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ULTRA-HIGH FREQUENCY WAVEMETER

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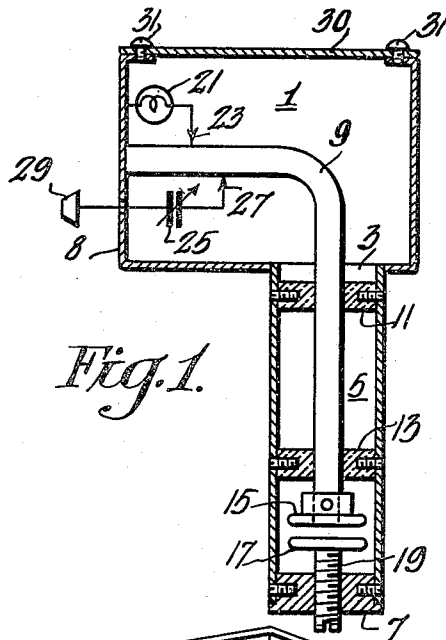


Fig. 1.

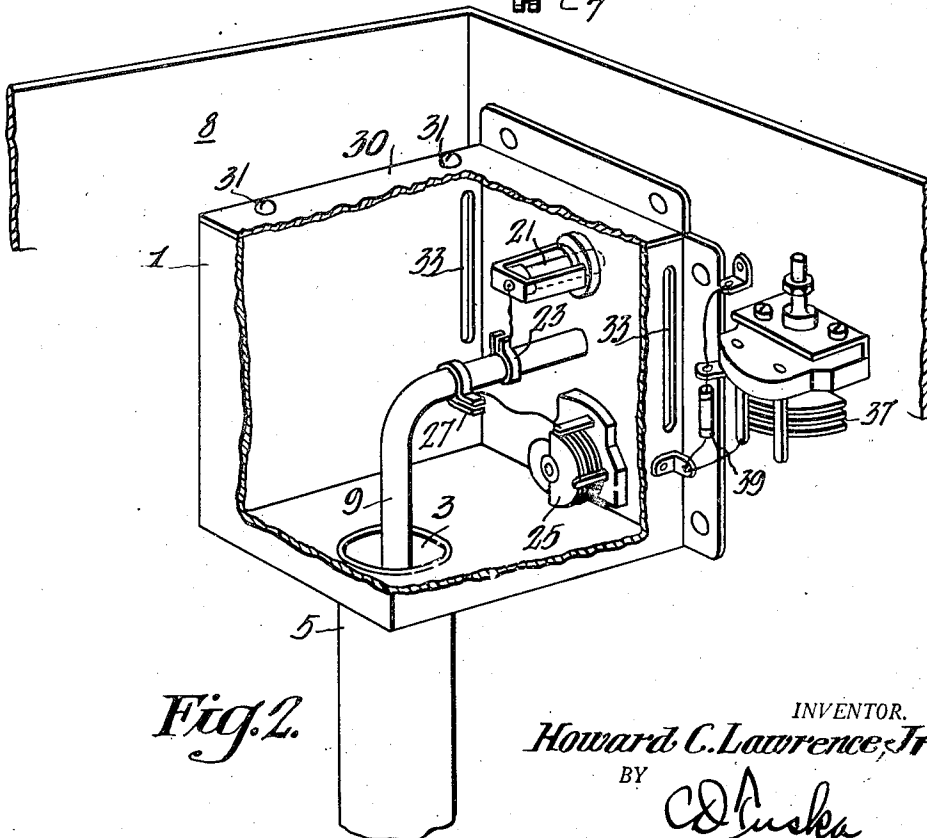


Fig. 2.

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ULTRA HIGH FREQUENCY WAVEMETER

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11 Claims. (Cl. 250—39)

This invention relates generally to radiant energy wavemeters and more particularly to an improved adjustably tuned coaxial line type of ultra-high frequency wavemeter adapted, after preliminary adjustment, to cover a predetermined frequency scale.

One of the requisites of a practicable ultra-high frequency wavemeter is that adjustment thereof over the desired frequency range be obtainable by means of simple and easily calibrated mechanical means. The instant invention contemplates the use of a conventional midget type variable capacitor for this purpose, and means for preliminary adjustment of the wavemeter to permit the matching of the capacitor adjustment to a predetermined uniform frequency scale.

Another requisite of ultra-high frequency wavemeters is that they be adaptable to quantity production and simple preliminary adjustment. The instant invention provides a rugged, compact structure providing desired shielding from extraneous fields and permitting the original calibration to be maintained within practicable limits under ordinary operating conditions, and simple, convenient means for adjustment of the intensity of the frequency indicator.

Briefly, the instant invention comprises a shielding enclosure, at least a portion of which comprises a cylindrical, or rectangular, conductive member in which is enclosed a coaxial central conductor which is terminated at both ends in the conductive walls of the shielding enclosure and cylindrical conductive member, respectively. A midget type variable capacitor is enclosed within the shielding enclosure, and connected between one of the end walls thereof and an adjustable point on the centrally located inner conductor.

The variable capacitor may be adjusted to a predetermined frequency scale by adjusting the point of connection thereof to the inner conductor to match the low frequency end of the frequency range to the calibrated wavemeter scale. An adjustable series capacitor, comprising two parallel conductive electrodes, is inserted in series with the end of the inner conductor remote from the variable capacitor. The space between the parallel conductive electrodes may be adjusted, externally of the end of the cylindrical conductive shielding portion, to provide for matching of the variable tuning capacitor to the high frequency end of the wavemeter frequency scale.

An indicator lamp, or other indicator device, viewed through one wall of the shielding enclosure, and connected between said wall and an adjustable point on the inner conductor, provides

indications of the tuning of the wavemeter to resonance with ultra-high-frequency energy, which is introduced into the shielding enclosure in any desired manner. For example, a gap of predetermined length and width may be left in the shielding enclosure for coupling the ultra-high-frequency energy into the wavemeter in the proper mode. If desired, an externally shunt-connected variable capacitor-resistor network may be employed to vary the ultra-high-frequency coupling to the wavemeter for adjusting the indicator sensitivity.

Among the objects of the invention are to provide an improved means for measuring the frequency of ultra-high-frequency radiant energy. Another object of the invention is to provide an improved ultra-high frequency wavemeter employing an adjustably resonant coaxial line. An additional object of the invention is to provide an improved ultra-high frequency wavemeter including a shielding enclosure having a central conductor coaxial with at least a portion of said shielding enclosure, and an adjustable tuning capacitor for varying the resonant characteristics of said wavemeter. Additional objects of the invention are to provide means for matching the tuning scale of an ultra-high frequency wavemeter of the type described to a predetermined calibrated frequency scale. A further object of the invention is to provide an improved ultra-high frequency wavemeter of the type described including means for matching the tuning range of said wavemeter to a predetermined frequency scale, and additional means for adjusting the sensitivity and damping of a resonance indicator integral with said wavemeter. A further object is to provide an improved means for adjustably coupling an ultra-high-frequency energy source to a shielded energy responsive circuit.

The invention will be described in greater detail by reference to the accompanying drawing of which Figure 1 is a cross-sectional, partially schematic, elevational view of a preferred embodiment thereof, and Figure 2 is a perspective fragmentary view of said preferred embodiment illustrating the relation of said invention to typical adjacent ultra-high frequency apparatus. Similar reference characters are applied to similar elements throughout the drawing.

Referring to Figures 1 and 2 of the drawing, the principal portion 1 of a hollow shielding enclosure, having rectangular sides, includes a circular aperture 3 forming an opening into a cylindrical shielding enclosure portion 5. The end of the cylindrical shielding enclosure portion 5 remote

from the aperture 3 is closed by a conductive plug 7. A central solid cylindrical conductor 9 is secured, for example, to the panel wall 8 of the principal shielding enclosure 1, and extends into the cylindrical shielding enclosure portion 5. The portion of the central solid cylindrical conductor 9 extending into the cylindrical shielding portion 5 is supported in coaxial relation therewith by means of annular insulators 11, 13. The end of the central conductor 9 within the cylindrical shielding portion 5 is terminated in a flat capacitor electrode 15. A second flat capacitor electrode 17, supported by a threaded cylindrical member 19 extending through a complementarily threaded hole in the end plug 7, provides series-capacitive tuning of the central conductor. Adjustment of the series-capacitive tuning may be accomplished externally of the shielding enclosure by rotating the threaded cylindrical conductor 19 in any convenient manner such as, for example, by screw driver or wrench adjustment.

An indicator lamp 21, viewed through an opening in said panel wall 8 of said principal shielding enclosure portion 1, is connected to said panel wall 8, and adjustably connected to said central conductor 9 by means of a first spring clamp contact 23.

A tuning capacitor 25 such as, for example, a midget-type variable air condenser, is supported by and connected to said panel wall 8 of said principal shielding enclosure portion 1 and adjustably connected to said central conductor 9 by means of a second spring clamp contact 27. The control shaft of the tuning capacitor 25 extends through the panel wall 8. A tuning knob 29, secured to the shaft of the tuning capacitor 25, cooperates with a predetermined fixed frequency scale on the panel face, not shown.

The top wall 30, of the principal shielding enclosure portion 1 preferably is removable by means of screws 31 to provide access to the adjustable spring contacts 23, 27 connected to the indicator lamp 21 and to the tuning capacitor 25, respectively. The position of the second spring contact 27, longitudinally along the central conductor 9, may be adjusted to match the wavemeter frequency response at the low frequency end of the predetermined frequency scale when the tuning capacitor 25 is adjusted to maximum capacity. The capacity of the series capacitor, comprising the electrodes 15, 17, may be adjusted by rotating the threaded shaft 19, to match the high frequency end of the predetermined frequency scale when the tuning capacitor 25 is adjusted to minimum capacity. The intermediate portions of the tuning scale thereafter will be determined by the design of the variable tuning capacitor 25. The tuning capacitor 25 may be designed for straight-line frequency, straight-line wavelength, or other tuning scales.

Referring to Figure 2, energy from an external source of radiant energy, of which the frequency is to be measured, is introduced into the principal portion 1 of the shielding enclosure through slots 33 through the rectangular side walls of the principal shielding enclosure portion 1 adjacent the panel wall 8 of the ultra-high frequency apparatus which includes the wavemeter. The slots 33 may be any desired length to provide desired ultra-high frequency coupling to the wavemeter cavity. A second adjustable midget-type air capacitor 37, having a shunt-connected resistor 39, is supported by the apparatus panel wall 8 and connected between said wall and one of the rectangular walls of the wavemeter adjacent one

of the coupling slots 33. Selection of the resistance of the resistor 39 controls the damping of the wavemeter coupling adjustment, thus reducing resonance effects in said adjustment. Adjustment of the second air capacitor 37 provides a convenient control of the brilliance of the indicator lamp 21, when the wavemeter tuning capacitor 25 is adjusted to resonance with the ultra-high frequency energy to be measured. The second variable air capacitor 37 therefore may be employed to control the effective sensitivity of the wavemeter to the ultra-high frequency energy source.

The particular constructional features of the apparatus thus disclosed may be varied in any manner known in the art to provide convenient structure for particular ultra-high frequency applications. For example, the particular conformation of the shielding enclosure may be varied in any desired manner and the central conductor may be straight or may be curved, as illustrated. Furthermore, the principal shielding enclosure portion 1 may be entirely closed to prevent ultra-high frequency coupling directly to the cavity 1; and an auxiliary pickup electrode, coupling coil or antenna, not shown, may project through the shielding enclosure wall for coupling ultra-high frequency energy into the cavity 1. In addition, the second air capacitor 37 and resistor 39 may be omitted if the additional operational flexibility thus provided is not desired.

Thus the invention disclosed comprises an improved ultra-high-frequency wavemeter of the coaxial line type, wherein a single conventional midget-type tuning capacitor may be matched to a predetermined frequency scale by means of simple and convenient preliminary adjustments.

I claim as my invention:

1. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

2. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure having at least one hollow cylindrical portion, cylindrical conductive means disposed within said enclosure means coaxial with at least said cylindrical portion of said enclosure means and terminated at both ends in said enclosure means, means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

3. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, means defining an opening in said enclosure means for coupling ultra-high-frequency energy to be measured

ured to the cavity formed within said enclosure means, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

4. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor disposed within said shielded enclosure means and connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

5. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor disposed within said shielded enclosure means and connected between predetermined points on said coaxial means, and indicator lamp means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

6. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, adjustable capacitive means serially interposed in said conductive means adjacent one of said terminations thereof for matching the high frequency portion of said wavemeter range to a predetermined scale, means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

7. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, adjustable capacitive means serially interposed in said conductive means adjacent one of said terminations thereof for matching the high frequency portion of said wavemeter range to a predetermined scale, means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, means for adjusting said point of connection of said calibrated capacitor to said conductive means for matching the low frequency portion of said wavemeter range to said scale, and indicator means connected be-

tween said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

8. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, adjustable means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustments of said wavemeter to resonance with said coupled energy.

9. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure having at least one hollow cylindrical portion, cylindrical conductive means disposed within said enclosure means coaxial with at least said cylindrical portion of said enclosure means and terminated at both ends in said enclosure means, adjustable capacitive means serially interposed in said conductive means adjacent one of said terminations thereof for matching the high frequency portion of said wavemeter range to a predetermined scale, means defining an opening in said enclosure means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a calibrated adjustable capacitor disposed within said shielded enclosure means and connected between predetermined points on said coaxial means, means for adjusting said point of connection of said calibrated capacitor to said conductive means for matching the low frequency portion of said wavemeter range to said scale, and indicator lamp means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

10. A wavemeter for measuring ultra-high-frequency energy including means defining a shielding enclosure, conductive means disposed within said enclosure means coaxial with at least a portion of said enclosure means and terminated at both ends in said enclosure means, means defining an opening in said enclosure means for coupling ultra-high-frequency energy to be measured to the cavity formed within said enclosure means, a shunt-connected variable capacitor and resistor connected between a predetermined point on said enclosure means and ground for controlling the sensitivity and decrement of said wavemeter, a calibrated adjustable capacitor connected between predetermined points on said coaxial means, and indicator means connected between said coaxial means for indicating adjustment of said wavemeter to resonance with said coupled energy.

11. Apparatus for adjustably coupling a source of ultra-high-frequency energy to energy responsive apparatus including shielding means surrounding said apparatus, said shielding means defining at least one aperture of predetermined dimensions to provide ultra-high-frequency energy coupling through said shielding means, an adjustable capacitor connected to said shielding means adjacent said aperture for varying said coupling, and a resistor shunt-connected to said capacitor for damping said coupling adjustment.

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