PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in or relating to Spring Forks for Motor Cycles

We, NORTON MOTORS LIMITED, a British Company, of *Bracebridge Street, Birmingham*, 6, and CHARLES GILBERT SMITH, a British Subject, of the Company's address, do hereby declare the nature of this invention to be as follows:—

This invention relates to improvements in spring forks for motor cycles and refers particularly to a fork of the type comprising a pair of tubes rigidly secured to the steering head of the machine, movable tubes carrying the wheel spindle and adapted to slide over the fixed tubes, and spring means for supporting the load, with or without hydraulic means for damping the return movement of the fork.

In a fork of this type according to our invention the load is supported by two or more compression springs of different rating which are arranged between abutments on the fixed and moving tubes and come into action progressively as the deflection of the wheel increases, and the rebound or return movement is preferably controlled by an hydraulic damper or dash-pot device which is housed within the tubes and allows substantially free upward movement of the wheel against the action of the springs but checks the return movement.

The fork may also incorporate a tension spring housed within the fixed tube and connected at its ends to the fixed and moving tubes respectively or to parts associated therewith to act as a rebound spring.

The hydraulic damper may be so arranged that upon an excessive upward movement of the wheel due to a cause other than normal road shocks the damper provides a positive hydraulic limit for the movement and prevents complete closing or "bottoming" of the fork.

In one preferred practical design of our improved fork each of the two fixed tubes is secured in two rigid lugs which extend laterally from the steering head and are spaced apart at a substantial distance in a vertical direction to reduce to a minimum the bending stresses on the tube under load. The upper end of the tube is rigidly secured in the upper lug by providing a tapered end on the tube which is drawn into a tapered socket in the lug by a plug screwed into the tube and bearing against the lug. The other lug has a split sleeve part in which the tube is clamped by a clamping bolt.

The lower end of the fixed tube is fitted with an external bush or sleeve which is a sliding fit in the moving tube carrying the wheel spindle. The upper end of the moving tube is fitted with an internal bush which is a sliding fit on the fixed tube, and an oil seal fitting around the fixed tube and bearing against the upper end of the moving tube is retained by a spring ring in a tubular socket screwed on to the outside of the moving tube.

At least two helical compression springs are fitted over the fixed tube between the upper end of the moving tube and the lower lug on the head. One spring is of such a rating that it yields under normal road shocks and provides the normal springing, while the other, which is preferably shorter, is of higher rating and yields only under heavy road shocks and excessive upward movement of the wheel. The springs may be arranged in tandem, their inner ends abutting against each other, or they may be arranged one within the other, the heavier spring only coming into action when engaged by a shoulder on one of the tubes after the lighter spring has been compressed to a predetermined extent.

The springs are preferably enclosed by telescopic metal sleeves of which one is attached to the socket on the moving tube and the other is attached to the upper end of the fixed tube.

The hydraulic damping device is housed within the moving tube and the lower end of the fixed tube. A thin-walled tube having opposed longitudinal slots is anchored at its lower end to the bottom of the fixed tube which is closed and bored transversely to receive the wheel spindle, and this tube, which we shall call the outer tube to distinguish it, extends up for a substantial distance into the fixed fork tube. At its upper end the outer tube has screwed into a bush into which is screwed the upper end of an inner tube of smaller diameter which extends downwardly inside the outer tube for one third to one half of the length of the latter. The lower end of the inner tube is closed by a plug having a small calibrated passage through it normally closed by a one-way ball or other valve opening upwardly.

Entering the annular space between the inner and outer tubes is an intermediate tube into the lower end of which is secured a plug having an axial bore of substantial diameter normally closed by a one-way ball or other valve opening upwardly. A transverse pin or a pair of short aligned pins keys the plug and intermediate tube to the lower end of the fixed fork tube, the pins extending through the longitudinal slots in the outer tube.

The inner tube is a working fit in the intermediate tube, or the plug in the lower end of the inner tube may be formed as a piston working in the intermediate tube.

The moving fork tube is filled with oil or other liquid and when this tube moves upwardly under a road shock it takes with it the inner and outer tubes of the damper and so creates a partial vacuum in the space at the lower end of the intermediate tube between the two valves. Oil is thus drawn into this space through the slots in the outer tube and through the lower valve. On the return movement of the moving fork tube this oil cannot return through the lower valve and is forced upwardly through the calibrated passage at the lower end of the inner tube and through the upper valve so that a considerable resistance is offered to the return movement and rebound is checked. The degree of damping is of course dependent on the size of the calibrated passage. Oil which passes the upper valve accumulates in the inner tube until it can flow over the upper end of this tube and back down the outside of the outer tube to the reservoir formed by the moving fork tube.

If desired the axial bore in the plug at the lower end of the intermediate tube may be of such a diameter that a certain amount of resistance is offered by the liquid to the upward movement of the wheel.

The closed lower end of the moving fork tube may have an upstanding cylindrical boss of substantially the same diameter as the internal diameter of the fixed tube so that if an excessive movement of the wheel takes place this boss enters the lower end of the fixed tube and oil trapped between the lower end of the fixed tube and the bottom closure of the moving tube provides an hydraulic stop and prevents direct metallic abutment.

The outer tube of the damper is conveniently secured in the closed lower end of the moving tube by means of a plug screwed into the lower end of the tube and having a screwed shank passing through the closed end of the fork tube, a nut being screwed on to the shank from below. The part of the shank passing through the end of the fork tube may be square to engage with a complementary opening and so prevent rotation and unscrewing of the damper tube.

The moving fork tube may conveniently be formed as a casting or forging having a lug at its lower end into which the wheel spindle is secured.

If it is desired to incorporate a rebound spring in the fork this can be done by connecting a tension spring between the upper end of the damper and the upper end of the fixed tube, the spring being housed within the fixed tube. To enable a spring of reasonable length to be used its upper end may be attached to the lower end of a tension rod depending from the screwed plug which closes the upper end of the rod. The ends of the spring may be connected to the rod and to the damper by screwing its ends into helical grooves formed in these parts.

Dated the 21st day of May, 1942.
BARKER, BRETTELL & DUNCAN,
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COMPLETE SPECIFICATION

Improvements in or relating to Spring Forks for Motor Cycles

We, Norton Motors Limited, a British Company, of Bracebridge Street, Birmingham, 6, and Charles Gilbert Smith, a British Subject, of the Company's address, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in spring forks for motor cycles and refers particularly to a fork of the type comprising a pair of tubes rigidly secured to the steering head of the machine, movable tubes carrying the wheel spindle and adapted to slide over the fixed tubes, and spring means for supporting the load, with or without hydraulic means for damping the return movement of the fork.

In a fork of this type according to our

invention the load is supported by two or more compression springs of different rating which are arranged between abutments on the fixed and moving tubes and come into action progressively as the deflection of the wheel increases, and the rebound or return movement is preferably controlled by an hydraulic damper or dash-pot device which is housed within the tubes and allows substantially free upward movement of the wheel against the action of the springs but checks the return movement.

The fork may also incorporate a tension spring housed within the fixed tube and connected at its ends to the fixed and moving tubes respectively or to parts associated therewith to act as a rebound spring.

The hydraulic damper may be so arranged that upon an excessive upward movement of the wheel due to a cause other than normal road shocks the damper provides a positive hydraulic limit for the movement and prevents complete closing or "bottoming" of the fork.

One practical design of front fork for a motor-cycle in accordance with our invention is illustrated by way of example in the accompanying drawing, which is a front elevation of the fork with one side in section. As both sides of the fork are identical only one need be described in detail.

The fixed tube 10 which forms the upper part of the fork at each side is secured in two rigid lugs 11, 12 which extend laterally from the steering head 13 and are spaced apart at a substantial distance in a vertical direction to reduce to a minimum the bending stresses on the tube under load. The upper end of the tube is rigidly secured in the upper lug 11 by providing a tapered end 14 on the tube which is drawn into a tapered socket in the lug by a flanged plug 15 screwed into the tube and bearing against the lug. The lower lug 12 has a split sleeve part in which the tube is clamped by a bolt 16.

The lower end of the fixed tube 10 is fitted with an external bush or sleeve 17 which is a sliding fit in the moving tube 18 carrying one end of the wheel spindle. The tube 18 may be formed as a casting or forging having an integral lug 19 at its lower end in which the wheel spindle 20 is secured. The upper end of the tube 18 is fitted with an internal flanged bush 21 which is a sliding fit on the fixed tube 10. An oil seal 22 which fits around the fixed tube 10 and bears against the upper end of the bush 21 is retained by a ring 23 in an annular recess formed by an upward extension of a tubular socket 24 screwed on to the outside of the moving tube 18.

At least two helical compression springs are fitted over the fixed tube 10 between the upper end of the moving tube 18 and the lower lug 12 on the head. One spring is of such a rating that it yields under normal road shocks and provides the normal springing, while the other, which is preferably shorter, is of higher rating and yields only under heavy road shocks and excessive upward movement of the wheel. In the arrangement shown in the drawings the two springs 25, 26 are in tandem, but in an alternative construction they may be arranged one within the other, the heavier spring only coming into action when engaged by a shoulder on one of the tubes after the lighter spring has been compressed to a predetermined extent.

The springs and the fixed tube are enclosed by telescopic sleeves 27, 28, of which the upper sleeve 27 is supported by a ring 29 at the upper end of the fixed tube and by a pressing 30 secured to the lug 12, while the lower sleeve is secured to the socket 24 on the moving tube.

An hydraulic damping device is housed within the moving tube 18 and the lower end of the fixed tube 10. A thin-walled tube 31 is secured at its lower end into a socket 32 having a screwed shank passing through the closed bottom end of the tube 18, a nut 33 being screwed on to the shank from below. The part of the shank passing through the end of the tube 18 is preferably square to engage with a complementary opening and so prevent rotation and unscrewing of the tube 31. The tube 31, which is referred to hereinafter as the outer tube to distinguish it, extends for a substantial distance up into the fixed fork tube 10. At its upper end the outer tube 31 has screwed into it a bush 34 into which is screwed the upper end of a concentric inner tube 35 of smaller diameter which extends downwardly inside the tube 31 for about one-half to two-thirds of the length of the latter. The lower end of the inner tube is closed by a plug 36 having a small calibrated axial passage 37 through it normally closed by a ball-valve 38 opening upwardly.

Sliding on the inner tube 35 is an intermediate tube 40, the lower end of which is secured into a hollow plug 41 which is a sliding fit in the outer tube 31. An axial passage 42 of substantial diameter in the plug 41 is normally closed by a ball-valve 43 opening upwardly. A transverse pin 44 keys the plug 41 and intermediate tube to the lower end of the fixed fork tube 10, the pin extending through opposed longitudinal slots 45 in the outer tube 31. The part of the pin traversing the passage 42 in the plug may be reduced in diameter as shown to avoid obstruction of the passage or the pin 44 may be replaced by a pair of short aligned pins which do not extend into the passage.

In a modification instead of the intermediate tube 40 being a sliding fit on the inner tube, the lower end of the inner tube may be formed as a piston working in the intermediate tube.

Two or more radial holes 46 are formed in the wall of the fixed fork tube 10 a substantial distance above the bush 17 on the lower end of the fixed fork tube 10 but below the bush 21 at the upper end of the moving tube 18 in the normal position of that tube.

The moving fork tube 18 is filled with oil or other liquid and when this tube moves upwardly under a road shock it takes with it the outer and inner tubes 31, 35 of the damper and so increases the length of and creates a partial vacuum in the space at the lower end of the intermediate tube between the two valves. Oil is thus drawn into this space through the slot 45 in the outer tube 31 and the lower valve 43. On the return movement of the moving fork tube 18 this oil cannot return through the lower valve 43 and is forced upwardly through the calibrated passage 37 at the lower end of the inner tube 35 so that a considerable resistance is offered to the return movement and rebound is checked. The degree of damping is of course dependent on the size of the calibrated passage 37 which can be selected according to the work for which the fork is intended. The oil which passes the upper valve 38 accumulates in the inner tube until it can flow over the upper end of this tube and back down the outside of the outer tube to the reservoir formed by the moving fork tube 18.

If desired the axial passage 42 in the plug 41 at the lower end of the intermediate tube 40 may be of restricted diameter so that a certain amount of resistance is offered by the oil to the upward movement of the wheel.

In the event of the fork being completely relieved of load for an appreciable time, as might happen if the wheel left the ground after striking an obstacle, the downward movement of the moving fork tube 18 will cause the bush 21 to cover the holes 46 in the fixed tube 10 so that a certain amount of oil is trapped between the bushes 17 and 21 and will prevent these bushes coming into immediate contact and so prevent any tendency for the tubes to wedge when the wheel strikes the ground again.

In the event of an excessive upward movement of the moving fork tube taking place the socket 32 at the lower end of this tube will enter the lower end of the fixed tube 10 and the oil thus trapped between the lower end of the fixed tube and the closed bottom of the moving tube provides an hydraulic stop and prevents direct metallic abutment.

If it is desired to incorporate a rebound spring in the fork this can be done by connecting a tension spring between the upper end of the damper and the plug 15 at the upper end of the fixed tube 10, the spring being housed within the fixed tube. To enable a spring of reasonable length to be used its upper end may be attached to the lower end of a tension rod depending from the plug 15. The ends of the spring may be connected to the rod and to the damper by screwing its ends into helical grooves formed in these parts.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A spring fork of the type set forth for motor cycles in which the load on the fork is supported by two or more compression springs of different rating which are arranged between abutments in or on the fixed and moving tubes forming each side of the fork and which come into action progressively as the deflection of the wheel increases.

2. A spring fork as claimed in Claim 1 in which two springs are arranged in tandem around the fixed tube between an abutment on that tube and an abutment at the upper end of the moving tube.

3. A spring fork as claimed in Claim 1 in which the springs are arranged one within the other and the heavier spring only comes into action when engaged by a shoulder on one of the tubes after the lighter spring has been compressed to a predetermined extent.

4. A spring fork as claimed in any of the preceding claims in which one spring is of such a rating that it yields under normal road shocks and provides the normal spring while the other, which is preferably shorter, is of higher rating and yields only under heavy road shocks and excessive upward movement of the wheel.

5. A spring fork as claimed in any of the preceding claims in which an hydraulic damping device is housed within the fork tubes and is arranged to allow substantially free upward movement of the wheel against the action of the springs but to check the return movement.

6. A spring fork as claimed in Claim 5 in which the damping device is formed by concentric tubes housed within the fork tubes, one tube being carried by the moving fork tube and another by the fixed fork

tube, and the lower ends of the damper tubes are closed by plugs having axial passages controlled by one-way valves through which liquid contained in the moving fork tube flows on relative movement between the fork tubes, oil being drawn into the space between the valves on upward movement of the moving fork tube and being forced through one of the passages which is of restricted area on the return movement of the moving fork tube.

7. A spring fork as claimed in Claim 6 in which one damper tube is secured to and depends from the upper end of a third tube extending upwardly from the lower end of the moving fork tube, and the second damper tube slides on the first and is secured to the lower end of the fixed fork tube by a transverse pin or pins extending through longitudinal slots in the third damper tube.

8. A spring fork as claimed in any of Claims 1 to 4 and 5 in which the lower end of the moving fork tube has an internal upward projection adapted, on excessive upward movement of the tube, to enter the lower end of the fixed fork tube and trap between that tube and the bottom of the moving tube liquid which forms an hydraulic stop and prevents metallic abutment.

9. A spring fork as claimed in any of Claims 1 to 4 and 5 in which the moving fork tube is of substantially greater diameter than the fixed tube and is slidably guided thereon by an external bush on the lower end of the fixed tube and an internal bush in the upper end of the moving tube, and the annular space between these bushes is normally in free communication with the interior of the tubes through holes in the wall of the fixed tube which are closed by the second bush on excessive downward movement of the moving tube so that liquid is thus trapped between the bushes for the purpose set forth.

10. A spring fork for motor cycles substantially as described with reference to the accompanying drawing.

Dated the 5th day of June, 1943.

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