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(54) **Title:** SYNCHRONIZED BRAKING SYSTEM

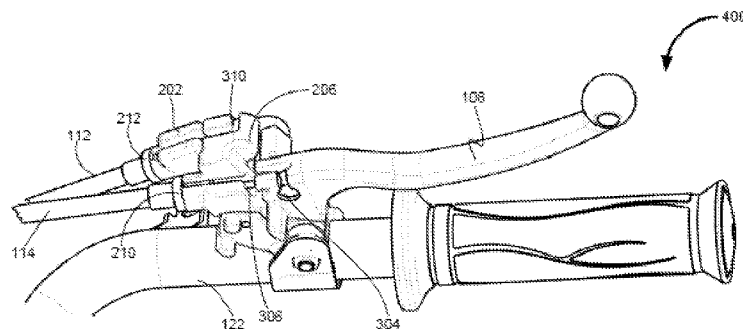


FIG. 4 (b)

(57) **Abstract:** The present subject matter discloses a synchronized braking system (100) for a two-wheeled vehicle (105). The synchronized braking system (100) disclosed herein includes a front wheel brake (102) capable of applying braking forces to a front wheel and a rear wheel brake (104) capable of applying braking forces to a rear wheel. A front wheel brake lever (106) is coupled to the front wheel brake (102) by a front wheel brake cable (116). A rear control hand lever (108) capable of transmitting brake actuating forces is operatively connected to at least one of a rear brake cable (114) and a synchronized brake cable (112) and directly actuates the at least one of the connected rear brake cable (114) and the synchronized brake cable (112) and at least the other cable (112, 114) by reaction of the connected cable (112, 114) for synchronously operating the rear wheel brake (104) and the front wheel brake (102).



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SYNCHRONIZED BRAKING SYSTEM

TECHNICAL FIELD

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

BACKGROUND

[0002] In the last few decades, two-wheeler automobile industry has shown a remarkable growth and development, in terms of technology as well as sales. Due
10 to consistent advancement in technology, two-wheeled vehicles, such as bicycles, motorcycles, scooters and light-weight scooters, have succeeded in maintaining their popularity among different sections of society. Different sections of society, based on their requirement, utilize the two-wheeled vehicles for various purposes, such as a recreational activity, a means of transportation, and for sports activities.
15 As a result, it becomes pertinent for the two-wheeler automobile industry to constantly develop and modify the components of the two-wheeled vehicles to suit requirements of different riders.

[0003] In accordance with the same ideology, various types of braking systems have been developed for facilitating braking functionalities in the two-wheeled
20 vehicles. Conventionally, braking systems that allows simultaneous actuation of a front brake and a rear brake by application of a single brake lever have gained widespread popularity across the globe.

BRIEF DESCRIPTION OF THE DRAWINGS

25 [0004] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the drawings to reference like features and components.

[0005] FIG. 1 (a) illustrates a layout of a braking system of a two-wheeled vehicle, in accordance with an embodiment of the present subject matter.

[0006] FIG. 1 (b) illustrates a two-wheeled vehicle depicting the braking system, in accordance with the embodiment depicted in Fig. 1 (a) of the present
5 subject matter.

[0007] FIG. 2 (a) illustrates a synchnronized bracking system (SBS) mechanism for the two-wheeled vehicle, in accordance with an embodiment of the present subject matter.

[0008] FIG. 2 (b) illustrates the synchnronized bracking system (SBS)
10 mechanism for the two-wheeled vehicle, in accordance with another embodiment of the present subject matter.

[0009] FIG. 3 (a) illustrates a SBS assembly, in accordance with a first embodiment of the present subject matter.

[00010] FIG. 3 (b) illustrates mounting of the SBS assembly of Fig. 3 (a), in
15 accordance with a first embodiment of the present subject matter.

[00011] FIG. 3 (c) and FIG. 3 (d) illustrates working of the SBS assembly of Fig.3 (a), in accordance with a first embodiment of the present subject matter.

[00012] FIG. 3 (e) illustrates a SBS assembly, in accordance with a second embodiment of the present subject matter.

20 [00013] FIG. 3 (f) illustrates an exploded view of the SBS assembly of Fig. 3 (a), in accordance with an embodiment of the present subject matter.

[00014] FIG. 4 (a) illustrates a top view of a SBS assembly, in accordance with a third embodiment of the present subject matter.

[00015] FIG. 4 (b) illustrates a perspective front view of the SBS assembly
25 shown in Fig. 4 (a) of the present subject matter.

[00016] Fig. 4 (c) illustrates working of the SBS assembly shown in Fig. 4 (a) of the present subject matter.

[00017] The subject matter described herein relates to a synchronized braking system for a two-wheeled vehicle, according to an embodiment of the present subject matter.

[00018] Conventionally, two-wheeled vehicles are provided with a braking system for slowing or stopping the vehicle. The braking system, usually, includes at least one brake assembly, such as a front wheel brake assembly and a rear wheel brake assembly for a front wheel and a rear wheel, respectively. Such brake assemblies may include, but are not limited to a cam lever, a hinge pin, and a pair of brake shoes. Further, each of the front wheel brake assembly and the rear wheel brake assembly is connected to a brake lever for actuation. For example, the brake lever may be coupled to a pair of brake shoes for applying friction to each wheel of the two-wheeled vehicle, as and when required. The brake lever can be connected to the brake assembly in a variety of ways. For example, the brake lever can be connected to the brake assembly by means of a cable. In such a case, one end of the cable may be secured to the brake assembly, and the other end of the cable may be secured to the brake lever. Consequently, actuation of the brake lever may result in actuation of the brake assembly and subsequently, the brake may be applied.

[00019] Generally, the front wheel and the rear wheel are provided with separate braking systems. Conventional two-wheeler braking systems usually include either hand-operated brakes for both the wheels or include a combination of hand-operated and foot-operated brakes. In the latter case, generally, the front wheel brakes are hand-operated, and include a front wheel brake lever mounted on a handle of the two-wheeled vehicle for actuation, whereas the rear wheel brakes can be foot-operated by a rear wheel brake lever provided near a foot-rest of the rider.

[00020] During operation of the brakes, usually, riders apply the rear wheel brake alone. Such a practice stems from the fact that actuating both the brake levers at the same time may be inconvenient for the rider. In addition, when the front wheel brake is applied, less load on the front wheel and weight transfer towards the front wheel cause the front wheel to brake abruptly, and may result in a sudden jerk to the vehicle. The sudden jerk may affect the ride quality and may

disturb the balance and stability of the vehicle leading to an accident. However, on the other hand, the braking force applied for braking the rear wheel may have to be limited, to prevent skidding of the vehicle. As a result, the deceleration experienced by the vehicle may also be limited and subsequently, the stopping distance of the vehicle may be significantly large.

[00021] Conventionally, in order to address the above-mentioned concerns, braking systems that allow simultaneous actuation of a front brake and a rear brake by application of a single brake lever have been developed. Such braking system is capable of uniting the braking operation of both the front wheel brake and the rear wheel brake with the help of a single brake lever, for example the rear wheel brake lever. Accordingly, upon actuation of the single brake lever, such a braking system may allow application of braking force to the front wheel as well as the rear wheel of the vehicle. Therefore, the front wheel brake and the rear wheel brake can be simultaneously applied by actuating one brake lever, for example, the rear wheel brake lever. In addition to being convenient for the rider, such braking systems may ensure that the deceleration of the vehicle can be increased and subsequently, the stopping distance may be reduced. Further, as would be understood, in two-wheeled vehicles with such braking systems, a front wheel brake lever may also be provided to independently operate the front wheel brake.

[00022] Further, in such conventional braking systems, a cable from each of the front wheel brake lever and the rear wheel brake lever may be connected to the front wheel brake assembly. In one example, a cable connects the rear wheel brake lever to the front wheel brake assembly. Similarly, another cable connects a front wheel brake lever to the front wheel brake assembly. Further, the front wheel brake assembly may include a cam lever and a hinge pin for supporting each of the cables. Therefore, the first cable and the second cable may be coupled to the front wheel brake assembly through the cam lever, and may maintain a contact with the corresponding hinge pin.

[00023] In the conventional combined braking system, upon actuation of the combined brake lever, the braking force is distributed to the front wheel brake and

the rear wheel brake. However, even in such scenarios, due to lesser load on the front wheel brake than that on the rear wheel brake, the braking force experienced by the front wheel brake may be substantially more than the rear wheel brake causing instability of the vehicle. Such situations may also result the vehicle to
5 nose dive, i.e., experience a jerk in the forward direction. Under such circumstances, the rider, for example a novice rider, may experience discomfort while riding. In addition, various components, such as front fork suspension assembly and the wheel, may experience large forces leading to accelerated wear and tear, and increasing the cost of maintenance of the vehicle.

10 **[00024]** Further, during operation of the combined braking system, when the rider actuates the combined wheel brake lever, the first cable is pulled to actuate the cam lever of the front wheel brake assembly. However, in such a situation, the second cable may remain stationary with reference to the first cable and the cam lever. As a result, the portion of the cam lever and the hinge pin in contact with
15 the second cable may slide over the second cable. The sliding of the cam lever over the second cable results in abrasion of the second cable. Similarly, the first cable may experience abrasion when the second cable and the cam lever are actuated. As a result, overall service life of the brake cables may be substantially low due to the continuous wear and tear and poor braking feedback. In addition,
20 the generation of the frictional forces may cause a loss of the braking force, which in turn, may cause a reduction in the effectiveness of braking.

[00025] In addition, the conventional combined braking systems employ a large number of components and linkages to connect the combined brake lever to both the rear wheel brake assembly and the front wheel brake assembly. Consequently,
25 weight of the combined braking system assembly may be substantially high. Further, such heavy and complex combined braking systems with the large number of components may require greater maintenance, and skilled labor. Such a situation may add to the maintenance cost of the vehicle. In addition, due to lack of space on the vehicle, providing a parking brake arrangement may also become
30 difficult. Accordingly, the conventional combined braking systems may suffer from lack of overall braking effectiveness and high costs.

[00026] Conventionally, such braking systems are provided to improve braking efficiency while actuating rear control lever alone over standard brake system that has independent control for both the brakes. Generally, such known braking systems are based on a concept in which the rear control hand lever is pivoted on
5 to a lever holder directly receives both front and rear brake control cables (inner), while the corresponding outer brake control cables are abutted on the lever holder. Further, such conventional braking systems also involve pivoting the rear control hand lever on to the lever holder, while both the inner brake cables from the front and the rear brakes are connected to the rear control hand lever through an
10 equalizer lever distributes forces between the front and the rear brake cables with some ratio in order to effect proper braking. The outer cables of these front and rear brake control cables are generally abutted on the lever holder or any part thereof.

[00027] However, such braking systems known in the prior art has certain
15 limitations. For example, though the braking system in which both the brake control cables are directly connected to the hand lever is simpler and involves less parts count, lacks reliability in terms of performance benefit or safety as it is not possible to maintain equal free-play between the front and rear brake systems. As it works based on only displacement control it is not possible to maintain the
20 distribution of actuation forces between the front and rear brake control cables. Furthermore, even in case where an equalizer lever is used, this helps in adjusting any difference in free-play between front and rear brake systems by its pivotal action. Based on moment balancing, the actuation forces to both front and rear brake control cables are distributed with a predetermined-ratio irrespective of
25 free-play difference between the front and rear brake systems. However, such a braking system often turns out to be complex with cumbersome construction and mechanism that increases the parts count, which eventually leads to bulkier space utilization in the already constricted handle bar area of the two-wheeled vehicle.

[00028] Moreover, the prior art braking systems have less freedom to optimize.
30 For example, a change in free play of one system design between front and rear affects the other. Furthermore, such conventional systems also lack freedom to adjust and often turn out to be difficult to service and/or maintain the working of

the independent braking properly. Further, any deterioration in one system affects the other system.

[00029] It is to be noted that in case of such prior art braking systems, consistently keeping the set operating parameters through the life cycle of the product cannot be ensured. Such systems are complex and involve complicated mechanisms with more components that are difficult to assemble and cumbersome to service. Further, the known prior arts that distribute the force between two cables leads to more force necessary to be applied at the rear brake lever. Hence, there is a requirement of distribution of displacement in addition to or in place of force distribution when simultaneously actuating both the front and rear control brake cables.

[00030] The synchronized braking system (SBS) of the present subject matter is provided to overcome the above stated problems of the conventional braking systems known in the prior art. For example, the SBS of the present subject matter provides a mechanism that includes a rear control hand lever pivoted on to a lever holder. The hand lever is operatively connected to one of the two brake control cables. For example, an outer cable of a first brake control cable is used for connecting the rear control hand lever to a second brake control cable, which is in turn supported by the lever holder. Further, in an embodiment, the second brake control cable of the present subject matter is movably supported to the first brake control cable in such a manner that the rear control hand lever directly actuates the first brake control cable. The outer cable or the sheath of the first brake control cable in turn actuates the second brake control cable by means of reaction of the sheath on the movable abutment. One of these brake control cables is used for operation of brake system mounted on the rear wheel, while the other is used for operation of brake system mounted on the front wheel.

[00031] Further, in one embodiment, the rear control hand lever is pivotally supported by the lever holder, which is in turn rigidly mounted on the handle bar of the two-wheeled vehicle in a known manner. Accordingly, both the brake control cables are operatively connected in series between the rear control hand lever and the lever holder. Further, instead of rear control hand lever, the first

brake control cable alone enables interlocking the traction of both the brake control cables.

[00032] Further, in an embodiment, the first brake control cable is operatively connected to the rear control hand lever by means of an inner cable and at least
5 through a hinge. In this case, the sheath is supported by the second brake control cable instead of the lever holder. This allows the traction of the first brake control cable. Further, the second brake control cable is supported by the lever holder as a fixed abutment to allow its traction in a known manner. For example, the inner cable of the second brake control cable is connected to the outer cable of the first
10 brake control cable. This enables movably supporting the sheath of the first brake control cable and for the traction of the second brake control cable by means of reaction of the sheath of the first brake control cable. Furthermore, in an embodiment, the rear control hand lever is pivotally supported by lever holder, which in turn is rigidly mounted on the handle bar of the two-wheeled vehicle.
15 The first brake control cable is operatively connected to the rear control hand lever by means of the inner cable through a hinge joint. For example, this cable is used for operation of brake system mounted on the rear wheel. However, the sheath of the first brake control cable is movably supported by means of the second brake control cable instead of directly abutting on the lever holder.

[00033] Further, in another embodiment, the means of the movable abutment is provided in the form of a link that connects the outer cable of the first brake control cable, for example, the rear brake control cable, and the inner cable of the second brake control cable, for example, the front brake control cable. Further, the link is capable of being provided in a simple form such that the movable abutment
25 and connection of the inner cable of the second brake control cable are in line along the direction of traction forces of both the brake control cables for effective traction of the brake control cables. Further, the self-weight of the sheath of the first brake control cable and the link is supported by preload of self-return mechanism of brake system mounted on the corresponding (front) wheel.

[00034] In yet another embodiment, the present subject matter provides a means of the movable abutment in the form of lever as an alternate to the link described in the above embodiment. For example, in one embodiment, such a lever is also

called as a reaction lever or a reaction-relay member since it relays the reaction of the first brake control cable, for example, the rear brake control cable from the sheath of the first brake control cable to the front brake control cable with a required traction force and direction. The sheath of the first (rear) brake control
5 cable is supported by one end of the reaction-relay member (lever) as a movable abutment, while the reaction-relay member is pivotally supported by the lever holder as a fixed pivot support. Further, in an embodiment, the second (front) brake control cable is operatively connected to the reaction-relay member at a point away from its fixed pivot support and is also supported by the lever holder
10 as a fixed abutment in a such a manner that the reaction of the sheath of the first brake control cable is used for traction of the second brake control cable. In an embodiment, the reaction-relay member is mounted with its pivotal axis substantially parallel to the pivotal axis of the rear control hand lever.

[00035] Further, in an embodiment, the inner cable of the second brake control
15 cable is operatively connected to the lever holder by means of a hinged joint. The sheath of the second brake control cable is supported by the reaction-relay member as a movable abutment at a point away from the fixed pivot support of the reaction-relay member. This enables utilizing the reaction of the sheath of the first brake control cable for the traction of the second brake control cable by
20 means of the reaction-relay member and the sheath of the second brake control cable.

[00036] In another embodiment, the present subject matter includes operatively connecting the inner cable of the second brake control cable to the reaction-relay member by means of a hinged joint. Further, instead of the inner cable, the sheath
25 of the second brake control cable is supported by the lever holder. Such an arrangement can be used for traction of the second brake control cable by means of reaction of the sheath of the first brake control cable. In one embodiment, a predetermined space is provided between the lever holder and the movable abutment of the first brake control cable or the reaction-relay member in order to
30 prevent the movable abutment of the sheath of the first brake control cable from moving beyond a predetermined distance in case of failure in developing the traction of the second brake control cable. Further, such a predetermined space

between the lever holder and the movable abutment is less than the traction limit of the rear control hand lever. Hence, the rear control hand lever is capable of being used for the traction of the first brake control cable even while the second brake control cable is cut or broken. Thus, the present subject matter provides a fail-safe condition. It is also used to limit the traction of the second brake control cable beyond a predetermined value corresponding to front wheel braking force limit in terms of safety during slippery or muddy road conditions, including hard braking conditions occurring in curved road stretches.

[00037] In another embodiment, the reaction-relay member is pivotally supported on the lever holder by means of an integrated pivot axis that also mounts the rear control hand lever. For example, the sheath of the rear brake control cable is supported by a movable abutment on the reaction-relay member and its inner cable is hinged on the rear control hand lever in the same manner as in the previously explained embodiments. However in this embodiment, an inner cable of the front brake control cable is hinged at the reaction-relay member instead of the lever holder. Similarly the sheath of the front brake control cable is supported by the lever holder as a fixed abutment instead of the reaction-relay member.

[00038] In an alternative embodiment, the reaction-relay member is mounted with its pivotal axis substantially transverse to the pivotal axis of the rear control hand lever. Further, in another alternative embodiment, a rear control foot pedal that is mounted to a frame of the two-wheeled vehicle replaces the rear control hand lever.

[00039] The SBS described in the present subject matter is simpler and involves less number of parts. Moreover, the simple SBS assembly enables the front handle bar assembly of the two-wheeled vehicle to become more compact. Further, the SBS of the present subject matter is reliable and optimally applies the actuation forces to both the front and the rear brake control cables with a predetermined ratio irrespective of free-play difference between the front and rear brake systems.

[00040] Moreover, unlike the prior arts, the SBS of the present subject matter works based on the force-balancing between the first brake control cable traction force and its reaction on the movable abutment. The outer cable of the first brake

control cable distributes only the displacement of the traction of the rear control hand lever to the two brake control cables for achieving their tractions. In addition, the SBS of the present subject matter also ensures that the traction forces are balanced with a predetermined ratio. The SBS of the present subject matter has enhanced reliability in terms of performance benefit and safety. Similarly, the SBS of the present subject matter distributes only the displacement of the traction rather than the force to both the brake control cables. Hence, no additional effort is required for the rear control hand lever to actuate the second brake control cable. This helps in reducing front brake control cable strain because of sheath movement with reference to the handle bar. Moreover, the SBS of the present subject matter using second/third order lever as reaction-relay member improves both brake feel and performance. While the rear control hand lever is actuated, its traction force directly acts upon the inner cable of the rear brake control cable that is used for actuating the rear wheel brake. Simultaneously, the reaction of the outer cable of the rear brake control cable acting upon the reaction-relay member is used for the traction of the front brake control cable that actuates the front wheel brake.

[00041] Further, even in circumstances such as failure of the front brake system or the breaking of the front brake control cable, the SBS of the present subject matter enables the traction of the front brake control cable without exerting any traction force. Moreover, the SBS of the present subject matter prevents the reaction-relay member from travelling beyond a predetermined clearance and ensures traction for the rear brake control cable. This clearance is limited to avoid any bottoming of the rear control lever due to excess travel so that the reaction-relay member will provide the traction force on the rear brake control cable easily.

[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.

[00043] FIG. 1 (a) illustrates a layout of a braking system 100 of a two-wheeled vehicle, in accordance with an embodiment of the present subject matter. The system 100 includes a front wheel brake 102 and a rear wheel brake 104. Further, a front wheel brake lever 106 may be actuated to apply the front wheel brake 102.

Similarly, a rider may actuate a rear control hand lever 108 for applying the front wheel brake 102 as well as the rear wheel brake 104. In one implementation, the front wheel brake lever 106 and the rear control hand lever 108 may be disposed on a right-hand side and a left-hand side of a handle bar 110 of the vehicle, respectively. In another implementation, instead of providing the rear control hand lever 108 on the handle bar 110, a foot pedal (not shown) can serve as the integrated brake actuating member to apply the front wheel brake 102 as well as the rear wheel brake 104. In a further implementation, instead of the independently provided front wheel brake lever 106, the braking system 100 may include a rear wheel brake lever (not shown) to independently apply the rear wheel brake 104. Therefore, in such an implementation, the braking system 100 may include the rear wheel brake lever to independently apply the rear wheel brake 104, and the front wheel brake lever 106 may act as the integrated brake actuating member for applying the front wheel brake 102 as well as the rear wheel brake 104.

[00044]

[00045] Further, the synchronized brake cable 112 and the independent front brake cable 116 may be connected to a front wheel brake assembly (not shown) of the front wheel brake 102. The front wheel brake assembly may include a cam lever 124 (shown in Fig. 1 (b)), and an end (not shown) for each of the synchronized brake cable 112 and the independent front brake cable 116. In one implementation, a force suppressing apparatus (not shown) may also be provided to support the synchronized brake cable 112 and the independent front brake cable 116 for improving safety.

[00046] FIG. 1 (b) illustrates a two-wheeled vehicle 105 depicting the braking system 100, in accordance with the embodiment depicted in Fig. 1 (a) of the present subject matter. In an embodiment, the vehicle 105 includes a handle bar assembly 122 that is enclosed on both sides by a headlamp housing 120. The headlamp housing 120 also contains SBS assembly (not shown) that includes the rear control hand lever 108 used for synchronously actuating both the front wheel brake 102 and the rear wheel brake 104. In one embodiment, a synchronized brake cable 112 and a rear brake cable 114 are functionally coupled to the rear control

hand lever 108 such that the actuation of the rear control hand lever 108 causes a corresponding simultaneous actuation of the front wheel brake 102 and the rear wheel brake 104 in no particular order. In one embodiment, the synchronized brake cable 112 and a front brake cable 116, the other end of which is coupled to the front brake lever 106, are connected to a cam lever 124 of the front wheel brake 102. In an embodiment, when the front brake lever 106 is actuated, the front wheel brake 102 is independently controlled by means of the front brake cable 116. Similarly, the actuation of the rear control brake lever 108 also causes actuation of the front wheel brake 102 independent of the front brake lever 106 actuation. Further, the actuation of the rear control brake lever 108 also causes a corresponding actuation of the rear wheel brake 104.

[00047] FIG. 2 (a) and 2 (b) illustrates a synchronized braking system (SBS) mechanism 200 for the two-wheeled vehicle 105, in accordance with an embodiment of the present subject matter. In an embodiment, the SBS mechanism 200 includes the rear control brake lever 108 pivotally supported to a lever holder 202 of the two-wheeled vehicle 105 and establishes a first hinged joint 302 with the lever holder 202. In an embodiment, actuation of the rear control brake lever 108 by the rider causes a corresponding actuation of an inner rear cable 306 that is coupled to the rear control brake lever 108 through an inner rear cable hinge 304. The actuation of the rear control brake lever 108 causes the inner rear cable hinge 304 to be pulled that causes the rear brake cable 114 to be actuated. The rear brake cable 114 includes an outer sheath 210 that reacts due to the actuation of the rear brake cable 114 causing actuation of an inner SBS cable 308 that is coupled to the outer sheath 210 through an inner SBS cable hinge 310. The actuation of the inner SBS cable 308 causes the corresponding actuation of the synchronized brake cable 112 as an outer sheath 212 of the synchronized brake cable 112 is abutted against the lever holder 202 enabling sufficient tractional forces to be generated as a result of reaction of the outer sheath 210 of the rear brake cable 114.

[00048] Further, in another embodiment as explained in Fig. 2 (b), the inner SBS cable hinge 310 is coupled to a link member 312 instead of direct coupling to the outer sheath 210 of the rear brake cable 114. In an embodiment, the actuation of the rear control hand lever 108 causes a corresponding actuation of the inner

rear cable 306 hinged to the rear control hand lever 108 through the inner rear cable hinge 304 that in turn actuates the rear brake cable 114. The outer sheath 210 of the rear brake cable 114 is supported by the link member 312 as an abutment at one end. The other end of the link member 312 is supported by the inner SBS cable hinge 310 as a result of actuation of the inner rear cable 306. The reaction of the link member 312 causes the corresponding actuation of the inner SBS cable 308 that transmits braking force to the synchronized brake cable 112 by means of the outer sheath 212 of the synchronized brake cable 112 that is abutted against the lever holder 202.

10 **[00049]** FIG. 3 (a) and FIG. 3 (b) illustrate a SBS assembly 300, in accordance with a first embodiment of the present subject matter. In an embodiment, the SBS assembly 300 is depicted in dotted lines in Fig. 3 (a) to indicate the mounting location of the SBS assembly 300 within the headlamp housing 120. In one embodiment, the lever holder 202 is mounted on to the handle bar assembly 122 in such a manner that enables mounting of the rear control hand lever 108 with its longitudinal axis substantially parallel to the longitudinal axis of the handlebar assembly 122. Such a mounting of the lever holder 202 ensures that the rear control brake lever 108 is extended to be optimally operated by the rider while applying the rear wheel brake 104. The rear control hand lever 108 is pivotally supported to the lever holder 202 at a lever mounting 204. In an embodiment, the lever holder 202 extends transversely to the longitudinal axis of the handle bar assembly 122 and in a direction towards the vehicle front. In one embodiment, the lever holder 202 is provided with a mounting hinge 208 for mounting a reaction-relay member 206.

25 **[00050]** In an embodiment, the reaction-relay member 206 is movably hinged to the lever holder 202. Further, in one embodiment, as clearly depicted in Fig. 3 (b), the synchronized brake cable 112 and the rear brake cable 114 are coupled to the reaction-relay member 206. For example, the outer sheath 210 of the rear brake cable 114 is abutted against a distal end of the reaction-relay member 206 away from the mounting hinge 208, while the outer sheath 212 of the synchronized brake cable 112 is abutted against a proximal end of the reaction-relay member 206.

[00051] FIG. 3 (c) and FIG. 3 (d) illustrate working of the SBS assembly 300 of Fig.3 (a), in accordance with a first embodiment of the present subject matter. In an embodiment, Fig. 3 (c) depicts the non-actuated condition of the rear control hand lever 108, while, Fig. 3 (d) depicts the actuated condition of the rear control hand lever 108. Referring to Fig. 3 (c), in the non-actuated condition of the rear control hand lever 108, the proximal end of the reaction-relay member 206 rests against the lever holder 202. However, in the actuated condition of the rear control hand lever 108, the inner rear cable hinge 304 mounted on the rear control hand lever 108 causes the corresponding actuation of the inner rear cable 306. The displacement of the inner rear cable hinge 304 causes the outer sheath 210 of the rear brake cable 114 to actuate the reaction-relay member 206 by means of reaction of the outer sheath 210.

[00052] In an embodiment, the reaction-relay member 206 in turn actuates the outer sheath 212 of the synchronized brake cable 112 thereby providing the required traction of the synchronized brake cable 112. The traction forces between the rear brake cable 114 and the synchronized brake cable 112 are in a predetermined ratio. In an embodiment, the above traction force ratio remains constant. Thus the actuation of the rear control hand lever 108 provides the traction of the rear brake cable 114 and the synchronized brake cable 112 with a predetermined force ratio between them. For instance, the actuation of the reaction-relay member 206 pushes the outer sheath of the synchronized brake cable 112 resting against the proximal end of the reaction-relay member 206 in a direction away from the mounting hinge 208 of reaction-relay member 206. The inner SBS cable hinge 310 with the lever holder 202 ensures that appropriate traction forces are transmitted to the front wheel brake 102 as a result of reaction of the outer sheath 210 of the rear brake cable 114.

[00053] FIG. 3 (e) illustrates a SBS assembly 300, in accordance with a second embodiment of the present subject matter. In an embodiment, the alternate embodiment of the SBS assembly 300 includes the reaction-relay member 206 mounted at the reaction-relay member mounting hinge 208 with its pivot axis transverse to the pivotal axis of the rear control hand lever 108 pivotally supported to the lever holder 202 at the pivotal mounting location 204 and

transverse to the handle bar assembly 122. In one embodiment, the rear brake cable 114 abutted against the reaction-relay member 206 is disposed on the same plane as that of the rear control hand lever 108 such that the inner rear cable 306 is directly hinged to the rear control hand lever 108. The synchronized brake cable 112 is disposed substantially parallel to the rear brake cable 114 at a plane below the inner rear cable 306 mounting plane such that the actuation of the rear control hand lever 108 causes the corresponding actuation of the inner rear cable 306, which in turn causes the outer sheath 210 of the rear brake cable 114 to react causing the reaction-relay member 206 to push the outer sheath 212 of the synchronized brake cable 112 away from the lever holder 202.

[00054] FIG. 3 (f) illustrates an exploded view of the SBS assembly 300 of Fig. 3 (a), in accordance with an embodiment of the present subject matter. In an embodiment, the rear control hand lever 108 is pivotally supported to the lever holder 202, which is held rigidly to the handle bar assembly 122 by means of a downwardly disposed mounting plate 314. In an embodiment, the mounting plate 314 ensures that the lever holder 202 remains stationary and allow seamless actuation of the rear control hand lever 108 and the reaction-relay member 206 in conjunction with the angular displacement of the rear control hand lever 108. In an embodiment, the reaction-relay member 206 is rotatably supported against the lever holder 202 at the mounting hinge 208 by means of a plurality of fastening elements 316. Further, the outer sheaths 210, 212 of the rear brake cable 114 and the synchronized brake cable 112 are firmly held in the corresponding recesses provided in the distal and proximal ends of the reaction-relay member 206 respectively.

[00055] FIG. 4 (a) illustrates a top view of a SBS assembly 400, in accordance with a third embodiment of the present subject matter, while FIG. 4 (b) illustrates a perspective front view of the SBS assembly 400 shown in Fig. 4 (a) of the present subject matter. In one embodiment, the rear control hand lever 108 is pivotally supported to the lever holder 202 along with the reaction-relay member 206 at an integrated mounting hinge 402.

[00056] In an embodiment, the reaction-relay member 206 includes a lower end that receives the rear brake cable 114 and allows the inner rear cable 306 to extend

and hinge at the inner hinge 304 of the inner rear cable 306. Thus, the actuation of the rear control hand lever 108 causes the corresponding actuation of the inner rear cable 306 without the influence of the reaction-relay member 206. In an embodiment, the reaction-relay member 206 includes an upper end that receives
5 the inner SBS cable hinge 310 of the synchronized brake cable 112. In an embodiment, the outer sheath 210 of the rear brake cable 114 is abutted against the lower end of the reaction-relay member 206, while the outer sheath 212 of the synchronized brake cable 112 is abutted against the lever holder 202 that allows the inner SBS cable 308 to be hinged at the upper end of the reaction-relay
10 member 206.

[00057] Fig. 4 (c) illustrates working of the SBS assembly 400 shown in Fig. 4 (a) of the present subject matter. While the rear control hand lever 108 is actuated, its traction force is directly allowed to act upon the inner rear cable 306 that enables actuation of the rear wheel brake 104. Simultaneously, the reaction of the
15 outer sheath 210 of the rear brake cable 114 acts upon the reaction-relay member 206 for producing required traction forces to the inner synchronized cable 308 of the synchronized brake cable 112. This reaction enables actuation of the front wheel brake 102. In this embodiment, the reaction of the outer sheath 210 of the rear brake cable 114 enables to pull the inner synchronized cable 308 by reacting
20 through the reaction-relay member 206. The reaction-relay member 206 is pivoted on the lever holder 202 enabling guiding or leveraging the reaction of the outer sheath 210 of the rear brake cable 114 into traction force of the synchronized brake cable 112. However, the reaction-relay member 206 ensures that the traction forces of the rear control hand lever 108 is not distributed between the rear brake
25 cable 114 and the synchronized brake cable 112.

[00058] Furthermore, in an embodiment, a lug is provided on the upper end of the reaction-relay member 206 and a corresponding stopper is provided on the lever holder 202 across the path followed by the lug for the 'Fail-Safe' condition. A predetermined clearance provided between the lug and stopper allows the
30 traction of the inner synchronized cable 308 caused by means of the outer sheath 210 of the rear brake cable 114 and the reaction-relay member 206 for appropriate actuation of the front wheel brake 102. In an embodiment, such a clearance is

sufficient to accommodate any increase in free play of the front brake system so that the operation of the front brake system when actuating the rear control hand lever 108 is more reliable.

- [00059]** 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 100 and the SBS assembly 300, 400.
- 5

We claim:

1. A synchronized braking system (100) for a two-wheeled vehicle (105), the synchronized braking system (100) comprising:

5 a front wheel brake (102) capable of applying braking forces to a front wheel of the two-wheeled vehicle (105);

a rear wheel brake (104) capable of applying braking forces to a rear wheel of the two-wheeled vehicle (105);

a front wheel brake lever (106) mounted to a handlebar (110) of said vehicle (105), said front wheel brake lever (106) coupled to said front wheel brake
10 (102) by a front wheel brake cable (116); and

a rear control hand lever (108) capable of transmitting brake actuating forces is pivotably supported to the handlebar (110) of said vehicle (105), wherein said rear control hand lever (108) is operatively connected to at least one of a rear brake cable (114) and a synchronized brake cable (112) and directly actuates the
15 at least one of the connected rear brake cable (114) and the synchronized brake cable (112) and at least the other cable (112, 114) by reaction of the connected cable (112, 114) for synchronously operating said rear wheel brake (104) and said front wheel brake (102).

20 2. The synchronized braking system (100) as claimed in claim 1, wherein said rear control hand lever (108) is coupled to an inner rear brake cable (306) of said rear brake cable (114), said synchronized brake cable (112) is operatively coupled and movably supported to an outer sheath (210) of said rear brake cable (114) through an inner SBS cable (308), and an outer sheath (212) of said synchronized brake
25 cable (112) is supported by a lever holder (202), wherein reaction of said outer sheath (210) of the rear brake cable (114) actuates the synchronized rear brake cable (112).

3. The synchronized braking system (100) as claimed in claim 1, wherein the
30 outer sheath (210) of the rear brake cable (114) is movably supported to the inner

SBS cable (308) of the synchronized brake cable (112) by means of a movable link (312), and wherein the movable link (312) and the inner SBS cable (308) are in line along direction of traction forces of both the cables (112, 114).

5 4. The synchronized braking system (100) as claimed in claim 1, wherein the rear control hand lever (108) is operatively coupled to a reaction-relay member (206) pivotally supported to the lever holder (202) at a reaction-relay member mounting pivot (208), said reaction-relay member (206) relays the reaction of the rear brake cable (114) from the outer sheath (210) to the synchronized brake cable (112)
10 with a required traction force and direction, and wherein the outer sheath (210) of the rear brake cable (114) movably abuts and supported on one end of the reaction-relay member (206), and synchronized brake cable (112) is operatively connected to the reaction-relay member (206) at a point away from the reaction-relay member mounting pivot (208) and fixedly supported by the lever holder
15 (202).

5. The synchronized braking system (100) as claimed in claim 4, wherein the reaction-relay member (206) is mounted with its pivotal axis substantially parallel to the pivotal axis of the rear control hand lever (108).

20

6. The synchronized braking system (100) as claimed in claim 4, wherein the synchronized brake cable (112) has an inner SBS cable (308) hingedly connected to the lever holder (202) at a SBS cable inner hinge (310), and an outer sheath (212) movable abutted against the reaction-relay member (206).

25

7. The synchronized braking system (100) as claimed in claim 4, wherein the reaction-relay member (206) is disposed at a predetermined gap from the lever holder (202) for preventing the movable abutment of the outer sheath (210) of the rear brake cable (114) from moving beyond a predetermined distance during
30 failure in developing the traction of the synchronized brake cable (112), and

wherein the predetermined space between the lever holder (202) and the reaction-relay member (206) is less than the traction limit of the rear control hand lever (108), allowing the rear control hand lever (108) to apply traction of the rear brake cable (114) during failure in developing the traction of the synchronized brake cable (112).

8. A synchronized braking system (SBS) assembly (300, 400) for a two-wheeled vehicle (105), the SBS assembly (300) comprising: a rear control hand lever (108) is pivotally supported to a lever holder (202) at a lever mounting (204), said lever holder (202) extending transversely to the longitudinal axis of a handle bar assembly (122) of said vehicle (105) in a direction towards the vehicle front, and wherein the lever holder (202) is provided with a mounting hinge (208) capable of movably hinging a reaction-relay member (206), said reaction-relay member (206) is coupled with a rear brake cable (114) and a synchronized brake cable (112), said rear brake cable (114) has an outer sheath (210) movably abutted against a distal end of the reaction-relay member (206) and said synchronized brake cable (112) has an outer sheath (212) movably abutted against a proximal end of the reaction-relay member (206).

9. The SBS assembly (300, 400) as claimed in claim 8, wherein the rear control hand lever (108) is pivotally supported to the lever holder (202), which is held rigidly to the handle bar assembly (122) by means of a downwardly disposed mounting plate (314), said mounting plate (314) allows seamless actuation of the rear control hand lever (108) and the reaction-relay member (206) in conjunction with the angular displacement of the rear control hand lever (108).

10. The SBS assembly (300, 400) as claimed in claim 8, wherein the rear control hand lever (108) is pivotally supported to the lever holder (202) along with the reaction-relay member (206) by means of an integrated mounting hinge (402).

11. The SBS assembly (300, 400) as claimed in claim 8, wherein the reaction-relay member (206) includes a lower end receiving the rear brake cable (114), said lower end allowing the inner rear cable (306) to extend and hinge at the inner hinge (304), and wherein the actuation of the rear control hand lever (108) causes
5 corresponding actuation of the inner rear cable (306) without the influence of the reaction-relay member (206), said reaction-relay member (206) includes an upper end receiving an inner SBS cable hinge (310) of the synchronized brake cable (112).

10 12. The SBS assembly (300, 400) as claimed in claim 11, wherein the outer sheath (210) of the rear brake cable (114) is abutted against the lower end of the reaction-relay member (206), and the outer sheath (212) of the synchronized brake cable (112) is abutted against the lever holder (202) allowing the inner SBS cable (308) to be hinged at the upper end of the reaction-relay member (206).

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13. A two-wheeled vehicle (105) comprising a synchronized braking system (100) having an SBS assembly (300, 400) as claimed in any one of the preceding claims.

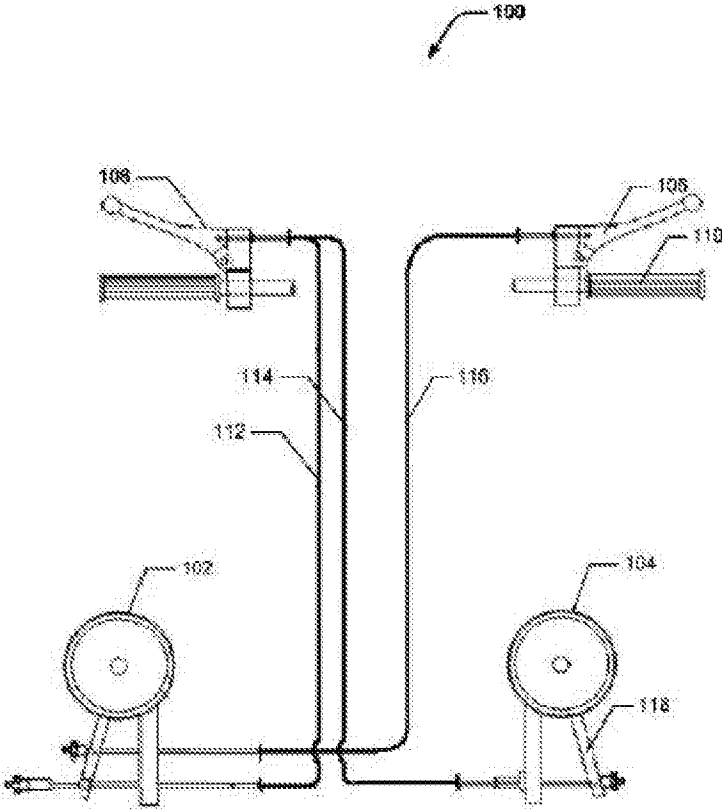


FIG. 1 (a)

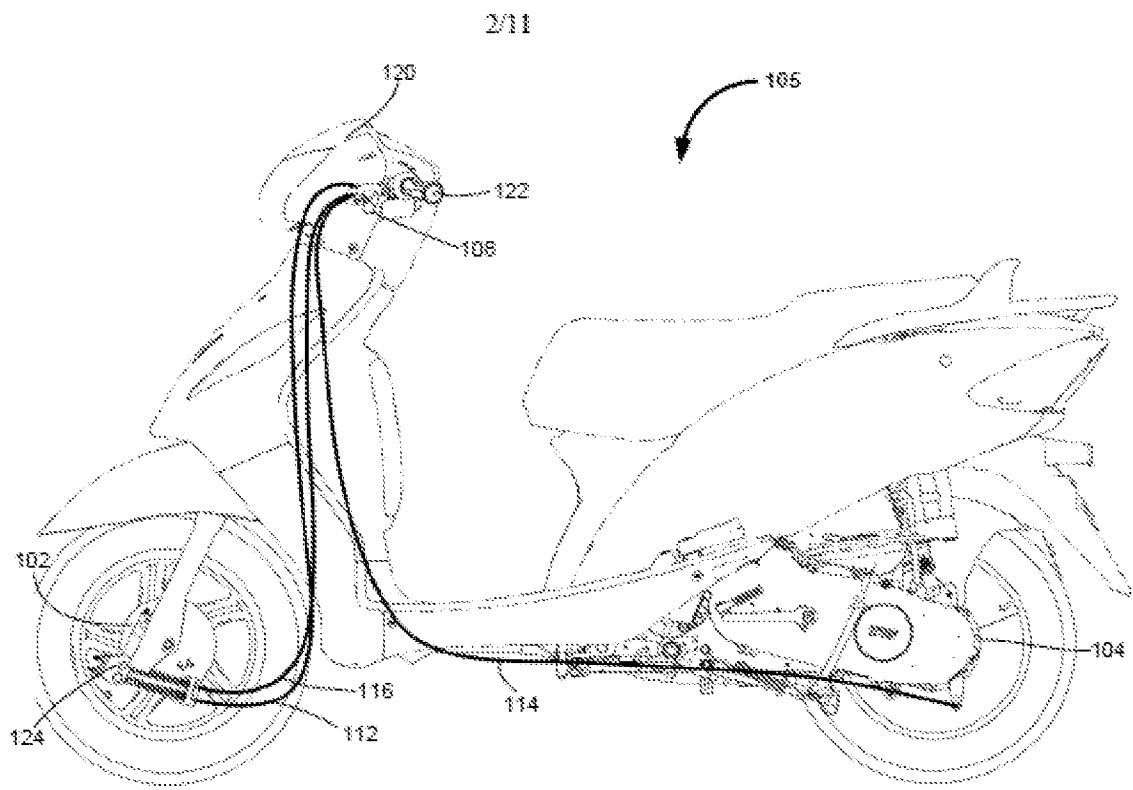
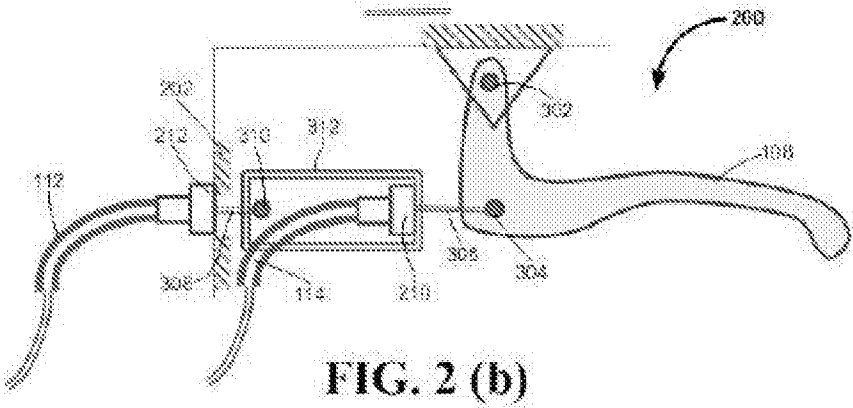
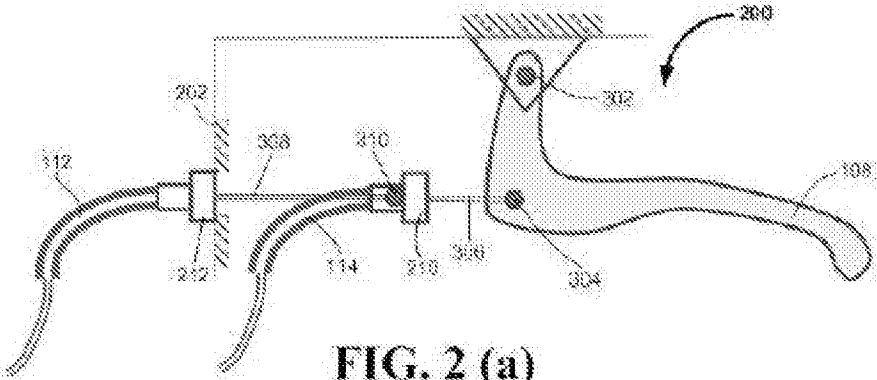


FIG. 1 (b)



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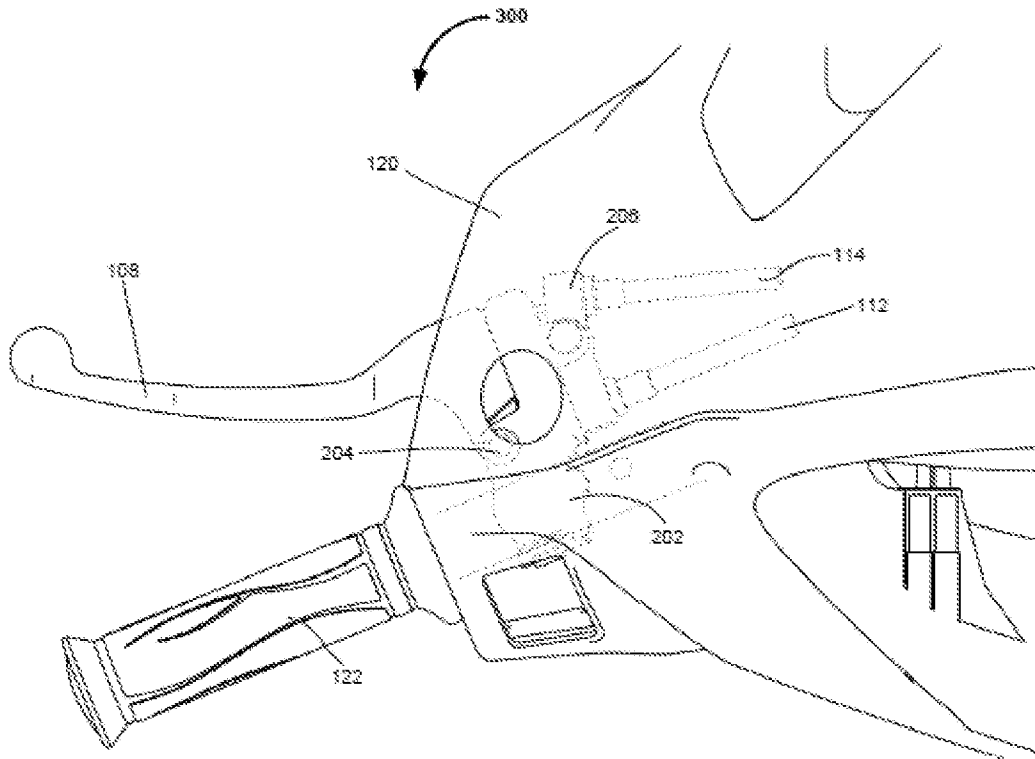


FIG. 3 (a)

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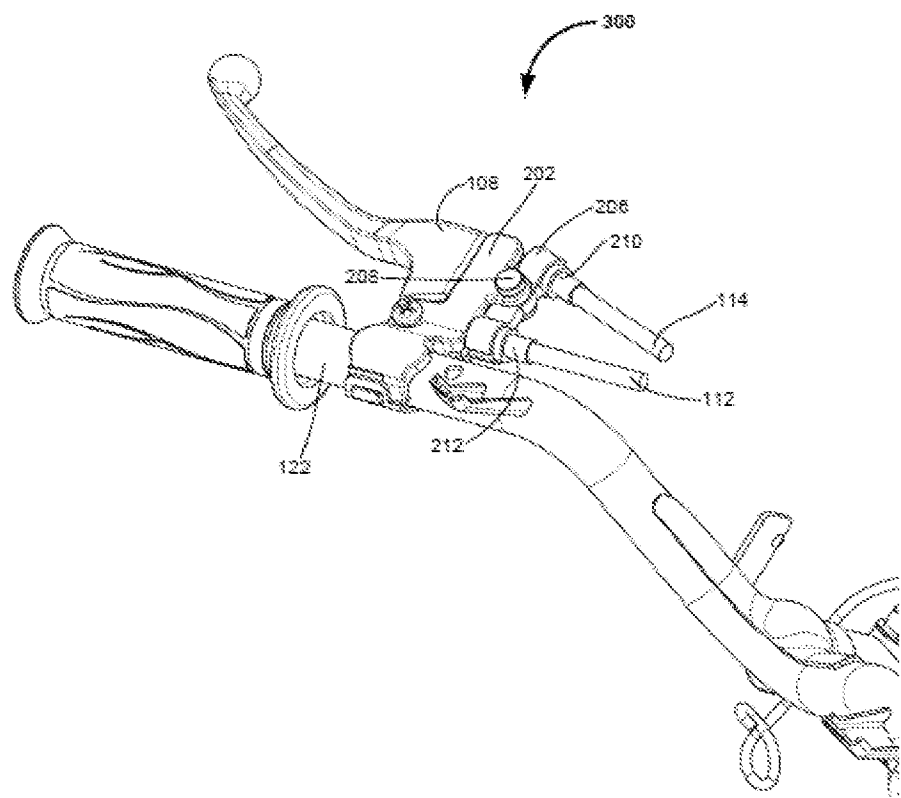


FIG. 3 (b)

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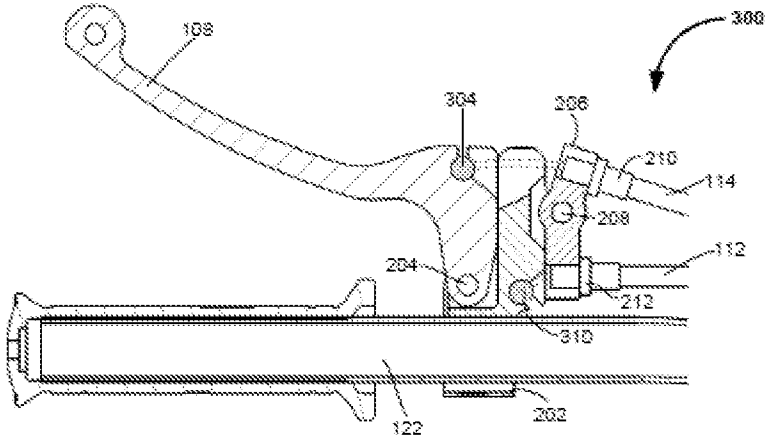


FIG. 3 (c)

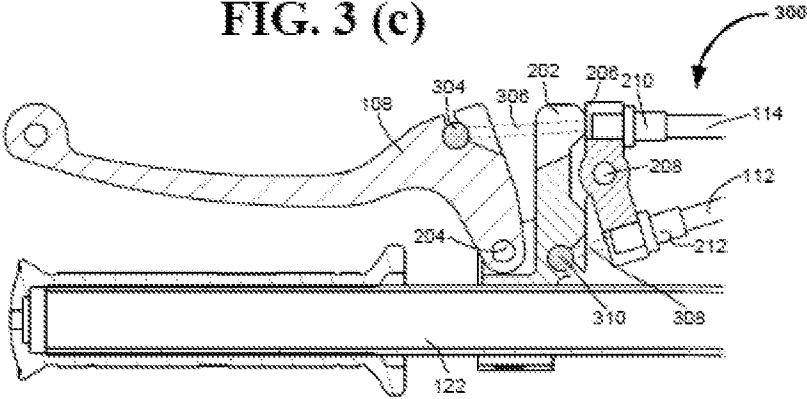


FIG. 3 (d)

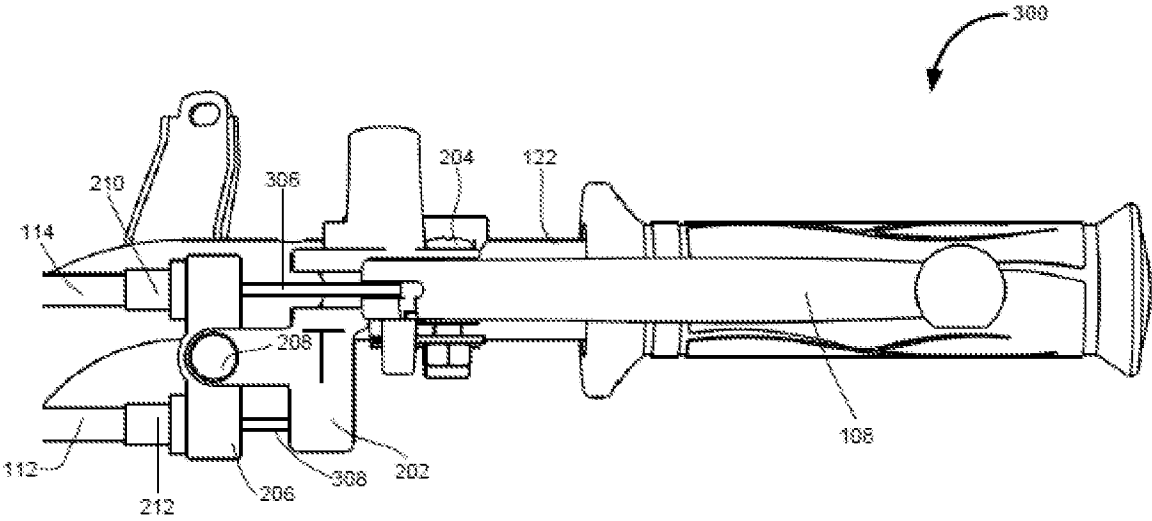


FIG. 3 (e)

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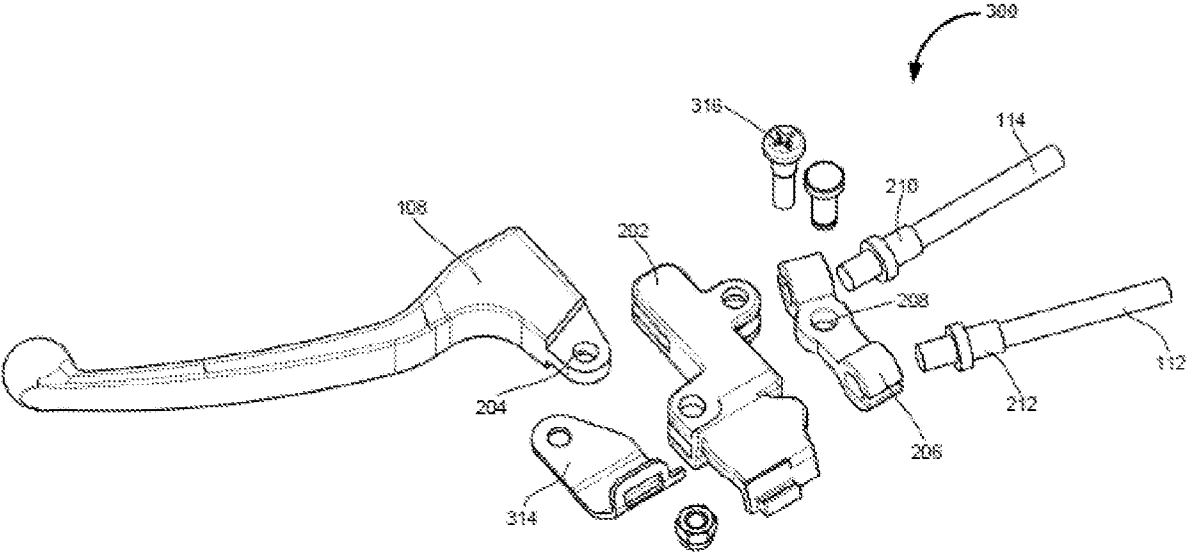


FIG. 3 (f)

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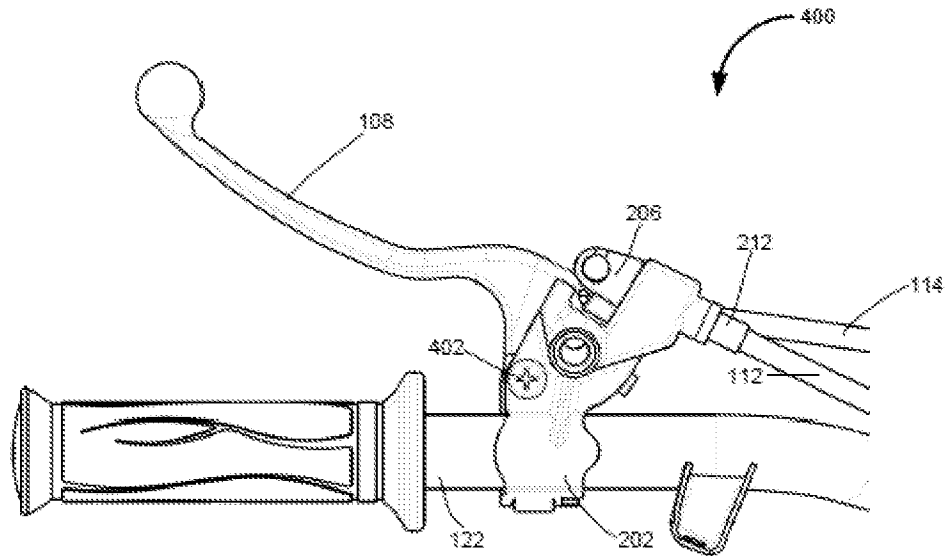


FIG. 4 (a)

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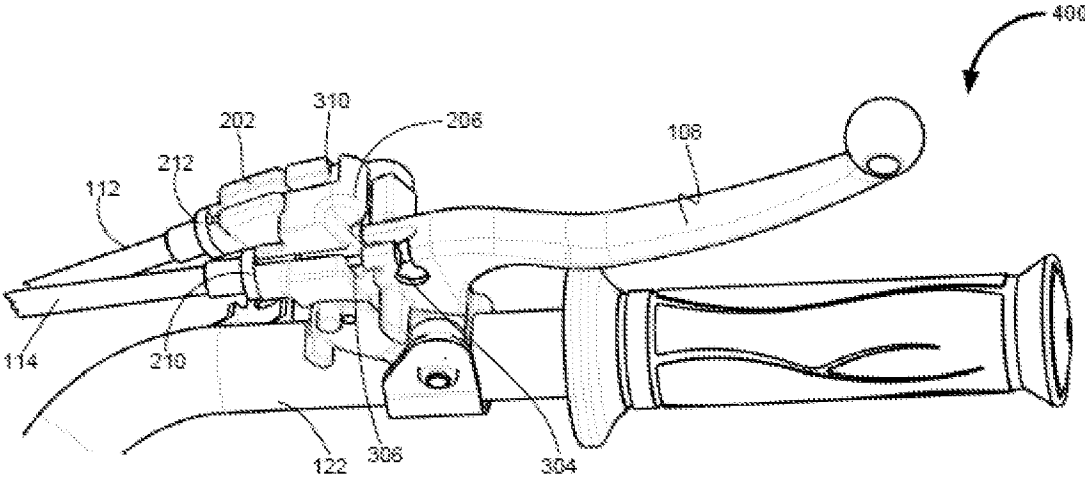


FIG. 4 (b)

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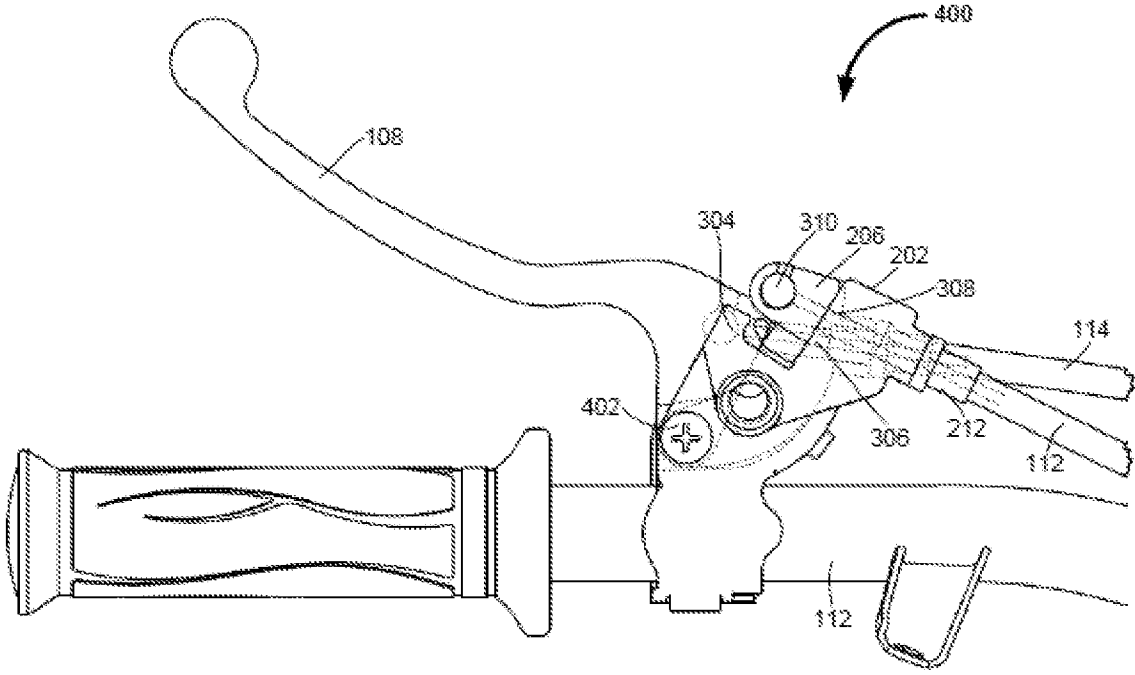


FIG. 4 (c)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2015/050218

A. CLASSIFICATION OF SUBJECT MATTER INV. B60T8/17 B60T8/32 B60T8/26 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		
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	US 6 298 744 B1 (HUANG HAN-CHEN [TW]) 9 October 2001 (2001-10-09) column 3, line 24 - line 65 figures 3, 4B, 5B -----	1-13
X	EP 1 955 938 A2 (YAMAHA MOTOR CO LTD [JP]) 13 August 2008 (2008-08-13) paragraph [0084] - paragraph [0089] figures 3, 5, 12 figures 15-18 -----	1-13
X	EP 1 795 418 A2 (NISSIN KOGYO KK [JP]) 13 June 2007 (2007-06-13) figures 2, 5-7 -----	1, 8
X	DE 297 15 855 U1 (HUANG HAN CHEN [TW]) 13 November 1997 (1997-11-13) figure 1 -----	1-13
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "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 "&" document member of the same patent family		
Date of the actual completion of the international search 6 May 2016		Date of mailing of the international search report 17/05/2016
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 Colonna, Massimo

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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