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(54) **METHOD AND APPARATUS FOR TREATING MEIBOMIAN GLAND DYSFUNCTION EMPLOYING FLUID JET**

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(58) **Field of Classification Search**
USPC 604/294, 295
See application file for complete search history.

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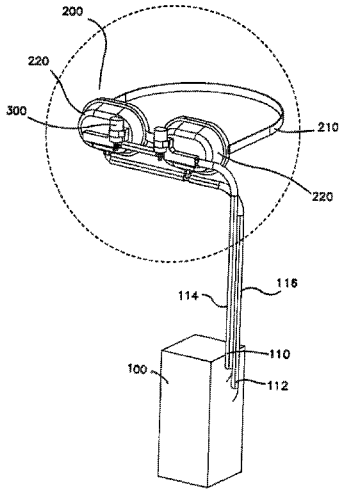
(57) **ABSTRACT**

According to the present invention, there is provided a method of treating meibomian gland dysfunction in a mammal wherein an occlusion blocks at least a portion of the flow of naturally occurring secretion out of a gland channel orifice. The invention comprises selecting a device capable of delivering a jet of heated medium. The device is positioned such that when the jet is it is applied to the exterior surface of the eyelid, proximate to the gland channel orifice, a jet of heated medium is applied to the exterior surface of the eyelid proximate to the gland channel orifice at a pressure of from about 2 psi to about 30 psi. Application of the jet of heated medium is maintained for sufficient time to loosen, break up, fracture, soften or liquefy at least a portion of the occlusion such that at least a portion of the occlusion is removed. In an exemplary embodiment, the medium is water heated to a temperature of between about 42° C. and about 46° C. Depending on the particular type and composition of the obstruction, the fluid jet operates to melt or soften the obstruction and to milkingly move the corpus of the softened obstruction up the gland channel from the end opposite the meibomian gland orifice and out of the gland orifice. Repeated application of the heated fluid jet may also be necessary to soften and/or express the obstruction.

44 Claims, 6 Drawing Sheets



gland margin. Similarly, the heating and vibrational features discussed above may also be employed.

Another embodiment of the invention employs the use of chemical or pharmacological agents to open or dilate the gland and gland orifice wherein the obstruction naturally is expressed and returns the normal secretions of the gland. Alternatively, the chemical or pharmaceutical agent would be used to soften or breakup the obstruction with such obstruction being expressed with the use of devices as defined above or combinations thereof. Chemical or pharmacological agents may also be used in connection with the device for post treatment. Once the glands have been opened then chemical or pharmacological agents may be used to enhance the normal production or secretion to maintain the glands in its unblocked state.

Dilation of the meibomian gland channel and orifice may also be employed to loosen or free the obstruction from the gland walls. Dilation may be accomplished by chemical, pharmacological, or mechanical means.

Stimulation of the meibomian gland may also be employed in conjunction with the other modalities discussed above to loosen or fracture the obstruction.

As mentioned herein above, the present invention has been described in detail on conjunction with the figures in connection with the meibomian glands of the eye. The reader will note that the principals of this invention may be applied with equal efficacy to the other glands of the human body and potentially to valuable domesticated farm animals to treat various ailments.

That which is claimed is:

1. An apparatus for treating meibomian gland dysfunction in an eyelid wherein at least one occlusion blocks at least a portion of a flow of naturally occurring secretion out of at least one meibomian gland, comprising:

a mask configured to deliver and maintain at a pressure from about 2 psi to about 30 psi the application of at least one jet of heated medium to an exterior surface of a closed eyelid, proximate to at least one meibomian gland, for sufficient time to loosen, break up, fracture, soften or liquefy at least a portion of at least one occlusion in the at least one meibomian gland such that at least a portion of the at least one occlusion is removed; and

a rotary distributor valve comprising a cylindrical manifold having a bore extending along its length, the rotary distributor valve being configured to deliver a heated medium to the at least one jet.

2. The apparatus of claim **1**, wherein the mask further comprises at least one eyepiece configurable to cover an orbit of an eye and eyelid.

3. The apparatus of claim **2**, wherein the at least one eyepiece is configurable to create a seal around the orbit of an eye and eyelid.

4. The apparatus of claim **3**, wherein the seal is comprised of a water tight seal.

5. The apparatus of claim **2**, wherein the at least one eyepiece further comprises an oval annulus or ring.

6. The apparatus of claim **5**, wherein the at least one eyepiece is composed of a flexible material.

7. The apparatus of claim **6**, wherein the flexible material is selected from the group consisting of rubber, plastic, and neoprene.

8. The apparatus of claim **5**, further comprising a lens mounted to the oval annulus or ring.

9. The apparatus of claim **5**, further comprising a membrane communicating with the oval annulus or ring and configurable to cover and contact an eyelid;

wherein the membrane is further configured to receive the at least one jet of heated medium from the mask and thereby transmitting a force of the at least one jet to the eyelid so as to soften the at least a portion of the at least one occlusion in the at least one meibomian gland.

10. The apparatus of claim **5**, further comprising a nose bridge connecting the at least one eyepiece to a second eyepiece.

11. The apparatus of claim **5**, further comprising a headband configured to connect outer edges of the mask and further configurable to maintain the mask firmly in place against orbit and cheek areas surrounding an eye.

12. The apparatus of claim **11**, wherein the headband is composed of a flexible material.

13. The apparatus of claim **12**, wherein the flexible material is selected from the group consisting of rubber, plastic, and neoprene.

14. The apparatus of claim **1**, wherein the heated medium is configured to maintain the temperature of the meibomian gland from at least 40 degrees Celsius to 47 degrees Celsius.

15. The apparatus of claim **1**, wherein the heated medium is selected from the group consisting of fluids, gases, and flowable creams.

16. The apparatus of claim **1**, wherein the mask is configurable to be attached to a mammal so as to position the at least one jet of heated medium to the exterior surface of the closed eyelid.

17. The apparatus of claim **1**, wherein the mask is configurable to be positioned by manually holding the apparatus so as to position the at least one jet of heated medium to the exterior surface of the closed eyelid.

18. An apparatus for treating meibomian gland dysfunction in an eyelid wherein at least one occlusion blocks at least a portion of a flow of naturally occurring secretion out of at least one meibomian gland, comprising:

at least one jet configured to deliver and maintain at a pressure from about 2 psi to about 30 psi the application of at least one jet of heated medium to an exterior surface of a closed eyelid, proximate to at least one meibomian gland, for sufficient time to loosen, break up, fracture, soften or liquefy at least a portion of at least one occlusion in the at least one meibomian gland such that the at least a portion of the at least one occlusion is removed; and

a rotary distributor valve comprising a cylindrical manifold having a bore extending alone its length, the rotary distributor valve being configured to deliver a heated medium to the at least one jet.

19. The apparatus of claim **18**, wherein the rotary distributor valve further comprises at least one jet orifice positioned along a portion of the cylindrical manifold, wherein the at least one jet orifice is in fluid communication with the bore.

20. The apparatus of claim **19**, wherein the rotary distributor valve further comprises a housing surrounding the cylindrical manifold having the bore extending along its length.

21. The apparatus of claim **20**, wherein the housing further comprises a longitudinal slit configured to allow fluid from the at least one jet orifice to pass there through such that upon rotation of the cylindrical manifold, the at least one jet orifice is sequentially exposed to the longitudinal slit.

22. The apparatus of claim **20**, wherein the cylindrical manifold is mounted for rotation within the housing.

23. The apparatus of claim **19**, wherein the rotary distributor valve further comprises an integrally molded gear communicating with the cylindrical manifold and configured to rotate the cylindrical manifold.

24. The apparatus of claim 23, wherein the rotary distributor valve further comprises a rotor communicating with the manifold through the gear and configured to rotate the manifold.

25. The apparatus of claim 19, wherein the rotary distributor valve further comprises:

a first nipple communicating with a first end of the cylindrical manifold in fluid communication with the bore; and

a second nipple communicating with a second end of the cylindrical manifold in fluid communication with the bore.

26. The apparatus of claim 25, wherein the first nipple is configured as a fluid inlet.

27. The apparatus of claim 25, wherein the second nipple is configured as a fluid outlet.

28. The apparatus of claim 25, wherein the cylindrical manifold is mounted for rotation between the first and second nipples.

29. The apparatus of claim 19, wherein the rotary distributor valve further comprises:

a pump in fluid communication with the cylindrical manifold configured to deliver the heated medium into the cylindrical manifold; and

a rotor communicating with the cylindrical manifold and configured to rotate the bore so as to rotate the position of the at least one jet orifice.

30. The apparatus of claim 29, wherein the rotary distributor valve is configured to milkingly massage the at least one meibomian gland so as to soften the at least a portion of the at least one occlusion.

31. The apparatus to claim 29, wherein the rotary distributor valve is configured to apply the at least one jet to the at least one meibomian gland in a manner that milkingly moves up the at least one meibomian gland from an end opposite at least one meibomian gland channel orifice towards the at least one meibomian gland channel orifice.

32. The apparatus of claim 29, wherein the pump maintains a pressure of the heated medium into the cylindrical manifold.

33. The apparatus of claim 29, wherein the rotary distributor valve further comprises a heater configured to maintain a temperature of the heated medium.

34. The apparatus of claim 33, wherein the heater is configured to supply heat to the heated medium by a modality selected from the group consisting of conduction, convection, and radiation.

35. The apparatus of claim 33, wherein the heater is configured to maintain the temperature of at least a portion of the heated medium to at least 42 degrees Celsius.

36. The apparatus of claim 35, wherein the heater is configured to maintain the temperature of the at least a portion of the heated medium to at most 46 degrees Celsius.

37. The apparatus of claim 19, wherein the application of the at least one jet of heated medium is intermittent.

38. The apparatus of claim 37, wherein the intermittent application of the at least one jet of heated medium is pulsed.

39. The apparatus of claim 37, wherein the at least one jet of heated medium is applied at a frequency between 1 Hz and 300 Hz.

40. The apparatus of claim 37, wherein the at least one jet of heated medium is applied at a frequency between 5 Hz and 60 Hz.

41. The apparatus of claim 18, wherein the heated medium is selected from the group consisting of fluids, gases, and flowable creams.

42. The apparatus of claim 18, wherein the at least one jet is configured to be repositionable during the application of the at least one jet of heated medium.

43. The apparatus of claim 18, wherein the at least one jet is not configured to be repositionable during the application of the at least one jet of heated medium.

44. An apparatus for treating meibomian gland dysfunction in a mammal wherein at least one occlusion blocks at least a portion of a flow of naturally occurring secretion out of at least one meibomian gland, comprising:

at least one jet configured to deliver and maintain at a pressure from about 2 psi to about 30 psi the application of at least one jet of heated medium to maintain the internal temperature of at least one meibomian gland between 40 degrees Celsius and 47 degrees Celsius, for sufficient time to loosen, break up, fracture, soften or liquefy at least a portion of at least one occlusion in the at least one meibomian gland such that the at least a portion of the at least one occlusion is removed; and

a rotary distributor valve comprising a cylindrical manifold having a bore extending along its length, the rotary distributor valve being configured to deliver a heated medium to the at least one jet.

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