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(71) Applicant: **TVS MOTOR COMPANY LIMITED**

[IN/IN]; TVS Motor Company Limited, "Chaitanya", No.12 Khader Nawaz Khan Road, Nungambakkam, Chennai 600 006 (IN).

(72) Inventors: **HANMUGAM, Mohan**; TVS Motor Company Limited, "Chaitanya", No.12 Khader Nawaz Khan Road, Nungambakkam, Chennai 600 006 (IN). **ENDHAPADI MOTHILAL, Balakrishnan**; TVS Motor Company Limited, "Chaitanya", No.12 Khader Nawaz Khan Road, Nungambakkam, Chennai 600 006 (IN). **KARNAM, Venkata Mangaraju**; TVS Motor Company Limited, "Chaitanya", No.12 Khader Nawaz Khan Road, Nungambakkam, Chennai 600 006 (IN).

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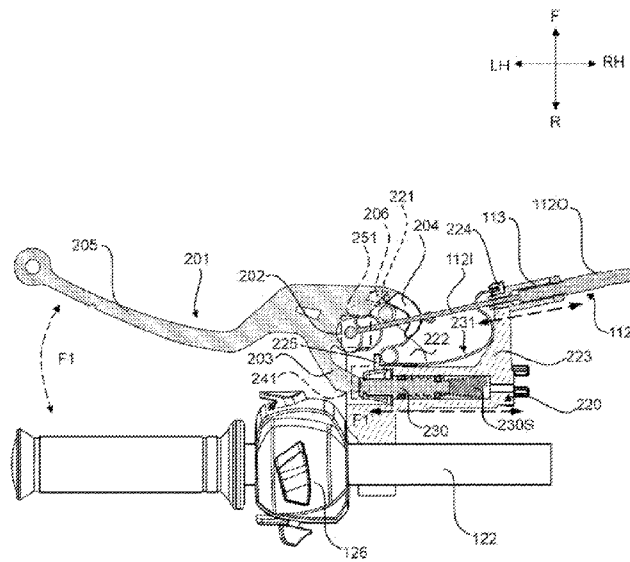


Fig. 4

(57) Abstract: The present subject matter relates to a braking system. A synchronized braking system (200) for a motor vehicle is provided. The synchronized braking system (200) comprises a synchronized brake lever (201, 301) configured to actuate a front wheel brake and a rear wheel brake. The synchronized brake lever (201) is operatively connected to a synchronizing intermediate member (112). The synchronizing intermediate member (112) is configured to actuate the front wheel brake (102). The synchronized brake lever (201, 301) is disposed in a movable pivot-contact (241, 341) with a rear actuating member (220, 320) and is configured to actuate a rear wheel brake (104). The present subject matter is compact and uses less number of components.



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## A SYNCHRONIZED BRAKING SYSTEM

### TECHNICAL FIELD

[0001] The present subject matter, in general, relates to a braking system, and, in particular relates, to a synchronized braking system of a motor vehicle.

### BACKGROUND

5 [0002] Generally, motor vehicles are provided with a braking system, which is used for slowing down the motor vehicle and / or for bringing the motor vehicle to a complete halt. Be it a mono-cycle or a multi-wheeled vehicle, all the motor vehicles incorporate a braking system. Generally, multi-wheeled vehicles, especially, motor vehicles having a plurality of wheels incorporate various  
10 electronics based braking systems like anti-lock braking system (ABS), electronic brake-force distribution (EBD) etc., which operate based on complex electronics. Two-wheeled or three-wheeled motor vehicles, catering to commuter applications, popularly incorporate a braking system that allows simultaneous application of a front wheel brake and a rear wheel brake by actuation of a single brake lever.

### 15 BRIEF DESCRIPTION OF THE DRAWINGS

[0003] The detailed description is described with reference to the accompanying figures. Similar numbers are used throughout the drawings to reference like features and components.

20 [0004] Fig. 1 illustrates a schematic layout of a synchronized braking system of a motor vehicle, in accordance with an embodiment of the present subject matter.

[0005] Fig. 2 illustrates an enlarged view of a portion of synchronized braking system for a motor vehicle, in accordance with an embodiment of the present subject matter.

25 [0006] Fig. 3 illustrates an exploded view of the synchronized braking system, in accordance with an embodiment of the present subject matter.

[0007] Fig. 4 illustrates a sectional top view of the synchronized braking system, the section taken along axis X-X' as shown in Fig. 2 and axis of master cylinder bore, in accordance with an embodiment of the present subject matter.

[0008] Fig. 5 (a) depicts a top view of a synchronized brake lever, in accordance with an embodiment of the present subject.

[0009] Fig. 5 (b) depicts a perspective view of a synchronized brake lever when viewed from front top side, in accordance with an embodiment of the present subject.

[00010] 6 (a) illustrates a side perspective view of a body of an actuating member when viewed from right top side, in accordance with an embodiment of the present subject matter.

[00011] Fig. 6 (b) illustrates another perspective view of an actuating member, in accordance with an embodiment of the present subject matter.

[00012] Fig. 7 (a) to Fig. 7 (c) illustrate various views of an elastic member in accordance with an embodiment of the present subject matter.

[00013] Fig. 8 (a) depicts a front perspective view of the synchronized braking system, in accordance with an embodiment of the present subject matter.

[00014] Fig. 8 (b) a sectional bottom view of the synchronized braking system, section taken along axis Y-Y' as shown in Fig. 8 (a) and axis of master cylinder bore, in accordance with an embodiment of the present subject matter.

[00015] Fig. 9 (a) depicts a perspective view of a portion of a synchronized brake lever, in accordance with another embodiment of the present subject.

[00016] Fig. 9 (b) depicts a partially exploded view of a portion of the synchronized braking system, in accordance with an embodiment of the present subject.

[00017] Fig. 9 (c) illustrates a sectional top view of a synchronized braking system, section taken along axis Z-Z', in accordance with an embodiment of the present subject matter as depicted in Fig. 9 (a) and along axis of master cylinder bore.

## 25 DETAILED DESCRIPTION

[00018] Conventionally, two-wheeled or three-wheeled motor vehicles are considered to be less stable when compared to motor vehicles having four or more wheels. Hence, braking system plays a crucial role in slowing down or in bringing the motor vehicle to a halt effectively. Generally, in the two-wheeled or three-wheeled motor vehicles, a disc brake or a drum brake is provided to operate as a front wheel brake and a drum brake is provided to operate as a rear wheel brake.

For example, the disc brake is provided as front wheel brake in motor vehicles that operate at high-speeds. Moreover, in case of high-speed applications, the rear wheel is also configured with a disc brake. Conventionally, a hand-operated lever or a foot-operated lever is used for actuation of the brakes.

5 [00019] In order to simultaneously operate both the front wheel brake and the rear wheel brake, a brake force distribution member like an equalizer is typically used in some braking system known in the art. The equalizer and corresponding cables or hose connections cannot be accommodated near a handle bar, where a hand-operated brake lever is disposed, or near a rider foot-peg/ foot-rest, where a foot-operated brake lever is disposed. Moreover, the equalizer-based system may require  
10 a separate space / casing on the motor vehicle away from the handle bar or the rider foot-peg. Provision of such aforementioned braking system that simultaneously operates the front wheel brake and the rear wheel brake upon actuation of the single brake lever is a major challenge due to space constraints. For example, the  
15 handlebar already incorporates various system like switches, head lamp assembly, a cover or casing, display etc. Moreover, equalizer-based systems work on principle of brake force distribution, which may require the user to apply more braking force for application of brakes.

[00020] Typically, in some other braking systems that are known in the art, when  
20 the front wheel brake is a disc brake, the system uses two hydraulic master cylinders for achieving independent brake operation and simultaneous brake operation. One master cylinder is used to actuate one or more calipers of the front wheel brake when one brake lever is actuated and other master cylinder is also used to actuate one or more additional caliper-pistons (other than the calipers earlier mentioned) of  
25 the front wheel brake when the other brake lever is actuated. Thus, when a braking system uses a single disc brake itself, two master cylinders are required in some cases.

[00021] When the rear wheel brake is also provided with a disc brake, the system may require a third master cylinder or pressure control valve (PCV) for actuation  
30 of the rear disc brake. The braking systems with more than two master cylinders or with pressure control valves become very complex and moreover, the master

cylinders have to be accommodated on the motor vehicle. Moreover, there are severe risk in safety due to probability of piston seizure while using multiple piston-based systems like PCV along with master cylinders. These systems are expensive due to multiple components and need for multiple mechanical or hydraulic connections between them. The master cylinder that operates in conjunction with hydraulic hoses requires hydraulic fluid in large quantities adding to the cost and complexity of oil filling during assembly and maintenance. Certain other solutions known in the art comprise two master cylinders for the front wheel brake and the rear wheel brake and for simultaneous actuation of both brakes. However, owing to the challenges mentioned above like multiple connections, number of components, space constraints etc., such braking system again utilize the equaliser to establish connection between the master cylinders as well as the brake in order to perform simultaneous actuation of the front wheel brake and the rear wheel brake. Moreover, wear and tear with cycle time due to repetitive usage is higher in such system because of number of moving components involved in the system. Even presence of multiple hydraulic connections may be considered as potential weak points that may result in failure of leakage, seepage or burst in critical braking system.

[00022] Moreover, an additional challenge is, that due to multiple connections it becomes a major challenge for service personnel during service and maintenance to access and to do the maintenance. Also, systems known in the art, use large number of components adding to the weight of the system, which increases overall weight of the motor vehicle as an effect adversely affecting performance and fuel economy. The multiple master cylinders could not be placed in a place that is visible to the user making it as a challenge for the user to observe and act when an oil level in the hydraulic system goes down below the limit for serviceability. Further, as mentioned above, in certain motor vehicles which are typically referred to as scooters, a headlamp assembly is also mounted on the handlebar and more than two master cylinders cannot be accommodated in the vicinity of the handlebar due to crowding of various components thereat.

[00023] Hence, there exists a challenge to provide a braking system that is capable of actuating front wheel brake and rear wheel brake simultaneously. It should be capable of being accommodated on a compact two-wheeled or three-wheeled motor vehicle by occupying less space and by utilising a smaller number of components  
5 without any compromise on braking effectiveness and safety.

[00024] Thus, the present subject matter provides a braking system that addresses the aforementioned and other problems in the prior arts.

[00025] In one embodiment, a synchronized braking system for a motor vehicle is provided. The synchronized braking system as per the present invention, comprises  
10 a front wheel brake capable of applying braking forces to one or more front wheels of the motor vehicle. A rear wheel brake capable of applying braking forces to one or more rear wheels of the motor vehicle. An independent brake lever is provided, which is typically a hand-operated lever. The independent brake lever is mounted to a handlebar assembly of the motor vehicle. The independent lever is coupled to  
15 the front wheel brake by a front connecting member.

[00026] In one embodiment, a synchronized brake lever, which is capable of synchronously/ simultaneously actuating the front wheel brake and a rear wheel brake, is provided. The synchronized brake lever is operatively connected to a synchronizing intermediate member. The synchronizing intermediate member is  
20 configured to actuate the front wheel brake. The synchronized brake lever is disposed in a movable pivot-contact with a rear actuating member. In a preferred embodiment, the rear actuating member is a hydraulic master cylinder and the synchronized brake lever is pivotable about a free end of a movable piston of the hydraulic master cylinder through the movable pivot-contact. Unlike conventional  
25 brake levers, the synchronized brake lever of the present subject matter comprises a movable pivot.

[00027] In one embodiment, upon actuation of the synchronized brake lever, the movable pivot-contact enables actuating the rear actuating member. In one embodiment, a rotation of the synchronized brake lever about the movable pivot-  
30 contact causes a pulling effect on the synchronizing intermediate member (through its other end). In one implementation, pulling effect on the synchronizing

intermediate member can be utilized for actuating a front actuating member, which can be either a hydraulic master cylinder (when using a disc brake) or a cam-lever (when using a drum brake). The present subject matter is designed with a single synchronized brake lever without the need for any auxiliary additional levers or relay members or any third master cylinder or PC.

5 [00028] In one embodiment, the synchronized brake lever is operatively connected to the synchronizing intermediate member through a movable hinge-joint. Thus, the synchronized brake lever comprises two movable pivot points viz. the movable pivot-contact and the movable hinge-joint. This movable hinge-joint will also act  
10 as another movable pivot while actuating the first movable pivot support/joint. Therefore, both the joints have dual functions, one is the pivot-support and other is actuation. Thus, unlike a conventional brake lever that has a fixed pivot, the synchronized brake lever is configured to comprise two movable pivot supports/joints.

15 [00029] In one embodiment, the synchronized brake lever is provided in the form of a bell-crank lever. During actuation of the synchronized brake lever, a force is exerted by the user. Due to the exerted force, the synchronized brake lever pivots about the movable hinge-joint and exerts a push on rear actuating member (piston) through the movable pivot-support. Simultaneously, a reaction force is generated  
20 on the movable hinge-joint, owing to a couple due to force exerted on the synchronized brake lever by user and a reaction from the rear actuating member (piston and piston spring). This reaction force at the movable hinge-joint creates a pull on the synchronizing intermediate member. For example, the synchronizing intermediate member is a brake cable. A pulling effect of the brake cable is utilized  
25 to actuate a piston of a front actuating member or a front brake cam-lever. The present subject matter thus eliminates need for a pressure control valve or a third master cylinder thereby problems associated therewith. Moreover, further subject matter is limited to a hydraulic or a mechanical (cable) system, as a combination of both can be used.

30 [00030] In one embodiment, the synchronizing intermediate member comprises another end being connected to a front actuating member configured to actuate the

front wheel brake. In one implementation, the another/second end (as aforementioned) is pre-loaded to retract the synchronizing intermediate member when braking force is released. The first end of the synchronizing intermediate member is connected to said synchronized brake lever.

5 **[00031]** In one embodiment, the synchronizing intermediate member comprises an inner cable and an outer cable (sheath); The inner cable is slidable along the outer cable. The outer cable (at the front actuating member side) is secured to a member support arm. Thus, the outer cable is fixed and actuation of the synchronized brake lever causes pulling effect on the inner cable. The inner cable is operatively  
10 connected to the synchronized brake lever, through a movable hinge-joint, enabling the synchronized brake lever to additionally pivot about the movable hinge-joint. In a preferred implementation, the member support arm is integrated with the rear actuating member itself to reduce number of components and for ease of assembly.

**[00032]** In one embodiment, the synchronized brake lever comprises an engaging  
15 portion, which in one implementation is integrally provided. The engaging portion extending towards a piston of the rear actuating member. In one implementation, the engaging portion abuts against a piston of the rear actuating member forming the movable pivot-contact. In another implementation, a hinge-joint may be provided between the piston and engaging portion.

20 **[00033]** In one embodiment, the synchronized brake lever comprises an engaging portion, which is secured to a guiding-member through a movable pivot member. For example, the movable pivot member can be a pivot pin and one end of the guiding-member is secured to the engaging portion. Other end of the guiding-member is fixedly pivoted to the rear actuating member through a fixed pivot  
25 member. Since, a fixed pivot is not provided for the synchronized brake lever, the guiding member is configured to restrict degree of movements of the synchronized brake lever up to only in two different directions along a substantially horizontal plane.

**[00034]** In one embodiment, the synchronized brake lever comprises an integrated  
30 locking portion. In one implementation, the integrated locking portion comprises an inward curved profile, when viewed from top thereof. An outward portion of

said integrated locking portion comprises one or more engagement slots to enable engagement with an elastic member to exert a pre-load thereon. In one implementation, the pre-load acts in a same direction of pull created by the synchronizing intermediate member.

5 [00035] In one embodiment, the integrated locking portion comprises a plurality of sub-arms, say a first sub-arm and a second sub-arm, being spaced apart in a first direction. The synchronizing intermediate member passes through a gap/space formed between the sub-arms without any interference. Thus, any relative movement between the synchronizing intermediate member and the synchronized  
10 brake lever can be achieved without any interference therebetween. The synchronizing intermediate member and the synchronized brake lever can be packaged on a motor vehicle within minimum space.

[00036] In one embodiment, the synchronized brake lever is pre-loaded with an elastic member. The elastic member comprises a first abutment portion and a  
15 second abutment portion. The first abutment portion engages the elastic member with the rear actuating member. The first abutment portion is accommodated on the rear actuating member without interfering with ancillary parts. The second abutting portion is configured to engage with one or more engagement slots of the synchronized brake lever.

20 [00037] In one embodiment, the first abutment portion of the elastic member comprises a serpentine profile. In one embodiment, the second abutment portion comprises a curved profile. The first abutment portion and the second abutment portion are connected through a helical portion, which is configured to provide the pre-load and elastic loading/stiffness.

25 [00038] In one embodiment, the first abutment portion and the second abutment portion of the elastic member comprises at least a portion thereof overlapping with the synchronizing intermediate member, when viewed from top. In one implementation, the components of the synchronized braking system are optimally assembled on the handlebar assembly or near the handlebar assembly without  
30 affecting existing utility space thereat.

[00039] In one embodiment, the rear actuating member comprises an extended portion formed by a first planar portion and a second planar portion. The first planar portion are spaced apart in a first direction (say an up-down direction). A region is defined between the planar portions to securely accommodate at a portion of the  
5 synchronized brake lever. In one implementation, the extended portion covers a substantial portion of the movable hinge-joint thereby protecting that region from the atmosphere, and also slidably supporting the synchronized brake lever in horizontal plane.

[00040] In one embodiment, the extended portion of the actuating member  
10 comprises a stopper. The stopper is disposed in proximity to the integrated locking portion of the synchronized brake lever. The integrated locking portion of the synchronized brake lever engages with the stopper, especially the inward curved profile, during a failure condition of the synchronizing intermediate member. In such a failure condition, due to the pre-load acting on the synchronized brake lever,  
15 the lever is pushed to engage with the stopper whereby stopper forms a fixed-pivot for the synchronized brake lever to enable actuation of the synchronized brake lever on the rear actuating member thereby retaining safety.

[00041] In one embodiment, the braking system comprises a synchronized brake lever, which is pivotable about at least one of a movable hinge-joint (formed  
20 through an operational connection with a synchronizing intermediate member) and a movable pivot-contact (formed through an operational connection with an actuating member). The synchronized brake lever operates through the movable pivot-contact/ movable hinge-joint without the need for a fixed pivot for rotation. Further, the synchronized brake lever comprises an integrated locking portion  
25 configured to engage with a stopper of the aforementioned actuating member. The synchronized brake lever engages with the stopper forming a fixed pivot for operation/rotation of the synchronized brake lever during failure condition of the synchronizing intermediate member. The failure condition may include breakage of cable, loss of tension of the synchronizing intermediate member  
30 or the like.

[00042] These and other advantages of the present subject matter would be described in greater detail in conjunction with, the figures in the following description. Arrows shown in top right corner of the drawings follows the following notation. An arrow 'F' represents forward direction, an arrow 'R' represents  
5 rearward direction, an arrow 'RH' represents right side or right-hand side, an arrow 'LH' represent left side or left-hand side, an arrow 'Uw' represents upward direction, and an arrow 'Dw' represents downward direction with respect to a motor vehicle.

[00043] Fig. 1 illustrates a schematic layout of a synchronized braking system for  
10 a motor vehicle, in accordance with an embodiment of the present subject matter. The synchronized braking system (hereinafter also referred to as 'system') 200 comprises a front wheel brake 102 and a rear wheel brake 104 corresponding to at least one front wheel and at least one rear wheel (not shown), respectively. Further, an independent brake lever 106 is provided to apply the front wheel brake 102.  
15 Similarly, a synchronized brake lever 201 is provided for simultaneous application of the front wheel brake 102 as well as the rear wheel brake 104. In the depicted implementation, the independent brake lever 106 is mounted to a handlebar assembly 122 on a right-side thereof. The synchronized brake lever 201 is disposed one left-side of the handlebar assembly 122. In another implementation, a foot pedal  
20 (not shown) serves as the synchronized brake lever, which will be disposed near to a rider foot-peg (not shown) where rider applies brake actuation through his feet.

[00044] The synchronized brake lever 201 is configured to actuate a rear actuating member 220. Hereinafter, the terms 'rear actuating member' and 'actuating member' are interchangeably used for brevity. A synchronizing intermediate  
25 member 112 operatively connects the synchronized brake lever 201 to a front actuating member 130. In one embodiment, the synchronizing intermediate member 112 is a brake cable. In another embodiment, the synchronizing intermediate member 112 can be a brake cable, a brake hose or a combination of brake cable and brake hose. The front actuating member 130 is capable of actuating  
30 the front wheel brake 102 through an independent connecting member 116. Similarly, a rear connecting member 114 connects the rear actuating member 220

to the rear wheel brake 104. Further, the handlebar assembly 122 comprises a first switch assembly 124 and a second switch assembly 126 disposed near to the front actuating member 130 and the rear actuating member 220, respectively.

**[00045]** Fig. 2 illustrates an enlarged perspective view of a portion of synchronized  
5 braking system for a motor vehicle, in accordance with an embodiment of the present subject matter. The synchronized braking system 200 comprises of synchronized brake lever 201 capable of actuating a piston 230 (shown in Fig. 4) of the rear actuating member 220. In the present implementation, the rear actuating member 220 is a hydraulic master cylinder, which predominantly uses a single  
10 piston. The synchronized braking system 200 is compact due to preferable use of single piston master cylinder, which can be compactly mounted to the handlebar assembly 122. One end of the synchronizing intermediate member 112 is operatively connected to the synchronized brake lever 201 and other end of the synchronizing intermediate member 112 is connected to a front actuating member  
15 130. In one embodiment, the front actuating member is a hydraulic master cylinder. The hydraulic master cylinder (front or rear) is connected to one or more brake calipers through a brake hose that carries hydraulic brake fluid to transfer the hydraulic pressure/ force. Actuation of the synchronized brake lever 201 actuates the rear actuating member 220 and simultaneously, an inner cable 112I of the  
20 synchronizing intermediate member 112 is pulled thereby actuating the front actuating member 130 thereby effective braking is achieved with shorter stopping distance.

**[00046]** Fig. 3 illustrates an exploded perspective view of the synchronized braking system, in accordance with an embodiment of the present subject matter. The rear  
25 actuating member 220 comprises an extended portion 222 that is configured to accommodate at least a portion of the synchronized brake lever 201. The rear actuating member 220 comprises a member support arm 223, which is capable of supporting the synchronizing intermediate member 112. In one embodiment, the synchronizing intermediate member 112 comprises an outer cable 112O and an  
30 inner cable 112I, which is slidable about the outer cable 112O. The outer cable 112O is secured to the member support arm 223 of the rear actuating member 220

and the inner cable 112I has one end operatively connected to the synchronized brake lever 201 at a first connection portion 202 thereof. Other end of the inner cable 112I is functionally connected to the front actuating member 130 to actuate the front brake when the cable is pulled.

5 [00047] The synchronised brake lever 201 comprises an engaging portion 203, which is an integral part of the synchronised brake lever 201 abutting on the piston 230 of the rear actuating member 220. The engaging portion 203 of the synchronised brake lever 201 is in a movable pivot-contact 241 (shown in Fig. 4), which comes in contact with a piston 230 of the actuating member 220. In one  
10 embodiment, the movable contact 241 is formed by a guided pivot joint and a simply support /contact pivot-joint. The synchronized brake lever 201 is configured to actuate the rear actuating member 130 and is also capable of pivoting about the piston 230 without the need for fastening at a fixed pivot point. An axis about which the synchronized brake lever 201 pivots (with reference to the pivoting about the  
15 piston 230) is dynamic and the axis follows a pre-determined path. A holding portion 205 of the synchronized brake lever 201 extends in a lateral direction RH-LH and towards LH side from the synchronized brake lever 201 and it enables the user to hold/ apply braking force therethrough.

[00048] An elastic member 231 of the system 200 is configured to provide / exert  
20 a pre-load and an elastic load stiffness on the synchronised brake lever 201, wherein the elastic member 231 exerts a force on an integrated locking portion 204 of the synchronized brake lever 201. In one implementation, the elastic member 231 comprises a first abutment portion 232 and a second abutment portion 233. The second abutment portion 233 is capable of abutting against the synchronized brake  
25 lever 201 exerting force for pre-loading and the first abutment portion 232 is abutting against the rear actuating member 220. In one embodiment, a secondary arm 225 is provided on the actuating member 220 and the first abutment portion 232 is accommodated between the secondary arm 225 and the member support arm 223. In one embodiment the first abutment portion 232 is longer than the second  
30 abutment portion 233.

[00049] In one embodiment, the synchronized brake lever 201 is provided with a switch control arm 206. In one implementation, the switch control arm 206 is protruded from a surface of the synchronized brake lever 201. Corresponding, the actuating member 220 is provided with an additional support arm 221. The  
5 additional support arm 221, in one implementation, protrudes from the extended portion 222 of the actuating member 220. In an assembled condition, during non-actuation of the synchronized brake lever 201, the switch control arm 206 is configured to rest on the additional support arm 221. The additional support arm 221 restricts further movement of the synchronized brake lever 201 beyond a  
10 certain angle, say beyond the additional support arm 221. The additional support arm 221 avoids disengagement of the synchronized brake lever 201 from the actuating member 220 due to a pull from the synchronizing intermediate member 112, which is pre-loaded. Resting of the switch control arm 206 on the additional support arm 221 is schematically illustrated in Fig. 4 by dotted lines.

[00050] Fig. 4 illustrates a sectional view of the synchronized braking system, the section taken along axis X-X' and axis of the master cylinder piston, in accordance with an embodiment of the present subject matter as shown in Fig. 2. The rear actuating member 220 comprises a piston 230 that is pre-loaded with a piston spring 230S. The piston 230 is slidable within a cylinder bore (not shown) of the rear  
20 actuating member 220 and a movement of the piston 230 therein displaces a hydraulic fluid that exerts a force on the brake calipers thereby actuating wheel brake. The engaging portion 203 of the synchronized brake lever 201 is disposed to engage with the piston 230 of the rear actuating member 220 through a movable pivot-contact 241. The movable pivot-contact 241 of the synchronized brake lever  
25 201 becomes a movable pivot for the synchronised brake lever 201 to rotate about. When user exerts braking force on the synchronized brake lever 201, the synchronized brake lever 201 moves towards a throttle-grip of the handlebar assembly 122 and at the same time the synchronized brake lever 201 also causes the piston 230 to slide in laterally inward direction (along the master cylinder bore and towards RH side), as per depicted implementation. The sliding movement of  
30 the piston 230, in effect, changes the position of the movable pivot-contact 241

thereby making it a moving pivot-point every time. In one implementation, the ‘movable pivot-contact’ can be a rigidly simple-support between the piston and the lever where the engaging portion 203 is connected to the piston 230 (end portion) through a pivot joint. In the depicted embodiment, the movable pivot-contact is an  
5 abutting simple-support without any physical pivot / pin joint therebetween.

**[00051]** Further, the inner cable 112I is connected to the synchronized brake lever 201 through a movable hinge-joint 251. The outer cable 112O is secured to the actuating member 220 through a location pin-type stud 113. The movable hinge-joint 251 enables the synchronizing intermediate member 112 to retain its  
10 orientation and at the same time allowing the synchronized brake lever 201 to pivot. When the synchronized brake lever 201 is actuated by application of force by user, the synchronized brake lever 201 exerts a push on rear actuating member 220 with a force thereby actuating the rear wheel brake 104. Simultaneously, a reaction of a couple is generated due to force exerted on the synchronized brake lever 201 and a  
15 reaction from the rear actuating member 220, thereby creating a pull on the synchronizing intermediate member 112. For example, considering the movable hinge-joint 251 as a pivot point for the synchronized brake lever 201, during application of force on the synchronized brake lever 201, the synchronized brake lever 201 acts as a bell-crank lever and rotates about the movable hinge-joint 251,  
20 which acts as another pivot point).

**[00052]** Further, the reaction of the force couple at pivot point, which is the movable hinge-joint 251, causes a pull of the synchronized brake lever 201. The synchronized brake lever 201 rotates about the movable pivot-contact 241 and the rotation of the synchronized brake lever 201 causes the pulling of the synchronizing  
25 intermediate member 112, which in turn causes actuation of the front actuating member 130 thereby applying the front wheel brake 102. Thus, application of the synchronized brake lever 201 causes a pushing of the piston 230 and pulling of the synchronizing intermediate member 112 simultaneously. Further, under the application of rider’s actuation force on the holding portion 205 of the synchronized  
30 brake lever 201, a pull on the synchronizing intermediate member 112 and a push of the rear actuating member 220 balance each other because of which the system

200 acts as a force-balancing system which is more reliable for variable free play between rear and front wheel brakes. Moreover, any need for additional effort to actuate the synchronizing intermediate member 112 is eliminated. Thus, the synchronized brake lever 201 is provided with two movable pivot joints viz.  
5 movable pivot-contact 241 and movable hinge-joint 251.

[00053] The additional support arm 221 is provided on the rear actuating member 220 as an abutment for the synchronized brake lever 201 during non-operating conditions. During non-actuation/ non-operating of the synchronized brake lever 201, the switch control arm 206 is configured to rest on the additional support arm  
10 221. The synchronized brake lever 201 is supported at two portions viz. the additional support arm 221 and the movable pivot contact 241. The synchronized brake lever 201 is supported on a virtual beam by resting over the two (support) portions disposed on either side of the movable hinge joint 251. In a preferred embodiment, the first connection portion 202 and the movable hinge joint 251 are  
15 to be provided between the switch control arm 206 (that rests on the additional support arm 221) and the engaging portion 203 (that rests on the piston 230 by the movable pivot contact 241). The synchronized brake lever 201 is supported on the actuating member 220 in a balanced manner and at desired orientation, in non-actuated condition. Thus, both the switch control arm 206 and the additional support  
20 arm 221 are disposed in corresponding places such that even under tension of the inner cable 112I of the synchronizing intermediate member 112, the synchronized brake lever 201 is statically kept under equilibrium during non-operating conditions. Further, the additional support arm 221 is configured to provide an uninterrupted movement for the synchronized brake lever 201 during both normal  
25 working conditions and a fail-safe condition.

[00054] Fig. 5 (a) depicts a top view of a synchronized brake lever, in accordance with an embodiment of the present subject. Fig. 5 (b) depicts a perspective view of a synchronized brake lever, in accordance with an embodiment of the present subject. The synchronized brake lever comprises a first connection portion 202,  
30 which comprises a cylindrical aperture with a slotted opening to enable connection /assembly of the inner cable 112I of the synchronizing intermediate member. In one

embodiment, the first connection portion 202 is provided with a slit -portion 208. One end of the inner cable 112I (shown in Fig. 4) is connected to the synchronized brake lever 201 by sliding the one end of the inner cable 112I through the slit-portion 208.

5 [00055] In one embodiment, the engaging portion 203 is formed in the shape of a tear drop with the broader portion disposed towards a side coming in contact with piston 230.

[00056] Further, an integrated locking portion 204 is disposed on other side of the first connection portion 202. In the depicted implementation, the integrated  
10 extended locking portion comprises a first sub-arm 204A and a second sub-arm 204B. The sub-arms 204A and 204B are spaced apart from each other in a first direction, which is in a vertical direction Uw-Dw in the present implementation. Further, the integrated locking portion 204 is formed in the shape of a curved beak /parrot beak in order to act as a fail-safe engagement portion to lock the  
15 synchronized brake lever 201 from moving beyond certain limits of travel in both laterally LH direction and rearward direction. Further, the integrated locking portion 204 comprises one or more engagement slots 207 for securely engaging an elastic member 231 (as shown in Fig. 4) thereat. In the depicted embodiment, a switch control arm 206 is also integrated with the synchronized brake lever. The  
20 first connection portion 202, the engaging portion 203 and the integrated locking portion 204 are disposed in vicinity to the actuating member 220 (as shown in Fig. 4). The holding portion 205 extends in a laterally outward direction (LH side), as per present embodiment.

[00057] Fig. 6 (a) illustrates a side perspective view of a body of an actuating  
25 member, in accordance with an embodiment of the present subject matter. Fig. 6 (b) illustrates another perspective view of the body of an actuating member, in accordance with an embodiment of the present subject matter. The actuating member 220 comprises a reservoir 227 for storing brake-fluid and a piston 230 is provided to slide within a cylinder/ chamber (not shown).

30 [00058] The actuating member 220 comprises an extended portion 222 formed by a first planar portion 222A and a second planar portion 222B that are spaced apart

from each other in a first direction, which is a vertical direction Uw-Dw. In the present implementation, the planar portions 222A, 222B are spaced apart from each other in a vertical direction Uw-Dw defining a region 261 therebetween and the synchronized brake lever 201 is accommodated thereat (at the region 261). The planar portions 222A, 222B extend from one or more sides faces of the reservoir 227. In the depicted implementation, the extended portion 222 extends in a substantially forward direction from a front face and sideward (LH side) face of the reservoir 227. In the current implementation, which is configured for the actuating member 220 to be mounted to a handlebar assembly 122, a member support arm 223 also extends in a forward direction and the member support arm 223 is configured to support an outer cable 112O of the synchronizing intermediate member 112. The actuating member 220 further comprises a mirror holding portion 228 and a securing portion 226 to secure the actuating member 220 to the handlebar assembly 122. Further, between inward surfaces of the extended portion 222 (222A & 222B) a stopper 229 is provided, which in one embodiment is a cylindrical protrusion. The stopper 229 acts as a fail-safe stopper for the synchronized brake lever 201, when the inner cable 112I fails.

[00059] Fig. 7 (a) to Fig. 7 (c) illustrates various views of an elastic member in accordance with an embodiment of the present subject matter. The elastic member 231 comprises a first abutment portion 232, a second abutment portion 233 and a connecting member 234 that are integrally formed. In one embodiment, the connecting member 234 is a helical portion. The connecting member 234 may include at least a partial ring member. The first abutment portion 232 is formed by two members 232A, 232B and similarly the second abutment portion 233 is formed by two members 233A, 233B. The first abutment portion 232 is formed in a serpentine shape, which is configured to be accommodated on the actuator member 220, and the second abutment portion 233 is formed in the shape of a curved profile and is configured to be accommodated on the brake lever 201. The elastic member 231 comprises an upper portion and lower portion with a spacing therebetween. In one embodiment, a first width D1 is provided about at least a portion of the first abutment portion 232 and a second width D2 is relatively wider when compared to

first width D1 which is maintained at the second abutment portion 233 and at least a portion of the first abutment portion 232. The spacing formed by the width D2 enables the inner cable 112I to pass freely and operate at the spacing without any interference. The elastic member 231 is accommodated in the system 200 without  
5 need for any connections or fasteners and is effectively retained through abutment between the actuating member 220 and the synchronized brake lever 201.

**[00060]** Fig. 8 (a) depicts a front perspective view of the synchronized braking system, in accordance with an embodiment of the present subject matter. Fig. 8 (b) a sectional view of the synchronized braking system, section taken along axis Y-Y' as shown in Fig. 8 (a) and axis of master cylinder bore, in accordance with an  
10 embodiment of the present subject matter. As shown in Fig. 8 (a) and Fig. 8 (b), the extended portion 222 covers critical components of the system 200. At least a portion of the connection portion 202, the engaging portion 203, and the integrated locking portion 204 of the synchronized brake lever 201 are covered by the  
15 extended portion 222 when viewed in top or a down direction thereof. The elastic member 231 comprises the first abutment portion 232 that sits in a groove 224 formed in the member support arm 223. The second abutment portion 233 of the elastic member 231 with the serpentine profile till the helical portion 234 is disposed and abutted on the actuating member 220. The second abutment portion  
20 233 engages with the engagement slots 207, formed in the shape of grooves, on an outward portion of the integrated locking portion 204. The first abutment portion 232 acts as a base or support and the second abutment portion 233 acts as a force exerting portion on the synchronized brake lever 201.

**[00061]** Further, any failure of the inner cable 112I due to breakage or the like, the  
25 elastic member 231 exerts force on the synchronized brake lever 201 whereby the integrated locking portion 204 with curved beak or parrot beak profile (which is curved inward) engages with the stopper 229 that protrudes from the extended portion 222. The integrated locking portion 204 with the curved beak or the inward curved profile locks against the stopper 229. Thus, the synchronized brake lever  
30 201 in addition to the movable pivot-contact 241 also gets engaged with the stopper

229 whereby the brake lever 201 can still be operated. The elastic member 231 is configured to exert force on the synchronized brake lever 201 in such condition.

[00062] Fig. 9 (a) depicts a perspective view of a portion of a synchronized brake lever, in accordance with another embodiment of the present subject. Fig. 9 (b) depicts a partially exploded view of the synchronized braking system, in accordance with an embodiment of the present subject. Fig. 9 (c) illustrates a sectional view of a synchronized braking system, section taken along axis Z-Z' and axis of master cylinder bore, in accordance with an embodiment of the present subject matter. The synchronized brake lever 301 comprises an engaging portion 303 that extends towards a piston 230 of the actuating member 320. In one embodiment, a guide-member 365 is provided. The guide-member 365 is configured to restrict degree of movement of lever 301 in only two directions. In one embodiment, the guide-member 365 is provided in the form of a kidney shape comprising two apertures provided substantially on either ends thereof. One end of the guide-member 365 is fixedly pivoted to the actuator member 320. In the depicted embodiment, a fixed pivot member 375 is configured to pivotally secure one end of the guide-member 365.

[00063] In one embodiment, another end of the guide-member 365 is pivotally secured to the synchronized brake lever 301. In one implementation, the engaging portion 303 comprises a slit portion 303P. The guide-member 365 is at least partially disposed at the slit portion 303P. At least one end (second end) of the guide-member 365 and the engaging portion 303 abut the piston 230 and actuates the piston 230 during application of brake. The guide-member 365 is pivoted to the engaging portion 303 through a movable pivot member 376. During actuation of the synchronized brake lever 301, the synchronized brake lever 301 rotates about the movable hinge-joint. Rotation of the synchronized brake lever 301 causes exertion of force on the piston 230 thereby pushing the piston 230. A movable pivot-point 371, formed about the movable pivot member 376, moves forming the movable pivot-contact 341. At the same time, the synchronized brake lever 301 also pivots about the movable pivot-contact 341 whereby a synchronizing intermediate member 112 gets pulled causing actuation of the front wheel brake 102. For

example, in one implementation, the synchronising intermediate member 112 is connected to a front actuating member including a front master cylinder or a cam-lever. Further, the fixed pivot member 375 that forms a fixed pivot point 370 enables the synchronized brake lever 301 to move only along a substantially horizontal plane and thereby restricting degree of movement of the synchronized brake lever 201 to substantially one plane.

5  
10  
[00064] Although the subject matter has been described in considerable detail with reference to certain embodiments thereof, other embodiments are possible. It is to be understood that the appended claims are not necessarily limited to the features described herein. Rather, the features are disclosed as embodiments of the braking system of the present subject matter.

List of reference signs:

102	front wheel brake	222	extended portion
104	rear wheel brake	222A/222B	planar portion
106	independent brake lever	30 223	member support arm
5 112	synchronizing intermediate member	224	groove
112I	inner cable	225	secondary arm
112O	outer cable	226	securing portion
113	location stud	226B	securing bracket
10 114	rear connecting member	35 227	reservoir
116	independent connecting member	228	holding portion
122	handlebar assembly	229	stopper
124/ 126	switch assembly	230	piston
15 130	front actuating member	230S	piston spring
200	synchronized braking system	40 231	elastic member
201/301	synchronized brake lever	232	first abutment portion
202	first connection portion	233	second abutment portion
20 203/303	engaging portion	234	helical portion/ connecting member
204	integrated locking portion	45 241/ 341	movable pivot-contact
204A/ 204B	sub-arm	251	movable hinge joint
205	holding portion	261	region
206	switch control arm	365	guide lever
25 207	engagement slot(s)	50 370	fixed pivot point
208	slit-portion	371	movable pivot point
220/320	actuating member	375	fixed pivot member
221	additional support arm	376	movable pivot member

We claim:

1. A synchronized braking system (200) for a motor vehicle, the synchronized braking system (200) comprising:
  - a front wheel brake (102) capable of applying braking forces to one  
5 or more front wheel(s) of the motor vehicle;
  - a rear wheel brake (104) capable of applying braking forces to one  
or more rear wheel(s) of the motor vehicle;
  - an independent brake lever (106) mounted to a handlebar assembly  
(122) of said motor vehicle, said independent brake lever (106) coupled to  
10 said front wheel brake (102) by an independent connecting member (116);
  - a rear actuating member (220, 320), said rear actuating member  
(220, 320) configured to actuate said rear wheel brake (104); and
  - a synchronized brake lever (201, 301) capable of actuating said rear  
actuating member (220, 320), said synchronized brake lever (201, 301)  
15 disposed with a movable pivot-contact (241, 341) joint with said rear  
actuating member (220, 320), said synchronized brake lever (201, 301)  
operatively connected to a synchronizing intermediate member (112) to  
operate said front wheel brake (102) therethrough, and said synchronized  
brake lever (201, 301) configured to pivot about said rear actuating member  
20 (220, 320) during actuation thereof thereby enabling actuation of both the  
front wheel brake (102) and the rear wheel brake (104) simultaneously.
2. The synchronized braking system (200) for the motor vehicle as claimed in  
claim 1, wherein said synchronized brake lever (201, 301) is operatively connected  
to said synchronizing intermediate member (112) through a movable hinge-joint  
25 (251).
3. The synchronized braking system (200) for the motor vehicle as claimed in  
claim 1, wherein said synchronizing intermediate member (112) comprises one end  
being connected to a front actuating member (130) configured to actuate said front  
wheel brake (102) and other end being connected to said synchronized brake lever  
30 (201, 301).

4. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said synchronized brake lever (201, 301) being operatively connected to said synchronizing intermediate member (112) through a movable hinge-joint (251) whereby said synchronized brake lever (201, 301) is pivotable  
5 about said movable hinge-joint (251).
5. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said synchronizing intermediate member (112) comprises an inner cable (112I) and an outer cable (112O), said outer cable (112O) is secured to a member support arm (223) and said inner cable (112I) is operatively connected to  
10 said synchronized brake lever (201, 301) through a movable hinge-joint (251).
6. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said synchronized brake lever (201, 301) comprises an engaging portion (203, 303) extending to form a movable pivot-contact (241, 341) with the piston (230).
- 15 7. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said synchronized brake lever (301) comprises an engaging portion (303), said engaging portion (303) secured to a guiding-member (365) through a movable pivot member (375), and said guiding-member (365) fixedly pivoted to said rear actuating member ( 320).
- 20 8. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said synchronized brake lever (201, 301) comprises an integrated locking portion (204), said integrated locking portion (204) comprises an inward curved profile, when viewed from top thereof, and an outward portion of said integrated locking portion (204) comprises one or more engagement slots (207).
- 25 9. The synchronized braking system (200) for the motor vehicle as claimed in claim 8, wherein said integrated locking portion (204) comprises a first sub-arm (204A) and a second sub-arm (204B) being spaced apart in a first direction (Uw-Dw), and said synchronizing intermediate member (112) extending from between said first sub-arm (204A) and said second sub-arm (204B).

30

10. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said synchronized brake lever (201, 301) is pre-loaded with an elastic member (231), said elastic member (231) comprises a first abutment portion (232) and a second abutment portion (233), said first abutment portion (232) engaging with said rear actuating member (220, 320) and said second abutment portion (233) engaging with one or more engagement slots (207) of said synchronized brake lever (201, 301).

11. The synchronized braking system (200) for the motor vehicle as claimed in claim 10, wherein said first abutment portion (232) and said second abutment portion (233) are connected through a connecting member (234), said elastic member (231) comprises an upper portion and lower portion, said first abutment portion (232) comprises at least a portion with a first width (D1) between said upper portion and said lower portion and a remaining portion of said elastic member (231) comprises substantially a second width (D2) between said upper portion and said lower portion, and said second width (D2) is substantially wider when compared to the first width (D1).

12. The synchronized braking system (200) for the motor vehicle as claimed in claim 11, wherein said elastic member (231) with said remaining portion provided with said second width (D2) enables said synchronizing intermediate member (112) to pass therethrough.

13. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said rear actuating member (220, 320) comprises an extended portion (222) formed by a first planar portion (222A) and a second planar portion (222B) spaced apart in a first direction (Uw-Dw) defining a region (261) therebetween and at least a portion of said synchronized brake lever (201, 301) is accommodated at said region (261) enabling pivotal motion of said synchronized brake lever (201, 301) about at least one of said movable pivot-contact (241, 341) and a movable hinge-joint (251) thereat.

14. The synchronized braking system (200) for the motor vehicle as claimed in claim 13, wherein said extended portion (222) comprises a stopper (229) configured to engage with an integrated locking portion (204) of the synchronized brake lever

(201, 301) during a failure condition of said synchronizing intermediate member (112).

15 15. The synchronized braking system (200) for the motor vehicle as claimed in claim 1, wherein said rear actuating member (220, 320) comprises an additional support arm (221), and said synchronized brake lever (201) comprises a switch control arm (206) extending from at least one surface thereof, and said additional support arm (221) is configured to support the synchronized brake lever (201) through said switch control arm (206) during non-operating condition of said synchronized brake lever (201).

10 16. An actuating member (220, 320) for a braking system (200), wherein said actuating member (220, 320) comprises:

a piston (230) slidable inside a cylindrical bore;  
a reservoir (227) configured to accommodate brake fluid for storage;  
an extended portion (222) formed by one or more planar portions (222A,  
15 222B) extending from one or more faces of said reservoir (227); and  
a member support arm (223) configured to support an intermediate member (112) of said braking system (200).

17. An elastic member (231) for a braking system (200), wherein said elastic member comprises:

20 a first abutment portion (232) comprising a serpentine profile;  
a second abutment portion (233) comprising a curved profile; and  
a helical portion (234) connecting said first abutment portion (232) and said second abutment portion (233).

18. A synchronized brake lever (201, 301) for a braking system (200), said  
25 synchronized brake lever (201, 301) comprising:

a holding portion (205) configured to activate said synchronized brake lever (201, 301);

a first connection portion (202) configured to connect to a synchronizing intermediate member (112) of said braking system (200) by  
30 a movable hinge-joint (251);

an engaging portion (203, 303) capable of actuating an actuating member (220, 320); and

an integrated locking portion (204) configured to engage with a stopper (229) of said actuating member (220, 320) thereby enabling fixed pivotal rotation of said synchronized brake lever (201, 301).

5

19. A braking system (200) comprising:

an actuating member (220, 320), said actuating member (220, 320) comprising a stopper (229); and

10 a synchronized brake lever (201, 301), said synchronized brake lever (201, 301) pivotable about at least one of a movable hinge-joint (251) formed through an operational connection with a synchronizing intermediate member (112) of said braking system (200) and a movable pivot-contact (241) formed through an operational connection with said actuating member (220, 320), and

15 said synchronized brake lever (201, 301) comprises an integrated locking portion (204) configured to engage with said stopper (229) forming fixed pivot for operation of said synchronized brake lever (201, 301) during failure of said synchronizing intermediate member (112).

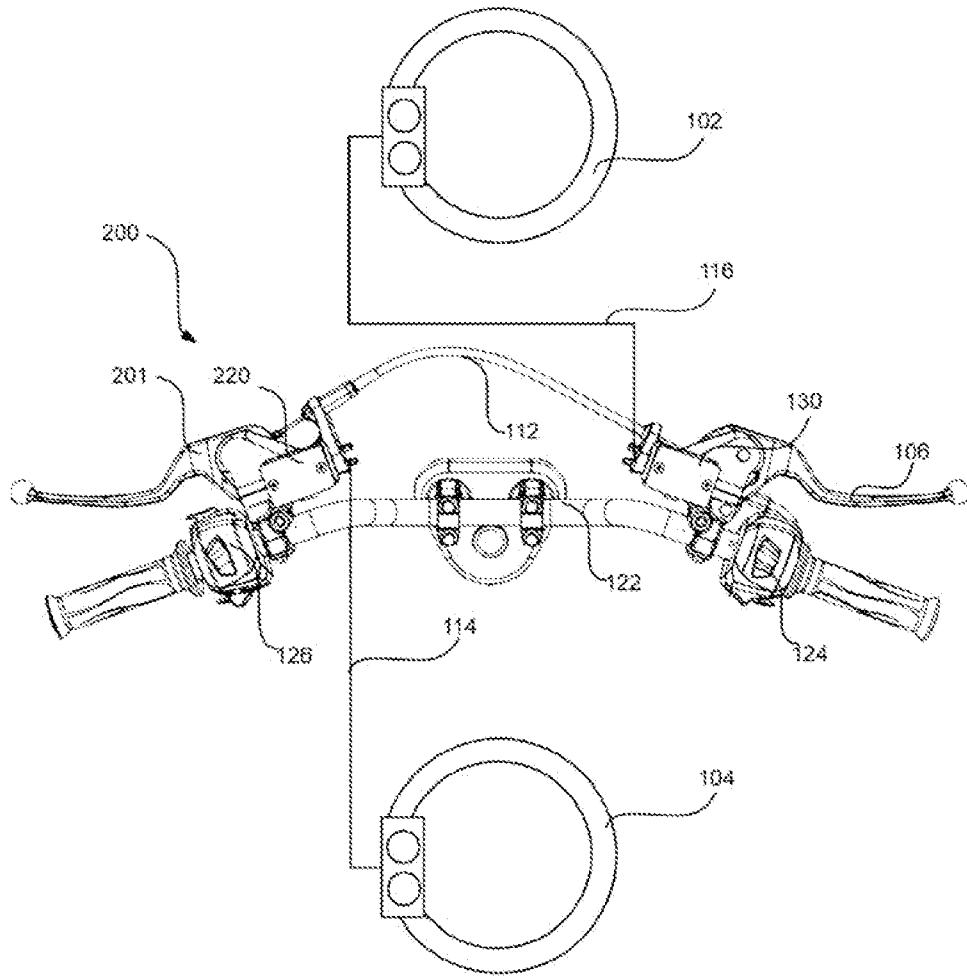


Fig. 1

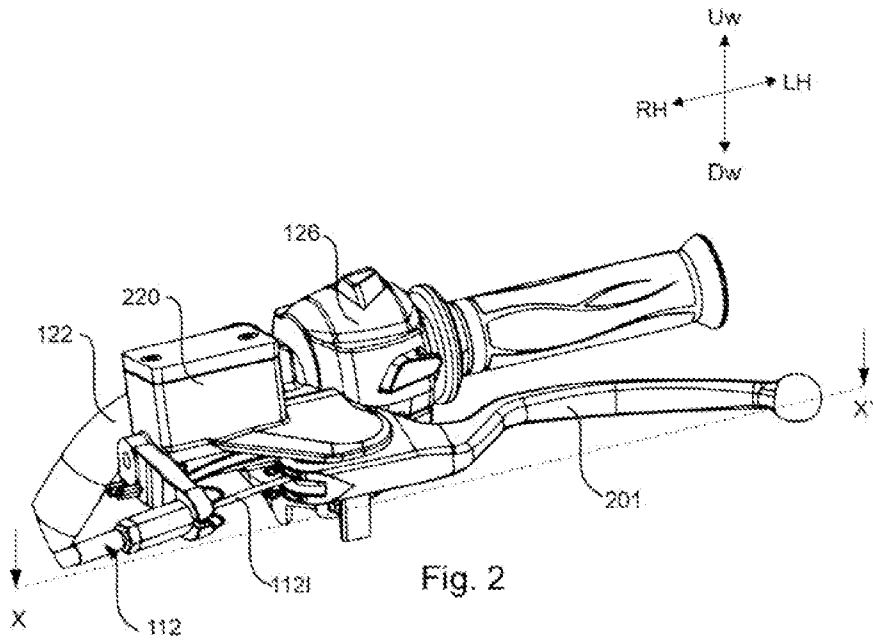


Fig. 2

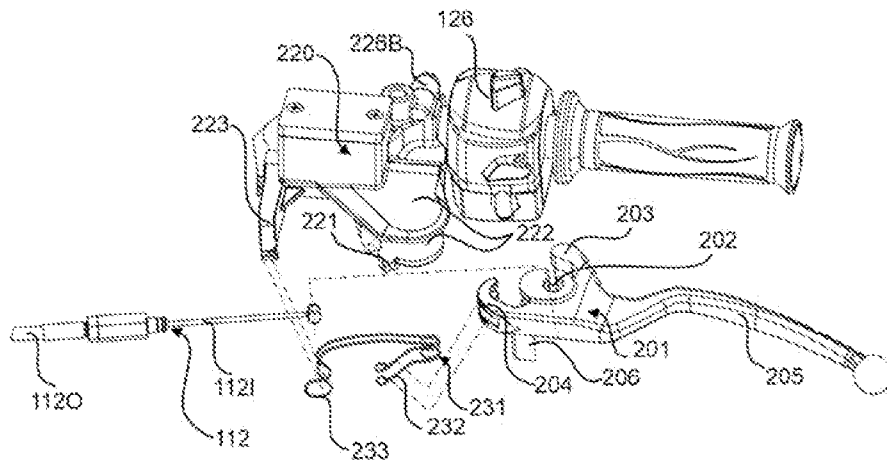
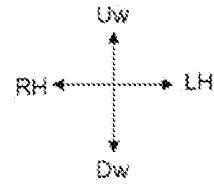


Fig. 3

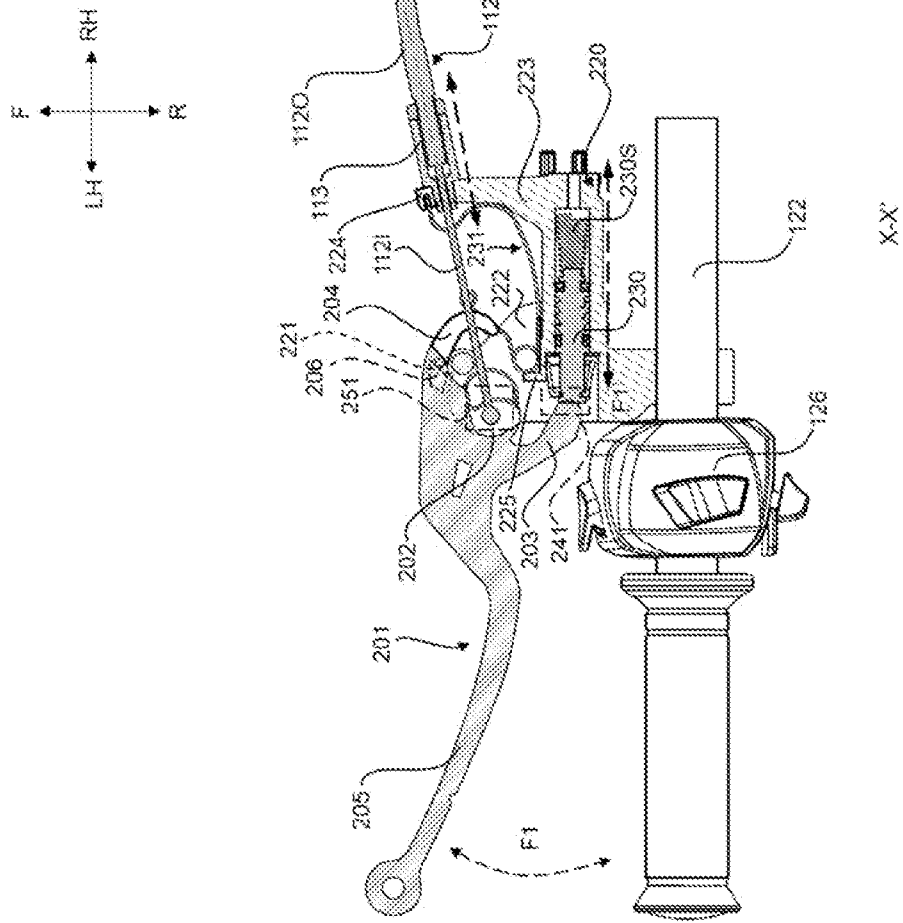
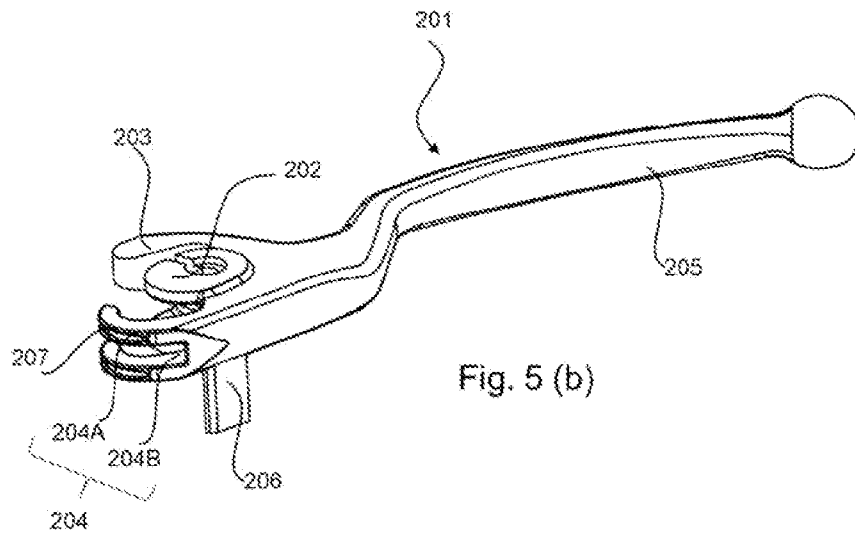
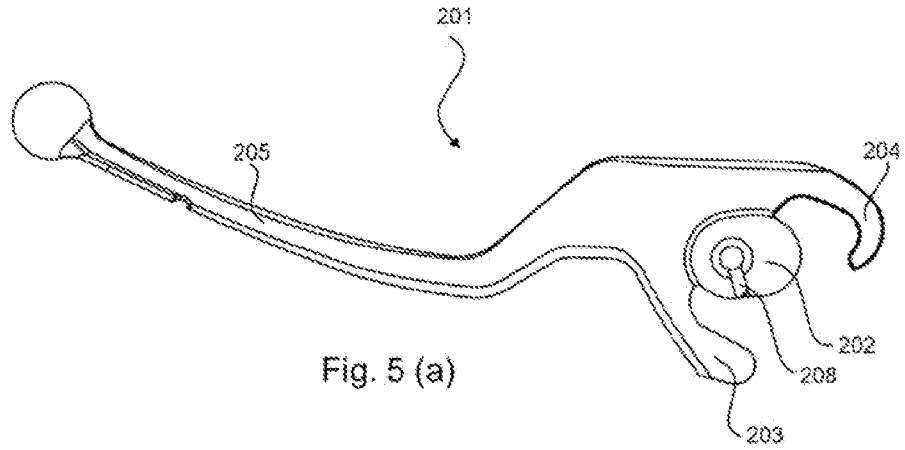


Fig. 4



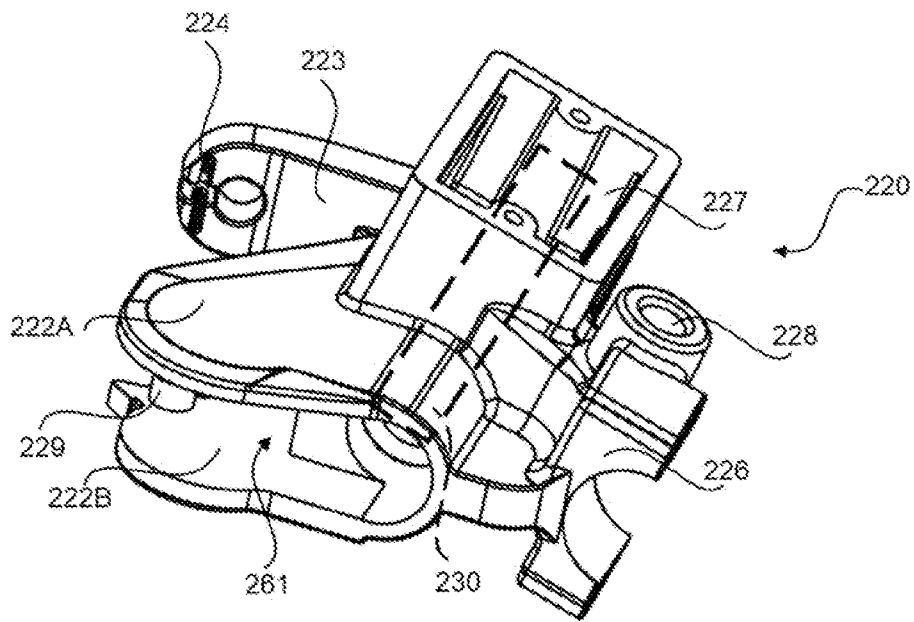


Fig. 6 (a)

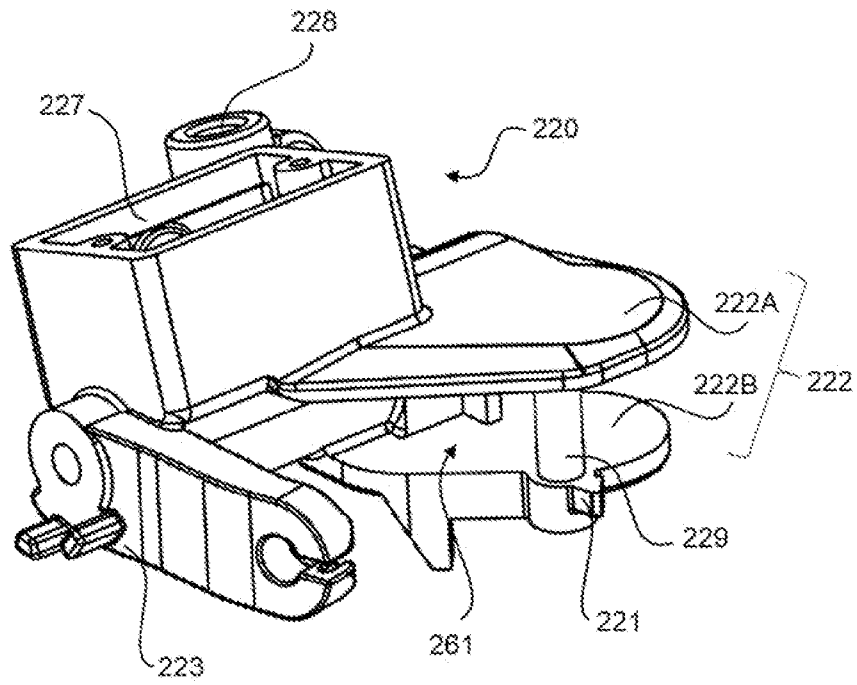
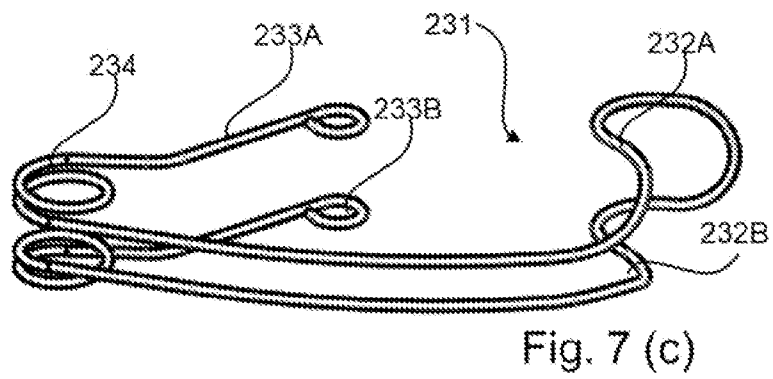
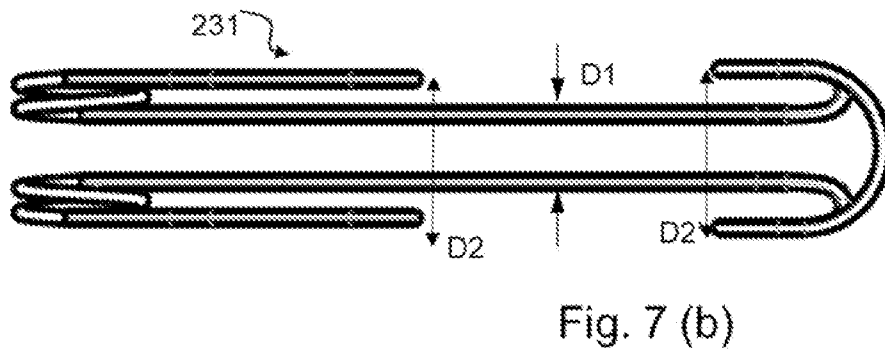
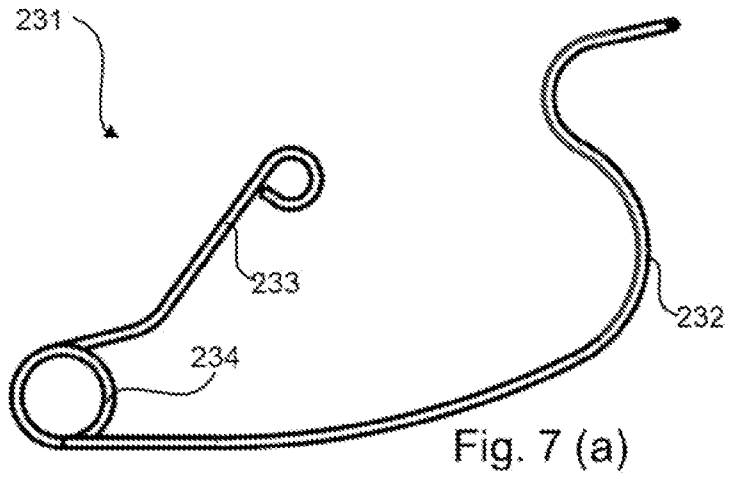


Fig. 6 (b)



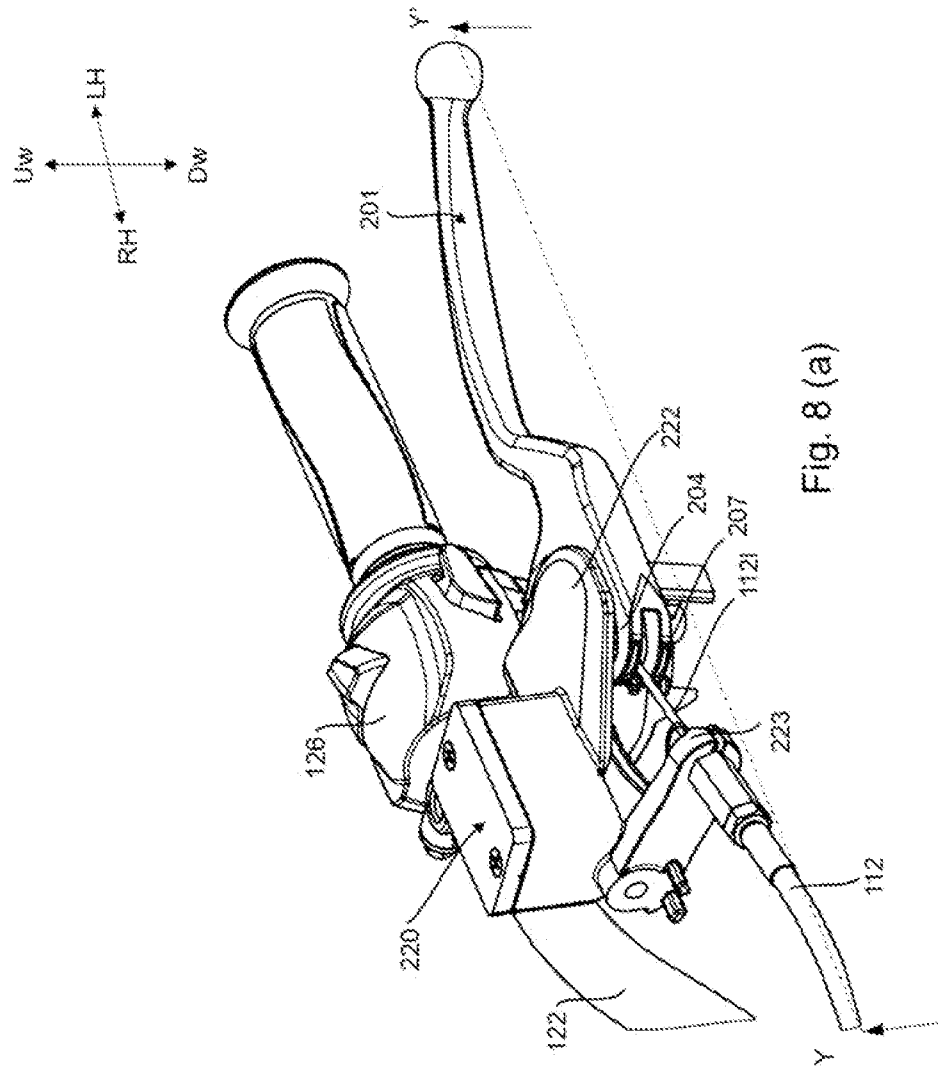


Fig. 8 (a)

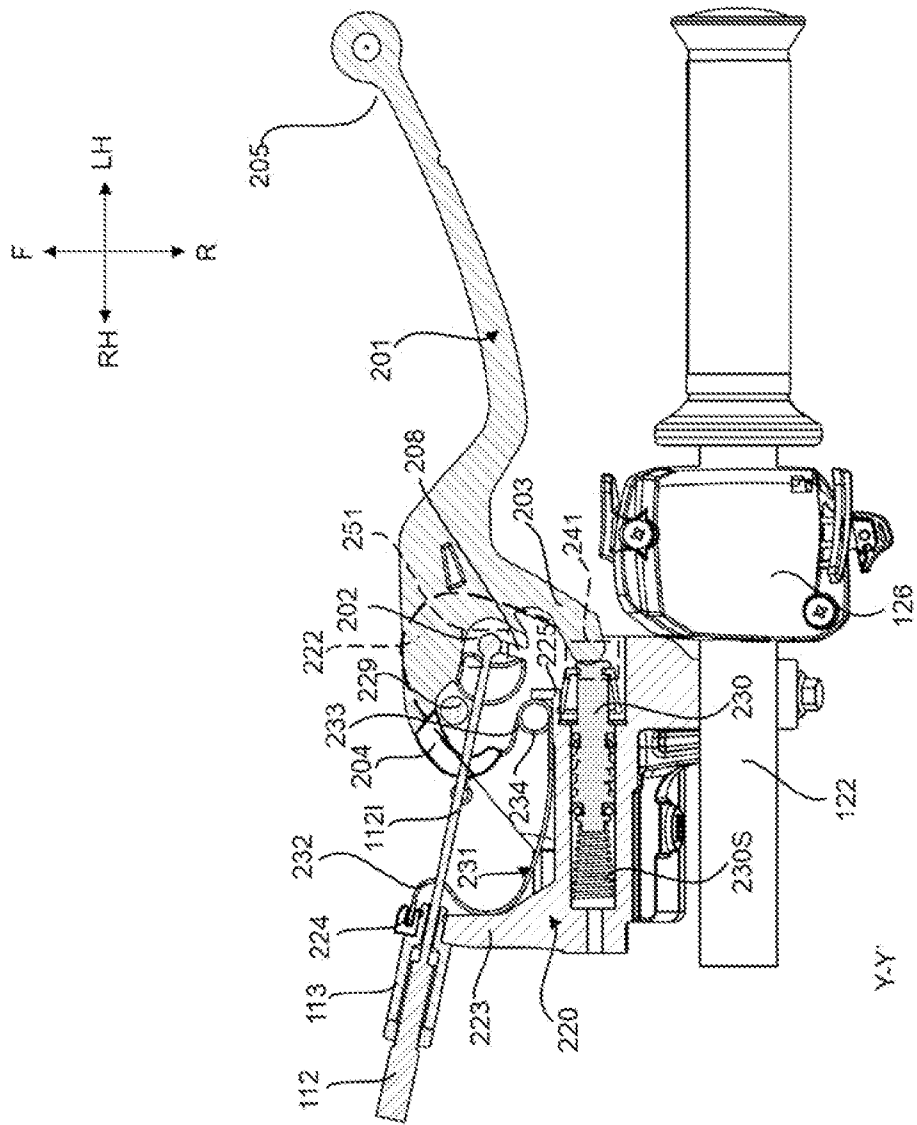
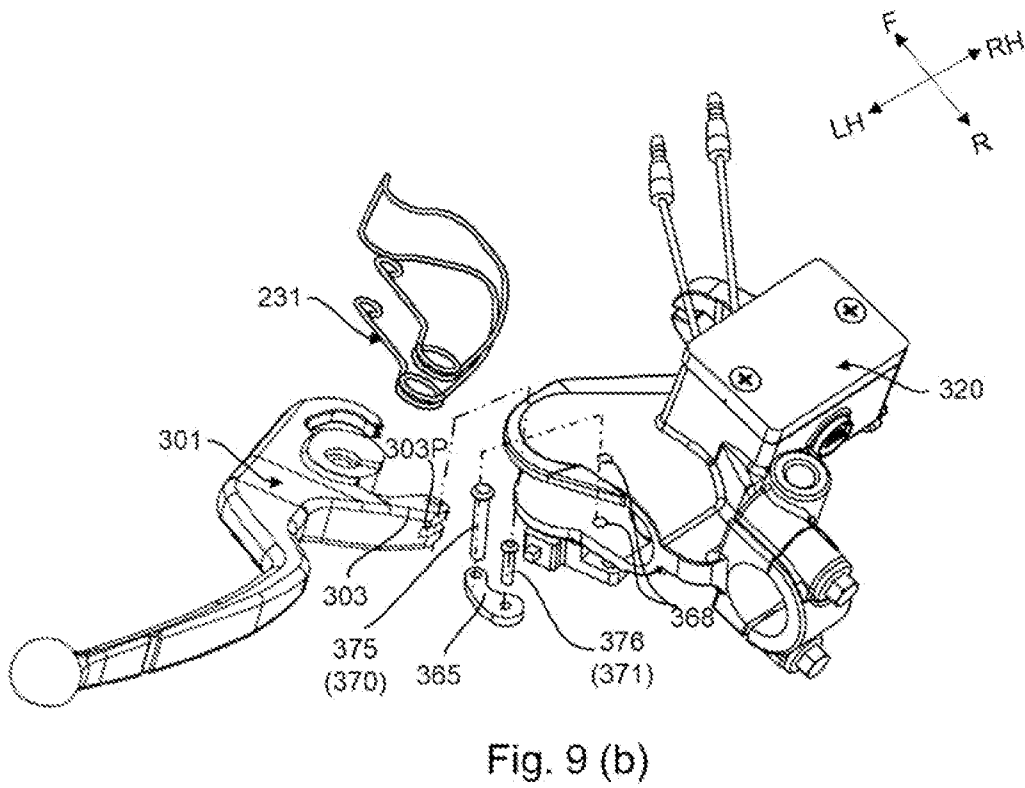
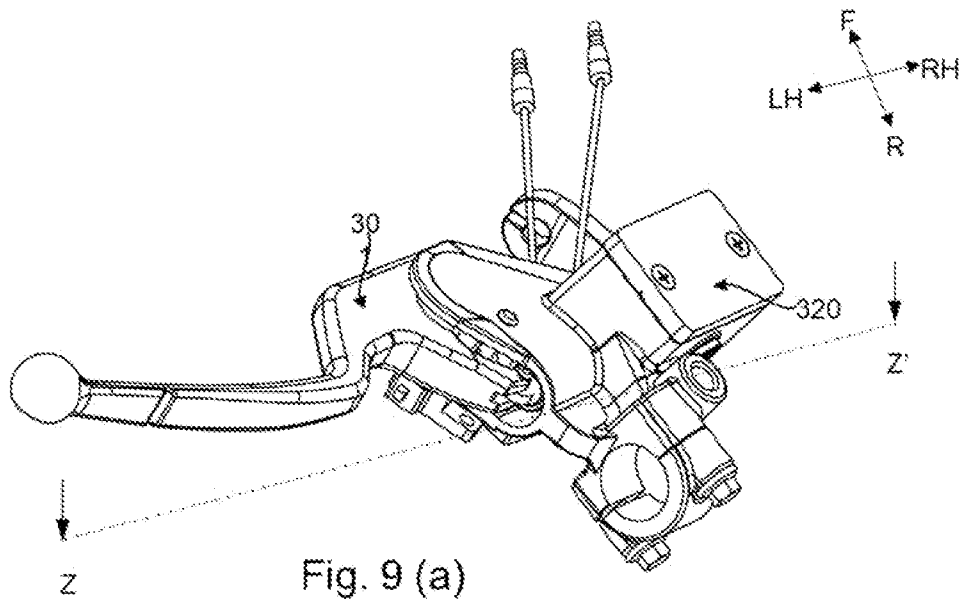


Fig. 8 (b)



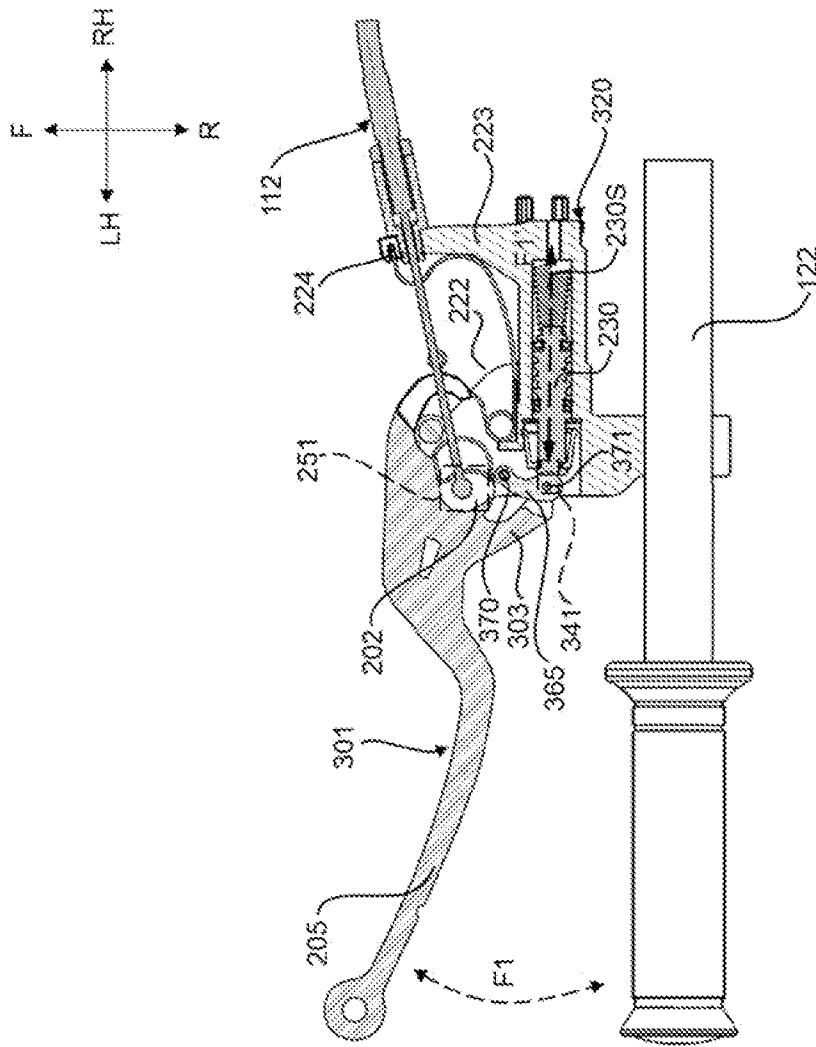


Fig. 9 (c) X-X'

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/IN2021/050488

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. B62L3/08 B60T7/10 B60K23/06 B60T11/04 B60T11/06  
 B60T11/18  
 ADD.  
 According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
 Minimum documentation searched (classification system followed by classification symbols)  
 B60T B62L B62M B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 2018/104833 A1 (TVS MOTOR CO LTD [IN]) 14 June 2018 (2018-06-14) abstract; figure 1 -----	1-13, 15-19 14
X A	WO 2016/108247 A1 (TVS MOTOR CO LTD [IN]) 7 July 2016 (2016-07-07) abstract; figure 1 -----	1,2, 4-13, 15-19 3,14
X A	WO 2017/168231 A1 (TVS MOTOR CO LTD [IN]) 5 October 2017 (2017-10-05) abstract; figure 2 -----	1,2, 4-13, 15-19 3,14
A	TW I 629 207 B (SANYANG MOTOR CO LTD [TW]) 11 July 2018 (2018-07-11) abstract; figure 1 -----	3

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search  21 September 2021	Date of mailing of the international search report  29/09/2021
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Gaillard, Alain
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IN2021/050488

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