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(54) A MULTI-STAGE BRAKING SYSTEM/RETARDER FOR A VEHICLE

(71) We, WABCO FAHRZEUGBREMSEN GmbH (formerly Wabco Westinghouse GmbH), a German Company of, Am Lindener Hafen 21, 3000 Hannover 91, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a multi-stage braking system or multi-stage retarder for a vehicle, in particular a braking system/retarder including an electrical switching arrangement for causing switching between, the individual braking or retarder stages.

The automatic switching-on of an auxiliary brake when actuating the vehicle brake valve by means of the brake pedal or foot plate is disclosed in German Patent 1 122 850. The switching on of the auxiliary brake, which in the case of the patent mentioned is a motor brake, is effected by slight pressure of the foot on the brake pedal whereupon by way of an air inlet valve first of all the working cylinder of the motor brake is charged with air, and, upon further pressure of the foot on the brake pedal, the working cylinder of the friction brake, that is, the service brake, is also charged with air.

Switching devices on motor vehicle brake valves are furthermore known which switch on an auxiliary brake so that the braking action occurs in several stages. More especially, in the case of buses, so-called retarders having three switching or braking stages are used, these stages being controlled, in the case of a vehicle having a pressure medium-operated brake system, by means of electric and pressure medium-operated switches: as a general rule, the first two braking stages of the retarder are switched on by electric switches before the friction brake is actuated, and the third stage of the retarder is switched on shortly after.

The control of the three braking stages of such an arrangement can be effected by means of the control piston of the motor vehicle brake valve: this has a few disadvantages, however, to which transport authorities in particular object. For example, the resilient member which is normally arranged between the brake pedal and the control piston can result in an undesirable hysteresis upon reversing or switching-off the brake stages and upon return of the resilient member to its initial state following the relief of pressure on the brake pedal; This path hysteresis can be further increased, when pressure-medium operated switches are used, by the hysteresis of the pressure medium. Occasionally the second braking stage switches back whilst the third braking stage is still switched on as a result of the combined hysteresis due to the resilient member and the pressure medium. A further disadvantage has proved to be the fact that the change-over between the first two braking stages, which takes place before the friction brake is actuated occurs without any distinct mechanical transition point, so that an unnoticed switching from the first braking stage in to the second braking stage can cause an undesirably sharp braking of the vehicle which may sometimes have unpleasant consequences for the traffic following and, in the case of a bus, for any standing passengers.

The present invention provides a multi-stage braking system or multi-stage retarder for a vehicle, including an electrical switching arrangement operable to cause switching from one braking/retarder stage to another and a control device including an operating member movable to operate at least one switching element of the switching arrangement and thereby to cause successive switching from one braking/retarder stage to the next, and a rotatably-mounted transition point device which is resiliently-biased into engagement with a stop and is co-operable with the operating member whereby a switch

from the one braking/retarder stage to the next is accompanied by a change in the resilient bias on the operating member, the transition point device being so arranged that there is a predetermined play between the transition point device and the operating member.

In embodiments of the invention to be described herein, a control device is provided which so controls both the motor vehicle brake valve and the electrical switching arrangement for a multi-stage auxiliary brake, for example a retarder that the braking stages are switched automatically one after another and, after the first stage has been switched, the switching of the next stage or stages is indicated by a distinct transition point (due to a change in resilient bias on the operating member) and the release of the individual braking stages is influenced neither by hysteresis caused by connecting elements within the control device, nor by hysteresis caused by pressure medium. In these embodiments, the first braking stages of the retarder are intended to be effective before the friction brake is actuated.

By way of example, braking installations including multi-stage retarders constructed in accordance with the invention, will now be described in detail with reference to the accompanying drawings, in which:

Figure 1 shows a switching arrangement and control device for a retarder, arranged directly on a motor vehicle brake valve;

Figure 2 shows a switching arrangement and control device similar to that of Fig. 1 but as a separate unit joined to a motor vehicle brake valve by way of guide levers and rods;

Figure 3 shows the arrangement of three switching stages viewed from above, of the embodiments of Figs 1 and 2;

Figure 4 shows the three stage switching arrangement in the direction X in Fig. 3;

Figure 5 shows a schematic view of the three-stage switching arrangement;

Figure 6 shows, in section, the transition point device of the control device of Figs. 1 and 2;

Figure 7 shows a graph of the transition point and switching-on point of the control device as a function of the path covered by the motor vehicle brake pedal and of the force of the pedal; and

Figure 8 shows the design of a second transition point device using captive springs, which suitable for use in the control device of Figs. 1 and 2.

The braking installations to which Figs. 1 and 2 relate each include, in addition to a multi-stage retarder, a friction/service brake system of which only the conventional brake valve 100 is shown. The details of the piston and valve arrangement in the brake valve housing are not illustrated in Figs. 1 and 2 since a description of the actual function of the motor vehicle brake valve for operating the friction/service brake system is unnecessary for the explanation of the invention which relates particularly, to the control of the multi-stage retarder. In the arrangements illustrated, the brake valve 100 (which may be of any appropriate design) is operated by the same control device as the retarder and may have the control device mounted directly on it, as shown in Fig. 1 or be a separate unit coupled to the control device by guide levers and rods as shown in Fig. 2.

The control device has an operating member, denoted as 1 in Figure 1 and as 2 in Figure 2, which may take the form of a foot plate or pedal, for example and a thrust rod 3 of which the lower end 4, provided with a sloping annular face 4*a*, is in operative connection with three electric switching members 6, 7 and 8 (Figs. 3 to 5) of a three-stage switching arrangement 12 consisting of three electrical switches 9, 10 and 11. The electrical switches 9, 10 and 11 relate, respectively, to three braking stages I, II and III of the retarder of the vehicle braking arrangement. These three retarder stages I, II and III are brought into effect consecutively, through operation of the switches 9, 10 and 11, when the foot pedal 1, 2 is depressed, as will be described below. The friction/service brake system is also brought into effect as the foot pedal 1, 2 is depressed, through operation of the brake valve 100, this occurring after the introduction of stages I and II of the retarder but before the introduction of stage III.

Figures 1, 2 and 5 shows the control device in its inoperative position, in which none of the three retarder stages I, II and III (Fig. 5) provided by the switches 9, 10 and 11 respectively of the switching arrangement 12 is utilised. The switches 9, 10 and 11 are adjustable so that the switching stages I, II and III can be adjusted in accordance with the conditions of use or conditions of braking of the vehicle.

To produce a distinct transition point between the first and second retarder braking stages a transition point device comprising a rocking frame 19 is rotatably mounted between the flanges of the foot pedal 1, 2. This rocking frame 19 is rotatably mounted on bushes 20 and 20*a* of a bolt 13 on which the foot pedal 1, 2 is rotatably-mounted, the frame 19 being constructed from two cross-truts 15 and 16 and two side members 17 and 18 (Fig. 6). The rotary movement of the frame 19 is limited by a stop 14*a* arranged on the support plate 14 and adjustable in height. A torsion spring 21 arranged between the side members 17 and 18 of the frame 19 and centred by the bushes 20 and 20*a*, rests with its long shank 22 against the upper cross-strut 16 of the frame and with its shorter end

23 against a stop bolt 24, and is pretensioned by the frame. The pretensioning force of the torsional spring 21 may be adjusted by inserting washers 25 between the upper cross-strut 16 of the frame 19 and the long spring shank 22. The frame 19 carries a stop 27 on the cross strut 16, with which the foot pedal 1,2, when depressed, can engage but is so arranged that there is a predetermined play between the frame and the pedal allowing a predetermined movement of the latter before it comes into engagement with the stop 27.

The inclusion of the graph, shown in Figure 7, in the following description of the manner in which the control device functions, facilitates understanding of the operation of the three-stage switch arrangement for the switching of the retarder.

When the foot pedal 1, 2 is depressed, the thrust rod 3, 4 moves downwards and, under the influence of a spring, the switching member 6 of the switch 9 follows the sloping annular face 4*a*: the switch 9 closes and the retarder stage I is brought into operation. As the foot pedal 1, 2 is depressed further, it strikes the stop 27 on the rocking frame 19 (which stop may be adjusted in height by an adjusting screw 26 to alter the play between the pedal and the frame). The engagement of the foot pedal 1,2 with the stop 27 produces a distinct transition point in the form of a change in resilient bias on the pedal, after which the pedal moves the rocking frame 19 with it against the constant force of the spring 21. Only after this transition point does the switching member 7 of the switch 10, having followed the sloping annular face 4*a* of the thrust rod 3,4, causes the switch 10 to close, bringing the retarder stage II into operation as shown in the graph in Figure 7.

Upon further depression of the foot pedal 1, 2 the operation proper of the motor vehicle brake valve 100 comes into force, i.e., the friction brake or the service brake system is charged with air and only thereafter, upon further depression of the foot pedal, does the switching member 8 cause the switch 11 of the retarder to close, bringing stage III of the retarder into operation, as the graph in Figure 7 shows.

Figure 8 shows an embodiment of the invention for use if a second transition point between retarder stages II and III is desired. Here, an additional transition point device 28 is secured to the upper cross-strut 16 of the rocking frame 19 by a fastening flange 28*a* which also serves to determine the pretensioning of the spring 21. In a cup-shaped formation 28*b* of this additional transition point device 28 there is guided a captive spring 29, the upper end of which carries a pressure or thrust piece 30. The pretensioning of the spring 29 and the position of the pressure piece 30 may be adjusted by means of a screw 31.

The operation of this double transition point device is as follows:

When the foot pedal 1, 2 is depressed, the retarder stage I switches on before the play between the pedal and the transition point device 28 is taken up and the pedal touches the pressure piece 30. As the force of the spring 29 is overcome the first transition point, to retarder stage II, is rendered distinct by a change in resilient bias on the pedal. As the pedal 1,2 is depressed further, thereby depressing the pressure piece 30 against the force of the spring 29, the retarder stage II is switched on. It is important that the pretensioning of the spring 21 is that much greater than that of the spring 29 that the transition point device (rocking frame) 19 will not follow the downward movement of the pedal 1, until the play between the latter and the frame 19 has been taken up and the pedal is in operative connection with the cross-strut 16 of the frame acting as a stop. When the operative connection between the frame 19 and the pedal occurs and the foot force on the pedal overcomes the tension of the spring 21, the second transition point becomes distinct as a further change in resilient bias on the pedal. When the second transition point has been overcome, the retarder stage III switches on upon the further downward movement of the pedal against the force of the spring 21, the service brake system having been charged with air prior to this, by the normal operation of the brake valve.

Finally, although the embodiments described above all relate to the control of a multi-stage retarder they could be applied to the control of other multi-stage braking systems incorporating electrical switching arrangements.

WHAT WE CLAIM IS:—

1. A multi-stage braking system or multi-stage retarder for a vehicle, including an electrical switching arrangement operable to cause switching from one braking/retarder stage to another, and a control device including an operating member movable to operate at least one switching element of the switching arrangement and thereby to cause successive switching from one braking/retarder stage to the next, and a rotatably-mounted transition point device which is resiliently-biased into engagement with a stop and is co-operable with the operating member whereby a switch from the one braking/retarder stage to the next is accompanied by a change in the resilient bias on the operating member, the transition point device being so arranged that there is a predetermined play between the transition point device and the operating member.

2. A braking system/retarder according to claim 1, in which the operating member is

rotatably-mounted on the same member as the transition point device.

3. A braking system/retarder according to claim 1 or claim 2, in which the play between the transition point device and the operating member is adjustable.

4. A braking system/retarder according to any one of the preceding claims, in which the resilient bias on the transition point device is adjustable.

5. A braking system/retarder according to any one of the preceding claims, in which between the operating member and the rotatably-mounted transition point device, there is arranged a second transition point device co-operable with the operating member whereby a switch from a second braking/retarder stage to the next is accompanied by a change in resilient bias on the operating member.

6. A braking system/retarder according to claim 5, in which the second transition point device comprises a thrust piece carried by a captive spring guided in a housing.

7. A braking system/retarder according to claim 6, in which the pre-tension of the captive spring is adjustable.

8. A braking system/retarder according to any one of the preceding claims in which the switching arrangement has, for each braking/retarder stage, a switching element in constant operative connection with the operating member.

9. A braking system/retarder according to any one of the preceding claims, in which the transition point device is substantially as described herein with reference to, and as shown in Figs. 1, 2 and 6, or Fig. 8 of the accompanying drawings.

10. A braking system/retarder according to any one of the preceding claims, in which the electrical switching arrangement is substantially as described herein with reference to, and as shown in, Figs. 1 to 5 of the accompanying drawings.

11. A multi-stage braking system/retarder, substantially as described herein with reference to, and as shown in, Figs. 1 to 6, or Fig. 8 of the accompanying drawings.

12. A braking installation for a vehicle, including a braking system/retarder according to any one of the preceding claims, and a brake valve actuable by the operating member to control a pressure medium-operated brake system for the vehicle.

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1591629 COMPLETE SPECIFICATION
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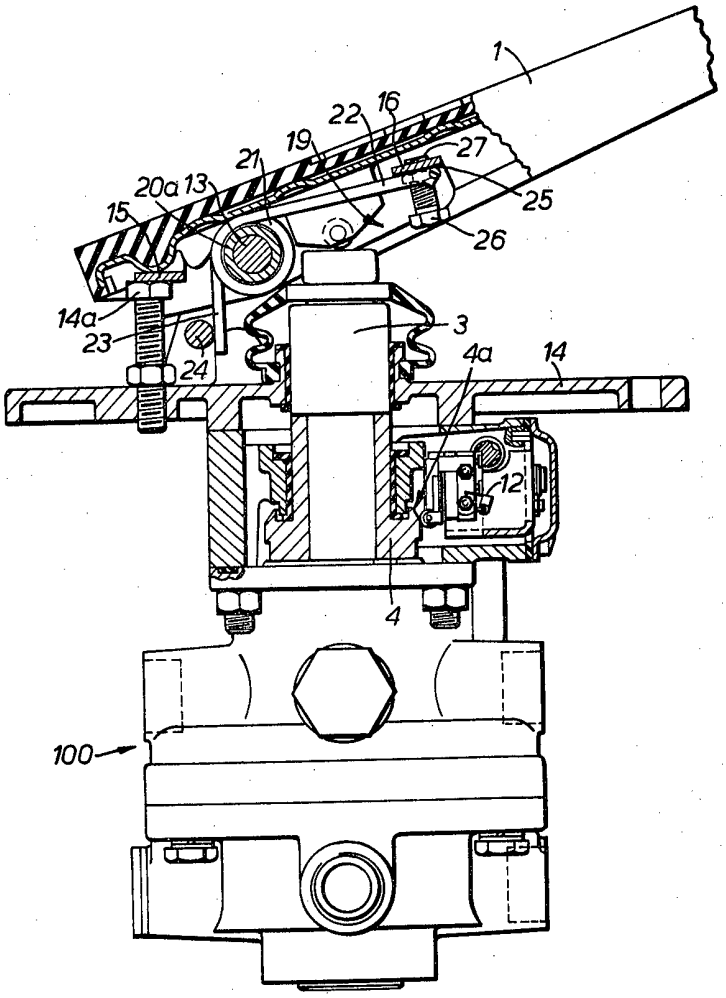


FIG. 1.

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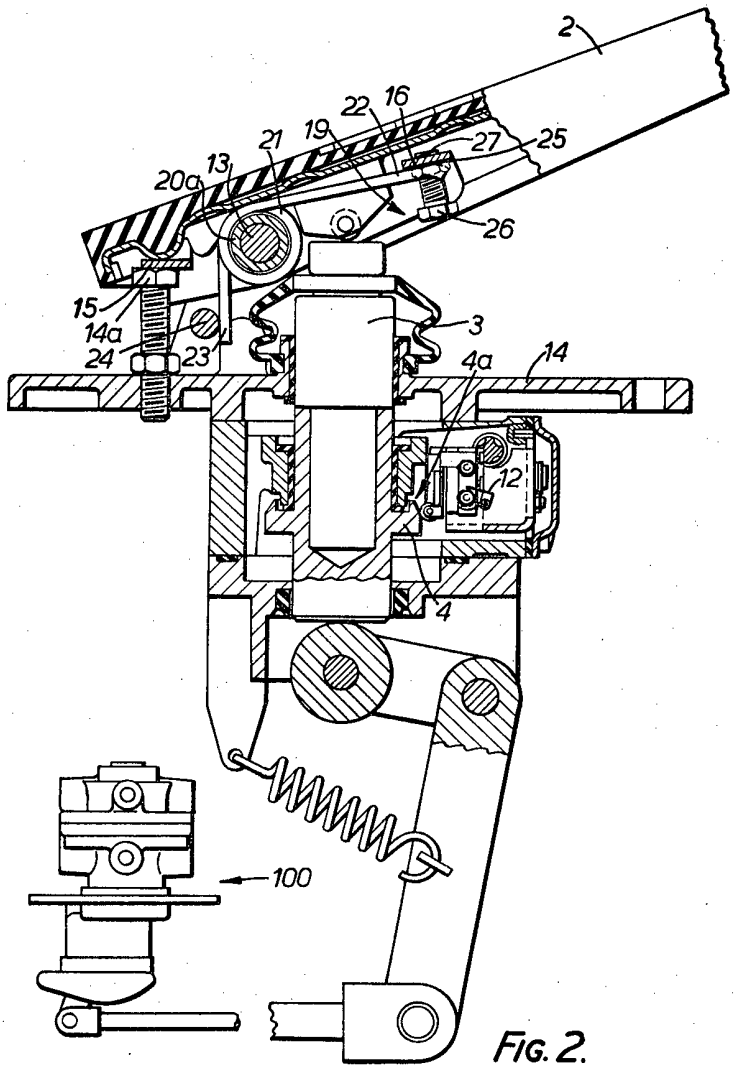


FIG. 2.

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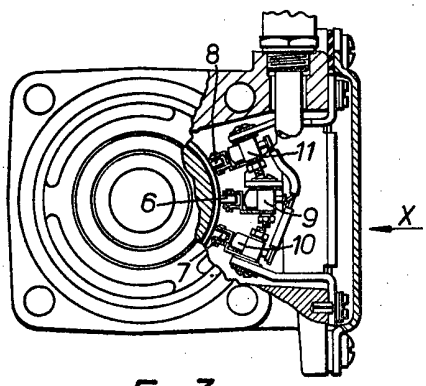


FIG. 3.

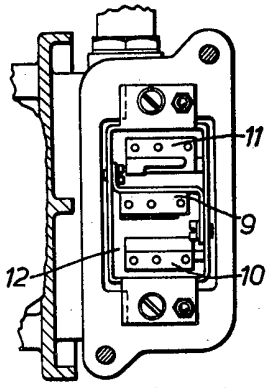


FIG. 4.

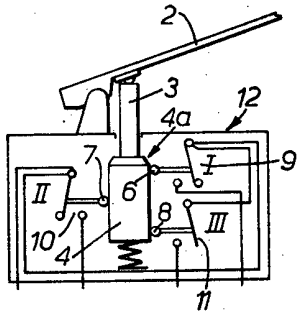


FIG. 5.

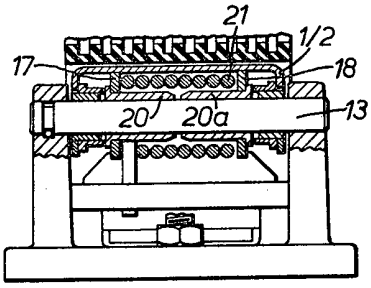


FIG. 6.

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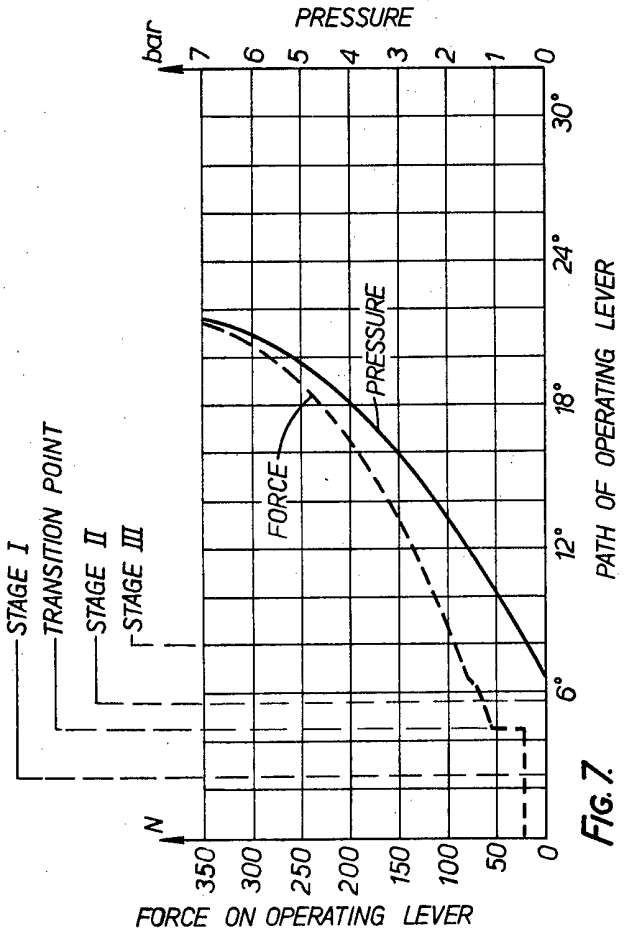


FIG. 7.

1591629 COMPLETE SPECIFICATION

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Sheet 5

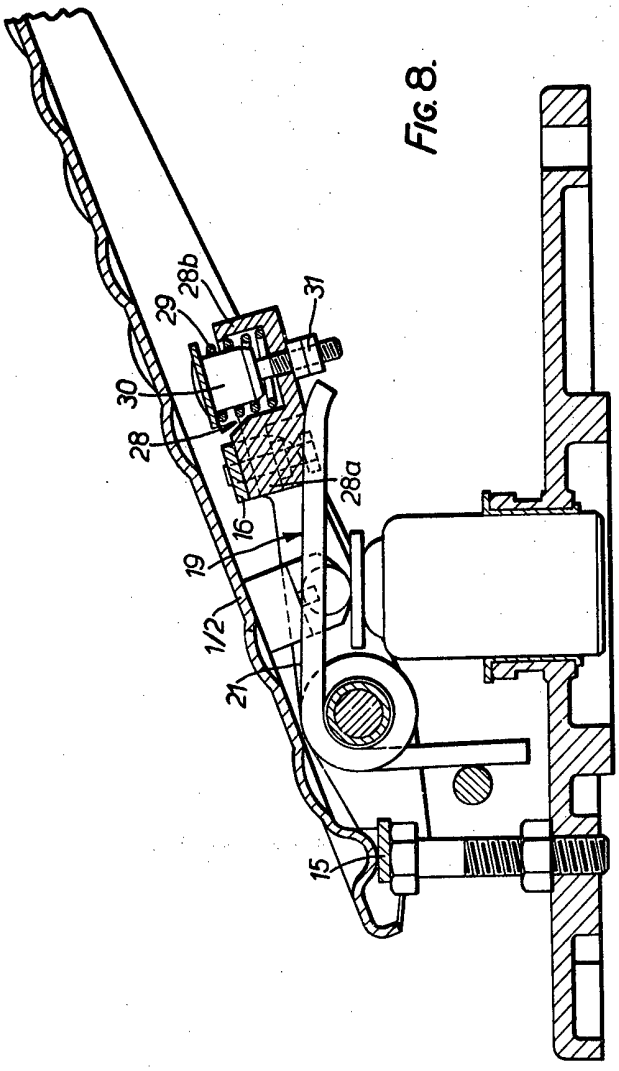


FIG. 8.