(12) UK Patent Application (19) GB (11) 2 182 991 (13) A

(43) Application published 28 May 1987

(21) Application No 8625850

(22) Date of filing 29 Oct 1986

(30) Priority data
(31) 3540366 (32) 14 Nov 1985 (33) DE

(71) Applicant
Alfred Teves GmbH

(Incorporated in FR Germany)

7 Guerickestrasse, 6000 Frankfurt am Main, Federal Republic of Germany

(72) Inventor
Gunther Buschmann

(74) Agent and/or Address for Service
J. C. Vaufrouard,
ITT Patent Department UK, Maidstone Road, Foots Cray, Sidcup DA14 5HT

(51) INT CL⁴
B60T 8/32

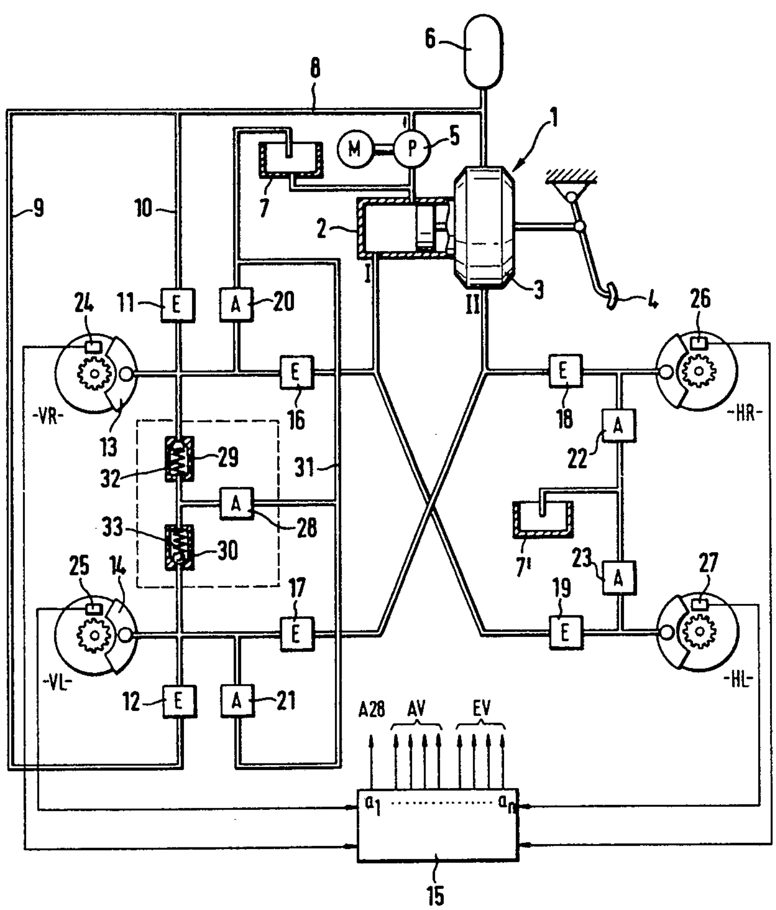
(52) Domestic classification (Edition I):
F2F 611 66X 681 C FE

(56) Documents cited
GB A 2020382

(58) Field of search
F2F
Selected US specifications from IPC sub-class B60T

(54) Method and brake system for traction slip control

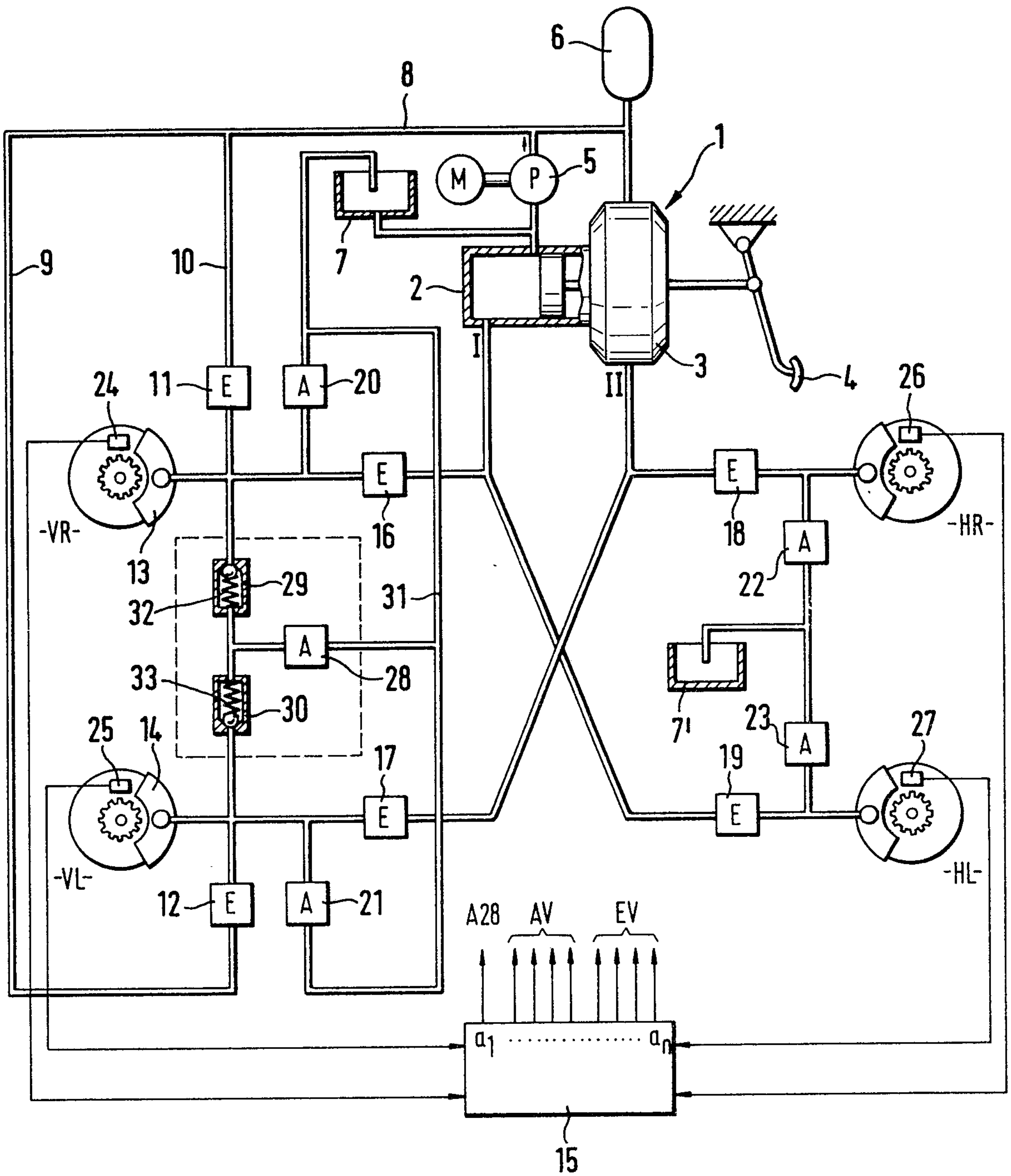
(57) For traction slip control, wheel brakes (13, 14) of driven wheels (VR, VL) are connected to an auxiliary-pressure source (5, 6) of the brake system by means of electromagnetically actuatable multidirectional control valves (11, 12). In an initial phase at the beginning of brake actuation, the wheel brakes (13, 14) are connected for a short time to both the source (5,6) and a low pressure reservoir (7) of the brake system via biassed non-return pressure relief valves (29, 30) and an outlet valve (28) so that, prior to the actual commencement of traction slip control, brake lost travels are taken up, after which the wheel brakes (13, 14) are applied at a higher pressure and a defined and even pressure level is produced in these wheel brakes thereby.



GB 2 182 991 A

25850 - 29 OCT. 86
1 / 1
D F A

2182991



SPECIFICATION

Method and brake system for traction slip control

This invention relates to a method for traction slip control in automotive vehicles with the aid of wheel brakes which are actuated by pressure fluid and which, for the development of braking pressure, are connected to an auxiliary-pressure source for specific intervals derived from the rotational behaviour of the wheels. Brake systems for implementing the method are likewise comprised by the present invention.

It is already known to use the brake system of an automotive vehicle for the control of traction slip. To this end, one can extend an anti-lock control system having an auxiliary-pressure source and sensors for measurement of the wheel rotational behaviour to such effect that, even in the event of the brake not being applied, namely in the presence of too high driving force or, respectively, for control of traction slip, braking pressure can be built up in the driven wheels via additional pressure fluid conduits (for instance West German laid-open printed patent application 33 38 826, 34 07 538, 34 07 539). With the aid of electromagnetically actuated multidirectional control valves, a connection will be established between the pressure source and the wheel brake of the skidding wheel, either via a braking pressure generator or directly. The magnitude of the necessary braking energy is determined from the wheel rotational behaviour by means of calculating circuits in an electronic control unit and is predefined by the duration of the intervals of excitation, that means the open-passage periods, of the valve which constitutes the connection between the pressure source and the wheel brake. The quality of the control is dependent on the precision of pressure proportioning. The pulses or pulse trains determining the open-passage periods of the valve, therefore, must be set precisely, even more so as it is via these valves that the wheel brakes are connected to the auxiliary-pressure source and thus to a very high pressure level. In doing so, difficulties arise with the known methods and brake systems. This is because, at the beginning of brake actuation, first the so-called clearance and other lost travels must be overcome, that is the brakes must be applied, prior to a braking effect being able to occur. However, the volume or pressure-transmitting medium required to cover these lost travels varies in consequence of manufacturing tolerances, adjustment of the brakes, uneven wear etc. so that a filling period or duration of change-over of the braking-pressure inlet valves which is invariably preset in time (constant), will not permit to bring about an even pressure level in the individual wheel brakes.

To overcome these lost travels, in actual practice, a constant filling pulse is employed which allows to change the braking-pressure inlet valves over to their opened position for a specific constant time. An even pressure level in the wheel brakes cannot be accomplished thereby; varying pressure is rather built up by the constant filling pulse, depending on the lost travel covered.

Proportioning of the pressure during the subsequent traction slip control operation suffers from this initial inaccuracy.

Therefore, it is an object of the present invention to overcome the difficulties described and, within traction slip control, to eliminate the effects the different lost travels, which must be covered until application of the brake, have on the proportioning of the braking pressure and thus on the control accuracy. This aim is to be reached by simple means and without entailing any appreciable additional effort.

According to one aspect of the present invention there is provided a method for traction slip control in automotive vehicles with the aid of wheel brakes which are actuated by pressure fluid and which, for the development of braking pressure, are connected to an auxiliary-pressure source for specific intervals derived from the rotational behaviour of the wheels, characterised in that, in an initial phase at the beginning of brake actuation, an amount of pressure will be metered for a short time into the wheel brakes of (at least) the driven wheels (VR, VL), which amount is just sufficient to overcome lost travels, clearances and the like.

According to a particularly expedient embodiment of this invention, in the initial phase, the pressure in the wheel brakes will be confined to a predetermined value. To this effect, a biassed valve which is set to the pressure required to apply the brakes of e.g. 3 to 10 bar can be connected with a pressure-compensating reservoir.

According to another aspect of the present invention there is provided a brake system, for traction slip control, comprising a braking pressure generator, an auxiliary-pressure source, a pressure-compensating reservoir and multidirectional control valves for the metering of pressure out of the auxiliary-pressure source into wheel brakes of the driven wheels, further comprising wheel sensors as well as an electronic control circuitry for the generation of braking-pressure control signals, characterised in that, in an initial phase at the beginning of brake actuation, an amount of pressure will be metered for a short time into the wheel brakes of (at least) the driven wheels (VR, VL), which amount is just sufficient to overcome lost travels, clearances and the like, and in that pressure fluid lines are arranged in the brake system which provide communication between the wheel brakes of the driven wheels (VR, VL) and the pressure-compensating reservoir and into which at least one electromagnetically actuatable multidirectional control valve, closed in its de-energised state, as well as valve assemblies set to the pressure in the initial phase is inserted.

According to one embodiment, it is favourable to use biassed non-return valves as the valve assemblies. To economise on multidirectional control valves, it is possible to assign to each driven wheel one separate non-return valve which is connected to the pressure-compensating reservoir via one common, normally closed two-way/two-position directional control valve.

Hence it follows that according to the instant invention a simple measure which can be realised by little effort enables a considerably preciser adjustment of the braking pressure and control of the traction slip because tolerances and wear phenomena influencing the lost travel are compensated for in the initial phase. In contrast to previous methods and brake systems, the zero position, that is the reference pressure at the commencement of the controlled braking pressure development will be determined. Delayed response of the control due to a relatively long lost travel, undesirable pressure differences in the wheel brakes of the driven wheels etc. will be reliably precluded.

An embodiment of the invention will now be described with reference to the accompanying drawing, which shows a schematically simplified view of the most important assemblies of the inventive brake system and the hydraulic connection of the components in an automotive vehicle with front-wheel drive.

The brake system illustrated comprises a dual-circuit hydraulic brake power booster 1 which herein is composed of a master cylinder 2 and a power brake booster 3. A brake pedal 4 is likewise illustrated symbolically.

In this embodiment, an auxiliary-pressure source is composed of an electromotively driven hydraulic pump 5 and a hydraulic pressure accumulator 6. The suction side of the pump 5 communicates with a pressure-compensating reservoir 7 which also serves as a pressure-compensating and supply reservoir of the braking pressure generator 1.

An anti-lock brake system is concerned herein which is extended to a traction slip control system by virtue of an additional hydraulic connection via lines 9, 10 into which inlet valves (E)11, 12 are inserted and which provide communication between the brakes 13, 14 of the driven front wheels VR, VL and the auxiliary-pressure source 5, 6, as well as by virtue of a supplement of the electronic control circuitry with in a control unit 15.

For brake slip control inlet valves (E) and outlet valves (A) 16 to 19, 20 to 23 are inserted into the two hydraulic circuits I, II which lead to diagonal wheels VR, HL and VL, HR, respectively. In order to prevent locking of the wheels and to keep the brake slip in the optimal range, these valves (E,A) 16 to 23 serve to maintain the braking pressure constant, to decrease it and to re-increase it at the appropriate time individually for each wheel. For instance, two-way/two-position directional control valves which are open in their de-energised state can be used as inlet valves (E) 16 to 19 which can be switched over to close by an electromagnetic signal during the control period. In contrast thereto, the outlet valves (A) 20 to 23 are closed normally, that means in the de-energised state, and permit to be switched over to their opened condition by electric signals, whereupon pressure fluid discharges into the pressure-compensating reservoir 7, 7′ for the purpose of pressure reduction.

The braking-pressure control signals serving to switch the inlet and outlet valves (E,A) 16 to 23 over are generated by means of the electronic control unit 15. Said control unit 15 is supplied with information about the wheel rotational behaviour via wheel sensors 24 to 27. After logic combining, signals A 28, AV, EV will be available at the outlets a_1 to a_n which are delivered via signal lines, not shown herein, to the inlet valves (EV) (16 to 19) and outlet valves (AV) (A20 to 23) and A28 to an additional outlet valve (A) 28.

To implement the inventive method by which improvement of traction slip control is attained, the wheel brakes 13, 14 of the two driven wheels VR, VL are each connected to a return line 31 leading to the pressure-compensating reservoir 7 via a respective biassed non-return valve 29 or 30 and via the additional outlet valve 28.

The bias of the non-return valves 29, 30 is in each case accomplished by a spring 32, 33 which permits the non-return valves to open only after an amount of pressure has developed which is just sufficient to apply the brakes 13, 14.

At the beginning of a traction slip control operation, first the additional outlet valve (A) 28 is excited in an initial phase for a very short period of time which will not result in any appreciable delay of the brake actuation. This causes the valve 28 to switch to open so that the pressure introduced via the inlet valves (E) 11, 12 from the auxiliary pressure source 5, 6 will be able to overcome the lost travels in the brakes 13, 14 and to apply the brakes, while, however, the braking pressure is limited to the opening pressure set by the springs 32, 33 of the biassed non-return valves 29, 30. Thus, a defined and even pressure level will be obtained in the wheel brakes 13, 14 of the driven wheels VR, VL. After this initial phase, the outlet valve 28 will re-assume its initial position in which it is closed, so that now the predetermination of the change-over times for the inlet valves (E) 11, 12 allows to precisely set that braking pressure in the wheel brakes 13, 14 which is required for optimal traction slip control, which is ascertained by the control unit 15 and is transferred into corresponding actuation signals for the valves (E) 11, 12. The variations, that means differences in pressure, to be expected are very slight because a reference point for the pressure development has been created owing to the described initial phase or filling phase of the wheel brake cyclinders.

CLAIMS

1. A method for traction slip control in automotive vehicles with the aid of wheel brakes which are actuated by pressure fluid and which, for the development of braking pressure, are connected to an auxiliary-pressure source for specific intervals derived from the rotational behaviour of the wheels, characterised in that, in an initial phase at the beginning of brake actuation, an amount of pressure will be metered for a short time into the wheel brakes (13, 14) of (at least) the driven wheels (VR, VL), which amount is just sufficient to overcome lost travels, clearances and the like.

2. A method as claimed in claim 1, characterised in that, in the initial phase, the pressure in the wheel brakes (13, 14) will be limited to a predetermined value.

3. A method as claimed in claim 1 or claim 2, characterised in that, in the initial phase, the wheel brakes (13, 14) are connected to a pressure-compensating reservoir (7) via biassed valve assemblies (29, 30) which are set to the pressure necessary for applying the wheel brakes (13, 14).

4. A method as claimed in any one of the claims 1 to 3, characterised in that, in the initial phase, the pressure is limited to 3 to 10 bar.

5. A brake system, for traction slip control, comprising a braking pressure generator, an auxiliary-pressure source, a pressure-compensating reservoir and multidirectional control valves for the metering of pressure out of the auxiliary-pressure source into wheel brakes of the driven wheels, further comprising wheel sensors as well as an electronic control circuitry for the generation of braking-pressure control signals, characterised in that, in an initial phase at the beginning of brake actuation, an amount of pressure will be metered for a short time into the wheel brakes (13, 14) of (at least) the driven wheels (VR, VL), which amount is just sufficient to overcome lost travels, clearances and the like, and in that pressure fluid lines (31) are arranged in the brake system which provide communication between the wheel brakes (13, 14) of the driven wheels (VR, VL) and the pressure-compensating reservoir (7) and into which at least one electromagnetically actuatable multidirectional control valve (28), closed in its de-energised state, as well as valve assemblies (29, 30) set to the pressure in the initial phase is inserted.

6. A brake system as claimed in claim 5, characterised in that the valve assemblies (29, 30) are designed as biassed non-return valves which are set to the pressure in the initial phase.

7. A brake system as claimed in claim 6, characterised in that one separate non-return valve (29, 30) is assigned to each driven wheel (VR, VL), and in that these non-return valves are connected to the pressure-compensating reservoir (7) via one common, normally closed two-way/two-position directional control valve (28).

8. A method for traction slip control in automotive vehicles substantially as herein described with reference to the accompanying drawing.

9. A brake system for traction slip control substantially as herein described with reference to and as illustrated in the accompanying drawing.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.