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Vanslette

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[54] CONSTRUCTION OF ION ELECTRODE

[75] Inventor: **Robert A. Vanslette,** Medfield, Mass.

[73] Assignee: **The Foxboro Company,** Foxboro, Mass.

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[52] **U.S. Cl.** .....**204/195 M**

[51] **Int. Cl.**.....**G01n 27/46**

[58] **Field of Search**.....174/75 R, DIG. 8; 204/1 T, 204/195, 195.1

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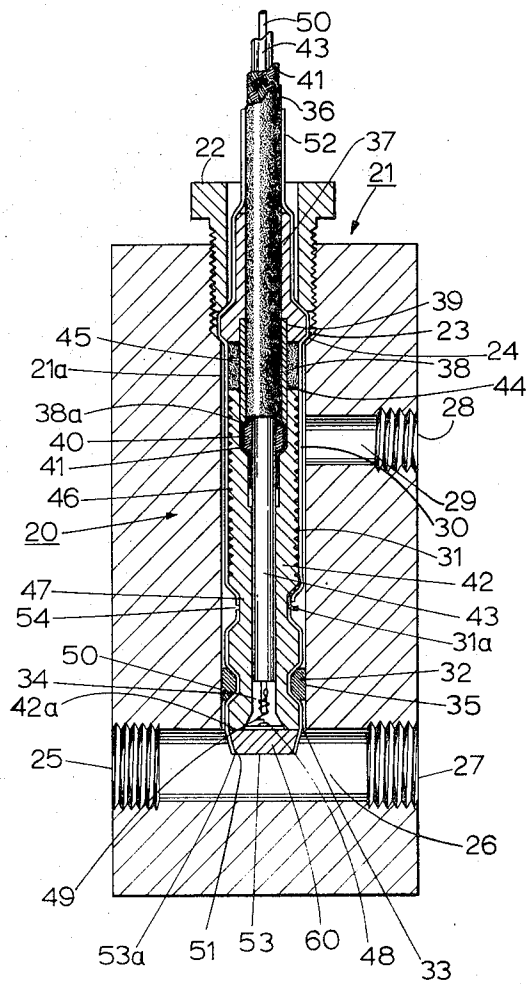
Primary Examiner—T. Tung

Attorney—Lawrence H. Poeton

[57] **ABSTRACT**

A compact construction for ion selective electrodes and reference electrodes, and a combination of both, is proposed wherein a plastic shrink tubing is employed for enclosing an integral assembly incorporating an attachment to an electrical cable; the shrink tubing also confines and supports the specific active membrane; the combination of specific ion and reference electrode is formed in a unitary compact assembly convenient for process applications.

5 Claims, 4 Drawing Figures



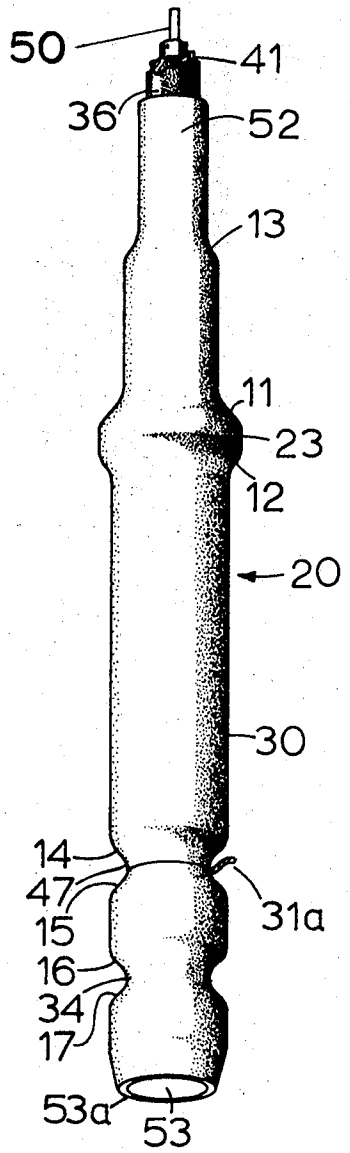


FIG. 1

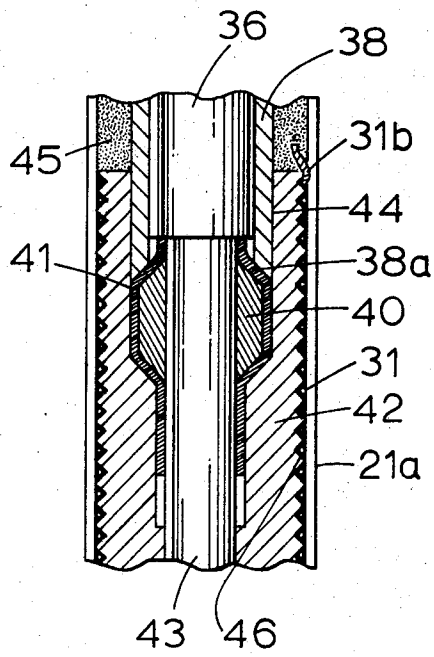


FIG. 3

INVENTOR.
ROBERT A. VANSLETTE
BY David E Hoffer
ATTORNEY

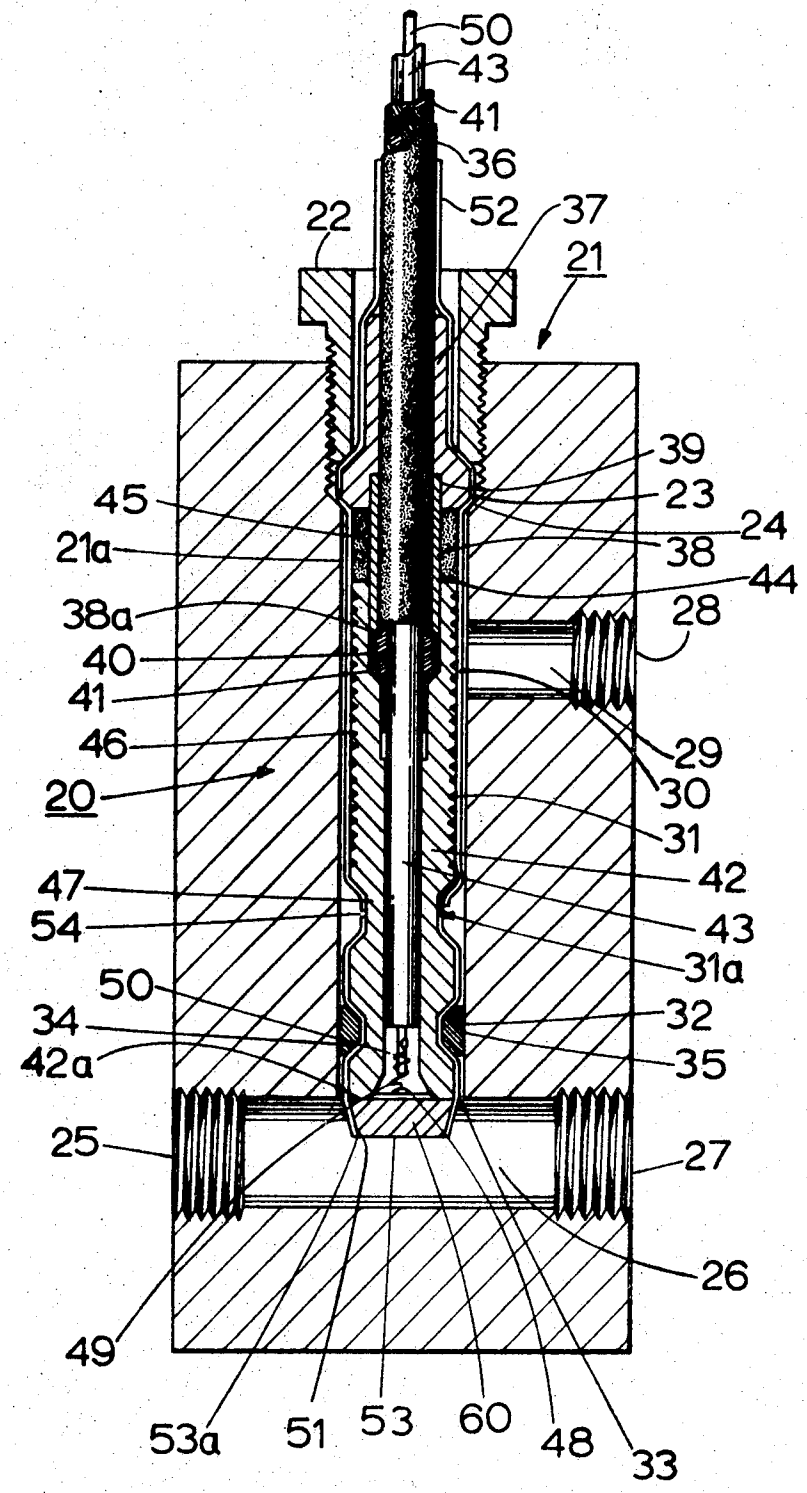


FIG. 2

INVENTOR.
ROBERT A. VANSLETTE
BY David E Hoffe
ATTORNEY

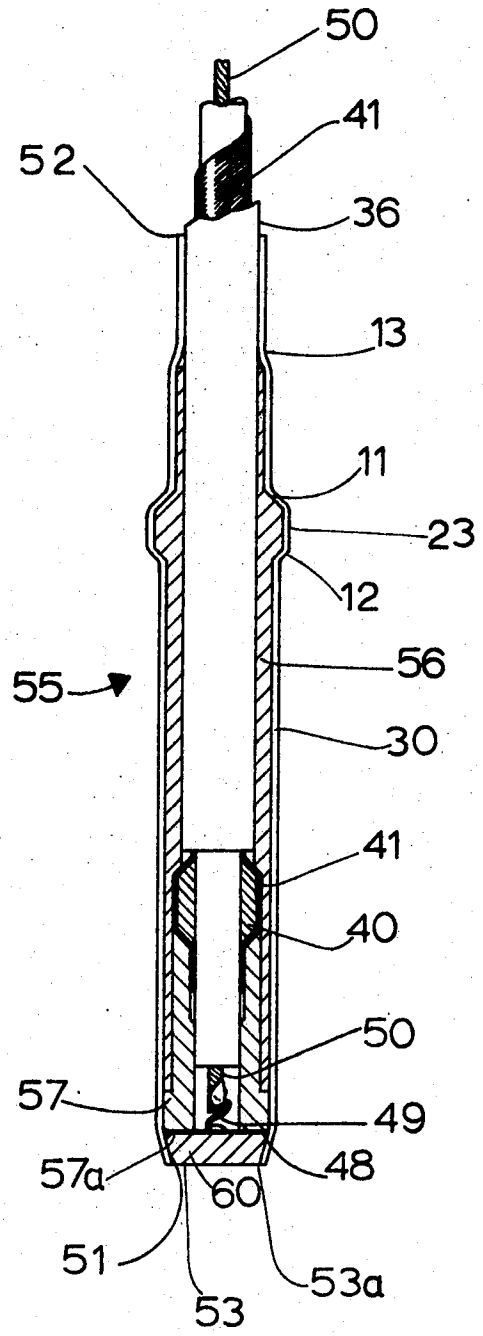


FIG. 4

INVENTOR.
ROBERT A. VANSLETTE
BY David E. Hoffe
ATTORNEY

CONSTRUCTION OF ION ELECTRODE

This invention relates to construction of ion selective and reference electrodes, and in particular to a combination construction containing both measurement and reference junctions.

It is desireable in electrode construction to provide a compact unitary assembly which may be readily employed in process applications. The invention is for an assembly enclosed and attached to an electrical conductor by a shrink tubing, whereby the finished product is in the form of an electrical cable having a firmly attached electrode assembly at its tip. The construction of the electrode is simple compact, inexpensive, conveniently handled and replaced, and suitable for a variety of applications. The arrangement of the invention in particular permits a combination electrode application employing a salt solution for an electrolyte which is not saturated with silver chloride. In this application, the silver is internal to the electrode, and the salt solution appearing at the process junction consequently contains little silver to cause precipitation at the junction with the consequent plugging and fouling common to electrodes of conventional construction. Consequently, an electrode constructed in accordance with the invention will require minimal maintenance during its life.

These and other advantages of the invention will be apparent from the following specification taken together with the various FIGS. in which;

FIG. 1 is a three-dimensional outline view of a combination electrode;

FIG. 2 is a cross-sectional view of the combination electrode in combination with a cell;

FIG. 3 is a detailed view in cross-section of a portion of the combination electrode;

FIG. 4 is a cross-sectional view of a construction of a measurement electrode in which the which the reference junction is omitted.

Referring to FIG. 1, a three dimensional outline view of a combination electrode **20** is represented, which is a unitary construction covered overall by a shrink tubing **30** extending from circumference **53***a* of active face **53** up to end **52** of tubing **30** which is shrunk fit over coaxial cable **36**. The portion of shrink tubing **30** between shoulder **13** and end **52** makes a close shrink fit with coaxial cable **36** to serve in sealing and retaining the electrode **20** in integral relationship with coaxial cable **36**. Shoulder **23**, together with faces **11** and **12** thereof, serve as mounting and retaining means for electrode **20**, to be placed in an appropriate receptacle **21***a* such as is shown interior to cell **21** in FIG. **2**. Indentation **47** is provided in the region that wick end **31***a* is extended from shrink tubing **30**, the space provided for by indentation **47** being filled with electrolyte solution under operating conditions. Indentation **34** is provided for retaining and locating a porous member **32**, shown in FIG. **2**, serving as a process junction in an appropriate application. The view of FIG. **1** represents the exterior appearance of a combination electrode **20** shown in cross-sectional particulars in FIG. **2**. The view of FIG. **1**, without indentations **47** and **34**, and without wick end **31a** would closely represent the external appearance of a sensing ion electrode construction **55** shown in cross-sectional particular in FIG. **4**.

Referring to FIG. **2**, combination electrode assembly **20** is shown installed in cell **21**, combination electrode

20 being held in place by means of threaded collar **22** which clamps shoulder **23** of electrode **20** against shoulder **24** of the cell **21** receptacle **21a**. The process stream is injected into inlet **25** of cell **21** passing through channel **26** and exiting from outlet of cell **21**. The salt solution, conveniently one molar potassium chloride, is injected into inlet port **28** at a small positive pressure. The salt solution flow along channel **29** into the interior receptacle **21a** of cell **21** comes in contact with shrink tubing **30** of combination electrode **20**, and flows therealong following the outside of combination electrode **20**, coming in contact with wick end **31a**, in a electrolyte region provided for by indentation **47** of electrode **20**. The salt solution continues therefrom through porous fiber gasket **32** into the process stream. Porous fiber gasket **32** provides for the process junction, providing an interface between the salt solution and the process solution. It will be seen that the process solution will enter into annular channel **33** between the combination electrode **20** and the inside diameter of the lower part of receptacle **21***a*. Porous gasket **32** has a size such as forms a sealable contact between the body of combination electrode **20** at indentation **34** thereof and inner wall **35** of cell receptacle **21***a*.

The construction of combination electrode **20** may be seen, referring to FIGS. **2**, and the detail shown in FIG. **3**, in that a coaxial cable **36** is employed for the electrical connections. Annular insulator **37** is fitted over the outside insulation of coaxial cable **36**. A silver sleeve **38** is also fitted over the outside insulation of cable **36**, sleeve **38** being cemented to insulator **37** at abutment **39** therebetween. The insulation of coaxial cable **36** is stripped from the sensing end up to sleeve **38**, and annular ferrule **40** is inserted underneath braid **41**, so that braid **41** contacts end **38***a* of sleeve **38**. Insulator **42** is slipped over the inner insulator **43** of coaxial cable **36**, in a manner to compress braid **41** and annular insert **40** against sleeve end **38***a*. Insulator **42** is cemented to abutting region **44** between sleeve **38** and insulator **42**. The region **45** annular to sleeve **48** provided for between insulator **37** and insulator **42** is filled with a silver chloride powder or paste, such as may be conveniently applied circumferentially to sleeve **38** prior to the application of shrink tubing **30**. End **31b** of wick **31** is in contact with silver chloride region **45**, and wick **31** runs therefrom along threaded grooves **46** on the body of insulator **42** down to indentation **47** of insulator body **42**.

For the sensing end of the electrode, an active membrane **60** is cemented, such as by epoxy to end **42***a* of insulator **42**. Active membrane **60**, employing material such as pressed silver sulfide for sulfide measurement, is backed by silver backing **48** and connected by wire **49**, preferably silver, to center conductor **50** of the coaxial cable. Some suitable non-hardening sealant is applied to the outside diameter **51** of membrane **60**, and tubing **30** shrunk over the entire assembly, thus making a continuous sealed assembly from point **52** abutting the outside insulator of coaxial **36** down to face **53** of the active membrane **60**. The tubing **30** may be any resilient shrinkable covering material suitable for the intended environmental conditions; any suitable method of shrinking the material may be employed. The non-hardening sealant prevents leakage under variable environmental conditions. A cut **54**, which

may be circumferential or alternatively a small opening for the wick, is made in the body of tubing **30** at indentation **47** of insulator **42**, and end **31a** of wick **31** pulled out therefrom for contacting the salt solution supplied to the annular region defined by indentation **47** and walls **14** and **15** thereof. Shrink tubing **30** is trimmed to present a flush uniform with face **53** of membrane **60**.

In operation, the electrolyte solution is wicked into electrode **20** by wick end **31***a* extending into the electrolyte solution in the region of indentation **47**, the electrolyte wicking up the length of wick **31** along screw thread **46** to wick end **31b** wetting the silver chloride powder **45** thereby creating a wet silver chloride half cell reference junction. The electrical signal therefrom is taken via coaxial braid **41** and supplied to conventional measuring equipment, not shown. Inasmuch as any silver is internal to the electrode **20**, the solution entering into the process contains very little silver at junction **32**, thus reducing precipitation at junction **32**. The signal from the ion sensing membrane **60** is taken via center conductor **50** of coaxial cable **36** and supplied to conventional measuring equipment, not shown.

Referring to FIG. **4**, a construction of an electrode is shown in which the reference junction is omitted, and in which only the ion selective measurement function is provided. An electrode body **56** is placed over coaxial cable **36**, electrode body being of any suitable material. Ferrule **40** is inserted under braided shield **41** and a lower body piece **57**, made of some suitable insulating material, is slipped over the braid end and the inner coaxial insulator, body piece **57** being cemented to body piece **56**. Alternatively, the body pieces **56** and **57** may be formed as part of a molded assembly in which the molded assembly provides a strain relief for the electrical cable **36** and support for the pellet **60**. The ion selective membrane **60**, such as a silver sulfide pellet, is epoxied to end **57***a* of lower body piece **57**, and a silver backing **48** of pellet **60** is connected by thin wire **49** to center conductor **50** of the coaxial cable. As an alternative form of construction, not shown, a conventional liquid electrical connection may be employed, such as the saturated potassium chloride used with pH electrodes. A non-hardening sealant is applied to circumferential portion **51** of pellet **60** and a shrink tubing **30** applied over the entire assembly, extending from pellet **60** face **53** up to point **52** on coaxial cable **56**. The finished assembly includes a shoulder **23** for mounting to the appropriate application. It is to be noted that the resilient tubing in the region of shoulder **23** provides means for sealing the electrode with the receptacle employed without requirement for additional seals or gaskets.

What is claimed is:

1. An ion electrode assembly comprising:

a tubular body of insulating material,

an ion selective membrane supported in contact with one end of said tubular body,

a coaxial electrical cable disposed in said body and being solidly electrically connected to said ion selective membrane,

a resilient tubing being sealably shrinkfitted over the outside of said tubular body and said electric cable,

said tubing extending from a seal with the outside of said electrical cable to said membrane and over the circumference of said membrane to its exposed sensing face,

and a non-hardening sealant disposed between said resilient tubing and said circumference of said membrane,

whereby said membrane is supported by said resilient tubing.

2. The ion electrode assembly as claimed in claim **1** further including:

a reference junction enclosed within said resilient tubing, said reference junction being electrically connected with the outside conductor of said coaxial electrical cable.

3. The ion electrode assembly as claimed in claim **2** further including:

a wicking means incorporated with said reference junction having an end protruding through said tubing.

4. The ion electrode assembly as claimed in claim **1** wherein said tubular body includes a shoulder portion adapted to provide means for sealably mounting said assembly to a receptacle.

5. The ion electrode assembly as claimed in claim **1** wherein one end of said resilient tubing is substantially flush with exposed sensing face of said membrane.

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