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(12) # EUROPEAN PATENT APPLICATION

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(54) **Line feeding device.**

(57) A line feeding device for feeding a flexible line (10) comprises an assembly (13) of five or more drive rollers (19) so disposed in spaced relation to each other as to present to the line (10) a drive path for the line (10) in which the line (10) is drivingly engaged by and advanced through a predetermined angle of wrap around the assembly (13) by contact in turn with an arcuate surface of each drive roller (19) over an angle of contact which is less than the predetermined angle of wrap and in which the line (10) so extends between each drive roller (19) and the next adjacent drive roller (19) as to be relieved from bending stresses imposed on the line (10) by contact with the arcuate surfaces of the rollers (19).

EP 0 145 271 A1

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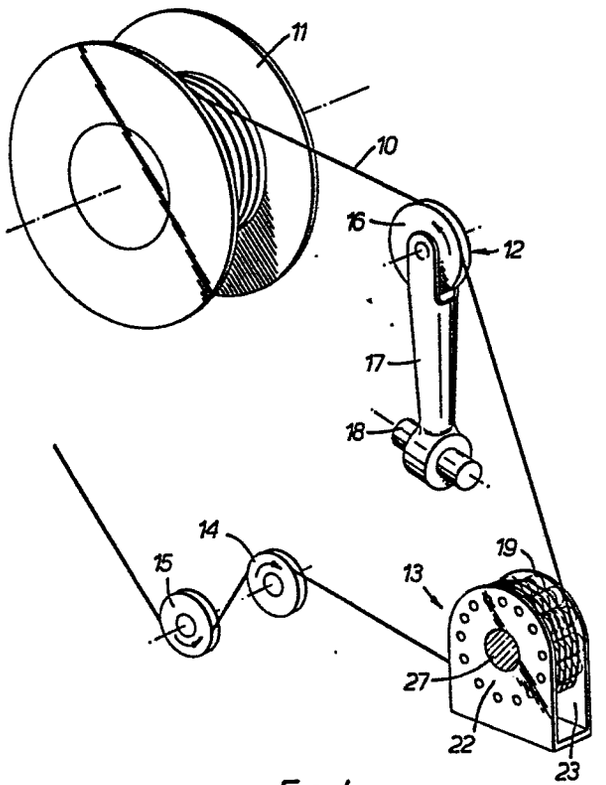

FIG. 1.

LINE FEEDING DEVICE.

The present invention relates to a line feeding device for advancing a flexible line and is particularly concerned with a line feeding device in which the line is advanced by contact with an arcuate surface of a driven roller.

It is well known to provide winches for paying out and hauling in ropes for a wide variety of purposes, some of which call for the hauling in of ropes under considerable loading. For example in the recovery of disabled vehicles of considerable weight, such as military tanks, the load imposed on the winch calls for an exceptionally robust structure. It has been found that where a drum winch is employed deformation of the rope resulting from the winding of the rope layer upon layer on the drum gives rise to unacceptable stresses in the rope. To overcome this difficulty it has hitherto been proposed to employ a capstan winch in which the rope is advanced by contact with the arcuate surfaces of a pair of driven capstan rollers around which the rope is passed in a plurality of turns and from which it is fed to a driven storage drum at a tension which is only a very small fraction of the load on the rope taken up by the capstan rollers. By arranging for the capstan rollers to take the rope pull the storage drum may then be made less robust and arranged to accommodate a large number of layers of rope.

While the capstan winch enables long ropes to be accommodated on storage drums of lightweight

construction, the capstan rollers which accept the heavy line loads must themselves be of robust construction and of large diameter. This makes the equipment expensive. They furthermore become subject to wear and replacement of them is costly.

It has additionally been found that the rope, which is usually of steel, suffers fatigue when it is subjected to bending stresses and that this fatigue increases with the length of the path in which it is continuously subjected to bending. Clearly, while capstan rollers of adequate diameters need be made to accept the large hauling loads rope fatigue due to bending remains.

It is an object of the present invention to provide a winch assembly in which the need for capstan rollers of large diameters can be avoided whilst the advantages of them maintained.

It is a further object of the present invention to provide a winch assembly in which bending stress and rope fatigue can be reduced.

According to the present invention there is provided a line feeding device for feeding a flexible line in which the line is drivingly engaged and advanced by contact with an arcuate surface of drive means characterised in that the drive means comprises an assembly of five or more drive elements so disposed in spaced relation to each other as to present to the line a drive path for the line in which the line is drivingly engaged by and advanced through a predetermined angle of wrap around the assembly by

contact in turn with an arcuate surface of each drive element over an angle of contact which is less than the predetermined angle of wrap and in which the line so extends between each drive element and the next adjacent drive element as to be relieved from bending stresses imposed on the line by contact with the arcuate surfaces of the elements.

In one embodiment of the invention hereinafter to be described the elements are rollers so disposed about a centre point of the assembly and so driven as to present a drive path for the line in which the line contacts the surfaces of the rollers only on the sides of the rollers remote from the centre point of the assembly.

In a first embodiment of the invention hereinafter to be described the rollers of the assembly are mounted in a stationary roller support structure and are rotatably driven in the support structure. The angle of contact of the line with the arcuate surface of each roller is preferably made much less than 180° and the number of rollers is preferably such as to effect a significant reduction in the bending stress and fatigue in the line relative to that which would be imposed on the line following an equivalent drive path in which the line is engaged throughout by a continuous arcuate contact surface of a single driven roller.

It has been found that where a rope is deviated by a very small roller or pulley if the angle of deviation is kept low the bending stress and fatigue in the rope is negligible. Thus, if the rope is made to pass

through a full turn by passing it over a large number of small rollers or pins then the bending stress and fatigue can be minimised and made equivalent to that imposed by a single roller or capstan of a diameter much greater than that of any of the rollers or pins.

In the first embodiment of the invention hereinafter to be described, the drive path is arranged to make a plurality of turns around the assembly and the rollers are so constructed as to provide adjacent contact surfaces for the line. Furthermore, the rollers are arranged on axes equidistant from the centre point of the assembly and are equiangularly spaced around the centre point.

In the first embodiment of the invention hereinafter to be described, the contact surfaces of each roller are formed by circumferential grooves, preferably of semi-circular or part-circular cross-section, arranged adjacent each other along the length of the roller and the rollers are so constructed that the grooves in each roller are displaced axially with respect to those in the next adjacent roller so that the line is guided by the grooves of successive rollers into a helical drive path round the assembly.

In the first embodiment of the invention, hereinafter to be described, the rollers are preferably mounted in a stationary roller support structure and are rotatably driven. They may however be adjustably fixed against rotation in a roller support structure which is itself arranged to be rotatably driven about the centre point of the assembly.

Accordingly, in a second embodiment of the invention, the elements are rollers and the rollers are assembled as two spaced sub-assemblies, the rollers of each sub-assembly being non-rotatably mounted in a roller support structure which is arranged to be rotatably driven about a centre point of the sub-assembly. The rollers of each sub-assembly are arranged on axes equidistant from the centre point of the sub-assembly and are equi-angularly spaced around the centre point of the sub-assembly and the roller support structures are so driven as to present a drive path for the line in which the line is drivingly engaged by and advanced through the predetermined angle of wrap around the two sub-assemblies by contact in turn with the outer surfaces of the rollers of the two sub-assemblies.

Two embodiments of the invention will now be described by way of example with reference to the accompanying drawings in which:-

Fig. 1 is a schematic perspective view of a capstan winch employing a line feeding device according to a first embodiment of the invention, with the drive to the device omitted;

Fig. 2 is a schematic elevation of the line feeding device illustrated in Fig. 1, drawn to an enlarged scale and showing the drive thereto;

Fig. 3 is a cross-section taken on the line III-III in Fig. 2 of part of the line feeding device shown in Fig. 2, drawn to an enlarged scale and showing one of the rollers of the device; and

Fig. 4 is a schematic elevation of a line feeding device for use in a capstan winch according to a second embodiment of the invention.

Referring first to Fig. 1, the device shown, which is used for hauling in steel rope under considerable tension, as for example in the recovery of disabled vehicles, comprises a storage drum 11 on which the rope 10 is stored, a guide pulley arrangement 12 for guiding the rope 10 in its passage to and from the drum 11, a capstan roller assembly 13 around which the rope passes in a plurality of turns and guide pulleys 14 and 15 which accept the rope 10 for hauling in and which guide it to the roller assembly 13.

The storage drum 11 and the rollers on the roller assembly 13 are driven for winding on of the rope 10 on the drum 11. The assembly 13 accepts the rope 10 from the pulleys 14 and 15 under considerable load and advances the rope 10 via the guide pulley arrangement 12 to the storage drum 11 which is driven for winding on the rope at low tension. The pulley arrangement 12 comprises a freely rotatable pulley 16 mounted on the upper end of a pivotal arm 17 which is freely pivotal at its lower end on a shaft 18, the arrangement being such that the rope 10 winds itself on the storage drum 11, with the guide pulley following the line determined by the rope, to produce a natural build on the drum 11 in which each successive turn of the rope 10 on the drum is laid adjacent the preceding turn first in a traverse of the drum in one direction to form a first layer on the drum and then in a traverse in the opposite direction to form a superposed next layer.

Referring now to Figs. 2 and 3, the roller assembly 13 comprises a plurality of grooved rollers 19 mounted for rotation on shafts 20 and 21 carried in stationary support plates 22 and 23 which together with other support structure form a rigid support for the rollers 19. Although for convenience of illustration the assembly 13 is shown with twelve rollers 19, in practice a large number of rollers 19 will be provided in the assembly and in a preferred arrangement a total of sixty are provided in place of the twelve shown. Each of the rollers 19 is provided with a plurality of grooves 24 in which the rope 10 is guided in a plurality of turns round the assembly 13. As will be seen, five grooves 24 are provided in the roller 19 illustrated in Fig. 3 and are arranged on the roller so as to leave a spacer section 25 at one end of the roller. The next roller 19 in the assembly 13 is arranged with the grooves 24 offset in relation to those of the roller 19 illustrated in Fig. 3 and similarly the grooves of each successive roller in the assembly are offset in relation to those of the preceding roller so that the rope 10 is guided by the grooves 24 of successive rollers 19 into a helical drive path round the assembly 13.

Each of the rollers 19 shown in Figs. 2 and 3 is provided with a pinion 26 and a gear wheel 28. The gear wheel 28 is fixedly mounted on a centre shaft 27 rotatably mounted in the support plates 22 and 23 and is arranged to be driven by a drive motor (not shown).

The capstan winch illustrated in Figs. 1 to 3 of the drawings may be vehicle mounted and used for the recovery of disabled vehicles. The rope 10 is stored on the drum 11 and in a recovery operation is paid out by reversing the drive to the roller assembly 13 and arranging for the storage drum 11 to exert back tension on the rope 10. While no tension is applied to the rope 10 the roller assembly 13 remains ineffective to pay out the rope. When a sufficient tension is applied to the free end of the rope to be paid out the roller assembly 13 then becomes effective to draw the rope from the storage drum 11. In this way, the rope 10 is paid out only when required and by an amount which can be controlled simply by the operator increasing or reducing the pull on the end of the rope. The paid out rope 10 is then hooked up to the disabled vehicle, the drive to the roller assembly 13 reversed and the drive to the storage drum 11 engaged.

As will be seen from Fig. 2, the rope 10 passes in a plurality of turns in a helical path round the assembly 13 and then passes to the guide roller 16 and to the storage drum 11. The rope 10 in making a complete turn round the roller assembly 13 is drivingly engaged by each roller 19 in turn. It follows an arcuate path round each roller in which it is subjected to bending stresses followed by an unsupported path in which it is subjected to little or no bending stresses. At each roller 19, the rope 10 has a small angle of wrap equal to 360° divided by the number of rollers 19, that is to say, an angle of wrap of 6°. The bending stresses in the rope are in effect imposed discontinuously by passage round successive rollers and are relatively

small. The rope 10 is nevertheless wound on to the assembly 13 on a large diameter which provides substantially the same advantages as those obtained when using a large diameter capstan roller.

The assembly 13 whilst maintaining the advantages of the large diameter capstan roller can furthermore be constructed using components of relatively low cost and of robust construction. As is well known, capstan rollers become subject to wear and the replacement a large diameter roller is costly. While the small diameter rollers 19 also become subject to wear provision can readily be made for replacement of them at low cost. In the assembly 13 illustrated in Fig. 2, it could well be found that the roller 19 which is first to receive the rope 10 being hauled in becomes subjected to more wear than the other rollers. In this event, its replacement can be carried out as a minor maintenance task at low cost.

In the embodiment of the invention described with reference to Figs. 1 and 3, the rollers 19 are arranged to be driven by a pinion 26 engaged by a gear wheel mounted on the centre shaft 27. It will however be appreciated that drive to the pinions 26 may be made through a number of intermediate idler gears. Furthermore, for some applications it may be found desirable to provide a separate drive motor for each of the rollers 19 or to provide separate drive motors for separate groups of rollers or only some of the rollers.

In paying out the rope 10 in the embodiment of the invention described with reference to Figs. 1 to 3,

tension is applied to the free end of the rope to be paid out so that the roller assembly 13 becomes effective to draw the rope from the storage drum 11. It will be appreciated that the rope 10 may alternatively simply be pressed on to one or more of the rollers 19 of the assembly 13 to allow a positive drive to the rope even when there is no tension on the free end of the rope.

While the grooves 24 of the rollers 19 are shown as being of semi-circular cross section, it will be appreciated that grooves of other cross sections may be used. For example, for some purposes it may be found preferable to use rollers having grooves of V-shaped form. In the first embodiment of the invention illustrated in Figs. 1 to 3, the rollers 19 are individually rotatably driven in a stationarily arranged support. In a second embodiment of the invention, as illustrated in Fig. 4, the rollers 19 are held against rotation in a support cage, which is itself arranged to be rotatably driven so as to present to the rope 10 a succession of spaced arcuate surfaces.

Referring now to Fig. 4, the roller assembly shown comprises two sub-assemblies 29 and 30. The sub-assembly 29 includes rollers 191 fixedly mounted between roller support plates 31 and 32 carried by a drive shaft 33. Similarly, the sub-assembly 30 comprises rollers 192 fixedly mounted between support plates 34 and 35 carried by a drive shaft 36. The drive shafts 33 and 36 carry gears 37 and 38 engaged by a drive chain 39 driven by a gear 40 mounted on the output shaft 41 of a drive motor 42.

Each of the rollers 191 is provided with a plurality of circumferential grooves in which the rope is guided and each may take the form of the roller 19 in the embodiment of the invention described with reference to Figs. 1 to 3, with the provision of five grooves and the omission of the spacer section 25. In contrast, however, to the rollers 19 of the assembly 13, the rollers 191 are identical to each other and have an identical positioning of the grooves so that the rope 10 each time it passes round the sub-assembly 29 in contact with the grooves of successive rollers is constrained to remain in a plane at right angles to the shaft 33. Similarly all the rollers 192 of the sub-assembly 30 are identical to each other and have identical positioning of the grooves so that the rope 10 each time it passes round the sub-assembly 30 in contact with the grooves of successive rollers is constrained to a path lying in a plane at right angles to the shaft 36. The rollers 192 of the sub-assembly 30 are however arranged with their grooves offset in relation to those of the rollers 191 so that the rope 10 is guided in a helical path round the two sub-assemblies.

The line feeding device described with reference to Fig. 4 whilst maintaining the advantages of the large diameter capstan winch employing two large diameter capstan drums can be constructed using components of relatively low cost and of robust construction. While the small diameter rollers 191 and 192 also become subjèct to wear provision can readily be made for replacement of them at low cost. Furthermore the mounting of the rollers 191 and 192 may be adjustably

fixed so that when a roller surface becomes subjected to wear the roller can be repositioned to present to the rope 10 an unworn part of the roller surface.

In the embodiments of the invention hereinbefore described with reference to the drawings, the pulley 16 is arranged to follow the winding on position of the rope 10 by mounting it on the freely pivotal arm 17. It will be appreciated that alternatively the pulley 16 may be mounted on a fixed horizontal slide bar and either be allowed freely to slide on the bar to follow the winding on position of the rope 10 or be driven along the bar by means which cause it to position itself at the winding on position during the build of the rope 10 on the drum 11. Although the arm 17 in the embodiment illustrated in the drawings is freely pivotal and is caused to follow the winding on position of the rope 10 by the rope itself, for some purposes it may be found desirable to arrange for the pivotal arm 17 to be driven, for example from a drive element engaged by a helical drive profile on a drive screw.

CLAIMS

1. A line feeding device for feeding a flexible line in which the line is drivingly engaged and advanced means by contact with an arcuate surface of drive means characterised in that the drive means comprises an assembly of five or more drive elements so disposed in spaced relation to each other as to present to the line a drive path for the line in which the line is drivingly engaged by and advanced through a predetermined angle of wrap around the assembly by contact in turn with an arcuate surface of each drive element over an angle of contact which is less than the predetermined angle of wrap and in which the line so extends between each drive element and the next adjacent drive element as to be relieved from bending stresses imposed on the line by contact with the arcuate surfaces of the elements.

2. A device according to claim 1, characterised by the fact that the elements are rollers so disposed about a centre point of the assembly and so driven as to present a drive path for the line in which the line contacts the surfaces of the rollers only on the sides of the rollers remote from the centre point of the assembly.

3. A device according to any of claim 2, characterised by the fact that the rollers of the assembly are mounted in a stationary roller support structure and are rotatably driven in the stationary support structure.

4. A device according to claim 3, characterised by the fact that the drive path extends to at least one turn about the centre point of the assembly.

5. A device according to claim 4, characterised by the fact that the rollers are arranged on axes equidistant from the centre point of the assembly.

6. A device according to claim 5, characterised by the fact that the rollers are equi-angularly spaced around the centre point of the assembly.

7. A device according to any of claims 4 to 6, characterised by the fact that the drive path makes a plurality of turns round the assembly and that the rollers are so constructed as to provide adjacent contact surfaces for adjacent turns of the line.

8. A device according to claim 7, characterised by the fact that the adjacent contact surfaces of each roller are formed by circumferential grooves arranged adjacent each other along the length of the roller.

9. A device according to claim 8, characterised by the fact that the rollers are so constructed that the grooves in each roller are displaced axially with respect to those in the next adjacent roller so that the line is guided by the grooves of successive rollers into a helical drive path round the assembly.

10. A device according to claim 1, characterised by the fact that the elements are rollers assembled as two spaced sub-assemblies, that the rollers of each

sub-assembly are non-rotatably mounted in a roller support structure which is arranged to be rotatably driven about a centre point of the sub-assembly, that the rollers of each sub-assembly are arranged on axes equidistant from the centre point of the sub-assembly and are equi-angularly spaced around the centre point of the sub-assembly and that the roller support structures are so driven as to present a drive path for the line in which the line is drivingly engaged by and advanced through the predetermined angle of wrap around the two sub-assemblies by contact in turn with the outer surfaces of the rollers of the two sub-assemblies.

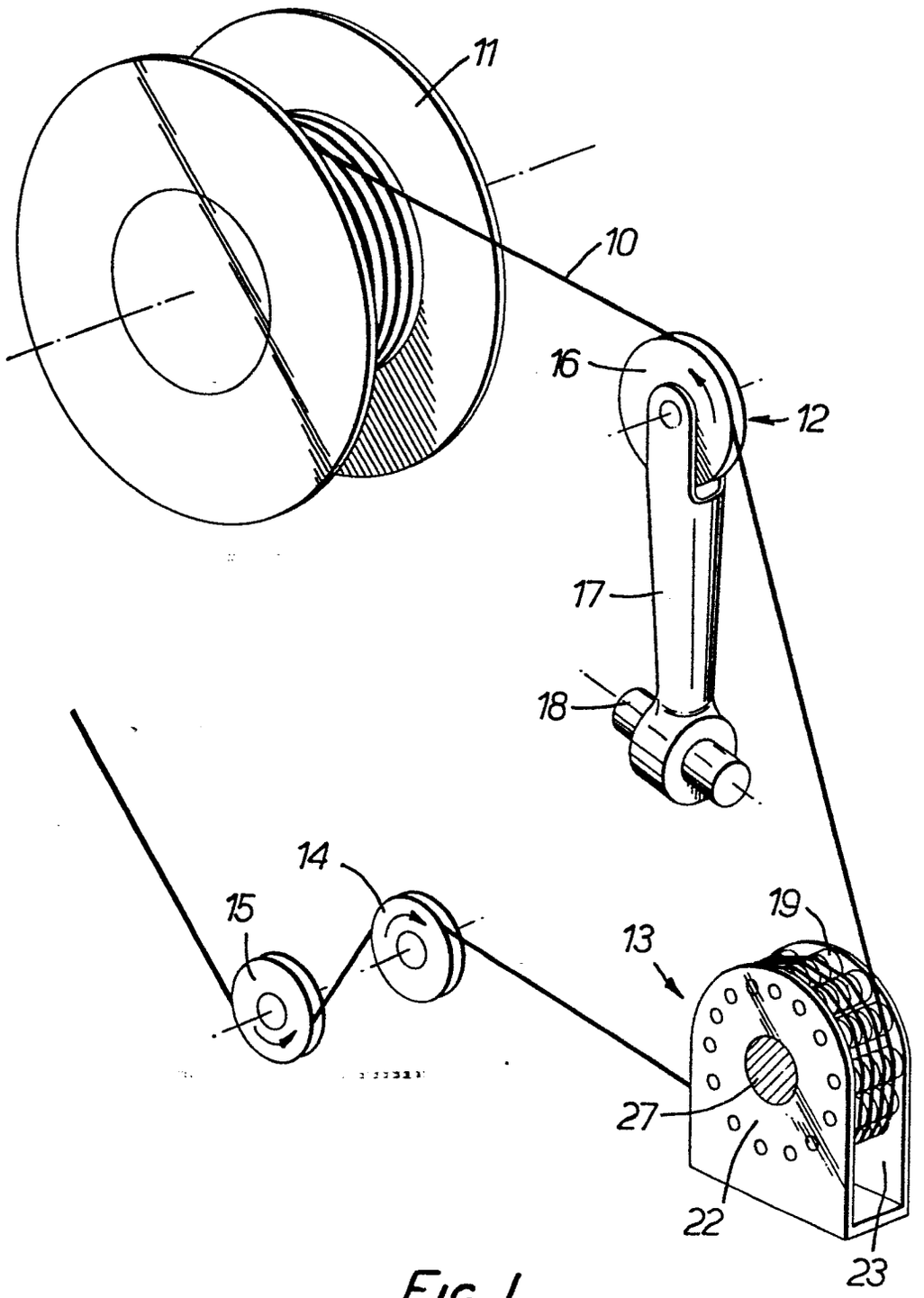

FIG. 1.

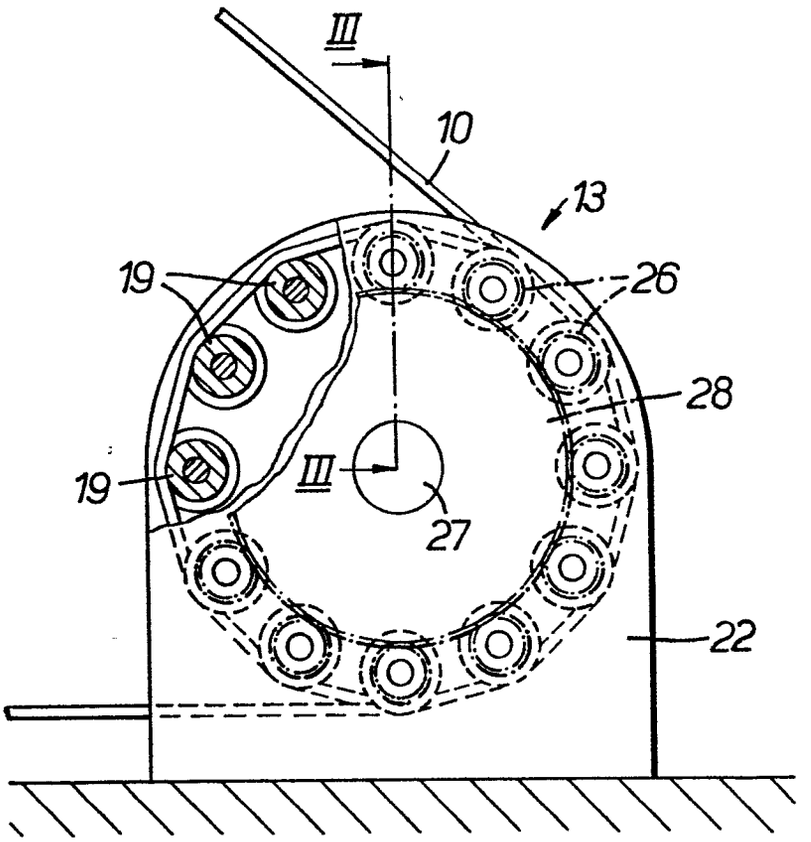

FIG. 2.

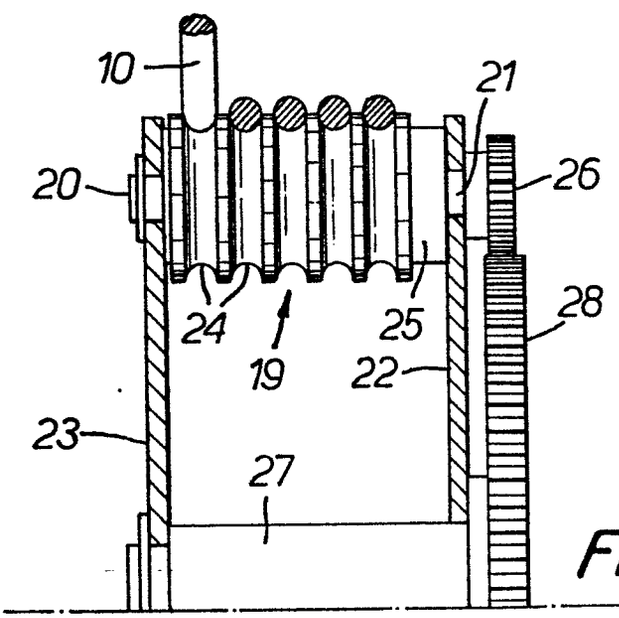

FIG. 3.

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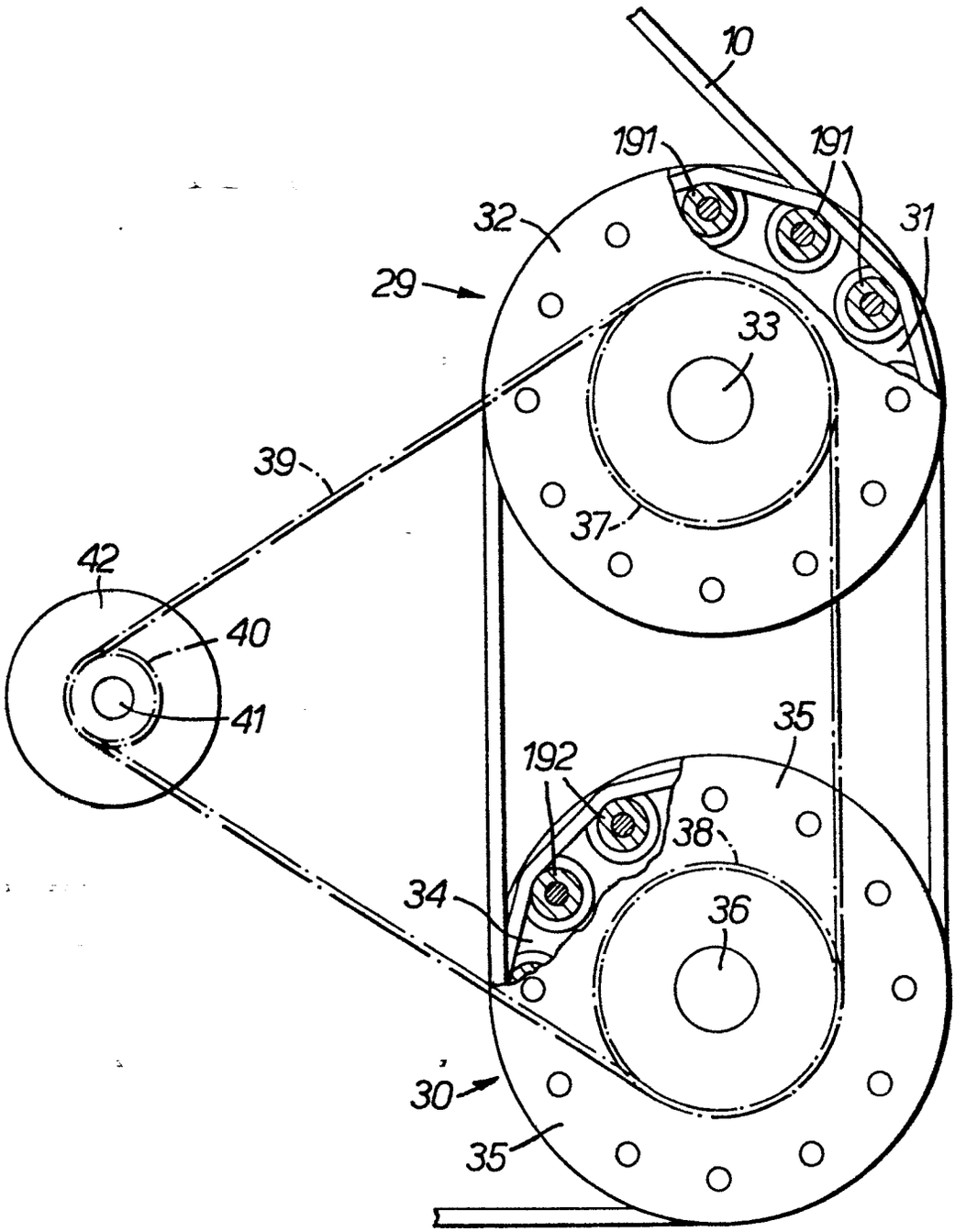

FIG. 4.

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EUROPEAN SEARCH REPORT

0145271
. Application number

EP 84 30 7703

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-1 920 224 (WEAVER) * Page 1, lines 1-49; figures 1-6 *	1-9	B 66 D 1/74
X	US-A-4 065 101 (KORKUT) * Claims 1, 2; figures 1-5 *	1-9	
A	US-A-3 834 673 (ALEXANDER) * Figure 4 *	10	
A	US-A-3 258 247 (JONES et al.)		
A	Soviet Inventions Illustrated Derwent Publications Ltd. Week E 34, 6 October 1982 Section Q38 Abstract number L3183 & SU-A-874-590 (GROMOV P.A.) 28-10-1981		TECHNICAL FIELDS SEARCHED (Int. Cl.4) B 63 B 21/00 B 63 B 27/00 B 66 D 1/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	31-01-1985	BARNY DE ROMANET P.M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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