Title: HYDRAULIC BRAKE-SYSTEM FOR A BICYCLE

Abstract: The invention relates to a hydraulic brake system for a bicycle which may or may not be provided with an auxiliary motor, comprising a brake disc and brake claws cooperating with the brake disc, as well as fluid-containing channels (4,6) that extend between an operating organ (1) and the brake claws, and which system further possesses a spring-loaded piston (11) accommodated and moveable in a first chamber (13).
Hydraulic brake-system for a bicycle

The invention relates to a hydraulic brake system for a bicycle which may or may not be provided with an auxiliary motor, comprising a brake disc and brake claws cooperating with the brake disc, as well as fluid-containing channels that extend between an operating organ and the brake claws, and which system further possesses a spring-loaded piston accommodated and moveable in a first chamber.

Such a hydraulic brake system is known from the American patent specification US-B-6,435,318.

In the known hydraulic brake system the spring-loaded piston serves to prevent the brake from jamming when abruptly engaging the brake, which could cause the cyclist to go over the handlebars.

A drawback of the known hydraulic brake system is that the brake claws have to be mounted very precisely in relation to the brake disc, because the known system is only capable of delivering a limited stroke. In the state of rest therefore, the brake claws need to be almost in contact with the brake disc. In practice this results in the brakes contacting during cycling and, as a result of wear, there is a continuous need to readjust the brake claws. Another drawback is that the precise adjustment has to be repeated when changing the wheels.

The American patent US-A-3,630,027 discloses a hydraulic brake system wherein fluid-containing channels extend between an operating organ and brake provisions, in which a spring-loaded piston is accommodated in a first chamber and in which the piston is provided with a rod fixed to the piston, which rod is provided on the spring-loaded side of the piston, and whose cross-sectional diameter is smaller than that of the piston, and which rod reaches from the first chamber into a second chamber.

This known hydraulic brake system possesses a further valve which, when the exerted brake pressure increases
opens, allowing free passage through a fluid channel, whereby
an increased brake pressure can be exerted.

However, the American patent US-A-3,630,027 offers
no solution for the above-mentioned adjustment problem inher-
ent to the brake system disclosed in US-B-6,435,318.

It is an object of the invention to improve the
known hydraulic brake system so as to make it possible to
carry out the adjustment with greater tolerances.

To this end the hydraulic brake system according to
the invention is characterized by one or several of the ap-
pended claims.

In a first aspect of the invention, the hydraulic
brake system is characterized in that both the first chamber
and the second chamber are in communication with a first liq-
uid-containing channel, which is coupled to the operating or-
gan, and in that a second liquid-containing channel couples
the second chamber with the brake claws, and the second cham-
ber is provided with a seal between the first liquid-
containing channel and the second liquid-containing channel,
which becomes effective by moving the piston with the rod
fixed thereon.

When the pressure in the first liquid-containing
channel increases due to the operating organ being operated,
the brake system according to the invention allows the piston
initially to maintain a stationary position in the first
chamber, because the spring in the spring-loaded piston and
the pressure exerted on a surface of the rod in the second
chamber will compensate at least a pressure exerted on the
piston in the first chamber.

Simultaneously, the pressure exerted by the operat-
ing organ via the second chamber causes the brake claws to be
moved until they abut to the brake disc.

Through further pressure increase as a result of op-
erating the operating organ, the pressure in the first cham-
ber and the second chamber may increase further to a level
where the pressure exerted on the piston is greater than the
spring load on the piston and the pressure exerted on the rod
together. As soon as this is the case, the piston with the
rod fixed thereon moves, causing the rod to be moved further
into the second chamber, and allowing said seal between the first fluid-containing channel and the second fluid-containing channel to become effective. As seal it is possible to use, for example, a quad-ring or a lip-seal. In a simple embodiment of the seal, the same is formed by the assembly of the rod and an O-ring provided in the second chamber. Moving the rod inserts it with a tight fit into the O-ring so that together they form a seal between the first fluid-containing channel in communication with the second chamber and the second fluid-containing channel. Further operation of the operating organ subsequently ensures that the pressure thus applied in the first fluid-containing channel and the first chamber is exerted via the piston and the rod on the fluid in the second fluid-containing channel, wherein the respective diameters of the piston and the rod are predetermined subject to a desired increase in brake capacity between the operating organ and the brake claws.

A further aspect of the hydraulic brake system according to the invention is that the spring of the spring-loaded piston has a predetermined spring characteristic for determining a brake force necessary to be exerted with the operating organ to render the brake claws effective.

Hereinafter the invention will be further elucidated by way of the drawing and an exemplary embodiment of the hydraulic brake system according to the invention, without limiting the patent claims.

A single figure in the drawing shows a hydraulic circuit diagram, according to which the hydraulic brake system of the invention may be embodied.

The figure shows an operating organ in the form of a brake handle 1, which is functionally coupled with a brake cylinder 2 comprising a piston 3 having a functional surface Ab. This piston is spring-loaded with a spring having a spring stiffness $C_b$ and this causes the piston 3, in a state of rest, to assume a neutral position.

Via a first fluid-containing channel 4 the brake piston 2 is coupled with a brake capacity amplifier 5, whose function will be explained in more detail below. From the brake capacity amplifier 5, a second fluid-containing channel
6 extends to a set of brake claws 7, between which a brake disc 8 is provided. The brake claws 7 are preferably spring-loaded by means of a spring having a spring stiffness Cr in order to place said brake claws 7 into a preferential position in which they clear the brake discs 8.

The crux of the invention lies in the brake capacity amplifier 5 and the manner in which the same is operationally connected with and coupled between the first fluid-containing channel 4 and the second fluid-containing channel 6.

The brake-capacity amplifier 5 comprises a spring-loaded piston 11 accommodated and moveable in a first chamber 10. On said piston 11 a rod 12 is fixed, on the spring-loaded side of the piston 11. This is represented in the figure by showing the rod 12 on the same side as the spring 13.

The figure further clearly shows that in cross section, the diameter of the rod 12 is smaller than that of the piston 11, and that the rod 12 extends from the first chamber 10 into a second chamber 14. Both the first chamber 10 and the second chamber 14 are in communication with the first fluid-containing channel 4, which is coupled with the operating organ 1.

The coupling to the brake claws 7 is provided by the fact that the second fluid-containing channel 6 couples the second chamber 14 with the brake claws 7.

It is further of importance that the second chamber 14 is provided with a seal 12, 15 between the first fluid-containing channel 4 and the second fluid-containing channel 6, which is actuated only after the brake claws 7 have been moved up against the brake disc 8. This is achieved by operating the brake handle 1, a first consequence of which is that via the second chamber 14 and the second fluid-containing channel 6, the oil in the first fluid-containing channel 4 moves the brake claws 7 until they abut against the brake disc 8. At this stage, the brake pressure exerted in the second chamber 14 upon the functional surface \( A_w \) of the rod 12, and consequently on the piston 11, together with the force exerted by the spring 13 on the piston 11, is at this instance still greater than the same brake pressure exerted
by the oil in the first chamber 10 on the functional surface $A_k$ of the piston 11 located at the other side.

As soon as the point is reached where the brake claws 7 abut against the brake disc 8, a further movement of the brake handle 1 causes the pressure in the first fluid-containing channel 4 to increase, so that the pressure upon the functional surface $A_k$ of the piston 11 increases and, at a predetermined value, exceeds the spring load 13 on the piston 11 and the brake pressure in the second chamber 14 on the functional surface $A_w$ of the rod 12. At that point the piston 11 and the rod 12 fixed thereon move counter to the pressure of the spring 13, pushing the rod 12 further into the chamber 14 and into engagement with an O-ring 15. The rod 12 and the O-ring 15 together form a seal 12, 15 between the first fluid-containing channel 4 and the second fluid-containing channel 6. A subsequent further operation of the brake handle 1 causing a further increase of the pressure in the first fluid-containing channel 4, results in a corresponding pressure exertion on the functional surface $A_k$ of the piston 11, and a corresponding pressure exertion via the rod 12 coupled with the piston 11 on the oil in the second fluid-containing channel 6. The ratio between the functional surface $A_k$ of the piston 11 and the functional surface $A_w$ of the rod 12 determines the degree of pressure increase between the first fluid-containing channel 4 and the second fluid-containing channel 6. This causes the brake claws 7 to be pressed against the brake disc 8 more forcefully. The ratio between the brake pressure exerted by the brake claws 7 on the brake disc 8 and the pressure exerted by means of the brake handle 1 is therefore $A_k/A_w$.

For the sake of completeness it should be noted that the seal provided in the second chamber 14 between the first fluid-containing channel 4 and the second fluid-containing channel 6 does not necessarily have to be an O-ring 15 but that it is also possible to use, for example, a quad-ring or a lip seal.
CLAIMS

1. A hydraulic brake system for a bicycle which may or may not be provided with an auxiliary motor, comprising a brake disc (8) and brake claws (7) cooperating with the brake disc, as well as fluid-containing channels (4, 6) that extend between an operating organ (1) and the brake claws (7), and which system further possesses a spring-loaded piston accommodated and moveable in a first chamber (10), in which the piston (11) is provided with a rod (12) fixed to the piston, which rod (12) is provided on the spring-loaded side of the piston (11), and whose cross-sectional diameter is smaller than that of the piston, and which rod (12) reaches from the first chamber (10) into a second chamber (14), characterized in that both the first chamber (10) and the second chamber (14) are in communication with a first liquid-containing channel (4), which is coupled to the operating organ (1), and in that a second liquid-containing channel (6) couples the second chamber (14) with the brake claws (7), and the second chamber (14) is provided with a seal (12, 15) between the first liquid-containing channel (4) and the second liquid-containing channel (6), which becomes effective by moving the piston (11) with the rod fixed thereon (12).

2. A hydraulic brake system according to claim 1, characterized in that the seal (12, 15) is formed by the assembly of the rod (12) and an O-ring (15) provided in the second chamber (14).

3. A hydraulic brake system according to claim 1 or 2, characterized in that the respective diameters of the piston (11) and the rod (12) are predetermined subject to a desired increase in brake capacity between the operating organ (1) and the brake claws (7).

4. A hydraulic brake system according to one of the claims 1-3, characterized in that the spring of the spring-loaded piston (11) has a predetermined spring characteristic for determining a brake force necessary to be exerted with the operating organ (1) to render the brake claws effective (7).
### A. CLASSIFICATION OF SUBJECT MATTER

INV. B60T11/224  B60T15/38  B60T11/12  B62L3/02

According to International Patent Classification (IPC) or to both national classification and IPC.

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60T  B62L

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

Electronic database consulted during the international search (name of database and, where practical, search terms used)

EPO-Internal, WPI Data

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

### Date of the actual completion of the international search

22 June 2007

### Date of mailing of the international search report

04/07/2007

Name and mailing address of the ISA/
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2299 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 21 651 apo nl, Facs. (+31-70) 340-3316

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Schroeder, Rainer

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