Using Multilink Type Suspension as a Front Suspension For a Motorcycle

Verwendung Eines Multilink als Vorderradaufhängung für ein Motorrad

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Abstract — In the paper are investigated the possibilities to use a Multilink suspension as a motorcycle front suspension and how the common geometric parameters of the front wheel suspension are represented. One of the possibile variants is shown.

Zusammenfassung — In der Artikel werden die Möglichkeiten zur Verwendung einer Multilink-Aufhängung als Motorrad-Vorderradaufhängung untersucht und wie die gemeinsamen geometrischen Parameter der Vorderradaufhängung dargestellt sind. Eine der möglichen Varianten wird gezeigt.

I. Introduction

In modern motorcycles the most widely used type of suspension is the telescopic fork. Despite its advantages such as simplicity of construction, low cost and easy maintenance, this front suspension also has drawbacks: change of the trail when the suspension travels and increased tendency to "dive" the motorcycle when braking. Some companies offer different types of front suspension designs that somewhat compensate for the above-mentioned drawbacks. Examples include the BMW Motorrad with Telelever and Duolever suspension similar to the trapezoidal suspension for a car and the Yamaha with a one-arm front suspension similar to the McPherson suspension

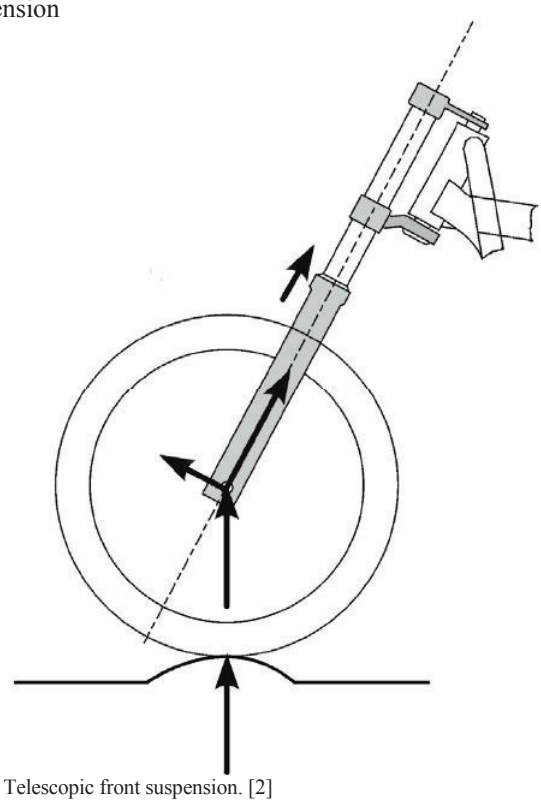

Fig. 1. Telescopic front suspension. [2]

Fig. 2. Telelever suspension type. (BMW Motorrad)

Fig. 3. Duolever suspension. (BMW Motorrad)

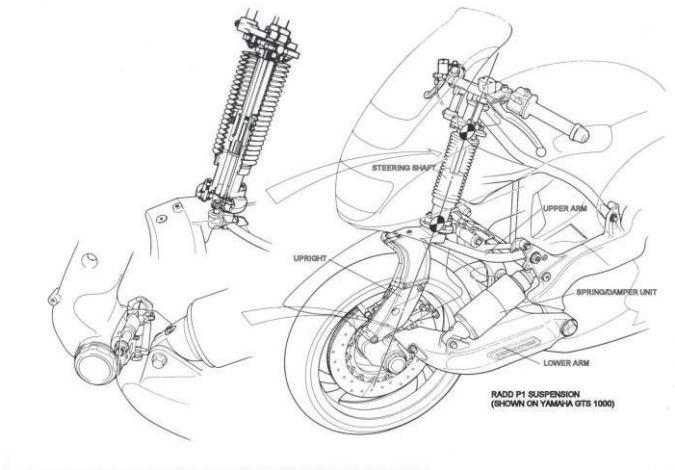

Fig. 4. Front suspension Yamaha GTS 1000.

II. Basic Geometric Characteristics of the Front Suspension of the Motorcycle

In Fig. 5 are shown the basic parameters of the front suspension of a motorcycle. The inscriptions are as follows:

- wheelbase L - 1350 - 1600 mm.
- rake angle α - 61 – 64°.
- trail c - 80 - 125 mm.
- height of the center of masses h – around 600 mm.

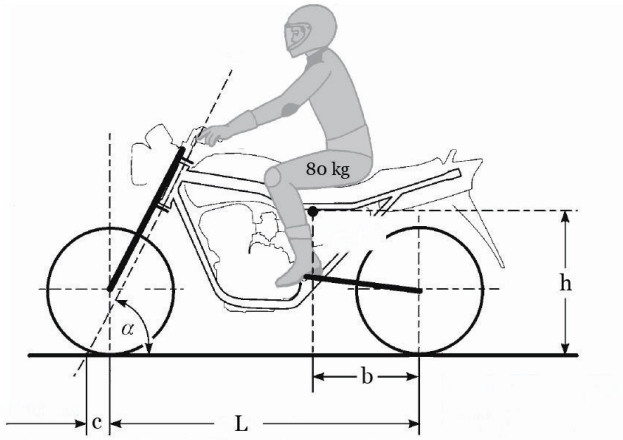

Fig. 5. Basic parameters of the motorcycle suspension [2].

While the motorcycle travels on a road the suspension moves and his geometric characteristics change. When driving on a flat road, the change is not very important due to the small shift only from the road bumps, but in the case of intensive braking, the changes have a significant influence on the suspension parameters, hence on the stability and controllability of the motorcycle.

Fig. 6 shows the change in the geometric parameters of a front suspension of a motorcycle with a telescopic fork while braking. It can be seen that the wheelbasebase and the trail are reduced and the rike angle increases. This reduces the stability of the motorcycle. In some extreme cases, for example in the case of intensive braking, this effect allows the driver to perform an extreme turn to overcome an obstacle, but overall the change in geometric parameters is considered a drawback. [4,5]

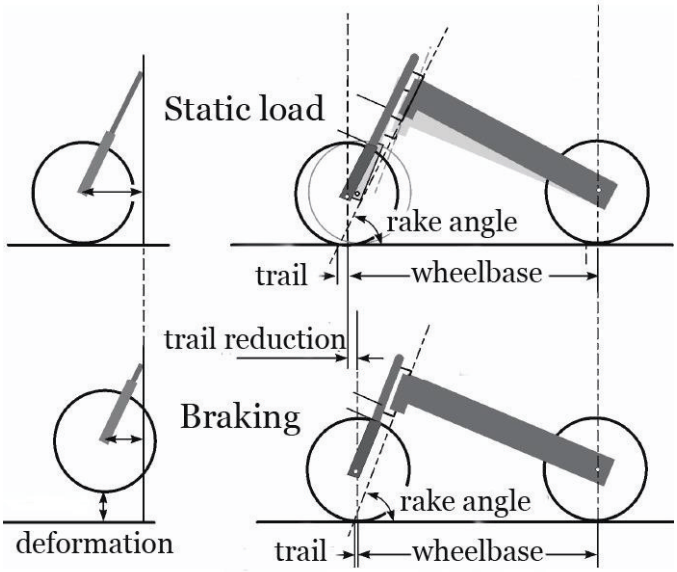

Fig. 6. Changes in the geometric characteristics of a motorcycle suspension with a telescopic fork.

III. Multilink Front Suspension for Motorcycle.

Multilink suspension is common in cars, primarily for high-end and sport cars. This type of suspension has not been seen so far as a front suspension for a motorcycle and one of the possible options for its application is shown below.

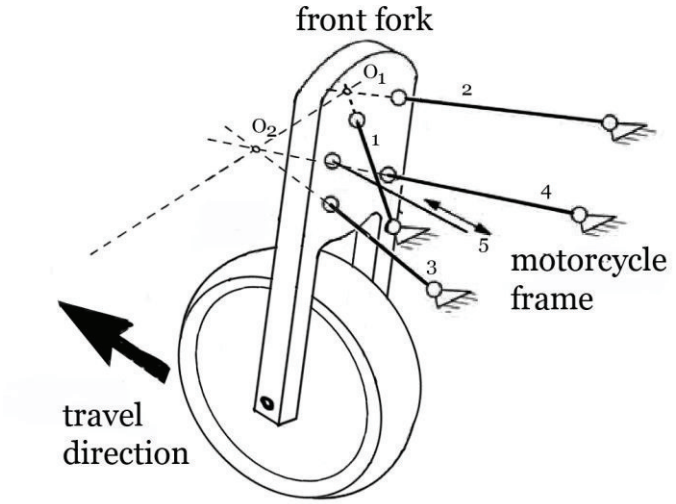

Fig. 7. Basic front Multilink suspension scheme for motorcycle.

Fig. 7 shows a general front Multilink suspension scheme for a motorcycle. This suspension is similar to trapezoidal suspension. The front wheel is hinged on the front fork. It is connected to the frame of the motorcycle through four carriers. The shoulders 1 and 2 form the upper carrier and, according to the four-seater rule, the instant center of rotation of the fork against the two arms is at point O1. Shoulders 3 and 4 form the lower carrier and the momentary center of rotation is point O2. Thus points O1 and O2 form the virtual axis of rotation of the fork. The arm 5 is a control element for the suspension and is connected to the steering handlebar of the motorcycle. In the absence of movement, the whole system has a degree of freedom and the only movement in it is in the vertical direction. Then there is no turning in the fork and the motorcycle moves in a straight line. When the arm 5 moves along the axis, then the fork rotates with respect to the virtual

axis of rotation and at the same time moves along the horizontal axis. The control arm 5 may be either directly connected to the motorcycle's handlebars or be made as two triangular jaws, one for the fork and one for the motorcycle handle (Fig. 8).

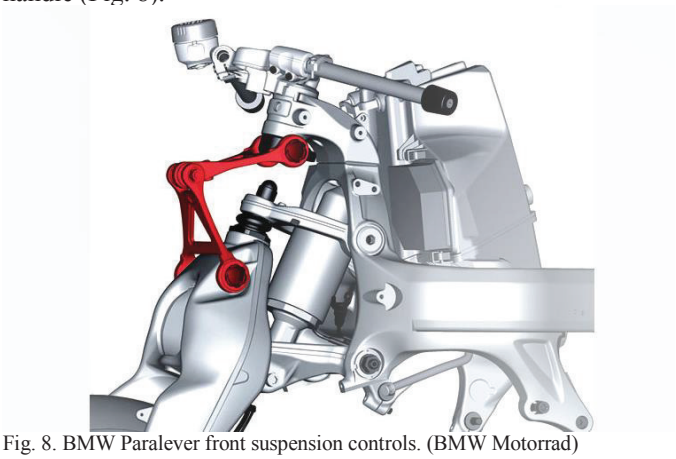

Fig. 8. BMW Paralever front suspension controls. (BMW Motorrad)

IV. Advantages and Disadvantages.

Advantages:

- By choosing the size of the levers in the suspension, it is possible to achieve constant geometrical characteristics of the suspension during its compression and relaxation.
- When changing the longitudinal slope of the upper and lower levers, can be achieved a desired anti-dive effect during braking.
- When changing the transverse slope of the levers, it is possible to achieve different momentary points of rotation of the fork, hence the inclination of the fork rotation axis and its stabbing in the road, which will give the trail to the front suspension.

Disadvantages:

- More complex construction.
- Multiple hinged connections (10 and more).
- Higher mass of unsprung masses.

V. Conclusions.

Multi-arm suspension meets the geometric characteristics of the front suspension of a motorcycle can be used as such. Detailed kinematic and dynamic research will be done in subsequent publications.

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