United States Patent [19]

Staub et al.

[11] **3,830,226**

[45] **Aug. 20, 1974**

[54] **VARIABLE OUTPUT NERVE LOCATOR**

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[73] Assignee: **Concept, Inc.**, Clearwater, Fla.

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[21] Appl. No.: **370,223**

[52] **U.S. Cl.** ..... **128/2.1 R**, 128/405

[51] **Int. Cl.** **A61f 5/00**

[58] **Field of Search** ..... 128/2.1 R, 2.1 C, 303.1, 128/303.13, 303.18, 405, 406, 2.06 R, 419 R; 324/51, 53

[56] **References Cited**

UNITED STATES PATENTS

1,548,184	8/1925	Cameron	128/409
2,437,697	3/1948	Kalom	128/2.1 R
2,949,107	8/1960	Ziegler	128/2.1 R
3,128,759	4/1964	Bellis	128/2.1 R
3,207,151	9/1965	Takagi	128/2.1 R
3,664,329	5/1972	Naylor	128/2.1 R

FOREIGN PATENTS OR APPLICATIONS

179,379	8/1954	Germany	128/2.1 R

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[57] **ABSTRACT**

An electrically powered nerve locator designed to be used on animal or human bodies comprising an elongated, hollow casing having a conventional direct current power source mounted therein and electrically connected to current regulator means so as to vary the energy output of the locator. A nerve probe is rotably mounted within the casing in circuit with the power source and the current regulator. A flexible conductor is disposed in electrical contact with the current source and a grounding needle is attached to the free end of the flexible conductor wherein the conductor is disposed and dimensioned to allow the needle to cooperatively engage a test aperture formed in the casing between the current source and the current regulator.

9 Claims, 6 Drawing Figures

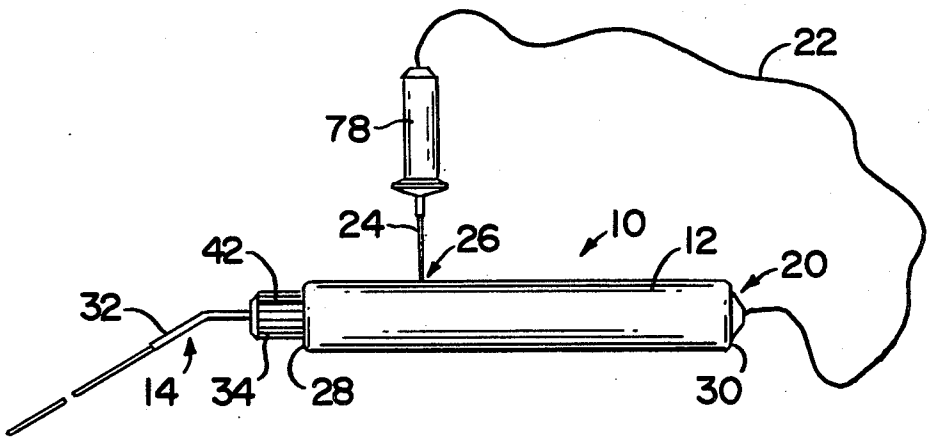


FIG. 3

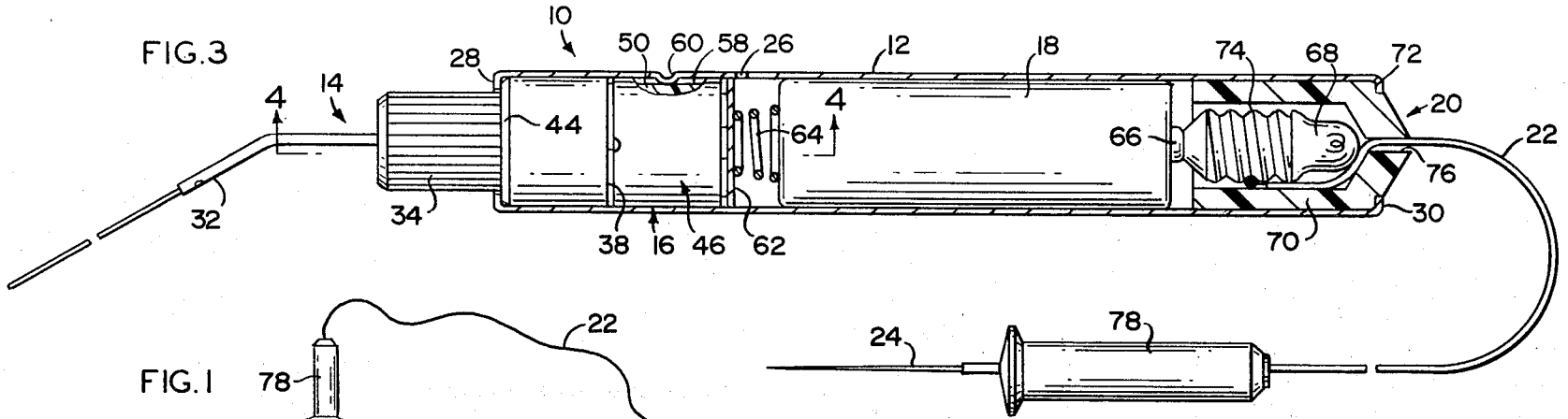


FIG. 1

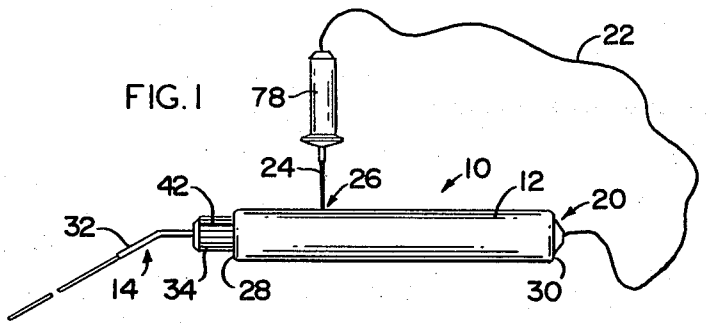


FIG. 5

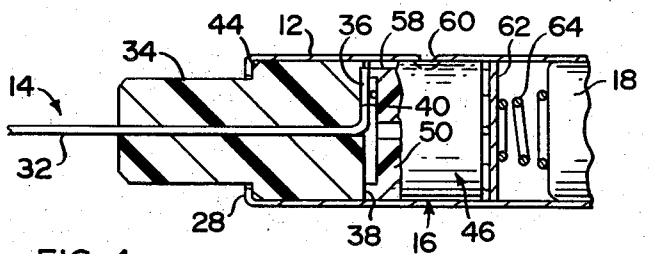
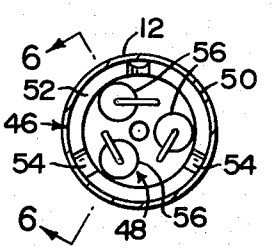


FIG. 4



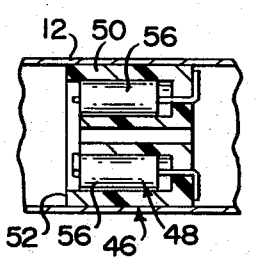


FIG. 6

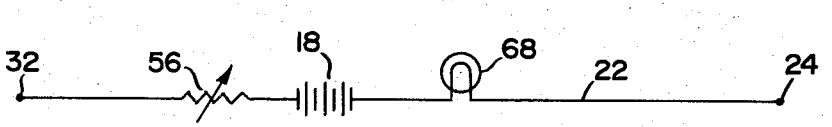


FIG. 2

VARIABLE OUTPUT NERVE LOCATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a portable, disposable, self-testing nerve locator including elements designed to be used on animal or human bodies such that its energy output may be varied.

2. Description of the Prior Art

Various types of nerve locators/stimulators, primarily designed for medical uses, are well known in the art. These type devices have been particularly popular in surgical procedures where identification and monitoring of motor nerves is necessary; e.g., long thoracic and inner coastal nerves and chest surgery, hand and joint surgery, traumatic surgery and head and neck surgery. However, prior art devices have proved to be generally unsatisfactory because of their large size, complexity, cost of manufacturing and difficulty of operation. Furthermore, it is desirable to be able to vary the amount of electrical energy output of the nerve locator. While most body nerves will not respond to less than 2 milliamperes of current, there are some nerves that cannot tolerate this much and may even be impaired to some extent by this great an output.

One such prior art device, U.S. Pat. No. 3,664,329, discloses a nerve locator/stimulator quite similar to the present invention. However, the disclosure of that device does not show means for varying its energy output.

U.S. Pat. No. 3,128,759 discloses a tooth vitality determining device having a variable output. Examination of this disclosure reveals, however, that the device is not self-contained or disposable, nor does it disclose the specific structural elements comprising the present invention.

Accordingly, it can be seen that there is a great need for a portable, disposable, self-testing nerve locator device which includes means for easily varying the energy output thereof.

SUMMARY OF THE INVENTION

This invention relates to a nerve locator device which includes means whereby the energy output thereof may be easily varied. More specifically, the device comprises a casing, a source of direct current disposed within the casing and current limiting means mounted in the casing in electrical contact with the source. A nerve probe needle is rotatably mounted at one end of the casing in electrical contact with the current limiting means and a flexible insulated conductor is mounted at the other end of the casing in electrical contact with the power source. Signal means in electrical series with the conductor and the source may be mounted within the casing. A grounding needle is in electrical contact with the other end of the conductor. Testing means may be formed in the casing between the source and the current limiting means.

The casing comprises a rigid tube preferably formed of polyvinyl material or a similar substance capable of being sufficiently durable to withstand relatively abusive treatment. The casing further includes inwardly extending annular retaining flanges on each end thereof to provide a container for other elements of the invention.

A nerve probe needle comprising a blunt electrical or current conducting probe is rigidly mounted in the probe needle retainer. The base of the nerve probe needle extends through the probe needle retainer and is bent across the base of the retainer into a slot formed thereon. The probe needle is formed from an insulating material and is rotably mounted within the casing. The base of the probe needle abuts the current limiting means.

The current limiting means is mounted within the casing by engaging a slot formed on the side of the current limiting means with a depression formed in the side of the casing, whereby the current limiting means is locked against rotary motion. The current limiting means comprises a housing having mounted therein a current regulator. The end of the current limiting means contacting the base of the nerve probe needle is constructed so that rotary motion of the needle results in selective engagement of the current regulator, whereby a predetermined current may be passed through the needle. The inner end of the current limiting means has electrical contact with a conductive disc, which in turn has electrical contact with a terminal of the direct current source.

The other terminal of the direct current source is in contact with the terminal of the test light bulb. The bulb retainer has an axial opening through which the insulated conductor is threaded, one end of which is in electrical contact with the metal casing of the bulb base, while its other end is connected to the ground needle.

The testing means comprises an aperture formed in the casing in corresponding relation to a point of contact between the source of direct current and the current limiting means. The aperture is configured to allow the grounding needle to pass therethrough. To test the device for operativeness the ground needle is inserted in the test aperture formed in the casing. The grounding needle contacts a spring interposed between the direct current source and the current limiting means, thereby bypassing the current limiting means. Thus, the full current output of the source is utilized to energize and light the test light bulb as a signal that the battery is in working order.

In normal use, the operator first determines the required current output needed for a particular application. The operator then sets the device to deliver this preselected current output by rotating the probe needle retainer. The current output selected is indicated by means of aligning an index mark formed on the exterior of the nerve probe retainer with a scale printed around the exterior of the casing. Having thus selected the desired output, the operator next inserts the ground needle into living subcutaneous tissue. The operator next inserts the probe needle into an incision to locate and/or stimulate a nerve controlling a motor muscle. Where the probe needle is touched to exposed nerve tissues, contraction of the normally innervated muscle will occur. Having previously determined by test that the battery is working properly, the current limiting means of proper value to deliver the desired output through the tissue being probed will be activated. It will be noted that the test bulb will not light because of reduced current output.

It will thus be seen that by virtue of the invention, a single device can be set to selectively deliver a variety of current outputs. The device can be presterilized as

a whole for one time use and may then be disposed of. The structure is simple, economical to manufacture, easy to use and is self-testing to insure sufficient current flowing through the device to stimulate normal nerve tissue.

The invention accordingly comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

FIG. 1 illustrates the device in the manner of testing.

FIG. 2 is a schematic representation of the series circuit utilized in the device.

FIG. 3 is a sectional view through the casing showing the various structural elements of the present invention in elevation.

FIG. 4 is a longitudinal sectional view taken along line 4—4 of FIG. 3 showing the nerve probe needle mounted in the insulating retainer.

FIG. 5 is an elevational view of the end of the current limiting means which contacts the nerve probe needle.

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5 showing details of the current limiting means.

Similar reference characters refer to similar parts throughout the several views of the drawings.

DETAILED DESCRIPTION

This invention relates to a variable output nerve probe device generally indicated as **10** in FIGS. **1** and **3.** The device comprises an elongated, hollow casing **12** having inturned annular flanges **28** and **30** formed on the ends thereof, and further includes a nerve probe needle generally indicated as **14** rotably mounted in one end of casing **12.** Current limiting means **16** is mounted within casing **12** in electrical series with nerve probe needle **14** and direct current source **18.** Flexible insulated conductor **22** is electrically attached to current source **18** at the other end of casing **12.** Grounding needle **24** is electrically connected to the free end of conductor **22.** Signal means generally indicated as **20** may be mounted in electrical series with conductor **22** and source **18.** Testing means **26** may be formed in casing **12** between source **18** and current limiting means **16.**

As best illustrated in FIG. **4,** nerve probe needle **14** comprises a blunt current conducting probe **32** rigidly mounted in insulating retainer **34.** Base **36** of current conducting probe **32** extends beyond the aft end **38** of insulating retainer **34** and is angularly oriented as much as **90** degrees or greater to retainer **34** to fit into correspondingly configured slot **40** correspondingly positioned on retainer **34.** A longitudinally extending index mark **42** is formed on the exterior of insulating retainer **34** in corresponding relation to slot **40.** Nerve probe needle **14** is rotably mounted in casing **12** and is held in position by engaging annular lip **44** of insulating retainer **34** with inturned annular flange **28.** Base **36** of current conducting probe **32** is in electrical contact with current limiting means **16.**

As best seen in FIG. **5,** current limiting means **16** comprises a housing generally indicated as **46** having mounted therein a current regulator generally indicated as **48.** Housing **46** comprises a manifold **50** having formed about the periphery of the end thereof in contact with blunt current conducting probe **32** an annular ridge **52** having formed therein a plurality of notches **54.** Current regulator **48** comprises a plurality of resistors **56** mounted in manifold **50** in corresponding relation to notches **54** for individual contact with blunt current conducting probe **32,** whereby a predetermined current is passed through nerve probe needle **14.** Current limiting means **16** is mounted in casing **12** by engaging longitudinal grooves **58** formed along the periphery of manifold **50** with depression **60** formed in casing **12,** whereby current limiting means **16** is locked against rotary motion. The inner end of current limiting means **16** has electrical contact with disc **62.** Current limiting means **16** and disc **62** are maintained in position by the outward biasing force of conductive spring **64,** as best seen in FIG. **3.** The inner end of conductive spring **64** is in electrical contact with direct current source **18.**

The other terminal **66** of direct current source **18** is in electrical contact with signal means **20.** Signal means **20** comprises test light bulb **68** and bulb retainer **70** mounted in casing **12** in series with direct current source **18** and flexible insulated conductor **22.** Signal means **20** is mounted in casing **12** by engaging annular shoulder **72** of bulb retainer **70** with inturned annular flange **30,** and is maintained in position by the outward biasing force of conductive spring **64.** Terminal **66** of direct current source **18** is in contact with terminal **74** of test light bulb **68.** Bulb retainer **70** has an axial opening **76** through which flexible insulated conductor **22** is threaded, one end of which is in electrical contact with terminal **74,** while its other end is connected to ground needle **24.**

Ground needle **24** is rigidly mounted in a hand gripping tube **78** having a longitudinal bore through which ground needle **24** and flexible insulating conductor **22** are connected.

Thus, it will be seen that in testing the device for operativeness, as illustrated in FIG. **1,** where ground needle **24** is inserted through test means **26** to contact conductive spring **64,** current limiting means **16** is bypassed, and the full current output of direct current source **18** is utilized to energize and light test light bulb **68** as a signal that the battery is in working order.

In normal use, the operator sets the desired output of the device by rotating insulating retainer **34** to the desired position, as indicated by index mark **42.** Ground needle **24** is implanted into living subcutaneous tissue and blunt current conducting probe **32** in inserted in an incision to locate and stimulate a nerve controlling motor muscle. Where the nerve probe needle is touched to exposed nerve tissue, the electical circuit is completed and contraction of normally innervated muscle will occur. Having previously determined by test that the device is in working order, the preselected resistor **56** to deliver the desired output through the tissue being probed will be activated. It will be noted that test light bulb **68** will not light because of reduced current output of the device.

It will thus be seen that the objects made apparent from the preceding description are efficiently attained, and since certain changes may be made in the above

construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Now that the invention has been described, what is claimed is:

1. A nerve locator device, said device comprising: a casing, a source of direct current disposed within said casing, current limiting means mounted in said casing in electrical contact with said source, a nerve probe needle rotably mounted in said casing in electrical contact with said current limiting means, conductor means electrically connected at one end with said source, a signal means electrically connected in series with both said conductor means and said source, a grounding needle means electrically connected with said conductor means, and means formed in said casing between said source and said current limiting means for allowing electrical contact between said grounding needle means and a point of contact between said source and said current limiting means.

2. A device as in claim **1** wherein said nerve probe needle comprises a current conducting probe rigidly mounted in an insulating retainer, the base of said nerve probe needle being configured to selectively engage said current limiting means whereby a predetermined current is passed through said nerve probe needle.

3. A device as in claim **2** wherein said base extends beyond the aft end of said insulating retainer and is angularly oriented as much as 90° or greater to fit into a correspondingly configured slot correspondingly formed in said insulating retainer aft end.

4. A device as in claim **2** wherein said insulating retainer includes an index mark formed thereon in corresponding relation to the point of contact of said nerve probe needle with said current limiting means.

5. A device as in claim **1** wherein said means comprises an aperture formed in said casing in corresponding relation to the point of contact between said source and said current limiting means, said aperture being correspondingly configured as said grounding needle means.

6. A device as in claim **1** wherein said current limiting means comprises a housing having mounted therein a current regulator.

7. A device as in claim **5** wherein said housing comprises a manifold, said manifold having an annular ridge formed about the periphery of the end thereof in contact with said nerve probe needle, said ridge having a plurality of notches formed therein, said current regulator comprises a plurality of resistors, said resistors being mounted in said manifold in corresponding relation to said notches for individual contact with said nerve probe needle whereby a predetermined current is passed through said nerve probe needle.

8. A device as in claim **5** wherein said current regulator comprises a potentiometer, said potentiometer being mounted in said housing and configured for contact with said nerve probe needle at a plurality of points, said contact at each of said points allowing a predetermined current to pass through said nerve probe needle.

9. A device as in claim **1** wherein said signal means comprises a test light bulb and a bulb retainer mounted in said casing electrically connected in series with said conductor means and said source.

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