(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 093 264 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.11.2016 Bulletin 2016/46

(51) Int Cl.:
B66D 1/08 *(2006.01)* ***B66D 1/50*** *(2006.01)*

(21) Application number: **15203152.2**

(22) Date of filing: **30.12.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **09.05.2015 SI 201500123**

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(54) A MECHANIC-HYDRAULIC SYSTEM WITH A PRESSURE REGULATOR FOR MAINTAINING A CONSTANT TRACTIVE FORCE POWER OF A WINCH

(57) A mechanic-hydraulic system with a pressure regulator for (21) maintaining a constant tractive force of a winch is disclosed whereby for each new layer of a towing rope on a winch drum (30) a pushing cylinder (33) is pushed away, wherein the cylinder rotates the axis of forks (34), which carry the pushing cylinder. Rotation of the forks' axis (34a) causes movement of a pole (36), which pushes a piston of a pressure regulator, consequently leading to an increase in oil pressure, which causes an increase of the cylinder piston pressure on couplings (15), resulting in an increase of the drum torque. The dimensions »e«, »f« and »g« of the forks and pole are adjustable and can be selected to maintain an almost constant tractive force of the winch.

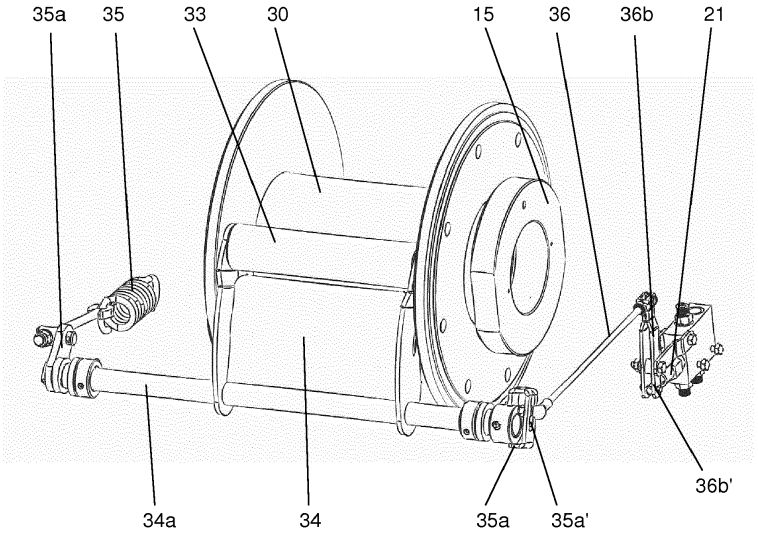

Figure 3

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Description

Field of invention

[0001] The present invention belongs to the field of mechanical engineering, more precisely to the field of hydraulic systems with a hydraulic accumulator as an additional source of hydraulic pressure energy particularly important in devices with uneven consumption. At the same time, the present invention also belongs to the field of pressure regulators for maintaining constant tractive force of forest winches.

Technical problem

[0002] The technical problem, which is solved by the present invention, is construction of such hydraulic system for steering and controlling a winding drum of a winch, which will together with the mechanic assembly at the winding drum enable keeping almost constant tractive force of the winch. When a winch is in use, the diameter of the drum changes in relation to the number of layers of wound wire rope, which consequently affects the tractive force of the winch. The task of the present invention is constructional arrangement of individual functional winch elements together with the elements of the hydraulic system, which would enable maintenance of constant tractive force of the winch even in the case when the towing rope is entirely wound to the drum or in the case when the towing rope is almost entirely unwound. During use of the winch a situation, in which the tractive force must be regulated according to a specific situation in a work process, can occur. If the tractive force of the winch decreases due to the increase of rope radius on the drum to a such extent that the force of resistance is larger than the tractive force, the load stops, as the lamella of the coupling start to slide, which represents a problem in practice. A constant tractive force enables optimal function of the coupling. The aim of the invention is a constructional solution of mechanic parts of the drum together with accessory parts, which will allow influence on hydraulic parameters.

State of the art

[0003] Usual forest winches have the highest tractive force when the drum is empty or when the drum has one layer of rope wound to it. Lamellar clutch/coupling are compressed with a constant force, therefore a constant momentum is always transferred from the drive shaft to the drum of the winch. With winding of the rope to the drum the radius of the last layer of the rope increases, therefore the tractive force decreases, as the torque is equal to the product of force and distance of the force line from the axis.

[0004] Until now known solutions for optimization of the tractive force of a winch due to the effect of number of layers/coils of the towing rope on the drum of a winch are EP2565144 »Winch« and SI24108 »Forestry winch with controlled winding of traction rope and protection thereof overload«.

[0005] The winch described in patent document EP2565144, comprises a drive shaft, a drum for winding a rope, a coupling of the drum for transfer of rotational movement of the drive shaft to the wire drum, a break of the drum for braking the rope drum and an outlet device of the rope with at least one sheave. The sheave can be propelled for unwinding the rope and with transmission, which has a coupling of the rope outlet, wherein the sheave is connected with the drive shaft. The invention is characterized in that the coupling of the rope outlet is formed with a coupling, which is activated hydraulically. This solution differs from the present invention, in which hydraulically steered mechanism is included in assuring mechanical deviation of handles with the aim of maintaining almost constant tractive force of the winch.

[0006] Slovene patent no. 24108 discloses a solution of a forest winch, in which winding of a rope is performed in a controlled manner, which means that each disposable windings of said cable on the surface of a winding drum should be arranged side by side relatively to each other and without any transpositioning or overlapping, while at the same time each overloading of said towing cable and other components of a driving assembly due to towing of too heavy load should be excluded. To this aim, the winch is furnished-with-a-directing assembly, which is arranged between an upper pulley block and said winding drum and is freely rotatable or least pivotable at certain angle around the vertical geometric axis, wherein said winch moreover includes a dynamometer suitable for measuring of tensioning force within said towing cable, so that also the winding drum can be controlled depending on each measured loading of the towing cable.

[0007] Known solutions from practice do not solve the technical problem in a manner similar to the present invention, which enables regulation of oil pressure in dependence on the diameter of the wound wire rope, which consequently means maintenance of almost constant tractive force of the rope of a winch.

Description of the invention

[0008] The essence of the mechanic-hydraulic system with a pressure regulator for maintaining constant tractive force of a winch is that at each new layer of a towing rope on a winch drum a pushing cylinder is pushed away, wherein the cylinder rotates the axis of forks, which carry the pushing cylinder. Rotation of the forks' axis causes movement of a pole, which pushes a piston of a pressure regulator for one step, consequently leading to an increase in oil pressure, which causes an increase of the cylinder piston pressure on couplings, resulting in an increase of the drum momentum. The invention is based on a mathematical algorithm defined by distances »e«, »f« and »g«, which causes movement of the piston of

the pressure regulator for each movement of the pushing cylinder or fork axis, respectively, due to a new layer of the towing rope on the drum. Increasing or decreasing the oil pressure in the hydraulic system in accordance with changes in distances »e«, »f« and »g« results in maintenance of an almost constant tractive force of the winch.

[0009] The mechanic-hydraulic system with a pressure regulator for precise definition of the tractive force of a winch will be described in further detail by reference to the accompanying figures, which show:

Figure 1 A hydraulic scheme of the system with a pressure regulator,
Figure 2 A scheme of the system for controlling constant or variable tractive force,
Figure 3 The mechanic-hydraulic system according to the invention,
Figure 4 A scheme of radii of the rope on the drum,
Figure 5 A graphic representation of possibilities for setting the tractive force.

[0010] A pump 3 fills a hydraulic accumulator 9 via check valves 4 and 7 to a working pressure, which is set on a pressure relief valve 5. When oil in the hydraulic accumulator 9 reaches the set working pressure, the pressure relief valve 5 opens and remains in an open position until the pressure in the hydraulic accumulator 9 drops for a specified value, which is approximately 10 to 15 bar. Oil freely flows to a flow regulator 16 and a control valve 6, when the valve 5 is open. The smaller resistance is on the side of the valve 6, therefore oil flows through the valve 6 into an oil reservoir 1. Due to this technical realization of the hydraulic equipment, the pump 3 operates most of the time at a lower pressure, namely at a pressure up to 10 bar. In case the user selects a function of rope unwinding, the valve 6 (right) and a valve 11 (right) are simultaneously switched. Oil runs from the pump through the valve 6 to the flow regulator 16, a check valve 17 to a hydraulic motor 19, which drives the unwinding sheave, with which a rope 31 is led from a drum 30 of the winch. At the same time oil from the hydraulic accumulator 9 via a damper 8, a valve 11 and an adjustable damper 33 activates a cylinder of a break 14 and thereby releases the break of the drum, so that the rope on the drum 30 starts to unwind due the tractive force in the rope 31, which is caused by the hydraulic motor 19. Pressure in the inlet line to the hydraulic motor 19 rises up to 50 to 70 bar.

[0011] When the user turns on rope winding, the valve 11 (left) and a valve 20 (right) are switched, so the oil runs from the hydraulic accumulator 9 through the damper 8, the valve 11 and a pressure regulator 21 activates a cylinder 15 of a coupling.

[0012] In case the pressure in the hydraulic accumulator 9 drops for a specified value, the pressure relief valve 5 is closed and the pump fills the hydraulic accumulator 9 to the set working pressure.

[0013] When the oil flows through the valve 5 into a common point with the valve 6 and reservoir, the current runs to a controlling valve 20, which is connected in parallel to the hydraulic cylinder 15 of the coupling. When winding, the valve 11 and the valve 20 have to be simultaneously switched, so that the hydraulic cylinder 15 of the coupling is turned on. Activation of winding results in simultaneous switching of the left part of the valve 11 and the right part of the valve 20. Oil from the accumulator flows towards the hydraulic cylinder 15 of the coupling, thereby activating the latter, while oil cannot run through the right part of the valve 20. After winding is stopped the valve 11 and the valve 20 are switched into their starting position. If any of the valves is blocked, oil can always freely flow into the reservoir through the valve 11 or the valve 20. The hydraulic scheme also includes the pressure regulator 21 and a check valve 22, which is on one side connected with the reservoir 1 hub, the valve 6 and the valve 20, and on the other side with the pressure regulator 21.

[0014] Common forest winches have the highest tractive force F, when the drum 30 is empty or has only one layer of the rope 31 wound on it. Lamellae of the coupling are compressed with a constant force, therefore a constant torque M is transferred from the drive shaft onto the drum 30 of the winch. By winding of the rope 31 to the drum 30 the radius »r« of the last layer of rope on the drum increases, therefore the tractive force F decreases, as follows from the equation

$$M = r \times F.$$

[0015] As shown in figure 3 the first layer of rope on the drum has a radius »rn« and the last anticipated layer of rope on the drum has a radius »rz«. The working pressure is »po«. When the pushing cylinder is at the level of the first rope layer on the drum, a decreased working pressure reaches the coupling, namely

$$pn = po \times rn/rz;$$

[0016] The result is that in case of an empty drum the working pressure »p« is lower. When the whole length of the rope is wound on the drum, the working pressure »p« is equal to the pressure »po«. When the rope is partially wound and »r« has any value, the pressure can be calculated with the following equation:

$$p=po \times r/rz.$$

[0017] The pressure »p« in the pressure regulator 21 is set by transposing levers or lever arms, respectively,

thus by selecting lever arms »e« and »g« and length »f« of the pole 36.

[0018] The mechanic-hydraulic system according to the invention has a pushing cylinder 33 mounted to forks 34, which oscillate around a lower axis 34a, to which a spring 35 is mounted with an accessory 35a on one side and a fastening element 36a for a pole 36 is mounted on the other side. Distance »g« is between the centreline of the axis 34a, where the bottom part of the accessory 35a is mounted, and the centreline of the upper part of the accessory 35a, where the spring 35 is mounted. On the other side of the axis 34a a fastening element 36a with a groove 36a' is mounted, into the said groove 36a' the second part of the pole 36 is installed, which is preferably a threaded rod. The second part of the pole 36 is rotatably mounted into a holder 36b, which is via a part 36b' in contact with the piston of the regulation valve 21. Distance »e« is between the centreline of the axis 34a and the area in the groove 36a', where the first part of the pole 36 is fixed. Distance »f« is between the first part of the pole 36 and the centreline of the mounting of the second part of the pole 36 in the holder 36b. Pre-strained spring 35 pulls the forks 34 on the lever arm »g« and thereby pushes the pushing cylinder 33 on the drum 30 with the wound rope 31.

[0019] By winding of the rope 31 onto the drum 30 the radius of the current layer of rope on the drum is increased. The pushing cylinder 33, which is mounted on the forks 34, is therefore moving away from the axis of the drum 30, as the forks 34 rotate around the axis 34a. Rotation of forks 34 causes a horizontal shift of the pole 36 along the groove 36a' of the fastening element 36a. The size of the horizontal shift of the part 36b' of the holder 36b is adjustable with distances »f« and »e«. The pole 36 pushes the piston of the pressure regulator 21 with the part 36b' of the holder 36b, which causes an increase in oil pressure. If the pole 36 is moved away, the piston of the pressure regulator 21 is released due to the shift of the part 36b', resulting in decreased oil pressure.

[0020] Depending on the construction of the pressure regulator 21, the piston of the check valve 22 can be pushed for a defined value with the pole 36. The distance of the movement of the part 36b' of the holder 36b towards the regulating valve 21 is limited. The starting position of the part 36b' is fully retracted. The pushing cylinder 33 on the drum 30 pushes onto the first layer of the rope. The pressure of oil, which is let by the pressure regulator 21 to the coupling cylinder, is »pn« and its lowest value is around 90 bar. The relationship between the shift of the pushing cylinder 33 from the drum 30 axis and the shift of part 36b' of the holder 36b towards the regulation valve 21 is approximately linear. Therefore, with an increase of the radius of the layers on the drum 30 the oil pressure to the coupling cylinder 15 is linearly increased. When the layers of rope on the drum reach radius »rz«, the piston of the pressure regulator 21 is with the pole 36 maximally pushed and the oil pressure to the coupling cylinder 15 is the highest.

[0021] Figure 4 shows the winch drum and radius »rn« as well as diameter »rz« and on the vertical axis force F, wherein areas A, B, C, D depend on selected sizes of force Fn, so that the force F is constant. It is visible from the figure 4 that it is possible to select the size of force Fn by altering distances »e«, »g« and »f«, wherein the force F changes in an approximately linear manner. Setting of distances »e«, »g« and »f« is enabled by altering the mounting position of the spring 35 and both ends of the pole 36.

[0022] The result of previously described construction of the drum 30 with the wound rope 31, forks 34, pole 36, which is directly connected with the pressure regulator 21, is almost a constant tractive force F for the entire area of rope 31 winding on the drum 30, as well as the possibility of setting different tractive forces F by setting distances »e«, »g« and »f«.

Claims

1. A mechanic-hydraulic system with a pressure regulator for maintaining a constant tractive force of a winch, **characterized in that** a pushing cylinder is pushed away with each new layer of a towing rope on a winch drum, wherein the cylinder rotates the axis of forks, which carry the pushing cylinder; that rotation of the forks' axis causes movement of a pole, which pushes a piston of a pressure regulator for one step, consequently causing an increase in oil pressure, which causes an increase of the cylinder piston pressure on couplings, resulting in an increase of the drum momentum; that distances »e«, »f« and »g« change with each movement of the pushing cylinder or the forks' axis due to a new layer of the towing rope on the drum, resulting in closing or opening of the pressure regulator with movable part of attachments, which consequently increases or decreases oil pressure in the hydraulic system; that in accordance with changes in distances »e«, »f« and »g« and directly connected forks of the pushing cylinder, a spring and the pole, an almost constant tractive force of the winch is maintained.

2. The mechanic-hydraulic system with a pressure regulator for maintaining a constant tractive force according to claim 1, **characterized in that** the pushing cylinder (33) pushes the rope (31) onto the drum (30); that the pushing cylinder (33) is rotatably mounted onto forks (34), which oscillate around the lower axis; that the forks (34) have a variable length of lever arms (e) and (g); that a pole 36 with length (f), which is adjustable, is between the lever arm (e) and the proportional pressure regulator (21); that a pre-strained spring (35) pulls the forks (34) on the lever arm (g) and pushes the pushing cylinder (33) onto the rope (31) and the drum (30).

3. The mechanic-hydraulic system with a pressure regulator for maintaining a constant tractive force according to claim 2, **characterized in that** the pressure (p) in the pressure regulator (21) is set by transposing levers or lever arms, respectively, thus by selecting lever arms »e« and »g« and length »f« of the pole 36.

4. The mechanic-hydraulic system with a pressure regulator for maintaining a constant tractive force according to any of preceding claims, **characterized in that** it is possible to select the size of force (Fn) by altering distances (e), (g) and (f), wherein the force (F) changes in an approximately linear manner.

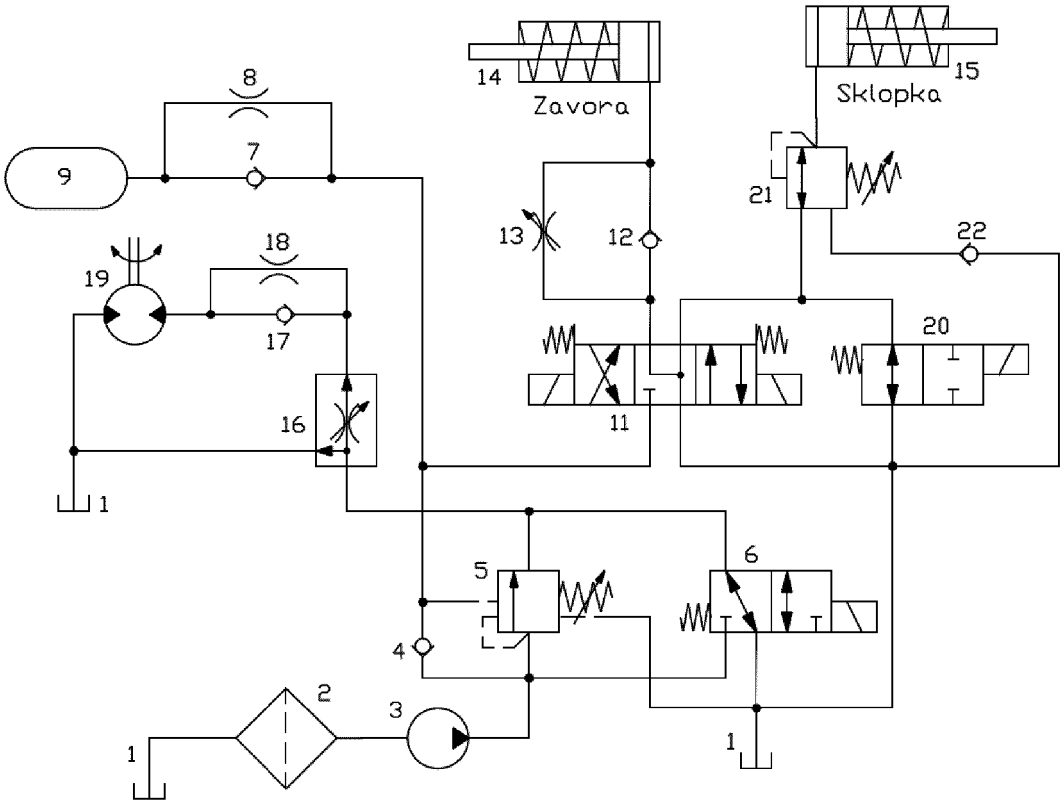

Figure 1

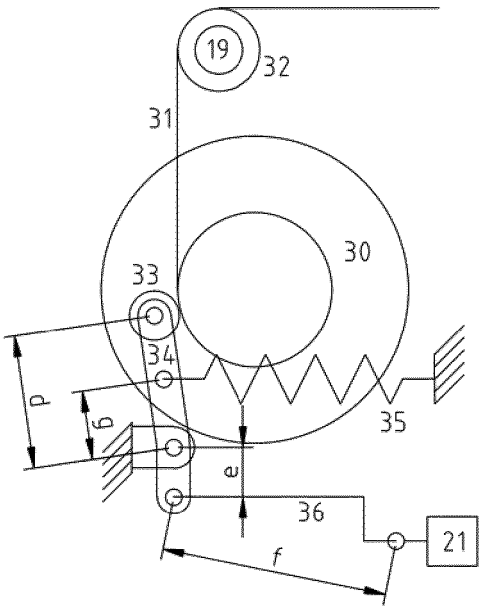

Figure 2

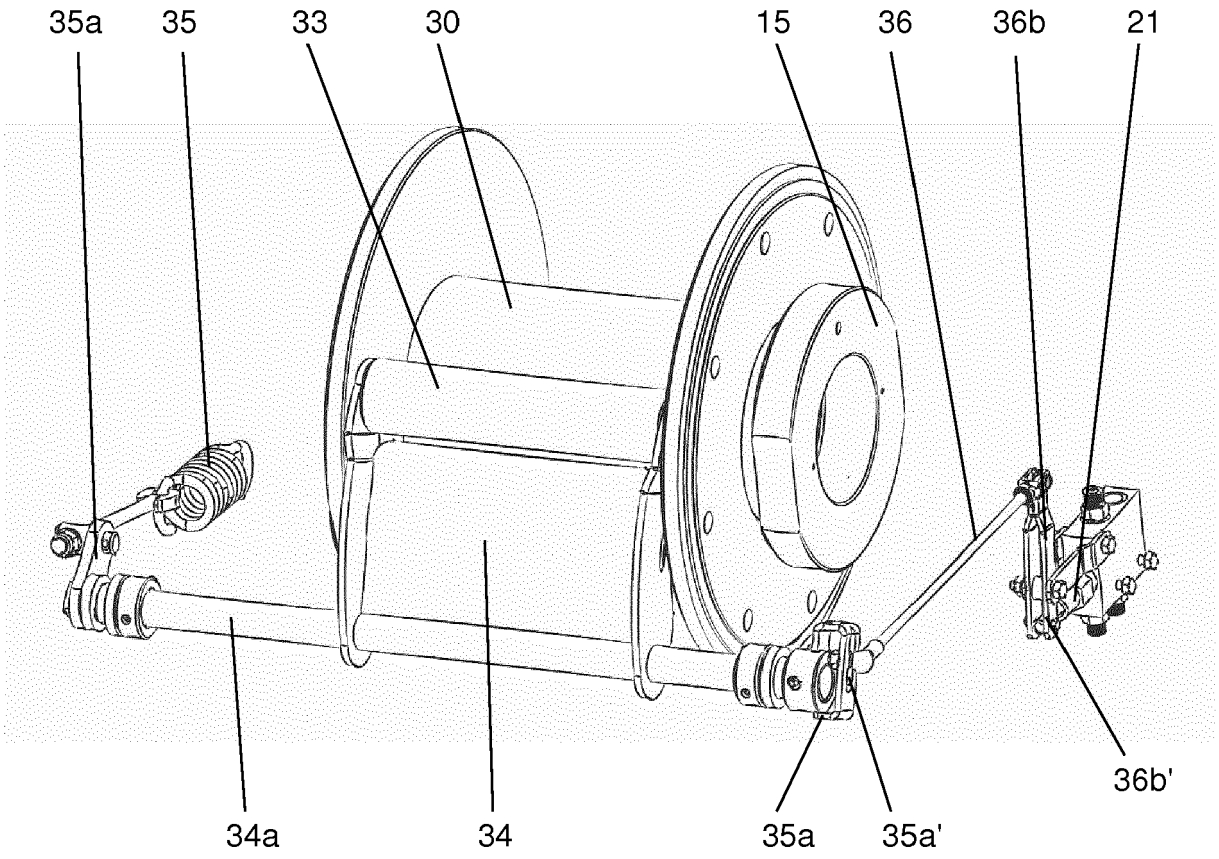

Figure 3

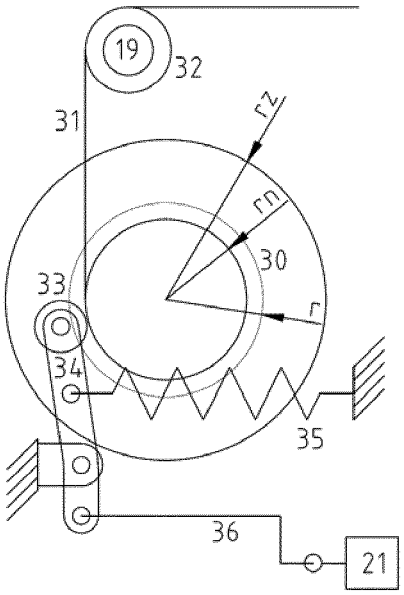

Figure 4

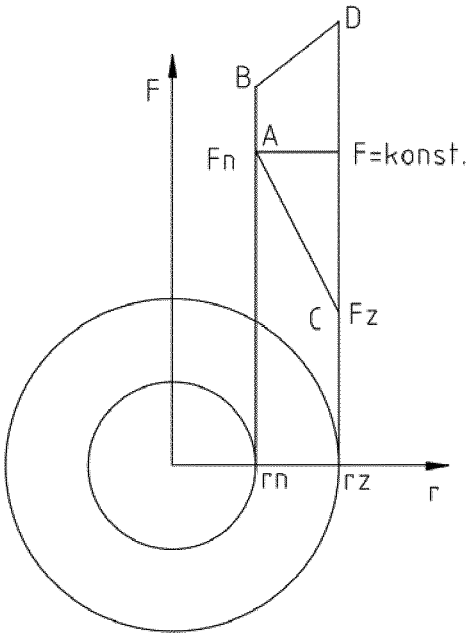

Figure 5

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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 3152

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 100 34 336 A1 (WELTE FAHRZEUGBAU GMBH [DE]) 31 January 2002 (2002-01-31) * abstract * * paragraph [0028] - paragraph [0038] * * figures *	1	INV. B66D1/08 B66D1/50
A	DE 29 22 421 A1 (BBC BROWN BOVERI & CIE) 11 December 1980 (1980-12-11) * page 9 - page 11 * * figures *	1	
A	GB 1 244 661 A (HELSINGBORGS VARFS AKTIEBOLAG [SE]) 2 September 1971 (1971-09-02) * the whole document *	1	
A	JP S58 78999 A (SHIN MEIWA IND CO LTD) 12 May 1983 (1983-05-12) * figures *	1	
			TECHNICAL FIELDS SEARCHED (IPC) B66D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 September 2016	Sheppard, Bruce

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10034336 A1	31-01-2002	NONE	
DE 2922421 A1	11-12-1980	DE 2922421 A1	11-12-1980
		IT 1131493 B	25-06-1986
GB 1244661 A	02-09-1971	DE 1809441 A1	14-08-1969
		GB 1244661 A	02-09-1971
JP S5878999 A	12-05-1983	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- EP 2565144 A **[0004] [0005]**
- SI 24108 **[0004] [0006]**