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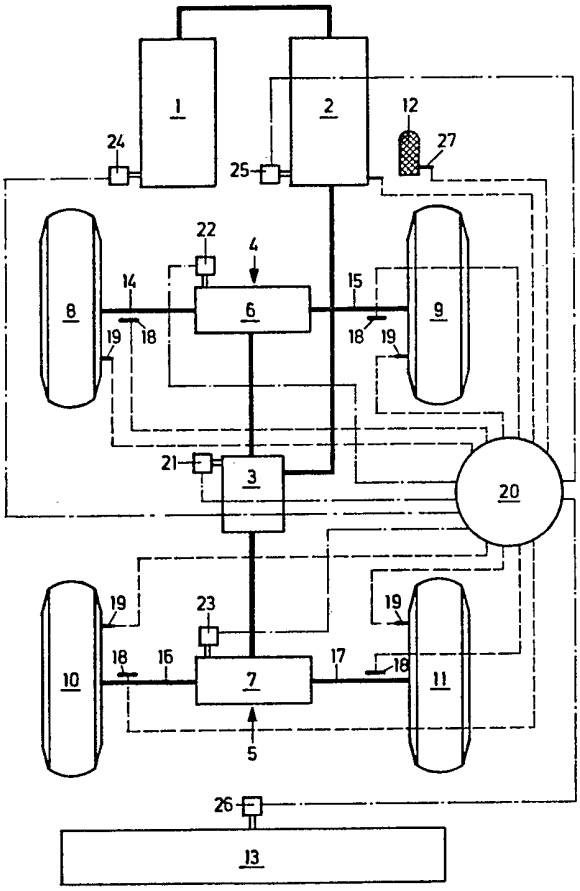
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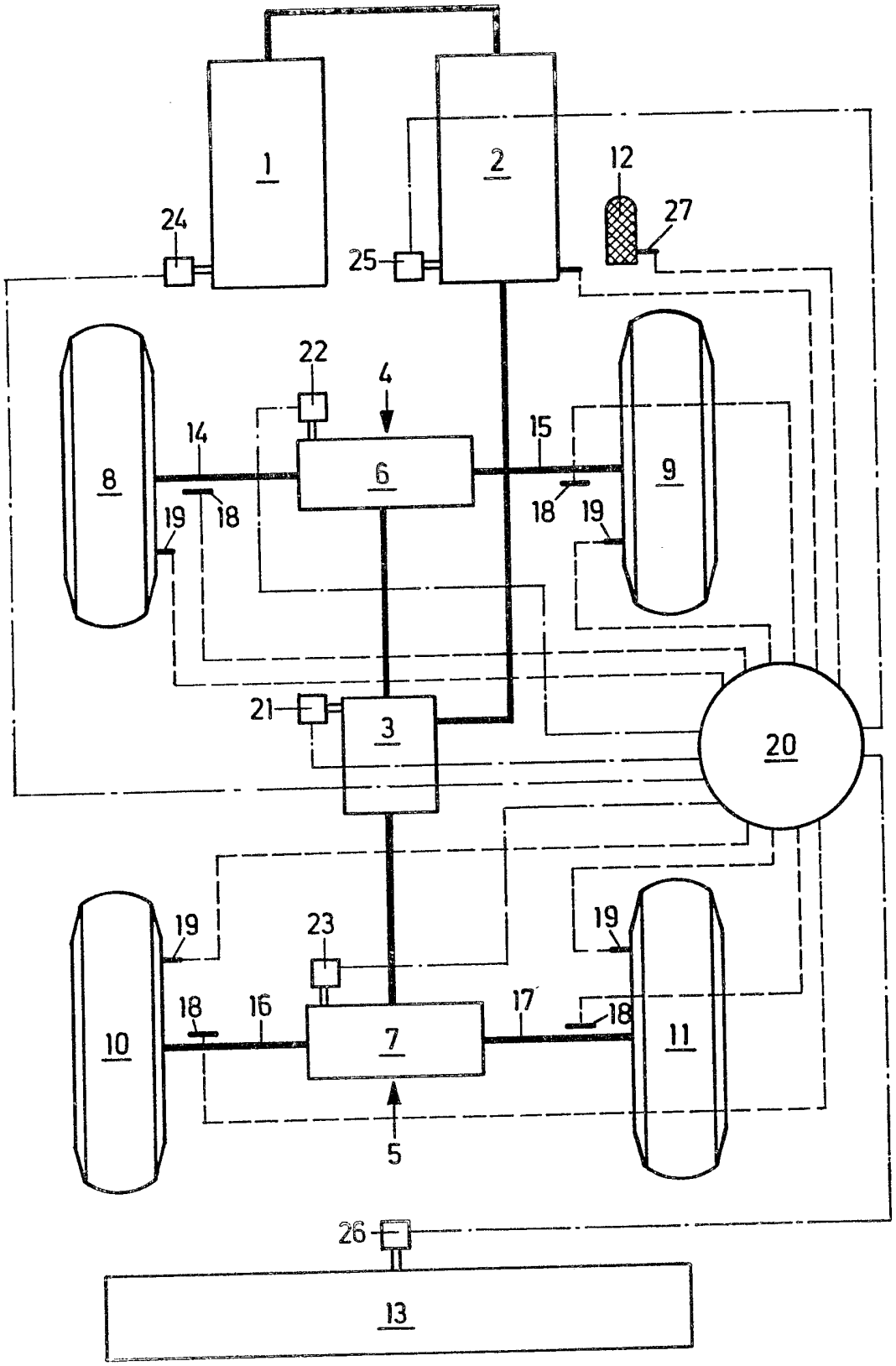
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(54) Drive for a motor vehicle having at least one locking differential

(57) A drive for a motor vehicle comprises at least one locking differential (3, 6, 7) with a driving gear fixed to the differential casing, and with an operable coupling device for the direct, non-rotary connection of the driving gear to at least one driven shaft or driving axle (14, 15, 16, 17), tachometers (19) associated with each driving axle (14, 15, 16, 17) and a processor (20) to which are supplied the signals from tachometers (19) and which, as a function of these signals, supplies an output signal for operating the coupling device by means of a transducer (21, 22, 23) bringing about a mechanical conversion of the electrical output signal, for optimizing the transmission of the available drive power to the ground in each driving situation, a torque pickup (18) is associated with each driving axle, the output signals of the torque pickups (18) being supplied to the processor (20) which, as a function of said signals, supplies the transducers (22 or 23) with a signal for releasing or for changing the locking value of the coupling device of the locking differentials (6 or 7).



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SPECIFICATION

Drive for a motor vehicle having at least one locking differential

This invention relates to a drive for a motor vehicle comprising at least one locking differential with a driving gear fixed to the differential casing and with an operable coupling device for the direct, non-rotary connection of the driving gear to at least one driven shaft or driving axle.

Locking differentials in the drives of motor vehicles make it possible to cancel out the action of the differential in certain driving situations, particularly in the case of spinning of a driving wheel. This locking of the differential can be brought about at random, e.g. by the vehicle driver, as a function of the assessment of the situation. In addition, purely mechanical—hydraulic locking differentials are known, in which the hydraulic operation of the locking device takes place automatically by means of a control pump as a function of the speed differences of the driving wheels. (see for example German Offenlegungsschrift No. 25 57 152).

The known locking differentials suffer from the disadvantage that the locking action only occurs if there is a relatively large speed difference. However, driving situations can arise in which the driving axle functions as a rigid axle or a partial locking action is to be obtained, without there being the criterion of a speed difference or a considerable speed difference between the driving wheels.

An improvement in this connection resulted from the locking differential which forms the subject of German Offenlegungsschrift No. 30 40 120, which has a processor, to which are supplied the speed signals of tachometers associated with the wheels and which, as a function of the stored criteria, supplies operating signals to an electromechanical transducer, which operates the locking differential coupling device which brings about the locking action.

However, particularly in the case of commercial vehicles, driving situations arise as a result of the often widely differing characteristics of the ground under each driving wheel and through the use of implements connected to the vehicle, in which the criterion of speed or speed difference is not adequate to bring about an optimum control of the locking differential via a processor.

The present invention aims to convert the available drive power in a maximum advantageous manner into a desired vehicle drive and therefore permit the optimum manoeuvering of the vehicle under difficult conditions, whilst in particular preventing the spinning of wheels.

According to the invention, there is provided a drive for a motor vehicle, comprising at least one locking differential with a driving gear fixed to the differential casing and with an operable coupling device for the direct, non-rotary connection of the driving gear to at least one driven shaft or driving axle, a tachometer associated with each driving axle and a processor to which the tachometer signals are supplied and which, as a function of said signals, supplies an output signal for operating the coupling device by means of a transducer bringing about a mechanical conversion of the electrical output signal, wherein a torque pickup is associated with each driving axle, the output signals of the torque pickups being supplied to the processor which, as a function of said signals, supplies the transducer with a signal for locking, releasing or changing the locking value of the coupling device of the or each locking differential.

As a result of the processor, which comprises a memory and an evaluation logic, it is possible to store release values for certain operating situations. The evaluation logic then compares the measured and stored values, so that as a function of the result of this comparison, e.g. if a specific measured value exceeds a predetermined level, an operating signal can be released. It is possible with the aid of the processor to very accurately define the release values, i.e. it is e.g. possible to previously store the maximum possible speed differences which can occur between individual wheels when taking curves, thereby ensuring that this does not lead to the locking of the differential. However, there can be a complete or partial locking of the differential, even when the limit value is slightly exceeded, without large speed differences being necessary for release purposes. As a result of the arrangement according to the invention which apart from tachometers, also provides torque pickups on each driving shaft, it is possible to bring about a partial or complete initiation of the locking action, independently of the speed difference criterion or in addition to such criteria. Thus, particularly in the case of commercial vehicles, there is a particularly favourable utilization of the available drive power.

It is fundamentally possible to use the drive according to the invention in conjunction with fourwheel driven vehicles, it merely being necessary to supply the measured values of all four wheels to the processor. In accordance with correspondingly predetermined criteria, the processor can then separately control the transducers for the speed differential of the front and rear axle. However, according to a preferred embodiment of the invention, a drive for a motor vehicle with four-wheel drive is provided in which a locking differential is provided on the front axle, a locking differential is provided on the rear axle and a lockable longitudinal or central differential is provided between the front and rear axles, wherein an electromechanical transducer is associated

with the processor for operating the locking device of the longitudinal differential.

This arrangement is particularly useful for driving situations in which the front axle wheels on the one hand and the rear axle wheels on the other have a common driving behaviour, e.g. when the load is largely removed from the front axle in the case of an excavator, so that both front wheels spin to a greater or lesser extent. Through influencing the locking device of the longitudinal or central differential, it is possible to bring about an optimum distribution of the drive power over the front and rear axles in such a situation. In parallel to the operation of the locking device of the longitudinal differential, the processor can control the locking differentials of the front and rear axle and then, as a function of specific criteria, e.g. lock both locking devices, only lock one locking device completely and release the other, or merely bring about a reduction of the locking value. An electromechanical transducer for operating the throttle setting may be associated with the processor and, as a function of the speed and/or torques of the driving axles, the processor can then be arranged to supply the transducer with an operating signal. This arrangement ensures that the driving parts are protected against excessive torque and undesired spinning of the wheels is prevented.

According to another embodiment of the invention, an electromechanical transducer for operating an implement is associated with the processor and, as a function of the speed and/or torques of the driving axles, the processor supplies said transducer with an operating signal for the implement in order to modify the power input of the implement in accordance with the drive conditions. This arrangement makes it possible, with the aid of the processor, to set the implement in such a way that the motor can supply its maximum power. The processor may also be associated with an electromechanical transducer for operating gear shifting, the processor supplying an operating signal to the transducer as a function of the speed and/or torque values of the driving axles. By means of this arrangement it is possible for an operation of the gear to take place in such a way that in each case the most advantageous gear is used. The shifting criteria are greatly improved if a gear oil temperature measuring device is connected to the processor. An interrogation device for the position of the vehicle brake pedal is also desirably connected to the processor.

Where a hydraulic or electrical eddy brake is provided, an electromechanical transducer for operating the hydraulic or electrical eddy brake may be associated with the processor, the latter supplying the transducer with an operating signal, as a function of the speed and/or torque values of the driving axles. This makes it possible to operate said brake as a function of the determined criteria, as compared with the predetermined criteria.

The invention will now be further described, by way of example, with reference to the drawing which illustrates, diagrammatically, one embodiment of a drive according to the invention.

The drawing shows the transmission paths for the torques by means of continuous thick lines, the information flow paths from the pickups to the processor by broken lines and the control lines from the processor to the transducers by means of dot-dash lines.

The diagrammatically shown drive comprises a motor 1, a gear 2, a longitudinal or central differential 3, a locking differential 6 on a front axle 4 and a locking differential 7 on a rear axle 5. The torque is transmitted from the motor 1, via the gear 2 to the longitudinal differential 3 and from the latter to the locking differentials 6 and 7. There is a further torque transmission to the front driving sheels 8, 9 or the rear driving wheels 10, 11 by means of the locking differentials 6, 7. The illustrated embodiment relates to a four-wheel drive. The brakes are operated by means of a brake pedal 12. The braking action can be brought about by means of drum or disk brakes or, in addition thereto, by hydraulic or electrical eddy brakes.

In addition, a working implement 13 is associated with the vehicle, for which the diagrammatically represented drive is intended. This implement can e.g. be a plough, a dredger bucket, a trenching shovel or the like.

On either side of the particular locking differentials 6 or 7, the front axle 4 and rear axle 5 cover the driving axles 14, 15 or 16, 17 for each driving wheel 8, 9 or 10, 11. On each driving axle is provided a torque pickup 18 and on each driving wheel 8 to 11 there is a tachometer 19. The torque pickups 18 and tachometers 19 are connected to a processor 20, which, in per se known manner, comprises a memory and an evaluation logic for comparing the measured values or value combinations with the stored values or value combinations. With the processor 20 are associated electromechanical transducers, which can convert an electrical operating signal into a mechanical operating movement. There is a transducer 21 for operating a locking device of the longitudinal or central differential 3, transducers 22, 23 for operating the locking differentials 6, 7, a transducer 24 for operating the throttle setting of the motor 1, a transducer 25 for operating the shifting of the gear 2 and a transducer 26 for operating the implement 13. An interrogation device 27 is used for interrogating the position of the brake pedal, but for ease of viewing reasons the brakes to be operated and the associated transducer or transducers are not shown. The transducers 21 to 26 used for converting the

output signal of the processor 20 can be randomly operable and/or acting transducers, i.e. hydraulic, pneumatic, electrical or purely mechanical transducers.

CLAIMS

1. A drive for a motor vehicle, comprising at least one locking differential with a driving gear fixed to the differential casing and with an operable coupling device for the direct, non-rotary connection of the driving gear to at least one driven shaft or driving axle, a tachometer associated with each driving axle and a processor to which the tachometer signals are supplied and which, as a function of said signals, supplies an output signal for operating the coupling device by means of a transducer bringing about a mechanical conversion of the electrical output signal, wherein a torque pickup is associated with each driving axle, the output signals of the torque pickups being supplied to the processor which, as a function of said signals, supplies the transducer with a signal for locking, releasing or changing the locking value of the coupling device of the or each locking differential.

2. A drive according to claim 1 for a motor vehicle with four-wheel drive, in which a locking differential is provided on the front axle, a locking differential is provided on the rear axle and a lockable longitudinal or central differential is provided between the front and rear axles, wherein an electromechanical transducer is associated with the processor for operating the locking device of the longitudinal differential.

3. A drive according to claim 1 or claim 2, wherein an electromechanical transducer for operating throttle setting is associated with the processor and, as a function of the speed and/or torques of the driving axles, the processor is arranged to supply the transducer with an operating signal.

4. A drive according to any preceding claim, wherein an electromechanical transducer for operating an implement is associated with the processor and, as a function of the speed and/or torques of the driving axles, the processor supplies said transducer with an operating signal for the implement in order to modify the power input of the implement in accordance with the drive conditions.

5. A drive according to any preceding claim, wherein the processor is associated with an electromechanical transducer for operating gear shifting, the processor supplying an operating signal to the transducer as a function fo the speed and/or torque values of the driving axles.

6. A drive according to claim 5, wherein a gear oil temperature measuring device is connected to the processor.

7. A drive according to any preceding claim, wherein an interrogation device for the position of a brake pedal is connected to the processor.

8. A drive according to any preceding claim, wherein an electromechanical transducer for operating a hydraulic or electrical eddy brake is associated with the processor, the latter supplying the transducer with an operating signal, as a function of the speed and/or torque values of the driving axles.

9. A drive for a motor vehicle substantially as described herein with reference to the drawing.

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