US 20060216671A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0216671 A1**

Neubardt (43) **Pub. Date: Sep. 28, 2006**

(54) **SURGICAL BONE WAX APPLICATOR**

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(21) Appl. No.: **11/091,089**

(22) Filed: **Mar. 28, 2005**

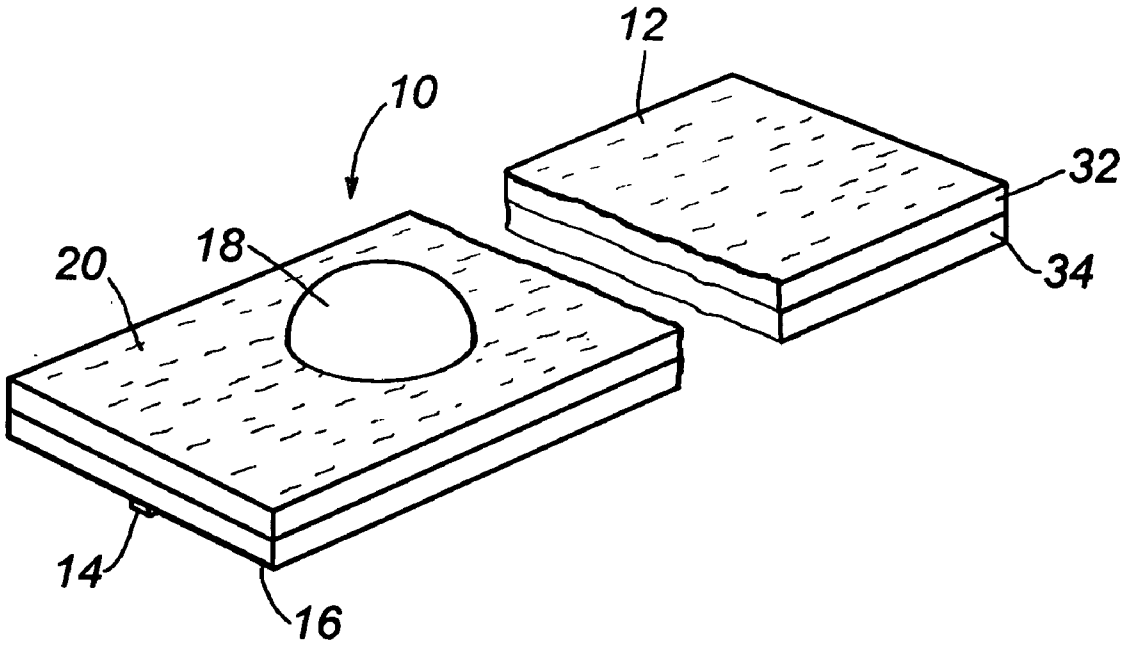
Publication Classification

(51) **Int. Cl.**
A61C 13/225 (2006.01)

(52) **U.S. Cl.** **433/172**

(57) **ABSTRACT**

A surgical bone wax applicator includes one or more layers of absorbent material such as cotton, and a mass of bone wax adhered on the material. A heating device such as, for example, a resistive electrical conductor is fixed on or within the absorbent material. The heating device has associated electrical contact terminals and operates to heat and soften the bone wax in response to an electric potential applied across the terminals. The potential may be applied through blades of bipolar forceps after the forceps are connected to a bipolar generator, and the forceps blades are placed in contact with the terminals of the heating device. When the wax softens, the surgeon may continue to grip the applicator with the forceps and manipulate the applicator over the pores of bone tissue to effect hemostasis.



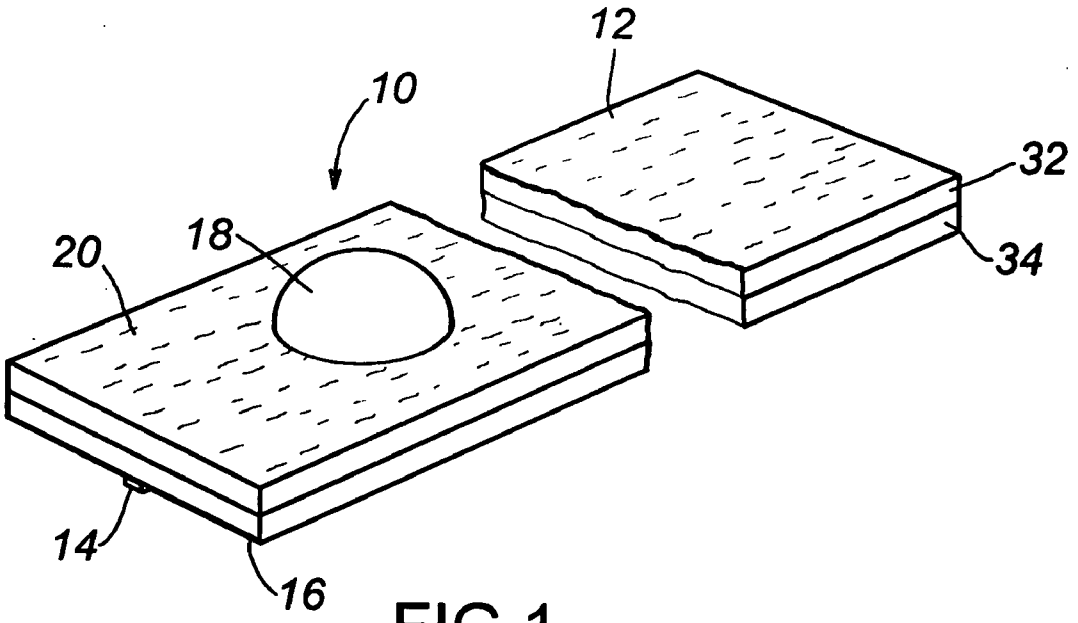


FIG.1

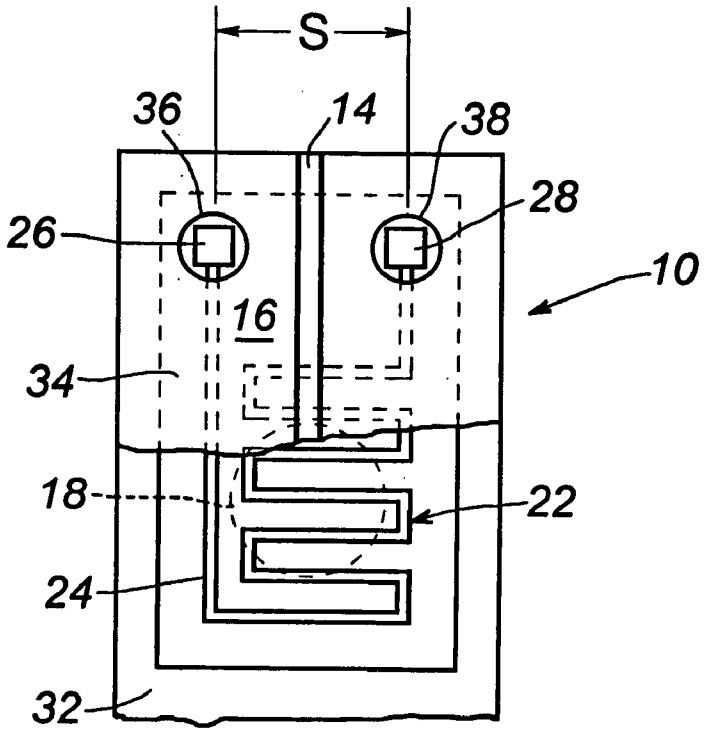


FIG.2

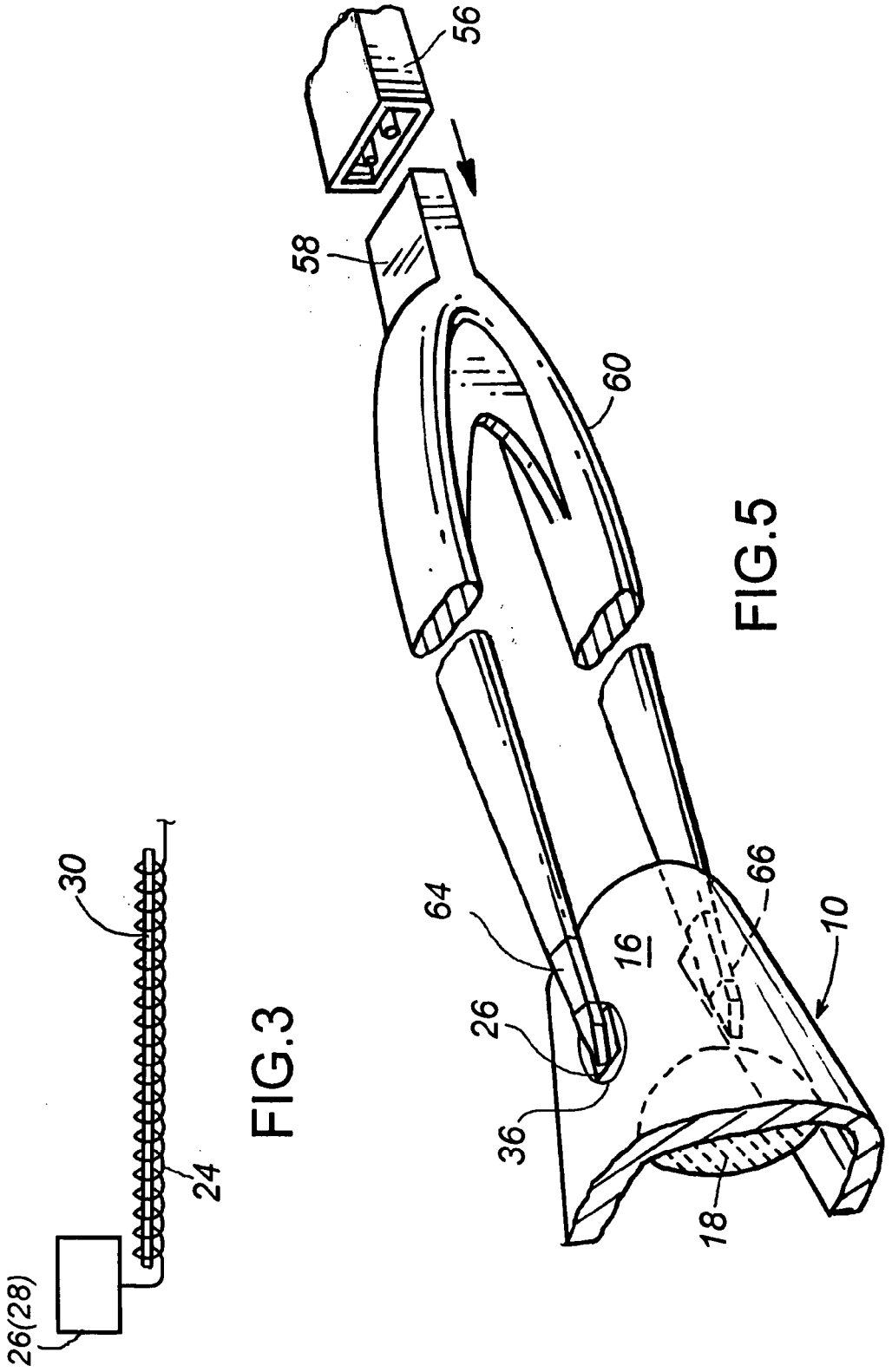


FIG.3

FIG.5

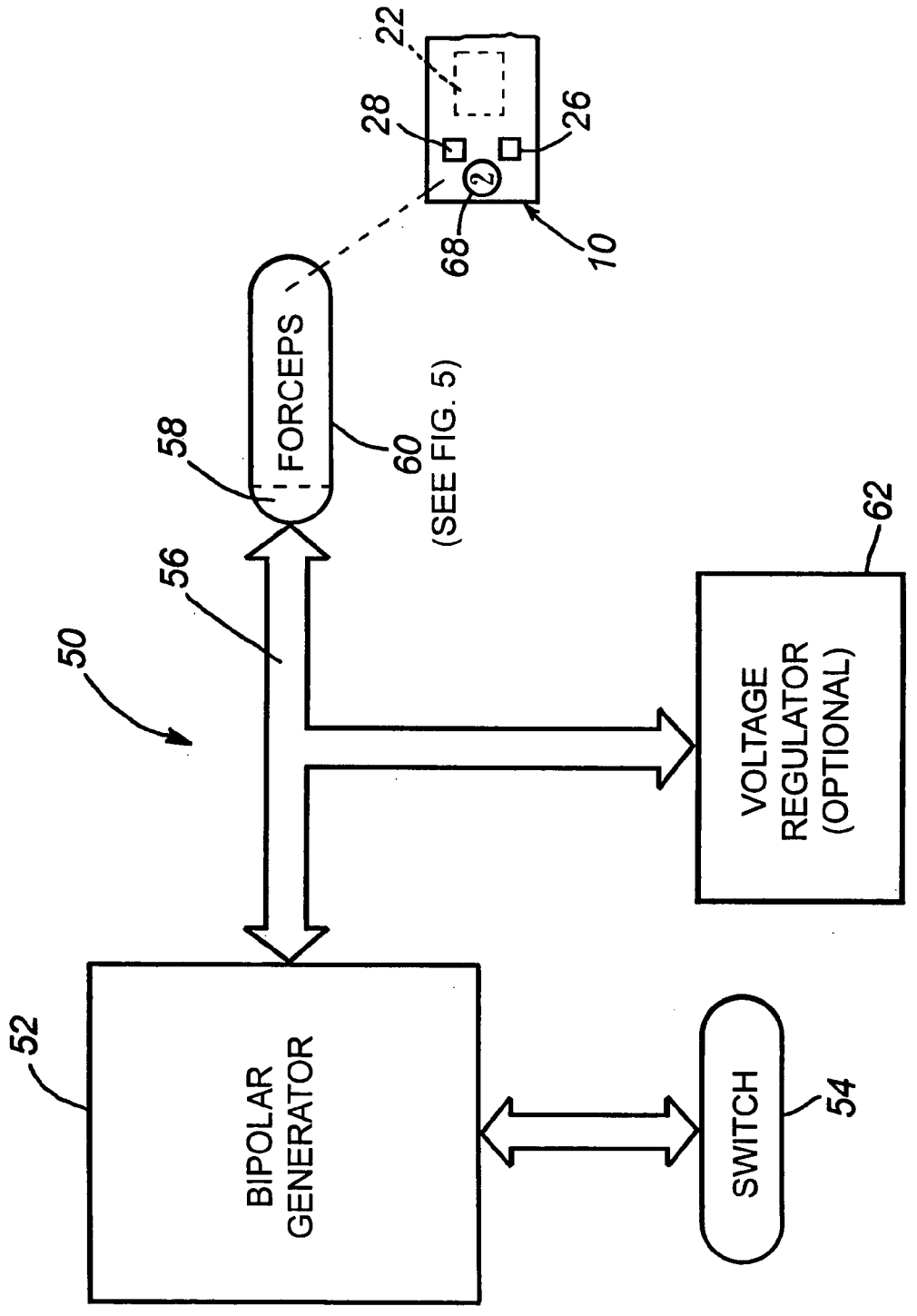

22
28
26
68
10
FORCEPS
58
60
(SEE FIG. 5)
56
50
62
VOLTAGE
REGULATOR
(OPTIONAL)
52
BIPOLAR
GENERATOR
SWITCH
54

FIG.4

SURGICAL BONE WAX APPLICATOR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This application relates generally to surgery, and particularly to an apparatus and technique for applying bone wax during a surgical procedure.

[0003] 2. Discussion of the Known Art

[0004] U.S. Pat. No. 5,374,246 (Dec. 20, 1994) discloses a method and a device for delivering a hemostatic agent onto a patient's bone tissue during surgery. A mass of bone wax is attached on a surface of a strip of absorbent material, e.g., a "Cottonoid"®. Prior to use, the bone wax is heated so that it becomes soft enough to enter pores of the bone tissue when the Cottonoid is gripped with forceps and pressed against the bone tissue to effect hemostasis. A water bath is preset to a temperature sufficient to soften the wax on the Cottonoid, and each Cottonoid/bone wax combination must be immersed in the bath prior to use. See also U.S. Pat. No. 5,685,879 (Nov. 11, 1997), which discloses a surgical bone wax applicator in the form of a footplate with a handle, and with bone wax adhered on a bottom surface of the footplate.

[0005] An arrangement and technique wherein quantities of bone wax can be applied to bone tissue without a requirement for a heated water bath or other external heating means, would be highly desirable.

SUMMARY OF THE INVENTION

[0006] According to the invention, a surgical bone wax applicator includes one or more layers of absorbent material, and a mass of bone wax adhered on an outside surface of the material. A heating device is fixed on or within the absorbent material. The heating device is constructed and arranged to heat and soften the bone wax when the heating device is energized.

[0007] Other features, objects and advantages of the present invention will be apparent to those skilled in the art in view of the following specification when taken in conjunction with the accompanying drawing and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

[0008] In the drawing:

[0009] **FIG. 1** is a perspective view of a surgical bone wax applicator according to the invention;

[0010] **FIG. 2** is a bottom view of the applicator in **FIG. 1**;

[0011] **FIG. 3** is a partial view of a heating device in the applicator;

[0012] **FIG. 4** is a schematic block diagram of an electrical operating system for the applicator; and

[0013] **FIG. 5** shows the applicator when gripped with bipolar forceps according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] **FIG. 1** shows a surgical bone wax applicator **10** according to the invention. The applicator **10** is constructed with one or more layers of a soft, surgically safe absorbent material **12** such as cotton. The material **12** is preferably treated to be flame resistant or retardant, for example, "Indura"® treated cotton. The overall size of the applicator **10** may be the same or similar to that of currently available Cottonoid strips, for example, one-half inch wide by up to six inches long. For spinal surgical use, it may be preferable that the length of the applicator **10** not exceed about five inches.

[0015] A radiopaque strip marker **14** is provided on a lower surface **16** of the applicator **10** such that the marker **14** is aligned medially between the long side edges of the applicator. The marker **14** will be highly visible in post-operative X-ray imaging if the applicator **10** is inadvertently allowed to remain inside a patient after surgery.

[0016] As seen in **FIG. 1**, a mass of bone wax **18** is adhered on an upper surface **20** of the applicator **10**, toward one end of the applicator as shown in the drawing. The wax may be deposited initially in a softened state on the surface of the applicator such that the wax solidifies into globular form, and adheres to the fibers of the applicator material **12** on and below the upper surface **20** of the applicator **20**.

[0017] A heating device **22** is disposed on or within the material **12** of the applicator **10**, in the vicinity of the deposited bone wax **18**. In the present embodiment, the heating device **22** is in the form of a resistive heating wire or conductor **24** that extends in a serpentine path beneath the bone wax **18** and is terminated at both ends with a pair of electrical contact terminals **26**, **28** as shown in **FIG. 2**. The terminals **26**, **28** are exposed on the lower surface **16** of the applicator **10**, for example, at either side of the radiopaque marker **14** as seen at the top of **FIG. 2**. As explained later below, a spacing S between the terminals **26**, **28** preferably does not exceed a typical rest spacing between confronting blades of conventional bipolar forceps.

[0018] The heating conductor **24** should present an impedance or electrical load between the terminals **26**, **28** such as to allow sufficient current to flow through the conductor **24** to heat the conductor just enough to soften the bone wax **18**, so that the wax can be urged into pores of bone tissue by manipulating the applicator **10** with the mentioned bipolar forceps. Examples of such conductors include, without limitation, nickel-chrome alloys and iron-chrome alloys in wire or ribbon form and available from Hyndman Industrial Products Inc., Fort Wayne, Ind. (www.resistancewire.com). For example, as seen in **FIG. 3**, a resistive wire **24** of a gage between about 35 and 45 AWG may be tightly coiled about a heat resistant thread or cord **30**. The overall length of the wire **24** between the terminals **26**, **28** should provide enough electrical resistance to prevent excessive current flow when a potential is applied to the terminals by blades of conventional bipolar forceps.

[0019] In the illustrated embodiment, the applicator **10** comprises two absorbent material layers **32**, **34**. It is contemplated that a multi-layer construction will allow the serpentine heating conductor **24** to be disposed between confronting plies or layers of the absorbent material **12**. Whether in ribbon, wire or coiled form, the conductor **24** may also be formed on a separate thin strip of electrically insulated heat resistant material (not shown). In the latter case, the terminals **26**, **28** may be disposed on the separate

strip, and be formed to project through corresponding holes **36**, **38** that are cut, e.g., in the lower material layer **34** as shown in **FIG. 2**.

[**0020**] **FIG. 4** is a schematic block diagram of an electrical operating system **50** for the bone wax applicator **10** of **FIGS. 1-3**. The system **50** includes a bipolar generator **52**. The generator **52** may be one of a number of commercially available bipolar generators such as, for example, ELMED Model BC 50 M/M; Wet-Field® No. 221320, or the like. Such generators typically have a low radio frequency (RF) power output that is adjustable from less than one watt to as much as 50 watts into a non-inductive load of approximately 100 to 500 ohms. The generator **52** may be operated manually by a surgeon using, e.g., a foot switch **54**, a hand switch, or other means not shown in the drawing. The output of the generator **52** is applied through a cable **56** to a power input connector **58** of bipolar forceps **60**. See **FIG. 5**. A voltage regulator **62** may be provided if necessary to ensure that power transmitted from the generator **52** to the forceps **60** will not exceed a level that might possibly overload the heating device **22** in the bone wax applicator **10**. Regulator **62** may be provided externally, or be integrated with the circuitry of the generator **52**. It will be understood that protective power regulation may also be provided within the heating device **22** of the bone wax applicator including, for example, one or more Zener diodes or varistors.

[**0021**] **FIG. 5** shows opposing electrical contact blades **64**, **66** of the forceps **60**, in contact with corresponding contact terminals **26**, **28** of the heating device inside a given bone wax applicator **10**. In use, the surgeon holds the forceps **60** and grasps the applicator **10** by placing the opened, opposing blades **64**, **66** of the forceps on the contact terminals **26**, **28** of the applicator **10**. The bipolar generator **52** is then activated so that the output voltage of the generator is applied across the terminals **26**, **28** and a corresponding current is caused to flow in the heating device **22** of the applicator. The mass of bone wax **18** is then heated and softens enough so that while continuing to grasp the applicator with the forceps **60**, the surgeon can apply the bone wax by manipulating the applicator over exposed porous bone tissue to effect hemostasis. When the bone wax on a given applicator is depleted, the surgeon merely releases the used applicator from the forceps and closes the forceps blades onto the contact terminals of a new applicator.

[**0022**] It will be appreciated that the inventive bone wax applicator **10** obviates the need for a heated water bath or other external means in order to heat bone wax to a proper temperature for application. By dispensing with the need to attend to such outside heating means, the attention of the operating personnel will not be distracted from the patient's operating situs, and any likelihood of surgical error is reduced.

[**0023**] To help the operating room personnel to account for all of the bone wax applicators **10** used during a given operation, the applicators may be packaged in boxes of, for example, ten applicators per box with each applicator having a different identifier **68** clearly printed or marked on an outside surface as shown in **FIG. 4**. For example, each applicator in a box of ten may be marked with a single numerical digit between 0 and 9. Further, the print style or font used for the identifiers may vary from box to box, thus making it easier for the personnel to account for all of the applicators if two or more boxes were opened during the operation.

[**0024**] While the foregoing represents a preferred embodiment of the invention, it will understood by those skilled in the art that various modifications and changes may be made without departing from the spirit and scope of the invention, and that the invention includes all such modifications and changes as are within the scope of the following claims. For example, during surgery and after bloodying one end of an absorbent strip, it is not unusual for the surgeon to "flip" the strip around and use the opposite clean end of the strip before retrieving a new strip. Accordingly, separate masses of bone wax may be adhered at or near the opposite ends of the strip, with each wax mass having an associated heating device on or within the material. In addition, for instances where one wax mass is insufficient to cover a large bone surface area to be treated, two or more bone wax masses may be provided at or near each end of the absorbent strip, each with an associated heating device.

I claim:

1. A surgical bone wax applicator, comprising:

one or more layers of absorbent material;

a mass of bone wax adhered on an outside surface of the absorbent material; and

an energizable heating device fixed on or within the absorbent material, wherein the heating device is constructed and arranged to heat and soften the bone wax when the heating device is energized.

2. A surgical bone wax applicator according to claim 1, wherein the heating device comprises an electrical heating element.

3. A surgical bone wax applicator according to claim 2, wherein the heating element has associated electrical contact terminals arranged for contact with an outside power source.

4. A surgical bone wax applicator according to claim 3, wherein the contact terminals are located and formed to contact corresponding blades of a given bipolar forceps.

5. A surgical bone wax applicator according to claim 4, wherein the heating element has a substantially non-inductive load impedance so that the heating element is energizable by a given bipolar generator.

6. A surgical bone wax applicator according to claim 2, wherein the electrical heating element comprises a resistive conductor.

7. A surgical bone wax applicator according to claim 1, wherein the absorbent material comprises cotton.

8. A surgical bone wax applicator according to claim 1, including a radiopaque marker disposed on the absorbent material.

9. A set of surgical bone wax applicators comprising a plurality of the bone wax applicators according to claim 1, wherein each of the applicators of the set has a different associated identifier to distinguish the applicator from remaining applicators of the set.

10. A system for applying bone wax on bone tissue to effect hemostasis, comprising:

a surgical bone wax applicator having one or more layers of an absorbent material, a mass of bone wax adhered

on an outside surface of the absorbent material, and an energizable heating device fixed on or within the absorbent material;

a bipolar generator constructed and arranged to supply a certain electrical output;

bipolar forceps having a pair of opposed electrical contact blades; and

a cable arranged for connecting the electrical output from the bipolar generator to the bipolar forceps;

wherein the heating device of the bone wax applicator has associated electrical contact terminals, and is constructed and arranged to heat and soften the bone wax in response to the output of the bipolar generator when applied to the terminals of the heating device through the blades of the bipolar forceps.

11. A system according to claim 10, wherein the heating device of the bone wax applicator has a substantially non-inductive load impedance.

12. A system according to claim 10, wherein the heating device of the bone wax applicator comprises an electrically resistive conductor.

13. A surgical bone wax applicator according to claim 1, wherein the absorbent material is in the form of an elongate strip, and a mass of said bone wax is disposed at or near each end of the strip.

14. A surgical bone wax applicator according to claim 1, wherein the absorbent material is in the form of an elongate strip, and two or more masses of said bone wax are disposed at or near each end of the strip.

15. A system according to claim 10, wherein the absorbent material of the bone wax applicator is in the form of an elongate strip, and a mass of said bone wax is disposed at or near each end of the strip.

16. A system according to claim 10, wherein the absorbent material of the bone wax applicator is in the form of an elongate strip, and two or more masses of said bone wax are disposed at or near each end of the strip.

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