United States Patent

[11] **3,631,676**

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[54] **DUAL-RATIO MASTER CYLINDER**
8 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **60/54.6 A,** 60/54.6
[51] **Int. Cl.** **F15b 7/00**
[50] **Field of Search** ..... 60/54.6, 54.6 A

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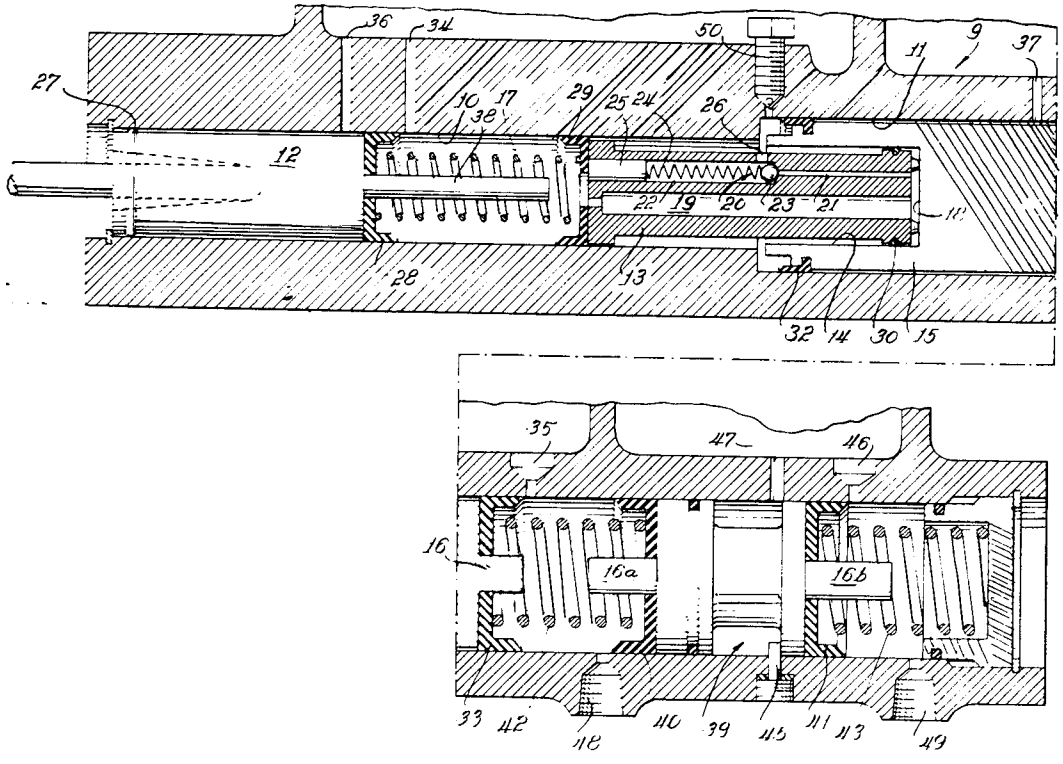
ABSTRACT: The present invention is a dual-ratio master cylinder comprising a housing with coaxially disposed cylinders of different diameters which have pistons of matching diameters operable therein. The larger of the pistons has a bore therein of a diameter matching the diameter of the smaller of the two cylinders. An additional piston matching the diameter of the bore and the diameter of the small cylinder is disposed therein and urged into contact with a wall in the bore by means of a spring interposed between it and the small piston. The additional piston is provided with a fluid passage therethrough and a valve-type sensing means which provides fluid communication with the cylinders at a predetermined value of the valve-type sensing means.



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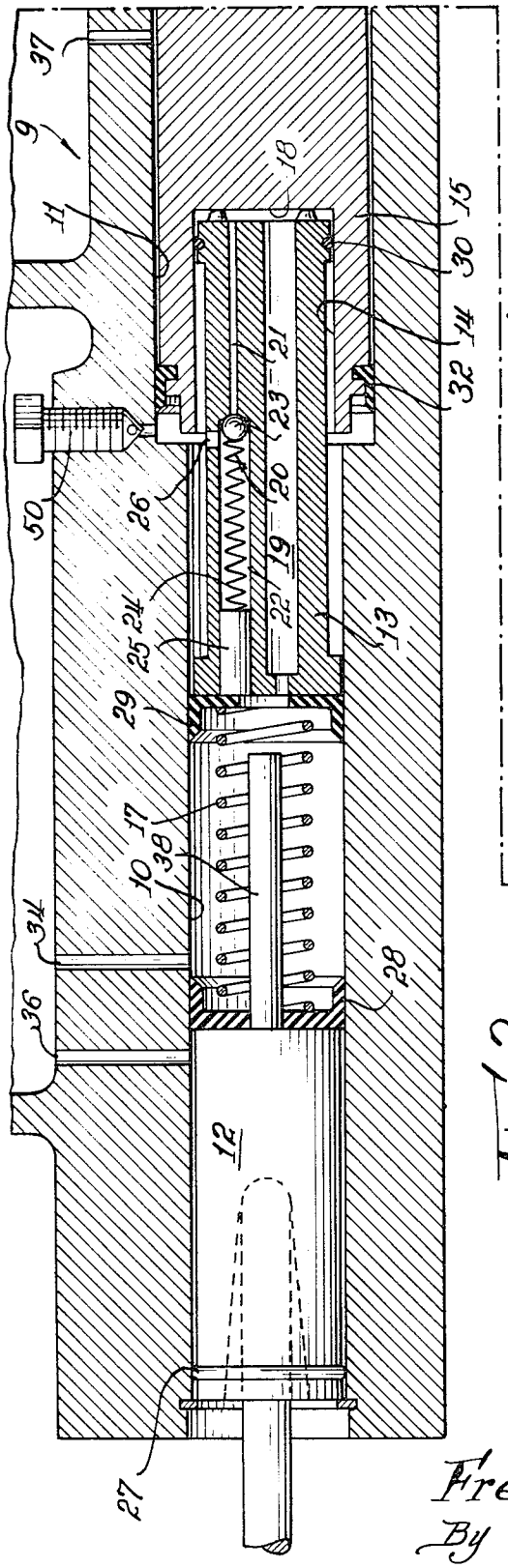


Fig. 1

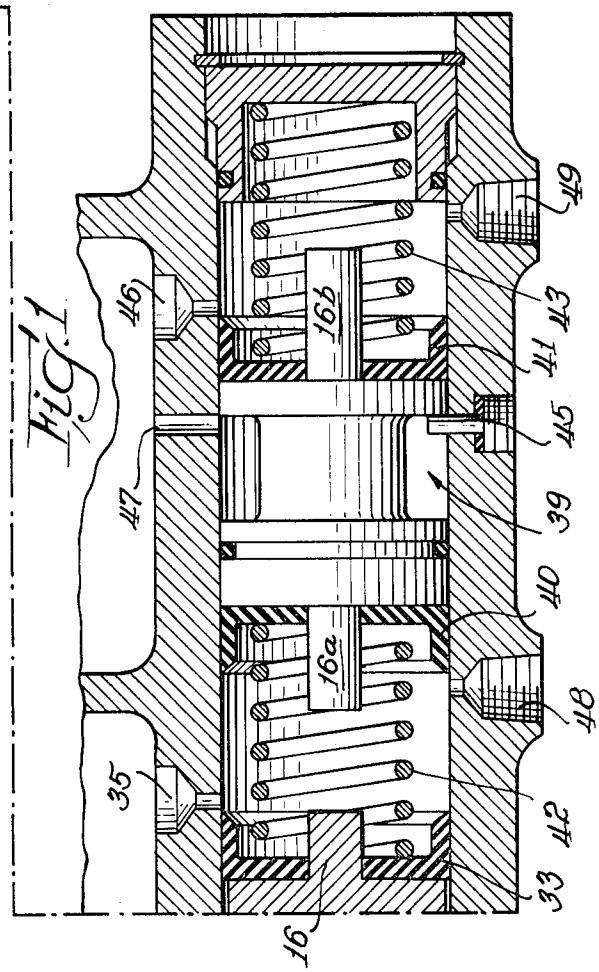
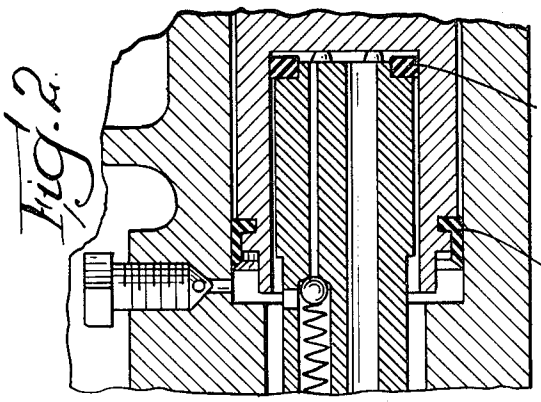


Fig. 2



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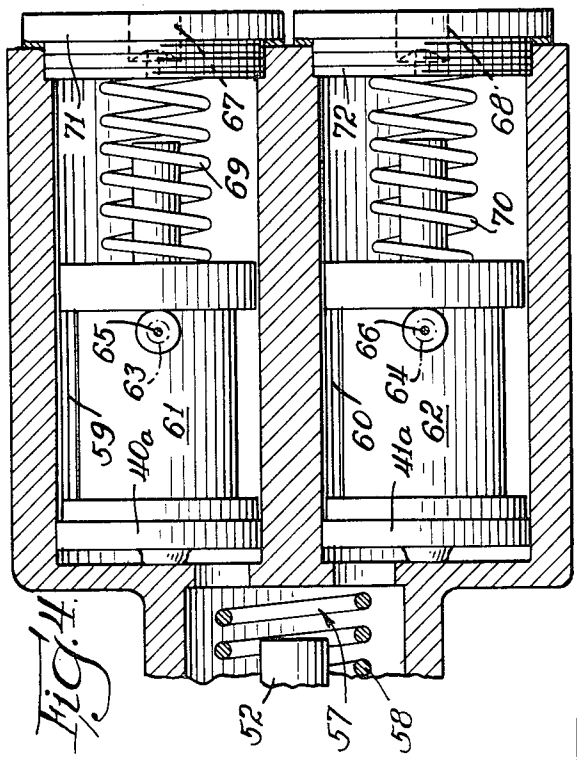

Fig. 4.

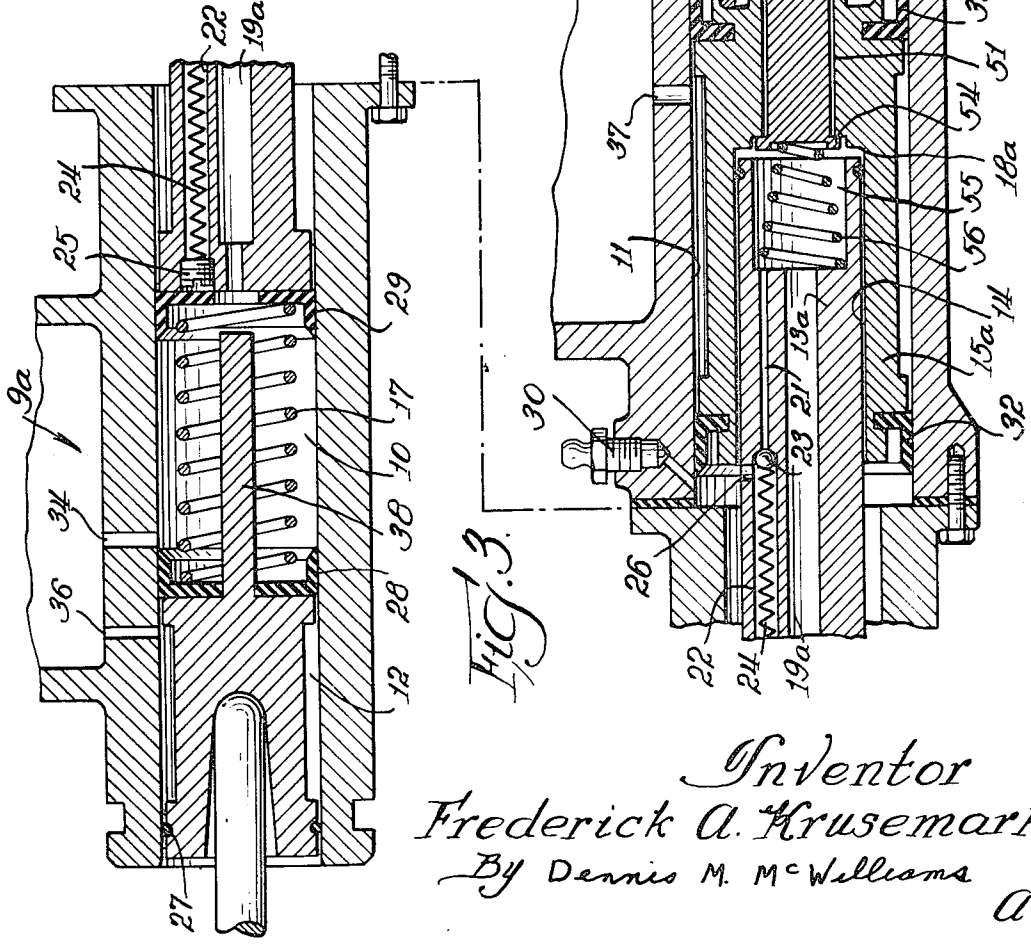

Fig. 3.

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DUAL-RATIO MASTER CYLINDER

SUMMARY OF THE INVENTION

The present invention relates to a dual-ratio master cylinder and comprises a housing having a large cylinder and a small cylinder, each having large and small pistons operable therein, respectively. A small second piston is carried in the small cylinder and a bore in the large piston which is urged against a wall in the bore by spring means interposed between the two small pistons. A hydraulic pressure sensing means carried by the small second piston is communicable with fluid passages which interconnect the cylinders with a passage in the small second piston.

Initially, in operation the fluid interposed between the small second piston and the wall of the bore in the large piston causes the two pistons to move in unison thereby delivering fluid in the braking system by the large piston. This may be termed the first stage. When the fluid pressure in the small cylinder reaches a predetermined value, the pressure-sensing means opens fluid communication with the cylinders which initiates the second stage of fluid delivery to the system thereby reducing pedal effort on further movement of the pedal because fluid from the small cylinder provides pressure against the face area of the forward end of the large piston, thus in this stage the small and large pistons no longer move in unison; the small piston moving further than the large piston during the second stage of operation.

The modified form of the present invention has an added feature, namely, a rod passing through the large piston which displaces fluid in the bore in the large piston approximately at the beginning of the second stage.

The purpose of the present invention is to provide an improved dual-ratio master cylinder which, during the initial stage of operation, provides a large volumetric supply of fluid to the system, which at a predetermined pressure, a second stage is initiated which reduces pedal effort and has substantially no further pedal travel than the conventional system.

The present invention also provides a fail-safe means which causes a reversion to the first stage in the event pedal travel is excessive; obviously a high volumetric supply of fluid is delivered to the system.

THE DRAWINGS

FIG. 1 is a vertical sectional view of a dual-ratio master cylinder according to the present invention, the rearward portion shown offset;

FIG. 2 is a view corresponding to a portion of FIG. 1 showing a different type of seal;

FIG. 3 is a vertical sectional view of a modified form of a dual-ratio master cylinder shown in FIG. 1, the rearward end portion being offset; and

FIG. 4 is a longitudinal sectional view, partially in plan, of the offset portion of FIG. 3 taken on line 4—4 of FIG. 3.

DESCRIPTION

Referring now to the drawings, there is shown in FIG. 1 a fluid reservoir 9, below which, and integral therewith, is a relatively small cylinder 10 and a relatively large cylinder 11 in coaxial alignment. Relatively small first and second pistons 12 and 13 respectively are operably disposed in said relatively small cylinder 10. The piston 13 is also operably disposed in a bore 14 in a relatively large piston 15 operably disposed in the relatively large cylinder 11. A protuberance 16 extends from the relatively large piston 15. A spring 17 is interposed between the relatively small first and second pistons, 12 and 13 respectively, thereby urging the relatively small second piston 13 against a wall 18 at the end of the bore 14.

The relatively small second piston 13 is provided with a longitudinal passage 19 extending therethrough and a check valve passage 20 consisting of a small-diameter passage 21 and a larger-diameter passage 22. This arrangement of components may be termed a check valve means. Disposed in the larger-diameter passage 22 is a ball 23 which is urged against

the small-diameter passage 21 by a spring 24 interposed between the ball 23 and a closure 25. The larger-diameter passage 22 is provided with a port 26 communicable with the relatively small and large cylinders 10 and 11 respectively.

The first relatively small piston 12 is provided with an O-ring 27 at its forward end and a lip seal 28 at its rearward end and the relatively small second piston 13 is provided with a lip seal 29 at its forward end and an O-ring 30 at its rearward end. A flat-faced seal 31 shown in FIG. 2 is interposed between the rearward end of the relatively small second piston 13 and the wall 18 of the bore 14 which is modification of that shown in FIG. 1. Lip seals 32 and 33 are provided at the forward and rearward ends respectively of the relatively large piston 15.

Recuperating ports 34 and 35 provide fluid communication between the reservoir 9 and the relatively small and relatively large cylinders 10 and 11, respectively, in close proximity to the lip seals 28 and 33 respectively. Reservoir ports 36 and 37 are in fluid communication with the relatively small and relatively large cylinders 10 and 11 respectively and are rearward of the lip seals 28 and 33 respectively.

A fail-safe protuberance 38 extends from the rearward end of the relatively small first piston 12 a predetermined distance from the forward end of the relatively small second piston 13 and serves as a fail-safe means hereinafter more fully explained. An additional relatively large piston 39 having protuberances 16*a* and 16*b* at opposite ends thereof is shown slideably disposed in the relatively large cylinder 11 in a position rearward of the relatively large piston 15 and is provided with a pair of lip seals 40 and 41, each being attached to an end of the relatively large piston 39. The relatively large piston 39 is provided with a stop means 45 whereby the rearward movement of the relatively large piston 39 is limited. A recuperating port 46 provides fluid communication between the fluid reservoir 9 and the relatively large cylinder 11 forward of the lip seal 41 and in close proximity thereto. A reservoir port 47 is communicable with the relatively large cylinder 11 rearward of the lip seal 41. A pair of fluid outlets 48 and 49 are shown in communication with the relatively large cylinder 11. Each outlet is adapted to be connected to a hydraulic line leading to a pair of wheel brakes.

A bleeder 50 communicable with the forward end of the relatively large cylinder 11 serves to remove trapped air.

OPERATION

The operation of the embodiment shown in FIG. 1 is as follows.

The application of pressure against the relatively small first piston 12 applies fluid pressure against the face of the relatively small second piston 13 which at its far end is in contact with the wall 18. A longitudinal passage 19 extends through the relatively small second piston 13 which by means of the O-ring 30 seals off fluid communication with the relatively large cylinder 11 thus causing the relatively large piston 15 to move in unison with the relatively small pistons 12 and 13 thereby delivering a relatively large volumetric supply of fluid to a hydraulic line leading to the wheel cylinders.

When the hydraulic pressure in the system reaches a predetermined value, the ball 23 of the check value means provides fluid communication with the relatively small and large cylinders 10 and 11 respectively thus initiating the second stage of operation during which fluid from the relatively small cylinder 10 is delivered against the face area of the relatively large piston 15 which, of course, includes the wall 18. Hence, at this stage, the pedal effort is reduced because the relatively small first piston 12 travels a further distance than the relatively large piston 15 in the volumetric supply of fluid to the wheel brakes.

It should be noted that, although the foot pedal travels slightly farther during the second stage than the conventional system, this is compensated for by the use of a larger piston than that used in the conventional system whereby the pedal travels a shorter distance as compared with the conventional

system and manifestly at a time when the brake is taken up which requires but minimal effort.

A fail-safe protuberance 38 serving as a fail-safe means will contact the forward face of the relatively small second piston 13, in the event that pedal travel becomes excessive, thereby causing the relatively small and large pistons to travel in unison and thus deliver the optimum in volumetric fluid supply.

The independent delivery of hydraulic fluid to each of a pair of wheel brakes is provided by the use of the relatively large piston 39 which has a pair of lip seals 40 and 41 one each mounted on the end faces thereof. The areas of the relatively large cylinder 11 forward of the lip seals 40 and 41 are provided with fluid outlets 48 and 49, respectively, each adapted to be connected to one each of a hydraulic line leading to a pair of wheel brakes whereby, in operation, fluid delivered from the master cylinder is delivered separately to one each of a pair of wheel brakes.

A modified form of the invention identified in FIG. 1 is shown in FIG. 3. The purpose of this modified form of the invention is to provide a means whereby a larger volumetric supply of fluid may be provided during the second stage of operation. The use of this means necessitates rearrangement and changes of some of the components. The components which are identical to those shown in FIG. 1 except as to size of some are given the same identifying number.

Referring now to FIG. 3, a relatively large piston 15*a*, a modified form of relatively large piston 15, is provided with a bore 51 extending axially through a wall 18*a* and having slideably operable therein a fluid displacement rod 52 provided with a seal 53 and an annular flange 54 serving as a stop means against the wall 18*a*.

A relatively small piston 13*a* is provided with a bore 55 having a spring 56 mounted therein and in contact with the fluid displacement rod 52 thus urging the annular flange 54 against the wall 18*a*. Longitudinal passage 19*a*, is in communication with the bore 55 and the relatively small cylinder 10. A wall 57 at the rearward end of the relatively large cylinder 11 serves as a stop means for the fluid displacement rod, 52. A return spring 58 is interposed between the wall 57 and the relatively large piston 15*a*.

FIG. 4 shows a pair of laterally disposed cylinders 59 and 60 longitudinally disposed below a fluid reservoir 9*a* and having slideably disposed therein a pair of pistons 61 and 62 respectively provided with a pair of lip seals 40*a* and 41*a* respectively at their forward ends. Reservoir ports 63 and 64 are in fluid communication with the cylinders 59 and 60 respectively having disposed therein tipping valves 65 and 66 respectively whereby fluid communication is provided to outlets 67 and 68 respectively one each of which is adapted to be connected to one pair of hydraulic lines leading to a pair of wheel brakes. A pair of return springs 69 and 70 are interposed between the pistons 61 and 62 respectively and a pair of walls 71 and 72 respectively whereby the pistons 61 and 62 are urged against the wall 57.

The operation of the embodiment shown in FIGS. 3 and 4 is similar in performance to the embodiment which is shown in FIG. 1 except for an additional feature, namely the fluid displacement rod 52, which moves in unison with the relatively large piston 16*a* until it contacts the wall 57 which serves as a stop means. At this stage, the face area of the relatively large piston 15*a* is reduced to the extent of the face area of the fluid displacement rod 52. Thus, during the second stage of operation, the pedal effort will be less than the embodiment shown in FIG. 1, and still have substantially the same pedal travel.

An additional modification shown in FIG. 4 pertains to a means for independently supplying fluid to wheel brakes, which comprises the pair of laterally disposed cylinders 59 and 60 longitudinally disposed below a fluid reservoir 9*a* provided with a pair of pistons 61 and 62 respectively which independently are connected to hydraulic lines one each of which leads to a pair of wheel brakes.

This modification was necessary in order to provide a stop means, namely the wall 57, for the fluid displacement rod 52.

Various of the features of the invention have been particularly shown and described, it should be obvious to one skilled in the art that various modifications may be made therein without departing from the scope of the invention.

I claim:

1. A pressure cylinder for a hydraulic brake system including a housing;

A. a first relatively small cylinder at the forward end of said housing;

B. a relatively large cylinder in coaxial alignment with said first relatively small cylinder;

C. a relatively large first piston having a bore therein operably disposed in said relatively large cylinder;

D. a relatively small first piston operably disposed in said relatively small cylinder and a relatively small second piston having a longitudinal passage axially extending therethrough, operably disposed in the said relatively small cylinder and in a bore in said relatively large piston;

E. a spring interposed between the said first and second relatively small pistons whereby the said relatively small second piston is urged into contact with a wall of said bore in said relatively large piston;

F. a sealing means disposed in the area of the end of the outer periphery of said relatively small second piston;

G. a pressure-sensing means disposed in the said relatively small second piston between small-diameter and larger-diameter passages which are communicable with the said longitudinal passage and the area in the relatively large cylinder forwardly of the said relatively large piston; and

H. a fluid reservoir in said housing provided with passages communicable with said relatively small cylinder and relatively large cylinder.

2. A pressure cylinder for a hydraulic brake system including a housing;

A. a relatively small cylinder at the forward end of said housing;

B. a relatively large cylinder in coaxial alignment with said relatively small cylinder;

C. a relatively large first piston having a bore therein operably disposed in said relatively large cylinder;

D. a relatively small first piston operably disposed in said relatively small cylinder;

E. a relatively small second piston operably disposed in said relatively small cylinder and in a bore in said relatively large piston;

F. a spring interposed between the said first and second relatively small pistons whereby the said relatively small second piston is urged into contact with a wall of said bore in said relatively large piston;

G. a sealing means disposed in the area of the end of the outer periphery of the said relatively small second piston;

H. a pressure-sensing means disposed in the said relatively small second piston between small-diameter and larger-diameter passages which are communicable with the said relatively small cylinder and relatively large cylinder in the area of the said relatively large piston;

I. a fluid reservoir in said housing provided with passages communicable with said relatively small cylinder and relatively large cylinder;

J. a first fluid reservoir recuperating port forward of the said relatively small first piston;

K. a second fluid reservoir recuperating port forward of the said relatively large piston;

L. a first fluid reservoir port rearward of the forward end of the said relatively small first piston;

M. a second fluid reservoir port rearward of the forward end of the said relatively large piston;

N. a first-piston lip seal at the forward end of the said relatively small first piston;

O. a second piston lip seal at the forward end of the said relatively large piston;

P. a third piston lip seal at the rearward end of the said relatively large piston;

Q. a fourth piston lip seal at the rearward end of the said relatively small second piston; and

R. a fluid outlet interposed between the said relatively large cylinder and the said hydraulic system.

3. A pressure cylinder as in claim 2 wherein the said sealing means is an O-ring.

4. A pressure cylinder as in claim 2 wherein the said sealing means is an annular ring disposed between the end of the outer periphery of said relatively small second piston and the said wall of the said bore.

5. A pressure cylinder as in claim 2 wherein a bleeder is provided at the forward end of the relatively large cylinder.

6. A pressure cylinder as in claim 3 wherein the said relatively small first piston is provided with a fail-safe protuberance engageable with said relatively small second piston thereby serving as a fail-safe means which causes a reversion to first stage operation.

7. A pressure cylinder for a hydraulic brake system including a housing;

A. a relatively small cylinder at the forward end of the said housing;

B. a relatively large cylinder in coaxial alignment with said relatively small cylinder;

C. first and second relatively small pistons operably disposed in said relatively small cylinder, said relatively small second piston extending into a bore in a first relatively large piston having a first protuberance;

D. a longitudinal passage extending through said second relatively small piston;

E. a spring interposed between the said first and second relatively small pistons whereby the said relatively small second piston is urged into contact with the wall of said bore in said first relatively large piston;

F. a fail-safe protuberance extending from said relatively small first piston;

G. a sealing means disposed in the area of the end of the outer periphery of the said second relatively small piston;

H. a pressure-sensing means disposed in the said relatively small second piston between small-diameter and large-diameter passages which are communicable with the said longitudinal passage and the area in the large cylinder forwardly of the said first relatively large piston;

I. a second relatively large piston provided with second and third protuberances extending in opposite directions toward the said first protuberance and a wall at the end of the said large cylinder, respectively;

J. a second spring interposed between the said first relatively large piston and the forward end of the said second relatively large piston thereby urging the said second relatively large piston in a direction toward a stop means disposed in a reduced diameter between opposite ends of the said second relatively large piston;

K. a third spring interposed between the rearward end of the said second relatively large piston and the said wall at the end of the said relatively large cylinder;

L. a fluid reservoir in said housing provided with first, second, and third recuperating ports one each of which is rearwardly of the said first relatively small piston, rearwardly of the said first relatively large piston and rearwardly of the said second relatively large piston, respectively;

M. a first fluid outlet forwardly of the said second relatively large piston communicable with brake means for a first pair of wheels; and

N. a second fluid outlet rearwardly of said second relatively large piston communicable with brake means for a second pair of wheels.

8. A pressure cylinder for a hydraulic brake system including a housing having relatively small and large cylinders disposed therein;

A. said relatively small cylinder positioned forwardly of said relatively large cylinder;

B. a relatively large first piston operably disposed in said relatively large cylinder;

C. a relatively small first piston in coaxial alignment operably disposed in said relatively small and large cylinders respectively;

D. a relatively small second piston having a longitudinal passage axially extending therethrough operably disposed in said relatively small cylinder and a bore in said relatively large piston;

E. a spring interposed between said relatively small first and second pistons whereby the relatively small second piston is urged into contact with a wall of the said bore in said relatively large piston.

F. a sealing means disposed in the area of the end of the outer periphery of the said relatively small second piston;

G. a pressure-sensing means disposed in the said relatively small second piston between small-diameter and large-diameter passages respectively which are communicable with the said longitudinal passage and the relatively large cylinder area forward of the said relatively large piston; and

H. a fluid reservoir in said housing provided with passages communicable with said relatively small and large cylinders.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,631,676 Dated January 4, 1972

Inventor(s) Frederick A. Krusemark

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 5, line 37, "large" should read -- larger --.
Column 6, line 36, cancel the period (.) after "piston" and insert a semi-colon (;).

Signed and sealed this 17th day of October 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

ORM PO-1050 (10-69)

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* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.