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(19)



(54) IMPROVEMENTS RELATING TO
 FRICTION PAD ASSEMBLIES FOR SLIDING
 CALIPER DISC BRAKES

(71) We, GIRLING LIMITED, a British Company, of Kings Road, Tyseley, Birmingham B26 1AW, West Midlands, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a friction pad assembly for use in sliding caliper disc brakes and a sliding caliper disc brake incorporating such a friction pad assembly.

In most constructions of caliper disc brakes, the friction pads are supported on or between guides to which forces due to braking are transmitted from the pad and hence to the vehicle frame. It is necessary to provide some degree of clearance at these guides to permit the pads to slide towards and away from the disc during braking and to ensure freedom from pad seizure. This can result in the pads rattling in these guides. To reduce this problem it is known to incorporate a resilient means, usually a spring, to bias the pad against one side of the guide. Problems with such resilient means, specifically springs, are that the springs heretofore known are subject to many of the following:-

1. They do not exert substantially the same force between pad and guide throughout the life of the pad.
2. They are not easy to assemble in and dismantle from a brake.
3. They give rise to spurious loads and couples that tend to displace the pad from its desired position and attitude in a brake caliper.
4. They cut, or otherwise damage the flexible rubber boots which are provided to protect the piston or pistons in a brake caliper.
5. They are not particularly cheap to manufacture or instal.
6. They take up space which could be use-

fully filled by other brake components to enhance brake performance, particularly the rigidity of the brake.

The aim of the present invention provides a friction pad assembly which includes an anti-rattle spring arrangement which solves all of these problems.

According to the present invention there is provided a friction pad assembly for use in a disc brake, comprising a backing plate and a pad of friction material secured thereto, a wire spring comprising a coiled region from which two free end regions of the spring extend in generally opposite directions, being attached to the backing plate by the coiled region of the spring being engaged over a pin secured to the backing plate.

In a preferred embodiment of the present invention the backing plate has a tab or projecting part thereof which is free of friction material and which is located in the middle region of what will be the upper side of the assembly when inserted in a brake. A hole is provided in the tab and a pin engages through the hole, the wire spring being pivotally mounted on the pin. Preferably the pin and spring are permanently fixed to the backing plate. Alternatively, however, the spring may be detachable from the backing plate. The wire spring essentially comprises a coiled region formed by at least one coil which engages over the pin so that the axis of the coiled region is substantially perpendicular to the working surface of the friction pad, the free end regions of the spring projecting in generally opposite directions from the coiled region of the spring. Further, the sides of the backing plate are provided with laterally projecting shoulders which, in use, engage guides in the torque member.

The spring is thus located on the pad backing plate during assembly to the brake, so that it cannot slip and damage the flexible boot normally provided in a disc brake to protect the cylinder and piston against the

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ingress of dirt and moisture. Also, if the spring is permanently attached to the pad back-plate it cannot be mislaid during pad replacement and must always be replaced when the pads are changed, ensuring no degradation of performance. The attachment assures that, in use, the attitude of the spring to its associated pad backing plate remains constant, irrespective of the state of pad wear, so avoiding spurious displacements of the pad caused by offset spring forces.

According to a further feature of the present invention there is provided a friction pad assembly in combination with a sliding caliper disc brake, the brake comprising a torque member and a caliper member incorporating at least one hydraulic actuator, the caliper member being attached to the torque member for sliding movement relative thereto and arranged to act on the friction pad assembly which is located in a recess in the torque member, the friction pad assembly comprising a backing plate, a pad of friction material, and a wire spring, the wire spring comprising a coiled region from which two free end regions of the spring extend in generally opposite directions, the spring engaging the caliper member and being attached to the backing plate by the coiled region engaging over a pin secured to the backing plate.

Thus, when a friction pad assembly constructed in accordance with the present invention is in use in a sliding caliper disc brake e.g. of the sliding pin type, the outwardly extending arms of the spring press against the caliper member and are deflected somewhat from their free attitude. The arms thus exert resilient forces against the caliper member, the reaction to the sum of which forces appears at the spring attachment point on the backing plate, thus pressing the friction pad assembly down on guides in the torque member. The spring thus has a two-fold purpose, to bias the friction pad assembly relative to the caliper member and to effectively bias the caliper member relative to the torque member. Thus the spring acts both to prevent the friction pad assembly rattling in the guides in the torque member and to reduce the possibility of rattling occurring between the caliper member and torque member. This latter source of rattling is inherent in any sliding caliper disc brake as a clearance must be provided on the guides which control the sliding movement of the caliper member to ensure freedom from seizure or jamming. For example, in a sliding caliper disc brake of the sliding pin type, guide pins on the caliper member pass with clearance through bores in the torque member, and in accordance with the further feature of the present invention the pins will be biased against the

walls of the bores.

It has previously been known to achieve this duplication of function, but by means of a plate spring which is not attached to the backing plate and which suffers from all the problems itemised hereabove.

The spring that forms part of the friction pad assembly of the present invention provides for a high performance from the minimum quantity of metal resulting in the benefits described hereinafter.

Whilst the friction pad assembly according to the present invention can be used to best advantage in a sliding caliper disc brake, in accordance with the further feature of the present invention it may also be used with advantage in any other type of disc brake to overcome the problems itemised hereabove. However in such other types of disc brake the spring will have only one function. That is, to prevent the friction pad assembly rattling on its guides in the brakes.

The present invention will now be further described, by way of example, with reference to the drawings which accompanied the provisional specification:-

Figure 1 is a front view of a preferred embodiment of a friction pad assembly constructed according to the present invention;

Figure 2 is a plan view of the embodiment of Figure 1;

Figure 3 is a partial cross-sectional view of an end elevation of the embodiment of Figure 1;

Figure 4A, 4B, 4C are enlarged views of the wire spring used in the friction pad assembly illustrated in Figures 1 to 3.

Figure 5 is a plan view of a sliding caliper disc brake incorporating friction pad assemblies as per Figure 1;

Figure 6 is a sectional view along line VI-VI in Figure 5; and

Figure 7 is a rear view of the disc brake of Figure 5 cut away along line VII-VII in Figure 5.

Figures 1 to 3 illustrate a preferred embodiment of a friction pad assembly constructed in accordance with the present invention, for use in a sliding caliper disc brake. The friction pad assembly generally designated 1, comprises a backing plate 2 and a pad of friction material 3. The upper edge 2a of the backing plate 2 as illustrated in Figure 1, has an upwardly projecting part or tab 4 which is free of friction material, and two laterally projecting shoulders 5 also free of friction material. The tab 4 is arranged approximately in the middle of the upper side edge 2a of the backing plate and a hole 6 extends therethrough. A pin 7 engages through hole 6, a wire spring 8 being pivotally mounted on pivot pin 7. The pin 7 and wire spring 8 are permanently fixed to the backing plate so that an old

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weak spring cannot be fixed to a replace-
 ment friction pad and backing plate. How-
 ever, alternatively the pin 7 may be detach-
 able from the backing plate 2 enabling wire
 spring 8 to be replaced if so desired.

As shown in Figures 4A, 4B, and 4C, the
 wire spring 8 comprises a central coiled
 region 9 formed by a couple of coils 9a. If
 required only one coil or more than two
 coils may alternatively form the coiled
 region 9. The end regions 10 and 11 of the
 spring extend from opposite ends of the
 coiled region 9 in substantially opposite
 direction and are each bent at one location
 12 about an axis parallel to the axis of the
 coiled region 9 and at another location 13
 further from the coiled region 9, about an
 axis perpendicular to the axis of the coiled
 region 9. The coiled region 9 of the spring 8
 is located over pin 7 so that the axis of the
 coiled region is substantially perpendicular
 to the working surface 3a of the pad 3.

In use the end regions 10 and 11 of the
 spring are subject to a varying bending
 movement which is zero at the points of
 application of the load i.e. points 13, rising
 to a maximum at the point where the spring
 abuts the pin 7. When designing a steel
 spring the amount of metal used to provide
 the required loads and travels is determined
 by the maximum stress permissible in the
 metal. If a spring design leads to the max-
 imum stress occurring at a single point as
 often happens with plate or leaf springs,
 then the rest of the metal of the spring is not
 utilised to its full potential. This is wasteful
 of material and space. Thus it is desirable
 that the metal should be subject to its max-
 imum stress over a large a proportion of its
 volume as possible. In the spring illustrated
 in Figure 4A the position of maximum stress
 are marked 'S'. These points are of course
 the positions of maximum bending moment.
 The stress around the whole coiled region 9
 is only slightly reduced from the maximum
 and most of the metal is concentrated in this
 region. Thus by providing a circular coil
 about an axis perpendicular to the plane
 defined by the lines of action of the forces on
 the spring the metal is concentrated in the
 region of highest stress achieving maximum
 metal utilisation. The present invention in
 the above described embodiment, achieves
 this benefit whilst fulfilling the requirements
 of a pad anti-rattle spring.

Apart of course from using the minimum
 quantity of metal in the spring, the high
 metal utilisation ensures that it takes up very
 little room, at a place where the minimum of
 interference with other components is essen-
 tial.

Figures 5 to 7 of the drawings illustrate
 the friction pad assembly of Figure 1 instal-
 led in a sliding caliper disc brake of the slid-
 ing pin type. The disc brake comprises a

caliper member 14 and a torque member 15,
 the caliper member 14 being provided with
 pins 16 (only one of which is evident in Fig-
 ure 7) which slide in bores 17 in the torque
 member 15. As seen in Figure 6 the caliper
 member 14 includes a hydraulically oper-
 able piston 18 which can be axially moved
 by hydraulic pressure in cylinder 19 to act
 on friction pad assembly 21, caliper member
 14 sliding relative to torque member 15
 causing friction pad assemblies 20 and 21 to
 grip opposite sides of disc 22. The friction
 pad assemblies 20 and 21 are located in
 recesses 23 in the torque member 15 (Figure
 7), the laterally projecting shoulders 5 of the
 respective backing plates engaging on
 shoulders 24 on the sides of the recesses 23,
 which shoulders 24 act as guides for the fric-
 tion pad assemblies. As seen in Figure 7
 wherein only one friction pad assembly is
 evident, point A (Figure 4C) of each end of
 the wire spring 8 engages against the caliper
 member 14 thus both pressing the friction
 pad assembly 21 down onto the shoulders
 24 preventing or reducing pad rattle in the
 torque member and also pressing up on the
 caliper member 14 to thus take up any
 tolerance between pins 16 and bores 17 so
 preventing or reducing rattle between the
 caliper member and torque member.

Thus, the wire spring of the friction pad
 assembly of the present invention obviates
 the necessity for two specific springs, sets of
 springs, or resilient members which have
 previously been used for biasing the caliper
 member away from the torque member to
 take up manufacturing tolerances and to
 prevent pad rattle.

In known sliding caliper disc brakes utilis-
 ing a spring to bias the caliper member away
 from the torque member, when the caliper
 member is removed, the biasing spring is
 immediately released and in practice quite
 often damages the dirt seal on the hydraulic
 actuator in the caliper member. This is of
 course undesirable and the friction pad
 assembly of the present invention removes
 this danger as the spring is secured to the
 backing plate preventing random movement
 of the spring.

Further, utilising a friction pad assembly
 constructed according to the present inven-
 tion, the bridge portion of a caliper member
 which straddles the disc of the disc brake,
 may occupy almost the whole of the space
 between the outer periphery of the disc and
 the inside of the road wheel without
 interference from the wire spring of the pre-
 sent invention. Thus the construction of the
 caliper member may be such as to provide
 for maximum rigidity of the caliper member.

WHAT WE CLAIM IS:-

1. A friction pad assembly for use in a
 disc brake comprising a backing plate and a



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weak spring cannot be fixed to a replacement friction pad and backing plate. However, alternatively the pin 7 may be detachable from the backing plate 2 enabling wire spring 8 to be replaced if so desired.

As shown in Figures 4A, 4B, and 4C, the wire spring 8 comprises a central coiled region 9 formed by a couple of coils 9a. If required only one coil or more than two coils may alternatively form the coiled region 9. The end regions 10 and 11 of the spring extend from opposite ends of the coiled region 9 in substantially opposite direction and are each bent at one location 12 about an axis parallel to the axis of the coiled region 9 and at another location 13 further from the coiled region 9, about an axis perpendicular to the axis of the coiled region 9. The coiled region 9 of the spring 8 is located over pin 7 so that the axis of the coiled region is substantially perpendicular to the working surface 3a of the pad 3.

In use the end regions 10 and 11 of the spring are subject to a varying bending movement which is zero at the points of application of the load i.e. points 13, rising to a maximum at the point where the spring abuts the pin 7. When designing a steel spring the amount of metal used to provide the required loads and travels is determined by the maximum stress permissible in the metal. If a spring design leads to the maximum stress occurring at a single point as often happens with plate or leaf springs, then the rest of the metal of the spring is not utilised to its full potential. This is wasteful of material and space. Thus it is desirable that the metal should be subject to its maximum stress over a large a proportion of its volume as possible. In the spring illustrated in Figure 4A the position of maximum stress are marked 'S'. These points are of course the positions of maximum bending moment. The stress around the whole coiled region 9 is only slightly reduced from the maximum and most of the metal is concentrated in this region. Thus by providing a circular coil about an axis perpendicular to the plane defined by the lines of action of the forces on the spring the metal is concentrated in the region of highest stress achieving maximum metal utilisation. The present invention in the above described embodiment, achieves this benefit whilst fulfilling the requirements of a pad anti-rattle spring.

Apart of course from using the minimum quantity of metal in the spring, the high metal utilisation ensures that it takes up very little room, at a place where the minimum of interference with other components is essential.

Figures 5 to 7 of the drawings illustrate the friction pad assembly of Figure 1 installed in a sliding caliper disc brake of the sliding pin type. The disc brake comprises a

caliper member 14 and a torque member 15, the caliper member 14 being provided with pins 16 (only one of which is evident in Figure 7) which slide in bores 17 in the torque member 15. As seen in Figure 6 the caliper member 14 includes a hydraulically operable piston 18 which can be axially moved by hydraulic pressure in cylinder 19 to act on friction pad assembly 21, caliper member 14 sliding relative to torque member 15 causing friction pad assemblies 20 and 21 to grip opposite sides of disc 22. The friction pad assemblies 20 and 21 are located in recesses 23 in the torque member 15 (Figure 7), the laterally projecting shoulders 5 of the respective backing plates engaging on shoulders 24 on the sides of the recesses 23, which shoulders 24 act as guides for the friction pad assemblies. As seen in Figure 7 wherein only one friction pad assembly is evident, point A (Figure 4C) of each end of the wire spring 8 engages against the caliper member 14 thus both pressing the friction pad assembly 21 down onto the shoulders 24 preventing or reducing pad rattle in the torque member and also pressing up on the caliper member 14 to thus take up any tolerance between pins 16 and bores 17 so preventing or reducing rattle between the caliper member and torque member.

Thus, the wire spring of the friction pad assembly of the present invention obviates the necessity for two specific springs, sets of springs, or resilient members which have previously been used for biasing the caliper member away from the torque member to take up manufacturing tolerances and to prevent pad rattle.

In known sliding caliper disc brakes utilising a spring to bias the caliper member away from the torque member, when the caliper member is removed, the biasing spring is immediately released and in practice quite often damages the dirt seal on the hydraulic actuator in the caliper member. This is of course undesirable and the friction pad assembly of the present invention removes this danger as the spring is secured to the backing plate preventing random movement of the spring.

Further, utilising a friction pad assembly constructed according to the present invention, the bridge portion of a caliper member which straddles the disc of the disc brake, may occupy almost the whole of the space between the outer periphery of the disc and the inside of the road wheel without interference from the wire spring of the present invention. Thus the construction of the caliper member may be such as to provide for maximum rigidity of the caliper member.

WHAT WE CLAIM IS:—

1. A friction pad assembly for use in a disc brake comprising a backing plate and a



- pad of friction material secured thereto, a wire spring comprising a coiled region from which two free end regions of the spring extend in generally opposite directions, being attached to the backing plate by the coiled region of the spring being engaged over a pin secured to the backing plate.
2. A friction pad assembly as claimed in claim 1 in which the pad of friction material has a planar working surface and the spring includes at least one coil whose axis is substantially perpendicular to said working surface.
3. A friction pad assembly as claimed in claim 1 or 2, in which the free end regions of the spring are each bent at two spaced apart locations, each end region in one location nearest to the coiled region being bent about an axis substantially parallel to the axis of the coiled region and in the other location being bent about an axis substantially normal to the axis of the coiled region.
4. A friction pad assembly as claimed in any of claims 1 to 3, in which the backing plate has a tab which is free of friction material and is located in the middle region of what is the upper side of the assembly when inserted in a brake, the wire spring being supported by the tab, the sides of the backing plate having laterally projecting shoulders which in use, engage guides in a brake.
5. A friction pad assembly in combination with a sliding caliper disc brake, the brake comprising a torque member and a caliper member incorporating at least one hydraulic actuator, the caliper member being attached to the torque member for sliding movement relative thereto and arranged to act on the friction pad assembly which is located in a recess in the torque member, the friction pad assembly comprising a backing plate, a pad of friction material and a wire spring, the wire spring comprising a coiled region from which two free end regions of the spring extend in generally opposite directions, the spring engaging the caliper member and being attached to the backing plate by the coiled region engaging over a pin

secured to the backing plate.

6. A friction pad assembly in combination with a sliding caliper disc brake, as claimed in claim 5, in which the wire spring presses the backing plate down onto an abutment in the recess in the torque member and also presses against the caliper member.

7. A friction pad assembly in combination with a sliding caliper disc brake, as claimed in claim 7, in which the backing plate has laterally projecting shoulders which engage the abutment in the recess.

8. A friction pad assembly in combination with a sliding caliper disc brake, as claimed in any of claims 5 to 6 in which the pad of friction material has a planar working surface and the spring includes at least one coil whose axis is substantially perpendicular to said working surface.

9. A friction pad assembly in combination with a sliding caliper disc brake, as claimed in any one of claims 5 to 8, in which the free end regions of the spring are each bent at two spaced apart locations, each end region in one location nearest to the coiled region being bent about an axis substantially parallel to the axis of the coiled region and in the other locations being bent about an axis substantially normal to the axis of the coiled region, said other locations engaging the caliper member.

10. A friction pad assembly for use in a disc brake, constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 4 of the drawings.

11. A friction pad assembly as claimed in claim 12, in combination with a sliding caliper disc brake constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figures 5 to 7 of the drawings.

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