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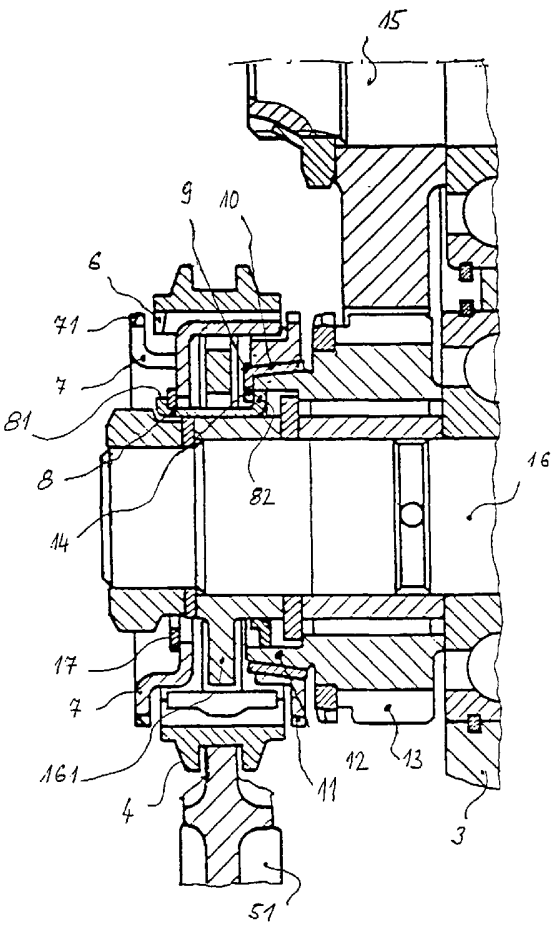
(54) Title: SYNCHROMESH DEVICE IN MANUAL GEARBOX



(57) Abstract: The subject of the invention is a synchromesh device in manual gearboxes, modified to improve engaging reverse gear, which features a gear for the locked synchromeshing of one of the forward gears and a device for a temporary friction connection of the same shaft with the same forward gear's wheel, installed on this shaft, where the basic idea is that the friction clutch, modified in the synchromeshing clutch, designed originally just for engaging forward gear, is carried out by the pulling casing (8) joined on side of the synchromeshing clutch to a part (9) of this synchromeshing clutch that is carried by the freely rotating gear (13). The clutch can be shifted to make friction contact with the part (11) of the carrier (161) of the synchromeshing sleeve (4), which is carried, together with the carrier (161) shaft (16) of this gear (13). On the opposite side from the carrier (161) of the synchromeshing sleeve (4) the pulling casing (8) is connected through for one-way control, depending on the synchromeshing sleeve (4)'s movement direction, i.e. on the direction corresponding to engaging reverse gear.

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— *of inventorship (Rule 4.17(iv)) for US only*

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Synchromesh device in manual gearbox

Technical Field

The invention relates to manual gearboxes, namely to their synchromeshing gear. It deals with modifications to the synchromeshing gear, which are designed to engage one forward gear, where by shifting the synchromeshing sleeve assembly in the direction opposite to the forward gear engaging the rotation of the shaft and gear, to which the reverse idler is to be meshed, most often by an axial shifting, is stopped.

Background Art

At present there are many designs of so-called synchromeshed engaging of forward gears in manual gearboxes. Usually these are primarily designs based on synchromeshing sleeves, which, when moved, first produce pressure on a conical friction brake, which in turn, because of the friction between the freely rotating gear and the carrier of the synchronizing sleeve, together with the harbouring shaft of the device described, equalizes the angular velocity of them and makes it possible, because of no or minimum peripheral forces between the two bodies to be joined, to complete the gear changing movement so that the internal teeth of the synchronizing sleeve get over the outside teeth of the friction plate of the clutch, which is joined by grooves to the carrier of the synchronizing sleeve, to the additional outside teeth, that are permanently joined to the freely rotating gear originally installed there. In this way the final engaging of the forward gear chosen takes place.

With regard to engaging reverse gear there is often no synchromeshing. The engaging is achieved by the axial shifting of the

reverse idler to the corresponding gear on the gearbox's shaft(s). Taking into consideration that engaging reverse gear does not take place so often as that of the other gears and it only seldom has to be done in an urgent manner the non-synchromesh engaging is basically acceptable for today's car operating conditions. Recently however the demand for more comfortable gear changing has increased, including that of engaging reverse gear and its speed, which is -among other things- a result of the ever growing speed of transport and traffic intensity, especially in cities. Today more often than before engaging reverse gear has to be done urgently; every delay can impair the safety of the car's passengers. This is why even designs for engaging reverse gear are now being modified in the way described above for engaging forward gears. Similar modifications have been applied for quite some time, mainly to expensive and/or some sports cars. The simplified design(s) that exist at present are a compromise between the device working properly and its price, while at the same time trying to save the maximum amount of space in the gearbox. Basically there are two different designs. The first one the so called "reverse gear brake" is achieved by a friction clutch starting to work at the beginning of the engaging reverse gear shift by braking the rotating shaft against a member joined to the gearbox case, which is the case of patents US 4225024 and/or US 5381878, or against the member, represented by an additional pair of joined wheels of which each one is firmly joined to one of the gearbox shafts as can be seen in patent US 5381878.

Another solution is based on braking the rotating shaft, which carries the forward gear wheel that cannot be disengaged, which means that the shaft of this wheel on which it is freely rotating-if this forward gear is not engaged is, during the course of changing gear, braked. In other words it is also stopped against the gearbox case, for when reverse gear is being engaged the car is not usually moving at all, or it is moving at a very low speed. This is the solution put forward by patent applications GB 2213884 and 2214247 and also DE 19955769. Braking the shaft against the gear installed on it

seems to be a better solution than braking against the gearbox case, and/or braking against the other shaft through an additional pair of wheels, for the later design is more complex and takes up more room. Among the systems based on braking the shaft against the existing gear there are even some designs with no additional braking device. They use the existing conical friction clutch meant originally just for synchromeshing the shaft rotation and the freely rotating wheel installed on it, prior to their being joined via a dog clutch. This solution is especially useful because the additional device only transfers the forces to the friction clutch that is activated by a reverse shifting movement during shifting into reverse gear, which is what occurs in the device described in patent application GB 2213884. There - during the reverse movement of the synchromeshing sleeve- the movement is transferred back to the friction clutch of the original synchromesh device via shifting members with tapered faces. Although such a solution makes use of the original friction clutch, in operation the back transfer of the movement through a system of shifted members with tapered faces would evidently tend to increase the size. It is probably because of this that a later patent application, GB 2214247, filed by the same applicant is also based on a separate reverse gear brake, but this time of a simplified brake control. Another solution to reverse the direction of the movement of the reverse gear brake control is put forward by patent application DE 19955769. In this case the movement from the synchronizing sleeve to the friction brake takes place through a tilting, segmented ring, which actuates the friction brake or a clutch during the engagement of a forward gear, using the idea of a single arm lever. During the movement in the opposite direction of the synchromeshing sleeve the movement is reverted by the principle of a two-arm lever, which again results in the axial force in the original direction, activating the same friction brake /or the clutch/, which in its turn results in the braking of the idler against its shaft. The later solution seems to be very simple and relevant members do not tend to size, but what the forces and stress development between the segmented ring and associated members will look like remains

to be seen, because during the course of tilting the transfer of forces between the members will evidently not take place between flat contacts, but rather in a curve or even in a point contact manner.

Disclosure of Invention

Most of the weak points of the existing designs are removed by the synchromesh device in manual gearboxes which has been modified to improve shifting into reverse gear, comprising one of the forward gears locked synchromesh device and a device used as a temporary friction joint of the same shaft with the gear of the same forward gear, installed on this shaft, where the present invention is based on combination, wherein the friction clutch control, modified in the synchromeshing clutch, originally designed just to engage the forward gear, is achieved via a pulling casing, joined to the side of the synchromeshing clutch to a part of it that is rotating because of the freely rotating gear, but which can be shifted to friction contact with a part of the carrier of the synchromeshing sleeve, which is carried away -together with the carrier- by this gear's shaft, and on the opposite side of the carrier of the synchromeshing sleeve the pulling casing is joined for one-way control that depends on the movement of the synchromeshing sleeve in the direction indicated by the direction of the shifting movement, which corresponds to engaging reverse gear. It is advantageous to design the synchromeshing device so that the axially shifted synchromeshing sleeve of the forward gear is joined within the framework of the gear changing control mechanism via an engaging gear using a shifting fork, or a reverse gear lever, and the synchromeshing sleeve has inward-pointing face-tapered sleeve teeth, but it is the outside oriented, axially tapered locking teeth, made on the axial shift-limited connecting locking casing, which goes through the axial openings via the synchromeshing sleeve´s carrier up to the synchromeshing ring, that goes up

to the path of the sleeve´s teeth axial shifting, and is propped against the first radial centrifugal border of the pulling casing, which goes through the synchromeshing sleeve's carrier a place close to the shaft concerned, and on the other side of this carrier it meshes via its second centripetal border, which has detents, made on the cone-like friction casing, installed between the forward gear's neck and synchromeshing ring, carried by the synchromeshing sleeve, and, additionally, the detents of its radial border mesh with the axially-protruding detents of the forward gear's neck to get, near the axis, up to the path of the second radial centrifugal border of the pulling casing's axial shifting.

Using this invention a synchromesh device with the minimum of additional elements compared with the original design can be produced. It can also provide braking of the freely rotating gear on the gearbox shaft, by which its meshing gear, joined firmly through its housing shaft with another gear to which the idle reverse gear is to be shifted to, or engaged in some other way, to achieve engagement of reverse gear, is stopped as well. Therefore basically the reverse gear sychromeshing is achieved by a modification that is simple, cheap, reliable in operation and takes up almost no additional room in the gearbox. As far as the application of the synchromeshing device described above on a driven shaft is concerned it can be said that such an application will be more frequent, but it is also possible to install this synchronizing device on the driving shaft, for the main benefit of this design is the braking of both shafts against each other which naturally takes place in both cases, provided one of the gears of the two is joined firmly to its shaft and the other can be disengaged from its housing shaft (where the rotation of it is concerned).

Brief Description of Drawings

A synchromesh device designed according to the invention is described and explained in more detail in the drawings attached, where Fig.1 is a longitudinal section through the synchromeshing device assembly, and Fig.2 is a detailed longitudinal section of the synchromeshing clutch modified to improve engaging reverse gear.

Description of the Preferred Embodiment

In the gearbox case 3 there are the driving shaft 15 and the driven shaft 16. The reverse gear driving wheel 2 is on the driving shaft, to the teeth of which it is possible to shift the idler 1 meshing with the driven gear, not shown here, housed on the driven shaft 16. The shifting gear 5, a part of the gearbox control device, is first modified to make an engaging step of one of the forward gears, in this particular case the fifth gear, by shifting the control mechanism 5 in one direction and, second, to make the shifting step to engage reverse gear by shifting the control gear 5 in the opposite direction. The shifting fork 51 is on the shifting gear, which is placed in the synchromeshing sleeve 4 of the shifting clutch to engage the fifth forward gear. This shifting clutch is of a normal design, and consists of a synchromeshing ring 11-carried -together with the synchromeshing sleeve 4 - by the carrier 161 of the shifting clutch assembly. The friction casing 9 is fitted onto the synchromeshing ring 11 -through its internal conical surface - by its conical friction surface 10.

The friction casing 9 is installed, so that it can be shifted, outside on the neck 12 of the gear 13 in such way that the detents 14 of the friction casing 9, made on its narrower end and shaped as a radial centripetal border, go between the axial detents of the neck 12. This border goes - after going through the axial detents of the neck 12 - even closer to the driven shaft

16´s axis. There the pulling casing 8, meshes via its second radial centrifugal border 82 with the detents 14 of the friction casing 9 to go in the axial direction via the openings in the carrier 161 to the other side of this carrier to mesh there using its first radial centrifugal border 81 - via the spring ring 17 with the internal part of the locking casing 7. This connecting locking casing 7 is designed in such a way, that there are axially tapered locking teeth 71 on its outside border going into the path of the internal teeth 6 (also axially tapered), made on the inside of the synchromeshing sleeve 4.

The device works as follows:

The device works in a completely conventional manner when engaging forward gear. The shifting gear shifts the synchromeshing sleeve towards the forward gear dog clutch´s teeth where, initially, the synchromeshing clutch´s internal teeth touch crossways the outside teeth of the synchromeshing ring which generates a force, pressing -via the friction casing- the neck of the forward gear, which induces friction of these members and therefore their speeds become unified. The peripheral forces between the synchromeshing sleeve and synchromeshing ring disappear, which makes it possible for the synchromeshing sleeve to proceed to the connecting teeth made on the side of the forward gear, where - by shifting the synchromeshing sleeve over the last mentioned teeth of the forward gear the engagement is completed by the total connection that takes place in the synchromeshing clutch.

When engaging reverse gear, starting from the neutral position of the synchromeshing clutch, the shifting gear moves the synchromeshing sleve towards the outside teeth, or to the locking teeth of the connecting locking casing, where – because of the transfer of forces through the internal pulling casing up to the conical surface of the friction casing, which presses onto the synchromeshing ring, a peripheral force between the internal teeth of the synchromeshing sleeve and the outside teeth, or locking teeth of the connecting locking casing appears. This in turn, after these teeth mesh to

one another over the crossways face of the surfaces, induces the axial force, which prevents the synchromeshing sleeve proceeding further and this continues as long as the shifting force trying to engage reverse gear exists, i.e. until the speeds of the forward gear and gearbox´s driven shaft are not identical. When this happens the peripheral force between the forward gear´s neck, joined with the friction casing and the synchromeshing ring, joined with the synchromeshing clutch´s carrier disappears, therefore also the force between the connecting locking casing and synchromeshing sleeve disappears. This means that the axial force, i.e. the resistance against the synchromeshing sleeve moving further also disappears and the synchromeshing sleeve proceeds to the position corresponding to engaging reverse gear, which takes place together with the axial shifting of the idler into the teeth of the driven and driving gear installed on the driven and driving shafts, respectively. Engaging reverse gear can take place without the collision of their teeth, because the respective gears on the driven and driving shafts have been stopped. This stoppage is of an absolute nature with regard to the gearbox case, because the driving shaft is stopped, because of the connection to the car wheels, which are as a rule also stopped when reverse gear is engaged.

Industrial Applicability

A device based on the invention can be used in manual gearboxes of cars and trucks, or of other moving machinery. Such a device could also be used with other kinds of gearboxes, provided a solution of a similar kinematic task is developed.

CLAIMS

1. Synchromesh device in manual gearbox, modified to improve engaging reverse gear, comprising a device for the locked synchromeshing of one of the forward gears and a device for a temporary friction connection of the same shaft with the same forward gear's wheel, installed on this shaft, characterized in that the friction clutch control, modified in the synchromeshing clutch, designed originally only for engaging a forward gear, is designed here comprising a pulling casing (8), joined on the side of the synchromeshing clutch to a part (9) of this synchromeshing clutch, carried by a freely rotating gear (13), but which can be shifted to make friction contact with a part (11) of the synchromeshing sleeve´s (4) carrier (161), which is carried, together with the carrier (161), on this gear´s (13) shaft (16), and on the oposite side from the carrier (161) of the synchromeshing sleeve (4) the pulling casing (8) is connected for the same direction control, depending on the synchromeshing sleeve (4) movement, i.e. in the direction set by the movement corresponding to engaging reverse gear.

2. Synchromesh device of claim 1, characterized in that an axially shifting synchromeshing sleeve (4) of the forward gear engaging clutch´s is connected within the gear engaging control by the gear engaging device (5) with a shifting fork (51), or a reverse gear lever, and the synchromeshing sleeve (4) is provided with inward facing tapered teeth (6), while the outside directed axially tapered locking teeth (71), made on the connecting locking casing (7) with an axially limited shift that goes through the axial openings in the carrier (161) of the synchromeshing sleeve (4) up to the synchromeshing ring (11) and fits the first radial centrifugal border (81) of the pulling casing (8) also going through -next to the respective shaft (16)- the carrier (161) of the synchromeshing sleeve (4), which meshes on the opposite side of this carrier (161) by its second radial centrifugal border (82), the detents (14), made on the conical friction casing (9), which casing (9) is installed between

the neck (12) of the forward gear (13) and the synchromeshing ring (11), which is carried by the synchromeshing sleeve (4), and its radial border detents (14) mesh with the axially protruding detents of the forward gear(13)´s neck, and the detents (14) go even further, next to the axis, up to the axial path of the pulling casing's (8) second centrifugal border (82) shift.

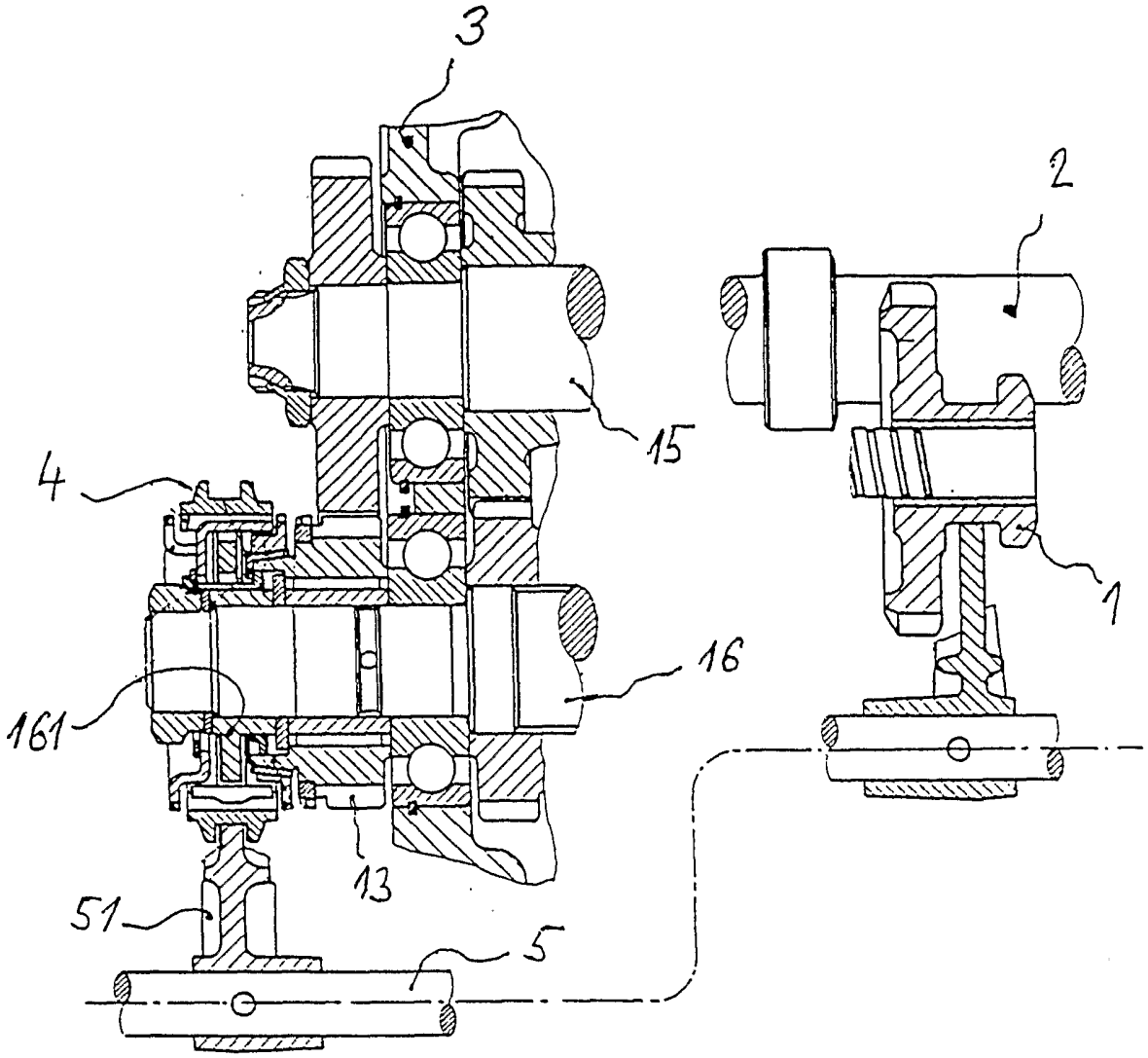

FIG. 1

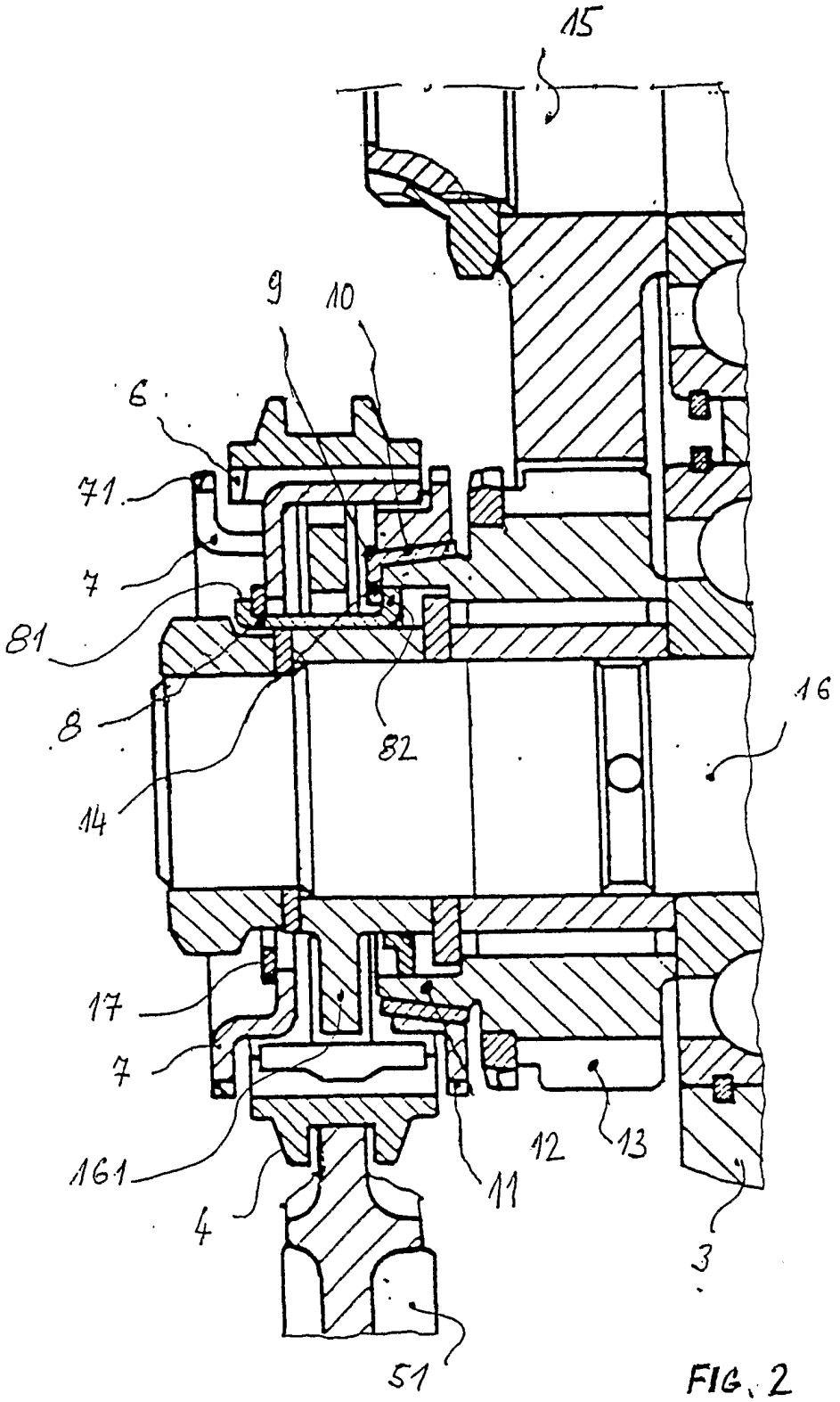

FIG. 2

INTERNATIONAL SEARCH REPORT

Inte nal Application No
PCT/CZ 01/00050

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16H63/30 F16D23/06

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 7 F16H F16D

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 889 003 A (RIETSCH DONALD R) 26 December 1989 (1989-12-26) cited in the application column 5, line 27 -column 6, line 62; figures 2,3	1,2
A	EP 0 668 457 A (SATURN CORP) 23 August 1995 (1995-08-23) column 3, line 66 -column 4, line 12; figure 2	1
A	US 4 674 346 A (HIRAIWA KAZUYOSHI) 23 June 1987 (1987-06-23) the whole document	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

ormation on patent family members

Inte ›nal Application No
PCT/CZ 01/00050

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4889003 A	26-12-1989	DE 3841390 A1	06-07-1989
		DE 3842265 A1	05-10-1989
		GB 2213884 A ,B	23-08-1989
EP 0668457 A	23-08-1995	US 5445253 A	29-08-1995
		DE 69501972 D1	14-05-1998
		DE 69501972 T2	30-07-1998
		EP 0668457 A1	23-08-1995
		JP 7259990 A	13-10-1995
US 4674346 A	23-06-1987	JP 1766509 C	11-06-1993
		JP 4057895 B	16-09-1992
		JP 60129428 A	10-07-1985
		DE 3445519 A1	04-07-1985
		GB 2152163 A ,B	31-07-1985