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(54) **Front fork assembly, front fork comprising the same, and motorcycle**

(57) The present invention relates to a front fork assembly and to a front fork comprising the same. The present invention further relates to a motorcycle that is provided with such a front fork assembly or front fork.
According to the invention, the front fork assembly comprises a tuned mass damper that is fixedly attached to the unsprung section of the telescopic unit.

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Front fork assembly, front fork comprising the same, and motorcycle

The present invention relates to a front fork assembly and to a front fork comprising the same. The present invention further relates to a motorcycle that is provided with such a front fork assembly or front fork.

A motorcycle comprises a front fork that connects a motorcycle's front wheel and axle to the motorcycle frame. It typically comprises a telescopic unit, which unit comprises a first elongated tubular section and a second elongated tubular section, wherein the first tubular section is at least partially received in the second tubular section in a slideable manner, such that the first and second tubular sections can perform a telescopic motion with respect to each other along their longitudinal axes.

Near its top, the front fork is mounted to the frame of the motorcycle, typically using a coupling element known as a triple tree. Typically, the first tubular section is mounted above the second tubular section. This configuration will hereinafter be referred to as the regular configuration. Alternatively, the first tubular section may be mounted closer to the wheels. This later configuration is known as an upside-down fork.

With respect to the suspension, several types of front forks can be distinguished. A first type comprises a spring or other resilient member mounted to or in the telescopic unit. This resilient member is configured for subjecting the telescopic motion to a spring force. Moreover, the resilient member defines an unsprung section and a sprung section of the telescopic unit when this unit is mounted in the motorcycle. However, the resilient member may also be mounted spaced apart from the telescopic unit. For example, in a Telelever® configuration, the first and second tubular sections are each independently hingedly connected to the motorcycle frame using respective arms and/or frame parts. In this configuration, the resilient member is mounted between the arms and/or frame parts. In an embodiment, the second tubular section, being located close to the wheel axis, is connected to the motorcycle frame using an arm that on one end is hingedly connected to the motorcycle frame and on the other end is hingedly connected to the second tubular section. An upper end of the first tubular section is hingedly connected to a frame part of the motorcycle frame using a ball joint. The resilient member can in this case be mounted in between this frame part and the aforementioned arm.

A common problem encountered when driving a motorcycle relates to the front or rear wheels losing contact with the ground. These problems are referred to as wheel-hop or chatter. A known solution to counter these problems is to use tuned mass dampers mounted at different positions on the motorcycle, as disclosed by JP 5702071.

JP2014008932A discloses a front fork assembly as defined by the preamble of claim 1. This document discloses a telescopic unit having the second tubular section mounted near the steering bar and the first tubular section near the wheel axle. The telescopic movement of the tubular sections is subjected to a spring force that is provided by a spring. According to this document, a tuned mass damper, operating in a frequency range between 15-25 Hz, is mounted in the first tubular section above the spring. The tuned mass damper comprises a mass that is able to perform an oscillatory movement parallel to the longitudinal axes of the telescopic unit.

The applicant has found that, although the abovementioned solution provides an improvement over other existing designs, the steering properties and traction of the motorcycle during heavy braking and corner entry may still be unsatisfactory.

It is an object of the invention to provide a solution in which the abovementioned problem does not occur or at least to a lesser extent.

According to the invention, this object is achieved with the front fork assembly as defined in claim 1 which is characterized in that the tuned mass damper is fixedly attached to the unsprung section of the telescopic unit.

The applicant has found that by fixedly attaching the tuned mass damper to the unsprung section of telescopic unit, the variation in the force and/or force component pushing the tire to the road surface can be reduced, thereby improving riding characteristics such as the steering properties and traction.

The present invention relates to the regular configuration wherein the first tubular section is connected to the steering bar and the second tubular section to the front wheel bearing axis, and to the upside-down configuration, wherein the second tubular section is connected to the steering bar and the first tubular section to the front wheel bearing axis. In both configurations, the resilient member, which is configured for subjecting the telescopic motion to a spring force, is mounted in or on the first or second tubular section, depending on which section corresponds to the unsprung section of the telescopic unit.

The present invention also relates to the Telelever® configuration, wherein the first tubular section is connected to the steering bar and the second tubular section to the front wheel bearing axis, but wherein the resilient member for subjecting the telescopic motion to a spring force is arranged spaced apart from these sections.

The tuned mass damper may comprise a mass element guiding device and a mass element, wherein the mass element guiding device is configured for guiding the mass element to allow the mass element to slide relative to the mass element guiding device when performing the oscillatory movement. As an example, the mass element guiding device may comprise a housing that is elongated along a direction parallel to the longitudinal axis of the first and second tubular sections, and wherein the mass element is slideably arranged in the housing, wherein the mass element is able to slide back and forth in the housing along the longitudinal direction of the housing.

The tuned mass damper may comprise a further resilient member arranged in between the housing and the mass element for subjecting the sliding movement of the mass element relative to the housing to a spring force, wherein the further resilient member preferably comprises a compressed gaseous medium and/or a spring, more preferably a resilient member made out of elastic material.

The further resilient member need not be fixedly coupled to the housing and/or the mass element. For instance, the further resilient member may comprise a coil spring that is arranged in between a first end of the housing and the mass element. In this case, the first end of the housing and/or the mass element is provided with guiding structures, such as protrusions, to ensure that the spring is guided to the correct position relative to the housing and/or mass element.

Regardless the mounting of the spring, i.e. fixedly or loosely attached, it may be pre-biased or not. Moreover, the housing may comprise a pair of said further resilient members arranged on respective sides of the mass element.

The tuned mass damper may have an oscillation frequency that is tuned to a dominant oscillation frequency of the unpsrung section encountered while driving. For instance, when the motorcycle encounters a bump, an oscillation may be triggered. During this oscillation, the front wheel will move back and forth in along the longitudinal axis of the telescopic unit. This oscillation will reduce the contact force between the front wheel and the ground. In extreme cases, the front wheel may loose contact with the ground altogether. By designing the tuned mass damper to have an oscillation frequency that corresponds to this dominant oscillation frequency, the variation in contact force can be reduced. For most motorcycles, this results in an oscillation frequency of the mass element that lies in the range between 8and 20 Hz, more preferably between 10 and 17 Hz.

The present invention is not limited to tuned mass dampers that show a particular damping. More specifically, the present invention could equally apply to tuned mass dampers that have resilient members to couple the mass element to the housing, but wherein the resilient members or other components, do not present a significant amount of damping. An example of such a tuned mass damper, is a mass element fixedly connected on both ends to an ideal spring.

As an example, the housing may comprise an evacuated airtight chamber in which the mass element is slideably received. In this case, the mass element will not be substantially damped by compressed air when it moves back and forth relative to the housing. Depending on the application, such damping may however be desired.

The housing may comprise a liquid filled container in which the mass element is slideably received. In this case, the mass element is damped by the liquid.

The container may have an upper and lower section. In this case, a bypass conduit may be provided between an upper and lower section of the container. For example, during its movement towards an end of the upper section, the mass element will push liquid through the conduit towards the lower section. In a further embodiment, the flow resistance of the bypass conduit may be adjustable. For instance, an adjustable throttle valve may be provided in the bypass conduit.

The mass element itself may comprise at least one through hole to allow the liquid to pass between the upper and lower section. In the example above, during its movement towards an end of the upper section, liquid is able to flow through the at least through hole towards the lower section. In a further embodiment, the flow resistance of the at least one through hole may be adjustable. For example, the tuned mass damper may comprise an adjusting element for controlling a throttle opening between the at least one through hole and the upper or lower section.

Alternatively, the mass element guiding device may comprise a guiding rod that is fixedly attached to the unsprung section of the telescopic unit, and wherein the mass element comprises a longitudinal through hole, wherein the guiding rod is arranged at least partially inside the longitudinal through hole. In this case, the mass element slides along the guiding rod. The guiding rod can be mounted to an outside of the telescopic unit. This allows common motorcycle components typically found near the placement area of the tuned mass damper. For example, the mass element can be formed by and/or can be comprised in a front mudguard and/or front fender of the motorcycle.

The resilient member for subjecting the telescopic motion to a spring force can be mounted in the second tubular section. Alternatively, it may be mounted around the first tubular section, wherein the first and second tubular sections each comprise a support, wherein the resilient member is mounted in between the supports.

The resilient member for subjecting the telescopic motion to a spring force may comprise a spring, an elastic material, such as Cellasto®, and/or wherein the resilient member is formed by a gas cylinder.

A first end of the telescopic unit may be connectable to a wheel bearing axis of the motorcycle, and a second end of the telescopic unit opposite to the first end may be connectable to a steering device of the motorcycle, wherein the tuned mass damper is arranged in between the first end and the resilient member. In the regular configuration, the first end corresponds to an end of the second tubular section. In the upside-down configuration, the first end corresponds to an end of the first tubular section.

In the regular configuration, the tuned mass damper can be arranged in the second tubular section. The front fork assembly may comprise a damper for damping the telescopic motion, wherein the damper is arranged inside the second tubular section in between second end and the tuned mass damper.

In the upside-down configuration, the tuned mass damper can be mounted to or in the first tubular section. Also in this configuration, a damper may be provided for damping the telescopic motion, wherein the damper can be arranged in the second tubular section.

According to a further aspect, the present invention provides a front fork for a motorcycle, comprising a first and second fork member that are spaced apart in a parallel manner, wherein at least one of the fork members comprises the front fork assembly as described above.

The first and second fork member may be substantially identical. Alternatively, the first fork member may comprise the front fork assembly as described above, but the second fork member may only comprise a further telescopic unit that is configured as the telescopic unit in the first fork member. In other words, the tuned mass damper can be only comprised in the first fork member. In such embodiments, it may be advantageous to arrange the damper for damping the telescopic motion of the further telescopic unit and the tuned mass damper in different fork members in view of available space in the fork members,

According to a further aspect, the present invention provides a motorcycle comprising the front fork assembly or the front fork as described above.

Next, the invention will be described in more detail referring the appended drawings, wherein:

Figures 1A-1C illustrate a front fork having a regular configuration with an externally mounted tuned mass damper in accordance with the present invention;

Figures 2A-2C illustrate a front fork having an upside-down configuration with an externally mounted tuned mass damper in accordance with the present invention;

Figures 3A-3C illustrate a front fork having a Telelever® configuration with an externally mounted tuned mass damper in accordance with the present invention;

Figures 4A-4C illustrate a front fork having a regular configuration with an internally mounted tuned mass damper in accordance with the present invention;

Figures 5A-5C illustrate a front fork having an upside-down configuration with an internally mounted tuned mass damper in accordance with the present invention;

Figures 6A-6C illustrate a front fork having a Telelever® configuration with an internally mounted tuned mass damper in accordance with the present invention;

Figures 7A-7C illustrate different embodiments of a tuned mass damper according to the present invention;

Figures 8A and 8B illustrate cross sections of the fork members of the front fork depicted in figure 4; and

Figures 9A and 9B illustrate another embodiment of an externally mounted tuned mass damper in accordance with the present invention.

In the description below, elements or components that are identical or which have similar functionality will be referred to using the same reference signs.

Figures 1-3 show different embodiments of the present invention in which a tuned mass damper 150 is externally mounted. Figures 1A-1C illustrate a front fork 100 having a regular configuration, figures 2A-2C illustrate a front fork 200 having an upside-down configuration, and figures 3A-3C illustrate a front fork 300 having a Telelever® configuration.

In each of these configurations, the front fork comprises a pair of fork members, i.e. a left fork member L and a right fork member R. Each of these members comprises a first tubular section 101, 102 and a second tubular section 103, 104 that can move telescopically with respect to each other. Here, first tubular section 101, 102 and second tubular section 103, 104 are part of respective telescopic units.

Fork members L, R are mutually coupled by means of a triple tree 105, also referred to a yoke. Triple tree 105 comprises two plate members 105A, 105B having appropriate through holes through which first tubular sections 101, 102 (figures 1 and 3) or second tubular sections 103, 104 (figures 2) pass. In addition, an axis 106 is provided by which the front fork is pivotally coupled to the frame of the motorcycle. On top plate member 105A, known connection members 105C are provided to fixedly attach the first or second tubular sections to plate member 105A.

The front fork according to the invention also comprises a wheel bearing axis 107 that is, depending on the configuration, coupled to either the first 101, 102 or the second 103, 104 tubular sections.

In the Telelever® configuration shown in figures 3A-3C, a spring 171 and a damper 172 are also provided. However, in this configuration spring 171 and damper 172 are mounted spaced apart from the first and second tubular sections 101-104. Second tubular sections 103, 104 are coupled using a pair of first arms 180 to respective second arms 181 that are fixedly mounted to the frame of the motorcycle. The frame of the motorcycle is hingedly coupled to a pair of third arms 182, which in turn are coupled to first tubular section 101, 102.

The connection between first arms 180 and second tubular section 103, 104 comprises a plate member 105B that is fixedly attached to second tubular section 103, 104. Plate member 105B defines a pivot point 106B around which front fork 300 is able to pivot to enable steering of the motorcycle. First arms 180 are on one end fixedly connected to plate member 105B, and on another end hingedly to second arm 181, by means of a hinge 185.

Third arms 182 are hingedly coupled to the frame of the motorcycle. A spring 171 and damper 172 are hingedly mounted between third arms 182 and first arms 180, using hinges 183, 184. Third arms 182 are fixedly connected to a plate member 105A. Also this latter plate defines a pivot point 106A around which front fork 300 is able to pivot, see figure 3B. It should be noted that the present invention is not limited to the Telelever® configuration shown in figures 3.

Compared to figures 1-2, spring 171 is mounted at a different position relative to the telescopic unit. Here, the unsprung section of the telescopic unit also comprises the second tubular sections 103,104, whereas the first tubular sections 101, 102 are comprised in the sprung section.

The front fork according to the invention comprises a Tuned Mass Damper (TMD) that is either mounted externally (figures 1-3) or internally (figures 4-6). Moreover, according to the present invention, the TMD is mounted to the unsprung section of the telescopic unit. This particular placement improves the steering properties and traction of the motorcycle during heavy braking and corner entry.

Front forks 400-600 illustrated in figures 4-6, respectively, correspond to front forks 100-300, with the exception that TMD 150 is now mounted internally inside a wall 110 of the relevant tubular section. For convenience, the same reference signs are used to refer to elements being identical or similar with respect to the front forks having the externally mounted TMD 150. Furthermore, the construction of TMD 150 in figures 1-6 is substantially identical, apart from being mounted internally or externally.

As shown in figure 1C, TMD 150 comprises a container 151 in which a pair of springs 152, 155 is mounted. These springs act on a mass element 154 that is moveably mounted in container 151 by means of guiding rings 157. At both ends of mass element 154, mounting structures 153, 156 may be provided for mounting springs 152, 155.

In the embodiments in figures 1-6, the container is evacuated. Therefore, spaces 158, 159 in between mass element 154 and container 151 are essentially kept at a vacuum. Due to this vacuum, the movement of mass element 154 is solely damped by springs 152, 155. Therefore, if springs 152, 155 would behave as ideal springs having no damping coefficient, the movement of mass element 154 would be essentially undamped.

Figures 7A-7C show embodiments of a TMD 250, 350, 450 that comprise internal damping. This damping is achieved by having a liquid inside spaces 158, 159. However, to allow mass element 154 to move sufficiently, liquid has to be exchanged between spaces 158, 159. This is achieved using a through hole 251 in mass element 154. The diameter of this hole determines the amount of damping during the motion of mass element 154 relative to container 151.

The embodiments in figures 7A and 7B, corresponding to an externally mounted TMD and an internally mounted TMD, respectively, comprise an adjusting element 252 in the form of a needle. This needle is able to determine the flow resistance between through hole 251 and a radial opening 253. For the figure 7A and 7B embodiments, liquid has to pass from space 159, through hole 251, through radial opening 253, inside space 158. By adjusting the position of needle 252, the passage between through hole 251 and radial opening 253 can be throttled less or more, thereby determining the amount of damping. In the figure 7C embodiment, needle 252 is absent. The internal damping of TMD 450 can therefore not be adjusted.

In each of the embodiment in figures 7A-7C, a fill opening in container 151 is provided through which the liquid can be supplied to container 151. A sealing element 260 closes this opening after filling.

Front forks 100-600 each comprise a resilient member in the form of a spring 171 for subjecting the telescopic motion of first and second tubular sections to a spring force. For example, figure 8A illustrates a cross section of fork member L of figure 4. Fork member L comprises a first tubular section 101 and a second tubular section 103. A spring 171 is provided that provides a spring force in response to a telescopic motion between tubular sections 101 and 103. As illustrated, spring 171 is provided in first tubular section 101. In addition to spring 171, a hydraulic damper 172 is provided in second tubular section 103.This damper dampens the telescopic motion. Fork member L is known in the art.

Damper 172 comprises a nitrogen filled membrane and a bottom valve 211. It further comprises a main piston 212 that is provided with a compression and rebound shim setting. Piston 212 is connected with a spindle 214 that is fixedly attached to first tubular section 101. A sealing and bearing 213 is provided by which spindle 214 is able to actuate piston 212. Damping is achieved when first tubular section 101 moves inward relative to second tubular section 103. This will cause main piston 212 to move through a fluid, such as oil, inside damper 172. Piston 212 is provided with through openings to throttle the flow of fluid between the chambers on opposite sides of piston 212.

Figure 8B illustrates a cross section of fork member R of figure 4. Compared to fork member L, it does not comprise damper 172 thereby saving space. According to the invention, this space can be used to place the TMD. The front fork in figure 1 therefore comprises a spring 171 in each fork member, a damper in one fork member L, and a TMD damper in the other fork member R. However, the present invention does not exclude embodiments of a front fork wherein both fork members comprise a spring 171, a TMD, and a damper 172, or embodiments wherein both fork members comprise a spring 171 and a TMD but wherein only one fork member a damper 172.

Here, it is noted that both spring 171 and damper 172 are known in the art and require no further elaboration. Although front forks 100, 200, 400, 500 have a spring that is mounted inside first tubular section 101, 102, it should be noted that it is equally possible to arrange the spring around first tubular section 101, 102. For example, first tubular sections 101, 102 and second tubular sections 103, 104 could each be provided with supports, in between which supports the spring could be mounted.

Spring 171 defines an unsprung section and a sprung section of the telescopic unit when this unit is mounted in the motorcycle. More in particular, the unsprung section in figure 8A and 8B comprises each component of the telescopic unit that is configured to move relative to the motorcycle frame as a result of the telescopic movement. Hence, the unsprung section of a telescopic unit may comprise spring 171 and the second tubular section 103, 104. Furthermore, the unsprung mass of the motorcycle as a whole can be defined as the mass that is unsuspended by spring 171 and may for example comprise the mass of spring 171, second tubular sections 103, 104 (figures 1A-1C) or first tubular sections 101, 102 (figures 2A-2C), wheel bearing axis 107, and the front wheels of the motorcycle.

Figures 9A and 9B illustrate an externally mounted tuned mass damper 200 that comprises a guiding rod 201 that is fixedly connected to a mounting bracket 202 by which tuned mass damper 200 can be externally mounted to the telescopic unit. Tuned mass damper 200 further comprises a mass element 203 that is provided with a longitudinal through hole 204. As illustrated, guiding rod 201 is at least partially received in through hole 204 allowing mass element 203 to be guided while moving along a direction parallel to guiding rod 201.

Guiding rod 201 is fixedly connected to two supports 205. These supports cooperate with mounting structures 207 for the mounting of spring coils 206.

Mass element 203 can be connected to a mudguard. The present invention does however not exclude other motorcycle components to be connected to mass element 203.

Although the present invention has been described using detailed embodiments thereof, the skilled person will understand that the present invention is not limited thereto, but that modifications are possible without deviating from the scope of the invention, which is defined by the appended claims.

CONCLUSIES

1. Voorvorksamenstel voor een motorfiets, omvattende:

een telescopische eenheid omvattende een eerste uitgestrekt buisvormig gedeelte en een tweede uitgestrekt buisvormig gedeelte, waarbij het eerste buisvormige gedeelte ten minste ten dele opgenomen is in het tweede buisvormige gedeelte op een schuivende manier, zodanig dat de eerste en tweede buisvormige gedeeltes een telescopische beweging kunnen uitvoeren ten opzichte van elkaar langs de longitudinale assen ervan;

een veerkrachtig lid ingericht voor het toepassen van een veerkracht op de telescopische beweging, waarbij dit veerkrachtige lid een niet-geveerd gedeelte en een geveerd gedeelte van de telescopische eenheid definieert wanneer deze eenheid gemonteerd is in de motorfiets; en

een gestemde massademper omvattende een massa-element dat in staat is om een oscillerende beweging uit te voeren parallel aan de longitudinale assen;

met het kenmerk, dat de gestemde massademper vast verbonden is aan het niet-geveerde gedeelte van de telescopische eenheid.

2. Voorvorksamenstel volgens conclusie 1, waarbij de gestemde massademper een massa-element-geleidende inrichting en een massa-element omvat, waarbij de massa-element-geleidende inrichting ingericht is voor het geleiden van het massa-element om het mogelijk te maken voor het massa-element om te schuiven ten opzichte van de massa-element-geleidende inrichting wanneer de genoemde oscillerende beweging uitgevoerd wordt.

3. Voorvorksamenstel volgens conclusie 2, waarbij de massa-element-geleidende inrichting een behuizing omvat welke uitgestrekt is langs een richting parallel aan de longitudinale as van de eerste en tweede buisvormige gedeeltes, en waarbij het massa-element schuifbaar gerangschikt is in de behuizing, waarbij het massa-element in staat is om heen en weer te schuiven in de behuizing langs de genoemde longitudinale as van de behuizing.

4. Voorvorksamenstel volgens conclusie 3, waarbij de behuizing een verder veerkrachtig lid omvat gerangschikt tussen de behuizing en het massa-element en ingericht is voor het toepassen van een veerkracht op de schuivende beweging van het massa-element ten opzichte van de behuizing, waarbij het verdere veerkrachtige lid bij voorkeur een samengeperst gasachtig medium en/of een veer omvat, meer bij voorkeur een veerkrachtig lid gemaakt van een elastisch materiaal.

5. Voorvorksamenstel volgens conclusie 4, waarbij de behuizing een paar van genoemde verdere veerkrachtige leden omvat, gerangschikt aan respectievelijke zijdes van het massa-element.

6. Voorvorksamenstel volgens een van de voorgaande conclusies, waarbij de oscillatie-frequentie van het massa-element ligt in het bereik tussen 8 en 20 Hz, bij voorkeur tussen 10 en 17 Hz.

7. Voorvorksamenstel volgens een van de conclusies 3-6, waarbij de behuizing een geëvacueerde, luchtdichte kamer omvat waarin het massa-element schuivend opgenomen is.

8. Voorvorksamenstel volgens een van de conclusies 3-6, waarbij de behuizing een met vloeistof gevulde container omvat waarin het massa-element schuivend opgenomen is.

9. Voorvorksamenstel volgens conclusie 8, verder omvattende een omloopleiding tussen een bovenste en een onderste gedeelte van de container.

10. Voorvorksamenstel volgens conclusie 8 of 9, waarbij het massa-element ten minste één doorgaand gat omvat om het mogelijk te maken voor de vloeistof om tussen het bovenste en het onderste gedeelte te gaan.

11. Voorvorksamenstel volgens conclusie 9 of 10, waarbij de stromingsweerstand van de omloopleiding en/of het ten minste één doorgaande gat aanpasbaar is.

12. Voorvorksamenstel volgens conclusie 10 en 11, waarbij de gestemde massademper een aanpassingselement omvat voor het aansturen van een smoor-opening tussen het ten minste één doorgaande gat en het bovenste of onderste gedeelte.

13. Voorvorksamenstel volgens conclusie 2, waarbij de massa-element-geleidende inrichting een geleidingsstaaf omvat die vast verbonden is aan het niet-geveerde gedeelte van de telescopische eenheid, en waarbij het massa-element een longitudinaal doorgaand gat omvat, waarbij de geleidingsstaaf ten minste ten dele in het longitudinale doorgaande gat gerangschikt is.

14. Voorvorksamenstel volgens conclusie 13, waarbij de geleidingstaaf gemonteerd is aan een buitenkant van de telescopische eenheid.

15. Voorvorksamenstel volgens conclusie 14, waarbij het massa-element gevormd is door en/of omvat is in een voorste spatbord van de motorfiets.

16. Voorvorksamenstel volgens een van de voorgaande conclusies, waarbij het veerkrachtige lid voor het toepassen van een veerkracht op de telescopische beweging gemonteerd is in het tweede buisvormige gedeelte.

17. Voorvorksamenstel volgens een van de conclusies 1-15, waarbij het veerkrachtige lid voor het toepassen van een veerkracht op de telescopische beweging gemonteerd is rond het eerste buisvormige gedeelte, waarbij de eerste en tweede buisvormige gedeeltes elk een steun omvatten, waarbij het veerkrachtige lid gemonteerd is tussen de steunen.

18. Voorvorksamenstel volgens een van de conclusies 16-17, waarbij het veerkrachtige lid voor het toepassen van een veerkracht op de telescopische beweging een veer, een elastisch materiaal, zoals Cellasto ® omvat, en/of waarbij het veerkrachtige lid gevormd wordt door een gascilinder.

19. Voorvorksamenstel volgens een van de voorgaande conclusies, waarbij een eerste uiteinde van de telescopische eenheid verbindbaar is met een wieldragende as van de motorfiets, en waarbij een tweede uiteinde van de telescopische eenheid, tegenovergesteld aan het eerste uiteinde, verbindbaar is met een stuurinrichting van de motorfiets, waarbij de gestemde massademper gerangschikt is tussen het eerste uiteinde en het veerkrachtige lid.

20. Voorvorksamenstel volgens conclusie 19, waarbij het eerste uiteinde gevormd is door een uiteinde van het tweede buisvormige gedeelte.

21. Voorvorksamenstel volgens conclusie 20, waarbij de gestemde massademper gerangschikt is in het tweede buisvormige gedeelte.

22. Voorvorksamenstel volgens conclusie 21, verder omvattende een demper voor het dempen van de telescopische beweging, waarbij deze demper gerangschikt is in het tweede buisvormige gedeelte tussen het tweede uiteinde en de gestemde massademper.

23. Voorvorksamenstel volgens conclusie 19, waarbij het eerste uiteinde gevormd is door een uiteinde van het eerste buisvormige gedeelte.

24. Voorvorksamenstel volgens conclusie 23, waarbij de gestemde massademper gemonteerd is aan of in het eerste buisvormige gedeelte.

25. Voorvork voor een motorfiets, omvattende een eerste en tweede vorklid welke apart van elkaar geplaatst zijn op een parallelle manier, waarbij ten minste één van de vorkleden het voorvorksamenstel volgens een van de conclusies 1-24 omvat.

26. Voorvork volgens conclusie 25, waarbij het eerste vorklid het voorvorksamenstel volgens een van de conclusies 1-24 omvat, en waarbij het tweede vorklid een verdere telescopische eenheid omvat welke ingericht is zoals de telescopische eenheid zoals gedefinieerd in conclusie 1.

27. Voorvork volgens conclusie 26, waarbij het tweede vorklid een demper omvat voor het dempen van de telescopische beweging van de verdere telescopische eenheid.

28. Motorfiets omvattende de voorvork volgens een van de conclusies 25-27 of het voorvorksamenstel volgens een van de conclusies 1-24.

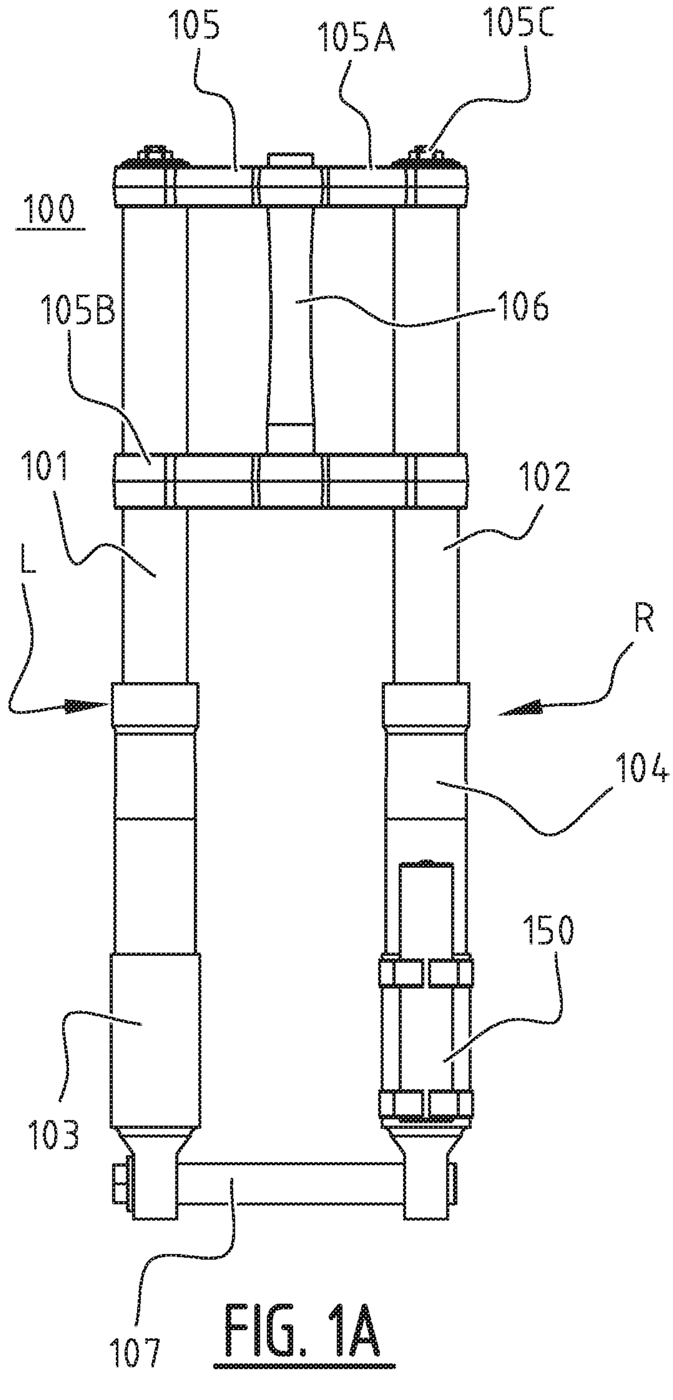

105
105A
105C
100
105B
106
101
102
L
R
104
150
103
107

FIG. 1A

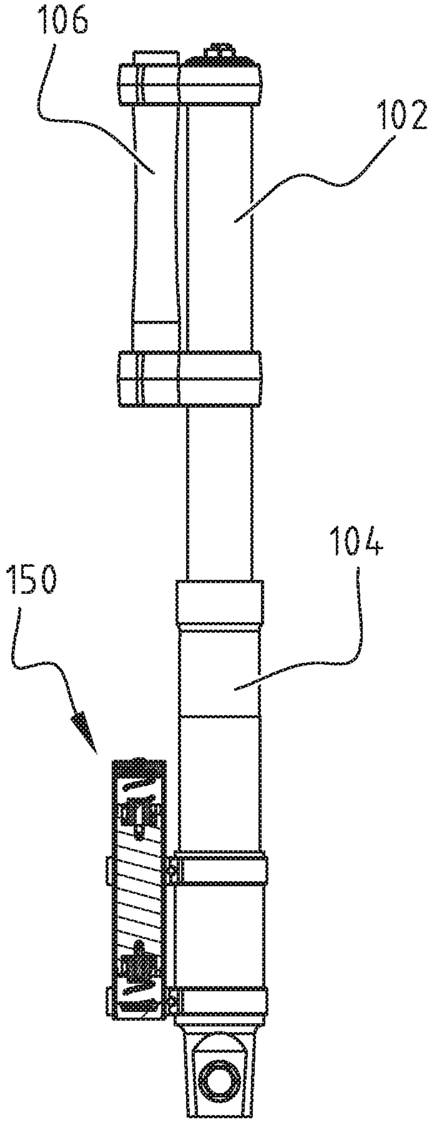

106
102
150
104

FIG. 1B

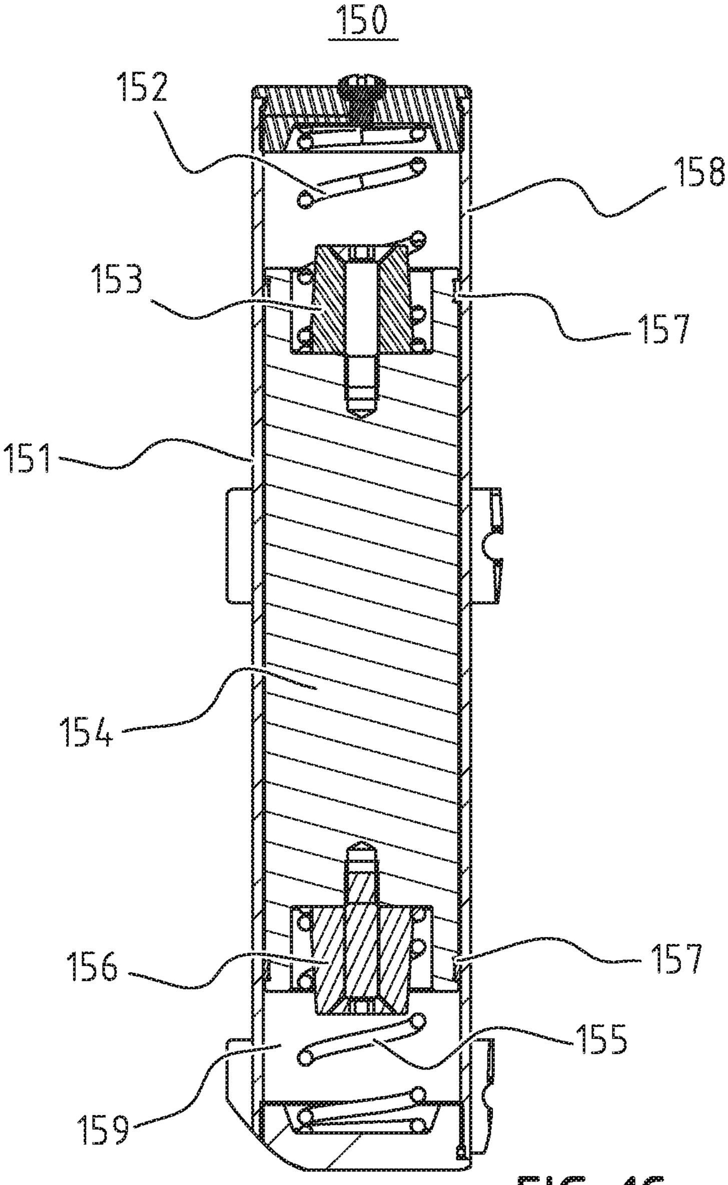


FIG. 1C

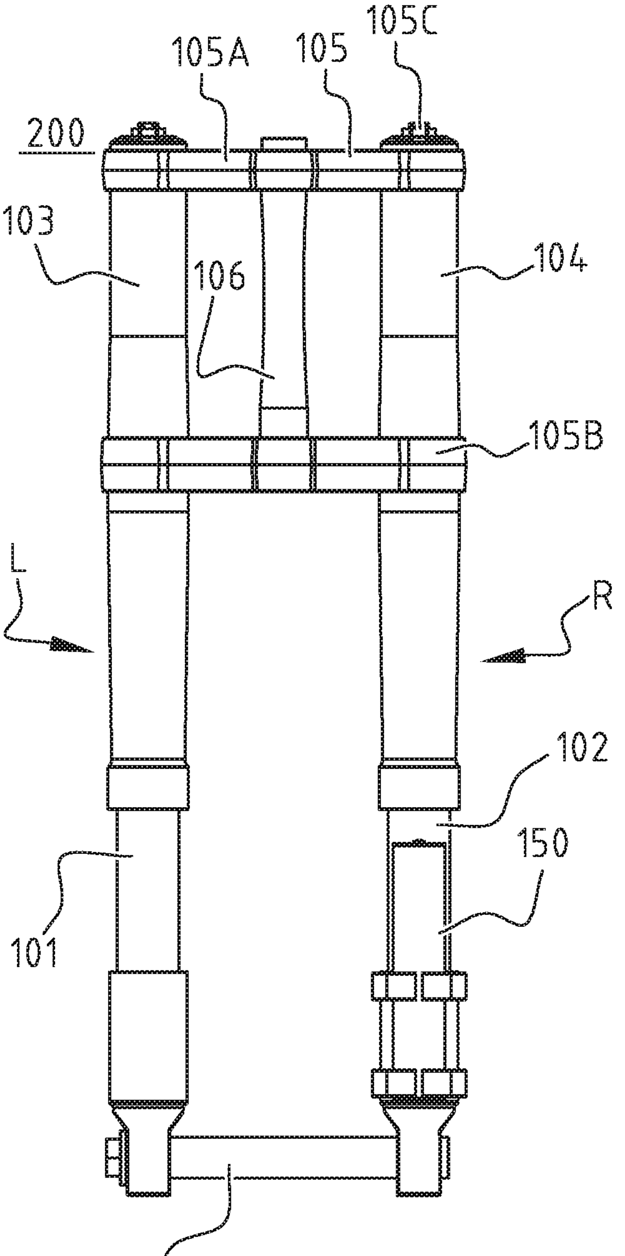

200
105A
105
105C
103
106
104
105B
L
R
102
150
101
107

FIG. 2A

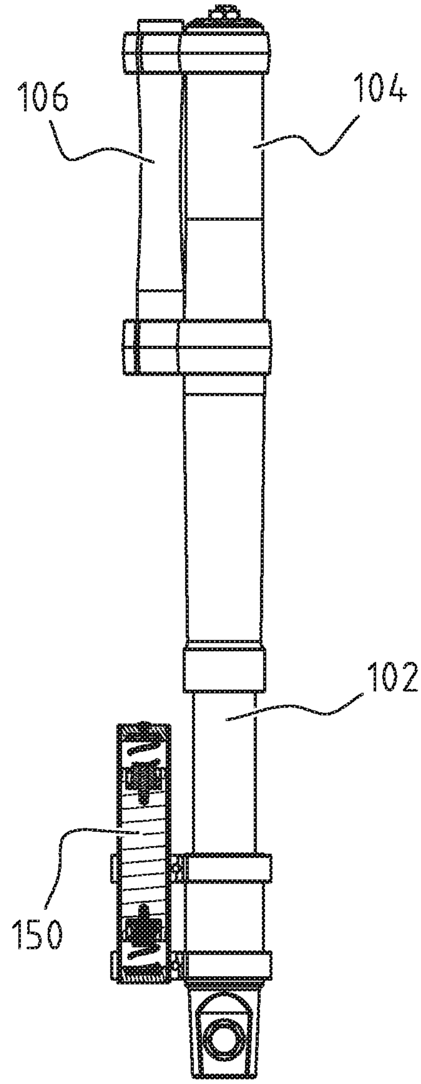

106
104
102
150

FIG. 2B

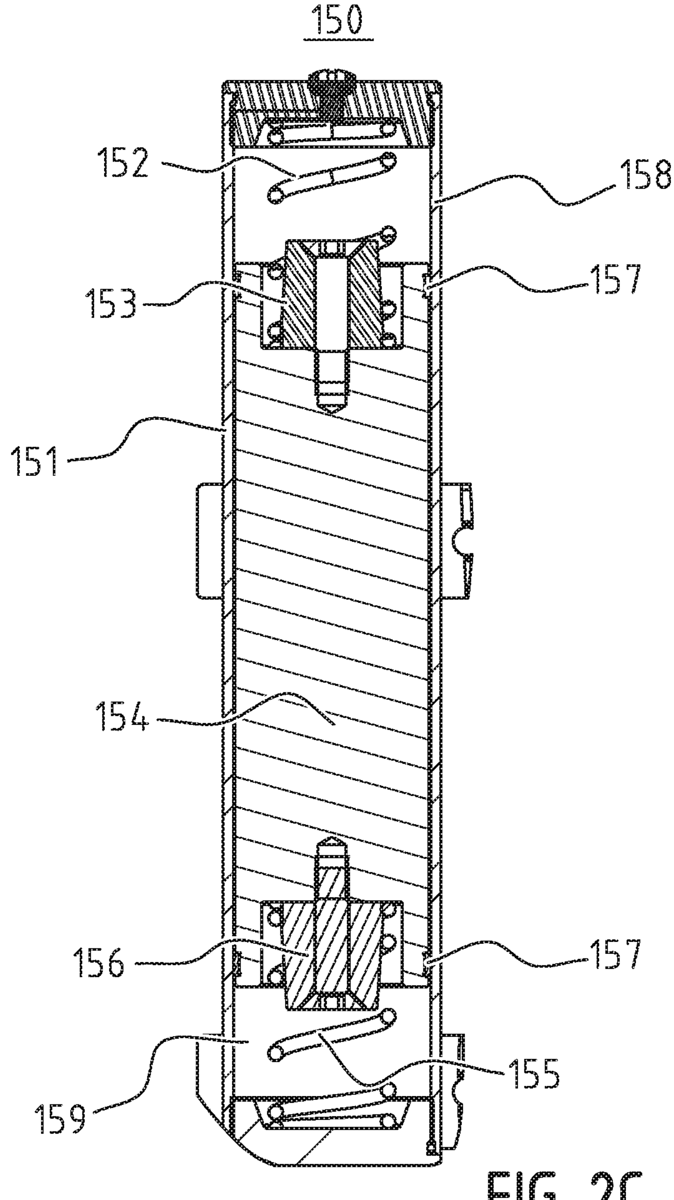


FIG. 2C

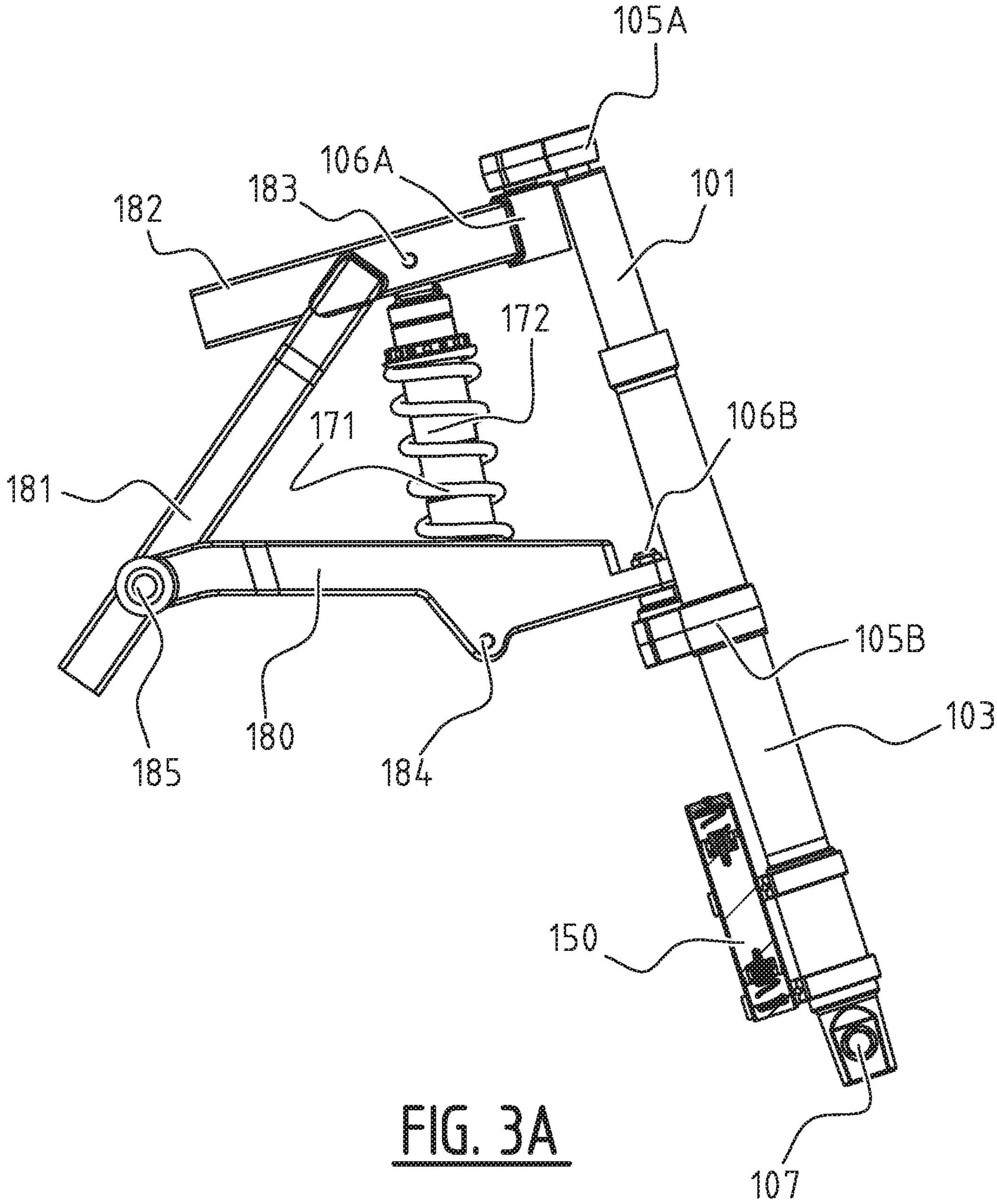

105A
106A
183
182
101
172
106B
171
181
105B
185
180
184
103
150
107

FIG. 3A

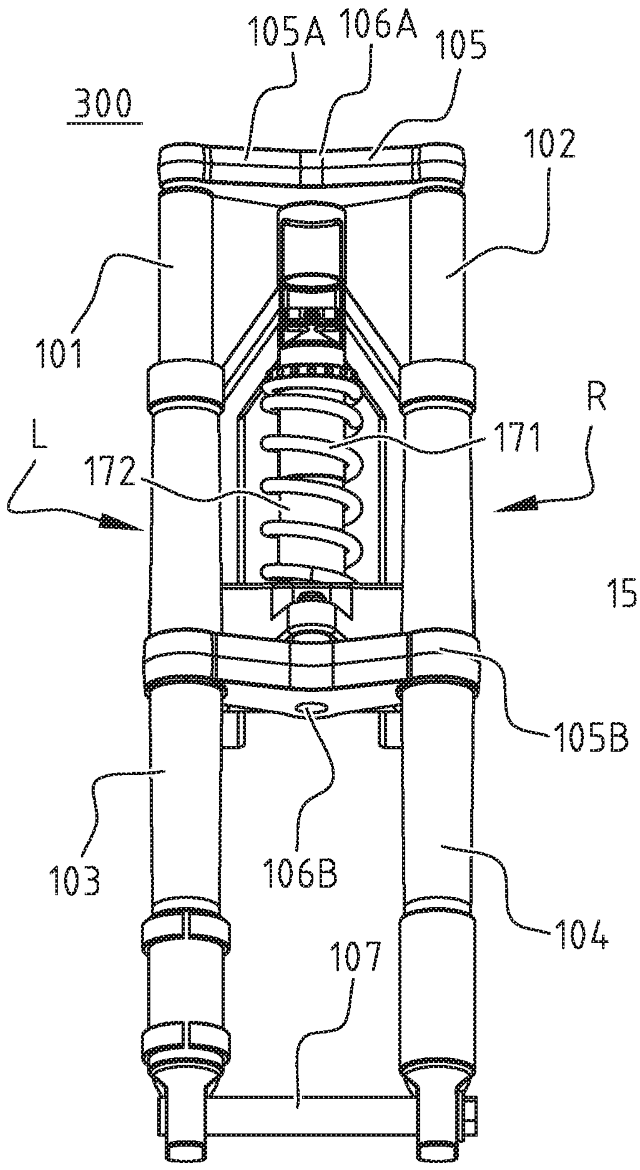
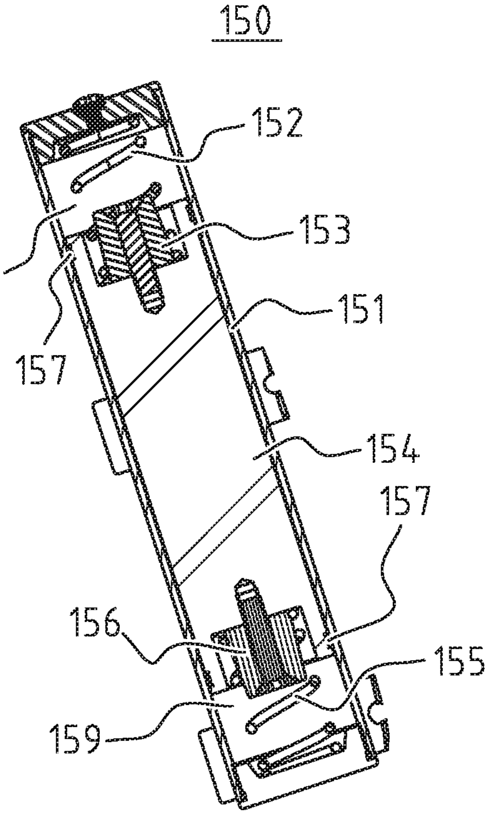

300
105A
106A
105
102
101
L
172
171
R
105B
103
106B
104
107

FIG. 3B


150
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155
159

FIG. 3C

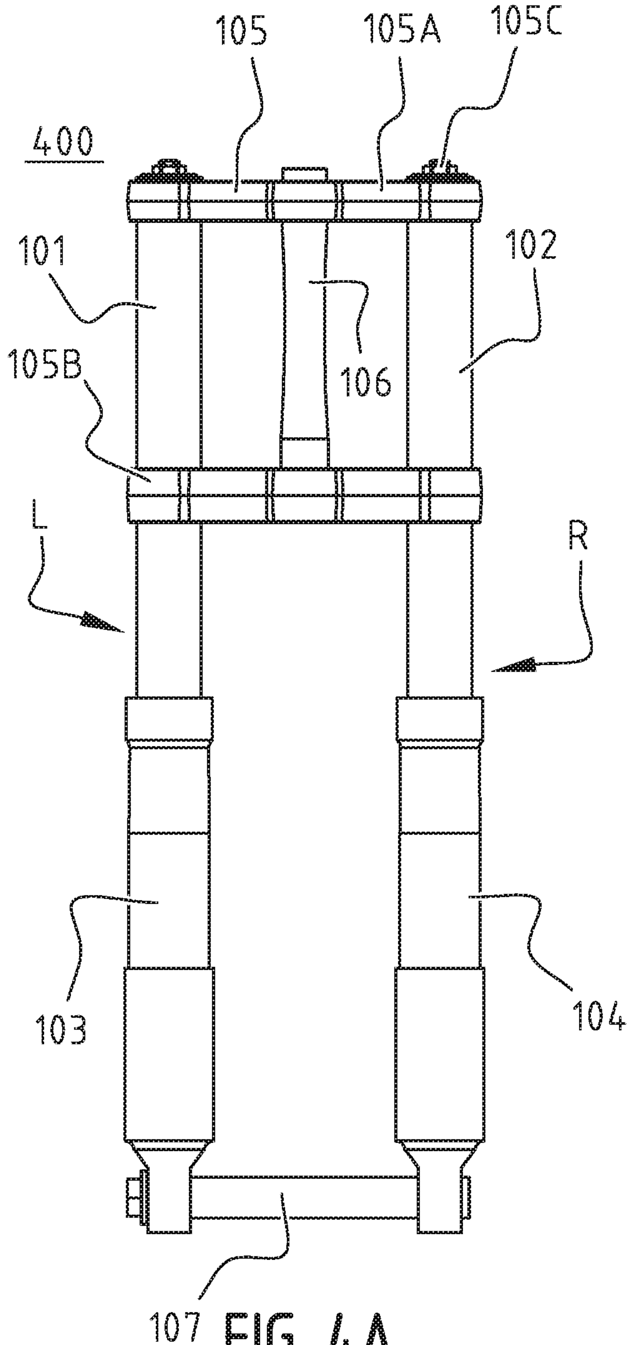

400
105
105A
105C
101
102
106
105B
L
R
103
104
107

FIG. 4A

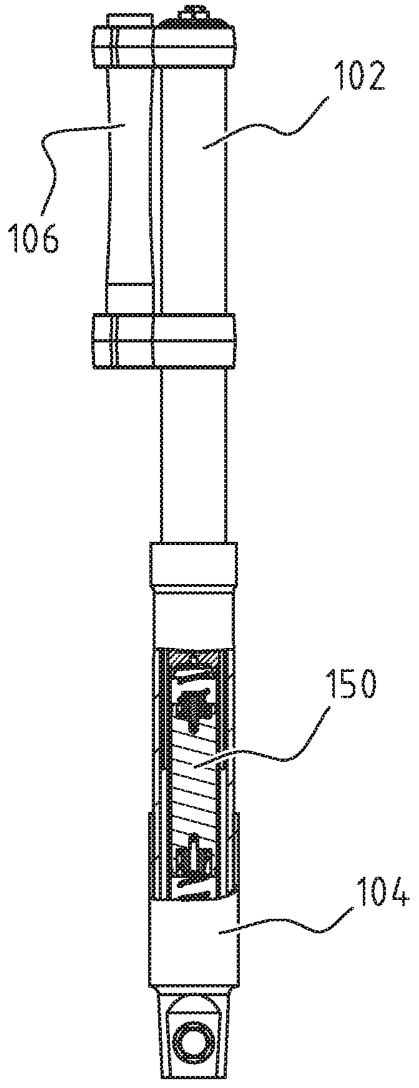

102
106
150
104

FIG. 4B

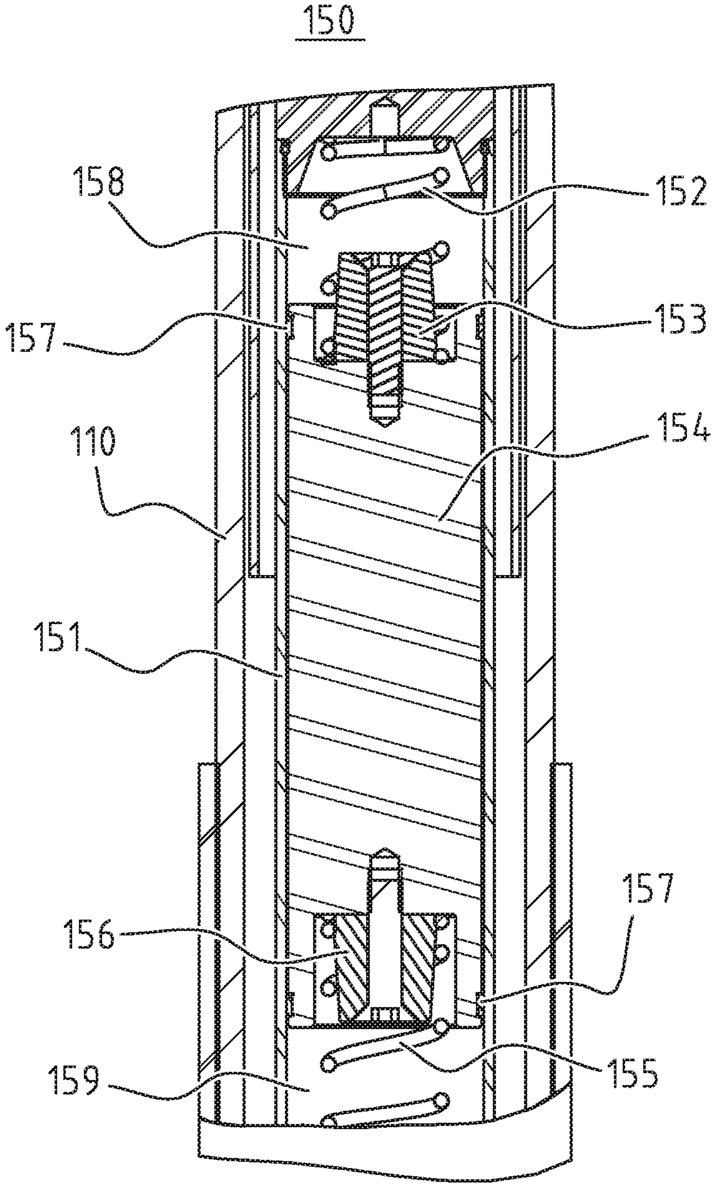


FIG. 4C

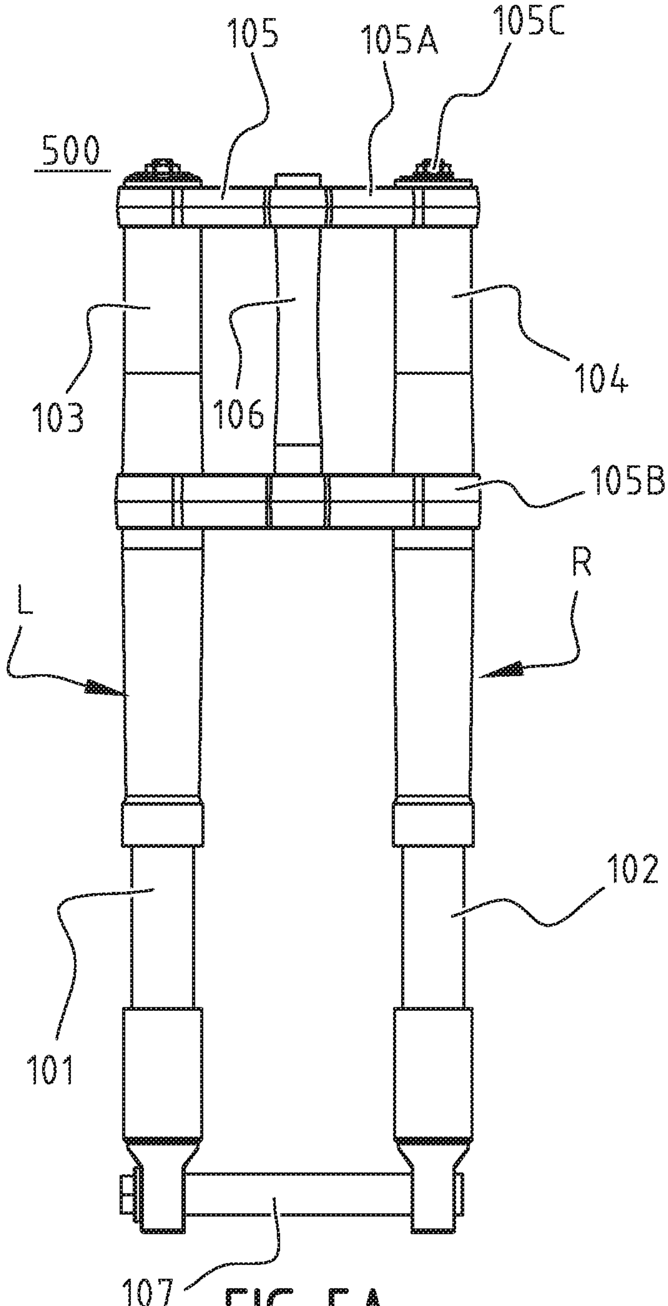
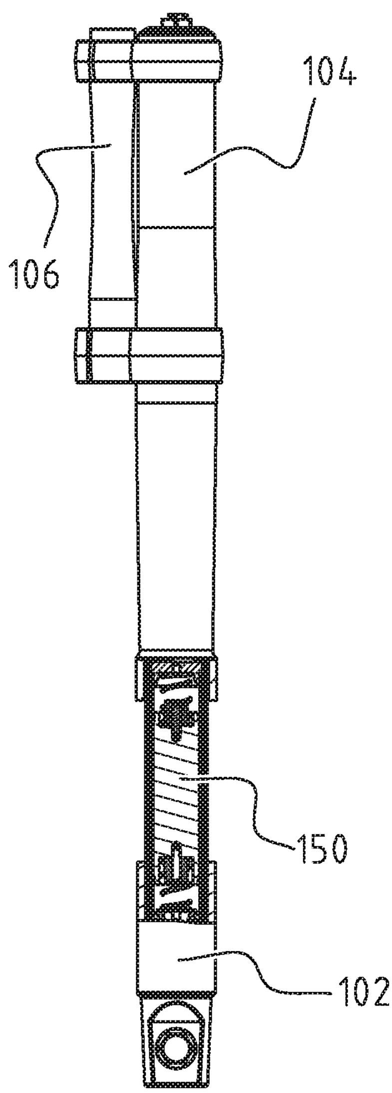

500
105
105A
105C
103
106
104
105B
L
R
101
102
107

FIG. 5A


104
106
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102

FIG. 5B

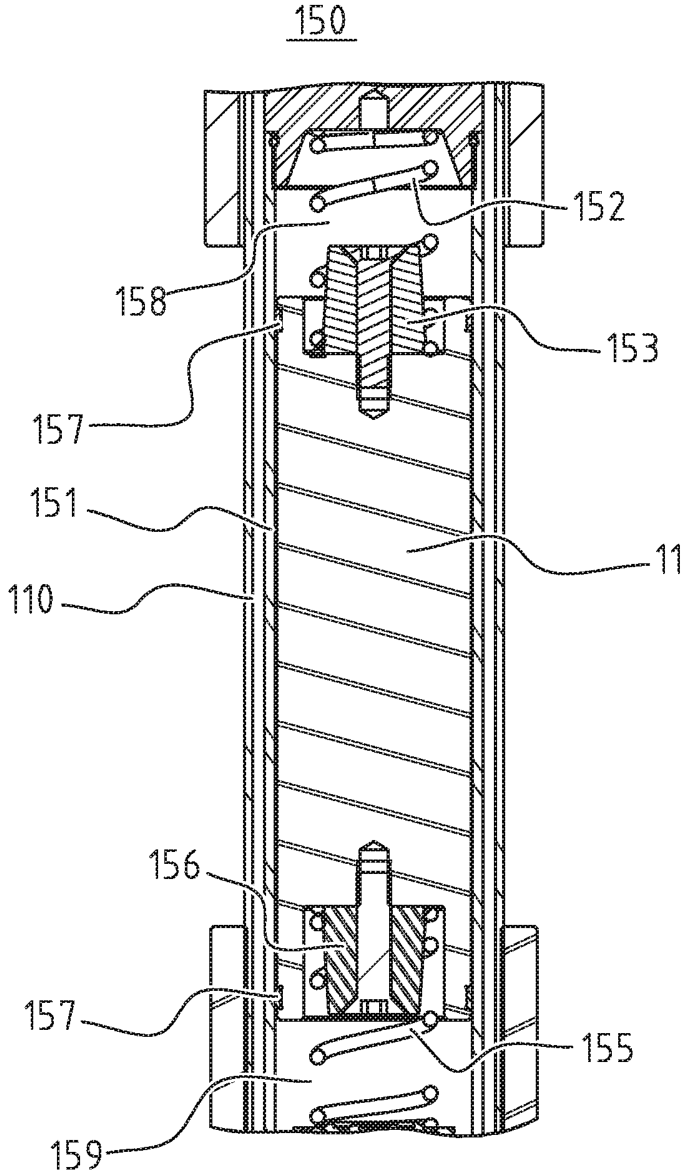
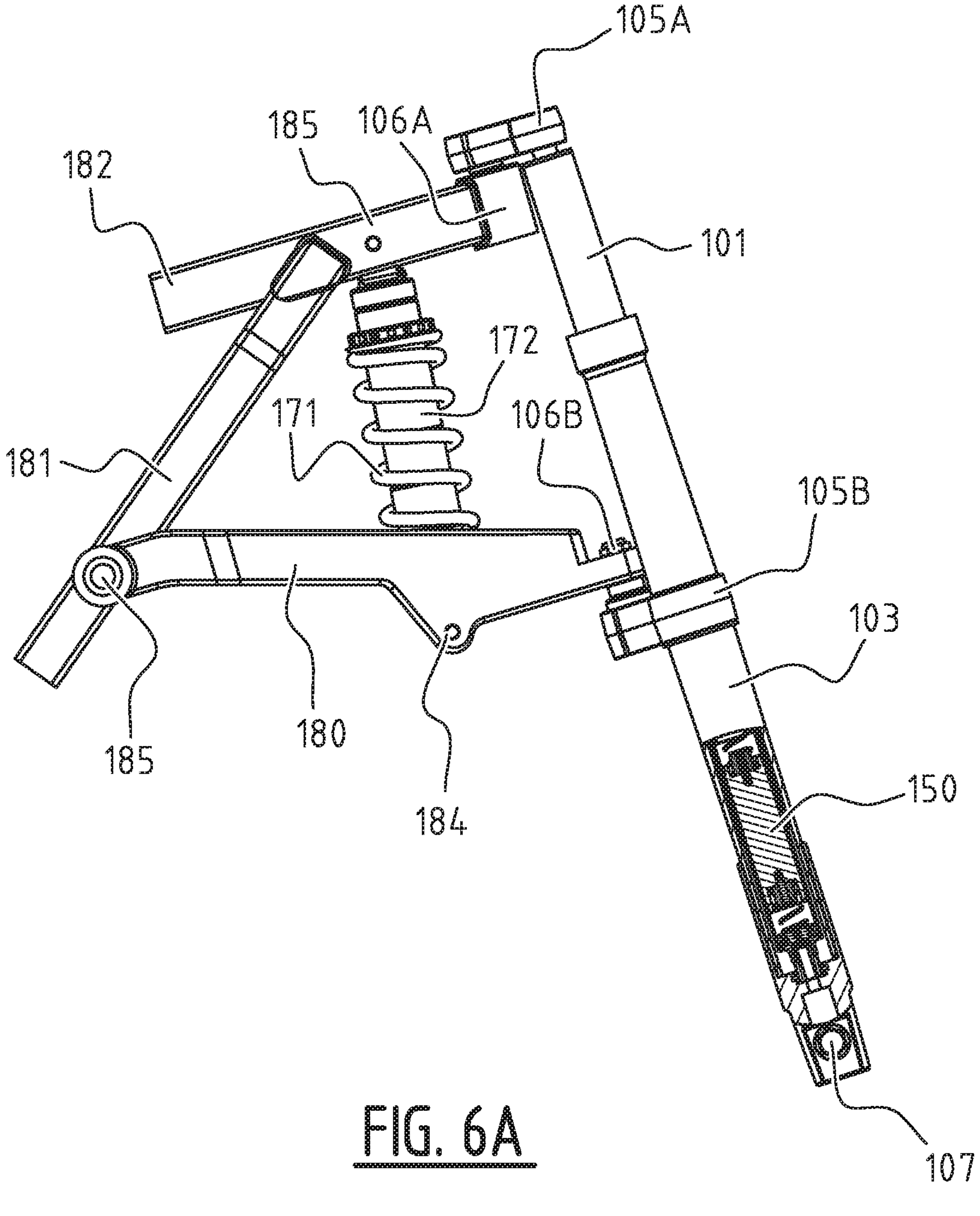


FIG. 5C


105A
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106A
182
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106B
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105B
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185
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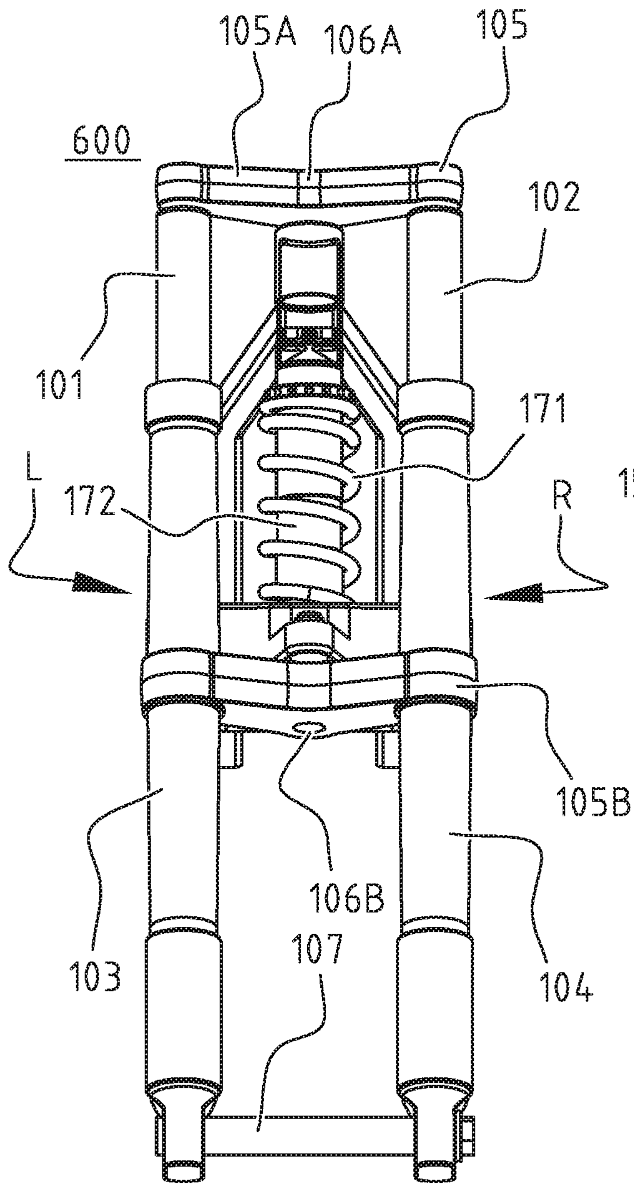
FIG. 6A



600
105A
106A
105
102
101
171
L
172
R
105B
106B
103
107
104

FIG. 6B

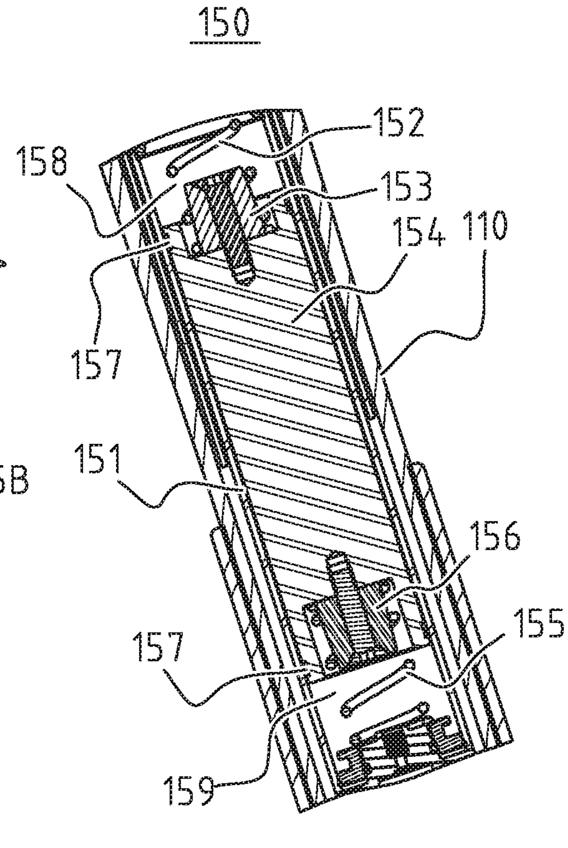


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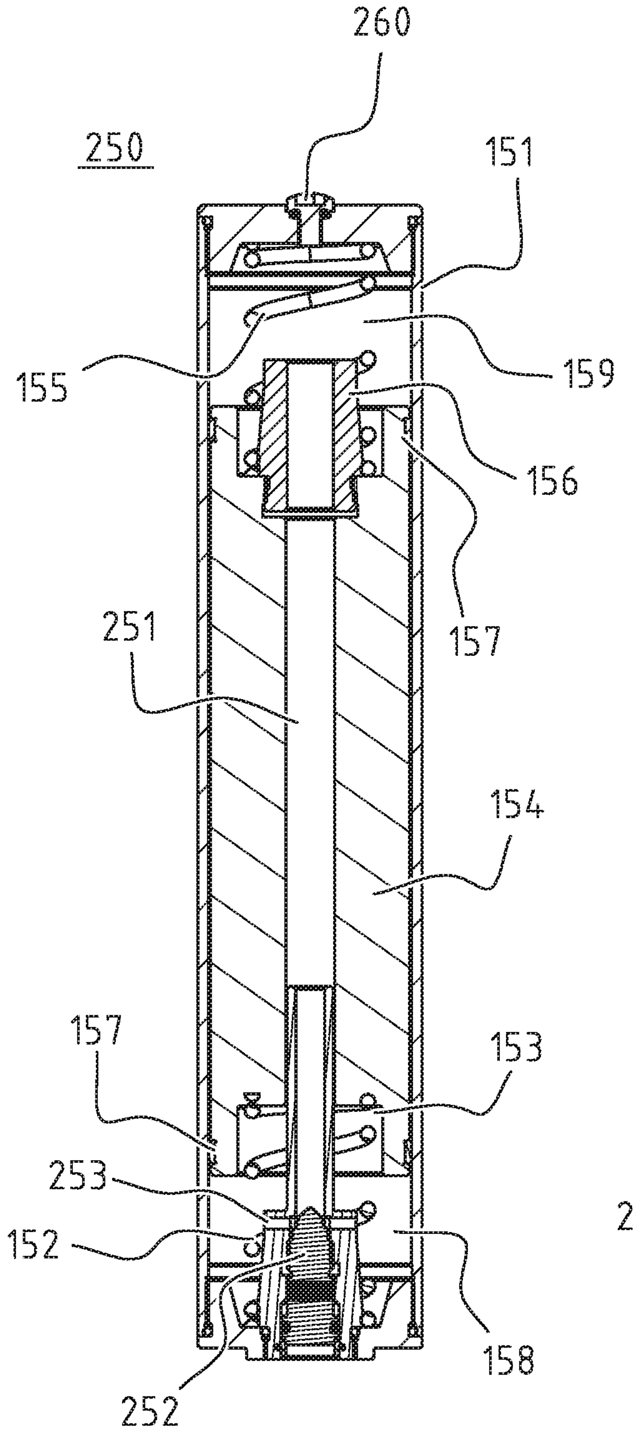
FIG. 6C



260
250
151
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FIG. 7A

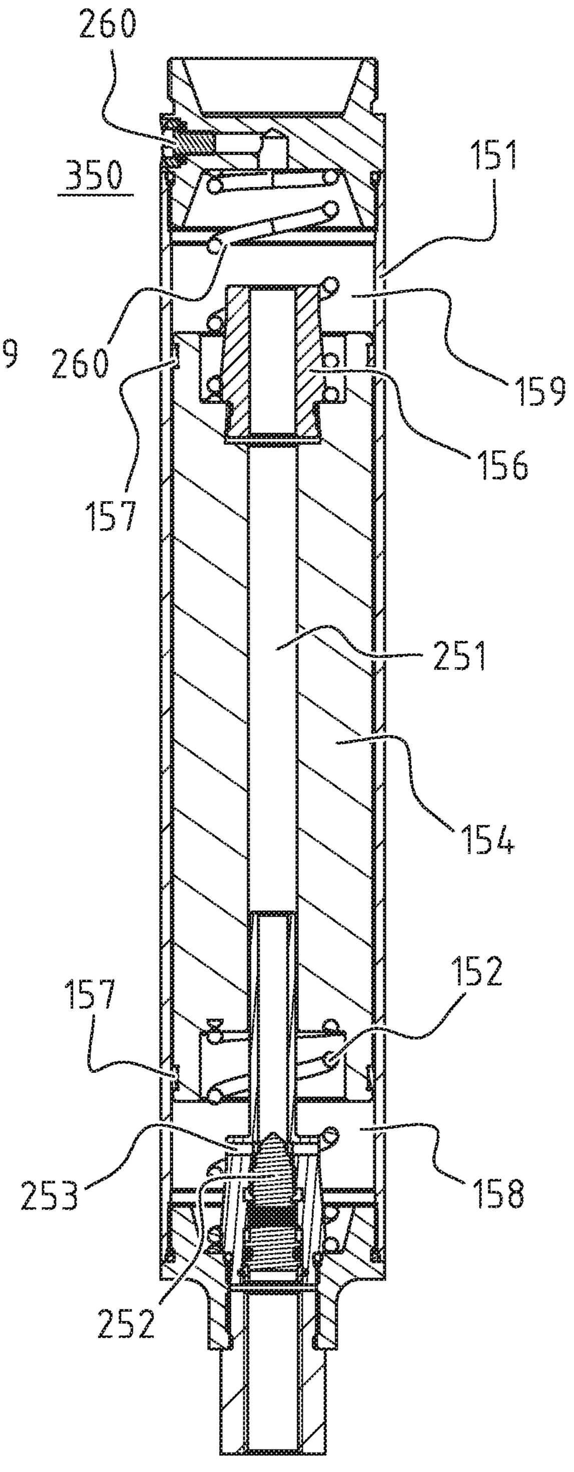

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FIG. 7B

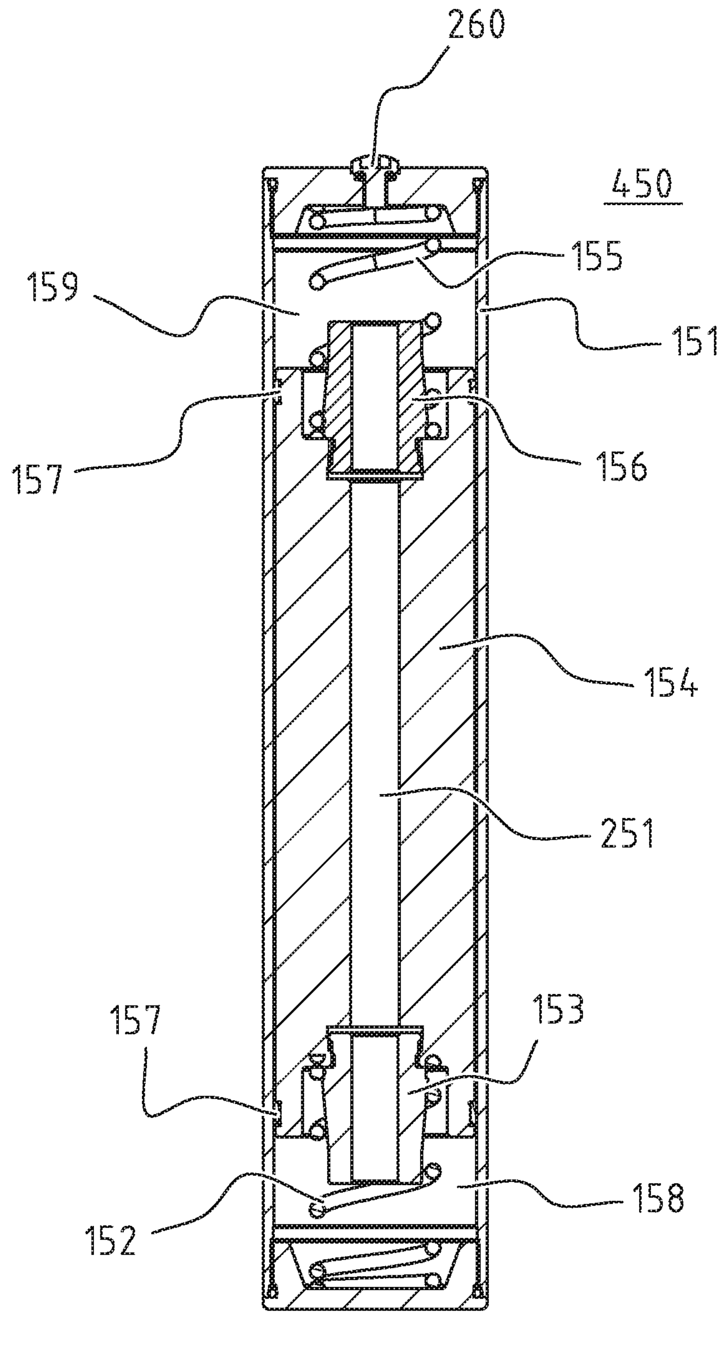


FIG. 7C

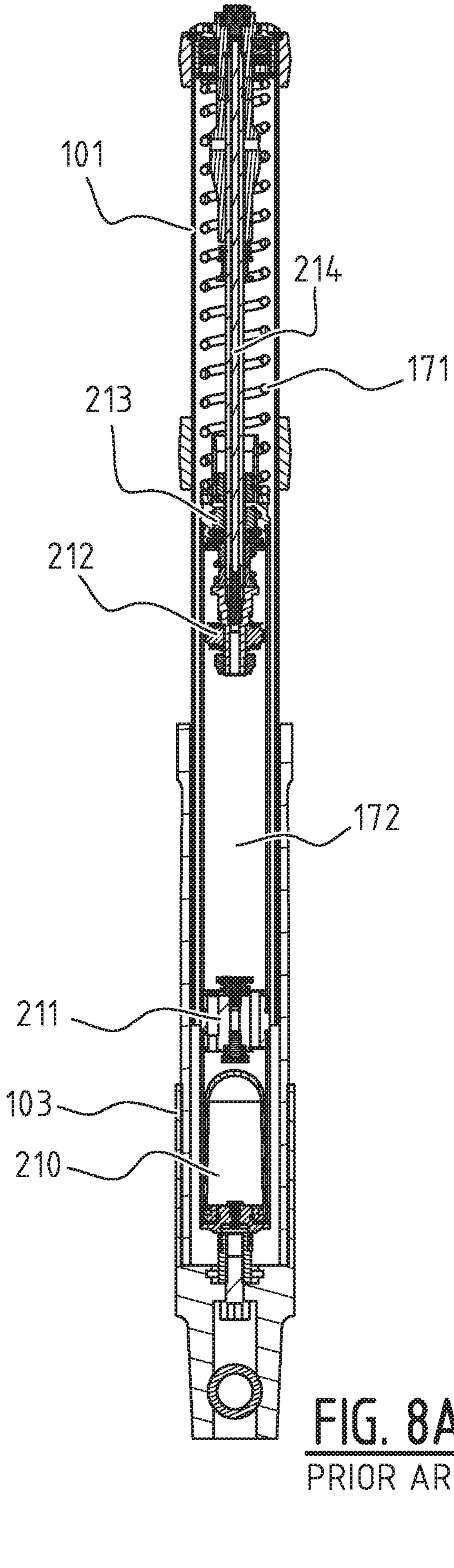


FIG. 8A
PRIOR ART

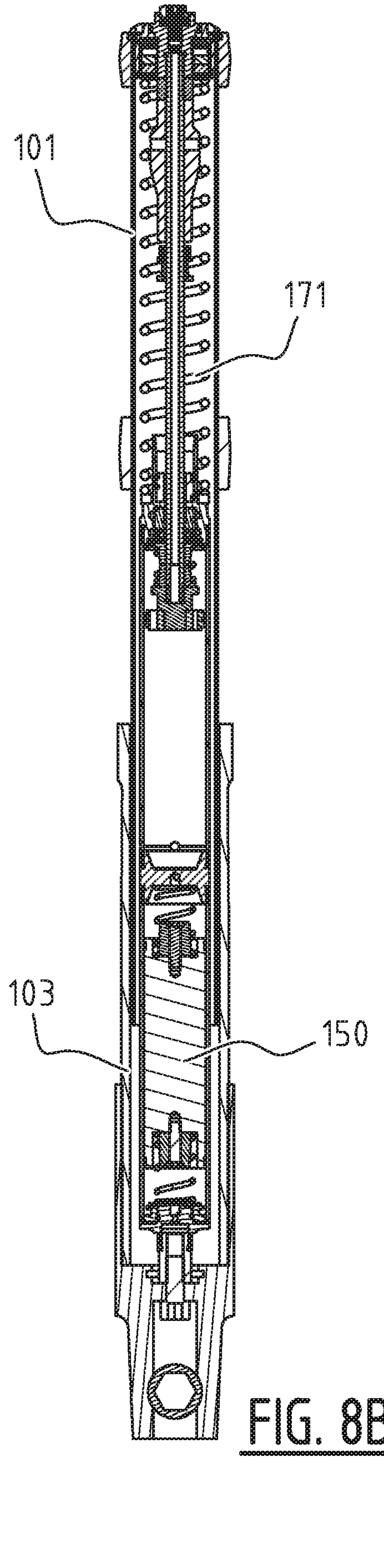
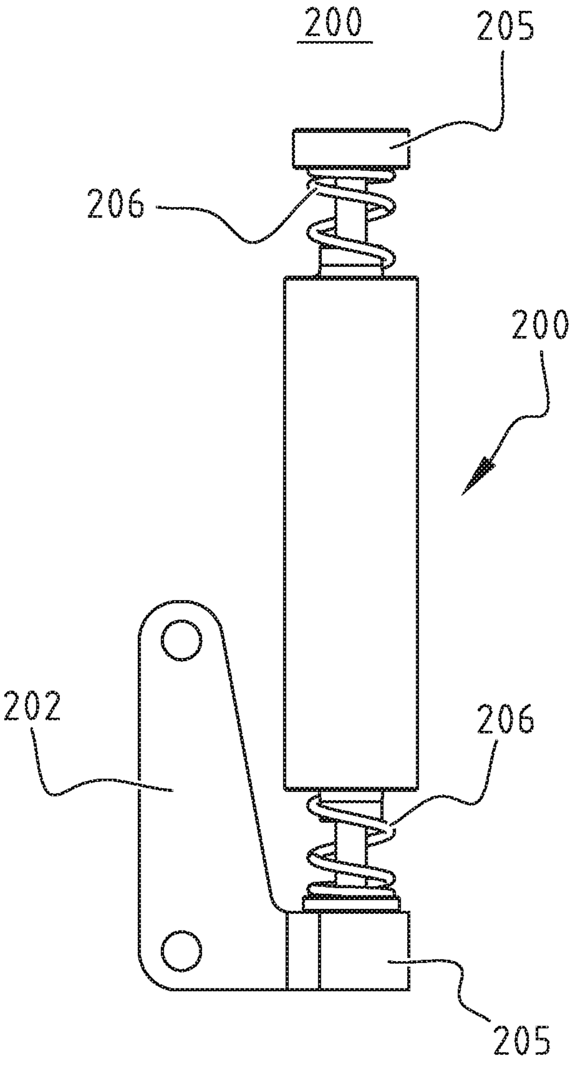


FIG. 8B


200
205
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202
205

FIG. 9A

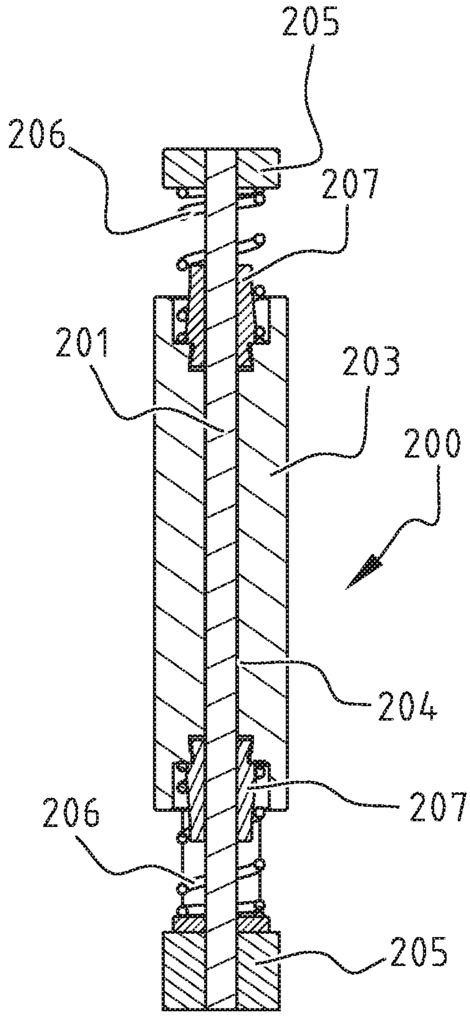
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FIG. 9B

ABSTRACT

The present invention relates to a front fork assembly and to a front fork comprising the same. The present invention further relates to a motorcycle that is provided with such a front fork assembly or front fork.

According to the invention, the front fork assembly comprises a tuned mass damper that is fixedly attached to the unsprung section of the telescopic unit.

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	**KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE** **3B/2TG70/BD/4**
Nederlands aanvraag nr. **2016884**	Indieningsdatum **02-06-2016**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Tractive Suspension B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **15-10-2016**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN67565**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

F16F7/112;B62K25/08;F16F7/116

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**F16F;B32K**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES	(opmerkingen op aanvullingsblad)
IV.	☐	GEBREK AAN EENHEID VAN UITVINDING	(opmerkingen op aanvullingsblad)

Form PCT/ISA 201 A (11/2000)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2016884

A. CLASSIFICATIE VAN HET ONDERWERP
INV. F16F7/112 B62K25/08 F16F7/116
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte mimimum documentatie (classificatie gevolgd door classificatiesymbolen)
F16F B62K

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)

EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie *	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 6 050 558 A (AGRA LUIS ALBERTO [AR]) 18 april 2000 (2000-04-18)	1-12, 16-18, 25-28
Y	* het gehele document *	13-15
A		19-24
A,D	JP 2014 008932 A (HONDA MOTOR CO LTD) 20 januari 2014 (2014-01-20) in de aanvraag genoemd * samenvatting; figuren *	1-28
Y	US 4 925 198 A (ITO TOSHIAKI [JP] ET AL) 15 mei 1990 (1990-05-15)	13-15
A	* het gehele document *	1,2,25
A	US 2015/034427 A1 (PICKMAN SAM [US] ET AL) 5 februari 2015 (2015-02-05) * het gehele document *	1,25

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

* Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid

24 januari 2017

Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type

Naam en adres van de instantie

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

1

De bevoegde ambtenaar

Kramer, Pieter Jan

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek

NL 2016884

In het rapport genoemd octrooigeschrift		Datum van publicatie	Overeenkomend(e) geschrift(en)		Datum van publicatie
US 6050558	A	18-04-2000	GEEN		
JP 2014008932	A	20-01-2014	JP 5911015	B2	27-04-2016
			JP 2014008932	A	20-01-2014
US 4925198	A	15-05-1990	GEEN		
US 2015034427	A1	05-02-2015	DE 102014011223	A1	05-02-2015
			FR 3009360	A1	06-02-2015
			TW 201515916	A	01-05-2015
			US 2015034427	A1	05-02-2015

WRITTEN OPINION

File No. SN67565	Filing date *(day/month/year)* 02.06.2016	Priority date *(day/month/year)*	Application No. NL2016884
International Patent Classification (IPC) INV. F16F7/112 B62K25/08 F16F7/116			
Applicant Tractive Suspension B.V.			

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

	Examiner Kramer, Pieter Jan

WRITTEN OPINION

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	7, 13-15, 17, 19-24
	No:	Claims	1-6, 8-12, 16, 18, 25-28
Inventive step	Yes:	Claims	19-24
	No:	Claims	1-18, 25-28
Industrial applicability	Yes:	Claims	1-28
	No:	Claims	

2. Citations and explanations

   see separate sheet

Application number

WRITTEN OPINION

NL2016884

Box No. VII Certain defects in the application

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 6 050 558 A (AGRA LUIS ALBERTO [AR]) 18 april 2000 (2000-04-18)

D3 US 4 925 198 A (ITO TOSHIAKI [JP] ET AL) 15 mei 1990 (1990-05-15)

2 The present application does not meet the criteria of patentability, because the subject-matter of independent claims 1 and 25 is not new.

2.1 Document D1 discloses (the references in parentheses applying to this document) een

voorvorksamenstel voor een motorfiets, omvattende:
een telescopische eenheid omvattende een eerste uitgestrekt buisvormig gedeelte en een tweede uitgestrekt buisvormig gedeelte, waarbij het eerste buisvormige gedeelte tenminste ten dele opgenomen is in het tweede buisvormige gedeelte op een schuivende manier, zodanig dat de eerste en tweede buisvormige gedeeltes een telescopische beweging kunnen uitvoeren ten opzichte van elkaar langs de longitudinale assen ervan;
een veerkrachtig lid ingericht voor het toepassen van een veerkracht op de telescopische beweging, waarbij dit veerkrachtige lid een niet-geveerd gedeelte en een geveerd gedeelte van de telescopische eenheid definieert wanneer deze eenheid gemonteerd is in de motorfiets (all of the afore mentioned features are considered to be implicitly disclosed by document D1, since the , see column 3, lines 21-23 and column 4, lines 1-8); en
een gestemde massademper (1, 3, 5, 6, 10) omvattende een massa-element 3) dat in staat is om een oscillerende beweging uit te voeren parallel aan de longitudinale assen (See for example column 3, lines 29-59), waarin de gestemde massademper vast verbonden is aan het niet geveerde gedeelte van de telescopische eenheid (See for example column 3, lines 21-23).
(**Claim 1**)

3 The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 25, which therefore is also considered not new nor inventive. (**Claim 25**)

4 Dependent claims 2-18 and 26-28 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step.

4.1 The subject-matter of claims 2-6, 8-12, 16, 18 and 26-28 are known from document D1. Although not all features are directly and explicitly disclosed by document D1, the skilled man is aware of the features of the various damping systems in the references made to the specific motorcycles in column 4, lines 1-8. (**Claims 2-6, 8-12, 16, 18 and 26-28**)

4.2 The features as disclosed in claims 7 and 17 are considered to be merely one of several straightforward possibilities from which the skilled person in the field of motorcycle vibration damping would select, in accordance with circumstances, without the exercise of inventive skill, which arise during standard design stages.

4.3 The subject-matter of claims 13-15 are rendered obvious by the combination of documents D1 and D3. Although the tuned mass damper according to D3 is utilised in a different direction than the tuned mass damper in D1, the skilled man in the field of motorcycle vibration damping is well able of using various features of the tuned mass damper according to document D3 and apply them to the tuned mass damper according to D1, without the use of inventive skill, in case an alternate construction is desired. (**Claims 13-15**)

5 The combination of the features of dependent claims 19-24 is neither known from, nor rendered obvious by, the available prior art. The incorporation of the tuned mass damper in the unsprung part of the front fork contributes to an integral damping system solution. (**Claims 19-24**)

Re Item VII

Certain defects in the application

6 The same feature shall be denoted by the same reference sign throughout the application. This requirement is not met in view of the use of reference sign 260. See for example on page 8, line 2 and figure 7B.

7 The features of claims 1-28 are not provided with reference signs placed in parentheses.