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(54) **Fluid dispenser with spring-mounted contact nozzle**

(57) The invention relates to an apparatus for applying a viscous fluid material to a surface of a substrate. The apparatus comprises material supplying means for supplying said viscous fluid material, a nozzle body (10) comprising a contacting surface (17) for contacting the substrate, a dispense opening in the nozzle body: The dispense opening is in fluid communication with said material supplying means and a gun body (20) for supporting said nozzle body (10). The invention addresses the problem the substrate to be coated may be damaged by peak contact forces between the substrate and the nozzle body. To this extent, it is proposed to support said nozzle body by said gun body (20) such that said nozzle body is relatively moveable to the gun body.

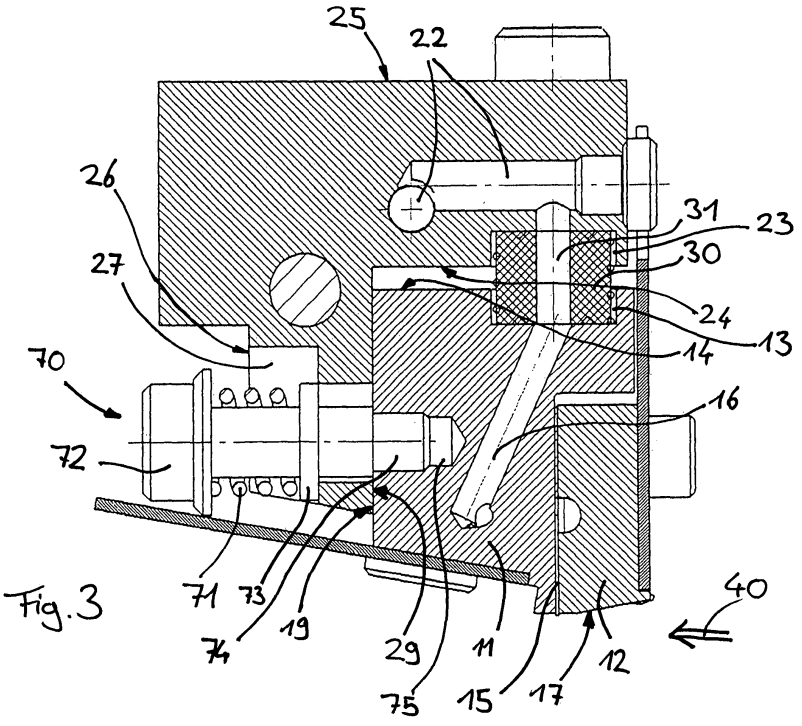

Fig.3

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Description

[0001] The invention relates to an apparatus for applying a viscous fluid material to a surface of a substrate, comprising: material supplying means for supplying said viscous fluid material, a nozzle body comprising a contacting surface for contacting the substrate, a dispense opening in the nozzle body, the dispense opening being in fluid communication with said material supplying means and a gun body for supporting said nozzle body. Further, the invention relates to a method for applying a viscous fluid material to a surface of a substrate.

[0002] The application of a viscous fluid material like hot-melt adhesive using contact application is a technique widely used in different applications. US 6,164,568 discloses a device for such contact application. Such devices are characterized by a contact surface of the applicator which is in contact to or in very close relationship to the substrate. Such contact or close relationship ensures a continuous and aesthetic coating and is in particular useful for applying film layers to substrates.

[0003] WO 2004/039505 A1 discloses a method for applying viscous fluid material onto a substrate and an apparatus therefore, wherein the fluid material is dispensed via a slot nozzle, the nozzle brought into contact with the surface of the substrate which is to be coated.

[0004] A particular problem arising in such contact applicators is the guidance of the substrate in relation to the dispense apparatus, i.e. in particular to the contact surface of the nozzle. This guidance must be very precise since it is required to provide a constant and uniform pressure over the whole contacting surface or to provide a constant and uniform small gap between the contacting surface and the substrate. Variations in the contacting pressure or the gap height may result in tearing or scuffing of the substrate or may cause irregularities in the coating.

[0005] When the substrate is fixed in place and the dispenser moves along the substrate, such precise alignment can only be achieved by precisely clamping the substrate with complicated clamping devices and positioning and precisely moving the dispenser. However, such precise clamping and movement requires expensive control means and clamping means since tolerances have to be kept very low. Often, such precise movement is not possible due to tolerances of the substrate itself or due to irregularities in the surface of the substrate. In the same way, when moving the substrate and keeping the dispenser at a fixed position, a precise guiding of the substrate along the contact surface must be achieved, requiring in the same way a precise clamping and guiding of the substrate.

[0006] The invention seeks to provide an apparatus and a method for contact application of viscous fluid materials which allows to dispense the material in a continuous or discontinuous manner to the substrate and to minimize the risk of damage to the substrate and irregularities in the coating.

[0007] These and other objects of the invention are solved by an apparatus as described beforehand, wherein said nozzle body is supported by said gun body such that said nozzle body is relatively moveable to the gun body.

[0008] The apparatus according to the invention comprises material supplying means which could be a container wherein the viscous fluid material is stored and from which the material is supplied to the dispense opening. Alternatively, the material supplying means may comprise a coupling which can be connected to a material supply channel to receive the viscous fluid material from an external source.

[0009] Further the apparatus comprises a nozzle body and a gun body for supporting said nozzle body. The nozzle body is adapted to contact the substrate which is to be coated with the viscous fluid material. To this extent the nozzle body comprises a contacting surface which is preferably smooth to facilitate sliding movement of the nozzle body versus the substrate.

[0010] A dispense opening is provided in the nozzle body. The dispense opening may be constituted by a gap between two elements which are part of the nozzle body or may be a single or a plurality of bores in the nozzle body. Usually, the dispense opening may end adjacent to or in the contacting surface of the nozzle body but this is not compulsory for the invention.

[0011] The nozzle body is mounted to the gun body in such a way that a relative movement of the nozzle body in relation to the gun body is possible. Such relative movement allows that the contact surface always contacts the substrate surface and can follow any surface elevations or depressions of the substrate surface. Further, any misalignment or imprecise guidance of the substrate or the gun body in relation to each other can be levelled out and balanced by the relative movement. As apparent to those skilled in the art, the relative movement of the nozzle body in relation to the gun body serves to provide a variable distance between the contact surface of the nozzle body and the gun body which is guided in relation to the substrate surface. By this, differences of the distance between the gun body and the substrate surface can be balanced.

[0012] According to a first preferred embodiment said nozzle body is supported by said gun body such that said nozzle body is moveable to the gun body in a direction perpendicular to said surface of said substrate. Basically, the contact surface should be able to carry out a movement in a direction perpendicular to the substrate surface to balance out surface irregularities or misalignments. The actual direction of movement of the nozzle body may be different from such perpendicular direction but the resulting movement of direction of the contact surface should comprise a component of direction which is directed perpendicular to the substrate surface. Preferably, such movement of the nozzle body versus the gun body may be achieved by a sliding action along a linear bearing surface.

[0013] The nozzle body may be supported by the gun body such that a tilting of the nozzle body around an axis lying parallel to the direction of movement of the apparatus in relation to the substrate may occur. This will further enhance the ability to balance misalignment on surface variations of the substrate.

[0014] Further, it is preferred that said nozzle body is pivoted to said gun body such that the distance between said contacting surface and said gun body is changed by said pivotal movement. According to this preferred embodiment, the nozzle body may conduct a rotational movement in relation to the gun body wherein the contacting surface is arranged such that by this rotational movement a component of the direction of the movement of the contacting surface results which is oriented perpendicular to the substrate surface, thus allowing the balance of irregularities and misalignments as described above.

[0015] According to a further preferred embodiment, a relative movement is provided between said substrate and said dispense opening and said dispense opening is a slot extending in a plane being parallel to and in a direction being perpendicular to the direction of said relative movement. Such slot nozzle will allow effective coating of a film to a substrate. Since in particular when applying films to substrates the problems of discontinuous coating, tearing or scuffing of the substrate may occur due to irregularities in the surface or imprecise guidance of the surface versus the gun, it is preferred to provide a nozzle body which is moveable in relation to a gun body when said nozzle body comprises a slot nozzle. The slot usually should extend perpendicular to the direction of movement of the substrate in relation to the nozzle but may be inclined in relation to this direction as well.

[0016] As an alternative, in another preferred embodiment a relative movement is provided between said substrate and said dispense opening and the nozzle body comprises a plurality of dispense openings distanced from each other and arranged in a line extending in a plane being parallel to and in a direction being perpendicular to the direction of said relative movement. Said plurality of dispense openings may dispense a bead of materials which coalesces after leaving the dispense opening, in particular coalesces after being brought into contact with the substrate surface. The dispense openings may be arranged in an exact line or may be staggered versus each other in a certain distance.

[0017] Still further it is preferred that an elastically deformable element is coupled between said nozzle body and said gun body. Such elastically deformable element may be a spring, e.g. a coil spring, a plate spring, a leaf spring or a helical spring and will act in such a way to press the contact surface onto the substrate surface. It is particularly preferred to pre-stress the elastically deformable element to prevent a significant increase in contact stresses between the contact surface and the substrate surface when the spring is further compressed. In particular, it is desirable to provide the same or substantially the same elastic force exerted by the elastically deformable element in each position of the relative movement between the nozzle body and the gun body.

[0018] Preferably, said elastically deformable element is a spring element, in particular a compressive spring. A spring element, in particular a compressive spring is well suited to exert a force to the nozzle body pressing the contact surface onto the substrate surface.

[0019] According to a further preferred embodiment, said nozzle body and said gun body are coupled for heat transfer. In a number of applications of the apparatus according to the invention the material which is to be dispensed must be dispensed at a specific temperature, in particular a specific elevated temperature, e.g. when applying a hot-melt adhesive. In such case it is preferred to heat all components of the apparatus which are in contact with the material, in particular those components at the end of the flow path of the material to ensure the material to have the correct temperature when leaving the dispense opening and to prevent any blockage or obstruction in the flow path. To this extent it is preferred to transfer heat from the gun body to the nozzle body in order to keep the nozzle body at a specific temperature. The nozzle body and gun body are coupled for such heat transfer which coupling may be achieved preferably by a direct heat conduction.

[0020] It is particularly preferred that said nozzle body comprises a nozzle heat transfer surface and said gun body comprises a gun heat transfer surface and said heat transfer surface and said gun transfer surface are arranged such that a contact relationship is established in each position of the nozzle body in relation to the gun body. Such surfaces in contact relationship will provide effective and sufficient heat transfer. The surfaces may extend along the whole length or width of the nozzle body and the gun body or may be provided along only a portion of these bodies.

[0021] Still further it is preferred that a relative movement is provided between said substrate and said dispense opening and said nozzle heat transfer surface and said gun heat transfer surface extend perpendicular to the direction of said relative movement. By this, a sliding movement of said nozzle heat transfer surface in relation to said gun heat transfer surface is provided to allow a movement of the nozzle body in relation to the gun body perpendicular to direction of movement between the substrate and the dispense opening while still maintaining the heat transfer between these two bodies.

[0022] As an alternative, said nozzle body is pivoted to said gun body and said nozzle heat transfer surface and said gun heat transfer surface are arranged along a cylindrical segment around the axis of said pivotal movement. In such case a sliding movement of said nozzle heat transfer surface in relation to said gun heat transfer surface will occur in the same way but the sliding movement takes place along a cylindrical surface to allow rotational movement of the nozzle body in relation to the gun body while still maintaining the heat transfer between

the two bodies.

[0023] According to a further preferred embodiment said nozzle body comprises a nozzle fluid passage and said gun body comprises a gun fluid passage, said nozzle fluid passage and said gun fluid passage being coupled via a deformable tube. A particular problem arising when providing a movement between the nozzle body and the gun body is to supply the dispense material to the dispense opening. Usually, the dispense material is provided to the dispense opening through a nozzle fluid passage which may be a bore or a plurality of bores in the nozzle or may be constituted by a gap between two elements of the nozzle. It is particularly preferred, to supply the dispense material via a gun fluid passage to provide a compact design of the apparatus and to allow heat transfer to the material via the gun body. In such case, it is particularly preferred to supply the dispense material from the gun body to the nozzle body via a deformable tube. The deformable tube may be a tube which can be bended to follow the movement of the nozzle body in relation to the gun body or may be compressed or extended for following such movement. Preferably, the deformable tube is made of an elastomeric material to provide deformability. The tube may preferably be arranged in or close to the axis of tilting of the nozzle body if such tilting action is provided.

[0024] Finally, according to a preferred embodiment, a relative movement is provided between said substrate and said dispense opening and said deformable tube is oriented in a direction perpendicular to said movement. In such case, the deformable tube will experience a compression or extension when following the movement between nozzle body and gun body and may further comprise or contribute to the function of exerting an elastic force onto the nozzle body to press the contacting surface against the substrate surface.

[0025] According to a further aspect of the invention a method for applying a viscous fluid material to a surface of a substrate is provided, the method comprising:

- supplying the viscous fluid material to a dispense opening in a nozzle body,
- providing a relative movement between said dispense opening and said substrate,
- supporting said nozzle body by a gun body,

whereby a relative movement between said nozzle body and said gun body is provided.

[0026] The method may preferably be conducted using an apparatus as described beforehand. The method allows to apply a constant and homogenous film of a viscous fluid material to a surface of a substrate without the risk of tearing or scuffing the substrate.

[0027] The method may be further improved according independent claims 15-25. With regard to these preferred embodiments of the method according to the invention it is referred to the description of the corresponding features of the apparatus as described above and used to provide or allow the respective method steps.

[0028] The application will be described in detail with reference to a preferred embodiment shown in the figures, wherein:

Fig. 1: is a partially sectional front view of a fluid dispenser according to the invention,

Fig. 2 is a bottom view onto the side facing the substrate which is to be coated, and

Fig. 3: is a sectional side view along plane A-A of the fluid dispenser shown in Figure 1.

[0029] The fluid dispenser shown in the figures comprises a slot nozzle body 10 and a gun body 20, to which the slot nozzle body is mounted.

[0030] A hot-melt adhesive material is supplied via a supply channel (not shown) to an inlet 21 of the gun body 20. From the inlet 21 the adhesive material is supplied via supply channels provided in the gun body, some of which are shown in the figures and designated with reference numeral 22. Supply channel 22 is in fluid communication with a bore 31 provided in an elastomeric ring element 30 which is inserted into a circular recess 23 in a bottom surface 24 of the gun body 20.

[0031] The nozzle body 10 comprises a central element 11, to which a side element 12 is mounted in distant relationship to provide a gap 15 between the side element 12 and the central element 11.

[0032] The elastomeric ring 30 is inserted into a circular recess 13, which is provided in a top surface 14 of the central element 11. The bore 31 extending through the elastomeric ring 30 is in fluid communication with a nozzle supply channel 16 supplying the hot-melt adhesive material to the gap 15.

[0033] A polished and slightly curved contacting surface 17 is provided on the bottom side of the central component 11 and side element 12 of the nozzle body. A substrate may be moved along the direction shown with arrow 40 along a part of the contacting surface 17. By supplying the hot-melt adhesive material to the gap 15 a film will be coated onto the substrate along the whole width of the nozzle body.

[0034] The central element 11 of the nozzle body is fixed to the gun body via two screws 50a, b which are arranged at a distance to each other along the width of the nozzle body. The screws 50a, b comprise a screw head 51 a, b which is supported on a top side 25 of the gun body. As shown for screw 50a, a through-hole 52a extends through the gun body for each screw 50a, b to take up a shaft section 53a of the screws 50a, b.

[0035] A circular recess 54a is provided in the bottom surface of the gun body 20 in coaxial alignment with each trough-hole 52a.

[0036] Further, opposed to the circular recess 54a, a

corresponding circular recess 55a is provided in the top surface 14 of the nozzle body 10. Each opposing pair of circular recesses 54a, 55a accommodate a compressive spring 56a which is supported on the ground surface of the circular recesses 54a, 55a, thus exerting a force onto the gun body 20 and the central component of the nozzle body 10 to ensure a position as depicted in the figures leaving a gap 60 between the bottom surface 24 of the gun body and the top surface 14 of the central component 11 of the nozzle body 10.

[0037] As shown for screw 50a, a winding 57a is provided on the tip of the screw only whereas the shaft section 53a extends along the rest of the screw 51 a. The winding 57a is screwed into a threadened bore 18 in the central component 11 of the nozzle body 10 thus acting as a stopper in cooperation with the screwhead 51 a and defining an end position having a maximal gap 60.

[0038] As will be apparent from figure 1, the elastomeric ring 30 is arranged in the middle between the two screws 50a, b. Further, a single mounting screw 70 is screwed into the central component of the nozzle body in the middle between the two screws 50a, b. The axis of the screw 70 is oriented perpendicular to the axes of the screws 51 a, b and is lying parallel to the plane of movement of the substrate, i.e. substantially parallel to the contacting surface 17.

[0039] The screw 70 is fixed with a winding 74 in a threadened bore 75 of the central component 11 of the nozzle body. A circular recess 27 is provided in a rear surface 26 of the gun body and accommodates a compressive spring 71 which is arranged coaxially with the screw axis of the screw 70 and wound around a shaft region of the screw 70. The compressive spring 71 abuts the screw head 72 of the screw 70 and a ring 73 supported on the ground of the circular recess 27 thus exerting a compressive force and pressing a heat transfer surface 19 of the central component 11 onto a heat transfer surface 29 of the gun body 20. The two heat transfer surfaces 19, 29 are thus in contact to each other to transfer heat from the gun body 20 to the nozzle body 10 in every position of the nozzle body 10 in relation to the gun body 20. The screw shaft of screw 70 is guided in a large longhole of the gun body 20 allowing the screw to move in a vertical direction perpendicular to the surface of the substrate the two heat transfer surfaces 19, 29 can slide against each other thus allowing the nozzle body to move in relation to the gun body.

[0040] As will be apparent from the figures, the nozzle body may perform a tilting action as depicted with arrow 80 in relation to the gun body 20 or may perform a linear vertical movement in relation to the gun body 20 as depicted with arrow 81. In each position provided by such tilting or vertical linear movement the elastomeric ring 30 will ensure that there is no leakage as the surface nozzle moves. By this, a dispenser is provided, wherein the nozzle body can follow the substrate to a certain extent and thus ensure uniform pressure between the contacting surface 17 and the substrate. Still further, heat transfer from the gun body 20 to the nozzle body 10 is ensured via heat transfer surfaces 19, 29.

[0041] It will be apparent to those skilled in the art that the embodiment shown in the figures is only exemplary and specific components of the embodiment may be left out or added or replaced by other components. As an example, the elastomeric ring could be replaced by a metal or diaphragm bellows to provide the same function without deviating from the invention as claimed. Still further, the springs 55a, b could be replaced by elastomeric elements providing a compression spring property as well.

[0042] It is preferred, to dimension the springs 56a, b such that they are in a prestressed condition if the gap 60 is at maximum. This will further enhance the function of the dispenser according to the invention in that a sharp increase of the contact force between the substrate and the contacting surface is avoided when the spring is compressed.

[0043] Further, it will be understood that the nozzle body 10 aligns itself via the force of the springs 56a, b and the screws 50a, b and thus will always return to its original position after tilting or linear movement along the arrows 80, 81.

Claims

1. An apparatus for applying a viscous fluid material to a surface of a substrate, comprising:

   - material supplying means for supplying said viscous fluid material,
   - a nozzle body comprising a contacting surface for contacting the substrate,
   - a dispense opening in the nozzle body, the dispense opening being in fluid communication with said material supplying means,
   - a gun body for supporting said nozzle body,

   characterized in that said nozzle body is supported by said gun body such that said nozzle body is moveable in relation to the gun body.

2. Apparatus according to claim 1
   wherein said nozzle body is supported by said gun body such that said nozzle body is moveable to the gun body in a direction perpendicular to said surface of said substrate.

3. Apparatus according to claims 1 or 2,
   wherein said nozzle body is supported by said gun body such that said nozzle body is allowed to tilt around an axis the axis lying preferably parallel to a direction of movement between the substrate and the apparatus.

4. Apparatus according to claim 1, 2 or 3,

wherein said nozzle body is pivoted to said gun body such that the distance between said contacting surface and said gun body is changed by said pivotal movement.

5. Apparatus according to any of the preceding claims, wherein a relative movement is provided between said substrate and said dispense opening and said dispense opening is a slot extending in a plane being parallel to and in a direction being perpendicular to the direction of said relative movement.

6. Apparatus according to any of the preceding claims 1-4,
wherein a relative movement is provided between said substrate and said dispense opening and the nozzle body comprises a plurality of dispense openings distanced from each other and arranged in a line extending in a plane being parallel to and in a direction being perpendicular to the direction of said relative movement.

7. Apparatus according to any of the preceding claims, wherein an elastically deformable element is coupled between said nozzle body and said gun body.

8. Apparatus according to the preceding claim,
wherein said elastically deformable element is a spring element, in particular a compressive spring.

9. Apparatus according to any of the preceding claims, wherein said nozzle body and said gun body are coupled for heat transfer.

10. Apparatus according to the preceding claim,
wherein said nozzle body comprises a nozzle heat transfer surface and said gun body comprises a gun heat transfer surface and said heat transfer surface and said gun transfer surface are arranged such that a contact relationship is established in each position of the nozzle body in relation to the gun body.

11. Apparatus according to the preceding claim,
wherein a relative movement is provided between said substrate and said dispense opening and said nozzle heat transfer surface and said gun heat transfer surface extend perpendicular to the direction of said relative movement.

12. Apparatus according to claim 10,
wherein said nozzle body is pivoted to said gun body and said nozzle heat transfer surface and said gun heat transfer surface are arranged along a cylindrical segment around the axis of said pivotal movement.

13. Apparatus according to any of the preceding claims, wherein said nozzle body comprises a nozzle fluid passage and said gun body comprises a gun fluid passage, said nozzle fluid passage and said gun fluid passage being coupled via a deformable tube.

14. Apparatus according to the preceding claim,
wherein a relative movement is provided between said substrate and said dispense opening and said deformable tube is oriented in a direction perpendicular to said movement.

15. A method for applying a viscous fluid material to a surface of a substrate, comprising:

- supplying the viscous fluid material to a dispense opening in a nozzle body,
- providing a relative movement between said dispense opening and said substrate,
- supporting said nozzle body by a gun body,

characterized by providing a relative movement between said nozzle body and said gun body.

16. Method according to claim 15,
wherein said relative movement between said nozzle body and said gun body is oriented in a direction perpendicular to said surface of said substrate.

17. Method according to claim 15 or 16,
wherein said nozzle body tilts in relation to said gun body.

18. Method according to claim 14 or 15,
wherein said nozzle body is allowed to rotate in relation to said gun body such that the distance between said dispense opening and said gun body is changed by said rotational movement.

19. Method according to any of the preceding claims 15-18,
wherein a dispense slot is provided as dispense opening, the dispense slot extending in a plane being parallel to and in a direction being perpendicular to the direction of said relative movement between said substrate and said slot.

20. Method according to any of the preceding claims 15-19,
wherein a plurality of dispense openings is provided the dispense openings being distanced from each and arranged in a line extending in a plane being parallel to and in a direction being perpendicular to the direction of said relative movement between said substrate and said dispense openings.

21. Method according to any of the preceding claims 15-20,
wherein the relative movement between said nozzle body and said gun body is provided by an elastically deformable element.

22. Method according to any of the preceding claims, wherein heat is transferred between said nozzle body and said gun body.

23. Method according to the preceding claim, wherein said heat is transferred via a nozzle heat transfer surface of said nozzle body and a gun heat transfer surface of said gun body in each position of the nozzle body in relation to the gun body.

24. Method according to the preceding claim, wherein said nozzle heat transfer surface and said gun heat transfer surface are provided to extend perpendicular to the direction of said relative movement between said substrate and said dispense opening.

25. Method according to claim 23, wherein said nozzle body is allowed to rotate to said gun body and said said nozzle heat transfer surface and said gun heat transfer surface are provided along a cylindrical segment around the axis of said rotational movement.

26. Method according to any of the preceding claims 15-25, further comprising the step of coupling a nozzle fluid passage in the nozzle body and a gun fluid passage in said gun body via a deformable tube.

27. Method according to the preceding claim, wherein said deformable tube is oriented in a direction perpendicular to said movement.

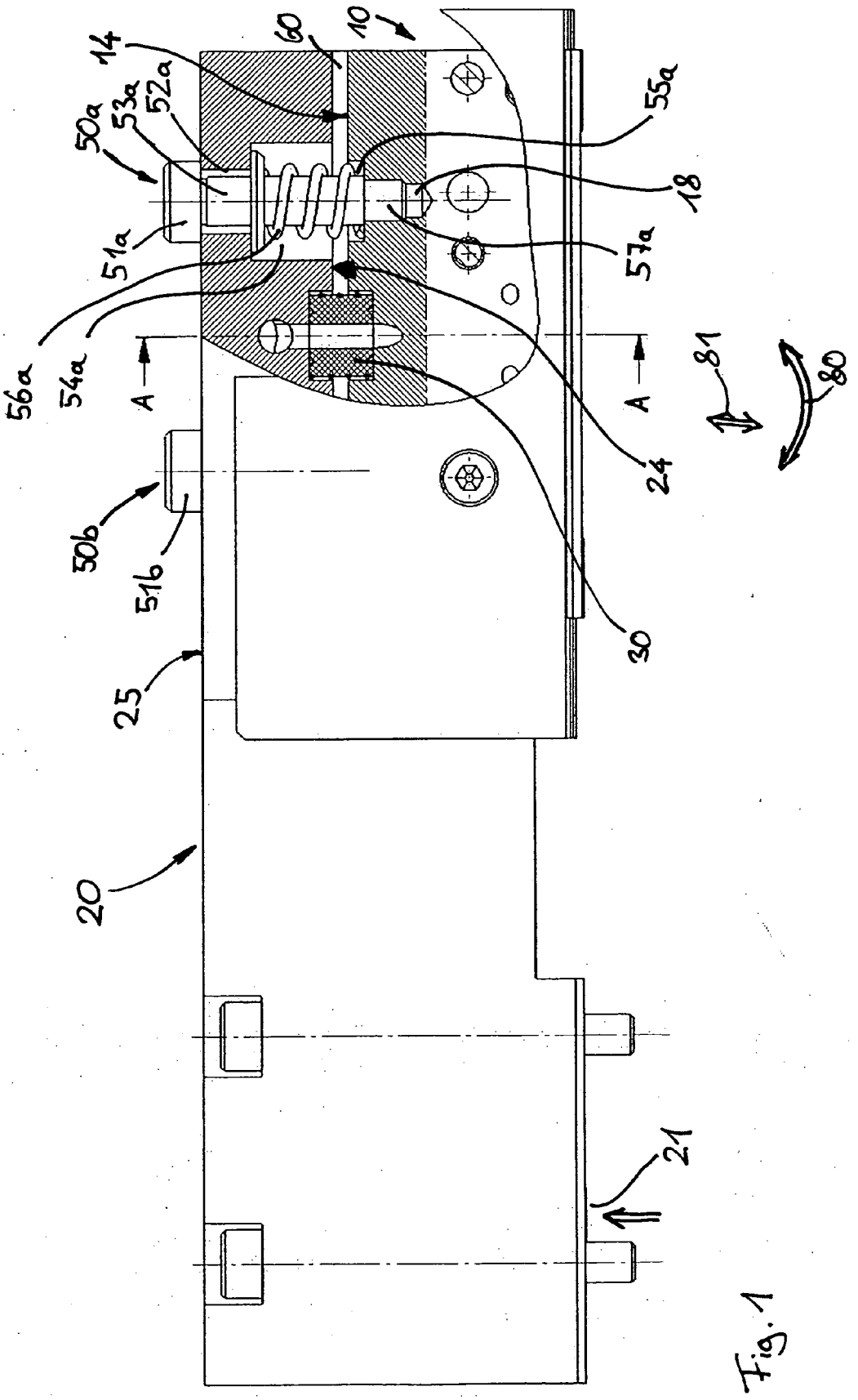
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Fig. 1

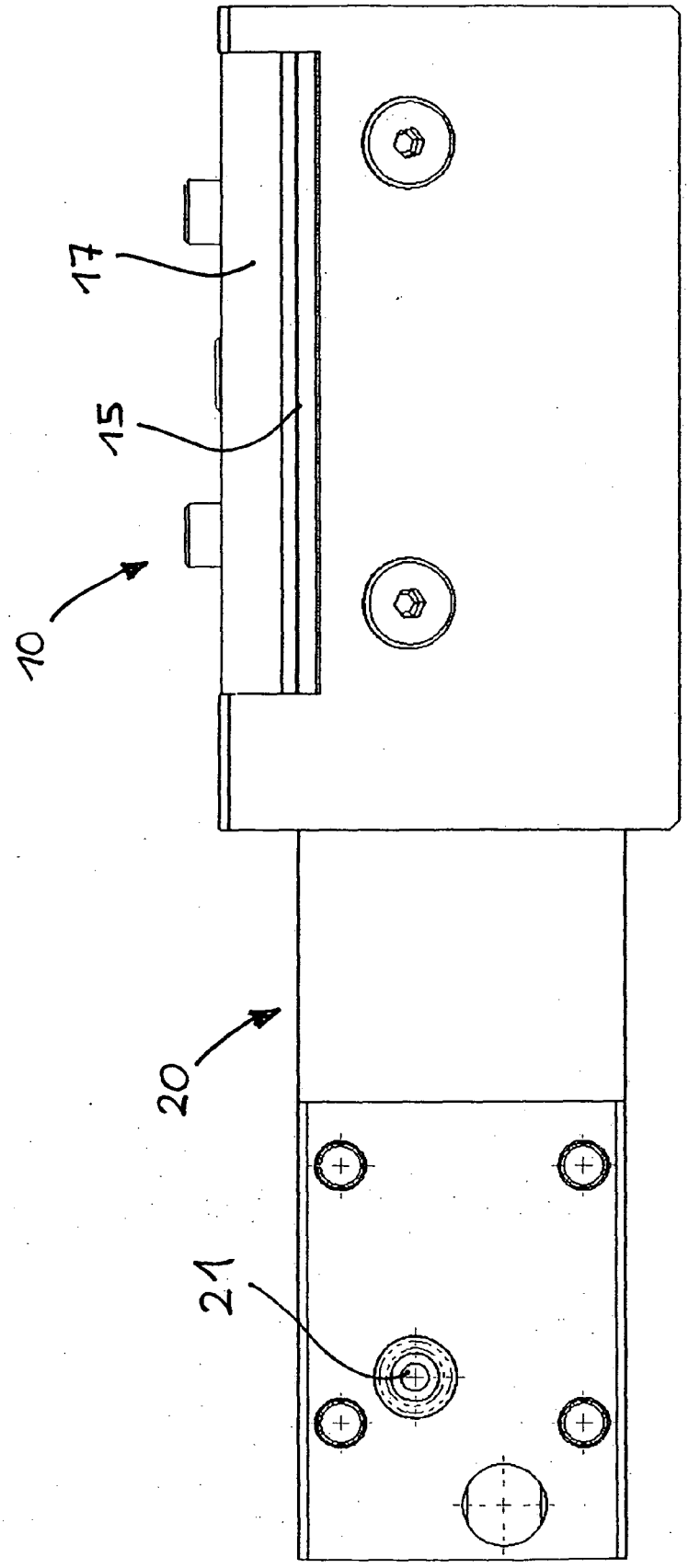

Fig. 2

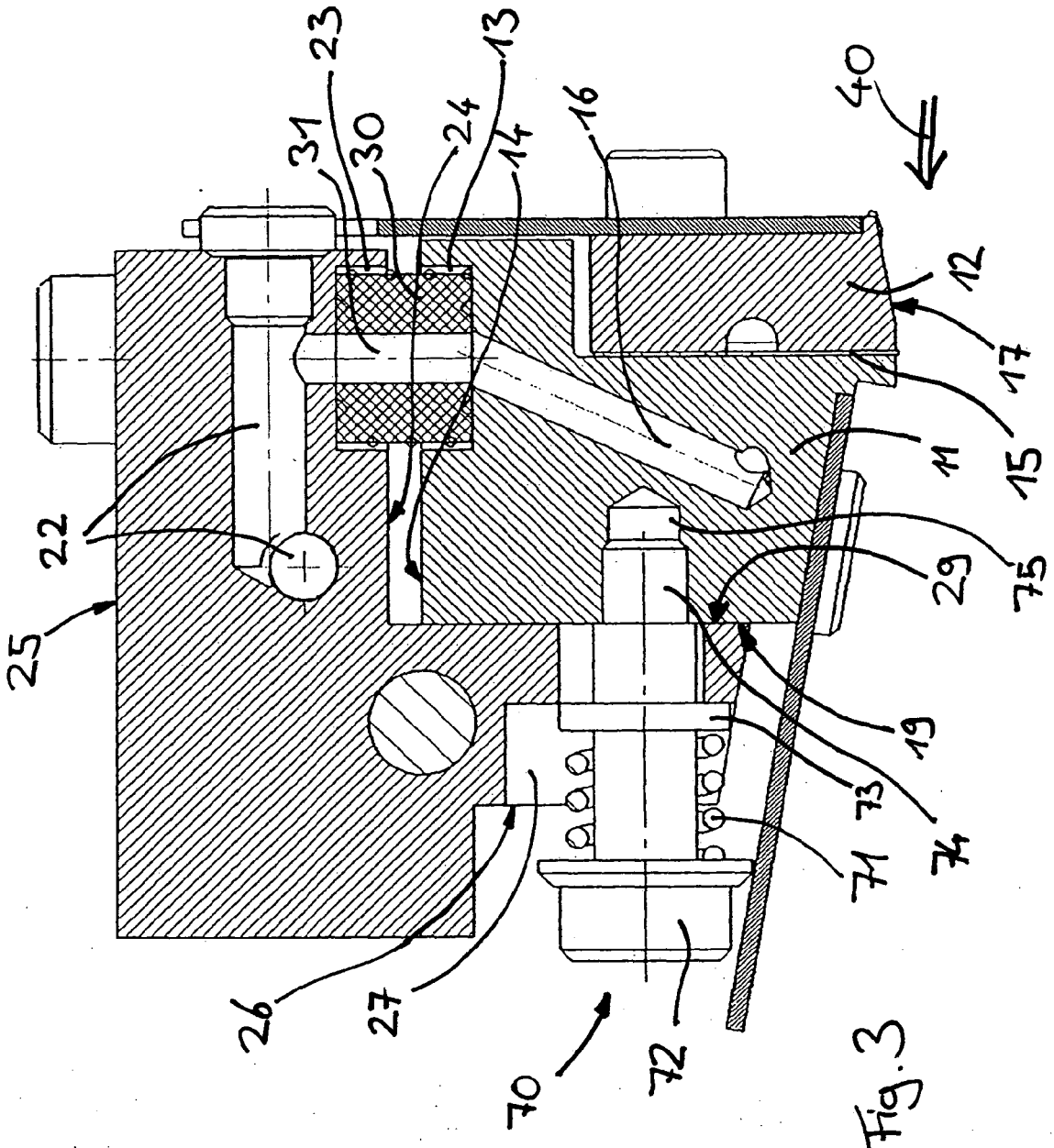

Fig. 3

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 January 2008	Pöll, Andreas

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X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 01 6162

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6164568 A **[0002]**
- WO 2004039505 A1 **[0003]**