NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: GP

March 27, 1971

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General
Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned
U.S. Patents in STAR

In accordance with the procedures contained in the Code GP to Code USI memorandum on this subject, dated June 8, 1970, the attached NASA-owned U.S. patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U.S. Patent No. : 3,356,885

Corporate Source : Lewis Research Center

Supplementary
Corporate Source :

NASA Patent Case No.: XLE-02578

Gayle Parker

Enclosure:
Copy of Patent

N71-20747

Dec. 5, 1967 A. F. BECK 3,356,885

SMALL PLASMA PROBE

Filed July 1, 1965

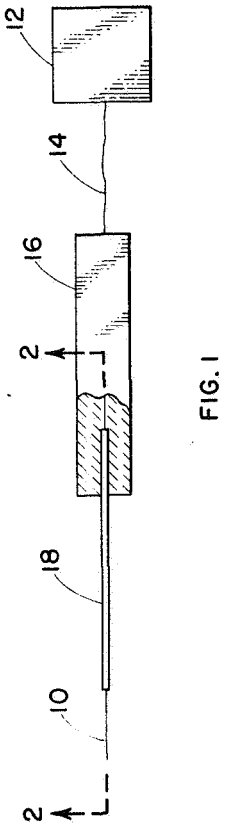

FIG. 1

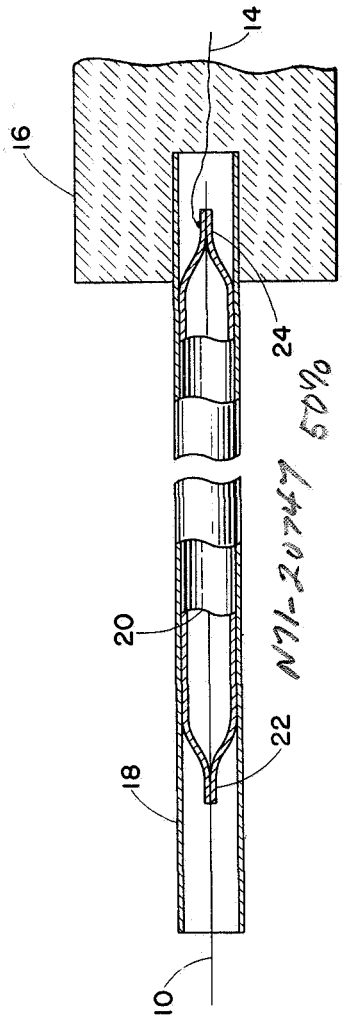

FIG. 2

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United States Patent Office 3,356,885
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3,356,885

SMALL PLASMA PROBE

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5 Claims. (Cl. 313—271)

ABSTRACT OF THE DISCLOSURE

A very small plasma probe in the form of a tungsten wire collector supported in a tubular shield by a hypodermic tubing liner. Both ends of the liner are symmetrically pinched onto the wire to center the collector in the shield.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention is concerned with sensors for studying various properties of ionized gases and, more particularly, is directed to small plasma probes. The invention further relates to plasma probes having improved structures which maintain the probe components in their proper positions relative to each other.

Various devices have been used in the past to measure the properties of ionized gases. The operation of such devices relies on the fact that any object of device in contact with a plasma or neutral ionized gas accumulates a negative charge. This potential difference between the plasma and the contacting object develops because electrons in the plasma have much greater velocities than ions therein.

A probe can be placed in a plasma and connected through a variable potential, with appropriate instrumentation, to another electrical entry into the plasma, such as one of the electrodes used to generate the plasma or another probe. The probe potential can be varied from negative to positive relative to the plasma, and characteristic positive to negative currents, respectively, can be measured. When the shapes and areas of these probes are known, values for plasma properties can be obtained from the voltage-current functions. Because the general principles of plasma probes have been publicized in the literature, a knowledge of such general principles will be assumed in what follows. Reference is made to the General Electric Review No. 27.

Because of the size, conventional probes cause local perturbations of the plasma being measured which effect the accuracy of the data obtained. Also, certain shielding is required to prevent the deposition of a conductive coating on certain portions of the probe. Such coatings add to the collecting area and make it difficult to determine the actual area of the collecting surface. This shielding gives rise to several problems because it not only increases the physical size of the probe, but also fails to function properly if the various components of the probe are not properly positioned. As the size of the probe is decreased the problem of fabrication increases because of the close tolerances involved and the difficulty of obtaining reliable electrical connections.

These problems have been solved by probes constructed in accordance with the present invention which are very small in size to reduce local perturbations in the plasma. Also, these probes have portions of their collectors shielded by a tubular member. Each collector is supported inside its tubular shield in such a manner as to reduce the possibility of the collector contacting the shield.

It is, therefore, an object of the present invention to provide a device for measuring the properties of a plasma which is small in size to reduce the effect of its presence on the plasma being measured.

Another object of the invention is to provide a very small plasma probe having a collector that is shielded to prevent the deposition of conductive coatings on areas adjacent the collector which would increase the area of the collecting surface.

A further object of the invention is to provide a small plasma probe which is easily fabricated.

These and other objects of the invention will be apparent from the specification which follows and from the drawings wherein like numerals are used throughout to identify like parts.

In the drawings.

FIG. 1 is a partial sectional view of a plasma probe constructed in accordance with the invention, and

FIG. 2 is an enlarged sectional view taken along the line 2—2 in FIG. 1.

Referring now to the drawings, there is shown in FIG. 1 a very small plasma probe constructed in accordance with the invention. This probe includes a collector **10** in the form of a wire that is connected to a suitable variable potential source **12** through a lead **14**. The collector **10** is carried by a support **16** of an insulating material which is used to position the collector in the ionized gas to be studied. A ceramic rod having a diameter of ⅛ inch has provided a satisfactory support for a one-mil tungsten wire collector.

A hollow shield **18** of an insulating material is utilized to prevent the conductive coating which is deposited on the collector **10** during normal use of the probe from extending onto the support **16** which would increase the collecting area of the probe. The width of the hollow shield **18** is kept as small as possible to reduce perturbations in the plasma being studied. Clearance between the collector **10** and the bore of the hollow shield **18** is required to prevent the conductive coating from bridging the space at the end of the shield which is shown in FIG. 2. A quartz tube having an inside diameter of 0.015 inch and a wall thickness of 0.0015 inch has been satisfactorily used to shield the aforementioned one-mil tungsten wire collector. The collector wire **10** must be rigidly supported and properly centered within the bore of the shielding tube **18** to prevent the collector wire from being displaced laterally toward the surface of the bore.

According to the present invention, the collector wire **10** is mounted in the shielding tube **18** by a deformable metal liner **20**. Both ends of the liner **20** are symmetrically pinched or swaged at **22** and **24** onto the collector wire **10** as shown in FIG. 2. Electrically conducting tubing of the hypodermic type having an outside diameter of 0.010 inch has been satisfactory when used with the above-mentioned tubular quartz shield and tungsten wire collector.

The probe is assembled in accordance with the invention by first passing the collector wire **10** through the metal liner **20** while permitting one end of the wire to extend a proper distance from the end **22** of liner. The ends of the tubular liner **20** are pinched at **22** and **24** onto the wire **10** to center it along the axis of liner which is inserted into the quartz shielding tube **18** so that the protruding end of the wire **10** extends a proper distance from the end of the shield as shown in FIG. 2. The lead **14** is then soldered to the pinched end **24** which eliminates any fragile electrical connection directly between the wire **10** and the lead **14**. The liner **20** is then inserted into the shielding tube **18**, and the pinched end **22** of the liner should be positioned well inside the shielding tube to prevent any bridging by the collective film.

By way of example, 1½ inch length of hypodermic tubing **20** was pinched to a length of one-mil tungsten wire **10** so that one end of the wire extended approximately ¼ inch from a pinched end **22** of the tubing. After connecting the lead **14** to the pinched end **24**, the wire **10** and hypodermic tubing **20** were inserted in a quartz shielding tube **18** until the opposite pinched end **22** was approximately 0.1 inch from the outermost end of the shielding tube, and the outermost end of the collector wire protruded approximately 0.15 inch beyond the end of the shielding tube.

After the tubing **20** which carries the wire **10** has been secured to the bore of the shielding tube **18**, the assembly is mounted on the end of the support rod **16** as shown in FIG. 1. This is accomplished by inserting the quartz tubing **18** with the hypodermic tubing **20** contained therein approximately ½ inch into a suitable hole of the support rod **16**.

While only one embodiment of the invention has been shown and described, it will be appreciated that various structural modifications may be made to the disclosed plasma probe without departing from the spirit of the invention or the scope of the subjoined claims.

What is claimed is:

1. A probe for measuring the properties of ionized gases comprising,

an elongated collector adapted to be electrically connected to a variable potential source,

a support mounting said collector for insertion into the ionized gases,

a hollow shield extending outward from said support for preventing the deposition of a conductive coating on said support adjacent said collector,

a liner in engagement with the inner surface of said shield for mounting said collector therein, one end of said collector extending outward from said liner away from said support through said shield so that a portion of said one end of said collector extends outward from said shield into said ionized gases, said one end of said collector being spaced from said inner surface of said shield.

2. A probe as claimed in claim **1** wherein the collector comprises a length of one-mil tungsten wire.

3. A probe as claimed in claim **1** wherein the shield comprises a length of quartz tubing.

4. A probe as claimed in claim **1** wherein the liner comprises a length of deformable tubing having at least one end thereof pinched on the collector and adapted to be electrically connected to the variable potential source.

5. In a probe for measuring the properties of ionized gases of the type having a collector wire connected to a variable potential source and a support for mounting the collector wire for insertion of an end thereof into the ionized gases, the improvement comprising

a tubular shield surrounding a portion of the end of the collector wire in the ionized gases, and

a length of deformable tubing rigidly mounted in said shield, a portion of said deformable tubing being pinched onto said collector wire for maintaining the same concentric with the bore of said tubular shield.

References Cited

UNITED STATES PATENTS

2,653,199 9/1953 Brown et al. ------ 313—152 X

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