June 17, 1947. M. V. WEISS 2,422,454

HIGH-FREQUENCY TUNING STRUCTURE

Filed April 18, 1945

Fig. 1

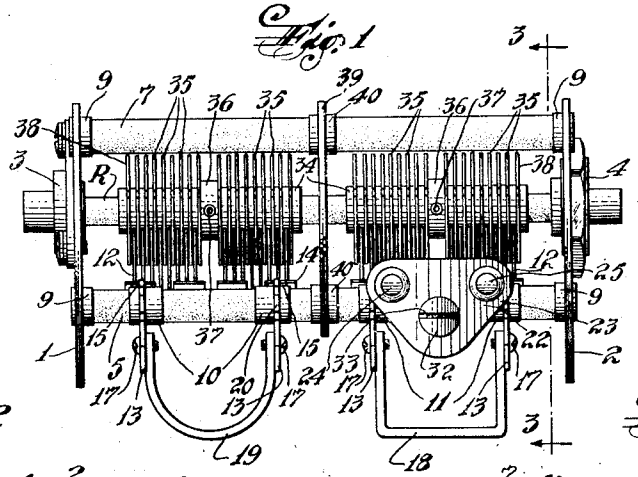


Fig. 2

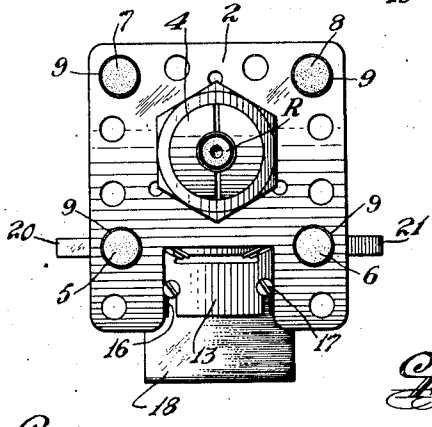


Fig. 3

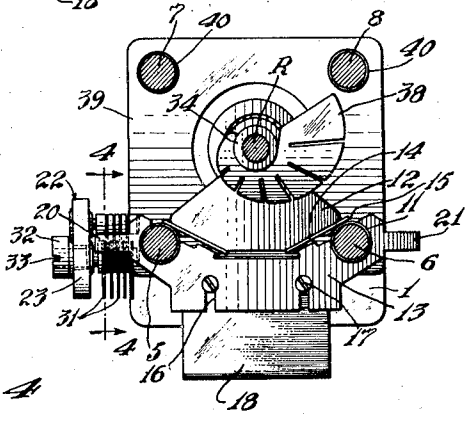


Fig. 4

Fig. 7

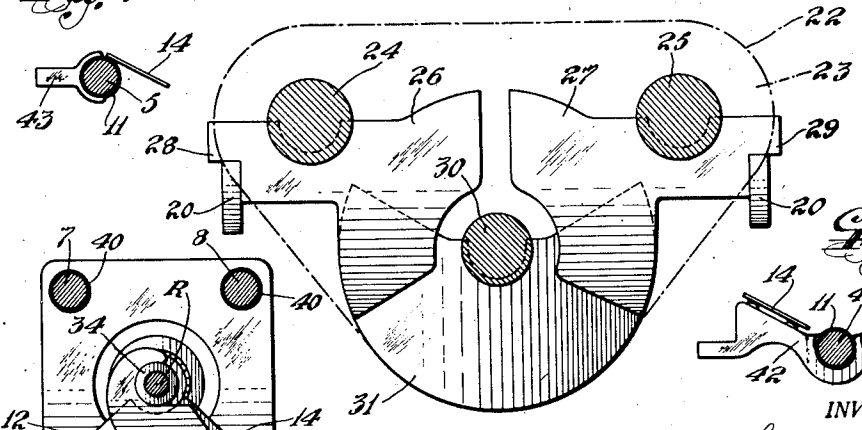


Fig. 5



Fig. 6



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## HIGH-FREQUENCY TUNING STRUCTURE

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7 Claims. (Cl. 250—40)

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This invention relates to a variable tuning capacitor structure especially adapted for use in connection with tuning circuits operating at ultra-high frequencies in the order of two hundred mc. and higher. The usual type of gang condensers used in circuits operating in the present-day broadcast range is entirely unsuited for operation in this ultra-high frequency range because such gang condensers have high inherent inductance which would make the condensers themselves a resonant circuit at high frequencies, the actual frequency of resonance depending of course on the physical size of the condensers and arrangement of the metallic frame members.

I have found that in order to get a gang variable capacitor to tune up at such high frequencies as two hundred mc. and up, an entirely new structure would be necessary, and the following specification is directed to the new structure developed by me that can be manufactured in large quantity production, which feature has been one of the drawbacks in obtaining a condenser for use in the ultra-high frequency field mentioned.

It is therefore the principal object of my present invention to provide a gang condenser for use in tuning ultra-high frequencies of the order of two hundred mc. and up, that can be produced in large quantity at reasonable prices.

My invention is depicted in the annexed drawing wherein:

Figure 1 is a side elevation of a gang condenser with one of the elements removed and also showing a slight modification of another one of the elements used.

Figure 2 is an end view of Figure 1 looking from right to left.

Figure 3 is a view on the line 3—3 of Figure 1.

Figure 4 is an enlarged view on the line 4—4 of Figure 3 and also showing in broken line one of the parts in front of the section line.

Figure 5 is a view on a line equivalent to 3—3 of Figure 1, of a modified form of construction.

Figure 6 is a view of a modified form of a detail element.

Figure 7 is a view of a further modified form of an element.

Referring now to the drawing wherein like numbers refer to corresponding parts, 1 and 2 are frame support end plates of suitable metal carrying bearing structures 3 and 4, respectively, for supporting the rotor shaft R which is made of suitable insulating material such as steatite.

In the usual type of gang condenser used in the present broadcast range, the construction is to hold the metal end plates 1 and 2 together

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with metal rods usually swaged to the end plates, but as heretofore stated, such a frame structure cannot be used in the frequency range mentioned. Therefore, I have constructed the frame in an entirely different way by utilizing anchor rods, four of which are illustrated, 5, 6, 7 and 8, made of suitable insulating material such as steatite. These steatite rods are provided wtih metallized portions which may be applied in one or more ways, such as spraying molten copper onto the steatite rods, using suitable masks to cover the portions which are not to be sprayed.

Another way is to use copper sleeves which are expanded by heat and then slipped into position on the rods. In addition, the metallized portions may be applied electro-chemically. However, since the application of these metallized portions to the steatite rods is no part of my present invention, further description thereof is unnecessary, but it may be mentioned that the rods are highly polished before the metal sleeves are applied. This polishing operation prevents absorption of any flux which may be used in the solder operation for fastening the parts together. It is also preferable to perform a slight grinding operation on the metal sleeves, especially if they have been applied by the spray or "sputtering" process to obtain uniformity.

By reference to the figures, it will be seen that all of the rods at their opposite ends have metallized portions or sleeves 9 to which the end support plates 1 and 2 are fastened as by soldering. Two of the oppositely disposed rods 5 and 6 are supplied with spaced metallized portions 10 and 11, to which are fastened, as by soldering, the stator units 12, four of which are indicated in Figures 2 and 3 of the drawing. The rotor shaft R is provided between the end plates 1 and 2 with elongated metallized portions for receiving rotor sleeves 34 carrying the rotor plates 35, and at its ends with metallic bushings to cooperate with the bearing structures 3 and 4. Each rotor sleeve 34 is long enough to carry two closely adjacent groups of plates and is provided with a collar portion 36, fastened to the metallized portion by one or more small set screws 37. The object of this arrangement of rotor plates in two groups on a common sleeve will be later pointed out.

Extending along one edge of each stator 12 is a support member 13 that is also fastened to its respective metallized portions 10 and 11 as by soldering. The stator tie plates 14, while being soldered directly to their respective metallized portions 10 and 11, as indicated at 15, are

also preferably soldered to the support members 13, but this does not show in the drawing as it is hidden by the rod 5.

The cross-support member 13 is slotted at 16 to receive screws 17 which are threaded into an inductance device 18 that is formed as a single half-loop of suitable metal. In Figure 1, the inductance device is shown in two forms, that of 18 being rectangular in shape, while 19 is semi-circular. While the inductance device as shown is not claimed per se, I have provided a new arrangement for its association with the stators 12, and it may be of such form and size best suited to individual conditions of circuit and frequency coverage. The inductance loops 18 and 19 as shown illustrate possible forms and method of attaching to the variable capacitor. After the inductance devices 18 or 19 have been adjusted vertically with respect to the member 13, by means of the screws 17 and slots 16, they are preferably soldered into permanent adjusted position.

The members 13 have projecting fingers 20 and 21 extending from opposite ends of the strips. The fingers 21 are used for making electrical connection to the stators 12, while the other fingers 20 may be utilized for mounting a balancing trimmer capacitor. A trimmer capacitor 22 of satisfactory design to work in conjunction with the main capacitor structure is illustrated on an enlarged scale in Figure 4, one of these being shown in Figure 1, and the other associated with the inductance 19 being omitted to show the parts in back of it.

The trimmer capacitor 22 comprises a plate of insulating material 23 on which are mounted metallic studs 24 and 25. The stud 24 carries stator plates 26, while the stud 25 carries stator plates 27, each group of stator plates 26 and 27 having projecting ends 28 and 29 that are adapted to pass over and rest on the fingers 20 of the support members 13 and are fastened thereto as by soldering.

Carried by the mounting plate 23 is a metal bushing, not shown in the section of Figure 4, for supporting a rotor shaft 30 carrying rotor plates 31. The shaft 30 carries a collar 32 with a slot 33 therein for adjusting the position of the rotor 31, the adjustment being retained by means of a spring which exerts pressure on the rotor shaft, the spring being compressed when the end of the shaft 30 is pushed into position. Because of the smallness of the parts, this spring is not illustrated in Figure 3, but its application will be readily understood.

It will be noted from Figure 4 that as the capacitor rotor 31 is turned, the stators 26 and 27 are connected in series capacity arrangement through the common rotor and are bridged across their respective main tuning capacitor stators 12 and inductance device 18 or 19, whichever form or modification thereof is utilized. As the rotor 31 is turned, the capacity across the stators 26 and 27 is changed reaching maximum capacity when the rotor is completely enmeshed between the two stators. In this manner, a balancing or trimming of the condenser units may be obtained.

It may be noted in passing that the support rods 5 to 8 inclusive have an intermediate shield plate 39 which is fastened to metallized portions 40 by soldering—the same as the end plates 1 and 2 are fastened to these rods. It may also be noted, by reference to Figure 3, that each group of rotor plates is provided on opposite sides with



slotted plates 38 for adjusting the main condenser units. Furthermore, it may be mentioned that the frame and condenser units are preferably treated with a protective coating of water-dip lacquer, the latter being of a rosin-base nature which aids as a flux in the soldering operations heretofore mentioned.

In Figure 5, I have shown a sectional view somewhat similar to that shown in Figure 3, but of a modified construction in which the end plates 1 and 2 are held together by a pair of top rods 7 and 8, and a single bottom rod 41, and a rotor plate slightly different from that shown in Figure 3. Also, the conductor 18 and the trimmer capacitor are not illustrated; otherwise the construction is the same as that of Figure 3.

In Figure 6, a further modified form of construction is used wherein the bottom rod 41 of Figure 5 has fastened to its metallized portion 10 or 11, as by soldering, a metallic member 42, to which are fastened the stator tie plates 14, the stator plates themselves not being shown. This construction may be used where the inductor takes some other form than that shown by 18 and 19, such as a loop of wire which may be soldered to the ends of the member 42.

In Figure 7, I have shown a further modified construction in which pieces 43 may be soldered to the metallized portions 11 on the two rods 5 and 6 shown in Figure 3. In this construction, the trimmer capacitor 22 may be mounted as in Figure 3 and the inductor may be fastened to the pieces 43 used on the opposite side of the structure, where the inductor is in the form of a wire loop. The stator tie bar 14 is shown in Figure 7 merely to show that the position of the stator unit is the same as in Figure 3.

This variable tuning capacitor operates similarly to the conventional variable capacitors in that the capacity is varied progressively by rotation of rotor shaft R. It should be noted, however, that the capacity change is obtained between two closely adjacent stator units 12 which co-act as one capacitor. The rotor group assembly of each capacitor being insulated from each other and from the metal end plates 1, 2 and 39, serves as a series capacity connection only between said closely adjacent stator assemblies 12. This series stator-rotor-group-stator arrangement eliminates the necessity for sliding or wiping contacts to the rotor which are detrimental to satisfactory variable capacitor operation at high frequencies.

It will be appreciated that certain of the details may be varied without departing from the spirit of my invention or the scope of the appended claims.

What I claim is:

1. A multi-section high-frequency variable tuning structure comprising stator and rotor units, each composed of spaced plates, those of the rotor unit adapted to be moved into intermingled relationship with the plates of the stator units, and metallic frame support plates carrying rotor bearing members, each rotor unit having a sleeve to which its plates are fastened, a rotor shaft of suitable insulating material having metallized portions between said support plates for receiving the rotor sleeves with metallic bushings at its opposite ends to cooperate with said bearing members, frame rods of suitable insulating material extending between said support plates and provided with means for anchoring them to the support plates for completing the frame, certain of said frame rods having metal-

lized sections to which the stator units are directly fastened at least in part, a transversely positioned metallic member for each stator unit fastened as by soldering to the same metallized sections as their associated stator units, and connected to adjacent stator units to form one capacitor, and having an inductance device attached therebetween.

2. A multi-section high-frequency variable tuning structure comprising stator and rotor units, each composed of spaced plates, those of the rotor unit adapted to be moved into intermingled relationship with the plates of the stator units, and metallic frame support plates carrying rotor bearing members, each rotor unit having a sleeve to which its plates are fastened, a rotor shaft of suitable insulating material having metallized portions between said support plates for receiving the rotor sleeves with metallic bushings at its opposite ends to cooperate with said bearing members, frame rods of suitable insulating material extending between said support plates and provided with means for anchoring them to the support plates for completing the frame, certain of said frame rods having metallized sections to which the stator units are directly fastened at least in part, a transversely positioned metallic member for each stator unit fastened as by soldering to the same metallized sections as their associated stator units and provided with means for conductively connecting an inductance device between two of them adjacent to their stator units, an inductance device carried on said means, said transversely positioned members having means for adjusting the position of the inductance device.

3. A multi-section high-frequency variable tuning structure comprising stator and rotor units, each composed of spaced plates, those of the rotor unit adapted to be moved into intermingled relationship with the plates of the stator units, and metallic frame support plates carrying rotor bearing members, each rotor unit having a sleeve to which its plates are fastened, a rotor shaft of suitable insulating material having metallized portions between said support plates for receiving the rotor sleeves with metallic bushings at its opposite ends to cooperate with said bearing members, frame rods of suitable insulating material extending between said support plates and provided with means for anchoring them to the support plates for completing the frame, certain of said frame rods having metallized sections to which the stator units are directly fastened at least in part, a transversely positioned metallic member for each stator unit fastened as by soldering to the same metallized sections as their associated stator units and provided with means for conductively connecting an inductance device between two of them adjacent to their stator units, an inductance device carried on said means, said device being of metal which may be in one piece but generally U-shaped, with each of the arms of the U adapted to be fastened to their respective metallic members.

4. A multi-section high-frequency variable tuning structure comprising stator and rotor units, each composed of spaced plates, those of the rotor unit adapted to be moved into intermingled relationship with the plates of the stator units, and metallic frame support plates carrying rotor bearing members, each rotor unit having a sleeve to which its plates are fastened, a rotor shaft of suitable insulating material having metallized



portions between said support plates for receiving the rotor sleeves with metallic bushings at its opposite ends to cooperate with said bearing members, frame rods of suitable insulating material extending between said support plates and provided with means for anchoring them to the support plates for completing the frame, certain of said frame rods having metallized sections to which the stator units are directly fastened at least in part, a transversely positioned metallic member for each stator unit fastened as by soldering to the same metallized sections as their associated stator units, and connected to adjacent stator units to form one capacitor, said transversely positioned members being adjustable and having fingers projecting from their opposite ends, the fingers at the same ends of a connected pair of these members serving to mount circuit-balancing devices thereon.

5. A multi-section high-frequency variable tuning structure comprising stator and rotor units, each composed of spaced plates, those of the rotor unit adapted to be moved into intermingled relationship with the plates of the stator units, and metallic frame support plates carrying rotor bearing members, each rotor unit having a sleeve to which its plates are fastened, a rotor shaft of suitable insulating material having metallized portions between said support plates for receiving the rotor sleeves with metallic bushings at its opposite ends to cooperate with said bearing members, frame rods of suitable insulating material extending between said support plates and provided with means for anchoring them to the support plates for completing the frame, certain of said frame rods having metallized sections to which the stator units are directly fastened at least in part, a transversely positioned metallic member for each stator unit fastened as by soldering to the same metallized sections as their associated stator units, and connected to adjacent stator units to form one capacitor, said transversely positioned members being adjustable and having fingers projecting from their opposite ends, the fingers at the same ends of a connected pair of these members serving to mount circuit-balancing devices thereon, and when such devices include a condenser, the same is carried on an insulator supported across a pair of said connected fingers, a pair of spaced studs fastened to the insulator, stator plates carried by said studs and projecting as groups toward each other, the stator plates of each group having projections to engage the fingers of its transverse member, a bushing carried by the insulator, a shaft carried by the bushing and carrying rotor plates so as to intermesh with the groups of stator plates to make a series connection therebetween in cooperation with the two main condensers with which they are associated.

6. A tuning structure including stator and rotor intermingling plate elements, a frame having metal end bearing plates fastened together with rods of suitable insulating material, the ends of the rods having metallized portions securely anchored to the ends of the rods and these portions fastened to the end bearing plates as by soldering, one of said rods having longitudinally spaced metallized portions intermediate said ends for attachment means thereto and forming the sole support for the stator tuning elements.

7. A tuning structure including stator and rotor intermingling plate elements, a frame having metal end bearing plates fastened together with rods of suitable insulating material, the ends of the rods having metallized portions securely an-

chored to the ends of the rods and these portions fastened to the end bearing plates as by soldering, one of said rods having longitudinally spaced metallized portions intermediate said ends and having transverse metallic members fastened thereto, the stator groups of plates being carried by said transverse members, said members having extensions at both ends, those at one end serving to make electrical connection to the stator units, while those at the other end serve to mount at least one reactance device thereon.

MELVIN V. WEISS.

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