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(54) **Machine for stranding a bundle of yarns**

(57) A machine (10) for stranding a bundle of yarns, of the type that comprises a supporting frame (11) for a first rotor (12) and a second rotor (13), which are external and are moved by same motor drive means (14) and support an interposed first bow (15) for the torsion of the bundle of yarns (16), within the space generated by the rotation of the first bow (15) there being a second torsion bow (17) which is arranged to rotate in the opposite direction with respect to the first bow (15) and about the same axis of rotation and is supported between two opposite coaxial rotors, a third rotor (18) and a fourth rotor (19), which are moved by symmetric transmission means of the epicyclic type (20, 21), which are interposed respectively between the adjacent first (12) and third (18) rotors and between the adjacent second (13) and fourth (19) rotors. The transmission means of the epicyclic type

(20, 21) are constituted, for each pair of rotors, by
- a first gear (22), which is fixed with respect to the supporting frame (11) and coaxial to the axis of rotation of the bows (15, 17),
- two second and third planet gears (23, 24), which are keyed on a same shaft (25), which in turn is coupled freely on a radial protrusion (26) of the respective first (12) or second (13) external rotor,
- a fourth gear (27), which is jointly connected and coaxial to the corresponding third (18) or fourth (19) inner rotor,
- a first toothed belt (28) for transmitting the relative motion between the first fixed gear (22) and a first one (23) of the planet gears, for the rotation of the planet gears about their own axis, - a second toothed transmission belt (29) between the second (24) of the two planet gears and the fourth gear (27) of the corresponding inner rotor.

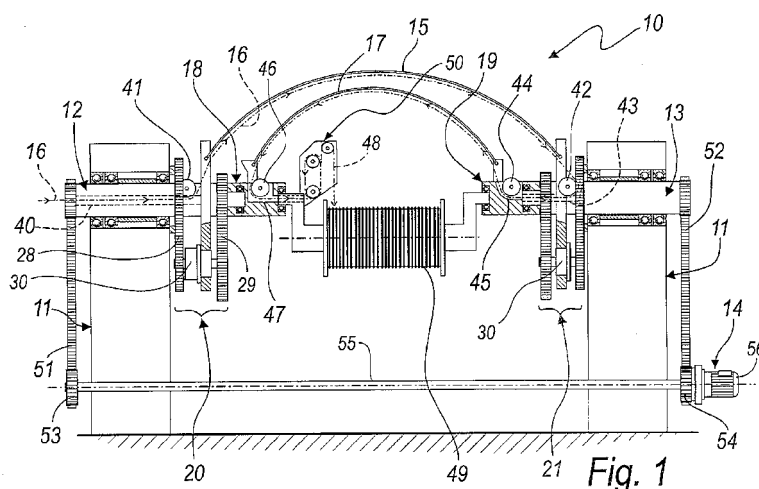


Fig. 1

Description

[0001] The present invention relates to a machine for stranding yarns.

[0002] As is known, stranding consists in practice in the spiral twisting of a bundle of yarns gathered and compacted to provide a cable or rope with a typical spiral-like shape.

[0003] The yarns that compose this bundle may come from different spools for storing the yarn in order to compose said bundle according to the desired number and geometry.

[0004] Stranding devices have now been known for many years which provide for the passage of the bundle of yarns inside a guide in which the bundle is drawn and inside which the bundle undergoes two torsions which, according to the torsion rate and the advancement rate thereof in the guide, determine the pitch of the spiral.

[0005] In particular, stranding devices of the type with a rotating bow are known which comprise a pair of coaxial rotors, connected to the same motor drive in order to rotate jointly, on which there are, coaxially to the rotation axis and thus in mutual alignment, respectively a first passage and a second passage, which are connected by a central passage constituted by a bow which is fixed by its ends to the two rotors and thus rotates about an axis which is coaxial to said first and second passages.

[0006] A motorized winding spool is arranged between the two rotors and is rotationally free from the rotors, being able to rotate independently by virtue of its own motor drive.

[0007] In input to the winding spool there are rollers, so-called "capstans", adapted to draw the yarn before winding in order to determine the pitch.

[0008] The rotation of the bow allows to generate two torsions on the bundle of yarns substantially at the points where said bundle of yarns exits from the first passage in order to enter the bow, and where said bundle exits from the bow and enters the second passage.

[0009] In order to balance the mass of the rotating bow, in some applications an additional bow is fixed to the rotors, staggered by 180° with respect to the first bow; no bundle slides on this additional bow, which is used exclusively as a rotary counter-mass.

[0010] It is evident that the pitch of the spiral of the cable or rope formed by the stranded bundle of yarns is given by the advancement rate of the yarns in combination with the rotation rate of the bow.

[0011] The productivity of these devices is thus determined by the maximum rotation rate that can be imposed to the bow and by the maximum rate that the bundle of yarns can withstand.

[0012] There are, therefore, structural limits, in particular as regards to the rotation rate of the bow, which limit productivity.

[0013] In order to obviate this problem, one solution is to arrange in series two devices (with the output of a first device associated in series with the input of the second

device); in this manner four torsions are imposed on the bundle of yarns and thus, by doubling the advancement rate of the bundle of yarns, a strand is obtained which has the same pitch as the case of two torsions and normal advancement rate, virtually obtaining a doubling of productivity.

[0014] An arrangement in series of devices of this type encounters substantially two problems which are not negligible.

[0015] The first problem is linked to the fact that by using two similar devices, the yarns that form the bundle must be fed starting from a storage spool arranged instead of the winding spool of the first device, limiting considerably the possible configurations of cable that can be provided.

[0016] The second problem is linked to the total volume, which in practice is doubled.

[0017] In order to obviate this drawback, a device for stranding a bundle of yarns has been perfected, as well as disclosed and claimed in Italian Patent No. 1361089 in the name of this same Applicant, which is of the type that comprises a guide, on which the bundle of yarns to be stranded is drawn and which comprises a first passage and a second passage, which are at least partially mutually aligned and connected by a central passage constituted by a first bow, which rotates about an axis which is coaxial to the aligned parts of such first and second passages and generates two torsions on the bundle of yarns at the points where such bundle of yarns exits from the first passage to enter the first bow, and where such bundle exits from the first bow and enters the second passage; downstream of the guide there are means for collecting the stranded bundle of yarns; the particularity of this invention resides in that the guide comprises a second bow, which rotates coaxially to the axis of the first bow, is arranged within the space generated by the rotation of such first bow and rotates in the opposite direction with respect to such first bow in order to generate two additional torsions of the bundle of yarns at the exit of the bundle from such second passage and in input to a third passage, which leads from the outlet of the second bow to the means for collecting the stranded bundle.

[0018] The fine-tuning of this device has revealed some aspects of such patented device that can be perfected.

[0019] In particular, the noisiness of the gear drives that transfer the rotary motion from the first external rotors, which turn the first outer bow, to the second coaxial rotors, which turn the second inner bow with the opposite direction of rotation, has been noted.

[0020] Moreover, the increase in productivity in stranding machines is directly proportional to the number of torsions per minute that the machine is capable of imparting to the bundle of yarns to be stranded; the main technical constraint for increasing the number of torsions per minute is the rotation rate of the motor and of the main shaft of the machine, and therefore one seeks to increase the rotation rate of the second bow in order to

increase the number of torsions per minute and thus the productivity, keeping unchanged the rotation rate of the main shaft of the machine.

[0021] The rotation rate variation of the second bow is possible by way of a variation of the gear ratio between the pairs of gears of the two mutually opposite symmetric epicyclic gear systems that transmit the torque from the rotors that support the first outer bow to the two rotors that support the second inner bow.

[0022] In order to vary the gear ratio by way of a gear train while keeping unchanged the power that can be transmitted it is in fact necessary to vary the diameters and the center distance, or the width of the set of teeth, by replacing therefore the planetary gear and the gear carrier or sun gear, in order to change the center distance.

[0023] The use of gears, moreover, makes it necessary to provide a gear case for the oil lubrication system of the gear pairs; this case, however, has to be rotated, with consequent splashing of the oil and displacement of the oil mass in rotation, causing an unwanted dynamic imbalance of the machine.

[0024] The aim of the present invention is to provide a machine for stranding yarns that solves the highlighted problems and at the same time is quieter.

[0025] Within this aim, an object of the present invention is to provide a stranding machine that allows to double productivity without increasing the total space occupations with respect to similar known devices having a lower productivity.

[0026] Another object of the present invention is to provide a stranding machine that has a higher productivity and greater operational flexibility, i.e., whose number of torsions imposed to the bundle of yarns can be modified easily.

[0027] Another object of the present invention is to perfect a machine for stranding yarns that can be manufactured with known systems and technologies.

[0028] This aim and these and other objects that will become better apparent hereinafter are achieved by a machine for stranding a bundle of yarns, of the type that comprises a supporting frame for a first rotor and a second rotor, which are moved by same motor drive means and support an interposed first bow for the torsion of the bundle of yarns, within the space generated by the rotation of said first bow there being a second torsion bow which is arranged to rotate, in the opposite direction with respect to the first bow and about the same axis of rotation and is supported between two opposite coaxial rotors, a third rotor and a fourth rotor, which are moved by symmetric transmission means of the epicyclic type, which are interposed respectively between the adjacent first and third rotors and between the adjacent second and fourth rotors, in the space defined by the rotation of said second bow there being means for winding the bundle of stranded yarns, said machine being characterized in that said transmission means of the epicyclic type are constituted, for each pair of rotors, by

- a first gear, which is fixed with respect to the supporting frame coaxial to the axis of rotation of said bows,
- two second and third planet gears, which are keyed on a same shaft, which in turn is coupled freely on a radial protrusion of the respective first or second external rotor, the axis of said shaft being parallel to the axis of said first and second rotors,
- a fourth gear, which is jointly connected and coaxial to the corresponding third or fourth inner rotor,
- a first toothed belt for transmitting the relative motion between said first fixed gear and a first one of said planet gears, for the rotation of said planet gears about their own axis,
- a second toothed transmission belt between the second of said two planet gears and said fourth gear of said corresponding inner rotor.

[0029] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the machine according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic partially sectional side view of a machine according to the invention;

Figure 2 is a sectional view of a detail of the machine according to the invention;

Figure 3 is sectional view of a further detail of the machine according to the invention.

[0030] With reference to the figures, a machine for stranding a bundle of yarns according to the invention is generally designated by the reference numeral 10.

[0031] The machine 10 comprises a supporting frame 11 for first and second external rotors, respectively 12 and 13, which are moved by the same motor drive means 14, described hereinafter.

[0032] The first rotor 12 and the second rotor 13 support an interposed first bow 15 for the torsion of the bundle of yarns; the bundle of yarns is represented schematically by the dot-and-dash line designated by the numeral 16.

[0033] Inside the space generated by the rotation of the first bow 15, a second torsion bow 17 is arranged so as to rotate, in the opposite direction with respect to the first bow and about the same axis of rotation, and is supported between two opposite inner coaxial rotors, a third rotor 18 and a fourth rotor 19, which are moved by symmetric transmission means of the epicyclic type, respectively 20 and 21.

[0034] These epicyclic transmission means 20 and 21, described better hereinafter, are interposed respectively between the adjacent first rotor 12 and third rotor 18 and between the adjacent second rotor 13 and fourth rotor 19.

[0035] In the space defined by the rotation of the second bow 17 there are means for winding the bundle of stranded yarns, which also are described hereinafter.

[0036] The transmission means of the epicyclic type 20 and 21 are provided, for each pair of rotors, by

- a first gear 22, which is fixed with respect to the supporting frame 11 and is coaxial to the axis of rotation of the bows 15 and 17,
- two planet gears, a second one 23 and a third one 24, which are keyed on a same shaft 25, which in turn is coupled freely on a radial protrusion 26 of the corresponding external rotor, the first rotor 12 or the second rotor 13; the axis of the shaft 25 is parallel to the axis of the rotors 12, 13, 18 and 19;
- a fourth gear 27, which is jointly connected and coaxial to the corresponding inner rotor, the third rotor 18 or the fourth rotor 19,
- a first toothed belt 28 for transmitting the relative motion between the first fixed gear 22 and a first one, for example the first gear 23, of such planet gears, for the rotation about their own axis of the planet gears 23 and 24;
- a second toothed belt 29 for transmission between the second gear 24 of such two planet gears and the fourth gear 27 associated with the inner rotor 18.

[0037] In the embodiment of the machine 10 according to the invention described herein by way of non-limiting example of the invention, the shaft 25 is supported by a sleeve 30, which in turn is fixed by means of screws or other threaded elements or other similar or equivalent systems to the protrusion 26 of the first rotor 12, by means of a flange 31 that extends radially from the sleeve 30.

[0038] Inside the sleeve 30, two oblique bearings 32 and 33 are interposed between the shaft 25 and the sleeve itself.

[0039] The gears 23 and 24 are locked against the inner crown of an adjacent oblique bearing 32 or 33 by the screwing of an internally threaded ring, respectively 34 and 35, each of which is screwed to a corresponding thread formed on one end 25a and 25b of the shaft 25.

[0040] Centering means for correct arrangement with respect to the shaft 25 and the axis of rotation are associated with each one of the second gear 23 and third gear 24.

[0041] For each gear 23 and 24, such centering means are constituted by two concentric rings 37 and 38, with a wedge-like operation: a first inner ring 37 surrounds the central collar 23a and 24a of the corresponding gear and has a substantially frustum-like outer surface, while the second outer ring 38 has an inner surface which also is frustum-like, with the same inclination (same apex angle of the generatrix of the conical surface) of the outer surface of the first ring 37.

[0042] The smallest inside diameter of the second ring 38 is smaller than the smallest outside diameter of the first ring 37, while the largest inside diameter of the second ring 38 is greater than the smallest outside diameter of the first ring 37 but is smaller than the largest outside diameter of the first ring 37.

[0043] The second ring 38 is drawn in an axial direction against the first ring 37 by way of a plurality of threaded connections 39, which pass through corresponding holes provided in the disk or on the spokes of the gears 23 and 24 and designed to be screwed to corresponding complementarily threaded holes provided in the second ring 38.

[0044] The third rotor 18 and the fourth rotor 19 are mounted so that they can rotate respectively on the first rotor 12 and the second rotor 13, which are axially contiguous.

[0045] The path of the bundle 16 of yarns to be stranded inside the machine 10 according to the invention comprises a first inlet channel 40, which is defined in the axial direction on the first external rotor 12, a pulley 41 for diverting the bundle 16 toward the first bow 15, a second pulley 42 for diverting the bundle 16 in output from the first bow 15, a first intermediate channel 43 defined on the second external rotor 13, for the passage of the bundle of yarns between the second pulley 42 and a third pulley 44, which is mounted on the fourth rotor 19, for diverting the bundle of yarns in input to the second bow 17, a second intermediate channel 45, which is contiguous to the first intermediate channel 43 but is defined on the fourth rotor 19, a fourth pulley 46, which is mounted on the third rotor 18 and is designed to divert the bundle of yarns 16 toward the collecting means, and a fifth channel 47, which is defined on the third rotor 18, between the fourth pulley 46 and the collecting means of the stranded bundle 48.

[0046] The means for collecting the stranded bundle 48 comprise a winding spool 49, which is motorized for rotation about its own axis and is arranged in the internal space delimited by the rotation of the second bow 17; the winding spool 49 is rotationally uncoupled from the rotors 12, 13, 18 and 19.

[0047] Between the winding spool 49 and the outlet of the fifth guiding channel 47 so-called capstan rollers 50 for drawing the stranded bundle 48 are provided.

[0048] The first rotor 12 and the second rotor 13 are directly connected by means of corresponding transmission belts 51 and 52 to two corresponding pulleys 53 and 54, which are keyed on a common transmission shaft 55, which is connected directly to a motor 56, for example of the electric type.

[0049] The operation of the machine according to the invention is as follows.

[0050] The bundle 16 of yarns is made to pass through the bows 15 and 17 by the winding action of the spool 49.

[0051] The discordant rotation of the bows causes at least four torsions at the points where the bundle exits from the coaxial channels of the rotors in order to enter the guiding portions defined by the bows, or at the points where the bundle enters the channels by exiting from the bows.

[0052] The increase in productivity in the stranding machines is directly proportional to the number of torsions per minute that the machine is capable of imparting to

the bundle of yarns to be stranded.

[0053] By increasing the rotation rate of the second bow 17 it is possible to increase the number of torsions per minute and thus increase the productivity of the machine 10, keeping unchanged the rotation rate of the main shaft 55 of the machine.

[0054] Variation of the rotation rate of the second bow 17 is possible by way of a variation of the transmission ratio between the pairs of gears 22 and 23 and 24 and 27 of the epicyclic gear system 21.

[0055] The use of belts 28 and 29 instead of the pairs of gears as in the background art makes it easier to vary this transmission ratio, since the relatively easy and quick replacement of one of the planet gears 23 and 24, keeping unchanged the center distance with the first gear 22 and fourth gear 27, is possible.

[0056] By replacing the gears 23 and 24 with other gears of a different preset diameter and keeping an equal center distance it is possible to obtain from the machine 10 a stranded bundle with six or eight torsions instead of only four torsions.

[0057] In order to vary the transmission ratio by way of a train of gears while keeping unchanged the power that can be transmitted it is in fact necessary to vary the diameters and the center distance, or the width of the set of teeth.

[0058] Moreover, according to the background art, the use of gears makes it necessary to use a gear case for the oil lubrication system of the gear pairs, however, but by turning such case the oil sloshes, with consequent movement of the oil mass in rotation, with consequent dynamic unbalancing of the machine.

[0059] The adoption of belts does not provide for the use of a lubrication system and of a corresponding gear case.

[0060] Moreover, another fundamental advantage in the adoption of belt drives resides in that by using toothed belts one has a considerable reduction in the noisiness of the drive.

[0061] Moreover, toothed belts require less maintenance, which is a fundamental element for this type of machines.

[0062] In practice it has been found that the invention thus described solves the problems highlighted in known types of device for stranding cables.

[0063] In particular, the present invention has provided a stranding machine that allows to double productivity without increasing substantially the total volumes with respect to similar devices having lower productivity.

[0064] Moreover, the invention has provided a stranding machine with higher productivity and greater operational flexibility, i.e., whose number of torsions imposed to the bundle of yarns can be changed easily.

[0065] Moreover, the invention has provided a machine for stranding yarns that can be manufactured with known systems and technologies.

[0066] The invention thus conceived is susceptible of numerous modifications and variations, all of which are

within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0067] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements and to the state of the art.

[0068] The disclosures in Italian Utility Model Application No. PD2010U000018 from which this application claims priority are incorporated herein by reference.

[0069] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A machine (10) for stranding a bundle of yarns, of the type that comprises a supporting frame (11) for a first rotor (12) and a second rotor (13), which are external and are moved by same motor drive means (14) and support an interposed first bow (15) for the torsion of the bundle of yarns (16), within the space generated by the rotation of said first bow (15) there being a second torsion bow (17) which is arranged to rotate, in the opposite direction with respect to the first bow (15) and about the same axis of rotation and is supported between two opposite coaxial rotors, a third rotor (18) and a fourth rotor (19), which are internal and are moved by symmetric transmission means of the epicyclic type (20, 21), which are interposed respectively between the adjacent first (12) and third (18) rotors and between the adjacent second (13) and fourth (19) rotors, in the space defined by the rotation of said second bow (17) there being means for winding the bundle of stranded yarns, said machine (10) being **characterized in that** said transmission means of the epicyclic type (20, 21) are constituted, for each pair of rotors, by

- a first gear (22), which is fixed with respect to the supporting frame (11) and coaxial to the axis of rotation of said bows (15, 17),
- two second and third planet gears (23, 24), which are keyed on a same shaft (25), which in turn is coupled freely on a radial protrusion (26) of the respective first (12) or second (13) external rotor, the axis of said shaft (25) being parallel to the axis of said first and second rotors,
- a fourth gear (27), which is jointly connected and coaxial to the corresponding third (18) or fourth (19) inner rotor,
- a first toothed belt (28) for transmitting the relative motion between said first fixed gear (22) and a first one (23) of said planet gears, for the

rotation of said planet gears about their own axis,

- a second toothed transmission belt (29) between the second (24) of said two planet gears and said fourth gear (27) of said corresponding inner rotor. 5

2. The machine according to claim 1, **characterized in that** said shaft (25) is supported by a sleeve (30), which in turn is fixed to the protrusion (26) of the first rotor (12) or second rotor (13) by way of a flange (31) that extends radially from said sleeve (30), two oblique bearings (32, 33) being interposed inside said sleeve (30), between the shaft (25) and the sleeve itself. 10 15

3. The machine according to the preceding claims, **characterized in that** said planet gears (23, 24) are locked against the inner crown of an adjacent oblique bearing (32, 33) by the screwing of an internally threaded ring (34, 35) which is screwed to a corresponding thread formed on one end (25a, 25b) of the shaft (25). 20

4. The machine according to the preceding claims, **characterized in that** centering means for correct arrangement with respect to the shaft (25) and the axis of rotation are associated with each one of said second (23) and third (24) gears. 25 30

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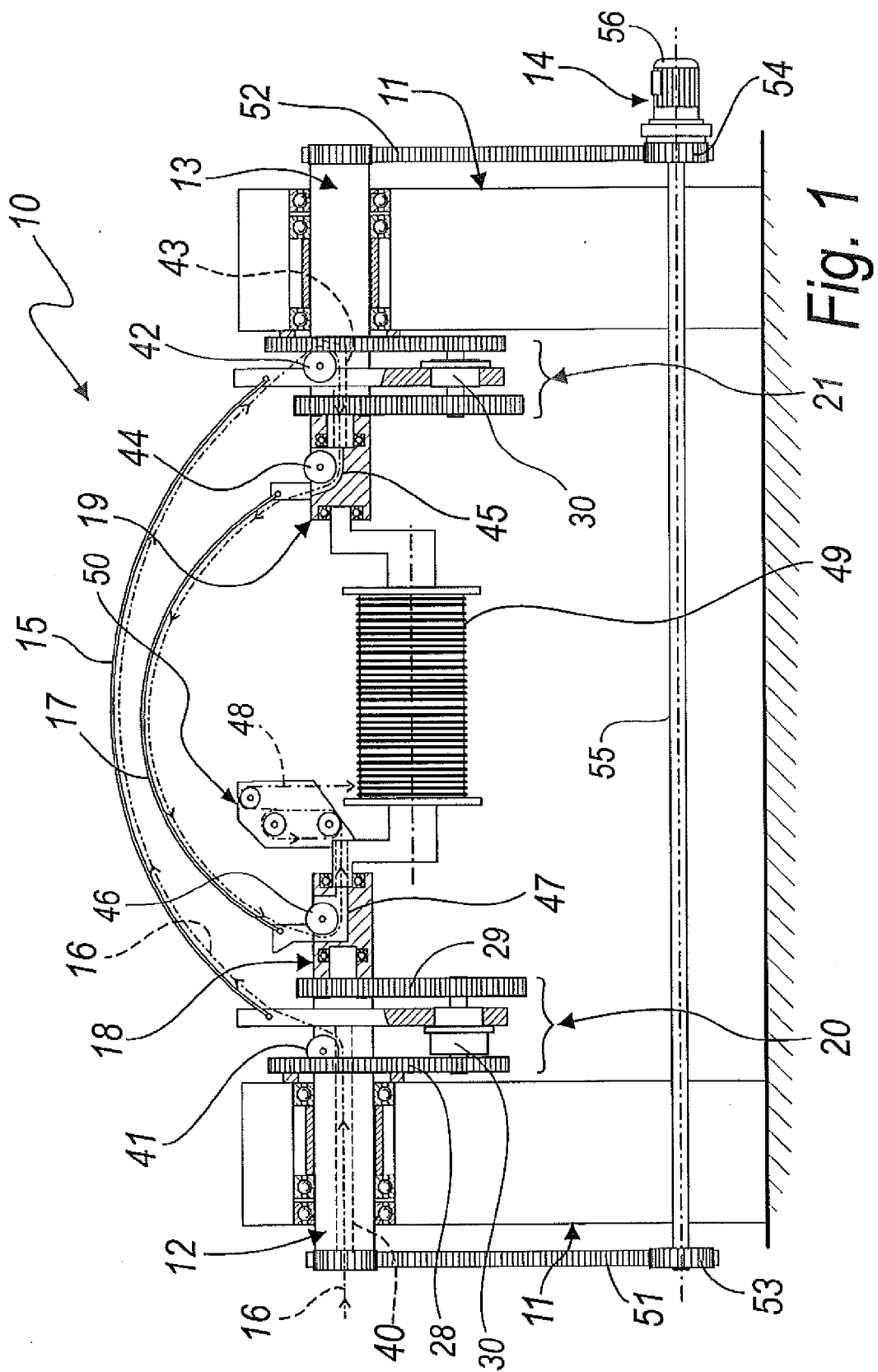


Fig. 1

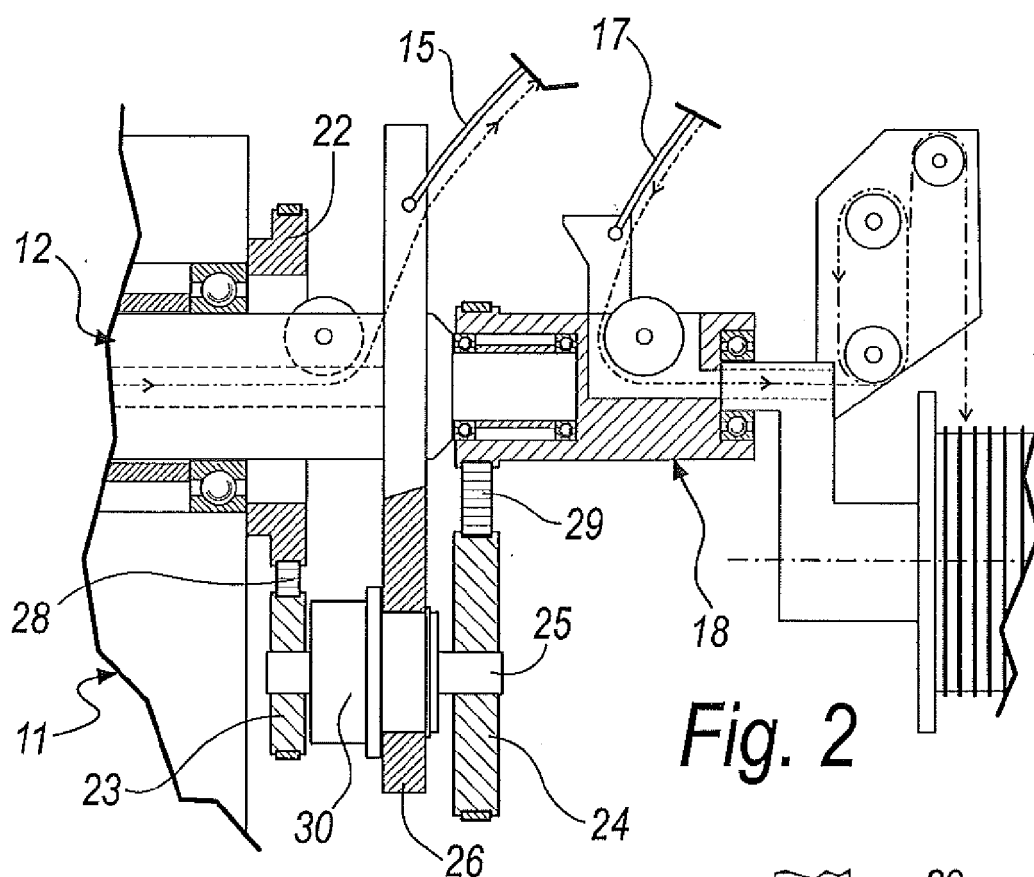


Fig. 2

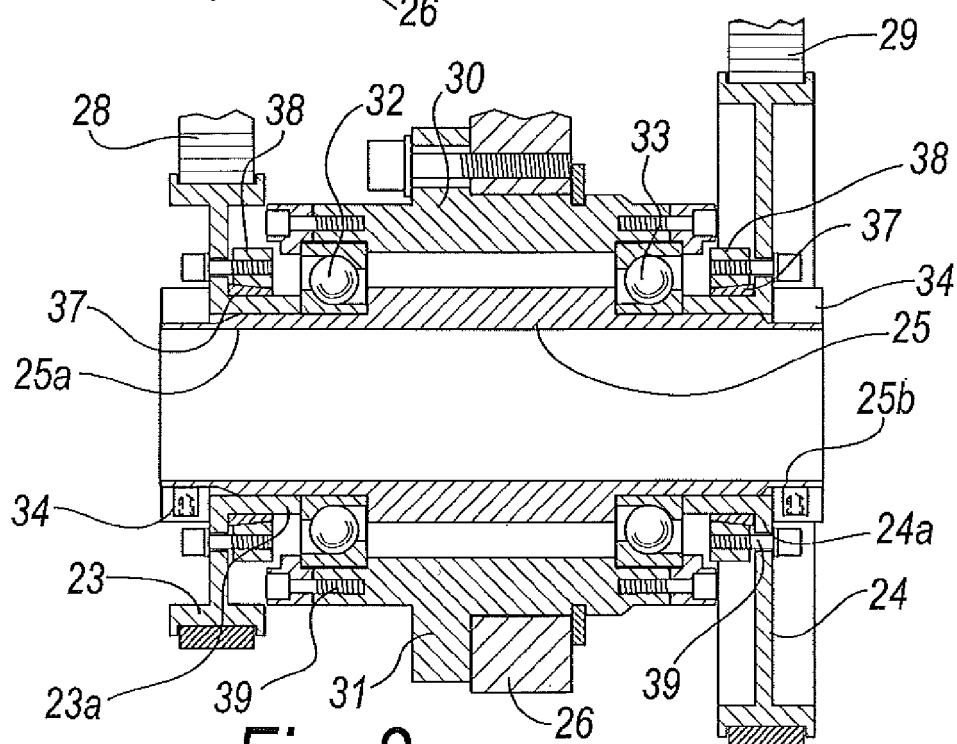


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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- IT PD20100018 U [0068]