Title: DRY POWDER INHALER AND INHALING SYSTEM COMPRISING SUCH DRY POWDER INHALER

Abstract: The invention relates to a dry powder inhaler comprising: - a suction tube (5), - a slider (8) comprising a support surface (9) adapted to receive a container (2), said suction tube (5) and said slider (8) being moveable relative to one another along a path, between an actuating position and a delivering position, - an opener (10) placed in said path. The support surface (9) comprises a support member (25) and a reception space delimited by the support member (25), the slider (8) comprising a retaining member (26) adapted to retain the container (2) onto the support member (25).
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Dry powder inhaler and inhaling system comprising such dry powder inhaler

The invention relates to a dry powder inhaler and to an inhaling system comprising such dry powder inhaler.

In particular, the invention relates to a dry powder inhaler intended to be used with a container comprising a reservoir provided with dry powder, said dry powder inhaler comprising:
- a suction tube,
- a slider having a support surface adapted to receive the container, said suction tube and said slider being moveable relative to one another along a path from a first to a second position, the support surface of the slider facing the suction tube in at least part of said path,
- an opener adapted to open the reservoir as the suction tube and the slider are moved relative to one another along said path, so as to allow discharge of the dry powder upon inhalation by a user through the suction tube.

Such an inhaler, in which discharge of the dry powder is obtained by synchronisation of an inhalation by the user with an actuating movement performed by the user to move the suction tube and the slider relative to one another, is disclosed in document WO-A-02/24266.

An inhaler of the above mentioned type may be used in particular to discharge a metered dose of medication, for example insulin or other, in a fine dry powder form, contained in the reservoir of the container. It is thus essential that the user receives the appropriate dose of medication.

In order to ensure a release of a precise dose of dry powder with an efficient deaggregation of said dry powder, the positioning of the reservoir of the container with respect to the opener and the suction tube needs to be accurate for each use of the inhaler.

One purpose of the invention is to solve this technical problem.

To this end, the invention provides for a dry powder inhaler of the above mentioned type, further including an interfering device adapted to prevent the suction tube and the slider from moving relative to one another from the first to
the second position if a dry powder container is improperly positioned on said support surface.

Hence, the user is compelled to properly position the dry powder container in the inhaler in order to use the inhaler, thus contributing to the delivery of a precise dose of dry powder to the user.

In various embodiments of the dry powder inhaler, one may further make use of one or several of the following features (each of the features below might be used alone, without the dispositions explained above):

- the slider supports a retaining member which is movable between a supplying position enabling to load the container on said support surface and a locking position in which said retaining member is adapted to retain the container onto the support surface, and said interfering device is adapted to prevent the suction tube and the slider from moving relative to one another from the first to the second position unless the retaining member is in the locking position;

- the interfering device comprises an abutment element movably mounted on the slider, said abutment element being resiliently biased toward an interfering position wherein said abutment element is adapted to interfere with a portion of the inhaler which is fixed relative to the suction tube so as prevents the suction tube and the slider from moving relative to one another from the first to the second position, and said abutment element being adapted to be moved by a part placed on said support surface, to a remote position wherein said abutment element enables the suction tube and the slider to move relative to one another from the first to the second position;

- the slider supports a retaining member which is movable between a supplying position enabling to load the container on said support surface and a locking position in which said retaining member is adapted to retain the container onto the support surface, and said abutment element being adapted to be moved by said retaining member to said remote position when said retaining member is in said locking position;

- said abutment element is pivotally mounted on said slider and has a control arm linked to a sliding piece which is slingly mounted on said slider and
is adapted to interfere with said part placed on the support surface to move the
abutment element to the remote position;
- the slider comprises at least one positioning member protruding on
said support surface and adapted to engage with the container to ensure a
precise positioning thereof;
- the slider comprises at least two positioning members protruding
from the support surface and defining between them a reception space which is
adapted to receive said reservoir of the container when said container is loaded
on said support surface, the opener being arranged so as to pass between said
positioning members as the suction tube and the slider are moved relative to one
another;
- said positioning members are two support walls extending in a
direction substantially parallel to the path;
- the positioning member is made in one piece with the support
surface;
- the slider supports a retaining member which is movable between a
supplying position enabling to load the container on said support surface and a
locking position in which said retaining member is adapted to retain the container
onto the support surface;
- the retaining member comprises a flap which is pivotally mounted
on the slider;
- the flap comprises a free end adapted to be snap-fitted to the slider
in the locking position;
- the dry powder inhaler further comprises a substantially cylindrical
hollow frame extending along a central axis and comprising an open end and a
lateral opening, the suction tube communicating with the hollow frame through
the lateral opening, the opener being secured to the frame close to the suction
tube, the slider being engaged in the open end and being slidingly mounted in
said hollow frame along the central axis between said first position, in which the
slider protrudes from the frame, and said second position, in which the slider is
placed within the frame;
the dry powder inhaler further comprises a hollow frame in which the slider slides, wherein the suction tube is secured to the frame in a removable manner;

- the frame comprises an annular wall cooperating by fitting engagement with the suction tube, a first element, chosen between said suction tube and said annular wall, comprises two protruding opposite spurs and a second element, chosen between said suction tube and said annular wall, has two grooves in which the spurs may engage, respectively, said grooves being symmetrically disposed on two opposite sides of said annular wall;

- each groove comprises an axial portion extending up to an arched portion presenting a concavity turned towards said free end, said arched portion surrounding a perforated, flexible, central core and having a recess adapted to receive one of the spurs;

- the slider comprises at least one stopping surface and the frame comprises at least one abutment surface, the stopping surface and the abutment surface being moveable relative to one another between a stopping position, in which the stopping surface and the abutment surface are in abutment, when the slider is in the second position, and a release position, in which the stopping surface and the abutment surface are spaced apart;

- the slider comprises a plate provided with said stopping surface, said plate being resiliently urged toward the stopping position in abutment against said abutment surface belonging to the frame, the plate being moveable in the release position and actuable by a pushbutton;

- the frame comprises a protective front cover adapted to be placed in a removable manner on the suction tube, said protective front cover having said abutment surface in abutment against said stopping surface belonging to the slider, when the cover is placed on the suction tube;

- the inhaler comprises a braking system adapted to slow down the movement of the slider.

Another object of the invention is a dry powder inhaler intended to be used with a container comprising a reservoir provided with dry powder, said dry powder inhaler comprising:
- a suction tube,
- a slider having a support surface adapted to receive the container, said suction tube and said slider being moveable relative to one another along a path from a first to a second position, the support surface of the slider facing the suction tube in at least part of said path,
- an opener adapted to open the reservoir as the suction tube and the slider are moved relative to one another along said path, so as to allow discharge of the dry powder upon inhalation by a user through the suction tube, wherein the slider comprises at least one positioning member protruding on said support surface and adapted to engage with the container to ensure a precise positioning thereof.

Still another object of the invention is a dry powder inhaler intended to be used with a container comprising a reservoir provided with dry powder, such dry powder inhaler comprising:

- a frame,
- a suction tube removably held on the frame,
- a slider movably mounted on the frame, said slider having a support surface adapted to receive the container, said suction tube and said slider being moveable relative to one another along a path from a first to a second position, the support surface of the slider facing the suction tube in at least part of said path,

- an opener adapted to open the reservoir as the suction tube and the slider are moved relative to one another along said path, so as to allow discharge of the dry powder upon inhalation by a user through the suction tube, wherein the frame comprises an annular wall cooperating by fitting engagement with the suction tube, a first element, chosen between said suction tube and said annular wall, comprises two protruding opposite spurs and a second element, chosen between said suction tube and said annular wall, has two grooves in which the spurs may engage, respectively, said grooves being symmetrically disposed on two opposite sides of said annular wall, each groove comprising an axial portion extending up to an arched portion presenting a concavity turned towards said free end, said arched portion surrounding a perforated, flexible, central core and having a recess adapted to receive one of the spurs;

According to a second aspect, the invention concerns an inhaling system comprising a dry powder inhaler as defined above and a container comprising a reservoir provided with dry powder, said container further comprising a peripheral flange surrounding the reservoir, said container being adapted to be received on the support surface, and said support surface including at least one protruding positioning member adapted to engage with the container to ensure a precise positioning thereof.

In various embodiments of the inhaling system according to the invention, the inhaling system may comprise one or several of the following features:

- the slider comprises at least two positioning members protruding from the support surface and defining between them a reception space which is adapted to receive said reservoir of the container when said container is loaded on said support surface, the opener being arranged so as to pass between said positioning members as the suction tube and the slider are moved relative to one another;
- said positioning members are adapted to support the peripheral flange of the container on both sides of the reservoir when said container is loaded on said support surface;
  - the slider supports a retaining member which is movable between a supplying position enabling to load the container on said support surface and a locking position in which said retaining member presses on the peripheral flange of the container opposite to the positioning members when said container is loaded on said support surface, to retain the container onto the support surface;
  - the container comprises:
    - a rigid substrate,
    - a blister supported by said substrate, said blister including a lower foil and an upper foil adapted to be cut open, said reservoir being formed between said lower and upper foils, and the blister forming said peripheral flange around the reservoir,
  - wherein said reservoir is spaced apart from said substrate and wherein said substrate and said blister are adapted to be engaged by at least one positioning member for ensuring a precise positioning of the reservoir when said container is used in the inhaler;
    - said substrate extends substantially in a plane;
    - said substrate has at least one opening adapted to receive said positioning member of the inhaler;
    - said lower foil has a central recess partially defining said reservoir and a peripheral border in contact with the upper foil, said substrate having two openings on both sides of said recess, in correspondence with said peripheral border, adapted to receive said two positioning members of the inhaler for supporting said peripheral border;
    - the lower foil extends between two boundaries spaced apart along a first direction and said lower foil is secured to the substrate at said boundaries, and wherein the lower foil has an arched portion extending between said boundaries, said first direction being parallel to said path of movement;
    - the lower foil has an upper face having a convex shape along said first direction between said boundaries, at least outside said reservoir;
the lower foil presents substantially straight cross sections in a second direction perpendicular to the first direction, at least outside said reservoir;
- each positioning member has a convex shape adapted to accommodate the convexity of the lower foil;
- the recess has a bottom which is flat in cross sections parallel to the first direction, the plate presents an apex between said boundaries, the flat bottom being at a first distance from the apex of the plate, each positioning member presenting an apex, the opener protruding between the positioning member at a second distance from the apexes of the positioning member, said second distance being less than the first distance;
- the retaining member comprises a border surrounding an opening, said border presenting a rear surface having a concavity along the first direction to accommodate the convexity of the lower foil.

Other objects and advantages of the invention will emerge from the following description of one of its embodiments, made in reference to the enclosed drawings in which:
- Figure 1 is an exploded perspective view of a dry powder inhaler according to an embodiment of the invention,
- Figure 2 is an enlarged view illustrating a removable suction tube of the inhaler of Figure 1,
- Figure 3 is a perspective view of a container used in the inhaler of Figure 1,
- Figure 4 is an exploded view on the container of Figure 3,
- Figures 5 and 6 are plan views in longitudinal and transverse cross-sections, respectively, of the container of Figure 3,
- Figure 7 is a perspective side view of a slider of the inhaler of Figure 1, the reservoir of Figure 3 being positioned on a support member of the slider,
- Figure 8 is a perspective view of an assembly comprising a retaining member of the slider and the reservoir of Figure 3,
- Figure 9 is a perspective view of the assembly of Figure 8, in which the reservoir is positioned on the retaining member,
- Figure 10 is a perspective view of the assembly of Figure 8, pivotally mounted on the slider of Figure 7.

- Figures 11 and 12 are side views of an interfering device of the inhaler of Figure 1, said interfering device being illustrated in an interfering position and a remote position, respectively.

- Figure 13 is a perspective view of the inhaler of Figure 1 with an outer shell, in a storage position.

- Figure 14 is a plan view in longitudinal cross-section of the inhaler of Figure 13.

- Figure 15 is a view similar to that of Figure 13 illustrating a protective front cover partly removed.

- Figure 16a is a plan view in longitudinal cross-section of the inhaler of Figure 13 at a first step of use of the inhaler.

- Figure 16b is an enlarged lateral view of the interfering device at said first step.

- Figure 17a is a plan view in longitudinal cross-section of the inhaler of Figure 13 at a second step of use of the inhaler.

- Figures 17b and 17c are enlarged lateral views of the interfering device at said second step.

- Figure 18 is an enlarged lateral view of the interfering device in the interfering position.

- Figure 19a is a plan view in longitudinal cross-section of the inhaler of Figure 13 at a third step of use of the inhaler.

- Figure 19b is an enlarged lateral view of the interfering device at said third step.

- Figure 20 is a plan view in longitudinal cross-section of the inhaler of Figure 13 at a fourth step of use of the inhaler.

- Figure 21a is a plan view in longitudinal cross-section of the inhaler of Figure 13 at a fifth step of use of the inhaler.

- Figure 21b is an enlarged lateral view of the interfering device at said fifth step.

- Figure 22 is a plan view in longitudinal cross-section of the inhaler of Figure 13 with a reservoir retained on the slider, the protective front cover being moved toward the suction tube.
- Figure 23 is a plan view in longitudinal cross-section of the inhaler of Figure 13 with a reservoir retained on the slider, the protective front cover being placed on the suction tube.

On the figures, same references refer to same or analogous elements.

Figure 1 represents a dry powder inhaler 1 intended to be used with a container 2 shown in Figures 3 and 4, comprising:
- a rigid substrate 80, e.g. in the form of a plane plate,
- and a blister 60, 70 secured to the substrate, said blister forming a reservoir 3 provided with dry powder and a peripheral flange 4 surrounding said reservoir.

The dry powder inhaler 1 may be used to discharge a dose of medication, such as insulin or other, in fine dry powder form.

The dry powder inhaler 1 shown in Figure 1 comprises:
- a suction tube 5, for instance made out of plastic material, having an inlet end 6 and an outlet end 7 through which the user may inhale,
- a slider 8, for instance made out of plastic material, having a support surface 9 and adapted to receive the container 2 on said support surface 9, and
- an opener 10, e.g. a cutting blade.

In such inhaler 1, as it will appear from the following disclosure, discharge of the dry powder occurs upon inhalation by the user through the outlet end 7 of the suction tube 5 as the container 2 and the suction tube 5 are moved relative to one another along a path, the reservoir 3 facing the inlet end 6 of the suction tube 5 during at least part of this movement and being opened previously by opener 10 as the dry powder container 2 and the suction tube 5 are moved relative to one another.

In the particular example shown in the drawings, the suction tube 5 and said slider 8 are moveable relative to one another along said path, between a first position (see Figure 19a), in which the support surface 9 of the slider 8 and the inlet end 6 of the suction tube 5 are spaced apart, and a second position (see Figure 21a), in which the support surface 9 of the slider 8 substantially faces the inlet end 6 of the suction tube 5.
The opener 10 is fixed relative to the suction tube 5 and is placed in said path, upstream the inlet end 6 of the suction tube 5 with respect to the direction of travel of the slider, so that said opener 10 opens the reservoir 3 as the suction tube 5 and the slider 8 are moved relative to one another from the first to the second position.

The following disclosure is made with an inhaler 1 in which the slider 8 is moveable in translation along a path substantially parallel to a vertical direction V with respect to the suction tube 5 and the opener 10. It should be noted however that the invention is not limited to such embodiment. For example, in other embodiments, the suction tube 5 and the opener 10 could be moveable with respect to the slider 8 or both the suction tube 5 and the slider 8 could be moveable with respect to the opener 10. Besides, relative movements other than translation could be used, in directions other than vertical.

As shown in Figure 1, the inhaler may comprise a substantially cylindrical hollow frame 11, for instance made out of plastic material, of substantially rectangular cross-section for example, extending along a vertical axis A parallel to the vertical direction V. The frame 11 may be formed of two lateral half frames 11a, 11b assembled together along a longitudinal plane (LV) comprising the vertical direction V and a front direction L perpendicular to the vertical direction V.

A transverse direction T perpendicular to the vertical and front directions V, L, is also defined.

The frame 11 may thus comprise front and back walls parallel to a transverse plane (TV), spaced apart along the front direction L and linked with one another by two lateral walls parallel to the longitudinal plane (LV) and spaced apart along transverse direction T. The frame 11 may also comprise a bottom wall parallel to a horizontal plane (LT) and linking one end of the front back and lateral walls. The hollow frame 11 may comprise an upper open end 12, opposite the bottom wall, and a front opening 13 having an axis B parallel to the longitudinal direction L.

The above mentioned suction tube 5 and opener 10 may be secured for instance to the frame 11.
The suction tube 5 is substantially cylindrical along an axis B which is parallel to the front direction. As shown on Figure 2, the suction tube 5 may comprise a central hollow stem 14 defining a conduit, for example of substantially oval cross-section, between the inlet end 6 and the outlet end 7. The suction tube 5 may further comprise an annular mouthpiece 15 attached to the hollow stem 14 close to the outlet end 7.

The mouthpiece 15 may have an inner surface of substantially circular cross-section and an outer surface of substantially oval cross-section offset of an angle of 90° with respect to the oval cross-section of the conduit of the hollow stem 14.

In the figures, the inner surface of the mouthpiece 15 is formed by an external ring 16 surrounding the hollow stem 14 and made in one piece with the hollow stem. The outer surface of the mouthpiece 15 is formed with a sleeve 17 secured to an end of the external ring 16, at said outlet end 7 of the suction tube.

The suction tube 5 is mounted on the frame 11 so as to extend coaxially through the front opening 13, the inlet end 6 being placed within the frame 11 and the mouthpiece 15 standing outside the frame 11.

In the described embodiment, the suction tube 5 is secured to the frame 11 in a removable manner. In alternative embodiments, it may be permanently attached to the frame.

As can be seen on Figure 2, the frame 11 may comprise an annular wall 13a encircling the front opening 13. Said annular wall may be of substantially cylindrical form, centered on said axis B. The annular wall 13a is dimensioned to receive the external ring 16 and the hollow stem 14 coaxially to the axis B, and to be surrounded by the sleeve 17 of the mouthpiece 15.

The suction tube 5 may comprise two opposite spurs 20 protruding from an outer surface of the external ring 16. The annular wall 13a may be provided with two grooves 21, symmetrical with respect to the axis B of the front opening 13 and in which the spurs 20 may engage, respectively.

In the illustrated embodiment, each groove 21 may comprise:
- an axial portion 21a extending from a free end of the annular wall 13a parallel to axis B,
and an arched portion 21b presenting a concavity turned towards said free end.

Each arched portion 21b surrounds a perforated central core 21c and has a recess 21d. A protrusion 21e extends from the central core 21c in the arched portion 21b behind the recess 21d with regard to the axial portion 21a.

Since the displacements of the spurs 20 along the grooves 21 are symmetrical, the following disclosure is only made for one of the spurs 20. To secure the suction tube 5 to the annular wall 13a, one of the spur 20 is first engaged in the axial portion 21a and then in the arched portion 21b. The perforated central core 21c provides for elasticity to the arched portion 21b so that the arched portion 21b may deform when urged by the spur 20. Abutment surfaces 21f may be provided in the perforation of the central core 21c to limit the deformation. The spur 20 slides along the arched portion 21b until it engages the recess 21d, the protrusion 21e preventing the spur to slide further. As the spur 20 engages the recess 21d, the arched portion is urged toward a rest position where it locks the spur 20.

The spurs 20 and the grooves 21 are arranged such that the oval cross-section of the mouthpiece 15 when the spurs 20 are locked in the recesses 21d extends in the transverse direction T.

The above removable connection of the suction tube 5 is of special interest. In particular, this technical solution ensures a precise positioning of the suction tube and avoids accidental removal or displacement of the suction tube, for a reasonable cost.

As shown on Figure 1, the slider 8 may be engaged in the upper open end 12 of the frame 11 and is mounted on said frame 11 so as to be moveable between the first position, in which the slider 8 protrudes from the frame 11, and the second position, in which the slider 8 is placed within the frame 11.

The slider 8 may be substantially cylindrical, for example with a substantially rectangular cross-section, along an axis parallel to the vertical direction V. The slider 8 may thus comprise a front wall facing the front wall of the frame 11, a back wall facing the back wall of the frame 11 and two side walls facing the side walls of the frame 11, respectively. The slider 8 may further
comprise a top wall 22 at an upper end of the front, back and side walls. This top wall 22 may be concavely shaped to be used as a pusher by a user of the inhaler 1.

The support surface 9 formed on the front wall of the slider 8 bears at least one protruding positioning member 25, here two positioning members 25 defining a reception space 23 between them. As explained later, the positioning members 25 are adapted to protrude through the substrate 80 and engage at least part of the lower face of the peripheral flange 4 of the container 2, so as to precisely position and maintain the container 2 and more specifically the reservoir with respect to the support surface. Further, the reception space 23 is adapted to receive the reservoir 3 of the container 2. The positioning members 25 have sloping faces turned one to the other, which define together a V-shaped constraining structure for pressing the reservoir 3 and precisely center the latter in the D2 (lateral) direction.

As shown on Figures 1, 7, 10, the positioning members 25 of the slider may be in the form of two support walls 25 protruding from the support surface 9 to a free end 25a. The support walls 25 may be made in one piece with the support surface 9 and extend in a direction substantially parallel to the path, i.e. parallel to the plane L, V in the disclosed embodiment.

The free edge 25a of each support wall 25 may present a convexity adapted to accommodate a curvature of the blister 60, 70 of the container, as explained later, or to conform the blister in a convex shape.

The slider 8 further supports a retaining member 26, made out for instance out of plastic material, adapted to retain the container 2 onto the support surface 9. In particular, the retaining member may be adapted to be in contact with at least part of an upper surface of the peripheral flange 4 of the container 2 when said container 2 is retained onto the support walls 25.

As shown on Figures 1 and 10, the retaining member may comprise a flap 26 having a front surface, a rear surface and a lower end 27 pivotally mounted on the slider 8 so as to be moveable with respect to said support surface 9 between a supplying position, represented on Figure 10, and a locking position, represented on Figure 1.
In the supplying position, the flap 26 is spaced apart from the support surface 9 so as to be able to load a container 2 on the support surface 9. In the locking position, the flap 26 may face the support surface 9 and be fixed to the slider 8, for example by means of a free upper end 28 opposite the lower end 27 adapted to be snap-fitted on the slider 8. The upper end 28 may have resilient legs 28a perpendicular to the rear surface and provided each with a shoulder adapted to engage an opening 29 of the front wall of the slider 8.

The flap 26 may comprise an opening 30 and a border 31 surrounding the opening 31. The opening 30 and the border 31 being arranged with respect to the lower end 27 such that, in the locking position, the border 31 faces the support walls 25 and the opening 30 faces the reception space 23. The border 31 may present, on the rear surface, a concavity conformed to the convexity of the free edges 25a of the support walls 25.

The dry powder inhaler 1 may further comprise an interfering device adapted to prevent the slider 8 from moving in translation with regard to the suction tube 5 until the flap 26 is in the locking position, or more generally if a dry powder container 2 is improperly positioned on said support surface 9.

On figures 11 and 12, the interfering device comprises an abutment element 35 pivotally mounted on the slider 8, around an axis of rotation which is perpendicular to the direction of movement of the slider 8, said abutment element 35 being linked to the flap 26. The abutment element 35 may be resiliently urged toward an interfering position, represented on Figure 11, and be moveable to a remote position, represented on Figure 12, when the flap 26 is in the locking position.

In particular, the abutment element 35 may comprise a transverse cylindrical pivot pivotally mounted in a transverse cylindrical housing 36 of the slider 8 (see Figure 7), an abutment arm 37 extending downwardly from the cylindrical bar and a control arm 38 extending upwardly from the cylindrical bar. Said abutment arm 37 and control arm 38 are angled with respect to each other and installed in a lateral groove 35a provided in the lateral wall of the slider 8 (see Figure 1).
As shown in Figures 11, 12, to link the abutment element 35 to the flap 26, the inhaler 1 may comprise a sliding piece 40 slidingly mounted on the slider, beneath the top wall 22, along the front direction L. The sliding piece 40 presents a lower surface provided with a recess 41 in which a free end of the control arm 38 is engaged.

As illustrated on Figure 11, when the flap 26 is spaced apart the support surface 9, for example to load a container 2 on the slider 8 or because the container 2 is in a wrong position, the sliding piece 40 is urged forward, for example by means of a spring (not shown), in a position where it protrudes from the support surface 9 of the slider 8. The sliding piece 40 thus moves the control arm 38 forward toward the support surface 9 and the abutment arm 37 backward away from the support surface 9, so that the free end of the abutment arm 37 may be arranged over a part 11c of the frame 11. In this position, when the user tries to actuate the slider 8, the abutment arm 37 comes in contact with the frame 11 and prevents the translation of the slider 8.

As illustrated in figure 12, when the flap 26 is returned to the locking position, the rear surface of the flap 26 pushes backward the sliding piece 40, thus pivoting, by means of the control arm 38, the abutment arm 37 forward, remote from any part of the frame. As the flap 26 is snap fitted to the slider 8, the abutment arm 37 is maintained in the remote position, and the slider 8 may be moved with regard to the frame 11 and thus to the suction tube 5.

In order to maintain the slider 8 in the second, where said slider 8 is hidden within the frame 11, the slider 8 may comprise at least one stopping surface and the frame 11 may comprise at least one abutment surface. The stopping surface and the abutment surface are moveable relative to one another between a stopping position, in which the stopping surface and the abutment surface are in abutment, when the slider 8 is in the second position, and a release position, in which the stopping surface and the abutment surface are spaced apart.

For example, the slider 8 may comprise a back plate 56 provided with rear stopping surfaces 52 facing upwardly (see Figure 7 and 10, the plate 56 being omitted on the other Figures). The back plate 56 may be pivotally mounted
around pivots 53 on the back wall of the slider 8 and be resiliency urged in the direction of arrow 54 toward the stopping position, where the rear stopping surfaces 52 are in abutment below rear abutment flanges 55 of the frame 11 (see Figure 1). The back plate 56 may be moveable in the release position in a direction opposite to direction 54, in particular by means of a push button 46 slidingly mounted in an opening 47 of the back wall of the frame 11.

The slider 8 may be resiliency urged toward the first position, by means of a compression spring 43.

The inhaler 1 comprises a guiding device adapted to guide the slider 8 in translation along axis A between the first and second positions.

The guiding device may comprise a central rod extending in the vertical direction from the bottom wall of the frame 11 and lateral walls of the frame 11. The slider 8 may have a central bore fitted on the central rod, and the lateral walls of the slider 8 may be moved close to the lateral walls of the frame 11.

The guiding device may further comprise a braking system or damper adapted to slow down the translation of the slider 8. In Figure 1, the braking system comprises a gear wheel 50 pivotally mounted on the slider 8, beneath the flap 26 and adapted to mesh with a vertical rack 51. Said gear wheel 50 may be turning with flaps enclosed in a receptacle full of viscous liquid, to brake the movement of the wheel and thus of the slider 8.

The opener 10 may be secured to the frame 11 close to the inlet end 6 of the suction tube 5. As explained before, the opener 10 may comprise a blade adapted to form a slit on reservoir 3 and a support to which the blade is secured. The blade is shaped to lift and separate the two cut foil flaps and to create a symmetrical opening for the tube to subsequently suck out the powder. The blade is designed to cut the blister in an even manner, then pealing back the cut foil pieces such that the tube can pass over the powder which is then extracted by patient inspiration.

The opener 10 is arranged so as to pass between the support walls 25 and in the opening 30 of the flap 26 as the slider 8 is moved in translation relative to the suction tube 5.
On Figure 13, the inhaler 1 may comprise an outer shell 42 formed of two half-shells enclosing the frame 11 and attached thereto. The outer shell 42 comprises an upper opening through which the slider 8 may extend in the first position. The outer shell 42 is so dimensioned that in the second position of the slider 8, the top wall 22 flushes with the surface of the outer shell 42.

Besides the outer shell 42 may comprise a protective front cover 44 adapted to be placed in a removable manner on the mouthpiece 15 of the suction tube 5. The protective front cover 44 may have a front abutment surface 44a in abutment against a front stopping surface 44b of the slider 8, when the cover 42 is placed on the mouthpiece 15 and the slider 8 is in the second position.

As shown in Figures 3 to 6, the blister 60, 70 the dry powder container 2 comprises two superposed foils which are secured together at said peripheral flange 4, i.e. a lower, conformed foil 60 and an upper foil 70 adapted to be cut open.

Both foils 60, 70 may consist in laminates each comprising for instance at least one metallic layer, such as an aluminum layer, and at least one layer of polymeric material. Such polymeric material may be for instance PVC and / or PA for the lower foil and for instance Polyester for the upper foil.

The lower foil 60 presents an upper face 60a and extends between two boundaries 60b spaced apart along a first direction D1.

The upper face 60a of the lower foil 60 presents a convexity along the first direction D1 between said boundaries 60b. In particular, as illustrated on the Figures 3 and 4, the lower foil 60 may be arched between said boundaries 60b, the upper face 60a of the lower foil being convexly curved along the first direction D1 between said boundaries 60b, outside the reservoir 3. The upper face 60a of the lower foil 60 may have a substantially constant radius of curvature in the arched portion.

Besides, the upper face 60a of the lower foil 60 may present substantially straight cross sections in a second direction D2 perpendicular to the first direction D1, outside said reservoir 3. A third direction D3 is defined perpendicular to the first D1 and second D2 directions.

The lower foil 60 comprises, in said arched portion:
- a recess 61 which forms an opening 62 into said upper face 60a, and a peripheral border 63 surrounding the opening 62.

The recess 61 may be centered between said boundaries 60b and may present a flat bottom, parallel to the first direction D1.

The lower foil 60 may have two opposite tongues 64 extending along the first direction D1, each tongue 64 being linked to the arched portion by a fold line 60b parallel to the second direction D2 and forming one of said boundaries.

The upper foil 70 is conformed to the convexity of the upper face 60a of the lower foil 60. The upper foil 70 has a central part which covers the recess 61, and a peripheral part sealed to the peripheral border 63.

The recess 61 of the lower foil 60 and the central part of the upper foil 70 form the reservoir 3, and the peripheral border 63 of the lower foil 60 and the peripheral part of the upper foil 70 form the peripheral flange 4.

Provision of the recess 61 and of the peripheral border 63 portion presenting a convexity along a determined direction is particularly suitable for an inhaler of the above disclosed type, where the opener 10 should open the reservoir 3 as the container 2 is moved in translation along said determined translation. Furthermore, the arched portion of the blister provides for a regular upper face 60a without angled portion in the peripheral border so that the container presents an efficient barrier to moisture.

The arch shape also enables the blade to cut the foil in an optimum way so that it does not ride over the surface of the lid foil.

Besides, as shown in Figure 4, the substrate 80 may be for example a plastic plate made out of a polymer such as PVC. The substrate 80 may extend substantially in a plane and have a substantially rectangular shape. The substrate 80 presents a width between two opposite large sides 80a and a length between two opposite small sides 80b. The length of the substrate 80 may extend along the first direction D1.

The lower foil 60 may be secured to the substrate 80 at the boundaries 60a of the arched portion. In Figure 3, the lower foil 60 has a width and a length substantially the same as that of the substrate 80. The tongues 64 of the lower foil 60 may then be glued, thermo sealed or fixed in any other appropriate manner
to the substrate 80. In other embodiments, the lower foil 60 may have a length smaller than that of the substrate 80, the upper foil 70 having end portions 71 sealed to the tongues 64 and to the substrate 80.

In the arched portion of the lower foil 60, between fold lines 60b, the lower foil 60 is spaced apart from the substrate 80 in the third direction D3. The lower foil 60 may thus present an apex P between the fold lines 60b, said apex comprising at least one point located at the maximum distance from the substrate 80. In the embodiment, the apex P comprises a line centered with regard to the recess 61.

The substrate 80 may comprise two elongated openings 81 extending along the first direction D1, said openings being arranged in regard to the lower face of the lower foil 60, on both sides of the recess 61. In other embodiments, the substrate 80 may have one or several opening 81 of any convenient shape to allow the passage of the positioning member(s) of the slider 8.

The dimensions of the container are chosen to impart specific performance in terms of deaggregation of the dry powder and of amount of released dry powder. In particular, the fine particle fraction of the dry powder should be over 65%, with a drop of less than 15% when passing from an ambient atmosphere to a humid atmosphere. The emitted dose of dry powder should be over 85%, with a drop of less than 15% when passing from an ambient atmosphere to a humid atmosphere.

As an illustrative example, a suitable container 2 may have the following dimensions:
- the length of the substrate 80 may be between 25 and 30 mm,
- the width of the substrate 80 may be between 13 and 15 mm,
- a maximum height of the container 2, measured in the third direction D3 from the lower face of the substrate 80 to the upper face of the upper foil 70, is between 4 and 6 mm,
- the radius of curvature of the arched portion of the lower foil 60 is between 8 and 9 mm,
- a length of the recess 61 measured along the first direction D1 is between 9 and 10 mm,
- a width of the recess 61 measured along the second direction D2 is between 4 and 6 mm,
- a maximum depth of the reservoir 3, measured along the third direction D3 between the flat bottom to the apex P, between 2 and 3 mm.

As shown on Figure 7, the container 2 may be installed directly on the support surface 9 of the slider 8, the openings 81 engaging the support walls 25 so that the free edges 25a of the support walls are in contact with a part of a rear side of the peripheral border 63 of the lower foil 60. The support walls 25 are arranged on each side of the recess 61, the reception space 23 receiving the recess 61, and may provide a convenient support and positioning of the lower foil 60 and the recess 61 on the support surface 9. Further, the openings 81 of the substrate 80 provide for a further positioning means of the container 2 with regard to the slider 8.

In such a position, the first direction D1 of the container 2 corresponds to the vertical direction V, the second direction D2 of the container 2 corresponds to the transverse direction T and the third direction D3 of the container 2 corresponds to the longitudinal direction L.

The free edges 25a of the support walls may be convexly curved along the vertical direction V to accommodate the curvature of the arched extent. In order to ensure a safe functioning of the inhaler 1, the flat bottom of the recess 61 is placed at a first distance d1 from the apex P of the lower foil 60. Each support wall 25 present an apex Q, comprising at least one point located at a maximum distance from the support surface 9. The opener 10 is placed at a second distance d2, shown on Figure 14 from the apexes Q of the support walls 25 and said second distance d2 is less than the first distance d1.

The flap 26 may then be placed in the locking position, the rear surface of the border 31 being in contact with at least one part of a front side of the peripheral part of the upper foil 70, with the opening 30 facing the central part of said upper foil 70. The rear surface of the border 31 may then be concavely curved along the vertical direction V, in the locking position, to accommodate the curvature of the arched extent. The V-shaped structure formed by the sloping faces of the positioning members 25 engages the lateral curved walls of the
reservoir 3, thus precisely centering the reservoir between the members 25. Thus
the blister is constrained in three dimensions.

Another way to install the container 2 on the support surface 9 is shown on
Figures 8 to 10. The front side of the peripheral part of the upper foil 70 may be
placed against the rear surface of the border 31 of the flap 26 in the supplying
position. The flap 26 is moved toward the locking position where the openings 81
of the substrate 80 engages the support walls 25 until the free edges 25a of the
support walls 25 are in contact with the rear side of the peripheral border 63 of
the lower foil 60, on both sides of the recess 61.

In relation with Figures 14 to 23, the use of the inhaler is now disclosed.

On Figure 14, the dry powder inhaler 1 is in an unused state where the
protective front cover 44 is placed on the mouthpiece 15, the slider 8 is in the
second position within the frame 11. The slider 8 is maintained in said second
position by the front 44a and rear abutment surfaces of the frame 11 on which the
front 44b and rear stopping surfaces of the slider 8 abuts.

On Figure 15, the protective front cover 44 is pivoted, the front abutment
surface 44a being placed in the release position.

As the user pushes the push button 46, the back plate is moved to the
release position. The slider 8 under the effect of the spring 43 is urged to the first
position.

On Figure 16a, the flap 26 is placed in the supplying position so as to allow
a dry powder container 2 provided with dry powder within the reservoir 3 to be
installed on the support surface 9. As shown on Figure 16b, the sliding piece 40
is urged forward so as to protrude from the support surface 9 and to move the
abutment arm 37 in the interfering position.

On Figure 17a, the dry powder container 2 is positioned on the flap 26 as
disclosed earlier, the sliding piece 40 protruding from the support surface 9 and
the abutment arm 37 remaining in the interfering position (Figures 17b, 17c).

As the user pivots the flap 26 toward the support surface 9, the upper end
of the flap 26 comes in contact with the sliding piece 40 so as to move said
sliding piece backward and to place the abutment arm 37 in the remote position.
As long as the flap 26 is not in the locking position, with the legs 28a snap fitting
the openings 29 of the slider 8 (for example if the container 2 is in a wrong position with regard to the support surface 9), the abutment arm 37 urged by the sliding piece 40 remain in the interfering position (Figure 18).

On Figures 19a and 19b, the flap 26 is in the locking position and the abutment arm 37 is in the remote position. The user places the mouthpiece 15 in his mouth and inhale while exerting a force F on the top surface 22 of the slider 8 to move said slider 8 from the first position to the second position. The speed of the slider 8 and the time to depress the slider are controlled by the damper including the toothed wheel 50.

On figure 20, the opener 10 suitably placed in the path of the reservoir 3 as explained above slits the upper foil 70 of the container 2 and space apart lips formed on both sides of the slit thus obtained so as to open the reservoir 3.

On Figure 21a, the reservoir 3 faces the inlet end 6 of the suction tube 5. This corresponds to the final position of the slider where all the powder has been removed from the blister and all relative travel has ceased. At his stage, the user has inhaled the desired amount of fragmented dry powder. The abutment device 35 in the remote position follows the movement of the slider 8 with regard to the frame 11 (Figure 21b).

On Figures 22 and 23, the slider 8 is maintained in the second position by the rear stopping surface of the back plate in abutment against the abutment surface of the frame 11. The protective front cover 44 may placed on the mouthpiece 15.
claims

1. Dry powder inhaler intended to be used with a container (2) comprising a reservoir (3) provided with dry powder, said dry powder inhaler (1) comprising:
   - a suction tube (5),
   - a slider (8) having a support surface (9) adapted to receive the container (2), said suction tube (5) and said slider (8) being moveable relative to one another along a path from a first to a second position, the support surface (9) of the slider (8) facing the suction tube (5) in at least part of said path,
   - an opener (10) adapted to open the reservoir (3) as the suction tube (5) and the slider (8) are moved relative to one another along said path, so as to allow discharge of the dry powder upon inhalation by a user through the suction tube (5),
   characterized in that said dry powder inhaler further includes an interfering device (35, 40) adapted to prevent the suction tube (5) and the slider (8) from moving relative to one another from the first to the second position if a dry powder container (2) is improperly positioned on said support surface (9).

2. Dry powder inhaler according to claim 1, wherein the slider (8) supports a retaining member (26) which is movable between a supplying position enabling to load the container (2) on said support surface (9) and a locking position in which said retaining member is adapted to retain the container (2) onto the support surface (9), and said interfering device (35, 40) is adapted to prevent the suction tube (5) and the slider (8) from moving relative to one another from the first to the second position unless the retaining member (26) is in the locking position.

3. Dry powder inhaler according to claim 1 or claim 2, wherein the interfering device (35, 40) comprises an abutment element (35) movably mounted on the slider (8), said abutment element (35) being resiliently biased toward an interfering position wherein said abutment element (35) is adapted to interfere with a portion (11c) of the inhaler which is fixed relative to the suction tube (5) so
as prevents the suction tube (5) and the slider (8) from moving relative to one another from the first to the second position, and said abutment element (35) being adapted to be moved by a part (26) placed on said support surface (9), to a remote position wherein said abutment element enables the suction tube (5) and the slider (8) to move relative to one another from the first to the second position.

4. Dry powder inhaler according to claim 3, wherein the slider (8) supports a retaining member (26) which is movable between a supplying position enabling to load the container (2) on said support surface (9) and a locking position in which said retaining member is adapted to retain the container (2) onto the support surface (9), and said abutment element (35) being adapted to be moved by said retaining member (26) to said remote position when said retaining member is in said locking position.

5. Dry powder inhaler according to claim 3 or claim 4, wherein said abutment element (35) is pivotally mounted on said slider (8) and has a control arm (38) linked to a sliding piece (40) which is slidingly mounted on said slider (8) and is adapted to interfere with said part (26) placed on the support surface (9) to move the abutment element (35) to the remote position.

6. Dry powder inhaler according to any preceding claims, wherein the slider (8) comprises at least one positioning member (25) protruding on said support surface (9) and adapted to engage with the container (2) to ensure a precise positioning thereof.

7. Dry powder inhaler according to claim 6, wherein the slider comprises at least two positioning members (25) protruding from the support surface (9) and defining between them a reception space (23) which is adapted to receive said reservoir (3) of the container (2) when said container is loaded on said support surface (9), the opener (10) being arranged so as to pass between said positioning members (25) as the suction tube (5) and the slider (8) are moved relative to one another.

8. Dry powder inhaler according to claim 7, wherein said positioning members are two support walls (25) extending in a direction substantially parallel to the path.
9. Dry powder inhaler according to any of claims 6 to 8, wherein the positioning member (25) is made in one piece with the support surface (9).

10. Dry powder inhaler according to any preceding claims, wherein the slider (8) supports a retaining member (26) which is movable between a supplying position enabling to load the container (2) on said support surface (9) and a locking position in which said retaining member is adapted to retain the container (2) onto the support surface (9).

11. Dry powder inhaler according to claim 10, wherein the retaining member comprises a flap (26) which is pivotally mounted on the slider (8).

12. Dry powder inhaler according to claim 11, wherein the flap (26) comprises a free end (28) adapted to be snap-fitted to the slider (8) in the locking position.

13. Dry powder inhaler according to any preceding claims, further comprising a substantially cylindrical hollow frame (11) extending along a central axis (A) and comprising an open end (12) and a lateral opening (13), the suction tube (5) communicating with the hollow frame (11) through the lateral opening (13), the opener (10) being secured to the frame (11) close to the suction tube (5), the slider (8) being engaged in the open end (12) and being slidingly mounted in said hollow frame along the central axis (A) between said first position, in which the slider (8) protrudes from the frame (11), and said second position, in which the slider (8) is placed within the frame (11).

14. Dry powder inhaler according to any preceding claims, further comprising a hollow frame (11) in which the slider (8) slides, wherein the suction tube (5) is secured to the frame (11) in a removable manner.

15. Dry powder inhaler according to claim 14, wherein:

- the frame (11) comprises an annular wall (13a) cooperating by fitting engagement with the suction tube (5),
- a first element, chosen between said suction tube (5) and said annular wall (13a), comprises two protruding opposite spurs (20),
- and a second element, chosen between said suction tube (5) and said annular wall (13a), has two grooves (21) in which the spurs (20) may
engage, respectively, said grooves (21) being symmetrically disposed on two opposite sides of said annular wall.

16. Dry powder inhaler according to claim 15, wherein each groove (21) comprises an axial portion (21a) extending up to an arched portion (21b) presenting a concavity turned towards said free end, said arched portion surrounding a perforated, flexible, central core (21c) and having a recess (21d) adapted to receive one of the spurs (20).

17. Dry powder inhaler according to any of the preceding claims, wherein the slider (8) comprises at least one stopping surface (44b, 52) and the frame comprises at least one abutment surface (44a, 55), the stopping surface (44b, 52) and the abutment surface (44a, 55) being moveable relative to one another between a stopping position, in which the stopping surface (44b, 52) and the abutment surface (44a, 55) are in abutment, when the slider (8) is in the second position, and a release position, in which the stopping surface (44b, 52) and the abutment surface (44a, 50) are spaced apart.

18. Dry powder inhaler according to claim 17, wherein the slider (8) comprises a plate (56) provided with said stopping surface (52), said plate being resiliently urged toward the stopping position in abutment against said abutment surface (50) belonging to the frame, the plate (51) being moveable in the release position and actutable by a pushbutton (46).

19. Dry powder inhaler according to any of claims 17 and 18, wherein the frame (11) comprises a protective front cover (44) adapted to be placed in a removable manner on the suction tube (5), said protective front cover (44) having said abutment surface (44a) in abutment against said stopping surface (44b) belonging to the slider (8), when the cover (44) is placed on the suction tube (5).

20. Dry powder inhaler according to any of the preceding claims, wherein the inhaler comprises a braking system (50, 51) adapted to slow down the movement of the slider (8).

21. Inhaling system comprising a dry powder inhaler (1) according to any of the preceding claims and a container (2) comprising a reservoir (3) provided with dry powder, said container further comprising a peripheral flange (4) surrounding the reservoir (3), said container being adapted to be received on the
support surface (9), and said support surface (9) including at least one protruding
positioning member (25) adapted to engage with the container (2) to ensure a
precise positioning thereof.

22. Inhaling system according to claim 21, wherein the slider comprises
at least two positioning members (25) protruding from the support surface (9) and
defining between them a reception space (23) which is adapted to receive said
reservoir (3) of the container (2) when said container is loaded on said support
surface (9), the opener (10) being arranged so as to pass between said
positioning members (25) as the suction tube (5) and the slider (8) are moved
relative to one another.

23. Inhaling system according to claim 22, wherein said positioning
members (25) are adapted to support the peripheral flange (4) of the container (2)
on both sides of the reservoir (3) when said container is loaded on said support
surface (9).

24. Inhaling system according to claim 23, wherein the slider (8)
supports a retaining member (26) which is movable between a supplying position
enabling to load the container (2) on said support surface (9) and a locking
position in which said retaining member presses on the peripheral flange (4) of
the container (2) opposite to the positioning members (25) when said container is
loaded on said support surface (9), to retain the container (2) onto the support
surface (9).

25. Inhaling system according to any of claims 21-24, wherein the
container (2) comprises:
   - a rigid substrate (80),
   - a blister (60, 70) supported by said substrate, said blister including a
     lower foil (60) and an upper foil (70) adapted to be cut open, said reservoir (3)
     being formed between said lower and upper foils (60, 70), and the blister forming
     said peripheral flange (4) around the reservoir (3),
     wherein said reservoir (3) is spaced apart from said substrate (80) and
     wherein said substrate and said blister (60, 70) are adapted to be engaged by at
     least one positioning member (25) for ensuring a precise positioning of the
     reservoir when said container is used in the inhaler.
26. Inhaling system according to claim 25, wherein said substrate (80) extends substantially in a plane.

27. Inhaling system according to claim 25 or claim 26, wherein said substrate (80) has at least one opening (81) adapted to receive said positioning member (25) of the inhaler (1).

28. Inhaling system according to claim 23 in combination with any of claims 25-27, wherein said lower foil has a central recess (61) partially defining said reservoir (3) and a peripheral border (63) in contact with the upper foil (70), said substrate (80) having two openings (81) on both sides of said recess, in correspondence with said peripheral border (63), adapted to receive said two positioning members (25) of the inhaler (1) for supporting said peripheral border (63).

29. Inhaling system according to any of claims 25-28, wherein the lower foil (60) extends between two boundaries (60b) spaced apart along a first direction (D1) and said lower foil (60) is secured to the substrate (80) at said boundaries (60b), and wherein the lower foil (60) has an arched portion extending between said boundaries (60b), said first direction being parallel to said path of movement.

30. Inhaling system according to claim 29, wherein the lower foil (60) has an upper face (60a) having a convex shape along said first direction (D1) between said boundaries (60b), at least outside said reservoir (3).

31. Inhaling system according to claim 30, wherein the lower foil (60) presents substantially straight cross sections in a second direction (D2) perpendicular to the first direction (D1), at least outside said reservoir (3).

32. Inhaling system according to claim 23 in combination with any of claims 30 and 31, wherein each positioning member (25) has a convex shape adapted to accommodate the convexity of the lower foil (60).

33. Inhaling system according to 32 in combination with claim 28, wherein the recess (61) has a bottom which is flat in cross sections parallel to the first direction (D1), the plate (60) presents an apex (P) between said boundaries (60b), the flat bottom being at a first distance (d1) from the apex (P) of the plate (60), each positioning member (25) presenting an apex (Q), the opener (10)
protruding between the positioning member (25) at a second distance (d2) from
the apexes (Q) of the positioning member (25), said second distance (d2) being
less than the first distance (d1).

34. Inhaling system according to any of claims 30-33 in combination with
claim 24, wherein the retaining member (26) comprises a border (31) surrounding
an opening (30), said border (31) presenting a rear surface having a concavity
along the first direction (D1) to accommodate the convexity of the lower foil (60).
A. CLASSIFICATION OF SUBJECT MATTER
INy. A61M15/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>EP 1 685 866 A (NEKTAR THERAPEUTICS [US]) 2 August 2006 (2006-08-02) column 1, line 48 - column 3, line 1 column 7, lines 42-50 column 12, line 32 - column 23, line 53 column 18, lines 18-50 figures</td>
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<tr>
<td>A</td>
<td>WO 02/24266 A (MICRODRUG AG [CH]; MYRMAN MATTIAS [SE]; GRAESSL HERBERT [DE]) 28 March 2002 (2002-03-28) cited in the application the whole document</td>
<td>1-34</td>
</tr>
<tr>
<td>A</td>
<td>WO 02/24268 A (MICRODRUG AG [CH]; NILSSON THOMAS [SE]; MYRMAN MATTIAS [SE]) 28 March 2002 (2002-03-28) the whole document</td>
<td>1-34</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search
5 November 2008

Date of mailing of the international search report
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Name and mailing address of the ISA/
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Authorized officer
Azaïzia, Mourad
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<td>US 6651341 Bl</td>
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<td>28-03-2002</td>
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<td>AU 2001290432 B2</td>
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