



(51) International Patent Classification:

F16D 23/00 (2006.01) *F16D 11/14* (2006.01)
F16D 11/00 (2006.01) *F16D 23/06* (2006.01)

(21) International Application Number:

PCT/SE2015/050680

(22) International Filing Date:

12 June 2015 (12.06.2015)

(25) Filing Language:

Swedish

(26) Publication Language:

English

(30) Priority Data:

1450840-2 3 July 2014 (03.07.2014) SE

(71) Applicant: SCANIA CV AB [SE/SE]; S-151 87 Södertälje (SE).

(72) Inventors: NORBERG, Peer; Östergatan 5, S-152 43 Södertälje (SE). HÄGGSTRÖM, Daniel; Erikshällsgatan 35, S-151 46 Södertälje (SE). ARNELÖF, Per; Albatrossvägen 5, S-136 66 Vendelsö (SE). FLORÉN, Nicholas; Järnvägsgatan 28 A, S-611 30 Nyköping (SE).

(74) Agent: WALLIN, Ulf; Scania CV AB, 151 87 Södertälje (SE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: LOCKING DEVICE TO LOCK A COGWHEEL ON A SHAFT IN A GEARBOX

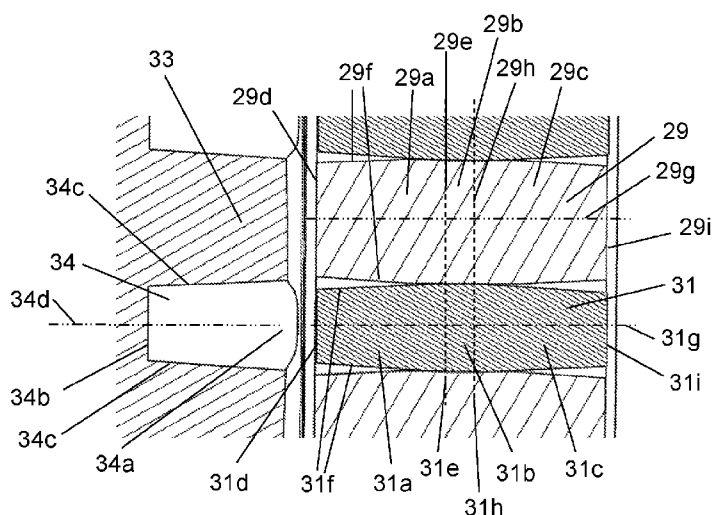


Fig 5

(57) Abstract: The present invention relates to a locking device (21) to lock a cogwheel (15) on a rotatable shaft (11) in a gearbox. The locking device (21) comprises a driver unit (25), a clutch sleeve (26) and a cogwheel unit (27). Each one of the clutch sleeve's teeth (31) comprises a locking part (31a), which is adapted to be inserted into a space (34) between adjacent teeth (33) of the cogwheel unit (27) in a locked state. The locking part (31a) has an extension between a front end (31d), which is adapted to be arranged in connection with an inner end (34b) of the space (34) in the locked state, and a rear end (31e), which is adapted to be arranged in connection with an opening (34a) of the space (34) in the locked state. The locking part (31a) has a width that increases continuously from the front end (31d) to the rear end (31e), and the space (34) has a width corresponding to that of the locking part (31a), both in relation to its size and shape, so that the locking part (31a) fills up substantially the entire width of the space (34) in the locked state.

Locking device to lock a cogwheel on a shaft in a gearbox

5

BACKGROUND OF THE INVENTION AND PRIOR ART

The invention relates to a locking device to lock a cogwheel on a shaft in a gearbox according to the preamble of claim 1.

10

Conventional gearboxes comprise a countershaft, a main shaft, several gear sets, each one of which comprises a cogwheel, which is rotatably arranged on the countershaft, as well as cogwheels, which are arranged on the main shaft. A locking device to lock a cogwheel on the main shaft usually comprises an axially shiftable clutch sleeve, which is in constant engagement with a driver on the main shaft via an axially extending toothed section comprising teeth and intermediate spaces. The clutch sleeve therefore rotates with the same rotational speed as the driver and the main shaft. When the clutch sleeve is shifted from an initial state to a locked state, the clutch sleeve's toothed section also engages with a toothed section of the cogwheel on the main shaft. The clutch sleeve thus establishes a rotationally fixed connection between the driver and the cogwheel, in such a way that the cogwheel obtains a rotational locking on the main shaft.

15

20

25

30

35

One prior art method, ensuring that the clutch sleeve remains in the locked state when a driving torque is transmitted via the rotationally locked cogwheel, is to adapt the clutch sleeve's axial teeth and the driver's axial teeth with oblique contact surfaces. In the case when the driver transmits a driving torque to the clutch sleeve, a force is created with the help of the oblique contact surfaces retaining the clutch sleeve in the locked state. Another prior art method is to supply the clutch sleeve's teeth with a central section, protruding a short distance in a radial direction. Thus, this section comes into contact with a front end surface of the driver's teeth when a torque is transferred in the gearbox, which ensures that the clutch sleeve is retained in the locked state. In both the prior art methods, spaces, which are wider than the teeth of the clutch sleeve, must be created between the driver's axial teeth and the cogwheel's axial teeth. Accordingly, a play is obtained when the torque in the gearbox changes direction. The

two methods also require that the clutch sleeve has relatively long axial teeth, which increases the total length of the gearbox.

SUMMARY OF THE INVENTION

5

The objective of the present invention is to provide a locking device, which, in an efficient manner, prevents that a clutch sleeve is shifted from a locked state while it occupies a relatively small axial space, and which facilitates the establishment of a connection, substantially free from play, in the gearbox.

10

This objective is achieved with the arrangement of the type specified at the beginning, which is characterised by the features specified in the characterising portion of claim 1. The clutch sleeve's teeth comprise a locking part, which is adapted to be inserted into a space between adjacent teeth of the cogwheel unit in the locked state. The locking part has a width which increases continuously from a front end to a rear end. The locking part may thus be described as wedge-shaped. The space between the teeth of the cogwheel unit has a width that increases continuously from an inner end to an opening for receipt of the locking part. The spaces between the cogwheel unit's teeth may thus also be described as wedge-shaped. The front end, which thus constitutes the least wide section of the locking part, is first inserted into the space via the opening defining the widest section of the space. It is therefore easy to insert the locking part into the space when the clutch sleeve and the cogwheel have a synchronous rotational speed. If and when needed, the wedge-shaped space centres the locking part during the insertion process, so that it obtains a correct position in the recess when it reaches the fully inserted state in the space. The fully inserted state is referred to as a locked state. Since the space has a width corresponding to the width of the locking part, both in respect of size and shape, the locking part fills substantially the entire width of the space in the locked position. Accordingly, substantially no play arises when the torque in the gearbox changes direction. Such a locking part functions well, even if it is rather short. The locking part thus occupies a relatively small axial space in the gearbox.

20

25

30

35

According to one embodiment of the present invention, the locking part has a width that increases in a linear manner from the front end to the rear end. The width of the locking part may be defined by two plane side surfaces. Accordingly, the locking part obtains a relatively simple shape. It is possible, however, to provide a locking part with a width that increases successively from the front end to the rear end in a non-linear

manner. In such case, the side surfaces may have a more or less curved shape. The locking part may have a width that is defined by two side surfaces, which are symmetrically arranged on opposite sides of a longitudinal central axis through the respective teeth. The locking part thus provides a symmetrical shape, which further

5 improves the feature of inserting the locking part into the space when the clutch sleeve and the cogwheel have a substantially synchronous rotational speed. With a symmetrical shape of the locking part, the manufacturing process of the clutch sleeve's teeth is also simplified.

10 According to one embodiment of the present invention, the clutch sleeve's teeth comprise a basic part, which is adapted to remain in a space between two adjacent teeth of the driver unit in the locked state, and the basic part comprises at least one side surface, which is located at a distance from a longitudinal central axis through the
15 respective teeth, so that the distance of the side surface to the longitudinal central axis continuously decreases from a front end to a rear end of the basic part. Such a side surface obtains a gradient, so that a torque transmitted from the driver's teeth results in a force that strives to retain the locking part in the locked state. Since the inclined side surface extends along the entire basic part, the basic part may be made rather short. The basic part thus occupies a relatively small axial space in the gearbox. The basic
20 part may have an axial extension corresponding to that of the locking part.

According to one embodiment of the present invention, the basic part comprises two side surfaces, which are symmetrically arranged on opposite sides of a longitudinal central axis through the respective teeth. Accordingly, two inclined side surfaces are
25 obtained, whereat one of the side surfaces transmits said force retaining the locking part in the locked state when a positive torque is transmitted in the gearbox, and a second side surface transmits said force retaining the locking part in the locked state when a negative torque is transmitted in the gearbox.

30 According to one embodiment of the present invention, the clutch sleeve's teeth comprise an intermediate part, which is arranged between the locking part and the basic part. This intermediate part may be used to bridge the required play, which must exist between the clutch sleeve and the cogwheel unit in order for them to rotate at different speeds. Advantageously said play, and thus the intermediate part, has a
35 relatively small axial extension. The intermediate part may have a substantially

constant width. The intermediate part may constitute the widest part of the teeth in the clutch sleeve.

5 According to one embodiment of the present invention, the driver unit's teeth comprise a front part, having a width defined by two side surfaces having an angle in relation to a longitudinal central axis through the respective teeth, so that the front part has a width increasing continuously from a front end to a rear end. The two side surfaces advantageously have angles corresponding to the inclined side surfaces of the basic part of the clutch sleeve's teeth. Accordingly, the entire side surface of the front part of
10 the driver's teeth may come into contact with an entire side surface of the rear part of the clutch sleeve's teeth when a torque is transmitted in the gearbox. Accordingly, loads on specific points on the teeth are avoided.

15 According to one embodiment of the present invention, the driver unit's teeth comprise a rear part, having a width defined by two side surfaces having an angle in relation to a longitudinal central axis through the driver unit's teeth, so that the rear part has a width decreasing continuously from a front end to a rear end. In this case, the rear part of the driver's teeth has a design corresponding to the front part of the driver unit's teeth. In some cases, two-directional locking devices are used. In such case, the cogwheel units
20 are arranged on both sides of a clutch sleeve. The clutch sleeve may in this case be shifted in one axial direction, from an initial state to a locked state for one of the cogwheel units, and in an opposite axial direction to a locked state for the second cogwheel unit. A rear part with the above mentioned design in this case functions like a front part, when a cogwheel unit on the opposite side must provide a rotational
25 locking. If the locking device is one-directional, the rear part may have any shape. It may, in such case, have a constant width.

30 According to one embodiment of the present invention, the driver unit's teeth comprise an intermediate part, arranged between the front end and the rear end. The intermediate part may have a substantially constant width. The intermediate part may constitute the widest section of the driver's teeth. The intermediate section of the driver unit's teeth may have an axial extension corresponding to the extension of the intermediate section of the clutch sleeve's teeth.

35 The intermediate parts may constitute the contact surface between the driver's teeth and the clutch sleeve's teeth, when the clutch sleeve's teeth are in the initial, load free, state.

BRIEF DESCRIPTION OF THE DRAWINGS

Below, as an example, a preferred embodiment of the invention is described with reference to the enclosed drawings, on which:

5

Fig. 1 shows a gearbox, which is equipped with a locking device according to the present invention,

Fig. 2 shows a side view of the locking device,

Fig. 3 shows the locking device's component parts in a separated state,

10 Fig. 4 shows the locking device's component parts in an initial state,

Fig. 5 shows a section view of a connecting area between the component parts, when they are in the initial state,

Fig. 6 shows the locking device's component parts in an intermediate state,

Fig. 7 shows a section view of the connecting area between the component parts,

15 when they are in the intermediate state,

Fig. 8 shows the locking device's component parts in a locked state and

Fig. 9 shows a section view of the connecting area between the component parts, when they are in the locked state.

20 DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Fig. 1 shows a gearbox that may be arranged in a schematically drawn vehicle 1. The vehicle 1 may be a heavy goods vehicle. The gearbox is attached inside a house 2, containing gearbox oil. The gearbox comprises an input shaft 3, which is operated by a non-displayed combustion engine. The gearbox comprises a countershaft 4, which is equipped with several cogwheels 5-10 of various dimensions. The cogwheels 5-10 are rotatably arranged on the countershaft 4. The gearbox comprises a main shaft 11, which is equipped with several cogwheels 12-17 rotatably arranged on the main shaft 11. The cogwheels 5-10 constitute primary cogwheels and the cogwheels 12-17 constitute secondary cogwheels of the gear sets, arranged in engagement with each other in the gearbox. The gearbox is equipped with a split gear, which in a first split state connects the input shaft 3 with the countershaft 4 via a first gear set 5, 12. In a second split state, the input shaft 3 is connected with the countershaft 4 via a second gear set 6, 13. The countershaft 4 thus provides a rotation movement in both the split states of the input shaft 3. The second gear set 6, 13 also provides a gearing, which

defines the third gear in the gearbox. The gearbox also comprises a third gear set 7, 14 defining the second gear in the gearbox, a fourth gear set 8, 15 defining the first gear in the gearbox, a fourth gear set 9, 16 defining a crawling gear and a sixth gear set 10, 17 defining a reverse gear. The gear set 10, 17 for the reverse gear comprises an interim cogwheel, which provides a reverse rotational direction of the main shaft 11.

The secondary cogwheels 12-17 are arranged in a rotatable manner on the main shaft 11 or on the input shaft 3 with the help of a bearing 18, which may be a needle bearing. Locking devices 19-21a, are, according to the invention, arranged in connection with the secondary cogwheels 12-17 on the main shaft 11. The task of each of the locking devices 19-21a is to achieve a rotational locking on the main shaft 11 of at least one of the secondary cogwheels 12-17 in connection with engaging a gear. A first locking device 19 is comprised in the split gear, where its task is to set the different split states, so that it connects the input shaft 3 with the countershaft 4 in the gearbox, via the first gear set 5, 12 in the first split state, and via the second gear set 6, 13 in the second split state. A second locking device 20 is adapted to be responsible for the rotational locking of the secondary cogwheels 13, 14 for the second and third gears. A third locking device 21 is adapted to be responsible for rotational locking of the secondary cogwheel 15 for the first gear. A fourth locking device 21a is adapted to be responsible for the rotational locking of the secondary cogwheels 16, 17 for the crawling gear and the reverse gear. The gearbox also comprises a range gear 22, which is arranged between the main shaft 11 and an output shaft 23 in the gearbox. With the help of a range gear 22, all ordinary gears in the gearbox may be provided with a high and a low gearing, respectively. Accordingly, the gearbox may obtain twice as many gears. A control device 24a is adapted to activate a manoeuvring locking device 24b, which controls the activation of the locking devices 19-21 during a shifting process in the gearbox.

Fig. 2 shows a side view of an embodiment of a one-directional locking device, corresponding to the locking device 21. Fig. 3 shows the locking device's 21 component parts in a separated state. Fig. 3 also shows a section view of the component parts in an A-A plane defined in Fig. 2. The locking device 21 comprises, in this case, three components, namely a driver unit 25, a clutch sleeve 26 and a cogwheel unit 27. The driver unit 25 comprises a radially internally toothed section 28, with which it is rotatably connected to a toothed section 11a on the main shaft 11. The driver unit 25 thus rotates continuously with the same speed as the main shaft 11. The driver unit 25 comprises a second toothed section, consisting of outwardly directed

teeth 29 and intermediate spaces 30 with an axial extension. The clutch sleeve 26 comprises a toothed section with inwardly directed teeth 31 and intermediate spaces 32 with an axial extension. The toothed section 31, 32 of the clutch sleeve 26 is rotatably connected to the toothed section 29, 30 of the driver unit 25. The clutch sleeve 26 therefore rotates continuously with the same speed as the driver unit 25 and the main shaft 11. Since the driver unit's 25 toothed section and the clutch sleeve's 26 toothed section comprise interacting teeth 29, 31 and intermediate spaces 30, 32 with an axial extension, the clutch sleeve 26 may be shifted in an axial direction in relation to the driver unit 25. The cogwheel unit 27 comprises the secondary cogwheel 15 and a side part which is equipped with a toothed section, consisting of outwardly directed teeth 33 and intermediate spaces 34 with an axial extension. The toothed sections of the driver 25, the clutch sleeve 26 and the cogwheel unit 27 have the same number of axial teeth 29, 31, 33 and intermediate spaces 30, 32, 34. They are also arranged at a corresponding radial distance from a longitudinal central axis 11b of the main shaft 11. The clutch sleeve 26 may be shifted in an axial direction in relation to both the driver unit 25 and the cogwheel unit 27.

Fig. 4 shows the component parts 25-27 in an initial state. In this case the driver unit 25 is not visible, since it is arranged radially inwardly of the clutch sleeve 26. The driver unit 25 and the clutch sleeve have the same extension in an axial direction. The driver unit 25 and the clutch sleeve 26 are arranged at a smaller radial distance from the toothed section 33, 34 of the cogwheel unit 27. The cogwheel unit 27 and the cogwheel 15 may thus rotate freely in relation to the clutch device 26, the driver unit 25 and the main shaft 11. Fig. 5 shows a detailed section of the connecting area between the components 25, 26, 27 when they are in the initial state. The axial teeth 29 of the driver unit 25 have a front part 29a, an intermediate part 29b and a rear part 29c. The front part 29a has an extension, between a front end 29d in the form of a plane end surface and a rear end 29e, indicated with a dashed line in the figures. The teeth 29 have side surfaces 29f with a symmetrical extension in relation to a central longitudinal axis 29g through the teeth 29. The distance of the side surfaces 29f to the central axis 29g increases continuously from the front end 29a to the rear end 29e. The width of the teeth 29 thus increases continuously from the front end 29a to the rear end 29e. The intermediate part 29b has an extension between the rear end 29e of the front part 29a and a front end 29h of the rear part 29c. The distance of the side surfaces 29d to the central axis 29e is here constant. The teeth 29 thus have a constant width in the intermediate part 29b. The rear part 29c has an extension between the front end 29h

and a rear end 29i. The distance of the side surfaces 29f to the central axis 29g decreases continuously from the front end 29h to the rear end 29i. The width of the teeth 29 thus decreases continuously from the front end 29h to the rear end 29i.

- 5 The axial teeth 31 of the clutch sleeve 26 have a locking part 31a, an intermediate part 31b and a basic part 29c. The locking part 31a has an extension between a front end 31d in the form of a plane end surface, and a rear end 31e indicated with a dashed line. The teeth 31 have side surfaces 31f with a symmetrical extension in relation to a central longitudinal axis 31g through the teeth 31. The distance of the side surfaces 31f to the central axis 31g increases continuously from the front end 31a to the rear end 31e. The width of the teeth 31 thus increases continuously from the front end 31a to the rear end 31e. The intermediate part 31 has an extension between the rear end 31e of the locking part 31a, and a front end 31h of the basic part 31c. The distance of the side surfaces 31d to the central axis 31g is constant. The teeth 31 thus have a constant width in the intermediate part 31b. The rear part 31c has an extension between a front end 31f, indicated with a dashed line, and a rear end 31i in the form of a plane end surface. The distance of the side surfaces 31f to the central axis 31g decreases continuously from the front end 31f to the rear end 31i. The width of the teeth 31 thus decreases continuously from the front end 31f to the rear end 31i. The axial teeth 33 of the cogwheel unit 27 define an intermediate space 34, which comprises an opening 34a, a bottom surface 34b and side surfaces 34c. The axial distance from the opening 34a to the bottom surface 34b corresponds to the axial length of the locking part 31a. The distance of the side surfaces 34c to a central longitudinal axis 34d in the space 34 increases continuously from the bottom surface 34a to the opening 34a. The width of the space 34 thus increases continuously from the bottom surface 34b to the opening 34a.

- When the cogwheel 15 provides a rotational locking on the main shaft 11, initially a synchronous rotational speed is created between the cogwheel 15 and the main shaft 11. During an up-shifting process, the control device 24a may activate a non-displayed braking device, which provides a deceleration of the countershaft 4 until the cogwheel 15 obtains a synchronous rotational speed with the main shaft 11. During a downshift process, a drive engine is activated, which provides an acceleration of the countershaft 4, via the input shaft 3 to the gearbox, until the cogwheel 15 obtains a synchronous rotational speed with the main shaft 11. The control device 24a may subsequently activate the manoeuvring locking device 24b, which may comprise a pneumatic

cylinder, in charge of the shifting motion of the clutch sleeve 26 from the initial state to a locked state.

Fig. 6 and 7 show the clutch sleeve just after said shifting motion has started. The driver unit 25 is in its fixed axial state, while the clutch sleeve 26 has started its axial shifting motion. The front end 31d of the locking part 31a in the teeth 31 of the clutch sleeve thus has a smaller width than the opening of the recess 34a of the cogwheel unit 37. It is therefore generally not difficult to insert the locking part 31a into an opening 34a between the teeth 33 of the cogwheel unit 37 when a synchronous rotational speed has been achieved. Since the recess 34 has side surfaces 34c that are inclined in relation to the longitudinal central axis 34d, the side surfaces 34c provide, where needed, a successive centring of the front end 31d of the locking part 31a during the shifting motion in the space 34.

Fig. 8 and 9 show the teeth 31d of the clutch sleeve, when the front end 31d of the locking part 31a has reached an inner end 34b, which is defined by an internal end surface in the space 34. The locking part is now in a locked state. Since the space 34 and the locking part 31d have a corresponding width, the locking part 31a fills substantially the entire width of the space 34 in the locked state. Accordingly, substantially no play is obtained in the locking device 21 in the connection between the clutch sleeve 26 and the cogwheel unit 27. The intermediate part 31b has an axial length, which substantially corresponds to the axial distance between the driver 25 and the cogwheel unit 27. The basic part 31c of the clutch sleeve remains in the recess 30 between the driver unit's teeth 29. The basic part 31c of the clutch sleeve has side surfaces 31f with a gradient corresponding to the side surfaces 29f of the driver's front part 29a. Thus, a torque may be transmitted from the driver 25 to the clutch sleeve 26 via said side surfaces 29f, 31f. When the driver's teeth 29 transmit a torque to the teeth 31 of the clutch sleeve via said side surfaces 29f, 31f, a force is obtained, retaining the teeth 31 of the clutch sleeve in the locked state in the recess 34. The rear part 29c of the driver in this case has a shape corresponding to the front part 29a. The locking device 21 may in this case be double acting, if it is arranged between two cogwheels, as is the case with the locking devices 19, 20.

The locking devices 19-21 may, in addition to the function of providing a rotational locking of the secondary cogwheels 12-15 on the main shaft 11, also have the function to synchronise the secondary cogwheels' rotational speed with the rotational speed of

the main shaft 11, before the secondary cogwheels provide a rotational locking on the main shaft 11. In this case, the driver unit 25 comprises a driver and a non-displayed latch cone, comprising a conically shaped friction surface. The latch cone in this case comprises the axial teeth 29 of the driver unit 25. The synchronisation cone may be
5 connected in a rotatably locked manner with the driver, via a toothed connection, so that they rotate as one unit. The cogwheel unit 27 comprises the cogwheel 15 and a non-displayed clutch cone with a conically shaped friction surface. The clutch cone may be connected in a rotatably locked manner with the cogwheel, via a toothed connection, so that they rotate as one unit. The clutch cone in this case comprises the
10 axial teeth 33 of the cogwheel unit 27.

When a gear is to be engaged in the gearbox, in this case the clutch sleeve 26 is shifted in an axial direction, from an initial state to a synchronising state, wherein the latch cone's conical friction surface goes into engagement with the clutch cone's conical
15 friction surface. Thus, the clutch cone and the latch cone obtain a synchronous rotational speed relatively soon. When the synchronous rotational speed has been achieved, the clutch sleeve 26 may be shifted further along to the locked state, wherein the toothed section 31, 32 of the clutch sleeve's 26 creates a rotatable connection between the driver unit 25 and the clutch cone's toothed section 33, 34 so that the
20 cogwheel 15 obtains a rotational locking on the main shaft 11.

The invention is not limited to the embodiment described above, but may be varied freely within the scope of the patent claims.

Claims

1. Locking device (21), to lock a cogwheel (15) on a rotatable shaft (11) in a gearbox, wherein the locking device (21) comprises

- 5 - a driver unit (25) comprising a connection (28, 11a), rotatably locked with the rotatable shaft (11) so that they rotate with a joint rotational speed, and a toothed section, which comprises teeth (29) with intermediate spaces (30) having an axial extension in relation to the shaft (11),
- a clutch sleeve (26) comprising a toothed section, which comprises teeth (31) with intermediate spaces (32), having with an axial extension in relation to the shaft (11),
10 wherein the clutch sleeve's toothed section (31, 32) is adapted to be in constant engagement with the driver's toothed section (29, 30) and
- a cogwheel unit (27) comprising a toothed section with teeth (33) with intermediate spaces (34), having an axial extension in relation to the shaft (11),
- 15 wherein the clutch sleeve (26) is shiftably arranged in an axial direction between an initial state, wherein the clutch sleeve's toothed section (29, 30) is in engagement only with the driver unit's toothed section (31, 32), and a locked state, wherein the clutch sleeve's (26) toothed section (31, 32) is in engagement with both the driver unit's toothed section (29, 30) and the cogwheel unit's toothed section (33, 34), characterised
20 in that each one of the clutch sleeve's teeth (31) comprises a locking part (31a), which is adapted to be inserted into a space (34) between adjacent teeth (33) of the cogwheel unit (27) in the locked state, wherein said locking part (31a) has an extension between a front end (31d), which in the locked state is adapted to be arranged in connection with an inner end (34b) of the space (34), and a rear end (31e), which in the locked
25 state is adapted to be arranged in connection with an opening (34a) of the space (34), and wherein the locking part (31a) has a continuously increasing width from the front end (31d) to the rear end (31e), and in that the space (34) has a width corresponding to that of the locking part (31a) both in relation to its size and shape, so that the locking part (31a) fills up substantially the entire width of the space (34) in the locked state.

30 2. Locking device according to claim 1, characterised in that the locking part (31a) comprises two side surfaces (31f) defining the width of the locking part, and in that said side surfaces (31f) have a mutual inclination, so that the width of the locking part increases linearly from the front end (31d) to the rear end (31e).

3. Locking device according to claim 2, characterised in that the two side surfaces (31f) of the locking part (31a) are symmetrically arranged on opposite sides of a longitudinal central axis (31g) through the respective teeth (31).

5 4. Locking device according to any of the previous claims, characterised in that the clutch sleeve's teeth (31) comprise a basic part (31c), which is adapted to remain in a space (30) between two adjacent teeth (29) of the driver unit (25) in the locked state, and in that the basic part (31c) comprises at least one side surface (31f), which is located at a distance from a longitudinal central axis (31g) through the respective teeth
10 (31), so that the distance of the side surface to the central axis (31g) continuously decreases from a front end (31h) to a rear end (31i) of the basic part (31c).

5. Locking device according to claim 4, characterised in that the basic part (31a) comprises two side surfaces (31f), which are symmetrically arranged on opposite sides
15 of a longitudinal central axis (31g) through the respective teeth (31).

6. Locking device according to claim 5, characterised in that the teeth (31) of the clutch sleeve comprise an intermediate part (31b), which is arranged between the locking part (31a) and the rear part (31c).
20

7. Locking device according to claim 6, characterised in that the intermediate part (31b) has a substantially constant width.

8. Locking device according to any of the previous claims, characterised in that the
25 teeth (29) of the driver unit (25) comprise a front part (29a), with a width that is defined by two side surfaces (29f) having an angle in relation to a longitudinal central axis (29g) through the respective teeth (29), so that the front part (29a) obtains a width that increases continuously from a front end (29d) to a rear end (29e).

9. Locking device according to any of the previous claims, characterised in that the
30 driver's teeth (29) comprise a rear part (29c) which has a width defined by two side surfaces (29f) that have an angle in relation to a longitudinal central axis (29g), so that the rear part (29c) has a width that decreases continuously from a front end (29h) to a rear end (29i).
35

10. Locking device according to claim 8 or 9, characterised in that the driver's teeth (29) comprise an intermediate part (29b), which is arranged between the front part (29a) and the rear part (29c).

5 11. Locking device according to claim 10, characterised in that the intermediate part (29b) has a substantially constant width.

10 12. Locking device according to any of the previous claims, characterised in that the driver unit (25) comprises a driver that is in constant engagement with the shaft (11) and a first synchronisation device comprising the toothed section (29, 30) of the driver unit, and in that the cogwheel unit (27) comprises a cogwheel (15) and a second synchronisation device, comprising the toothed section (33, 34) of the cogwheel unit.

15 13. Gearbox comprising a locking device according to any of claims 1 to 10.

14. Vehicle comprising a gearbox according to claim 13.

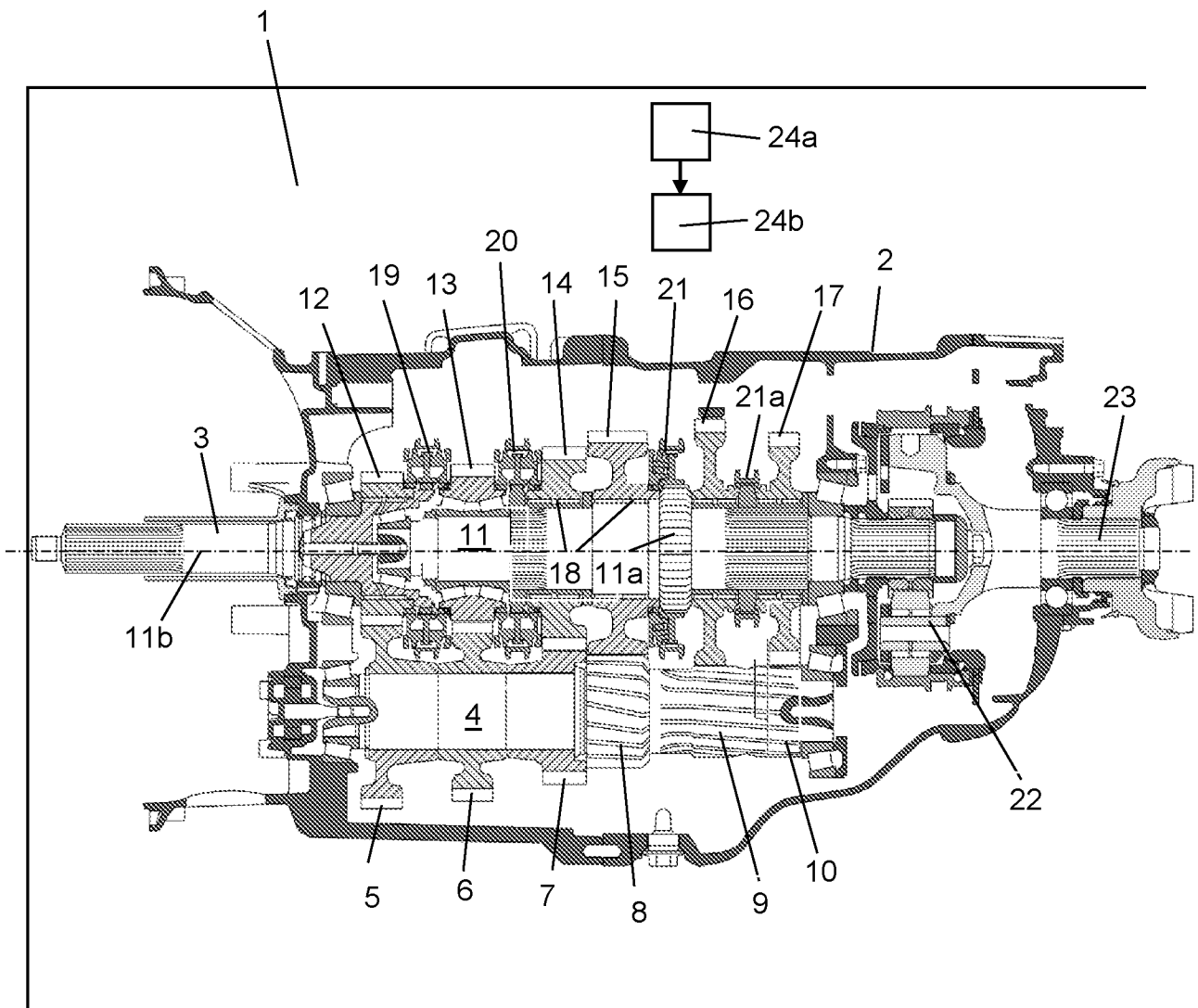


Fig 1

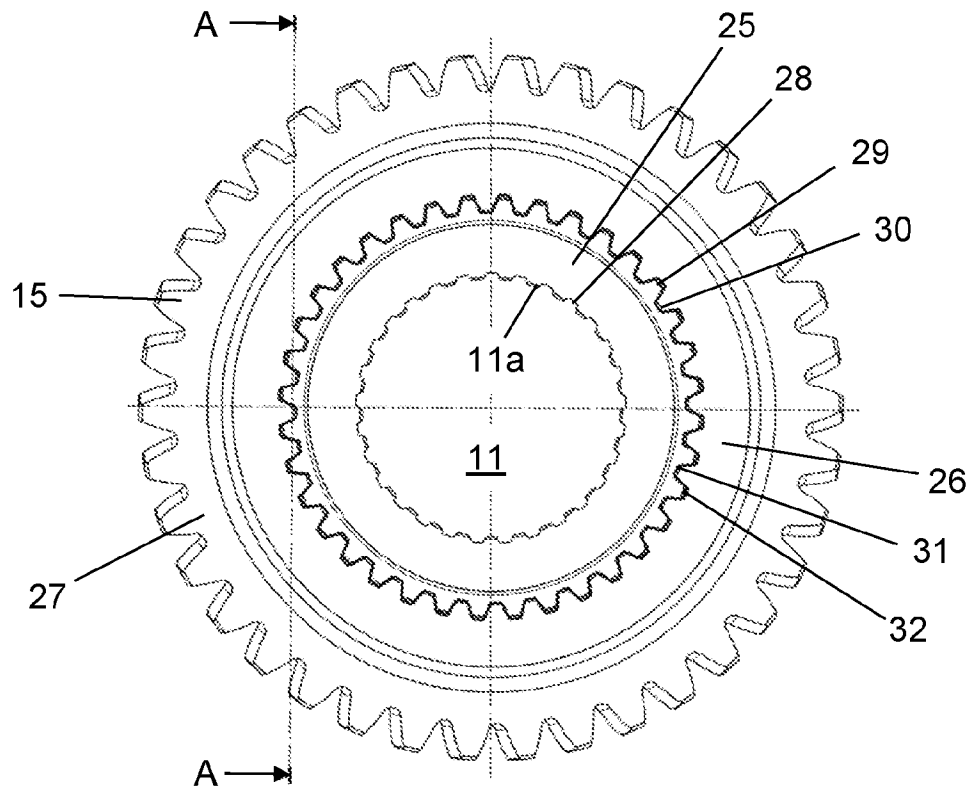


Fig 2

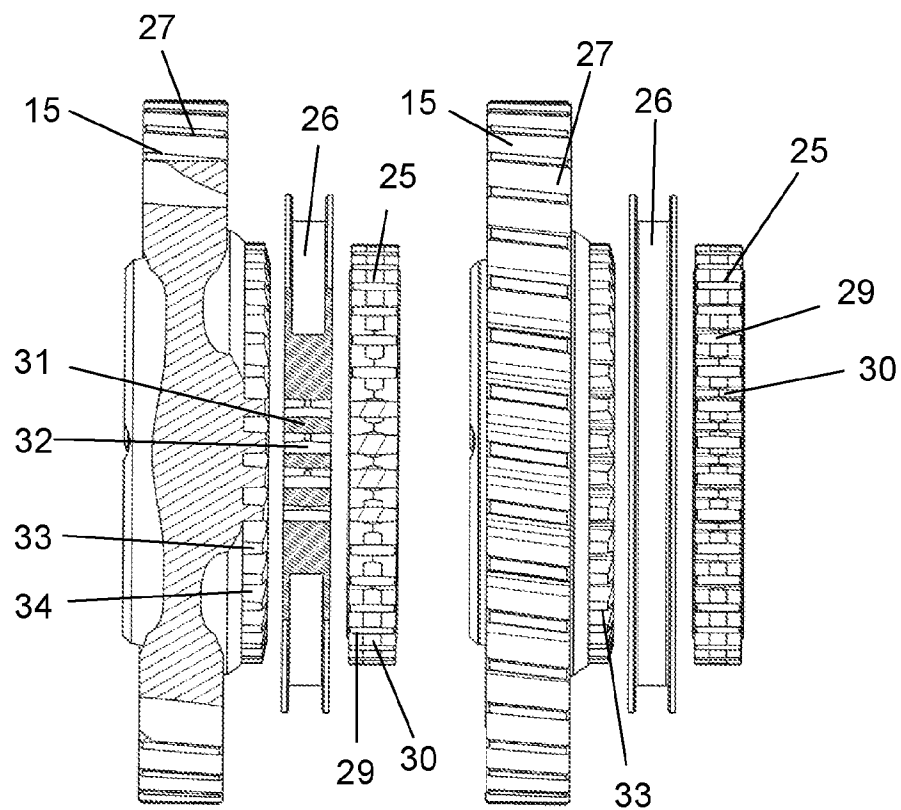


Fig 3

3/5

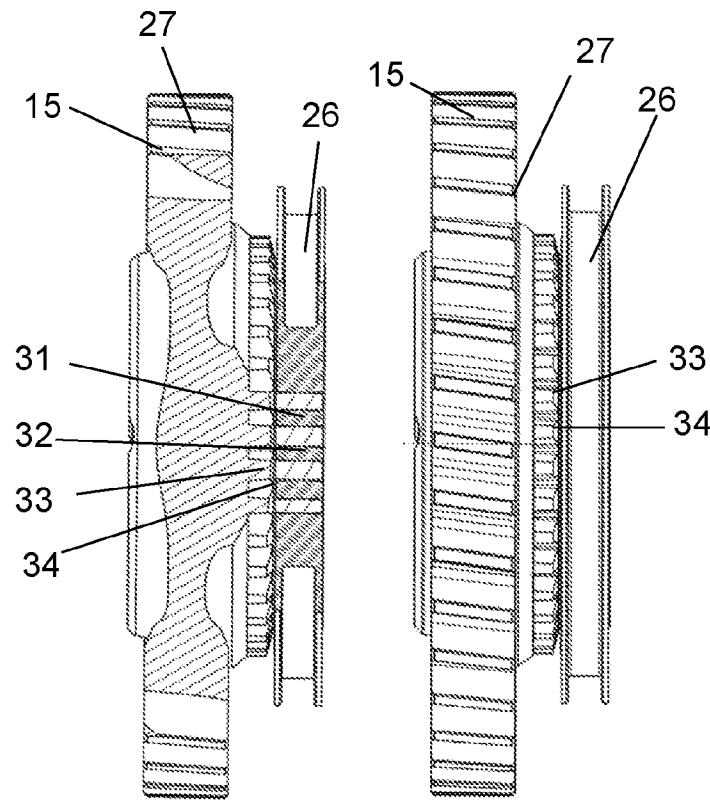


Fig 4

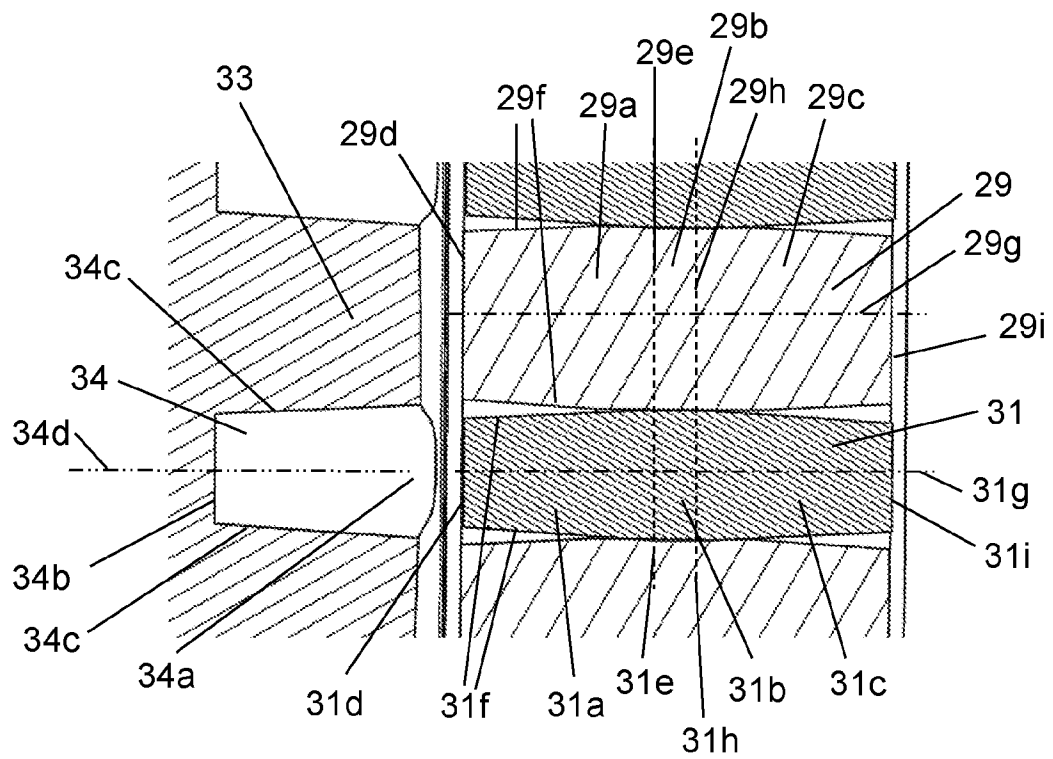


Fig 5

4/5

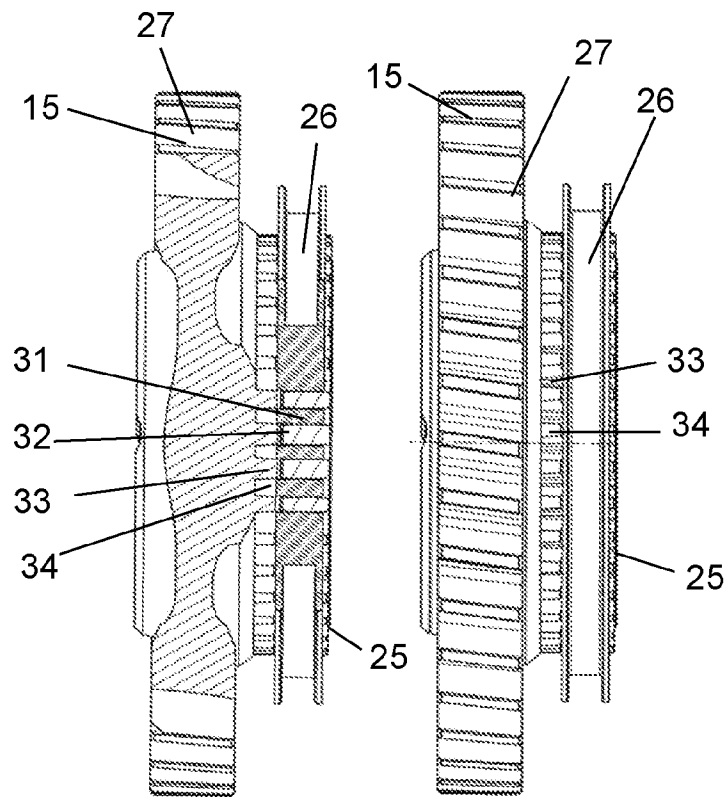


Fig 6

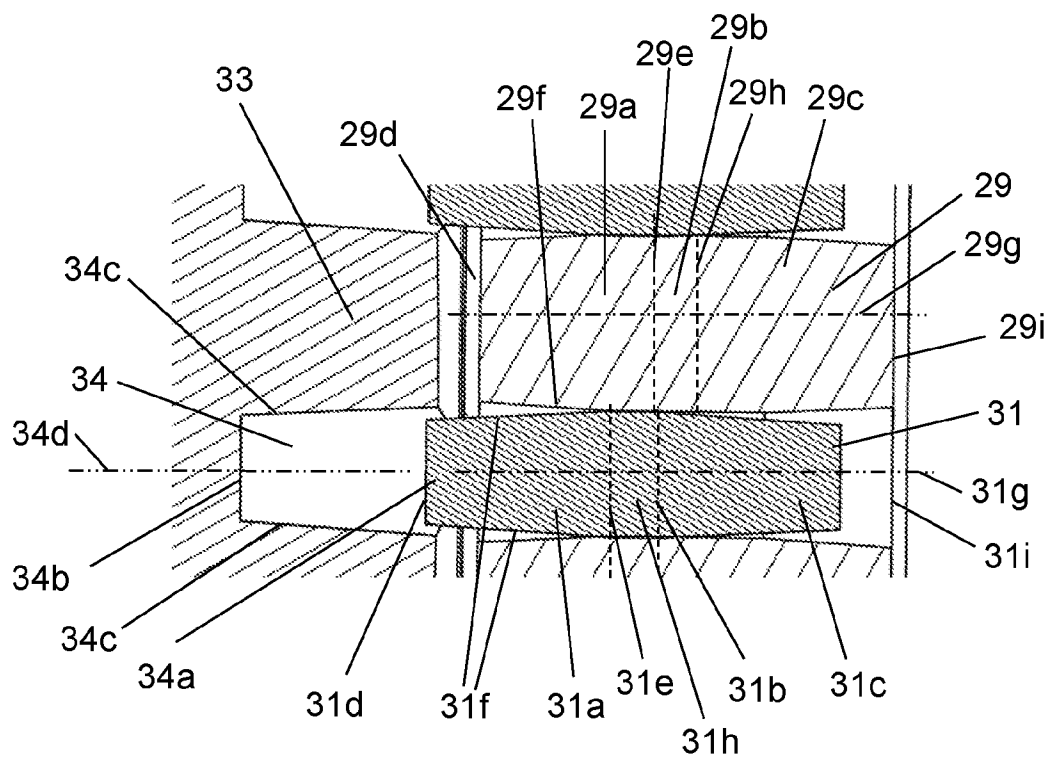


Fig 7

5/5

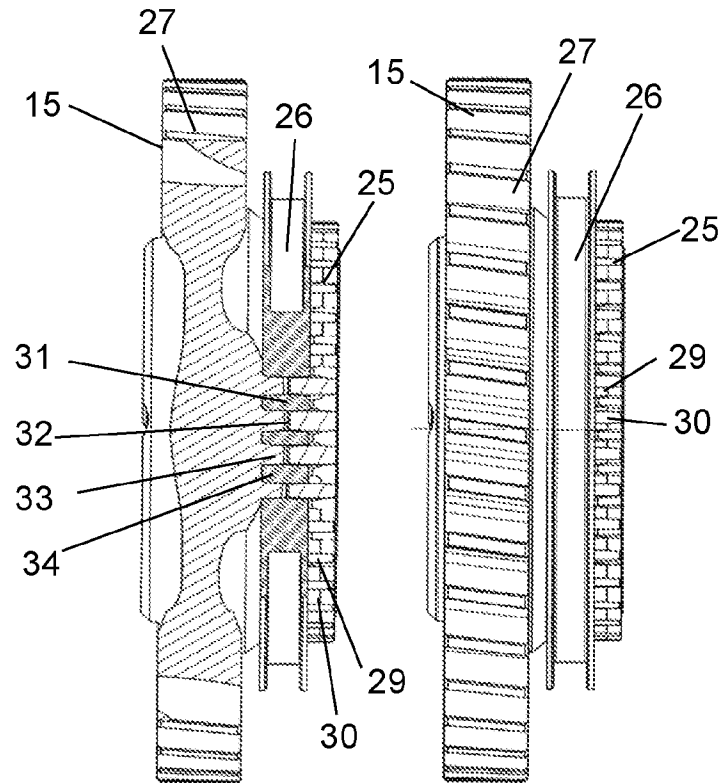


Fig 8

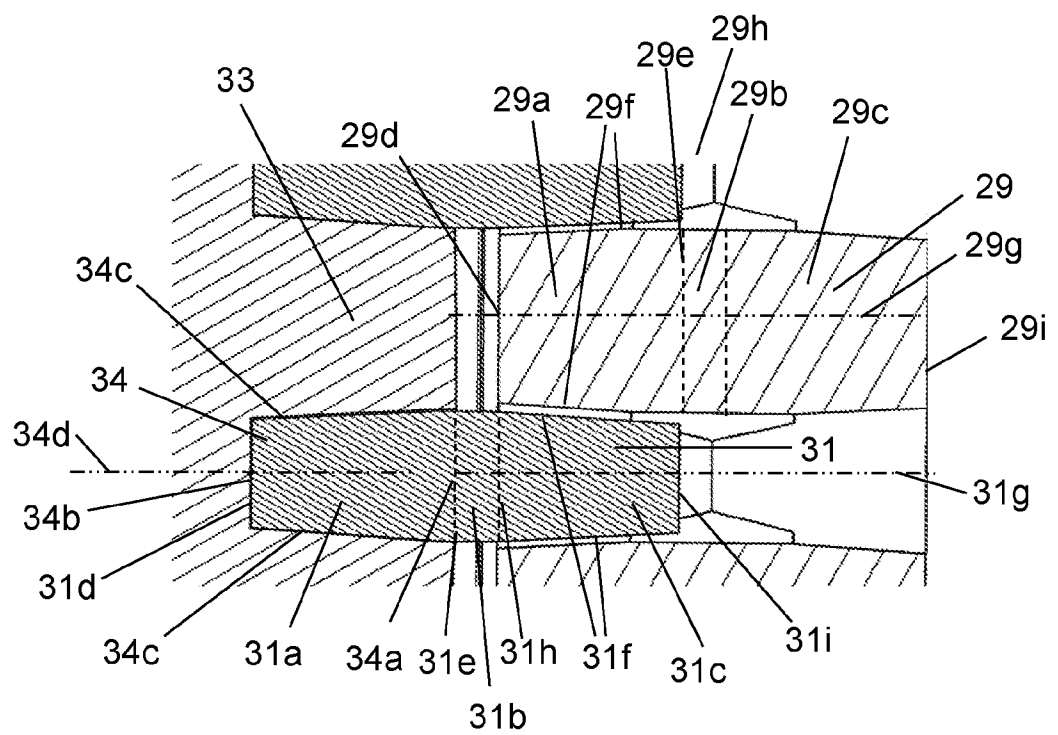


Fig 9

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/SE2015/050680

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: F16D

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)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1159569 A (BORG WARNER), 30 July 1969 (1969-07-30); page 2, line 62 - line 87; figures 1,3,4 --	1-14
A	US 4782929 A (MUELLER ROBERT), 8 November 1988 (1988-11-08); abstract; figures --	1-14
A	DE 10164203 C1 (GETRAG SYNCHRON TECHNIK GMBH), 30 April 2003 (2003-04-30); abstract; figures --	1-14
A	GB 900436 A (DAIMLER BENZ AG), 4 July 1962 (1962-07-04); figures --	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“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

23-09-2015

Date of mailing of the international search report

24-09-2015

Name and mailing address of the ISA/SE

 Patent- och registreringsverket
 Box 5055
 S-102 42 STOCKHOLM
 Facsimile No. + 46 8 666 02 86

Authorized officer

Jan-Axel Ylivainio

Telephone No. + 46 8 782 28 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2015/050680

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3043414 A (LUCIEN PERAS), 10 July 1962 (1962-07-10); figures -- -----	1-14

Continuation of: second sheet

International Patent Classification (IPC)

F16D 23/00 (2006.01)

F16D 11/00 (2006.01)

F16D 11/14 (2006.01)

F16D 23/06 (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2015/050680

GB	1159569 A	30/07/1969	NONE		
US	4782929 A	08/11/1988	DE	3612741 A1	22/10/1987
			EP	0241640 A1	21/10/1987
			JP	0745901 B2	17/05/1995
			JP	62261738 A	13/11/1987
DE	10164203 C1	30/04/2003	AT	271663 T	15/08/2004
			EP	1323940 B1	21/07/2004
			ES	2224016 T3	01/03/2005
			JP	4334218 B2	30/09/2009
			JP	2003222161 A	08/08/2003
GB	900436 A	04/07/1962	DE	1098825 B	02/02/1961
US	3043414 A	10/07/1962	NONE		