

March 3, 1970

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3,498,421

HYDRAULIC DISK BRAKE WITH MECHANICAL ACTUATING MEANS

Filed Sept. 22, 1967

3 Sheets-Sheet 1

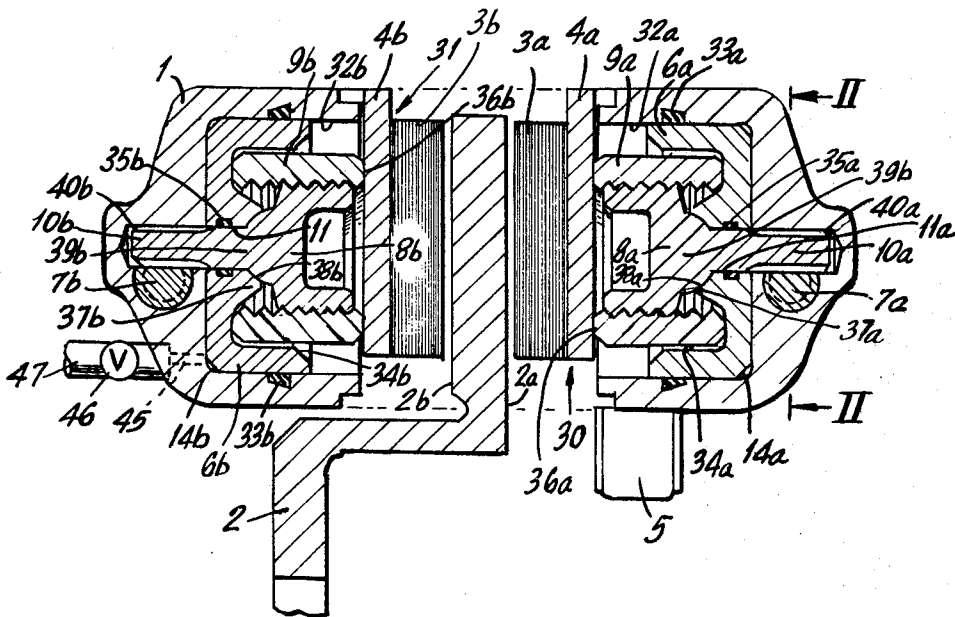


FIG. 1

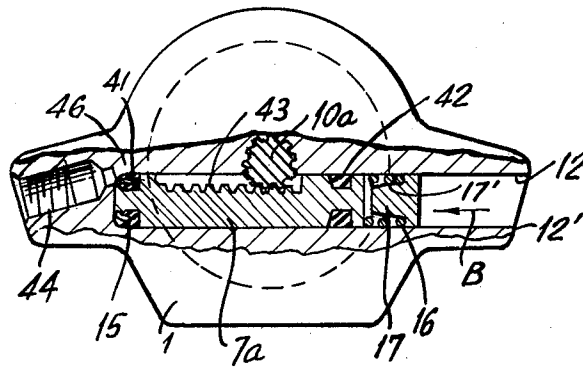


FIG. 2

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3 Sheets-Sheet 2

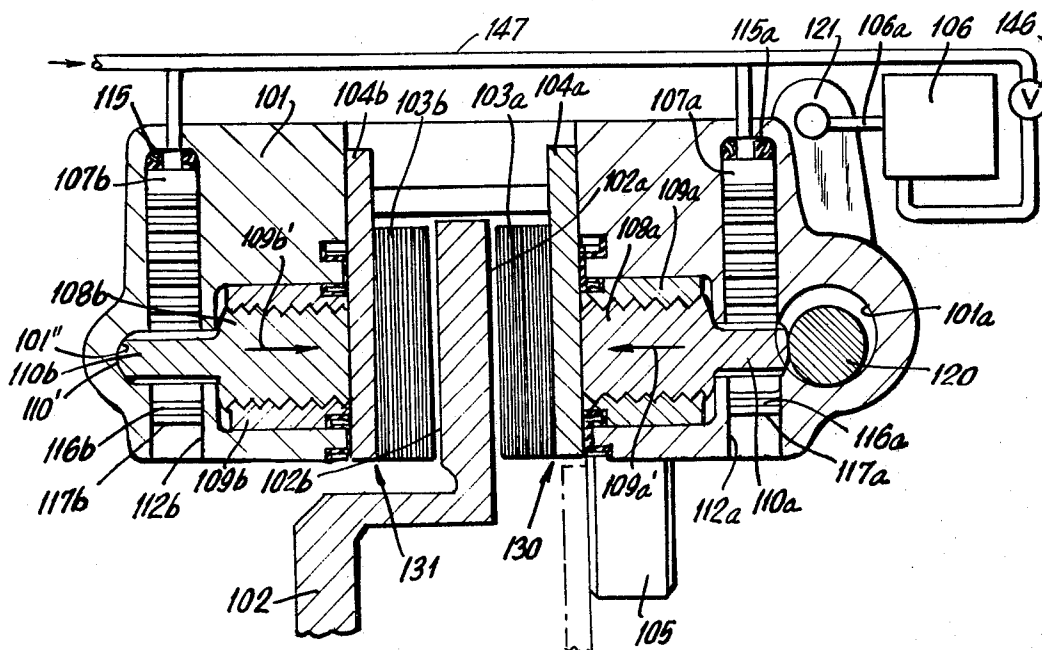


FIG. 3

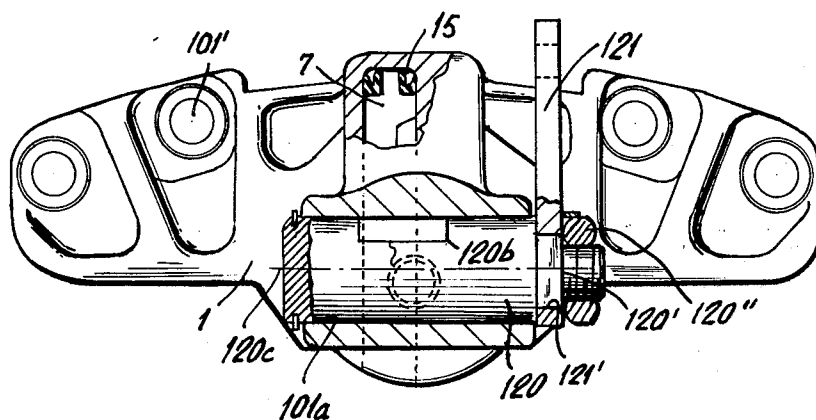


FIG. 4

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3 Sheets-Sheet 3

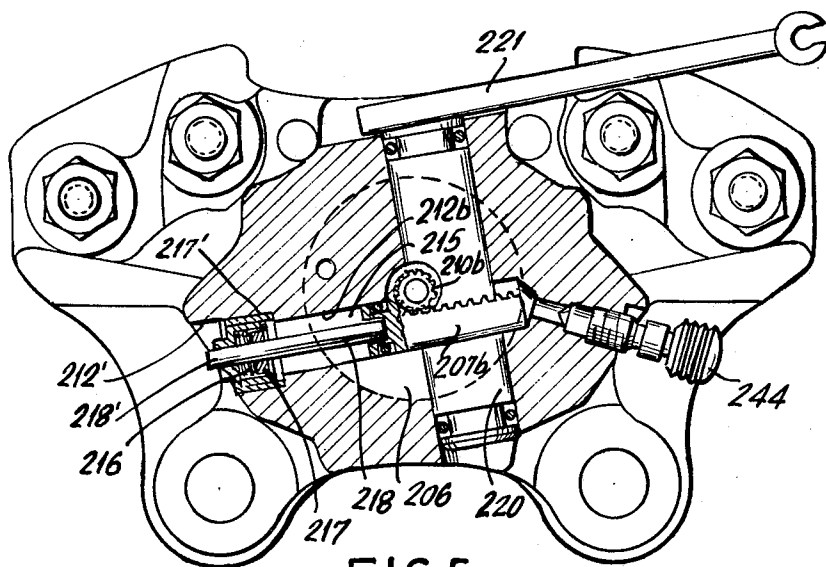


FIG. 5

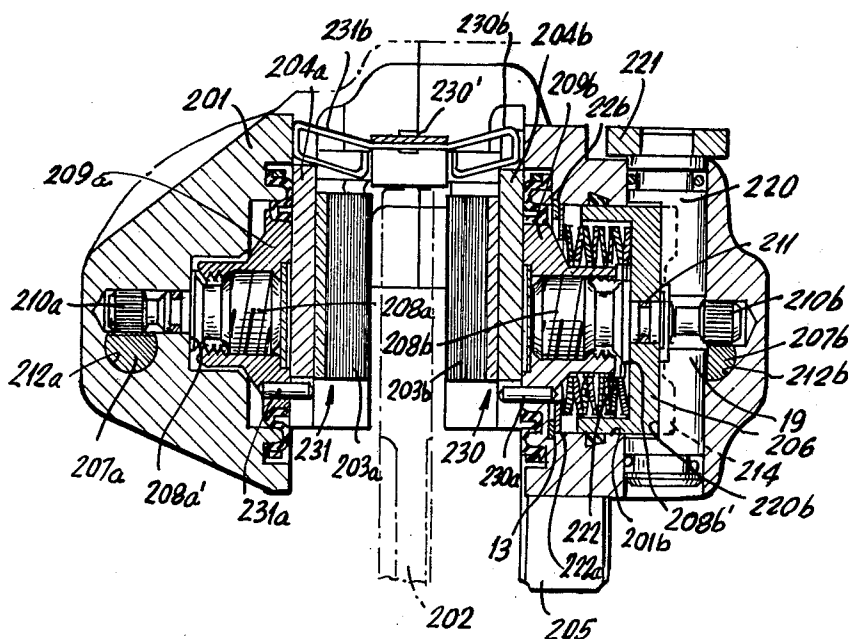


FIG. 6

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HYDRAULIC DISK BRAKE WITH MECHANICAL ACTUATING MEANS

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U.S. Cl. 188—152

11 Claims

ABSTRACT OF THE DISCLOSURE

A motor-vehicle disk brake having a hydraulic actuating piston slidable in a disk-brake yoke and having a relatively small effective area (as contrasted with that of the power piston) and wherein, between the auxiliary actuating piston and the backing plate of the brakeshoe, a mechanical rack-and-pinion threaded spindle drive is provided to advance the shoe through the brake play prior to application of the main brake force.

My present invention relates to a disk-brake system and, more particularly, to a hydraulically actuatable disk brake with an auxiliary piston or actuating means.

In the commonly assigned copending application Ser. No. 601,501, filed Aug. 15, 1966, and entitled "Hydraulic Disk Brake" (now U.S. Patent 3,371,755), there is described a disk-brake system having means for automatically compensating the progressive wear of the brake linings by repositioning of the power piston abutting the brakeshoe and a system for mechanically advancing the brakeshoes independently of or in conjunction with their hydraulic actuation. In that system, each wheel-brake cylinder is provided with a main piston and an auxiliary piston acting jointly upon an associated brakeshoe, the two pistons being interconnected by coupling means e.g. a thread which is unidirectionally effective in such manner that the auxiliary piston may move forward independently of the main piston but an operative displacement of the latter entrains the auxiliary piston and, with it, the brakeshoe. The auxiliary piston is received in a fluid chamber formed by the brakeshoe support, e.g. a yoke spanning the disk periphery as is well known per se, while the main piston moves in a cylinder of its own. The working face of the main piston in its cylinder is substantially larger than the working face of the auxiliary piston in the aforementioned fluid chamber so that, if both fluid spaces are simultaneously subjected to hydraulic pressure from a common fluid source or from separate sources, these smaller auxiliary pistons will rapidly advance to urge the brakeshoe under relatively low pressure against its confronting disk surface whereas the larger main piston will lag behind, being held back by a suitable biasing force, until the brakeshoes make contact with their disks. After overcoming this biasing force, and with a delay due to an inherent lost motion of the unidirectional coupling means, the main piston will then supplement the braking force exerted by the auxiliary piston. The same lost motion, incidentally, allows a limited reverse movement of the auxiliary piston with reference to the main piston upon a subsequent release of the hydraulic pressure, so as to facilitate the disengagement of the brakeshoe from the disk. Furthermore, the force transmission from the main piston to the auxiliary piston takes place through the intermediary of the housing shiftably mounted on the support or yoke which defines the fluid chamber for the auxiliary piston and is connected therewith through the aforementioned unidirectional coupling means.

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In a preferred embodiment incorporating this construction, the auxiliary piston is generally mushroom-shaped so as to have a relatively wide head bearing in a stable manner upon the brakeshoe and a relatively narrow stem received in a shiftable housing. A wedge member, positively connected with the housing for maintaining contact therewith through the intermediary of a restoring spring, forms part of the unidirectional coupling by cooperating with a set of spherical rotary bodies which surround the stem of the auxiliary piston and are clamped between the latter and a frustoconical bore of the wedge member whenever the housing moves forwardly beyond the permissible tolerance with reference to the stem. This housing also constitutes a convenient anchorage for a manually operable control member designed to displace the auxiliary piston independently of or supplementary to the action of the hydraulic control member, e.g. in response to actuation of the usual emergency-brake, parking-brake or locking-brake lever of the vehicle. In fact, the main piston need not bear directly upon the housing but may be coupled therewith by way of the same control member, the latter arrangement permitting a repositioning of the main cylinder at a location remote from the auxiliary cylinder or fluid chamber so as to allow for a more effective cooling of this main cylinder.

As noted earlier, the prior application provides for a pressure piston which is subjected to the primary hydraulic pressure as well as a second piston adapted to bear upon the brakeshoe over a contact area or cross-section which is less than the effective hydraulic cross-section of the power cylinder while the unidirectionally effective coupling is provided between these pistons to permit axial separation thereof in the direction of brake actuation. This arrangement has, however, the disadvantage that when the pistons are mounted upon the oscillating portions of the vehicle chassis, namely the unsuspended wheel axle and nondamped structures depending from the main portion of the chassis by a torsion bar or spring suspensions, the vibrations cause an impermissible relative movement between the pressure piston and the contacting piston. When brakes of this type are provided as so-called floating-yoke brakes, they tend to bind and become ineffective. Additionally, the rear portions of the yoke must be provided with openings to permit readjustment of the mushroom-shaped piston by its stem and screw-type closures or plates must be provided to cover these openings. This involves difficulty with respect to access and with respect to the assembly and production of the brakes, especially since these cover enclosures must be sealed against hydraulic pressure. Some other minor disadvantages of these systems derive from the fact that they cannot be fabricated easily, are relatively large and cannot be positioned in small spaces, require special apparatus for resetting the position to the brakeshoes and removing same, etc.

It is the principal object of the present invention, therefore, to provide a brake system of the general type described in the aforementioned patent application but improving on that system.

Another object of this invention is to provide a relatively compact brake of low volume and bulk which is easily mounted in an automotive vehicle, which can be used on the nonresiliently supported portions of the body, which is easily adjusted and which avoids the difficulties hitherto encountered with the systems previously described.

These objects and others which will become apparent hereinafter are attainable, in accordance with the present invention, by providing between the auxiliary actuating high-speed piston and the brakeshoe, a mechanical drive arrangement or transmission which transfers the actuating

force of the latter piston to the backing plate of the brake-shoe. This mechanical drive is, according to the invention, constituted from a rack-and-pinion arrangement acting upon the piston and having a pinion connected to a threaded spindle onto which a nonrotatable, axially shiftable adjusting nut is threaded. This nut has a radial contact face adapted to bear upon a backing plate of the brakeshoe.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is an axial cross-sectional view of a hydraulic disk brake embodying this invention;

FIG. 2 is an elevational view partly in section along the lines II—II of FIG. 1 showing the rack-and-pinion arrangement;

FIG. 3 is an axial cross-sectional view through the yoke of a modified disk brake having means for manually actuating one of the brakeshoes;

FIG. 4 is an elevational view, partly broken away, of the actuating system;

FIG. 5 is an elevational view, partly broken away of still another system embodying the invention; and

FIG. 6 is an axial cross-sectional view through the device of FIG. 5.

In the embodiments of FIGS. 1 and 2, the brake yoke is represented at 1 and is disposed along the periphery of a brake disk 2 whose braking faces 2a and 2b are respectively confronted by the brake linings 3a and 3b of a pair of brakeshoes 30 and 31 whose backing plates 4a and 4b have the linings bonded to them. The yoke 1 has a flange case integrally therewith and secured to the axle-housing flange adjacent the wheel of a motor vehicle, the disk 2 being secured by conventional means to the vehicle wheel disk or its rotary axle. Thus the brake illustrated in FIGS. 1 and 2 constitutes a disk-type wheel brake of the automotive vehicle. A pair of power pistons 6a and 6b are received within the wheel-brake cylinders 32a and 32b formed by the yoke 1 on opposite sides of the disk 2 such that the axis of these cylinders extends in the direction of movement of the pistons 6a and 6b and perpendicularly to the braking faces 2a and 2b of the disk. Seals 33a and 33b prevent escape of the brake fluid around the pistons 6a and 6b which they slidably engage. The pistons 6a and 6b are connected each with a respective sleeve or nut 9a or 9b of the threaded-spindle means which is axially shiftable within the piston 6a or 6b but is restrained from rotation therein. To this end, the pistons 6a and 6b can be formed at 34a and 34b with concavities open in the direction of the backing plate 4a or 4b of the respective brakeshoe and of a rectangular or other polygonal cross-section for engagement with the correspondingly polygonal outer periphery of the sleeves 9a and 9b.

The threaded-spindle assembly comprises members 9a and 9b which constitute nuts threadedly engaging an adjusting spindle 8a and 8b extending through the respective nuts. The spindles 8a and 8b are generally mushroom-shaped and have axially extending shanks 10a and 10b passing rotatably through the respective pistons 6a and 6b and sealed relatively thereto via sealing rings 35a and 35b. The members 9a and 9b bear against the backing plate 4a and 4b via relatively narrow radial contact zones over a relatively large cross-section as represented at 36a and 36b. Each of the pistons 6a and 6b is also provided with a central boss 37a and 37b surrounding the axial passage 11 through which the spindles 10a and 10b extend and defining a socket 38a or 38b for the correspondingly shaped portion 39a, 39b of the adjustment member 8a or 8b. The portions 38a, 39a and 38b, 39b conform to surfaces of revolution centered on the axis of the spindles so as to permit rotation of the members 8a and 8b and axial force transfer between these members and the respective pistons 6a and 6b.

The extremities of the shanks 10a and 10b remote

from the backing plates 4a and 4b are formed as pinions whose teeth are indicated at 40a and 40b, respectively in mesh with a rack 7a or 7b constituting an actuating piston or plunger. Each actuating piston, as shown for the piston 7a in FIG. 2, is provided at its extremity with a pair of gland-type seals 41, 42 and along an intermediate portion, an array of axially spaced teeth 43 in mesh with the teeth 40a or 40b of the respective pinion 10a or 10b. Furthermore, each lobe of the yoke is provided rearwardly of the respective cylinder 32a and 32b with a bore 12 slidably receiving the respective actuating piston 7a and 7b and defining therewith working chambers as represented at 15 communicating via an inlet port 44 with the hydraulic brake network which includes a master cylinder actuable by the brake pedal and adapted to drive hydraulic fluid through the port 44 into chamber 15. The pistons 6a and 6b also define respective working chambers 14a and 14b in the cylinder bores 32a and 32b which are connected to the same hydraulic network, e.g. via a passage 45 in each lobe of the yoke. A forward-pressure valve 46 is provided in the supply line to the main piston chambers 14a and 14b and opens only upon the attainment in the transmission network of a predetermined elevated pressure to connect these chambers with the hydraulic lines which otherwise are blocked. Thus each piston 7a and 7b is shifted hydraulically prior to the pressurization of the respective main brake chamber 14a or 14b.

In normal operating conditions, the brake yoke 1 is stationary while the disk 2 is rotating and the brakeshoes 30 and 31 have been thrown back from the braking faces 2a and 2b of the disk after the previous brake operation. When the brake pedal is operated, hydraulic pressure is forced through port 44 and to line 47 communicating with passage 45 and initially shifts the pistons 7a and 7b relatively to the axis of the pinions 10a and 10b in mesh therewith, thereby rotating the spindles 8a and 8b within the adjusting nuts 9a and 9b which are held against rotation. The brakeshoes 30 and 31 are thus advanced axially until their linings 3a and 3b bear against the braking faces 2a and 2b of the disk 2. The brake-fluid consumption is, as determined by the relatively small volume of the cylinder bores within which the auxiliary pistons 7a and 7b ride, relatively little so that the corresponding displacement of the brake pedal necessary to take up the brake play is negligible.

As a result of the engagement of the braking faces 2a, 2b by the brake linings 3a and 3b of the faces 2a and 2b of disk 2, a further increase in the brake-fluid-volume requirements of the chambers 15, etc. of the cylinders 43, etc. is not possible and the pressure at line 47, etc. of the fluid-transmission network increases rapidly, opens the pressure-responsive valve 46, etc. and admits hydraulic fluid under the higher pressure to the chambers 14a and 14b behind piston 6a and 6b. The latter need undergo no significant displacement as the brake linings 3a and 3b already abut the braking faces 2a and 2b so that the elevated brake pressure immediately is translated into a friction force at the disk 2 via the spindle 8a and 8b of each piston 6a or 6b and the respective abutment nut 9a, 9b which presses against the backing plate 4a, 4b of each shoe. The stroke of each piston 6a, 6b thus corresponds only to that determined by frictional wear of the brake lining 3a or 3b and the yield or distention of the support system.

This stroke is so meager that the effective cross-sectional areas of the piston 6a and 6b can be made relatively large without increasing the stroke of the master cylinder or the fluid requirements of the brake, it being noted that the fluid requirement V_m of the main pressure stroke can be represented by $V_m = (A_1 \times S_1 + A_2 \times S_2)$ where A_1 and A_2 are the effective surface areas of pistons 6a and 6b respectively and S_1 and S_2 are the strokes of these pistons. If the fluid volume V_a required to displace the auxiliary piston 7a and 7b and rotate the spindles 8a

and 8b is represented by $V_a = (a_1 \times s_1 + a_2 \times s_2)$, the total volume requirement of the wheel-brake system is

$$V = V_a + V_m$$

a_1 and a_2 represent the cross-sectional areas of the bores 12 while s_1 and s_2 are the strokes of the auxiliary pistons 7a and 7b. The force applied to the auxiliary pistons is represented as $F_a = p(a_1 + a_2)$ while the main braking force is $F_m = P(A_1 + A_2)$ where p is the initial pressure in the hydraulic lines and P is the pressure in chambers 14a and 14b when pistons 7a and 7b have been immobilized be contact of the brakeshoes 30 and 31 with the disk 2. From these relationships it can be seen that a relatively small force F_a is required to initially bring the brakeshoes into contact with the disk since this force need only overcome the inertia of the system. The areas a_1 and a_2 are relatively small and, with a stroke s_1 and s_2 determined only by the brake play, the fluid volume V_a required for initial movement of the brakeshoes into contact with the disk can be minimized in spite of the fact that the areas A_1 and A_2 of the main cylinders and pistons are relatively large. Since these areas are large, the brake force F_m applied by them to the shoes is considerable while the strokes S_1 and S_2 are held to the minor movement required for yielding of the brake support and wear of the linings. Preferably, the hydraulic ratio between the master cylinder and the wheel-brake cylinder is relatively high in terms of the force applied to the latter with a relatively small total volume of brake-fluid displacement. Note that the pistons 6a and 6b do not aspirate fluid into the chambers 14a and 14b when the spindles 8a and 8b advance the nuts 9a and 9b in the direction of the disk 2.

Upon release of the brake, a restoration of the brakeshoes to their original rest positions is permitted by the action of the restoring springs acting upon each of the auxiliary pistons 7a and 7b as represented at 16 in FIG. 2. The springs 16 are seated against a respective friction element 17 which is axially shiftable in the bore 12 and has a frustoconical boss 17' receiving the spring 16 between itself and the surrounding wall of this bore. When the wear of the brake linings 3a and 3b is less than the normal brake play, the pistons 7a and 7b are shifted toward the friction element 17 but do not contact it with force, while compressing the spring 16. Upon release of the brake pedal, the spring 16 shifts each rack-like piston 7a, 7b in the opposite direction to withdraw the nut 9a, 9b from the backing plate 4a, 4b and permit the surfaces 2a and 2b to fling the shoes 30 and 31 outwardly. When, however, the brake-lining wear exceeds the normal brake play, the rack 7a abuts the frictional member 17 directly and shifts it along the bore 12 with the hydraulic force developed by member 7a. Upon replacement of the brakeshoes 30 and 31, the original brake play can be restored merely by inserting a tool through the open end 12' of bore 12 to shift member 17' and the respective piston 7a or 7b in the opposite direction (arrow B) until the system once again assumes the position illustrate in FIG. 2.

In FIGS. 3 and 4, I show a modified brake system in which the brake disk 1 or 2 is sandwiched between a pair of brakeshoes 130 and 131 shiftable in a yoke 101 attached at 105 to the axle housing adjacent the vehicle wheel for movement toward and away from the respective braking faces 102a and 102b along the outer periphery of this disk. The brakeshoes 130 and 131 have respective linings 103a and 103b confronting the braking faces 102a and 102b of the disk 102 and bonded to backing plates 104a and 104b guided in the yoke 101 in the usual manner (e.g. via bolts 101a interconnecting both lobes of the yoke).

Each yoke half is here provided with a respective non-rotatable adjustment nut 109a or 109b which is shiftable in the direction of arrow 109a' and 109b' respectively for actuation of the brake. In this embodiment, the hydraulic force necessary to actuate the brake derives from a hy-

draulically operable cylinder 106 independent of the yoke 101 and connected via a piston rod 106a to an actuating arm 121. The actuating arm 121 has a rectangular socket 121' hugging the correspondingly shaped head 120' of an eccentric 120 journaled in the right-hand side of yoke 101. A locking nut 120'' clamps the actuating lever or arm 121 in place while a split ring 120a, remote from head 120', retains the eccentric shaft in the bore 101a provided therefor. The shaft 120 has its eccentric portion 120b offset from the axis of rotation 120c of this shaft, the axis running parallel to the braking faces 102a, 102b of the disk, transversely of the axis of rotation of the disk 102 and perpendicularly to the direction of displacement of 109a' and 109b' of the brakeshoes 130, 131. The eccentric portion 120b of shaft 120 bears against the pinion-forming extremity or stem 110a of a spindle 108a at the right-hand lobe of the yoke 101 and, upon rotation of the lever 121 in the clockwise sense (FIG. 3) shifts the spindle 108a and its brakeshoe 130 against the braking face 102a of the disk. The reaction force developed by the shaft 120 draws the yoke 101 which is mounted on the axle housing with freedom of limited axial movement, to the right to apply brakeshoe 131 to the other face of the disk.

The other lobe of yoke 101 is also provided with a spindle 108b threadedly received by the nonrotatable but axially shiftable nut 109b and bearing at 110' in a socket 101'' of the yoke. The spindle 108b has a toothed stem 110b forming a pinion analogous to the pinion 110a of spindle 108a. The pinions 110a and 110b of each of the brakeshoes 130 and 131 are in mesh with respective auxiliary piston 107a and 107b slidable in respective bores 112a and 112b parallel to the braking faces 102a and 102b and perpendicular to the direction of displacement of the respective brakeshoes 109a' and 109b'. The chambers 115a and 115b of the pistons 107a and 107b are connected in the hydraulic network 147 which is pressurized by the master cylinder and delivers hydraulic fluid to the wheel-brake cylinder 106 by a valve 146 of the type described at 46 in FIGS. 1 and 2. A friction member 117a and 117b is mounted in each bore 112a, 112b and serves as a seat for respective spring 116a or 116b bearing upon the piston 107a or 107b. When the brake piston is depressed, initial increase in hydraulic pressure advances the pistons 107a and 107b downwardly (FIG. 3) to drive the spindles 108a and 108b and thus advance the nonrotatable nuts 109a and 109b in the direction of arrows 109a' and 109b' to bring the brakeshoes 130 and 131 into contact with the braking forces 102a and 102b of the disk 102. As soon as the brakeshoes contact the disk (with continued pressure on the brake pedal), the pressure increases sharply in line 147 and hydraulic fluid is forced past the valve 146 into the wheel-brake cylinder 106 to draw the actuating arm 121 in the clockwise sense (FIG. 3) and apply the main braking force to the stem-like pinions 110a and 110b as indicated earlier. Upon release of the brake pressure, the arm 121 permits retraction of the threaded-spindle arrangement 108a, 109a, and 108b, 109b, the springs 116a and 116b establishing the brake play as previously described in connection with FIGS. 1 and 2.

Another embodiment of the invention is illustrated in FIGS. 5 and 6 which show a brake yoke 201, the right-hand half of which serves for mounting the yoke via lugs 205 with freedom of axial movement upon the axle housing of a motor vehicle. The wheel-brake disk 202 which is secured to the wheel disk of a vehicle wheel, rotates relatively to the yoke 201 and is peripherally surrounded thereby over a sector of its path. A pair of brakeshoes 230 and 231 flank the disk 202 and are guided by pins 230a and 231a in the adjusting nuts 209a and 209b of the brake-actuating system. In addition, a spring clip 230' has arms 230b and 231b forming guides for the brakeshoes 230 and 231 at the upper part of the brake yoke. The brakeshoes 230 and 231 have brake linings

203a and 203b confronting the disk 202 and bonded to backing plates 204a and 204b.

In this embodiment, a pair of pistons 207a and 207b respectively displace the nut 209a, 209b to advance the brakeshoes 230 and 231 through the desired brake play. To this end, the pistons 207a and 207b which are shiftable in respective bores 212a and 212b form racks meshing with pinions 210a and 210b affixed to the ends or integral with respective threaded spindles 208a and 208b. The spindles are threadedly received in the nuts 209a and 209b and have shoulders 208a' and 208b' respectively seated against the yoke 201 and the actuating piston 206 which is here built into the yoke 201. The piston 206 defines, at the right-hand side of the yoke 201, a main working chamber 214 energizable with hydraulic fluid via the forward-pressure valve 46 previously described and is also engageable by the eccentric portion 220b of an eccentric shaft 220 whose axis runs perpendicularly to that of the spindle 208b and the rack 207b.

As can also be seen from FIG. 6, the spindle 208b is rotatably mounted in a bore 211 of the power piston 208 which is held yieldably to the right by a stack 222 of dished-disk spring washers of the Belleville type. These springs are seated against a ring 222a which, in turn, is retained by a split ring 222b anchored in the wall of the yoke portion 201' defining the cylinder 201b. The piston 207b (as illustrated in FIG. 5) as well as the piston 207a may be connected via a rod 218 to a friction body 217 at the open end 212' of the bore 212b, the friction body being shiftable within a casing 217' against the force of restoring spring 216 in the form of a stack of Belleville washers. The end 218' of the rod 218 may emerge from the casing 217' to allow the rod 218 to be forced inwardly when the device is to be reset.

For normal brake actuation, hydraulic fluid is supplied to the bores 212a and 212b via, for example, the fitting 244, thereby shifting the rack-forming pistons 207a and 207b to rotate the spindles 208a and 208b and bring the nonrotatable nuts 209a and 209b into axial engagement with the backing plates 204a and 204b of the respective brakeshoes and advance these brakeshoes until the brake linings 203a and 203b engage the braking faces of the disk. When the displacement of the pistons 207a and 207b exceeds the normal brake play due to increased wear of the brakeshoes, the rods 218 displace the friction bodies 217 (e.g. to the left in FIG. 5) until the restoring springs 216 are fully compressed and the friction body 217 immobilized. Further sliding movement of rod 218 compensates for the lining wear so that, upon release of the brake pedal, the springs 216 return the pistons 207a and 207b in the opposite direction through a distance only to the predetermined brake play. After the initial displacement of the brakeshoes 230 and 231 against the disk 202, the augmented brake pressure is applied to the large-area piston 206 to displace the latter in the direction of the disk and entrain the spindle assembly 208b, 209b as well as the brakeshoe 230 in that direction. The reaction force is applied to the yoke 201 which is shifted to the right to transmit force via the spindle assembly 208a and 209a to the brakeshoe 231. The total stroke is determined by the yielding of the yoke and the wear of the brakeshoes. When it is desired to provide a locking brake, parking brake or emergency brake, the eccentric shaft 220 is employed and is provided with an arm 221 which can be engaged by a bowden line or other flexible-cable arrangement for operation by the hand-brake lever of the vehicle. When lever 221 is rotated, the eccentric 220 shifts the piston 206 to the left and may retain it in its left-hand position as long as the flexible cable (not shown) remains tensioned.

I claim:

1. In a disk brake comprising a brake disk, a housing positioned along the periphery of said disk, a brakeshoe mounted in said housing for movement toward and away from said disk and engageable therewith to brake relative

rotation of said housing and said disk, main actuating means for applying said brakeshoe with substantial force to said disk, and auxiliary actuating means for advancing said brakeshoe in the direction of said disk prior to the application of the brakeshoe thereagainst with substantial force, the improvement wherein said auxiliary actuating means includes a hydraulically displaceable auxiliary piston mounted in said housing and shiftable therein under hydraulic pressure, and a mechanical transmission interposed between said auxiliary piston and said brakeshoe for displacing said brakeshoe upon movement of said auxiliary piston, said main actuating means including a cylinder, and a piston shiftable in said cylinder and having an effective area greater than the effective area of said auxiliary piston and operatively coupled with said brakeshoe for applying same against said disk, said mechanical transmission including a threaded-spindle assembly acting upon said brakeshoe and having an axis extending in the direction of displacement thereof, said auxiliary piston being shiftable in a direction transverse to said axis for operating said assembly.

2. The improvement defined in claim 1 wherein said mechanical transmission further includes a pinion provided on said assembly and a rack formed on said auxiliary piston and meshing with said pinion.

3. The improvement defined in claim 2 wherein said assembly includes a nonrotatable axially shiftable nut bearing upon said brakeshoe, and a spindle carrying said pinion and threadedly received in said nut for axially displacing same upon rotation of said spindle by said rack.

4. The improvement defined in claim 3 wherein said housing is provided with a bore opening along the surface of said housing and accessible thereat, said auxiliary piston being axially shiftable in said bore, said auxiliary actuating means further comprising friction means in said bore displaceable by said auxiliary piston upon movement of said brakeshoe beyond a predetermined brake play for resetting the predetermined brake play.

5. The improvement defined in claim 4, further comprising spring means in said bore acting upon said auxiliary piston for shifting same relatively to said friction means through a distance corresponding, upon motion transfer to said assembly, to said predetermined brake play.

6. The improvement defined in claim 5 wherein said friction means includes a rod extending through said bore and engaging said auxiliary piston, and a friction element mounted in said bore and engaging said rod, said spring means including a spring bearing upon said element and yieldably limiting displacement thereof upon movement of said rod.

7. The improvement defined in claim 5 wherein said friction means includes a friction element yieldably engaging the wall of said bore, said spring means being interposed between said friction element and said auxiliary piston.

8. In a disk brake comprising a brake disk, a housing positioned along the periphery of said disk, a brakeshoe mounted in said housing for movement toward and away from said disk and engageable therewith to brake relative rotation of said housing and said disk, a main actuating means for applying said brakeshoe with substantial force to said disk, and auxiliary actuation means for advancing said brakeshoe in the direction of said disk prior to the application of the brakeshoe thereagainst with substantial force, the improvement wherein said auxiliary actuating means includes a hydraulically displaceable auxiliary piston mounted in said housing and shiftable therein under hydraulic pressure, and a mechanical transmission interposed between said auxiliary piston and said brakeshoe for displacing said brakeshoe upon movement of said auxiliary piston, said main actuating means including an eccentric mounted in said housing and rotatable about an axis transverse to the direction of displacement

of said brakeshoe, and an actuating arm connected to said eccentric for rotating same.

9. In a disk brake comprising a brake disk, a housing positioned along the periphery of said disk, a brakeshoe mounted in said housing for movement toward and away from said disk and engageable therewith to brake relative rotation of said housing and said disk, main actuating means for applying said brakeshoe with substantial force to said disk, and auxiliary actuating means for advancing said brakeshoe in the direction of said disk prior to the application of the brakeshoe thereagainst with substantial force, the improvement wherein said auxiliary actuation means includes a hydraulically displaceable auxiliary piston mounted in said housing and shiftable therein under hydraulic pressure, and a mechanical transmission interposed between said auxiliary piston and said brakeshoe upon movement of said auxiliary piston, said housing being a yoke carrying a pair of brakeshoes each mounted for movement relatively to said disk and confronting respective brake faces thereof, each of said brakeshoes being provided with a respective auxiliary piston and a mechanical transmission interposed between the corresponding auxiliary piston and brakeshoe for displacing the latter upon hydraulic displacement of said auxiliary piston, said main actuating means including a cylinder, a piston having an effective area greater than the effective areas of said auxiliary pistons and acting upon said brakeshoes for applying same to said disk, said mechanical transmissions each including an axially shiftable nonrotatable nut mounted in said yoke and bearing upon the respective brakeshoe, a spindle threadedly received in the respective nut and journaled for rotation relatively to said housing about an axis parallel to the direction of displacement of said brakeshoes and perpendicular to said braking faces, said spindles each being formed remote

from the respective brakeshoes with stems forming pinions, said auxiliary pistons being shiftable perpendicularly to the axis of said spindles and being formed with racks meshing with the respective pinions, said auxiliary actuating means further comprising friction means cooperating with the respective auxiliary pistons for resetting the rest positions thereof to maintain a substantially constant brake play upon wear of the respective brake linings, and respective spring means acting upon said auxiliary pistons for displacing same upon release of the brake through a distance corresponding to the respective brake play.

10. The improvement defined in claim 9 wherein the piston of said main actuating means is mounted in said yoke for movement parallel to the axis of one of said spindles and said one of said spindles bears axially against said piston of said main actuating means.

11. The improvement defined in claim 9 wherein said main actuating means includes an eccentric mounted in said yoke for rotation about an axis perpendicular to the axis of one of said spindles and to the direction of displacement of the corresponding auxiliary piston, and an actuating lever connected with said eccentric and coupled with said piston of said main actuating means.

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DUANE A. REGER, Primary Examiner

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