

Feb. 17, 1948.

R. C. KENT

2,436,172

AUTOMATIC TUNING CONTROL FOR RADIO SYSTEMS AND THE LIKE

Filed Dec. 27, 1946

3 Sheets-Sheet 1

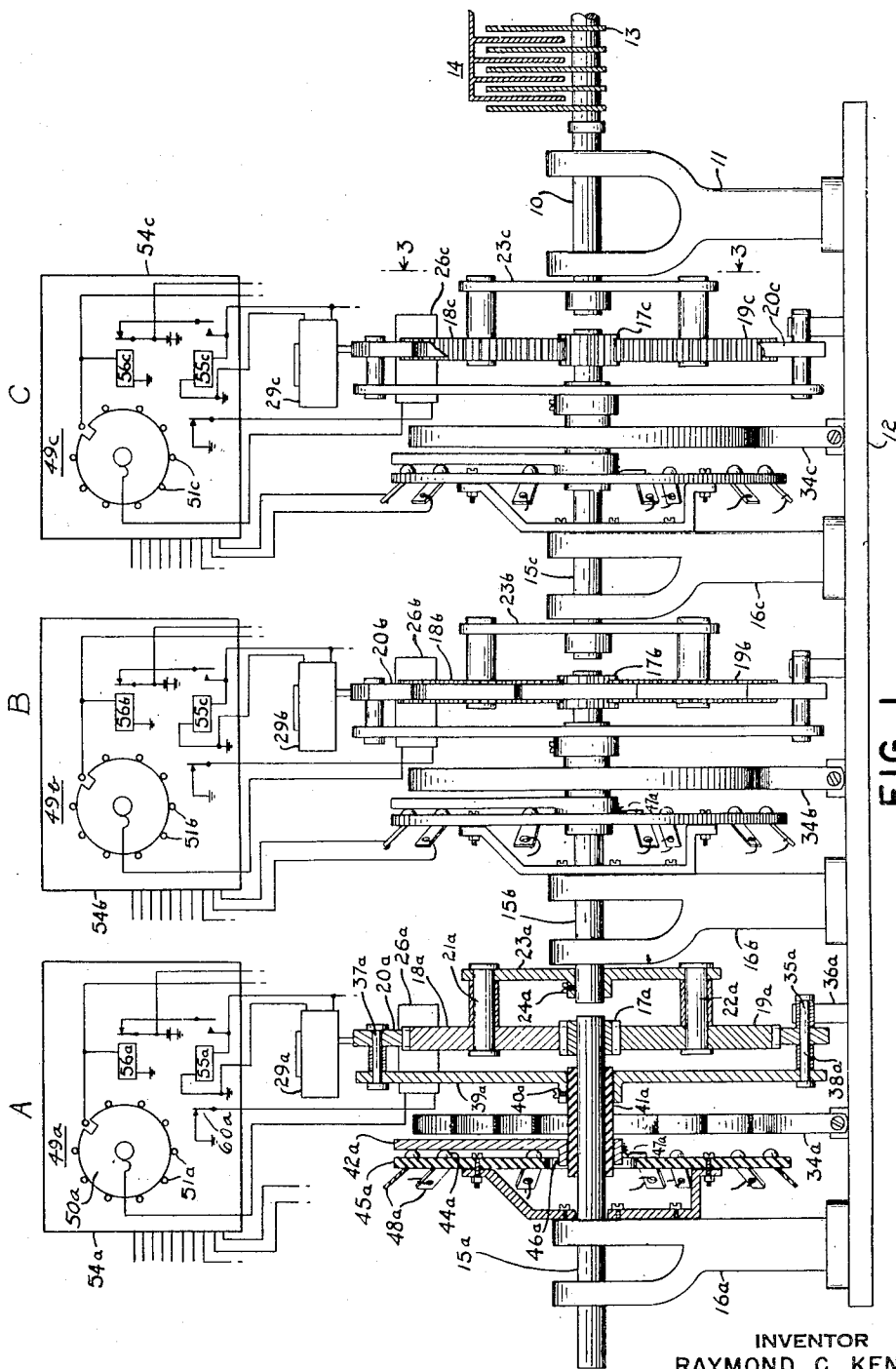


FIG. 1.

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3 Sheets-Sheet 2

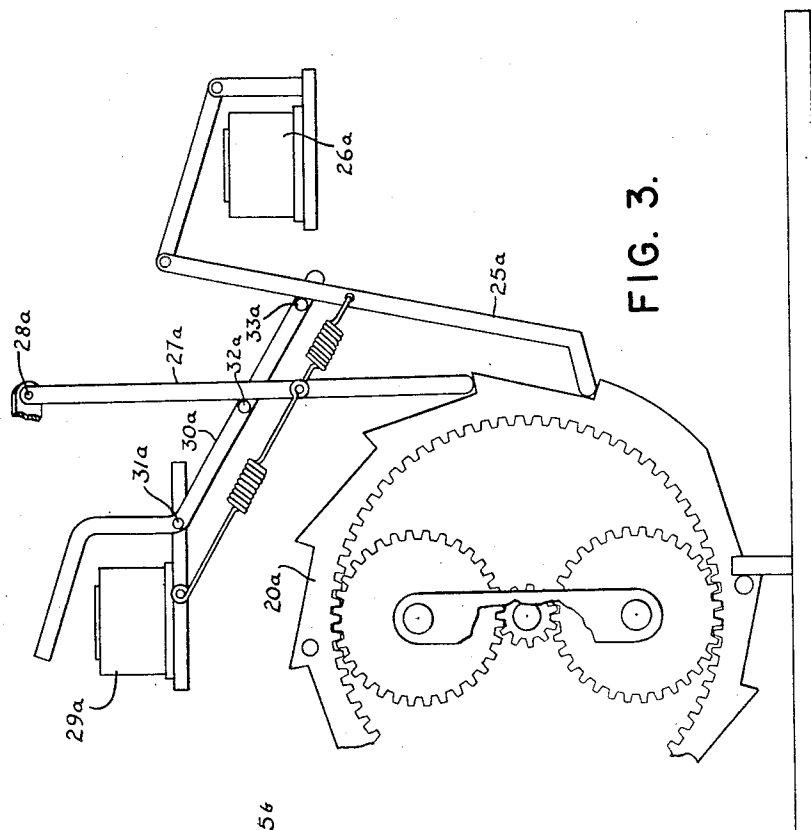


FIG. 3.

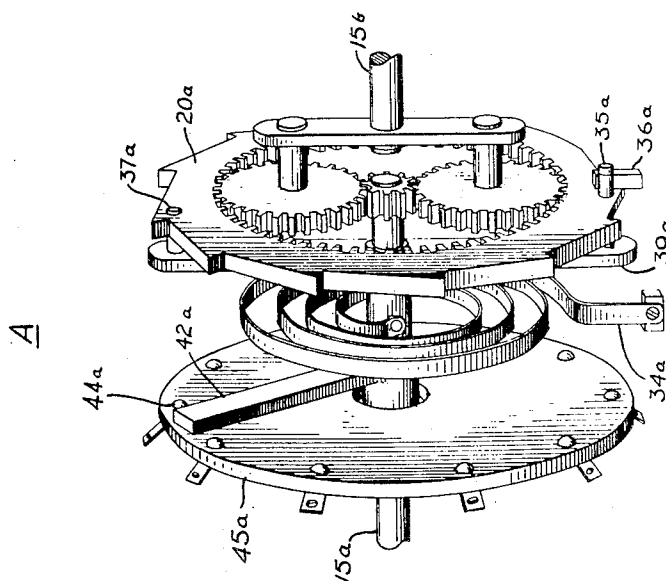


FIG. 2.

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3 Sheets-Sheet 3

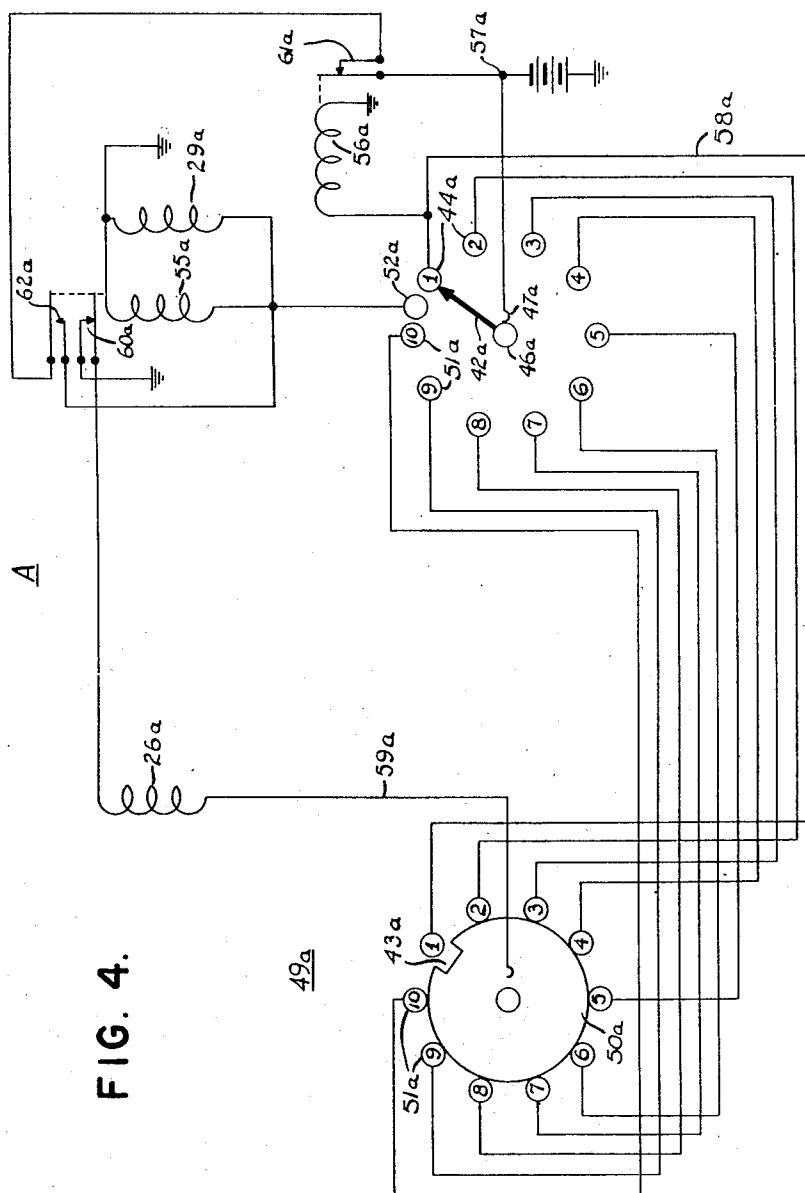


FIG. 4.

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2,436,172

AUTOMATIC TUNING CONTROL FOR RADIO SYSTEMS AND THE LIKE

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Application December 27, 1946, Serial No. 718,811

3 Claims. (Cl. 318-21)

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This invention relates to automatic controls and more especially to the automatic positioning of control shafts for radio apparatus and the like.

A principal object of the invention is to provide a simplified and efficient electromechanical device for moving a control shaft to any one of a very large number of selected positions.

Another principal object is to provide a selective shaft-positioning unit particularly suited to the tuning or adjusting of radio apparatus, employing a plurality of selective control stages which are arranged to act cumulatively on the shaft to be controlled.

A feature of the invention relates to a device for selectively stopping a shaft in any one of a large number of selective positions by employing a series of control stages each comprising an epicyclic or differential gear unit and a rotary selector switch unit, whereby the separate stages can be selectively controlled individually or cumulatively in so far as the final control of the shaft is concerned.

Another feature relates to the combination of a bank of automatic rotary selector switches and a bank of epicyclic or differential gear units which cooperate to provide a highly flexible system for controlling the selective rotation of a master shaft to any one of a large number of positions, for example as many as one thousand.

A further feature relates to the novel organization, arrangement and relative interconnection of parts which cooperate to provide an improved automatic radio tuning control device.

Other features and advantages not specifically enumerated will become apparent after a consideration of the following detailed descriptions and the appended claims.

In the drawing which shows one preferred embodiment,

Fig. 1 is a front view, partly sectional, of the multi-stage control system according to the invention.

Fig. 2 is a perspective view of one of the switch and gear train units of Fig. 1.

Fig. 3 is a partial sectional view of Fig. 1, taken along the line 3-3 thereof.

Fig. 4 is a detailed schematic wiring diagram of the electrical controls of one of the stages of Fig. 1.

Referring to Fig. 1, the master shaft 10 to be selectively controlled or angularly positioned is supported for rotation in suitable bearings in a bracket 11, which is fastened to a common base plate 12. Merely for illustration, shaft 10 is shown connected to the rotary plates 13 of an

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electrostatic tuning condenser 14. It will be understood that any other similar tuning device or circuit element of radio apparatus or the like, can be substituted for the condenser 14 and this device can be connected either directly to shaft 10 or through suitable gearing. The system as shown in Fig. 1, is capable of accurately setting the shaft 10 in any one of a thousand different rotational settings throughout its 360° of rotation. If desired, shaft 10 may be attached to a lead screw which cooperates with a lead screw follower in the well-known manner to move a tuning device, such as the magnetic core of a permeability tuning unit to any one of a thousand different longitudinal settings. In general, the system consists of three stages designated respectively "A," "B" and "C"; each stage comprising an epicyclic or differential gear unit and an associated automatic rotary selector switch together with a remotely located control box. The gear and switch unit of one of the stages, for example stage "A," is shown in perspective in Fig. 2. The three stages are so interconnected that by the automatic selective control of the stages, either individually or in combination, the shaft 10 can be rotated to the desired position. Furthermore, the arrangement is such that the stages are cumulative in their control of shaft 10. Thus, if stage "A" alone is selectively operated, shaft 10 will be rotated through successive equal incremental angles of " n " degrees. If stage "B" is selectively operated, shaft 10 can be turned through successive incremental angles of " $10n$ " degrees; and if stage "C" is operated the shaft 10 can be rotated through successive incremental angles of " $100n$ " degrees. In other words, stage "C" can be considered the "hundreds" stage; stage "B" as the "tens" stage; and stage "A" as the "units" stage.

Since all the stages are substantially identical in construction, a detailed description of one stage will suffice. However, the corresponding parts in the three stages shown bear the same designation numerals but with the postscripts "a," "b" or "c" to identify the respective stages. Referring to stage "A," it comprises a shaft 15a which is journaled in a suitable bearing bracket 16a, so as to freely rotate but to be restrained against longitudinal movement. Fastened to the right-hand end of shaft 15a is a gear wheel 17a, which forms the sun gear of an epicyclic or differential train, including a two planetary gear 18a, 19a, and the ring gear 20a. Planetary gears 18a, 19a, are respectively rotatably mounted on stub shafts 21a, 22a, which are fastened to a yoke

23a. This yoke is fastened for example by screw 24a to shaft 15b of unit "B."

As shown more clearly in Figs. 2 and 3, the ring gear 20a has its outer periphery provided with a series of ten ratchet teeth with which the stepping pawl 25a is adapted to engage so as to rotate the said ring gear in a step-by-step manner under control of the associated stepping magnet 26a. A locking or holding pawl 27a is pivotally supported at a fixed point 28a, to hold the ring gear 20a in its selectively set position. Also associated with each ring gear is a homing control magnet 29a whose armature operates arm 30a, pivoted at 31a, and carrying pins 32a, 33a, which respectively engage pawls 27a and 25a. Then, when magnet 29a is energized, both pawls 25a and 27a are moved clear of ring gear 20a, which is thereupon free to rotate back to its home or normal position under control of a coiled spiral spring 34a, having one end fastened to a sleeve 41a on shaft 15a, and the other end anchored to the base 12. The ring gear 20a carries a pin 35a, which engages the rigid stop 36a on base 12 when the ring gear reaches its home position.

Attached to the ring gear e. g., by studs 37a, 38a, is a yoke 39a, which is fastened by screw 40a to a sleeve 41a, rotatable around shaft 15a. Also fastened to sleeve 41a is the rotating element or wiper brush 42a of an automatic selector switch of the line finder type. As shown more clearly in Fig. 2, this wiper is in the form of a metal brush. Cooperating with wiper brush 42a is a contact bank comprising a series of ten contact points 44a, which are circularly arranged and suitably anchored in disc 45a of insulating material, this disc being fixedly supported for example by angle members to bracket 16a. Likewise, brush 42a is connected to a slip ring 46a on sleeve 41a with which a fixed brush 47a contacts. An additional homing contact 52a is provided between the #10 and #1 contacts as schematically shown in Fig. 4. Suitable wiring lugs 48a are provided for connecting the respective bank contacts into circuit. Brush 42a is arranged to be remotely controlled from the associated control box which includes a manually rotatable switch 49a, whose metal wiper disc 50a can be turned until its cut-out notch 43a registers with the desired one of ten fixed contacts 51a.

The control box 54a for unit "A," can be located at any suitable remote point and in addition to the manual selector switch 49a it includes a homing control relay 55a and an interlock relay 56a.

The fixed contacts 51a of switch 49a are multiplied to the corresponding fixed bank contacts 44a. The arrangement is such that by turning the disc 50a to the desired contact, the magnet 26a is given an impulse to turn the brush 42a step-by-step to each succeeding contact 44a. When the selected contact 44a is found by brush 42a, the circuit of the stepping magnet 26a is finally broken, thus stopping the ring gear 20a, and the shaft 10. By well-known principles of epicyclic gearing, and by suitable design of the number of teeth and diameter of the gears, each step of ring gear 20a will cause a corresponding angular rotation of shaft 10. For example, if the ring gears are each designed to have steps of 30° per ratchet tooth, the shaft 10 may move .27 degree for each step of gear 20a; 2.7 degrees for each step of gear 20b, and 27 degrees for each step of gear 20c. These incremental steps may be chosen by using ring gears having appropriate angles on the ratchet teeth. While of course the rotation of shaft 10 is limited to 360° C., if desired,

a step-up gear ratio can be provided between shaft 10 and the device 14.

Referring to Fig. 4, a description will be given of the electrical interlocking and control circuits for the unit "A," it being understood that each of the remaining units has similar sets of circuits. In Fig. 4, the unit "A" had been previously operated so as to selectively move the ring gear 20a only one step as indicated by the position of switch arm 50a on #1 contact. It will be assumed that a new setting is required for shaft 10 e. g., one requiring four steps of ring gear 20a. For that purpose, disc 50a is manually moved to #4 contact, thus completing a circuit from the positive battery terminal 57a, brush 42a, #1 contact, conductor 58a, #1 contact of switch 49a, disc 50a, winding of stepping magnet 26a to ground through contacts 60a of the relay 55a. This causes brush 42a and ring gear 20a to rotate in a step-by-step manner until the brush 42a comes into registry with the selected #4 contact, whereupon the circuit for magnet 26a is finally broken and the ring 20a comes to rest. As a result of the rotation of ring gear 20a, sun gear 17b is rotated, in turn rotating planetary gears 18b, 19b, shaft 15c, planetary gears 18c, 19c, and shaft 10.

The above description is on the assumption that the brush 42a was originally set on contact #1 and is selectively moved clockwise to contact #4. If however for example, switch arm 42a is now to be selectively moved to contact #3, disc 50a is moved so that notch 43a registers with contact #3, the stepping switch magnet 26a will then operate as above described and will step the gear 20a and the brush 42a in search of the open #3 contact. However, as the brush 50a passes by the homing contact 52a, both relays 29a and 55a are operated in parallel from the battery 57a. Since relay 55a operates, it closes a holding circuit for itself traceable from the positive battery terminal 57a through the normally closed contacts 61a of relay 56a, through the operated contacts 62a of relay 55a and thence through the windings of relay 55a to ground. The operation of relay 55a opens the circuit of the stepping magnet 26. Since magnet 26a operates, it moves both of the parts 25a and 27a out of the path of the ring gear 20a which immediately restores to normal under control of its spring 34a carrying with it the brush 42a. As the brush 42a reaches #1 contact, it closes an operating circuit for interlock relay 56a traceable from ground through the winding of relay 56a, #1 contact, brush 42a to positive battery terminal 57a. Relay 56 in operating opens the holding circuit for relay 55a. This allows the stepping magnet 26a again to be energized in step-by-step manner so as to advance the brush 42a in search of the #3 contact, whereupon the circuit of the stepping magnet 26a is finally opened as above described, thus completing the cycle of operations.

What is claimed is:

1. An automatic shaft positioning system for radio control apparatus and the like, comprising a plurality of shaft positioning stages each including an epicyclic gear train and an associated automatic selector switch of the line finder type, the sun gear of one epicyclic stage being driven from the planetary gear of the preceding stage, and the automatic switch of each stage being connected to revolve as a unit with the planetary gear thereof.

2. An automatic shaft positioning system for radio control apparatus and the like, comprising a plurality of shaft positioning stages each

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including an automatic switch of the line finder type, an epicyclic gear train for each train, a step-by-step operating magnet for advancing the ring gear of each stage a selected number of steps under control of the associated finder switch, and means connecting the planetary gear of each stage to the sun gear of a succeeding stage, the sun gear of the final stage being connected to the shaft to be controlled.

3. An automatic shaft positioning system for radio control apparatus and the like, comprising a plurality of shaft positioning stages each including an automatic switch and an epicyclic train, the ring gear of each train having a ratchet toothed periphery, a stepping magnet for each ring gear and having a member for cooperating with the ratchet teeth thereof, means connecting the ring gear of each stage with the rotatable wiper of the associated automatic switch for rotation as a unit therewith, an operating circuit for each stepping magnet, and circuit means effective when each switch reaches a predetermined selected position for opening the circuit of the associated stepping magnet.

4. An automatic shaft positioning system for radio control apparatus and the like, comprising an epicyclic gear train having its sun gear connected to the shaft to be positioned, an automatic selector switch of the line finder type having a wiper rotatable as a unit with the ring gear of said gear train, and means to operate said ring gear selectively step-by-step, the last-mentioned means including a stepping magnet for said ring gear which is automatically impulsed until said wiper reaches a selected position.

5. An automatic shaft positioning system for radio control apparatus and the like, comprising an epicyclic gear train having its sun gear connected to the shaft to be positioned, an automatic selector switch of the step-by-step hunting type having a rotatable wiper element rotatable as a unit with the ring gear of said gear train, spring return means tending to return said wiper and ring gear to a homing position, a stepping magnet having a member cooperating with said ring gear to operate it in a step-by-

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step manner, a circuit for said stepping magnet controlled through the contacts of said selector switch, and another magnet having a member for operating the first-mentioned member to permit said ring gear and switch to return to normal and thereafter permitting said ring gear and switch to automatically advance to a selected position under control of said stepping magnet.

6. An automatic shaft positioning system according to claim 5 in which the sun gear of said epicyclic gear train is driven from the planetary gear of another epicyclic gear train, and means are provided for selectively operating the ring gear of said other gear train in a step-by-step manner and including a second automatic selector switch of the hunting type and a stepping magnet for said second selector switch.

7. An automatic tuning control device for radio sets and the like, comprising a master shaft to be selectively positioned, a "units" shaft control stage, a "tens" shaft control stage, a "hundreds" shaft control stage, each stage having an individual and selectively operable gear train, means connecting said gear trains to said shaft to position said shaft under control of any one of said stages individually or cumulatively under control of a plurality of said stages, and means including an automatic selector switch of the finder type for each stage for controlling the selective operation of the gear train thereof.

8. An automatic tuning control device according to claim 7 in which each stage includes an epicyclic gear train whose ring gear is provided with spring means tending normally to return it together with its associated selector switch to a home position.

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REFERENCES CITED

The following references are of record in the file of this patent:

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