

Nov. 21, 1950

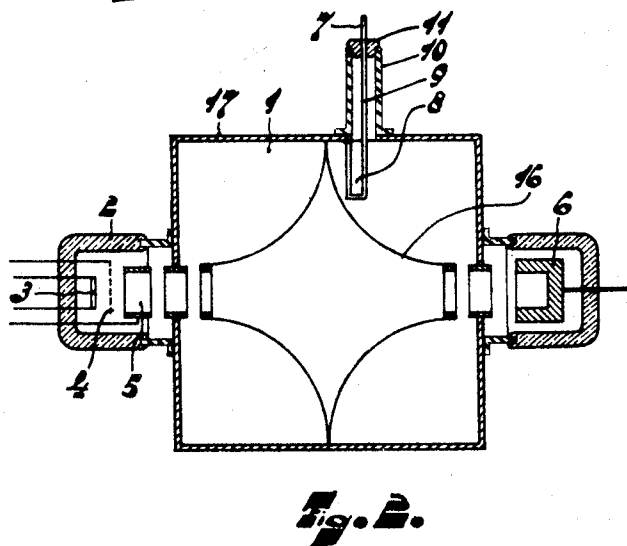
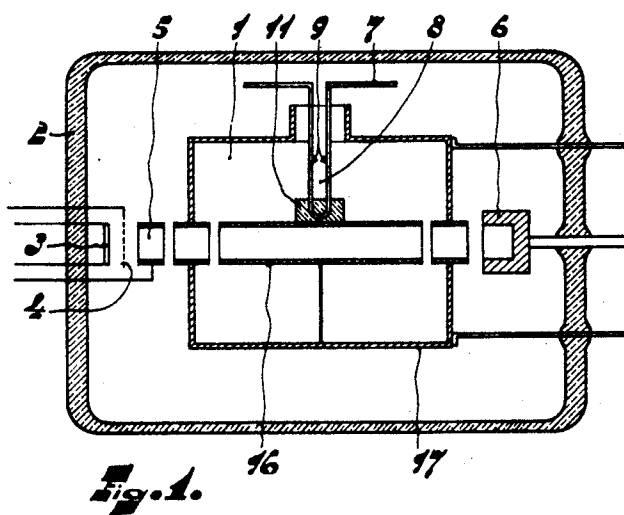
E. G. DORGELO

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DEVICE FOR VERY HIGH FREQUENCIES COMPRISING A LEAD-THROUGH CONDUCTOR CARRYING HIGH-FREQUENCY ENERGY		

Filed July 20, 1946

2 Sheets-Sheet 1



INVENTOR.
EDUARD GERARDUS DORGELO
BY *Jean M. Dorge*
AGENT

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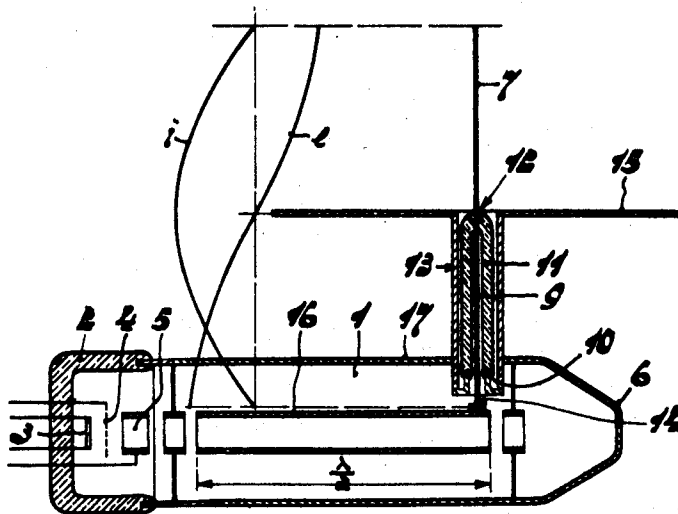
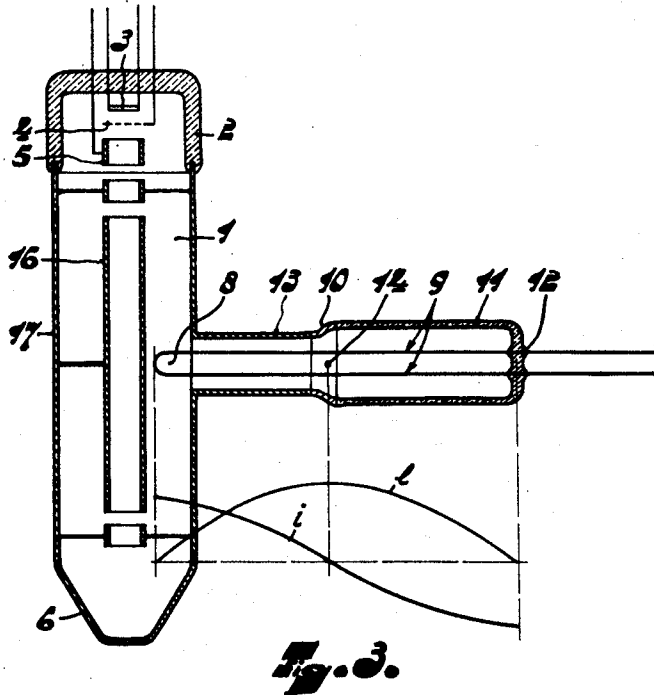
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2 Sheets-Sheet 2



INVENTOR.

Fig. 4. EDUARD GERARDUS DORGELO

BY

John M. H. [Signature]

AGENT

UNITED STATES PATENT OFFICE

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DEVICE FOR VERY HIGH FREQUENCIES
COMPRISING A LEAD-THROUGH CONDUCTOR
CARRYING HIGH-FREQUENCY ENERGY

Eduard Gerardus Dorgelo, Eindhoven, Netherlands,
assignor to Hartford National Bank and
Trust Company, Hartford, Conn., as trustee

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3 Claims. (Cl. 178-44)

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This invention relates to a device operating at very high frequencies of the order of magnitude of 3×10^8 cycles per second and consequently in the region of decimeter wavelengths, and more particularly to the lead-through of a high-frequency energy carrying conductor.

Such devices generally consist of the combination of an electric discharge tube of special design and a hollow body having conductive walls.

In such hollow bodies, so-called box circuits or hollow space resonators stationary oscillations may develop; they are used, for instance, with magnetrons, velocity modulated tubes and the like.

In all these devices the high-frequency energy in the hollow chamber is to be led to the outside, for instance for feeding an antenna. This may take place in various ways, as will be explained by reference to the accompanying drawing, given by way of example. In this drawing Fig. 1 represents a possible form of construction of a device in which the antenna extends in the vacuum chamber, Fig. 2 showing a common form of construction of a device comprising a lead-through arrangement for the supply of high-frequency energy to an antenna outside the vacuum. Fig. 3 shows one form of construction in accordance with the invention and Fig. 4 illustrates another form of construction in accordance with the invention.

In Fig. 1, similarly to the remaining figures, the hollow body constituted by concentric conductors 16 and 17 is designated 1, the glass wall 2, the cathode 3, accelerating electrodes 4 and 5 and a collecting electrode 6, the assembly constituting the system of a velocity modulator tube. The radiator 7 having a length of half a wavelength receives the high-frequency energy through the intermediary of a coupling loop 8 and a feed conductor 9. The fastening insulator 11 is provided in the proximity of a potential node in order to keep the dielectric losses low. Since in the present case the insulator 11 need not form an air-tight junction, the problem of sealing the conductors 9 into the insulator does not exist. This construction, however, has the drawback of a poor robustness, since the combination of the conductors 9 and the radiator 7 cannot be supported in another way.

The solution illustrated in this figure is very simple, since the conductor carrying off the high-frequency energy need not pass in an air-tight manner through the wall of the hollow body.

As a rule, however, it will be desirable to lead the high-frequency energy from the vacuum

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chamber to the outside in order that the various radiators or other devices, for instance measuring devices or the like, may be connected to the conductor 9. The conductor 9, which may consist of one or a plurality of conductors, must be passed in an air-tight manner through the metal wall of the hollow body 2, which in itself often forms part of the vacuum chamber. A well-known construction of such a device is shown in Fig. 2 in which corresponding parts bear the same reference numbers as in Fig. 1. Since in this case the insulator 11 must be sealed in an airtight manner to the metal wall of the hollow body 1, it is necessary to make use of a sealing member to constitute a transition from the insulator to the said metal wall. In fact, the hollow member consists of a conductive metal such as copper, silver or aluminium or is coated with such a metal at least at the inner surface, so that the insulator cannot be sealed directly to this wall.

In the well-known form of construction shown in Fig. 2 the sealing member is shaped as a cylinder 10 made from fernico or chrome iron.

In this case it is also very desirable that the insulator should be connected to the lead-through conductor 9 at a potential node to avoid high dielectric losses in the glass. Since, however, current and voltage are displaced by 90° with respect to one another strong currents are induced on the sealing member 10, which losses, due to the comparatively high resistance of fernico and chrome iron, involve high losses and consequently undesired heating. Hence a compromise must be adopted in the case of a seal according to Fig. 2.

The aforesaid drawbacks are avoided if according to the invention, in a device for working with very high frequencies and comprising a metal wall which consists at least at the inner surface of a material having a low resistance and through which is passed a high-frequency conveying conductor by means of a lead-through insulator which is connected on the one hand to the said conductor and on the other hand, with the interposition of a metal sealing member made from a material perfectly adhering to glass but exhibiting higher losses, to the conductive wall, the lead-through insulator is given such a shape as to be sealed as close as possible to a potential node to the lead-through conductor and as close as possible to a current node to the sealing member. To this end the lead-through insulator may preferably be shaped as a tube in which the lead-through conductor is provided

parallel with the longitudinal axis and which is sealed about this conductor at one end and at the other end to a sealing member. If the length of the tubular lead-through conductor still amounts to $\frac{1}{4}$ wavelength, which is not objectionable in working with decimeter waves, it can be achieved that the sealing member is on a level with a point where the lead-through conductor has a current node, whereas the seal of the said conductor is on a level with a potential node. In this case, the size of the sealing member should be as small as possible in a direction parallel with the lead-through conductor.

Fig. 3 shows a definite form of construction of a device according to the invention. Similarly to Figures 1 and 2 the reference number 1 designates the hollow resonator chamber whose wall consists, for instance, of copper and in which electromagnetic oscillations are generated by means of a velocity modulator tube. To this end the hollow chamber is traversed in an axial direction by an electron stream which is emitted at one end by a cathode 3 and upon traversing the hollow chamber is collected at the other end by a collecting electrode 6 which forms an assembly with the wall of the hollow chamber 1. This collecting electrode may be cooled with water. The hollow chamber is closed in a manner known per se at the first-mentioned end by a glass member 2 in which are secured the cathode 3 and the accelerating electrodes 4 and 5 producing the electron stream.

The wall of the hollow chamber 1 is provided with a slit about which is soldered the metal tube 13 also consisting of copper. At 14 a junction member in the form of a narrow ring 10 is soldered to the copper tube 13. This junction ring 10 may consist of ferrico. On the other side of this ring 10 is sealed the glass inlet insulator 11 which may be shaped as a tube and is sealed to the lead-through conductors 9 at the other end 12. The conductors 9 extend parallel with the axis of the tube 13 and unite to form a loop at 8 at some depth within the hollow chamber 1. The loop is coupled with the field in the hollow chamber. The current strength in the conductors 9, which constitute a Lecher system in the case under view, is a maximum in the loop 8, and there is a second maximum of current strength at 12. On a level with the sealing ring 10 the Lecher lines exhibit a current node but a maximum of potential, whereas the potential node is exactly at 12. As a result thereof no dielectric losses are caused in the lead-through insulator at the seal 12 of the Lecher lines, and on the other hand no currents are induced on the ferrico ring 10. In this case the length of the lead-through insulator amounts to about $\frac{1}{4}$ wavelength, and that of the conductors 9 to about $\frac{1}{2}$ wavelength.

Another form of construction is represented in Fig. 4, where only one conductor 9 is used which projects into the hollow chamber 1 where the electric field is strongest. The conductor 9 is partly surrounded by the copper tube 13 which is connected to the hollow chamber 1 and sealed by means of the chrome iron sealing ring 10 to the lead-through insulator 11 having the shape of a glass tube. The conductor 9 is sealed into the glass at 12 exactly at a potential node. In fact, stationary oscillations are produced along the conductor 9, as is illustrated in the figure by curves i and e , the conductor 9 having a current node at 14 at the end extending in the hol-

low chamber and consequently about on a level with the sealing ring 10. Therefore the induction losses in the ring 10 are low. The part 7 of the conductor 9 freely projecting to the outside constitutes a radiator and has a wavelength, from 12 onwards, of about $\frac{1}{4}$ wavelength. The glass tube 11 is surrounded by the copper tube 13 which merges at 12 into a large flat disc 15, as a result of which solely the freely projecting part 7 is able to radiate.

The drawing represents only two examples of the invention but it will be appreciated that it may also be realised in a different way.

What I claim is:

1. A high frequency device having a tubular wall portion of low electrical surface resistance, a current carrying member positioned within said tubular portion, extending therefrom and having a voltage and current distribution to produce thereon a current node and a potential node, and means to hermetically seal said current carrying member to the end of said tubular portion in an insulating manner, said means comprising an annular metal sealing member having a greater electrical surface resistance than said tubular portion positioned in spaced relationship to said current carrying member in the vicinity of a current node on said current member and secured to said tubular portion, and a tubular insulating member approximately one-quarter wavelength in length, having one end thereof secured to said annular member in the vicinity of said current node and the other end thereof secured to said current carrying member in the vicinity of a potential node on said current carrying member.

2. A high frequency device having a resonator with distributed electrical constants and a resonant frequency of the order of 3×10^8 cycles per second, comprising a tubular portion of low electrical surface resistance and open to said resonator, a Lecher-wire current carrying system positioned within said tubular portion having one end thereof extending from said tubular portion and having the other end thereof coupled to said resonator, and means to hermetically seal said Lecher-wire system to said tubular portion in an insulating manner, said means comprising an annular metal sealing member having a greater electrical surface resistance than said tubular portion positioned in spaced relationship to said Lecher-wire system in the vicinity of a current node on said system and secured to said tubular portion, and a tubular insulating member approximately one-quarter wavelength in length having one end thereof secured to said annular member in the vicinity of said current node and the other end thereof secured to said Lecher-wire system in the vicinity of a potential node on said Lecher-wire system.

3. A high frequency device having a metal enclosure and a circuit element positioned within said enclosure and having distributed electrical constants and a resonant frequency of the order of 3×10^8 cycles per second, comprising a tubular reentrant member of low electrical surface resistance hermetically sealed to said enclosure and having the inner end thereof positioned adjacent to said circuit element in the vicinity of a current node thereof, a current carrying member positioned within said tubular member coupled to said circuit element at a current node thereof and having a voltage and current distribution to produce thereon a current node and a potential node, and means to hermetically seal said current car-

rying member within said tubular member in an insulating manner, said means comprising an annular metal sealing member having a greater electrical surface resistance than said tubular member positioned in spaced relationship to said current carrying member and secured to said tubular member at the inner end thereof, and a tubular insulating member surrounding said current carrying member and positioned within said reentrant member and having a first portion secured to said sealing member in the vicinity of said current node and a second portion secured to said current carrying member in the vicinity of a potential node on said current carrying member.

EDUARD GERARDUS DORGELO.

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