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(54) **TRANSMISSION COMPRISING A DISCONNECT UNIT AND ELECTRIC VEHICLE COMPRISING SUCH A TRANSMISSION**

(57) The invention relates to a transmission comprising an input shaft, configured for receiving torque applied by a motor, a gear system, a differential, at least one output shaft, and a disconnect unit which is switchable between an engaged and a disengaged state, wherein in the engaged state the input shaft is connected to the output shaft via the gear system and the differential for driving the at least one output shaft, and wherein in the disengaged state the at least one output shaft is disconnected from the input shaft. The invention also relates to an (electric) vehicle comprising such a transmission.

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TRANSMISSION COMPRISING A DISCONNECT UNIT AND ELECTRIC VEHICLE COMPRISING SUCH A TRANSMISSION

The invention relates to a transmission, comprising an input shaft, configured for receiving torque applied by a motor, a gear system, a differential and at least one output shaft. In particular, the invention relates to a transmission that allows disconnecting, i.e. rotationally decoupling, the input shaft from the at least one output shaft.

Some electric vehicles are provided with two motors, each driving one axle of the vehicle. In such a case, one of the motor often serves as the primary motor, whereas the other serves as a secondary motor. Employing the secondary motor may increase driving performance at the expense of power consumption. As such, a desire exists to allow selective use of the secondary motor, so that a user may prioritize between driving performance and power consumption at will. When the secondary motor is unused a need exists to decouple it and the corresponding transmission from the output shafts, in order to save wear on the motor and the transmission, and to avoid friction, would otherwise reduce efficiency. Of course there are other applications for said decoupling, outside of multi-motor electric vehicles.

Transmissions exist that allow switching between two gears by selectively engaging or disengaging parts of a gear system. A first example of such a transmission is given in US 2,152,771, which proposes to drive a differential casing either directly or via an additional gear set 102, 103. A second example is given in figure 4 of US 2019/0158603 A1, which proposes to use a shifting sleeve 41 to selectively couple a motor to an output shaft 12 via a planetary gear set 53 in addition to driving the same output shaft 12 via a differential, in order to allow torque vectoring on the output shaft 12. However, none of these documents allow disconnecting the motor from the output shafts entirely.

It is therefore an object of the invention to, amongst others, provide a transmission that allows decoupling the motor from the output shafts, and to preferably allow disconnecting the transmission or a part thereof at the same time.

The object is achieved by a transmission of the above described type, further provided with a disconnect unit which is switchable between an engaged and a disengaged state, wherein in the engaged state the input shaft is connected to the output shaft via the gear system and the differential for

driving the at least one output shaft, and wherein in the disengaged state the at least one output shaft is disconnected from the input shaft.

By virtue of the disconnect unit, the output shaft and the input shaft may be uncoupled from each other. As such, the motor need not turn even when the output shaft does turn. This allows disengaging the motor, thereby saving wear on the motor and eliminating frictional forces arising in the motor, thereby increasing efficiency.

Connected may herein be understood to mean coupled such that rotation of one component corresponds to rotation of another component, possibly via a transmission ratio. Components may be connected via other components, and need not directly and physically engage each other, although they might.

In an embodiment of the transmission, the disconnect unit engages at least a part of the differential in the engaged state.

By engaging at least a part of the differential, the disconnect unit may be used to connect the motor to two output shafts in the engaged state. As such, only a single disconnect unit is needed for the two output shafts. In this embodiment the disconnect unit may engage relatively close to the final stage of the transmission, i.e. the output shaft. As a result, a relatively large part of the transmission may be disconnected in the disengaged state, so that friction losses are prevented to a relatively large degree.

In particular, the disconnect unit may engage a casing of the differential in the engaged state.

By engaging the differential casing, two output shafts may be driven at the same time, via a single disconnect unit. Engaging the differential casing has the further advantage of allowing the disconnect unit to engage the differential from the outside thereof, thereby allow external placement of the disconnect unit. This may allow a relatively compact and/or elegant design of the differential.

In another embodiment of the transmission, the gear system is a planetary gear system.

The planetary gear system may aid in providing a suitable transmission ratio from the motor to the output shaft for driving an electric vehicle, possibly without the use of an additional gear box.

It is envisioned the planetary gear system comprises a sun gear, at least one planet gear, a planet carrier, and a ring gear, wherein the at least one planet gear is rotationally mounted on the planet carrier and engages the sun gear and the ring gear.

In particular, the planetary gear system may be a stepped planetary gear system in order to allow for a suitable transmission ratio. To this end, the at least one planet gear may be a stepped gear, comprising two sets of teeth having a different amount of teeth. Each set may engage another of the sun gear and the ring gear.

In the engaged state, the disconnect unit may engage at least a part of the planetary gear system.

By engaging the planetary gear system in the engaged state, the disconnect unit may be used to disconnect another part of the planetary gear system, thereby thus disconnecting a larger part of the transmission, and reducing friction and wear accordingly.

It is preferred the disconnect unit engages a planet carrier of the planetary gear system in the engaged state.

Accordingly, the planetary gear system may be connected/disconnected at the planet carrier, thereby allowing disconnecting the entire planetary gear system from the output shaft. Additionally or alternatively, using the planet carrier as a point of engagement for the disconnect unit may allow to put the disconnect unit at a distance from a central axis of the planetary gear system, thereby allowing a relatively compact and/or elegant design of the planetary gear system.

Practically, the input shaft may be fixed or rotationally fixed to an input of the planetary gear system, such as a sun gear of the planetary gear system.

In a particularly advantageous embodiment of the transmission, the planet carrier and the casing are rotationally fixed with respect to each other in the engaged state, whereas in the disengaged state the planet carrier and the casing are rotationally uncoupled.

Accordingly, the disconnect unit works by selectively coupling the planet carrier and the differential casing in rotation.

This embodiment may provide the advantage that a compact design of the transmission is possible, since the planet carrier and the differential casing may be similar in size and position. As such, the disconnect unit may be placed external of the differential casing and the planetary gear system. This allows easy installation and servicing of the disconnect unit, and reduces design constraints on the differential and the planetary gear system.

Accordingly, it is preferred if the disconnect unit is arranged in an off-axial position. Off-axial, sometimes referred to as offset, may herein be understood as a position at a distance from the axis of rotation of the components upon which the disconnect unit operates, e.g. the differential casing and/or the planet carrier.

It is noted that the advantages obtained by using an offset actuator may be achieved regardless of the components upon which the disconnect unit engages. Accordingly, the offset actuator can be employed in any disconnect unit, or any other unit that requires axial actuation. The features of the disconnect unit described above and below, may therefore be employed together with the offset position of the actuator, regardless of the components upon which the disconnect unit acts. These additional features may include the sleeve for engaging splines and the lever for moving the sleeve.

As an alternative to an offset disconnect unit, an axial disconnect unit may be used, which is arranged coaxially with said differential casing and/or the planet carrier. Such a coaxial disconnect unit may extend entirely around e.g. the differential casing and/or the planet carrier, or at least around the input and/or output shafts.

In order to connect the differential casing and the planet carrier, one or both of them may comprise external splines, wherein in the engaged state the disconnect unit engages said external splines.

By providing external splines, the disconnect unit may easily engage and lock a rotational position of the two components from the outside.

The disconnect unit may further comprise a shift sleeve configured to cooperate with said splines on the casing and/or the planet carrier.

Using a shift sleeve, the external splines may be engaged in order to transfer rotation of the splined component to another component.

The shift sleeve may be configured to engage external splines of both the planet carrier and the differential casing in the engaged state. The sleeve may be brought to a disengaged state by translating it along an axial direction, so that the sleeve disengages the external splines of at least one of the components, i.e. of the planet carrier and/or of the differential casing.

It may be advantageous to couple the shift sleeve permanently in rotation to the planet carrier. Accordingly, when the disconnect unit is in the disengaged state, the shift sleeve is also disconnected from the output shaft. Accordingly, a relatively large part of the transmission is disconnected from the output shaft.

In this case, switching from the engaged state to the disengaged state may be achieved by selectively sliding the shift sleeve over the external splines of the differential casing.

As an alternative, the shift sleeve may be permanently rotationally coupled to the casing of the differential.

In this alternative, the planet carrier may be designed relatively small, thereby allowing the differential to be arranged relatively close to the planet carrier. As a result, the transmission may be relatively short as seen in the axial direction.

In another embodiment, the transmission further comprises a bearing arranged between the planet carrier and the casing, said bearing being pretensioned.

The pretension in the bearing may facilitate the casing and the planet carrier remaining coaxial to each other, i.e. it may reduce or prevent the two components from becoming out of coaxial alignment. Accordingly, additional bearings between the casing and the housing and/or the planet carrier and the housing may be dispensed with. As such a more light-weight and/or elegant design may be made.

It is noted this embodiment may be applied to any transmission as described herein, and even to those without a disconnect unit.

In another embodiment, the disconnect unit comprises an actuator for switching between the engaged and the disengaged state. Using the actuator, the disconnect unit may be operated e.g. electronically.

The actuator may be mounted offset from a central axis of the casing and/or the planet carrier. Accordingly, an offset disconnect unit may be obtained. Advantages thereof are described above. As explained above, the offset actuator may be applied to any type of disconnect unit, regardless upon which components it acts.

In particular, the actuator may be rotationally stationary. By mounting the actuator rotationally stationary, the total rotating mass of the transmission is reduced, thereby increase efficiency and/or reducing wear.

In an embodiment, the actuator comprises a solenoid. A solenoid may provide sufficient force to switch between the states of the disconnect unit. Moreover, a solenoid may easily be operated electrically, thereby making the disconnect unit especially suitable for electric vehicles.

When the actuator comprises an offset solenoid, which is thus mounted away from the central axis, further synergistic advantages exist. In particular, the actuated part of the offset solenoid, e.g. a pin, need not rotate. Accordingly, the design of the solenoid may be simplified. As an example, no bearings are needed to allow rotation of the pin.

The solenoid may comprise an actuatable pin and a first stop, wherein the pin engages the first stop when the solenoid is actuated.

By providing a stop for the pin to engage on when the solenoid is actuated, the actuated position for the pin may be well-defined. It is noted that the fact that the pin is not rotating, which ultimately results from the offset position of the solenoid, allows the pin engaging the stop without introducing friction.

As compared to a co-axial solenoid, the offset solenoid may have additional advantages. Firstly, the offset solenoid need not be shimmed since due to ability to use a stop for defining the engaged position

of the pin, there is a less stringent constraint on the windings of the solenoid. A coaxial solenoid however would require the pin to rotate, and therefore keep clear of non-rotating parts of the solenoid. The coaxial solenoid must therefore keep the pin, or any other actuated part, in a desired actuated position without the use of a stop. Moreover, said desired position needs to be achieved within relatively small tolerances, which requires shimming of the solenoid. Moreover, keeping the pin in the actuated position without the use of a stop requires a relatively large amount of energy, since the hold-power is relatively high in this case. The hold power can be reduced by the interaction with the stop, since no precise position need be effected by the solenoid. After all, the engaged position can be defined by the stop.

The solenoid may comprise the actuatable pin and further a second stop and a biasing means, wherein the biasing means is configured to bias the actuatable pin towards the second stop, and wherein in the disengaged state the biasing means force the actuatable pin into engagement with the second stop.

Accordingly, a disengaged position may be defined by an additional stop, which contributes to a relatively elegant design. The biasing means further allow retraction of the pin without requiring any further external force. As such, removing power from the solenoid may default into the disengaged state relatively quickly.

Of course it is possible to invert the solenoid's operation, so that powering the solenoid moves the disconnect unit to the engaged state and powering the solenoid moves the disconnect unit to the disengaged state.

In another embodiment, the disconnect unit comprises a lever for switching between the engaged and the disengaged state. In particular, the lever may drive the shift sleeve. The lever may drive the shift sleeve via a slide shoe engaging in a track of the sleeve. The slide shoe may be rotatably engaged with the lever in order to allow for sufficient play between the sleeve and the lever as one component rotates with respect to the other.

The lever may aid in arranging the solenoid in the offset position, thereby allowing to choose a suitable location for the solenoid. It is noted the lever may be used for the same reasons with any other type of actuator, or even when driven manually. Moreover, the lever may provide a suitable amount of

leverage, which may in turn allow selecting a suitable solenoid, such as one with a desired maximum force and/or a desired range of motion.

The lever may be actuatable via a pin-slot joint. Accordingly, rotation of the lever and translation in a direction perpendicular to the direction of actuation may be free. As a result, the solenoid may be fixed in location, thereby allowing the solenoid to be rigidly fixed to an external casing of the transmission.

As an alternative to the lever, a shift-fork could be used, which may be guided unidirectionally, as opposed to the pivoting motion of the lever.

The invention also relates to a vehicle comprising a motor and a transmission as described above, wherein the vehicle is drivable by the motor via the transmission. The vehicle may be an electric vehicle. The transmission may have any one or more of the above-described features, alone or in any suitable combination.

The vehicle may comprise a second motor for driving the vehicle. The first motor may be a so-called secondary motor, which may be disconnected from the output shafts using the disconnect unit in the transmission.

It is noted that the terms primary and secondary when relating to the motors are used only to distinguish the motors, and in no way require that the secondary motor is ancillary to, or rated lower in power or importance than, the primary motor. Regardless, the secondary motor may indeed be smaller, have lower power output, be used less often, or otherwise be ancillary.

The vehicle may be an electric vehicle. The motor and/or the secondary motor may accordingly be electric motors.

The invention will be further elucidated with reference to the attached drawings, in which:

Figure 1 shows a schematic of a transmission; and

Figures 2A – 2D schematically show different perspective views of a transmission, detailing various components.

Throughout the figures, like elements will be referred to using like reference numerals. Like elements of different embodiments are referred to using reference numerals increased by one hundred (100).

The schematic of figure 1 shows a transmission 1 and an electric motor 2 configured for driving a first and second output shaft 3, 4 through the transmission 1. The motor 2 drives a sun gear 5 of a planetary gear system 6. Torque is transmitted further via stepped planet gears 7 (only one shown) with a first set of teeth 8 engaging the sun gear 5, and a second set of teeth 9 engaging a ring gear 10. The stepped planet gears 7 are carried by a planet carrier 11.

The output shafts 3, 4 are driven via a differential 12 which includes a casing 13 configured for receiving torque in order to drive the output shafts 3, 4.

The casing 13 of the differential 12 and the planet carrier 11 are provided with corresponding splines 14, 15 on their exterior. A shifting sleeve 16 is movably arranged over the external spline 15 of the differential casing 13, so that it can selectively engage or disengage the external spline 14 of the planet carrier 11. Accordingly, rotation of the planet carrier 11 and the differential casing 13 can be coupled or uncoupled by moving the shifting sleeve 16, thus providing an engaged and a disengaged state of a disconnect unit. The shifting sleeve 16 is driven via a lever 17 which pivots about a pivot point 18. The lever 17 is actuated by a solenoid 19 mounted offset from a central axis A of the differential casing 13. The solenoid 19 is fixed in position, as shown by it being connected to an outer transmission casing 24. The solenoid 19 includes an actuatable pin 21 connected to the lever via a pin-and-slot joint 22. Accordingly, movement of the pin 21 from the right to left in figure 1 pivots the lever, thereby moving the sleeve 16 from left to right, so that the sleeve 16 engages both external splines 14, 15 of the differential casing 13 and the planet carrier 11. The solenoid 19 further includes a first stop 23 upon which the pin 21 engages when the solenoid 19 is powered. Although not shown in figure 1, the solenoid 19 may be further provided with a biasing means biasing the actuatable pin away from the first stop, and optionally a second stop which limits movement of the actuatable pin 21 at a certain distance from the first stop 23.

Figures 2A – 2D show a transmission 101 which has a casing 124. An output shaft 104 protrudes from the casing 124. Further an opening 125 can be seen for accommodating another output shaft. The casing 124 also forms a pivot 118 upon which a lever (see figures 2B – 2D) can rotate. Further, an

electrical connection 126 is exposed, through which the solenoid (see figures 2B – 2D) can be powered.

In figure 2B, the casing 124 has been removed to expose the internals of the transmission 101. In figure 2C additionally a part of the planet carrier 111 has been removed. Accordingly, stepped planetary gears 107 with first 108 and second 109 sets of teeth can be seen engaging a ring gear 110 of a planetary gear system 106. The planetary gear system 106 is driven via the sun gear 105 (figure 2C). the planet carrier 111 has an external spline 114. A differential 112 with a casing 113 is also shown. The differential 112 is provided with an external spline 115 (figure 2D) which correspond with the spline 114 of the planet carrier 111. A shift sleeve 116 engages the spline 115 of the differential casing 113 and selectively engages the spline 114 of the planet carrier 111, depending on its axial position. Accordingly, an engaged and a disengaged state are provided. Movement of the shift sleeve is driven via a lever 117 which pivots about a pivot point 118. The lever 117 is connected to the shift sleeve 116 via slide shoes 128 connected to the lever 117 via a pin 127 allowing some rotation of the shoe 128. The shoe 128 slides in a track 128' when the shift sleeve 116 rotates, thereby allowing the lever 117 to be rotationally stationary. Movement of the lever 117 is effected by a solenoid 119 which engages the lever 117 via a pin-and-slot joint 122, which includes a hook 130 attached to an actuatable pin 121 of the solenoid 119, which forms the slot, and a pin 129 fixed to the lever, which forms the pin of the pin-and-slot joint 122 (figure 2D).

Figure 2C further shows a bearing 199 between the planet carrier 110 and the casing 113 of the differential 112. The bearing 199 is pretensioned, so that a coaxial alignment of the planet carrier 110 and the casing 113 is guaranteed.

Although the invention has been described above with reference to specific examples and embodiments, the scope of this application is not limited thereto. In fact, the scope is also defined by the following claims.

Conclusies

1. Transmissie omvattende:

- een invoeras, die is geconfigureerd om koppel te ontvangen die door een motor wordt opgelegd;
- een tandwielsysteem;
- een differentieel;
- ten minste één uitvoeras, en
- een ontkoppeleenheid, die schakelbaar is tussen een ingeschakelde toestand en een uitgeschakelde toestand, waarbij in de ingeschakelde toestand de invoeras gekoppeld is aan de uitvoeras via het tandwielsysteem en het differentieel om de ten minste ene uitvoeras aan te drijven, en waarbij in de uitgeschakelde toestand de ten minste ene uitvoeras ontkoppeld is van de invoeras.

2. Transmissie volgens de vorige conclusie, waarbij in de ingeschakelde toestand de ontkoppeleenheid althans op een deel van het differentieel aangrijpt.

3. Transmissie volgens de vorige conclusie, waarbij het differentieel een behuizing omvat, waarbij in de ingeschakelde toestand de ontkoppeleenheid aangrijpt op de behuizing van het differentieel.

4. Transmissie volgens een der voorgaande conclusies, waarbij het tandwielsysteem een planetair tandwielsysteem is.

5. Transmissie volgens de vorige conclusie, waarbij in de ingeschakelde toestand de ontkoppeleenheid aangrijpt op althans een deel van het planetaire tandwielsysteem.

6. Transmissie volgens de vorige conclusie, waarbij in de ingeschakelde toestand de ontkoppeleenheid aangrijpt op een planeetdrager van het planetaire tandwielsysteem.

7. Transmissie volgens een der conclusies 4 - 6, waarbij de invoeras in rotatie gefixeerd is aan een invoer van het planetaire tandwielsysteem, zoals een zonnetandwiel van het planetaire tandwielsysteem.

8. Transmissie volgens een der conclusies 4 - 7, waarbij in de ingeschakelde toestand, de planeetdrager en de behuizing in rotatie gefixeerd zijn ten opzichte van elkaar, en waarbij in de uitgeschakelde toestand de planeetdrager en de behuizing in rotatie ontkoppeld zijn.

9. Transmissie volgens een der conclusies 4 - 7, waarbij de transmissie verder een lagering omvat die tussen de planeetdrager en de behuizing is aangebracht, waarbij de lagering voorgespannen is.

10. Transmissie volgens een der voorgaande conclusies, waarbij de behuizing en/of de planeetdrager externe spieën omvat, waarbij in de ingeschakelde toestand de ontkoppeleenheid aangrijpt op de externe spieën.

11. Transmissie volgens de vorige conclusie, waarbij de ontkoppeleenheid een schakelhuls omvat die is geconfigureerd om samen te werken met de spieën op de behuizing en/of de planeetdrager.

12. Transmissie volgens de vorige conclusie, waarbij de schakelhuls permanent in rotatie is gekoppeld met de planeetdrager.

13. Transmissie volgens de vorige conclusie, waarbij de schakelhuls permanent in rotatie is gekoppeld met de behuizing van het differentieel.

14. Transmissie volgens een der voorgaande conclusies, waarbij de ontkoppeleenheid een actuator omvat voor het schakelhuls tussen de ingeschakelde en de uitgeschakelde toestand.

15. Transmissie volgens de vorige conclusie, waarbij de actuator versprongen is gemonteerd ten opzichte van een centrale as van de behuizing en/of de planeetdrager.

16. Transmissie volgens conclusie 14 of 15, waarbij de actuator in rotatie stationair is.

17. Transmissie volgens een der conclusies 12 - 16, waarbij de actuator een solenoïde omvat.

18. Transmissie volgens de vorige conclusie, waarbij de solenoïde een actueerbare pin omvat en een eerste aanslag, waarbij de pin aangrijpt op de eerste aanslag wanneer de solenoïde wordt bekrachtigd.

19. Transmissie volgens conclusie 17 of 18, waarbij de solenoïde de actueerbare pin omvat en verder een tweede aanslag en een voorspanmiddel, waarbij het voorspanmiddel is ingericht om de actueerbare pin naar de tweede aanslag voor te spannen, en waarbij in de uitgeschakelde toestand het voorspanmiddel de actueerbare pin tegen de tweede aanslag aan duwen.

20. Transmissie volgens een der voorgaande conclusies, waarbij de ontkoppeleenheid een hendel omvat voor het schakelen tussen de ingeschakelde en de uitgeschakelde toestand.

21. Transmissie volgens de vorige conclusie, waarbij de hendel aandrijfbaar is via een pin-sleuf-gewricht.

22. Voertuig omvattende een motor en een transmissie volgens een der voorgaande conclusies, waarbij het voertuig door de motor aandrijfbaar is via de transmissie.

23. Voertuig volgens de vorige conclusie, verder omvattende een tweede motor voor het aandrijven van het voertuig.

24. Voertuig volgens conclusie 22 of 23, waarbij het voertuig een elektrisch voertuig is.

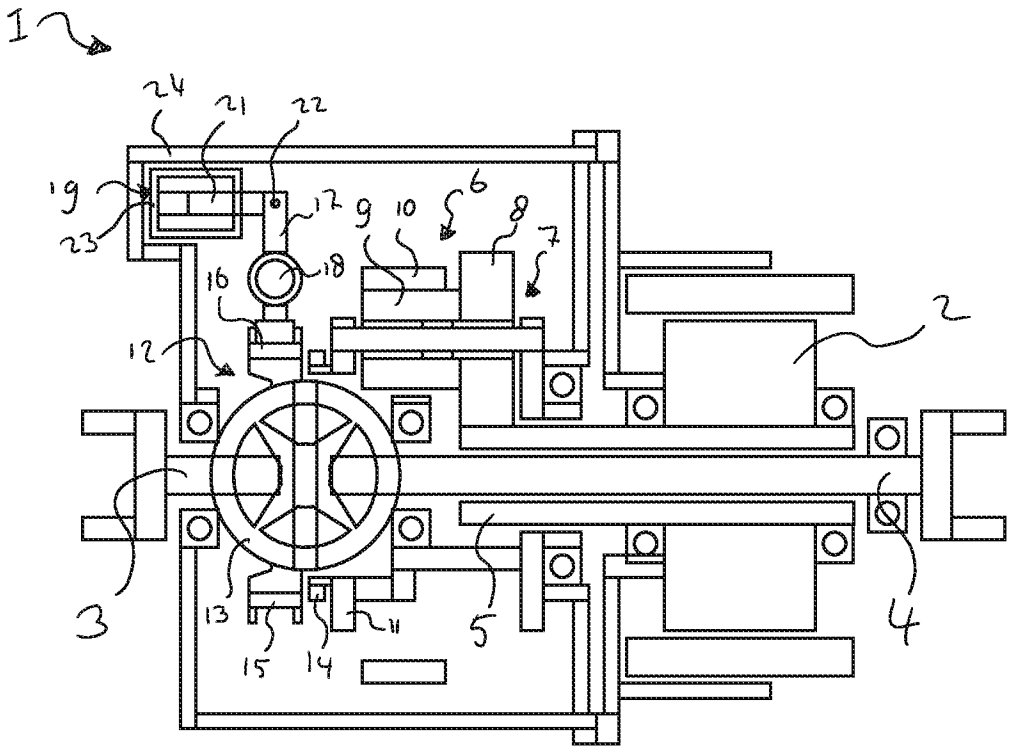

Fig. 1

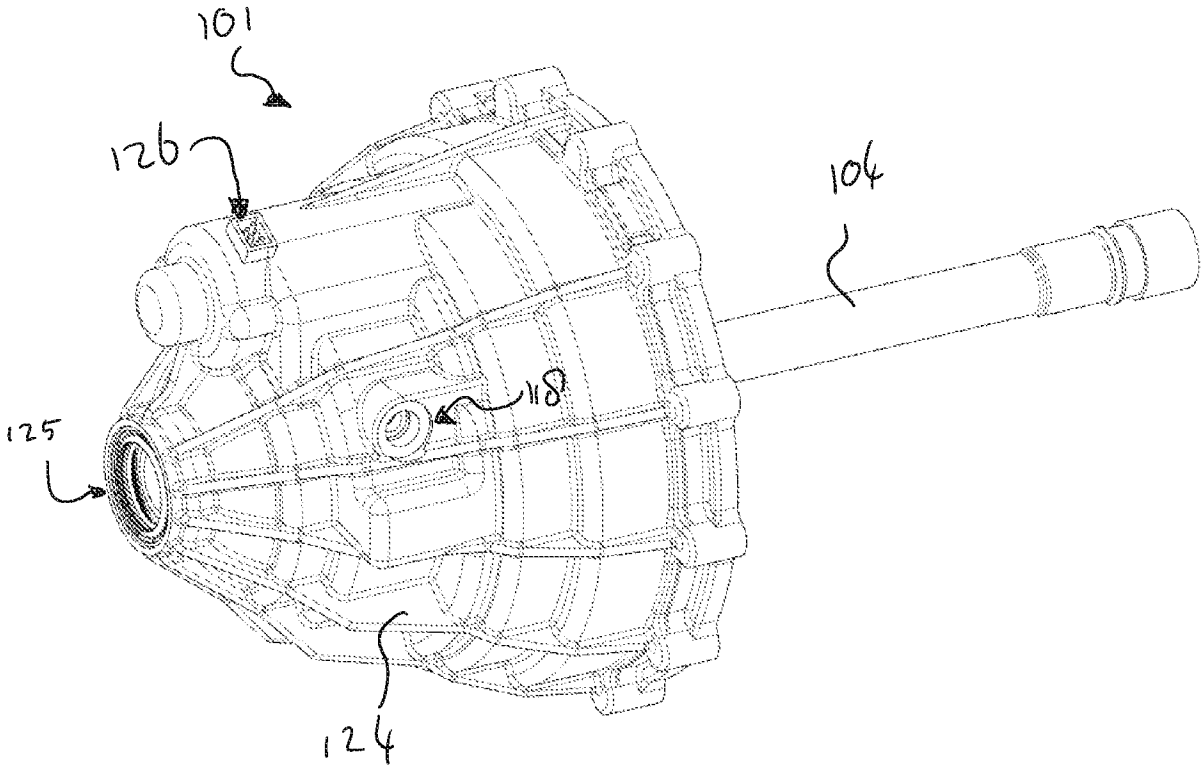

Fig. 2A

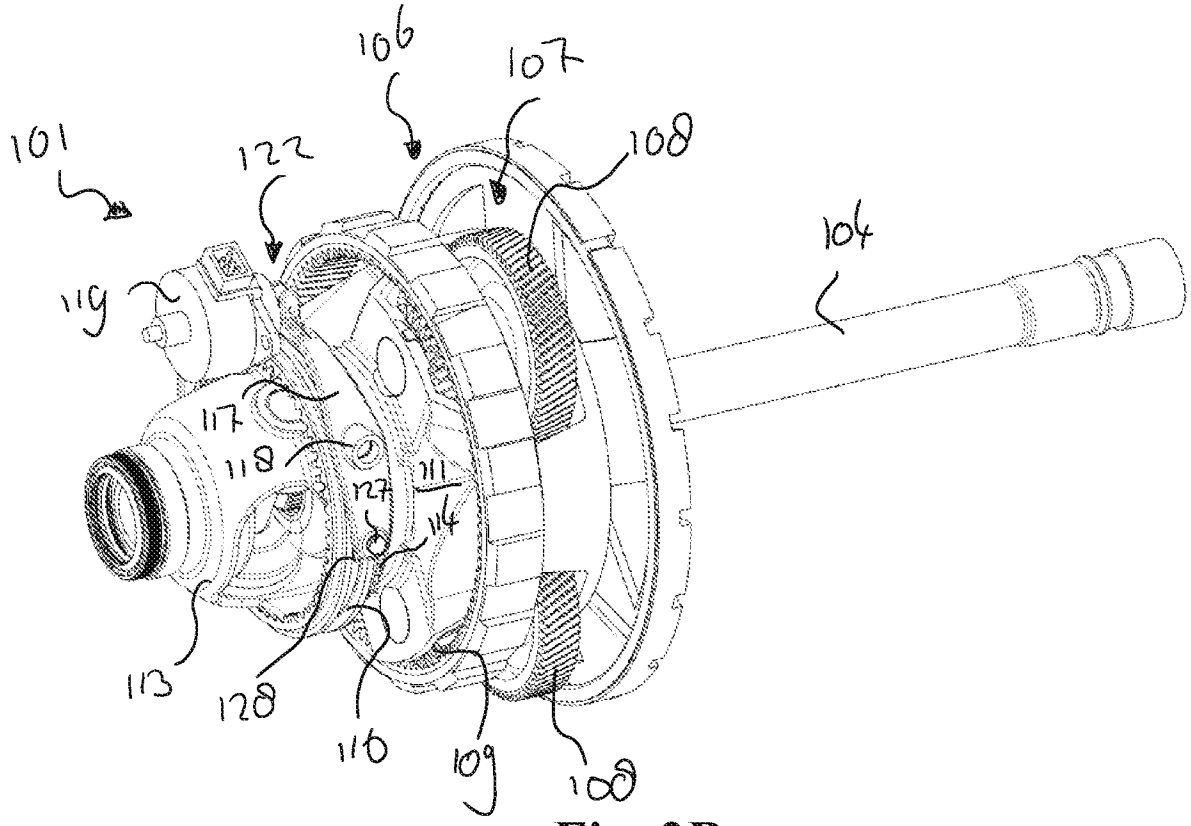
101
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Fig. 2B

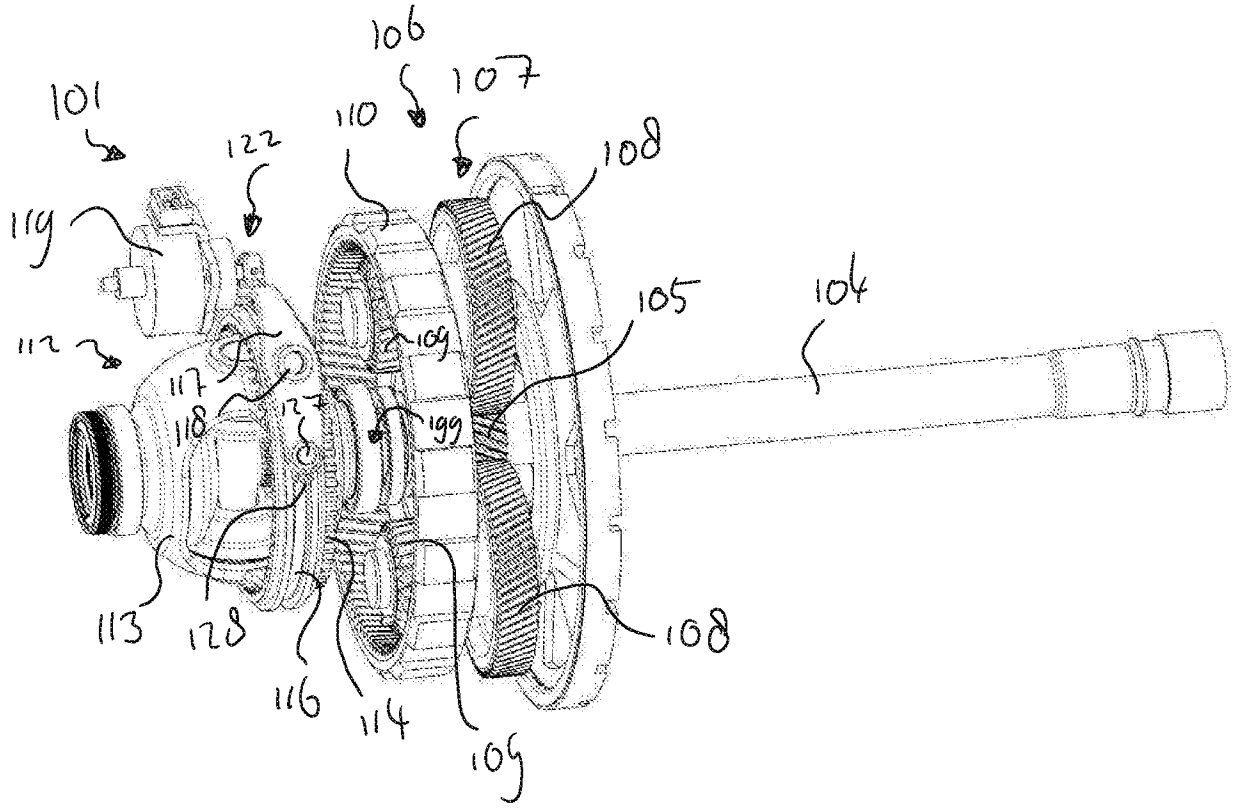
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Fig. 2C

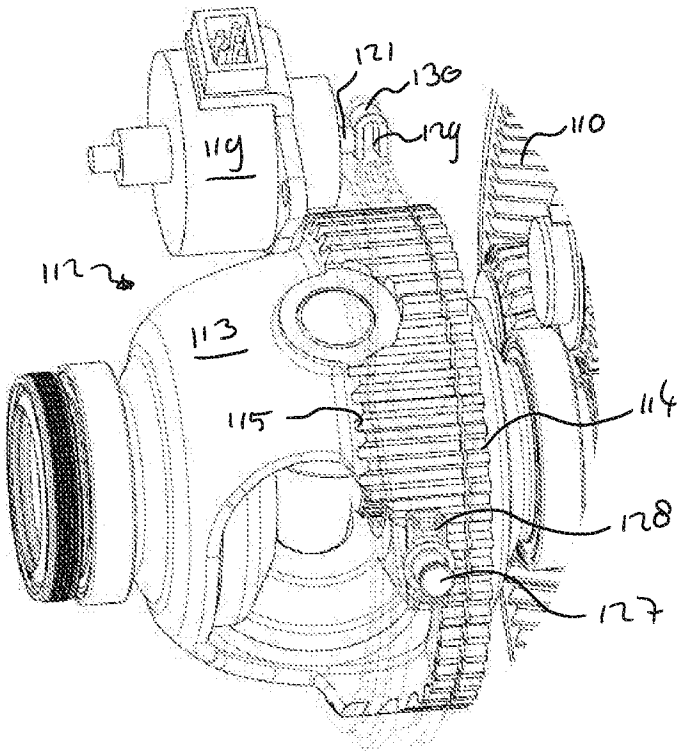

Fig. 2D

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
Nederlands aanvraag nr. **2029523**	Indieningsdatum **27-10-2021**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Punch Powertrain PSA e-transmissions N.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **05-02-2022**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN80625**
I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)	
Volgens de internationale classificatie (IPC) **Zie onderzoeksrapport**	
II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK	
Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
IPC	**Zie onderzoeksrapport**
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	
III. ☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES** (opmerkingen op aanvullingsblad)	
IV. ☐ **GEBREK AAN EENHEID VAN UITVINDING** (opmerkingen op aanvullingsblad)	

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2029523

A. CLASSIFICATIE VAN HET ONDERWERP
INV. F16H37/08 B60K1/00
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
F16H B60K

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	CN 111 717 024 A (CHONGQING CHANGAN NEW ENERGY AUTOMOBILE TECH CO LTD) 29 september 2020 (2020-09-29) * figuur 1 *	1-24
X	DE 10 2017 108005 A1 (SCHAEFFLER TECHNOLOGIES AG [DE]) 18 oktober 2018 (2018-10-18) * figuur 1 *	1-8, 10-24

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
17 mei 2022	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	**Belz, Thomas**

Formulier PCT/ISA/201 (tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek

NL 2029523

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
CN 111717024 A	29-09-2020	GEEN	
DE 102017108005 A1	18-10-2018	CN 110546023 A	06-12-2019
		DE 102017108005 A1	18-10-2018
		WO 2018188682 A1	18-10-2018

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN80625	27.10.2021		NL2029523

International Patent Classification (IPC)
INV. F16H37/08 B60K1/00

Applicant
Punch Powertrain PSA e-transmissions N.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☒ Box No. VIII Certain observations on the application

	Examiner
	Belz, Thomas

Application number

WRITTEN OPINION

NL2029523

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	9-13, 18-21, 23
	No:	Claims	1-8, 14-17, 22, 24
Inventive step	Yes:	Claims	
	No:	Claims	1-24
Industrial applicability	Yes:	Claims	1-24
	No:	Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Box No. VII Certain defects in the application

see separate sheet

Box No. VIII Certain observations on the application

see separate sheet

Re Point V

1 Reference is made to the following documents:

D1 CN 111 717 024 A (CHONGQING CHANGAN NEW ENERGY AUTOMOBILE TECH CO LTD) 29 september 2020 (2020-09-29)

D2 DE 10 2017 108005 A1 (SCHAEFFLER TECHNOLOGIES AG [DE]) 18 oktober 2018 (2018-10-18)

2 **Summary**

The subject-matter of each of **claims 1-8, 14-17, 22 and 24** is not considered to be new.

The subject-matter of each of **claims 10-13, 17-20 and 23** is not considered as involving an inventive step.

Claim 9 is not considered as disclosed in the application as filed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

There are further deficiencies.

3 The subject-matter of each of **claims 1-8, 14-17, 22 and 24** is not considered to be new.

3.1 **Document D1** (CN111717024A) discloses in its Fig.1:

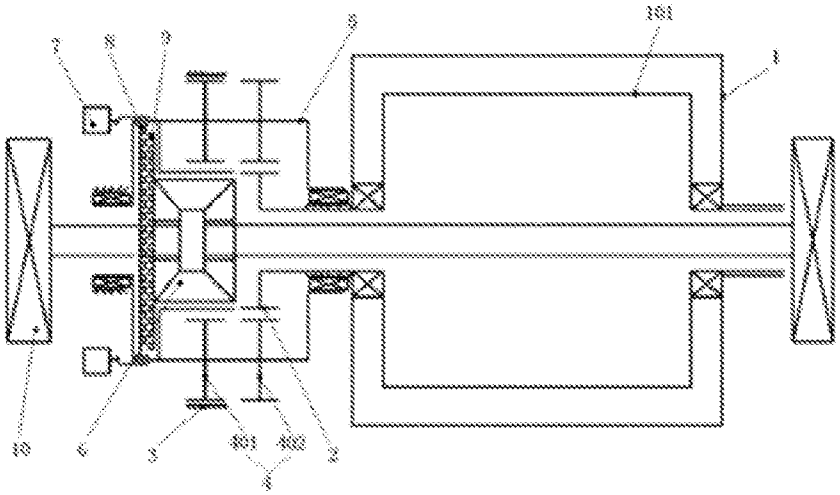

图1

An English machine translation of the description of **D1** discloses:

"*The sun gear 2 and the fixed outer ring gear 3 rotate the planet gear 4 while revolving around the rotation axis of the sun gear 2, and the planet gear 4 drives the differential The housing 5 rotates with the rotation axis of the sun gear 2 as the center, and finally* ***the differential housing 5 inputs power to the differential gear train 6 through the power disconnection mechanism****;* ***because the differential housing 5 also functions as a planet carrier*** *Therefore, it is possible to reduce the volume of the coaxial electric drive axle power assembly, make the structure more compact, and facilitate the lightweight of the entire vehicle, thereby reducing the energy consumption of the entire vehicle and improving the endurance of the entire vehicle.*

In this embodiment, the power disconnection mechanism includes a shifter 7, a movable shift ring gear 8, and a fixed shift ring gear 9 capable of meshing with the movable shift ring gear 8. The fixed shift gear ring A ring gear 9 is provided on the ***power input end of the differential gear train 6****,* ***the movable shift ring gear 8 is connected to the differential housing 5****, and the shifter 7 can make the movable The gear shifting ring gear 8 engages or disengages from the fixed shifting gear ring 9. The*

movable gear ring 8 and the fixed gear ring 9 are driven by gears. The heat generated during the transmission is low, the transmission ratio is accurate, the transmission efficiency is high, and the structure is compact.

In this embodiment, ***the movable shift ring gear 8 is arranged inside the differential housing 5****, and the movable shift ring gear 8 can be moved along the axis of the sun gear 2 The way of directional movement is connected with the differential housing 5. The movable gear ring 8 and the differential housing 5 cannot rotate relative to each other; the movable gear ring 8 and the fixed The shift ring gear 9 is arranged in sequence along the axis of the rotation axis of the sun gear 2, and the shifter 7 can drive the movable shift ring gear 8 to move along the axis of the rotation axis of the sun gear 2. , So as to achieve the meshing and separation of the movable gear ring 8 and the fixed gear ring 9.*

In this embodiment, the shifter 7 and the movable shifting ring gear 8 both generate a magnetic field after being energized. ***The magnetic field generated by the shifter 7 is the same as the magnetic field generated by the movable shifting ring gear 8. Repelling each other, a return spring is also provided between the movable shift ring gear 8 and the shifter 7****. After the shifter 7 and the movable shifting ring gear 8 are energized, the shifter 7 moves the movable shifting ring gear 8 toward the fixed shifting ring gear 9, the return spring is stretched, and the movable shifting ring gear 8 and The fixed gear ring 9 is engaged; after the power to the shifter 7 and the movable gear ring 8 is stopped, t****he return spring contracts, driving the movable gear ring 8 and the fixed gear ring 9 to separate****."*

With the wording of an English machine translation of the claims, **document D1** is considered as disclosing:

3.1.1 **Claim 1**

Transmission (Fig.1 of **D1**) including:

- an input shaft (101), configured to receive torque imposed by an engine (1),

- a gear system (4),

- a differential (6);

- at least one output shaft (10), and

- a declutch unit (7, 8, 9), which is switchable between a switched-on condition and a switched-off condition, with the input shaft (101) coupled to the output shaft (10) via the gear system (4) and the differential (6) in the on position to drive the at least one output shaft (10), with at least one output shaft (10) disconnected from the input shaft (101) when disengaged.

3.1.2 **Claim 2**

Transmission according to the previous conclusion, in which the declutch unit (7, 8, 9) engages at least part of the differential (6) when engaged.

3.1.3 **Claim 3**

Transmission according to the previous conclusion, where the differential (6) comprises a housing (="*power input end of the differential gear train 6*"), in which the declutch assembly engages with the differential housing (="*power input end of the differential gear train 6*") in the engaged position.

Note:

See English machine translation of the description of **D1**:

"*the differential housing 5 inputs power to the differential gear train 6 through the power disconnection mechanism; because the differential housing 5 also functions as a planet carrier*"

"*The fixed shift gear ring A ring gear 9 is provided on the power input end of the differential gear train 6*"

3.1.4 **Claim 4**

Transmission according to one of the previous conclusions, where the gear system is a planetary gear system (4).

3.1.5 **Claim 5**

Transmission according to the previous conclusion, with the declutch unit (7, 8, 9) engaged at least part (5) of the planetary gear system (4).

3.1.6 **Claim 6**

Transmission according to the previous conclusion, with the declutch unit (7, 8, 9) engaged on a planetary carrier of (5) the planetary gear system (4).

3.1.7 **Claim 7**

Transmission according to one of the conclusions 4 - 6, where the input shaft (101) is fixed in rotation to an input of the planetary gear system, such as a sun gear (2) of the planetary gear system (4).

3.1.8 **Claim 8**

Transmission according to one of the conclusions 4 - 7, with the planetary carrier (5) and housing (="*power input end of the differential gear train 6*") fixed in rotation relative to each other in the engaged position, and with the planet carrier (5) and housing (="*power input end of the differential gear train 6*") disengaged in rotation in the disengaged position.

Note:

See English machine translation of the description of **D1**:

"*the differential housing 5 inputs power to the differential gear train 6 through the power disconnection mechanism; because the differential housing 5 also functions as a planet carrier*"

"*The fixed shift gear ring A ring gear 9 is provided on the power input end of the differential gear train 6*"

3.1.9 **Claim 14**

Transmission according to one of the previous conclusions, where the declutch unit (77, 8, 9) comprises an actuator (7) for the shift sleeve (8) between the engaged and disengaged condition.

3.1.10 **Claim 15**

Transmission according to the previous conclusion, where the actuator (7) is offset from a central shaft of the housing (="*power input end of the differential gear train 6*") and~~/or~~ the planet carrier (5).

3.1.11 **Claim 16**

Transmission according to conclusion 14 or 15, with the actuator (7) stationary in rotation.

3.1.12 **Claim 17**

Transmission according to one of the conclusions 12 - 16, with the actuator (7) incorporating a solenoid.

Note:

See English machine translation of the description of **D1**:

"*In this embodiment, the shifter 7 and the movable shifting ring gear 8 both generate a magnetic field after being energized. The magnetic field generated by the shifter 7 is the same as the magnetic field*

generated by the movable shifting ring gear 8. Repelling each other, a return spring is also provided between the movable shift ring gear 8 and the shifter 7."

3.1.13 **Claim 22**

Vehicle (see Fig.1) comprising an engine (="*motor 1*") and a transmission in accordance with one of the previous conclusions, where the vehicle is driven by the engine (1) via the transmission.

Note:

The description, page 8, lines 11-14, which seems to repeat **claim 1**, uses the terms "*motor*" and "*electric vehicle*", but not "*engine*". IN other words: "*engine*" might be a wrong machine translation.

3.1.14 **Claim 24**

Vehicle in conclusion ~~**22 or**~~ 23, where the vehicle is an electric vehicle (see Fig. 1 of **D1**).

3.1.15 Consequently, the subject-matter of each of **claims 1-8, 14-17, 22 and 24** is not considered to be new over the disclosure of **document D1**.

3.2 **Document D2** (DE102017108005A1) discloses in its Fig.1 a transmission which is considered as falling within the wording of any of **claims 1-8, 22 and 24**:

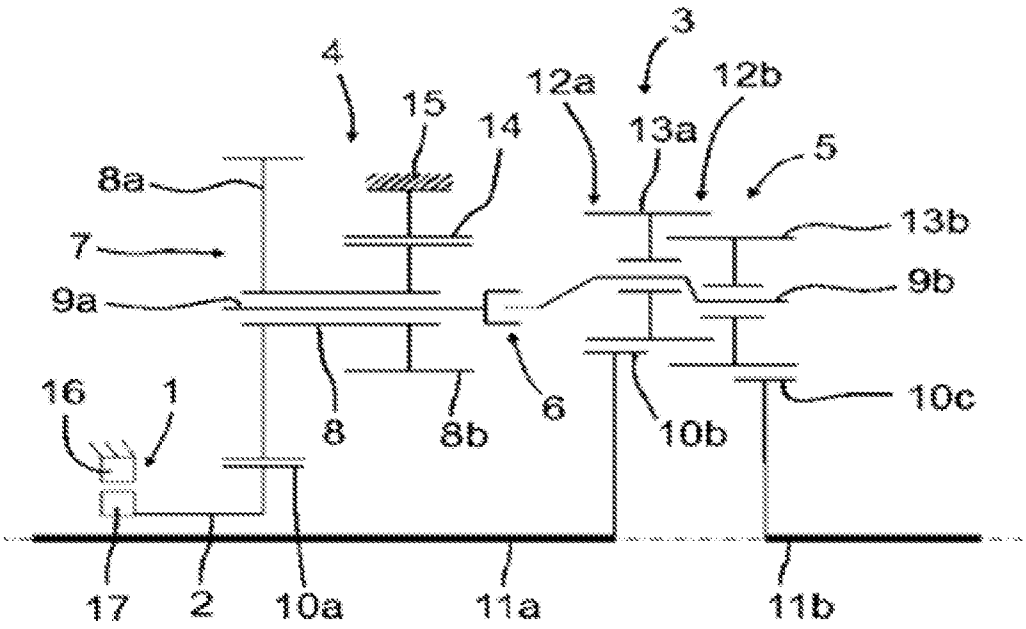

Fig.

4 The subject-matter of each of **claims 10-13, 17-20 and 23** is not considered as involving an inventive step.

4.1 **Claims 10-13**

Fig.1 of **document D1** is not very detailed with regard to its depicted disconnect unit (7, 8, 9). Consequently, a skilled person is forced to design the disconnect unit (7, 8, 9) on its own.

In this respect, "*external splines*", which are connectable by a shift sleeve are considered as **common general knowledge** and, thus, to be obvious.

Consequently, the subject-matter of each of **claims 10-13** is not considered as involving an inventive step.

4.2 **Claims 17-19**

Fig.1 of **document D1** is not very detailed with regard to its depicted disconnect unit (7, 8, 9). Consequently, a skilled person is forced to design the disconnect unit (7, 8, 9) on its own.

Solenoids having a "*pin*", a return spring and two opposite end stops, which prevent the "*pin*" to "*fall out*" of the solenoid, are considered as **common general knowledge**.

Incited thereby, a skilled person provides the disconnect unit (7, 8, 9) disclosed in Fig.1 of **document D1** with an appropriate solenoid, thereby arriving at the subject-matter of any of **claims 17-19**.

Consequently, the subject-matter of each of **claims 17-19** is not considered as involving an inventive step.

4.3 **Claim 20**

Fig.1 of **document D1** is not very detailed with regard to its depicted disconnect unit (7, 8, 9). Consequently, a skilled person is forced to design the disconnect unit (7, 8, 9) on its own.

In this respect, a "*shift lever*" is considered as **common general knowledge**. A skilled person is well aware that with a shift lever the maximum power required to move the shift sleeve can be reduced by a respective shift lever ratio.

Incited thereby, and in order to reduce the maximum power of "*shifter 7*" in **document D1**, he provides the transmission shown in Fig.1 of **document D1** with an appropriate shift lever, thereby arriving in an obvious manner at the subject-matter of **claim 20**.

Consequently, the subject-matter of **claims 20** is not considered as involving an inventive step.

4.4 **Claim 23**

It belongs to **common general knowledge** to add an electric axle, such as that disclosed in Fig.1 of **document D1**, to an engine-front-driven vehicle in order to hybridize said vehicle and to provide it with a 4WD functionality.

Incited thereby, a skilled person arrives in an obvious manner at the subject-matter of **claim 23**.

Consequently, the subject-matter of **claims 23** is not considered as involving an inventive step.

4.5 The statements under cipher 4.1-4.4 above apply mutatis mutandis to **document D2**, i.e. the subject-matter of each of **claims 10-13, 17-20 and 23** is also not considered as involving an inventive step starting from **document D2**.

5 **Claim 9**

The present application does not meet the requirements that it shall disclose the invention as claimed in **claim 9** in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art.

At least, the present application does not seem to disclose at least one way in detailed to carry the invention as claimed in **claim 9**.

In particular, the application does not seem to disclose how and why "*additional bearings between the casing and the housing and/or the planet carrier and the housing may be dispensed with.*", as mentioned on page 5, lines 27-33.

On the contrary, Fig.1 of the present application seems to use such an "*additional bearings*" between casing 13 and housing 24 and its not recognizable how it might be dispensed with:

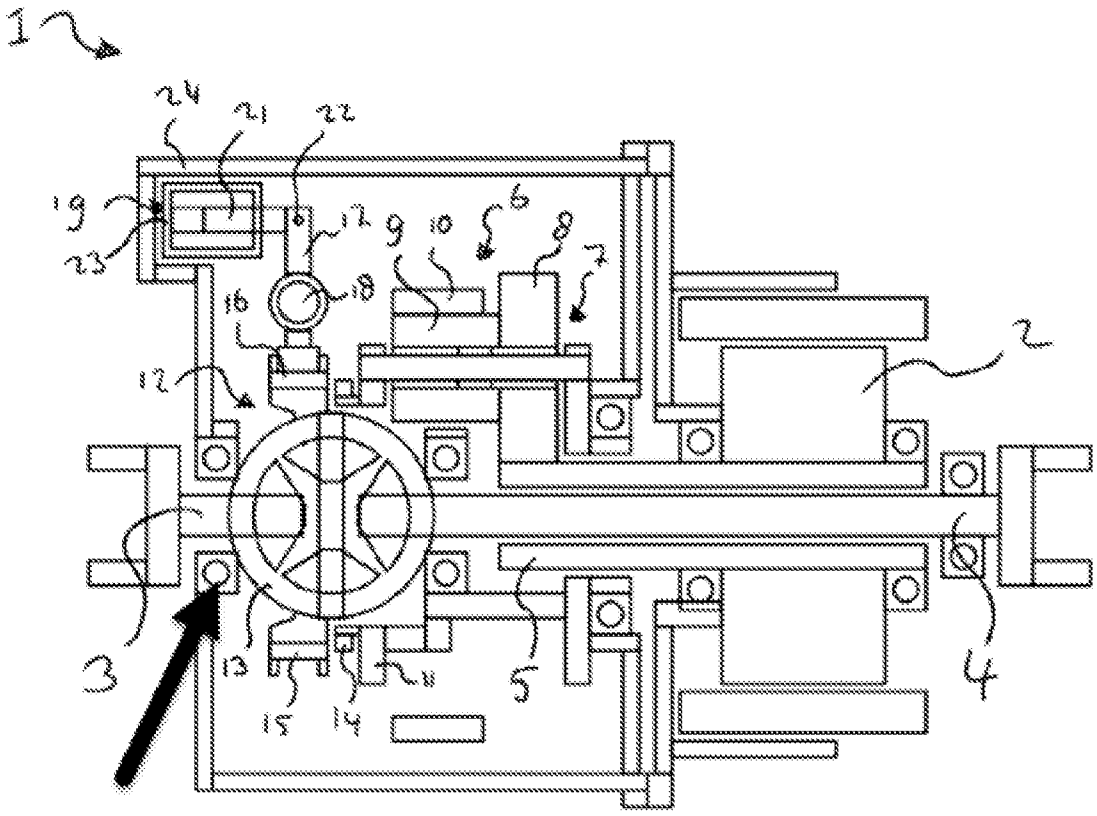

Fig. 1

In addition, it does not seem to be disclosed against which element the bearing shall be pre-tensioned.

Re Point VII

6 **Claim 1** is not formulated in the two-part form which can be easily done as shown in the feature analyses under cipher 3.1 above.

7 The technical features of the claims are not followed by reference signs placed between parenthesis.

In the present case this would increase the intelligibility of the claims.

8 **Document D1** is regarded as useful to understand the invention as claimed.The background art reflected therein has to be indicated in the description, in such a way as to allow the skilled person to see clearly which features necessary for the definition of the claimed subject-matter are, in combination, part of the prior art.

Note:

Merely adding the literal wording of the abstract of **document D1** to the description will **not** allow the skilled person to see clearly which features necessary for the definition of the claimed subject-matter are, in combination, part of the prior art.

Re Point VIII

9 The present application does not meet the requirements that the claims shall define the matter for which protection is sought and that they shall be clear and concise and be supported by the description.

9.1 **Claim 1**

An English machine translation of **claim 1** uses the term "*at least one output shaft*".

However, a differential with only one output shaft does not seem to make any technical sense.

In addition, the term "*at least one output shaft*" seems to be inconsistent with the description. At least, p.2, l.17-19 and l.25-26 use the term "*two output shafts*".

This deficiency may be corrected by replacing in **claim 1** the term "*at least one output shaft*" by the term "*two output shafts*", which is disclosed on p.2, l.17-19 an 25-26 as well as in Fig.1.

9.2 **Claim 13**

Claim 13 is not considered to be clear and supported by the description. It seems to contain a reference to its previous claim, i.e. to **claim 12**.

However, if the shift sleeve was actually permanently connected to both, the planet carrier and the casing of the differential the shift sleeve would no longer be a shift sleeve for disconnecting, but a connecting sleeve for a permanent connection.

In particular, said reference of **claim 13** seems to be inconsistent with the description, page 5, lines 20-21. This passage repeats the wording of **claim 13**, but denoting it as "*alternative*" to previous lines 12-15 which repeat the wording of **claim 12**. Consequently, this "*alternative*" excludes a reference of **claim 13** to **claim 12**.

This deficiency may be corrected by replacing in **claim 13** the reference "*according to the previous claim*" by the reference "*according to claim 11*".

9.3 Description, page 6, lines 1-2

This passage is considered to be inconsistent with **claim 1**, since its term

> "*It is noted this embodiment may be applied to any transmission as described herein, **and even to those without a disconnect unit***."

seems to imply that the invention shall be broader than the subject-matter of **claim 1**. This is because, this passage describes an embodiment (of the invention?) as not having the feature "*disconnect unit*": However, a "*disconnect unit*" is an essential feature of the invention which is mentioned in **claim 1**.

This deficiency may be corrected by deleting the term

> "*, and even to those without a disconnect unit.*"

9.4 Description, page 10, lines 25-27

This passage contains general statements ("*scope of this **application***", "*the scope is **also** defined by the following claims*") which imply that the extent of protection may be expanded in some vague and not precisely defined way.

Does "*application*" mean "*invention as claimed*" or something else?

Does "*also*" mean that the "*scope (of the invention)*" extends beyond what is claimed?

This deficiency may be corrected by deleting this passage.