was integrated to the bicycle and the model was validated by a working prototype which was ridden to check for any failures. The bicycle model used for checking the effectiveness of floating handlebar suspension was a Hercules Terminator V2. One major problem that we faced was the maneuverability of the bicycle during hard turns. This was due to the increase in weight of the front suspension.

Keywords: *Bobbing, MR Fluids, Suspension, Telescopic Forks*

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1. INTRODUCTION

At a time when there were no suspension systems the vibrational stresses on vehicle riders did not only affect riding comfort but also impaired the rider's capability of perception and reaction as well. It even caused damage to the riders health[1,2]. Studies were done in the late 1990's on the effect of vibrational stresses on cyclists and the study was concluded by introducing a suspension followed by the study of vibrational comfort of bicycles[3][4]. The empirical basis for the comparison is a set of extensive measuring data concerning weighted accelerations on the human body, depending on bicycle design, rider mass, and road surfaces, the majority of which were cycle tracks[5]. The main purpose of introducing suspension system to bicycles is to improve the bicycle comfort and handling, by dissipating terrain induced energy. This addition of suspension systems also lead to the dissipation of cyclist's energy through small oscillatory movements termed as Bobbing [6][7][8][9]. The advantages include enhanced cycling velocity and braking capacity due to shock absorption [10]. The traditional choice in bicycles has been the telescopic fork type suspension and for many years there has not been much of progress in improvising or replacing the conventional front suspension. Telescopic forks are basically prismatic joints, thus the static friction between the sliding parts cannot be eliminated and this is usually experienced as a poor response to small road excitations for example negotiating a bump while leaning[11]. Bicycles with front suspension are majorly used by the children in the age group of 12-20 and their rough usage of bicycles also lead to jamming of the suspension system when they hit on hard bumps, this shows us that the load carrying capacity of the conventionally used springs in the front telescopic suspension is less. When the front suspension gets jammed people also generally find it difficult to service their jammed suspension as it remains concealed and often prefer buying a new suspension set. The introduction of Floating handlebar suspension, increases to a large extent the load carrying capacity as a stiffer spring is used. The spring used to give the suspension effect is no more concealed, in case of any problems people can service it themselves as it is just a matter of unscrewing and replacing the spring, thereby saving a lot of trouble and money.

1.1 Spring Design Calculation

Spring Specification:
Spring Material = Chrome silicon steel
Wire diameter, d = 5mm
Mean coil diameter, D = 45mm
Number of active coils = 6
Weight of the bicycle= 9kgs
Let Weight of single person= 70kgs
Total weight= 9+70= 79kgs
Front Suspension = 35%
35% of 79 = 27.65kgs
Considering dynamic loads it will be double,
W = 55.3kgs
Spring Force, F = 55.3*9.81 = 542.493N
Solid length = 30mm
Spring deflection = 47.88mm
Energy stored = 12.99J
Stiffness, K = $11.33*10^3$N/m
Free length of spring = 77.8mm
Pitch of lead = 12.98mm
Shear stress = 497.32 Mpa

1.2 Experimental Validation

A prototype of the proposed model was made. For prototyping, a Hercules Terminator V2 model was used. This model was chosen because it does not have a front suspension system and hence it will be easier for us to study the effect of the floating handlebar suspension. The handle

bar of the model was replaced with an aluminum handlebar that has a fixed rotation about the horizontal axis and unlike other handlebars which are welded to the stem. In our prototype the handlebar was connected using a pin joint.

Model: Hercules Terminator V2

The rotation is possible because of the pin type link that is used to connect the stem and the head tube. Now to hold the spring intact two U joints were used. These are similar to the ones used to hold the springs in the bicycles that have a rear suspension system. The first joint was welded to the stem, to hold the other joint and to fix the spring a supplementary steel rod was used. This steel rod was welded at the fork split area and hence was projected at an angle that was manually chosen to accommodate the length of the spring. The joint was welded to the rod and hence the spring was held between these joints to provide the necessary suspension effect.

2. IMAGES

Floating Handlebar suspension (Closer look)

Different view of the suspension

3. CONCLUSIONS

The prototype was successfully built and was ridden to test for its suspension effect. It proved to handle loads more effectively. Some problems that this model faced was maneuverability at hard turns as the spring system adds to the weight of the handlebar. It adds about .523g to the existing system. In order to overcome the problem of increased weight at the handlebar we can replace the spring mass system with a Magnetorheological(MR) fluid system which will reduce the weight of the system to a great extent and hence help in easier maneuverability during turns. Further research is to be carried out on the same.

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