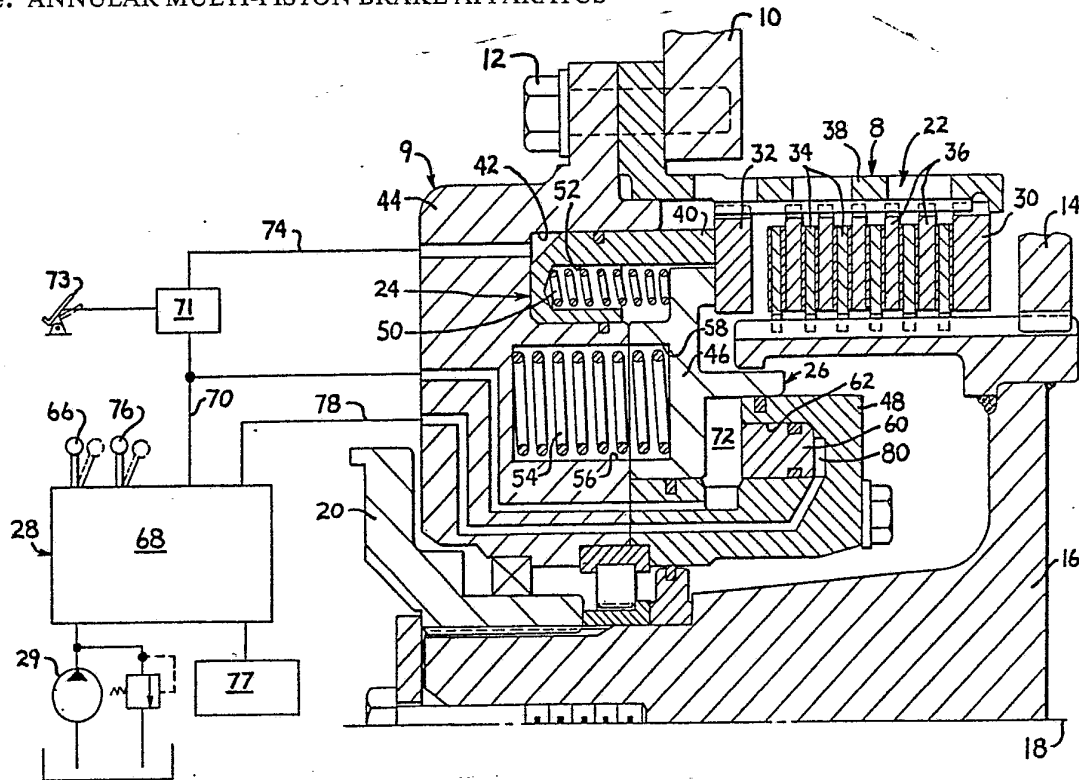




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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| <p>(21) International Application Number: PCT/US82/00293 (22) International Filing Date: 8 March 1982 (08.03.82) (71) Applicant (for all designated States except US): CATERPILLAR TRACTOR CO. [US/US]; 100 N. E. Adams Street, Peoria, IL 61629 (US). (72) Inventors; and (75) Inventors/Applicants (for US only) : WINDISH, Willis, E. [US/US]; 1524 Center Street, Pekin, IL 61554 (US). SCHNEIDER, Marvin, L. [US/US]; 4410 West Broyhill Court, Peoria, IL 61615 (US). (74) Agents: LANCHANTIN, Charles, E., Jr. et al.; Caterpillar Tractor Co., 100 Northeast Adams Street, Peoria, IL 61629 (US). (81) Designated States: AT (European patent), BE (European patent), BR, CH (European patent), DE (European patent), FR (European patent), GB (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.</p> | | <p>Published <i>With international search report.</i></p> |

(54) Title: ANNULAR MULTI-PISTON BRAKE APPARATUS



(57) Abstract

An annular multi-piston brake apparatus (8) for selective holding engagement against a rotatable element (34). The annular multi-piston brake apparatus (8) advantageously includes first and second brake pistons (40, 46) radially overlapping to allow the pistons to individually contact the rotatable element and stop rotation. Compact packaging of the brake apparatus is featured.

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DescriptionAnnular Multi-Piston Brake Apparatus5 Technical Field

This invention relates generally to an annular multi-piston brake apparatus for disc-type brakes and more particularly to such a brake apparatus affording both service and parking brake capability in a relatively compact unit.

10Background Art

Disc-type braking systems have for a number of years utilized dual piston apparatus having a fluid pressure applied service brake piston and a fluid pressure retracted/spring applied parking brake piston. The pistons were either located one on each side of a friction disc-pack or the parking brake piston reacted through the service brake piston in a series arrangement to apply pressure to the friction disc-pack. The apparatus having one piston on each side of the friction disc-pack requires a greater amount of space and also requires the entire friction disc-pack to move axially. In the series arrangement where the parking brake piston abutts and moves the service brake piston to apply the parking brakes, the parking brakes could not be applied if the service brake piston is damaged or cannot be moved and becomes inoperable.

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The present invention is directed to overcoming one or more of the problems as set forth above.

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Disclosure of Invention

In one aspect of the present invention an annular multi-piston brake apparatus having a friction pack with a pack engaging plate is provided for
5 selective holding engagement against a rotatable element. A first and second piston means overlap to allow the piston to individually move the pack engaging plate into engagement with the rotatable element. A
spring is positioned between the pistons.

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Brief Description of the Drawing

The drawing is a diagrammatic, fragmentary vertical cross section of an annular multi-piston brake apparatus embodying the principles of the present
15 invention.

Best Mode for Carrying Out the Invention

With reference to the drawing, an annular multi-piston brake apparatus 8 having a three piece
20 housing 9 and embodying the principles of the present invention is mounted and secured in a support structure 10 by a plurality of fastening means such as bolts 12. A gear 14 is used to transfer rotation from a power source (not shown) through an annular spindle 16 having
25 a central axis 18 to drive an output flange 20.

The brake apparatus 8 has a friction pack means 22, a first brake actuating means 24, a second brake actuating means 26, and fluid pressure source means 28.

30 The friction pack means 22 includes a reaction plate 30, a pack engaging plate 32, and a plurality of annular brake discs 34 interleaved with a plurality of brake plates 36. The brake discs 34 are splined to the spindle 16 for rotation therewith. The reaction plate

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30, pack engaging plate 32, and brake plates 36 are splined to a first piece 38 of the housing 9 to prevent rotation.

5 An annular service brake piston 40, which is pressure applied and spring released, is mounted within a groove or chamber 42 of a second piece 44 of the housing 9 and is reciprocally movable for directly contacting the pack engaging plate 32.

10 An annular parking brake piston 46, which is normally pressure disengaged and spring applied, is mounted about a third piece 48 of the housing 9 and is reciprocally movable for directly contacting the pack engaging plate 32 at a point radially inward of the service piston 40.

15 One of a plurality of circumferentially spaced springs 50 is shown positioned between a bore 52 in the service brake piston 40 and the parking brake piston 46 to disengage the service brake piston or apply the parking brake piston.

20 One of a second plurality of circumferentially spaced springs 54 is shown positioned between a bore 56 in the second piece 44 of the housing 9 and a bore 58 in the parking brake piston 46 to move the parking brake piston 46 into an engaged position.

25 A third annular piston 60 is mounted within a groove 62 in the third piece 48 of the housing 9 and is reciprocally movable for contacting and moving the parking brake piston 46 into a disengaged position against the forces of springs 54. The piston 60 is used when the vehicle needs to be towed.

30 The fluid pressure source means 28 includes a pump 29 and a first manually operable control lever 66 and associated control system 68 of the spool valve type. In a first position of the control lever such a control system is adapted to communicate a source of



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fluid under pressure to a conduit and associated passage 70 to a brake valve 71 and an annular chamber 72, located between the parking brake piston 46 and the third piston 60, to hold the parking brake piston in a disengaged condition. A foot pedal 73 is movable from a first to a second position to communicate fluid under pressure from conduit 70 to the groove 42 via a conduit and associated passage 74 to move the service brake piston into an engaged condition. In a second position of the control lever the source of pressurized fluid can be blocked by the control system from both of these conduits and the conduits depressurized by communicating them back to a drain passage within the control system, not shown. When chamber 72 is depressurized the combined force of springs 50 and 54 automatically move the parking brake piston 46 into an engaged condition. A second manually operable control lever 76 using the same control system is adapted to communicate an auxiliary source 77 of fluid under pressure to a conduit and associated passage 78 to an annular chamber 80 for urging the third annular piston 60 leftwardly for moving the parking brake piston into a disengaged condition.

25 Industrial Applicability

While the operation of the present invention is believed clearly apparent from the foregoing description, further amplification will be made in the following summary of operation. During vehicle movement the first control lever 66 is in the first full line position and the control system is adapted to communicate a source of fluid under pressure into conduit and associated passage 70 and parking brake chamber 72. Such fluid pressure in chamber 72 serves to fully disengage the parking brake piston 46 by



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overcoming the force of springs 54, and with the pedal 73 maintained in its full line first position, fluid is blocked by valve 71 from chamber 42. Thus, the axially leftward movement of the parking brake piston also serves to disengage the service brake piston 40 through the additionally axially compressed springs 50. Thus, the two pistons are placed in a disengaged condition.

Service braking is achieved by movement of the pedal 73 to its second broken line position and positioning the brake valve 71 to selectively deliver fluid from the conduit 70 to the conduit 74 and service brake actuation chamber 42 at a pressure that is proportionate to operator demand. The pressurization of chamber 42 forces piston 40 rightwardly, overcoming the spring 50, directly against the engaging plate 32 and stack of interleaved brake discs 34 and brake plates 36 to compress them against the reaction plate 30. In this way the discs are frictionally clamped to the housing 9, thereby holding the spindle 16 and flange 20 against rotation.

In a parking situation, the fluid pressure to the parking brake chamber 72 is drained through the control system 68. When the pressure drops below a predetermined value, the springs 54 and 50 are effective to bias the parking brake piston 46 directly abuttingly against the plate 32 to compress the brake discs 34 and brake plates 36 against the plate 30 to hold the spindle 16 stationary.

To move or tow the vehicle during a system failure, fluid pressure is introduced into conduit 78 from an auxiliary source 77 to pressurize piston chamber 80. The fluid pressure moves piston 60 leftwardly abuttingly against the parking brake piston 46. Continued movement overcomes the biasing force of springs 54 and 50 thus releasing the brake plates and discs and allowing spindle 16 to rotate.



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While the invention has been described and shown with particular reference to a single embodiment, it will be apparent that variation might be possible that would fall within the scope of the present
5 invention, which is not intended to be limited except as defined in the following claims.



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Claims

1. An annular multi-piston brake apparatus (8) having a housing (9) with a friction pack means (22) mounted therein, the friction pack means includes an annular pack engaging plate (32) for selective holding engagement against a rotatable element (34) comprising:

a first brake piston (40);
10 a second brake piston (46) overlapping said first brake piston (40) and allowing the pistons (40,46) to individually move the pack engaging plate (32) into engagement with the rotatable element (34);
and
15 a spring (50) positioned between the pistons (40,46).

2. The annular multi-piston brake apparatus (8) of claim 1 wherein the spring (50) serves as a retraction spring in two conditions of operation and as a brake applying spring in a third condition of operation.

3. The annular multi-piston brake apparatus (8) of claim 1 wherein the first brake piston (40) is fluid pressure applied and spring released.

4. The annular multi-piston brake apparatus (8) of claim 1 wherein the second brake piston (46) is spring applied and is released by fluid pressure.

5. The annular multi-piston brake apparatus (8) of claim 1 including a third piston (60) overlapping the second brake piston (40) to contact and
35 move the second brake piston.

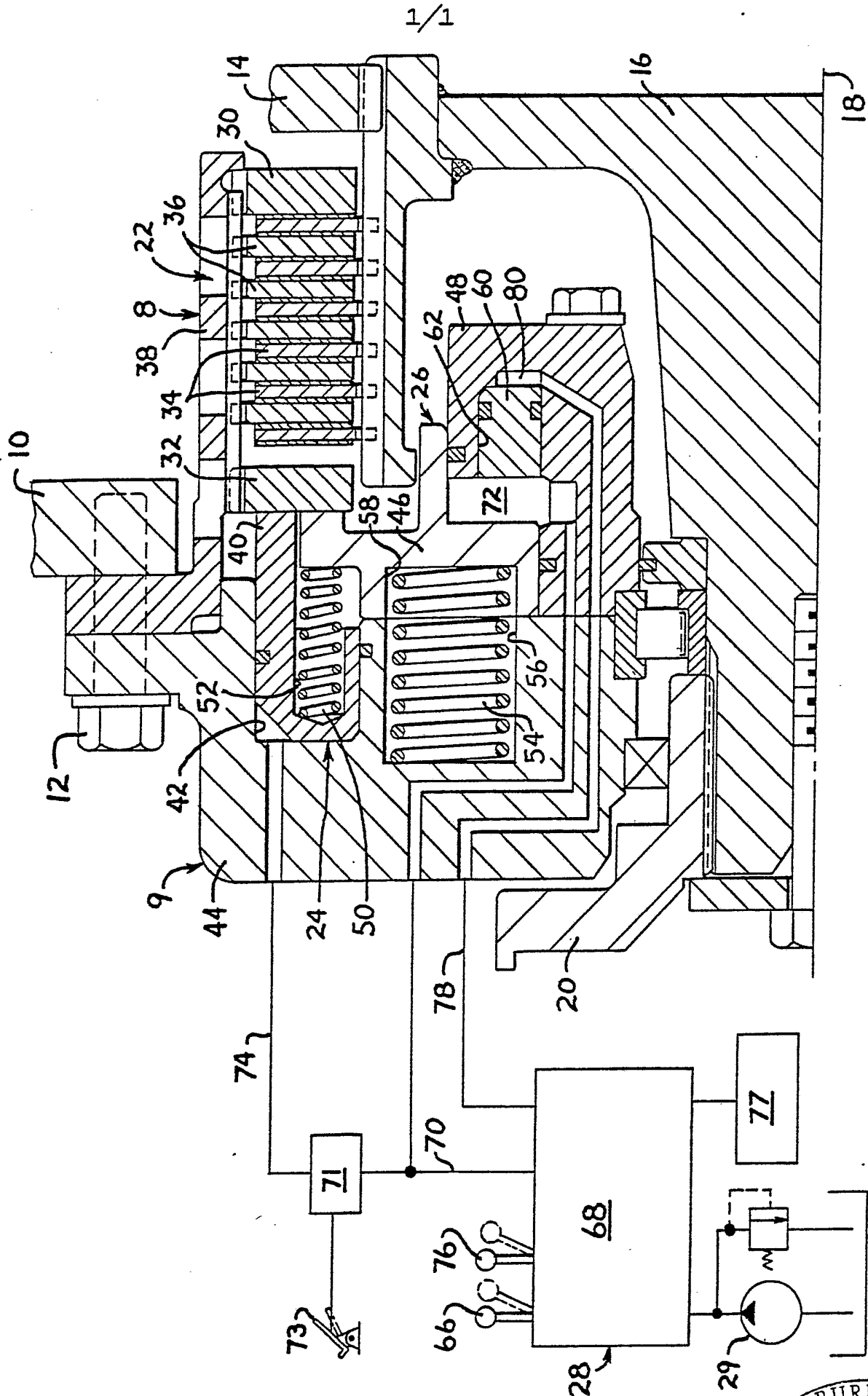


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6. The annular multi-piston brake apparatus (8) of claim 1 including a second spring (54) positioned between the piston (46) and housing (9).

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INTERNATIONAL SEARCH REPORT

International Application No PCT/US82/00293

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|---|--|-------------------------------------|
| I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³ | | |
| According to International Patent Classification (IPC) or to both National Classification and IPC | | |
| INT. CL. ³ F16D 55/22 | | |
| U.S. CL. 188/72.3, 106P, 369 | | |
| II. FIELDS SEARCHED | | |
| Minimum Documentation Searched ⁴ | | |
| Classification System | Classification Symbols | |
| U.S. | 188/72.3, 72.4, 106P, 170, 369, 370 | |
| Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁵ | | |
| | | |
| III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ | | |
| Category ⁶ | Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷ | Relevant to Claim No. ¹⁸ |
| A | US, E, 26,106 Published 01 November 1966, Dotto. | 1-4, 6 |
| A | US, A, 3,547,233 Published 15 December 1970, Girvan. | 1-5 |
| A | US, A, 4,024,936 Published 24 May 1977, Crabb. | 1, 4 |
| A | US, A, 3,650,364 Published 21 March 1972, Laing. | 1, 3, 5 |
| Y | US, A, 4,184,573 Published 22 January 1980, Bricker et al. | 1, 4 |
| Y | US, A, 3,946,837 Published 30 March 1976, Houser. | 1, 4, 6 |
| Y | US, A, 3,974,896 Published 17 August 1976, Rach. | 1, 4-5 |
| A | US, A, 4,245,724 Published 20 January 1981, Beck. | 1, 4 |
| <p>* Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"Y" relevant document (obviousness)</p> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p> | | |
| IV. CERTIFICATION | | |
| Date of the Actual Completion of the International Search ² | Date of Mailing of this International Search Report ² | |
| 16 June 1982 | 28 JUN 1982 | |
| International Searching Authority ¹ | Signature of Authorized Officer ²² | |
| ISA/US | Richard R. Diefendorf | |

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

| | | |
|---|---|-------|
| Y | US, A, 4,263,991 Published 28 April 1981, Morgan et al. | 1,4 |
| Y | US, A, 4,279,330 Published 21 July 1981, Pottorff et al. | 1-3 |
| A | AT, B, 258,655 Published 11 December 1967 | 1-4 |
| A | FR, A, 92,641 Published 06 December 1968 | 1-2,4 |

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. Claim numbers _____, because they relate to subject matter ¹² not required to be searched by this Authority, namely:
2. Claim numbers _____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

- The additional search fees were accompanied by applicant's protest.
- No protest accompanied the payment of additional search fees.