

June 21, 1960

H. L. LEVIN ET AL

2,942,149

LIQUID COOLED ATTENUATOR AND HELIX SUPPORT

Filed Aug. 20, 1959

Fig. 1

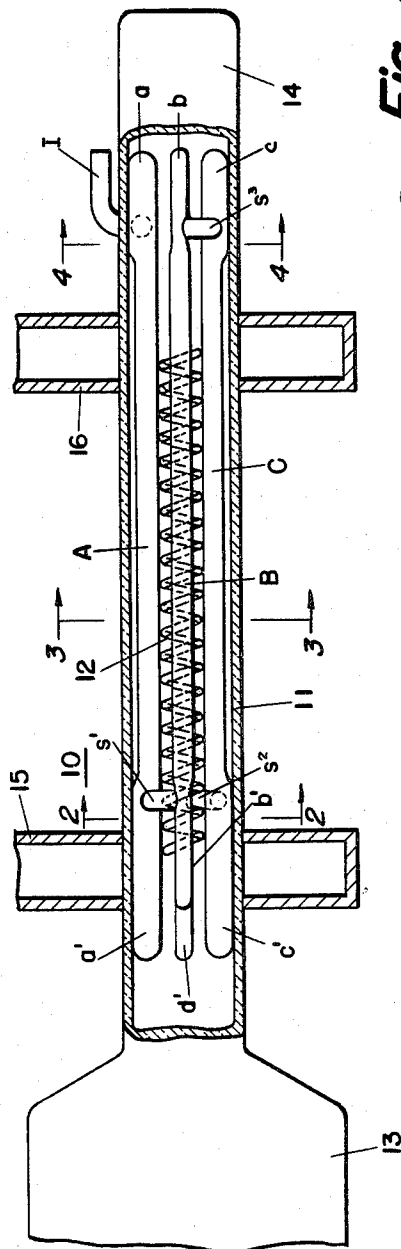


Fig. 4

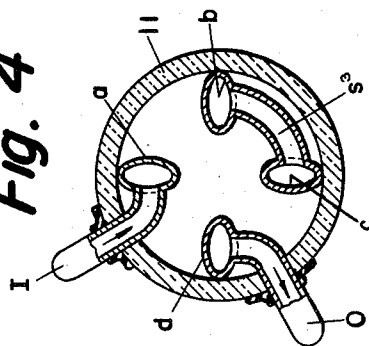


Fig. 3

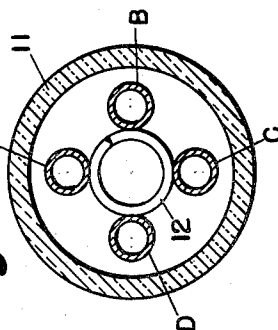
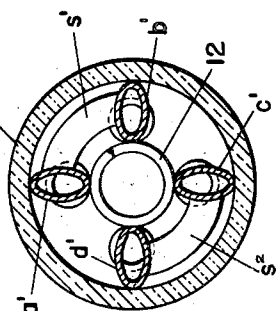


Fig. 2



INVENTORS
HERBERT L. LEVIN
THEODORE J. MARCHESE
BY

J. F. Sheehan
ATTORNEY

1

2,942,149

LIQUID COOLED ATTENUATOR AND HELIX SUPPORT

Herbert L. Levin, Paterson, N.J., and Theodore J. Marchese, Sepulveda, Calif., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Filed Aug. 20, 1959, Ser. No. 835,157

3 Claims. (Cl. 315—39.3)

This invention relates to traveling wave tubes and particularly to such apparatus utilizing a helically wound conductor for propagating electro-magnetic waves for interaction with an electron beam which is projected axially through the traveling wave tube.

In traveling wave tubes of the helix conductor type, various cooperating elements are enclosed in an evacuated envelope. The envelope having closed end portions which are usually enlarged providing an elongate central portion in which the helix is housed while one end portion houses an electron gun assembly for producing an electron beam and the other end portion houses a collector assembly. The evacuated envelope which encloses the various elements is usually constructed of a low loss insulating material such as glass or quartz and has between its end portions, on the elongate central portion, a laterally disposed wave guide for supplying the input wave signal to the helix for amplification and an output wave guide for removing the amplified output wave for desired use or application.

In such traveling wave tubes it has usually been found desirable to introduce loss along the helix or helical conductor in order to attenuate or dissipate any waves which may be reflected from the output section of the envelope in a reverse direction towards the input section. These reflected waves are generally caused by discontinuities in the electromagnetic fields along the wave path, particularly where the wave is conducted from the helix to the waveguide. To assist in accomplishing this attenuation, glass or quartz support rods of elongate design have been used and arranged generally in the central elongate section of the wave tube to mount the helix and these rods have been sprayed or coated with a lossy resistive material to provide loss along the wave path. The purpose of using a lossy material is to introduce an artificial loss along the helix which attenuates or dissipates the reflected waves and thereby suppress oscillations; however, the introduction of attenuation to the wave tube presents another problem, that of removing the resultant heat energy.

The principal object of the present invention resides in providing an attenuating and supporting structure for the helix which is arranged to permit the circulation of a fluid for the removal of heat energy resulting from the attenuation or dissipation of the reflected waves.

Other objects of the invention will become apparent from the following detailed description of the invention: In the drawings:

Fig. 1 discloses in partial section a helix type wave tube with the attenuating support of the present invention applied thereto.

Fig. 2 is a view taken on the line 2—2 of Fig. 1.

Fig. 3 is a view taken on the line 3—3 of Fig. 1.

Fig. 4 is a view taken on the line 4—4 of Fig. 1.

The various wave tube elements are enclosed in an evacuated glass envelope 10 having an elongated central portion 11 which is advantageously of uniform diameter along its length to receive a helix or helical conductor 12. The central portion 11 terminates in an enlarged portion

2

13 at one end which houses an electron gun for producing an electron beam. Details of the electron gun are not shown but usually comprise a heater which is supplied with energy from suitable voltage source, a cathode, and an electrode arranged for forming the electrons emitted from the cathode into a concentrated stream which is then directed through the helix 12 which may be considered to be formed of a non-magnetic material. At its other end 14, a target electrode will be provided to collect the electrons after they have passed through the helix 12. Input wave energy is supplied by the input wave guide 15 which will be connected to a source of signal energy and the wave energy is imparted to the helix 12, traveling along its circumference and the amplified wave will be distributed from the wave tube 10 through the output wave guide 16.

The combined attenuator and helix support of the present invention is comprised of a group of elongate tubular legs spaced from each other along a longitudinal axis and interconnected by tubular cross-over sections in a manner to provide a continuous tubular structure permitting the circulation of a fluid medium from an inlet which is in communication with the tubular structure. A suitable lossy material may be applied to the tubular structure to provide attenuation characteristics thereto. In Figs. 1 and 3 an attenuator and support arrangement having four elongate tubular legs or conduits is shown and the legs are indicated respectively by the letters A, B, C and D. Spacing of and communication between the legs is provided by means of three sections S^1 , S^2 and S^3 . The adjacent legs A and B are interconnected by the tubular cross-over section S^1 and the adjacent legs C and D are interconnected by the tubular cross-over section S^2 while the legs B and C are interconnected by the cross-over section S^3 . The cross-over sections S^1 and S^2 are as shown in Figs. 1 and 2 located at one end of the attenuator and helix support while the cross-over section S^3 is located at its opposite end and hence communication is provided amongst all of the legs A, B, C and D. One of the legs, for example A, as shown in Fig. 1 is provided with an inlet I while an outlet conduit O is in communication with conduit D and as in Fig. 4 suitable sealing means is provided about the inlet and outlet. A liquid coolant such, for example, as a silicone oil having a suitable or desired dielectric constant and temperature characteristics may thus be circulated through the legs and cross-overs of the attenuator between the inlet I and outlet O and thus provide for circulating the coolant in heat exchange relation with substantially all the surface area of the helix 12.

Each of the tubular legs A, B, C and D terminate in flattened solid end portions identified as a , b , c and d and a^1 , b^1 , c^1 and d^1 at the right and left respectively of Fig. 1. These solid end portions are conveniently formed by being pinched off during fabrication of the support.

While the invention has been described and illustrated in connection with only one embodiment it will be appreciated that other forms are contemplated and that the invention is to be limited only by the scope of the claims.

What is claimed is:

1. A travelling wave tube comprising an evacuated elongate envelope having wave input and wave output end portions providing a wave transmission path therebetween, a helix extending longitudinally of said transmission path, means for circulating a cooling medium in heat conducting relationship with said helix, said means comprising a plurality of elongate tubular members extending longitudinally between said envelope and said helix, each of said tubular members having a first closed end disposed adjacent one end of the helix and a second closed end disposed adjacent the other end of the helix,

3

a first transverse tubular section providing communication between one pair of tubular members adjacent the first closed ends of each, a second transverse tubular section providing communication between a second pair of different tubular members adjacent the first closed ends of each, a third transverse tubular section providing communication between one tubular member of said one pair of tubular members and one member of said second pair of tubular members adjacent the second closed ends of each, an inlet for the heat exchange fluid in communication with the other tubular member of said one pair and an outlet for the heat exchange fluid in communication with the other tubular member of said second pair.

2. A travelling wave tube as in claim 1, further characterized by portions of the outer walls of each tubular

4

member being in contact with the inner wall of the envelope and other portions being in contact with the helix and providing a support therefor.

3. A travelling wave tube as in claim 1, further characterized by said closed end portions being flattened to provide solid structures having greater transverse cross-section than the hollow portions of the tubular members for contacting the inner wall of the envelope and providing supporting means for said helix.

References Cited in the file of this patent

UNITED STATES PATENTS

2,678,407	Brown et al. _____	May 11, 1954
2,884,556	Iversen _____	Apr. 28, 1959