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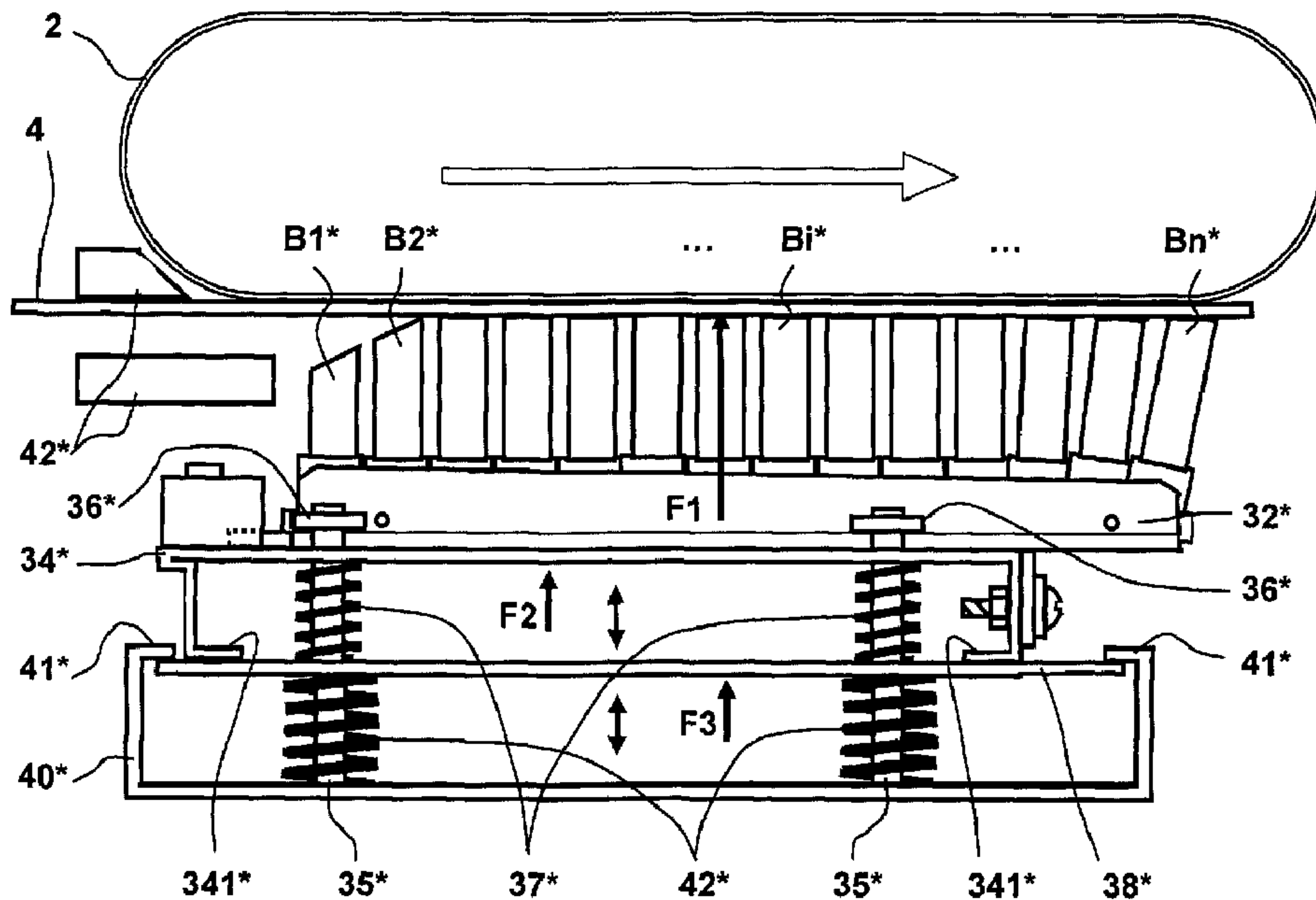
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(54) **Titre : DISPOSITIF A PRESSION DOTE D'ELEMENTS RESILIENTS**

(54) **Title: PRESSURE DEVICE WITH RESILIENT ELEMENTS**



(57) **Abrégé/Abstract:**

A pressure device with resilient elements, in particular brush elements of a brush body that are mechanically coupled with a spring system having a number of spring elements (37*) arranged between a base plate (34*) and a bottom plate (38*), wherein the brush



(57) Abrégé(suite)/Abstract(continued):

elements (B1*, B2*, ..., Bi*, ..., Bn*) of the pressure device are mechanically coupled with a double spring system, that is composed of the aforementioned spring system and a further spring system, wherein the aforementioned spring system altogether is pre-tensioned to a pre-defined minimum pressure force F2min in the state of rest. The pressure force F2 rises linearly with the thickness, wherein there are provided at least two first stop elements (341*) that limit the stroke of the base plate (34*) to the bottom plate (38*) in the direction of gravity, wherein, after the stop elements (341*) have hit, the brush elements in total exert a minimum pressure force F1min that, depending on the thickness, exert a non-linearly rising pressure force up to an optimum pressure force F1opt on the flat item, and that the further spring system is altogether pre-tensioned to a pre-defined pressure force F3min that is equal to the optimum pressure force F1opt of the brush elements and, in the state of operation for flat items from a second thickness on, exerts a pressure force F3 linearly rising with the thickness, wherein the following applies:

$$F3 > F3min = F1opt > F1 > F1min = F2max > F2 > F2min.$$

Abstract:

A pressure device with resilient elements, in particular brush elements of a brush body that are mechanically coupled with a spring system having a number of spring elements (37*) arranged between a base plate (34*) and a bottom plate (38*), wherein the brush elements (B1*, B2*, ..., Bi*, ..., Bn*) of the pressure device are mechanically coupled with a double spring system, that is composed of the aforementioned spring system and a further spring system, wherein the aforementioned spring system altogether is pre-tensioned to a pre-defined minimum pressure force F2min in the state of rest. The pressure force F2 rises linearly with the thickness, wherein there are provided at least two first stop elements (341*) that limit the stroke of the base plate (34*) to the bottom plate (38*) in the direction of gravity, wherein, after the stop elements (341*) have hit, the brush elements in total exert a minimum pressure force F1min that, depending on the thickness, exert a non-linearly rising pressure force up to an optimum pressure force F1opt on the flat item, and that the further spring system is altogether pre-tensioned to a pre-defined pressure force F3min that is equal to the optimum pressure force F1opt of the brush elements and, in the state of operation for flat items from a second thickness on, exerts a pressure force F3 linearly rising with the thickness, wherein the following applies:

$$F3 > F3min = F1opt > F1 > F1min = F2max > F2 > F2min.$$

Pressure device with resilient elements

Description

The invention refers to a pressure device with resilient elements of the kind indicated in the generic part of Patent Claim 1 that is applicable for all arrangements using resilient pressure elements that shall not be subject to permanent deformation. The invention allows in particular to simplify a transport or printing device designed for use in a postal franking system or a franking machine. When speaking of flat goods in the following, that shall not be meant to exclude paper strips, postal items or other goods for which the counter-pressure device is suitable, too.

From the German utility-model specification DE 20 2007 019 194 U1, there is known a device for pressing flat goods against a transport module that uses a transport belt-brush system. That system works sufficiently well for postal items having a sufficient thickness, such as e.g. letters, also over an extended period of time. The pressure force is realised by an excess stroke between transport belt and brush elements with simultaneous movement of the transport belt. The brush elements include holders. The holders are fixed to a brush body. The latter is mounted in a receiver carrier. Another prototype known from DE 20 2007 019 194 U1, Fig. 4, shows a first spring system including a brush system as mentioned above and a second spring system mechanically coupled with the first one. The second spring system comprises a base plate fixed by spacer bolts on a bottom plate in a resilient manner in relation to the latter.

For pressing, there are used brush elements as spring elements that generate a non-linearly rising pressure force F_1 . The second spring system presses, with a linearly rising pressure force F_2 , the receiver carrier with the brush elements against the transport belt contrary to the force of gravity. An excess stroke is also generated when there is no flat item between the transport belt and the pressure device (state of rest). The excess stroke is designed in such a manner that, also with occurring tolerances of the components of the pressure device, a pressure force against the transport belt is surely present also in the state of rest. The swing of the pressure device is effected by spring force contrary to the force of gravity and is limited by limiting means to an excess stroke of about 2 mm. The pressure force F_2 is that big that it causes, in the state of rest, an overstrain and thereby a permanent deformation of the brush elements of the pressure device, according to the formula:

$$F_1 \ll F_2.$$

Depending on the material, the spring force F_1 is getting lower and lower in the state of rest with the period of deformation, which leads to transport problems with very thin flat items, in particular franking strips.

There had to be solved the problem of developing a pressure device with resilient elements that is suitable for postal items of different thickness and ensures, without deformation of the brush elements, a safe transport especially of very thin flat items, in particular franking strips, over an extended period of time.

The problem is solved by the features of Claim 1.

It was found that the brush elements of a brush body forming a first spring system are especially well suited for the transport of thin, flat goods when the brush elements are not deformed in the state of rest of the pressure device.

A pressure device equipped with resilient elements, in particular brush elements, now, instead of being coupled with a single spring system, is mechanically coupled with a double spring system that, on the one hand, provides the required pressure force and, on the other hand, optimizes the pressure force in such a manner that a permanent deformation of the brush elements during the state of rest is prevented. The brush elements are the resilient elements of a first spring system that start to be deformed with a force corresponding to a minimum pressure force F_{1min} of the first spring system. Their pressure force increases in a non-linear manner with an increasing thickness of the items transported in the state of operation by the transport belt along a transport path and get between the transport belt and the pressure device. It was empirically determined that a permanent deformation of the brush elements in the state of rest is prevented when the brush elements act on the transport belt with a lower pressure force than a minimum pressure force F_{1min} of the first spring system. Therefore, in the state of rest of the pressure device, a second spring system acts with the pressure force F_2 via the first spring system on the transport belt in order to absorb those forces that might deform the brush elements, the following applying to the pressure forces:

$$F_{1min} > F_{2min}.$$

Here, there is chosen a minimum pressure force F_2 of the second spring system that is so much lower than the minimum pressure force F_{1min} of the first spring system that it is ensured that the minimum pressure force F_2 acting on the transport belt in the state of rest of the pressure device remains below the deformation forces D_{B^*} of all brush elements $B1^*, B2^*, \dots, Bi^*, \dots, Bn^*$:

$$F_{2min} < F_{1min} = \sum D_{B^*} = D_{B1^*} + D_{B2^*} + \dots + D_{Bi^*} + \dots + D_{Bn^*}$$

In the state of rest of the pressure device, there is no item present on the transport path, in difference to the state of operation. In the state of operation; a flat item is being transported. Due to the thickness of the flat item, there occurs a deflection of the receiver carrier in the direction of gravity. The deflection of the receiver carrier is counteracted by a spring force. The latter is limited by limiting means arranged between the base plate and the bottom plate. Due to the limitation, the

second spring system is pre-tensioned. Moreover, there are provided at least two first stop elements that limit the stroke of the base plate to the bottom plate in the direction of gravity. Due to a spring constant $R2$ of the spring force of all compression springs together, the pressure force $F2$ rises proportionally with the deflection. In the deflection, there is travelled a path that is limited by the stop elements. The aforementioned path corresponds to an average thickness of the flat item (postal item). That path is designated as stroke.

Even though individual brush elements at first are deformed upon arrival of the edge of a flat item and during its transport, their deflection subsequently is fully transmitted to the deflection of the receiver carrier up to a pre-defined stroke of $s_1 = 2 \text{ mm}$. The pressure force $F2$ of the second spring system is altogether lower than the minimum pressure force $F1_{\min}$ of the first spring system. With the mechanical coupling of both spring systems, there will not occur any deformation of the brush elements during the state of rest as long as the pressure force as a whole remains below the sum of the deformation forces ΣD_B^* . Up to a stroke of the receiver carrier in the direction of gravity according to a first thickness of a flat item, for example a postal item of 2 mm , there will only act the pressure force $F2$ of the second spring system on the postal item. With the stroke $s_1 = 2 \text{ mm}$ of the receiver carrier in the direction of gravity according to the first thickness of a postal item, there is reached the first stop of the arrangement that limits the stroke that may occur between the base plate and the bottom plate of the pressure device. Due to the limitation of the stroke, the pressure force $F1$ of the first spring system acts instead of the pressure force $F2$ of the second spring system. Because of the deformation of the brush elements, the pressure force $F1$ rises, from the minimum pressure force $F1_{\min}$ in a non-linear manner with the thickness of the flat item as long as there is not reached the minimum pressure force $F3_{\min}$ of a further third spring system. Also postal items of a medium thickness can be transported in the state of operation without occurrence of a permanent deformation of the brush elements, as long as long as there is not exceeded a pressure force of the first spring system under which the reversible deformation passes into an irreversible deformation. In the brush elements used in the embodiment, it occurs upon the first thickness of a flat item. The further rise of the pressure force with the thickness of the flat item is limited upon a second thickness of the flat item. With that second thickness, an optimum pressure force $F1_{\text{opt}}$ was empirically determined.

In the state of operation of the pressure device, a further spring system becomes active for postal items as from the second thickness that acts with a minimum pressure force $F3_{\min} = F1_{\text{opt}}$ when the optimum pressure force $F1_{\text{opt}}$ of the first spring system is reached. From $F3_{\min}$, the pressure force continues to rise in a linear manner with the thickness of the flat item. The proportionality factor is designated as spring constant $R3$ and is much bigger than the spring constant $R2$.

Thus, there results a mechanically coupled double spring system acting on the brush body. This way, there can be transported thin to thick flat items (postal items), wherein the following applies with regard to the pressure forces:

$$F_3 > F_{3\min} = F_{1\text{opt}} > F_1 > F_{1\min} = F_{2\max} > F_2 > F_{2\min}.$$

Each of the brush elements B_i^* is composed of a bundle of brush hairs or bristles and shows, in the pressure force/thickness diagram, a non-linearity of the deformation force $D_{B_i^*}$ that is based on the increasing friction among the brush hairs or bristles when they are deformed, wherein the friction increases with their deformation. With the optimum pressure force $F_{1\text{opt}}$, brush elements are deformed for a short time in the state of operation, but that deformation is not irreversible. The deformation is still reversible.

Advantageous developments of the invention are marked in the dependent claims and/or are described in more detail below together with the description of the preferred embodiment of the invention on the basis of the figures.

Fig. 1 shows a front view of the pressure device in its state of operation as a schematic representation. A white arrow points in the transport direction of a flat item 4. The brush body shows the brush elements $B^* = B_1^*, B_2^*, \dots, B_i^*, \dots, B_n^*$. The brush elements B_1^* and B_2^* are tapered in order to facilitate the entrance especially of a thicker item into the gap between the transport belt 2 and the pressure device. The receiver carrier 32* (brush body) is mechanically coupled with a double spring system. The double spring system comprises the already known spring elements 37* arranged between a base plate 34* and a bottom plate 38* that have already served before to press the brush elements against a transport belt 2 and that in total have a spring constant R_2 as well as further spring elements 42* that are arranged between the bottom plate 36* and the chassis 40* and in total have a spring constant of R_3 . The selected spring constant R_2 of the spring elements 37*, however, is substantially lower than in the previous solution according to DE 20 2007 019 194 U1, so that it is ensured that, in the state of rest of the printing device, the pressure forces remain below the deformation force of the brush elements B^* . The spring system with the spring elements 37* is sprung more softly than the first spring system with the brush elements B^* or the further third spring system with the spring elements 42*.

Fig. 1 shows that the base plate 34* has been deflected in the direction of gravity. The deflection of the base plate 34* is counteracted by a spring force produced by at least two compression springs 37*. The aforementioned spring force is limited by limiting means comprising for example a lock washer 36* and a spacer bolt 35* each, the base plate 34* having an opening for passing the spacer bolt 35* through it. Due to the limitation, the second spring system is pre-tensioned. The spring elements 37* are compressed according to the thickness of the flat item 4 so that the lock washer 36* and the base plate 34* are spaced from one another.

At least two stop elements 341* are mounted on the base plate 34* and are formed for limiting the stroke in the direction of gravity in such a manner that a stop on the bottom plate 38* is reached when the thickness of the flat item - in the manner shown - reaches or exceeds a first thickness.

At least two limiting elements 41* are arranged on the chassis 40* and limit the movement of the bottom plate 38" in the state of rest and in the state of operation - shown in Figure 1 - for thin flat items. That limits the effect of the further spring system contrary to the direction of gravity.

As an alternative to one of the first stop elements 341* fixed on the base plate, there can be mounted a first stop element - in a variant not shown here - on the bottom plate 38* and touch on the base plate 34* when the thickness of the item reaches or exceeds the first thickness.

Fig. 2 shows the deformation of a brush element B_{i+1}^* in comparison with a brush element B_i^* . The deformation of brush elements occurs when an item thicker than the flat item shown in Figure 1 is pressed.

The further spring system - shown in Figure 1 - is mounted between the bottom plate 38* and the chassis 40* and can only become effective when the pressure force rises above a threshold value F_{1opt} , which requires a respective thickness of the flat item.

Before the printing device, there is provided a sluice 42* with an passage opening for postal items that limits the thickness of an admitted item to a defined maximum thickness, for example to 10 mm.

Fig. 3 shows a pressure force/thickness diagram. The rise of the presented curve of the pressure force F_2 is $m_2 = (F_{1min} - F_{2min}) / (d_1 - d_0)$ and is equal to the spring constant R_2 . The rise of the presented curve of the pressure force F_3 is $m_3 = (F_{3min} - F_{1opt}) / (d_3 - d_2)$ and is equal to the spring constant R_3 . In the above-mentioned embodiment, there is $F_{3min} = F_{1opt} = 30$ N. In practice, that is achieved by the spring force of four compression springs 42*.

Within the above-mentioned pressure force/thickness diagram, there is shown, on the right margin of the figure, a further ordinate for the pressure force F_1 and, on the upper edge of the figure, a further abscissa for presenting the deformation of the brush elements. After at least the first stop element 341* has hit, there is only possible a deformation of the brush elements up to a value $D = 3$ mm with the brush used in the embodiment. It is visible that the pressure force acting on the postal item does not continue to rise linearly with the deformation of the brush elements.

Because, especially with thicker items, the rise of the curve under the effect of the pressure force F_1 would become too steep, there is required the further spring system that prevents that the pressure force acting on the postal item continues to rise non-linearly with the thickness of the

postal item. In this sense, the further spring system has an effect limiting the rise of the pressure force. Without the use of the further spring system having the spring constant R_3 , the brush elements would be further deformed in such a case, i.e. $d > 5 \text{ mm}$, so that the total pressure force acting on the postal item would not continue to rise in a non-linear manner. A curve according to the above-mentioned case was drawn with a broken line in Fig. 3.

The pressure force F_1 with which all brush elements in total would act on the postal item would exceed the pressure force F_3 of the further spring element, which may lead to an irreversible deformation of brush elements. On the other hand, the pressure force F_3 should rise with a defined rise because normally the effect of gravity must be compensated for with a higher weight, in particular with large-format postal items, such as e.g. of the format B4.

It is provided that a receiver carrier 32* or a brush body is mounted on the base plate 34*.

The invention is not restricted to the above-explained embodiment because, obviously, there can be developed and/or used further different embodiments of the invention that - starting from the same basic idea of the invention - are covered by the attached claims.

P a t e n t C l a i m s

1. A pressure device with resilient elements, comprising brush elements of a brush body that are mechanically coupled with a spring system having a number of spring elements (37*) arranged between a base plate (34*) and a bottom plate (38*), characterized in that the brush elements (B1*, B2*, ..., Bi*, ..., Bn*) of the pressure device are mechanically coupled with a double spring system, that said double spring system is composed of the aforementioned spring system and a further spring system mechanically coupled with the aforementioned spring system, wherein the aforementioned spring system altogether is pre-tensioned to a pre-defined minimum pressure force F_{2min} in the state of rest and, in the state of operation for flat items, exerts a pressure force F_2 linearly rising with the thickness, wherein, in the state of rest, there is exerted a pressure force lower than the pressure force provided by the brush elements, that there are provided at least two first stop elements (341*) that limit the stroke of the base plate (34*) to the bottom plate (38*) in the direction of gravity, wherein, after the stop elements (341*) have hit, the brush elements in total provide a minimum pressure force F_{1min} corresponding to the total of the deformation forces D_B of the brush elements in the state of rest of the pressure device, and wherein the brush elements, in the state of operation for flat items, exert, from the first thickness up to a second thickness, a non-linearly rising pressure force up to an optimum pressure force F_{1opt} on the flat item, and that the further spring system is altogether pre-tensioned to a pre-defined pressure force F_{3min} that is equal to the optimum pressure force F_{1opt} of the brush elements and, in the state of operation for flat items, exerts, from a second thickness on, a pressure force F_3 linearly rising with the thickness, wherein the following applies to the pressure forces:

$$F_3 > F_{3min} = F_{1opt} > F_1 > F_{1min} = F_{2max} > F_2 > F_{2min}.$$

2. A pressure device according to Claim 1, characterized in that the stop element (341*) is mounted on the base plate (34*) and, for limiting the stroke, is accordingly shaped in such a manner that a stop hit on the bottom plate (38*) is achieved.
3. A pressure device according to Claim 1, characterized in that the further spring system mechanically coupled with the aforementioned spring system comprises further spring elements (42*) arranged between the bottom plate (38*) and a chassis (40*).
4. A pressure device according to Claim 3, characterized in that a limiting element (41*) arranged on the chassis (40*) limits the movement of the bottom plate (38*) and thus the effect of the further spring system against the direction of gravity, whereby the further spring system is pre-tensioned to the pre-defined pressure force F_{3min} .
5. A pressure device according to Claim 1, characterized in that, for flat items from the first thickness of $d_1 = 2 \text{ mm}$, the stroke of the base plate (34*) to the bottom plate (38*) of the pressure device is limited.
6. A pressure device according to Claim 1, characterized in that a receiver carrier (32*) or a brush body is mounted on the base plate (34*).

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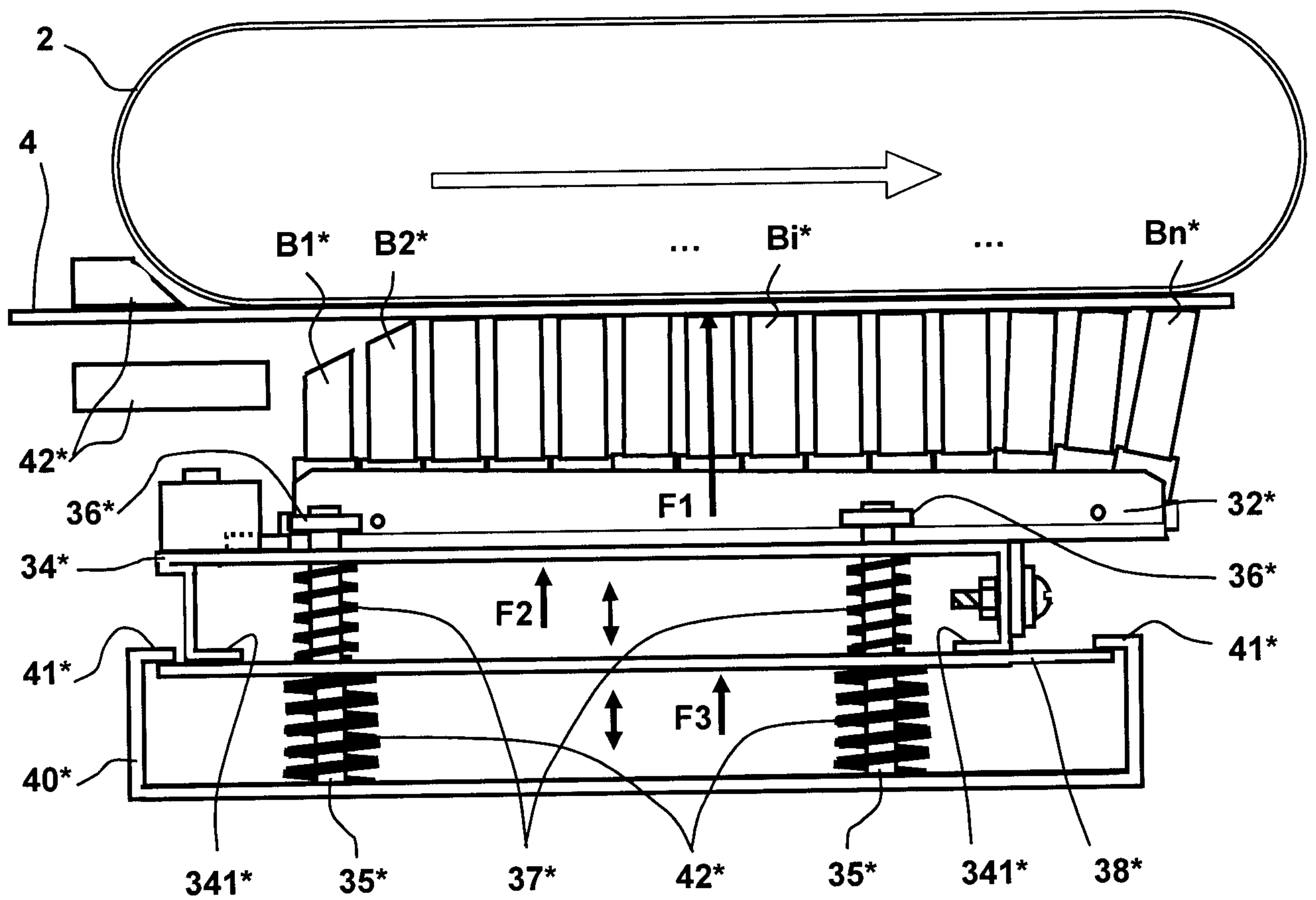


Fig. 1

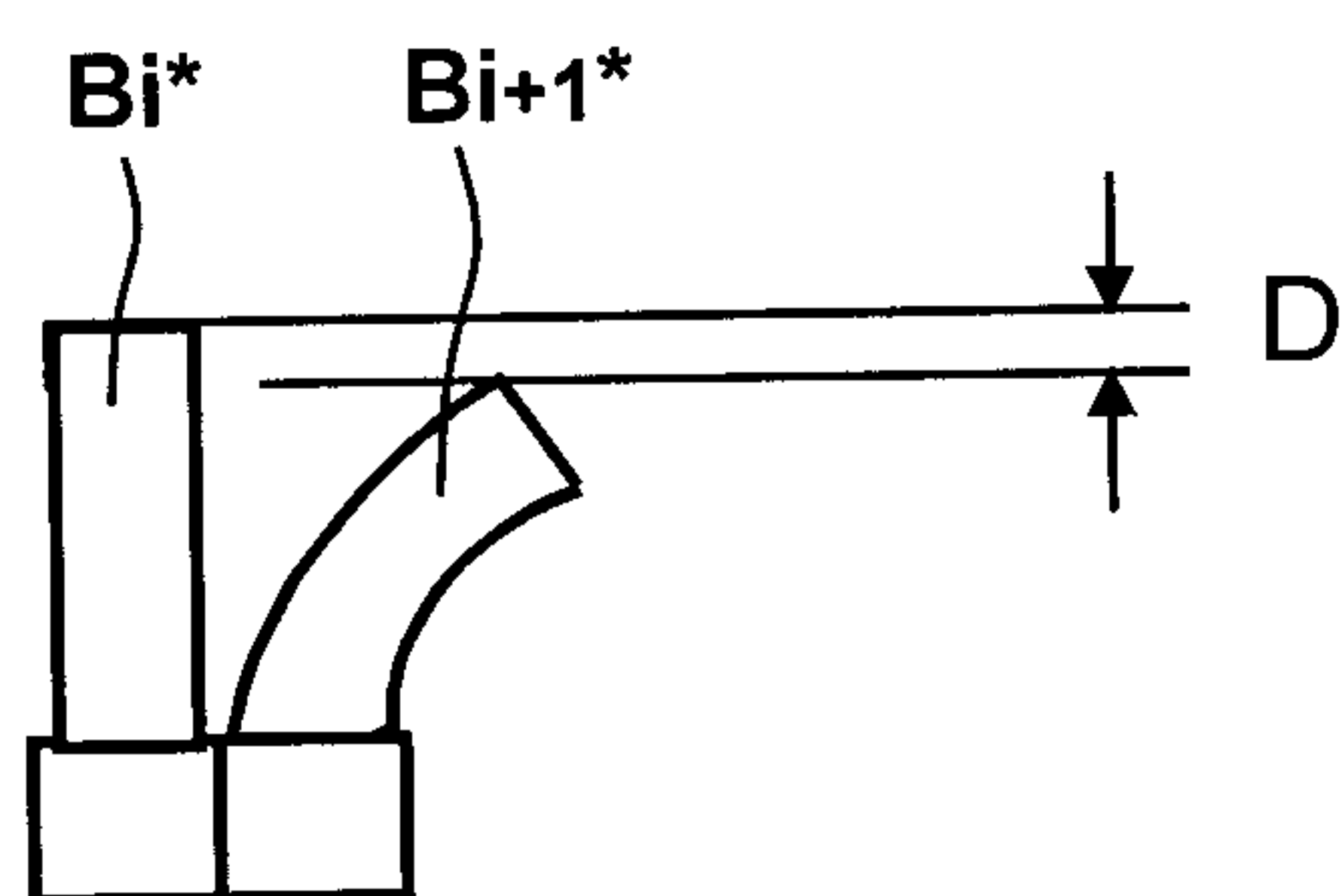


Fig. 2

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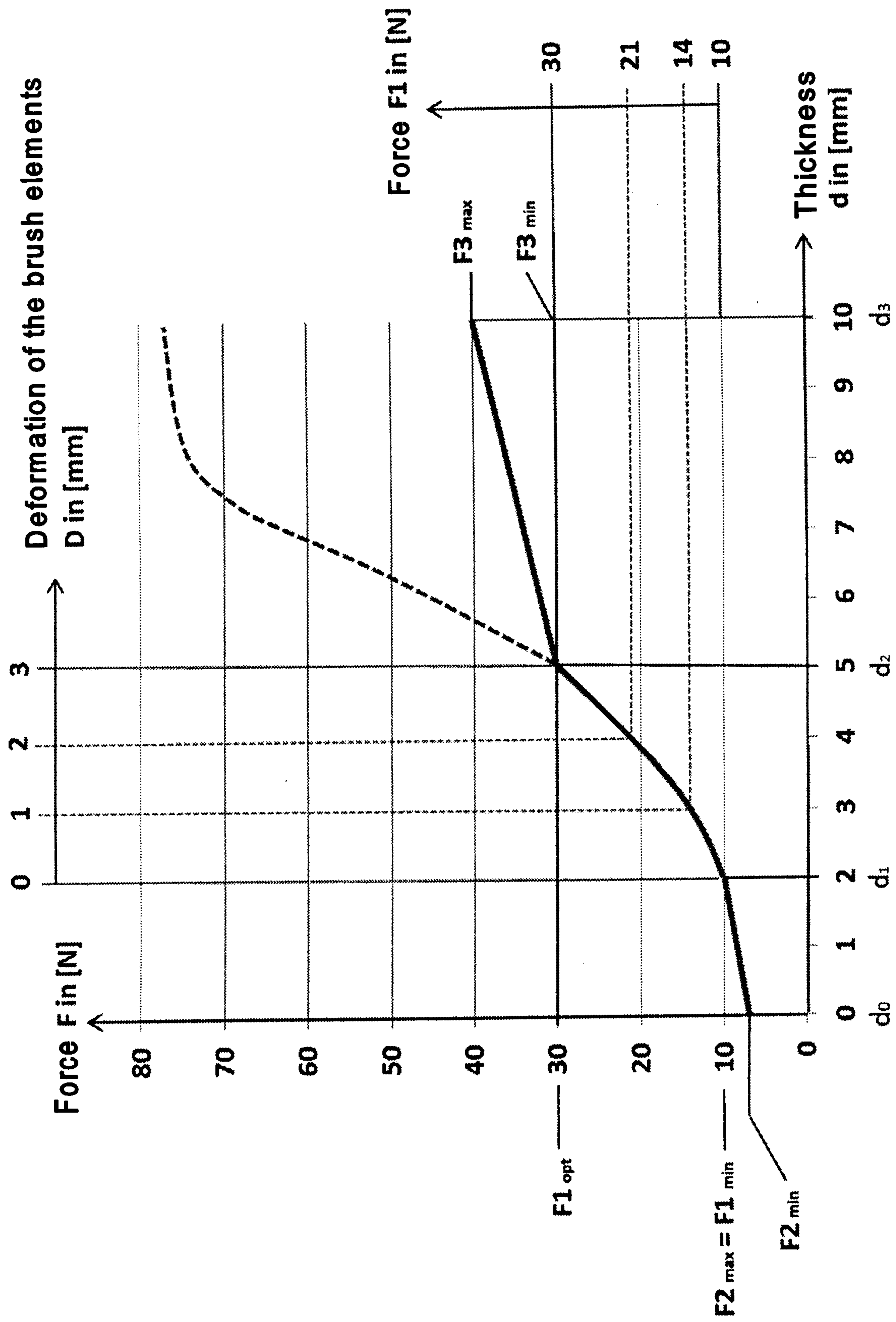


Fig. 3

