ORAL INHALER WITH SPRING BIASED, CAM DRIVEN PIERCING DEVICE

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13 Claims

ABSTRACT OF THE DISCLOSURE

A device for piercing gelatine or like capsules comprising a pair of opposed sharpened piercing members connected by a bent resilient bridging member and means for urging the piercing members together to pierce a capsule placed between them.

The piercing device is used in an oral inhaler which uses a propeller member to hold the capsule and cause the medicament contained therein to be ejected.

This invention is concerned with improvements in or relating to the piercing or perforation of capsules, such as gelatine capsules.

Capsules, such as gelatine capsules form a convenient method of transporting and storing pharmaceutically active substances. Thus, they maintain the pharmacologically active substances or medicament out of contact with the atmosphere and thus tend to prevent any deterioration of the contents due to the action of atmospheric components, e.g., oxidation by atmospheric oxygen or the action of atmospheric moisture.

When it is intended to dispense the contents of the capsule it is necessary to rupture or pierce the capsule and it is an object of this invention to provide a convenient device for piercing gelatine and like capsules.

According to the invention there is provided a device for piercing gelatine or like capsules comprising a pair of opposed sharpened piercing members connected by a bent resilient bridging member and means for urging the piercing members together to pierce a capsule placed between them.

The piercing members will generally be formed in one piece with the bridging member of a resilient material such as spring steel, carbon steel or stainless steel. If the piercing members are formed of a corrorable material, such as spring steel or carbon steel, they may be plated, e.g., with nickel or chromium, to inhibit corrosion.

In order to facilitate the piercing operation the piercing members are advantageously provided with stops which prevent the too deep penetration of one member into the capsule before the other member comes into operation, hence ensuring equal penetration by both members. The resilient bridging member may take the form of a simply bent strip or rod or material or may be provided with one or more turns to give better resistance to fatigue. The piercing members may be urged together by push buttons or, preferably, by sliding cams.

It has been found that, in order to obtain optimum perforation of a gelatine capsule, the perforating ends of the piercing members should not be sharpened to a conventional conical point but should be sharpened with a plane face at an acute angle to the axis of the member.

The piercing device according to the invention is particularly suitable for piercing gelatine or like capsules containing a finely divided medicament for administration by inhalation and it has been found convenient to incorporate the piercing device in the powder inhalation apparatus and, therefore, the invention is also for a powder inhalation device, in which the powder is dispensed from a gelatine capsule, provided with a piercing device as described above.

According to a particularly preferred embodiment, the invention is for a device for the oral inhalation of medicaments in finely divided form which comprises a hollow elongate housing, preferably a tubular housing having at both ends thereof one or more passageways to permit the passage of air and having one end thereof adapted for insertion into the mouth and a propeller-like device rotatably mounted on a rigid shaft mounted in said housing and co-axial with the longitudinal axis of said housing, said propeller-like device having, on the part thereof furthest from the end of the housing adapted for insertion into the mouth, a mounting means adapted to receive a gelatine or like container for finely powdered medicament; said device also being provided with capsule piercing means of the type described above for perforating the medicament container in situ in the device. (By the term propeller-like device is meant a device having two or more blades or vanes disposed about a central axis or hub, such that impingement of an airflow stream on the said vanes or blades tends to cause rotation of the device about said axis or hub.) Where the perforating ends of the piercing members are sharpened with an acute angle plane face, these acute angle plane faces should desirably face away from the propeller-like device.

Suitably the container used in such a device is a capsule, for example a gelatine or plastic capsule, and conveniently the capsule perforating means is so arranged to provide two or more holes, suitably of about 0.6—0.65 mm. in diameter, desirably in the part of the capsule furthest from the propeller-like device, advantageously in the shoulders of the capsule.

It is desirable that the shaft and bearing assembly whereby the propeller-like device is mounted within the housing be such that the passage of an airstream causes not only rotational movement of the propeller-like device but also a vibrational component of motion. Such a vibrational movement has been found to contribute to the release of the powdered medicament from the capsule. A suitable shaft and bearing arrangement for generating the desired rotational and vibrational motion is one where the bearing has an internal diameter at its inner end (i.e., that end housing the free end of the shaft) which is from 1.5 to 6%, preferably 2.5 to 5% optimally about 3.75%, greater than the diameter of the shaft, and has an internal diameter at its outer end which is equal to the diameter of the shaft plus from 1.3 to 3.5, preferably about 2.5% of the length of the bearing. The length of the bearing is preferably from 4 to 10 times the diameter of the shaft. Preferably that end of the shaft which engages with the inner end wall of the bearing tube terminates with a tapered portion of frusto-conical shape, preferably having a hemispherical tip.

The inhalation device of the invention is suitable for the administration of medicaments for the alleviation of ailments of the bronchial tract and of the lungs. The device may also be used for the administration of medicaments having systemic activity, for example it may be used for the administration of antidotes to poisonous substances such as nerve gases, as it provides a simple method of carrying medicaments which have to be used rapidly in an emergency.

In order that the invention may be well understood, an embodiment of an inhalation device provided with a capsule piercer according to the invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a vertical section through the inhalation de-
device showing the piercing device in the non-piercing position.

FIG. 2 is a vertical section through the inhalation device showing the piercing device in the piercing position.

FIG. 3 is a cross-section view at the line A—A in FIG. 1.

FIG. 4 is a cross-sectional view at the line B—B in FIG. 1; and

FIG. 5 is a cross-sectional view at the C—C in FIG. 1.

Referring now to the drawings, an inhalation device comprises a hollow elongated tubular housing member 1 of generally circular cross-section provided at one end with a hollow elongate passage 2 which is perforated by air passages 3, and at the other end with a mouthpiece 4 provided with air passages 5. End piece 2 is firmly attached to housing member 1, for example it may be glued thereto, and mouthpiece 4 is removably attached to housing member 1 by means of operating screw threads in body member 1 and mouthpiece 4.

End piece 2 has a central projection 6 in a slot in which is mounted a U-shaped resilient piercing member 7 which is provided with a piercing point on the free end of each arm thereof. The piercing points are of such size that they cut holes 0.60 to 0.65 mm. in diameter through the walls of the capsule and are capable of being sharpened. A plane face is at an acute angle to the axis of the piercing point. The piercing points are also provided with stops 18 to limit the depth of penetration of the piercing points into the capsule. Piercing member 7 is retained in the slot in projection 6 by means of retaining block 8 which is, in turn, held in position in the slot by means of pin 9. The arms of resilient piercing member 7 are located in slots in the walls of housing member 1 and in guideways formed by guide members 10 extending inwardly from the inner surface of housing member 1.

Mounted in mouthpiece 4 and extending into member 1 is shaft 11 having a frusto-conical end terminating in a hemispherical tip and on which is mounted propeller-like device 12 having blades 13 and a cup-like depression for receiving gelatine capsule 14.

Slidable mounted on housing member 1 is tubular member 15 having cam-like projections 16 extending inwardly through the slots in housing member 1. The projections 15 provide the sliding cams referred to earlier as a means for operating the piercing means. When member 15 is slid from the position shown in FIG. 1 to that shown in FIG. 2 the cam-like projections 16 engage with the arms of resilient piercing member 7 to force them inwards and thus to force piercing projections 17 into contact with the surface of gelatine capsule 14 and finally to pierce gelatine capsule 14 in the portion of the capsule furthest removed from the propeller-like device 12, as shown in FIG. 2, the depth of piercing being limited by stops 18. When member 15 is slid back from the position shown in FIG. 2 to that shown in FIG. 1 the resilience of member 7 causes the arms to spring apart and to resume the position shown in FIG. 1.

In operation, the device is first loaded with gelatine capsule 14 by unscrewing mouthpiece 4 from housing member 1 and placing capsule 14 in the cup-like depression in propeller-like device 12. Mouthpiece 4 is then screwed back into housing member 1 and the device is ready for use.

In use, the user first pierces gelatine capsule 14 by sliding member 15 from the position therein shown in FIG. 2 and then back to the position shown in FIG. 1.

The user then places mouthpiece 4 in the mouth and inhales through the device, thus administering powdered medicament contained in capsule 14.

What we claim is:

1. A device for oral inhalation of medicaments in finely divided form which comprises a hollow elongate housing having at both ends thereof one or more passage-ways to permit the passage of air and having one end thereof adapted for insertion into the mouth; a propeller-like member rotatably mounted in the said housing on a rigid shaft mounted in said housing and co-axial with the longitudinal axis of the housing, said propeller-like member having, on the end thereof furthest from the end of the housing adapted for insertion in the mouth, mounting means adapted to receive a container for the finely divided medicament; and piercing means on said device comprising a pair of opposed sharpened piercing members connected by a bent resilient bridging member and means for urging the piercing members together for perforating the container of medicament in situ in the device.

2. An inhalation device according to claim 1 in which the piercing members have a size for making two or more holes 0.6–0.65 mm. in diameter in the container.

3. An inhalation device as according to claim 1 in which the piercing means is arranged to provide the said holes in the part of the container furthest from the propeller-like device.

4. An inhalation device according to claim 1 in which the piercing members are provided with stops to limit the depth of penetration of the piercing member into a container.

5. An inhalation device as claimed according to claim 1 in which the piercing members are provided with piercing points having a plane face at an acute angle to the axis of the member.

6. An inhalation device according to claim 1 in which sliding cams are provided for urging the piercing members together.

7. An inhalation device according to claim 1 in which the hollow elongate housing is a tubular housing.

8. An inhalation device according to claim 1 in which the bearing in the propeller-like device in which the shaft engages has an internal diameter at its inner end from 1.5 to 6% greater than the diameter of the shaft and an internal diameter at its outer end equal to the diameter of the shaft plus 1.3 to 3.5% of the total length of the bearing.

9. An inhalation device according to claim 8 in which the internal diameter of the bearing at its inner end is from 2.5 to 5% greater than the diameter of the shaft.

10. An inhalation device according to claim 8 in which the internal diameter of the bearing at its inner end is about 3.75% greater than the diameter of the shaft and the internal diameter of the bearing at its outer end is equal to the diameter of the shaft plus about 2.5% of the length of the bearing.

11. An inhalation device according to claim 1 in which the length of the bearing is from 4 to 10 times the diameter of the shaft.

12. An inhalation device according to claim 1 in which the inner end wall of the bearing in the propeller-like device is flat and the end of the shaft which engages with it is of frusto-conical shape.

13. An inhalation device according to claim 12 in which the frusto-conical end of the shaft terminates in a hemispherical tip.

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