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(54) **Device for guiding bundles of parallel ropes, cables, or pipes according to a three-dimensional path in an earth-digging machine**

Vorrichtung zur Führung von Bündeln aus parallelen Seilen, Kabeln oder Rohren entlang eines dreidimensionalen Pfades in einem Bagger

Dispositif de guidage de grappes de cordes, câbles ou tuyaux parallèles selon un chemin tridimensionnel dans une foreuse

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## Description

**[0001]** Forming the subject of the present invention is a device for guiding bundles of parallel ropes, cables, or pipes according to a three-dimensional path in an earth-digging machine.

**[0002]** One of the problems frequently encountered in the sector of earth-digging machines consists in supplying a piece of equipment set within the excavation itself with a source of hydraulic power, external to the excavation.

**[0003]** In some cases, numerous flexible pipes are envisaged to be arranged possibly in orderly bundles that have to run out of and into the excavation and are to be gathered on winding drums.

**[0004]** In a similar way, there can be provided steel cables for suspension and manoeuvre and electric cables for control and/or transmission of data, with an arrangement and movements similar to those of flexible pipes or hoses.

**[0005]** In a particular case, which in what follows will form the preferred, but non-limiting, embodiment as reference for the description and the drawings, the excavation is vertical and requires at least one bundle of parallel pipes set in a plane, which descend vertically into the excavation as far as the piece of earth-digging equipment and are unwound from and wound onto individual winding drums set on the earth-moving machinery.

**[0006]** The most obvious solution is for each individual pipe to have a path that lies in a vertical plane, which passes through the axis of the pipe in the excavation and constitutes the median plane of the sheave and of the winder. In this way, parallel pipes have paths in parallel planes, and the vertical pipes can be in a single plane perpendicular to the aforesaid parallel planes.

**[0007]** Likewise obvious is the solution according to which different pipes converge towards the axis of excavation with paths in vertical planes that are different and convergent.

**[0008]** Document DE A1-10016021 discloses a crane comprising a device for guiding bundles of parallel ropes cables or pipes according to a three-dimensional path, in which the crane possesses a winder assembly for the ropes and at least two set of sheaves, of which one comprises sheaves of different diameter.

**[0009]** The European patent No. EP-0843050 describes one of these cases in which a piece of equipment is provided with winding drums having a horizontal axis and guiding sheaves with an axis closely parallel to that of the drums, in a way similar to a winch and the respective sheaves.

**[0010]** In the case where there are parts of the machine that interfere with the path in a plane, or if it is necessary to provide various bundles of pipes with different paths that can interfere with one another, a solution proves useful that enables three-dimensional paths and arrangements of co-planar bundles that are not orthogonal with respect to the planes of the path, with a wide freedom of choice.

**[0011]** This type of approach affords a good degree of flexibility of solution to various problems of arrangement and path of flexible elements, such as hydraulic pipes, steel cables, electric cables, and the like, set in planar bundles of parallel elements.

**[0012]** The invention is aimed at this type of solution and, in particular, is based upon the creation of a set of parallel sheaves, set on the same axis of rotation but of different diameters; the primitive diameters of the sheaves are preferably arranged on a conical surface of envelope.

**[0013]** By means of the solution proposed by the invention, parallel and co-planar pipes reach the sheaves according to a plane that is tangential to the cone and exit according to another tangential plane. The directions of entry and exit, to enable proper winding on the sheave, must lie in the median plane of the sheave; however, the planes of the incoming and outgoing bundles, unlike the case of sheaves of the same diameter, are not parallel to the axis of the sheaves.

**[0014]** By varying the angle of aperture of the cone, the angle of winding, and the position of the axis, it is possible to create arrangements as desired. By combining two sets of sheaves, at least one of which of different diameter, three-dimensional paths are obtained that are useful for preventing any interference, for following structures of the machine, and so forth.

**[0015]** To obtain the above and further advantages that will be understood more clearly from what follows, the invention proposes provision of an earth-digging machine according to claim 1 with a device for guiding bundles of parallel ropes, cables, or pipes according to a three-dimensional (or non-planar) path. The device has at least two sets of parallel sheaves, at least one of which is made up of sheaves of different diameters.

**[0016]** There now follows a description of the device according to the invention, with reference to the annexed plates of drawings, in which:

Figure 1 illustrates a set of sheaves of diameters that increase according to a cone, in accordance with the invention;

Figure 2 illustrates a set of sheaves of different diameters enveloped by a barrel shape, according to the invention;

Figure 3 is the top-plan view of an arrangement for guiding pipes according to a three-dimensional path, with a "conical" set and a "cylindrical" set;

Figure 4 is the perspective view from above of the same arrangement; and

Figure 5 is the preferred arrangement in an excavating machine.

**[0017]** With reference to Figure 1, by means of the solution proposed by the invention, parallel and co-planar pipes 1 arrive at the sheaves 7 according to a plane 2 tangential to the cone and exit according to another tan-

gential plane 3. The entry and exit directions, in order to enable proper winding on the sheave, lie in the median plane of the sheave; however, the planes 2 and 3 of the incoming and outgoing bundles, unlike the case of sheaves of the same diameter, are not parallel to the axis of the sheaves.

**[0018]** Figure 2 shows a similar solution, in which the diameters of the sheaves 7 are enveloped by a toric (barrel-shaped) surface so that the incoming and outgoing bundles of pipes 1' lie on cylindrical surfaces 2' and 3' tangential to the toric surface.

**[0019]** With reference to Figures 3 and 4 and to the case of vertical excavations, a vertical bundle of pipes 4 is guided by a cylindrical set of sheaves 5, in a plane close to the horizontal in a direction 6 orthogonal to the plane of the bundle 4. Next, a conical set of sheaves 7 guides in a desired skew direction 8, keeping the bundle in a plane oriented according to the position of the winder assembly 9.

**[0020]** From a comparison of Figures 3 and 4 with Figures 1 and 2, the set of sheaves of different diameters is always designated by 7, the bundle of pipes 1 and 1' of Figures 1 and 2 corresponds to the bundle 6 in Figures 3 and 4, whilst the bundle of pipes 3 and 3' of Figures 1 and 2 corresponds to the bundle 8 in Figures 3 and 4.

**[0021]** It may be noted that the plane that contains the bundle of the vertical pipes 4 is oriented in a different manner with respect to the plane of lie at exit from the winder assembly 9 and to the common axis of the sheaves of the two guiding assemblies.

**[0022]** The machine frequently causes convergence on the axis of drilling of various bundles of pipes having winder systems set in different positions on the excavating machinery. Figure 5 represents two bundles of vertical pipes in two planes parallel to one another, and a central pipe.

**[0023]** With reference to the diagrams of Figures 3 and 4, there may be noted the bundle of vertical pipes 4 that is wound on the winder 9 after being run over the guide assembly 5 and the guide assembly 7.

**[0024]** In addition, on the machine of Figure 5 there may be noted a vertical bundle of pipes 12, which is wound on the winder 42 after being run over the guide assembly 22; finally, there may be noted a central pipe 13, which is wound on the winder 43 after being run over the guiding sheave 23.

**[0025]** The above arrangement prevents any interference with the lattice arm 51, its stays 52, the stand 53, the manoeuvring ropes 54, and between the pipes of the system itself.

**[0026]** Hence, the subject of the invention is a set of sheaves set parallel to one another but of increasing diameters so that the primitive diameters are set on an imaginary surface of a conical shape.

**[0027]** Thus, by way of example, in the case where the bundle of pipes is deviated through ninety degrees, said bundle of pipes, which are horizontal and parallel as they enter, comes off as a bundle of parallel vertical pipes that lie in a plane inclined with respect to the initial direction of the pipes by an angle equal to the half-aperture of the cone.

**[0028]** With reference to the geometry of Figures 3, 4 and 5, the common axis of the sheaves of a conical set is neither horizontal nor parallel to that of the winding drums, whilst that of the cylindrical set is horizontal but not parallel.

**[0029]** Without departing from the scope of the inventive idea underlying this invention, the sheaves with different diameters may not be coaxial but have parallel axes, or else the bundle of incoming or outgoing pipes may not lie in a single plane, or again the sheaves of different diameters may not be enveloped by a cone-shaped imaginary surface as in Figure 1, but rather a barrel-shaped surface as in Figure 2 (convex toric surface), or else saddle-shaped surface (concave toric surface).

## Claims

1. An earth-digging machine for vertical excavation comprising a winder assembly and a device for guiding bundles of parallel ropes, cables, or pipes according to a three-dimensional (or non-planar) path, said device being provided downstream of the winder assembly (9), the vertical bundle of pipes being guided first by a cylindrical first set of parallel sheaves in a plane close to the horizontal in a direction orthogonal to the plane of said bundle and **characterised in that** said bundle is then guided by a second set of parallel sheaves mounted on the same axis and with different diameters that guides it in a desired skew direction, keeping the bundle of ropes, cables or pipes in a plane oriented according to the position of the winder assembly.

2. The earth-digging machine according to Claim 1, **characterized in that** the second set of sheaves (7) has are at least three and sheaves with their respective primitive diameters set on an imaginary surface of a conical shape.

3. The earth-digging machine according to Claim 1, **characterized in that** the second set of sheaves (7) has at least three and sheaves enveloped by an imaginary barrel-shaped surface (convex toric surface).

4. The earth-digging machine according to Claim 1 **characterized in that** the second set of sheaves (7) has at least three sheaves are enveloped by an imaginary saddle-shaped surface (concave toric surface).

5. The earth-digging machine according to Claim 1, **characterized in that** the axis common to the

sheaves of the second set (7) is neither horizontal nor parallel to that of the winding drums (9), whilst that of the cylindrical first set (5) is horizontal but not parallel to that of the winding drums (9).

6. The earth-digging machine according to Claim 2, **characterized in that** the bundles of pipes at entry into (1, 6) and the bundles of pipes at exit from (3, 8) the conical set lie in respective planes.

7. The earth-digging machine according to Claim 3 or Claim 4, **characterized in that** the bundles of pipes at entry into (1, 6) and the bundles of pipes at exit from (3, 8) the sheaves of different diameters lie on respective cylindrical surfaces.

**Patentansprüche**

1. Erdaushubmaschine zur vertikalen Ausgrabung, umfassend eine Wickeleinheit und eine Vorrichtung zum Führen von Bündeln von parallelen Seilen, Kabeln oder Rohren gemäß eines dreidimensionalen (oder nicht ebenen) Pfades, wobei die Vorrichtung stromabwärts der Wickeleinheit (9) vorgesehen ist, wobei das vertikale Bündel von Rohren zuerst durch einen ersten Satz von parallelen Seilrollen in einer Ebene nahe der Horizontalen in eine Richtung orthogonal zur Ebene des Bündels geführt wird und **dadurch gekennzeichnet ist, dass** das Bündel dann durch einen zweiten Satz von parallelen Seilrollen, die auf der gleichen Achse angebracht sind und unterschiedliche Durchmesser aufweisen, geführt wird, welcher es in eine angestrebte schräge Richtung lenkt, wodurch das Bündel von Seilen, Kabeln oder Rohren in einer Ebene gehalten wird, die entsprechend der Position der Wickeleinheit ausgerichtet ist.

2. Erdaushubmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** der zweite Satz von Seilrollen (7) zumindest drei Seilrollen mit ihren entsprechenden Ausgangsdurchmessern aufweist, welche von einer gedachten Oberfläche einer konischen Form abgenommen sind.

3. Erdaushubmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** der zweite Satz von Seilrollen (7) zumindest drei Seilrollen aufweist, welcher durch eine gedachte fassförmige Oberfläche (konvexe torische Oberfläche) eingehüllt ist.

4. Erdaushubmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** der zweite Satz von Seilrollen (7) zumindest drei Seilrollen aufweist, welcher durch eine gedachte sattelförmige Oberfläche (konkave torische Oberfläche) eingehüllt ist.

5. Erdaushubmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Achse, welche für die Seilrollen des zweiten Satzes (7) eine gemeinsame ist, weder horizontal noch parallel zu jener der Wickeltrommeln (9) ist, während jene des ersten Satzes (5) horizontal, aber nicht parallel zu jener der Wickeltrommeln (9) ist.

6. Erdaushubmaschine nach Anspruch 2, **dadurch gekennzeichnet, dass** die Bündel von Rohren beim Eintritt in (1, 6) und die Bündel von Rohren beim Austritt aus (3, 8) dem konischen Satz in jeweilig entsprechenden Ebenen liegen.

7. Erdaushubmaschine nach Anspruch 3 oder Anspruch 4, **dadurch gekennzeichnet, dass** die Bündel von Rohren beim Eintritt in (1, 6) und die Bündel von Rohren beim Austritt aus (3, 8) den Seilrollen unterschiedlicher Durchmesser auf jeweilig entsprechenden zylindrischen Flächen liegen.

**Revendications**

1. Foreuse pour l'excavation verticale comprenant un ensemble enrouleur et un dispositif destiné au guidage de faisceaux de cordes, câbles ou tuyaux parallèles selon un chemin tridimensionnel (ou non planaire), ledit dispositif étant prévu en aval de l'ensemble enrouleur (9), le faisceau vertical de tuyaux étant guidé d'abord par un premier jeu cylindrique de réas parallèles dans un plan proche de l'horizontale dans une direction orthogonale au plan dudit faisceau et **caractérisé en ce que** ledit faisceau est ensuite guidé par un second jeu de réas parallèles montés sur le même axe et avec des diamètres différents qui le guide dans une direction oblique souhaitée en maintenant le faisceau de cordes, câbles ou tuyaux dans un plan orienté selon la position de l'ensemble enrouleur.

2. Foreuse selon la revendication 1, **caractérisée en ce que** le second jeu de réas (7) possède au moins trois réas dont les diamètres primitifs respectifs sont positionnés sur une surface imaginaire de forme conique.

3. Foreuse selon la revendication 1, **caractérisée en ce que** le second jeu de réas (7) possède au moins trois réas enveloppés par une surface en forme de cylindre imaginaire (surface torique convexe).

4. Foreuse selon la revendication 1, **caractérisée en ce que** le second jeu de réas (7) possède au moins trois réas enveloppés par une surface en forme de selle imaginaire (surface torique concave).

5. Foreuse selon la revendication 1, **caractérisée en**

**ce que** l'axe commun aux réas du second jeu (7) n'est ni horizontal ni parallèle à celui des tambours d'enroulement (9), alors que celui du premier jeu cylindrique (5) est horizontal mais pas parallèle à celui des tambours d'enroulement (9).

**6.** Foreuse selon la revendication 2, **caractérisée en ce que** les faisceaux de tuyaux à l'entrée (1, 6) et les faisceaux de tuyaux à la sortie (3, 8) de l'ensemble conique se trouvent dans des plans respectifs.

**7.** Foreuse selon la revendication 3 ou la revendication 4, **caractérisée en ce que** les faisceaux de tuyaux à l'entrée (1, 6) et les faisceaux de tuyaux à la sortie (3, 8) des réas de diamètres différents se trouvent sur des surfaces cylindriques respectives.

Fig. 1

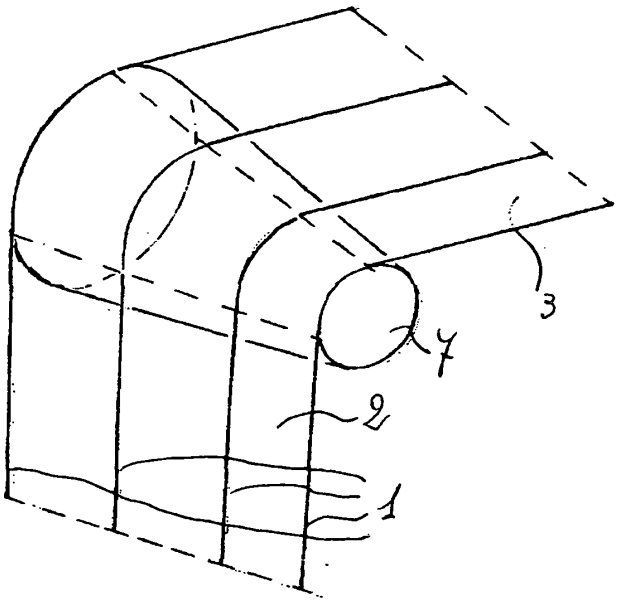



Fig. 2

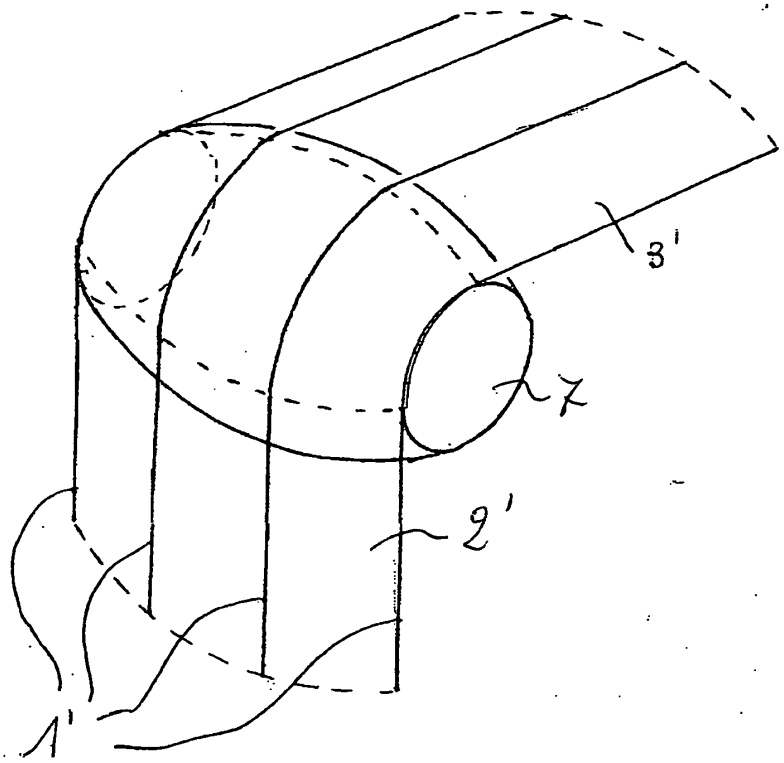
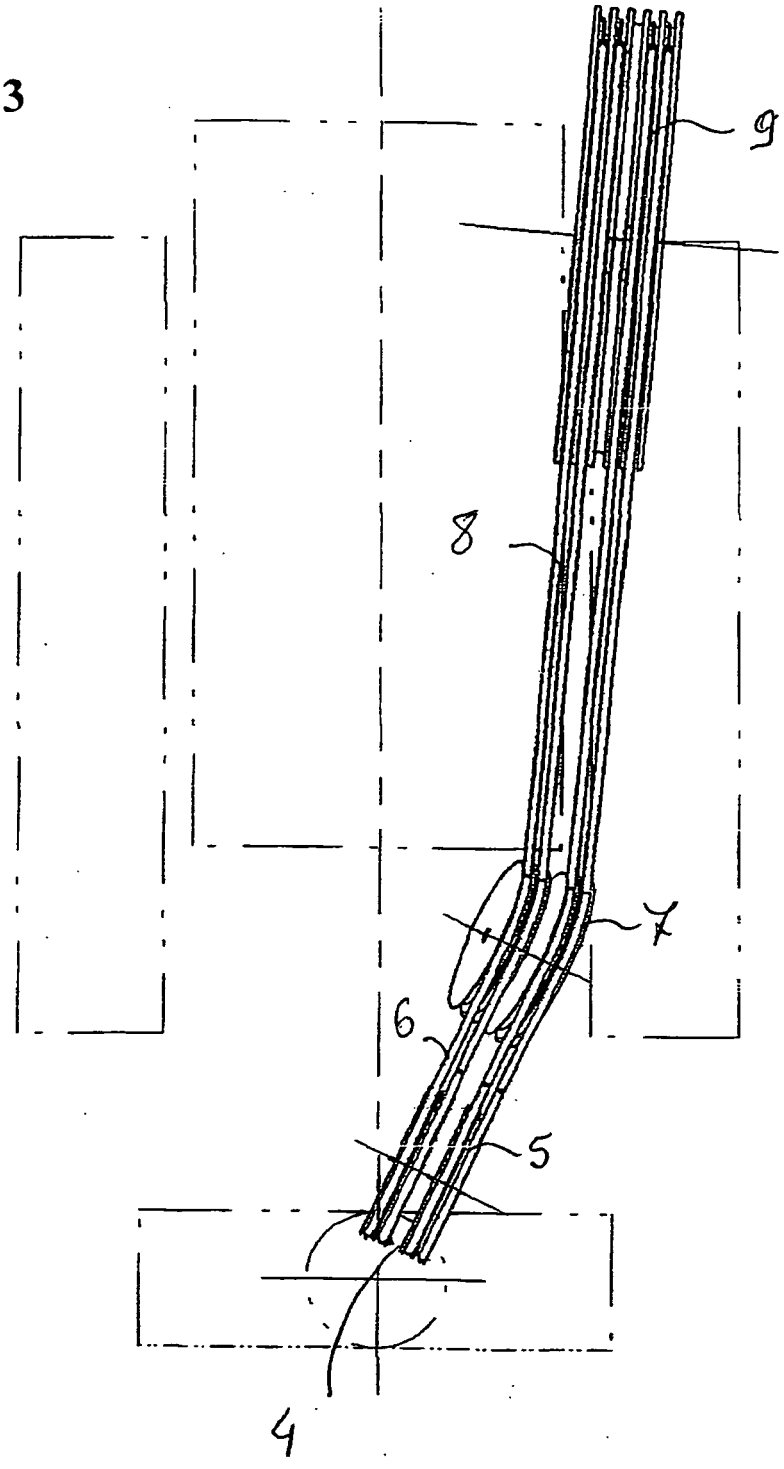


Fig. 3



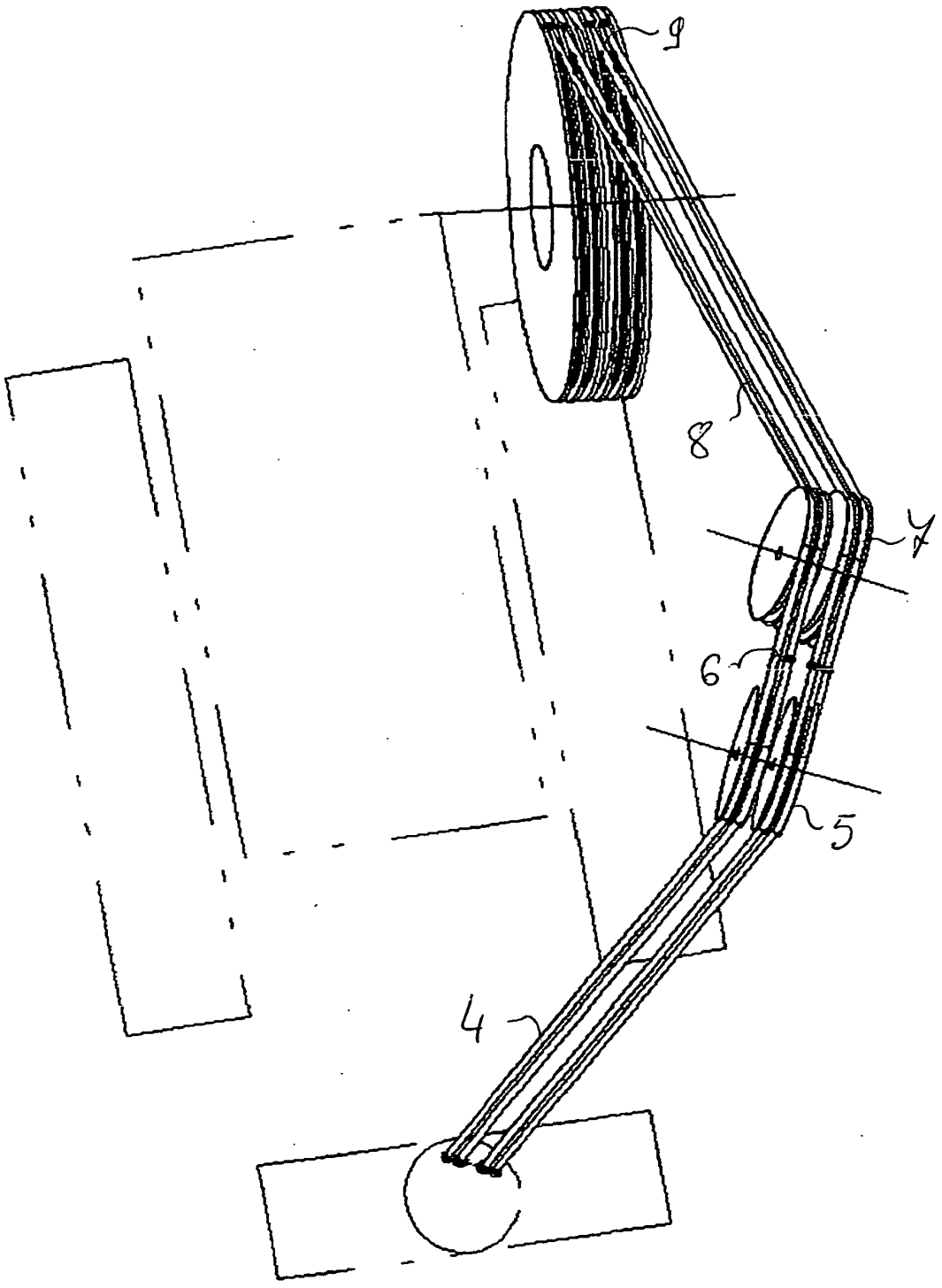
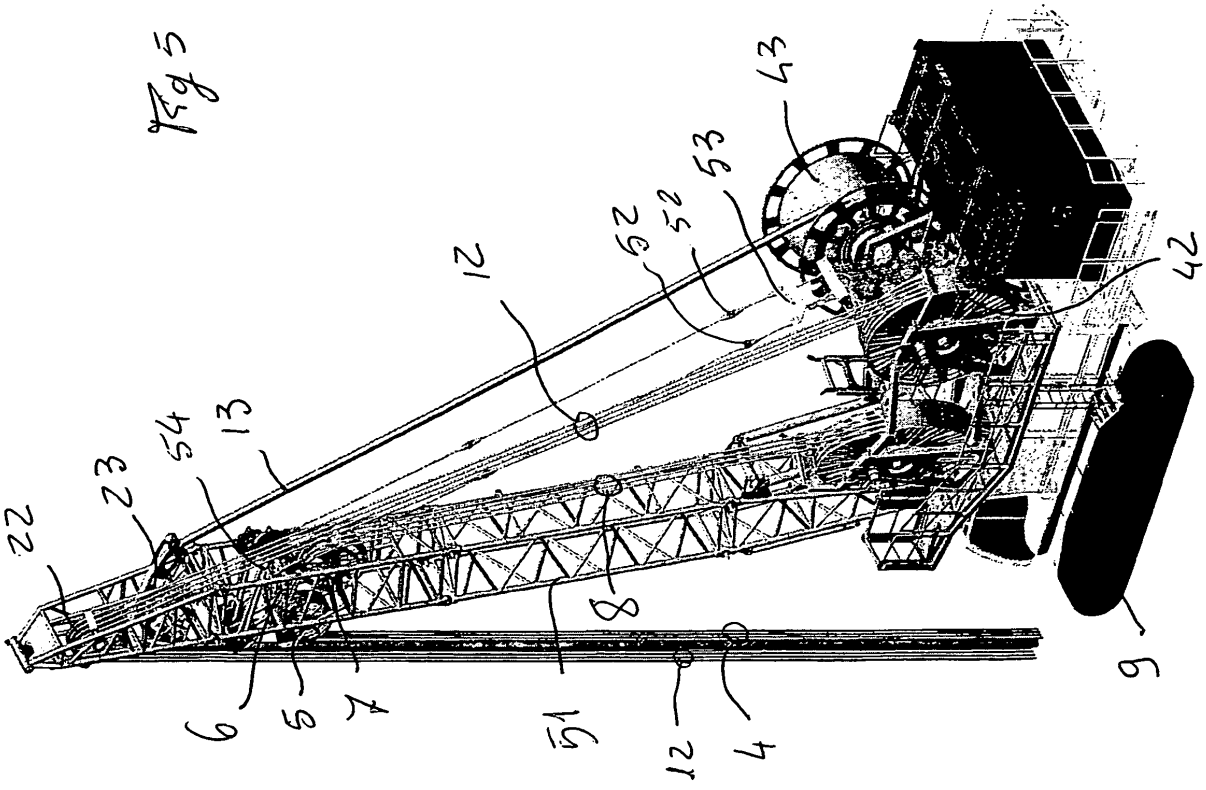



Fig. 4

Fig 5



## REFERENCES CITED IN THE DESCRIPTION

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