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

(11) EP 1 598 161 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
14.06.2006 Bulletin 2006/24

(51) Int Cl.:
B28D 1/08 *(2006.01)*

(21) Application number: **04425291.4**

(22) Date of filing: **29.04.2004**

(54) **A machine for cutting blocks of stone material or concrete manufactured products**

Maschine zum Schneiden von Steinblöcken oder Betonteilen

Machine pour couper des pierres en blocs ou des éléments en béton

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(43) Date of publication of application:
23.11.2005 Bulletin 2005/47

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Description

[0001] The present invention relates to a machine for cutting blocks of stone material or concrete manufactured products according to the preamble of claim 1.

[0002] Although the machine which forms the subject matter of the present invention can be used to cut any block of stone material or any concrete manufactured product, it is preferably intended for use for cutting precast reinforced concrete manufactured products.

[0003] In particular, it can be used to cut precast reinforced concrete pipes or beams, such as those used to build warehouses, bridges, etc., to which specific references are made below.

[0004] Such beams are normally produced by casting the concrete in a mould in which the metal reinforcement was previously prepared.

[0005] Very long beams (for example around 100 - 150 m) are normally produced, which must then be cut into lengths corresponding to the requirements of the end user.

[0006] At present two cutting techniques are known.

[0007] A first technique involves substantially manual cutting, using a machine with a disk for cutting concrete and an oxy-hydrogen flame for cutting metal parts.

[0008] However, this technology involves very time consuming work with consequent high operating costs. Moreover, there is always a certain risk for the operator who carries out the work.

[0009] The second technology involves the use of a machine consisting mainly of two opposite vertical cutter disks positioned transversally to the direction in which the beam extends.

[0010] However, this solution has some disadvantages too.

[0011] Firstly, the machine is very large since, for mechanical strength reasons, only around one third of the height of each disk can actually be used for cutting.

[0012] Secondly, in order to cut it, the beam must be lifted off the ground, which is not easy considering the size of the beam.

[0013] Moreover, this machine only allows the beam to be cut according to vertical cutting planes perpendicular to the direction in which the beam extends.

[0014] Patents US 3,158,146 and US 5,173,250 also describe two machines respectively for cutting blocks of stone material and walls of nuclear reactors, although not suitable for cutting precast beams made of reinforced concrete or the like.

[0015] In this situation, the technical need which forms the basis of the present invention is to provide a machine for cutting blocks of stone material or concrete manufactured products which overcomes the above-mentioned disadvantages.

[0016] In particular, the technical need of the present invention is to provide a machine for cutting blocks of stone material or concrete manufactured products which has limited dimensions and minimised operating cost.

[0017] A further technical need of the present invention is to provide a machine for cutting blocks of stone material or concrete manufactured products which allows a precast beam to be cut according to any predetermined profile.

[0018] Another technical need of the present invention is to provide a machine for cutting blocks of stone material or concrete manufactured products which guarantees greater operator safety than the known machines.

[0019] The technical need specified and the aims indicated are substantially achieved by a machine for cutting blocks of stone material or concrete manufactured products as described in the claims herein.

[0020] Other features and advantages of the invention are more clearly indicated in the detailed description which follows with reference to the accompanying drawings which illustrate a preferred non-restricting embodiment of a machine for cutting blocks of stone material or concrete manufactured products and in which:

- Figure 1 is a schematic front view, with some parts in cross-section and other parts cut away, of a machine for cutting blocks of stone material or concrete manufactured products in accordance with the present invention;
- Figure 2 is a schematic top view, with some parts cut away, of the machine illustrated in Figure 1; and
- Figure 3 is a schematic side view, with some parts cut away, of the machine illustrated in Figure 1.

[0021] With reference to the accompanying drawings, the numeral 1 denotes as a whole a machine for cutting blocks 2 of stone material or concrete manufactured products in accordance with the present invention.

[0022] Firstly, the machine 1 comprises a supporting structure 2 consisting of two vertical uprights 3 distanced from one another and a crosspiece 4 rigidly connected on top of the two uprights 3.

[0023] Advantageously, for each vertical upright 3 it also comprises a base 5 and an angled stiffening element 6 connected between the base 5 and the zone at which the upright 3 and the crosspiece 4 join.

[0024] According to the preferred embodiment, the machine 1 also comprises at least one horizontal track 7 on which the supporting structure 2 is slidably mounted on wheels 8.

[0025] The structure is also operatively connected to drive means 9 (of the known type) so that when the command is given the structure moves along the track 7.

[0026] Under the crosspiece 4 of the supporting structure 2 there is a zone 10 for positioning an element to be cut, which in the embodiment illustrated in Figure 1 consists of a reinforced concrete beam 11 (Figure 1 also schematically illustrates the mould 12 for the beam 11) resting on its own supporting element 13.

[0027] A wire cutting device 14 is slidably mounted on the supporting structure 2 according to a vertical sliding direction. In particular, in the embodiment illustrated in

the accompanying drawings, the machine 1 comprises a carriage 15 slidably connected, at its ends, to the vertical uprights 3, and at least one thrust block 16 rotatably connected under the carriage 15 and supporting the cutting device 14, which can therefore rotate relative to the supporting structure 2 about a substantially vertical axis of rotation (Figure 2 illustrates two possible cutting device 14 angles with dashed lines).

[0028] Moreover, the carriage 15 is operatively connected to drive means 17 which move the cutting device 14 vertically relative to the structure 2, whilst the thrust block 16 is operatively connected to rotation means 18 which, when the command is given, cause the cutting device 14 to rotate, again relative to the supporting structure 2.

[0029] The cutting device 14 has at least one driving pulley 19, at least two idle return pulleys 20 coplanar with the driving pulley 19, and a cutting wire 21 which runs along a looped path formed by the driving pulley 19 and the idle pulleys 20. In the embodiment illustrated there are also two additional return pulleys 22.

[0030] The idle pulleys 20 form between them an operating section 23 along the path of the cutting wire 21, where the element to be cut is cut.

[0031] The cutting device 14 also has at least two arms 24 which mainly extend vertically and are capable of reciprocal movement according to a substantially horizontal direction parallel with the plane in which the cutting wire 21 lies. In Figure 1 each arm 24 is illustrated in a closed position and in an open position.

[0032] One of the idle pulleys 20 is rotatably connected to each arm 24, at one end of the arm 24 close to the operating section 23.

[0033] According to the present invention, on both sides of the operating section 23, starting from the idle pulleys 20, the looped path of the cutting wire 21 has two secondary sections 25 extending mainly vertically.

[0034] The secondary sections 25 and the operating section 23 form an offshoot of the path of the cutting wire 21 which extends towards the positioning zone 10, and which allows the cutting device 14 to be inserted in the space in the mould 12.

[0035] For this purpose, the secondary sections 25 extend substantially parallel with the arms 24, or within the maximum dimensions of the arms 24.

[0036] When the command is given, each arm 24 can rotate about an axis of rotation substantially perpendicular to the plane in which the cutting wire 21 lies and distanced from the axis of rotation of the idle pulleys 20. In the embodiment illustrated this axis of rotation passes through the end of the arm 24 opposite that supporting the idle pulley.

[0037] Tensioning means 26, consisting of two actuators, are operatively connected to each arm 24 to make it rotate and so tension the cutting wire 21.

[0038] The distance between the two arms 24 is determined by spacer means 27 also consisting of two actuators. In this case, the cutting device 14 has a telescopic shape.

[0039] The entire path of the cutting wire 21, with the exception of the operating section 23, may be covered by special guards (not illustrated).

[0040] Figure 2 shows how the track 7 also extends mainly perpendicular to the plane in which the structure 2 lies.

[0041] Advantageously, the machine 1 also comprises a programmable electronic control unit 28 operatively connected to the mobile parts of the machine 1 to control their movements.

[0042] In particular, the control unit 28 allows simultaneous activation of the drive means 17, the rotation means 18, the tensioning means 26, the spacer means 27, the driving pulley 19 and the drive means 9. In this way, beams can be cut and ends shaped as required can be created on the individual lengths. The machine 1 can cut both horizontally and vertically and according to angled or curved cutting planes or surfaces, as required.

[0043] In particular, when intended for cutting reinforced concrete, the machine 1 preferably also comprises a system 28 for detecting the machine 1 absorbed power during a cutting operation, operatively connected to the control unit 28. The control unit 28 is in turn programmed to vary the cutting device 14 speed of vertical movement according to the machine 1 absorbed power, in particular reducing the speed of movement when the machine 1 absorbed power increases.

[0044] The speed of forward movement may be higher when cutting concrete (step during which power absorption is relatively low) whilst it must be lower when cutting metal (step during which power absorption is relatively high).

[0045] In the preferred embodiment, the detection system 28 measures the electrical current absorbed by the machine 1 (which, the power supply voltage being equal, is proportional to the power).

[0046] Machine 1 operation is immediately derived from the above description.

[0047] Preferably, during cutting, the idle pulleys 20 are kept as close as possible to the element to be cut, at the same time guaranteeing correct tensioning of the cutting wire 21, by operating appropriately on the rotation and distancing of the arms 24 from one another.

[0048] This minimises the rise of the cutting wire 21 and significantly improves the quality of the cut, particularly at the edges.

[0049] The present invention brings important advantages.

[0050] Firstly, the machine for cutting blocks of stone material or concrete manufactured products disclosed has limited dimensions and a minimised operating cost, thanks to the high cutting speeds, much greater than can be achieved with manual cutting.

[0051] Secondly, the machine allows cuts to be made according to any predetermined profile.

[0052] Moreover, it can be used for cutting reinforced concrete beams even with the mould present.

[0053] It should also be noticed that the present invention is relatively easy to make and even the cost linked to implementation of the invention is not very high.

Claims

1. A machine for cutting blocks of stone material or concrete manufactured products comprising:

   - a supporting structure (2) with at least two vertical uprights (3) distanced from one another and a crosspiece (4) rigidly connected on top of the two uprights (3),
   - a zone (10) for positioning an element to be cut, located below the crosspiece (4);
   - a wire cutting device (14) slidably mounted on the supporting structure (2) according to a predetermined sliding direction, and having at least one driving pulley (19), at least two idle return pulleys (20) coplanar with the driving pulley (19), and a cutting wire (21) which runs along a looped path formed by the pulleys, the idle pulleys (20) forming between them an operating section (23) along the path of the cutting wire (21);
   - the cutting device (14) also having at least two arms (24) which mainly extend vertically and each support, at their end close to the operating section (23), one of the idle pulleys (20);
   - the arms (24) being able to move relative to one another according to a substantially horizontal direction parallel with the plane in which the cutting wire (21) lies;
   - drive means (17) producing cutting device (14) vertical movement relative to the structure; the machine being **characterised in that** the looped path of the cutting wire (21) has two secondary sections (25) extending mainly vertically, starting from the idle pulleys (20) at the sides of the operating section (23), the secondary sections (25) and the operating section (23) forming an offshoot of the path, extending towards the positioning zone (10) .

2. The cutting machine according to claim 1, **characterised in that** the secondary sections (25) extend substantially parallel with the arms (24).

3. The cutting machine according to claim 1 or 2, **characterised in that** the cutting device (14) can rotate relative to the supporting structure (2) about a substantially vertical axis of rotation.

4. The cutting machine according to claim 3, **characterised in that** it also comprises a carriage (15) slidably connected to the vertical uprights (3), and at least one thrust block (16) rotatably connected to the carriage (15) and supporting the cutting device (14).

5. The cutting machine according to claim 4, **characterised in that** it also comprises rotation means (18) operatively connected to the thrust block (16), which cause the cutting device (14) to rotate when the command is given.

6. The cutting machine according to any of the foregoing claims, **characterised in that** when the command is given each of the arms (24) can rotate about an axis of rotation substantially perpendicular to the plane in which the cutting wire (21) lies and distanced from the axis of rotation of the idle pulleys (20).

7. The cutting machine according to claim 6, **characterised in that** it also comprises tensioning means (26) operatively connected to the arms (24), which cause the arms to rotate and tension the cutting wire (21).

8. The cutting machine according to any of the foregoing claims, **characterised in that** it also comprises at least one track (7), mainly extending perpendicular to the plane defined by the supporting structure (2) slidably mounted on the track (7).

9. The cutting machine according to claim 8, **characterised in that** it also comprises drive means (9) operatively connected to the structure so as to move it along the track (7) when the command is given.

10. The cutting machine according to any of the foregoing claims, **characterised in that** it comprises a programmable electronic control unit (28) operatively connected to the mobile parts of the machine for controlling their movement.

11. The cutting machine according to claims 5, 7, 9 and 10, **characterised in that** the control unit (28) allows simultaneous activation of the drive means (17), the rotation means (18), the tensioning means (26), the driving pulley (19), the arms (24) and the drive means (9).

12. The cutting machine according to claim 11, **characterised in that** it also comprises a system (28) for detecting the power absorbed by the machine (1) during a cutting operation, operatively connected to the control unit (28), the control unit (28) varying the cutting device (14) speed of vertical movement according to the power absorbed by the machine (1) during cutting.

13. The cutting machine according to claim 12, **characterised in that** the detection system (28) measures the electrical current absorbed by the machine (1) during cutting.

14. The cutting machine according to claim 12 or 13,

characterised in that the speed of movement is reduced as the power absorbed by the machine (1) during cutting increases.

Patentansprüche

1. Maschine zum Schneiden von Steinblöcken oder aus Beton hergestellten Produkten, enthaltend:

   - eine Trägerstruktur (2) mit wenigstens zwei vertikalen Ständern (3), die voneinander abstehend sind, und einen Querbalken (4), starr angeschlossen an die oberen Enden der beiden Ständer (3);
   - einen Bereich (10) zum Positionieren eines zu schneidenden Elementes, angeordnet unterhalb des Querbalkens (4);
   - eine Drahtschneidevorrichtung (14), gleitbar montiert an der Trägerstruktur (2) nach einer vorgegebenen Gleitrichtung und wenigstens eine Antriebsrolle (19), wenigstens zwei leerlaufende Umlenkrollen (20), koplanar zu der Antriebsrolle (19), und einen Schneiddraht (21) aufweisend, welcher entlang einer durch die Rollen gebildeten, ringförmig geschlossenen Bahn läuft, wobei die leerlaufenden Rollen (20) zwischen sich einen Arbeitsabschnitt (23) entlang der Bahn des Schneiddrahtes (21) bilden;
   - wobei die Schneidvorrichtung (14) ebenfalls wenigstens zwei Arme (24) hat, welche sich vorwiegend vertikal erstrecken und jeder an seinem Ende dicht an dem Arbeitsbereich (23) eine der leerlaufenden Rollen (20) trägt;
   - wobei die Arme (24) in der Lage sind, sich im Verhältnis zueinander nach einer horizontalen Richtung parallel zu der Ebene zu bewegen, in welcher der Schneiddraht (21) liegt;
   - Antriebsmittel (17) zum Erzeugen einer vertikalen Bewegung der Schneidvorrichtung (14) im Verhältnis zu der Struktur;
   wobei die Maschine **dadurch gekennzeichnet ist, dass** die ringförmig geschlossene Bahn des Schneiddrahtes (21) zwei sekundäre Abschnitte (25) aufweist, die sich vorwiegend vertikal erstrecken, ausgehend von den leerlaufenden Rollen (20) an den Seiten des Arbeitsabschnittes (23), wobei die sekundären Abschnitte (25) und der Arbeitsabschnitt (23) einen Ausläufer der Bahn bilden, der sich zu dem Positionierbereich (10) hin erstreckt.

2. Schneidmaschine nach Patentanspruch 1, **dadurch gekennzeichnet, dass** sich die sekundären Abschnitte (25) im wesentlichen parallel zu den Armen (24) erstrekken.

3. Schneidmaschine nach Patentanspruch 1 oder 2, **dadurch gekennzeichnet, dass** sich die Schneidvorrichtung (14) im Verhältnis zu der Trägerstruktur (2) um eine im wesentlichen vertikale Drehachse drehen kann.

4. Schneidmaschine nach Patentanspruch 3, **dadurch gekennzeichnet, dass** sie ebenfalls einen Schlitten (15) enthält, gleitbar angeschlossen an die vertikalen Ständer (3), und wenigstens ein Drucklager (16), drehbar an den Schlitten (15) angeschlossen und die Schneidvorrichtung (14) tragend.

5. Schneidmaschine nach Patentanspruch 4, **dadurch gekennzeichnet, dass** sie ebenfalls Drehmittel (18) enthält, die betrieblich mit dem Drucklager (16) verbunden sind, und welche auf einen Befehl hin das Drehen der Schneidvorrichtung (14) bewirken.

6. Schneidmaschine nach einem beliebigen der vorstehenden Patentansprüche, **dadurch gekennzeichnet, dass**, wenn der Befehl ausgegeben ist, sich jeder der Arme (24) um eine Drehachse drehen kann, die im wesentlichen lotrecht zu der Ebene verläuft, in welcher der Schneiddraht (21) liegt, und die einen Abstand von der Drehachse der leerlaufenden Rollen (20) hat.

7. Schneidmaschine nach Patentanspruch 6, **dadurch gekennzeichnet, dass** sie ebenfalls Spannmittel (26) enthält, betrieblich angeschlossen an die Arme (24), welche das Drehen der Arme bewirken und den Schneiddraht (21) spannen.

8. Schneidmaschine nach einem beliebigen der vorstehenden Patentansprüche, **dadurch gekennzeichnet, dass** sie ebenfalls wenigstens ein Gleis (7) enthält, das sich vorwiegend lotrecht zu der Ebene erstreckt, die durch die Trägerstruktur (2) beschrieben wird, welche gleitbar auf dem Gleis montiert ist.

9. Schneidmaschine nach Patentanspruch 8, **dadurch gekennzeichnet, dass** sie ebenfalls Antriebsmittel (9) enthält, betrieblich angeschlossen an die Trägerstruktur, so dass diese bei Aussenden eines Befehls entlang dem Gleis (7) bewegt wird.

10. Schneidmaschine nach einem beliebigen der vorstehenden Patentansprüche, **dadurch gekennzeichnet, dass** sie eine programmierbare elektronische Steuereinheit (28) enthält, betrieblich angeschlossen an die beweglichen Teile der Maschine zum Steuern von deren Bewegung.

11. Schneidmaschine nach den Patentansprüchen 5, 7, 9 und 10, **dadurch gekennzeichnet, dass** die Steuereinheit (28) die gleichzeitige Aktivierung der Antriebsmittel (17), der Umdrehungsmittel (18), der

Spannmittel (26), der Antriebsrolle (19), der Arme (24) und der Antriebsmittel (9) erlaubt.

12. Schneidmaschine nach Patentanspruch 11, **dadurch gekennzeichnet, dass** sie ebenfalls ein System (28) zum Erfassen der durch die Maschine (1) während eines Schneidvorgangs aufgenommen Leistung enthält, betrieblich angeschlossen an die Steuereinheit (28), wobei die Steuereinheit (28) die Geschwindigkeit der vertikalen Bewegung der Schneidvorrichtung (14) je nach der während des Schneidens durch die Maschine (1) aufgenommene Leistung verändert.

13. Schneidmaschine nach Patentanspruch 12, **dadurch gekennzeichnet, dass** das Erfassungssystem (28) den durch die Maschine (1) während des Schneidens aufgenommenen elektrischen Strom misst.

14. Schneidmaschine nach Patentanspruch 12 oder 13, **dadurch gekennzeichnet, dass** die Bewegungsgeschwindigkeit reduziert wird, wenn die durch die Maschine (1) während des Schneidens aufgenommene Leistung zunimmt.

Revendications

1. Une machine pour couper des pierres en blocs ou des éléments en béton, comprenant :

- une structure de support (2) ayant au moins deux montants verticaux (3) situés à distance l'un de l'autre et une traverse (4) fixée de façon rigide sur la partie supérieure des deux montants (3),
- une zone (10) pour le positionnement d'un élément à couper, située au-dessous de la traverse (4) ;
- un dispositif de coupe à fil (14) monté de façon coulissante sur la structure de support (2) suivant une direction de coulissement prédéfinie, et ayant au moins une poulie d'entraînement (19), au moins deux poulies folles de renvoi (20) coplanaires à la poulie d'entraînement (19), et un fil de coupe (21) qui se développe suivant un parcours en boucle formé par les poulies elles-mêmes, les poulies folles (20) formant entre elles un tronçon opérationnel (23) le long du parcours du fil de coupe (21) ;
- le dispositif de coupe (14) ayant aussi au moins deux bras (24) qui s'étendent principalement à la verticale et supportent chacun, au niveau de leur extrémité située à proximité du tronçon opérationnel (23), une des poulies folles (20) ;
- les bras (24) pouvant se déplacer l'un par rapport à l'autre suivant une direction essentiellement horizontale qui est parallèle au plan d'appartenance du fil de coupe (21) ;
- des moyens d'actionnement (17) destinés à imprimer au dispositif de coupe (14) un mouvement vertical par rapport à la structure ;

la machine étant **caractérisée en ce que** le parcours en boucle du fil de coupe (21) comprend deux tronçons secondaires (25) s'étendant principalement à la verticale à partir des poulies folles (20) de chaque côté du tronçon opérationnel (23), les tronçons secondaires (25) et le tronçon opérationnel (23) formant une branche du parcours s'étendant vers la zone de positionnement (10).

2. La machine de coupe selon la revendication 1, **caractérisée en ce que** les tronçons secondaires (25) sont essentiellement parallèles aux bras (24).

3. La machine de coupe selon la revendication 1 ou 2, **caractérisée en ce que** le dispositif de coupe (14) peut tourner par rapport à la structure de support (2) autour d'un axe de rotation essentiellement vertical.

4. La machine de coupe selon la revendication 3, **caractérisée en ce qu'**elle comprend aussi un chariot (15) associé de façon coulissante aux montants verticaux (3), et au moins un palier de butée (16) associé de façon rotative au chariot (15) et supportant le dispositif de coupe (14).

5. La machine de coupe selon la revendication 4, **caractérisée en ce qu'**elle comprend aussi des moyens de rotation (18) reliés de façon opérationnelle au palier de butée (16) et destinés à mettre le dispositif de coupe (14) en rotation lorsque la commande en est donnée.

6. La machine de coupe selon l'une quelconque des revendications précédentes, **caractérisée en ce que**, lorsque la commande est donnée, chaque bras (24) peut tourner autour d'un axe de rotation essentiellement perpendiculaire au plan d'appartenance du fil de coupe (21) et à distance de l'axe de rotation des poulies folles (20).

7. La machine de coupe selon la revendication 6, **caractérisée en ce qu'**elle comprend aussi des moyens de mise en tension (26) reliés de façon opérationnelle aux bras (24) et destinés à mettre les bras en rotation et à tendre le fil de coupe (21).

8. La machine de coupe selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle comprend aussi au moins un rail (7), s'étendant principalement à la perpendiculaire du plan défini par la structure de support (2), cette dernière étant montée de façon coulissante sur le rail (7) lui-

même.

9. La machine de coupe selon la revendication 8, **caractérisée en ce qu'**elle comprend aussi des moyens d'actionnement (9) reliés de façon opérationnelle à la structure de manière à mouvoir cette dernière le long du rail (7) lorsque la commande en est donnée.

10. La machine de coupe selon l'une quelconque des revendications précédentes, **caractérisée en ce qu'**elle comprend une unité de contrôle électronique programmable (28) reliée de façon opérationnelle aux parties mobiles de la machine pour en contrôler le mouvement.

11. La machine de coupe selon les revendications 5, 7, 9 et 10, **caractérisée en ce que** l'unité de contrôle (28) permet l'activation simultanée des moyens d'actionnement (17), des moyens de rotation (18), des moyens de mise en tension (26), de la poulie d'entraînement (19), des bras (24) et des moyens d'actionnement (9).

12. La machine de coupe selon la revendication 11, **caractérisée en ce qu'**elle comprend aussi un système (28) pour la détection de la puissance absorbée par la machine (1) durant une opération de coupe, relié de façon opérationnelle à l'unité de contrôle (28), ladite unité de contrôle (28) faisant varier la vitesse de mouvement vertical du dispositif de coupe (14) en fonction de la puissance absorbée par la machine (1) durant la coupe.

13. La machine de coupe selon la revendication 12, **caractérisée en ce que** le système de détection (28) mesure le courant électrique absorbé par la machine (1) durant la coupe.

14. La machine de coupe selon la revendication 12 ou 13, **caractérisée en ce que** la vitesse de mouvement est réduite au fur et à mesure que la puissance absorbée par la machine (1) durant la coupe augmente.

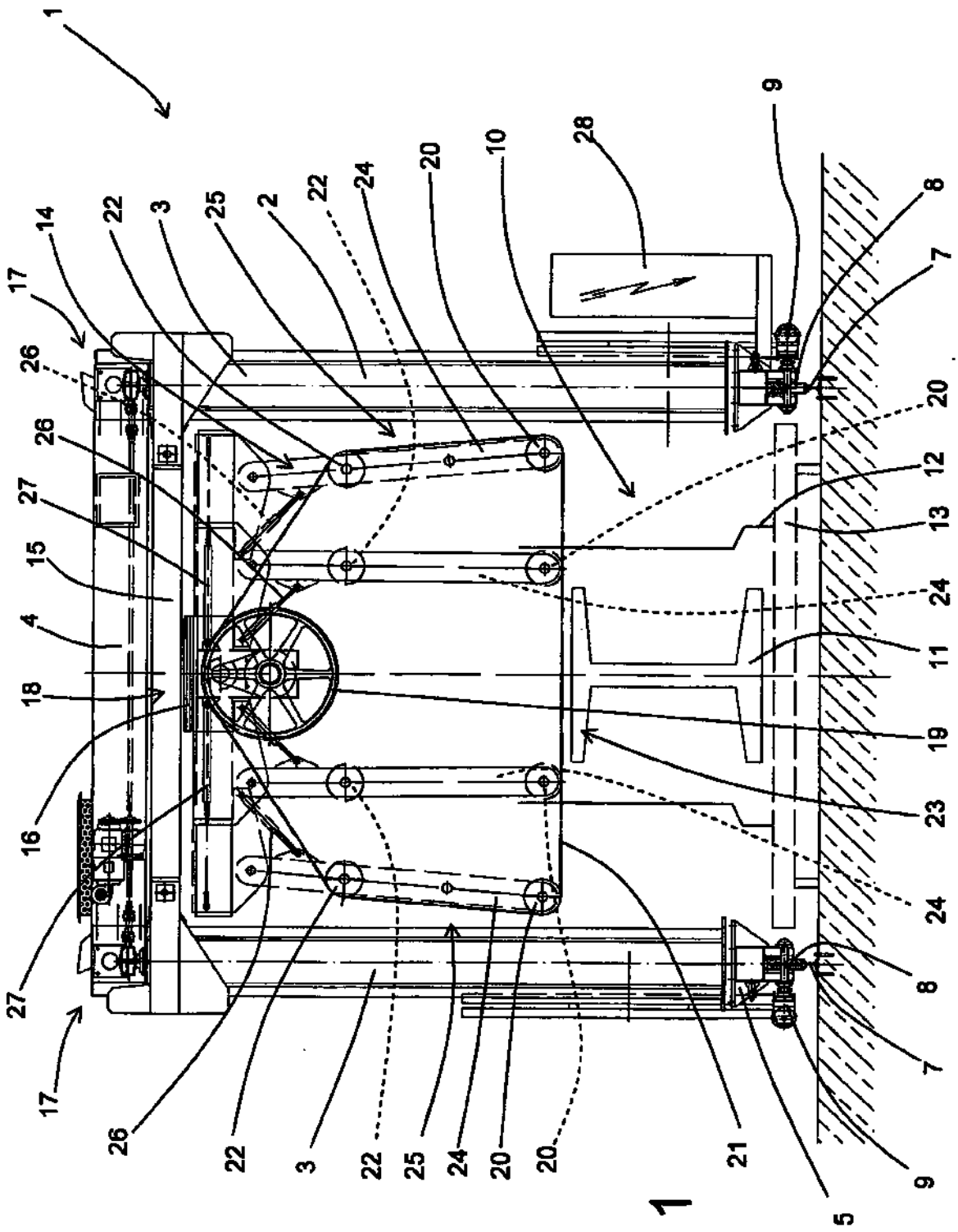
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FIG. 1

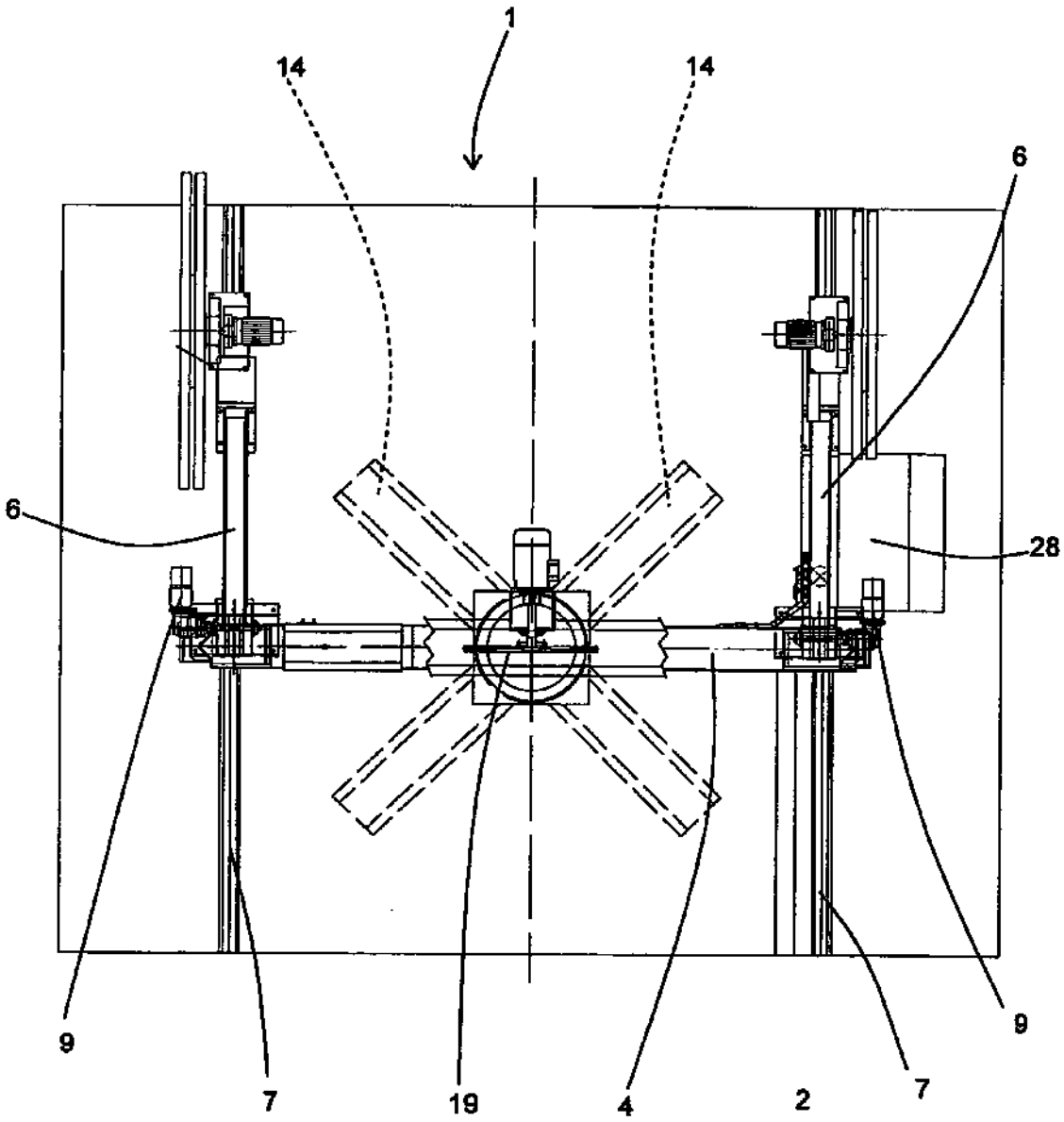

FIG. 2

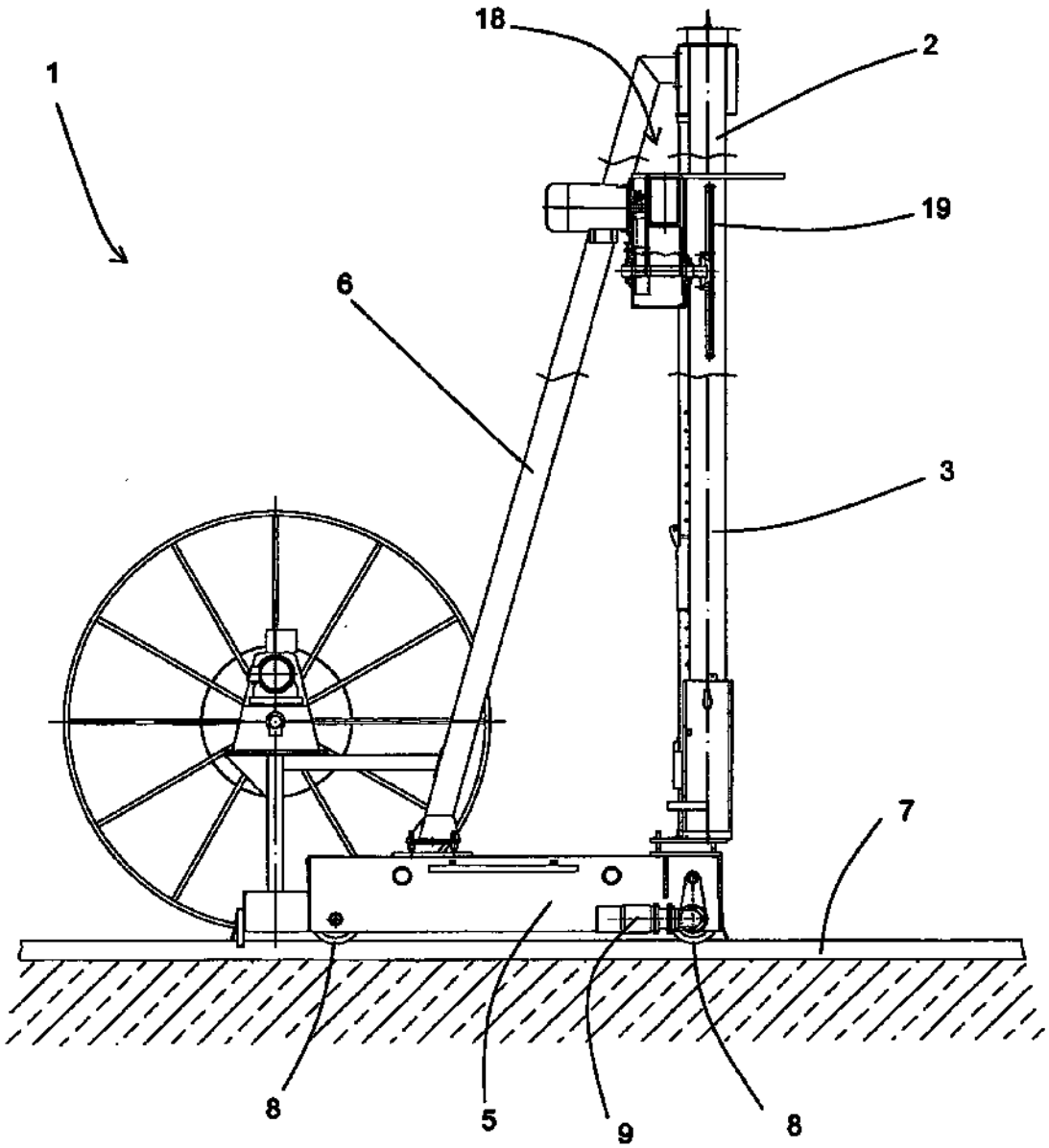

FIG. 3