The disclosures of WO2005/037353 A1, WO09/007352 A1 and WO2009/092652 A1 are all incorporated herein by reference.

The present invention seeks to provide another inhalation device of the type disclosed in the above-mentioned applications, and which also has a relatively simple construction, is robust, straightforward to manufacture and easy for the patient to use.

According to one aspect, there is provided an inhaler comprising a housing defining a chamber to receive a strip having a plurality of blisters each containing a dose of medicament for inhalation by a user, an actuating lever, and a blister strip drive wheel rotatably mounted in the chamber to sequentially move each blister into a blister opening position, wherein the blister strip drive wheel and the actuating lever comprise a drive gear and a drive gear element, respectively, that cooperate to effect rotation of the blister strip drive wheel in response to rotation of the actuating lever, characterised in that said drive gear and drive gear element being disposed on the outside of the housing remote from the chamber.

~~According to the invention~~In one embodiment, there is provided an inhaler comprising a housing defining a chamber to receive a strip having a plurality of blisters each containing a dose of medicament for inhalation by a user, an actuating lever, and a blister strip drive member rotatably mounted in the chamber to sequentially move each blister into a blister opening position, wherein the blister strip drive member and the actuating lever comprise a drive gear and a drive gear element, respectively, that cooperate to effect rotation of the blister strip drive member in response to rotation of the actuating lever, said drive gear and drive gear element being disposed on the outside of the housing remote from the chamber. This has the advantage that the drive gear and drive gear element are isolated from any residual powder that may be deposited within the chamber.

The inhaler may comprise a mouthpiece through which a dose of medicament

can be inhaled and a cap pivotally mounted on the housing to cover the mouthpiece. The drive gear and drive gear element are preferably disposed between the housing and the cap so as to be enclosed by said cap. As the cap covers the drive gear and drive gear element, they are protected from ingress of dirt and are concealed from view and cannot be contacted by a person holding the device.

In a preferred embodiment, the housing has opposing side wall surfaces and the cap has portions that extend across respective side wall surfaces, said drive gear and drive gear element being disposed between one of said side wall surfaces and one of said cap portions.

Claims

1. An inhaler comprising a housing defining a chamber to receive a strip having a plurality of blisters each containing a dose of medicament for inhalation by a user, an actuating lever, and a blister strip drive wheel rotatably mounted in the chamber to sequentially move each blister into a blister opening position, wherein the blister strip drive wheel and the actuating lever comprise a drive gear and a drive gear element, respectively, that cooperate to effect rotation of the blister strip drive wheel in response to rotation of the actuating lever, characterised in that said drive gear and drive gear element being disposed on the outside of the housing remote from the chamber.

2. An inhaler according to claim 1, comprising a mouthpiece through which a dose of medicament can be inhaled and a cap pivotally mounted on the housing to cover the mouthpiece.

3. An inhaler according to claim 2, wherein the drive gear and drive gear element are disposed between the housing and the cap so as to be enclosed by said cap.

4. An inhaler according to claim 3, wherein the housing has opposing side wall surfaces and the cap has portions that extend across respective side wall surfaces, said drive gear and drive gear element being disposed between one of said side wall surfaces and one of said cap portions.

5. An inhaler according to claim 4, wherein the drive gear of the blister strip drive wheel includes a shaft that extends through an aperture in a side wall surface of the housing, for coupling to the blister strip drive wheel.

6. An inhaler according to claim 5, wherein the actuating lever comprises an actuating button that extends across the outside of the housing between said opposing side wall surfaces of the housing, and a plate-like portion extending from each end of the actuating button across respective side wall surfaces on the outside of the housing, beneath said cap portions.

7. An inhaler according to claim 6, wherein each plate-like portion of the actuating lever is pivotally mounted to a respective side wall surface of the housing to pivotally mount the actuating lever to the outside of the housing remote from the chamber.

8. An inhaler according to claim 7, comprising a blister piercing member that pivots in response to rotation of the actuating lever to puncture the lid of an aligned blister, wherein one of the actuating lever and the blister piercing member has a drive cam element and the other of the actuating lever and the blister piercing member has a drive cam surface, the drive cam element and the drive cam surface cooperating with each other in response to rotation of the actuating lever so that the blister piercing element pivots to puncture the lid of an aligned blister.

9. An inhaler according to claim 8, wherein the blister piercing member pivots together with the mouthpiece, the mouthpiece being pivotally mounted to the housing such that the mouthpiece pivots to puncture the lid of an aligned blister in response to rotation of the actuating lever.

10. An inhaler according to claim 9, wherein the mouthpiece is pivotally mounted to the outside of the housing remote from the chamber.

11. An inhaler according to claim 10, wherein the mouthpiece has peripheral walls extending from opposing edges that extend across respective side wall surfaces on the outside of the housing remote from the chamber, said peripheral walls being pivotally mounted to said side wall surfaces of the housing to pivotally mount the mouthpiece to the housing, one of the drive cam element and drive cam surface being formed in one of said peripheral walls.

12. An inhaler according to claim 11, the drive cam element and drive cam surface are disposed beneath a cap portion.

Claims

1. An inhaler comprising a housing to receive a strip having a plurality of blisters, each blister having a puncturable lid and containing a dose of medicament for inhalation by a user, a mouthpiece mounted to the housing and through which a dose of medicament is inhaled by a user, a blister piercing member mounted for rotation about a first axis and an actuating mechanism including an actuating lever mounted for rotation about a second axis to sequentially move each blister into alignment with the blister piercing member, wherein the actuating lever cooperates with the blister piercing member so that the blister piercing member pivots about said first axis in response to rotation of the actuating member from an initial position about the second axis to puncture the lid of an aligned blister so an airflow through the blister is generated to entrain the dose contained therein and carry it, via the mouthpiece, into the user's airway when a user inhales through the mouthpiece.

2. An inhaler according to claim 1, wherein the blister piercing member is immovably attached to the mouthpiece and the mouthpiece is pivotally mounted to the housing so that the mouthpiece pivots, together with the blister piercing member, about said first axis in response to rotation of the actuating lever about the second axis.

3. An inhaler according to claim 1, wherein the blister piercing member is pivotally mounted to the mouthpiece for rotation about said first axis so that the blister piercing member pivots about said first axis relative to the mouthpiece, in response to operation of the actuating lever.

4. An inhaler according to any preceding claim, wherein the actuating lever is pivotable in the same direction about the second axis to sequentially move each blister into alignment with a blister piercing member and to cause rotation of the blister piercing member about the first axis so that the blister piercing member punctures the lid of an aligned blister.

5. An inhaler according to claim 4, wherein the actuating mechanism is configured such that rotation of the actuating lever about the second axis through a first portion of its stroke moves a blister into alignment with a blister piercing member and, further rotation of the actuating lever about the second axis in the same direction, during a second portion of its stroke, causes rotation of the blister piercing member about the first axis so that the blister piercing member punctures the lid of an aligned blister.

6. An inhaler according to claim 5, wherein the actuating mechanism includes a blister strip drive wheel, wherein the actuating lever is engaged with said blister strip drive wheel during rotation of the actuating lever to rotate said blister strip drive wheel and drive said strip.

7. An inhaler according to claim 6, wherein the blister strip drive member comprises a plurality of spokes extending from a hub, the spokes being spaced from each other such that a spoke locates between blister cavities as a blister strip passes around the blister strip drive member to engage and drive a strip as the blister strip drive member rotates, the blister strip drive member being positioned relative to a wall such that the distance between the hub and said wall is less than the height of a blister cavity such that onward rotation of the wheel causes a blister cavity to be at least partially squashed or sandwiched between the hub and said wall.

8. An inhaler according to claim 6 or 7, wherein the actuating mechanism is configured such that the actuating lever and blister strip drive wheel disengage at the end of the first portion of the stroke so that the blister strip drive wheel remains substantially stationary during rotation of the actuating lever through said second portion of its stroke..

9. An inhaler according to claim 8, wherein the actuating mechanism comprises a drive coupling member rotatable in response to rotation of the actuating lever to rotate the blister strip drive wheel, the blister strip drive wheel

being rotatably mounted on said drive coupling member, wherein the actuating mechanism includes means to control rotation of the blister strip drive wheel relative to rotation of the drive coupling member so that the blister strip drive wheel rotates together with the drive coupling member during the first portion of the stroke of the actuating lever but not during the second portion of the stroke of the actuating lever..

10. An inhaler according to claim 9, wherein said means for controlling rotation of the blister strip drive wheel is also configured to inhibit rotation of the blister strip drive wheel when the actuating lever is rotated in the opposite direction.

11. An inhaler according to claim 9 or claim 10, wherein the drive coupling member includes a drive gear rotatable together with the drive coupling member and the actuating lever includes a drive gear segment that drivingly engages with the drive gear member so that the drive gear rotates in response to rotation of the actuating lever to rotate the drive coupling member.

12. An inhaler according to any of claims 9 to 11, wherein the means to control rotation of the blister strip drive wheel includes cooperating elements on the drive coupling member and on the housing.

13. An inhaler according to any of claims 4 to 12, when dependent on claim 2, wherein one of the actuating lever and the mouthpiece has a drive cam element and the other of the actuating lever and the mouthpiece has a drive cam surface, wherein the drive cam element cooperates with the drive cam surface so that the mouthpiece pivots about said first axis in response to rotation of the actuating member about the second axis to puncture the lid of an aligned blister.

14. An inhaler according to any of claims 4 to 12, when dependent on claim 3, wherein one of the actuating lever and the blister piercing member has a drive cam element and the other of the actuating lever and the blister piercing member

has a drive cam surface, wherein the drive cam element cooperates with the drive cam surface so that the blister piercing element pivots about said first axis in response to rotation of the actuating member about the second axis to puncture the lid of an aligned blister.

15. An inhaler according to claim 13, wherein the cam groove has an arcuately shaped region having an axis that corresponds to the second axis about which the actuating lever rotates such that, during said initial rotation of the actuating lever through its first portion of its stroke, the drive cam element slides along said arcuately shaped region of the cam groove without causing rotation of the mouthpiece about the first axis.

16. An inhaler according to claim 14, wherein the cam groove has an arcuately shaped region having an axis that corresponds to the second axis about which the actuating lever rotates such that, during said initial rotation of the actuating lever through its first portion of its stroke, the drive cam element slides along said arcuately shaped region of the cam groove without causing rotation of the blister piercing member about the first axis.

17. An inhaler according to claim 15, wherein the cam groove has a second region shaped such that, during further rotation of the actuating lever through its second portion of its stroke, cooperation between the drive cam element and the second region of the cam groove causes the mouthpiece to rotate together with the actuating lever so that the blister piercing element punctures the lid of an aligned blister.

18. An inhaler according to claim 16, wherein the cam groove has a second region shaped such that, during further rotation of the actuating lever through its second portion of its stroke, cooperation between the drive cam element and the second region of the cam groove causes the blister piercing element to rotate together with the actuating lever so that the blister piercing element punctures the lid of an aligned blister.

19. An inhaler according to any preceding claim, comprising a cap and a coupling pivotally mounting the cap to the housing for rotation about a third axis, the cap covering the mouthpiece in a closed position.

20. An inhaler according to claim 19, wherein the housing comprises a shell and the actuating lever is mounted for rotation about the second axis on the shell and includes a mounting plate that extends within a space between the shell and the cap.

21. An inhaler according to claim 20, wherein the actuating lever comprises a button extending from said plate and protruding out of said space to enable actuation of the actuating lever by a user.

22. An inhaler according to claim 20 or 21, wherein the actuating lever comprises an arcuately shaped opening extending about the second axis, the coupling that pivotally mounts the cap to the housing extending through said opening so that the coupling travels along the arcuately shaped opening as the actuating lever pivots about the second axis.

23. An inhaler according to claim 22, wherein the cap and actuating lever include cooperating means configured such that, when the cap is rotated from its open position back into its closed position in which it covers the mouthpiece, the actuating lever is rotated rotate back into its initial position.

24. An inhaler according to claim 23, wherein the cooperating means comprises a wall on the actuating lever and a drive member depending from the cap towards the actuating lever, said wall and drive member being positioned between the second and third axes such that the drive member engages the wall when the cap is rotated in a direction back into its closed position to rotate the actuating member about the second axis back into its initial position.

25. An inhaler according to any of claims 20 to 24, comprising a detent mechanism including a cantilevered arm on the actuating lever and a pawl on the shell, the arm being resiliently deformed by said pawl as the actuating lever reaches the end of the second portion of its stroke, to hold the actuating lever in position until the cap is closed.

26. An inhaler according to claim 25, wherein the cantilevered arm includes a kinked portion that snaps over the pawl when the actuating lever is rotated towards the end portion of its stroke.

27. An inhaler according to any preceding claim, wherein a wall is slideably mounted in the housing to divide it into unused and used blister compartments.

28. An inhaler according to claim 27, wherein the wall comprises a baffle extending between opposing walls within the housing and an elongate foot extending substantially at right-angles to the baffle and being slideably received within a recess in a wall of the housing.

29. An inhaler according to claim 28, wherein the baffle is attached to a central region of the foot.

30. An inhaler according to claim 29, wherein the foot is widest at its ends remote from the baffle such that only the ends of said foot contact the walls of said recess in the housing.

31. An inhaler comprising a housing to receive a strip having a plurality of blisters, each blister having a puncturable lid and containing a dose of medicament for inhalation by a user, a mouthpiece pivotally mounted to the housing and through which a dose of medicament is inhaled by a user and an actuating mechanism including a lever operable to sequentially move each blister into alignment with a blister piercing member depending from the mouthpiece said actuating lever also being operable to cause the mouthpiece to pivot so that

the blister piercing member punctures the lid of an aligned blister so that, when a user inhales through the mouthpiece, an airflow through the blister is generated to entrain the dose contained therein and carry it, via the mouthpiece, into the user's airway.

32. An inhaler according to any of claims 2 to 31, comprising a shutter having a mouthpiece blocking element positioned such that it extends across and blocks passage through the mouthpiece, the shutter being pivotally mounted to the mouthpiece and configured to rotate in response to rotation of the actuating lever and the mouthpiece so that the blocking element rotates into a position in which the mouthpiece is unblocked when the actuating lever has reached the end of its stroke and a blister is pierced.

33. An inhaler according to claim 32, wherein the shutter includes a cam mechanism so that rotation of the mouthpiece causes the cam mechanism to rotate the shutter about its axis of rotation on the mouthpiece.

34. An inhaler according to claim 33, wherein the cam mechanism includes a slot and a fixed cam pin received in the slot such that engagement between the cam pin and slot forces the shutter to rotate about its axis of rotation on the mouthpiece as the mouthpiece rotates about its axis in response to activation of the actuating lever.

35. An inhaler according to claim 34, wherein the shutter comprises an arm and the mouthpiece blocking element extends from one end of said arm.

36. An inhaler according to any of claims 32 to 35, claim wherein the mouthpiece blocking element is arcuate in shape.

37. An inhaler according to any of claims 32 to 36, wherein the mouthpiece blocking element comprises a first section that extends across and blocks the mouthpiece and a second section that extends across the mouthpiece when the

shutter has been rotated in response to rotation of the actuating lever, the second section having a plurality of openings, or a mesh, formed therein to allow passage of an entrained dose of medicament through the mouthpiece when a patient inhales.

38. An inhaler comprising a housing defining a chamber to receive a strip having a plurality of blisters each containing a dose of medicament for inhalation by a user, an actuating lever, and a blister strip drive member rotatably mounted in the chamber to sequentially move each blister into a blister opening position, wherein the blister strip drive member and the actuating lever comprise a drive gear and a drive gear element, respectively, that cooperate to effect rotation of the blister strip drive member in response to rotation of the actuating lever, said drive gear and drive gear element being disposed on the outside of the housing remote from the chamber.

39. An inhaler according to claim 38, comprising a mouthpiece through which a dose of medicament can be inhaled and a cap pivotally mounted on the housing to cover the mouthpiece.

40. An inhaler according to claim 39, wherein the drive gear and drive gear element are disposed between the housing and the cap so as to be enclosed by said cap.

41. An inhaler according to claim 40, wherein the housing has opposing side wall surfaces and the cap has portions that extend across respective side wall surfaces, said drive gear and drive gear element being disposed between one of said side wall surfaces and one of said cap portions.

42. An inhaler according to claim 41, wherein the drive gear of the blister strip drive member includes a shaft that extends through an aperture in a side wall surface of the housing, for coupling to the blister strip drive wheel.

43. An inhaler according to claim 42, wherein the actuating lever comprises an actuating button that extends across the outside of the housing between said opposing side wall surfaces of the housing, and a plate-like portion extending from each end of the actuating button across respective side wall surfaces on the outside of the housing, beneath said cap portions.

44. An inhaler according to claim 43, wherein each plate-like portion of the actuating lever is pivotally mounted to a respective side wall surface of the housing to pivotally mount the actuating lever to the outside of the housing remote from the chamber.

45. An inhaler according to claim 40, comprising a piercing member that pivots in response to rotation of the actuating lever to puncture the lid of an aligned blister, wherein one of the actuating lever and the blister piercing member has a drive cam element and the other of the actuating lever and the blister piercing member has a drive cam surface, the drive cam element and the drive cam surface cooperating with each other in response to rotation of the actuating lever so that the blister piercing element pivots to puncture the lid of an aligned blister.

46. An inhaler according to claim 45, wherein the piercing member pivots together with the mouthpiece, the mouthpiece being pivotally mounted to the housing such that the mouthpiece pivots to puncture the lid of an aligned blister in response to rotation of the actuating lever.

47. An inhaler according to claim 46, wherein the mouthpiece is pivotally mounted to the outside of the housing remote from the chamber.

48. An inhaler according to claim 47, wherein the mouthpiece has peripheral walls extending from opposing edges that extend across respective side wall surfaces on the outside of the housing remote from the chamber, said peripheral walls being pivotally mounted to said side wall surfaces of the housing to

pivotally mount the mouthpiece to the housing, one of the drive cam element and drive cam surface being formed in one of said peripheral walls.

49. An inhaler according to claim 48, the drive cam element and drive cam surface are disposed beneath a cap portion.