May 9, 1950 R. D. FRACASSI 2,506,955

TUNABLE HIGH-FREQUENCY CIRCUITS

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FIG. 1

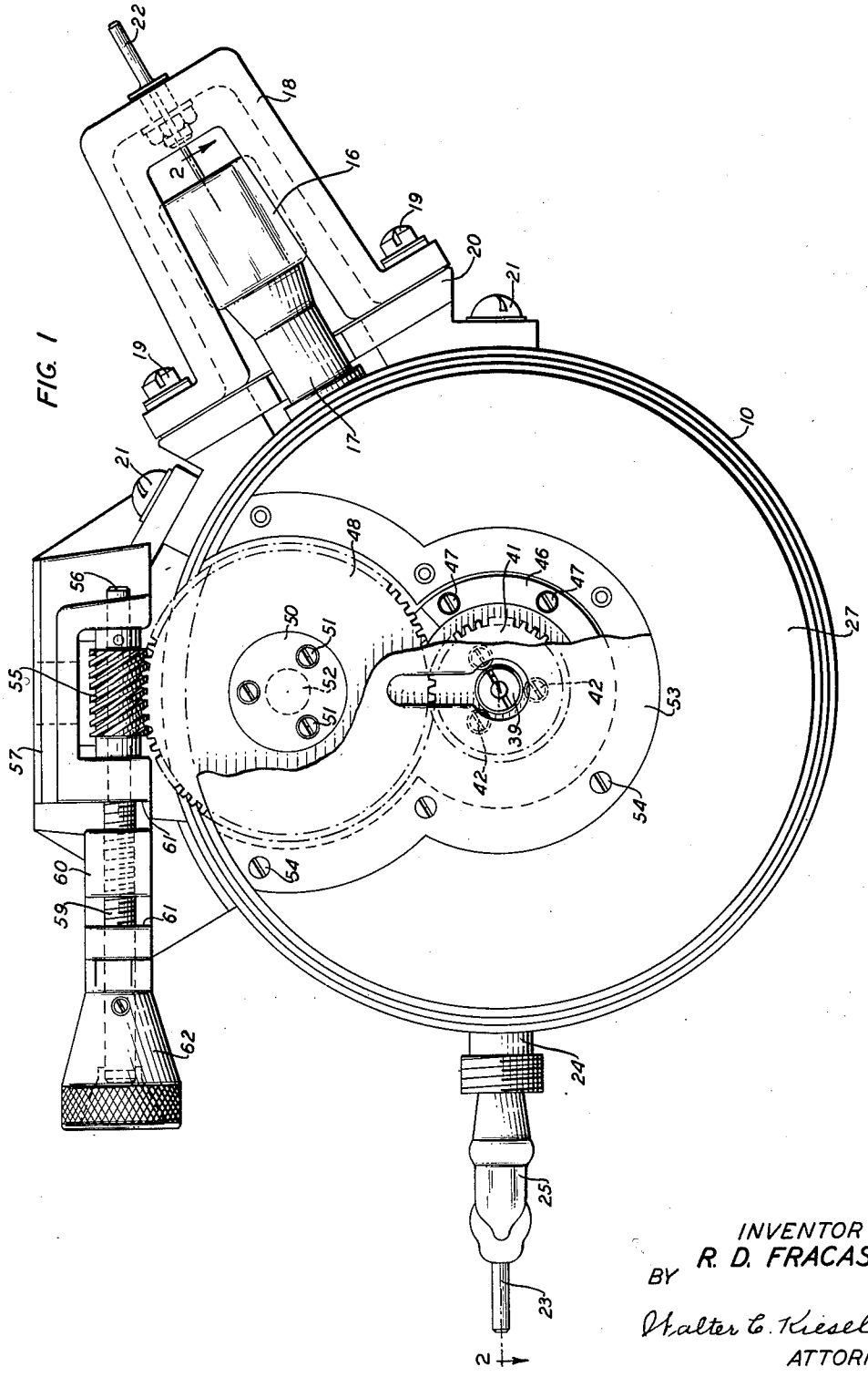

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FIG. 2

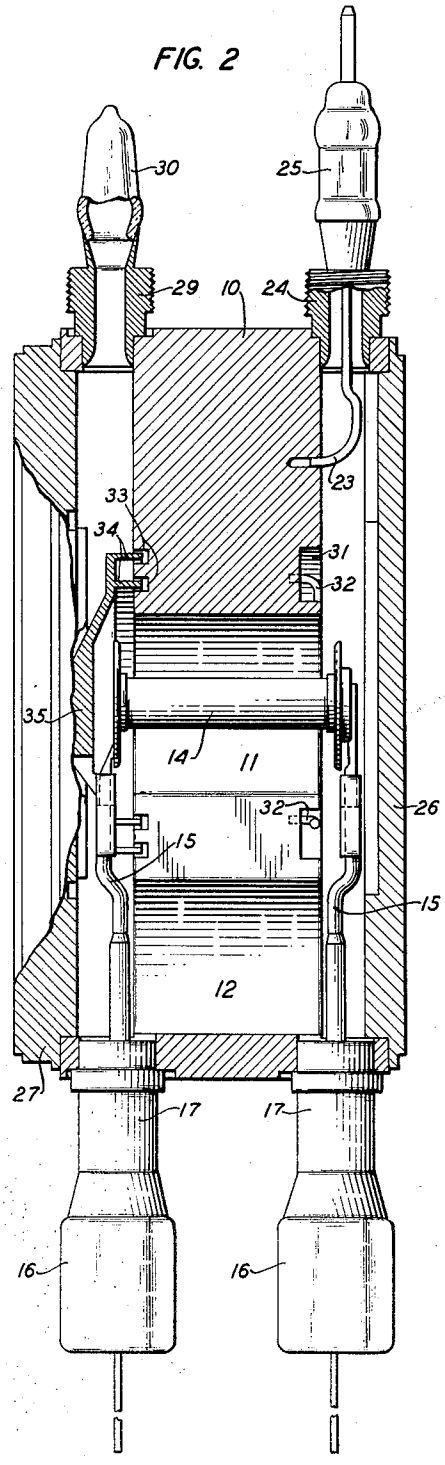
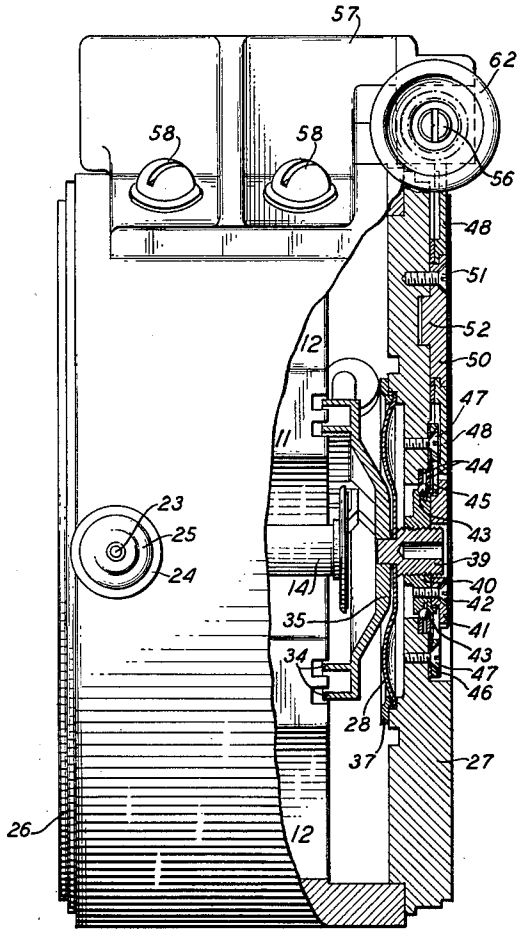


FIG. 3



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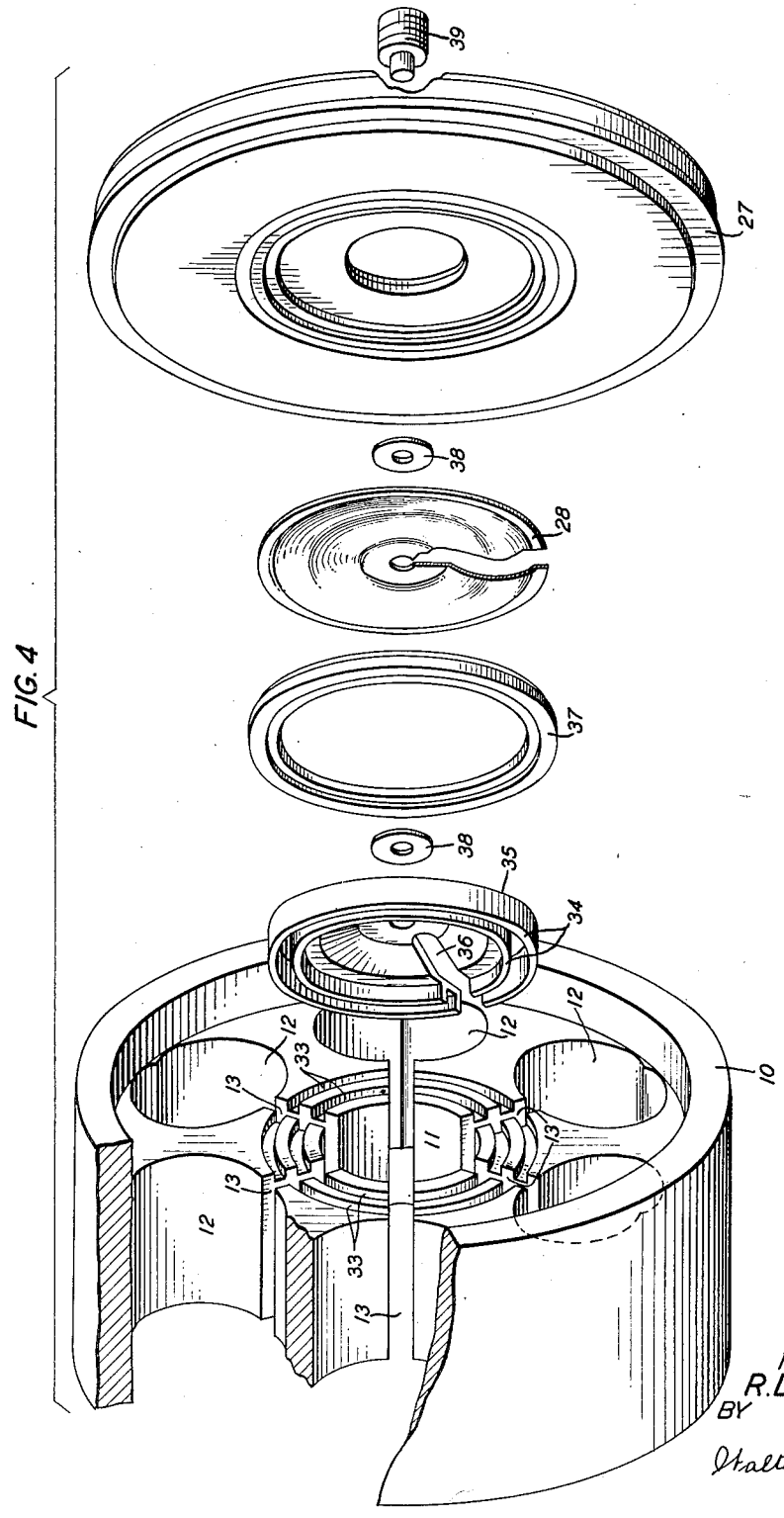

FIG. 4

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TUNABLE HIGH-FREQUENCY CIRCUITS

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3 Claims. (Cl. 315—40)

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This invention relates to tunable high frequency circuits and more particularly to magnetrons of the multiple cavity resonator type.

One object of this invention is to improve the tuning of magnetrons, enabling the use of a single device over a moderately wide rang of frequencies.

More specifically, objects of this invention are to increase the tuning sensitivity of tunable magnetrons of the multiple cavity resonator type and to realize substantially straight line tuning, i. e. linear relationship between the resonant frequency of the resonators and position of the tuning member.

In one illustrative embodiment of the invention, a magnetron comprises an anode or body member having a plurality of bores extending therethrough and defining substantially identical cavity resonators operatively associated with the anode-cathode region of the magnetron.

In accordance with one feature of this invention, one or more annular grooves are provided in one face of the anode or body member and adjacent one end of the resonator defining bores, and means are provided which together with the bounding walls of the groove or grooves constitute variable capacitances in the resonator circuits. In one construction, this means comprises a metallic cylindrical member or members mounted so as to be displaced axially in either direction thereby to vary the capacitances and, hence, the resonant frequency of the resonators.

The invention and the above noted and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is an end view of a magnetron illustrative of one embodiment of this invention, a portion being broken away to show details of construction;

Fig. 2 is a view mainly in section taken along line 2—2 of Fig. 1;

Fig. 3 is a side view of the device illustrated in Fig. 1, portions being shown in section to illustrate details of the tuning mechanism; and

Fig. 4 is an exploded perspective view showing details of the anode and of the tuning mechanism.

Referring now to the drawing, the magnetron therein illustrated comprises a circular metallic body or anode member 10, for example of copper, having an axial cylindrical bore 11 extending therethrough, the bounding surfaces of the bore constituting the anode segments of the device. The body 10 has also extending therethrough a

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plurality of parallel, substantially identical bores 12 equally spaced about the bore 11 and communicating therewith by radial slots 13, the bores 12 defining substantially identical cavity resonators. Disposed coaxially within the bore 11 is a cylindrical cathode 14, which may be of the equipotential indirectly heated type and mounted by leading-in conductors 15 sealed in vitreous caps 16. The caps 16 are sealed to metallic eyelets 17 in turn sealed to the body or anode member 10. As shown in Fig. 1, the caps 16 and eyelets 17 may be protected by an insulating guard 18, for example of glass, which is affixed, as by screws 19, to a bracket 20 in turn secured to the body member 10 by screws 21. The guard 18 carries terminals 22 to which the cathode leading-in conductors 15 are connected.

Power is taken from the magnetron by way of a coupling conductor 23 which extends through a metallic coupler 24 joined hermetically to the body 10 and is sealed to a vitreous stem 25 in turn sealed to the coupler 24.

One end of the anode or body member 10 is closed hermetically by a cover plate 26 joined to the body member 10 as by brazing. The other end is closed hermetically, in part by an annular plate 27 and in part by a diaphragm 28, which will be described further hereinafter. The interior of the magnetron may be highly evacuated by way of an exhaust coupling 29 sealed to the body member 10 and closed, after the evacuation operation, by a vitreous cap 30 sealed thereto.

One face of the anode or body member 10 has therein an annular groove 31 in which conductors or straps 32 are disposed. These conductors or straps 32 form couplings between the several cavity resonators and, as disclosed for example in the application Serial No. 529,619, filed April 5, 1944, of James B. Fisk, serve to assure oscillation of the resonators in a desired mode.

The other face of the anode or body member 10 is provided with a pair of concentric annular grooves 33 intersected by the radial slots 13, the grooves being coaxial with the central bore 11. Extending into the grooves 33 and spaced from the bounding walls thereof are coaxial cylindrical flanges 34 of a metallic, for example copper, plunger or tuning member 35, which as shown clearly in Fig. 4, is provided with a radial slot 36 to clear one of the cathode leading-in conductors 15. The tuning member 35 is mounted by the diaphragm 28, which is dished as illustrated and affixed, as by brazing and a retainer ring 37, to the annular plate 27. Carried by the diaphragm and tuner member and affixed thereto as

by solder washers, shown at 38 in Fig. 4, is a drive screw 39. The latter, when actuated as described presently, is displaced axially and drives the tuning member to move the flanges 34 into or out of the grooves 33.

The flanges 34 together with the bounding walls of the grooves 33 define capacitances coupled to the cavity resonators 12, the magnitude of the capacitances being determined by the extent to which the flanges extend into the grooves. The tuner construction is substantially symmetrical electrically so that the resonant frequencies of the several cavity resonators are varied to the same extent, and of course simultaneously and in the same sense, as the flanges 34 are displaced in the grooves 33. Highly sensitive tuning, i. e. large change in frequency for small axial movement of the flanges 34, is obtained. Further, it has been found that a linear relationship obtains between the resonant frequency of the several cavity resonators and the position of the flanges so that substantially straight line tuning of the magnetron is realized.

Very accurate and fine tuning of the magnetron is attained by the use of a gear train for actuating the drive screw 39. In a particularly advantageous construction, illustrated in Figs. 1 and 3, the gear train comprises an inner race 40 to which a first gear 41 is secured, as by screws 42, the race being threaded upon the screw 39 and having a channeled peripheral edge in which ball bearings 43 are disposed. The ball bearings are retained by an outer race 44 which is held in place by a resilient ring 45 affixed to the plate 27 by a retainer 46 secured to the plate 27 by screws 47.

The gear 41 is driven by a second gear 48 which bears against a bearing washer 49 and is held in position by a retainer 50 affixed to the plate 27 by screws 51, the retainer having a positioning hub 52 seated in a recess in the plate 27. The two gears 41 and 48 may be enclosed by a cover 53 fastened to the plate 27 by screws 54.

The gear 48 is driven in turn by a worm gear 55 which is locked to a shaft 56 carried by a bracket 57 having one end affixed to the body member 10 by two of the screws 21 and the other end affixed to this member by similar screws 58. A portion of the shaft 56 is threaded, as shown at 59 in Fig. 1, and carries a stop nut 60 which, by engagement with surfaces 61 or the bracket 57, serves to limit the number of turns of the shaft 56 in either direction. To facilitate manual rotation of the shaft 56 and, hence, tuning of the magnetron, a knurled knob 62 is provided on the shaft.

Although a specific embodiment of this invention has been shown and described, it will be understood that it is but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A magnetron comprising an anode body having a first bore therein and a plurality of cavity resonator defining bores disposed about said first bore, in communication therewith and extending from one face of the body, said body having in said one face an annular groove disposed intermediate said first bore and plurality of bores and removed therefrom, said groove being at regions of solely distributive capacitance, a cathode within said first bore, a cylindrical tuning member mounted opposite and insertable into said groove, and means coupled thereto for moving said tuning member into and out of said groove.

2. A tunable high frequency circuit comprising a block of electrically conductive material having therein a first bore, a plurality of bores spaced from said first bore and a plurality of slots each extending from said first bore to a respective one of said plurality of bores, whereby said block constitutes a multicavity resonator system, said block having also therein a groove intersecting said slots intermediate said first bore and said plurality of bores and removed therefrom, a conductive member adjacent said groove, and means coupled to said member for inserting it into said groove in spaced relation to the walls thereof to tune said system by alteration of capacitance solely.

3. An electron discharge device comprising an electrode member having a first bore therein, a plurality of bores spaced from said first bore and a plurality of slots each extending from said first bore to a respective one of said plurality of bores, whereby said electrode member constitutes a multicavity resonator system, conductor straps in the region of said slots on one side of said electrode member only, said electrode member having a groove therein intersecting said slots at the other side thereof opposite said conductor straps, said groove being in a region of large distributed capacitance only, a conductive member adjacent said groove, and means coupled to said conductive member for adjustably inserting it into said groove in spaced relation to the walls thereof to vary the capacitance of said multicavity resonator system.

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