Nov. 26, 1929. C. D. TUSKA 1,737,277

VARIABLE CAPACITY APPARATUS

Filed Feb. 28. 1925

Fig. 1.

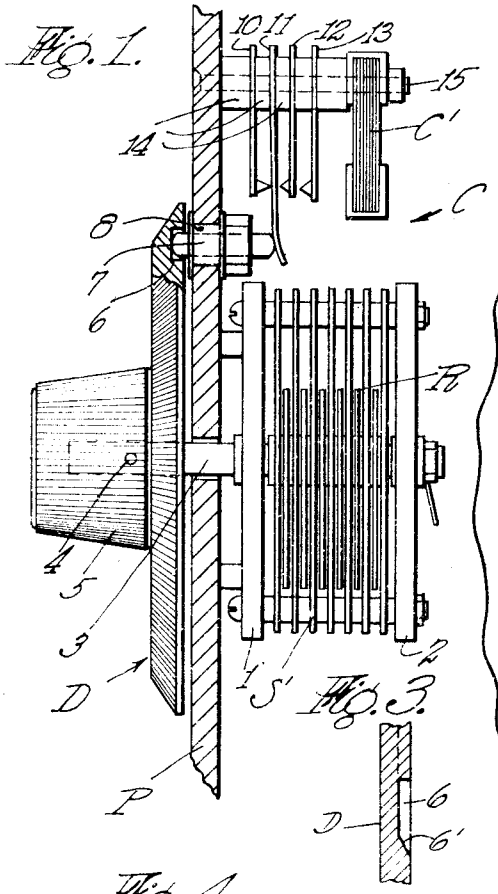


Fig. 2.

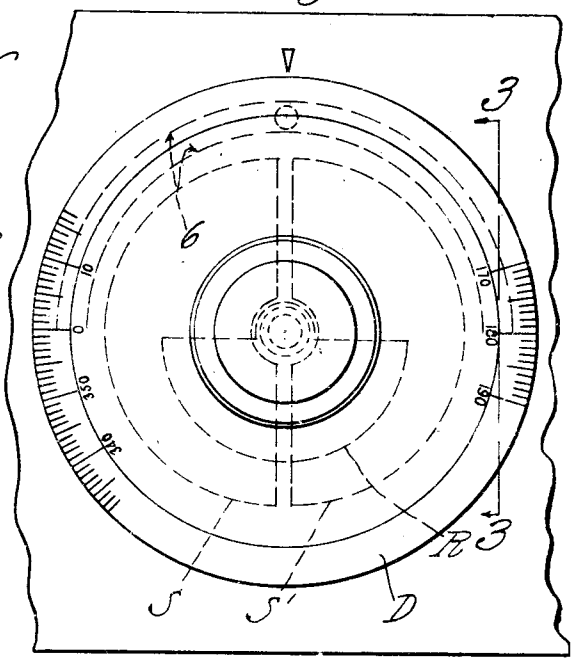


Fig. 3.

Fig. 4.

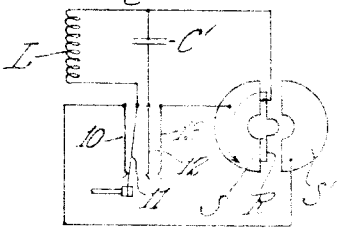


Fig. 5.

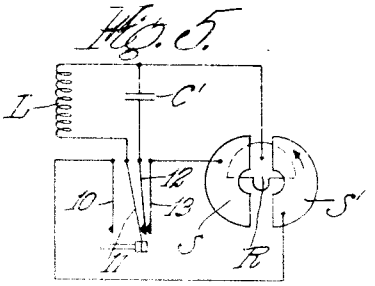


Fig. 4a.

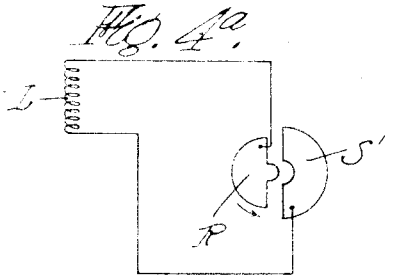
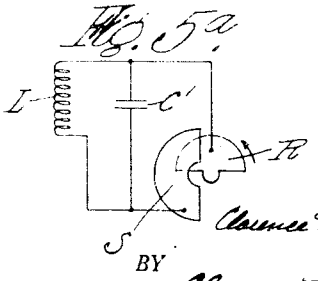


Fig. 5a.



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UNITED STATES PATENT OFFICE

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VARIABLE-CAPACITY APPARATUS

Application filed February 28, 1925. Serial No. 12,354.

This invention relates to improvements in radio apparatus and more particularly to a variable tuning arrangement for oscillating circuits of radio transmitting or receiving apparatus.

As is well known, oscillating circuits may be tuned by varying either the capacity or the inductance thereof and this is usually accomplished by mounting a part of the tuning element, such as the rotor of a condenser or variometer, upon a shaft for rotative relation with a stationary part of the tuning element, such as the stator of the condenser or variometer. The range of tuning effect with such variable tuning elements is limited to 180 degrees of turning for the shaft upon which the rotor is mounted and when said shaft is fixed directly to an operating knob or dial, the useful graduations on said dial for fixing the various adjustments are limited to the semi-circumference of the dial.

Various geared down arrangements have heretofore been designed for connecting the dial knob with the rotor shaft so that the dial knob will have a greater angular movement than the shaft and thus make available a larger portion of the dial circumference for the graduations which mark the different positions of the shaft. Such geared down arrangements or "vernier" dials (so called) have the objection of being complicated and expensive as compared with a direct connection between the dial and the rotor shaft and also have the further objection of not always being free from back lash and noisy operation.

Among the principal objects of the present invention is to provide an arrangement whereby the dial knob may be connected directly to the rotor shaft of the tuning element and at the same time be effective throughout approximately its full 360 degree movement for a continuous and gradual variation of the tuning effect upon the circuit. In the preferred form of the invention hereinafter described and illustrated in the drawings, I have disclosed the principle of the invention as applied to a variable capacity apparatus in which the tuning of the circuit is effected by the varying capacity of condensers, but I wish it to be understood that the same principle might be applied with slight modifications to a variable inductance apparatus for likewise tuning the circuit. In general, the principle underlying the invention consists in the employment of two independent variable condensers (or inductances), the movable element or elements of which are fixed to a single rotor shaft in combination with a supplement fixed condenser (or inductance) which is adapted to be connected additively to one of the variable condensers (or inductances). Appropriate connections and switching devices are employed so that during part of the 360 degree rotation of the rotor shaft, only one of said variable condensers (or inductances) is connected in the circuit and during the remaining of said 360 degree rotation of said rotor shaft, the other variable condenser, together with the added capacity of the fixed condenser (or the other variable inductance together with its added fixed inductance) is connected in the circuit, the first named variable condenser (or variable inductance) in the meantime being cut out of the circuit. In this manner, the dial knob connected to the rotor shaft may be operated to vary the tuning effect of the circuit gradually and continuously throughout approximately its full 360 degrees of movement.

For the purpose of simplicity in disclosure, I have shown an arrangement wherein the two variable condensers are of approximately the same maximum capacity, each acting throughout 180 degrees of rotation of the rotor shaft. Also, the supplemental fixed condenser is approximately equal to the maximum capacity of the variable condenser which it replaces when the former is cut out of the circuit. It is obvious, however, that this distribution of the full capacity range may be unevenly divided throughout each half rotation of the rotor shaft, so that during 180 degrees rotation of the shaft a smaller total variation of capacity, and through the remaining 180 degrees rotation a larger total variation of capacity may be effected, whereby graduations of capacity in the tuned circuit may be at a greater angular distance apart on the dial knob for short wave lengths

than equal graduations of capacity on the dial knob for the long wave lengths. Such an arrangement would facilitate the tuning of the circuit for the shorter wave lengths.

A preferred embodiment of the invention as applied to a variable capacity apparatus is illustrated in the accompanying drawings, in which:—

Fig. 1 is a side elevational view showing one form of an apparatus embodying the principal features of the invention;

Fig. 2 is a front elevational view of the same;

Fig. 3 is an enlarged sectional view taken on the line 3—3 of Fig. 2;

Figs. 4, 4ª, 5 and 5ª are diagrams illustrating the operation of the apparatus.

The invention will now be described in detail by reference to the drawings, it being understood that the form of the invention shown is merely intended to enable those skilled in the art to have a clear understanding thereof.

The preferred arrangement consists essentially of a variable capacity apparatus C which has separate stator sections S and S′ secured in a fixed relation at opposite sides of the shaft 3 of a rotatable rotor section R, together with a supplemental capacity C′ of the fixed type adapted for parallel or shunt connection with one of the stators to replace the other stator under certain conditions, as will be later explained. The stator sections S and S′ may each comprise a plurality of parallel plates of usual and well-known semi-disc form, held together in spaced relation as is usual, between supporting end plates such as 1 and 2. The rotor plates R, of similar shape, are fixed in parallel spaced relation upon the rotor shaft 3 which is rotatable in the end plates 1 and 2, and said shaft may extend forwardly of the plate 1 and through the panel P to carry an operating dial D fixed thereon.

The plates forming each of the stators are so arranged as to provide independent and separate stator sections located on opposite sides of the rotor shaft and are arranged so that the rotor plates may enter between and interleave with the plates of either stator. As shown, during the rotation of the rotor shaft through 360 degrees, the rotor plates will be simultaneously withdrawing from within one stator section while entering the other, and when completely out of one stator section will be fully within the other. Each of the stators is arranged to be cut in and out of the tuning circuit, as will later appear, and is adapted, in combination with the rotor, to form separate independent condensers accordingly as the rotor plates are in overlapping relation with one set of stator plates or the other. The number of plates constituting each of the stators and the rotor may be as desired, so that each stator with the rotor may form a condenser having a certain maximum capacity. Also, the maximum capacity of the fixed condenser C′ may be determined by the capacity chosen for stators and rotor as will be explained.

By reference to the diagrammatic views, Fig. 4, 4ª, 5 and 5ª, it will be observed that the stators S, S′ are arranged to be successively or alternately cut in and out of the tuning circuit comprising the inductance L and that the fixed capacity C′ is connectively in shunt with the stator S and arranged to be cut in and out of the circuit simultaneously therewith. As will be described in detail later, the stator S and its shunted fixed condenser C′ are simultaneously cut out of the circuit when stator S′ is cut in and vice versa. Theoretically, the total variable capacity of the circuit may be obtained by giving to each stator S, S′ a maximum of one half the total capacity of the circuit and by fixing the capacity of C′ at a value equal to the maximum capacity of S′, which it replaces when the latter is cut out of the circuit. However, for practical purposes, it is desirable to provide a slight overlap when changing from the capacity of one stator to that of the other so that wave lengths at the change-over point may be easily tuned in. Therefore, in actual practice, while the maximum working capacity of stator S′ may be one half the capacity of the system, the fixed capacity C′ should be slightly less than that of stator S′ and the maximum working capacity of stator S should be slightly more than that of stator S′. For example, if we assume that the maximum variable capacity to be attained in the system is .0005 microfarads, which is usual in grid circuits for tuning the same through a wave length range of 200 to 600 meters, then the maximum working capacity of stator S′ may be .00025 m. f., the fixed capacity of C′ .00024 m. f., and the full working capacity of stator S .00026 m. f. Then the rotor, when working in stator S′, will gradually raise the capacity to .00025 m. f. and upon leaving stator S′ (which is thereupon cut out) to enter stator S (which is thereupon cut in together with capacity C′) the capacity of the system will fall momentarily to .00024 m. f. but upon the continued movement of the rotor into stator S will rise gradually to the full maximum, i. e., .0005 m. f.

The mechanism for cutting the stators in and out of the circuit and for substituting the capacity C′ for the stator S will now be described and in general consists of a switch mechanism that is actuated by the dial D. The dial D is fixed to the outer end of the shaft 3 by means of the usual set screw 4 and may be provided with a knob portion 5 of ordinary and convenient size for turning the dial and shaft 3 and adjusting the rotor R with respect to the stators S and S′.

This dial, as distinguished from the usual so-called 180 degree dial, preferably carries

graduations about its entire circumference, the graduations shown representing angles of one degree each and reading from 0 to 360. A groove 6 is provided in the rear face of the dial that preferably extends from a point opposite the graduation 0 thereof to a point opposite the vicinity of the graduation 180 and is adapted to receive a spring pressed plunger 7 slidable in a bushing 8 carried by the panel P. An inclined ramp 6′ is formed at the end of the groove 6 adjacent the graduation 180 of the dial so that the plunger 7 will easily ride out of the groove 6 onto the rear face of the dial.

The switching devices for connecting and disconnecting the stators include a plurality of yieldable, spring-like contact leaves 10, 11, 12 and 13 held in a spaced apart relation by insulating washers 14 secured to the panel P by a screw 15 that passes therethrough. The contact leaf 11 is adapted to exert a pressure upon the end of the plunger 7 for forcing the plunger against the rear face of the dial or into the groove 6 thereof, as shown in Fig. 7.

The previously referred to fixed capacity C′ may be carried by the screw 15 of the switching devices and, as shown, is preferably of the usual form having condenser plates separated by dielectric insulators.

The apparatus just described may be adapted for use in connection with any radio apparatus where it is desired or required to tune a circuit and the connections to the different elements of the system may be, as indicated diagrammatically in Figs. 4, 4ª, 5 and and 5ª. L represents an inductance coil of the circuit to be tuned and is connected at one end to the rotor R, and at its other end to the contact member 11. The stator S′ of the condenser is connected to the contact 10 and the other stator S is connected to the contact 13, while the fixed condenser C′ is connected between the upper end of the inductance and contact 12, as shown, so as to be in parallel or shunt with the stator S.

With the apparatus connected as just described and while the dial is between its 0 and 180 graduations, the plunger 7 of the switch is forced to the left into the groove of the dial and the contacts 10 and 11 are in engagement so that only the stator S′ and the rotor R are in the circuit, as illustrated in Fig. 4ª. During the rotation of the dial between 0 and 180, the stator S′ is in working relation with the rotor to vary the capacity as described. When the 180 graduation is reached, the plunger 7 comes to the end of groove 6, is forced out of the groove by the ramp 6′ thereof or in a direction to the right in Fig. 1 to break the connection of switch contacts 10 and 11 and connect contacts 11, 12 and 13, whereby the stator S′ is cut out of the circuit and stator S and the fixed condenser C′ are cut in, the latter being in parallel with the stator S as shown in the diagrammatic views 5 and 5ª. A continued rotation of the dial will thus continue to raise the capacity of the tuned circuit to the maximum limit and at the end of its 360 degree movement will be ready to again restore the connections to the position shown in Fig. 4, due to the end of slot 6 again coming beneath plunger 7.

It will be apparent from the foregoing that I have provided a variable capacity aparatus that is variable by a rotating element that is movable through 360 degrees and by the means of which it is possible to move the said element through the small angles desired and necessary to thereby obtain small variations in the capacity.

It will be understood that if inductances instead of condensers are used for the tuning elements, the supplemental fixed inductance corresponding to the fixed capacity C′ will be arranged for series connection with its respective variable inductance so as to be additive as in the case of the capacity C′; the necessary changes required and appropriateness of such connections being obvious to those skilled in the art.

I am aware that many changes may be made in the form of the invention without departing from the scope thereof. I prefer, therefore, to be limited by the appended claims rather than by the foregoing description.

What I claim is:

1. The combination with an oscillating circuit of a variable tuning apparatus therefor comprising two independent tuning elements of variable value and a fixed tuning element of fixed value additively connective to one of said variable tuning elements, a rotor shaft, a single rotor coacting with said variable tuning elements fixed to said shaft, switching devices controlled by the rotation of said shaft to connect in said circuit only one of said variable tuning elements during part of the complete 360 degrees rotation of said shaft and to connect in said circuit only the other variable tuning element and the fixed tuning element during approximately the remainder of the 360 degree rotation of said rotor shaft, and a dial knob fixed to said rotor shaft having control means circumferentially thereof for operating said switching devices.

2. The combination with an oscillating circuit of a variable capacity apparatus for tuning the same comprising two independent variable condensers and a fixed condenser connectively in shunt with one of said variable condensers, switching devices for alternately connecting in said circuit one of said variable condensers or the other variable condenser simultaneously with its shunted condenser, and a rotor shaft provided for operating said variable condensers having a dial knob fixed thereto and means disposed circumferentially thereof for operating said switching devices.

3. The combination with an oscillating circuit of a variable tuning apparatus therefor comprising two independent tuning elements of variable value and a fixed tuning element of fixed value additively connective to one of said variable tuning elements, a rotor shaft operating said variable tuning elements, a dial knob fixed to the rotor shaft, switching devices operable to connect in the circuit one only of the variable tuning elements, or the other of the variable tuning elements shunted by the fixed tuning element, and means upon the dial knob for actuating the switching devices at predetermined rotative positions of the shaft.

4. The combination with an oscillating circuit of a variable tuning apparatus therefor comprising two independent sets of stator condenser plates, a rotor shaft, a single set of rotor condenser plates mounted upon said shaft, a switching device operable to connect in the circuit only one of the sets of stator plates, or the other of the sets of stator plates shunted by the fixed condenser, a control dial mounted on the rotor shaft, and a cam formed upon the dial and operable to actuate the switching device at predetermined rotative positions of the shaft.

5. The combination with an oscillating circuit of a variable capacity apparatus for tuning the same, comprising two independent variable condensers and a fixed condenser connectively in shunt with one of said variable condensers, switching devices for alternately connecting in said circuit one of said variable condensers or the other variable condenser simultaneously with its shunted condenser, a rotor shaft for operating said variable condensers, a dial knob affixed to said shaft, and means spaced around the peripheral portion of said dial knob for operating said switching devices.

In testimony whereof I have affixed my signature.

CLARENCE D. TUSKA.