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(54) **METHOD OF CONTROLLING THE COURSE OF THE LIFTING FUNCTIONS OF THE MAIN MECHANISMS OF A WEAVING MACHINE**

VERFAHREN ZUR STEUERUNG DES VERLAUFS DER HUBFUNKTIONEN DER HAUPTMECHANISMEN EINER WEBMASCHINE

PROCÉDÉ DE CONTRÔLE DU DÉROULEMENT DES FONCTIONS DE LEVAGE DES MÉCANISMES PRINCIPAUX D'UNE MACHINE À TISSER

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Description

Technical field

[0001] The invention relates to a method of controlling the course of the lifting functions of the main mechanisms of a weaving machine, in which each of the mechanisms is provided with an individual drive, whereby each of the drives comprises a servomotor with a controllably variable angular speed during one revolution of the servomotor.

Background art

[0002] The lifting functions of the main mechanisms of a weaving machine, namely of a beating-up mechanism and a shedding mechanism, are set in a fixed manner, as can be seen in Fig. 4, which shows the course of a stroke, for example the stroke of a batten of the beating-up mechanism, depending on the angle of rotation of the main shaft. To insert a weft into a shed, it is necessary to have a free insertion channel in a reed (position above the dashed line) for the entire duration of insertion. Fig. 4 shows an angle of the main (mechanical) shaft for weft insertion ranging from 75° to 285°. This angle is the result of the specific geometry of a joint mechanism (dimensions of the individual members) or of the shape of a cam path of a cam mechanism and cannot be continuously changed. The time t [s] available for weft insertion through the open shed is determined by the main shaft speed (by the machine frequency) and the insertion angle (285 ° - 75 ° = 210 °) and, for example for 600 min^{-1}, it is calculated: (60 x 210) / (600 x 360) = 0.05833 s. In cases where wefts of greater weight or wefts with less affinity for pneumatic insertion need to be inserted into the shed, the speed of the weaving machine must be reduced to create the required insertion time t, and so the machine operates at lower speeds than for which it is designed and, as a result, the use of its proposed technical parameters, as well as productivity, are reduced.

[0003] CZ302120 discloses a weaving machine in which a multi-member mechanism for providing reciprocating motion of a weaving reed with reduced moment of inertia is coupled to a motor with a controllably variable angular speed during one revolution of the motor. A part of a shedding mechanism is also coupled to this motor with a controllably variable angular speed during one revolution during one revolution of the motor. However, the relationship between the motion of the weaving reed and the respective part of the shedding mechanism, usually a heald rod, is unchanged, and so everything mentioned above and shown in Fig. 4 also applies to this relationship.

[0004] A method according to the preamble of claim 1 is known from US2006/207674A.

[0005] In order to reduce the energy intensity of the drive of the weaving machine or in order to increase the performance while maintaining the energy intensity of the weaving machine, separation of the drives of the beating-up mechanism and the shedding mechanism is proposed, whereby each of the mechanisms is provided with an individual drive controlled in the electronic cam mode. Each of these mechanisms can be coupled to an energy recuperation system.

Principle of the invention

[0006] The object of the present invention is achieved by a method of controlling the course of lifting functions of the main mechanisms of a weaving machine according to the present invention, whose principle consists in that the angular speed of the servomotor of the beating-up mechanism and the angular speed of the servomotor of the shedding mechanism change during their rotation according to the selected unevenness of operation according to adaptive algorithm, whereby in an exemplary embodiment, the value of the quadratic mean of the driving torque determined within an interval of one revolution of the main virtual shaft is maintained at the same selected level for all operating frequencies of the machine. The quadratic mean of the course of the driving torque can be replaced with another dynamic parameter of the weaving machine, such as the quadratic mean of the performance, maximum value of the driving torque, maximum value of the performance, mean value of the driving torque, mean value of the performance, the loading of the members of the transformation mechanisms or the service life of the bearings loaded by reaction forces.

[0007] This solution allows to change the stroke dependence by an adaptive system and maximize the insertion angle, thus enabling operation of the machine at higher speeds, optimizing machine operation with respect to the insertion requirements of a specific weft material and effectively utilizing the dynamic properties of the weaving machine in a wide range of operating speeds.

[0008] In addition, it is not necessary for the unevenness of rotation of the drive of the beating-up mechanism to be equal to the unevenness of rotation of the drive of the shedding mechanism.

Description of drawings

[0009] Fig. 1 shows a basic scheme of a drive of a batten of a beating-up mechanism and of a drive of a heald rod of a shedding mechanism of a weaving machine for the production of leno fabrics, Fig. 2 shows the drive of the batten of the beating-up mechanism and Fig. 3 shows the drive of the heald rod of the shedding mechanism, Fig. 4 shows the dependence of the stroke of the batten, or of the heald rod z_{41} on the angle τ of rotation of the main mechanical shaft during one revolution of this shaft according to the background art, Fig. 5 shows the course of the angle of rotation φ_{21} of servomotor rotor on the angle τ of rotation of the main virtual shaft during one revolution for the parameters of the unevenness of operation A% adjustable within a range from 0 % to 100 %, Fig. 6 shows the course of the dependence of the revolutions n_{21} of the servomotor rotor on angle τ of rotation of the main virtual shaft during one revolution for the operating frequency of the weaving machine 600 min^{-1} and the parameters of the unevenness of operation A% adjustable within a range from 0% to 100% and finally, Fig. 7 shows the course of the stroke z_{41} of a working member (the weaving reed in the case of a beating-up mechanism and the heald rod in the case of the shedding mechanism) depending on the angle τ of rotation of the main virtual shaft during one revolution for the parameters of the unevenness of operation A% which are adjustable within a range from 0 % to 100 % and after the transformation by a crank mechanism.

Examples of embodiment

[0010] The invention will be described with reference to an example of an air-jet weaving machine for producing leno fabrics. However, it is not limited to this type of weaving machine, but can be used in all weaving machines to control the lifting functions of the main mechanisms, each of these main mechanisms having an individual drive with a controllably variable angular speed during one revolution of the drive.

[0011] The air-jet weaving machine for producing leno fabrics comprises a beating-up mechanism **1** and a shedding mechanism **2.**

[0012] The beating-up mechanism **1** comprises a weaving reed **11** which is mounted on a stringer **121** of a batten **12.** The batten **12** is mounted in a known manner on the machine frame **3** by means of at least two flexible members **122** of the energy recuperation system of the beating-up mechanism **1,** as is schematically shown in Fig. 1. In the exemplary embodiment of Fig. 2, the flexible members **122** are arranged in two planar surfaces between which there is a spacing in the direction of the motion of the stringer **121** of the batten **12** between the insertion position and the beating-up position and the batten **12** is made according to patent CZ 302391 of a carbon-epoxy (CE) composite material or another suitable material. In the embodiment shown, the flexible members **122** consist of leaf springs **1221** which constitute in their upper part an integral part of the stringer **121,** whereby both the leaf springs **1221** and the stringer **121** are made of the same CE composite material and form an open profile in the shape of a parallelogram or a general quadrilateral. The beating-up mechanism **1** is provided with an individual drive which is in the illustrated embodiment formed by two servomotors **4** according to UV 29115 with crank rotors **41** which are at one end provided with eccentric pins **411** on which are mounted connecting rods **42** of the beating-up mechanism which are in the exemplary embodiment shown coupled to the batten **12** by means of connecting rod pins **123,** formed on the batten **12.** The two servomotors **4** with crank rotors **41** are controlled synchronously and have a controllably variable angular speed during one revolution. The servomotors **4** with crank rotors **41** are mounted on the frame **3** of the weaving machine and, in the embodiment shown, are spaced from each other by means of eccentric pins **411** with connecting rods **42.** The pins **123** of the connecting rod **42** are formed on the batten **12** below its stringer **121.** A weaving reed **11** and related accessories, for example main nozzles **124,** blowing nozzles **125,** etc., are mounted on the stringer **121** of the batten **12.** The servomotors **4** with crank rotors **41** are coupled in a known unillustrated method to an unillustrated control system of the weaving machine.

[0013] The shedding mechanism **2** of the weaving machine comprises a vertically reversibly displaceable heald rod **21** on which is mounted a guide rail **211** of stationary warp threads with holes to receive stationary warp threads which further pass through the lamellae of the weaving reed **11** to a binding point, where they become part of the fabric. The heald rod **21** is coupled to the shedding mechanism with an individual drive with the aid of means which are situated below the weaving plane which is formed by a horizontal plane interspersed with the binding point.

[0014] The heald rod **21** of the shedding mechanism of the weaving machine is slidably mounted on the machine frame in guides (not shown) by means of gliders **23** which are fixedly connected to the heald rod **21.** The individual drive of the heald rod **21** is formed by a servomotor **5** with a controllably variable angular speed during one revolution of the servomotor **5.** The servomotor **5** of the shedding mechanism is mounted on the frame **3** of the weaving machine and located below the middle part of the heald rod **21.** In the embodiment shown, the servomotor **5** of the shedding mechanism **2** is provided with a continuous shaft **51,** at the ends of which are arranged crankshafts **511,** which are coupled to the heald rod **21** in a known method by means of the connecting rods **52** of the shedding mechanism. In the embodiment shown, the heald rod **21** is made of CE composite material. The heald rod **21** of the shedding mechanism is associated with recuperative members **6** of the energy recuperation system of the shedding mechanism **2.**

[0015] In the exemplary embodiment shown in Fig. 3, four recuperative members **6** are arranged below the heald rod **21.** Below the middle part of the heald rod **21,** a central holder **60** of the inner recuperative members **601** is fixedly mounted on the frame **3** of the weaving machine, to which static stirrups of the inner recuperative members **601** are connected. The movable stirrups of the inner recuperative members **601** are coupled to the connecting rods **52** of the shedding mechanism **2** by means of flexible tow bars **67.** Outwards, flexible tow bars **67** of outer recuperation members

602 are mounted on the respective connecting rods **52** of the shedding mechanism **2,** whereby the static stirrups of the outer recuperation members **602** are fixedly mounted on the frame **3** of the weaving machine in the extreme holders **61, 62** of the outer recuperative members **6.** The inner recuperative member **601** and the outer recuperative member **602** constitute on both sides of the machine a pair of recuperative members **6** which serves for energy recuperation of the shedding mechanism **2.**

[0016] As the heald rod **21** moves, the flexible tow bars **67** also move and carry the movable stirrups of the respective pairs of recuperative members **6**. while the static stirrups do not move, which leads to the deformation of the leaf springs of the respective recuperative members. As the heald rod **21** moves backwards, the leaf springs straighten and recover energy.

[0017] In order to take advantage of all the possibilities provided by the separation of the drives of the beating-up mechanism and the shedding mechanism, whereby the drives are formed by servomotors with a controllably variable angular speed during one revolution of the servomotor, as described above, an adaptive system of controlling the lifting functions of these mechanisms is proposed. The adaptive system consists in the fact that due to the change of unevenness of rotation of the rotors of the respective servomotors depending on the operating frequency of the weaving machine, the maximum insertion angle is achieved, that is, the maximum space or time for the implementation of pneumatic weft insertion while making optimal use of the dynamic characteristics of the mechanisms of the weaving machine and their individual drives by the respective servomotors.

[0018] In the exemplary embodiment, the adaptive system is based on the below dependence for the angle of rotation of the rotor of the servomotor $\varphi_{A(\tau)}$:

$$\boldsymbol{\varphi}_{A(\tau)} = \boldsymbol{\tau} + \boldsymbol{A} * \sin(\tau) + \boldsymbol{A} * \sin[\boldsymbol{\tau} + \boldsymbol{A} * \sin(\tau)]$$

where τ is the angle of rotation of the main "virtual" shaft [rad]
(calculated by the control system) and defined by the relation:

$$\tau = \Omega * t$$

where Ω is circular frequency [rad/s], determined by the relation:

$$\Omega = \frac{2*\pi*n}{60} = 2^{*}\pi * f$$

t - time [s] n - machine revolutions [1/min]
where

$$\boldsymbol{A} = \frac{\boldsymbol{A\%}}{\mathbf{100}}$$

is a parameter expressing the degree of uneven operation of the beating-up shedding mechanism in [%], and is continuously variable within a range from 0 % to 100 %.

[0019] The course of the dependence of the angle $\varphi_{\mathbf{21}}$ of rotation of the rotor of the servomotor on the angle τ of rotation of the main (virtual) shaft for the parameters of the unevenness of operation A% from 0 % to 100 % are graphically represented in Fig. 5, from which it is evident that for A% = 0 % the dependence is linear (evenly linearly increasing) and with increasing unevenness A%, also the unevenness of the course of the angle φ_{21} of the servomotor rotation on the angle τ of rotation of the main virtual shaft increases, which, for example, for the beating-up mechanism and theoretical unevenness A % = 100 % means that the weaving reed practically moves from the beating-up position to the rear dead center after reaching the angle τ = 90 °, remains there until τ = 270 ° and after reaching τ = 360 ° moves back to the beating-up position. For the shedding mechanism and theoretical unevenness A % = 100 %, this means that the heald rod practically moves from the initial lower position after reaching the angle τ = 90 ° to the top dead center, in which it remains until τ = 270 ° and then it moves back to the initial lower position when the angle τ = 360 ° is reached.

[0020] The above corresponds to the course of the dependence of the speed n_{21} of the rotor of the servomotor on the angle τ of rotation of the main virtual shaft, during one revolution for the operating frequency of the weaving machine 600 min^{-1} and the parameters of the unevenness of operation A % adjustable in the range from 0 % to 100 %, as graphically represented in Fig. 6. With unevenness A % = 0, the speed is constant and is equal to the operating frequency

n of the weaving machine, i.e. the nominal speed of the main virtual shaft, and their course is therefore constant (horizontal line), while at unevenness A % = 100 %, the rotor of the servomotor has high speeds in the first part of its movement (from τ = 0 ° until reaching the angle τ = 90 °). The high speeds quickly decrease towards zero and again begin to increase sharply from τ = 270 ° until the maximum is reached at the angle τ = 360 °.

[0021] Similarly, Fig. 7 graphically represents the course of the stroke z_{41} of the working member (the weaving reed in the case of the beating-up mechanism and the heald rod in the case of the shedding mechanism) depending on the angle τ of rotation of the main virtual shaft, during one revolution of the main virtual shaft for the parameters of unevenness of operation A% adjustable in the range from 0% to 100% and after the transformation by the crank mechanism.

[0022] The adaptive system of controlling the lifting functions of the beating-up mechanism and the shedding mechanism is designed for the parameters of unevenness of operation A% such that for the set operating frequencies **n** of the weaving machine, i.e. for the selected nominal speed of the main virtual shaft of the weaving machine, the value of the quadratic mean of the course of the driving torque of the servomotor calculated for the interval of one revolution of the main virtual shaft is equal to the same selected value,

$^{RMS}Mh_{21}$ = 17 Nm

and was at the same selected level for all the set operating frequencies of the machine as shown in the following table, indicating:

n	operating frequency of the weaving machine, i.e. speed of the main virtual shaft
A%	parameter of unevenness of operation of the servomotor, that is, of the crankshaft
$^{min}n_{21}$	actual minimum speed of the servomotor, that is, of the crankshaft
$^{max}n_{21}$	actual maximum speed of the servomotor, that is, of the crankshaft
$\tau_{insertion}$	insertion angle of rotation of the main "virtual" shaft
$T_{insertion}$	time for insertion
^{RMS}P	quadratic mean of the performance of the servomotor for the interval of one period
^{max}P	maximum value of the performance of the servomotor
$^{RMS}M_h$	quadratic mean of the driving torque of the servomotor for the interval of one revolution of the main virtual shaft
$^{max}M_h$	maximum value of the driving torque of the servomotor

PARAMETERS OF AN EXEMPLARY EMBODIMENT OF A SHEDDING MECHANISM

[0023]

n	$A_{\%}$	$^{min}n_{21}$	$^{max}n_{21}$	τ of insertion	$T_{insertion}$	^{RMS}P	^{max}P	$^{RMS}M_h$	$^{max}M_h$
[rpm]	[%]	[RPM]	[RPM]	[deg]	[ms]	[W]	[W]	[Nm]	[Nm]
750	32.475	342	1316	202.0	44.889	1603	3621	17.00	37.10
725	34.465	311	1311	206.0	47.356	1585	3633	17.00	37,.9
700	36.618	281	1307	212.0	50.476	1568	3650	17.00	37.90
675	38.952	252	1303	216.0	53.333	1554	3672	17.00	38.36
650	41.489	223	1301	222.0	56.923	1542	3703	17.00	38.88
625	44.251	194	1301	226.0	60.267	1532	3744	17.00	39.45
600	47.263	167	1301	232.0	64.444	1526	3794	17.00	40.08
575	50.552	141	1303	238.0	68.986	1523	3853	17.00	40.77
550	54.143	116	1307	244.0	73.939	1523	3924	17.00	41.51
525	58.062	92	1312	250.0	79.365	1526	4005	17.00	42.31
500	62.330	71	1318	256.0	85.333	1530	4091	17.00	43.14
475	66.965	52	1324	262.0	91.930	1534	4176	17.00	43.93
450	71.982	35	1331	268.0	99.259	1536	4257	17.00	44.61
425	77.387	22	1337	274.0	107.451	1532	4320	17.00	45.08
400	83.182	11	1342	280.0	116.667	1520	4349	17.00	45.22

[0024] The optimization solution of the problem was performed numerically, at discrete points for the varying parameters of unevenness A% and the practical range of nominal speeds of the main virtual shaft of the weaving machine, and subsequently approximated by continuous analytic function. The other values shown in the Table are key physical quantities of the solved system and they also need to be critically assessed.

[0025] The optimization of parameters of unevenness of operation A% can also be performed for other dynamic parameters of the weaving machine, where the value of the dynamic parameter selected from the group of dynamic parameters: (the quadratic mean of the course of the driving torque, the quadratic mean of the performance, the maximum value of the driving torque, the maximum value of the performance, the mean value of the driving torque, the mean value of the performance, the loading of the members of the transformation mechanisms or the service life of the bearings loaded by reaction forces) and (the value) calculated for the interval of one period is maintained at the same selected level for all operating frequencies of the machine.

Industrial applicability

[0026] The method according to the invention can be used in weaving machines which have individual drives of the beating-up mechanism and the shedding mechanism, and both these drives are controlled in the electronic cam mode. The method can also be used in weaving machines in which the drive of the beating-up mechanism and the shedding mechanism is common but consists of a servomotor controlled in the electronic cam mode.

List of references

[0027]

1	beating-up mechanism
11	weaving reed
12	batten
121	stringer of the batten
122	flexible members of the energy recuperation system of the beating-up mechanism
1221	leaf springs of the batten
123	eyes of the batten
2	shedding mechanism
21	heald rod
211	guide rail of stationary warp threads
23	sliders of the heald rod
3	frame for the weaving machine
4	servomotors with crank rotors
41	crank rotors
411	eccentric pins
42	connecting rod of the beating-up mechanism
5	servomotor of the shedding mechanism
51	continuous shaft
511	crankshaft
52	connecting rod of the shedding mechanism
6	recuperative member
60	central holder of the inner recuperative members
601	inner recuperative member
602	outer recuperative member
61, 62	extreme holders of the outer recuperative members
67	flexible tow bar of the recuperative member
$\varphi_{\mathbf{A}(\tau)}$	angle of rotation of the servomotor
τ	angle of rotation of the main virtual shaft [rad]
Ω	circular frequency [rad/s]
T	time [s]
n	operating frequency of the weaving machine, i.e., speed of the main virtual shaft
A%	parameter of the unevenness of operation of the servomotor, i.e., of the crankshaft
$^{min}\mathbf{n}_{21}$	actual minimum speed of the servomotor, i.e., of the crankshaft
$^{max}\mathbf{n}_{21}$	actual maximum speed of the servomotor, i.e., of the crankshaft
$\tau_{\text{of insertion}}$	insertion angle of rotation of the main "virtual" shaft

$T_{insertion}$	time for insertion
^{RMS}P	quadratic mean of the performance of the servomotor for the interval of one period
^{max}P	maximum value of the performance of the servomotor
$^{RMS}M_h$	quadratic mean of the driving torque of the servomotor for the interval of one period of the main virtual shaft
$^{max}M_h$	maximum value of the driving torque of the servomotor

Claims

1. A method of controlling the course of lifting functions of a beating-up mechanism (1) and a shedding mechanism (2) of a weaving machine, in which each of the mechanisms is provided with an individual drive, whereby each of the drives comprises a servomotor (4, 5) with a controllably variable angular speed during one revolution of the servomotor (4,5), **characterized in that** the angular speed of the servomotor (4) of the beating-up mechanism (1) and the angular speed of the servomotor (5) of the shedding mechanism (2) varies during one revolution of the servomotor (4, 5) according to the selected unevenness of operation (A%) as defined in the description depending on the operating frequency (n) of the weaving machine to maximize the insertion angle and the time to implement weft insertion, whereby the value of a dynamic parameter selected from a group of dynamic parameters consisting of the quadratic mean of the course of the driving torque, the quadratic mean of the performance, the maximum value of the performance, the mean value of the driving torque, the mean value of the performance, the loading of the members of the transformation mechanisms, or the service life of the bearings loaded by reaction forces, and calculated for the interval of one revolution of the main virtual shaft is maintained for all the operating frequencies of the machine at the same selected level.

2. The method according to claim 1, **characterized in that** the dynamic parameter is the quadratic mean of the course of the driving torque ($^{RMS}MH_{21}$).

3. The method according to claim 1 or 2, **characterized in that** the unevenness of rotation of the drive of the beating-up mechanism equals the unevenness of rotation of the drive of the shedding mechanism.

4. The method according to claim 1 or 2, **characterized in that** the unevenness of rotation of the drive of the beating-up mechanism is different from the unevenness of rotation of the drive of the shedding mechanism

Patentansprüche

1. Verfahren zur Ablaufsteuerung von Hubfunktionen eines Anschlagmechanismus (1) und eines Fachmechanismus (2) einer Webmaschine, von denen jedem dieser Mechanismen ein selbständiger Antrieb zugeordnet ist, wobei jeder dieser selbständigen Antriebe einen Servomotor (4, 5) mit einer steuerbar veränderlichen Winkelgeschwindigkeit während einer seiner Drehzahlen aufweist, **dadurch gekennzeichnet, dass** die Winkelgeschwindigkeit eines Servomotors (4) eines Anschlagmechanismus (1) und die Winkelgeschwindigkeit eines Servomotors (5) eines Fachmechanismus (2) während einer ihrer Drehzahlen laut der gewählten Ungleichmäßigkeit des Gangs (A%), wie in der Beschreibung definiert, in der Abhängigkeit von der Arbeitsfrequenz (n) einer Webmaschine zur Maximierung eines Eintragswinkels und der Zeit zur Realisierung eines Schusseintrages verändert werden, wobei der Wert eines dynamischen von der Gruppe der dynamischen Parameter gewählten Parameters: quadratischer Mittelwert des Antriebsmomentverlaufes, quadratischer Mittelwert der Leistung, Maximalwert des Antriebsmomentes, Maximalwert der Leistung, Mittelwert des Antriebsmomentes, Mittelwert der Leistung, Belastung der Glieder der Transformationsmechanismen, oder Standzeit der durch Reaktionskräfte belasteten Lager, und berechnet auf Intervall von einer Drehzahl einer virtuellen Hauptwelle für alle Arbeitsfrequenzen der Maschine auf demselben gewählten Wert erhalten wird.

2. Verfahren nach dem Anspruch 1, **dadurch gekennzeichnet, dass** ein dynamischer Parameter quadratischer Mittelwert des Antriebsmomentverlaufes ($^{RMS}MH_{21}$) ist.

3. Verfahren nach dem Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Ungleichmäßigkeit der Rotation vom Antrieb eines Anschlagmechanismus der Ungleichmäßigkeit der Rotation vom Antrieb eines Fachmechanismus gleich ist.

4. Verfahren nach dem Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Ungleichmäßigkeit der Rotation vom

Antrieb eines Anschlagmechanismus von der Ungleichmäßigkeit der Rotation vom Antrieb eines Fachmechanismus abweicht.

Revendications

1. Procédé de commande de déroulement des fonctions de levage d'un mécanisme de battage (1) et d'un mécanisme de formation de la foule (2) d'une machine à tisser, où chacun de ces mécanismes se trouve rattaché à un entraînement individuel et chaque entraînement individuel et muni d'un servomoteur (4, 5) avec une vitesse angulaire variable et contrôlable pendant un tour du servomoteur (4, 5), **caractérisé en ce que** la vitesse angulaire du servomoteur (4) du mécanisme de battage (1) et la vitesse angulaire du servomoteur (5) du mécanisme de formation de la foule (2) changent lors de l'un de leur tours en fonction de l'irrégularité de fonctionnement sélectionnée (A%), tel que défini dans la description en fonction de la fréquence de travail (n) de la machine à tisser pour maximiser l'angle d'insertion et le temps de mise en œuvre de l'insertion de trame, tandis que la valeur de paramètre dynamique sélectionné d'un groupe de paramètres dynamiques : la moyenne quadratique de l'évolution du couple moteur, la moyenne quadratique de la performance, la valeur maximale du couple moteur, la valeur maximale de la performance, la valeur moyenne du couple moteur, la valeur moyenne de la performance, la charge des mécanismes de transformation, ou la durée de vie des roulements sollicités par les forces de réaction et calculée pour l'intervalle d'un tour de l'arbre virtuel principal, est maintenue pour toutes les fréquences de fonctionnement de la machine au même niveau sélectionné.

2. Procédé selon la revendication 1, **caractérisé en ce que** le paramètre dynamique est la moyenne quadratique de l'évolution du couple moteur ($^{RMS}MH_{21}$).

3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** l'irrégularité de la rotation de l'entraînement du mécanisme de battage est égale à l'irrégularité de la rotation de l'entraînement du mécanisme de formation de la foule.

4. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** l'irrégularité de la rotation de l'entraînement du mécanisme de battage est différente de l'irrégularité de rotation de l'entraînement du mécanisme de formation de la foule.

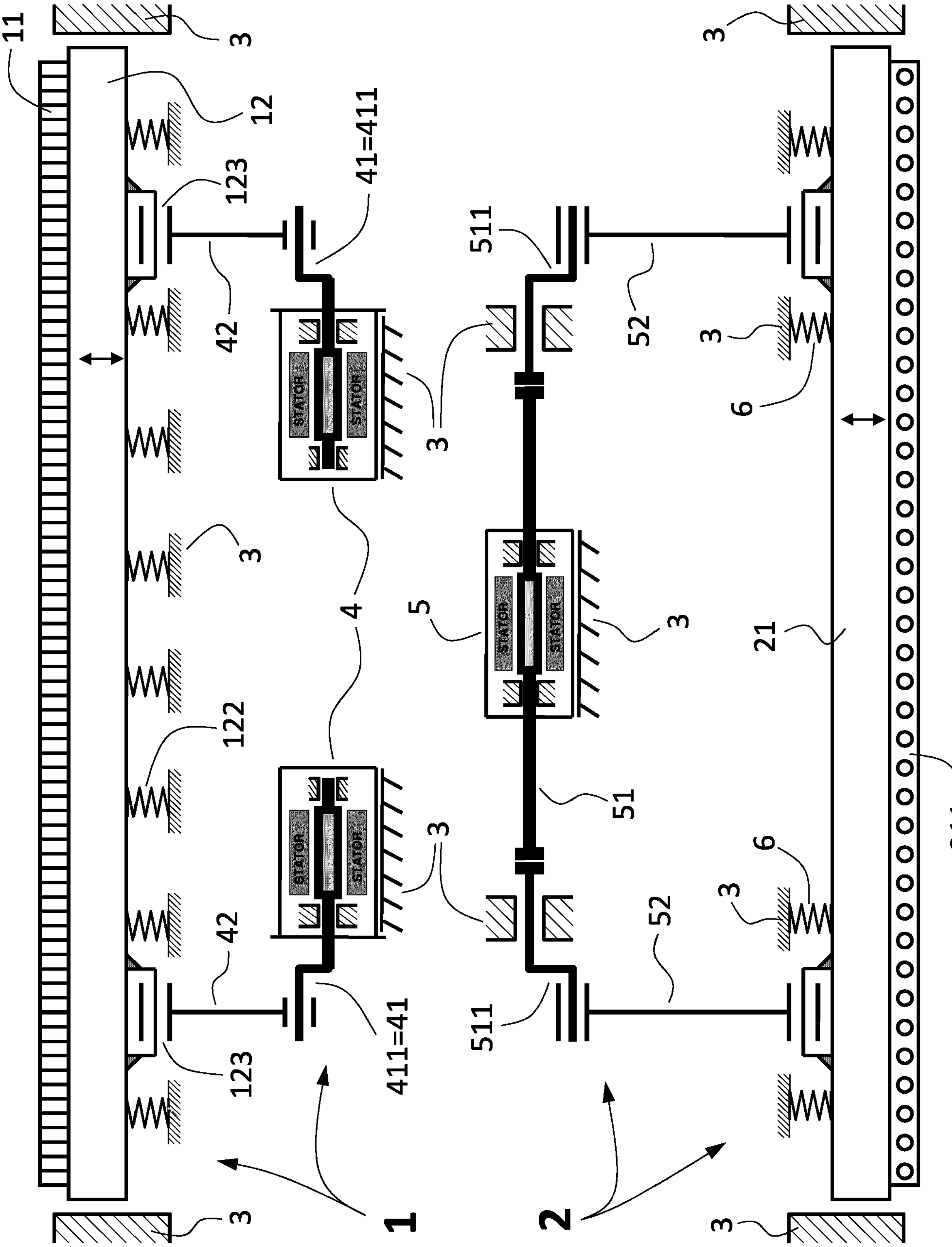


Fig. 1

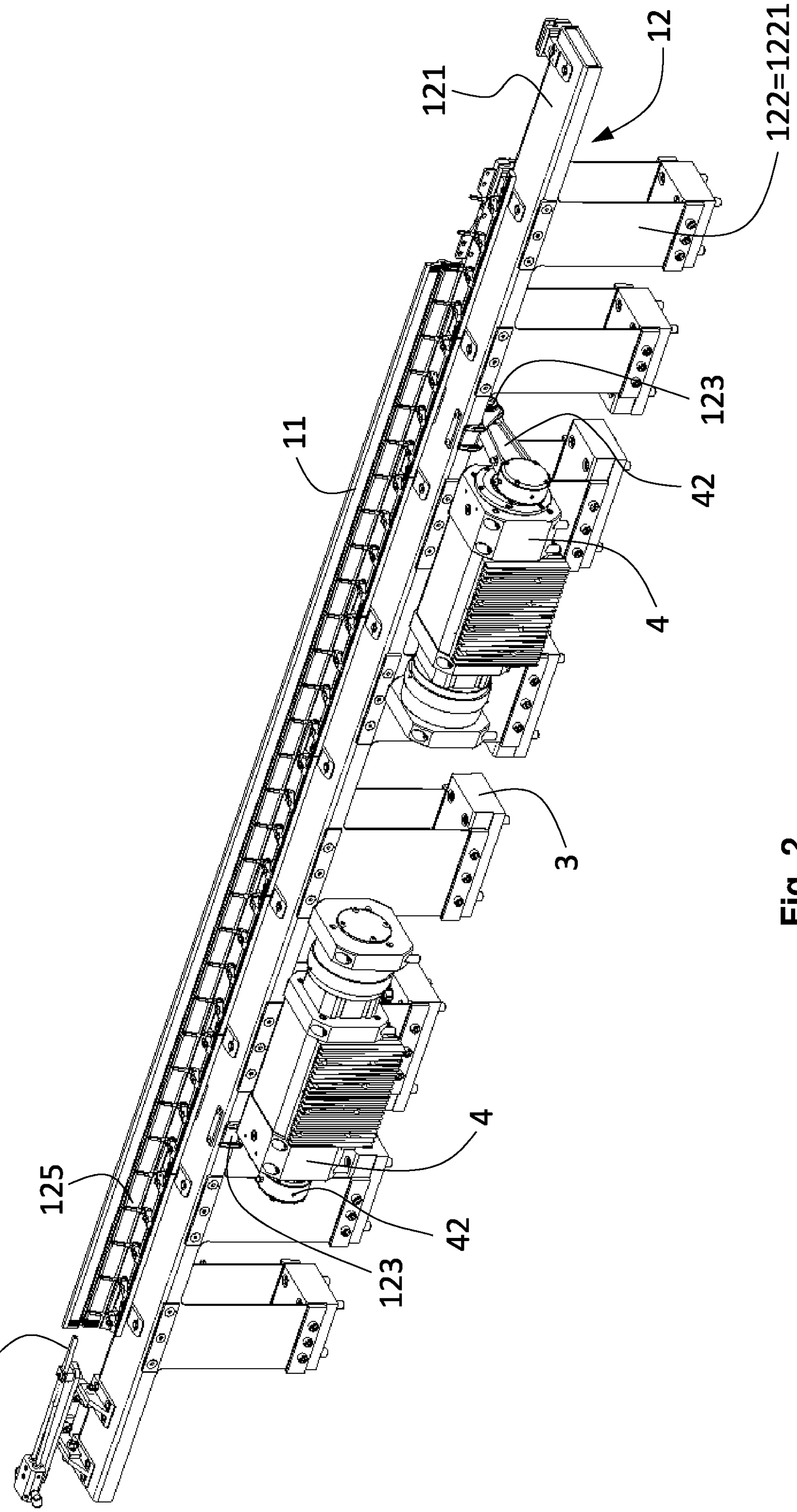


Fig. 2

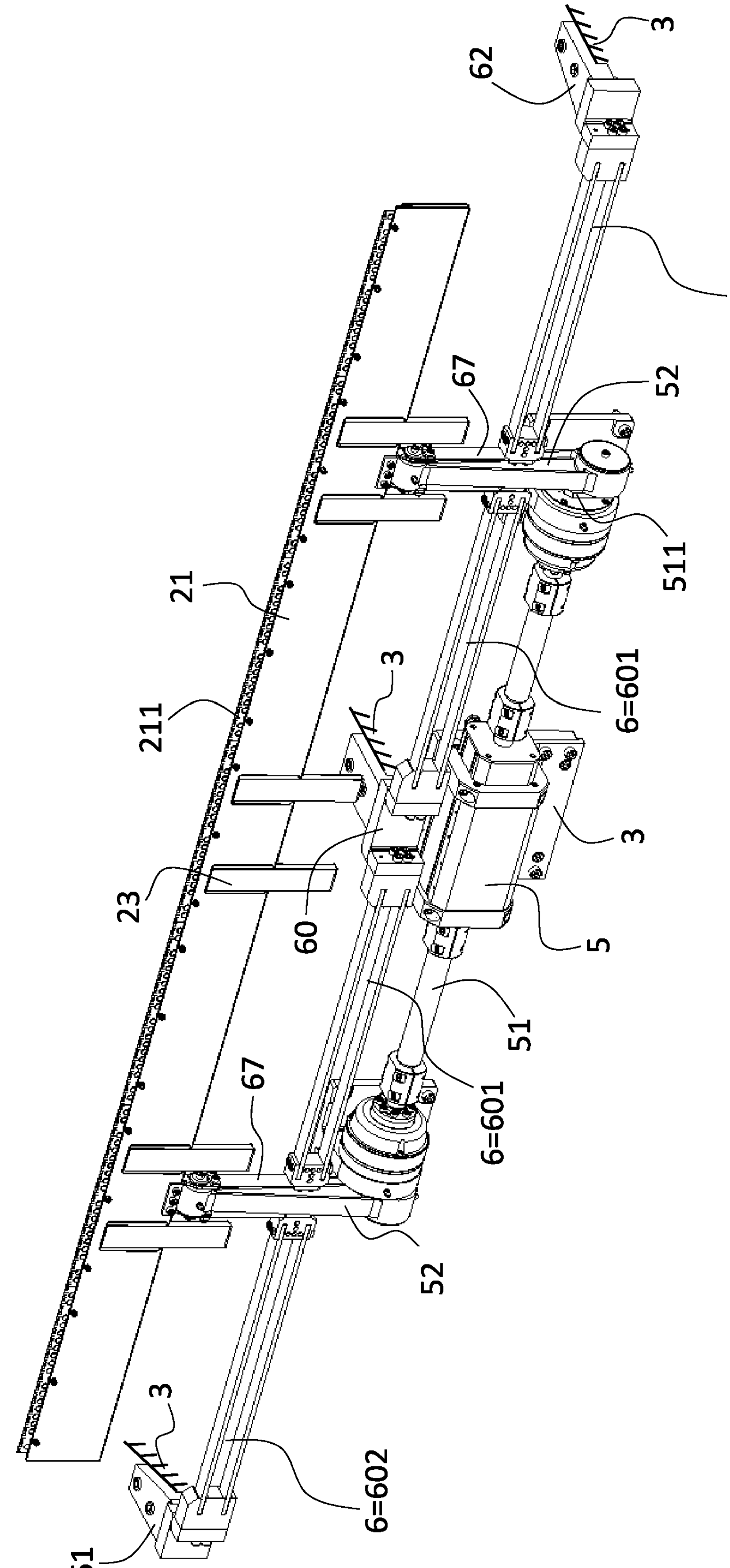
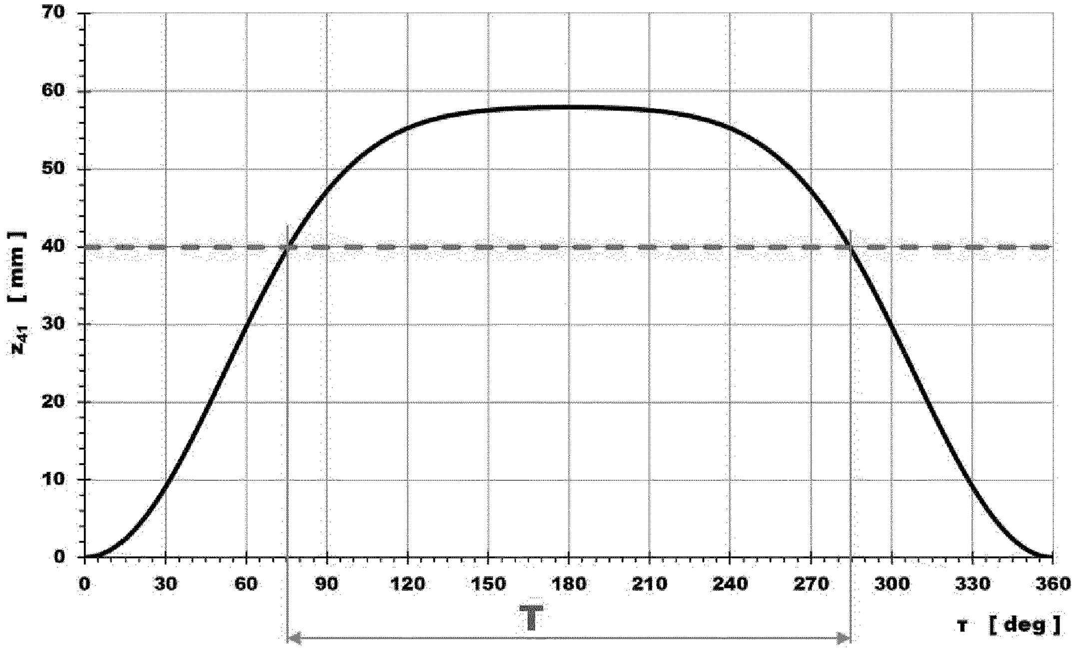


Fig. 3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60
50
40
30
20
10
0
z41 [mm]
0
30
60
90
120
150
180
210
240
270
300
330
360
T
τ [deg]

Fig. 4

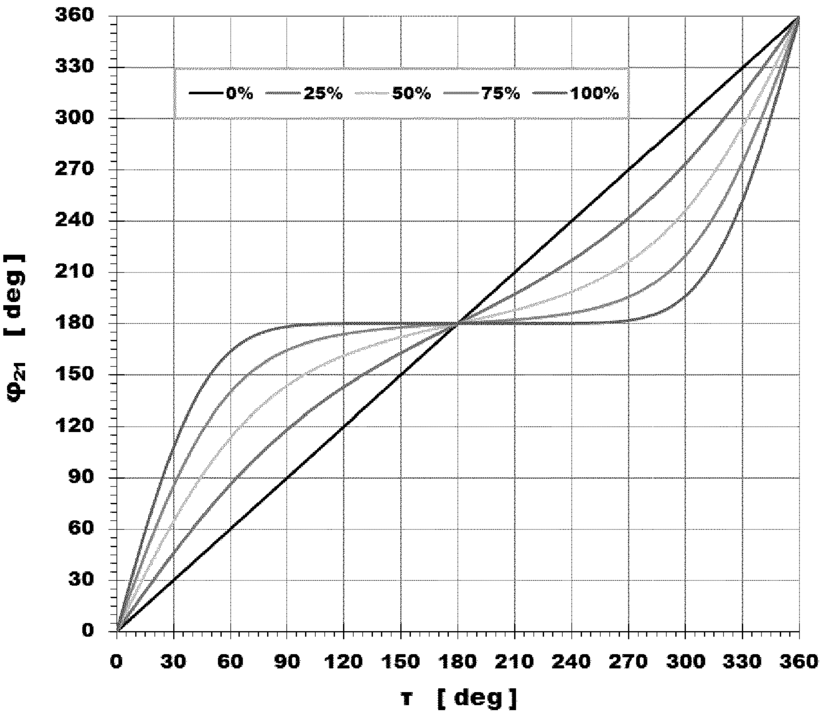

360
330
300
270
240
210
180
150
120
90
60
30
0
φ21 [deg]
0%
25%
50%
75%
100%
0
30
60
90
120
150
180
210
240
270
300
330
360
τ [deg]

Fig. 5

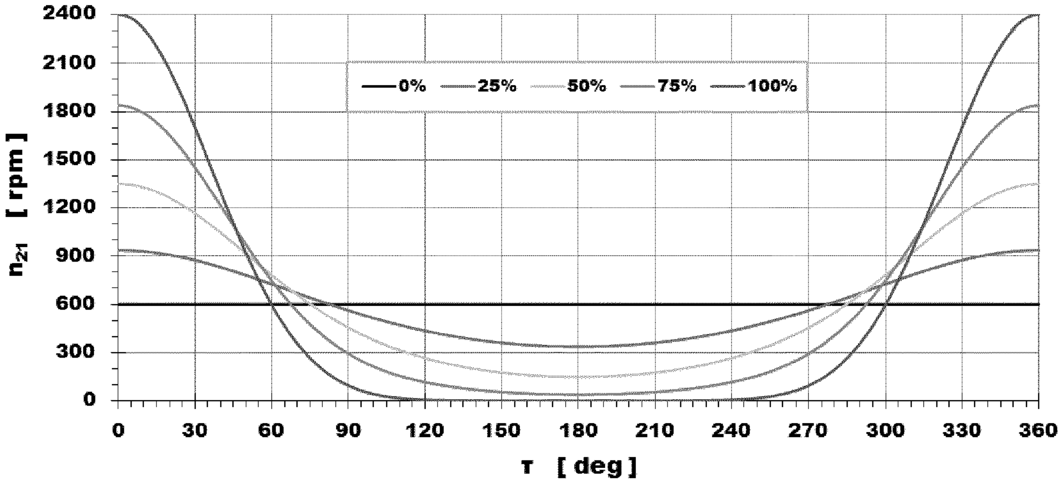
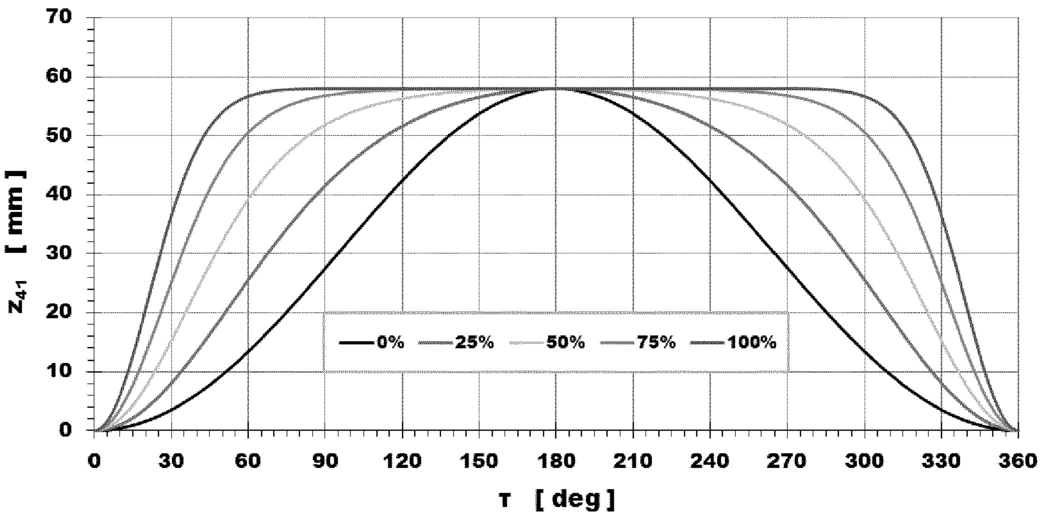

2400
2100
1800
1500
1200
900
600
300
0
n21 [rpm]
0% 25% 50% 75% 100%
0 30 60 90 120 150 180 210 240 270 300 330 360
τ [deg]

Fig. 6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60
50
40
30
20
10
0
z41 [mm]
0% 25% 50% 75% 100%
0 30 60 90 120 150 180 210 240 270 300 330 360
τ [deg]

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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