Nov. 17, 1970 R. TENENHOLTZ 3,541,480

BUTT DIODE CONTACTING

Filed Sept. 30, 1968

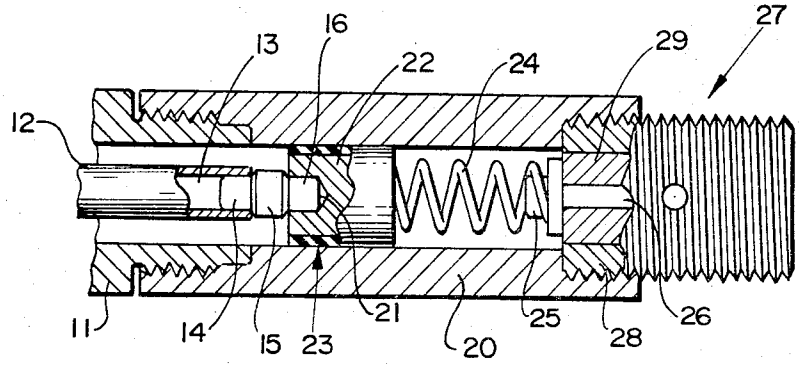


FIG. 1

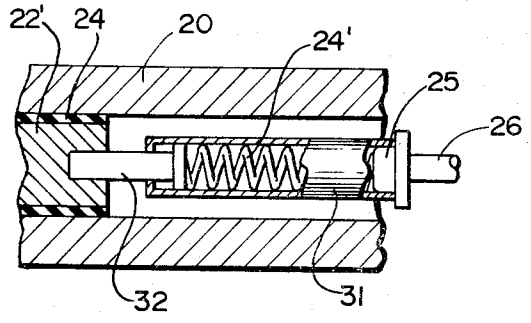


FIG. 2

INVENTOR.

ROBERT TENENHOLTZ

BY

Wolf, Greenfield & Hieken

ATTORNEYS

United States Patent Office 3,541,480 Patented Nov. 17, 1970

3,541,480

BUTT DIODE CONTACTING

Robert Tenenholtz, Framingham, Mass., assignor to Sage Laboratories, Inc., Natick, Mass., a corporation of Massachusetts

Filed Sept. 30, 1968, Ser. No. 763,576
Int. Cl. H01p 1/00
U.S. Cl. 333—98 7 Claims

ABSTRACT OF THE DISCLOSURE

A spring loaded butt contact establishes good connection to a microwave diode electrode while comprising an R-F bypass and a connecting link to the inner conductor of a low frequency coaxial output terminal pair.

BACKGROUND OF THE INVENTION

The present invention relates in general to contacting high frequency diodes and more particularly concerns a novel means for establishing a good mechanical and electrical contact to the diode to enhance mechanical strength, reliability and reduce sensitivity to dimensional tolerances. The invention establishes positive electrical contacting under a wide variety of mechanical and environmental conditions while reducing costs and facilitating correct and easy replacement of diodes by unskilled personnel.

For many years resilient finger contacts have been used for connecting microwave diodes in coaxial and waveguide circuits. Although these contacts have performed reasonably well under normal circumstances, any deviation from ideal conditions, such as departure from mechanical tolerances, replacement by inexperienced technical personnel, unusual environmental conditions and the like can present problems. These prior art contacts typically are slotted, crimped and usually heat treated annular conductors of resilient material. The diode may then be snapped into place to be grasped by the finger contacts. In addition to the disadvantages enumerated above, one or more resilient fingers may be bent during diode replacement and possibly resulting in permanent damage.

Accordingly, it is an object of this invention to provide high frequency contacting that overcomes one or more of the disadvantages enumerated above.

It is a further object of the invention to provide microwave diode contacting that is stronger, more reliable and less critical with regard to dimension tolerances associated with diodes.

It is a further object of the invention to provide microwave diode contacting that provides positive electrical contact under a wide variety of mechanical and environmental conditions while providing greater freedom from criticality in microwave circuit design.

It is a further object of the invention to achieve one or more of the preceding objects while reducing costs.

It is a further object of the invention to achieve one or more of the preceding objects while facilitating easy replacement of defective microwave diodes by unskilled personnel without reducing circuit performance.

It is still a further object of the invention to achieve one or more of the preceding objects with increased reliability.

SUMMARY OF THE INVENTION

According to the invention, there is means for butt contacting at least one electrode of a high frequency diode. Preferably the invention comprises spring means for urging the butt contacting means against the diode electrode. According to a specific form of the invention the means for butt contacting comprises a conducting cylinder formed with an axially centered opening for snugly receiving a

diode electrode and insulatedly separated from the outer coaxial conductor surrounding the microwave diode and the butt contact so that the latter also comprises an R-F bypass capacitor. Preferably a spring connected between an inner conductor connected to a low frequency coaxial output terminal pair and the butt contact urges the latter to make good mechanical and electrical contact with the microwave diode contact while electrically connecting the latter to the low frequency inner terminal. According to another form of the invention a low inductance assembly includes a spring seated inside a coaxial sleeve centered about the axis that acts on a piston attached to the butt contact.

Numerous other features, objects and advantages of the invention will become apparent from the following specification when read in connection with the accompanying drawing in which:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional view through a typical spring loaded diode contacting arrangement according to the invention; and

FIG. 2 is a view of an alternate low inductance spring loaded diode contacting arrangement according to the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference now to the drawing and more particularly FIG. 1 thereof, there is shown a sectional view through an exemplary embodiment of a typical butt diode contacting arrangement according to the invention. Outer conductor **11** and inner conductor **12** may form the output terminal pair of a hybrid or other device in which there is microwave energy between inner conductor **12** and outer conductor **11**. Inner conductor **12** is formed with a recess **13** for snugly accommodating electrode **14** of microwave diode **15**. The other electrode **16** of microwave diode **15** snugly rests in butt contact with the opening **21** of cylindrical butt contact **22** that is insulatedly separated from outer conductor **20** by an insulating sleeve **23** so that butt contacting element **22**, outer conductor **20** and insulating sleeve **23** form an R-F bypass capacitor. Insulating sleeve **23** thus prevents and allows radial and axial movement respectively of cylindrical butt contact **22**. A spring **24** urges butt contact **22** firmly against electrode **16** of diode **15** and urges diode **15** against inner conductor **12** so that the other diode electrode **14** snugly engages inner conductor **12** in butt contacting relationship. The right end of spring **24** is connected to stud **25** attached to low frequency inner conductor **26** that comprises the inner terminal of low frequency output coaxial terminal pair **27**. Inner conductor **26** is seated within an insulating sleeve **29** that in turn snugly fits within outer conductor **28**. Outer conducting sleeve **20** is conveniently internally threaded at both ends as shown so that it may screw on the externally threaded outer conductor **11** and receive the externally threaded outer conductor **28**.

Inserting or replacing a microwave diode is extremely simple. Outer conductor **20** is unscrewed, an electrode **14** of a new diode **15** is inserted in recess **13**, and outer conductor **20** screwed on over outer conductor **11**. Electrode **16** automatically seats in recess **21**. The diode will be properly and securely positioned from both mechanical and electrical viewpoints.

Referring to FIG. 2, there is shown an alternate spring arrangement in which a conducting sleeve **31** carries spring **24'**. Spring **24'** acts on a piston **32** soldered to butt contact **22'**. The other end of sleeve **31** fits snugly on stud **25** attached to inner conductor **26**. This assembly is characterized by exceptionally low inductance.

There has been described novel butt contacting means characterized by excellent mechanical and electrical contacting, insensitivity to mechanical variations and environmental conditions, ease of replacement, ease of manufacture, low cost and high reliability. It is evident that those skilled in the art may now make numerous uses and modifications of and departures from the specific embodiments and techniques described herein without departing from the inventive concepts. Consequently, the invention is to be construed as embracing each and every novel feature and novel combination of features present in or possessed by the apparatus and techniques herein disclosed.

What is claimed is:

1. High frequency device butt contacting structure comprising,
   - means defining a cylindrical conducting plug,
   - means defining a conducting housing normally maintained at reference potential,
   - annular sleeve means for insulatedly supporting said conducting plug within said conducting housing to allow and prevent axial and radial movement respectively of said plug within said housing and coacting therewith to form a bypass capacitance from said plug to said housing,
   - said conducting plug being formed with an opening for snugly receiving a device terminal in butting mechanical and electrical contacting relationship,
   - and spring means insulatedly separated from and within said conducting housing for urging said conducting plug against a microwave device terminal.

2. High frequency device butt contacting structure in accordance with claim 1 and further comprising,
   - a low frequency coaxial output terminal pair having an inner terminal connected by means including said spring means to said conducting plug and an outer conductor connected to said conducting housing.

3. High frequency device butt contacting apparatus in accordance with claim 2 wherein said recess in said conducting plug embraces the axis of said inner conductor.

4. High frequency device butt contacting structure in accordance with claim 3 and further comprising a conducting sleeve surrounding said spring means and contacting said inner conductor and supporting a piston urged against said conducting plug by said spring means to comprise a low inductance connection between said conducting plug and said inner conductor.

5. High frequency device butt contacting apparatus in accordance with claim 3 and further comprising,
   - another coaxial terminal pair having an outer conductor and an inner conductor formed with a second recess for receiving another electrode of a device.

6. High frequency device butt contacting apparatus in accordance with claim 5 and further comprising said device,
   - said device being a microwave diode having a pair of inline electrodes seated in respective ones of said recesses to coaxially mount said diode intercoupling said recesses in rectifying contact.

7. High frequency device butt contacting structure comprising,
   - means defining the outer conductor of a coaxial line,
   - and central means coacting with the outer conductor to form a coaxial line,
   - the central means comprising a conductive sleeve surrounding spring means in contacting relationship with a coaxial line center conductor stud and supporting a piston urged away from the stud by the spring means to comprise a low inductance connection between the piston and the stud.

References Cited

UNITED STATES PATENTS

2,642,494	6/1953	Zaslavsky et al.	329—162 X
2,810,829	10/1957	Schrock	329—162
2,894,229	7/1959	Fonda-Bonardi	333—98
3,002,155	9/1961	Dees	329—162
3,079,564	2/1963	Bogle et al.	329—162
3,191,125	6/1965	Hunton et al.	333—98 X

HERMAN KARL SAALBACH, Primary Examiner

S. CHATMON, JR., Assistant Examiner

U.S. Cl. X.R.

317—236; 329—162; 333—13