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(54) **Sheet metal accumulator of the loop type with traction winding and corresponding method**

Schlaufenförmiger Bandmetallspeicher zum Wickeln unter Zug und zugehöriges Verfahren

Accumulateur de bandes métalliques en forme de boucle pour un enroulement sous traction et méthode correspondante

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Description

[0001] The present invention refers to a sheet metal accumulator of the loop type with traction winding.

[0002] In the field of pipes and/or welded sections produced on continuous production lines, sheet metal accumulators which act as a reservoir to allow constant feeding of the production line situated downstream of the accumulator are well known to the art and normally used.

[0003] The accumulator is normally placed between at least one coil-carrying reel and the production line and accumulates a sufficient amount of sheet metal to allow an empty reel to be replaced with a reel bearing a coil of sheet metal and to join the sheet metal of the new coil with the "tail" of the sheet metal already unwound from the empty coil without having to stop the production line.

[0004] Many types of sheet metal accumulator are known to the art, amongst which can be cited, purely by way of example, pit accumulators (free loop) and accumulators of the loop type with thrust-type winding (known as floops) which have the great drawback of not operating correctly if the sheet metal is (too) thin and/or is made of (overly) ductile material.

[0005] A sheet metal accumulator of the loop type with traction winding is able to overcome the aforementioned drawback. Systems (such as, for example, coil winders) which accumulate sheet metal by traction are known to the art, but the Applicant is not aware of accumulators that accumulate sheet metal in loops by traction.

[0006] KR 2004 4039921 which forms the bain for the preamble of claim 1, discloses a sheet metal accumulator of the loop type which, to prevent the loosening of the loop(s) of sheet metal wound on the rolls of the rotatable turntable, provides strip laxity preventing means, comprising a plural links and a tightening roll, which acts on the outer surface of said sheet metal loop(s).

[0007] KR 2004 0039920 discloses a sheet metal accumulator of the loop type, comprising a mobile internal turntable and a fixed external one, having a plurality of winding roll and a lead roll, rotating forwards and backwards on the fixed turntable.

[0008] To avoid interference, if any, with the lead roll, each winding roll is supported by means tilting it of a certain angle towards the centre of the turntable when the lead roll arrives.

[0009] KR 2004 0039920 further comprises means rotating each winding roll around its axis.

[0010] Object of the present invention is to produce a sheet metal accumulator of the loop type with traction winding that does not present the drawbacks and limitations previously described; this object is achieved by means of a sheet metal accumulator of the loop type with traction winding having the features set forth in claim 1.

[0011] Further advantageous characteristics of the invention form the subject matter of the dependent claims.

[0012] The sheet metal accumulator of the loop type with traction winding is adapted to be placed between a source of sheet metal (preferably a coil-carrying reel) and a production line and comprises at least one inlet group, a pinch roll, an external mobile turntable, an internal fixed turntable coaxial with the mobile one, a helical path integral to the fixed turntable and adjustment means situated at the in-put and at the output of the accumulator.

[0013] The two turntables carry a plurality of rolls, suited to carry loops of sheet metal, which are mounted on swinging arms connected to one another by tie rods and moved by hydraulic or pneumatic means (or by other functionally equivalent hydraulic means), operation of which is managed by a logic unit that controls also adjustment means suited to control and adjust at least the tension of the sheet metal entering the accumulator.

[0014] The loops of sheet metal are traction wound on said rolls.

[0015] The invention will now be described with reference to purely exemplifying (and therefore non limiting) embodiments illustrated in the appended figures, wherein:

- Figure 1 shows diagrammatically a front view of a sheet metal accumulator of the loop type produced according to the invention, in a working condition;
- Figure 2 shows diagrammatically a side view of the sheet metal accumulator of Figure 1;
- Figure 3 shows diagrammatically a rear view of the sheet metal accumulator of Figure 1;
- Figure 4 shows diagrammatically the sheet metal accumulator of Figure 1 in a stand-by condition;
- Figure 5 shows diagrammatically the sheet metal accumulator of Figure 1 in a first step of winding of the sheet metal onto the fixed and mobile turntables;
- Figure 6 shows diagrammatically the sheet metal accumulator of Figure 1 in a second step of winding of the sheet metal, following that of Figure 5.

[0016] In the appended figures corresponding elements will by identified by the same reference numerals.

[0017] Figure 1 shows diagrammatically a front view of a sheet metal accumulator 1 produced according to the invention, which is carried by a metal structure 100 and which comprises at least one inlet group 2 suited to guide the sheet metal 20, a pinch roll 3, a mobile roll (dandy roll) 4 which controls the tension of the incoming sheet metal 20, a series of idle rolls 5, an external mobile turntable 6 carrying an idle traction roll 12, an internal fixed turntable 7 (coaxial with the turntable 6) carrying an idle transmission roll 13, a helical path 15 (seen better in Figure 2) integral with the fixed turntable 7 and a mobile roll (dandy roll) 18 which controls the tension of the sheet metal 20 exiting the accumulator 1.

[0018] The inlet group 2, the pinch roll 3, the mobile rolls (4, 18), the idle rolls (5, 12, 13) and the helical path 15 will not be described herein because they are known to a person skilled in the art.

[0019] The two turntables 6, 7 carry a plurality of rolls 8 suited to carry the loops of sheet metal traction wound on said rolls 8, which are mounted on swinging arms 9

connected to one another by tie rods 10 and driven by pistons 11 (or by other known hydraulic means; Figure 3), operation of which is managed by a logic unit which, preferably, also controls the pinch roll {3} and the external turntable 6.

[0020] For the sake of simplicity of the graphic representation, the logic unit and its sensors and actuators have been omitted in the appended figures; moreover, in Figure 1 only one loop of sheet metal has been indicated on the mobile turntable 6 and on the fixed turntable 7.

[0021] In the working condition (Figure 1), the sheet metal 20 passes through the inlet group 2, the pinch roll 3, the mobile roll 4 and the idle rolls 5 to reach the traction roll 12 of the mobile turntable 6 which, rotating with the turntable 6, winds up the entering sheet metal 20 onto the loops of sheet metal present on the mobile turntable 6 and, at the same time, winds up onto the loops of sheet metal present on the fixed turntable 7 the sheet metal 20 coming from the loop of sheet metal in contact with the rolls 8 of the mobile turntable 6.

[0022] The sheet metal 20 coming from the fixed turntable 7 and from the helical path 15 passes beneath the mobile roll 18 before reaching the production line.

Figure 2 shows diagrammatically a side view of the sheet metal accumulator 1 of Figure 1; for the sake of simplicity of the graphic representation, in Figure 2 only the metal structure 100, the mobile turntable 6, the helical path 15, one of the rollers 8, one of the swinging arms 9 and one of the tie rods 10 have been denoted by the respective reference numerals.

Figure 3 shows diagrammatically a rear view of the sheet metal accumulator 1 of Figure 1; visible in Figure 3 are the metal structure 100, the inlet group 2, the pinch roll 3, the means 41 that control the mobile roll 4, the rear part of the mobile turntable 6 carrying the hydraulic cylinders 11 which act on the pins of the swinging arms 9 and the rear part of the fixed turntable 7.

[0023] In the embodiment illustrated in Figure 3, each hydraulic cylinder 11 acts on the pin of one of the swinging arms 9, mechanically coupled to the pins of the adjacent swinging arms 9 by means of the tie rods 10.

Figure 4 shows diagrammatically the sheet metal accumulator 1 of Figure 1 in the stand-by condition: the sheet metal 20 passes only in the inlet group 2, in the pinch roll 3, on the mobile roll 4, on the idle rolls 5, on the idle transmission roll 13, on the helical path 15 and on the mobile roll 18 (which controls the tension of the sheet metal 20 exiting the accumulator 1) without involving the two turntables 6, 7.

Figures 5 and 6 show diagrammatically the sheet metal accumulator 1 of Figure 1 in two successive steps of winding of the sheet metal 20 on the mobile and fixed turntables 6, 7.

[0024] Starting from the stand-by condition (Figure 4) in which the input speed of the sheet metal 20 is equal to the output speed, the mobile turntable 6 begins to turn in a counter-clockwise direction (in the embodiment described here) causing the input speed of the sheet metal 20 into the accumulator 1 to be greater than its output speed towards the production line. The traction roll 12, integral with the turntable 6, draws the sheet metal 20 against the transmission roll-13 of the fixed turntable 7 (Figure 5) and then onto the rolls 8 carried by the mobile turntable 6 and by the fixed turntable 7 (Figure 6) and continues to rotate at this speed until the pre-set number of loops has been formed on the two turntables 6, 7.

[0025] It should be remembered that the input speed of the sheet metal 20 into the accumulator 1 correlates with the rotation speed of the pinch roll 3 and that during formation of the loops on the two turntables 6, 7, the sheet metal 20 leaves the accumulator 1 at the speed required to feed the production line.

[0026] When the required number of loops has been formed on the two turntables {6, 7}, the mobile turntable 6 and the pinch roll 3 reduce their rotation speed so that when the mobile turntable 6 is at a standstill, the quantity of sheet metal {20} that enters into the accumulator 1 is equal to that exiting towards the production line.

[0027] Once this situation has been reached, the pinch roll 3 gradually slows down until it stops (blocking the incoming sheet metal 20) while the mobile turntable 6 starts rotating in a direction opposite to the previous one to pay off the loops formed on the turntables 6 and 7 and feed the production line with the sheet metal 20 stored in the accumulator 1.

[0028] The fact that the pinch roll 3 blocks the incoming sheet metal 20 allows the sheet metal source to be replaced, joining another coil to the end of the incoming sheet metal 20.

[0029] When there is no more sheet metal 20 stored in the accumulator 1, the mobile turntable gradually slows down until it stops and, if the inflow of sheet metal 20 to the inlet thereof has been restored, it switches (or can switch) to the stand-by condition (Figure 4) and, subsequently, once again winds up (or can wind up) the sheet metal 20 onto the two turntables 6 and 7 (Figures 5 and 6).

[0030] Operation of the traction accumulator 1 of the present invention will not be described in greater detail because it is obvious to a person skilled in the art or in any case can be deduced from operation of thrust-type accumulators known to the art.

[0031] Without departing from the scope of the invention which is defined by the appended claims, a person skilled in the art can make to the sheet metal accumulator previously described all those modifications and improvements suggested by normal experience and/or by the natural evolution of the art.

Claims

1. A sheet metal accumulator (1) of the loop type, adapted to be placed between a unit feeding the sheet metal (20) and a production line and comprising at least an inlet group (2), a mobile external turntable (6), an internal fixed turntable (7) coaxial with the mobile one, a helical path (15) integral to the internal fixed turntable (7) and adjustment means (3, 4; 18) suited to control and to adjust the tension of the sheet metal (20) when entering into the accumulator (1), or when exiting from said accumulator, the two turntables (6, 7) carrying a plurality of rolls (8) suited to carry loops of sheet metal, **characterized in that means (3, 12, 13) are provided for traction-winding loops of sheet metal (20) on the rolls (8) of both turntables (6, 7) and in that** the rolls (8) **of both turntables (6, 7)** are mounted on swinging arms (9) connected one another by tie rods (10) and being movable by hydraulic means (11).

2. The sheet metal accumulator (1) according to claim 1, **characterized in that** the operation of the hydraulic means (11) is controlled by a logic unit that controls also the adjustment means (3) and the mobile turntable (6).

3. The sheet metal accumulator (1) according to claim 1, **characterized in that** it also comprises an idle traction roll (12) integral to the mobile turntable (6) and an idle transmission roll (13) integral to the fixed turntable (7).

4. The sheet metal accumulator, (1) according to claim 1, **characterized in that** each of the hydraulic means (11) is adapted to act on the pin of one of the swinging arms (9), which is mechanically coupled with the pins of the adjacent swinging arms (9) by means of the tie rods (10).

5. **Method for accumulating a sheet metal (20) through a** sheet metal accumulator (1) according to once of claims 1 to 4, **characterized by traction-winding the loops of sheet metal on the rolls (8) of the mobile turntable (6) and of the fixed turntable (7) and in** that, during operation, the sheet metal (20) passes at least through the inlet group (2) and the inlet adjustment means (3, 4) before reaching the traction roll (12) of the mobile turntable (6) that, rotating together with the turntable (6), winds up the entering sheet metal (20) onto the loops of sheet metal present on the mobile turntable (6) and, at the same time, winds up onto the loops of sheet metal present on the fixed turntable (7) the sheet metal (20) coming from the loops of sheet metal in contact with the rolls (8) of the mobile turntable (6), the sheet metal (20) coming from the fixed turntable (7) and from the helical path (15) passing underneath the outlet adjustment means (18) before reaching the production line.

6. The **method** according to claim 5, **characterized in that**, in order to wind up the sheet metal (20) onto the mobile and the fixed turntables (6, 7), the mobile turntable (6) starts rotating in a first direction at a first speed and the traction roll (12), integral to the mobile turntable (6), drives the sheet metal (20) against the transmission roll (13) of the fixed turntable (7) and then onto the rolls (8) carried by the mobile turntable (6) and by the fixed turntable (7) until forming on the two turntables (6, 7) a pre-set number of loops.

7. The **method** according to claim 6, **characterized in that**, when the pre-set number of loops have been formed on the two turntables (6, 7), the mobile turntable (6) and the inlet adjustment means (3) decrease their rotation speed so that, when the mobile turntable (6) is at a standstill, the quantity of sheet metal (20) that enters into the accumulator (1) is equal to that exiting to the production line.

8. The **method** according to claim **5, characterized in that**, when the feeding unit of the sheet metal (20) needs to be changed, the inlet adjustment means (3) block the incoming sheet metal (20) and the mobile turntable (6) starts rotating in a direction opposite to the previous one to pay off the loops formed on the turntables (6, 7) and to feed the production line with the sheet metal (20) stored in the accumulator (1) and **in that**, when there is no more sheet metal (20) stored in the accumulator (1), the mobile turntable (6) returns to the home position and the accumulator (1), if the feeding of the sheet metal (20) has been restored in the inlet thereof, switches to the "stand-by" mode and, then, once again winds-up the sheet metal (20) onto the two turntables (6, 7).

Patentansprüche

1. Schlaufenförmiger Bandmetallspeicher (1), der zur Anordnung zwischen einer Einheit, die das Bandmetall (20) zuführt, und einer Produktionslinie geeignet ist und zumindest eine Einlassgruppe (2), einen bewegungsfähigen äußeren Drehtisch (6), einen inneren starren Drehtisch (7) koaxial mit dem bewegungsfähigen, einen spiralförmigen Weg (15), der einstückig mit dem inneren starren Drehtisch (7) ist, und Anpassungsmittel (3, 4; 18) umfasst, die zum Steuern und Anpassen der Straffheit des Bandmetalls (20) geeignet sind, wenn es in den Speicher (1) eintritt oder wenn es aus dem Speicher austritt, wobei die zwei Drehtische (6, 7) mehrere Rollen (8) tragen, die dazu geeignet sind, Bandmetallschlaufen zu tragen, **dadurch gekennzeichnet, dass** die Mittel (3, 12, 13) zum Wickeln von Schlaufen von Band-

metall (20) unter Zug auf die Rollen (8) beider Drehtische (6, 7) vorgesehen sind, und dass die Rollen (8) beider Drehtische (6, 7) auf Schwenkarmen (9) angebracht sind, die durch Zugstangen (10) miteinander verbunden sind und durch hydraulische Mittel (11) beweglich sind.

2. Bandmetallspeicher (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Betrieb der hydraulischen Mittel (11) durch eine Logikeinheit gesteuert ist, die außerdem die Anpassungsmittel (3) und den bewegungsfähigen Drehtisch (6) steuert.

3. Bandmetallspeicher (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** er außerdem eine leerlaufende Zugrolle (12), die mit dem bewegungsfähigen Drehtisch (6) einstückig ist, und eine leerlaufende Übertragungsrolle (13) umfasst, die mit dem starren Drehtisch (7) einstückig ist.

4. Bandmetallspeicher (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** jedes der hydraulischen Mittel (11) dazu geeignet ist, auf den Zapfen von jedem der Schwenkarme (9) einzuwirken, der mit den Zapfen der benachbarten Schwenkarme (9) mithilfe der Zugstangen (10) mechanisch gekuppelt ist.

5. Verfahren zum Speichern eines Bandmetalls (20) über einen Bandmetallspeicher (1) nach einem der Ansprüche 1 bis 4, **gekennzeichnet durch** Wickeln der Schlaufen von Bandmetall (20) unter Zug auf die Rollen (8) des bewegungsfähigen Drehtischs (6) und des starren Drehtischs (7), und **dadurch**, dass das Bandmetall (20) im Betrieb zumindest **durch** die Einlassgruppe (2) und die Einlassanpassungsmittel (3, 4) läuft, bevor es die Zugrolle (12) des bewegungsfähigen Drehtischs (6) erreicht, die, zusammen mit dem Drehtisch (6) drehend, das eintretende Bandmetall auf die Bandmetallschlaufen aufwickelt, welche auf dem bewegungsfähigen Drehtisch (6) vorhanden sind, und gleichzeitig das Bandmetall (20), das von den Bandmetallschlaufen in Kontakt mit den Rollen (8) des bewegungsfähigen Drehtischs (6) kommt, auf die Bandmetallschlaufen aufwickelt, die auf dem starren Drehtisch (7) vorhanden sind, wobei das Bandmetall (20), das von dem starren Drehtisch (7) und von dem spiralförmigen Weg (15) kommt, unter den Auslassanpassungsmitteln (18) durchläuft, bevor es die Produktionslinie erreicht.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** zum Aufwickeln des Bandmetalls (20) auf den bewegungsfähigen und starren Drehtisch (6, 7) der bewegungsfähige Drehtisch (6) beginnt, in einer ersten Richtung mit einer ersten Geschwindigkeit zu drehen, und die Zugrolle (12), die mit dem bewegungsfähigen Drehtisch (6) einstückig ist, das Bandmetall (20) an die Übertragungsrolle (13) des starren Drehtischs (7) und dann auf die Rollen (8) treibt, die von dem bewegungsfähigen Drehtisch (6) und von dem starren Drehtisch (7) getragen sind, bis auf den zwei Drehtischen (6, 7) eine vorgegebene Anzahl von Schlaufen ausgebildet ist.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass**, wenn die vorgegebene Anzahl von Schlaufen auf den zwei Drehtischen (6, 7) ausgebildet wurde, der bewegungsfähige Drehtisch (6) und die Einlassanpassungsmittel (3) ihre Drehgeschwindigkeit derart verringern, dass, wenn sich der bewegungsfähige Drehtisch (6) im Stillstand befindet, die Menge von Bandmetall (20), die in den Speicher (1) eintritt, gleich jener ist, die aus der Produktionslinie austritt.

8. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass**, wenn die Zuführeinheit für das Bandmetall (20) gewechselt werden muss, die Einlassanpassungsmittel (3) das ankommende Bandmetall (20) blokkieren und der bewegliche Drehtisch (6) beginnt, in Gegenrichtung zu der vorherigen zu drehen, um die Schlaufen, die auf den Drehtischen (6, 7) ausgebildet sind, abzuwickeln und die Produktionslinie mit dem Bandmetall (20) zu versorgen, das in dem Speicher (1) gespeichert ist, und dass, wenn kein Bandmetall (20) mehr in dem Speicher (1) gespeichert ist, der bewegungsfähige Drehtisch (6) in die Ausgangsstellung zurückkehrt und der Speicher (1), falls die Zufuhr von Bandmetall (20) in seinen Einlass wiederhergestellt wurde, in den Bereitschaftsmodus umschaltet und dann erneut das Bandmetall (20) auf die zwei Drehtische (6, 7) aufwickelt.

Revendications

1. Accumulateur de bandes métalliques (1) en forme de boucle adapté pour être placé entre une unité alimentant en bande métallique (20) et une ligne de production et comprenant au moins un groupe d'entrée (2), une table tournante externe mobile (6), une table tournante interne fixe (7) coaxiale avec celle qui est mobile, un trajet hélicoïdal (15) intégral à la table tournante interne fixe (7) et des moyens de réglage (3, 4; 18) adaptés pour commander et régler la tension de la bande métallique (20) lorsqu'elle entre dans l'accumulateur (1) ou lorsqu'elle quitte ledit accumulateur, les deux tables tournantes (6, 7) supportant une pluralité de rouleaux (8) adaptés pour porter des boucles de bande métallique, **caractérisé en ce que** des moyens (3, 12, 13) sont prévus pour un enroulement sous traction de boucles de bande métallique (20) sur les rouleaux (8) des deux tables tournantes (6, 7) et **en ce que** les rouleaux (8) des deux tables tournantes (6, 7) sont montés

sur des bras pivotants (9) reliés l'un à l'autre par des tirants (10) et rendus mobiles par des moyens hydrauliques (11).

2. Accumulateur de bandes métalliques (1) selon la revendication 1, **caractérisé en ce que** le fonctionnement des moyens hydrauliques (11) est commandé par une unité logique qui commande également le moyen de réglage (3) et la table tournante mobile (6).

3. Accumulateur de bandes métalliques (1) selon la revendication 1, **caractérisé en ce qu'**il comprend également un rouleau de traction inactif (12) intégral à la table tournante mobile (6) et un rouleau de transmission inactif (13) intégral à la table tournante fixe (7).

4. Accumulateur de bandes métalliques (1) selon la revendication 1, **caractérisé en ce** chacun des moyens hydrauliques (11) est adapté pour agir sur la broche de l'un des bras pivotants (9) qui est couplé mécaniquement aux broches des bras pivotants adjacents (9) au moyen des tirants (10).

5. Procédé pour accumuler une bande métallique (20) à travers un accumulateur de bandes métalliques (1) selon l'une des revendications 1 à 4, **caractérisé par** l'enroulement sous traction des boucles de bande métallique sur les rouleaux (8) de la table tournante mobile (6) et de la table tournante fixe (7) et en ce que, pendant le fonctionnement, la bande métallique (20) passe au moins à travers le groupe d'entrée (2) et les moyens de réglage de l'entrée (3, 4) avant d'atteindre le rouleau de traction (12) de la table tournante mobile (6), qui, tournant conjointement avec la table tournante (6), enroule la bande métallique entrante (20) sur les boucles de bande métallique présentes sur la table tournante mobile (6) et, parallèlement, enroule sur les boucles de bande métallique présentes sur la table tournante fixe (7) les bandes métalliques (20) venant des boucles de bande métallique en contact avec les rouleaux (8) de la table tournante mobile (6), la bande métallique (20) arrivant de la table tournante fixe (7) et du trajet hélicoïdal (15) passant sous le moyen de réglage de la sortie (18) avant d'atteindre la ligne de production.

6. Procédé selon la revendication 5, **caractérisé en ce qu'**afin d'enrouler la bande métallique (20) sur les tables tournantes mobile et fixe (6, 7), la table tournante mobile (6) commence à tourner dans une première direction à une première vitesse et le rouleau de traction (12), intégral à la table tournante mobile (6), entraîne la bande métallique (20) contre le rouleau de transmission (13) de la table tournante fixe (7) puis sur les rouleaux (8) portés par la table tournante mobile (6) et par la table tournante fixe (7) jusqu'à former un nombre préréglé de boucles sur les deux tables tournantes (6, 7).

7. Procédé selon la revendication 6, **caractérisé en ce que**, lorsque le nombre préréglé de boucles a été formé sur les deux tables tournantes (6, 7), la table tournante mobile (6) et le moyen de réglage de l'entrée (3) baissent leur vitesse de rotation de telle façon que lorsque la table tournante mobile (6) est à l'arrêt, la quantité de bande métallique (20) qui entre dans l'accumulateur (1) est égale à celle existant dans la ligne de production.

8. Procédé selon la revendication 5, **caractérisé en ce que**, lorsque l'unité alimentant en bande métallique (20) doit être changée, le moyen de réglage de l'entrée (3) bloque la bande métallique (20) entrante et la table tournante mobile (6) commence à tourner dans une direction opposée à la précédente pour dérouler les boucles formées sur les tables tournantes (6, 7) et pour alimenter la ligne de production avec la bande métallique (20) stockée dans l'accumulateur (1) et **en ce que** lorsqu'il n'y a plus de bande métallique (20) stockée dans l'accumulateur (1), la table tournante mobile (6) retourne à sa position de départ et l'accumulateur (1), si l'alimentation en bande métallique (20) a été rétablie dans l'entrée de celui-ci, passe en mode « veille » et puis de nouveau, enroule la bande métallique (20) sur les deux tables tournantes (6, 7).

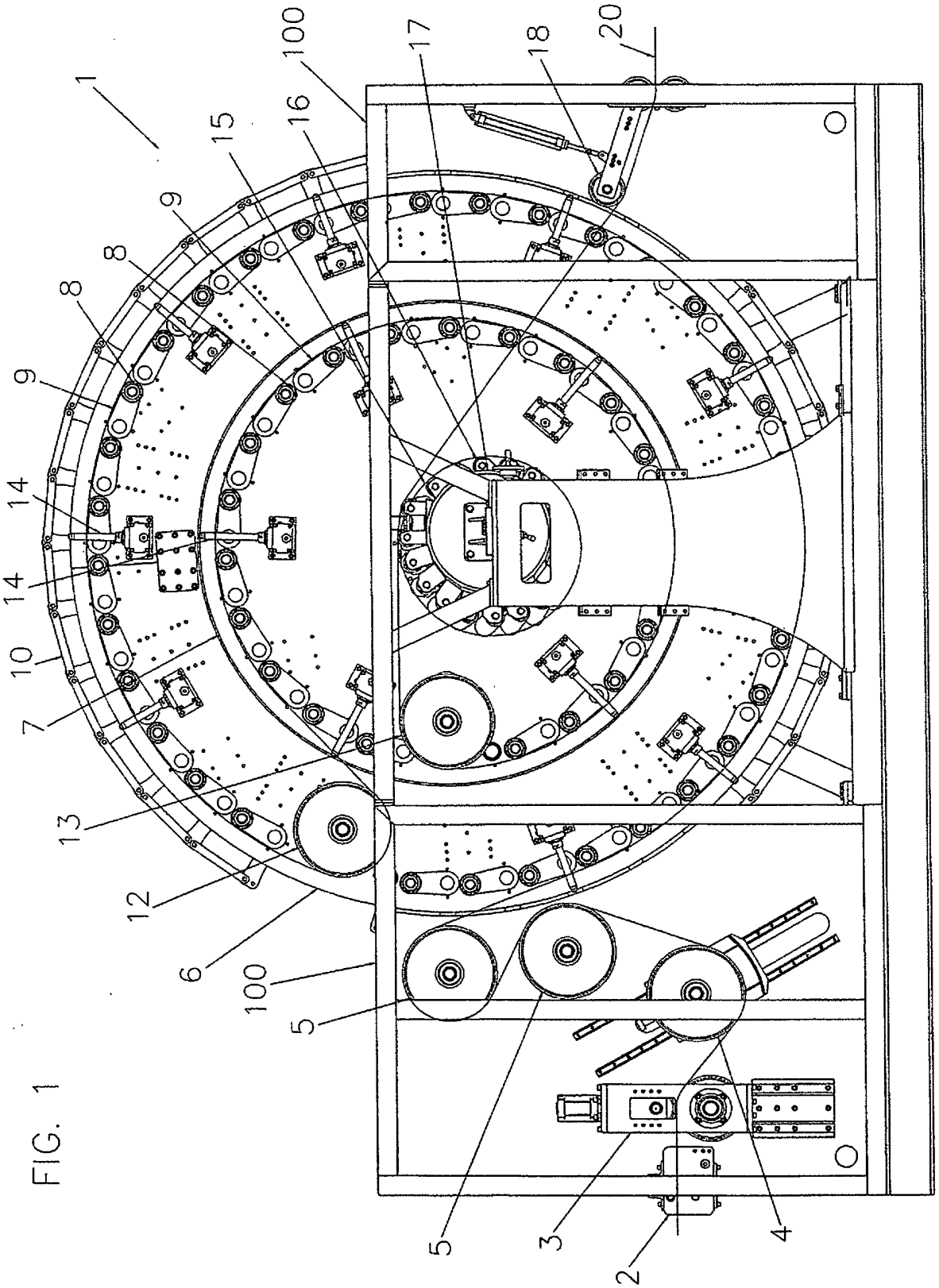


FIG. 1

FIG. 2

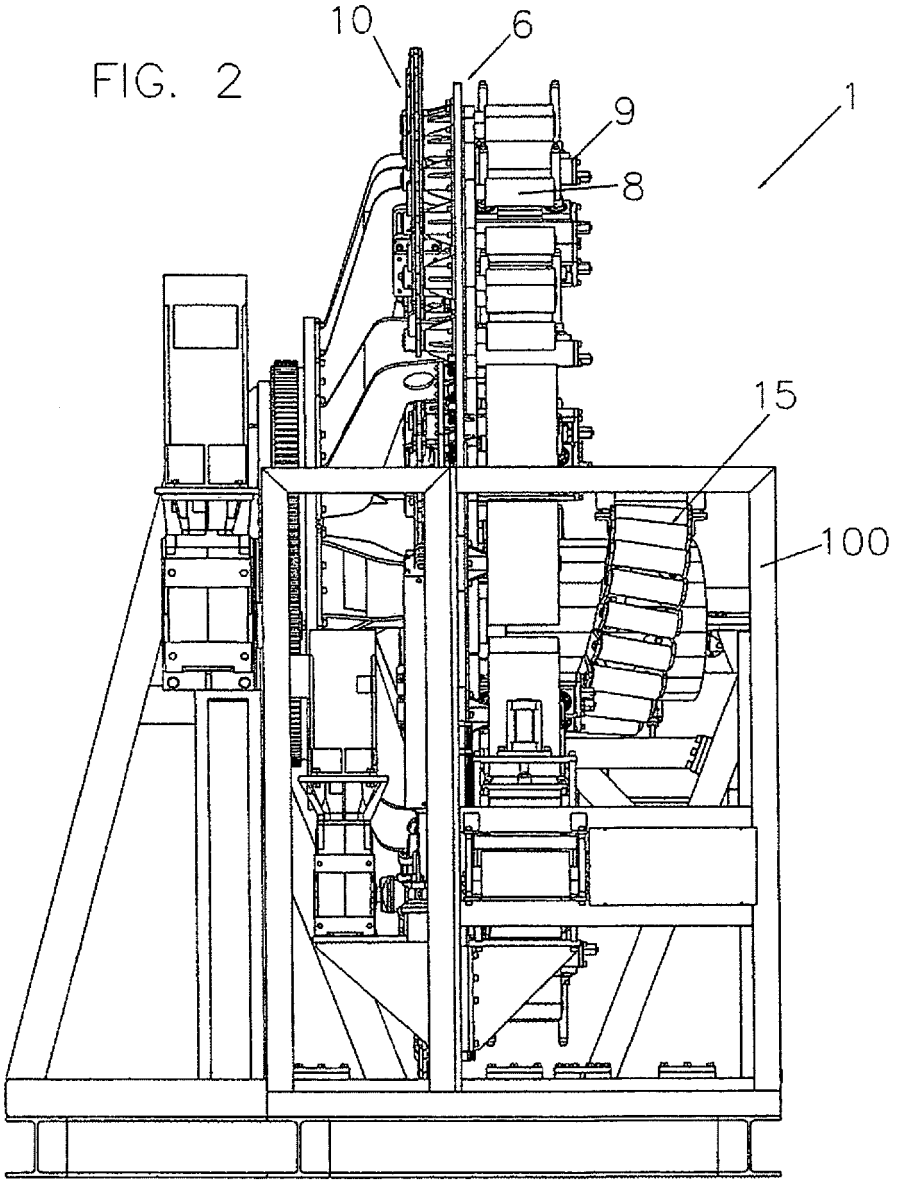
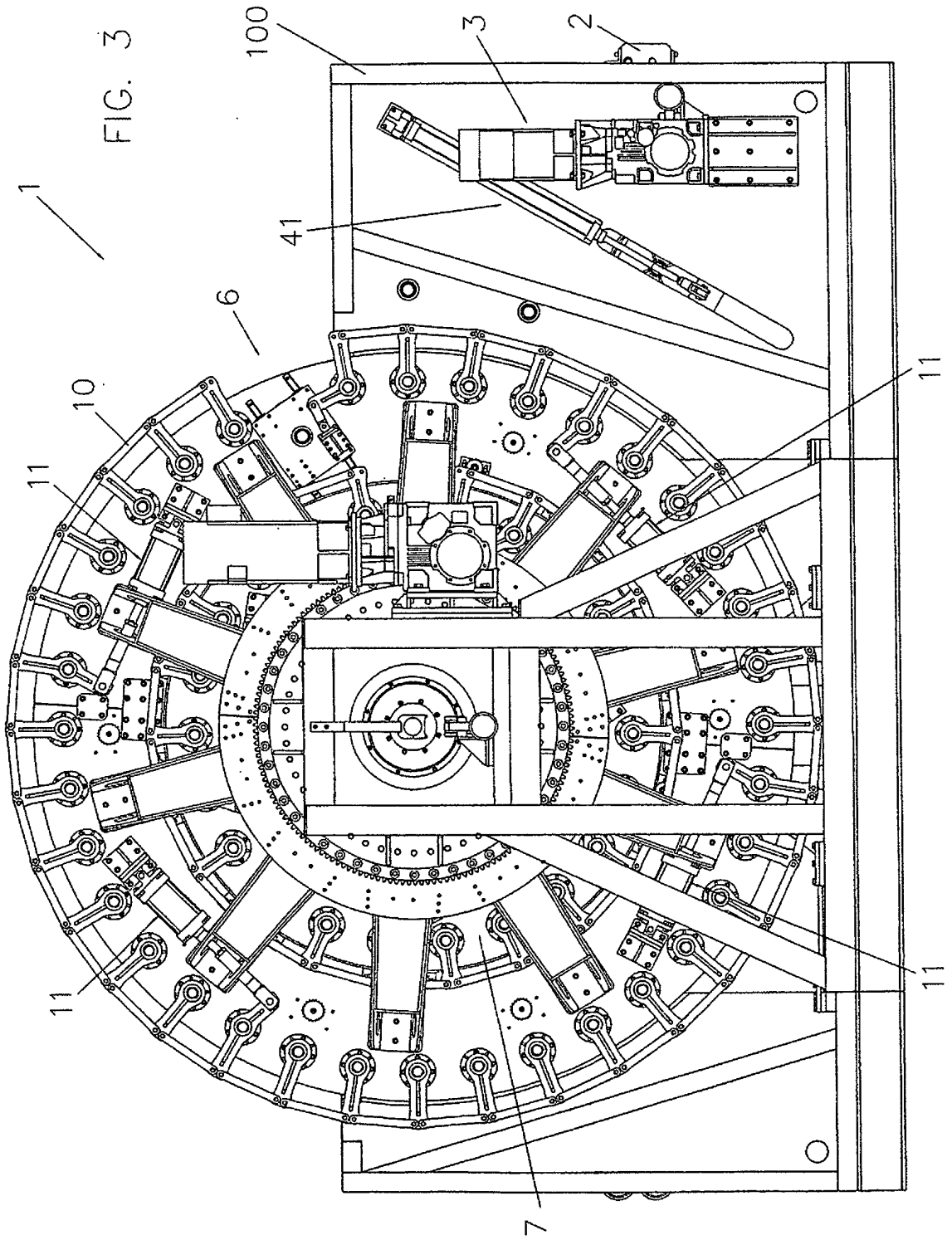


FIG. 3



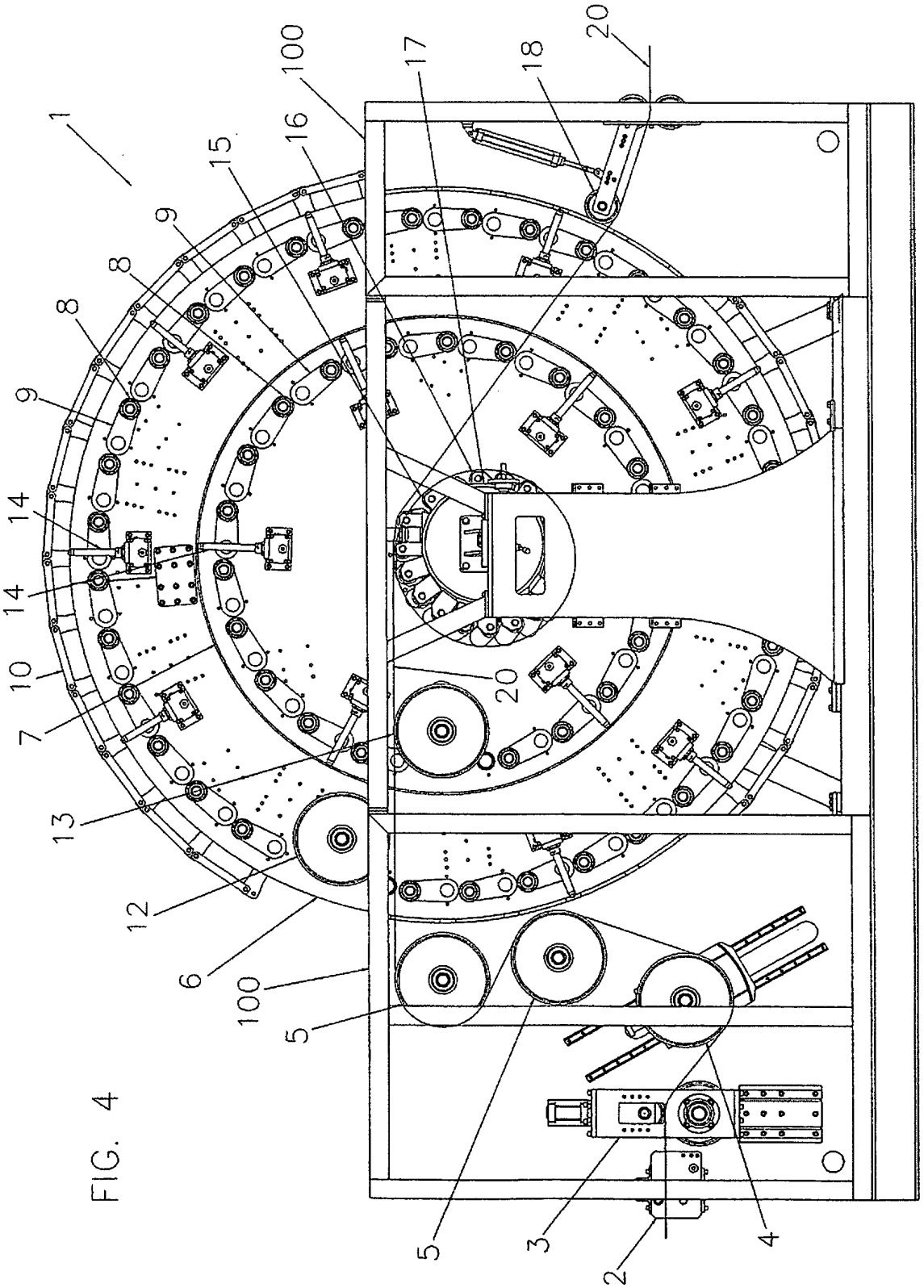


FIG. 4

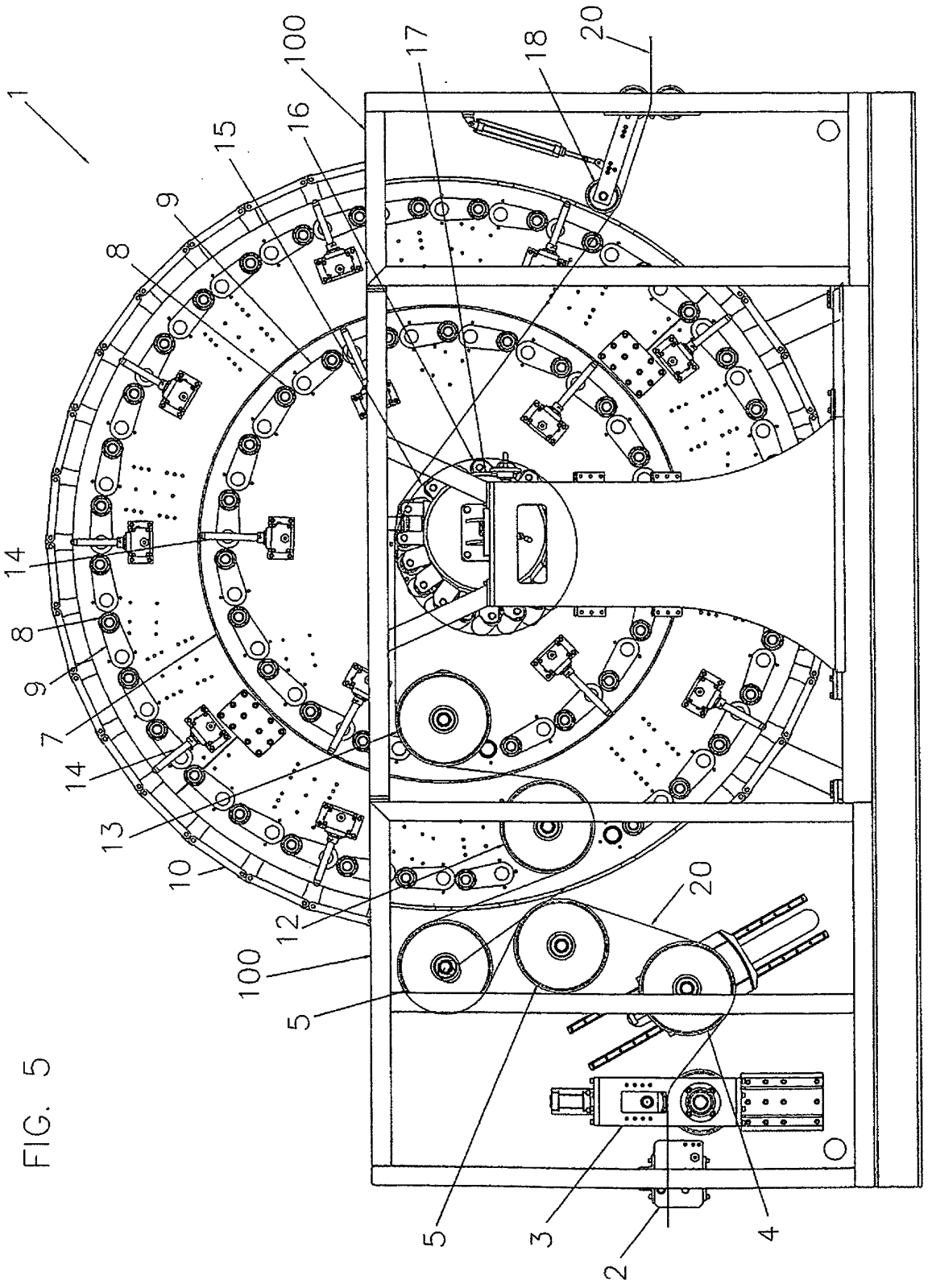


FIG. 5

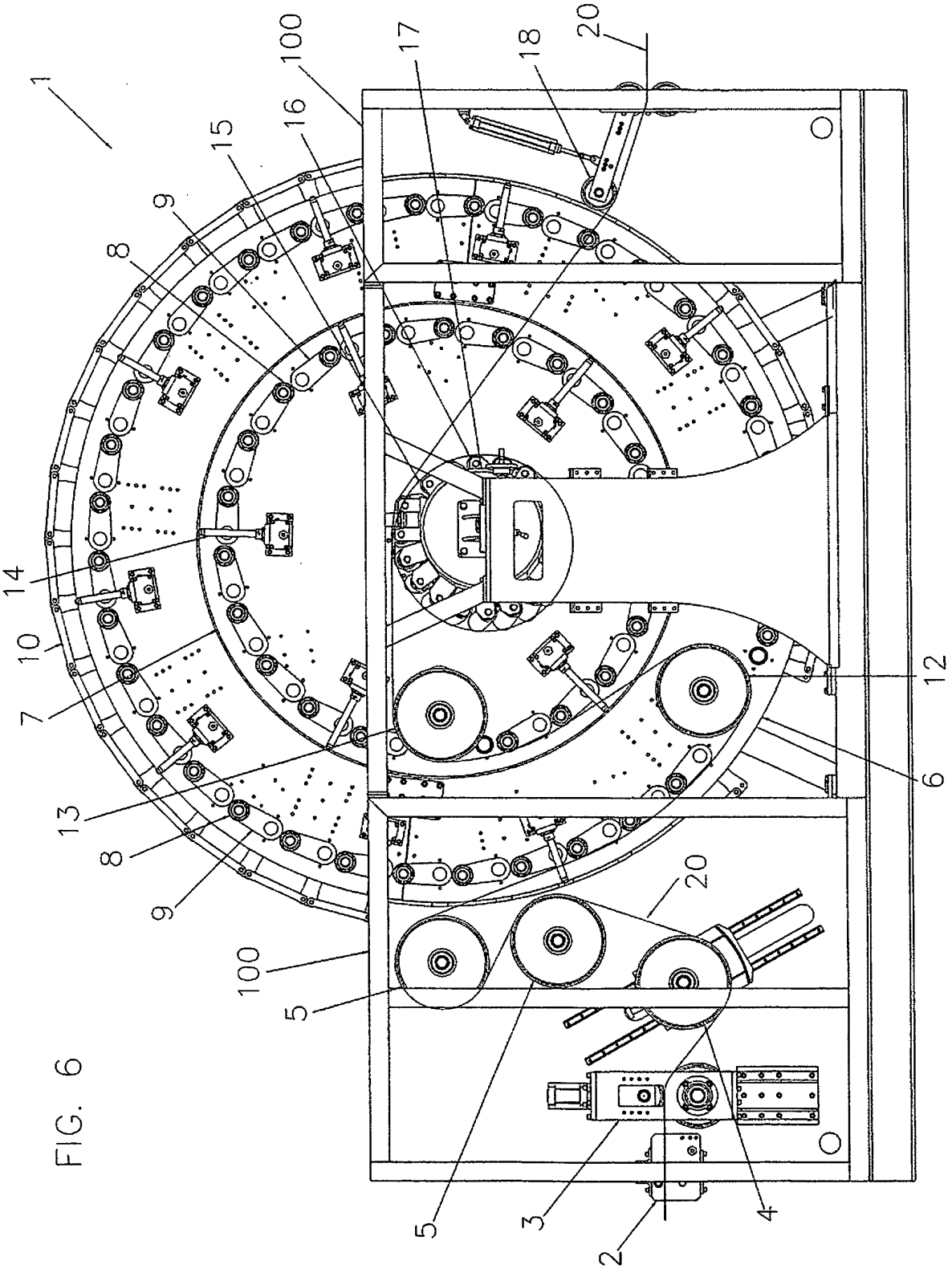


FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 20044039921 **[0006]**
- KR 20040039920 **[0007] [0009]**