Sept. 29, 1925. 1,555,254

J. A. PROCTOR

ELECTRICAL TUNING APPARATUS

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Fig. 1.

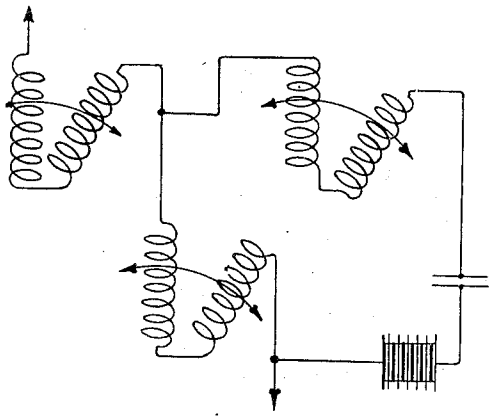


Fig. 2.

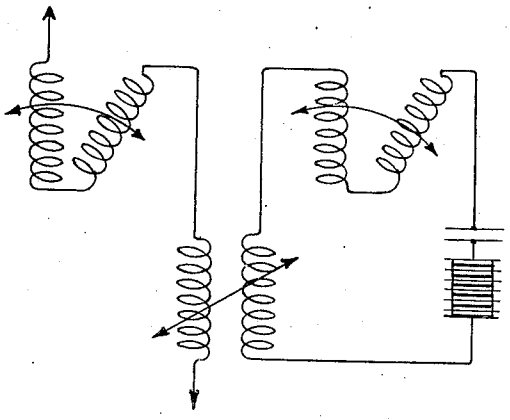


Fig. 3.

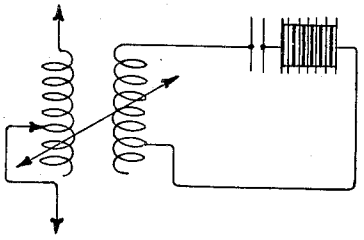
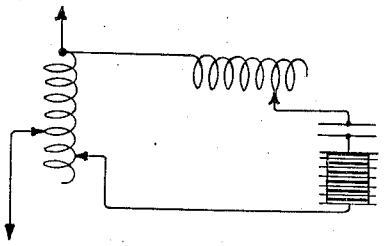


Fig. 4.



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Fig. 5.

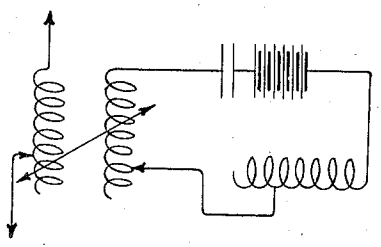


Fig. 6.

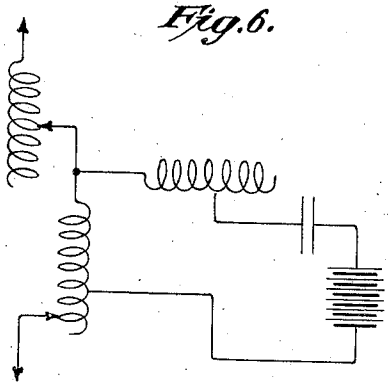
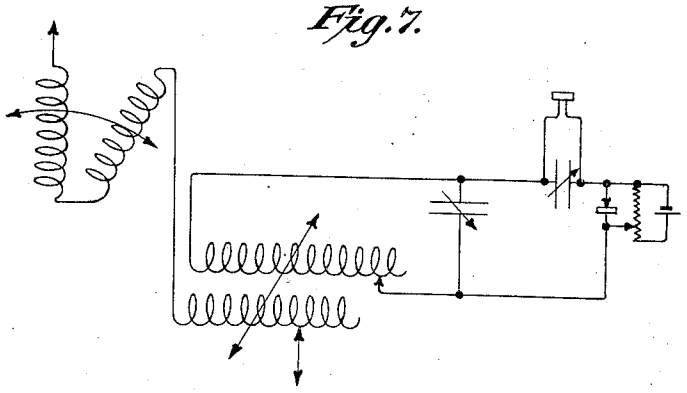


Fig. 7.



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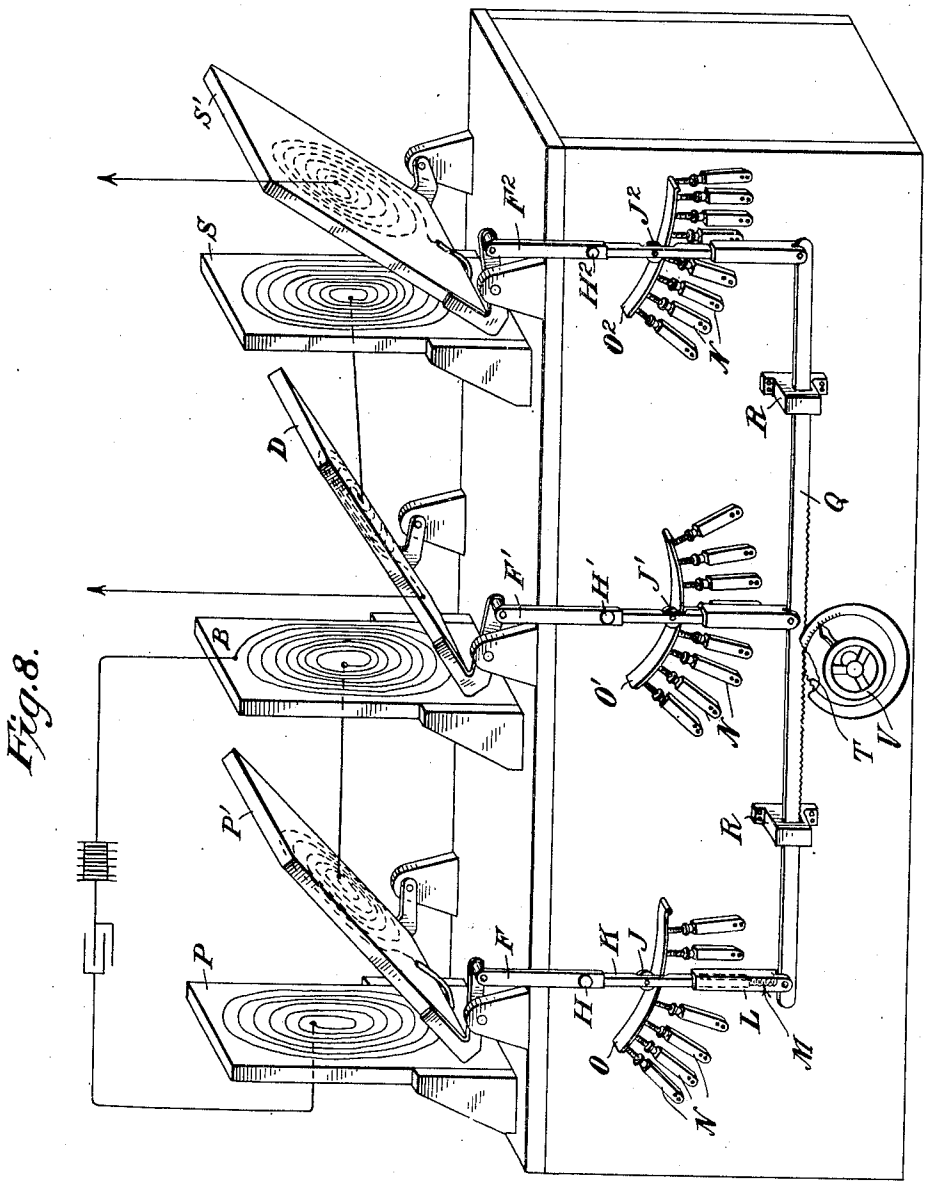


Fig. 8.

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Fig. 9.

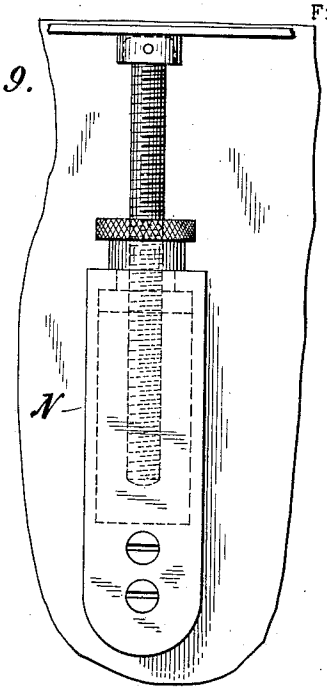
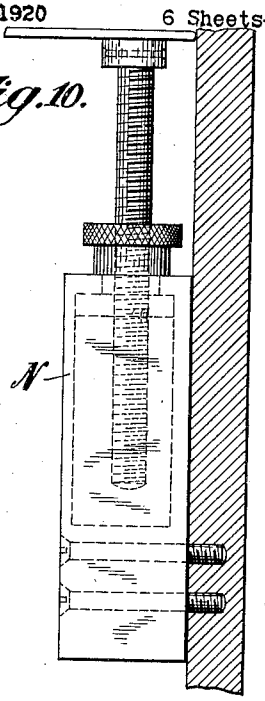


Fig. 10.



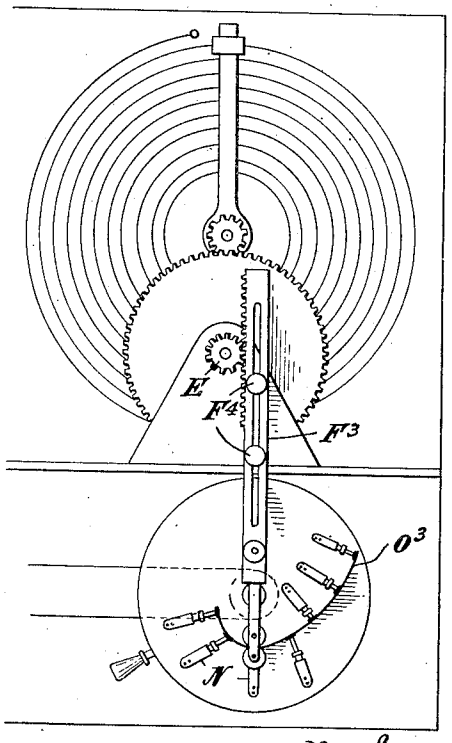


Fig. 11.

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Fig. 12.

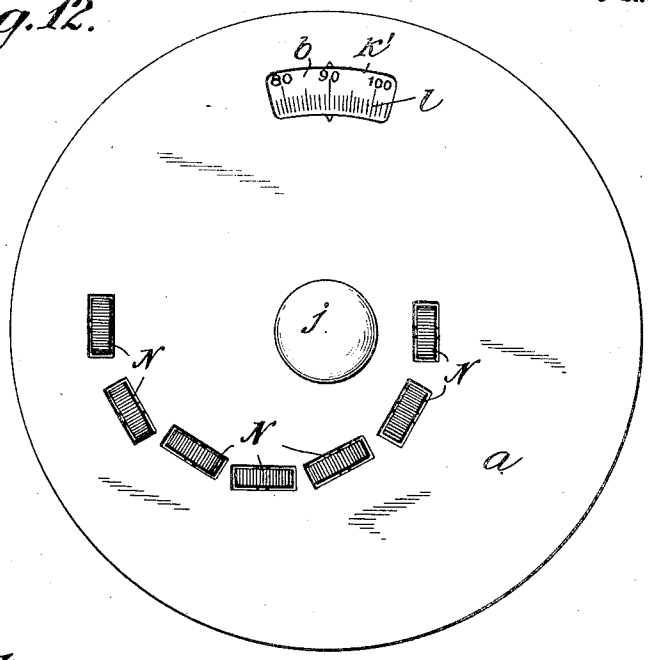
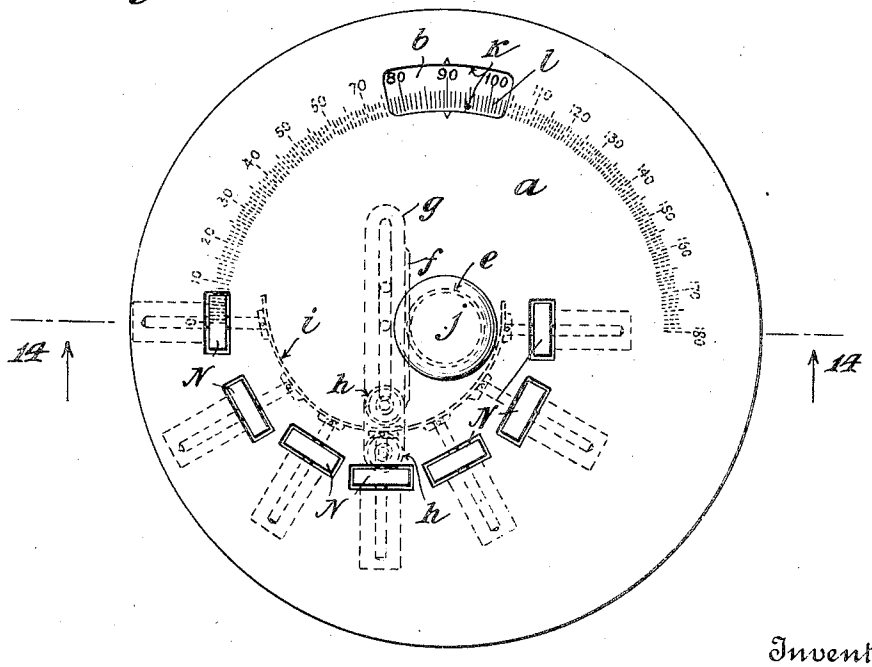


Fig. 13.



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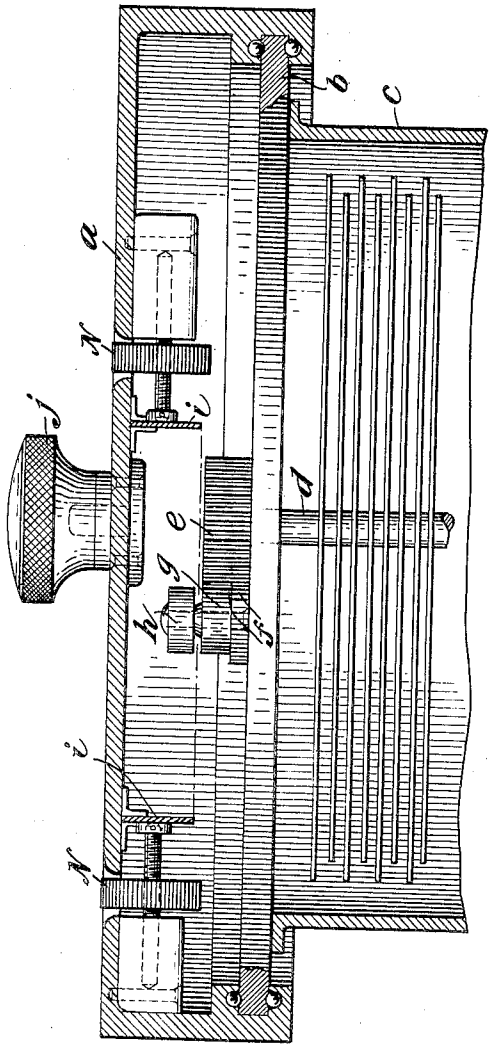
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Fig. 14.



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UNITED STATES PATENT OFFICE.

JOHN A. PROCTOR, OF LEXINGTON, MASSACHUSETTS, ASSIGNOR TO WIRELESS SPECIALTY APPARATUS COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF NEW YORK.

ELECTRICAL TUNING APPARATUS.

Application filed September 4, 1920. Serial No. 408,291.

To all whom it may concern:

Be it known that I, JOHN A. PROCTOR, a citizen of the United States of America, and a resident of Lexington, State of Massachusetts, have invented certain new and useful Improvements in Electrical Tuning Apparatus, the principles of which are set forth in the following specification and accompanying drawings, which disclose the form of the invention which I now consider to be the best of the various forms in which the principles of the invention may be embodied.

This invention relates to apparatus whereby in radio telegraphy and telephony there is produced a continuously variable wave length by the movement of a single handle, and whereby in electrical circuits or network in general or in other apparatus the operation of a plurality of independently variable elements is co-ordinated. The object of the invention is to provide a mechanical means which makes possible the mechanical linking of any number of variable elements in such a way that by the movement of a single turning member these elements may be varied in the proper relation to one another to maintain the optimum relations in the circuit or circuits of other apparatus.

Specifically in any radio transmitter or receiver, regardless of what system is used, there are in general several dependent variable elements. In a quenched gap transmitter, for instance, there is a primary variable inductance, a secondary or antenna variable inductance and a variable linking or coupling. It is a well-known fact that in changing the wave-length from a minimum value to a maximum value in such a transmitter, these three elements just mentioned vary according to the type or design of their respective parts. It is true that the inductance in both circuits increases as the wave-length increases and that the coupling assumes different values throughout the range of wave lengths. It is true also that the primary and antenna inductances vary in such a way that it has not been possible to connect these variable elements with a simple handle or other arrangement so that they will vary together in exactly the proper relation, for the reason that the mechanical movements, and, indeed, the electrical quantities varied by these mechanical movements, are not related by any simple ratio, so that no arrangement of ratio gears will suffice to maintain the circuits in optimum adjustment throughout the wave-length range.

In certain types of transmitters, the optimum adjustment between the primary and antenna circuits is that known as resonance, and in such transmitters, the product of inductance and capacity in the one circuit is to be maintained equal to that in the other. In quenched gap transmitters, this is not true, the optimum adjustment of the circuit often departing widely from resonance, owing largely to changes in the spark gap resistance, etc. In continuous wave transmitters, still other conditions are met, as, for instance, in oscillion transmitters or in arc transmitters, in which complex dependent adjustments of various elements in the different circuits are required, and in receiving undamped waves by the "beat" system, a certain detuning of the circuit must be maintained, in order that the proper beat note shall be preserved, regardless of changes in wave length adjustments.

The invention will be readily understood by reference to the accompanying drawings in which—

Fig. 1 is a circuit diagram for the apparatus shown in Fig. 8.

Figs. 2, 3, 4, 5 and 6 are diagrams of modified circuits which will be readily understood by those skilled in the art.

Fig. 7 is a diagram of the circuits for my apparatus as applied to a radio receiver.

Fig. 8 shows a mechanical embodiment of the invention employed with the circuit shown diagrammatically in Fig. 1.

Figs. 9 and 10 show a front and side elevation respectively of one of the adjusting screws N which support the flexible strip O of Fig. 8.

Fig. 11 is a mechanical embodiment of a modified form of the apparatus of Fig. 8.

Fig. 12 is an elevation of yet another modified form.

Fig. 13 is a similar view of the form of Fig. 12 with some of the concealed parts shown in dotted lines, and

Fig. 14 is a central section of the same

(Figs. 12 and 13) as indicated by the line 14—14 in Fig. 13 and looking in the direction of the arrows.

Referring to Fig. 8, which shows three variable elements in a transmitter, diagrammatically shown in Fig. 1, we have a variable inductance P, P′ in the primary circuit, a variable inductance S, S′ as secondary or antenna circuit, and a variable coupling as shown by the coils B D. Fig. 8 also shows a handle V with pointer to a wave length scale, the handle being mounted on the same shaft with pinion T, which is connected to the rack Q; thus a turning movement of the handle V allows the lateral sliding movement of the rack Q within its stationary bearings R as shown. We will suppose that P is the stationary primary coil of a so-called variometer and P′ the movable coil, and that when the coils are parallel or close together there is a minimum inductance in this primary circuit, and that when the coil P′ is at right angles to the coil P, the inductance is at a maximum. The coil P′ is swung on a pivot by connecting bar F, which telescopes about the rod K, on which is mounted roller J. This rod K continues down into the telescoping piece L which is fastened to the rack Q. The rod K is held in a downward position by a spring M inside as shown. The set screw H allows the rod K to be rigidly set at any selected position so that the length between the centre of the roller J and centre of pivot at top of rod F remains constant at a given setting of screw H.

O is a strip of flexible metal which can be bent into the shape of a fair curve, the shape of which can be altered at will and maintained after once being set as for example by means of the adjustment screws N, a detail of which is shown in Figs. 9 and 10.

Between rack Q, Fig. 8, and the three variables P, P′ and B, D and S, S′, the above devices are triplicated as shown.

Now let us suppose, for example, that the wave-length range of this particular arrangement will be between 600 and 1500 meters as determined by the minimum and maximum values of the inductances. It is assumed in this particular case also that the amount of inductance in the coupling coils B and D is the same over the range of wavelengths noted and that a change from minimum to maximum wave-length will require a simultaneous movement of the inductance coil P′, the coupling coil D and the inductance coil S_1. The primary circuit, including the variable inductance P, P′, can be calibrated directly in wave lengths on the fixed scale shown adjacent the movable pointer on handle V, and the curve O can be made to take any desirable shape so that the roller J, passing back and forth over this curve by the means of the handle V, will make the coil P′ move through the range necessary to change the wave-length from minimum to maximum in any definite required ratio. By glancing at Fig. 8 one can readily see that a movement of the handle, thereby moving the rack O to right or left, will cause roller J to traverse the surface of the curve strip from end to end in such a manner that the amount of variation of this coil P′ for a given movement of the handle V or the angular relation of the coil P′ to the coil P will vary according to the shape of the curve O. In other words, one really reproduces mechanically a wave-length curve plotted against movement of an inductance coil in such a way that the rate of change of movement in this inductance coil or system can be varied at will.

In the initial setting of the appartus for the normal co-ordinating operations, two steps are taken, first, the setting or adjustment of the curvature of member O for the desired wave lengths of the primary or master circuit throughout the range of movement of primary coil P′, and second, the setting of curves O′ and O^2 to provide for optimum transfer of energy from primary to secondary over the entire length of curve O and the corresponding range of wave lengths of the primary.

First, primary curve O is set initially as follows: Coil P′ is moved toward coil P to the position where the resulting inductance causes the 600 meter wave length (as observed by measurement). This independent movement of coil P′ is permitted by the telescoping of parts F and K. Roller J and the left-hand end of curve O then are brought into engagement with one another. This may be done in various ways with the apparatus shown, but may be effected by movement of handle V to the left, which moves rack Q to the left, carrying with it parts L, K and F swinging on the top pivot of part F while coil P′ is in the 600 meter position. When roller J engages with the left end of curve O, screw H is set to maintain constant the distance between roller J and the top pivot of part F for all settings of curve O for the rest of its length. When handle V has moved roller J to the left end of curve O, the wave length scale for that position of the handle is marked for 600 meters to correspond with the 600 meter position of coil P′. Then handle V is turned to the right to pull down coil P′ on its pivot with part F to a position corresponding with a greater inductance in the primary circuit to correspond with a given definite increased wave length (screws N being withdrawn below curve O to permit this if necessary). In the resulting position of roller J, screws N are closed up against member O to bend its flexible curve

up against the roller J to establish a new point of the curve. These operations are repeated until the entire length of curve O is set to the desired shape and condition of smoothness. Curve O maintains its shape after having been bent to the desired curvature as by screws N. It may be necessary to establish six or eight points of the curve from as many operations, both in the case of curve O for determining the wave lengths of the primary or master circuit and in the case of curves O′ and O² for determining the optimum conditions of energy transfer from primary circuit to secondary circuit throughout the range of wave lengths of curve O.

It is now desired to bring the three variable elements of Fig. 8 into such relation that maximum energy transfer may be effected from primary to secondary at every wave length in the range, i. e., throughout the movement of roller J on curve O. To accomplish this, handle V is left in its position indicating 600 meters on the scale, roller J being at the left end of curve O. Then the positions of coupling coil D and inductance S′ are adjusted until maximum energy transfer is established at the 600 meter setting of the primary circuit. This is accomplished by moving the rods F′ and F² up and down until the positions of coils D and S′ are such as to cause optimum energy transfer as observed by measurement. Then rollers J′, J² are engaged respectively with the left ends of curves O′ and O² and screws H′ and H² are set to maintain those positions, handle V being kept in its position pointing to 600 meters on the scale. (If desired, the ends of curves O′ and O² at the left may be brought up by adjusting screws N to meet rollers J′ and J².) It can then be assumed that the adjustments now made will correspond with the optimum conditions for the 600 meter adjustment. Then to adjust the transmitter for maximum energy transfer over the rest of the range of wave lengths corresponding to curve O, handle V is moved to move roller J further to the right along primary curve O until 750 meters is obtained. Then without releasing set screws H′ and H², coils D and S′ are moved back and forth until the adjustment is established for optimum energy transfer on the 750 meter wave length. Then up against rollers J′ and J² in these positions, the flexible curves O′ and O² are bent as by screws N. Then primary coil P′ is moved further by handle V and the operation of bending curves O′ and O² to new positions of rollers J′ and J² is repeated until said curves are bent throughout their length so as to be co-ordinated with curve O, i. e., so that the wave length of the secondary circuit and the coupling between the circuits are such as to provide optimum conditions of energy transfer at each and all points of operation on curve O corresponding to wave length adjustments of the primary circuit.

One can readily see that after these three curves are established, a movement of handle V in either direction will allow movable coils P′, D and S′ to vary according to the shape of their respective curves O, O′ and O² and in such manner that maximum energy transfer will be effected at each wave length to which the primary may be adjusted, i. e., at any point along curve O. The freedom of telescopic movement between parts K and L prevents movement of handle V without interference with the continued bearing of roller J on the curve. The rollers always will be brought back by springs M to the same positions to which they were originally set on the curves. These points determine the curve and experience shows that if a sufficient number of points are taken along the curve representing, for example, wave length against mechanical movement of the coil, then those points connected along a smooth or fair curve will represent the actual relation over the entire range and any points taken between the points of reading will be extremely accurate. This simple mechanical device, therefore, allows a variation of any number of continuously variable elements in the right proportion to maintain the proper circuit adjustment and coupling in a radio transmitter or receiver so that transmitted or received wave-length can be varied over the limits of the capacity of the instrument by the movement of a single lever or handle manually or otherwise mechanically operated.

In the mechanical means shown in Fig. 8, the principle of the curves O, O′ and O², with their variable qualities, by means of the adjusting screws, is the means by which these variations can be maintained simultaneously;—that is, the curves are the important parts of the invention. I do not limit myself to three variable elements as shown, as the different Figures 1 to 6 inclusive represent circuits in a transmitter embodying different variable elements, and also variable by different means through so-called variometers as indicated, and by other forms of variable inductances such as helices, and various forms having sliding or variable contacts thereon.

Fig. 11 also shows another method of producing variation of inductance in a circuit by means of a mechanical motion which is accomplished by the movement of the curve itself as shown instead of the movement of the arms along the surface of the curve; that is, a rotating movement of the curve O³ about a fixed point moves the arm F³ up and down, but this arm is confined

against lateral movement by the pins F^4 which slide in the slot as shown. On the side of the rod F^3 is cut a rack which engages with the pinion E. The shaft of this pinion might be connected through gearing or any other suitable means to the rotating element of any type of inductance or condenser, thereby varying the inductance value or capacity value over any desired range at any desired rate.

In Figs. 12–14 is shown a modified device comprising a variable condenser equipped with a curve arrangement whereby the capacity curve of the condenser relative to the movement of the handle may be made to assume any value. This is of special utility in constructing condensers for laboratory wave meter or decremeter circuits where it is desirable that such circuits be calibrated in wave length directly or where the ratio of capacity value of the condenser to a given movement of the handle may be made to assume any quantity. This modification includes a cover plate *a*, rotatably mounted on a plate *b*, which is secured to a casing *c*, within which is mounted the variable capacity in the form of an ordinary variable air condenser. On the inner surface of cover plate *a* are mounted a plurality of adjusting screws N arranged to bear against flexible curved plate *i*.

The movable element of the variable capacity may in this instance be mounted on a shaft *d*, which projects through the plate *b*, and carries at its outer end a pinion *e*, which meshes with a rack *f*, cut on the side of a flat bar *g*, which is slidably mounted on the plate *b*.

The bar *g* is provided with two rollers *h*, *h*, (Fig. 13) between which the flexible plate *i* is adapted to pass. The cover plate *a* is provided with a handle *j*, with which to rotate it, and an opening *k*, through which a scale *l*, marked on the plate *b*, is visible.

This mechanical arrangement is adaptable to a variable condenser in such a way that the capacity variation coordinated with movement of the handle can be made to assume a straight line, or, in other words, the movement of a handle over scale 1 graduated in equal units will produce an equal variation in capacity for each unit.

This invention includes broadly the principle of a simultaneous change of any number of variable elements in a radio transmitter or receiver, accomplished by means of a curved member, track or otherwise, or any mechanical means which would cause these elements to vary in the proper relation to one another or proportion to maintain their best adjustment. This is a very valuable invention to the art as heretofore wave-length has been varied by steps—the greater the number of steps, the greater the complication, as a large number of connections, wires, etc., are necessary to arrange for nine or ten variations of wave-length throughout the range of transmitter, when this latter is accomplished by means of switches.

This invention may be applied to any type of transmitter or receiver including the transmitters of Figs. 1–6 and the receiver of Fig. 7. It provides arrangements whereby the coupling may be quickly altered to adjust for different damping factors and still maintain optimum adjustment between the receiving circuits.

Adopting this invention for use in calibrating condensers, for use in wave meters and other measuring devices, eliminates the necessity of designing the condenser plates and adjusting them accurately to obtain the desired "capacity curve".

The value of such a device also is apparent for military purposes such as interfering with another station. The wave-length can be immediately changed from one value to another and, in fact, can be arranged so that by electrical operation of the single actuating device or controlling handle the wave-length can be played up and down the scale, so to speak.

By attaching a motor or an electro-mechanical-step-by-step device to the handle V (Fig. 8), in any well-known suitable manner, the transmitter may be readily controlled from a distance; i. e., this distant control may be at the operator's position, so that without leaving his desk, he may quickly adjust his transmitter to any desired wave length, whether the transmitter be in the same room, same building, or miles away, as is often required in diplex and in duplex systems of radio communication. Similarly, by mechanically or electro-mechanically connecting the controls of the transmitter and receiver to a switch, they may both be maintained at the same wave length, so that the operator, "listening in", may select a wave length that is not at that time in use by other neighboring stations, and he may transmit his messages on this wave length, thereby avoiding interference. Equally, by allowing the motor drive to run continuously on the receiver, the operator is enabled to "listen in" over a continuously and smoothly varying range of wave lengths, and so "pick up" any message or call that may be transmitted on a wave length within the range of his receiver.

By the present invention, I am able to coordinate the movements of the actuating member and the variable elements by the means such as herein described. The relation between the two movements is a complex one, that is non-linear, but by the coordinating means herein described a given movement of the actuating member causes a

given movement of the variable element irrespective of the complexity of the relation between the movements.

I claim:—

1. The improvement upon apparatus for tuning a pair of coupled electrical circuits, of the type wherein movable elements of the circuit coupling and of two reactance tuning devices connected to such circuits possess substantially uninterrupted adjusting movements, said improvement comprising three curved control members controlling the effect of such movable elements on the circuit coupling and tuning devices respectively; the curvature of one of said control members being shaped according to the plotting of various wave-lengths of the circuit controlled by it, against various adjusting positions of the movable element of its tuning device; and the curvature of the other two control members being shaped according to the values of the tuning reactances which produce the desired energy transfer from the first circuit at the various wave lengths thereof which are determined by the curvature of the first control member; and a common actuating device for the plurality of movable elements; said plurality of control members being parts of said actuating device and having relatively movable engagements therewith causing the movement of the common actuating device to determine the effective wave length of the coupled circuits in accordance with the curvatures of the several control members.

2. The improvement in electrical tuning reactances of the type comprising two members having substantially uninterrupted adjustable relation to one another for the purpose of selecting any one of a plurality of effective reactance values, said improvement comprising an actuating device consisting of two relatively movable parts, one of which is connected to a movable adjusting member of the tuning reactance; and a control member having a curved portion shaped according to the plotting of a curve of various reactance values against various adjusting positions of the movable member of the tuning reactance; said curved control member also being part of said actuating device but occupying a fixed position and the part of the actuating device which is connected to the movable adjusting member having movable engagement with the fixed curved portion of said control member.

3. The improvement upon apparatus for tuning a pair of coupled circuits, of the type wherein movable elements of the circuit-coupling and of a reactance tuning device connected to one of such circuits, have substantially uninterrupted adjusting movements, said improvement comprising two curved control members, the curvature of one of which is shaped according to the plotting of various wave lengths of the circuit controlled by it, against various adjusting positions of the movable element of its tuning device, and the curvature of the other of which control members is shaped according to values of the coupling which produce the desired energy transfer, from the circuit controlled by the first control member, at various wave lengths of said first circuit; and a common actuating device for the plurality of movable adjusting elements; said control members being parts of said actuating device and their curved portions having relatively movable engagement therewith.

4. The improvement upon apparatus for tuning a pair of associated electrical circuits, of the type wherein movable elements of reactance tuning devices connected to such circuits respectively have substantially uninterrupted adjusting movements, said improvement comprising two curved control members, and a common actuating device for the plurality of movable adjusting elements, said control members controlling the effect of the actuating means upon the respective tuning devices; the curvature of one of said control members being shaped according to the plotting of various wave lengths of the circuit controlled by it, against various adjusting positions of the movable element of its tuning device; and the curvature of the second of said control members being shaped according to values of its tuning reactance which produce the desired energy transfer to its circuit from the first circuit at the various wave lengths of the first circuit which are determined by the curvature of the first control member; said control members being parts of said actuating device and their curved portions having relatively movable engagement therewith.

5. The improvement in radio communication wave changers, of the type wherein movable elements of a plurality of reactances connected with associated radio circuits, have substantially uninterrupted adjusting movements, said improvement comprising a plurality of normally rigid strips flexible by force into curved form shaped according to the plotting of various wave lengths of the circuits against various adjusting positions of the movable elements of the reactances; means for holding said curved strips in their normal rigid condition of curvature; movable members operatively connecting said curved strips with said movable elements, said movable operating members comprising two relatively adjustable portions; and a common actuating device for said plurality of movable operating members.

6. In a system of apparatus for tuning a plurality of associated electrical circuits to any one of a plurality of successively closely

associated wave lengths, by means of the substantially uninterrupted progressive adjustment of movable elements of a plurality of tuning reactances respectively connected to such plurality of circuits, said improvement comprising a plurality of control members for said plurality of adjustable members respectively; said control members each having a portion which has a curvature shaped according to the plotting of various values of the respective tuning devices, against various adjusting positions of the movable adjusting members of such tuning devices; and a common actuating device for the plurality of movable adjusting elements, said control members being parts of said actuating device and their curved portions having relatively movable engagement therewith.

7. The improvement upon apparatus for tuning an electrical circuit to any one of a plurality of wave lengths, of the type wherein a movable element of a tuning device connected to the circuit has substantially uninterrupted adjusting movement, said improvement comprising a control member having a portion shaped according to the plotting of various wave lengths of the circuit against various positions of the movable adjusting element of the tuning device; said adjusting element and curved control member being co-operatively arranged and having relative movement causing movement of the adjusting element under the control of the curvature of the control member.

8. The improvement upon apparatus for tuning a pair of associated electrical circuits, of the type wherein movable elements of reactance tuning devices connected to said circuit have substantially uninterrupted adjusting movements, said improvement comprising two curved control members, and a common actuating means for the movable adjusting elements of the tuning devices, said curved members controlling the effect of the actuating means on the movable adjusting elements; a wave length scale co-operating with said actuating means; the curvature of one of said control members being shaped according to the plotting of various wave lengths of the circuit controlled by it, against various adjusting positions of the movable element of its tuning device; and the curvature of the second of said control members being shaped according to values of its tuning reactance which produce the desired energy transfer to its circuit from the first circuit at the various wave lengths of the first circuit which are determined by the curvature of the first control member; said control members being parts of said actuating device and their curved portions having relatively movable engagement therewith; and said wave length scale co-operating with said actuating means and being calibrated in accordance with the curvature of said first control member and in accordance with the wave length of said first circuit controlled thereby.

9. The improvement upon apparatus for tuning an electrical circuit to any one of a plurality of wave lengths, of the type wherein a movable element of a reactance device for tuning such circuit has substantially uninterrupted adjusting movement, said improvement comprising a control member and an indicating scale, said control member having a control portion shaped to the plotting of a curve of the various wave lengths of the circuit against various adjusting positions of the movable adjusting element of the tuning device; said scale being arranged co-operatively with the adjusting element of the tuning device and calibrated in accordance with the curvature of said control member and with the wave lengths of the circuit controlled thereby; and said movable adjusting element and the curvature of the control member being arranged co-operatively in setting the circuit at an operating wave length determined by the relation between them at a given setting indicated by the scale.

10. The improvement upon apparatus for tuning an electrical circuit to any one of a plurality of wave lengths, of the type wherein a movable element of a tuning device for the circuit has substantially uninterrupted adjusting movement, said improvement comprising a control member having a control portion shaped according to the plotting of various wave lengths of the circuit against various positions of the adjusting element of the tuning device; and a mechanical connection under the control of the curvature of said control member and having an operating connection with the movable adjusting element of the tuning device causing the setting of the circuit at an operating wave length determined by the relations between said mechanical connection and the curvature of said control member.

11. The improvement in electrical tuning inductances of the type comprising an inductance element and a member which has substantially uninterrupted adjusting movement for the purpose of selecting any one of a plurality of effective values of inductance, said improvement comprising a control member having a control portion shaped according to the plotting of a curve of various inductance values of the tuning inductance against various positions of the adjusting member thereof; and a scale calibrated in accordance with the curvature of said control member; the adjusting member of the tuning inductance being arranged under

the control of the curvature of said control member, the adjusting member and control member co-operating in selecting effective inductance values; and the scale and adjusting member being arranged and co-operating to provide indications of the inductance values at the various positions of the adjusting member which are determined by the curvature of the control member.

12. The improvement in electrical tuning inductances of the type comprising an inductance element and a member which has substantially uninterrupted adjusting movement for the purpose of selecting any one of a plurality of effective values of inductance, said improvement comprising a control member having a control portion shaped to the plotting of a curve of various inductance values of the tuning inductance against various positions of its adjusting member; said curved control portion of the control member and said adjusting member having relative movement co-operating in selecting effective inductance values of the tuning inductance under the control of said curved member.

13. The improvement in electrical tuning reactances of the type comprising two members having substantially uninterrupted adjustable relations to one another for the purpose of selecting any one of a plurality of effective reactance values, said improvement comprising an actuating device and a control member having a curved portion shaped according to the plotting of a curve of various effective values of the tuning reactance against various positions of the movable adjusting member thereof; said curved control member being a part of the actuating device and its curved portion having a relatively movable engagement with a portion of the actuating device.

14. The improvement in electrical tuning reactances of the type comprising two members having substantially uninterrupted adjustable relation with one another for the purpose of selecting any one of a plurality of effective reactance values, said improvement comprising a control member having a control portion shaped according to the plotting of a curve of various reactance values of the tuning device against various positions of a movable adjusting member thereof; an actuating device for such movable member of the tuning reactance; and a scale calibrated in accordance with the curvature of said control member; said control member being a part of the actuating device and its curved portion having relatively movable engagement with a portion thereof; and the scale and actuating device being arranged to co-operate in providing indications of the reactance values at various positions of the adjusting member determined by the curvature of the control member.

15. The improvement in electrical tuning reactances of the type comprising two members having substantially uninterrupted adjustable relation to one another for the purpose of selecting any one of a plurality of effective values of the reactance, said improvement comprising a control member having a control portion shaped according to the plotting of a curve of various reactance values of the tuning reactance against various positions of a movable adjusting member of the tuning reactance; and an actuating device for such movable adjusting member; said curved portion of the control member being a part of said actuating device and having relatively movable engagement with a portion thereof permitting movement by the actuating device of the adjustable member of the tuning reactance into various positions of adjustment corresponding with various points of the curvature of the control member.

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