

Dec. 16, 1958

C. V. LITTON

2,865,009

TUNING IRIS FOR WAVE GUIDES

Filed Dec. 14, 1953

FIG. 2.

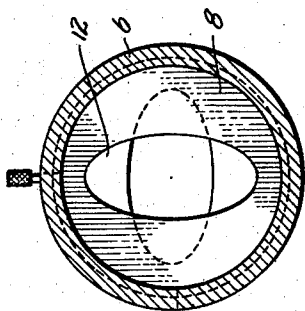


FIG. 4.

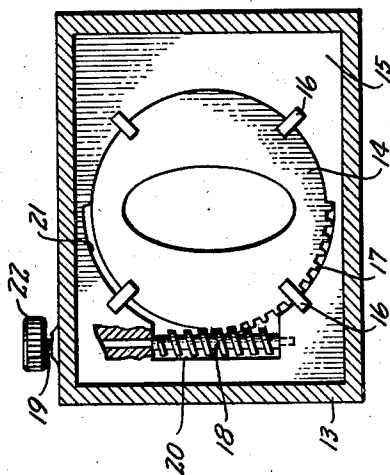


FIG. 1.

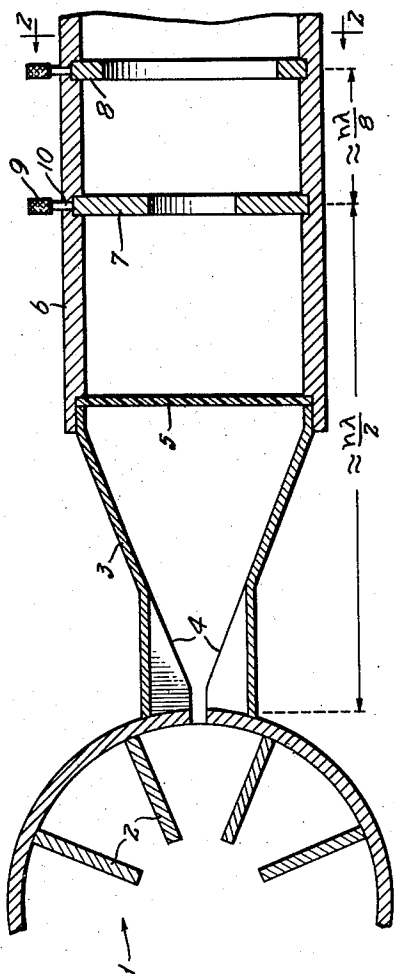
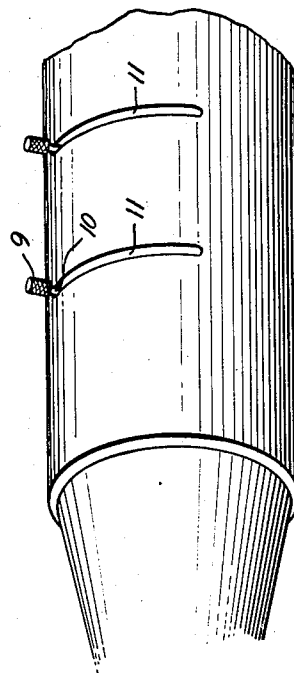


FIG. 3.



INVENTOR
C. V. LITTON
BY *Philip M. Bolton*
ATTORNEY

1

2,865,009

TUNING IRIS FOR WAVE GUIDES

Charles Vincent Litton, Redwood City, Calif., assignor to Litton Industries, Inc.

Application December 14, 1953, Serial No. 397,912

5 Claims. (Cl. 333—98)

This invention relates to an impedance adjusting means for use in wave guides and more particularly to the mounting and positioning of an iris member to obtain an adjustable impedance in the output coupling system of a high frequency electron discharge device.

Frequently, during the manufacture of evacuated high frequency electron discharge devices, the output coupling section i. e., frequency determining section, becomes distorted during the rigorous exhaust processing. This is particularly true in the magnetron and other electron discharge devices which operate at extremely high frequencies and employ cavity resonators. Therefore, means for external adjustment of the frequency determining parameters is very desirable, to compensate the effects of these distortions conveniently and inexpensively. Various means for compensating these distortions and adjusting the frequency have been proposed, such as adjustable coupling ramps, or movable walls which vary the resonator size or shape have been used. Such systems, however, require movable elements within the envelope, or flexible wall construction, and while they may perform quite satisfactorily, they are relatively expensive.

In order to compensate for errors due to manufacturing difficulties and tolerances, it is desirable to have a simple inexpensive means, external of the device, which will produce the desired impedance and/or frequency adjustments. Moreover, such adjustable means may serve to compensate for frequency drift in operation of the electron discharge device.

It is known that a rectangular or other non-circular iris may produce a reactive effect in a wave guide. By varying the major axis of this iris, with respect to the waves in the guide, the reactive component may be altered from predominantly inductive, to predominantly capacitive, depending on the mode of the waves.

It is an object of this invention to make use of the reactive effect of a non-circular or elliptical iris, in the output wave guide external of an electron discharge device, to provide a tuning adjustment to compensate for undesirable frequency shifts, within a given frequency range.

In accordance with this invention there is provided a wave guide adapted to be coupled to the output coupler of a high frequency discharge device, particularly to an output resonator of a magnetron. The invention is characterized by a pair of iris members, each having a non-circular aperture, which are rotatably mounted in the wave guide a given distance (electrically a half-wave length, for example) from the output coupler of the high frequency device, to vary the output coupling and to provide compensatory tuning of the device.

The above-mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood, by reference to the following description of an embodiment of the invention taken in connection with the accompanying drawings, wherein:

Fig. 1 illustrates a portion of a magnetron anode with

2

an output coupler and iris member in accordance with the invention;

Fig. 2 is a sectional view taken along lines 2—2 of Fig. 1;

Fig. 3 is a perspective view illustrating the output coupler shown in Figs. 1 and 2; and

Fig. 4 is an alternative arrangement for a rectangular wave guide utilizing the adjustable iris.

Referring now to Fig. 1 there is shown a portion of a magnetron body at 1 comprising a plurality of vanes 2 forming separate anode resonators. At the output of one of the resonators there is provided a conventional output wave guide 3 which is preferably provided with a pair of matching ramps 4 and a window 5 of insulating material such as plastic or glass. At the end remote from the magnetron body there is attached a wave guide 6 which serves as an energy output lead for the magnetron. In accordance with the invention there is provided in waveguide 6 at least one and preferably two rotatably mounted iris members 7 and 8, respectively. Each of irises 7 and 8 may be conveniently rotated by a knurled head 9 which in turn may be conveniently screwed on a spindle member 10, the spindle member being fastened by any suitable means to the surface of the iris member. As best shown in Fig. 3, the lead, illustrated as a cylindrical wave guide, is provided with circumferential slots 11 which guide and limit the movement of the respective spindles. To obtain the full effect from the iris members, it is only necessary that they be rotated 90°, as will be explained more fully hereinafter. The iris members are secured in position by simply tightening the knurled head against the surface of the wave guide 6.

The invention is characterized by providing the iris members 7 and 8 with non-circular openings 12 shown as elliptical, which are best seen in Fig. 2, and positioning the iris members a given distance from the output of the magnetron. Angular rotation of the iris may then be made to produce pure reactance variation, pure resistance variation, or a complex impedance variation depending upon its position in the wave guide. That is to say, that if the iris is located on a constant reactance contour, angular rotation will produce impedance variations of a resistance nature and conversely, if the iris is located on a constant resistance contour, rotation will produce reactance variation.

For example, assuming an iris is mounted on a constant resistance contour, when the ellipse is rotated so that its major axis is vertical as seen from the magnetron output as shown by the solid line in Fig. 2, there is produced an effect substantially equivalent to shunting the wave guide with an inductive reactance, whereas when the ellipse is rotated to the position shown by the dotted lines, there is produced the effect of a shunted capacitive susceptance. Intermediate these two extreme positions, there are both capacitive and inductive effects which may be utilized for tuning the output energy.

The first iris 7 is spaced substantially a half wavelength at the operating frequency of the magnetron or multiples thereof, from the coupling opening into the magnetron resonator and reflects its impedance to the opening itself. In other words, iris 7 is located on a constant reactance contour so that only a resistive variation is produced. This iris will then vary the power coupled out of the magnetron. It should be understood that guide wavelength is referred to here and not the free radiation wavelength spacing. Also, the various parameters of the system which modify the actual spacing must be taken into account.

The rotation of iris 7 while adjusting the impedance may also produce an undesirable phase change in the output energy. Moreover, a limited adjustment of the tuning separately from the impedance matching may be

desired. The second iris 8 is provided to make these adjustments, the second iris being preferably similar to the first iris member and being spaced approximately an eighth wave-length or odd multiples thereof, from the first iris. Thus the second iris presents a variable reactance shunting effect at the output coupling, and is rotated empirically to correct the phase distortion produced by the first iris and/or to achieve the desired tuning adjustment. The second iris is located on a constant resistance contour and therefore varies the frequency.

It will be understood that in practice there is, also, at all times a resistive impedance present. Accordingly the spacings referred to are only approximately correct. The exact values in each particular case are best determined by experiment, because rigorous calculation of the location is difficult, since the complex impedance parameters are difficult to determine. The spacings are determined so that the impedance of the iris, or irises, is properly reflected into the line as a pure real or pure reactive component. Consequently, the approximate spacings as indicated above refer to the precise spacing that are applicable if pure reactance or pure resistive components are involved.

In Fig. 4 there is shown an alternative arrangement for a rectangular wave guide 13 wherein rotary adjustment of the iris member 14 may be attained. The iris member 14 may be mounted in place on a rectangular support 15 within the wave guide by means of clamps 16 which hold the iris member 14 in position but permit free rotation thereof. The iris member may be provided with gear teeth 17 over 90° of its circumference, which mesh with worm gear threads 18 on a spindle 19. The worm gear spindle 19 is positioned in a well 20 provided with rectangular support plate 15; the rectangular plate 15 is also provided with a clearance 21 for the passage of the gear teeth 17.

The spindle 19 is journaled through the wave guide and the rotation thereof controlled by the knurled head 22. By rotating the head 22, the elliptical aperture in the iris member 14 thus may be adjusted to any desired angular position.

While elliptical irises have been illustrated by way of example, it will be clear to those skilled in the art, that other forms of transmitting irises which have an unsymmetrical form may be used. It is merely necessary that the iris be shaped so that a variation in the reactance component may be produced by rotary movement thereof.

It should be apparent to one skilled in the art that more than two irises may be mounted in the wave guide

to provide a plurality of independent adjustments. It will also be clear that the full range of adjustment may not always be desired. Accordingly, the mounting means for the iris may provide for less than the full ninety degree rotation shown in the given examples.

While I have described the above principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. An arrangement for tuning a high frequency electron discharge device, comprising a hollow wave guide coupled to the output of said device, a first iris member having a transmitting non-circular aperture, and means for rotatably mounting said iris in said wave guide on substantially a constant reactance contour of said guide and a given distance from the output of said device, whereby rotation of said iris produces impedance variations of a resistive nature, a second iris having a transmitting non-circular aperture, and means for rotatably mounting said second iris in said wave guide on substantially a constant resistance contour of said guide and a given distance from said first iris, whereby rotation of said second iris produces impedance variations of a reactive nature.

2. The wave guide according to claim 1, wherein said given distance between said first and second irises is electrically equal approximately to an eighth wave-length

$$\frac{(n\lambda)}{8}$$

3. The wave guide according to claim 1, and further comprising means for rotating said second iris through an angle of 90°.

4. The wave guide according to claim 1, wherein said wave guide is cylindrical.

5. The wave guide according to claim 1, wherein said wave guide is rectangular.

References Cited in the file of this patent

UNITED STATES PATENTS

2,427,100	Kihn	Sept. 9, 1947
2,523,841	Nordsieck	Sept. 26, 1950
2,541,375	Mumford	Feb. 13, 1953
2,660,667	Bowen	Nov. 24, 1953