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(54) **TRANSMISSION BASED ON GEARS WITH SPIRAL TOOTHED TRANSITIONS**

ÜBERTRAGUNG AUF DER BASIS VON ZAHNRÄDERN MIT SPIRALFÖRMIG GEZAHNTES ÜBERGÄNGEN

TRANSMISSION SUR PIGNONS AVEC DES TRANSITIONS DENTÉES EN SPIRALE

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Description

Field of Invention

[0001] The invention belongs to geared transmissions with a continuously-stepped variable transmission ratio between the input and the output, i.e. the transmission ratio between adjacent gears or steps is changed continuously.

State of the Art

[0002] Present technology knows such devices as transmissions: devices intended for matching the rotation speed and the rotation torque of a rotation movement source (as a rule, a motor) and the rotation torque of a rotation consumer. Three types of transmissions are widely used: mechanical, automatic and variators. Whereupon the geared mechanical and automatic transmissions have compact size and can transmit a large torque, but discretization in transmission ratio changes, the need for a torque converter for automatic transmissions that reduces efficiency, interruptions in torque transmission, complexity, the need for a clutch for changing transmission ratios are considered as their shortcomings. Complexity of transmitting a significant torque and significant power by a rotating continuous belt is considered as a shortcoming of variators that can change transmission ratio steplessly and continuously.

[0003] The technical solutions described in US patents 5608390, 5653143, 6321613 are known, as well as the solution "Gear Transmission with a Continuously Changeable Transmission Ratio" (RF patent 2340815) that is the closest analogy. The invention has a truncated conical shaft with rows of spiral geared coils situated thereon; they are located apart from each other along the shaft. The second shaft is installed in parallel to the enveloping surface of the first shaft. A gear member situated on the second shaft rotates together with it; the gear member has teeth that mesh with those of the spiral toothed coils and can slide along the second shaft for positioning at any point along the geared transition and includes two connected gear wheels. The gear wheels may turn elastically by a certain angle in relation to each other. Common features are a first truncated conical shaft (without stationary gear wheels thereon, and without two spiral toothed transitions contrawound on the truncated cone) and a second shaft with a single gear wheel that can move along the truncated conical shaft. Such a gear transmission has the following shortcomings: the second shaft gear wheels located at any point along the shaft while in rotation mesh with various coils of the gear transition. Whereupon the tooth engagement area and, respectively, the maximum transmitted torque are variable values. I.e., at certain shaft positions loads acting on the edges of the gear teeth of the first shaft and the second shaft can cause their failure. Besides, two second shaft gear wheels that may rotate elastically against each other do not ensure a distinct and definite engagement when changing from one gear transition coil to another. This may result in their increased wear, teeth failure or jamming of the transmission.

[0004] Another example of a gear train apparatus including a gear and a cone disposed in contact with the gear, where the cone includes a plurality of conic teeth, is disclosed in WO0144684 A1.

Summary of the Invention

[0005] The technical result is a stepless and continuous transmission ratio and rotation torque variation in the process of switching between stationary gear wheels of the truncated conical shaft being transmission steps.

[0006] The problem solved by the invention is a continuous change of transmission ratio between gear transmissions (including adjacent ones) without rotation torque interruption. Transmission ratio change may have a small increment at a large number of transmission stages. Another task that may be solved at the same time: the first truncated conical shaft, like the transmission as a whole, may perform the function of an engine flywheel because rotation torque is transmitted continuously and the transmission may have a large moment of inertia. Besides, a clutch used when switching between transmission stages becomes redundant.

[0007] A transmission based on gear wheels with spiral toothed transitions includes a first truncated conical shaft with gear wheels located at its beginning and end. The number of teeth of the gear wheels is proportionate to the truncated cone diameter at the point of their location, the adjacent gear wheels are connected by two contrawound spiral toothed transitions. Gear wheels are located at the points of intersection of those transitions as well; their diameters and the number of their teeth are proportionate to the truncated cone diameter at their locations. Two contrawound spiral toothed transitions are needed for increasing and reducing the transmission ratio without changing the rotation direction of the first shaft. Thereby, we have a truncated conical shaft with a number of gears connected with spiral toothed transitions between them. A second shaft with a gear wheel on it is installed in parallel to the surface of the truncated cone. The gear wheel may move along the shaft but is fastened on it so that it rotates together with it. The gear wheel is moved along the second shaft and, respectively, along the truncated conical shaft by an electronic control system that monitors and locates the linear position of second shaft, the angular position of and rotation speed of the first shaft, takes into account the starting and ending points of the spiral toothed transitions and allows for the need for an increase or decrease in the transmission ratio, possibly the shaft load value and other necessary parameters. Thereby, a change in transmission ratio is achieved by rolling the gear wheel on the second shaft along the spiral toothed transitions from one gear wheel on the first shaft to another. Such rolling is performed by a control system at calculated points in time when the gear wheel on the second shaft is located opposite to the beginning of a spiral toothed transition. The control system has a longitudinal actuating mechanism for moving the gear wheel along the second shaft. A transmission of such type is reversible, both the first and the second shaft may be the input and the output one. Whereupon the spiral transition pitch may be both the same for each turn and variable. The truncated cone surface of the first shaft may differ in shape from a truncated cone but nevertheless include all the toothed elements needed for operation. The teeth of the gear wheels and spiral toothed transitions may be sunken into the truncated cone surface, allowing the second shaft gear wheel to roll on them like on guides.

[0008] To ensure a large contact area between engaged teeth of the first shaft and the second one, the teeth can have any shape. The shape of the truncated conical shaft teeth may repeat the imprints of the second shaft teeth changing their position in space. Conical shaft teeth having such a shape may be cut by a gear cutter having an appropriate profile that would imitate rotation of the engaged second shaft gear wheel and the truncated conical shaft teeth in the process of cutting teeth on the truncated conical shaft. The shape of imprint created by the gear cutter will allow to ensure a large tooth contact area at any relative angular position of the truncated conical shaft teeth and the second shaft gear wheel teeth. Whereupon different conicity of teeth at the beginning and at the end of the truncated conical shaft will not influence the maximum value of rotation torque transmitted by the teeth. Apart from toothed gears, more efficient rotation transmission types may be used for such type transmissions, e.g., eccentric-cycloidal transmission. The specific feature of using such type of transmission is that the second shaft axis must be parallel to the first shaft axis and not the conical surface, i.e., the first and the second shaft must be coaxial. A mobile cardan suspension may be used for that purpose. I.e., the slide including the second shaft moves along guide rails parallel to the surface of the cone while the axis of the second shaft is parallel to the axis of the truncated conical shaft and rotation torque is transmitted to the second shaft through a cardan drive traveling in relation to the gear wheel to which the rotation toque is transmitted or from which it is taken. Such a type of rotation torque transmission from the first shaft to the second one may be used for toothed gears as well.

[0009] A transmission may also include one or several second shafts for power takeoff, operating at the first truncated conical shaft independently of each other, as well as their respective automatic control system, actuating mechanisms and second shaft gear wheels each of which operates independently and rotates at a speed determined by its own control system. Summing different rotation speeds of one or several second shafts and contrarotation speed of the truncated conical shaft with the help of known summing mechanisms subject to tooth numbers selection may ensure a combination set of resultant rotation speeds differing in value and direction, including a zero resultant rotation speed.

[0010] The truncated conical shaft may have any length, including zero length. Whereupon the truncated conical shaft is transformed into a flat wheel with gear wheel teeth and teeth of spiral toothed transitions situated thereon, and the second shaft rotation axis becomes parallel to the wheel plane and perpendicular to the wheel rotation axis.

Brief Description of Drawings

[0011] Fig. 1 shows a longitudinal section of the gear wheel transmission with spiral toothed transitions

Description of a preferred embodiment of Invention

[0012] Fig. 1 shows that a gear wheel transmission with spiral toothed transitions includes a casing 1 drawn in a longitudinal section, with bearing seats 2 - 8. Bearings 2 and 3 are installed in casing 1, on truncated conical shaft 9. Truncated conical shaft 1 includes stationary gear wheels at the beginning 10 and at the end 13 of the shaft; the numbers of their teeth are chosen proceeding from the necessary transmission ratio variation range. Stationary gear wheels on truncated conical shaft 9 may be also installed at the points of conventional intersection of two contrawound spiral toothed transitions 11 and 12. In general, the number of intersections and, respectively, intermediate gear wheels may be arbitrary, allowing to reduce the transmission ratio discretization interval, but with limits from the top imposed by the sizes of teeth and the length of truncated conical shaft 9. The diameters and number of teeth of those gear wheels increase from the narrow end of truncated conical shaft 9 to the broad one. Whereupon the pitch of the spiral toothed transitions may be the same or vary between stationary gear wheels. I.e., the diameters of stationary gear wheels on the truncated conical shaft located at the intersections of the spiral toothed transitions are not determined by equal pitch of the spiral toothed transitions but may vary at the design stage, allowing to set the necessary diameters and tooth numbers of intermediate gear wheels. The shape of shaft 9 may differ from the truncated conical shape but the shaft 9 must include the toothed elements needed for its operation. Thereby, the truncated conical shaft includes a certain number N of stationary gear wheels - there are four of them in Fig. 1: gear wheels 10, 13, 14 and 15 whose tooth numbers are proportionate to the truncated cone diameter at their location. Two or more contrawound spiral toothed transitions 11 and 12 that need not be continuous are needed for changing the transmission transmission ratio upward or downward without changing the direction of the truncated conical shaft rotation. The tooth module of the spiral toothed transitions and all gear wheels is the same. The teeth of the spiral conical gear transitions are directed away from the truncated conical shaft and in general are parallel to the axis of the second shaft. There are sensors 16 installed on the truncated conical shaft 9: the shaft angular position sensor needed for monitoring the angular positions of the teeth of the spiral toothed transitions, the truncated conical shaft rotation speed sensor and, possibly, the shaft load sensor.

[0013] The transmission in Fig. 1 includes a second shaft 17 located in parallel to the surface of the truncated conical shaft 9 at some distance from it. The second shaft 17 is mounted in the casing 1 by means of bearings 4 and 5. The second shaft 17 is provided with keys or splines 18 stretching along it and rotating together with the second shaft. Gear wheel 19 is installed on the second shaft 17 and rotates together with it because of splines, keys or teeth 18; but it can also move along the second shaft so that the teeth of the gear wheel 19 are permanently engaged with the teeth of the truncated conical shaft gear wheels 10, 13, 14, 15 or spiral toothed transitions 11 and 12 when they are aligned. Shafts 19 and 17 may act both as input and output shafts. The second shaft gear wheel 19 moves along the shaft 17 with the help of sliding member 20 connected with the gear wheel with the help of bearing 8. The longitudinal movement of the sliding member 20 is effected with the help of an actuating mechanism. It is shown in Fig. 1 as threaded shaft 21 of actuating drive 22 mounted in casing 1 on bearings 5 and 6. The sliding member includes threads 23. As the shaft21 rotates in it in clockwise or counterclockwise, it causes the sliding member 20 to move forward or backward and, respectively, causes the gear wheel 19 to move along the truncated conical shaft 9. The linear position of the sliding member 20 is monitored by the linear motion sensor 24. The linear position of gear wheel 19 in relation to shaft 21 at specific points in time needed to roll from one stationary gear wheel of the shaft 9 to another may be calculated by a digital computer (DC) 24. Any other known mechanism may be also used for moving the gear wheel 19 longitudinally along the truncated conical shaft. E.g., the teeth of the gear wheels and spiral toothed transitions may be sunken into the truncated gear shaft 9. Whereupon for the gear wheel 19 to roll from one stationary gear wheel on the truncated conical shaft to the other, it must be preliminarily placed into a spiral toothed transition groove or connected to shafts with two contrawound threads rotated by the truncated conical shafts at necessary points in time for necessary time intervals; other known methods may be used as well.

[0014] The DC 24 uses the selected gear sensor 25 for operation. It specifies which stationary gear wheel on the truncated conical shaft 9 must be engaged with the second shaft gear wheel 19; this sensor may be integrated into the DC. DC 24 calculates the required linear positions of the gear wheel 19 at certain points in time when switching to a desired stationary gear wheel on the shaft 9 from the current stationary gear wheel on the ground of the current position of the gear wheel 19 along the second shaft monitored with the help of linear travel sensor 26, as well as shaft rotation speed sensors 9, and shaft angular position sensors. Using these parameters and, possibly, the truncated conical shaft load level data received from the sensor 16, the DC 24 generates necessary control signals for the actuator 22 and calculates the gear shift beginning time when teeth of the gear wheel 19 will be aligned with the beginning of a spiral toothed transition. Actuator 22 rotates the threaded shaft 21, moves the sliding member 20 and also the second shaft gear wheel 19 along the shaft 17 so that during gear shifting the gear wheel 19 is permanently engaged with the teeth of the spiral toothed transitions on the shaft 9 until the position of the stationary gear wheel on shaft 9 set by the gear sensor 25 is reached.

[0015] DC 24 determines the angular speed of actuator shaft 22 ϖ_1 in radians per second with regard for the fact that the gear must be shifted during the time needed for the truncated conical shaft to turn by a half-turn and the initial moment of its actuation t_0 with the help of the following simplified formulas: $\varpi_1 = 8\pi^2 l / d\varpi$, where 1 is the linear length of the spiral toothed transition plus the width of the stationary gear wheel on shaft 9 monitored by the linear position sensor of second shaft gear wheel 26, d is the thread pitch 23 of shaft 21, ϖ is the truncated conical shaft 9 angular rotation speed in radians per second, $t_0 = (\alpha_0 - \alpha)/\varpi$, where α_0 is the angle of the beginning of the spiral toothed transition in radians whose value may be adopted as equal to 2π, α is the current angular position of the truncated conical shaft 9 in radians.

[0016] Besides, this control system is an automatic control system. As gears are shifted on the ground of the values calculated by the DC 24, the current linear position of the shaft 19 is also monitored by the sensor 26. The calculated linear position of the gear wheel 19 along the shaft 17 and the current one are constantly compared in the process of gear shifting, and when a misalignment exceeding a preset permissible value is detected, an additional corrective signal is generated for actuator 22, allowing to compensate the detected misalignment. This automatic control system is one of the measures protecting the transmission from the gear wheel 19 jumping off the spiral toothed transitions 11 and 12 of the shaft 9 at the moments when the transmission transmission ratio is changed. Wider spiral toothed transitions can be also used for prevention of jumping off. They will also allow to prevent the gear wheel 19 from jumping off the shaft 9 during gear shifting in case of possible fluctuations of load on the shaft 9. Blocking of shaft load fluctuations during transmission ratio changes can be used as another preventive measure. The transmission automatic control system can "learn" in order to prevent gear wheel jumping off. This "learning" consists in changing some transmission parameters in the course of time - e.g., the force needed to change the gear wheel 19 linear position, and the control system may monitor permanent deviations from the calculated values and adjust itself, i.e. correct its operation in view of wear and tear causing changes in parameters. Since there may be a significant number of stationary gear wheels on the truncated conical shaft 9, the transmission transmission ratio gaps may be small.

[0017] It can be seen from the invention embodiment that the device solves the tasks at hand. Since various changes and modifications not exceeding the range or protection are possible in the process of the invention embodiment, this description and solution shown in Fig. 1 is a non-restrictive illustrative example.

Claims

1. A transmission based on gear wheels with spiral toothed transitions including a casing (1) with a rotating first shaft (9) with toothed elements located on a truncated cone, a second rotating shaft (17) installed parallel to the surface of the first shaft and at a distance from it, including a second shaft gear wheel (19) engaged with the teeth of the first shaft and rotating together with the first shaft (9) by means of engagement facilities (18), said second shaft gear wheel (19) being movable along said second shaft (17) by means of a linear actuating mechanism (20) allowing to position the second shaft gear wheel (19) at any point along the second shaft (17), wherein the first shaft (9) has, at its beginning and end, stationary gear wheels (10, 13) whose diameters and numbers of teeth are proportionate to the diameter of the first shaft at their location points, said stationary gear wheels (10, 13) being connected by two or more, if discontinuous, contrawound spiral toothed transitions (11, 12), at whose intersection points intermediate gear wheels (14, 15) are located, wherein the transmission coefficient is changed by rolling the second shaft gear wheel (19) over said spiral toothed transitions (11, 12) from one gear wheel to another (10, 13, 14, 15) without changing the rotation direction of the first shaft (9),
wherein a sensor-based automatic control system (24) which is suitable for moving the actuating mechanism (20) connected with the second shaft gear wheel for positioning the second shaft gear wheel so that its teeth are permanently engaged either with stationary gear wheels (10, 13, 14, 15) of the first shaft (9) or with the teeth of the spiral toothed transitions (11, 12) when the transmission coefficient is changed, the sensor-based automatic control system (24) monitoring the current linear position of the second shaft gear wheel (19) along the second shaft (17),
characterized in that the sensor-based control system (24) constantly comparing the calculated linear position of the second shaft gear wheel (19) and the current one in the process of gear shifting, and when a misalignment exceeding a preset permissible value is detected, an additional corrective signal is generated by the sensor-based automatic control system (24), allowing to compensate the detected misalignment.

2. Transmission according to claim 1, wherein the tooth module of the two contrawound toothed transitions (11, 12), the first shaft (9) gear wheels (10, 13, 14, 15) and the second shaft (17) gear wheel (19) is the same.

3. Transmission according to claim 1, wherein the teeth on the first shaft (9) are sunken in the cone body and crimps along the teeth serve as guides for moving the second shaft gear wheel (19) along the spiral toothed transitions (11, 12).

4. Transmission according to claim 1, further comprising a device maintaining the force pressing the first shaft (9) and the second shaft gear wheel (19) if a straight line connecting longitudinal sections of the tips of any teeth of the first shaft is parallel to the axis of the first shaft.

5. Transmission according to claim 1, wherein the pitch of the spiral toothed transitions (11, 12) is either the same from one stationary gear wheel to another (10, 13, 14, 15) or variable, allowing to make stationary gear wheels on the first shaft (9) with arbitrary diameters and numbers of teeth that however depend on the diameter of the first shaft (9) at the points of their location.

6. Transmission according to claim 1, wherein the number of gear wheels (10, 13, 14, 15) on the first shaft (9) is limited from the top by the length of the first shaft and the dimensions of the teeth.

7. Transmission according to claim 1, wherein the shape of teeth on the first shaft (9) for transmission of rotation between the first (9) and the second (17) shaft are an imprint of the shape of the teeth or other engagement facilities of gear wheel (19) of the second shaft (17).

8. Transmission according to claim 1, wherein both the first shaft (9) and the second shaft (17) are used as the transmission input shafts, while, respectively both the second shaft (17) and the first shaft (9) are used as the output shafts.

9. Transmission according to claim 1, comprising one, two or more second shafts (17) at the first shaft (9), each provided with a respective automatic control

system (24), actuating mechanism (20) and second shaft gear wheel (19), said second shafts operating independently and rotating at a speed determined by the respective automatic control system (24).

10. Transmission according to claim 1, wherein summing different rotation speeds from one or more second shafts (17) by means of a summing mechanism and contrarotation speed of the first shaft (9), ensures a combination set of resultant rotation speeds different in rate and direction, including a zero resultant rotation speed.

11. Transmission according to claim 1, wherein the part of the first shaft (9) including toothed elements may have any length, including zero length, whereupon it is transformed into a disc with gear teeth (10, 13, 14, 15) and teeth of the spiral toothed transitions (10, 12) located thereon and the second shaft rotation axis (17) is parallel to the disc plane.

Patentansprüche

1. Getriebe basierend auf Zahnrädern mit spiralförmigen gezahnten Übergängen bzw. Zahnübergängen, enthaltend ein Gehäuses (1) mit einer rotierenden ersten Welle (9) mit gezahnten Elementen bzw. Zahnelementen, die sich an einem Kegelstumpf befinden, einer zweiten rotierenden Welle (17), die parallel zu der Fläche bzw. Oberfläche der ersten Welle und in einem Abstand davon installiert ist, enthaltend ein zweites Wellenzahnrad (19), das mit den Zähnen der ersten Welle in Eingriff ist und sich zusammen mit der ersten Welle (9) mittels Eingriffseinrichtungen (18) dreht, wobei das zweite Wellenzahnrad (19) entlang der zweiten Welle (17) mittels eines linearen Betätigungsmechanismus (20) beweglich ist, der es ermöglicht, das zweite Wellenzahnrad (19) an einem beliebigen Punkt entlang der zweiten Welle (17) zu positionieren, wobei die erste Welle (9) an ihrem Anfang und Ende stationäre Zahnräder (10, 13) aufweist, deren Durchmesser und Anzahl an Zähnen proportional zu dem Durchmesser der ersten Welle an ihren Stellenpunkten sind, wobei die stationären Zahnräder (10, 13) durch zwei oder mehr, falls diskontinuierlich, gegenläufig gewickelte, spiralförmige gezahnte Übergänge bzw. Zahnübergänge (11, 12) verbunden sind, an deren Schnittpunkten sich Zwischenzahnräder (14, 15) befinden, wobei der Übertragungskoeffizient durch Rollen des zweiten Wellenzahnrads (19) über die spiralförmigen Zahnübergänge (11, 12) von einem Zahnrad zu einem anderen (10, 13, 14, 15) geändert wird, ohne die Drehrichtung der ersten Welle (9) zu ändern,
wobei ein sensorbasiertes automatisches Steuer- bzw. Regelsystem (24), das geeignet ist zum Bewegen des mit dem zweiten Wellenzahnrad verbundenen Betätigungsmechanismus (20) zum Positionieren des zweiten Wellenzahnrads, so dass seine Zähne entweder mit stationären Zahnrädern (10, 13, 14, 15) der ersten Welle (9) oder mit den Zähnen der spiralförmigen Zahnübergänge (11, 12) dauerhaft in Eingriff sind, wenn der Übertragungskoeffizient geändert wird, wobei das sensorbasierte automatische Steuer- bzw. Regelsystem (24) die aktuelle lineare Position des zweiten Wellenzahnrads (19) entlang der zweiten Welle (17) überwacht,
dadurch gekennzeichnet, dass das sensorbasierte Steuer- bzw. Regelsystem (24) konstant bzw. ständig die berechnete lineare Position des zweiten Wellenzahnrads (19) mit der aktuellen Position in dem Prozess des Gangwechsels vergleicht, und wenn eine Fehlausrichtung erkannt wird, die einen voreingestellten zulässigen Wert überschreitet, wird von dem sensorbasierten automatischen Steuer- bzw. Regelsystem (24) ein zusätzliches Korrektursignal erzeugt, das es erlaubt, die erkannte Fehlausrichtung zu kompensieren.

2. Getriebe nach Anspruch 1, wobei das Zahnmodul der beiden gegenläufig gewickelten Zahnübergänge (11, 12), der Zahnräder (10, 13, 14, 15) der ersten Welle (9) und des Zahnrads (19) der zweiten Welle (17) das gleiche ist.

3. Getriebe nach Anspruch 1, wobei die Zähne an der ersten Welle (9) in den Kegelkörper eingelassen sind und Kräuselungen entlang der Zähne als Führungen zum Bewegen des zweiten Wellenzahnrads (19) entlang der spiralförmigen Zahnübergänge (11, 12) dienen.

4. Getriebe nach Anspruch 1, ferner umfassend eine Vorrichtung, welche die Kraft aufrechterhält, die auf die erste Welle (9) und das zweite Wellenzahnrad (19) drückt, wenn eine gerade Linie, die Längsschnitte der Spitzen jeglicher bzw. beliebiger Zähne der ersten Welle verbindet, parallel zu der Achse der ersten Welle ist.

5. Getriebe nach Anspruch 1, wobei die Steigung der spiralförmigen Zahnübergänge (11, 12) entweder von einem stationären Zahnrad zum anderen (10, 13, 14, 15) gleich oder variabel ist, was das Schaffen stationärer Zahnräder an der ersten Welle (9) mit beliebigen Durchmessern und Anzahlen der Zähne erlaubt, die jedoch von dem Durchmesser der ersten Welle (9) an den Stellen ihrer Position abhängen.

6. Getriebe nach Anspruch 1, wobei die Anzahl der Zahnräder (10, 13, 14, 15) an der ersten Welle (9) von oben durch die Länge der ersten Welle und die Abmessungen der Zähne begrenzt ist.

7. Getriebe nach Anspruch 1, wobei die Form der Zähne an der ersten Welle (9) zur Übertragung der Drehung zwischen der ersten (9) und der zweiten (17) Welle ein Abdruck der Form der Zähne oder anderer Eingriffseinrichtungen des Zahnrads (19) der zweiten Welle (17) ist bzw. sind.

8. Getriebe nach Anspruch 1, wobei sowohl die erste Welle (9) als auch die zweite Welle (17) als Getriebeeingangswellen verwendet werden, während jeweils sowohl die zweite Welle (17) als auch die erste Welle (9) als Abtriebswellen verwendet werden.

9. Getriebe nach Anspruch 1, umfassend eine, zwei oder mehrere zweite Wellen (17) an der ersten Welle (9), die jeweils mit einem jeweiligen automatischen Steuer- bzw. Regelsystem (24), einem Betätigungsmechanismus (20) und einem zweiten Wellenzahnrad (19) versehen sind, wobei die zweiten Wellen unabhängig voneinander arbeiten und sich mit einer Geschwindigkeit drehen, die durch das jeweilige automatische Steuer- bzw. Regelsystem (24) bestimmt wird.

10. Getriebe nach Anspruch 1, wobei das Summieren unterschiedlicher Drehgeschwindigkeiten von einer oder mehreren zweiten Wellen (17) mittels eines Summiermechanismus und der Gegendrehgeschwindigkeit der ersten Welle (9) einen Kombinationssatz von resultierenden Drehgeschwindigkeiten unterschiedlicher Rate und Richtung sicherstellt, einschließlich einer resultierenden Drehgeschwindigkeit von Null.

11. Getriebe nach Anspruch 1, wobei der Teil der ersten Welle (9), der gezahnte Elemente enthält, eine beliebige Länge einschließlich einer Länge von Null aufweisen kann, woraufhin er bzw. sie in eine Scheibe mit Zahnradzähnen (10, 13, 14, 15) und Zähnen der daran befindlichen spiralförmigen Zahnübergänge (10, 12) umgewandelt wird und die zweiten Wellendrehachsen (17) parallel zu der Scheibenebene sind.

Revendications

1. Transmission basée sur des pignons ayant des transitions dentées en spirale, comportant un carter (1) qui présente un premier arbre rotatif (9) comportant des éléments dentés situés sur un cône tronqué, un second arbre rotatif (17) installé parallèlement à la surface du premier arbre et à une distance de celuici, comportant un pignon de second arbre (19) en prise avec les dents du premier arbre et tournant conjointement au premier arbre (9) au moyen d'installations de mise en prise (18), ledit pignon de second arbre (19) étant mobile le long dudit second arbre (17) au moyen d'un mécanisme d'actionnement linéaire (20) permettant de positionner le pignon de second arbre (19) en tout point le long du second arbre (17), dans laquelle le premier arbre (9) présente, à son début et à sa fin, des pignons fixes (10, 13), dont le diamètre et le nombre des dents sont proportionnels au diamètre du premier arbre à leurs points d'emplacement, lesdits pignons fixes (10, 13) étant raccordés par deux ou plus de deux, si elles sont discontinues, transitions dentées en spirale contre-enroulées (11, 12), aux points d'intersection desquelles sont situés des pignons intermédiaires (14, 15), le coefficient de transmission étant modifié par roulement du pignon de second arbre (19) au-dessus desdites transitions dentées en spirale (11, 12) d'un pignon à un autre (10, 13, 14, 15) sans modifier le sens de rotation du premier arbre (9),
dans laquelle un système de commande automatique à base de capteur (24) est approprié pour déplacer le mécanisme d'actionnement (20) raccordé au pignon de second arbre pour un positionnement du pignon de second arbre de sorte que ses dents soient en prise permanente soit avec des pignons fixes (10, 13, 14, 15) du premier arbre (9) soit avec les dents des transitions dentées en spirale (11, 12) lorsque le coefficient de transmission est modifié, le système de commande automatique à base de capteur (24) surveillant la position linéaire actuelle du pignon de second arbre (19) le long du second arbre (17),
caractérisée en ce que le système de commande à base de capteur (24) compare en permanence la position linéaire calculée du pignon de second arbre (19) et la position actuelle dans le processus de changement de rapport, et lorsqu'un défaut d'alignement dépassant une valeur admissible prédéfinie est détecté, un signal correctif supplémentaire est généré par le système de commande automatique à base de capteur (24) pour permettre de compenser le défaut d'alignement détecté.

2. Transmission selon la revendication 1, dans laquelle le module de dent des deux transitions dentées contre-enroulées (11, 12), des pignons (10, 13, 14, 15) du premier arbre (9) et du pignon (19) du second arbre (17) sont les mêmes.

3. Transmission selon la revendication 1, dans laquelle les dents sur le premier arbre (9) sont enfoncées dans le corps de cône, et des cannelures le long des dents servent de guides pour déplacer le pignon de second arbre (19) le long des transitions dentées en spirale (11, 12).

4. Transmission selon la revendication 1, comprenant en outre un dispositif maintenant la force de pression sur le premier arbre (9) et le pignon de second arbre (19) si une ligne droite reliant des sections longitudinales des extrémités de toute dent du premier arbre est parallèle à l'axe du premier arbre.

5. Transmission selon la revendication 1, dans laquelle le pas des transitions dentées en spirale (11, 12) est soit le même d'un pignon fixe à un autre (10, 13, 14, 15), soit variable, ce qui permet d'avoir des pignons fixes sur le premier arbre (9) avec des diamètres et des nombres de dents arbitraires qui dépendent toutefois du diamètre du premier arbre (9) au niveau de leurs points d'emplacement.

6. Transmission selon la revendication 1, dans laquelle le nombre de pignons (10, 13, 14, 15) sur le premier arbre (9) est limité depuis le dessus par la longueur du premier arbre et les dimensions des dents.

7. Transmission selon la revendication 1, dans laquelle la forme de dents sur le premier arbre (9) pour une transmission de rotation entre les premier (9) et second (17) arbres est une empreinte de la forme des dents ou d'autres installations de mise en prise du pignon (19) du second arbre (17).

8. Transmission selon la revendication 1, dans laquelle le premier arbre (9) et le second arbre (17) sont tous deux utilisés comme arbres d'entrée de transmission, tandis que le second arbre (17) et le premier arbre (9) sont tous deux respectivement utilisés comme arbres de sortie.

9. Transmission selon la revendication 1, comprenant un, deux ou plus de deux seconds arbres (17) au niveau du premier arbre (9), chacun étant muni d'un système de commande automatique (24) respectif, d'un mécanisme d'actionnement (20) et d'un pignon de second arbre (19), lesdits seconds arbres fonctionnant indépendamment et tournant à une vitesse déterminée par le système de commande automatique (24) respectif.

10. Transmission selon la revendication 1, dans laquelle le calcul de la somme des différentes vitesses de rotation d'un ou de plusieurs seconds arbres (17) au moyen d'un mécanisme sommateur et d'une vitesse de contre-rotation du premier arbre (9), assure l'obtention d'un ensemble combiné de vitesses de rotation différentes en taux et en direction, notamment une vitesse de rotation obtenue nulle.

11. Transmission selon la revendication 1, dans laquelle la partie du premier arbre (9) comportant des éléments dentés peut avoir une longueur quelconque, y compris une longueur nulle, moyennant quoi elle est transformée en un disque avec des dents de pignon (10, 13, 14, 15) et des dents des transitions dentées en spirale (10, 12) situées sur celles-ci, et l'axe de rotation de second arbre (17) est parallèle au plan du disque.

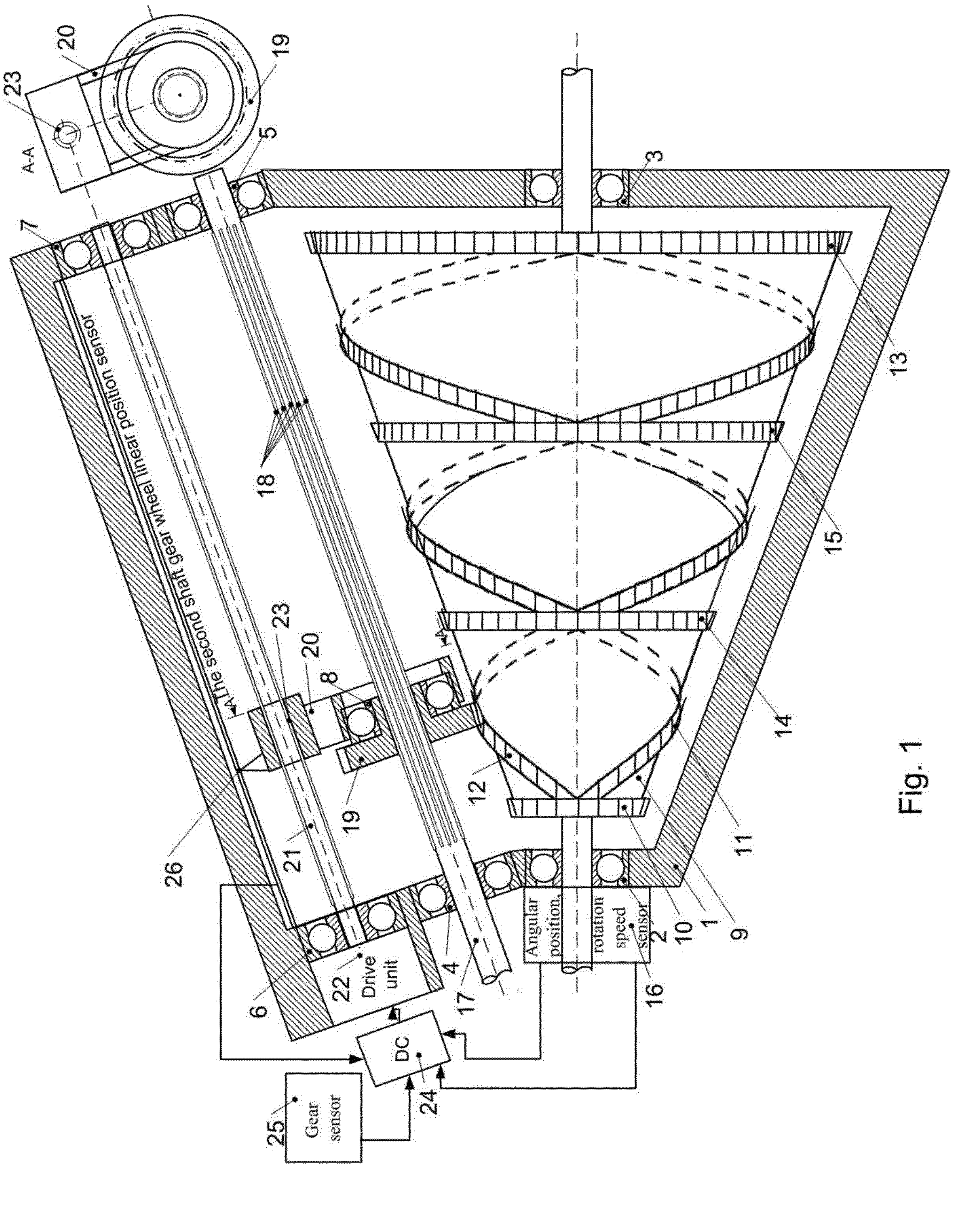
A-A
The second shaft gear wheel linear position sensor
Angular position,
rotation speed sensor
Drive unit
DC
Gear sensor
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
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Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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