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[54] **DISC BRAKES AND MOUNTING STRUCTURE THEREFOR**

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Related U.S. Patent Documents

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Appl. No.: **58,089**
Filed: **Jul. 24, 1970**

U.S. Applications:

[63] Continuation of Ser. No. 454,613, Mar. 25, 1974, abandoned.

[51] **Int. Cl.**[2] **F16D 65/00**

[52] **U.S. Cl.** **188/73.3**; 74/18.2

[58] **Field of Search** 188/73.3, 73.4, 72.4; 74/18.2

[56] **References Cited**

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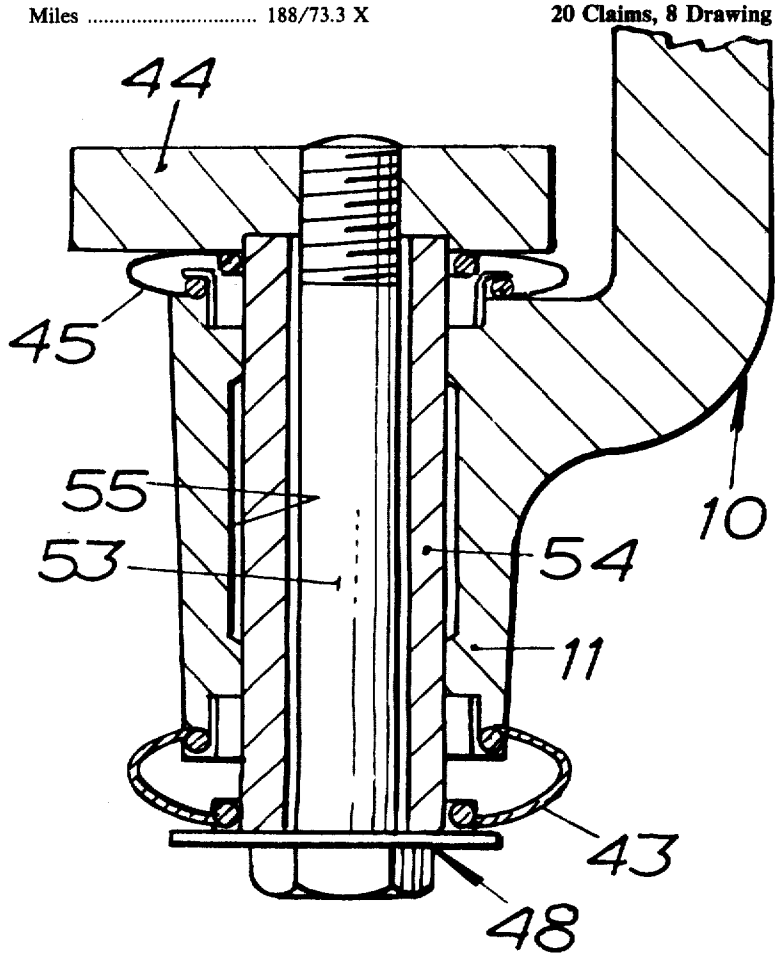
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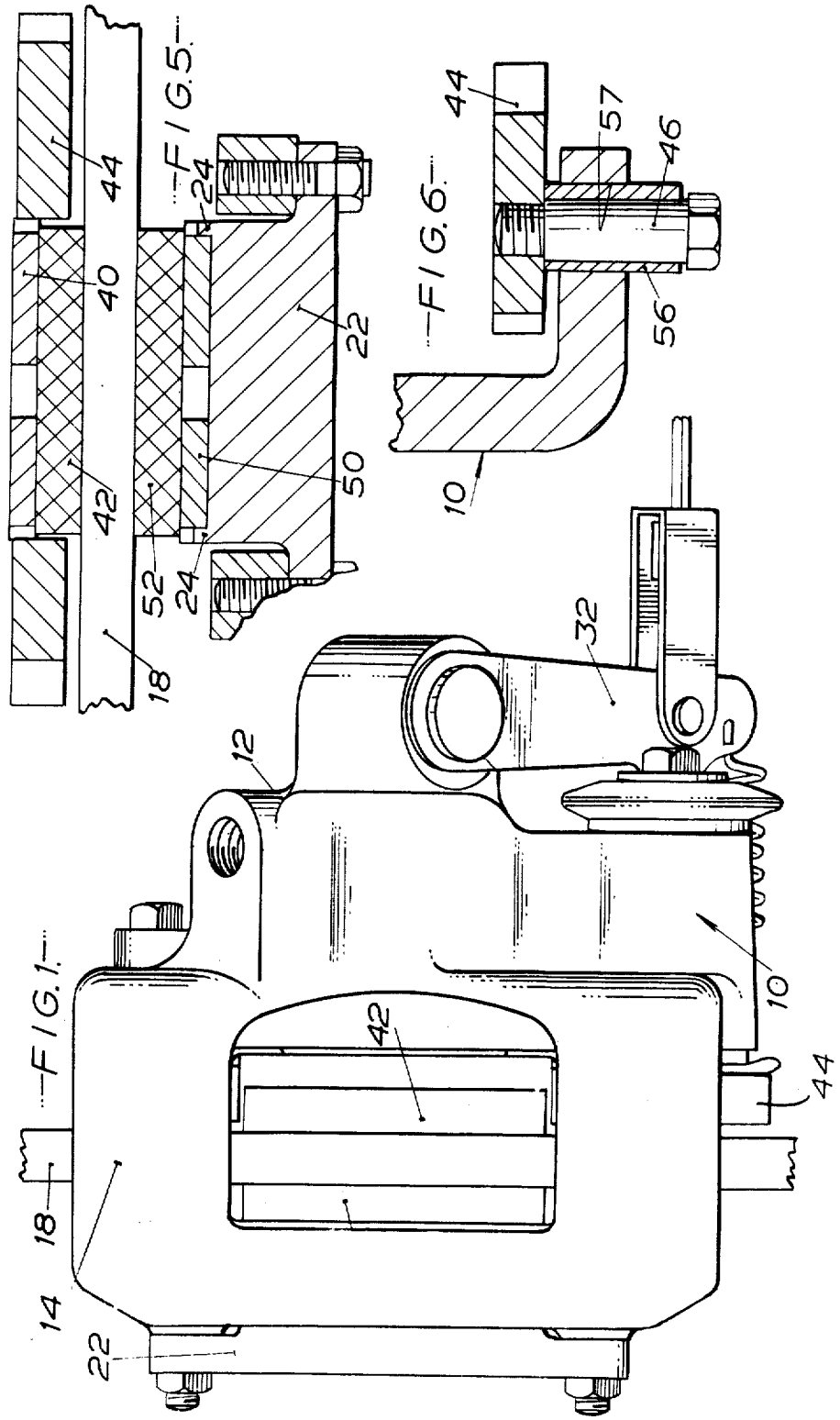
Primary Examiner—George E. A. Halvosa
Attorney, Agent, or Firm—Scrivener, Parker, Scrivener and Clarke

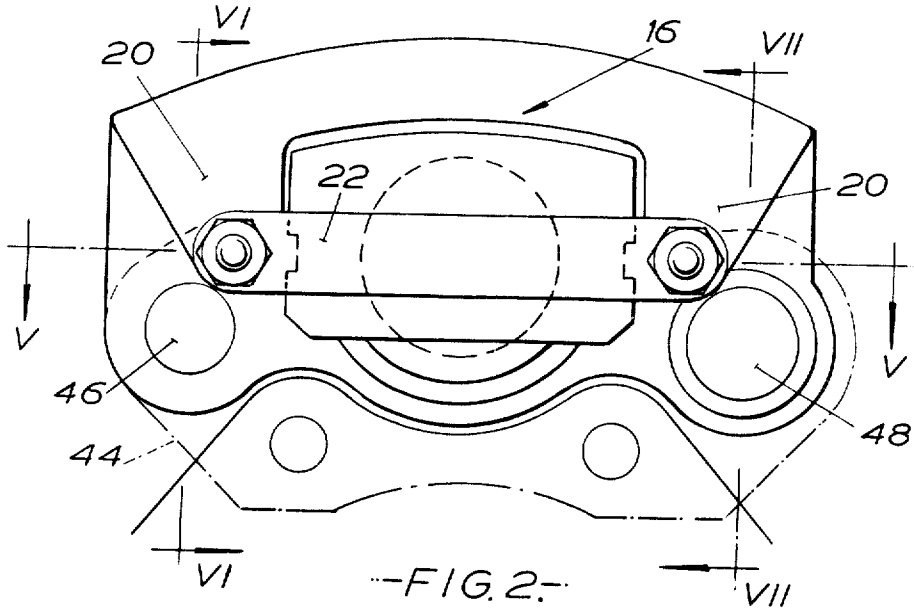
[57] **ABSTRACT**

The invention concerns disc brakes of the kind in which only one of the friction elements is directly moved into engagement with the brake disc or other rotor, the other friction element being displaced as a result of reaction forces set up by such engagement and for this purpose being carried by a caliper member which is slidable responsive to such reaction forces. In a disc brake of this type in accordance with the present invention, the caliper is mounted for sliding movement on a first pin arranged between the caliper member and a fixed torque plate member adjoining the brake disc, rotation of the caliper member about said first pin being restrained by a second pin secured to one of said members in circumferentially spaced relation with said first pin. The second pin is located in an aperture in the other of said members by an annular eccentric bush which at least partially embraces the second pin and is slidably received in said aperture to enable tolerance in the circumferential spacing of the pins to be accommodated during assembly of the brake and to enable the drag force to be aportioned between the two pins.

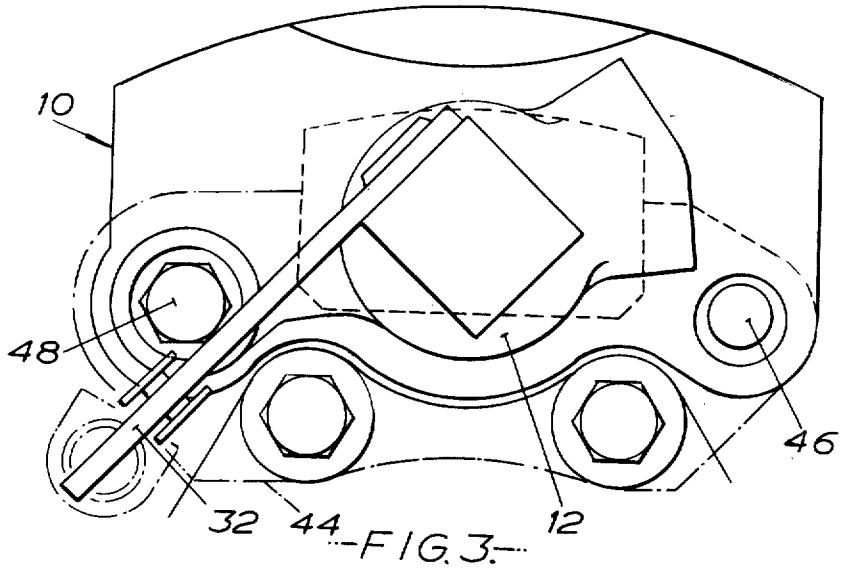
20 Claims, 8 Drawing Figures




FIG. 5
FIG. 6
FIG. 1
44
24
40
22
50
42
52
18
57
46
56
10
32
12
14



-FIG. 2.-



-FIG. 3.-

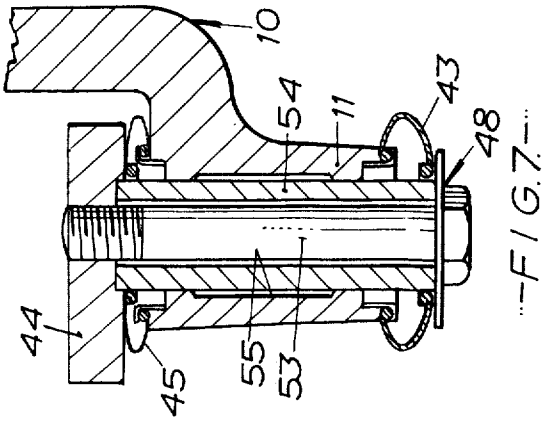


FIG. 7

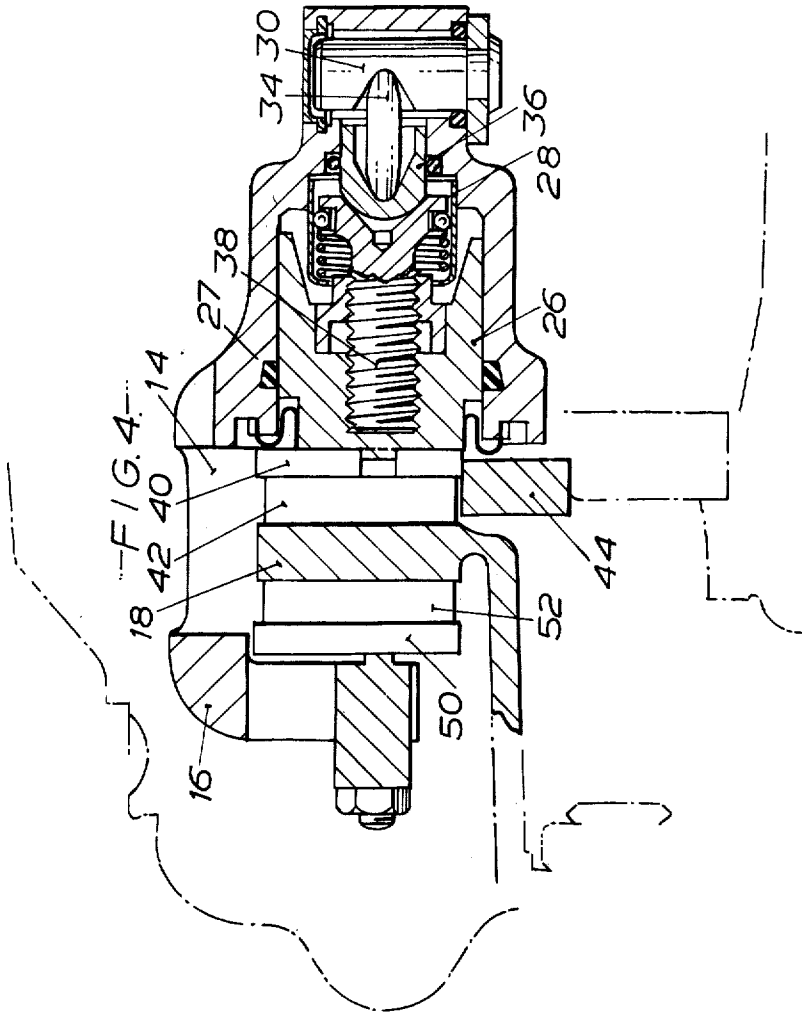
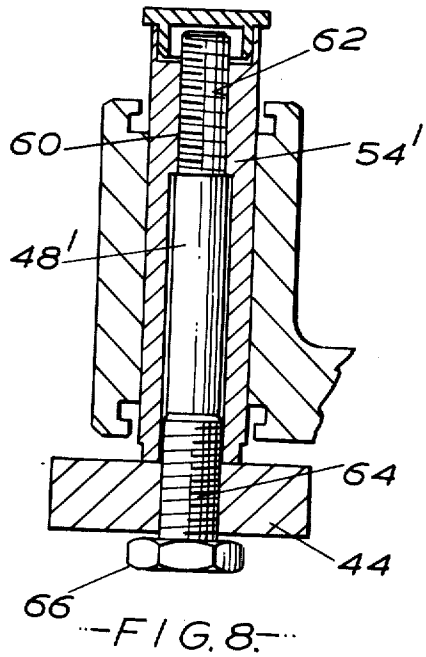


FIG. 4



-FIG. 8-

DISC BRAKES AND MOUNTING STRUCTURE THEREFOR

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This is a continuation of application Ser. No. 454,613 filed Mar. 25, 1974, now abandoned.

This invention concerns disc brakes of the kind in which only one of the friction elements is directly moved into engagement with the brake disc or other rotor, the other friction element being displaced as a result of reaction forces set up by such engagement and for this purpose being carried by a caliper member which is slidable responsive to such reaction forces. The slidable member usually takes the form of a so-called caliper or a yoke plate on which at least one of the friction elements, usually the indirectly operated friction element, is mounted.

It is known, in a disc brake of the kind described, for the caliper member to be mounted for sliding movement on a first pin arranged between the caliper member and a fixed torque plate member adjoining the brake disc, rotation of the caliper member about said first pin being restrained by a second pin secured to one of said members in circumferentially spaced relation with said first pin.

One object of the present invention is to provide a disc brake of the above type in which tolerance in the circumferential spacing of the first and second pins can be accommodated during assembly of the brake.

A second object of the present invention is to provide a disc brake of the above type in which the proportion of the drag force carried by the two pins in operation of the brake can be predetermined during the assembly of the brake.

A third object is to provide means for protecting the sliding surfaces between the caliper and a pin while at the same time substantially permanently retaining the pin connected to the caliper even after the latter has been dismounted from its torque plate.

According to the present invention, in a disc brake of the above type, the second pin is located in an aperture in the other of said members by an annular eccentric bush which at least partially embraces said second pin and is slidably received in said aperture.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of a disc brake embodying the invention,

FIG. 2 is an end view thereof taken from the left-hand side of FIG. 1,

FIG. 3 is a similar view taken from the right-hand side of FIG. 1.

FIG. 4 is a sectional elevation through the brake caliper,

FIGS. 5, 6 and 7 are sectional details taken respectively on the line V—V, VI—VI and VII—VII of FIG. 2; and

FIG. 8 is a view similar to FIG. 7 showing a second embodiment.

The embodiment of disc brake illustrated in the drawings comprises a caliper generally designated **10** having a body portion **12**, a bridge portion **14** and an end limb assembly **16** which together impart to the caliper **10**, a generally U-shaped configuration with the bridge portion **14** straddling a brake disc **18**. The end limb assembly **16** includes a pair of circumferentially spaced ears **20** depending from the bridge portion **14** and jointed by a transverse beam **22** bolted to them. The front face of the beam **22** is shaped to present circumferentially spaced lugs **24** for locating an indirectly operated friction pad as hereinafter described in more detail.

The body member **12** of the caliper **10** is internally formed to provide a hydraulic cylinder within which is received a hydraulic piston **26** displaceable towards the brake disc **18** responsive to hydraulic pressure in the cylinder. The piston **26** is also displaceable towards the brake disc through a detachable strut assembly generally designated **28** and including a cam **30** displaceable upon angular movement of a lever **32** to apply thrust through a dolly **34** to a dome ended plunger **36** which in turn acts on a strut **38** engageable with the piston **26**. The strut **38** is screw threaded into the piston **26** so that relative rotation between them, and effected in conventional manner responsive to wear of the brake friction linings, will effect adjustment of the length of the strut assembly to compensate for that wear.

The piston **26** is arranged to act on a backplate **40** carrying a pad **42** of friction material, the backplate **40** being arranged to be guided in an aperture of a torque plate **44** fixed to a convenient part of a vehicle structure and interposed between the body member **12** and the brake disc **18**. The torque plate **44** carries a pair of circumferentially spaced and axially directed pins **46** and **48**. As will be more evident from FIGS. **6** and **7**, the caliper **10** is mounted for sliding movement on the pins **46** and **48** and such sliding movement occurs as a result of the reaction set up when the friction pad assembly **40**, **42** is moved towards and engages the brake disc **18** responsive to actuation by the hydraulic piston **26**. As a consequence of such movement, a second friction pad assembly comprising a backplate **50** carrying a lining **52** of friction material is urged towards the disc **18** responsive to the sliding movement of the caliper. As will be noted the backplate **50** is engaged to accept the lugs **24** in the beam **22**, which are arranged to prevent both circumferential and radial displacement of the indirectly operated pad assembly.

The drag forces experienced by the friction pads are transferred in the case of the directly operated pad **40**, **42** to the torque plate **44**. In the case of the indirectly operated pad **50**, **52** however, the drag forces are transferred through the lugs **24** and the caliper to the pin **48** and thence to the torque plate **44**. The tendency of the caliper to rotate due to this transfer of drag forces is resisted by the pin **46**.

The contruction and arrangement of the drag taking pin **48** will be evident from FIG. **7** which shows that the torque plate **44** has a tapped hole for receiving a threaded portion of the pin **48**, which takes the form of a bolt *53*. The face of the torque plate **44** by which the bolt is introduced into the tapped hole is recessed to receive a tubular sleeve **54** having an internal diameter such that it is radially spaced from the bolt **[48]** *53* to enable the bolt to pass through it with clearance. The head of the bolt **[48]** *53* clamps the sleeve **54** to the torque plate **44** so that the sleeve is loaded under compression. The sleeve **54** in turn passes through a bore *55* in a rearwardly extending boss **11** of the caliper body member and the bore in the boss is relieved between its

end regions so as to provide a two point sliding contact between the boss and the sleeve.

Protective flexible rubber or plastic boots 43, 45 have sealing engagement with the caliper lug 11 at opposite ends of the bore 55 and with the ends of the sleeve 54. Not only do the boots exclude dirt and moisture from the sliding surfaces of the sleeve and bore but the boots also serve to retain the sleeve substantially permanently in the bore while continuing to protect the sliding surfaces when the caliper is dismounted from the torque plate 44 by removal of the bolt 53. It is this arrangement of the protective boots so that they extend between the relatively movable members rather than between separable members, e.g. the torque plate 44 and the sleeve 54, which enables the boots to perform their dual retention and protection functions.

The pin **46** will be seen from FIG. **6** to be located in an eccentric bush **56** having its external surface slidably arranged in an aperture **57** formed to receive it in the caliper body, whereby the bush serves as support means for the pin relative to the aperture.

It is to be noted that with this arrangement of the pin **46** and the eccentric bush **56**, since the axis of the pin **46** and the axis of the bush **56** are substantially in line in the radial direction, there can be substantially no radial movement of the caliper relative to the torque plate since the bush **56** will not rotate on the pin **46**. However, the bush **56** will rotate on the pin **46** when circumferential pressure is applied so that the pin and bush act as a circumferential slot in which the pin is slidable.

Thus the use of the eccentric annular bush **56** allows the pin and cylindrical sleeve arrangement to be used without the problem of tolerance and of binding under load, since tolerance in the circumferential spacing of the pins **46, 48** can be accommodated by rotation of the bush **56** within the aperture **57** to shift the axis of the internal bore of the eccentric bush **56** into line with the axis of the pin **46**. However, the take-up of radial tolerance is substantially nil so that very little angular movement of the caliper is allowed and rotational flop is negligible.

Furthermore the eccentric bush **56** can be of a relatively non-corrodable material such as a synthetic polymer material for example nylon, whereby to alleviate the problem of corrosion or a welding reaction between the bearing surfaces which can occur when these surfaces are both metallic. Alternatively, the eccentric bush can be made of compressible or resilient material so that any brake drag from the caliper to be transmitted to the torque plate must be substantially transmitted by the pin **48** and not the pin **46**.

It is also possible to utilize an eccentric bush, such as the bush **56**, to preselect the proportion of the drag force taken by the two pins **46, 48**. The "drag force" is the resultant of the frictional forces produced by the engagement of the indirectly actuated brake pad and the brake disc or rotor, which resultant acts along a line known as the drag line. During a braking operation, the brake force acts in a generally horizontal direction (FIG. **2**) on the brake pads and must be balanced by reaction forces exerted through the pins **46** and **48**. The force on the trailing pin **46** must act in the direction of the line joining the enter of that pin with the center of the eccentric bush **56**, otherwise the latter would rotate, assuming negligible pin to bush and bush to bearing frictional resistance. Therefore by projecting this line onto the drag line through which the brake force acts, the concurrent point of all the forces can be determined. Thus, assuming that the spacing between the centers of the apertures **55** and **57** in the caliper **10** are fixed, if the spacing between the centers of the pins **46, 48** is altered so that the eccentric bush has to rotate to a different position to accommodate the pins, it is apparent that the reaction force on the trailing pin **46** will be in a different direction and hence will be of a different magnitude, since the drag line remains substantially unaltered. In this way it is possible to preselect, between the pins **46** and **48**, the proportions of the drag force which they will be required in service to take off.

Similarly, taking into account the pin to bush and bush to bearing frictional resistance, it is possible to preselect the angular position of the eccentric bush to retain the preselected proportions of drag force to be taken by each pin.

Although the embodiment described and its variations, show the pins attached to the torque plate **44**, the caliper **10** being slidable on the pins so as to be moveable relative to the fixed torque plate, the pins **46, 48** could in all cases be equally well fastened to the caliper. In this case the torque plate would be provided with suitable apertures or bores for slidably receiving the pins.

In the embodiment described, a seal **27** for the piston **26** is located in the wall of the hydraulic cylinder adjacent the open end of the cylinder bore. This necessitates that the axial length of the cylinder bore is relatively great since the axial distance from the back internal wall of the cylinder to the seal must be at least three friction pad thicknesses in order to allow efficient working in the maximum worn condition and a further portion is necessary for piston guiding purposes. If however, the seal is carried by the piston, a shorter cylinder length is possible which means that a thicker and stronger torque plate can be accommodated in a brake of the same axial dimension.

It is envisaged that the support means locating the trailing pin **46** in the aperture **57** could comprise means other than an annular sleeve. For example, the sleeve could be replaced by a plurality of resilient support means angularly disposed around the wall of the aperture **57** which support the pin **46** relative to this aperture.

The means of mounting the sleeve **54** relative to the torque plate **44** in the embodiment illustrated is by means of the bolt **[48]** *53* which clamps the sleeve **54** to the torque plate **44** so that the sleeve **54** is loaded under compression. An alternative way of mounting the sleeve **54** is shown in FIG. **8**. A sleeve **54'** is provided at its end remote from the torque plate **44** with an internal screw-thread **62**. The bolt **[48]** *53* is replaced by an elongate stud **48'** which is correspondingly screw-threaded at **60**. The stud **48'** is screwed through the screw-threaded aperture **64** in the torque plate, normally occupied by the bolt **[48]** *53*, from the side of the torque plate remote from the sleeve, until the head **66** of the stud is hard up against the torque plate. The sleeve **54'** is then introduced over the stud so that its unthreaded end faces the torque plate. The length of the stud is arranged to be such that it can engage the threads on the sleeve which is then rotated to bring it into engagement with the torque plate in an annular groove therein. When the stud is then rotated in a direction to retract it from the torque plate, a compressive strain is applied to the sleeve. The head **66** of the stud **48'** can be arranged to shear off when a predetermined strain has been applied to the sleeve whereby the sleeve is rigidly held relative to the torque plate.

I claim:

1. In a disc brake of the type in which only one of a pair of friction elements is directly moved into engagement with the brake disc; the other friction element being displaced as the result of reaction forces set up by such engagement and for this purpose being carried by a caliper member, in combination with said caliper member, a first pin arranged between the caliper member and a fixed torque plate member adjacent the brake disc and slidably mounting said caliper member, a second pin secured to one of said members in circumferentially spaced relation with said first pin for restraining rotation of the caliper member about said first pin, means defining an aperture in the other of said members, and an annular eccentric bush slidably received in said aperture and at least partially embracing said second pin.

2. A disc brake according to claim 1, in which said second pin is of circular cross-section, and said annular eccentric bush has an inner diameter substantially that of the outer diameter of said second pin and an outer diameter substantially that of said aperture.

3. A disc brake according to claim 2 in which said aperture is located in the caliper member and the eccentric bush is freely rotatable within said aperture whereby tolerance in the circumferential spacing of said first and second pins can be accommodated during assembly of the brake by rotation of the eccentric bush within said aperture to shift the axis of the aperture in the eccentric bush which receives said second pin into line with the axis of that pin.

4. A disc brake according to claim 2 in which said aperture is located in the caliper member and the eccentric bush is freely rotatable within said aperture, the spacing of said first and second pins being preselected during assembly of the brake to achieve a particular orientation of the eccentric bush relative to said second pin and said aperture, whereby the trailing pin is made to take off a predetermined proportion of the drag force.

5. A disc brake according to claim 2 in which said first pin comprises a sleeve and a bolt which clamps the sleeve to the torque plate so that the sleeve is under compression.

6. A disc brake according to claim 2 in which said first pin comprises a sleeve and an elongated screw-threaded stud which engages corresponding internal screw threads on said sleeve located at the end of the sleeve remote from said torque plate for clamping said sleeve to said torque plate.

7. A disc brake according to claim 6 in which said stud is initially provided with a head to enable the stud to be screwed into said torque plate in a manner to apply a compressive load to said sleeve, said head being arranged to shear off the stud when a predetermined compressive load has been applied to said sleeve.

8. A sliding caliper disc brake comprising a rotatable disc, a torque plate member for fixing to a vehicle frame or like portion, a caliper member straddling a minor portion of the periphery of the disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, portions of the torque plate member being arranged to receive directly drag forces experienced by at least one of the pad means, motor means in the caliper member for directly urging one pad means onto one side of the disc to cause the caliper member to slide relative to the torque plate member to apply by reaction the opposite pad means to the other side of the disc, and a connection between the caliper member and the torque plate member comprising a first component having a surface slidably received in an opening in one of said members said surface having a direct, close sliding fit with the portion of said one member defining the wall of said opening, and a second component abutting said first component and in screw threaded engagement with the other of said members to clamp said first component against the other of said members, said first component having an oversized opening therethrough and said second component passing through said oversized opening, the latter being of a size that there is unobstructed spacing between all of that portion of said second component passing through said first component whereby said portion of said second component is at all times out of engagement with said first component and removal of said second component from said first component is thereby facilitated.

9. A sliding caliper disc brake comprising a rotatable disc, a torque plate member adapted for fixing to a vehicle frame or the like, a caliper member slidable relative to said torque plate member for moving friction pad means disposed on opposite sides of said brake disc into braking engagement with said disc, portions of the torque plate member being arranged to receive directly drag forces experienced by at least one of the pad means, at least one pin means constructed in two parts, one of said parts having a sliding surface received in a complementary opening in one of said members said surface having a direct, close sliding engagement with that portion of said one member defining the wall of said opening, the other of said parts passing with clearance fit through an oversize opening in the first part of said pin means, threaded means for connecting said second pin part with the other of said members, said second pin part having an abutment surface engaging said first pin part at one end of said oversized opening and being constructed and arranged that when said second pin part is lockingly connected to said other member by operation of said threaded means the abutment surface on said second pin part clamps the first pin part to said other member and thereby rigidly fixes said first pin part to said other member, said clearance being of a size that there is unobstructed spacing between that portion of said second pin part passing through said first pin part whereby said portion of said second pin part is at all times out of engagement with said first pin part.

10. A sliding caliper disc brake according to claim 9 wherein the one of said members is said caliper member and the other of said members is said torque plate member.

11. A sliding caliper disc brake according to claim 9 wherein said threaded means comprises a threaded portion on said second pin part and a threaded opening in the other of said members engaged by the threaded portion on said second pin part.

12. A sliding caliper disc brake comprising a rotatable disc, a torque plate member adapted for fixing to a vehicle frame, a caliper member straddling a minor portion of the periphery of the disc and slidable parallel to the axis of said disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, portions of the torque plate member being arranged to receive directly drag forces experienced by at least one of said pad means, a pin member having a sliding surface received in a complementary opening in one of the two first mentioned members, said surface having a direct, close sliding engagement with that portion of said one member defining the wall of said opening for guiding and supporting said caliper member in its axial movement relative to

the torque plate member, and means for rigidly connecting said pin member to the other of said first mentioned members comprising a clearance opening in one of the two last mentioned members, a bolt having a head engaging said one of the last mentioned members at one end of said clearance opening and extending with clearance through said opening into screw threaded engagement with the other of said last mentioned members, an abutment on the other of said last mentioned members engaging said one of the last mentioned members at the opposite end of the clearance opening, said head and said abutment clamping between them said one of the last mentioned members at opposite ends of the clearance opening thereby rigidly fixing said pin to the other of said first mentioned members, said clearance opening being of a size that there is unobstructed spacing between all of that portion of said bolt passing through said clearance opening in said one last mentioned member whereby said portion of said bolt is at all times out of engagement with the one of said last mentioned members.

13. A sliding caliper disc brake according to claim 12 wherein the one of the two first mentioned members is the caliper member, the other of the first mentioned members is the torque plate member, the one of the two last mentioned members is the pin member and the other of the two last mentioned members is the torque plate member.

14. A sliding caliper disc brake comprising a rotatable disc, a torque plate member for fixing to a vehicle frame or like portion, a caliper member straddling a minor portion of the periphery of the disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, motor means in the caliper member for directly urging one pad means onto one side of the disc to cause the caliper member to slide relative to the torque plate member to apply by reaction the opposite pad means to the other side of the disc, and a connection between the caliper member and the torque plate member comprising a pin element which has a sliding surface in sliding engagement with a wall of an opening in one of said members and which is releasably fixed to the other of said members, and sealing means extending between said pin element and said one of said members and at all times enclosing all of said sliding surface, said sealing means having one end sealed to said one of said members, and having its other end sealed to said pin element so as to protect all of the sliding surface of said pin element even when said caliper member is separated from said torque plate member.

15. The disc brake according to claim 14 wherein said sealing means comprises flexible boot means in sealing engagement with said one member at opposite ends of said opening, and in sealing engagement with said pin element adjacent the ends of said opening.

16. A sliding caliper disc brake comprising a rotatable disc, a torque plate member for fixing to a vehicle frame or like portion, a caliper member straddling a minor portion of the periphery of the disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, motor means in the caliper member for directly urging one pad means onto one side of the disc to cause the caliper member to slide relative to the torque plate member to apply by reaction the opposite pad means to the other side of the disc, and a connection between the caliper member and the torque plate comprising a two-part pin, one part of said pin having a sliding surface slidable in an opening in one of said members and the other part of said pin fixing said first part with respect to the other of said members, and sealing means extending between said one part and said one of said members and at all times enclosing all of said sliding surface, said sealing means having one end sealed to said one of said members, and having its other end sealed to said one pin part so as to protect all of the sliding surface of said one pin part even when said caliper member is separated from said torque plate member.

17. A sliding caliper disc brake comprising a rotatable disc, a torque plate member for fixing to a vehicle frame or like portion, a caliper member straddling a minor portion of the periphery of the disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, motor means in the caliper member for directly urging one pad means onto one side of the disc to cause the caliper member to slide relative to the torque plate member to apply by reaction the opposite pad means to the other side of the disc, and a connection between the caliper member and the torque plate member comprising a pin element having a sliding surface in sliding relation with a complementary surface of an opening in one of said members, fastening means securing said pin element with respect to the other of said members, and sealing means extending between said pin element and said one of said members and at all times enclosing all of said sliding surface, said sealing means having one end sealed to said one of said members and having its other end sealed to said pin element so as to protect all of the sliding surface of said pin element even when said caliper member is separated from said torque plate member.

18. A sliding caliper disc brake comprising a rotatable disc, a torque plate member for fixing to a vehicle frame or like portion, a caliper member straddling a minor portion of the periphery of the disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, motor means in the caliper member for directly urging one pad means onto one side of the disc to cause the caliper member to slide relative to the torque plate member to apply by reaction the opposite pad means to the other side of the disc, and a connection between the caliper member and the torque plate comprising a first component having a sliding surface slidably received in an opening in one of said members, a second component abutting said first component and in releasable engagement with the other of said members to clamp said first component against the other of said members, and sealing means extending between said first component and said one of said members and having releasable engagement with both so as to retain said first component in said opening, said sealing means having one end sealed to said one of said members and having its other end sealed to said first component so as to protect all of the sliding surface of said first component even when said caliper member is separated from said torque plate member.

19. A sliding caliper disc brake comprising a rotatable disc, a caliper member straddling a minor portion of the periphery of the disc and slidable parallel to the axis of said disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, a torque plate member adapted for fixing to a vehicle frame, a pin member having a sliding surface received in a complementary opening in one of the two first mentioned members for guiding and supporting said caliper member in its axial movement relative to the torque plate member, and means for rigidly connecting said pin member to the other of said first mentioned members comprising a clearance opening in one of the three members a bolt having a head engaging said one of the three members at one end of said opening and extending with clearance through said opening into screw threaded engagement with one of the two last

mentioned members an abutment on said one of the two last mentioned members engaging said one of the three members at the opposite end of the opening, said head and said abutment clamping between them said one of the three members at opposite ends of the opening thereby rigidly fixing said pin to the other of said first mentioned members, said clearance opening being of a size that there is unobstructed spacing between all of that portion of said bolt passing through said clearance opening in the one of said three members whereby said bolt portion is at all times out of engagement with said one member.

20. A sliding caliper disc brake comprising a rotatable disc, a torque plate member for fixing to a vehicle frame or like portion, a caliper member straddling a minor portion of the periphery of the disc for moving friction pad means disposed on opposite sides of the disc into braking engagement with the disc, motor means in the caliper member for directly urging one pad means onto one side of the disc to cause the caliper member to slide relative to the torque plate member to apply by reaction the opposite pad means to the other side of the disc, and a connection between the caliper member and the torque plate member comprising a pin element which has a sliding surface in sliding engagement with a wall of an opening in one of said members and which is releasably fixed to the other of said members, and sealing means extending between said pin element and said one of said members while having no connection with the other of said members, said sealing means at all times enclosing all of said sliding surface, said sealing means having one end sealed to said one of said members, and having its other end sealed to said pin element so as to protect all of the sliding surface of said pin element even when said caliper member is separated from said torque plate member.

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