

Trapped powder and a hindered airflow are the focus of WO2014/006135 from Glaxo Group Limited. It discloses a dry powder inhaler for receiving a single blister onto a blister seat. The inhaler housing is made up of a base and a lid which are pivotable relative to one another between open and closed positions, the lid supporting a punch and the base containing the aforementioned blister seat. The punch comprises an upstream blade and a downstream blade, each blade having a curved free cutting edge.

In use, the housing lid is moved from the open position, in which a blister may be placed on the blister seat, to the closed position, in which it abuts the housing base. In doing so, two apertures are created in the lid material. Once the initial piercing of the lid has taken place, and this occurs sequentially, flaps are formed in the lid material as the user continues to close the lid against the housing base. A final movement of the lid relative to the housing base causes the piercing blades to further enlarge the apertures formed in the lid.

In this prior art inhaler, the foil flaps are unusually considered advantageous as, together with an annular overhang about the blister bowl created during the opening process, they create a torturous flow path for the powder-laden airflow to follow as it exits the blister bowl. This torturous flow path is desirable because it assists with powder deagglomeration before inhalation.

In contrast to WO2014/006135, embodiments of the present invention seek to provide a blister opening device adapted for multi dose inhalers, one that ensures a smooth flow of air through an opened blister whilst it is still part of a blister strip. Some embodiments may avoid potentially expensive powder becoming trapped behind foil flaps created in the blister lid, which traditionally occurs when a blister lid is opened by piercing.

It is an object of the present invention to substantially overcome, or at least ameliorate, one or more of the above disadvantages.

According to the invention, there is provided a dry powder inhaler comprising a housing defining a chamber, a blister strip having a plurality of blisters each containing a dose of medicament for inhalation by a user, each blister comprising a blister lid attached to a blister bowl, the blister strip being inside the chamber, an actuator, an indexing system to sequentially move each blister into a blister opening position in response to movement of the actuator, a mouthpiece through which a dose of medicament is inhaled by a user, and a blister opening

device, the blister opening device comprising a blister support element for supporting one of said blisters, and a blister folding element co-operable with the blister support element, the blister folding element and the blister support element being movable relative to each other between a first position, permitting movement of said blister into or onto the blister support element, and a second, burst, position in which the blister folding element has co-operated with the blister support element, movement from the first position to the second position causing two spaced apart portions of said blister to each fold relative to the remainder of the blister along a respective fold line and against the blister support element to produce two spaced apart openings, each opening extending along the circumference of the blister bowl, beginning and terminating at points located on the fold line such that, when a user inhales through the mouthpiece, an airflow through the blister via the two openings is generated to entrain the dose contained therein and carry it out of the blister and via the mouthpiece into the user's airway.

The key advantage of preferred embodiments of this invention is that when the blister is burst open, two unobstructed openings are created. This facilitates a rapid and unhindered exit of powder from the blister, which improves the emitted dose of the inhaler. This mode of opening blisters is particularly useful for spray dried formulations and biologics, which currently represent the cutting edge of pharmaceutical research. Such powders can be expensive and a minimal retention of powder within the blister bowl after opening is highly desirable.

Preferably, the blister folding element and the blister support element are slidable relative to each other.

Preferably, the indexing system comprises a blister strip drive member rotatably mounted in the chamber.

Preferably, the blister strip drive member incorporates the blister support element.

The blister folding element may comprises two pairs of spaced apart fold members configured to slide adjacent to the blister strip drive wheel.

Preferably, the blister strip drive member comprises an indexing wheel, the indexing wheel comprising a plurality of blister seats to support a blister bowl, said plurality of seats being equi-angularly spaced apart about an axis of rotation of the blister strip drive member.

Preferably, each blister seat comprises a central portion which has a truncated geometric shape, each fold line being one edge of truncation.

CLAIMS

1. A dry powder inhaler comprising a housing defining a chamber, a blister strip having a plurality of blisters each containing a dose of medicament for inhalation by a user, each blister comprising a blister lid attached to a blister bowl, the blister strip being inside the chamber, an actuator, an indexing system to sequentially move each blister into a blister opening position in response to movement of the actuator, a mouthpiece through which a dose of medicament is inhaled by a user, and a blister opening device, the blister opening device comprising a blister support element for supporting one of said blisters, and a blister folding element co-operable with the blister support element, the blister folding element and the blister support element being movable relative to each other between a first position, permitting movement of said blister into or onto the blister support element, and a second, burst, position in which the blister folding element has co-operated with the blister support element, movement from the first position to the second position causing two spaced apart portions of said blister to each fold relative to the remainder of the blister along a respective fold line and against the blister support element to produce two spaced apart openings, each opening extending along the circumference of the blister bowl, beginning and terminating at points located on the fold line such that, when a user inhales through the mouthpiece, an airflow through the blister via the two openings is generated to entrain the dose contained therein and carry it out of the blister and via the mouthpiece into the user's airway.
2. A dry powder inhaler as claimed in claim 1, in which the blister folding element and the blister support element are slidable relative to each other.
3. A dry powder inhaler as claimed in claim 1 or 2, in which the indexing system comprises a blister strip drive member rotatably mounted in the chamber.
4. A dry powder inhaler as claimed in claim 3, in which the blister strip drive member incorporates the blister support element.
5. A dry powder inhaler as claimed in claim 4 when dependent on claim 2, the blister folding element comprising two pairs of spaced apart fold members configured to slide adjacent to the blister strip drive member.

6. A dry powder inhaler as claimed in claim 4 or 5, in which the blister strip drive member comprises an indexing wheel, the indexing wheel comprising a plurality of blister seats to support a blister bowl, said plurality of seats being equi-angularly spaced apart about an axis of rotation of the blister strip drive member.
7. A dry powder inhaler as claimed in claim 6, in which each blister seat comprises a central portion which has a truncated geometric shape, each fold line being one edge of truncation.
8. A dry powder inhaler as claimed in claim 6 or 7, in which a longitudinal extent of each blister seat is arranged perpendicularly to the direction of travel of the blister strip during indexing.
9. A dry powder inhaler as claimed in any one of claims 5 to 8, in which each blister seat incorporates a raised feature to cause an indentation at the base of the blister bowl for internally pressurising the blister.
10. A dry powder inhaler as claimed in any one of the preceding claims, in which the actuator is an actuating lever pivotally mounted to the housing.
11. A dry powder inhaler as claimed in claim 10, in which the actuating lever is operable to cause blister indexing during a first portion of its stroke, and to cause blister folding during a second and subsequent portion of its stroke.
12. A dry powder inhaler as claimed in any one of the preceding claims, in which the actuator is a cap pivotally mounted to the housing.
13. A dry powder inhaler as claimed in any one of the preceding claims, further comprising a deagglomeration chamber for deagglomerating powder from the opened blister.
14. A dry powder inhaler as claimed in any one of the preceding claims, further comprising an unfolding member to return folded portions of the opened blister back to their original unfolded conditions.

15. A dry powder inhaler as claimed in any one of the preceding claims, in which the blister strip incorporates two longitudinal edges, each edge comprising a series of spaced apart fold ears which extend laterally outwardly.