Jan. 25, 1949. E. G. SEATH ET AL 2,459,844

CIRCUIT ELEMENT AND MOTOR FOR DRIVING THE SAME

Filed July 25, 1944 2 Sheets-Sheet 1

FIG. 1.

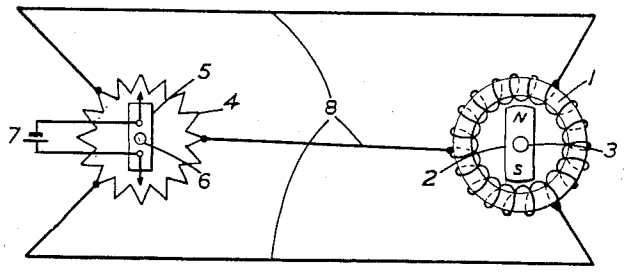
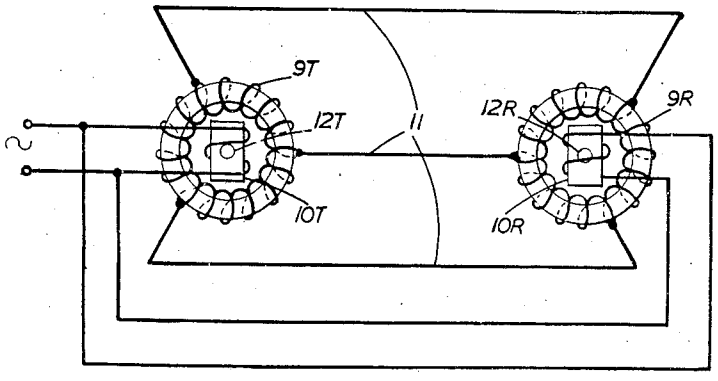


FIG. 2.



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FIG.3.

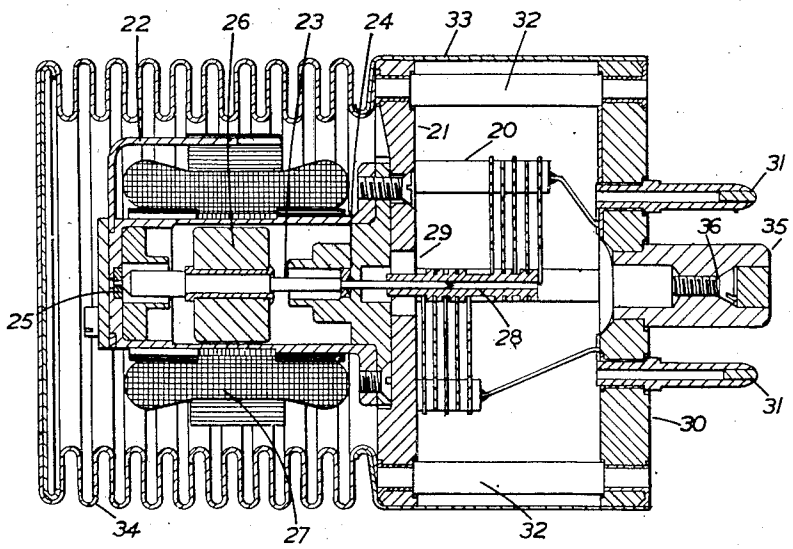
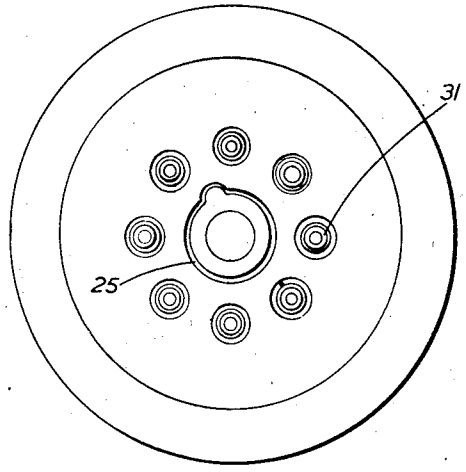


FIG.4.



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CIRCUIT ELEMENT AND MOTOR FOR DRIVING THE SAME

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7 Claims. (Cl. 172—36)

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The present invention relates to remote control tuning arrangements for electrical circuits and concerns more particularly means for tuning radio transmitting and receiving sets and the like from a distant point.

Radio receiving sets used in aircraft often have to be located at some point out of reach of the operator, and it is at the same time necessary to provide means whereby the operator may tune such a set without leaving his seat. In particular it is often necessary for him to be able to tune the set, and to transmit or receive messages on several different wavelengths in the course of a flight.

There are, of course, a number of well known electrical arrangements for the remote tuning of a radio set. One class of such arrangements makes use of an electric motor driven from a source of supply available in the set and controlled from the distant point over appropriate conductors. This motor is geared to an adjustable tuning element, such as an inductance or condenser, and drives it in the appropriate direction, being automatically switched off at the right moment depending on the setting of the control at the remote point.

This arrangement is often complicated, especially if accurate tuning is desired, and the object of the present invention is to provide a much simpler electrical arrangement by which accurate tuning adjustments may be made from the distant point, and which behaves substantially as if there were a direct mechanical connection between the tuning element and the control.

The invention consists in applying to the problem one of the remote indicating or telemetering systems such, for example, as the system known by the registered trade-mark "Desynn" in which a rotatable shaft connected to the armature of a local motor follows the movements of a similar rotatable shaft forming part of a control device or remote unit connected by wires to the motor.

The invention accordingly provides an arrangement for the remote adjustment of an electrical circuit element, for example, a condenser, comprising a rotatable shaft connected to the said element, a local motor having a plurality of windings and adapted to control the movement of the said shaft in accordance with the distribution of currents in the said windings, a control device at a distant point, and means controlled by the said device for supplying currents to the said windings distributed in a manner characteristic of the position of the said device.

The shaft of the remote unit or control device

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may be provided with a manual control knob and dial plate, if necessary, in any suitable way. The dial plate may be marked with a scale in capacity or wavelengths or the like, and the control of the tuning is precisely as though the control knob were mounted in the usual way directly on the radio set or other apparatus containing the adjustable circuit element. Thus there is no lag or delay such as would be produced by the tuning motor in the known arrangement already mentioned, and no complicated circuit arrangements are required to ensure the necessary accuracy of tuning.

The "Desynn" remote indication system is operated by direct currents; other known systems employ alternating currents. Either type of system may be employed for the present invention according to the available electricity supply, though the direct current system is preferred for reasons which will be explained later on.

The invention will be explained in detail with reference to the drawings accompanying the provisional specification, in which:

Figs. 1 and 2 show diagrammatically the known direct and alternating current remote indication systems;

Fig. 3 shows a section view of a remotely adjustable tuning condenser, according to the invention; and

Fig. 4 is a view of the base of the condenser shown in Fig. 3.

Fig. 1 shows a schematic circuit of the direct current remote indication system, and Fig. 2 shows that of the alternating current system.

Referring first of all to Fig. 1, the local motor is diagrammatically shown and comprises a stator 1 having a three phase winding, and a rotor 2 which consists of a permanent magnet N—S carried on a shaft shown in section at 3.

The remote unit at the distant point comprises a complete circular evenly wound resistance winding 4, provided with a pair of insulated contactors mounted on an arm 5 carried on a rotatable shaft shown in section at 6. The two contactors make contact at diametrically opposite points of the resistance winding 4, and are respectively connected to the terminals of a suitable direct current source, represented as a battery 7.

The three delta or star terminals of the winding 1 are respectively connected by three corresponding conductors 8 to three points on the winding 4 spaced 120 degrees apart.

When the arm 5 is set in any position, the potentials applied individually to the conductors 8 will be characteristic of that position, and will

produce a corresponding distribution of currents in the stator 1. A resultant magnetic field having an orientation corresponding to that of the arm 5 is thus obtained, and the magnet NS will assume the same orientation. If the arm 5 is rotated through any angle, then the rotor 2 will be rotated through the same angle.

In Fig. 2 is shown the corresponding alternating current system. In this case the remote unit and local motor are identical.

They comprise respectively stators 9T and 9R, each having three phase windings and rotors 10T and 10R each having a single phase winding. Both rotors are supplied in parallel with single phase alternating current, and the delta or star points of the stators are respectively connected together by three conductors 11.

The rotors are carried on respective rotatable shafts shown in section at 12T and 12R. When the rotor 10T is set in any position, a certain distribution of potentials is induced in the windings of the stator 9T which produces a corresponding alternating magnetic field of fixed direction in the stator 9R. Assuming that the rotor 10R has been placed in the position corresponding to this direction, it will be held there and will thereafter follow exactly the movements of the rotor 10T. If preferred, the three phase windings may be put on the rotors and the single phase windings on the stators.

The direct current system of Fig. 1 is preferred in the case of the present invention for the following reasons:

1. A much larger torque may be obtained at the receiver, other things being equal.

2. The direct current system requires only three wires to connect the remote unit to the local motor, instead of five as in the alternating current system.

If, however, a direct current supply is not available, the system of Fig. 2 may be employed.

According to the invention, the movable part of an adjustable tuning element forming part of an electrical tuned circuit, such as is used in a radio set, is mechanically connected to the shaft 3 in Fig. 1 (or 12R in Fig. 2). The shaft 6 in Fig. 1 (or 12T in Fig. 2) carries a knob or other appropriate manual adjusting means, together with a scale plate or the like, if desired. On rotating the knob, the movable part of the tuning element follows as though the two were joined by a direct mechanical coupling.

The movable part of the tuning element may, for example, be the rotatable vanes of an air condenser, or a movable dielectric; or it may be rotatable coil for a variable inductance, or an adjustable core.

In Fig. 3 is shown one embodiment of the invention comprising a local motor adapted for the direct current system described with reference to Fig. 1, mechanically coupled to the movable vanes of a condenser similar to an ordinary air condenser.

The condenser 20 is mounted on one side of an insulating base plate 21, on the other side of which is mounted the local motor 22. The shaft 23 rotates in bearings 24 and 25 and carries the permanent magnet rotor 26 which rotates in the field of the stator 27. The shaft 23 is rigidly coupled to the spindle 28 carrying the movable plates of the condenser 20, a central clearance hole 29 being provided on the base plate 21 to allow the shaft 23 to pass through. The terminals of the motor and condenser are carried on a second insulating plate 30, and may be arranged in the same way as in the well known "octal" type of valve base, as indicated in Fig. 4. The plate 30 is fixed to the plate 21 by metal rods 32.

Of the eight terminals 31 shown, only six are required. Of these, three may be used for the delta points of the stator winding, one each for the two sets of fixed plates of the condenser 20, and one for the movable plates. Connections to these terminals may be made in any convenient way.

The local motor and condenser are shown totally enclosed in a metal case 33 which is fixed to the plates 21 and 30. This can act as an electrostatic screen and if desired may be filled with a suitable insulating oil. This oil serves to protect the unit from moisture, to damp the movements of the rotatable parts, and to increase the capacity of the condenser. In order to allow for thermal expansion and contraction, the case may be formed into bellows 34 as indicated. A vent 35 is mounted in the plate 30. This is for the purpose of exhausting the case and subsequent filling with oil, after which the vent may be closed by means of a screw 36 and sealed with solder. The vent may also function as the central pin of the "octal" type base.

The external diameter of the case 33 may be under two inches, and that of the motor 22 may be perhaps 1⅛ inch. It will, therefore, be seen that the whole unit may be extremely compact and may be mounted in the radio set or other apparatus exactly like a small thermionic valve, and it will take up about the same space.

The local motor 22 is preferably of the type described and claimed in any of the British Patent Specifications Nos. 529,583, 537,833, or 545,730. It may, however, take any other desired form, and if the alternating current system described with reference to Fig. 2 is used, a suitable local motor may be mounted and coupled to the condenser in a manner similar to Figs. 3 and 4.

It will be evident that instead of a condenser, a variable inductance could be mounted in a similar manner with a rotatable coil or movable core coupled to the shaft 23. If desired, also, appropriate gearing or the like could be introduced so that the adjustable member might be indirectly driven from the shaft 23, possibly at a different speed.

The remote unit shown in Fig. 1 consists of a circular resistance potentiometer and can be provided in any well known way. In the case of the alternating current system the remote unit can be a duplicate of the local motor and the manual labor control knob can be coupled to it in any suitable manner.

It may be added that in automatic tuning arrangements in which a radio receiver is kept in tune by means of the received signal, a discriminator circuit or the like may be used, for example, to produce a voltage depending upon the departure of the resonance frequency of the tuned circuit from the signal frequency. This voltage is employed to re-adjust the tuned circuit. The arrangement of the present invention provides a convenient means for enabling the above mentioned voltage to control an element of the tuned circuit by causing it to act upon the local motor so as to adjust the element in the manner already described. In this case, the discriminator or other like arrangement takes the place of the remote unit.

What is claimed is:

1. Device for the control of the angular position of a rotatable electrical circuit element, including a rotatable shaft connected to said circuit element, a motor of the type having a plurality of windings and a rotor cooperating therewith to control the movement of said shaft in accordance with the relative distribution of currents in said windings, and a single terminal plate common to both said motor and said circuit element.

2. Device according to claim 1, also including means for damping the movements of said circuit element, comprising a liquid surrounding at least the rotatable portions thereof.

3. Device according to claim 1, wherein are also provided chambered means in which said circuit element and motor are enclosed, said chambered means comprising a unitary sealed envelope, and said single terminal plate comprising a unitary structure capable of being interchangeably plugged in and out of circuit.

4. Device according to claim 1, in which said circuit element is a rotatable condenser, and in which is provided a liquid surrounding said condenser and acting as a damping medium, while also serving as the dielectric for said condenser.

5. Device according to claim 1, likewise including an envelope enclosing said circuit element and said motor, a combination damping and dielectric liquid within said envelope, and an expansible liquid-confining member forming at least a portion of the parietal part of said envelope, whereby thermal expansion of said liquid causes said expansible member to maintain within said envelope a plenum condition, with respect to said liquid, when the circumambient temperature of said device is changed.

6. Device for the control of the angular position of a rotatable electrical circuit element, including a rotatable shaft connected to said circuit element, a motor of the type having a plurality of windings and a rotor cooperating therewith to control the movement of said shaft in accordance with the relative distribution of currents in said windings, and a flexible housing common to both said motor and circuit element.

7. Device for the control of the angular position of a rotatable electrical circuit element, including a rotatable shaft connected to said circuit element, a motor cooperating therewith to control the movement of said shaft, and a flexible housing common to both said motor and circuit element.

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