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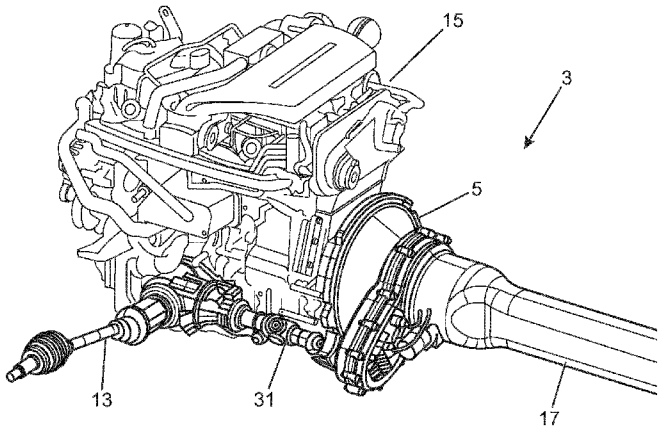


FIG. 3

(57) Abstract: A system for providing four wheel drive in a vehicle, the system comprising; transmission means comprising a plurality of gears, wherein the transmission means is arranged to be coupled to an engine via a propeller shaft and arranged to drive two primary wheels; power transfer means arranged to be coupled to an engine and arranged to drive two secondary wheels; wherein the power transfer means comprises a gear arrangement and at least one clutch positioned between the engine and the gear arrangement; wherein the gear arrangement and at least one clutch are configured to enable the power transfer means to provide an output at a plurality of different speeds such that when the transmission means is in a first subset of gears the power transfer means provides an output at a first speed and when the transmission means is in a second, different subset of gears the power transfer means provides an output at a second, different speed.

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SYSTEM FOR PROVIDING FOUR WHEEL DRIVE IN A VEHICLE

TECHNICAL FIELD

The present disclosure relates to a system for providing four wheel drive in a vehicle. In particular, but not exclusively it relates to a system for providing four wheel drive in a rear-mounted transaxle vehicle.

Aspects of the invention relate to a system, power transfer means and a vehicle.

BACKGROUND

In rear-mounted transaxle vehicles where the engine is mounted at the front of the vehicle and the transmission is mounted at the rear a propeller shaft is provided to connect the engine to the transmission. In order to provide power to the front wheels to enable four wheel drive it is necessary to connect the front wheels to the transmission. This requires a second propeller shaft to couple the transmission to the front axles. This additional propeller shaft is undesirable as it decreases the efficiency of the vehicle and also increases the cost and weight of the vehicle.

It is an aim of the present invention to address disadvantages associated with such systems.

SUMMARY OF THE INVENTION

Aspects and embodiments of the invention provide systems, transfer cases and vehicles as claimed in the appended claims.

According to an aspect of the invention there is provided a system for providing four wheel drive in a vehicle, the system comprising; power transfer means arranged to receive an input from an engine and arranged to transfer power from the engine via a first output to drive two wheels on a first axle; wherein the input from the engine is additionally provided as a second output from the power transfer means to a transmission means via a propeller

shaft; wherein the transmission means is arranged to transfer power from the engine to drive two wheels on a second axle.

As the power transfer means is arranged to be coupled to the engine rather than the transmission means this removes the requirement for a second propeller shaft between the transmission means and the two wheels on the first axle. This may increase the efficiency of the vehicle. It may also reduce the cost and weight of the vehicle.

Having the power transfer means arranged to be coupled to the engine rather than the transmission means allows the power transfer means to be provided towards the front of the vehicle. This may improve the design freedom for the floor of the vehicle. It may provide increased room for footwells within the vehicle. It may also enable a generic floor design to be used in both four wheel drive vehicle and rear wheel drive vehicles. This could reduce the cost of the vehicle.

The power transfer means may comprise a gear arrangement and at least one clutch positioned between the engine and the gear arrangement. The gear arrangement and the at least one clutch may be configured to enable the power transfer means to provide the first output at a plurality of different first output speeds to drive the two wheels on the first axle. The transmission means may comprise a plurality of gears, and the gears may be arranged to provide a transmission output at a plurality of different transmission output speeds to drive the two wheels on the second axle.

As the power transfer means enables the two wheels on the first axle to be driven at different speeds this may enable four wheel drive of the vehicle to be provided in different gears of the transmission means. This may enable four wheel drive of the vehicle in high gears of the transmission means as well as in low gears of the transmission means.

The transmission means may be a transmission and the power transfer means may be a transfer case.

The gear arrangement and one or more clutches may be arranged so that the plurality of different first output speeds of the power transfer means may be correlated with the plurality

of different transmission output speeds of the transmission means. The correlation of the plurality of first output speeds of the power transfer means and the plurality of transmission output speeds of the transmission means may enable the first output speed of the power transfer means to match the transmission output speed of the transmission means.

The power transfer means may be provided such that when the transmission means is in a first subset of gears the power transfer means provides the first output speed at a first speed and when the transmission means is in a second, different subset of gears the power transfer means provides the first output speed at a second, different speed.

The gear arrangement and at least one clutch may be configured such that when the transmission means is in a third, different subset of gears the power transfer means provides the first output speed at a third, different speed.

Having at least three different speeds provides a multi speed power transfer means which can provide outputs at a plurality of different speeds. This may enable the speed of the power transfer means to be matched to the speed of the transmission means for a larger number of gears. This may enable four wheel drive of the vehicle both in low gears and high gears of the transmission means.

The input to the power transfer means may turn at engine output speed.

Having the power transfer means arranged to be coupled to the engine rather than the transmission means enables the input to the power transfer means to be provided at the engine output speed rather than the transmission means output speed. This may enable the power transfer means to provide outputs when the transmission means is in a higher gear.

The power transfer means may comprise a plurality of clutches configured to enable different gear arrangements to be connected.

Having a plurality of clutches may enable one or more gear arrangements to be connected and/or disconnected. This allows for a plurality of different first output speeds to be provided

by the power transfer means and so allows for matching with more subsets of gears from the transmission means.

At least one of the clutches may disconnect the gear arrangement from the input from the engine and the two wheels on the first axle so that the two wheels on the first axle are coupled to the input from the engine.

This allows for one to one gearing between the input from the engine and the first output of the power transfer means. This may enable close matching of the first output speed of the power transfer means with the transmission output speed of the transmission means when the transmission means is in higher gears.

The clutches may comprise slippable clutches.

The slippable clutches may be arranged so that the first output speed of the power transfer means when the gearing arrangement is connected can be matched to more than one gear of the transmission means. This enables the power transfer means to use fewer gears than the transmission means because a single gear of the power transfer means can be matched to the transmission means.

The gears within the gear arrangement comprise epicyclic gears.

The epicyclic gears may be arranged so that connecting different stages of the epicyclic gears allows for different first output speeds to be provided by the power transfer means.

The system may comprise a controller configured to determine the current gear of the transmission means and provide a control signal to the power transfer means indicative of the current gear of the transmission means.

This allows for the speed of the power transfer means to be matched to the speed of the gear of the transmission means. Using the current gear of the transmission means may provide a simple input for controlling the output of the power transfer means. This may be simpler than monitoring multiple inputs from multiple sensors.

The vehicle may be a rear mounted transaxle vehicle.

Having the engine at the front and the transmission means at the rear may provide good weight distribution within the vehicle.

The power transfer means may be arranged to be coupled to the rear of the engine.

This provides improved weight distribution as the as the weight is added behind the engine rather than at the front end of the vehicle. This may avoid the vehicle becoming too heavy at the front end.

The power transfer means may comprise an electric motor configured to control the position of a clutch.

The electric motor may provide variable control for the speeds of the output of the transfer case. This may enable the speed of the first output of the transfer case to be matched to different transmission output speeds of the transmission.

According to another aspect of the invention, there is provided a vehicle comprising system as described in the preceding paragraphs.

According to yet another aspect of the invention, there is provided a power transfer means arranged to receive an input from an engine and to transfer power from the engine via a first output to drive two wheels on a first axle; wherein the input from the engine is additionally provided as a second output from the power transfer means to a transmission means via a propeller shaft.

The power transfer means may comprise: a gear arrangement; and at least one clutch arranged to be positioned in use between the engine and the gear arrangement; wherein the gear arrangement and at least one clutch are configured to enable the transfer case to provide the first output at a plurality of different speeds such that when a transmission means is in a first subset of gears the power transfer means provides the first output speed

at a first speed and when a transmission means is in a second, different subset of gears the power transfer means provides the first output speed at a second, different speed.

According to an aspect of the invention there is provided a system for providing four wheel drive in a vehicle, the system comprising; a transmission comprising a plurality of gears, wherein the transmission is arranged to be coupled to an engine via a propeller shaft and arranged to drive two primary wheels; a transfer case arranged to be coupled to an engine and arranged to drive two secondary wheels; wherein the transfer case comprises a gear arrangement and at least one clutch positioned between the engine and the gear arrangement; wherein the gear arrangement and at least one clutch are configured to enable the transfer case to provide an output at a plurality of different speeds such that when the transfer case is in a first subset of gears the transfer case provides an output at a first speed and when the transmission is in a second, different subset of gears the transfer case provides an output at a second, different speed.

According to an aspect of the invention there is provided a control system for controlling a four wheel drive vehicle comprising: means for receiving one or more signals indicative of a current gear of a transmission; means for controlling the output speed of a transfer case by providing a control signal to the transfer case wherein the control signal is dependent upon the current gear of the transmission.

The control signal may comprises information indicative of the current gear of the transmission.

According to an aspect of the invention there is provided a control system for controlling a four wheel drive vehicle as described above, wherein; the means for receiving one or more signals indicative of a current gear of a transmission comprises an electronic processor having an electrical input for receiving the one or more signals indicative of a current gear of a transmission; and an electronic memory device electrically coupled to the electronic processor and having instructions stored therein; the means for controlling the output speed of a transfer case by providing a control signal to the transfer case comprises the processor being configured to access the memory device and execute the instructions stored therein

such that is operable to control the output speed of a transfer case by providing a control signal to the transfer case.

According to an aspect of the invention there is provided a system for providing four wheel drive in a vehicle, the system comprising; transmission means comprising a plurality of gears, wherein the transmission means is arranged to be coupled to an engine via a propeller shaft and arranged to drive two primary wheels; power transfer means arranged to be coupled to an engine and configured to drive two secondary wheels; wherein the power transfer means comprises a first clutch configured to connect a gear arrangement between the propeller shaft and the secondary wheels and a second clutch configured to disconnect the gear arrangement such that when the transmission means is in a first subset of gears the gear arrangement is connected so that the power transfer means provides an output at a first speed and when the transmission means is in a second, different subset of gears the gear arrangement is disconnected so that the power transfer means provides an output at a second, different speed.

According to an aspect of the invention there is provided a system for providing four wheel drive in a vehicle, the system comprising; transmission means comprising a plurality of gears, wherein the transmission means is arranged to be coupled to an engine via a propeller shaft and arranged to drive two primary wheels; power transfer means arranged to be coupled to an engine and arranged to drive two secondary wheels; wherein the power transfer means is arranged to provide an output at a plurality of different speeds such that when the transmission means is in a first subset of gears the power transfer means provides an output at a first speed and when the transmission means is in a second, different subset of gears the power transfer means provides an output at a second, different speed.

According to an aspect of the invention there is provided a system for providing four wheel drive in a vehicle, the system comprising; transmission means comprising a plurality of gears, wherein the transmission means is arranged to be coupled to an engine via a propeller shaft and arranged to drive two primary wheels; power transfer means arranged to be coupled to an electric motor and arranged to drive two secondary wheels; wherein the power transfer means comprises a gear arrangement and at least one clutch positioned between the electric motor and the gear arrangement; wherein the gear arrangement and at

least one clutch are configured to enable the power transfer means to provide an output at a plurality of different speeds such that when the transmission means is in a first subset of gears the power transfer means provides an output at a first speed and when the transmission means is in a second, different subset of gears the power transfer means provides an output at a second, different speed.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig 1 illustrates an example vehicle which may comprise embodiments of the invention;

Fig 2 illustrates an example system;

Fig 3 illustrates a part of an example system;

Fig 4 illustrates an example transfer case;

Fig 5 schematically illustrates a gear arrangement and one or more clutches;

Fig 6 schematically illustrates another gear arrangement and one or more clutches; and

Fig 7 illustrates a controller.

DETAILED DESCRIPTION

Examples of the present disclosure relate to systems which may be used control four wheel drive in a vehicle 1. For instance, some examples relate to systems which may be used to control four wheel drive in a rear-mounted transaxle vehicle 1.

Fig 1 illustrates an example vehicle 1 which may comprise a system 3 according to examples of the present disclosure. It is to be appreciated that the vehicle 1 of Fig 1 is provided as an example and that examples of the disclosure may be provided in any four wheel drive vehicle 1.

Fig 2 illustrates an example system 3. The system 3 of Fig. 2 may be arranged for use in a rear-mounted transaxle vehicle 1 in which the engine 15 is mounted at the front of the vehicle 1 and the transmission 7 is mounted at the rear. It is to be appreciated that other systems 3 may be used in other types of vehicle 1.

Figs 3 and 4 illustrate a part of the example system 3 of Fig 2. Corresponding reference numerals are used for corresponding features. Fig 3 illustrates the transfer case 5 coupled to the engine 15. Fig 4 illustrates the same transfer case 5 with the engine 15 removed.

The example system 3 comprises power transfer means 5 and transmission means 7. The power transfer means may comprise a transfer case 5 and the transmission means may comprise a transmission 7. The system 3 is arranged to be connected to an engine 15 so that the transmission 7 can provide power from the engine 15 to the two primary wheels of the vehicle 1 and the transfer case 5 can provide power from the engine 15 to the two secondary wheels of the vehicle 1. A drive shaft 31 may be provided between the transfer case 5 and the front axle 13. A differential 41 may be provided between the wheels.

In the example system 3 the primary wheels are the rear wheels 19 of the vehicle 1. The transmission 7 is mounted on the rear axle 9. The transmission 7 is connected to the rear axle 9 so that the transmission 7 is arranged to drive the two rear wheels 19.

The transmission 7 is coupled to the engine 15 by a propeller shaft 18. The propeller shaft 18 may be provided within a torque tube 17. The propeller shaft 18 is arranged to connect to the engine 15 to the transmission 7 so that power from the engine 15 is can be provided to the transmission 7. The propeller shaft 18 may turn at the same speed as the engine 15. Therefore the input speed to the transmission 7 may be the same as the engine 15 output speed.

In the example system of Fig 2 the engine 15 is mounted on the opposite axle 13 to the transmission 7. The engine 15 is mounted on the front axle 13 while the transmission 7 is mounted on the rear axle 9. As the engine 15 and transmission 7 are provided on different axles 9, 13 the propeller shaft 18 extends within the torque tube 17 along the length of the vehicle 1.

The transmission 7 comprises a plurality of gears. The gears enable the output of the transmission 7 to have a different speed to the input provided from the engine 15. The transmission 7 may have any suitable number of gears. In some examples the transmission 7 may have five gears. In other examples the transmission 7 may have more than five gears. For instance the transmission 7 could have six or eight gears or any other suitable number.

The example system 3 also comprises a transfer case 5. The transfer case 5 may provide power transfer means. The transfer case 5 may be arranged to transfer power from the engine 15 to the front axle 13. This may enable the transfer case 5 to drive the two secondary wheels. In the example system 3 of Fig 2 the secondary wheels are the front wheels 11 (as shown in Fig 1).

The transfer case 5 is arranged to be coupled to the engine 15. In some examples the transfer case 5 may be directly coupled to the engine 15 with no intervening components. The transfer case 5 may be coupled to the engine 15 so that the input to the transfer case 5 is provided at the same speed as the engine 15.

In the example system of Fig 2 the transfer case 5 is positioned behind the engine 15. The transfer case 5 is positioned between the engine 15 and the transmission 7. The transfer case 5 may be provided close to the front axle 13. This may reduce the length of any drive shafts needed between the transfer case 5 and the front axle 13.

The transfer case 5 comprises power transfer means which enable the transfer case 5 to provide an output at a different speed to the input. In some examples the transfer case 5 may comprise one or more clutches 53, 55 and a gear arrangement 51 which may be arranged to provide an output at a different speed to the input.

The one or more clutches 53, 55 and a gear arrangement 51 may be arranged so that the plurality of different output speeds of the transfer case 5 may be correlated with the plurality of different output speeds of the transmission 7 (see for example Fig 5). The correlation of the speeds of the transfer case 5 with speeds of the transmission 7 may enable the output speeds of the transfer case 5 to be similar to, or the same as, the output speeds of the transmission 7. For instance when the transmission 7 is in a low gear the one or more clutches 53, 55 and a gear arrangement 51 may be arranged to provide a first output speed which may be a low speed and when the transmission 7 is in a higher gear the one or more clutches 53, 55 and a gear arrangement 51 may be arranged to provide a second output speed which may be a higher speed.

The one or more clutches 53, 55 and a gear arrangement 51 may be arranged such that when the transmission 7 is in a first subset of gears the transfer case 5 provides an output at a first speed and when the transmission 7 is in a second, different subset of gears the transfer case 5 provides an output at a second, different speed. In some examples when the transmission 7 is in a third, different subset of gears the transfer case 5 provides an output at a third, different speed.

It is to be appreciated that the transfer case 5 could have any number of output speeds configured to match to any number of subsets of gears of the transmission 7. The subsets of the gears of the transmission 7 could comprise one or more gears. In examples where a subset comprises more than one gear the one or more clutches 53, 55 and a gear arrangement 51 may be arranged to enable the speed of the transfer case to cover a range of the speeds provided by the transmission 7. Different subsets may comprise different numbers of gears.

Figs 5 and 6 schematically illustrates example gear arrangements 51 and clutches 53, 55, 63 which may be provided within the transfer case 5.

Fig 5 schematically illustrates a gear arrangement 51 and one or more clutches 53, 55 which may be provided within a transfer case 5 in some examples of the disclosure. The transfer

case 5 may be provided between the engine 15 and the transmission 7 as illustrated in Figs 2 to 4.

In the example of Fig 5 the transfer case 5 receives an input 52 from the engine 15. The input 52 from the engine 15 may be provided at the same speed as the engine 15. The input 52 from the engine 15 may also be provided as an output 54 to the transmission 7 via the propeller shaft 18. The gear arrangement 51 and one or more clutches 53, 55 are provided between the input 52 from the engine 15 and the front axle 13.

The output 56 of the transfer case 5 is provided to the front axle 13 to drive the front wheels 11. The gear arrangement 51 and one or more clutches 53, 55 controls the speed of the output 56. The gear arrangement 51 and one or more clutches 53, 55 are arranged to enable the output speed of the transfer case 5 to be correlated with the output speed of the transmission 7. In some examples the gear arrangement 51 and one or more clutches 53, 55 may be arranged to enable the output speed of the transfer case 5 to match the output speed of the transmission 7.

The transfer case 5 comprises a first clutch 53 and a second clutch 55. In other examples more than two clutches 53, 55 could be provided. Having more than two clutches 53, 55 could enable a plurality of different gear arrangements 51 to be connected to the input 52 from the engine 15 and enable a larger number of different output speeds to be provided by the transfer case 5.

The first clutch 53 is coupled to a gear arrangement 51. The first clutch 53 enables the gear arrangement 51 to be connected between the input from the engine 15 and the output to the front axle 13.

In the example of Fig. 5 the gear arrangement 51 comprises two epicyclic gears. The epicyclic gears comprise a first epicyclic stage 57 and a second epicyclic stage 59. The two stage gear arrangement 51 may enable two different gearing ratios to be provided. This enables multiple output speeds to be provided by the gearing arrangement 51.

The second clutch 55 is not coupled to the gear arrangement 51. The second clutch 55 enables the gear arrangement 51 to be disconnected between the input 52 from the engine 15 and the output 56 to the front axle 13. The second clutch 55 enables the input 52 from the engine 15 to be connected to the output 56 to the front axle 13.

The example transfer case 5 has three speeds which are provided by different configurations of the gear arrangement 51 and clutches 53, 55. The first speed may be provided when the first clutch 53 is closed and the first epicyclic stage 57 of the gear arrangement 51 is held stationary. The second speed may be provided when the first clutch 53 is closed and the first epicyclic stage 57 of the gear arrangement 51 is locked to the carrier of the epicyclic gears. The third speed may be provided by opening the first clutch 53 and closing the second clutch 55. This disconnects the gear arrangement 51 from the input 52 from the engine 15 and enables the output 56 to the front axle 13 to be connected to the input 52 from the engine 15. The third speed may enable one-to-one gearing with the input 52 from the engine 15 and the propeller shaft 18.

The clutch and gear arrangement may be arranged so that the output speeds of the transfer case 5 match the output speeds of the transmission 7. When the speeds are matched they could be the same as, or similar to, the speed of the transmission 7. In some examples the first speed of the transfer case 5 may match the lower gears of the transmission 7. The lower gears could be the first and second gears of the transmission 7. The second speed of the transfer case 5 could match the mid gears of the transmission 7. The mid gears could be the third and fourth gears. The third speed of the transfer case 5 could match the higher gears of the transmission 7. The higher gears of the transmission 7 could be the fifth gear and/or higher gears.

As an example the first speed of the transfer case 5 could have a gear ratio of 3.9:1, the second speed could have a gear ration of 1.9:1 and the third speed could have a ratio of 1:1. It is to be appreciated that other gear ratios could be provided in other examples of the disclosure.

The transfer case 5 may be configured to receive a control signal indicative of the current gear of the transmission 7. In response to receiving the control signal the transfer case 5

may be arranged to control the clutches 53, 55 and gear arrangement 51 to provide the output speed corresponding to the current gear of the transmission 7.

In the example of Fig. 5 the transmission 7 has five speeds but the transfer case 5 only has three. As the transmission 7 has more speeds than the transfer case 5 the gear arrangement 51 and clutches 53, 55 of the transfer case 5 are arranged so that the one configuration of the transfer case 5 can overlap more than one speed of the transmission 7. In the example of Fig. 5 this may be achieved by having slippable clutches. The slippable clutches may be arranged so that in some gear configurations of the transmission 7 and transfer case 5 the clutches 53, 55 may be arranged to slip at fixed speed under torque to enable the correct wheel speed to be provided by both the front wheels 11 and the rear wheels 19. The slippable clutches may be arranged to slip in gear configurations where the ratio of engine speed to wheel speed for the rear wheels 19 does not match the ratio of engine speed to wheel speed for the front wheels 11. Other suitable means may be used in other examples of the disclosure.

If both of the clutches 53, 55 are disconnected then the input 52 from the engine 15 is not connected to the transfer case 5. The four wheel drive is turned off as no power is provided from the transfer case 5 to the front wheels 19.

Fig 6 schematically illustrates another gear arrangement 51 and clutch 63 which may be provided within a transfer case 5 in some examples of the disclosure.

The transfer case 5 of Fig. 6 comprises a gear arrangement 51 and clutch 63 and an electric motor 61. The electric motor 61 may be configured to provide power to the front wheels 11 via the gear arrangement 51. The electric motor 61 may provide a secondary engine. The position of the clutch 63 may be controlled by an eletro-mechanical or hydraulic actuator. This may control the torque through the gear arrangement 51. The power provided by the electric motor 61 and/or the position of the clutch 63 may be arranged so that the output speed of the transfer case 5 can be correlated with the output speed of the transmission 7.

The power provided by the electric motor 61 and/or the position of the clutch 63 may be controlled in response to an input control signal. The electric motor 61 may receive a control

signal indicative of the current gear of the transmission 7. In response to the control signal the electric motor 61 may control the power provided by the electric motor 61 and/or the position of the clutch 63.

The clutch 63 may be arranged in an open configuration which enables the electric motor 61 to be disconnected from the front wheels 11. In such arrangements no output 56 is provided from the transfer case 5 to the front axle 13.

In examples of the disclosure the configuration of the gear arrangement 51 and the clutches 53, 55, 63 within the transfer case 5 is dependent on the current gear of the transmission 7. A controller 71 may be provided to enable the arrangement of the transfer case 5 to be controlled to correlate the current gear of the transmission 7 with the output speed of the transfer case 5. The controller 71 may be configured to receive an input indicative of the current gear of the transmission 7 and provide an output control signal to the transfer case 5 to control the output speed of the transfer case 5.

An example controller 71 is illustrated in Fig 7 and described below. In other examples the controller 71 could comprises a hydraulic and/or mechanical system or any other suitable means.

Fig 7 illustrates an example controller 71. The controller 71 may be a chip or a chip set. The controller 71 may form part of one or more systems comprised in a vehicle 1. The controller 71 may be configured to control the four wheel drive of the vehicle 1.

Implementation of a controller 71 may be as controller circuitry. The controller 71 may be implemented in hardware alone, have certain aspects in software including firmware alone or can be a combination of hardware and software (including firmware).

As illustrated in Fig 7 the controller 71 may be implemented using instructions that enable hardware functionality, for example, by using executable instructions of a computer program 77 in a general-purpose or special-purpose processor 73 that may be stored on a computer readable storage medium (disk, memory etc) to be executed by such a processor 73.

The processor 73 is configured to read from and write to the memory 75. The processor 73 may also comprise an output interface via which data and/or commands are output by the processor 73 and an input interface via which data and/or commands are input to the processor 73.

The memory 75 stores a computer program 73 comprising computer program instructions 79 (computer program code) that controls the operation of the controller 71 when loaded into the processor 73. The computer program instructions 79, of the computer program 77, provide the logic and routines that enables the controller 71 to control the output speed of the transfer case 5. The processor 73 by reading the memory 75 is able to load and execute the computer program 77.

The controller 71 therefore comprises: at least one processor 73; and at least one memory 75 including computer program code the at least one memory 75 and the computer program code configured to, with the at least one processor 73, cause the controller 71 at least to perform: receiving one or more signals indicative of a current gear of a transmission 7 and controlling the output speed of a transfer case 5 by providing a control signal to the transfer case 5 wherein the control signal is dependent upon the current gear of the transmission 7.

As illustrated in Fig 7, the computer program 77 may arrive at the controller 71 via any suitable delivery mechanism 81. The delivery mechanism 81 may be, for example, a non-transitory computer-readable storage medium, a computer program product, a memory device, a record medium such as a compact disc read-only memory (CD-ROM) or digital versatile disc (DVD), an article of manufacture that tangibly embodies the computer program 77. The delivery mechanism may be a signal configured to reliably transfer the computer program 77. The controller 71 may propagate or transmit the computer program 77 as a computer data signal.

Although the memory 75 is illustrated as a single component/circuitry it may be implemented as one or more separate components/circuitry some or all of which may be integrated/removable and/or may provide permanent/semi-permanent/ dynamic/cached storage.

Although the processor 73 is illustrated as a single component/circuitry it may be implemented as one or more separate components/circuitry some or all of which may be integrated/removable. The processor 10 may be a single core or multi-core processor.

For purposes of this disclosure, it is to be understood that the controller(s) described herein can each comprise a control unit or computational device having one or more electronic processors. A vehicle and/or a system thereof may comprise a single control unit or electronic controller or alternatively different functions of the controller(s) may be embodied in, or hosted in, different control units or controllers. A set of instructions could be provided which, when executed, cause said controller(s) or control unit(s) to implement the control techniques described herein (including the described method(s)). The set of instructions may be embedded in one or more electronic processors, or alternatively, the set of instructions could be provided as software to be executed by one or more electronic processor(s). For example, a first controller may be implemented in software run on one or more electronic processors, and one or more other controllers may also be implemented in software run on or more electronic processors, optionally the same one or more processors as the first controller. It will be appreciated, however, that other arrangements are also useful, and therefore, the present disclosure is not intended to be limited to any particular arrangement. In any event, the set of instructions described above may be embedded in a computer-readable storage medium (e.g., a non-transitory storage medium) that may comprise any mechanism for storing information in a form readable by a machine or electronic processors/computational device, including, without limitation: a magnetic storage medium (e.g., floppy diskette); optical storage medium (e.g., CD-ROM); magneto optical storage medium; read only memory (ROM); random access memory (RAM); erasable programmable memory (e.g., EPROM ad EEPROM); flash memory; or electrical or other types of medium for storing such information/instructions.

Although embodiments of the present invention have been described in the preceding paragraphs with reference to various examples, it should be appreciated that modifications to the examples given can be made without departing from the scope of the invention as claimed. In the examples describe above the system is provided in a rear-mounted transaxle vehicle in which the engine is mounted at the front of the vehicle and the transmission is

mounted at the rear. In other examples the engine could be mounted at the rear of the vehicle and the transmission could be mounted at the front.

Features described in the preceding description may be used in combinations other than the combinations explicitly described.

Although functions have been described with reference to certain features, those functions may be performable by other features whether described or not.

Although features have been described with reference to certain embodiments, those features may also be present in other embodiments whether described or not.

Whilst endeavoring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.

CLAIMS

1. A system for providing four wheel drive in a vehicle, the system comprising;

power transfer means arranged to receive an input from an engine and arranged to transfer power from the engine via a first output to drive two wheels on a first axle;

wherein the input from the engine is additionally provided as a second output from the power transfer means to a transmission means via a propeller shaft;

wherein the transmission means is arranged to transfer power from the engine to drive two wheels on a second axle.

2. A system as claimed in any preceding claim wherein the transmission means is a transmission and the power transfer means is a transfer case.

3. A system as claimed in any preceding claim wherein the power transfer means comprises a gear arrangement and at least one clutch positioned between the engine and the gear arrangement.

4. A system as claimed in claim 3 wherein the gear arrangement and the at least one clutch are configured to enable the power transfer means to provide the first output at a plurality of different first output speeds to drive the two wheels on the first axle; and

wherein the transmission means comprises a plurality of gears, wherein the gears are arranged to provide a transmission output at a plurality of different transmission output speeds to drive the two wheels on the second axle.

5. A system as claimed in claim 4 wherein the gear arrangement and the at least one clutch are arranged so that the plurality of different first output speeds of the power transfer means may be correlated with the plurality of different transmission output speeds of the transmission means.

6. A system as claimed in claim 5 wherein the correlation of the plurality of first output speeds of the power transfer means and the plurality of transmission output speeds of the transmission means enables the first output speed of the power transfer means to match the transmission output speed of the transmission means.

7. A system as claimed in any of claims 4-6, wherein when the transmission means is in a first subset of gears the power transfer means provides the first output speed at a first speed and when the transmission means is in a second, different subset of gears the power transfer means provides the first output speed at a second, different speed.

8. A system as claimed in claim 7 wherein the gear arrangement and the at least one clutch are configured such that when the transmission means is in a third, different subset of gears the power transfer means provides the first output speed at a third, different speed.

9. A system as claimed in any of claims 3 to 8 wherein the power transfer means comprises a plurality of clutches configured to enable different gear arrangements to be connected.

10. A system as claimed in any of claims 3 to 9 wherein one or more of the at least one clutch disconnects the gear arrangement from the input from the engine and the two wheels on the first axle, and couples the two wheels on the first axle to the input from the engine.

11. A system as claimed in claim 10 wherein the one or more of the at least one clutch that disconnects the gear arrangement enables one-to-one gearing between the input from the engine and the first output of the power transfer means.

12. A system as claimed in any of claims 3 to 11 wherein one or more of the at least one clutch comprises a slippable clutch.

13. A system as claimed in any of claims 3 to 12 wherein the gears within the gear arrangement comprise epicyclic gears.

14. A system as claimed in any preceding claim wherein the input to the power transfer means turns at engine output speed.

15. A system as claimed in any preceding claim comprising a controller configured to determine a current gear of the transmission means and provide a control signal to the power transfer means indicative of the current gear of the transmission means.

16. A system as claimed in any preceding claim wherein the vehicle is a rear mounted transaxle vehicle.

17. A system as claimed in any preceding claim wherein the power transfer means is arranged to be coupled to the rear of the engine.

18. A system as claimed in any preceding claim wherein the power transfer means is coupled to an electric motor configured to provide power to the power transfer means.

19. A vehicle comprising a system as claimed in any preceding claim.

20. Power transfer means arranged to receive an input from an engine and to transfer power from the engine via a first output to drive two wheels on a first axle;

wherein the input from the engine is additionally provided as a second output from the power transfer means to a transmission means via a propeller shaft.

21. A power transfer means as claimed in claim 20, wherein the power transfer means comprises:

a gear arrangement; and

at least one clutch arranged to be positioned in use between the engine and the gear arrangement;

wherein the gear arrangement and the at least one clutch are configured to enable the power transfer means to provide the first output at a plurality of different first output speeds such that when the transmission means is in a first subset of gears the power transfer means provides the first output speed a first speed and when a transmission means is in a second, different subset of gears the power transfer means provides the first output speed at a second, different speed.

22. Power transfer means as claimed in claim 20 or 21 wherein the transmission means is a transmission and the power transfer means is a transfer case.

23. A system substantially as described herein with reference to the accompanying drawings and/or as illustrated in the accompanying drawings.

24. A vehicle substantially as described herein with reference to the accompanying drawings and/or as illustrated in the accompanying drawings.

25. A transfer case substantially as described herein with reference to the accompanying drawings and/or as illustrated in the accompanying drawings.

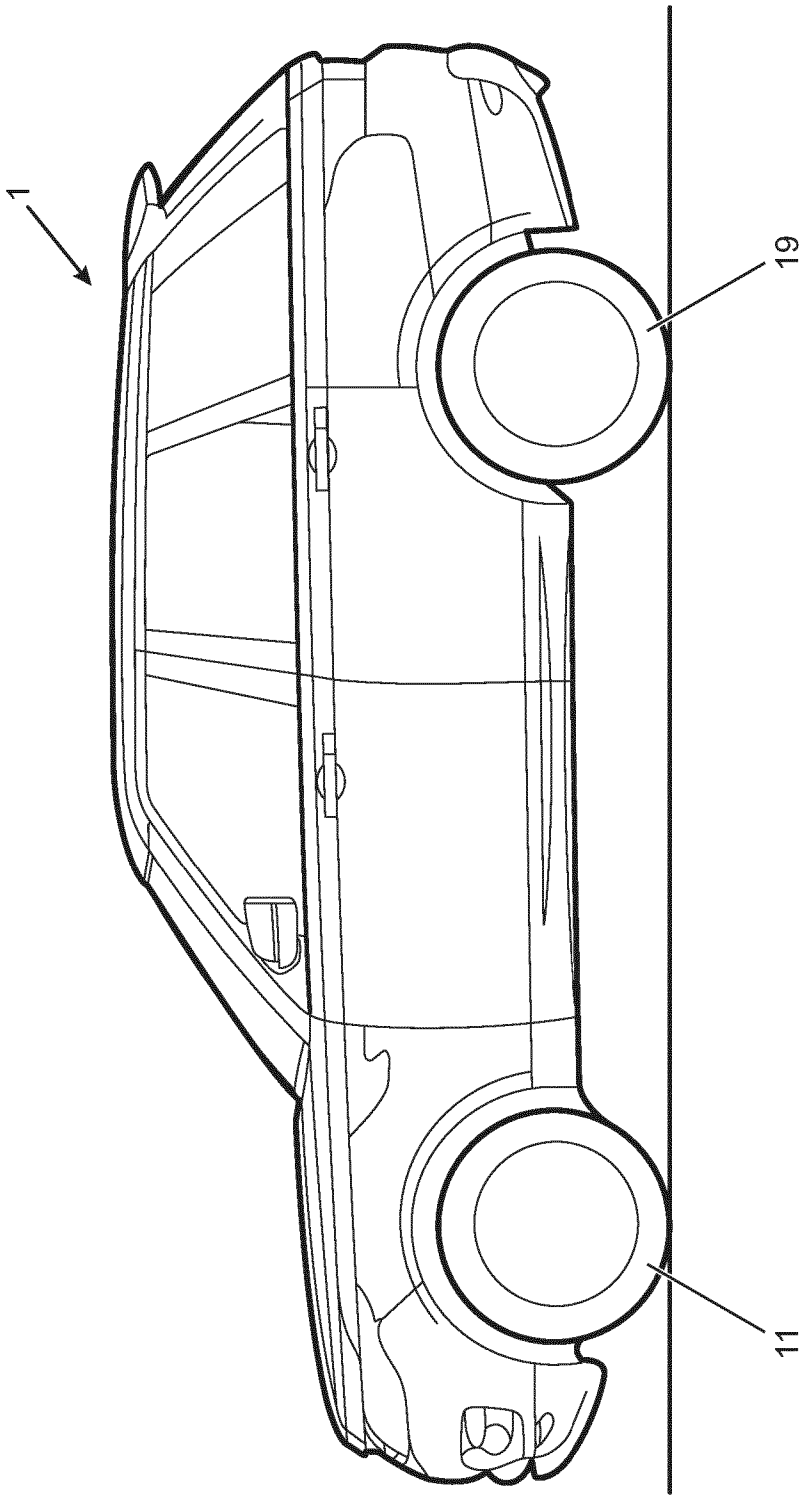


FIG. 1

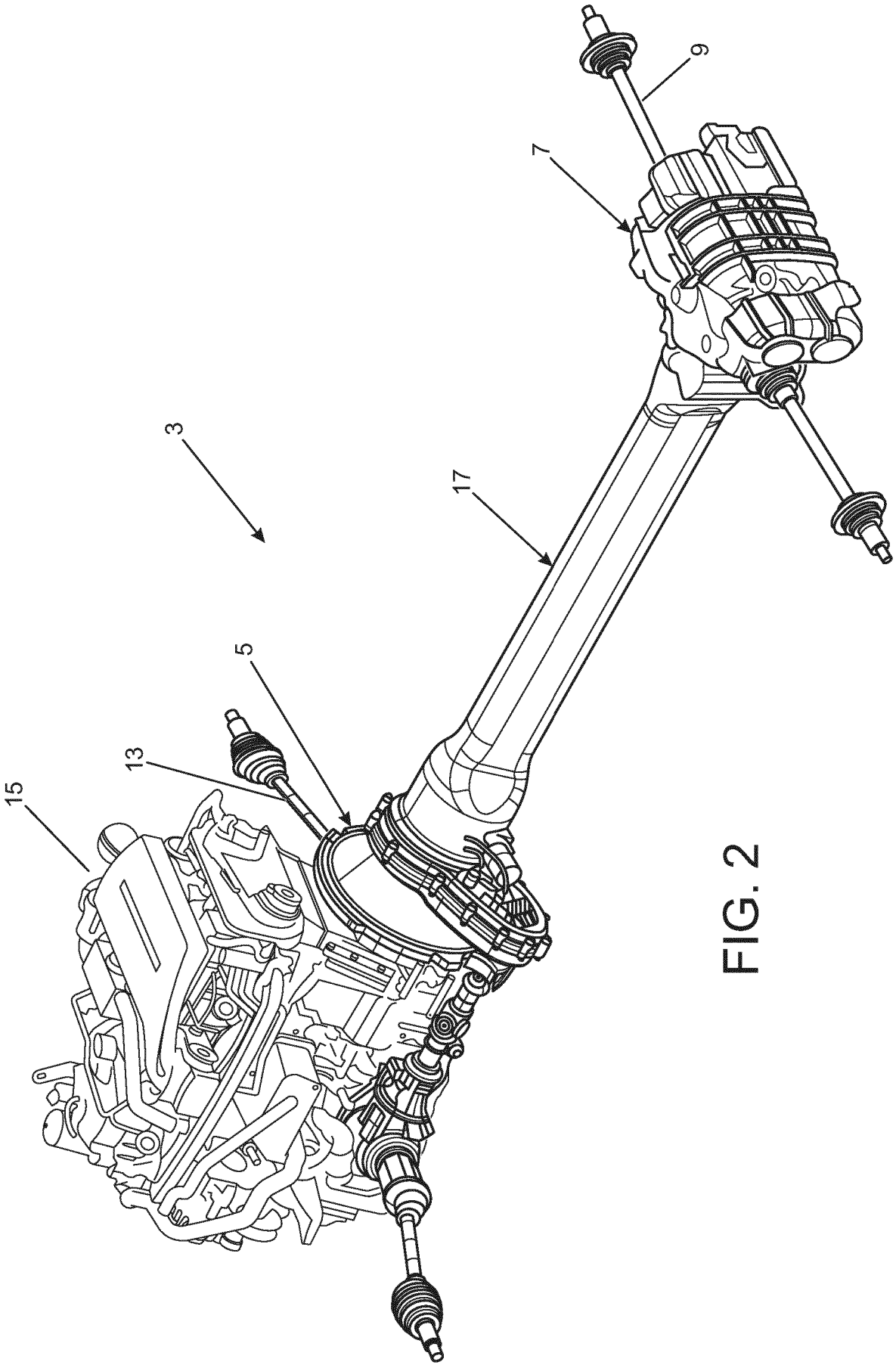


FIG. 2

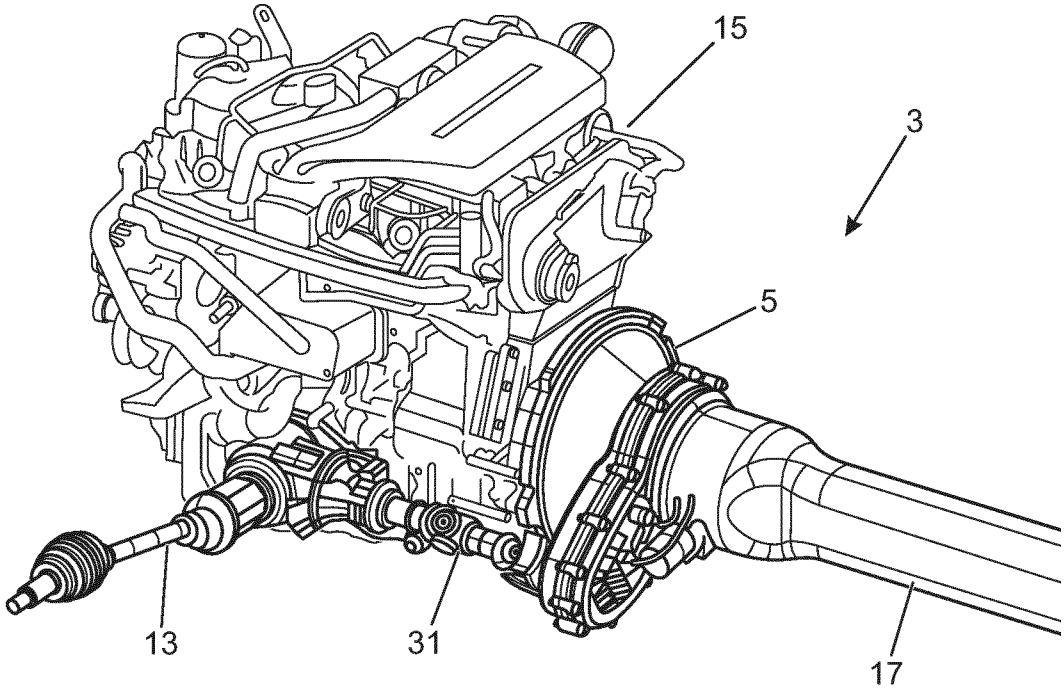


FIG. 3

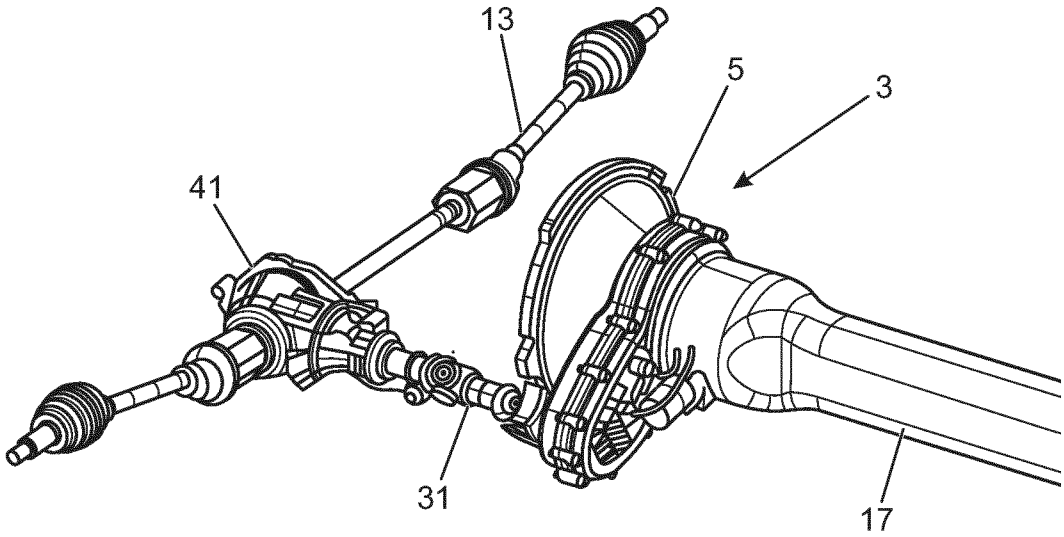


FIG. 4

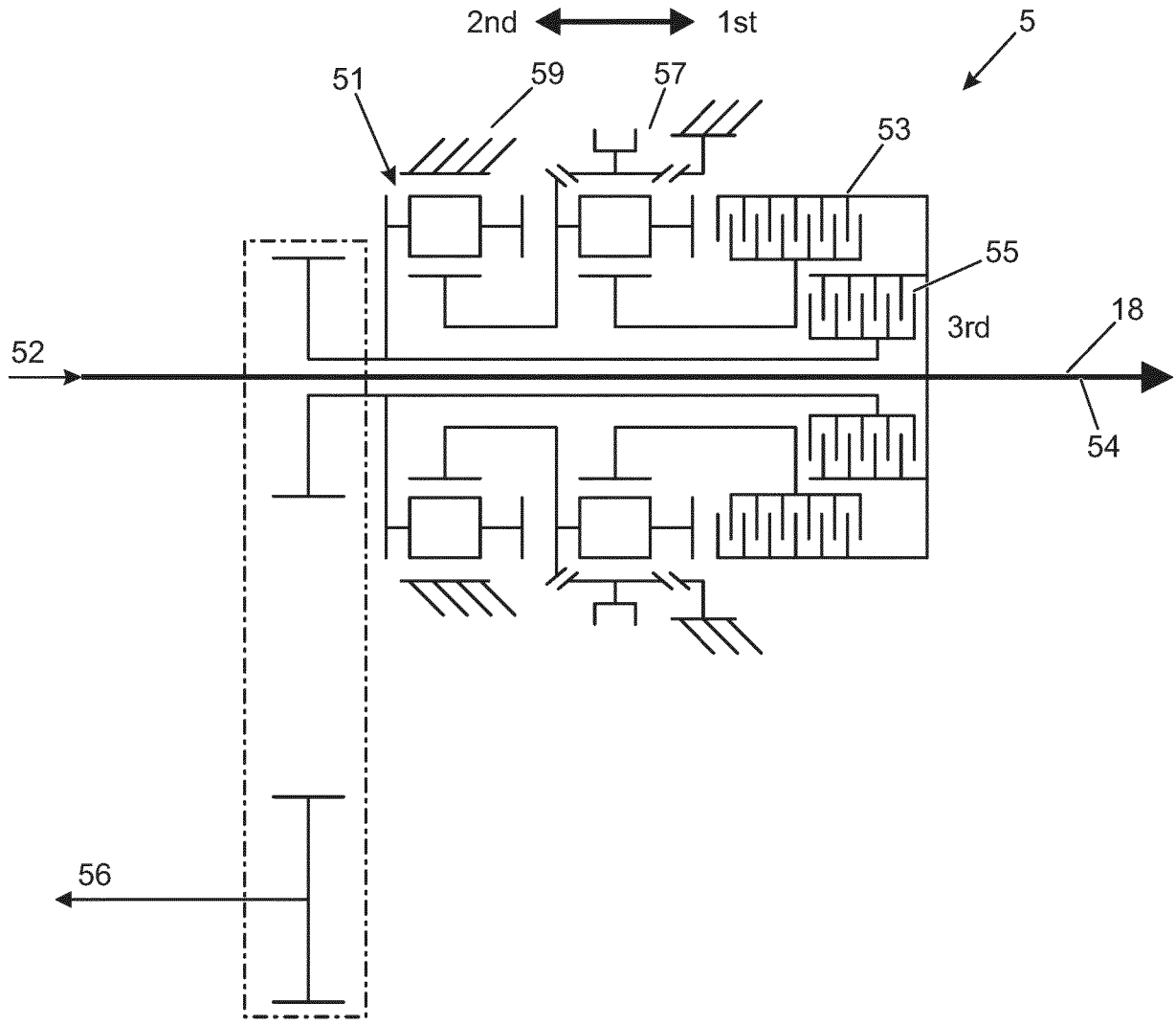


FIG. 5

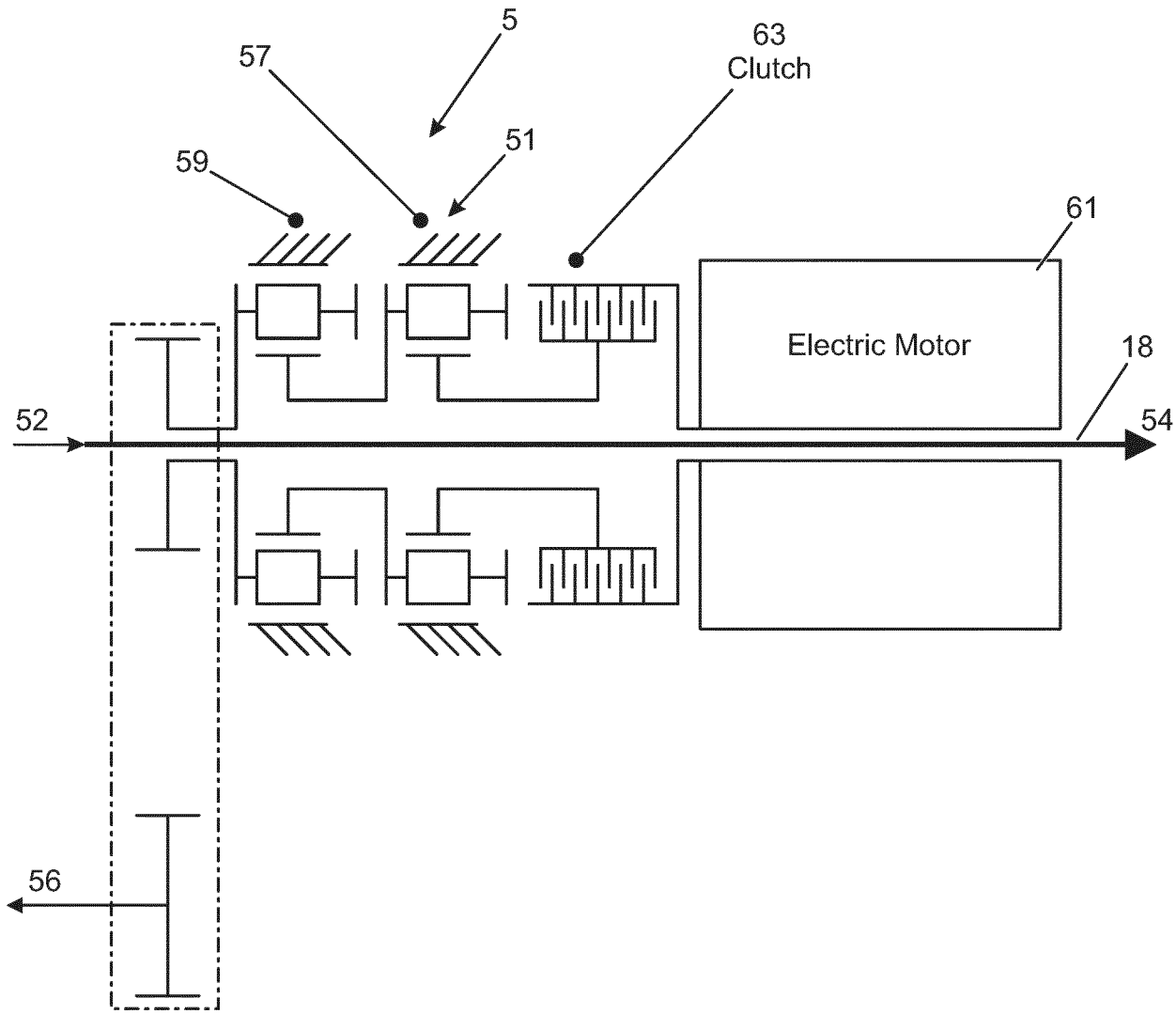
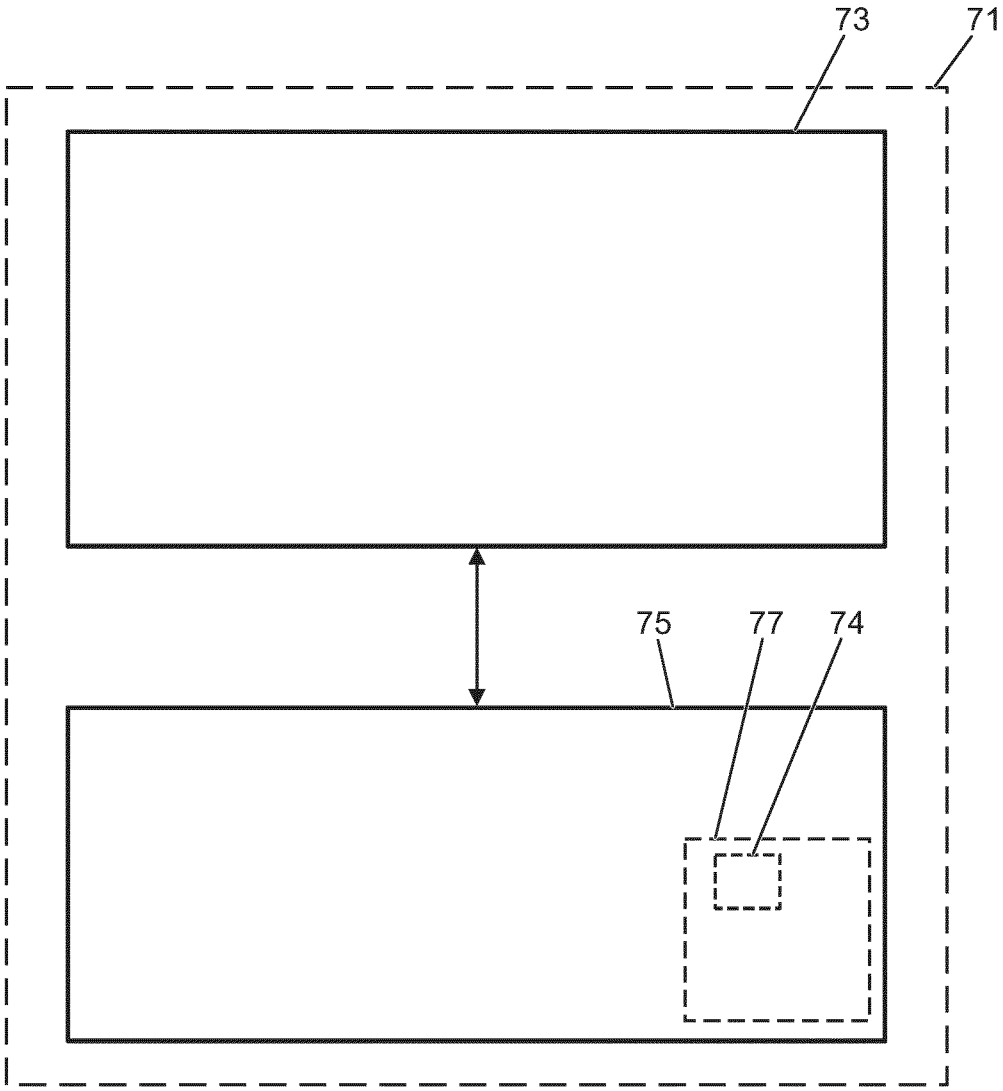


FIG. 6



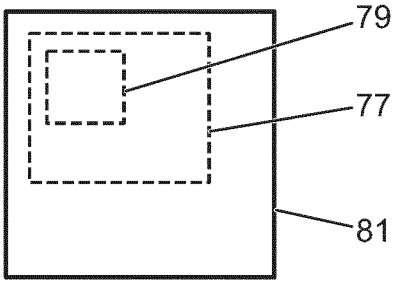


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/082123

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60K17/344
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 136 748 A (KUBOTA LTD) 26 September 1984 (1984-09-26) the whole document -----	1-7, 9-14,17, 19-22
X	GB 2 190 049 A (KUBOTA LTD) 11 November 1987 (1987-11-11) the whole document -----	1-7, 9-14,17, 19-22
X	GB 2 200 331 A (KUBOTA LTD) 3 August 1988 (1988-08-03) the whole document -----	1-7, 9-14,17, 19-22
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 March 2017	23/03/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Eriksson, Jonas

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/082123

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

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