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(54) **Combing machine with variable speed circular comb**

Kämmmaschine mit umlaufendem Kamm von veränderlicher Geschwindigkeit

Machine de peignage avec peigne circulaire à vitesse variable

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Description**DESCRIPTION**

[0001] The present invention relates to a combing machine of a spinning line for processing fibre to obtain a yarn.

[0002] On a fibre processing line for the production of yarn, after the initial phases of opening and cleaning the fibre, carding is performed by carding machines, after which the fibre appears in the form of a web.

[0003] After processing, if any, on a lap-winder, in which various separate webs are combined to form a lap, the web or lap is combed by a combing machine, so as to obtain a web in which the fibres have been rendered highly clean and parallel.

[0004] Combing is performed by circular combs, which are used to comb the heads of the tufts of the lap, and by straight nipper combs, used to comb the tails of the same tufts of the lap. The combed tufts are fed to the tearing rollers, situated downstream of the combs, so that the edges overlap; the continuous web formed proceeds for subsequent processing.

[0005] The circular comb is provided with a continuous rotatory movement, synchronised with the alternate movement of the nipper, so as not to interfere structurally with it.

[0006] It is therefore extremely advantageous for the circular comb to have a variable rotation speed, so that rotation is slower when the nipper is near the tearing rollers (and the circular comb is therefore idle) and faster when the circular comb combs the fibre (and the nipper is therefore distant from the tearing rollers) and when the tearing rollers move the already previously combed tuft backwards for overlapping with the new one. By so doing, timing is optimised, reducing the dynamic severity of the movements, in particular of the tearing rollers, and paying particular attention in any case to avoiding structural interference between the circular comb and the nipper.

[0007] Solutions of circular combs with variable speed rotatory movements exist. For example, one embodiment is described in the International Application WO 2011/073942 in the name of the Applicant.

[0008] The purpose of the present invention is to make a combing machine with variable speed circular combs having a law of motion permitting an optimal combing to be performed, maintaining a high level of reliability of functioning and of the mechanical components used to achieve such law.

[0009] Such purpose is achieved by a combing machine according to claim 1 below.

[0010] The characteristics and advantages of the combing machine according to the present invention will be evident from the description below, made by way of a non-limiting example, with reference to the appended drawings, wherein:

- figure 1 shows a diagram of a combing machine,

in a rearward position of the nipper, corresponding to an initial angular position of the circular comb (0° or 360°);

- figure 2 shows the diagram of figure 1, in a forward position of the nipper, corresponding to an initial angular position of the circular comb opposite the position as in figure 1 (180°);

- figure 3 shows a kinematic diagram of a combing machine according to the present invention, according to one embodiment;

- figure 4 shows a transmission device of the combing machine, according to one embodiment,

- figure 5 shows the trend of the angular output speed of the transmission device depending on the angular position of the circular comb;

- figure 6 shows the trend of the angular output acceleration of the transmission device depending on the angular position of the circular comb; and

- figure 7 shows the trend of the ratio of the angular output speed to the angular input speed of the transmission device depending on the angular position of the circular comb.

[0011] A combing machine according to the invention comprises a fixed frame 2, a nipper 4 and a circular comb 20.

[0012] The nipper 4 comprises a lower jaw 6 and an upper jaw 8; the nipper 4 further comprises a straight comb 10, suitable for combing the tail of the tuft.

[0013] In addition, the nipper 4 comprises a rotating feed roller 12, supported by the lower jaw 6.

[0014] Downstream of the nipper 4, are pairs of tearing rollers 14, 16, having an alternate rotatory movement.

[0015] The nipper 4 has an alternate back and forth movement; in a forward position, the nipper occupies a processing zone and the jaws 6, 8 are next to the tearing rollers 14, 16 and open; in a rearward position of the nipper, the jaws 6, 8 are distal from the tearing rollers 14, 16 and closed, so as to nip the web being processed.

[0016] The circular comb 20 is joined in rotation to a main shaft 18 and has a continuous rotatory movement. The circular comb 20 operates on the head of the tuft of the web when it transits immediately upstream of the tearing rollers, in other words through the processing zone.

[0017] The rotatory movement of the circular comb 20 is synchronised with the alternate movement of the nipper 4, so that when the nipper is in the forward position, in other words in the processing zone immediately upstream of the tearing rollers, the comb 20 is inactive, that is to say outside the processing zone; when the nipper is in the rearward position, in which the jaws do not occupy the processing zone, the comb is in said processing zone and performs combing of the head of the tuft.

[0018] The combing machine further comprises an electric motor 21 able to impose an angular speed and a kinematism 22 for the transmission of the rotatory movement from the motor 21 to the main shaft 18.

[0019] The kinematism 22 comprises a transmission

device 30 suitable for varying a uniform circular movement in input into a non-uniform circular movement in output, transmitting it to the main shaft 18.

[0020] According to one embodiment, the transmission device 30 comprises an intermittent drive, in particular of the flat type, comprising a first body or motor body 52, joined in rotation to the motor shaft 36 having an angular input speed W_{in} , and a second body or driven body 54, joined in rotation to the driven shaft 19, having an angular output speed W_{out} ; the driven body 54 meshing permanently with the motor body 52.

[0021] The term "intermittent drive" indicates herein a transmission wherein the motor body is composed of one or more cams and the driven body is composed of a plate bearing a series of rollers which form a shaped coupling with the cam at all times.

[0022] One of the two bodies 52, 54, for example the motor body 52, is shaped so as to form a plurality of lobes connected with each other. The other of the two bodies 52, 54, preferably the driven body 54, comprises a plurality of angularly spaced rollers 64, at least one of which is engaged with the other body 52, to ensure the transmission of movement to the driven shaft 19.

[0023] In particular the motor body 52 is shaped so as to ensure a variable speed circular movement to the driven body 54, for example a continuous circular movement.

[0024] Figure 5 shows the angular output speed W_{out} of the driven shaft 19 (and therefore of the circular comb 20, in the embodiment shown) depending on the angular position α of the motor shaft 36 (and therefore of the circular comb 20) and depending on the angular input speed W_{in} (constant and equal to 500 rounds /min).

[0025] The maximum angular output speed (W_{out}) is less than 800 rounds/minute, in particular less than 700 rounds/minute, approximately equal to 670 rounds/minute.

[0026] The minimum angular output speed W_{out} is more than 200 rounds/minute, in particular more than 300 rounds/minute, approximately equal to 330 rounds/minute.

[0027] Figure 5 also shows the angular output speed W_{prior} of a known combing machine, extracted experimentally on a combing machine of a rival company.

[0028] Figure 6 shows, depending on the angular position α , the angular output acceleration A_{out} of the driven shaft 19 (and therefore of the circular comb 20).

[0029] The maximum angular output acceleration A_{out} is less than 1500 rad/s² and the minimum angular output acceleration A_{out} is more than -1500 rad/s².

[0030] In particular the maximum angular output acceleration A_{out} is less than 1200 rad/s², for example approximately equal to 1000 rad/s², and the minimum angular output acceleration A_{out} is more than -1200 rad/s², for example approximately equal to -1000 rad/s².

[0031] Figure 6 also shows the angular output acceleration A_{prior} of a known combing machine, extracted experimentally on a combing machine of a rival company.

[0032] Figure 7 shows, depending on the angular po-

sition α , the ratio R of the angular output speed W_{out} to the angular input speed W_{in} of the transmission device.

[0033] The maximum ratio R is less than 1.55, and in particular less than 1.40, and about equal to 1.35.

[0034] The minimum ratio R is more than 0.45, and in particular more than 0.60, and about equal to 0.65.

[0035] Figure 8 also shows the ratio R_{prior} of the angular output speed to the angular input speed of a known combing machine, extracted experimentally on a combing machine of a rival company.

[0036] Innovatively, the transmission device of the combing machine according to the present invention, makes it possible to perform a particularly efficient combing, in that during the active phase of the circular comb, the angular speed is not excessively high, so that the fibres are not subject to an overly energetic action. This results in a higher quality of the finished product.

[0037] Advantageously, moreover, the angular output speed of the circular comb undergoes a limited variation during a combing cycle, so that the components of the kinematic system are subject to lesser forces of inertia. This results in a high level of machine reliability.

[0038] It is clear that a person skilled in the art may make modifications to the transmission device described above so as to satisfy contingent requirements while remaining within the sphere of protection of the following claims.

30 Claims

1. Combing machine (1) comprising:

- at least one pair of tearing rollers (14,16) suitable to rotate in alternating motion;
- a nipper (4) suitable to perform a back and forth movement from the pair of tearing rollers (14,16), between a forward position in which it is close to said rollers and positioned in an area of engagement with these, and a rearward position in which it is distanced from said rollers;
- a circular comb (20) moved in rotation in a synchronised manner with the movement of the nipper;
- a transmission device (30) having in input a motor shaft (36) movable in rotation with angular input speed (W_{in}) and in output a rotatable driven shaft (19) with angular output speed (W_{out}) and kinematically engaged with the circular comb (20);

wherein, the ratio (R) between the angular output speed (W_{out}) and the angular input speed (W_{in}) being defined, said ratio is variable depending on the angular position (α) of the circular comb and is **characterised by** a value between 1.55 and 0.45.

2. Combing machine according to claim 1, wherein said

ratio (R) is between 1.40 and 0.60.

3. Combing machine according to claim 2, wherein said maximum ratio (R) is about 1.35 and said minimum ratio (R) is about 0.65.
4. Combing machine according to any of the previous claims, wherein the angular output speed (Wout) is between 200 rounds/minute and 800 rounds/minute, preferably between 700 rounds/minute and 300 rounds/min.
5. Combing machine according to any of the previous claims, wherein the angular output acceleration (Aout) is between 1500 rad/s² and -1500 rad/s², preferably between 1200 rad/s² and -1200 rad/s².
6. Combing machine according to any of the previous claims, wherein the transmission device comprises a flat intermittent drive (30).
7. Combing machine according to claim 6, wherein the intermittent drive comprises a driven body (54) or second body, fitted with angularly spaced rollers loosely mounted in rotation and a first body (52) such as a motor body (52), joined in rotation to the electric motor (21) and permanently meshing with the driven body, provided with angularly spaced lobes.

Patentansprüche

1. Kämmaschine (1), umfassend:

- mindestens ein Paar von Reißwalzen (14, 16), die für eine Drehung in einer alternierenden Bewegung geeignet sind,
- eine Klemmeinrichtung (4), die zum Durchführen einer Vor-Zurück-Bewegung von dem Paar von Reißwalzen (14, 16) zwischen einer vorderen Position, in der sie sich nahe an den Walzen und in einem Bereich eines Eingriffs mit diesen befindet, und einer hinteren Position, in der sie von den Walzen beabstandet ist, geeignet ist,
- einen umlaufenden Kamm (20), der in einer synchronisierten Weise mit der Bewegung der Klemmeinrichtung drehend bewegt wird,
- eine Getriebevorrichtung (30), die eingangsseitig eine Motorwelle (36), die mit einer Winkeleingangsdrehzahl (Win) drehend bewegt werden kann, und ausgangsseitig eine drehend angetriebene Welle (19) mit einer Winkelausgangsdrehzahl (Wout), die mit dem umlaufenden Kamm (20) kinematisch in Eingriff ist, aufweist,

wobei das Verhältnis (R) zwischen der Winkelausgangsdrehzahl (Wout) und der Winkeleingangs-

drehzahl (Win) festgelegt ist, wobei das Verhältnis abhängig von der Winkelposition (α) des umlaufenden Kamms variabel ist und durch einen Wert zwischen 1,55 und 0,45 gekennzeichnet ist.

2. Kämmaschine nach Anspruch 1, bei der das Verhältnis (R) zwischen 1,40 und 0,60 beträgt.
3. Kämmaschine nach Anspruch 2, bei der das maximale Verhältnis (R) etwa 1,35 beträgt und das minimale Verhältnis (R) etwa 0,65 beträgt.
4. Kämmaschine nach einem der vorhergehenden Ansprüche, bei der die Winkelausgangsdrehzahl (Wout) zwischen 200 Umdrehungen/Minute und 800 Umdrehungen pro Minute, vorzugsweise zwischen 700 Umdrehungen/Minute und 300 Umdrehungen pro Minute beträgt.
5. Kämmaschine nach einem der vorhergehenden Ansprüche, bei der die Winkelausgangsbeschleunigung (Aout) zwischen 1500 rad/s² und -1500 rad/s², vorzugsweise zwischen 1200 rad/s² und -1200 rad/s² beträgt.
6. Kämmaschine nach einem der vorhergehenden Ansprüche, bei der die Getriebevorrichtung einen flachen intermittierenden Antrieb (30) umfasst.
7. Kämmaschine nach Anspruch 6, bei welcher der intermittierende Antrieb einen angetriebenen Körper (54) oder zweiten Körper, der mit winklig beabstandeten Walzen ausgestattet ist, die für eine Drehung lose montiert sind, und einen ersten Körper (52), wie z.B. einen Motorkörper (52), umfasst, der drehend mit dem Elektromotor (21) verbunden ist und dauerhaft mit dem angetriebenen Körper kämmt, und der mit winklig beabstandeten Nocken versehen ist.

Revendications

1. Peigneuse (1) comprenant :

- au moins une paire de cylindres effilocheurs (14, 16) adaptés pour tourner suivant un mouvement alternatif ;
- une pince (4) adaptée pour effectuer un mouvement de va-et-vient, à partir de la paire de cylindres effilocheurs (14, 16), entre une position avant dans laquelle elle est proche desdits cylindres et placée dans une zone de prise avec ceux-ci et une position arrière dans laquelle elle est éloignée desdits cylindres ;
- un peigne circulaire (20) déplacé en rotation de manière synchronisée avec le mouvement de la pince ;
- un dispositif de transmission (30) ayant à l'en-

trée un arbre moteur (36) mobile en rotation à une vitesse angulaire d'entrée (W_{in}) et à la sortie un arbre entraîné rotatif (19) à une vitesse angulaire de sortie (W_{out}) et venant en prise cinématique avec le peigne circulaire (20) ;

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dans laquelle le rapport (R) entre la vitesse angulaire de sortie (W_{out}) et la vitesse angulaire d'entrée (W_{in}) est défini, ledit rapport étant variable en fonction de la position angulaire (α) du peigne circulaire et **caractérisé par** une valeur comprise entre 1,55 et 0,45.

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2. Peigneuse selon la revendication 1, dans laquelle ledit rapport (R) se situe entre 1,40 et 0,60. 15
3. Peigneuse selon la revendication 2, dans laquelle ledit rapport (R) maximal est d'environ 1,35 et ledit rapport (R) minimal est d'environ 0,65. 20
4. Peigneuse selon l'une quelconque des revendications précédentes, dans laquelle la vitesse angulaire de sortie (W_{out}) se situe entre 200 tr/minute et 800 tr/minute, de préférence entre 700 tr/minute et 300 tr/minute. 25
5. Peigneuse selon l'une quelconque des revendications précédentes, dans laquelle l'accélération angulaire en sortie (A_{out}) se situe entre 1500 rad/s² et -1500 rad/s², de préférence entre 1200 rad/s² et -1200 rad/s². 30
6. Peigneuse selon l'une quelconque des revendications précédentes, dans laquelle le dispositif de transmission comprend un entraînement intermittent plat (30). 35
7. Peigneuse selon la revendication 6, dans laquelle l'entraînement intermittent comprend un corps entraîné (54) ou un second corps, muni de cylindres espacés de manière angulaire et montés librement en rotation et un premier corps (52), par exemple un corps de moteur (52), relié en rotation au moteur électrique (21) et s'engrenant de manière permanente au corps entraîné, muni de lobes espacés de manière angulaire. 40
45

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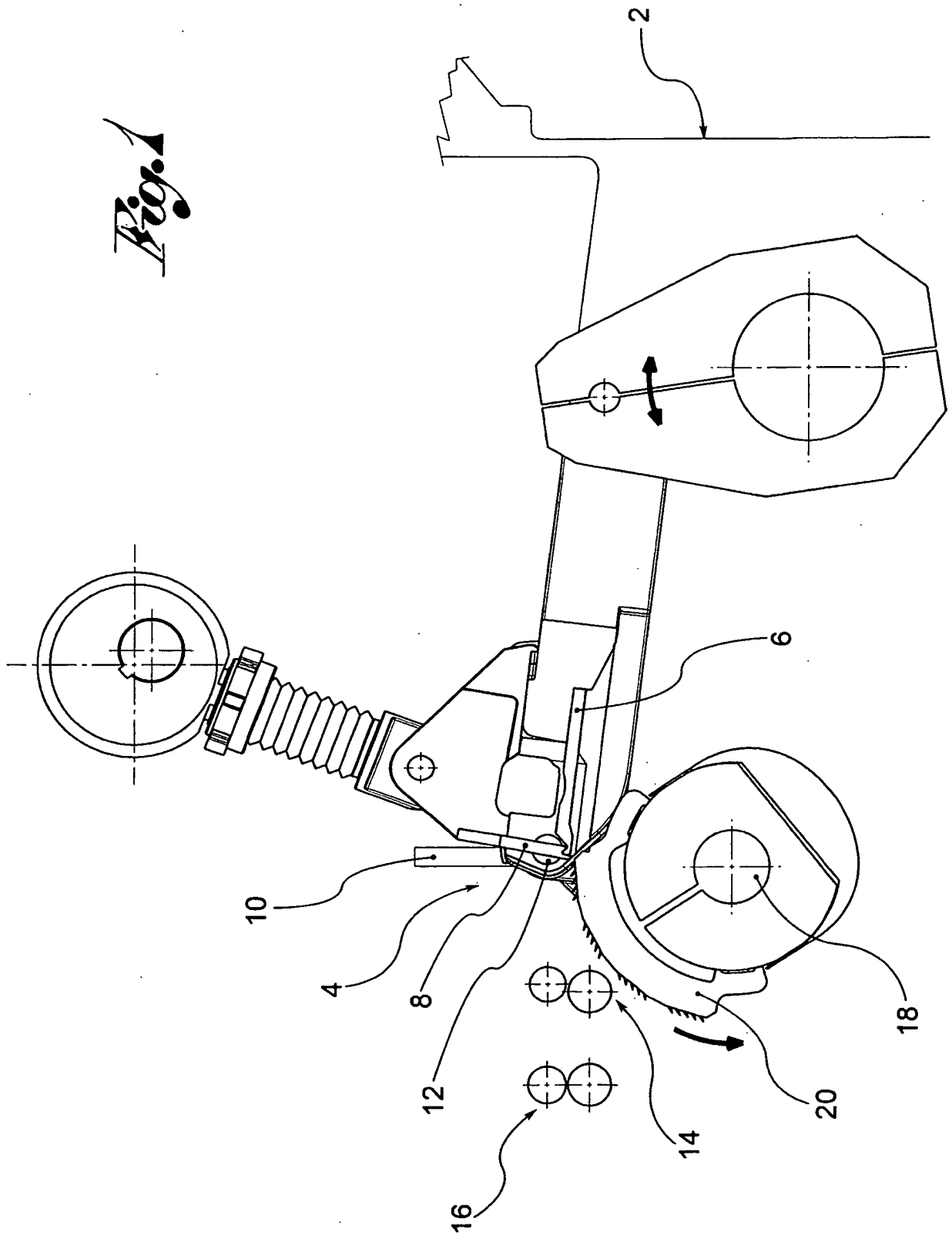
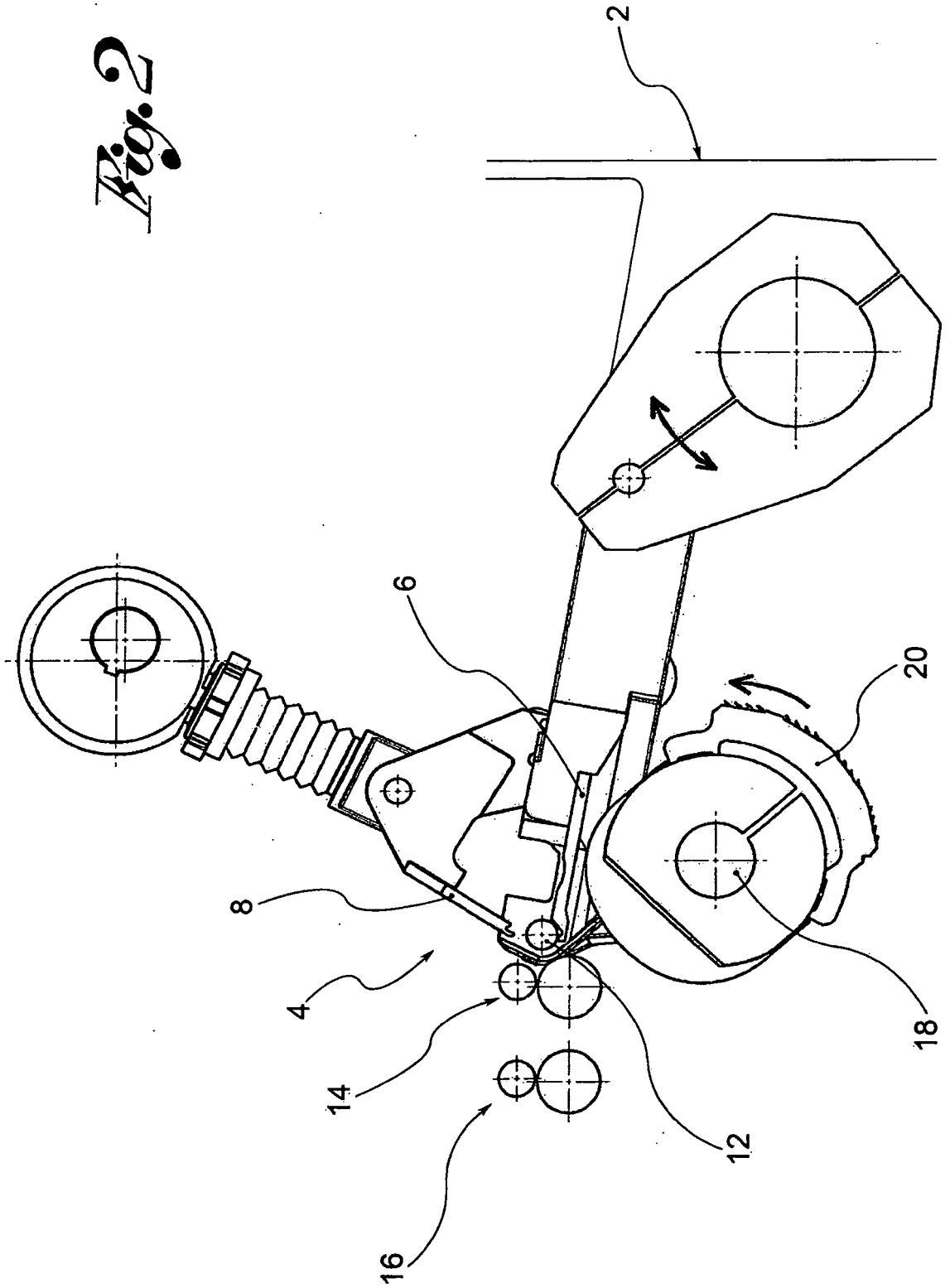


Fig. 2



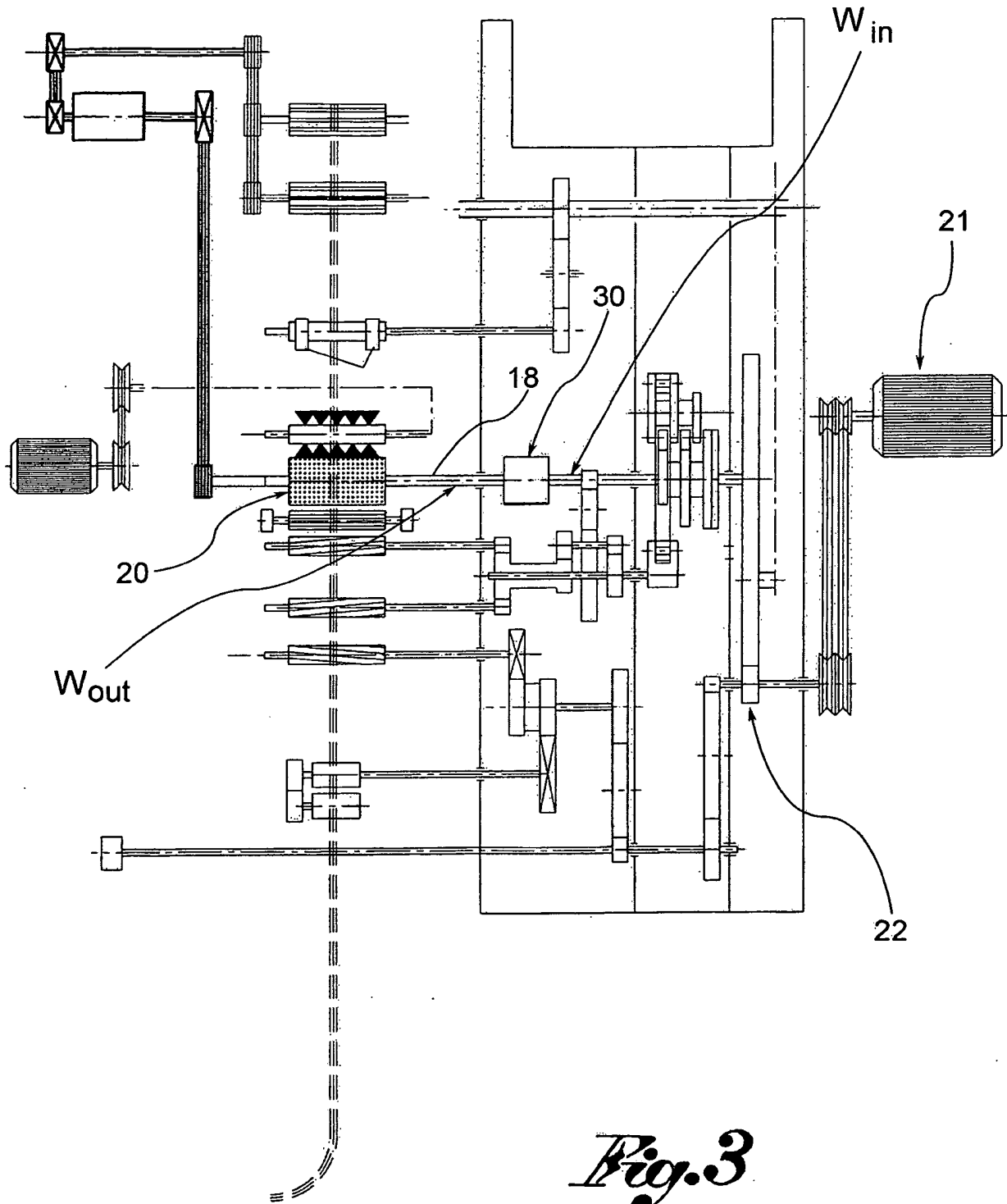


Fig. 3

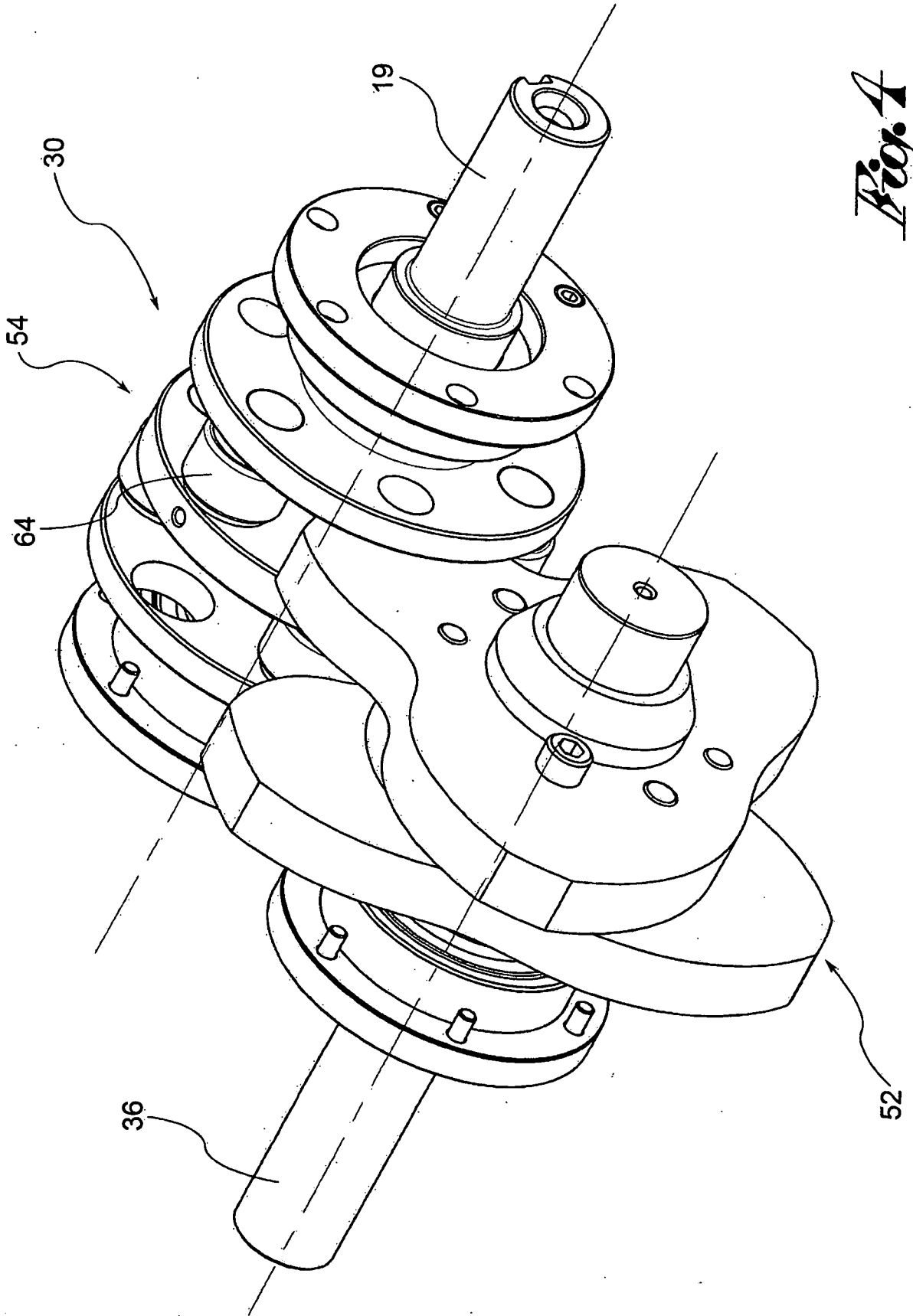


Fig. 1

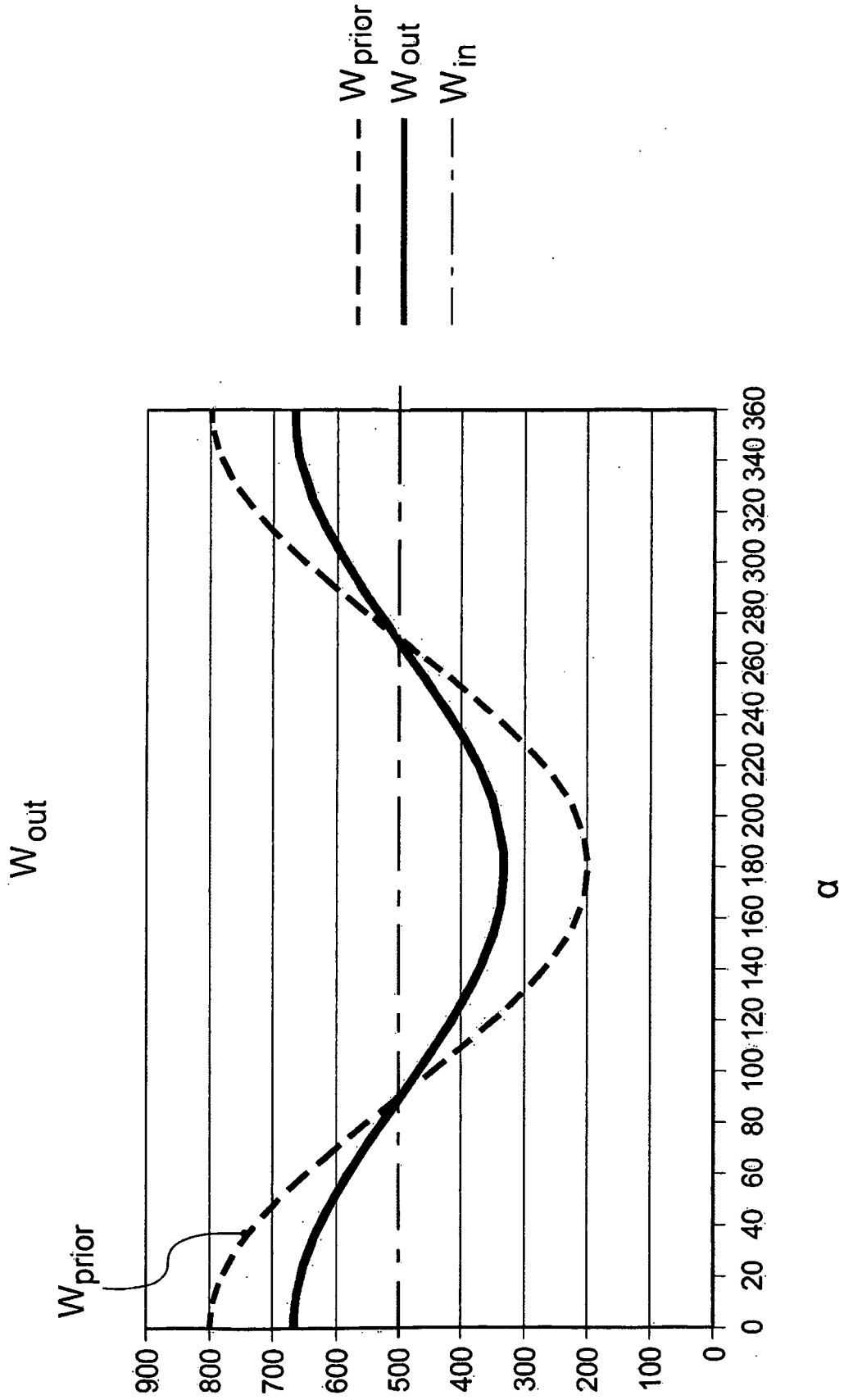


Fig. 5

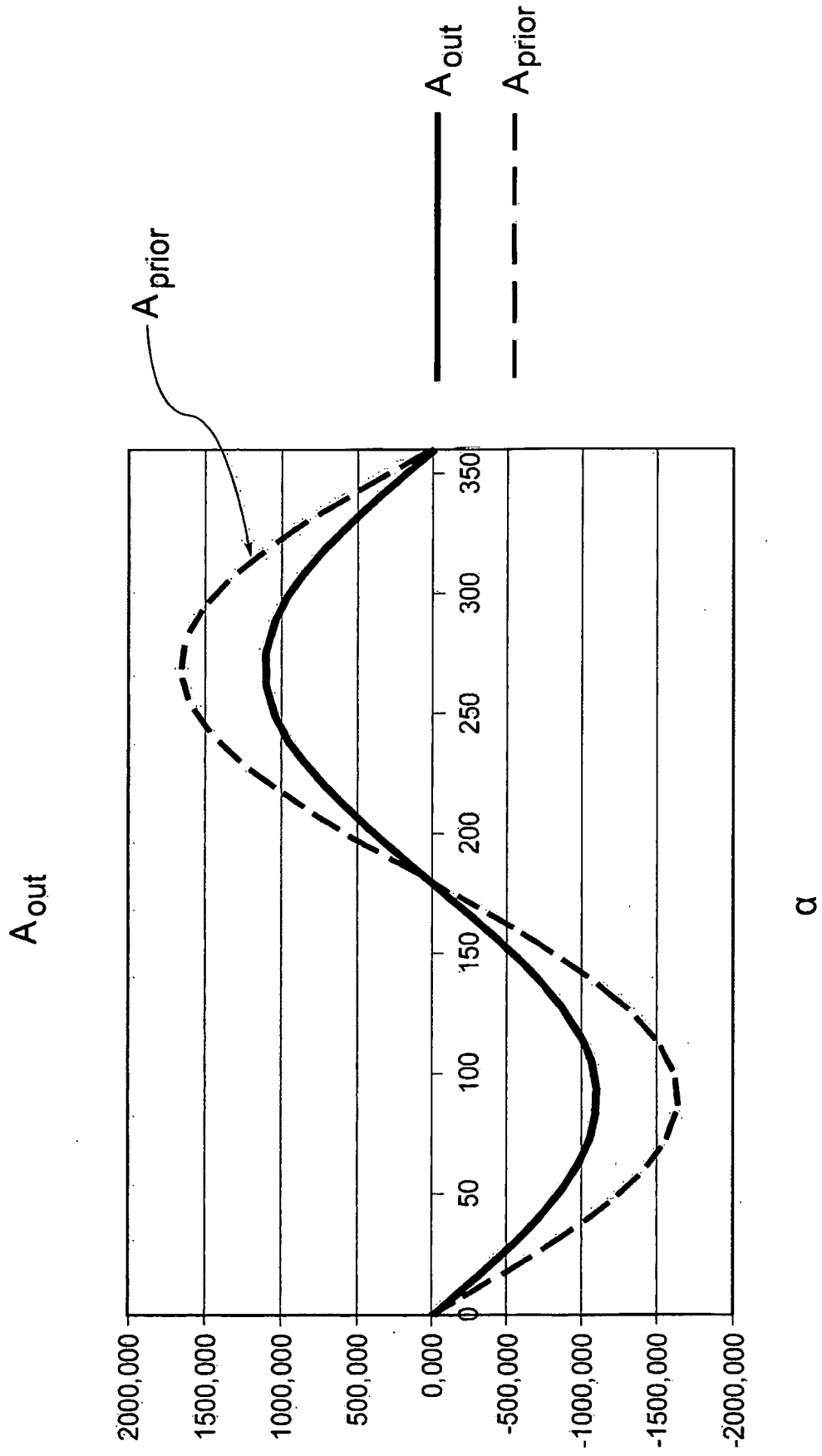


Fig. 6

$$R = \frac{W_{out}}{W_{in}}$$

R

R_{prior}

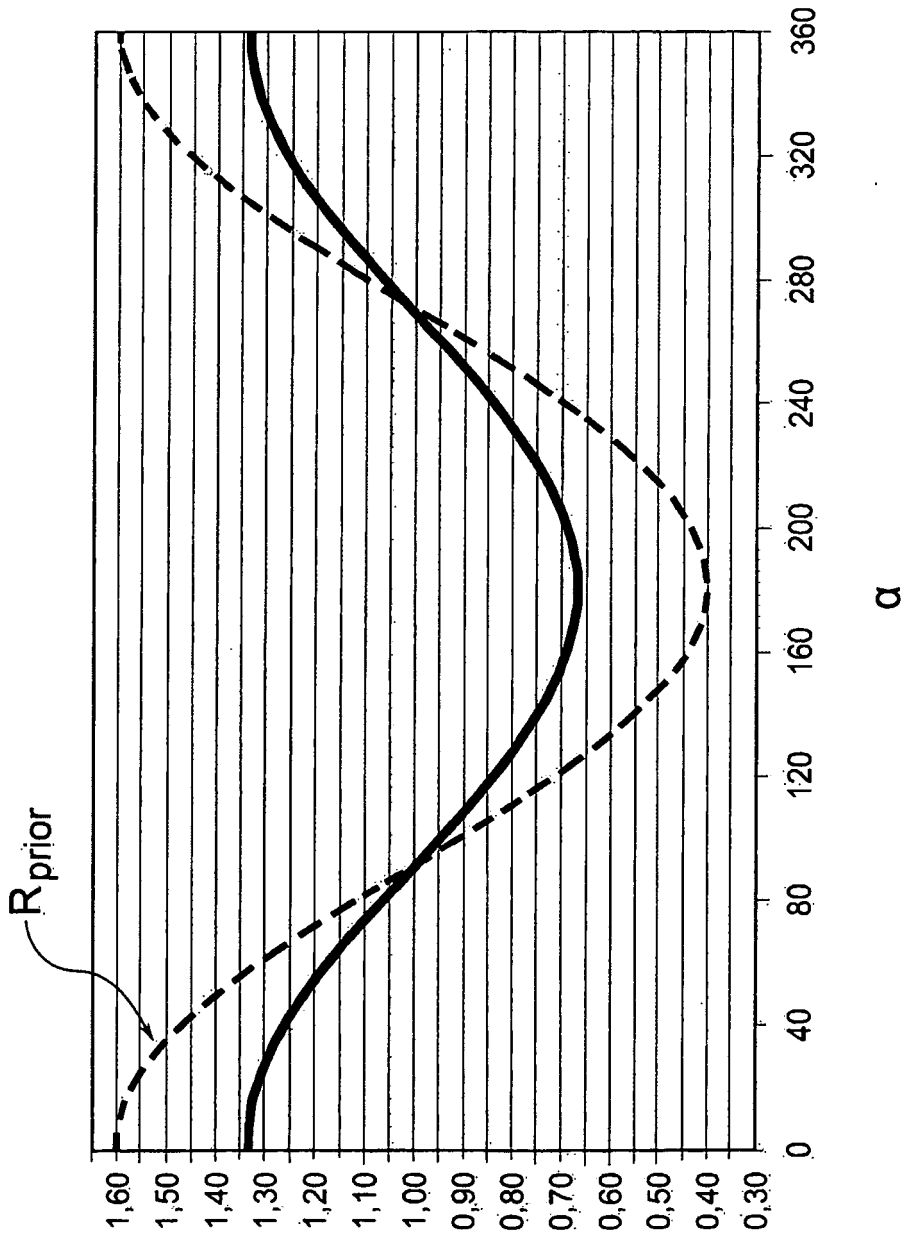


Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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