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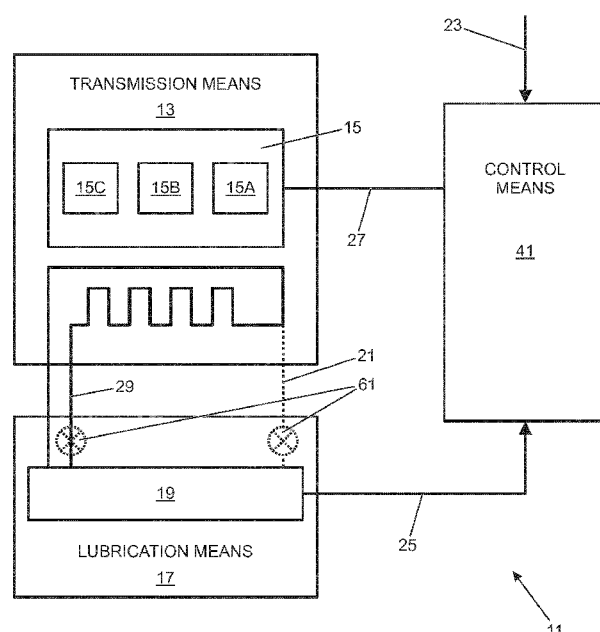


Fig. 2

(57) Abstract: A control means (41) for controlling a transmis-
sion system (11) for a vehicle (1), a transmission system (11), a
vehicle (1) and a method and a non-transitory storage medium (50)
are disclosed. The transmission system (11) comprises transmis-
sion means (17) comprising a plurality of clutches (15). The con-
trol means (41) is configured to: control opening and closing of
the plurality of clutches (15) of the transmission means (13); and
control one or more first clutches of the plurality of clutches (15)
to slip in dependence on receiving an input signal indicating that
the vehicle (1) is braking.



CONTROLLING A TRANSMISSION SYSTEM FOR A VEHICLE

TECHNICAL FIELD

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The present disclosure relates to controlling a transmission system for a vehicle. In particular, but not exclusively it relates to controlling a transmission system for a vehicle which may be arranged to heat transmission oil.

10 Aspects of the invention relate to a control means, a transmission system, a vehicle, a method and a non-transitory storage medium.

BACKGROUND

15 Vehicles with transmission systems are known. The transmission system may be provided between the torque provider of the vehicle and the drive shaft to control the power provided to the drive shaft.

Transmission oil may be circulated around the transmission system. The transmission oil
20 may have an optimum operating temperature at which the transmission oil performs most effectively.

It is an aim of the present invention to improve such transmission systems to improve efficiencies within the vehicle.

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SUMMARY OF THE INVENTION

Aspects and embodiments of the invention provide a control means, a transmission system, a vehicle, a method and a non-transitory storage medium as claimed in the appended
30 claims.

According to an aspect of the invention there is provided a control means for controlling a transmission system for a vehicle, the transmission system comprising transmission means comprising a plurality of clutches, and the control means being configured to: control

opening and closing of the plurality of clutches of the transmission means; and control one or more first clutches of the plurality of clutches to slip in dependence on receiving an input signal indicating that the vehicle is braking.

5 According to a further aspect of the invention there is provided a control means for controlling a transmission system for a vehicle, the transmission system comprising transmission means comprising a plurality of clutches and lubrication means arranged to provide transmission oil to the plurality of clutches, and the control means being configured to: control opening and closing of the plurality of clutches of the transmission means; receive
10 a first input signal indicating that the vehicle is braking; receive a second input signal indicative of temperature of transmission oil of the transmission system; and control one or more first clutches of the plurality of clutches to slip in dependence on the first and second input signals thereby to enable heat generated by the one or more first clutches, during slipping of the one or more first clutches, to be dissipated into the transmission oil.

15 This provides the advantage that it enables kinetic energy from the vehicle to be converted to heat and then the heat may be used to increase the temperature of the transmission oil when the vehicle is braking. This enables the kinetic energy from the torque provider which is no longer needed to be used to heat the transmission oil and may decrease the time it
20 takes for the transmission oil to reach its optimum temperature.

Clutches of a transmission system, such as an automatic transmission system, may comprise clutches that provide, when closed, connection between two rotating parts and also clutches that provide, when closed, connection between a rotating part and a non-
25 rotating part. The latter clutches may be referred to as “clutch brakes” or simply “brakes”. However, it should be understood that the term “clutch” as used herein includes “brakes” as well as other clutches of the transmission system.

In an embodiment the control means is configured to: control closing of one or more second
30 clutches of the plurality of clutches to cause transmission of torque between an input shaft and an output shaft of the transmission system, each of the one or more second clutches being different to each of the one or more first clutches; and control the one or more first clutches to slip during a period when the one or more second clutches are closed.

This provides the advantage that a torque provider such as an engine is able to remain connected to a drive shaft of the vehicle via the second clutches, and therefore, for example, the engine may provide engine braking via the second clutches while the slipping provided by the first clutches may provide additional braking and heat the transmission oil.

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In an embodiment the control means may be configured to: control closing of one or more third clutches of the plurality of clutches to cause transmission of torque between an input shaft and an output shaft of the transmission system in a different gear ratio; and control slipping of one or more fourth clutches of the plurality of clutches during a period when the one or more third clutches remain closed, each of the fourth clutches being different to each of the third clutches.

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This provides the advantage that kinetic energy from the vehicle may be converted to heat and then used to heat the transmission oil when the vehicle is braking in a gear corresponding to the third clutches being closed.

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In an embodiment the transmission system comprises lubrication means arranged to provide transmission oil to the plurality of clutches and enable heat generated by the one or more first clutches, during slipping of the one or more first clutches, to be dissipated into the transmission oil.

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In an embodiment the transmission means is in fluid communication with a reservoir and the control means is arranged to control a one or more valves to cause fluid to be returned to the reservoir from the transmission means via a first route when the one or more first clutches are arranged to slip and via a second route when none of the plurality of clutches of the transmission means are arranged to slip.

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In an embodiment the control means is arranged to: receive a second input signal indicative of temperature of transmission oil of the transmission system; and cause the one or more first clutches to slip in dependence of the second input signal.

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In an embodiment the control means is arranged to: receive a second input signal indicative of temperature of transmission oil of the transmission system; and select the one or more first clutches in dependence of the second input signal.

In an embodiment the control means is arranged to select the one or more first clutches to provide a predetermined slip ratio.

- 5 In an embodiment each of the plurality of clutches is configured, when closed, to provide connection between two rotating parts or a rotating part and a non-rotating part of the transmission means.

In an embodiment the control means comprises one or more processors.

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In an embodiment the one or more first clutches comprise several clutches.

- In another aspect of the present invention there is provided a transmission system for a vehicle, the transmission system comprising: the control means as described in any of the preceding paragraphs; transmission means comprising a plurality of clutches controlled by the control means; and lubrication means arranged to provide transmission oil to the plurality of clutches and enable heat generated by the first clutches when slipping to be dissipated into the transmission oil.

- 20 In an embodiment the transmission system comprises lubrication means arranged to provide transmission oil to the plurality of clutches and enable heat generated by the one or more first clutches when slipping to be dissipated into the transmission oil.

- In an embodiment the transmission means is in fluid communication with a reservoir and the control means is arranged to control a one or more valves to cause fluid to be returned to the reservoir from the transmission means via a first route when the first clutches are arranged to slip and via a second route when none of the clutches are arranged to slip.

- 30 In an embodiment each of the plurality of clutches is configured, when closed, to provide connection between two rotating parts or a rotating part and a non-rotating part of the transmission means.

In an embodiment the transmission means comprises an automatic transmission.

In an embodiment there is provided a system as described above, wherein:

said control means comprises an electronic processor having an electrical input for receiving said first and second input signals, and an electronic memory device electrically coupled to the electronic processor and having instructions stored therein, and

5 said electronic processor being configured to access the memory device and execute the instructions stored therein such that it is operable to, in dependence on said first and second input signals, output an electronic signal to control the one or more first clutches of the plurality of clutches to slip.

10 According to a further aspect of the present invention there is provided a vehicle comprising a transmission system as described in any of the above paragraphs.

According to a yet another aspect of the present invention there is provided a method of controlling a transmission system of a vehicle, the method comprising: receiving one or more
15 first input signals indicative of a value of braking force applied to the vehicle; detecting that the vehicle is braking based on the received one or more first input signals; receiving a second input signal indicative of temperature of transmission oil of the transmission system; and controlling one or more first clutches of a plurality of clutches of the transmission system to slip to enable energy to be transferred from the transmission system to transmission oil in
20 dependence on the received first and second input signals.

According to a yet another aspect of the present invention there is provided a method of controlling a transmission system of a vehicle, the method comprising: receiving one or more
25 signals indicative of a value of braking force applied to the vehicle; detecting that the vehicle is braking based on the received one or more signals; and controlling one or more first clutches of a plurality of clutches of the transmission system to slip to enable energy to be transferred from the transmission system to transmission oil.

In an embodiment the method comprises: controlling closing of one or more second clutches
30 of the transmission system to cause transmission of torque between an input shaft and an output shaft of the transmission system, each of the second clutches being different to each of the first clutches; and controlling the one or more first clutches to slip while the one or more second clutches remain closed.

In an embodiment the transmission means is in fluid communication with a reservoir and the method comprises causing fluid to be returned to the reservoir from the transmission means via a first route when the first clutches are arranged to slip and via a second route when none of the clutches are arranged to slip.

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In an embodiment the transmission system comprises one or more valves arranged to cause fluid to be returned to the reservoir from the transmission means via a first route when the first clutches are arranged to slip and via a second route when none of the clutches are arranged to slip.

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In an embodiment the method comprises: receiving a second input signal indicative of temperature of transmission oil of the transmission system; and causing the one or more first clutches to slip in dependence of the second input signal.

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In an embodiment the method comprises: receiving a second input signal indicative of temperature of transmission oil of the transmission system; and selecting the one or more first clutches in dependence of the second input signal.

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In an embodiment the method comprises selecting the first clutches to provide a predetermined slip ratio.

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According to a yet another aspect of the present invention there is provided a non-transitory storage medium storing a program which when run on a processor causes the processor to: receive one or more first input signals indicative of a value of braking force applied to the vehicle; detect that the vehicle is braking based on the received one or more first input signals; receive a second input signal indicative of temperature of transmission oil of the transmission system; and control one or more first clutches of a plurality of clutches of the transmission system to slip to enable energy to be transferred from the transmission system to transmission oil in dependence on the received first and second input signals.

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According to a yet another aspect of the present invention there is provided a non-transitory storage medium storing a program which when run on a processor causes the processor to: receive one or more signals indicative of a value of braking force applied to the vehicle; detect that the vehicle is braking based on the received one or more signals; and control one

or more first clutches of a plurality of clutches of the transmission system to slip to enable energy to be transferred from the transmission system to transmission oil.

In an embodiment the non-transitory storage medium stores a program which when run on a processor causes the processor to perform a method as described in any of the preceding paragraphs.

According to yet another aspect of the invention there is provided a controller for controlling a transmission system for a vehicle, the transmission system comprising a plurality of clutches, and the controller comprising a processor configured to: control opening and closing of the plurality of clutches of the transmission; and control one or more first clutches of the plurality of clutches to slip in dependence on receiving an input signal indicating that the vehicle is braking.

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 a vehicle;
- Fig. 2 illustrates an example transmission system;
- Fig. 3 illustrates an example transmission means;
- Fig. 4 illustrates an example control means;
- Fig. 5 illustrates an example method;

Fig. 6 shows a table of an example of combinations of clutches that are closed to provide the gears of a transmission system; and

Fig. 7 shows an example method further to the method of Fig. 5.

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DETAILED DESCRIPTION

The Figures illustrate a control means 41 for controlling a transmission system 11 for a vehicle 1, the transmission system 11 comprising transmission means 13 comprising a plurality of clutches 15, and the control means 41 being configured to: control opening and closing of the plurality of clutches 15 of the transmission means 13; and control one or more first clutches 15 of the plurality of clutches 15 to slip in dependence on receiving an input signal 23 indicating that the vehicle 1 is braking.

Fig. 1 illustrates an example vehicle 1 which may comprise a control means 41 and a transmission system 11 according to embodiments of the invention. The vehicle 1 may be an electric or hybrid vehicle 1 or any other suitable type of vehicle 1.

Fig. 2 schematically illustrates an example transmission system 11 according to embodiments of the invention. The example transmission system 11 comprises transmission means 13, lubrication means 17 and control means 41. It is to be appreciated that only components necessary for the understanding of the embodiments of the invention have been illustrated in Fig 2 and that the transmission system 11 may comprise other components in other embodiments of the invention.

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The transmission means 13 may comprise any means which may be arranged to enable power to be provided from a torque provider to a drive shaft of the vehicle 1. In embodiments of the invention the transmission means 13 may comprise a transmission. In some embodiments of the invention the transmission means 13 may comprise an automatic transmission.

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The transmission means 13 comprises a plurality of clutches 15. In the example of Fig. 2 the transmission means 13 comprises three clutches 15A, 15B, 15C. It is to be appreciated that other numbers of clutches 15 may be used in other embodiments of the invention. The

plurality of clutches 15 may be arranged to enable different gears to be connected to enable different gear ratios between the torque provider and the drive shaft.

5 The transmission means 13 comprises a plurality of clutches 15, and at any one time a plurality of the clutches 15 may be open. When the clutches are open they are not connected to a gear.

10 The lubrication means 17 may comprise any means which enables a lubricant, such as transmission oil, to be circulated around the transmission system 11. The lubrication means 17 may enable transmission oil to be provided to moving parts of the transmission means 13. The lubrication means 17 may enable transmission oil to be provided to the plurality of clutches 15 and any other suitable components of the transmission system 11.

15 In the example transmission system 11 of Fig. 2 the lubrication means 17 also comprises a reservoir 19. The reservoir 19 may comprise any suitable container which may be arranged to store the transmission oil when it is not being circulated around the transmission system 11. The reservoir is in fluid communication with the transmission means 13 so that the transmission oil may be provided to, and received from, the transmission means 13.

20 The lubrication means 17 may comprise a flow path around the transmission system 11 through which the transmission oil can be circulated. The flow path may enable the transmission oil to be circulated from the reservoir 19 to the other components of the transmission system 11. The lubrication means 17 may comprise a pump, or any other suitable means, which may enable the transmission oil to be circulated around the
25 transmission system 11.

In some examples the flow path may comprise a first route 21 between the plurality of clutches 15 and the reservoir 19. The first route 21 may be arranged to ensure that transmission oil can flow from one or more clutches 15 back to the reservoir 19 without
30 having to be circulated through other components of the transmission system 11. The first route 21 may provide the shortest route possible for the transmission oil between the one or more clutches 15 and the reservoir 19.

In some examples the first route 21 may comprise means for controlling flow of transmission oil through the first route 21. The means for controlling flow may comprise one or more valves 61 or any other suitable means. The valves 61 could be electromechanical valves or any other suitable type of valve. The means for controlling the flow of the transmission oil may be arranged so that the transmission oil flows through the first route 21 when one or more clutches 15 are arranged to slip. The means for controlling the flow of the transmission oil may be arranged to prevent the flow of transmission oil through the first route 21 when the clutches 15 are not arranged to slip. This may ensure that the transmission oil is circulated through an alternative second route 29 through other parts of the transmission system 11 when the clutches 15 are not slipping.

In some examples the lubrication system 17 may comprise one or more temperature sensors. The temperature sensors may comprise any means which may be arranged to measure the temperature of the transmission oil and provide a signal indicative of the temperature. The one or more temperature sensors may be located within the reservoir 19 or any other suitable location within the lubrication means 17.

The transmission system 11 also comprises control means 41. The control means 41 may comprise any means which may be arranged to control components of the transmission system 11 such as the one or more clutches 15. The control means 41 may comprise electrical means or mechanical means or any other suitable means. In some examples the control means 41 may comprise one or more processors. An example of a control means 41 comprising one or more processors is illustrated in Fig. 4.

The control means 41 may be arranged to receive a first input signal 23. The first input signal 23 may comprise a value indicative of the braking force applied to the vehicle 1. The first input signal 23 may be received from a braking system of the vehicle 1. The first input signal 23 may be received from any suitable components of the braking system of the vehicle 1.

The control means 41 may be arranged to use information obtained in the first input signal 23 to detect that the vehicle 1 is braking.

The control means 41 is also arranged to receive a second input signal 25. The second input signal 25 comprises a value indicative of the current temperature of the transmission oil. The second input signal 25 may be received from one or more temperature sensors within the lubrication means 17. The control means 41 may be arranged to use information obtained in
5 the second input signal 25 to detect whether or not the current temperature of the transmission oil is below a threshold temperature. The threshold temperature could be an optimum operating temperature of the transmission oil.

The control means 41 may also be arranged to provide a control signal 27 as an output. The
10 control signal 27 may be provided to the plurality of clutches 15. The control signal 27 may be provided in response to the control means 41 detecting that the vehicle 1 is braking. The control signal 27 is only provided if the control means 41 also detects that the temperature of the transmission oil is below a threshold temperature.

15 In response to the control signal 27 one or more of the plurality of clutches 15 may be arranged to slip. Any one or more of the plurality of clutches 15 that are currently open and not connecting the torque provider to the driveshaft may be arranged to slip.

The frictional forces action on the surfaces of the slipping of the clutches 15 converts the
20 kinetic energy provided by a torque provider into thermal energy. As the vehicle 1 is braking this kinetic energy is unwanted. However, if the temperature of the transmission oil is below a threshold temperature the thermal energy generated may be used to heat the transmission oil to the threshold temperature. This may enable the unwanted kinetic energy from the torque provider to be used to heat the transmission oil to the optimum operating temperature
25 or may enable the transmission oil to be maintained at the optimum operating temperature. If the temperature of the transmission oil is at, or above, the threshold temperature, the control means 41 may keep the open clutches open during braking and not cause them to slip.

Fig. 3 schematically illustrates an example transmission means 13 which may be used in
30 embodiments of the invention. The transmission means 13 comprises a plurality of clutches 15 and a plurality of gears 31. The transmission means 13 also comprises a torque provider 33, an input shaft 35 and an output shaft 37. In the example of Fig. 3 the transmission means is provided within a housing 39. The transmission means 13 may be an automatic transmission or any other suitable type of transmission.

The torque provider 33 may comprise any means which may be arranged to provide a torque to the input shaft 35. The torque provider 33 may comprise an engine, such as an internal combustion engine, an electric motor or a hybrid engine, or any other suitable power source that is capable of providing torque to the input shaft 35.

In the example of Fig. 3 the transmission means 13 comprises five clutches 15A, 15B, 15C, 15D, 15E. It is to be appreciated that other numbers of clutches 15 may be used in other examples of the disclosure.

The clutches 15 are arranged to enable different gears 31 to be connected to the output shaft 37. The different gears 31 enable different gear ratios to be provided between the output shaft 37 and the input shaft 35. At any given time one or more of the clutches 15 may be closed to enable a given torque output to be provided and one or more of the other clutches 15 are open and not connected to any of the gears 31.

When the control means 41 detects that the vehicle 1 is braking, while one or more of the clutches 15 are closed to provide connection between the input shaft 35 and the output shaft 37, one or more of the open clutches 15 may be arranged to slip. The friction of the surfaces of the slipping clutches 15 may cause the surfaces to be heated. This heat may be transferred to transmission oil which is being circulated through the transmission means 13.

In some examples the clutches 15 that are caused to slip by the control means 41 may be arranged to optimize the transfer of thermal energy from the clutches 15 to the transmission oil. In some examples the force that is used to partially close one or more clutches 15 to cause them to slip may depend on the geometry of those clutches 15 in order to maximize the transfer of thermal energy. For example, the force that is used to cause a clutch to slip may be a proportion of a minimum force that would cause the clutch to close and not slip, given the geometry of the clutch. .

In some examples the force that is used to partially close a clutch 15 to cause it to slip may depend on the material that is used for the surfaces of the clutches 15 to optimize the transfer of thermal energy to the transmission oil. For example, when the material that is selected has a high coefficient of friction, a relatively low force may be used to enable a

sufficient amount of thermal energy to be created by the slipping of the clutches 15. The material that is selected may be thermally conductive to enable the heat that is generated to be transferred into the transmission oil.

- 5 In some examples a plurality of clutches 15 may be arranged to slip at any one time. This may enable the force applied on any single slipping clutch 15 to be decreased and may prevent the clutches 15 from locking. This may also reduce the wear on the clutches 15.

10 In some examples the control signal 27 may cause the plurality of clutches 15 to be arranged into predetermined slip ratio. A predetermined slip ratio is the ratio of the speed of one side of a slipping clutch to the speed of the other side of the slipping clutch for a given set of closed clutches. For example, with regard to Fig. 3, a predetermined slip ratio may be the ratio of the speed of one side of the clutch 15B to the speed of the other side of that clutch when clutch 15C is closed to provide connection between the input shaft 35 and the
15 output shaft 37.

An optimum predetermined slip ratio may be selected to enable optimum transfer of thermal energy into the transmission oil with minimum wear on the clutches 15. The optimum predetermined slip ratio may depend on a plurality of different factors so that different
20 predetermined slip ratios are used for different circumstances. For instance the optimum predetermined slip ratio may depend on which clutches 15 are currently open, the braking force applied to the vehicle 1, the current temperature of the transmission oil and any other suitable factor.

- 25 In an example, one or more of the clutches 15A to 15E of the transmission means 13 of Fig. 3 are closed when the transmission means 13 is in a selected gear. That is, one or more of the clutches 15A to 15E are closed in order to provide a driving connection between the input shaft 35 and the output shaft 37 by a gear ratio. A table 601 providing an example of combinations of the clutches 15 that may be closed in the transmission means 13 to provide
30 first gear to eighth gear and reverse gear is shown in Fig. 6.

In this example, clutches 15A and 15B are referred to as “brakes” A and B respectively as they provide connection between a rotating part and a stationary part of the transmission

means, but clutches 15C, 15D and 15E are referred to as “clutches” C, D and E because they provide connection between two rotating parts of the transmission means.

For the avoidance of doubt, it may be noted that the “Gear” of Fig. 6 refers to the label given to the gear ratios provided by the transmission means 13. For example, the “1” in the “Gear” column refers to first gear, and the lowest gear ratio of the transmission means and it is not to a specific one of the physical gears 31. Similarly, the “8” refers to the eighth gear, which is the highest gear in this example, and corresponds to the highest gear ratio.

The table illustrates the clutches that are closed for a given “Gear” using a black circle. Therefore, for example, first gear is provided by the transmission means 13 by closing clutches A, B and C leaving clutches D and E open. During breaking, clutch D and/or clutch E may be slipped to generate heat and thereby heat the transmission oil. Thus, one or more first clutches D and/or E are slipped while second clutches A, B and C remain closed.

Similarly, for example, second gear is provided by the transmission means 13 by closing clutches A, B and E leaving clutches C and D open. During breaking clutch C and/or clutch D may be slipped to generate heat and thereby heat the transmission oil. Thus, one or more third clutches C and/or D are slipped while fourth clutches A, B and E remain closed.

As discussed above, the choice of closing clutch D and/or clutch E when the transmission is in first gear may depend upon the temperature of the transmission oil and/or the predetermined slip ratio of the clutches D and E given that clutches A, B and C are closed.

Fig. 4 illustrates an example control means 41 which may be used to control a transmission system 11 according to embodiments of the invention. In some examples the control means 41 may comprise a controller.

The control means 41 may be arranged to receive one or more signals 23 indicative of a value of braking force applied to the vehicle 1 and detect that the vehicle 1 is braking based on the received one or more signals. The control means 41 may also be arranged to provide a control signal 27 which causes one or more clutches 15 of the transmission system 11 to be arranged to slip to enable energy to be transferred from the transmission system 11 to the transmission oil.

The control means 41 may be a chip or a chip set. The control means 41 comprises at least one processor 43, at least one memory 45 and at least one computer program 47.

- 5 Implementation of a control means 41 may be as controller circuitry. The control means 41 may be implemented in hardware alone, may have certain aspects in software including firmware alone or may be a combination of hardware and software (including firmware).

10 In some examples the control means 41 may be implemented using instructions that enable hardware functionality, for example, by using executable instructions of a computer program 47 in a general-purpose or special-purpose processor 43 that may be stored on a computer readable storage medium (disk, memory, etc.) to be executed by such a processor 43.

15 The processor 43 may be arranged to read from and write to the memory 45. The processor 43 may also comprise an output interface via which data and/or commands are output by the processor 43 and an input interface via which data and/or commands are input to the processor 43.

20 The memory 45 may be arranged to store a computer program 47 comprising computer program instructions 39 (computer program code) that controls the operation of the controller 41 when loaded into the processor 43. The computer program instructions 49, of the computer program 47, provide the logic and routines that enables the control means 41 to detect that a vehicle is braking in response to one or more received signals and enable the control means 41 to control the slipping of the one or more clutches 15. The processor 43 by
25 reading the memory 45 is able to load and execute the computer program 47.

30 As illustrated in Fig. 4, the computer program 47 may arrive at the controller 41 via any suitable delivery mechanism 50. The delivery mechanism 50 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 47. The delivery mechanism may be a signal arranged to reliably transfer the computer program 47. The control means 41 may propagate or transmit the computer program 47 as a computer data signal.

Although the memory 45 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 43 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 43 may be a single core or multi-core processor.

Fig. 5 illustrates an example method which may be implemented by the control means 41.

The method comprises, at block 51 receiving one or more signals 23 indicative a value of braking force applied to the vehicle 1. The signal 23 may be received from a braking system of the vehicle 1.

The method also comprises, at block 53, detecting that the vehicle 1 is braking based on the received one or more signals 23. The control means 41 may be arranged to provide one or more control signals 27 in dependence on detecting that the vehicle 1 is braking. The one or more control signals 27 may be provided in dependence on the control means detecting that the braking demand is above a threshold value. The control signal 27 may be provided to the clutches 15 within the transmission means 13 so that, at block 55, the method comprises arranging the one or more clutches 15 of the transmission system 11 to slip to enable energy to be transferred from the transmission system 13 to the transmission oil. The control signal 27 may enable the clutches 15 to be arranged into an optimum predetermined slip ratio. The optimum predetermined slip ratio may be determined by the control means 41.

In some examples the method may comprise additional blocks. A flow chart 70 illustrating other methods that may be performed by the control means 41 and which include additional blocks to those of Fig. 5 is shown in Fig. 7.

At block 71 a method may comprises controlling of one or more second clutches of the transmission system to cause transmission of torque between an input shaft 35 and an output shaft 37 of the transmission system.

At block 72, one or more signals indicative of a value of braking force applied to the vehicle 1 is received and, at block 73, braking by the vehicle is detected in dependence on the one or more signals received at block 72. At block 74, a second input is received by the control means 41 indicative of the temperature of the transmission oil.

At block 75 one or more first clutches 15 of a plurality of clutches 15 of the transmission system 11 are controlled to slip, to enable energy to be transferred from the transmission system to the transmission oil. In an example method, the one or more first clutches 15 that are controlled to slip at block 75 are each different to each of the one or more second clutches 15 that are controlled to close at block 71.

The controlling of clutches 15 to slip at block 75 is performed in dependence on the second input signal 25 received at block 74. For example, controlling slipping of clutches at block 75 is only be performed if the second signal 25 indicates that the temperature is below a threshold value. Furthermore, the clutches 15 that are controlled to slip at block 75 may be selected in dependence of the second signal 15 at received at block 74 as discussed above.

In some examples, a method includes block 76 in which fluid is caused to be returned to a reservoir 19 from the transmission means 13 via a first route 21 when the first clutches 15 are arranged to slip and via a second route 29 when none of the clutches 15 are arranged to slip. In such examples, the control means 41 may be arranged to provide a control signal to the lubrication means 17 or one or more valves associated with the lubrication means 17. The control signal which is provided to the lubrication means 17 may enable the flow path of the transmission oil to be controlled. The flow path of the transmission oil may be controlled to optimize the heat transfer from the one or more slipping clutches 15 to the transmission oil. In some examples the flow path may be controlled by controlling one of more valves 61 within the first route 21 between the clutches 15 and the reservoir 19. This ensures that the transmission oil heated by the slipping clutches 15 is returned back to the reservoir 19 via the first route 21 rather than circulated through the rest of the transmission system 11 via a second route 29.

In some examples the flow rate of the transmission oil may also be controlled so as to optimize the heat transfer from the slipping clutches 15 to the transmission oil. For example

the flow rate of transmission oil past the slipping clutches 15 is controlled to ensure that sufficient thermal energy is transferred from the clutches 15 to the transmission oil.

The blocks illustrated in Fig. 5 may represent steps in a method and/or sections of code in the computer program 47. The illustration of a particular order to the blocks does not necessarily imply that there is a required or preferred order for the blocks and the order and arrangement of the block may be varied. Furthermore, it may be possible for some steps to be omitted.

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.

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 control means for controlling a transmission system for a vehicle, the transmission system comprising transmission means comprising a plurality of clutches and lubrication means arranged to provide transmission oil to the plurality of clutches, and the control means being configured to:

control opening and closing of the plurality of clutches of the transmission means;

receive a first input signal indicating that the vehicle is braking;

receive a second input signal indicative of temperature of transmission oil of the transmission system; and

control one or more first clutches of the plurality of clutches to slip in dependence on the first and second input signals thereby to enable heat generated by the one or more first clutches, during slipping of the one or more first clutches, to be dissipated into the transmission oil.

2. A control means according to claim 1, wherein the control means is configured to:

control closing of one or more second clutches of the plurality of clutches to cause transmission of torque between an input shaft and an output shaft of the transmission system, each of the one or more second clutches being different to each of the one or more first clutches; and

control the one or more first clutches to slip during a period when the one or more second clutches are closed.

3. A control means according to claim 2, wherein the control means is configured to:

control closing of one or more third clutches of the plurality of clutches to cause transmission of torque between an input shaft and an output shaft of the transmission system in a different gear ratio; and

control slipping of one or more fourth clutches of the plurality of clutches during a period when the one or more third clutches remain closed, each of the fourth clutches being different to each of the third clutches.

4. A control means according to any one of claims 1 to 3, wherein the transmission means is in fluid communication with a reservoir and the control means is arranged to control a one or more valves to cause fluid to be returned to the reservoir from the

transmission means via a first route when the one or more first clutches are arranged to slip and via a second route when none of the plurality of clutches of the transmission means are arranged to slip.

5 5. A control means according to any one of claims 1 to 4, wherein the control means is arranged to:

receive a second input signal indicative of temperature of transmission oil of the transmission system; and

select the one or more first clutches in dependence of the second input signal.

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6. A control means according to any one of claims 1 to 5, wherein the control means is arranged to select the one or more first clutches to provide a predetermined slip ratio.

7. A control means according to any one of claims 1 to 6, wherein each of the plurality
15 of clutches is configured, when closed, to provide connection between two rotating parts or a rotating part and a non-rotating part of the transmission means.

8. A control means according to any one of claims 1 to 7, wherein the control means comprises one or more processors.

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9. A control means according to any one of claims 1 to 8, wherein the one or more first clutches comprise several clutches.

10. A transmission system for a vehicle, the transmission system comprising:
25 the control means of any one of claims 1 to 9;
transmission means comprising a plurality of clutches controlled by the control means; and

lubrication means arranged to provide transmission oil to the plurality of clutches and enable heat generated by the first clutches when slipping to be dissipated into the
30 transmission oil.

11. A transmission system according to claim 10, wherein the transmission system comprises lubrication means arranged to provide transmission oil to the plurality of clutches

and enable heat generated by the one or more first clutches when slipping to be dissipated into the transmission oil.

12. A transmission system according to claim 10 or claim 11, wherein the transmission means is in fluid communication with a reservoir and the control means is arranged to control a one or more valves to cause fluid to be returned to the reservoir from the transmission means via a first route when the first clutches are arranged to slip and via a second route when none of the clutches are arranged to slip.

13. A transmission system according to any one of claims 10 to 12, wherein each of the plurality of clutches is configured, when closed, to provide connection between two rotating parts or a rotating part and a non-rotating part of the transmission means.

14. A transmission system as claimed in any one of claims 10 to 13, wherein the transmission means comprises an automatic transmission.

15. A vehicle comprising a transmission system as claimed in any one of claims 10 to 14.

16. A method of controlling a transmission system of a vehicle, the method comprising:
receiving one or more first input signals indicative of a value of braking force applied to the vehicle;
detecting that the vehicle is braking based on the received one or more first input signals;
receiving a second input signal indicative of temperature of transmission oil of the transmission system; and
controlling one or more first clutches of a plurality of clutches of the transmission system to slip to enable energy to be transferred from the transmission system to transmission oil in dependence on the received first and second input signals.

17. A method according to claim 16, comprising:
controlling closing of one or more second clutches of the transmission system to cause transmission of torque between an input shaft and an output shaft of the transmission system, each of the second clutches being different to each of the first clutches; and

controlling the one or more first clutches to slip while the one or more second clutches remain closed.

18. A method according to claim 16 or claim 17, wherein the transmission means is in fluid communication with a reservoir and the method comprises causing fluid to be returned to the reservoir from the transmission means via a first route when the first clutches are arranged to slip and via a second route when none of the clutches are arranged to slip.

19. A method according to claim 18, wherein the transmission system comprises one or more valves arranged to cause fluid to be returned to the reservoir from the transmission means via a first route when the first clutches are arranged to slip and via a second route when none of the clutches are arranged to slip.

20. A method according to any one of claims 16 to 19, comprising:
receiving a second input signal indicative of temperature of transmission oil of the transmission system; and
selecting the one or more first clutches in dependence of the second input signal.

21. A method according to any one of claims 16 to 20, comprising selecting the first clutches to provide a predetermined slip ratio.

22. A non-transitory storage medium storing a program which when run on a processor causes the processor to:

receive one or more first input signals indicative of a value of braking force applied to the vehicle;

detect that the vehicle is braking based on the received one or more first input signals;

receive a second input signal indicative of temperature of transmission oil of the transmission system; and

control one or more first clutches of a plurality of clutches of the transmission system to slip to enable energy to be transferred from the transmission system to transmission oil in dependence on the received first and second input signals.

23. A non-transitory storage medium according to claim 22 storing a program which when run on a processor causes the processor to perform the method of any one of claims 16 to 21.

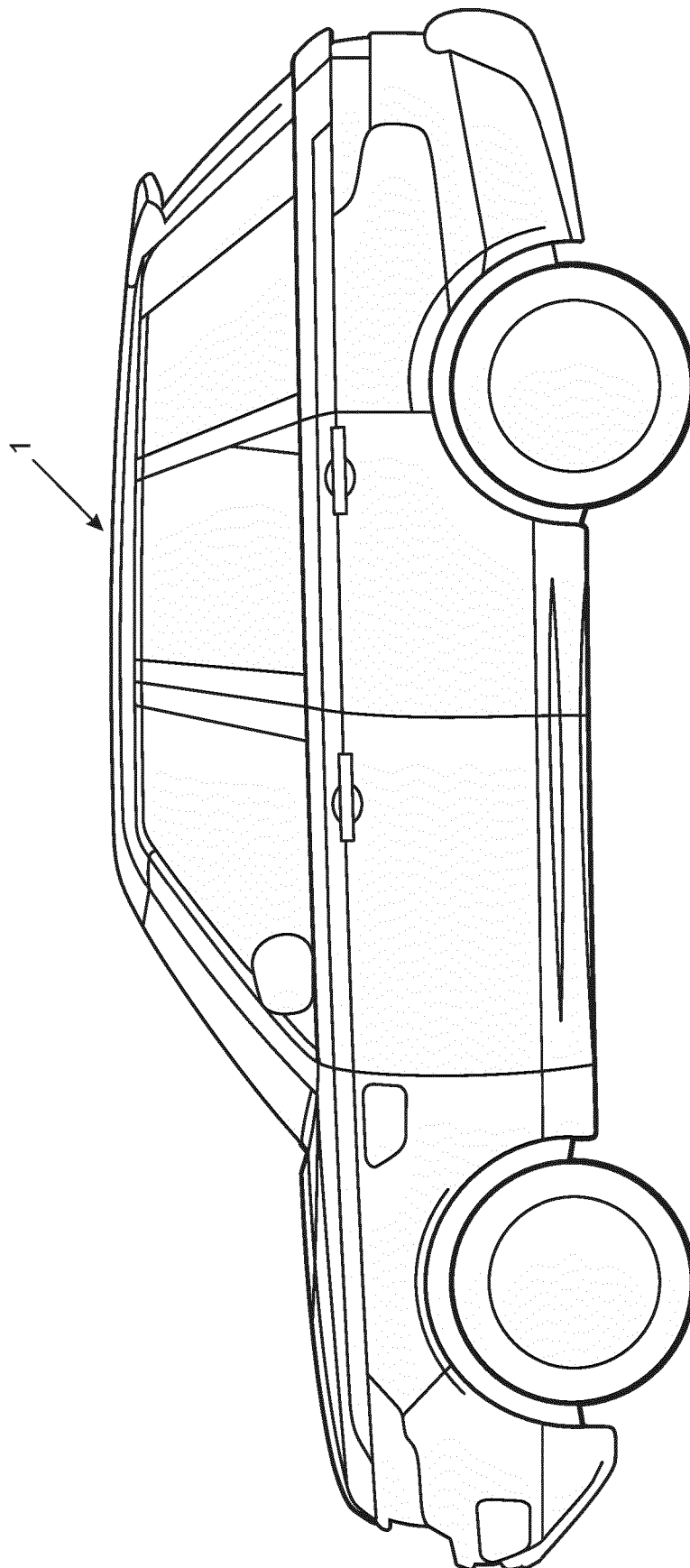


FIG. 1

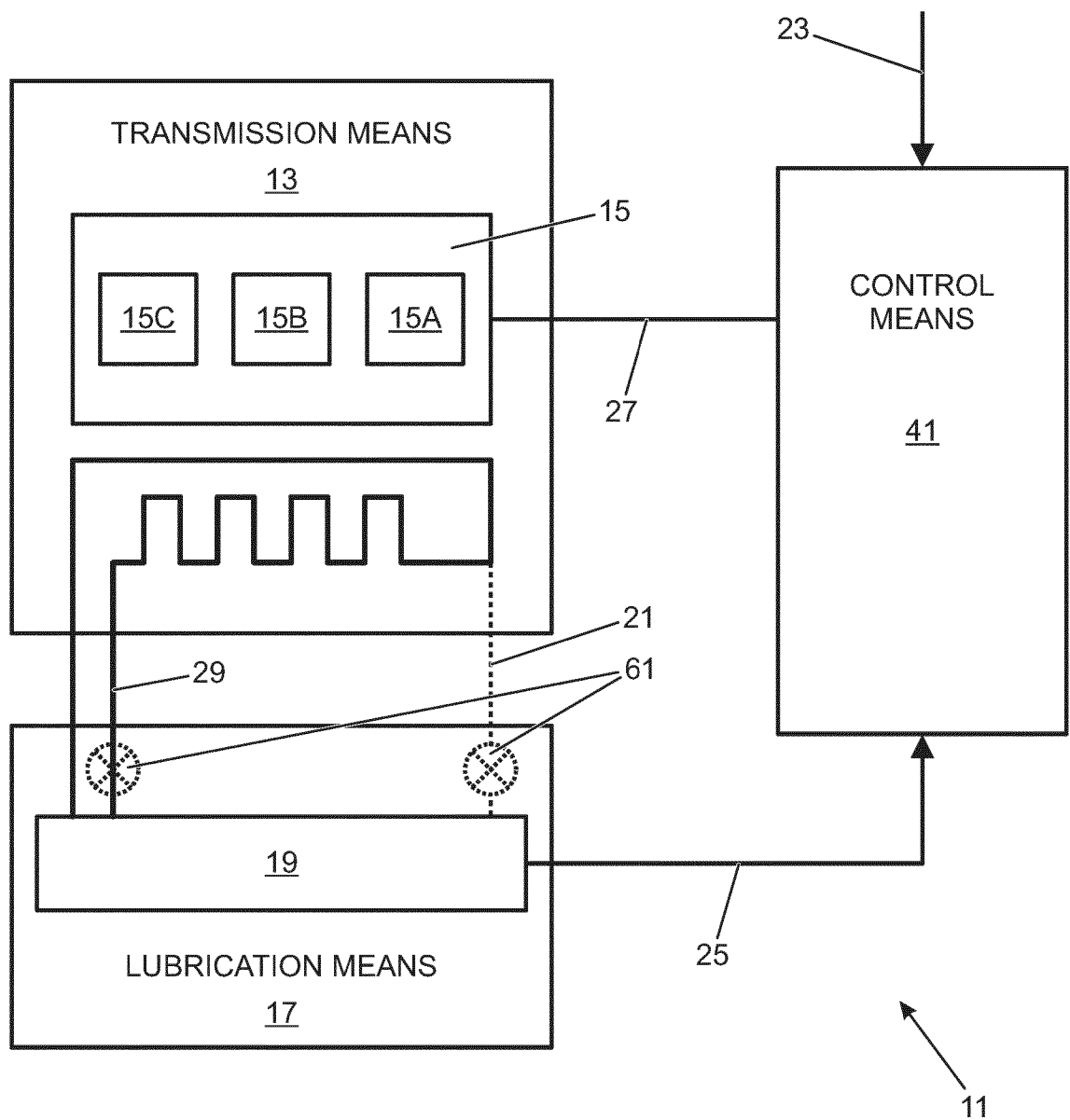


Fig. 2

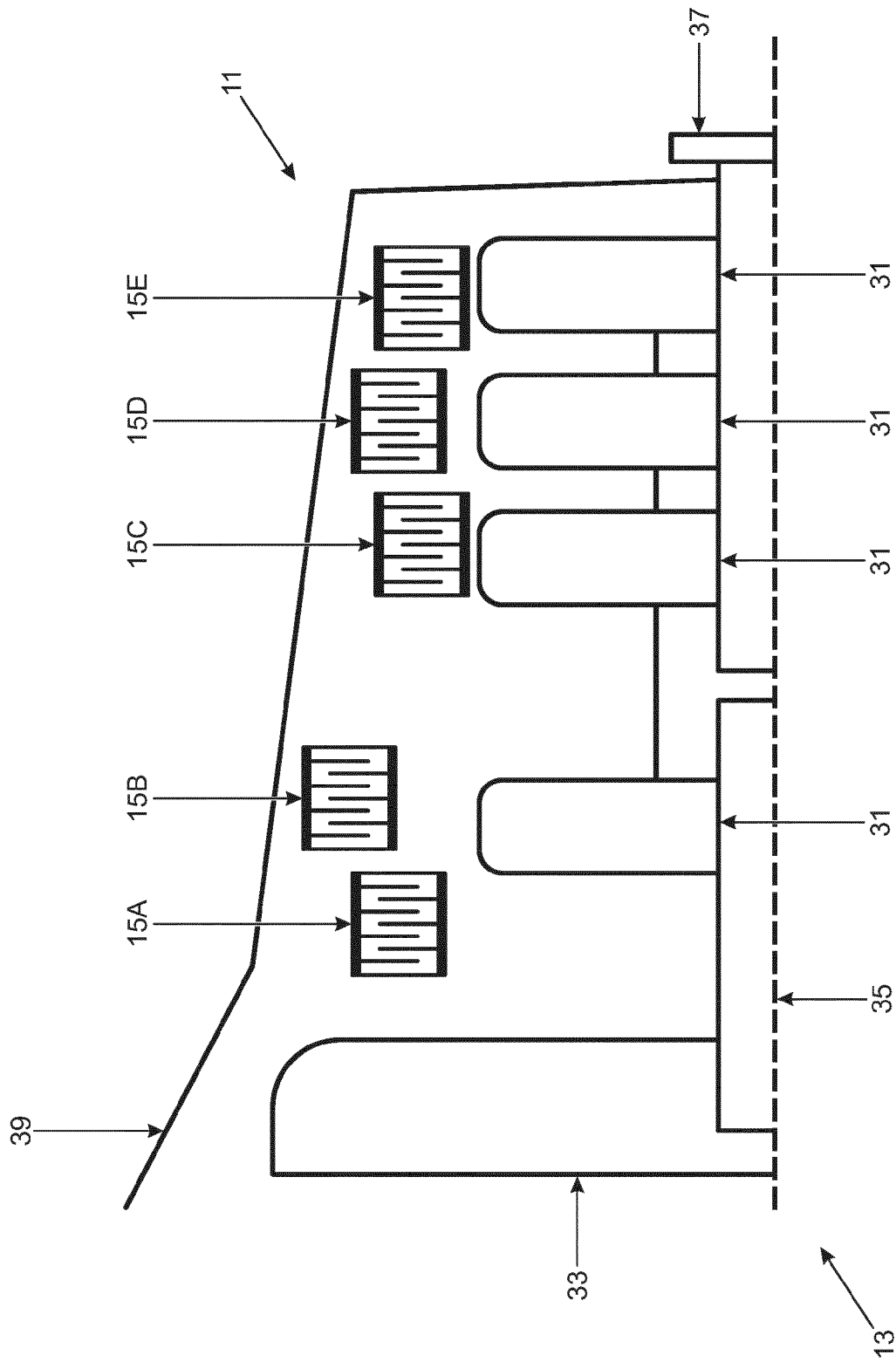


FIG. 3

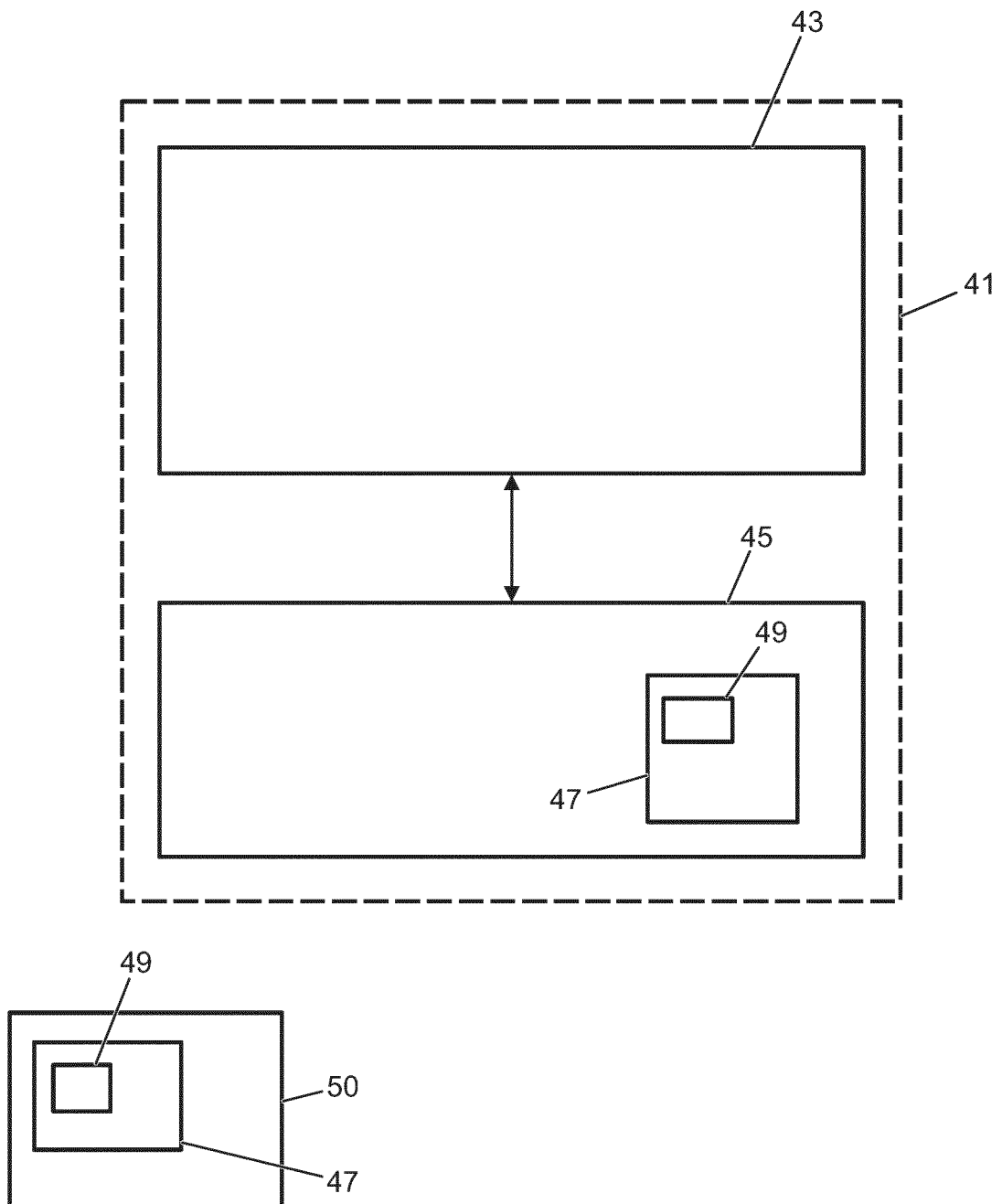


FIG. 4

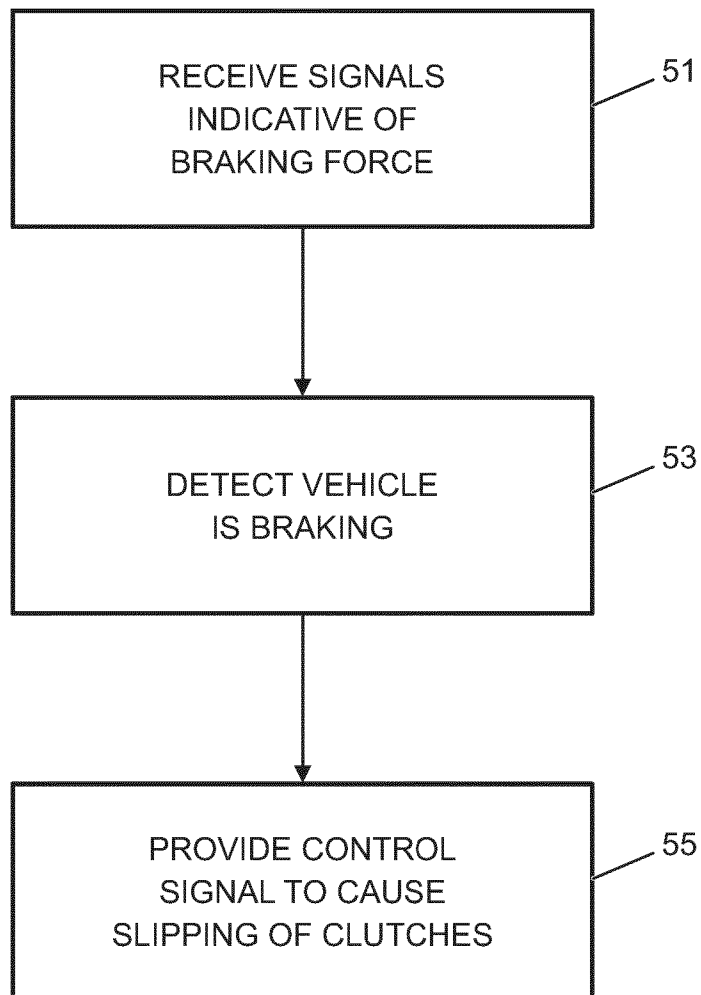


FIG. 5

Gear	Brake		Clutch		
	A	B	C	D	E
1	●	●	●		
2	●	●			●
3		●	●		●
4		●		●	●
5		●	●	●	
6			●	●	●
7	●		●	●	
8	●			●	●
Rev.	●	●		●	

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FIG. 6

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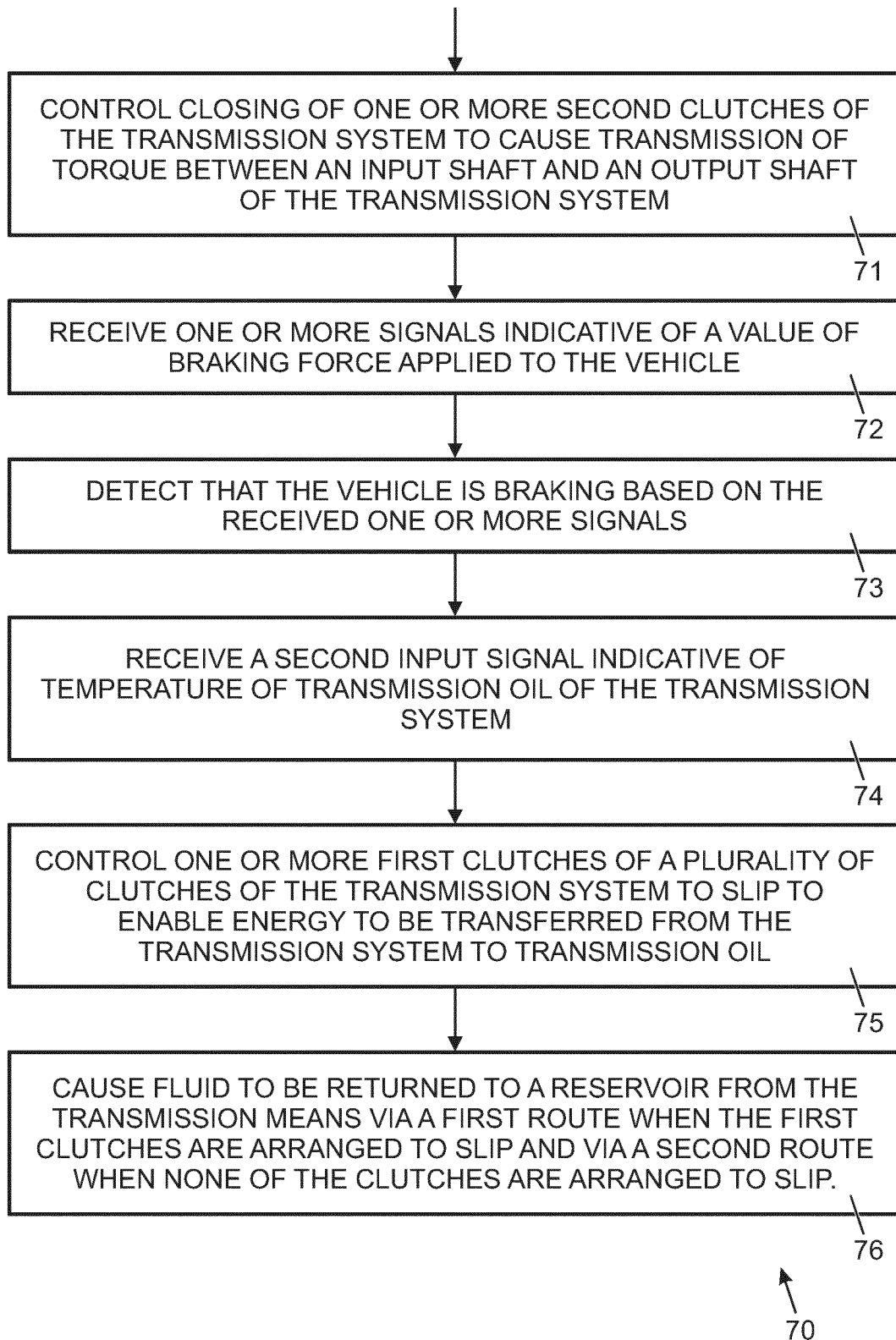


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/079030

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16H59/54 F16H59/72 F16H57/04
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)
F16H

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	WO 2016/121415 A1 (AISIN AW CO [JP]) 4 August 2016 (2016-08-04)	1-3,5, 7-11,13, 14,16, 17,20, 22,23 4,12,18, 19
A	figures 1, 5 paragraphs [0001], [0002], [0007], [0023], [0024], [0038] - [0040], [0042] paragraph [0060] -----	
X	JP 2015 001259 A (JATCO LTD) 5 January 2015 (2015-01-05) figure 3 claim 3 paragraphs [0001], [0010], [0011], [0015], [0016], [0036], [0038], [0040] paragraphs [0041], [0056], [0057] -----	1-3,6,7, 10,11, 13-17,21



Further documents are listed in the continuation of Box C.



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

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

6 February 2018

Date of mailing of the international search report

13/02/2018

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/079030

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		DE 112016000157 T5	03-08-2017
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