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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : F16H 3/093, B60K 17/08

A1

(11) International Publication Number: WO 94/07055

(43) International Publication Date: 31 March 1994 (31.03.94)

(21) International Application Number: PCT/SE93/00761

(22) International Filing Date: 20 September 1993 (20.09.93)

(30) Priority data:
9202722-6 21 September 1992 (21.09.92) SE

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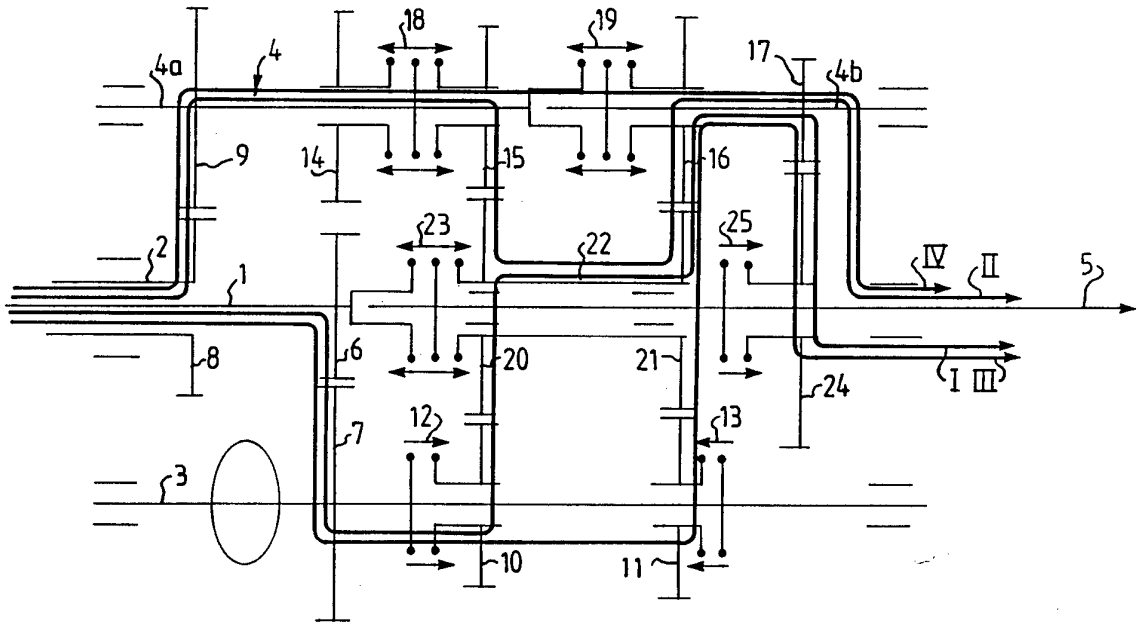
(81) Designated States: BR, JP, RU, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: MOTOR VEHICLE GEARBOX



(57) Abstract

Motor vehicle gearbox of the "power shift" type with two intermediate shafts (3, 4) for alternately transmitting an input torque to an output shaft (5). The intermediate shafts each present a pair of lockable gear wheels (10, 11 and 15, 16, resp.), rotatably mounted on respective shafts and lockable by means of coupling means (12, 13 and 18, 19 resp.), said gear wheels engaging with a pair of gear wheels (20, 21) common for both the intermediate shafts, mounted rotatably on the output shaft and drivably coupled together in order to allow torque transmission from said one intermediate shaft (3) to the other intermediate shaft (4) via either one or both of the common gear wheels (20, 21).

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Motor vehicle gearbox

The present invention relates to a motor vehicle gearbox comprising two intermediate shafts for transmission of an input torque to an output shaft, whereby a first gear wheel, rotatably mounted on each intermediate shaft and lockable by means of coupling means on respective shafts, is in engagement with a common gear wheel rotatably mounted with respect to the output shaft and lockable for rotation together with the output shaft, said gear wheel being arranged to transmit torque from one intermediate shaft to the other in the disengaged position.

Two main types of gearbox of the above mentioned type are known for example from SE 464347 and SE 467426. Both these gearbox types are so-called "power shift" gearboxes in which the torque is transmitted alternately via both the intermediate shafts to the output shaft, which means that whilst the torque is being transmitted by one of the intermediate shafts the next gear is preselected on the other intermediate shaft, whereby gear changing itself occurs in that the first intermediate shaft is disengaged and the other is engaged. This can be achieved either by driving the input shaft of each of the intermediate shafts and alternately engaging the input shafts via a pair of clutches outside the gearbox as shown in the aforementioned SE 464347, or by driving both intermediate shafts from a common input shaft via friction clutches arranged within the gearbox housing as shown in the aforementioned SE 462426.

A characteristic of these known gearboxes is that the torque in a gear stage, namely the lowest gear, is transmitted via both intermediate shafts by means of a

common gear wheel. In this way an additional reduction stage is achieved compared with the torque transmission, via only one intermediate shaft at a time, which allows the possibility of higher gearing in the lowest gear than can otherwise be obtained. Alternatively, for a given gearing, larger gear wheels can be used than with torque transmission via an intermediate shaft. The construction gives an extra gear stage without the gearbox needing to be complemented with additional cooperating gear wheels. The result is a very short and compact gearbox with a large number of gears.

The object of the present invention, starting from the gearbox described in the introduction, is to achieve a compact gearbox with many gear stages and with larger span, that is to say larger separation between the lowest and highest gears than can practically be obtained with the described known gearboxes.

This is achieved according to the invention in that at least a second gear wheel on each intermediate shaft is in engagement with at least a second common gear wheel which is driveably coupled to the first common gear wheel in order to allow torque transmission from said first gear wheel on said first-mentioned intermediate shaft to said second gear wheel on the second intermediate shaft via both the common gear wheels, and in that the second intermediate shaft is divided into two parts rotatable relative to each other, said parts being able to be coupled to each other by coupling means for rotation as a unit.

By creating an additional reduction stage in this way with a second common gear wheel which is smaller than the first common gear wheel, an extremely high gearing can be achieved in the lowest gear. Moreover two additional gears are obtained which, starting from the seven-gear gearbox of

the above described known types, give a compact nine-gear gearbox with larger span than can be achieved in these.

The invention will now be described in more detail with reference to the embodiments shown in the accompanying drawings wherein Fig. 1 and 2 are two identical figures of a schematically represented gearbox with the torque flow depicted on the different gears.

In the figures, numerals 1 and 2 denote two concentrically mounted input shafts, 3 a first intermediate shaft, 4 a second intermediate shaft and 5 and output shaft. One of the input shafts 1 drives the first intermediate shaft 3 via a pair of gear wheels 6 and 7 respectively fixed against rotation on respective shafts. The second input shaft 2 drives the second intermediate shaft 4 via a pair of gear wheels 8 and 9 respectively fixed against rotation on respective shafts. In the shown embodiment it is presumed that both input shafts 1 and 2 are alternately engageable and disengageable respectively by means of friction clutches (not shown in detail), such as shown in SE-A-464347, for alternately driving the intermediate shafts 3, 4.

The first intermediate shaft 3 supports two freely rotatably mounted gear wheels 10 and 11 which are lockable to the intermediate shaft 3 by means of each one's clutch sleeve 12 and 13 respectively. A first, second and third gear wheel 14, 15, and 16 are freely rotatably mounted on the second intermediate shaft 4 which is divided into an input shaft portion 4a and an output shaft portion 4b which are freely rotatably mounted with respect to each other. A fourth gear wheel 17 is fixedly mounted on the intermediate shaft portion 4. The gear wheels 14 and 15 are engageable by means of a clutch sleeve 18 whilst the gear wheel 16 is engageable by means of clutch sleeve 19 which also has an

engagement position in which both the shaft portions 4a and 4b are locked together to be driven as an unit.

The shafts lie in a V-formation and the gear wheel 14 on the intermediate shaft 4 engages with gear wheel 7 on intermediate shaft 3. The gear wheels 10 and 15 on shafts 3 and 4 respectively engage with a first common gear wheel 20 which is rotatably mounted on the output shaft 5 whilst the gear wheels 11 and 16 on the shafts 3 and 4 respectively engage with a second common gear wheel 21 with smaller diameter than gear wheel 20.

The gear wheel 21 is also rotatably mounted on the output shaft 5. In the shown embodiment the gear wheels 20, 21 are fixed onto a common hub 22 which is lockable to the output shaft in an engagement position of the clutch sleeve 23. In another engagement position of the clutch sleeve 23, the input shaft 1 and the output shaft 5 are coupled together for rotation as a unit. An additional gear wheel 24 on the output shaft 5 is rotatably mounted on the shaft and lockable to this by means of a clutch sleeve 25. The gear wheel 24 engages with the gear wheel 17 on the intermediate shaft portion 4b. As an alternative to the shown embodiment, the gear wheel 16 can be fixedly mounted on the shaft portion 4b and the gear wheel 21 can be rotatably mounted as well as being lockable to the hub 22 by clutch means.

The clutch sleeves 12, 13, 18, 19, 23 and 25 can be included in the clutch arrangements which comprise conventional synchronization devices, but the described gearbox is particularly designed to make use of a central synchronization arrangement of the type which is shown and described in the introductory portion of the cited publications.

The gearbox which is shown and described has nine gears, whereby the torque is transmitted to the output shaft 5 alternately between the input shaft 1 and 2, the intermediate shaft 3 and the intermediate shaft portions 4a, 4b, via the following cooperating gear-pairs, as indicated by the arrows I-VIII in the figures:

First	6,7 --> 10,20 --> 21,16 --> 17,24;
Second	8,9 --> 15,20 --> 21,16 --> 17,24;
Third	6,7 --> 11,21 --> 21,16 --> 17,24
Fourth	8,9 --> 17,24;
Fifth	6,7 --> 10,20;
Sixth	8,9 --> 15,20;
Seventh	6,7 --> 11,21;
Eighth	8,9 --> 16,21
Ninth	Direct drive from the input shaft 1 to the output shaft 5 with clutch sleeve 23 in the aforementioned second coupling position
Reverse	6,7 --> 7,14 --> 15,20 --> 21,11 --> 17,24;

From the table above it is clear that the common gear wheels 20, 21 are used at the same time with torque transmission in first and second gears in order to give extra high gearing in these gears by means of the additional reduction stage which is thus obtained. Additionally it is clear that the clutch sleeve 19 has an engagement position in eight gear with which the intermediate shaft portions 4a, 4b are coupled together at the same time as the gear wheel 16 is locked to the axle portion 4b. This is also true correspondingly for the clutch sleeve 18 which in reverse locks both the gear wheel 14 and the gear wheel 15 to the intermediate shaft portion 4a.

The invention has been described above with reference to a preferred embodiment having nine forward gears. Additional

gearing stages can be achieved with more than two common gear wheels according to the described principle.

The invention is of course not limited to a gearbox of the above described type with two input shafts, but can be used in a gearbox with one single input shaft, for example of the type shown in SE-A-467426.

Claims

1. Motor vehicle gearbox, comprising two intermediate shafts for transmission of an input torque to an output shaft, whereby a first gear wheel, rotatably mounted on each intermediate shaft and lockable by means of coupling means on respective shaft, is in engagement with a common gear wheel rotatably mounted with respect to the output shaft and lockable for rotation together with the output shaft, said gear wheel being arranged to transmit torque from one intermediate shaft to the other in the disengaged position, c h a r a c t e r i z e d i n that at least one second gear wheel (11, 16) on each intermediate shaft (3, 4) is in engagement with at least a second common gear wheel (21) which is drivably coupled to the first common gear wheel (20) in order to allow torque transmission from said first gear wheel (10) on said first-mentioned intermediate shaft (3) to said second gear wheel (16) on the second intermediate shaft (4) via both the common gear wheels (20, 21), and in that the second intermediate shaft (4) is divided into two parts (4a, 4b) rotatable relative to each other, said parts being engageable with each other by means of coupling means (19) for rotation as a unit.

2. Gearbox according to claim 1, c h a r a c t e r i z e d i n that the second intermediate shaft (4) comprises an input shaft portion (4a) and an output shaft portion (4b) which, in the shaft portions' disengaged position, allows torque transmission from the input shaft portion to the output shaft portion via the first and second common gear wheel (20 and 21 resp.).

3. Gearbox according to either of claims 1 or 2, c h a r a c t e r i z e d i n that the second common gear wheel (21) has a smaller diameter than the first common gear wheel (20).

4. Gearbox according to any one of claims 1-3, c h a r a c t e r i z e d i n that the second common gear wheel (21) is arranged - when the first common gear wheel (20) is disengaged from the output shaft (5) - to transmit torque via first gear's gearing with a locked first gear wheel (10) on said first intermediate shaft (3) and locked second gear wheel (16) on the second intermediate shaft (4).

5. Gearbox according to any one of claims 1-4, c h a r a c t e r i z e d i n that the second common gear wheel (21) is arranged to - when the first common gear wheel (20) is disengaged from the output shaft - to transmit torque via third gear's gearing with a locked second gear wheel (11, 16) on both the intermediate shafts (3, 4).

6. Gearbox according to any of claims 1-5, c h a r - a c t e r i z e d i n that both the common gear wheels (20, 21) are mounted on a common hub (22) which is rotatably mounted on the upper shaft (5) and lockable to this by means of coupling means (23).

7. Gearbox according to any one of claims 1-6, c h a r a c t e r i z e d i n that coupling means are foreseen, by means of which an input shaft (1) and the output shaft (5) are engageable for torque transmission directly from the input shaft to the output shaft.

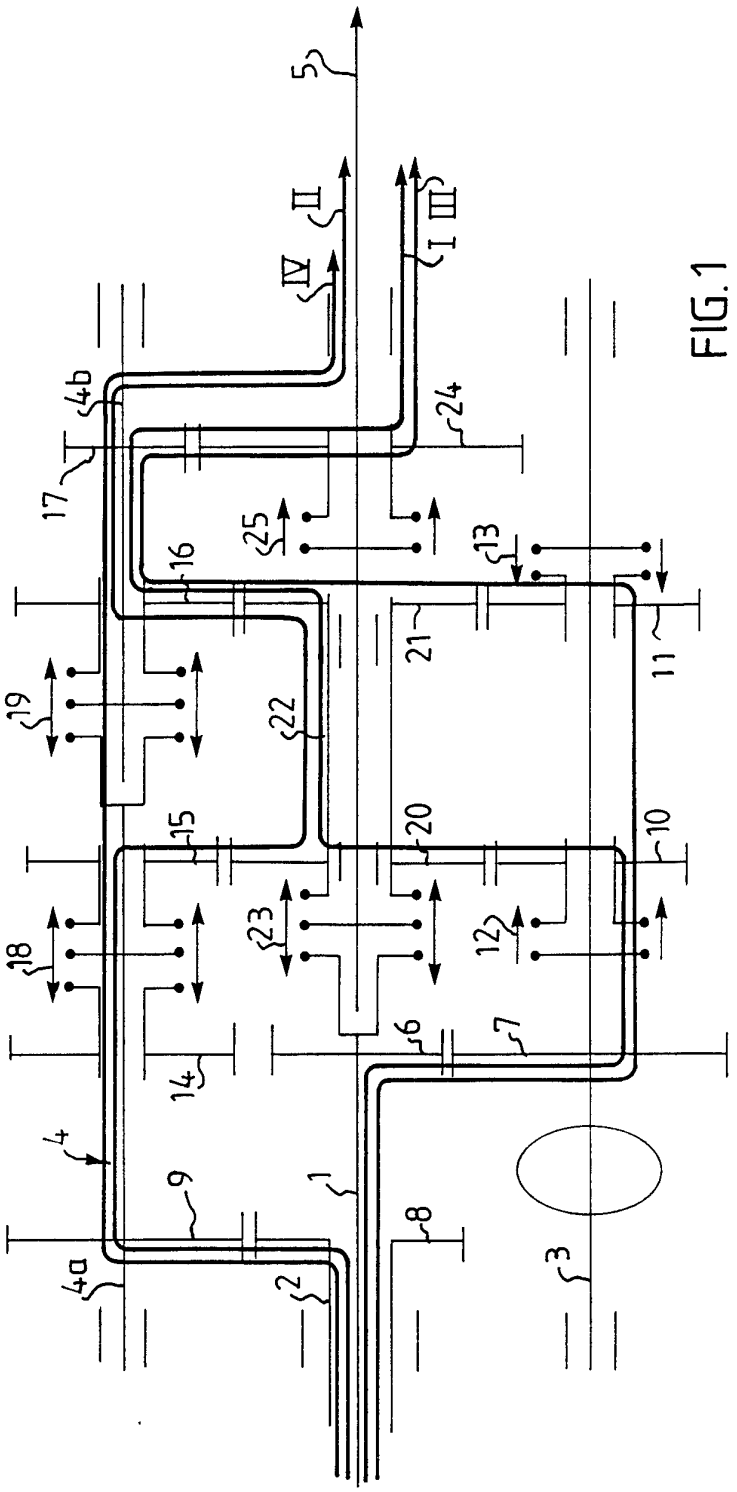
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FIG.1

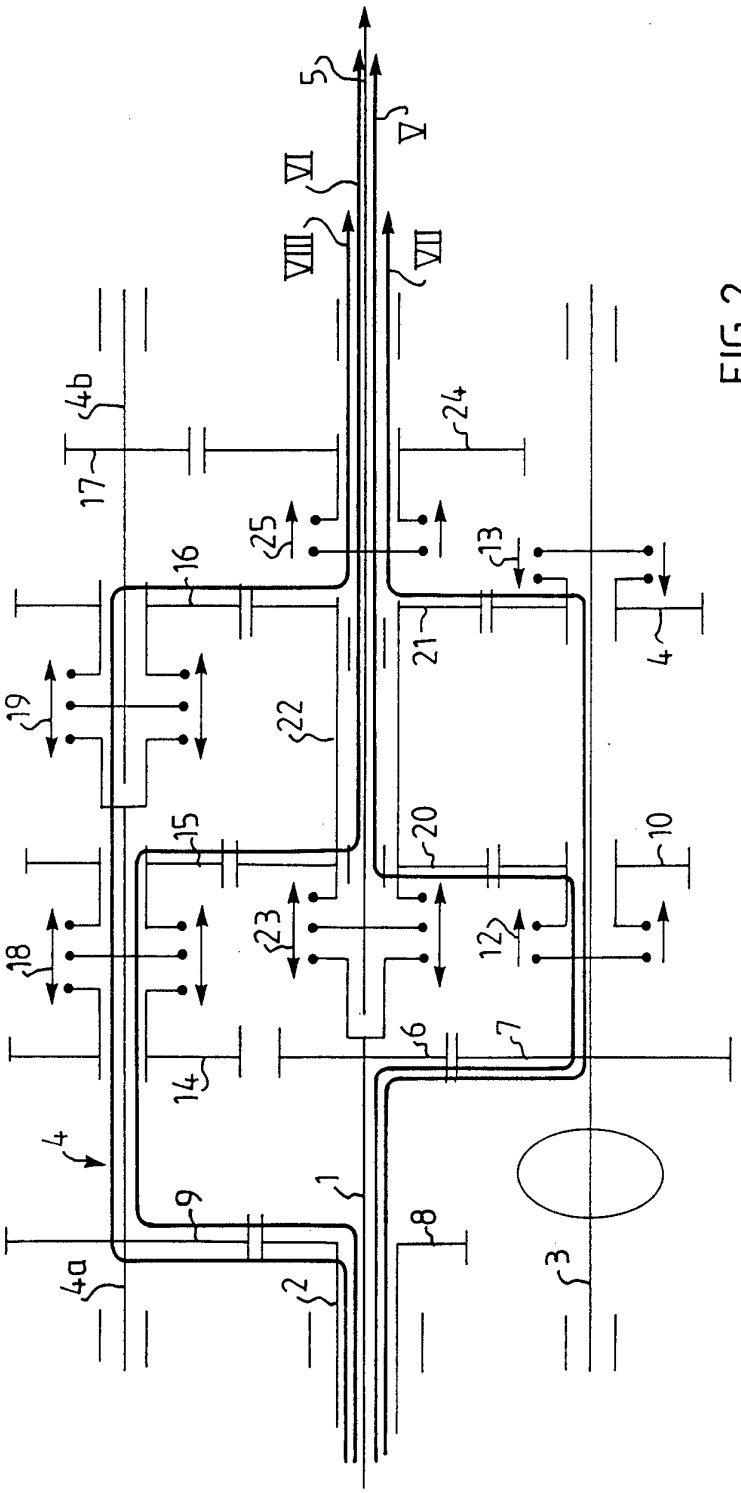
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FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 93/00761

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: F16H 3/093, B60K 17/08
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)

IPC5: F16H, B60K

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4226135 (WINTER), 7 October 1980 (07.10.80) --	1-7
A	SE, B, 433870 (SAAB-SCANIA AB), 18 June 1984 (18.06.84) --	1-7
A	US, A, Re.25458 (E.J. BARTH ET AL)8 October 1963 (08.10.63) -- --------	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

16/10/93

International application No.
PCT/SE 93/00761

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4226135	07/10/80	DE-A,B,C 2736929	22/02/79
		FR-A- 2400645	16/03/79
		JP-A- 54035557	15/03/79
		SE-A- 7808618	17/02/79
SE-B- 433870	18/06/84	SE-A- 8206299	06/05/84