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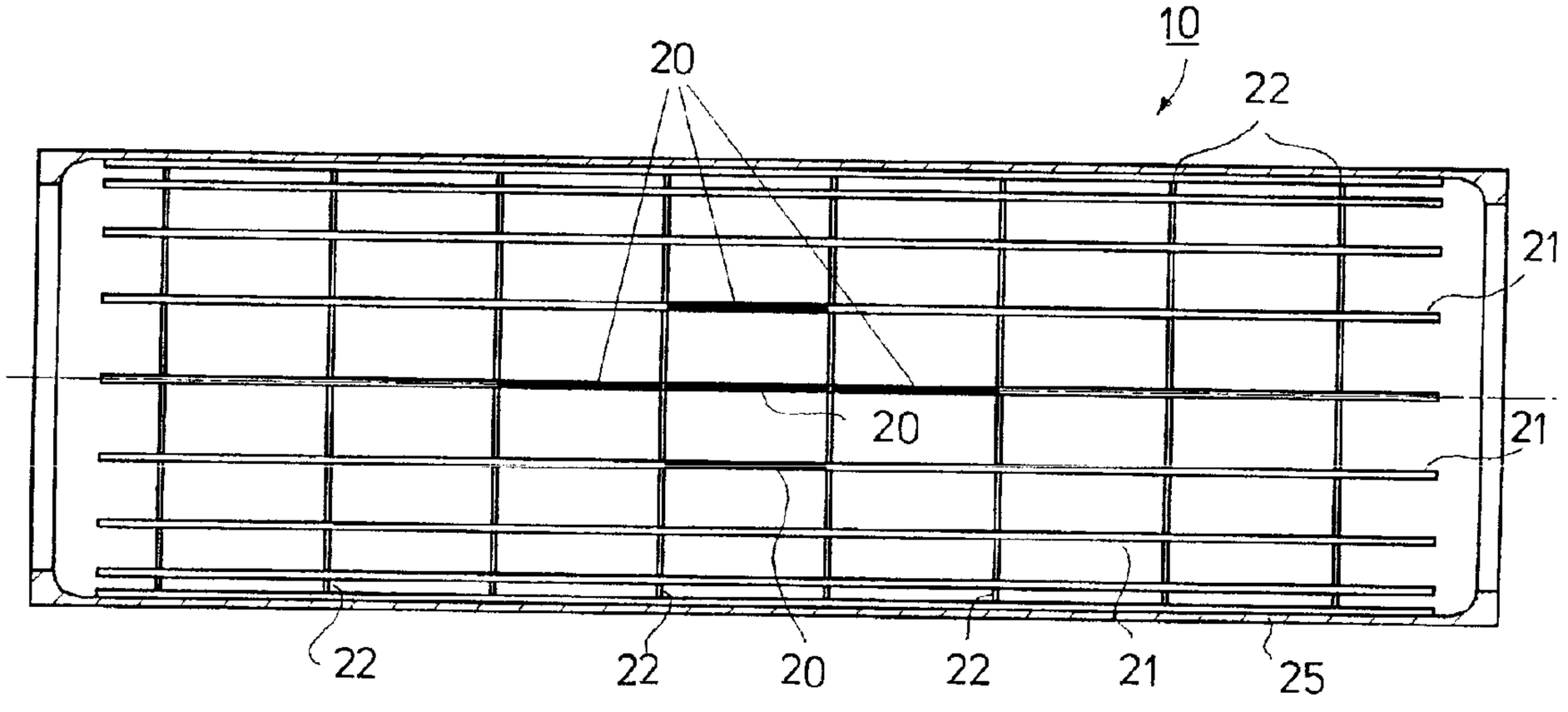
(72) Inventeurs/Inventors:
AHOKAS, MATTI, FI;
SAARI, AUVO, FI;
KALAPUDAS, EERO, FI;
SNELLMAN, JORMA, FI

(73) Propriétaire/Owner:
METSO PAPER, INC., FI

(74) Agent: SIM & MCBURNEY

(54) Titre : PROCEDE D'EQUILIBRAGE D'UN CYLINDRE, D'UN ROULEAU OU D'UN ELEMENT ANALOGUE A L'AIDE D'UNE FINE ENVELOPPE ET CYLINDRE, ROULEAU ET ELEMENT ANALOGUE EQUILIBRES A L'AIDE DE LA FINE ENVELOPPE

(54) Title: METHOD FOR BALANCING A CYLINDER, ROLL OR EQUIVALENT PART WITH A THIN MANTLE AND BALANCED CYLINDER, ROLL OR EQUIVALENT PART WITH A THIN MANTLE



(57) Abrégé/Abstract:
The invention relates to a method for balancing a cylinder, roll or equivalent part with a thin mantle intended to be revolving. The method comprises the following steps: in the method, the errors in the circumferential deflection line of the mantle (25) of the cylinder (10), roll or equivalent part with a thin mantle are measured, and dynamic unbalance is determined, locations and magnitudes of counterweights (20) necessary for balancing are determined based on the deformations and dynamic unbalance arising from the errors in the deflection line of the mantle (25), and the counterweights (20) are fixed to the inner face of the mantle (25) of the cylinder (10), roll or equivalent part with a thin mantle in order to compensate for the errors in the circumferential deflection line and, thus, to eliminate the dynamic unbalance. The invention also relates to a balanced cylinder, roll or equivalent part with a thin mantle which is intended to be revolving. Counterweights (20) of magnitudes necessary for balancing are fitted to the inner face of the mantle (25) of the cylinder (10), roll or equivalent part with a thin mantle, to positions determined on the basis of measurements, in order to compensate for the errors in the circumferential deflection line of the mantle (25) such that, when the cylinder (10), roll or equivalent part revolves, the circumferential deflection line is compensated and dynamic unbalance is eliminated.

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(71) Applicant *(for all designated States except US)*: VALMET CORPORATION [FI/FI]; Panuntie 6, FIN–00620 Helsinki (FI).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: AHOKAS, Matti [FI/FI]; Haapaheikintie 7, FIN–40420 Jyskä (FI). SAARI, Auvo [FI/FI]; Sinivuokko 8 A 2, FIN–40520 Jyväskylä (FI). KALAPUDAS, Eero [FI/FI]; Kaisankuja 3 B 7, FIN–41160 Tikkakoski (FI). SNELLMAN, Jorma [FI/FI]; Tupakatu 3, FIN–40500 Jyväskylä (FI).

(74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN–00100 Helsinki (FI).

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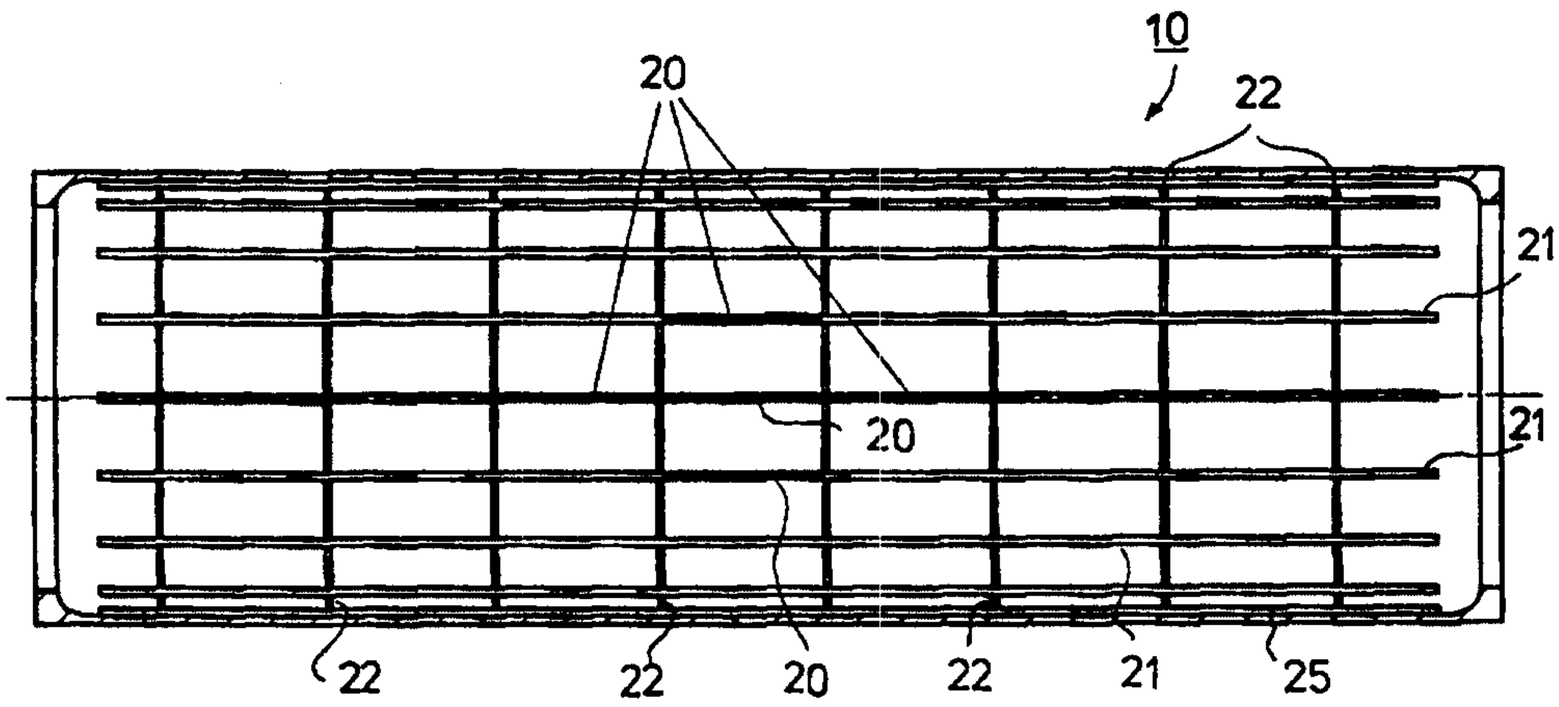


(57) Abstract

The invention relates to a method for balancing a cylinder, roll or equivalent part with a thin mantle intended to be revolving. The method comprises the following steps: in the method, the errors in the circumferential deflection line of the mantle (25) of the cylinder (10), roll or equivalent part with a thin mantle are measured, and dynamic unbalance is determined, locations and magnitudes of counterweights (20) necessary for balancing are determined based on the deformations and dynamic unbalance arising from the errors in the deflection line of the mantle (25), and the counterweights (20) are fixed to the inner face of the mantle (25) of the cylinder (10), roll or equivalent part with a thin mantle in order to compensate for the errors in the circumferential deflection line and, thus, to eliminate the dynamic unbalance. The invention also relates to a balanced cylinder, roll or equivalent part with a thin mantle which is intended to be revolving. Counterweights (20) of magnitudes necessary for balancing are fitted to the inner face of the mantle (25) of the cylinder (10), roll or equivalent part with a thin mantle, to positions determined on the basis of measurements, in order to compensate for the errors in the circumferential deflection line of the mantle (25) such that, when the cylinder (10), roll or equivalent part revolves, the circumferential deflection line is compensated and dynamic unbalance is eliminated.

METHOD FOR BALANCING A CYLINDER, ROLL OR EQUIVALENT PART WITH A THIN MANTLE, AND BALANCED CYLINDER, ROLL OR EQUIVALENT PART WITH A THIN MANTLE

The invention relates to a method for balancing a cylinder, roll or equivalent part with a thin mantle intended to be revolving. The deformations of said part while the part revolves are controlled by this method.

The invention also relates to a balanced cylinder, roll or equivalent part having a thin mantle which is intended to be revolving.

In the state of the art, it has been observed that the round shape of a drying cylinder becomes oval when the cylinder is rotated. The effect of this deformation cannot be eliminated by means of the modes of balancing known from prior art because it causes dynamic run-out, which is due to deviations in the circumferential deflection line. By means of prior-art balancing methods it has not been possible to control the problems caused by the states of dynamic run-out because the known methods compensate for deviations in the axial deflection line. In some instances, such deviations in the circumferential deflection line cause many problems, for example, inaccuracy in doctoring, wear of a doctor blade, fluttering of a web, and an increase in the curvature of the seam of a wire. Moreover, it has been necessary to use a thicker mantle or shell than required by other dimensioning considerations in order that the problems associated with the dynamic run-out might be solved.

The above-noted prior-art problems associated with dynamic run-out will be further aggravated in the future when the running speeds of paper machines increase.

With regard to the prior art, reference may be made to FI Patent 82856, which discloses a method for balancing a roll in which an annular rail is fixed to the inner face of the roll and a balance weight is attached to said rail. The rail is fixed to the inner part of the roll mantle only at the ends of the rail and preferably close to the longitudinal joint of the tubular roll. The final fixing of the rail takes place at the

stage at which the longitudinal jointing of the tubular roll is performed. This known method rectifies a deviation in the axial deflection line of the roll, but it cannot rectify deviations in the circumferential deflection line occurring in a cylinder, roll, or equivalent part with a thin mantle during rotation, when the mantle changes its shape, for example, flattens. Thus, by this arrangement it is not possible to rectify the uneven mass distributions resulting, for example, from differences in the thickness of the mantle.

The present invention is directed towards the provision of a method for balancing a cylinder, roll or equivalent part having a thin mantle or shell, by which method the deviations in the circumferential deflection line of the mantle can be compensated for such that the states of dynamic run-out do not cause problems when a cylinder, roll, or equivalent part with a thin mantle revolves.

The present invention is also directed towards the provision of a method which compensates for the deviations in the circumferential deflection line, which deviations depend on differences in the thickness/mass of the mantle or shell and thus produce deformations and unbalance when a cylinder, roll or equivalent part with a thin mantle revolves.

In accordance with one aspect of the present invention, there is provided a method for balancing a cylinder, roll or equivalent part with a thin mantle or shell intended to be revolving characterized in that the method comprises the following steps:

in the method, the deviations in the circumferential deflection line of a mantle of a cylinder, roll or equivalent part with a thin mantle are measured, and dynamic run-out is determined, locations and magnitudes of counterweights necessary for balancing are determined based on the deformations and dynamic run-out arising from the deviations in the deflection line of the mantle, and

the counterweights are fixed to the inner face of the mantle of the cylinder, roll, or equivalent part with a thin mantle in order to compensate for the deviations in the circumferential deflection line and, thus, to eliminate the dynamic run-out.

In accordance with a further aspect of the present invention, there is provided a balanced cylinder, roll or equivalent part with a thin mantle or shell which is intended to be revolving, characterized in that counterweights of magnitudes necessary for balancing are fitted to the inner face of the mantle of the cylinder, roll or equivalent part with a thin mantle, to positions determined on the basis of measurements, in order to compensate for the deviations in the circumferential deflection line of the mantle such that, when the cylinder, roll or equivalent part revolves, the circumferential deflection line is compensated for and dynamic run-out is eliminated.

In the method in accordance with the invention, the deviations in the circumferential deflection line are compensated for such that the dynamic run-out is determined first by measurement and the need for balancing is determined by calculation, and the cylinder is balanced by fitting counterweights to the inner face of the mantle, the magnitude and position of said counterweights being thus determined by calculation on the basis of run-out measurements. The measurements may be performed by a balance machine and/or as ultrasound measurement and/or as manual measurement so as to find out the differences in the thickness/mass of the mantle causing deviations in the circumferential deflection line, which differences are compensated for by means of counterweights fitted to the inner face of the roll, which counterweights rectify the deformation of the mantle such that, when the cylinder, roll, or equivalent part having a thin mantle revolves, its shape does not change, and the rotation thus takes place in a state of balance.

In accordance with the invention, some counterweights, which are preferably longitudinal, are fitted inside a drying cylinder mainly in the middle area of the mantle in the longitudinal direction in order to cancel the deformation of the mantle. The counterweights are fitted to positions determined by calculation, and if a cylinder mantle is involved that becomes, for example, oval during rotation, the counterweights are fitted preferably on two sides of the mantle such that they are situated at both ends of the minor axis of an ellipse, that is, at the narrowing of the diameter. The counterweights may be fixed, for example, inside heating strips made of a U-channel and nowadays placed on the inner face of a cylinder, to the portions

between arc hoops. When rolls are balanced in a similar way, the weights may be fixed either by means of screw couplings to the inner face of the mantle or, for example, by means of arc hoops. The counterweights may, of course, be also attached in many other ways familiar in itself to a person skilled in the art; in cylinders, however, special attention shall be paid to the fact that the mantle of the cylinder must not be damaged.

In the arrangement in accordance with the invention, advantages are achieved when the dynamic run-out decreases, in which connection, among other things, savings in costs are achieved since the thickness of the mantle can be reduced because of the decrease in run-out. Moreover, it is possible to "save" cylinders, rolls or equivalent whose run-out would otherwise exceed the limit of rejection. In addition, doctoring is improved because the shape remains round with the result that the blade pressure of the doctor is constant for a revolution of a cylinder, whereby the life of doctor blades also increases. Furthermore, fluttering of the web decreases and the curvature of the seam of the wire is reduced and the need for after-balancing also diminishes when rotation takes place without any run-out. Moreover, the arrangement in accordance with the invention reduces the need for precision machining because the mass/thickness errors and/or machining errors of material can be compensated for by the method in accordance with the invention.

When the method in accordance with the invention is compared with prior-art methods, one essential difference is that the prior-art methods compensate for a deviation in the axial deflection line, whereas the method in accordance with the invention compensates for deviations in the circumferential deflection line, which deviations depend on differences in the thickness/mass of the mantle.

In the following, the method in accordance with the invention will be described in more detail with reference to the figures in the accompanying drawing, to the details of which the invention is in no way intended to be narrowly confined.

Figs. 1A-1B show the problems encountered in connection with a prior-art cylinder, when the cylinder is not balanced; in Fig. 1A when the cylinder is not revolving and in Fig. 1B when the cylinder is revolving.

Figs. 2A-2B schematically show a cylinder balanced in accordance with one embodiment example of the invention; in Fig. 2A in a situation when the cylinder is not revolving and in Fig. 2B in a situation when the cylinder is revolving.

Fig. 3 schematically shows the dependence of dynamic run-out on the speed of revolution.

Figs. 4A-4B schematically show one embodiment example of a cylinder balanced in accordance with the invention.

Fig. 5 schematically shows one arrangement for fixing balancing masses in accordance with the invention to the inner face of a cylinder mantle.

As shown in Fig. 1A, a prior-art cylinder 10', which has not been balanced, is circular in its circumferential shape in a situation when the cylinder 10' is not revolving. When the cylinder 10' is started to revolve, it flattens and becomes elliptic, as seen from Fig. 1B, with the result that unbalance arises because of dynamic run-out.

Figs. 2A and 2B show a cylinder balanced in accordance with the invention in the above-mentioned situations, i.e. when the cylinder 10 is not revolving (Fig. 2A) and when the cylinder 10 is revolving (Fig. 2B), in which connection it is observed that there occurs no flattening during rotation. In this embodiment example of the invention, counterweights 20 are placed, as compared with Figs. 1A-1B, at both ends of the minor axis of the ellipse of the cylinder 10.

As seen from Fig. 3, dynamic run-out increases sharply with increasing speed of rotation, which is clear from an exponential curve 15 which shows the dynamic run-out S as a function of the speed of rotation V when a cylinder or equivalent has not

been balanced and there are differences in the thickness/mass of the mantle thereof. The speed of rotation V is shown on the horizontal axis and the dynamic run-out S is shown on the vertical axis. When the part has been balanced in accordance with the invention, in the cylinder or equivalent there occurs no more any dynamic run-out S exponentially increasing as a function of the speed of rotation V.

Figs. 4A-4B schematically show one embodiment example of the cylinder 10 balanced in accordance with the invention; Fig. 4A is a schematic sectional view in the cross direction and Fig. 4B is a schematic sectional view in the longitudinal direction. To simplify the matter, for example, the end structures of the cylinder 10 have been omitted from the figures and only the mantle structure 25 of the cylinder 10 is illustrated. Longitudinal heating strips, preferably made of a U-channel, fixed to the inner face of the mantle 25 of the cylinder 10 are denoted with the reference numeral 21 and cross-direction arc hoops are denoted with the reference numeral 22. When the need for balancing in the cylinder 10 has been determined by calculation after measurements of run-out, the locations of counterweights 20 are determined based on the measurement and calculation results, which counterweights 20 are fixed to the connection of heating strips 21, at locations where balancing is required. In the embodiment example illustrated in Figs. 4A-4B, six counterweights 20 have been used on both sides of the cylinder 10, i.e. in total twelve counterweights 20, each of which is a longitudinal counterweight 20 and fixed in the U-channel of heating strips 21 in portions between arc hoops 22. The arc hoops 22 are fixed by means of fixing members 23 in the vertical direction at both ends of a half of the arc hoop 22. The arc hoops 22 are tightened in place by means of the fixing members 23.

As a more detailed application, Fig. 5 shows fixing of a counterweight 20 in the U-channel of a heating strip 21 in a span of arc hoops 22. The heating strips 21 are made of a U-shaped channel, the counterweight 22 being placed inside the U-channel and the edge part of the U-channel being bent preferably at intervals, for example, by pressing to form fastenings 26. Of course, the counterweights 20 can also be fixed in other ways, which are in themselves obvious to a person skilled in the art and suitable depending on the application.

Above, the invention has been described only with reference to some of its preferred examples, to the details of which the invention is, however, by no means intended to be narrowly confined. Numerous variations and modifications are possible within the inventive idea.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for balancing a cylinder with a thin shell intended to be revolving, which comprises the following steps:

measuring deviations in a circumferential deflection line of the shell of the cylinder,

determining dynamic run-out,

determining locations and magnitudes of counterweights necessary for balancing based on the deformations and dynamic run-out arising from the deviations in the deflection line of the shell, and

fixing the counterweights to an inner face of the shell of the cylinder in order to compensate for the deviations in the circumferential deflection line and, thus, to eliminate the dynamic run-out.

2. The method as claimed in claim 1, wherein measurement of the deformations arising from the deviations in the circumferential deflection line of the shell is performed by at least one of a balance machine, as ultrasound measurement and as manual measurement in order to determine the thickness/mass differences in the shell causing deformations.

3. The method as claimed in claim 1 or 2, wherein the locations and magnitudes of the counterweights are determined by calculation based on the measurement results.

4. The method as claimed in any one of claims 1 to 3, wherein the method uses longitudinal counterweights placed in a middle area in the longitudinal direction of the shell.

5. The method as claimed in any one of claims 1 to 4, wherein the counterweights are fixed inside a U-channel of heating strips of the cylinder, and the edge part of the U-channel is bent so as to form fastenings spaced from one another in order to fix the counterweights in place.

6. A balanced cylinder with a thin shell which is intended to be revolving, wherein counterweights of magnitudes necessary for balancing are fitted to an inner face of the shell of the cylinder to positions determined on the basis of measurements, in order to compensate for the deviations in a circumferential deflection line of the shell such that, when the cylinder revolves, the circumferential deflection line is compensated for and dynamic run-out is eliminated.

7. The cylinder with a thin shell as claimed in claim 6, wherein the counterweights are fitted to positions which are determined by measurements and by calculation and in which differences in the thickness/mass of the shell cause deviations in the circumferential deflection line.

8. The cylinder with a thin shell as claimed in claim 6 or 7, wherein the counterweights are placed in a middle area of the shell.

9. The cylinder with a thin shell as claimed in any one of claims 6 to 8, wherein the counterweights are longitudinal and the counterweights are placed in the longitudinal direction of the shell.

10. The cylinder with a thin shell as claimed in any one of claims 6 to 9, wherein the counterweights are fixed inside the U- channel of heating strips situated on the inner face of the shell of the cylinder, and the edge part of the U-channel is bent to form fastenings spaced from one another.

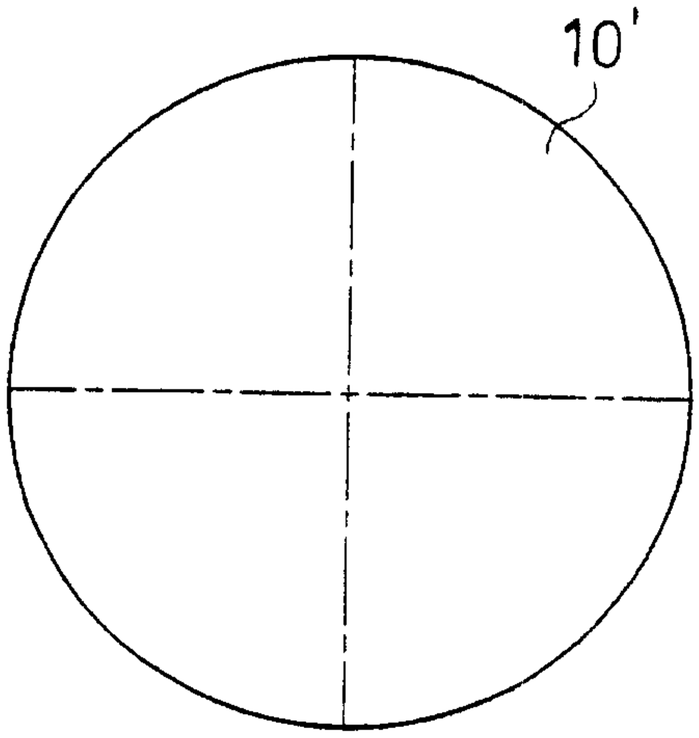


FIG. 1A
PRIOR ART

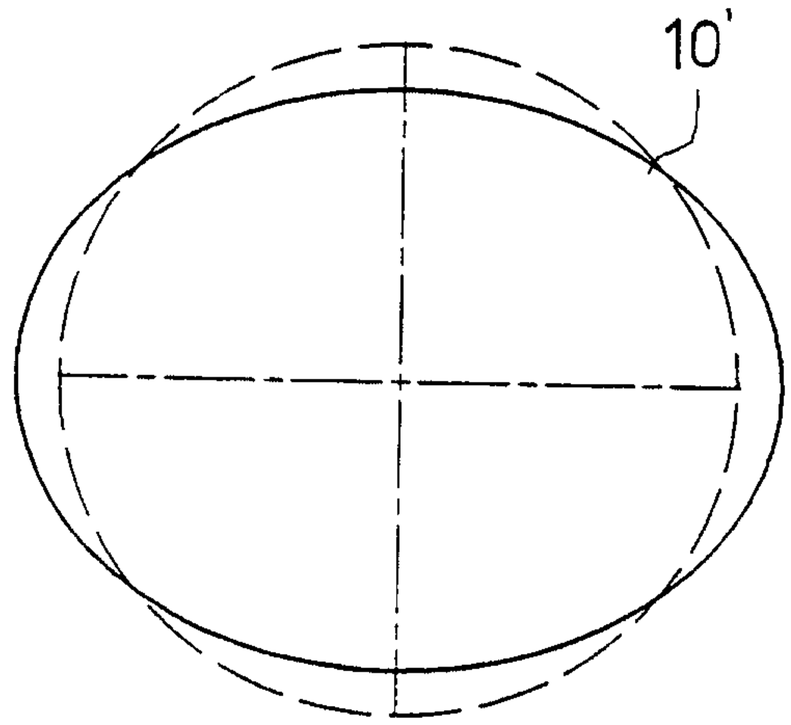


FIG. 1B
PRIOR ART

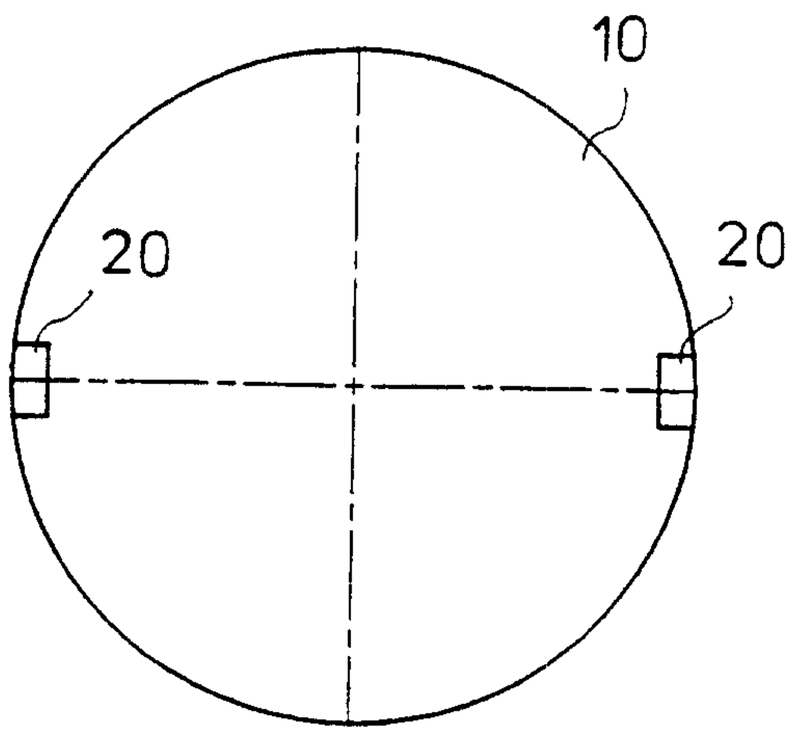


FIG. 2A

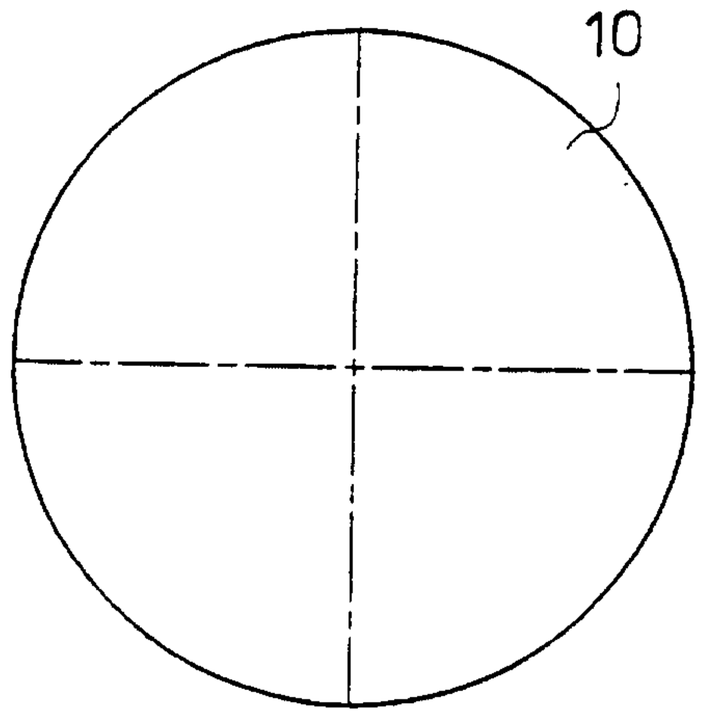


FIG. 2B

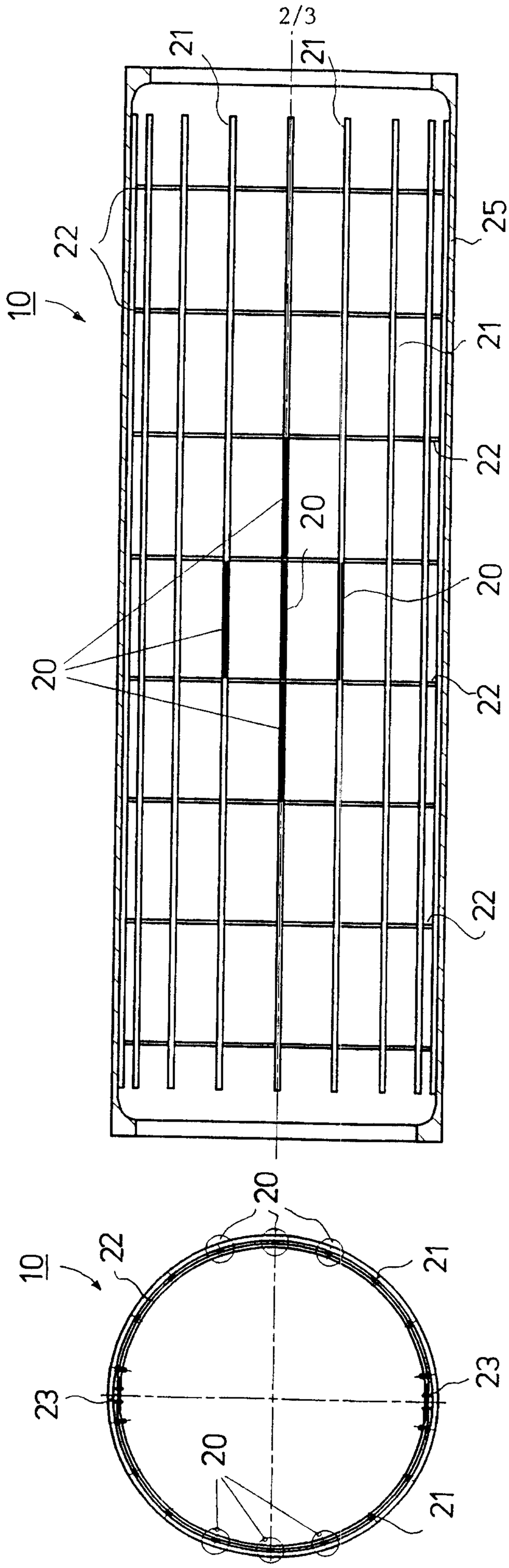


FIG. 4B

FIG. 4A

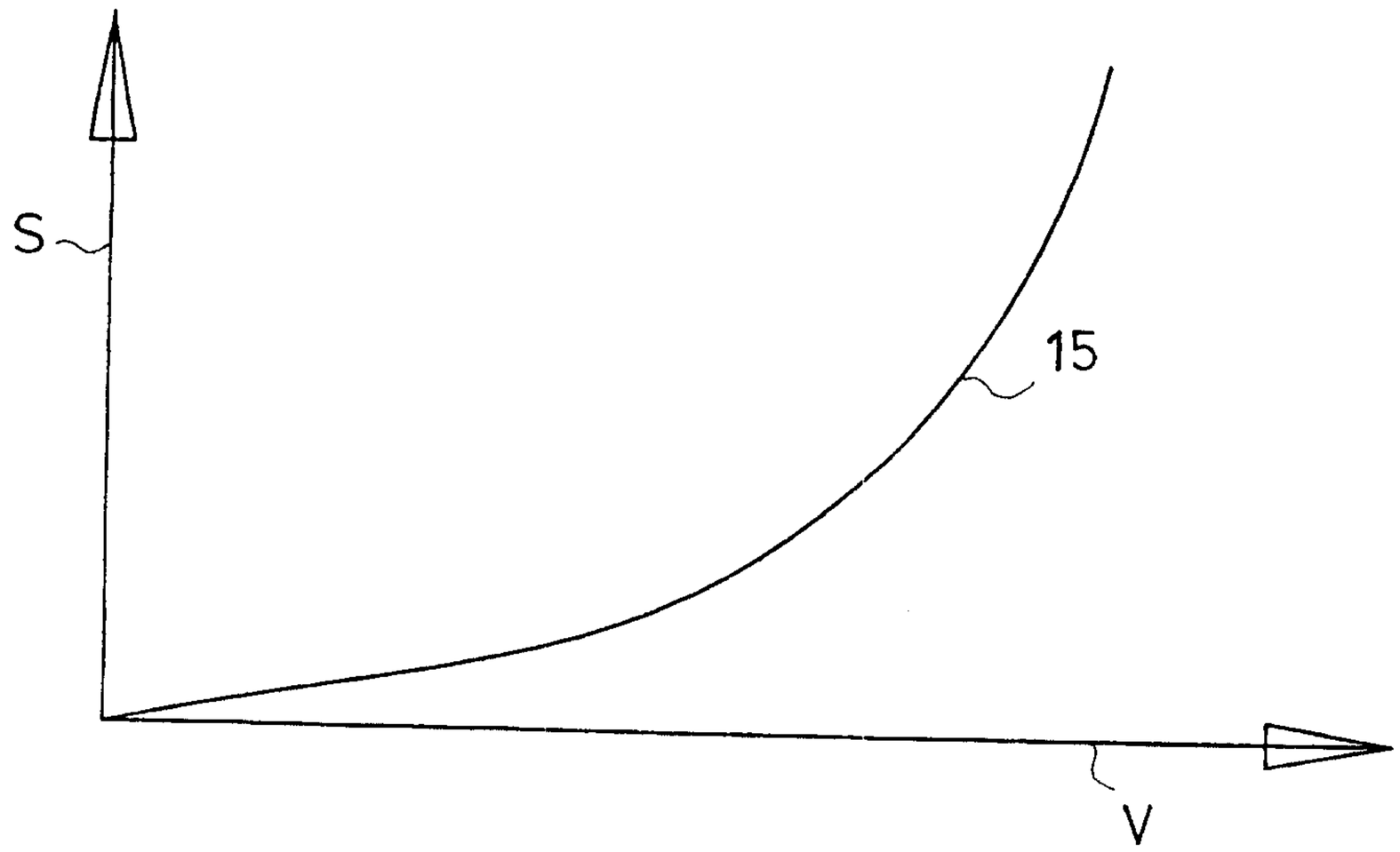


FIG. 3

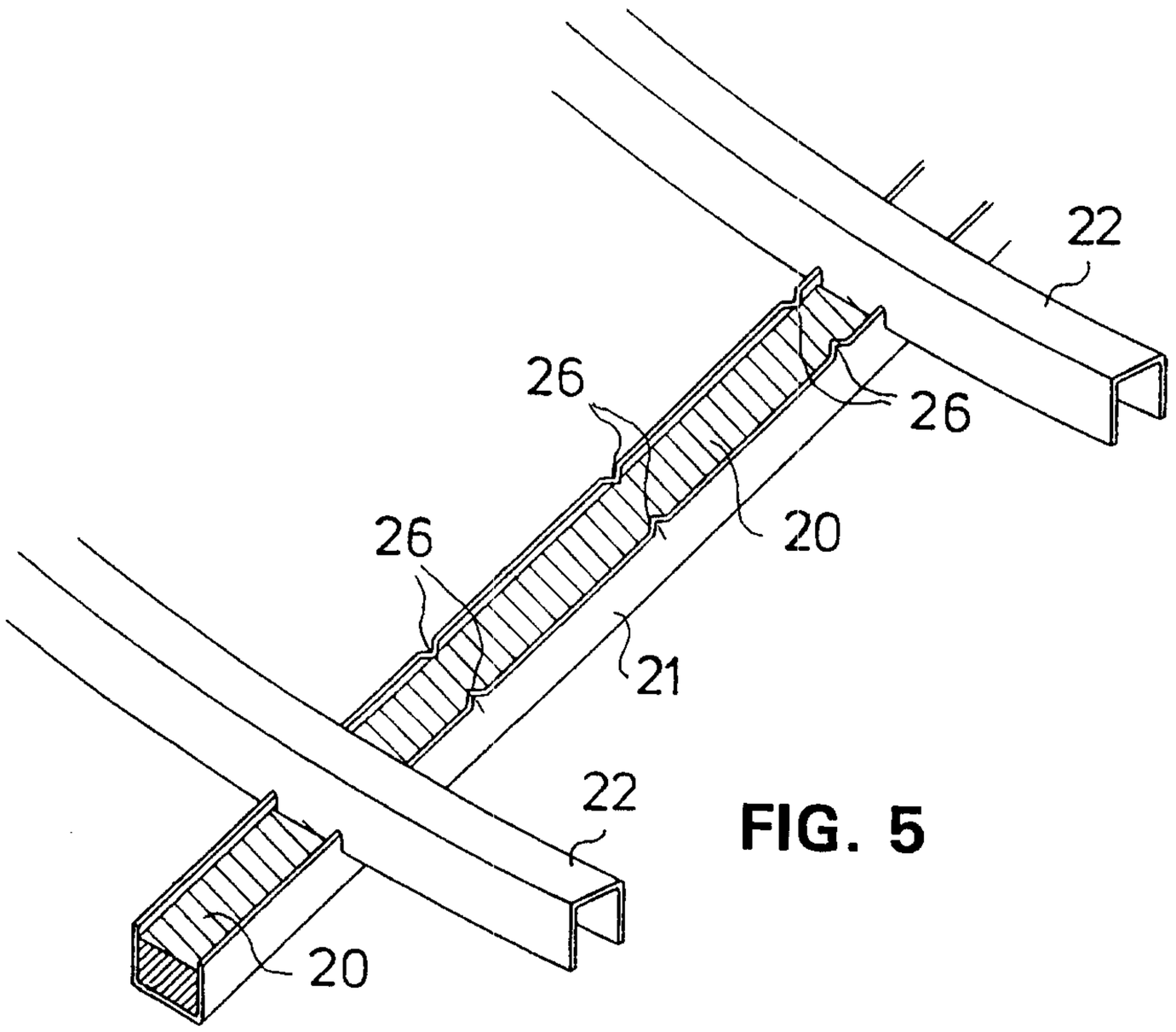
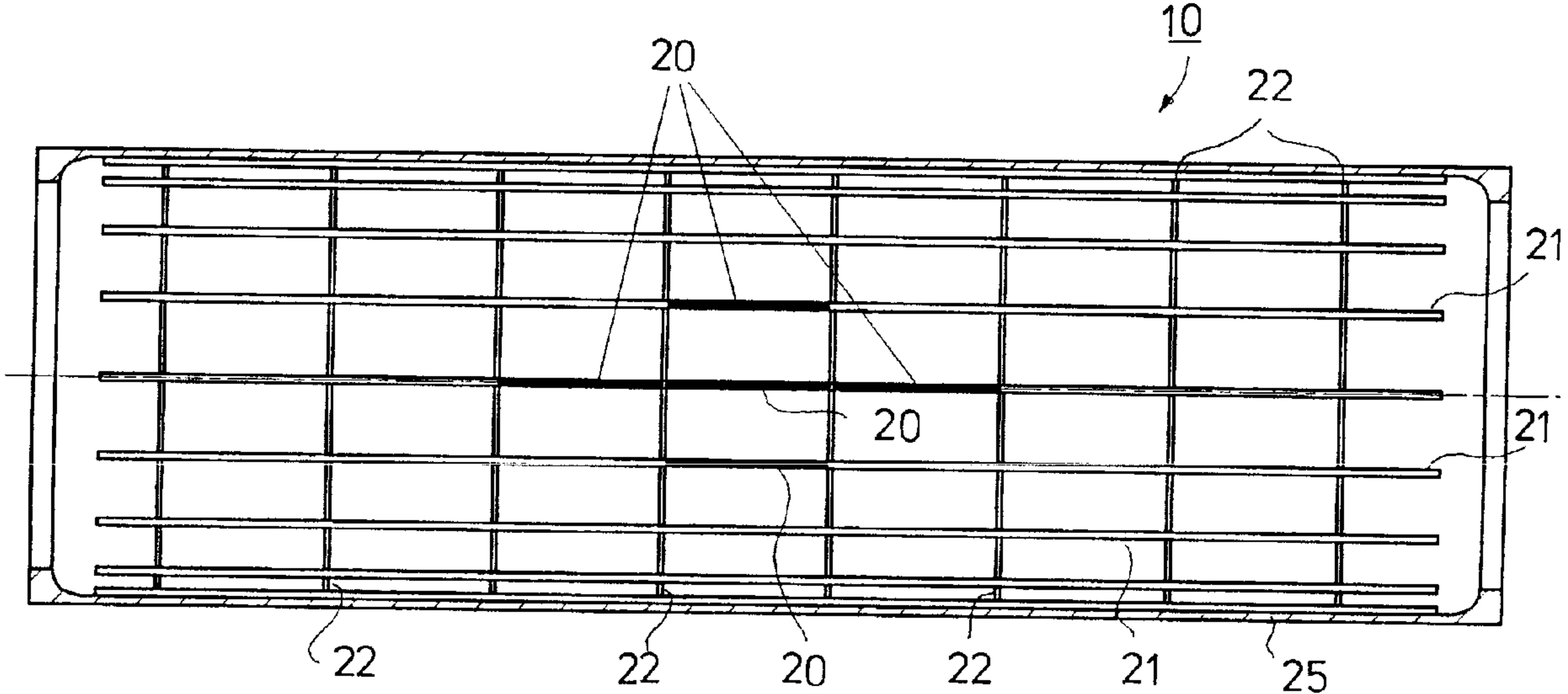


FIG. 5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