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(54) IMPROVEMENTS IN OR RELATING TO BRAKING SYSTEMS FOR VEHICLES

(71) We, ROBERT BOSCH GmbH., a German Company, of Postfach 50, 7 Stuttgart 1, Federal Republic of 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 present invention relates to anti-lock braking systems for vehicles

A known anti-lock braking system includes a wheel velocity sensor arrangement comprisesing a pulse generator adjacent a pulse wheel rotatable with a vehicle wheel and the pulse generator is connected to an electronic control unit which regulates the vehicle brakes and also includes a monitoring device for monitoring the correct operation of the anti-lock system.

In recent years there has been an increasing tendency to instal, at least on the front wheels of motor vehicles, brake pad wear detecting devices in order to indcate when predetermined wear of a pad or pads has occurred. Most such devices are electrical but mechanical devices are also known. Such wear indicating devices are important, because worn brake pads can give rise to a dangerous driving condition i.e. result in the application of differential braking forces. It is also possible, though, in the event of prolonged weak braking with worn pads for the drums or discs of the brake to be damaged, resulting in expensive repair work. Moreover, it is desirable in the installation of anti-lock systems to reduce the cost of the system itself as well as the cost of installation of component parts such as pulse generators. It has been found, for example, that the cost of providing electric cables to the movable front wheels is comparable with the cost of providing a pulse generator of the anti-clock system.

According to the present invention there is provided a braking system for a vehicle having a wheel anti-lock system including a wheel velocity sensor arrangement comprising a pulse wheel rotatable with a vehicle wheel and a pulse generator in proximity thereto for deriving therefrom signals indicative of wheel velocity, and a monitoring device for monitoring the correct operation of the anti-lock system and including a warning device, and in which a sensing device responsive to wheel brake pad wear is connected to the sensor to at least partially reduce the effective signal from the pulse generator to the anti-lock system when predetermined wear of brake pads has taken place, whereby to actuate the warning device of the anti-lock system operation monitoring device also when predetermined brake pad wear has taken place.

The brake pad wear detecting device can operate either electrically or mechanically.

The present invention will be further described by way of example with reference to the accompanying drawings in which:—

Fig. 1 is a diagrammatic illustration of part of an anti-lock system incorporating a brake pad wear sensing device according to a first embodiment of the present invention.

Fig. 2 is a block circuit diagram of an anti-lock system monitoring device incorporating the brake pad wear sensing device of Fig. 1, and

Fig. 3 is a partial section of part of another anti-lock system incorporating a brake pad wear sensing device according to a second embodiment of the present invention.

Fig. 1 shows a wheel brake of a vehicle 30 (only partially shown in the drawings) in the form of a disc brake having a brake pad wear sensing device 1. The wheel brake comprises a brake disc 2 and a substantially U-shaped brake caliper 3 whose limbs 4 and 5 overlie respective sides of the disc 2. Two pistons 6 and 7 are mounted in respective limbs 4 and 5 and carry at their outer ends brake pads 8 and 9. The brake pads 8 and 9 shown are new i.e. unworn and are provided at a certain depth with contact pins 10 and 11 which eventually become exposed and makes contact with the disc 2 after the pads 8 and 9 have been worn down to a predetermined extent.

The contact pins 10 and 11 are connected by contact pin signalling leads 12 and 13, and plug and socket connectors 14 and 15 to a carrier 16 of a wheel velocity sensor 17 of an anti-lock system. The sensor 17 a pulse

generator having a coil 23 and comprises a pulse wheel 18. The pulse wheel 18 is attached to a vehicle wheel (not shown in the drawings) so as to be rotatable therewith and the edge of the wheel 18 lies adjacent to a side face 20 of the pulse generator 17 but is spaced therefrom by an air gap 19. The coil 23 is connected by a lead 22 to a lead 24 interconnecting connector socket 14 and a connector 25 plug, and by a lead 21 to a connector 26 plug. It should be mentioned that a resistor 27 may be arranged in the lead 24 between the connector socket 14 and its junction into the lead 22. A lead 28 connects the connector socket 14 to the connector 15. The carrier 16 is attached by a fixing pin 29 to a stationary part of the vehicle 30.

In the manner described the contact pin signalling leads 12 and 13 are connected in parallel to the pulse generator 17.

The sockets of connectors 25 and 26 are connected by leads 31 and 32 to an electronic control unit 33 of the anti-clock system. In this control unit 33 a fail-safe monitoring device monitors the correct operation of the anti-lock system. This monitoring device is shown in detail in Fig. 2 whilst in Fig. 1 only an associated warning light 34 is shown. The brake pad wear serving device described operates as follows:—

When predetermined brake pad wear has occurred the respective contact pin 10 or 11 establishes a connection to earth through the brake disc 2. As a result one end of the coil 23 of the pulse generator 17 is connected directly, indirectly if the resistor 27 is used, to earth. This means that substantially the whole or part of the corresponding speed signal of the sensor 17 is by-passed to earth. This can be processed by the monitoring device in the control unit 33, so that the warning light 34 is lit.

Fig. 2 shows the monitoring device in greater detail, the reference numerals used in Fig. 1 also being used here for the corresponding parts. Many anti-lock systems. have a monitoring device which is identical or similar, and which in the event of a disturbance of a sensors 17 or of a solenoid valve or within the electronic system, switches off a corresponding control channel or the whole system so as to prevent any lengthening of braking distances and/or occurence of yawing moments.

The same monitoring device may also be used for both purposes. If, as a result of brake pad wear, contact pin 10 or 11 makes contact with earth, or if the sensor 17 fails, this is picked up in the monitoring device of the control unit 33. A corresponding output signal leads to a simple gating circuit, which cuts off the corresponding power output stage to the final control element of the anti-lock system. The monitoring device can be so adjusted by means of the resistor 27 in series with the contact pin signalling back 12, 13 so that for example the corresponding control channel is cut off e.g. only in the lower speed region.

The circuit can be further modified for example by measuring the current in the electric circuit 21, 22 23 of the sensor 17. By this means the cutting off, of one of the control channels for example during braking can be prevented.

The method described here has the further advantage that it can be picked up more readily by a diagnosis instrument during an inspection. This current measuring circuit has to be combined additionally with a signal of the input amplifier, so that for example only at standstill when the sensor 17 supplies no pulses, this is made use of by the circuit.

Apart from detecting brake pad wear electrically, it is also possible for brake pad wear to be detected. Such a mode of operation is illustrated in Fig. 3. Here a pin 40 of a brake pad wear detecting device 41 is linked with a brake pad 42. The pin 40 has a head 43 which via a lever 44 can act upon the wheel velocity sensor carrier 16 in such a manner that the carrier is moved along its fixing pin 29. Such a movement results in an increase in the operational air gap 19 in the sensor 17. Hence the signal amplitude at least in the region of low speed, is reduced. This in turn is picked up by the monitoring device according to Fig. 2 and a warning is given.

WHAT WE CLAIM IS:—

1. A braking system for a vehicle having a wheel anti-lock system including a wheel velocity sensor arrangement comprising a pulse wheel rotatable with a vehicle wheel and a pulse generator in proximity thereto for deriving therefrom signals indicative of wheel velocity, and a monitoring device for monitoring the correct operation of the anti-lock system and including warning device, and in which a sensing device responsive to wheel brake pad wear is connected to the sensor to at least partially reduce the effective signal from the pulse generator to the anti-lock system when predetermined wear of brake pads has taken place, whereby to actuate the warning device of the anti-lock system operation monitoring device also when predetermined brake pad wear has taken place.

2. A system as claimed in claim 1, in which the brake pad wear detecting device operates electrically and is connected in a circuit in parallel with a pulse generator of the anti-lock system.

3. A system as claimed in claim 2, in which the parallel circuit connects the output of the pulse generator directly to earth when predetermined brake pad wear is detected.

4. A system as claimed in claim 2, in which the parallel circuit by-passes the output of the pulse generator to earth through a

resistor when predetermined brake pad wear is detected.

5. A system as claimed in any of claims 1 to 4, in which the anti-lock system monitoring device measures the current in the pulse generator.

6. A braking system as claimed in claim 1, in which the brake pad wear detecting device operates mechanically and is adapted after a predetermined brake pad wear has occurred to displace the pulse generator so as to alter the air gap between the pulse generator and the pulse wheel, and the resultant changed signal from the pulse generator is detected by the anti-lock system operation monitoring device.

7. A braking system for a vehicle, constructed and arranged and adapted to operate substantially as hereinbefore particularly described with reference to and as illustrated in Figs. 1 and 2 or Fig. 3 of the accompanying drawings.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig. 1

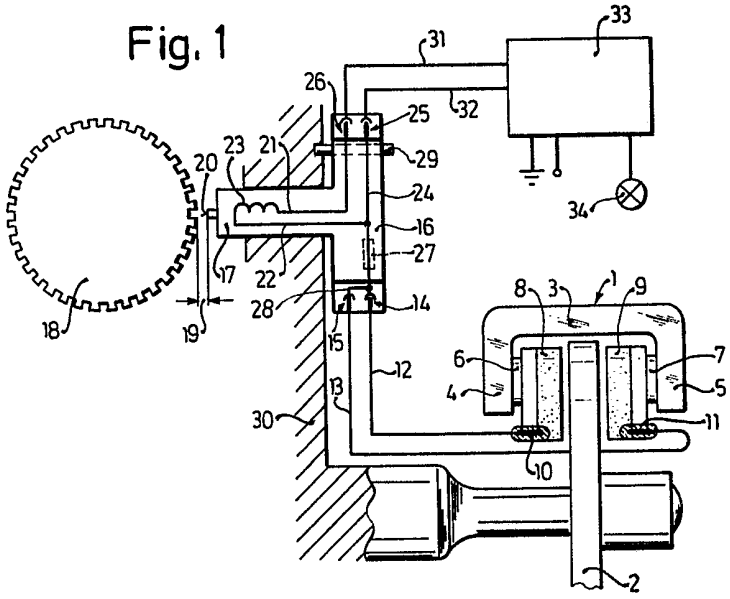
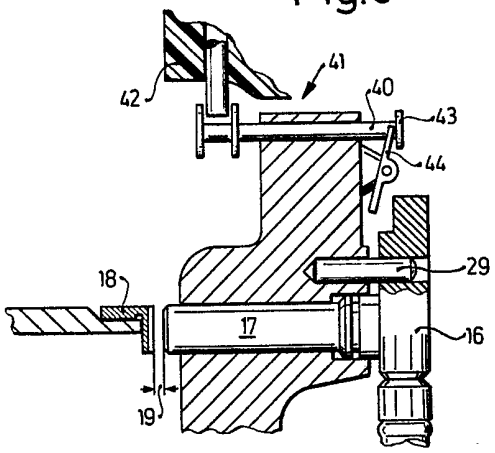


Fig. 3



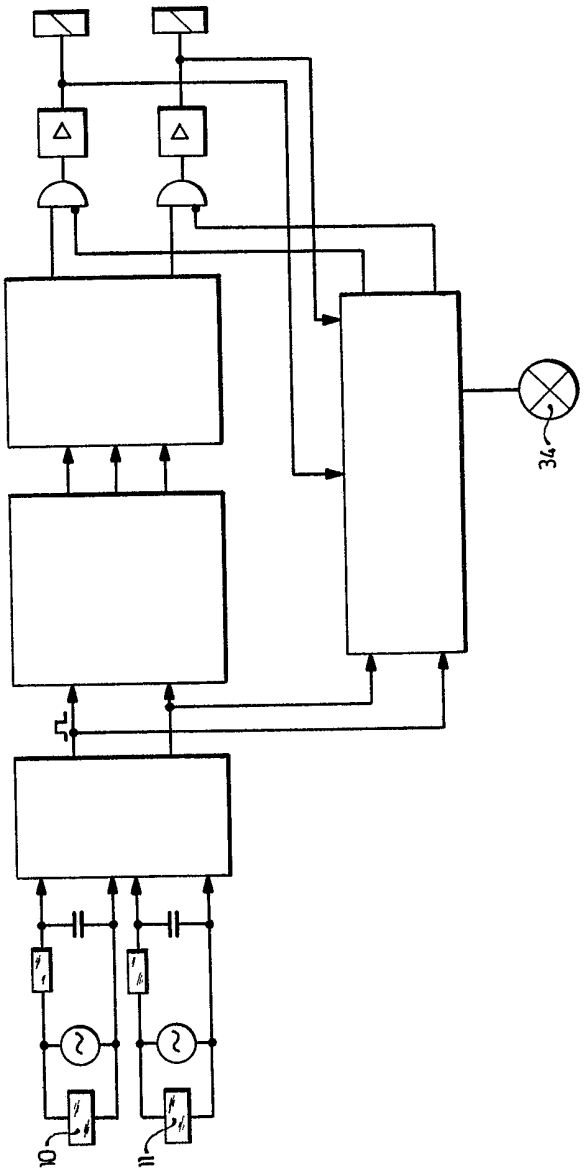


Fig. 2