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Hydraulic brake system and apparatus

Abstract

A braking system includes a vehicle having a front brake and a rear brake. The system includes a moveable structure connected to a rear brake. The rear brake may be a hydraulic brake. When the rear brake is actuated, the moveable structure moves. The movement of the structure pressurizes hydraulic fluid in a tube which actuates a front hydraulic brake.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This patent application is continuation of U.S. patent application Ser. No. 17/334,336, filed May 28, 2021, which is a continuation of U.S. patent application Ser. No. 16/379,514, filed Apr. 9, 2019, now issued as U.S. Pat. No. 11,390,355 on Jul. 19, 2022, which is a continuation of U.S. patent application Ser. No. 14/612,166, filed Feb. 2, 2015, now issued as U.S. Pat. No. 10,252,770 on Apr. 9, 2019, which claims the benefit of U.S. Provisional Patent Application 61/934,538, filed Jan. 31, 2014, and is a continuation-in-part of pending U.S. patent application Ser. No. 13/513,141, filed Jul. 9, 2012, now issued as U.S. Pat. No. 10,215,243 on Feb. 26, 2019, which is a U.S. national phase application under 35 U.S.C. § 371 of International Patent Application No. PCT/US2010/060411, filed Dec. 15, 2010, which is a continuation-in-part of U.S. patent application Ser. No. 12/638,944, filed Dec. 15, 2009, now issued as U.S. Pat. No. 8,333,266 on Dec. 18, 2012, and International Patent Application No. PCT/US2010/060411 claims priority to U.S. Provisional Patent Application No. 61/411,405, filed Nov. 8, 2010, all of which are incorporated by reference in their entireties along with all other references cited in this application.

BACKGROUND
(1) The present invention relates to a brake system and method. More particularly, the present invention relates to a brake system and method for a two-wheeled vehicle.
(2) A two-wheeled vehicle is equipped with a brake system to slow or stop its moving by applying friction upon its wheels. A rider uses both hands to press two brake levers, fixed on the handlebar, to control a front and rear brake of the two-wheeled vehicle. However, it would be dangerous if the rider presses either one of the brake levers too hard to make the vehicle's wheel to be locked by the front or rear brake. It is uncontrollable and dangerous for a moving two-wheeled vehicle with one of its wheels being locked, e.g. the vehicle may skid on the ground. In the instance of a two-

wheeled vehicle's tip over, the two-wheeled vehicle still moves with its front wheel being locked such that the rider may fall over beyond a handlebar of the two-wheeled vehicle when a rear wheel comes off the ground by a sufficient height. For the foregoing reasons, there is a need for preventing a moving two-wheeled vehicle from a tip-over or a wheel being locked.

BRIEF SUMMARY OF THE INVENTION

(3) A braking system includes a moveable structure connected to a rear brake. The rear brake may be a hub brake or a disc brake. A cable to the front brake is connected to the moveable structure. When the rear brake is actuated, the moveable structure moves. The movement of the structure pulls the cable to actuate the front brake. The movement may include a translation, rotation, or both.

(4) In a specific embodiment, an apparatus includes a lever coupled to a rear hub brake, a first cable clamp on the lever that secures an end of a rear brake cable, an opposite end of the rear brake cable being coupled to a rear brake lever, and a second cable clamp on the lever that secures an end of a front brake cable, an opposite end of the front brake cable being coupled to a front brake, wherein when the rear hub brake is actuated by the rear brake lever, the lever rotates to pull the front brake cable, thereby actuating the front brake.

(5) In another specific embodiment, an apparatus includes a pivot point; a brake mount to attach a rear disc brake; and a lever arm extending away from the pivot point and comprising a cable clamp that secures an end of a front brake cable, an opposite end of the front brake cable being coupled to a front brake, wherein when the rear disc brake is actuated, the lever arm rotates about the pivot point to pull the front brake cable, thereby actuating the front brake.

(6) In another specific embodiment, an apparatus includes a first link of a linkage and comprising a first joint, a second joint, and a front brake cable attachment end, wherein the second joint connects to a first tab on a bicycle frame and is between the first joint and the front brake cable attachment end; a second link of the linkage connected to the first joint and comprising a first mount, opposite the first joint, for a disc brake; and a third link of the linkage and comprising a fourth joint and a second mount, opposite the fourth joint, for the disc brake, wherein the fourth joint connects to a second tab on the bicycle frame.

Description

BRIEF DESCRIPTION OF THE FIGURES

(1) The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention. In the drawings,

(2) FIG. **1** illustrates a block diagram of an embodiment of the inventive braking system;

(3) FIG. **2** illustrates bicycle having the inventive braking system according to an embodiment of the invention;

(4) FIG. **3** illustrates a brake system according to an embodiment of the invention;

(5) FIG. **4** illustrates a brake system according to another embodiment of the invention;

(6) FIG. **5** illustrates a brake system according to another embodiment of the invention;

(7) FIGS. **6** and **7** illustrate top views of a brake according to an embodiment of the invention;

(8) FIGS. **8** and **9** illustrate top views of another brake according to an embodiment of the invention;

(9) FIGS. **10-14** illustrate views of a slider assembly according to an embodiment of the invention;

(10) FIGS. **15-19** illustrate views of a guide according to an embodiment of the invention;

(11) FIGS. **20-22** illustrate cross section views of the slider assembly and guide according to different embodiments of the invention;

(12) FIGS. **23** and **24** illustrate top views of another brake according to an embodiment of the invention;
(13) FIG. **25** illustrates a side view of the slider assembly and guide according to a disk brake embodiment of the invention;
(14) FIG. **26** illustrates a rear view of a released brake and a second brake actuator;
(15) FIG. **27** illustrates a side view of the released brake and the second brake actuator;
(16) FIG. **28** illustrates the rear view of the actuated brake and second brake actuator;
(17) FIG. **29** illustrates a side view of the actuated brake and second brake actuator;
(18) FIG. **30** illustrates a perspective view of the cantilever brake arm, slider assembly and guide;
(19) FIG. **31** illustrates a rear view of the cantilever brake arm, slider assembly and guide;
(20) FIGS. **32-33** illustrate top views of a brake according to an embodiment of the invention;
(21) FIGS. **34-35** illustrate top views of a brake coupled to LEDs according to another embodiment of the invention;
(22) FIGS. **36-37** illustrate top views of a brake coupled to brake signal transmitters according to another embodiment of the invention;
(23) FIG. **38** illustrates a side view of a brake signal transmitter and an electronic shifting system;
(24) FIG. **39** illustrates a side view of a rear hub brake;
(25) FIG. **40** illustrates a side view of a rear hub brake used with an embodiment of the inventive braking system;
(26) FIG. **41** illustrates a bottom view of a rear hub brake used with an embodiment of the inventive braking system;
(27) FIG. **42** illustrates a side view of a rear hub brake used with another embodiment of the inventive braking system;
(28) FIG. **43** illustrates a side view of a rear hub brake used with another embodiment of the inventive braking system;
(29) FIG. **44** illustrates a side view of front disc brake being actuated in an embodiment of the inventive braking system;
(30) FIG. **45** illustrates a side view of a rear hub disc brake used with another embodiment of the inventive braking system;
(31) FIG. **46** illustrates a side view of a rear hub disc brake used with another embodiment of the inventive braking system;
(32) FIG. **47**A illustrates a side view of a rear hub disc brake used with another embodiment of the inventive braking system;
(33) FIG. **47**B illustrates a side view of a rear hub disc brake used with another embodiment of the inventive braking system;
(34) FIG. **48**A shows a side view of a rear disc brake caliper in a first position of a sequence in an embodiment of the inventive braking system;
(35) FIG. **48**B shows a side view of the rear disc brake caliper of FIG. **48**A in a second position of the sequence;
(36) FIG. **48**C shows a side view of the rear disc brake caliper of FIG. **48**A in a third position of the sequence;
(37) FIG. **49**A shows a side view of a rear disc brake caliper in a first position of a sequence in another specific embodiment of the inventive braking system;
(38) FIG. **49**B shows a side view of the rear disc brake caliper of FIG. **49**A in a second position of the sequence;
(39) FIG. **49**C shows a side view of the rear disc brake caliper of FIG. **49**A in a third position of the sequence;
(40) FIG. **50**A shows a side view of a rear disc brake caliper in a first position of a sequence in another specific embodiment of the inventive braking system;
(41) FIG. **50**B shows a side view of the rear disc brake caliper of FIG. **50**A in a second position of

the sequence;
(42) FIG. **50**C shows a side view of the rear disc brake caliper of FIG. **50**A in a third position of the sequence;
(43) FIG. **51**A shows a side view of a rear disc brake caliper in a first position of a sequence in another specific embodiment of the inventive braking system;
(44) FIG. **51**B shows a side view of the rear disc brake caliper of FIG. **51**A in a second position of the sequence;
(45) FIG. **51**C shows a side view of the rear disc brake caliper of FIG. **51**A in a third position of the sequence;
(46) FIG. **52** shows a side view of a rear disc brake caliper used with another embodiment of the inventive braking system;
(47) FIG. **53** shows a side view of a rear disc braking system used with another embodiment of the inventive braking system;
(48) FIG. **54** shows a perspective view of a rear disc braking system used with another embodiment of the inventive braking system; and
(49) FIG. **55** shows a side view of a rear disc braking system used with another embodiment of the inventive braking system.

DETAILED DESCRIPTION

(50) Reference will now be made in detail to the present embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts. With reference to FIG. **1**, the present invention is directed towards a brake system **10** that can be used for bicycles and other vehicles supported by multiple wheels. The inventive braking system **10** that can include two or more brake mechanisms **15**, **19**, **23**, **27**, **31** that are actuated by one or more brake controls **11**, such as hand brake levers or foot brake pedals. When the user squeezes the one or more brake levers or steps on the foot brake pedal, a first brake actuator **13** actuates the first brake **15**. The friction force of a brake pad in the first brake **15** against a rotating structure then actuates a second brake actuator **17** coupled to the second brake **19** so that both brakes **15**, **19** are engaged to slow or stop the vehicle. The first brake **15** that is directly controlled by the brake controls **11** can be any brake on a vehicle.

(51) The inventive brake system can be used on any wheel supported vehicle having multiple brakes. For example, a two wheeled vehicle can include a front brake and a rear brake. The brake system on a three wheeled vehicle can include a front center brake, a left rear brake and a right rear brake. Alternatively, a three wheeled vehicle can include a left front brake, a right front brake and a center rear brake. On a four wheeled vehicle, the brake system can include a front left brake, a front right brake, a left rear brake and a right rear brake.

(52) These brakes can be sequentially coupled in any order. For example, if the first brake **15** is the front brake, the brake control **11** can be coupled to the front (first) brake **15** by a front (first) brake actuator **13** and the front (first) brake **15** can be coupled to the rear (second) brake **19** by a rear (second) brake actuator **17**. Conversely, if the first brake **15** is the rear brake, the brake control **11** can be coupled to the rear (first) brake **15** by a rear (first) brake actuator **13** and the front (second) brake actuator **17** can be coupled between the rear (first) brake **15** and the front (second) brake **19**. In other embodiments, the vehicle may have left and right brakes. The first brake **15** can be the right brake and the second brake **19** can be the left brake.

(53) It is also possible for the first brake to control multiple brake actuators **17**, **25**. For example, a first (rear) brake **15** can be coupled to a second (front left) brake actuator **19** can control the second (front left) brake **19** and a third (front right) brake actuator **25** can control the third (front right) brake **27** of the vehicle. It is also possible to extend the number of sequential brakes. For example, the brake controls **11** can actuate the first brake actuator **13** which is coupled to the first brake **15**. The braking friction of the first brake **15** can actuate a second brake actuator **17** coupled to the

second brake **19**. The braking friction of the second brake **19** can actuate a fourth brake actuator **21** coupled to a fourth brake **23**. Similarly, the braking friction of the third brake **27** can actuate the fifth brake actuator **29** coupled to a fifth brake **31**. This sequential brake actuator configuration can continue to three or more brakes.

(54) The following description is primarily directed towards a two wheeled bicycle in which the first brake is the rear brake and the second brake is the front brake. However, these same designs and operating principles can be applied to any multiple wheeled vehicle and the scope of the application is intended to cover the inventive braking system applied to all multiple wheeled vehicle configurations.

(55) Normal bicycle brakes include two hand levers which are used to individually control a front brake and a rear brake. A problem with existing brake systems is that the bicycle rider must be careful when applying the brakes because if the front brake is locked, the stopping force can flip the rider off of the bicycle. There are several techniques for efficient braking on a two-brake bicycle. The one most commonly taught is the 25-75 technique. This method entails supplying 75% of the stopping power to the front brake, and about 25% of the power to the rear. Since the bicycle's deceleration causes a transfer of weight to the front wheel, there is much more traction on the front wheel. However, excessive front braking force can cause skidding of the front tire which can cause the bike to flip forward over the front wheel and probably injury to the rider. Excessive rear braking force can cause skidding, but will not result in the bike flipping.

(56) The present invention is directed towards a brake system and apparatus which allows the rider to quickly stop the bicycle or other vehicle very quickly, but prevents the front wheel from locking up or being slowed too quickly. The brake system is also compatible with existing brake designs and can be produced in a very economical manner so that bicycle riders will not have to pay a significant amount of money for these very important safety features. In an embodiment, the inventive brake system can be retrofitted onto existing bicycle brakes and in other embodiments, the inventive brake system can be incorporated into the designs of the brakes.

(57) With reference to FIG. **2**, a bicycle having the inventive braking system is illustrated. The bicycle **100** has a frame **101** on which a front wheel **107** and a rear wheel **105** are rotatably mounted. In an embodiment, one or two brake levers **102** are fastened on a handlebar **103** and the lever(s) **102** are connected to a rear brake actuator **140** which is coupled to a rear brake **104**. A front brake actuator **150** is coupled between the front brake **106** and the rear brake **104**. The rear brake **104** can include one or two inventive brake pad assemblies. When the rear brake **104** is actuated by the brake lever(s) **102** a portion of the rotating rear wheel **105** (or other braking surface) is compressed between two or more brake pads and the friction generated by the direct contact of the brake pad with the rotating braking surface slows the rotational velocity of the rear wheel. One or more of the brake pads in the rear brake **104** can include an inventive brake pad assembly. In response to the direct contact between the brake pads with the rotating braking surface, inventive brake pad assembly actuates the front brake actuator **150** which causes the front brake **106** to be applied to the front wheel **107** or other front wheel braking surface. When the rear brake **104** is released, the brake pad assembly is pulled away from the rear wheel **105** and the brake pad assembly releases the front brake actuator **150** which releases the front brake **106**.

(58) If the braking occurs quickly, the weight of the rider can shift forward and the deceleration force applied by the front wheel **107** at the point of contact with the ground can cause the rear wheel **105** to be lifted from the ground. This loss of surface contact will reduce or eliminate the rotational force applied by the ground to the rear wheel **105**. Because the actuation force applied to the front brake **106** is proportional to the rotational force of the rear wheel **105**, the braking force applied to the front wheel **107** will also be reduced until the rear wheel **105** regains contact with the ground. The contact will generate a rotational force to the rear wheel **105** and the inventive brake pad assembly will be actuated again and apply more force to the front brake **106**. By automatically detecting the rotational force applied to the rear wheel **105** and adjusting the front brake **106** force

proportionally, the inventive braking system and brake pad assembly prevents the front wheel **106** from skidding which allows the rider to remain in control of the bicycle even if excessive braking forces are applied. Since the front brake **106** force is controlled to the rear wheel rotational force **105**, a rider can increase the braking force by moving as much body weight over the rear wheel **105** as possible during braking. However, even if the rider shifts his or her weight forward while riding, hard braking will not cause the bicycle to stop in a manner that would flip the bicycle over the front wheel **107**.

(59) FIG. **3** illustrates a brake system according to one embodiment of this invention. The brake system can include a brake lever(s) **202**, a first brake actuator **203**, a first brake which can be a rim brake **206***a*, a disk brake **206***b* or other type of brake, a second brake actuator **250** and a second brake which can be a rim brake **206***a*, a disc brake **206***b* or any other brake mechanism. When the brake lever **202** is squeezed, it transfers a braking force to the first brake actuator **203** which applies the first brake **206***a* or **206***b*. The friction force of the brake pad assembly in the first brake **206***a*, **206***b* transmits a braking force to the second brake actuator which actuate the second brake **208***a* or **208***b*.

(60) FIG. **4** illustrates a brake system according to another embodiment of this invention. The brake system may include two brake levers **302***a*, **302***b*, a first brake actuator **309**, a first brake **304**, a second brake actuator **350** and a second brake **306**. In this embodiment, two brake levers **302***a*, **302***b* are used to actuate the first brake **304**. In an embodiment, the first brake actuator **309** can be a cable that can be split into a first brake cable **309***a* and a second brake cable **309***b*. This configuration divides the first brake actuation force between the first brake cable **309***a* and the second brake cable **309***b* which are respectively pulled by a first brake lever **302***a* and a second brake lever **302***b*. In this configuration, a rider may use both hands to apply brake forces on the two brake levers **302***a*, **302***b* to actuate the rear brake **304**.

(61) However, the operator can still use either one of the two brake levers **302***a*, **302***b* alone and individually to actuate the first brake **304**. When the first brake is actuated, the movement of one or more of the brake pads in the inventive brake pad assembly will actuate the second brake actuator **350** which transfers a brake force to the second brake **306**. Although, caliper brakes **304**, **306** are illustrated, any other type of brake can be used.

(62) In some embodiments, the brake actuators can be brake cables surrounded by brake cable housings. The brake actuators can be actuated by pulling the cables through the brake cable housing, such that the brake cable is under tension and the brake cable housing is under compression. The brakes can be actuated by either pulling the brake cables away from the brake or pushing the brake cable housing towards the brake. With reference to FIG. **5**, in an embodiment, two brake levers **302***a* and **302***c* can be coupled to a first brake actuator that includes a brake cable **309** and a brake cable housing **310** that surrounds a portion of the brake cable **309**. The brake lever **302***a*, can be coupled to the brake cable **309** such that when actuated, the brake cable **309** is pulled towards the brake lever **302***a* and away from the first brake **304**. The brake lever **302***c* is coupled to the brake cable housing **310**. When the brake lever **302***c* is actuated, the brake cable housing **310** is pushed towards the first brake **304**. Again, the brake levers **302***a*, **302***c* can be operated independently to actuate the rear brake **304**. The friction force against one or more of the rear brake pads can actuate the second brake actuator **350** which transmits a brake force to the second brake **306** helping to stop the vehicle.

(63) With reference to FIG. **6**, a top cross sectional view of an embodiment of a first brake **401** having the inventive brake assembly **414** is illustrated. The brake **401** can include a slider assembly **403** and a guide **407** that are coupled to an arm **404** of the first brake **401**. The brake pad assembly **414** can include a slider assembly **403** that can slide within the guide **407**. The brake **401** can be mounted around a portion of the first wheel with the brake pads **402** aligned on opposite sides of a first wheel rim **411**. When the vehicle moves forward, the upper portion of the rim **411** also moves forward. The brake **401** can have two brake pads **402**. In an embodiment, the brake pad **402** on the

right side is coupled to a slider assembly **403** that moves within a guide **407**. The guide **407** can be coupled to a mounting rod **410** which is secured to the brake arm **404**. The slider assembly **403** can include a brake pad **402** which can be compressed against the rotating rim **411**. The brake pad assembly **403** can also include a layer of lubricious material **412** such as Nylatron, Teflon, graphite or other low coefficient of friction and high compression strength materials. Alternatively, the brake assembly **403** components can be made of these low friction materials.

(64) The orientation of the slider assembly **403**, brake pad **402** and guide **407** on the bicycle can depend upon the position of the brake **401** on the wheel. If the brake **401** is located on the upper half of the rim **411**, the described and illustrated positions are correct. However, if the brake is on the lower half of the rim **411**, the “front” and “back” of the bicycle can be reversed.

(65) The slider assembly **403** can also be coupled to a second brake actuator. In an embodiment, the second brake actuator can be a cable **122** having an end fitting **124** which can have a stepped cylindrical design with a first smaller diameter and a larger end diameter. The fitting **124** can engage an open hole coupling mechanism **132** on the slider **403**. The hole in the coupling mechanism **132** can be slightly larger than the first smaller diameter and smaller than the larger end diameter so that the fitting **124** is securely connected to the coupling mechanism **132**.

(66) The guide **407** can have a feature that engages the end of a brake cable “noodle” **126** which is rigid section of tubing that functions as a low friction guide for the brake cable **122**. In an embodiment, the guide **407** can have a counter bored recess which has an inner diameter that is slightly larger than the outer diameter of the end of the noodle **126**. In other embodiments, the end of the noodle **126** can be inserted into a ferrule that can be a metal or plastic piece that surrounds the outer diameter and end of the noodle **126** and has a hole for the brake cable **126** to protrude through.

(67) The guide can also have a threaded mechanism that allows the brake pads **402** of the second brake to be adjusted in the released state by effectively controlling the length of the second brake cable housing **128**. In an embodiment, the brake cable housing **128** includes a barrel adjuster which allows the user to effectively adjust the length of the cable housing **128**. If the brake is too tight and additional clearance is required, the barrel adjuster is adjusted to effectively shorten the cable housing **128** length. Conversely, if the second brake is too loose, the barrel adjuster can be adjusted to effectively lengthen the cable housing **128** length. The barrel adjuster can be located at any portion of the brake cable housing **128**, including at the intersection with the inventive brake pad assembly. The brake pads **402** will rest close to the second rim if the cable housing **128** is lengthened and conversely, if the brake cable **126** is shortened, the brake pads **402** on the second brake will rest farther away from the rim **411** in the normal open position.

(68) The other end of the noodle **126** opposite the side in contact with the guide **407** can be connected to an end of the brake cable housing **128**. The end of the noodle **126** can include an outer sleeve that surrounds the outer diameter of the cable housing **128** and an inner edge that engages the end of the brake cable housing **128**. The noodle **126** can allow the brake cable **126** to bend so that the brake cable can be directed in any desired direction, preferably towards the second brake. In an embodiment, another noodle can be coupled to the second brake and used to direct the brake cable **128** in the desired direction. The end of the brake cable **128** can be secured to the second brake with a “pinch bolt” mechanism which surrounds and secures the brake cable **128** to the second brake. In other embodiments, noodles may not be necessary and the brake cable housing **128** may be in direct contact with the first brake guide **407** and/or the second brake. The cable housing **128** can extend the entire length of the brake cable **126** or only be used over one or more sections of the brake cable **126**. For example, in many bicycles, the cable housing **128** may be secured to stationary stops coupled to the ends of the top tube and the bare brake cable **128** may extend along or inside the top tube. If the second brake cable **128** is used to actuate a mechanical front disk brake, the second brake cable **128** can extend down an arm of the front fork.

(69) The brake pad **402** on the left side of the rim **411** can be a normal brake pad. In an

embodiment, the brake pad **402** is coupled to a threaded mounting rod **410** that extends away from the braking surface. The brake pad **402** can be secured to the brake arm **404** by tightening a nut **408** that is screwed onto the mounting rod **410**. In this configuration, the brake pad **402** coupled directly to the threaded mounting rod **401** remains stationary relative to the arm **404** when the rear brake **401** is actuated. When the brake **401** is not actuated, the brake pads **402** are pulled away from the rim **411** by springs in the brake **401**. In other embodiments, the brake pads can both have the inventive brake pad **414** assemblies.

(70) With reference to FIG. **7**, the first brake **401** is coupled to a brake actuator which can be a brake lever(s). When the lever(s) is actuated, the inventive brake pad assembly **414** is pressed against the rim **411** of the wheel (or a rotating disk brake) coupled to the wheel to slow or stop the rotation. The rim brake pad **402** of the inventive brake pad assembly **414** can have an elongated shape like a normal brake pad. The slider assembly **403** and guide **407** are aligned with the brake pad **402** and rim **411** so that the movement of the slider **403** and brake pad **402** are also aligned with the rim **411** of the wheel.

(71) When the first brake **401** is actuated, the slider assembly **403** and brake pad **402** are pressed against the rotating rim **411** and the movement of the rim **411** causes the slider assembly **403** and brake pad **402** to slide forward in the guide **407** towards the front of the bicycle. The coupling mechanism **132** is connected to the fitting **124** on the end of the brake cable **122**. The movement of the slider assembly **403** will be greater than the spring force of the second brake and will cause the brake cable **122** to be pulled in tension. The noodle **126** is coupled to the guide **407** and the tension on the brake cable **122** will result in compression of the noodle **126** and the brake cable housing **128**. The brake cable **122** and housing **128** are also coupled to the second brake. The movement of the brake cable **122** within the housing **128** will actuate the second brake.

(72) The brake cable **122** tension force can be proportional to the friction force of the brake pad **402** against the moving rim **411**. A higher braking force applied to the first brake will result in a higher braking force applied to the second brake through the brake cable **122**.

(73) However, if the rim **411** loses traction with the road, the rim **411** may stop rotating and the friction force that creates the force that pulls on the brake cable **122** and the brake force applied to the second brake are reduced until the rim **411** regains traction and begins to rotate again. Since the rim **411** may lose traction when excessive braking is applied to the front brake the rear wheel is starting to lift off the ground, this system effectively functions as an anti-locking brake system.

(74) With reference to FIG. **8**, in an embodiment, the second brake actuator can be brake cable **122** in a brake cable housing **128**. The brake cable **122** can have an end fitting **124** which is attached to the guide **406** at a coupling mechanism **144**. The end of the brake cable housing **128** can butt up against a tab **142** coupled to the slider assembly **405**. This is similar to the brake pad assembly illustrated in FIGS. **6** and **7**. However, the action is reversed since the brake cable **122** can be coupled to the guide **406** and the brake cable housing **128** can be coupled to the slide assembly **405**. The compression of the brake cable housing holds the brake pad assembly towards the back of the guide while the brake is in the open position.

(75) With reference to FIG. **9**, when the first brake is actuated, the brake pad assembly **405** is pressed against the moving rim **411** and the friction force causes the brake pad assembly **405** to move forward. This movement causes the brake cable housing **128** to be compressed. Although the guide **406** and brake cable **128** may not move, the movement of the brake cable housing **128** results in tension in the brake cable **122** which actuates the second brake. The pushing force on the brake cable housing **128** due to the braking friction is greater than the front brake spring force, the brake cable housing **128** is compressed and the front brake cable **122** is pulled in tension. If the rim **411** stops rotating due to a lack of contact with the road, the slider **405** and brake cable housing **128** will no longer be pushed forward. This reduced force in the brake cable **122** and brake cable housing **128** will reduce the braking force on the second brake until the rim **411** regains traction on the road and starts rotating again. The brake configuration illustrated in FIGS. **8** and **9** may not

require a noodle to direct the second brake cable **122** from the rear brake to the front brake.

(76) In an embodiment, the inventive brake pad mechanism assemblies can be a direct replacement for the existing brake pads. The brake pad can be very similar to the known brake pads. FIGS. **10-14** illustrate different views of an embodiment of the slider assembly **403**. FIG. **10** illustrates an inner side view, FIG. **11** illustrates a back view, FIG. **12** illustrates a top view, FIG. **13** illustrates a front view and FIG. **14** illustrates an outer side view of the slider assembly **403**. Rather than being molded around a brake support structure or placed in a brake shoe, the brake pad **402** can be molded around a slider **403** which slides within a guide. In other embodiments, the brake pad **402** can be inserted into a brake shoe that holds the brake pad in the required position on the slider assembly **403**.

(77) The slider assembly **403** can include a slide portion **413** that engages a corresponding slot in the guide. In this embodiment, the slide portion **413** can have a "T" shape. In other embodiments, the slide portion **413** can be any other shape that can be held in a corresponding slot. The slider assembly can also include an open hole coupling mechanism **132** that can be securely connected to the brake actuator. Because the slide portion **413** is in physical contact with the guide, a film or sheet or the entire slider can be made of a lubricious material such as: Nylatron, Teflon, graphite or other low coefficient of friction and high compression strength materials can be attached to the sliding **451** surface(s) of the slider **403** and/or guide. In other embodiments, the entire slide portion **413** or the slider assembly **403** can be made of a lubricious material.

(78) The coefficient of friction of the brake pad **402** sliding against the rim can depend upon the brake pad **402** and rim materials. The rim can be made of aluminum, carbon fiber, plastic, titanium, steel, and other alloys. The brake pad **402** can be a plastic, rubber or other high coefficient of friction material that can molded around a slider **403** or attached in any other suitable manner to a brake support structure. The brake support structure prevents the brake pad **402** from deforming while it is compressed against the rim. The slider brake support structure and brake pad **402** can also be configured to apply uniform pressure to the contact areas where the brake pads contact the rim or other braking surface such as a disk brake.

(79) Different views of an embodiment of the guide **407** are illustrated in FIGS. **15-19**. FIG. **15** illustrates an inner side view, FIG. **16** illustrates a back view, FIG. **17** illustrates a top view, FIG. **18** illustrates a front view and FIG. **19** illustrates an outer side view of the guide **407**. The guide also has a groove **452** that the sliding portion of the slider assembly moves within. The rear end of the guide **407** can include a slot **454** and a recessed area **456** for holding an end of a noodle or a brake cable housing. The guide **407** can include a mounting rod **410** to secure the guide **407** to a brake arm. The rod **410** can be cylindrical and have a smooth surface. In other embodiments, the outer diameter of the rod **410** may be threaded. In other embodiments, any other type of attachment mechanism can be used to secure the brake to the guide. For example, the guide **407** may have a threaded hole which allows a bolt to be screwed into the hole to secure the guide to the brake. The assembled brake pad assembly with the slider assembly **403** and the guide **407** can be similar in size to a conventional brake pad.

(80) FIGS. **2-19** illustrate the slider as having an inverted "T" portion which slides within a corresponding inverted T shaped groove formed in the guide. The sliding portions can be the lower flat portion of the inverted T as well as the surfaces of the guide that are closest to the slider. Each of these sliding surfaces can be used with a lubricious material to minimize the sliding friction. In other embodiments, any other sets of sliding surfaces can be used as shown in the exemplary cross section illustrations. Various other configurations are available for the slider and guide as shown in FIGS. **20-22**. FIG. **20** illustrates a cross section of an embodiment of the brake pad assembly having a guide with a "T" cross section groove **460** and a slider assembly having a corresponding "T" shaped groove **465**. FIG. **21** illustrates a guide **407** having a tapered groove **461** and a slider assembly having a corresponding sliding portion **466**. FIG. **22** illustrates a guide having a "V" groove **462** and a slider assembly having a corresponding slider portion. Various other slider

groove combinations are contemplated.

(81) With reference to FIGS. **23** and **24**, in other embodiments, it is also possible to apply the described rear brake assembly to a hydraulic brake system. Rather than a cable pulling system, the rear brake assembly can be coupled to a hydraulic cylinder **471** filled with hydraulic fluid **475**. The cylinder **471** can be coupled to the guide **407** and the slide assembly **403** can be coupled to a piston rod **479** that is attached to a piston **473** that can move within the cylinder **471**. One end of the brake hydraulic tubing **477** is coupled to a cylinder **471** and the opposite end is coupled to the second brake. With reference to FIG. **23**, a spring in the second brake pressurizes the hydraulic fluid **475** pressing the piston **473** towards the back of the cylinder **471**. The hydraulic brake system can be a disc brake or a rim brake (cantilever, V-brake, etc.) In the normal position, the brake shoe **402** is not in contact with the rim **411** or disk brake.

(82) With reference to FIG. **24**, in the braking position the brake pads **402** are pressed against the moving rear rim **411** or disk brake. The slider **403** moves forward due to the friction of the brake pad **402** against the rim **411**. The slider **403** pushes the rod **479** and the piston **471** within the cylinder **471** pressuring the hydraulic fluid **475**. The pressurized hydraulic fluid **475** exits the cylinder **471** and flows through the hydraulic tubing **477** to actuate the second hydraulic brake. If the rim **411** stops rotating due to a lack of contact with the road, the friction force and the force moving the slider **403** forward will decrease. The forces on the piston **473** will decrease and the hydraulic fluid **475** pressure will also decrease. This reduced hydraulic fluid **475** pressure in the hydraulic tubing **477** will reduce the braking force on the second brake until the rim **411** regains traction on the road and starts rotating again.

(83) With reference to FIG. **25** an embodiment of the brake pad assembly **510** is illustrated. In many bicycles, hydraulic systems are used with disk brakes. Because the disk brakes use a disk rotor **509** rather than a rim as the braking surface, the brake pad **502** can be any geometric shape that provides sufficient surface area to stop the rotation of the disk rotor **509**. Because the disk brake pad **502** is located much closer to the center of rotation, the radial position of the disk brake pad **502** may shift as the slider **503** moves within the guide **507** if the path is linear. In an embodiment, the slider assembly **503** and guide **507** can be configured with an arched path that matches the disk rotor. This configuration may allow the disk brake pad **502** to maintain a constant radial position against the brake rotor **509** regardless of the position of the slider assembly **503** within the guide **507**. In the disk brake embodiment, the second brake actuator can be a brake cable in a brake cable housing, a hydraulic system or any other braking mechanism that can be actuated by the movement of the slider assembly **503** in the guide **507**.

(84) In other embodiments, the brake shoe slider assembly structure can be used for various other purposes. For example, the brake shoe slider assemblies can be coupled to springs which can provide smoother braking actuation. In this embodiment, both brake shoes of a brake mechanism can have brake shoe/slider assemblies that move within guides on opposite sides of the rim. In the normal open position, the springs are fully extended and the sliders are towards the back of the guides. When the brake is actuated, the brake pads are compressed on opposite sides of the rim and the brake pad/slider assemblies are moved in the guides to compress the springs. This spring motion can provide more uniform braking. If there are rough spots on the rim, the brake pad will have a higher coefficient of friction and tend to compress the spring more. If there are smoother sections of the rim, the coefficient of friction will decrease and the spring can expand. The compression of the spring will tend to absorb the braking force and the spring extension will tend to release the braking force. The overall effect is a smoother braking feel for the rider.

(85) FIGS. **26** and **28** respectively illustrate a rear cantilever brake and a transmission device according to another embodiment of this invention. FIG. **26** illustrates the rear view of a cantilever brake in the open position with the brake pads **907***a*, **907***b* away from the wheel **905**. FIG. **28** illustrates the rear cantilever brake in the actuated position with the brake pads **907***a*, **907***b* against the wheel **905**. In this embodiment, a transmission device is also integrated into the cantilever type

brake. A rear cantilever brake **904** can include two brake arms **904***a*, **904***b* and the second brake actuator brake assembly **906** can be integrated into either one or both of the two brake arms **904***a*, **904***b*. The brake arm **904***a* can be pivotally connected with a seat stay **901***a* which is part of the bicycle frame and the brake arm **904***a* can rotate about a pivot axis **903***a*. The brake arm **904***b* can be pivotally connected with a seat stay **901***b* and the lower end can rotate about a pivot axis **903***b*. A first brake actuator can be a first brake cable **908** that slides within a noodle **909**. The first brake cable **908** can be coupled to the first brake arm **904***a* and the noodle **909** can be coupled to the second brake arm **904***b* by a bracket **909***a*. When actuated, the brake arms **904***a*, **904***b* are squeezed towards each other and this inward rotation actuates their respective brake pads (**907***a*, **907***b*) to be pressed against the rear wheel **905**. The brake arms **904***a*, **904***b* can each be coupled to springs which rotate the brake arms **904***a*, **904***b* away from the wheel **905** as illustrated in FIG. **26** when the first brake cable **908** is not actuated by a brake lever.

(86) With reference to FIG. **28**, when the first cantilever brake **904** is actuated, the two brake arms **904***a*, **904***b* are pulled towards each other by the movement of the brake cable **908** and the noodle **909**, such that their respective brake pads **907***a*, **907***b* are pressed against the wheel **905** to slow the rotation of the wheel **905**. The second brake actuator device **906** can consist of a guide **906***a* and a slider **906***b*. The friction force of the brake pad **907***a* against the rotating wheel **905** causes the slider **906***b* to move within the guide **906***a* to move the second brake actuator. When the brake lever is released, the two brake arms **904***a*, **904***b* of the first cantilever brake **904** return to their respective open positions as illustrated in FIG. **26** by the torsion spring force.

(87) FIG. **27** illustrates a side view of the rear cantilever brake and the transmission device as illustrated in FIGS. **26** and **29** illustrates side views of the first brake and the second brake actuator as illustrated in FIG. **28**. An operation mechanism of the rear cantilever brake's right half is further described below with reference to FIGS. **27** and **29**. In the illustrated embodiment, an L-shaped bracket **910** can be secured to the brake arm **904***a* and an opposite end of the bracket **910** can be coupled to the second brake actuator which can be a brake cable housing **911** which surrounds the brake cable **911***a*. The brake cable **911***a* can be coupled to the slider assembly **906***b* and the brake pad **907***a* can be a component of the slider assembly **906***b*. The slider assembly **906***b* can be slidably connected to the guide **906***a* which allows the slider assembly **906***b* to slide along a direction **920**. The direction **920** is generally in parallel with the pivot axis **903***a*.

(88) When the second brake actuator **906** is not actuated as illustrated in FIG. **27**, the brake pad **907***a* is not in contact with the wheel **905** and the brake cable **911***a* is not pulled by the slider assembly **906***b* to actuate a second brake. In an embodiment, the first bake can be the rear brake and the second brake can be the front brake **106** of a bicycle as illustrated in FIG. **2**.

(89) With reference to FIG. **29**, when the second brake actuator **906** is actuated, the second brake cable **911***a* is pulled by the slider assembly **906***b* due to the friction of the brake pad **907***a* against the wheel **905**. The second brake cable **911***a* can be coupled to a second brake which is actuated by the pulling of the second brake cable. When the first brake is released and the second brake actuator **906** is released, the slider assembly **906***b* is pulled by the brake cable **911***a* towards the brake cable housing **911** and the second brake actuator returns to an original position as illustrated in FIG. **27**.

(90) FIG. **30** illustrates a perspective view of a slider assembly **906***b*, guide **906***a* and brake arm **904***a* and FIG. **31** illustrates a front view of the slider assembly **906***b*, guide **906***a* and brake arm **904***a*. As shown in FIG. **31**, the brake pad **907***a* is secured to the slider assembly **906***b* and the guide **906***a* is fastened to the brake arm **904***a*. The slider assembly **906***b* and brake pad **907***a* are slidably connected with the slider guide **906***a*. The guide **906***a* can have two stop members (**906***a***1** and **906***a***2**) that restrict the movement of an extension member **906***b***1** of the slider assembly **906***b* such that the slider assembly **906***b* may only slide back and forth along the direction **920** within a limited region of the guide **906***a*. With this limited movement region, the slider assembly **906***b* may not overly pull the brake cable **911***a* beyond a predetermined range of motion.

(91) The guide **906***a* and slider assembly **906***b* can be made from metallic materials, which could provide low friction sliding surfaces. In an embodiment, the slider assembly **906***b* is made from brass or other alloy of copper, and the slider guide **906***a* is made from bronze or other alloy of copper. The guide **906***a* may be oil-impregnated such that the slider assembly **906***b* can be slid along the slider guide **906***a* with an even low friction. In other embodiments, the guide **906***a* and slider assembly **906***b* can be made from high strength lubricious plastic materials.
(92) In other embodiments, various other functional mechanisms can be coupled to the inventive brake pad, slider and guide assemblies. With reference to FIGS. **32** and **33**, an embodiment of the brake pad assembly includes springs **381** that resist the movement of the slider assemblies **383** in the guides **385** during braking. FIG. **32** illustrates the brake **380** in the open position with brake pads **402** pulled away from the rotating rim **411**. FIG. **33** illustrates the brake **380** in the braking position with the brake pads **402** pressed against the rotating rim **411**. The friction force of the brake pads **402** against the rim **411** causes the springs **381** to be compressed. The spring movement can prevent the brake **380** from locking up the rotating rim **411** if the rider actuates the brake **380** with too much force. The compression of the springs **381** can smooth the braking forces applied to the rim **411**.
(93) In still other embodiments, the inventive system can be used for other purposes. For example, with reference to FIGS. **34** and **35**, the system can be a component of an electrical system. A piezoelectric mechanism **391** can be coupled to the slider assembly **393** and guide **395**. The piezoelectric mechanism **391** can produce electricity when compressed. An LED **397** can be coupled to the piezoelectric mechanism **391** by electrical conductors **396** such as wires. In the open position illustrated in FIG. **34**, the brake pads **402** are away from the rim **411** or disk and the piezoelectric mechanism **391** does not produce electricity and the LED **397** is not illuminated. With reference to FIG. **35**, the slider assembly **393** compresses the piezoelectric mechanism **391** which generates electricity which can be coupled to the LED **397**. The LEDs **397** may face towards the back of the bicycle so that when the bicycle brakes are applied, the illuminated red LEDs can indicate that the bicycle brakes are applied.
(94) With reference to FIG. **34**, in other embodiments, the slider **393** can be coupled to a switch **392** and a battery **394**. When the brake is open, the switch **605** can be open and the battery **394** can be disconnected from the LED **397** which will not be illuminated. With reference to FIG. **35**, when the brake is actuated, the braking can cause the brake pad **402** to close the switch **392** which can connect the battery **394** to the LED **397** which then produces light. In an embodiment, the LEDs **397** can be red in color and may be facing the back so they are visible to people behind the bicycle. The illuminated red LEDS can indicate that the bicycle is braking. In other embodiments, the LED can be white or any other color and can be pointed in any direction. The system can be used as a supplemental power source for the headlight. When the brakes are applied, the piezoelectric switch can increase the power output of a headlight. Thus, when riding normally, the lights can be lower and when the brakes are applied, the light power can be increased for higher visibility at a stop sign or during braking.
(95) In an embodiment with reference to FIGS. **36** and **37**, the inventive brake system can be coupled to a brake signal transmitter **399**. The piezoelectric mechanism **391** can be coupled to a brake signal transmitter **399**. With reference to FIG. **38**, when the brake is open, the piezoelectric mechanism **391** does not produce electricity and the brake signal transmitter **399** may not transmit an output signal. With reference to FIG. **39**, when the brakes are applied, the piezoelectric mechanism **391** can be compressed and emit an electrical signal which is used by the brake signal transmitter **399** to emit a brake signal.
(96) In other embodiments, the brake signal transmitter **399** can be connected to an electrical switch **392**, a power supply **394** and brake signal transmitter **399** which can be an RF transmitter or any other signal output device. With reference to FIG. **36**, when the brake is open, the electrical switch **392** is disengaged and the electrical power is not transmitted from the power supply **394**

which can be a battery to the brake signal transmitter **399**. With reference to FIG. **37**, when the brakes are actuated, the brake pad **402** can actuate the switch **392** causing electrical power to be transmitted from the power supply **394** to the brake signal transmitter **399**.

(97) In other embodiments, the brake signal can be coupled to an electronic gear shifting system. With reference to FIG. **38**, a bicycle gearing system **500** is illustrated. Bicycles typically include multiple gears that control the ratio of pedal rotation of a crank **501** to rear wheel **411** rotation. Lower gears provide lower rotation of the rear wheel **411** per each crank **501** rotation and higher gears provide a higher rotation of the rear wheel **411** per crank **501** rotation. The number of gears available is typically the number of gears on a rear cluster **507** that is coupled to the rear wheel **411** times the number of gears **509** on a front crank **501**. For example, in the illustrated embodiment, the rear cluster **507** can have 5-11 gears and the front crank **501** can have 2 or 3 gears. A bicycle having a 5 gear rear cluster **507** and a three gear crank **501** will have a total of 15 gears. A chain **511** can run over any combination of the front and rear gears to provide different gearing to the bike. By changing the position of the chain **511** on the rear cluster **507** and the crank **501**, the rider can change the rotational ratio of the cranks and the rear wheel. In an embodiment, the rider can select a gear through a shift controller **503** and the electronic system **505** will shift the chain **511** to the selected gears by adjusting a front derailleur **513** and a rear derailleur **515**. However, in order to properly shift gears, the rider must be pedaling since shifting of the chain **511** cannot occur when the crank **501** is not rotating.

(98) The rider is typically not pedaling when the brakes **104** are applied. The brake can be coupled to a brake signal transmitter **399** which can transmit a brake signal to the electronic system **505** when the brakes are applied. The brake actuation signal can indicate that the crank **501** is not rotating and the electronic system **505** should not attempt to shift the gears by controlling the front derailleur **513** or the rear derailleur **515**. In an embodiment, the electronic system **505** can delay the shift until the brakes have been released and the brake signal transmitter **399** does not emit the brake signal.

(99) In other embodiments, the inventive braking system **500** can be used with an electronic gear shifting system that can be configured to adjust the gearing ratio lower for hills and slower riding speeds and increase gearing ratio for descents and faster riding speeds. The application of the brakes can be used as a gear shift signal to automatically make adjustments to the gear ratio. For example, when a rider is braking on a flat section and the rider applies the brakes, this braking is usually in response to a stop sign or light. If the rider slows his or her speed significantly, the electronic shifting system can adjust the gearing to be lowered so that the rider will be able to pedal the bicycle from a stopped position. It can be very difficult to start moving a bicycle that is in a high gear when the bicycle is stationary.

(100) In an embodiment, it may be possible to shift gears based upon the actuation and duration of the braking. If the brakes are applied the system may downshift and the number of gears shifted may be proportional to the force and duration of the braking. A long and hard braking can cause the gears to shift to a lower gear so that the rider can be in a low gear when pedaling resumes. Thus, a short and light brake actuation may result in a single lower gear shift. In contrast, a longer and harder brake actuation may result in a multiple gear shift to a significantly lower gear. In an embodiment, it may be possible to transmit signals to the shift mechanism through the brake levers. For example, the decrease in the gear shift can be indicated by the number of brake taps, two taps of the brake lever can result in downshifting by two gears. Similarly, five taps of the brake lever can result in a five gear downshift.

(101) After the inventive brake pad assemblies have been used for a significant period of time, the brake pads will need to be replaced. In an embodiment, the present invention can be directed towards the repair kit for the brake pad assembly **403** illustrated in FIGS. **10-14**. If the only worn component is the brake pad **402**, a basic repair kit may only include the brake pad **402**. The user can remove the worn brake pad **402** from the slider assembly **403** and attach the new brake pad **402**

to the slider assembly **403**. In some embodiments, a fastener such as a screw may be used to secure the brake pad **402** to the slider assembly **403**.
(102) In other embodiments, the brake pad **402** may be integrated into the slider assembly **403** and when the brake pad **402** needs to be replaced, the slider assembly **403** may also be replaced. In this embodiment, the repair kit may include the slider assembly **403** that includes the brake pad **402**. If the actuation of the brake pad assembly **403** has worn the sliding portions of the guide **407** (illustrated in FIGS. **15-19**), a repair kit can include both the slider assembly **403** and the guide **407**. It is also possible that the lubricious material may need to be replaced periodically. The brake pad assembly may include some spare sliding surface materials which can be used as replacement parts.
(103) FIGS. **39-52** show various specific embodiments of a hub and disk brake system and apparatus. The inventive brake system and apparatus are related to an anti-locking system for bicycles and other wheeled vehicles such as motorcycles. In an embodiment, the brake system includes a rear wheel hub type brake. With reference to FIG. **39**, a rear hub brake **4100** is illustrated that can include an axle **4105** that extends through the rear brake hub and secures the rear hub to the rear drop outs **4110** of the bicycle frame **4115**, a hub brake mechanism **4120** that is at the center of the rear wheel that rotates around the rear axle, a brake arm **4130** on the left side of the hub brake that does not rotate and is coupled to the left chain stay **4135** of the bike frame and a brake actuator **4140** which is coupled to a rear brake cable **4145**. When the rear brake cable is tensioned, the actuator is pulled forward and the hub brake is actuated.
(104) As discussed in copending patent applications assigned to the applicant, the basic principle of the anti-locking brake system is that the user only actuates the rear brake and a front brake actuator is coupled directly between the rear brake and the front brake. Thus, the user does not have the ability to independently actuate the front brake. When the rear brake is actuated, the friction force between the rear tire and the ground actuates the front brake actuator which causes the front brake to stop or slow the front wheel.
(105) With reference to FIG. **40** a side view of a rear hub brake **4200** used with the inventive system is illustrated. The rear brake cable **4205** and rear brake cable housing **4210** are coupled to a rear brake actuator **4215** such that when the rear brake cable is tensioned, the rear brake is actuated. However in this embodiment, the rear hub lever is connected to the front brake cable **4220** having front brake cable housing **4221** but is not connected to the left rear chain stay **4225**. Thus, the friction force of the rear brake causes the rear brake hub to rotate counter clockwise and the movement of the rear brake lever tensions the front brake cable. If the rear tire skids, tension on the front brake cable will be reduced which will release the tension on the front brake cable preventing the front brake from locking.
(106) In the embodiment illustrated in FIGS. **40** and **41**, the rear brake cable extends through a noodle **4230** that is attached to the bottom of the bottom bracket **4235**. The noodle is attached to a load bearing strap **4240** which is secured around the down tube **4245** so that tension on the front brake cable will not cause the noodle to move relative the frame and bottom bracket. The noodle may also be attached to the left chain stay so that the back portion of the noodle is held in alignment with the rear brake lever and away from the rear tire and wheel. There can be an alignment strap **4242** to facilitate the alignment with the rear brake lever.
(107) In another embodiment shown in FIG. **42**, the rear brake lever **4410** will rotate within a limited range. If the rear brake lever rotates too far, it will hit a stop **4415** that will prevent further rotation. The stop can be a structure coupled to the rear portion **4420** of the left chain stay **4425**. If the front brake cable **4430** breaks, the rear hub may continue to rotate counter clockwise and the rear brake may no longer function. Thus, the stop prevents the failure of both the front and rear brakes in the event that the front brake cable breaks or becomes disconnected from the front brake.
(108) FIG. **43** illustrates another embodiment of the rear hub brake system. The rear brake cable **4505** and housing **4510** extend under the left rear chain stay **4515** and actuates the rear hub brake

4520. When the rear brake is actuated the friction of the rear tire **4525** against the ground causes the rear hub brake lever **4530** to rotate counter clockwise. The front brake cable **4535** is coupled to the hub brake lever and the front brake housing **4540** is coupled to the left chain stay. The front brake cable and front brake cable housing may be approximately perpendicular to the chain stay. The movement of the hub lever tensions the front brake cable and compresses the front brake cable housing which actuates the front brake **4605** shown in FIG. **44**.

(109) In the hub brake embodiment, the rear hub lever must rotate within a limited range. This component may normally be rigidly coupled to the rear dropouts of the frame. The rear hub may need to be modified with a thrust bearings or bushings that allow for low friction rotation between the dropouts and the hub brake.

(110) In a specific embodiment, there is a lever or rear hub brake lever. The lever is connected to the rear hub brake. There is a first cable clamp **4545** on or at an end the lever that secures an end of the rear brake cable. An opposite end of the rear brake cable is connected to a rear brake lever. This specific embodiment further includes a second cable clamp **4550** on the lever. The second cable clamp secures an end of the front brake cable. An opposite end of the front brake cable is connected to a front brake. When the rear hub brake is actuated by the rear brake lever, the lever rotates to pull the front brake cable, thereby actuating the front brake.

(111) There can be a first cable stop **4555** on the lever. The first cable stop may include a socket, and an opening. The socket receives an end of a rear brake cable housing for the rear brake cable, and the rear brake cable passes through the opening to the first cable clamp.

(112) There can be a second cable stop **4560** connected to the left chain stay of the bicycle having the rear hub brake. The second cable stop includes a socket, and an opening. The socket receives an end of a front brake cable housing, and the front brake cable passes through the opening to the second cable clamp.

(113) The lever may be permitted to rotate about the rear hub brake to actuate the front brake. The lever may be permitted to rotate within a limited range to actuate the front brake. The lever may rotate in a counter clockwise direction to pull the front brake cable. The front brake may include a disc brake.

(114) In other embodiments, a similar anti-locking braking system can be used in a disk brake configuration. With reference to FIG. **45**, a rear portion of a bike is illustrated with a rear disk brake **4705**. The rear disk brake is mounted on a rear brake structure **4710** that rotates about a pivot point **4715** around the rear hub so that any counter clockwise rotation will keep the brake in proper alignment with the rear disk. The rear brake structure can include threaded mounting holes **4720**A and **4720**B for the rear disk brake and a lever arm **4725** that can extend under the left rear chain stay **4730**. FIG. **46** illustrates a more detailed view an embodiment of the rear brake structure **4805**, rear hub **4810**, rotor **4815**, and rear disk brake **4820**. The front brake cable can be coupled to the lever arm and the front brake housing can be coupled to the chain stay or other portion of the frame. When the brakes are not actuated the lever arm can be close to the rear chain stay and the front brake cable is not tensioned. When the rear brake is actuated, the rear brake structure will rotate counter clockwise **4825** relative to the frame about a pivot point **4830** and the lever arm will move away from the chain stay. This rotation of the lever will tension the front brake cable and compress the front brake cable housing. The front brake tension will actuate the front brake. If the rear wheel loses contact with the ground, the rear brake structure will be able to rotate clockwise and the front cable tension will be relieved which will prevent the front brake from locking the front wheel.

(115) In a specific embodiment, a braking device includes a pivot point, a brake mount to attach a rear disc brake, and a lever arm extending away from the pivot point. The lever arm includes a cable clamp **4733**. The cable clamp secures an end of a front brake cable **4735**. An opposite end of the front brake cable is connected to a front brake. When the rear disc brake is actuated, the lever arm rotates about the pivot point to pull the front brake cable, thereby actuating the front brake.

There can be a cable stop connected to a left chain stay of a bicycle. The cable stop may include a socket, and an opening. The socket receives an end of a front brake cable housing, and the front brake cable passes through the opening to the cable clamp.

(116) When the rear disc brake is actuated, the rear disc brake rotates about the pivot point. In a specific embodiment, the pivot point is in-line or concentric with a center axis of a rear hub. In another specific embodiment, as shown for example in FIG. **47**A and discussed below, the pivot point is away or offset from a center axis of a rear hub. The rear disc brake may include a hydraulic disc brake. Alternatively, the rear disc brake may include a cable-actuated disc brake.

(117) FIG. **47**A illustrates another embodiment of the rear disk brake system. In this embodiment, the rear brake structure **4903** is coupled to a pivot point **4905** on the left chain stay **4910** which is away from the center axis **4915** of the rear hub **4917** and may be a less complicated rotational bearing. The pivot point may be brazed or welded-on. The rear hub is secured in the frame dropouts **4918** which may be horizontal dropouts or vertical dropouts. The rear brake structure **4903** can include threaded mounting holes **4925**A and **4925**B for the rear disc brake **4930** and a lever arm **4935** that can extend under the left rear chain stay. An adjustable mechanical advantage can be provided based on, for example, a length of the lever arm. The rear disc brake may be a conventional hydraulic or mechanical disc brake. The front brake mechanism and front brake actuation can be substantially the same as described above with reference to FIG. **45**.

(118) The rear brake can be actuated by either cable tension, hydraulic fluid pressure or any other suitable actuation means. Friction between the ground and the rear wheel can tension the front brake cable **4940** and compress the front brake cable housing **4945** which can actuate the front brake. However, it is also possible for the rear brake structures to be coupled to a hydraulic cylinder so that counter clockwise movement of the rear wheel from the friction between the ground and the rear wheel can increase the front brake hydraulic brake pressure to actuate the front brake as illustrated in FIGS. 23 and 24 of International Application Publication No. WO2011075502 which is hereby incorporated by reference.

(119) Although the front brake is only illustrated in FIG. **44** as a disk brake, it can be any type of cable actuated brake including: hub, cantilever, caliper, disk, or any other brake that is actuated by the tensioning of a front brake cable and the compression of the front brake cable housing.

(120) FIG. **47**B illustrates another embodiment of the rear disk brake system. In this embodiment, a rear brake structure **4950** is connected to a center axis of the rear hub. A disc brake caliper **4955** is mounted to the rear brake structure. The rear brake structure is permitted to rotate about the center axis. For example, when the rear brake is actuated to reduce the bicycle's speed, the rear disc caliper will rotate (along with the rear brake structure) in a counter clockwise direction as shown by an arrow **4960**. An end of a front brake cable may be connected to a portion **4965** of the rear brake structure to actuate the front brake.

(121) FIGS. **48**A-**48**C show a sequence of side views of a rear disc braking system having a mechanical linkage **5003** in another specific embodiment. The mechanical linkage includes an assembly of bodies connected to manage forces and movement. In a specific embodiment, these forces and movements are from the actuation of the rear brake and result in the actuation of the front brake.

(122) More particularly, FIG. **48**A shows the linkage in a first position. FIG. **48**B shows the linkage in a second position. FIG. **48**C shows the linkage in a third position. As shown in FIG. **48**C, in this specific embodiment, the linkage includes first, second, and third links **5005**A, **5005**B, and **5005**C. The second and third links include disc brake mounts **5010**A and **5010**B upon which a disc brake **5015** can be attached. The first and third links include joints **5020**A and **5020**B, respectively, which may be used to secure the linkage to the bicycle frame. An end **5025** of the first link may be connected to an end of a front brake cable. An opposite end **5030** of the first link is connected an end of the second link.

(123) In a specific embodiment, the actuation of the rear brake causes the disc caliper to move in a

counter clockwise direction as indicated by an arrow **5035** (FIG. **48**B). In particular, the first link rotates **5040** about joint **5020**A and the third link rotates **5045** about joint **5020**B. As shown in FIG. **48**C, end **5025** of the first link then moves in a direction **5050** which actuates the front brake such as by pulling the front brake cable connected to end **5025**.

(124) In a specific embodiment, a device includes a first link of a linkage and including a first joint, a second joint, and a front brake cable attachment end. The second joint connects to a first tab on a bicycle frame and is between the first joint and the front brake cable attachment end. There is a second link of the linkage connected to the first joint and including a first mount, opposite the first joint, for a disc brake. There is a third link of the linkage and including a fourth joint and a second mount, opposite the fourth joint, for the disc brake. The fourth joint connects to a second tab on the bicycle frame.

(125) FIGS. **49**A-**49**C show a sequence of side views of a rear disc braking system having a mechanical linkage **5103** in another specific embodiment. FIG. **49**A shows the linkage in a first position. FIG. **49**B shows the linkage in a second position. FIG. **49**C shows the linkage in a third position. As shown in FIG. **49**A, in this specific embodiment, the linkage includes a first link **5105**A, a second link **5105**B, and a third link **5105**C. The second link is connected between the first and third links. The third link includes disc mounts **5110**A and **5110**B for attaching a disc brake **5115**. A joint **5120**A on the first link is connects the linkage to a first disc tab on the bicycle frame. A joint **5120**B on the third link connects the linkage to a second disc tab on the frame. An end of a front brake cable may be connected at a point **5125** on the first link.

(126) In a specific embodiment, the actuation of the rear brake causes the disc caliper to move in a counter clockwise direction as indicated by an arrow **5130** (FIG. **49**B). In particular, the third link rotates **5135** (FIG. **49**B) about joint **5120**B and the first link rotates **5140** about joint **5120**A. As shown in FIG. **49**C, point **5125** on the first link at which the end of a front brake cable may be secured moves in a direction **5145** to actuate the front brake such as by pulling the connected front brake cable.

(127) In a specific embodiment, a device includes a first link of a linkage and including a first joint, a second joint, and a front brake cable attachment point. The second joint is between the first joint and the front brake cable attachment end, and connects to a first tab on a bicycle frame. There is a second link of the linkage connected to the first joint. There is a third link of the linkage and including a third joint, a fourth joint, and a set of disc mounts for mounting a disc brake. The third joint is connected to the second link, and the fourth joint connects to a second tab on the bicycle frame.

(128) FIGS. **50**A-**50**C show a sequence of side views of a rear disc braking system having a mechanical linkage **5203** in another specific embodiment. FIG. **50**A shows the linkage in a first position. FIG. **50**B shows the linkage in a second position. FIG. **50**C shows the linkage in a third position. As shown in FIG. **50**A, in this specific embodiment, the linkage includes a first link **5205**A, a second link **5205**B, and a third link **5205**C. The first link includes a joint **5210**A and a joint **5210**B, opposite joint **5210**A, and including mount for attaching a disc brake caliper **5215**. Joint **5210**A may be connected to the bicycle frame. The second link includes a joint **5210**C and a joint **5210**D, opposite joint **5210**C and connecting the third link. Joint **5210**C may include a mount for attaching the disc brake caliper. The third link includes a joint **5210**E and an end **5220**. Joint **5210**E may be connected to the bicycle frame. End **5220** of the third link may be connected to an end of a front brake cable.

(129) In a specific embodiment, the actuation of the rear brake causes the disc caliper to move as indicated by arrow **5230** (FIG. **52**B). In particular, the first link rotates **5235** about joint **5210**A. The third link rotates **5240** about joint **5210**E. As shown in FIG. **50**C, end **5220** on the third link at which an end of the front brake cable may be secured moves in a direction **5245** to actuate the front brake such as by pulling the connected front brake cable.

(130) In a specific embodiment, a device includes a first link of a linkage and including a first joint

and a first disc mount, opposite the first joint, to mount a disc brake. The first joint connects to a first tab on a bicycle frame. There is a second link of the linkage and including a second joint, and a third joint, opposite the second joint. The second joint includes a second disc mount to mount the disc brake, and the third joint connects to a second tab on the bicycle frame. There is a third link of the linkage connected to the third joint and includes a fourth joint and a front brake cable attachment end. The fourth joint connects to a second tab on the bicycle frame.

(131) FIGS. **51**A-**51**C show a sequence of side views of a rear disc braking system having a braking assembly or system **5303** that allows the disc caliper to move in a linear direction in another specific embodiment. FIG. **51**A shows the system in a first position. FIG. **51**B shows the system in a second position. FIG. **51**C shows the system in a third position. As shown in FIG. **51**A, in this specific embodiment, a braking assembly **5305** includes a set of disc mounts **5310**A and **5310**B for attaching the assembly to disc tabs of the bicycle frame. The assembly further includes a sliding carrier **5315** upon which a disc brake caliper **5320** is mounted. The sliding carrier may travel along a track or rail of the braking assembly.

(132) In a specific embodiment, the actuation of the rear brake causes the disc caliper to move in a linear direction as indicated by arrow **5330** (FIGS. **51**B and C). An end of the front brake cable may be attached an end portion of the sliding carrier so that the front brake cable can be pulled by the sliding carrier, thus actuating the front brake.

(133) In a specific embodiment, a device includes a first set of mounts for attaching to a bicycle frame, and a carrier including a second set of mounts for attaching a rear disc brake caliper. The carrier translates or slides in linear direction from a first position to a second position to actuate a front brake when the rear disc brake caliper is actuated.

(134) FIG. **52** shows a side view of a rear disc braking system that may be referred to as a floating caliper braking assembly. In this specific embodiment, an assembly **5405** includes a first structure **5410** and a second structure **5415**. The first structure includes a set of mounts **5420** to attach the assembly to a bicycle frame and adjustable settings **5425**. The second structure includes a set of mounts **5430** for attaching a disc brake caliper **5435**.

(135) In this specific embodiment, the actuation of the rear brake causes the second structure to move relative to the first structure. The movement may include a translation, rotation, or both. An end of the front brake cable may be secured to a portion of the second structure so that the front brake may be actuated. In a specific embodiment, the second structure on which the caliper is attached moves into a guide that may be on the first structure. For example, the guide may include a channel, track, or groove on the first structure through which a portion of the second structure passes. The shape of the channel helps to direct the movement of the caliper. The channel may be curved or curvilinear. There may be a stop on the first structure, second structure, or both that limits the movement.

(136) FIG. **53** shows a side view of a rear disc braking system in another specific embodiment. As shown in the example of FIG. **53**, a braking system **5505** includes a first structure **5510**A and a second structure **5510**B that moves relative to the first structure. The second structure may be rotatably connected **5507** to the first structure. The first structure includes a set of holes for attaching the system to a seat stay **5515** of the bicycle frame.

(137) The second structure includes a set of mounts **5520** and a front brake cable attachment point **5525**. Mounts **5520** allow for attaching a disc brake caliper. The front brake cable attachment point may include a slot and a hole. An end of the front brake cable may be received in the hole. For example, the end of the cable may terminate as a lug, nipple, or barrel that can be inserted into the hole. A portion of the cable can then pass through the slot.

(138) When the rear brake is actuated, an end of the second structure having the disc brake caliper moves in a direction as indicated by an arrow **5530**. An opposite end of the second structure having the attached front brake cable end moves in a direction as indicated by an arrow **5535**. The movement of the second structure pulls the front brake cable to actuate the front brake.

(139) FIG. **54** shows a perspective view of a rear disc braking system in another specific embodiment. As shown in the example of FIG. **54**, a braking system **5605** includes a first structure **5610**A and a second structure **5610**B that moves relative to the first structure. This braking system is similar to the braking system shown in FIG. **53**. In this specific embodiment, however, the braking system is mounted on the inside of the rear bicycle triangle whereas in FIG. **53**, the braking system is mounted on the outside of the rear bicycle triangle.

(140) The first structure includes a front brake cable housing stop **5620** having a socket and first slot. The second structure includes a front brake cable attachment point **5625** having a hole and a second slot. The socket receives an end of the front brake cable housing and the front brake cable passes through the first slot, through the second slot, and terminates in the hole provided by the front brake cable attachment point. Arrows **5630** and **5635** indicate the movement of the second structure when the rear disc brake is actuated to pull the front brake cable and actuate the front brake.

(141) FIG. **55** shows a side view of a rear disc braking system in another specific embodiment. As shown in the example of FIG. **55**, a braking system **5705** includes a first structure **5710**A and a second structure **5710**B. The first structure is connected to the bicycle frame. The first structure includes a front brake cable housing stop **5715** to secure the cable housing.

(142) The second structure includes a linkage including a first link **5720**, a second link **5725**, and a third link **5730**. An end of the first link includes a front brake cable attachment point **5735** from which the cable may be pulled. There is a joint on the first link that connects the first link to the first structure. An opposite end of the first link includes a joint that connects to the third link to which the disc brake caliper is attached. The first link includes a curved portion that at least partially curves around a central axis of the rear hub. The second link includes a joint that connects to the third link. An opposite end of the second link may include a joint connecting to the first structure. The joint may include a slot **5740** that allows some lateral caliper movement. In a specific embodiment, the slot is on the second link. In another specific embodiment, the slot is on the first structure.

(143) It should be appreciated that the various braking designs shown in the figures are merely examples of particular implementations of the braking system. In other implementations, other similar and equivalent elements and functions may be used or substituted in place of what is shown. For example, for the floating caliper design as described in the discussion accompanying FIG. **52** above, the channel is formed within the first structure, but one of ordinary skill in the art will recognize that the channel may instead be formed within the second structure. In this specific embodiment, the first structure may include a tab that protrudes into the channel on the second structure to direct the movement of the caliper. A rotating mechanism or sliding mechanism may include bearings, bushings, pulleys, or combinations of these.

(144) The present disclosure, in various embodiments, includes components, methods, processes, systems and/or apparatus substantially as depicted and described herein, including various embodiments, subcombinations, and subsets thereof. Those of skill in the art will understand how to make and use the present disclosure after understanding the present disclosure. The present disclosure, in various embodiments, includes providing devices and processes in the absence of items not depicted and/or described herein or in various embodiments hereof, including in the absence of such items as may have been used in previous devices or processes, e.g., for improving performance, achieving ease and/or reducing cost of implementation. Rather, as the flowing claims reflect, inventive aspects lie in less than all features of any single foregoing disclosed embodiment.

Claims

1. A bicycle comprising: a frame; a front wheel configured to be rotatably coupled to the frame; a front caliper brake assembly configured to slow a rotation of the front wheel; a rear wheel

configured to be rotatably coupled to the frame, the rear wheel comprising a braking surface; and a rear brake caliper assembly configured to slow a rotation of the rear wheel, the rear brake caliper assembly comprising: a first caliper brake arm and a second caliper brake arm; a first brake pad coupled to the first caliper brake arm and a second brake pad coupled to the second caliper brake arm, the first brake pad disposed on a first side of the braking surface, and the second brake pad disposed on a second side of the braking surface and configured to be coupled to a cable to activate the front caliper brake assembly, wherein the first brake pad and the second brake pad are configured to be pressed against the braking surface of the rear wheel; and a rear brake hand lever configured to be actuated to operate the rear brake caliper assembly; wherein the rear brake hand lever is configured to be actuated to press the first brake pad and the second brake pad against the braking surface such that the rotation of the rear wheel is slowed and the second brake pad moves relative to the second caliper brake arm with a rotation of the braking surface to tension the cable to activate the front caliper brake assembly to slow the rotation of the front wheel.

2. The bicycle of claim 1, further comprising a guide coupled to the second caliper brake arm.

3. The bicycle of claim 2, wherein the second brake pad is configured to slidably interface with the guide such that the second brake pad moves relative to the guide with the rotation of the braking surface.

4. The bicycle of claim 2, wherein the second brake pad comprises a slide portion.

5. The bicycle of claim 4, wherein the guide comprises a groove configured to receive the slide portion of the second brake pad.

6. The bicycle of claim 5, wherein the slide portion is configured to slide within the groove as the second brake pad moves with the rotation of the braking surface.

7. The bicycle of claim 4, wherein the slide portion is integral with the second brake pad.

8. The bicycle of claim 7, wherein the slide portion protrudes from a side of the second brake pad that is opposite the braking surface.

9. The bicycle of claim 4, wherein the slide portion comprises a hole configured to receive the cable.

10. A vehicle configured to be pedaled to move, the vehicle comprising: a frame with pedals; a front wheel configured to be rotatably coupled to the frame; a front brake assembly configured to slow a rotation of the front wheel; a rear wheel configured to be rotatably coupled to the frame, the rear wheel comprising a braking surface; and a rear brake assembly configured to slow a rotation of the rear wheel, the rear brake assembly comprising: a first brake pad coupled and a second brake pad, the first brake pad disposed on a first side of the braking surface, and the second brake pad disposed on a second side of the braking surface and configured to be coupled to a cable to activate the front brake assembly, wherein the first brake pad and the second brake pad are configured to be pressed against the braking surface of the rear wheel; and a rear brake hand lever configured to be actuated to operate the rear brake assembly; wherein the rear brake hand lever is configured to be actuated to press the first brake pad and the second brake pad against the braking surface such that the rotation of the rear wheel is slowed and the second brake pad moves relative to the first brake pad with a rotation of the braking surface to tension the cable to activate the front brake assembly to slow the rotation of the front wheel.

11. The vehicle of claim 10, further comprising a guide disposed on the second side of the braking surface.

12. The vehicle of claim 11, wherein the second brake pad is configured to slidably interface with the guide such that the second brake pad moves relative to the guide with the rotation of the braking surface.

13. The vehicle of claim 11, wherein the second brake pad comprises a slide portion.

14. The vehicle of claim 13, wherein the guide comprises a groove configured to receive the slide portion of the second brake pad.

15. The vehicle of claim 14, wherein the slide portion is configured to slide within the groove as

the second brake pad moves with the rotation of the braking surface.

16. The vehicle of claim 13, wherein the slide portion protrudes from a side of the second brake pad that is opposite the braking surface.

17. The vehicle of claim 13, wherein the slide portion comprises a hole configured to receive the cable.

18. A two-wheeled vehicle configured to be pedaled, the two-wheeled vehicle comprising: a frame with pedals; a front wheel configured to be rotatably coupled to the frame; a front brake assembly configured to slow a rotation of the front wheel; a rear wheel configured to be rotatably coupled to the frame, the rear wheel comprising a braking surface; and a rear brake assembly configured to slow a rotation of the rear wheel, the rear brake assembly comprising a first brake pad coupled and a second brake pad, the first brake pad disposed on a first side of the braking surface, and the second brake pad disposed on a second side of the braking surface and configured to be coupled to a cable to activate the front brake assembly, wherein the first brake pad and the second brake pad are configured to be pressed against the braking surface of the rear wheel; wherein the first brake pad and the second brake pad are configured to press against the braking surface such that the rotation of the rear wheel is slowed and the second brake pad moves relative to the first brake pad with a rotation of the braking surface to tension the cable to activate the front brake assembly to slow the rotation of the front wheel.

19. The two-wheeled vehicle of claim 18, further comprising a guide with a groove, wherein the second brake pad comprises a slide portion configured to be disposed in the groove, the slide portion protruding from a side of the second brake pad that is opposite the braking surface.

20. The two-wheeled vehicle of claim 19, wherein the slide portion comprises a hole configured to receive the cable.