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(54) IMPROVEMENTS IN OR RELATING TO MOTOR CYCLE FRONT WHEEL STEERING AND SUSPENSION UNITS

(71) I, JOHN DIFAZIO, a British Subject, of 25 Catherine Street, Frome, Somerset, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to steering and suspension systems for the front wheels of motor cycles and it is an object of the invention to provide an improved front wheel unit which will be particularly suitable for high performance vehicles.

The invention consists broadly in a motor cycle front wheel steering and suspension unit, including a front wheel having inner and outer hubs, the outer hub being connected to rotate with the rim of the wheel while the inner hub is non-rotary, a spindle passing through the inner hub and having a pivotal steering connection to the inner hub and within said hub on a pivotal steering axis, a pair of pivoted arms for connecting a respective end of the spindle to a position on the frame of the motor cycle lying substantially at the same level above the ground as the spindle when the unit is in use fitted to a motor cycle in its normal attitude, a forked structure bridging the wheel and connected at each of its lower ends to adjacent points on the inner hub, a pair of spaced apart generally parallel and horizontal links each pivotally connected at one end to a point on the forked structure, and pivotally connected at the other end to a crosspiece adapted to be secured to a steering column of the motor cycle, the arrangement being such that the links lie generally parallel with the arms and act both as radius arms for suspension purposes and also as steering rods for controlling the steering movements of the wheel about its pivotal steering axis.

According to a preferred feature of the invention the pivotal steering connection comprises a king pin or the equivalent steering pivot pin mounted centrally within the inner hub.

In a preferred construction there is a disc brake assembly (or preferably two such assemblies) mounted on the non-rotary inner hub and engaging a rotary brake disc connected to rotate with the outer hub. In this construction the unit also includes a pair of resilient suspension springs each adapted to act respectively between one of the arms and a fixed point on the frame of the motor cycle. The length of each link may be substantially equal to, but in the preferred construction is slightly shorter than, the length of the arms, and the unit also includes means for varying the trail angle of the pivotal steering axis.

Preferably the pivotal steering axis of the wheel is positioned in front of the steering axis of the steering column and the extended axis of the steering column may pass to the rear of the front wheel.

The invention may be performed in various ways and one specific embodiment will now be described by way of example with reference to the accompanying diagrammatic drawings in which:—

Figure 1 is a perspective view of a solo motor cycle including a steering and suspension unit according to the invention; and

Figure 2 is a section through the axis of the hub of the front wheel with certain parts omitted.

In this example a front wheel 10 of a solo motor cycle is provided with inner and outer hubs 11, 12 located by two intervening bearings 13, 14. The outer, rotary, hub 12 is approximately 6" in axial length and is provided with two surrounding shallow flanges 15, 16 to receive the inner ends of the normal spokes 17 and two outer flanges 18, 19 of larger diameter acting as brake discs. The inner, non-rotary, hub 11 is approximately 5 inches in axial length and is of hollow construction. At the centre of its length the inner hub 11 is formed with transverse diametral housings to receive tapered roller bearings 20, 21 supporting a king pin 22 or equivalent steering pivot pin which extends diametrically across the central opening in

the inner hub substantially mid-way along the length of the hub. The inner hub can thus pivot for steering purposes about the king pin 22, carrying with it the outer hub 12 and the wheel.

The king pin 22 is rigidly secured to a spindle 23 extending through the hollow central opening in the inner hub with sufficient clearance to allow the hub 11 to pivot about the king pin to provide normal steering movements. The spindle 23 is for example approximately 8 inches long and the outer ends of this spindle are supported in horizontal sleeves or bushings 24, 25 respectively at the forward ends of two suspension arms 26, 27 on either side of the wheel and whose rear ends 28 are pivotally mounted on a lower part 29 of the vehicle frame at a position which is substantially at the same level above the ground as the spindle 23, the two suspension arms 26, 27 being inter-connected by bars 9 for movement together. The arms 26, 27, are bowed outwards as seen in plan to accommodate the steering movements of the wheel. Telescopic suspension springs 30 and shock absorbers 31 act between an intermediate point of each suspension arm and another pivotal anchorage 32 at a higher point on the vehicle frame. The spindle 23 can thus pivot in the connections at the front ends of the suspension arms about the spindle axis, thus permitting the trail angle of the king pin 22 to vary in a controlled manner, as described hereafter.

The inner hub 11 is rigidly connected at opposite ends to two plates or brackets 33, only one of which is shown in Figure 1, which extend radially outwards alongside the two brake discs 18, 19 and support the brake mechanism, shown diagrammatically at 33*a*, for each disc. Each of these brackets 33 is also rigidly connected to two tube members 34 constituting one limb of a steering fork assembly spanning the wheel, the two limbs being slightly inclined upwards and rearwards. At the apex of this steering fork the two pairs of tubes 34 are rigidly connected to a transverse tube 35 extending across and close above the wheel, and the opposite ends of this transverse member are connected respectively by universal joints 36 to the forward ends of a pair of radius arms 37 which may be of substantially the same length as the suspension arms 26, 27, but in this example are slightly shorter. These radius arms lie generally horizontal and parallel to the suspension arms 26, 27, and their rear ends are connected by universal joints 38 to the two opposite ends of the cross-member of a T-piece 39 the upright member of which is rigidly attached to the lower end of a steering column 40, the upper end of this column being provided with the normal handlebars 41. A mud guard 7 is detachably secured to the tubes 34.

In the arrangement as described, steering movements of the handlebars 41 act in a push-pull manner on the two radius arms 37 to turn the steering fork and hence the inner hub 11. The inner hub thus turns on the tapered bearings 20, 21 at the ends of the king pin 22. The outer hub 12 and the wheel turn in like manner on the inner hub.

When the front wheel moves vertically relative to the vehicle frame the transverse spindle 23 will rise or fall on the front ends of the two suspension arms 26, 27, being acted on by the spring suspension 30 and dampers 31. The forked steering structure 34, 35 will likewise rise and fall with the wheel, being allowed to do so by the universal joints 36, 38 on the two radius arms. In this particular arrangement the length of the radius arms 37 is approximately 12 inches and the length of the suspension arms is approximately 14 inches. The complete linkage system therefore acts generally but not exactly as a parallel motion linkage and is so arranged in this example that there is a slight increase in the rearward trail angle of the king pin as the wheel moves upwards relative to the vehicle frame.

It will be noted that the steering fork assembly in conjunction with the radius arms provides a brake torque reaction when the brakes are applied and also governs the trail angle of the king pin according to the length of the suspension arms 26, 27, the distance between the axis of the spindle 23 and the transverse tube 35 of the steering fork assembly, the length of the radius arms 37, and the distance between the joints 38 at the rear ends of the radius arms and the rear pivotal axis of the suspension arms. In another arrangement embodying the invention the radius arms 37 may each comprise two telescopically associated parts so that the length of the arms can be adjusted, by means being provided for holding the parts in any selected position of adjustment, so as to control the trail angle of the king pin.

It will be noted that the pivotal steering axis of the steering fork structure 34 for the front wheel is displaced forwardly of the pivotal axis of the steering column 40, which itself passes to the rear of the rim of the front wheel, and the steering column is connected to the steering fork structure by the two radius arms 37 which also act as a pair of parallel steering rods.

WHAT I CLAIM IS:—

1. A motor cycle front wheel steering and suspension unit, including a front wheel having inner and outer hubs, the outer hub being connected to rotate with the rim of the wheel while the inner hub is non-rotary, a spindle passing through the inner hub and having a pivotal steering connection to the inner hub and within said hub on a pivotal

steering axis, a pair of pivoted arms for connecting a respective end of the spindle to a position on the frame of the motor cycle lying substantially at the same level above the ground as the spindle when the unit is in use fitted to a motor cycle in its normal attitude, a forked structure bridging the wheel and connected at each of its lower ends to adjacent points on the inner hub, a pair of spaced apart generally parallel and horizontal links each pivotally connected at one end to a point on the forked structure, and pivotally connected at the other end to a cross-piece adapted to be secured to a steering column of the motor cycle, the arrangement being such that the links lie generally parallel with the arms and act both as radius arms for suspension purposes and also as steering rods for controlling the steering movements of the wheel about its pivotal steering axis.

2. A motor cycle front wheel unit according to claim 1, including a disc brake assembly mounted on the non-rotary inner hub and engaging a rotary brake disc connected to rotate with the outer hub.

3. A front wheel unit according to claim 1 or claim 2, including a pair of resilient suspension springs each adapted to act respectively between one of the arms and a fixed point on the frame of the motor cycle.

4. A front wheel unit according to any of the preceding claims, in which the length of each link is substantially equal to the length of the arms.

5. A front wheel unit according to any of the preceding claims including means for varying the trail angle of the pivotal steering axis.

6. A motor cycle including a front wheel unit according to any of the preceding claims, with the pivotal steering axis of the wheel positioned in front of the steering axis of the steering column.

7. A motor cycle according to claim 6, in which the extended axis of the steering column passes to the rear of the front wheel.

8. A motor cycle according to claim 6 or claim 7, in which the links and arms are substantially horizontal and the limbs of the forked structure are inclined upwards and rearwards.

9. A motor cycle substantially as described with reference to the accompanying drawings.

10. A motor cycle front wheel unit substantially as described with reference to the accompanying drawings.

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1274441 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

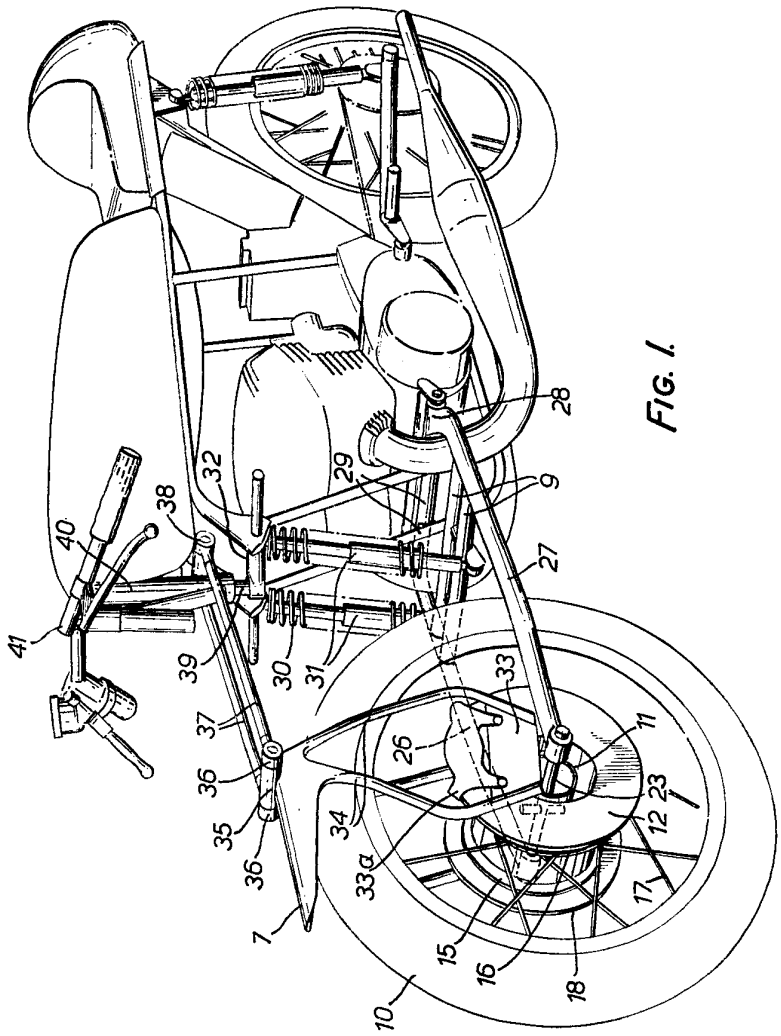

FIG. 1.

1274441 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

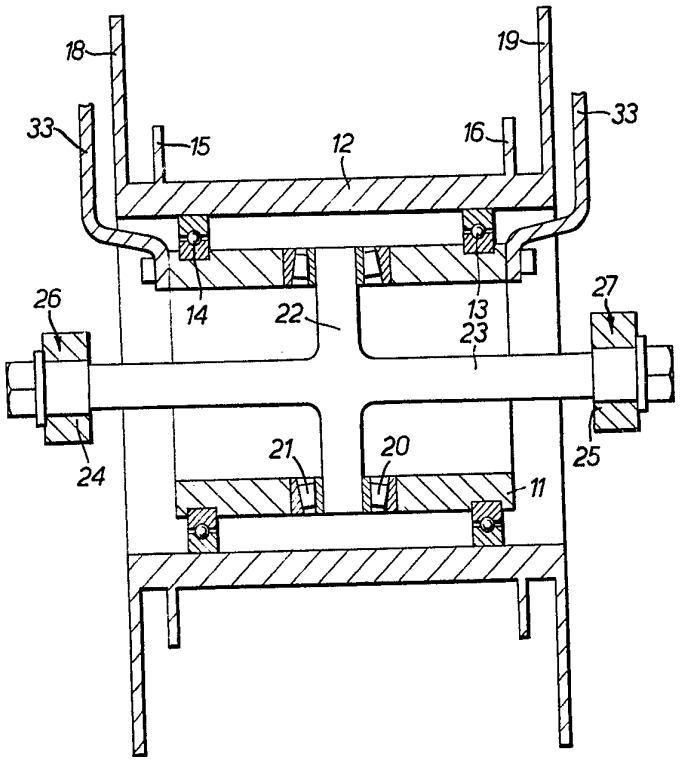

FIG. 2.