Feb. 28, 1933. R. E. THOMPSON 1,899,779

REMOTE CONTROL SYSTEM

Filed July 14, 1928 2 Sheets-Sheet 1

Fig. 1.

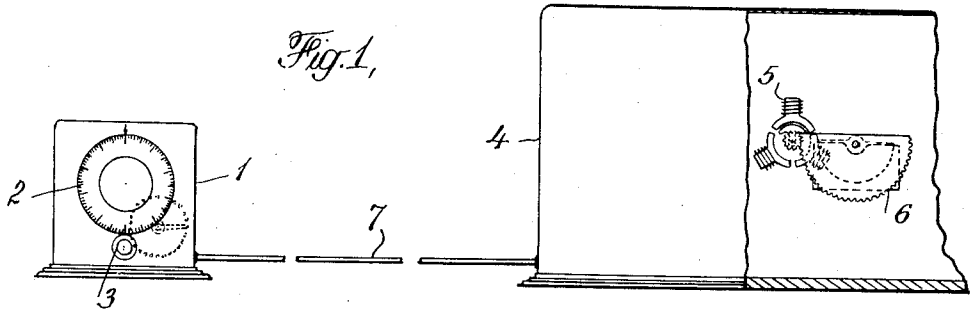
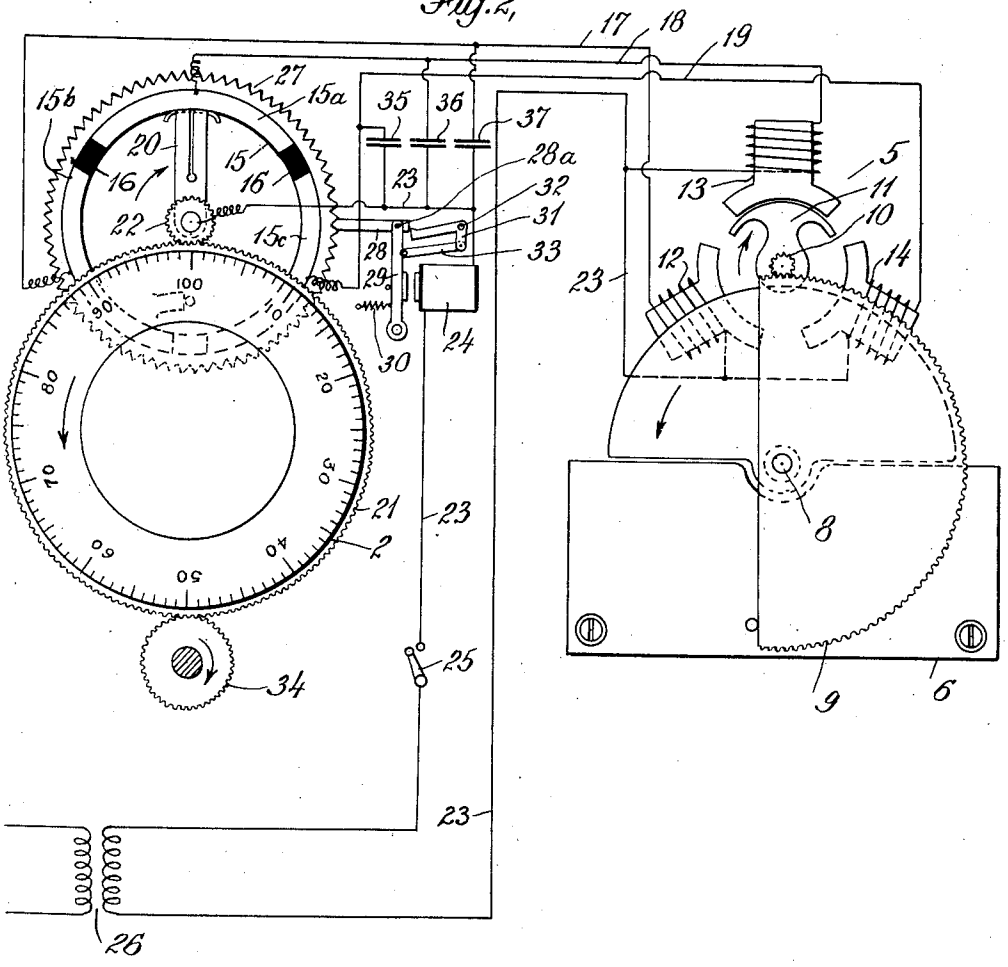


Fig. 2.



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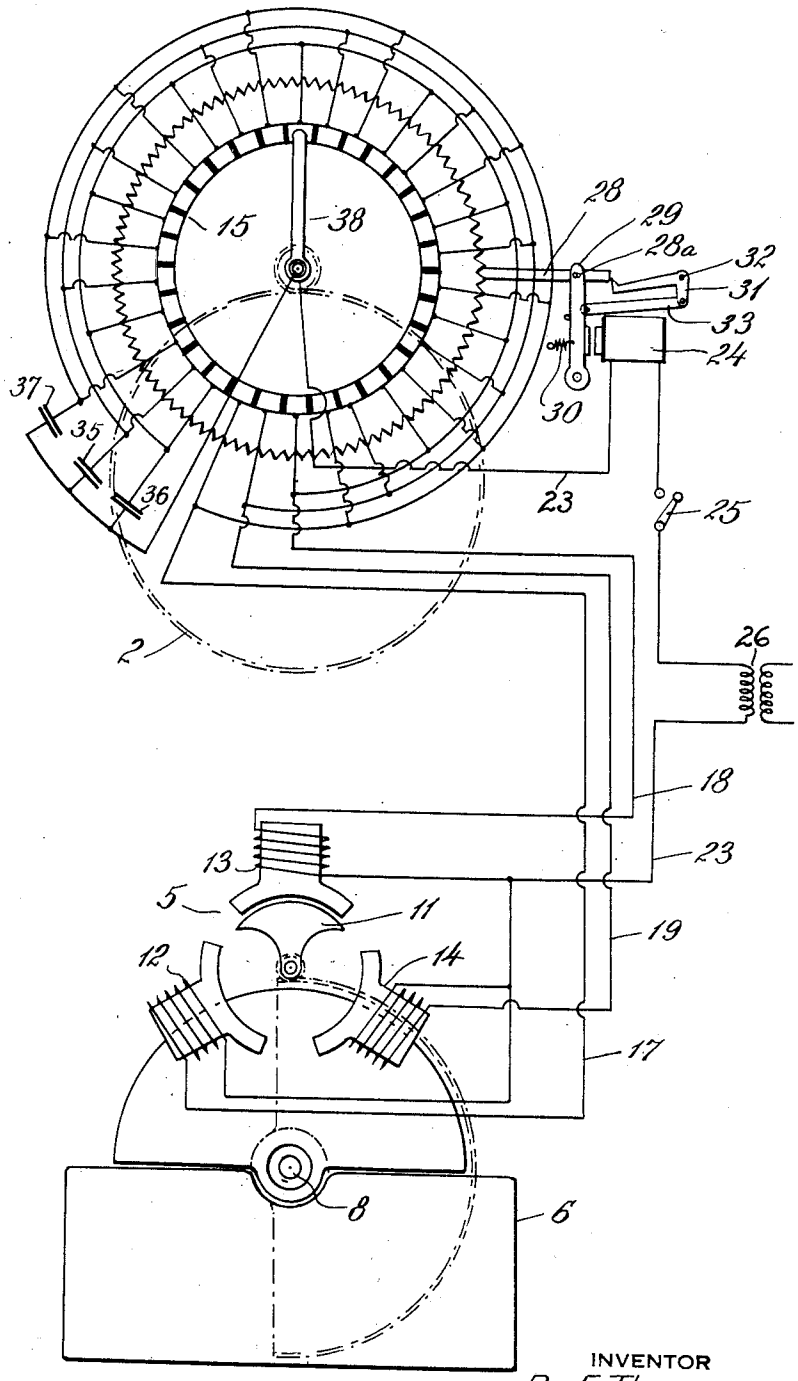
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Fig. 3,



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UNITED STATES PATENT OFFICE

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REMOTE CONTROL SYSTEM

Application filed July 14, 1928. Serial No. 292,885.

This invention has to do with remote tuning control systems for radio receivers—more especially broadcast receivers—the underlying object being to provide a system and apparatus which are entirely dependable and at the same time structurally simple and capable of effecting sufficiently precise tuning at all frequencies within the operating range of the receiver.

There are several important advantages susceptible of realization through the employment of remote tuning control apparatus in conjunction with a broadcast recever: The receiver, itself, may be located in an out-of-the-way place where space is not at a premium; it may be made as large as may be desirable from the standpoint of the best engineering practice—therefore easily accessible for repairs and replacement of parts; the components may be mounted all on one board or panel—thereby materially reducing the cost of manufacture; the wiring need not be crowded; and the cabinet (ordinarily a costly item) may be dispensed with.

Briefly summarized, it may be said that through the employment of a reliable and inexpensive remote tuning control system in accordance with the present invention, it is possible to provide a radio receiver of the finest quality at comparatively low cost and at the same time avoid having to sacrifice floor space in a part of one's home where, oftentimes, suitable space for such a purpose is not readily available.

The invention will be described and its characteristic features pointed out with reference to the accompanying drawings, in which

Fig. 1 is a general view or ensemble depicting a radio receiver adapted for remote tuning control, together with a remote control apparatus and an interconnecting cable through which the two main elements of the system are operatively associated;

Fig. 2 is a schematic diagram illustrating the invention in a simplfied form; and

Fg. 3 is another schematic diagram similar to that of Fig. 2 but in which the remote control commutator has a large number of segments.

In Fig. 1 the remote control apparatus is indicated by reference numeral 1. This comprises a suitable housing of small size in which are enclosed the commutator, contact member and automatic lock to be presently described. At the outside of the housing there is shown a graduated dial 2 together with an operating knob 3 which is geared to the dial shaft to provide for reduced motion. The radio receiver, per se, is indicated by numeral 4 while the synchronous tuning motor and tuning condenser or condensers are denoted, respectively, by numerals 5 and 6. A cable 7 containing the necessary conducting wires is shown interconnecting the remote control apparatus with the radio receiver.

In Fig. 2 the tuning condenser 6 may be assumed to represent either a single variable condenser or a gang of such condensers mechanically connected through a common shaft or otherwise. Each of these condensers may be assumed to be included as the tuning element in a tunable vacuum tube input circuit in accordance with the established practice in radio receiver design.

The rotatable shaft 8 of the condenser or condensers carries the usual rotatable condenser plates and has connected to it a gear 9 which is engaged by a driving pinion 10, the latter being mounted on the shaft of armature 11 of the synchronous motor 5. The armature 11 is preferably built up of soft iron laminations. By the term "synchronous" as employed herein, is meant a movement of the remote control device in either direction and over any given distance, which results in a fixedly related movement of the driving motor connected thereto, both as to distance and direction. Consequently, it is to be understood that no limitation to the present invention is intended by the use of the term herein, "synchronous motor"; for although that term is understood in the art as representing a certain type of motor, such motor is here described merely by way of example, the only limitation intended being in accordance with the definition just stated.

The function of the synchronous motor 5 is to rotate the movable plates of the tuning condensers in conformity with the movements of dial 2 which is manually operable.

The motor comprises, in addition to the armature 11, three electromagnetic poles 12, 13 and 14 respectively, each having an arcuately extending pole piece and an energizing winding. The magnetic circuits of the motor are not shown in their entirety, but it will be understood that for each of the three positions of the armature there is a magnetic circuit including the armature and one of the poles. The arrangement is such that only one pole-winding can be energized at a time and these successively. Manifestly, the armature is rotatably attracted from pole to pole as the latter are successively energized. The angular displacement of the condenser plates for each pole-to-pole movement of the armature 11 is a function of the gear ratio between the armature and condenser shafts. The larger this ratio is the smaller will be the individual movements of the condenser plates and consequently the more precise will be the tuning. The same degree of precision, however, may be accomplished with a smaller gear ratio and a motor having a larger number of field poles. It will be apparent that three is the minimum number of poles which may be used, but that as many more may be employed as may be desired within the limits of the space available, and that the larger the number of poles the smaller will be the individual step-by-step angular movements of the armature.

While the tuning of a broadcast receiver must be fairly sharp in order to attain satisfactory selectivity, the degree of sharpness is, nevertheless, definitely restricted by the necessity of avoiding cutting off of the audible side band frequencies. For this reason (in a properly designed broadcast receiver) an adjustment of the tuning condensers slightly to either side of the critical point for any given frequency does not result in material detuning as is more fully described in my co-pending application Serial No. 210,780, filed August 5, 1927. Hence it becomes practicable to tune with adequate precision by advancing the tuning condenser rotors by small steps rather than by uniformly continuous rotation. The present invention may be considered as an improved system for practicing the invention described in my mentioned co-pending application.

At the remote control end of the system there is a stationary commutator 15 comprising (in the case of Fig. 2) three conductive segments 15*a*, 15*b* and 15*c* each insulated from the others by insulating segments 16. Each conductive segment is connected through a conductor 17, 18, 19 to one of the pole-windings. A rotatable contact member 20 is arranged to wipingly engage the commutator segments successively. The contact member is drivingly connected with the dial 2 through a driving gear 21 and driven pinion 22. Obviously the contact member rotates several times as fast as the dial.

The contact member 20 is connected through conductor 23 to each of the pole-windings. Hence it establishes a closed circuit through the pole-windings successively—one at a time. Conductor 23 includes in series the winding of an electromagnet 24, a switch 25 and the secondary winding of a transformer 26 from which AC energizing current is obtained for operating the synchronous tuning motor. A battery or other source of direct current could be substituted for the transformer 26. An advantage in the type of power supply just described results from the fact that thus a low voltage may readily be employed in the remote control system with subsequent convenience, especially in extending the cable 7 to desired points of control.

Now it should be entirely clear that only one pole of the synchronous tuning motor can be energized at any one time and that the angular position of armature 11 will always conform to the position of contact member 20 and consequently to the position of dial 2. Such an assumption must be predicated, of course, upon the absence of any extraordinary restraint against the normal operation of the motor and also upon the provision of means for preventing the rotation of the contact member whenever the operating current supply may be interrupted. The latter end is accomplished by means of an automatic lock comprising a ratchet-wheel 27 which rotates with pinion 22, and a co-operating detent 28 which is pivotally connected to the armature 29 of the electromagnet 24. Although not specifically shown in the figure, it is presumed that ratchet 27 and pinion 22 may be secured to the same shaft. A spring 30 is operable to hold the armature 29 in its back position whenever the electromagnet 24 is de-energized. When the armature 29 is in its back position, as shown, the detent 28 is held in engagement with the teeth of the ratchet wheel, thus preventing any rotation of the contact member.

The electromagnet 24 being normally energized when the radio set is in operation, there is no restraint exercised against the operation of the remote control apparatus. Whenever it is desired to shut off the radio set the switch 25 may be opened thus preventing any useless consumption of current which would otherwise follow. In the alternative, of course, the current supply at 26 may be disconnected. Opening this switch de-energizes the electromagnet 24, and this results in the detent 28 being moved into engagement with the ratchet-wheel 27 thereby locking the control apparatus.

Due to the slope of the ratchet teeth it would be possible ordinarily to forcibly rotate the contact member together with its shaft and

the ratchet-wheel even when the latter is engaged by the detent, unless some suitable provision be made against such a contingency. The provision here made for that purpose consists in a link and lever mechanism comprising a bell-crank 31 pivoted at 32 and a link 33 connected between the armature 29 and the bell-crank. The detent 28 has an elongated slot 28*a* which is engaged by a pin in the free end of the armature 29. The long axis of the slot is parallel to the axis of detent 28 when in the locked position. The armature is shown in its back position wherein it holds the long arm of the bell-crank in a position to interfere with any backward movement of the detent which might tend to result from an attempt to forcibly rotate the dial while the current is shut off. Hence any effort to rotate the ratchet-wheel would be frustrated so long as the electromagnet 24 is de-energized. Upon the latter being energized its armature is attracted and by reason of the elongation of slot 28*a* the bell-crank is moved to a position wherein its long arm is out of the path of the detent before the pin in the end of armature 29 reaches the back of the slot 28*a* and starts to retract the detent.

The driving pinion 34 is shown meshed with gear 21. This pinion is mounted on the same shaft with the knob 3 shown in Fig. 1.

For the purpose of preventing disturbances in the radio receiver when the contact member 20 breaks contact with the commutator segments, it is preferable to provide shunt condensers 35, 36 and 37. These are connected between the terminals of the commutator segments and the terminal of the contact member, and their function is to absorb the electrical surges which would ordinarily accompany the breaking of contacts—hence avoiding the sharp clicking noises from the loud speaker which would otherwise occur at every contact interruption.

In Fig. 2 the commutator 15 is shown with only three conductive segments, in order to simplify the present disclosure as much as possible. It is evident that the use of a commutator with such a small number of segments necessarily involves a large gear ratio between the dial and contact member. While this is not altogether objectionable it is nevertheless preferable to use a commutator with a large number of conductive segments, as shown in Fig. 3, and do away with the gearing between the dial and contact member. In Fig. 3 the commutator is shown with thirty conductive segments. As a matter of fact it is usually preferable to have even a larger number of conductive segments than are shown in Fig. 3. If, for example, the tuning condensers are arranged to turn through an angle of 180°, and ninety conductive segments are provided on the commutator instead of thirty as shown, the angular displacement for each step of the condenser rotor would be 2°. This is about the order of accuracy necessary in order to tune to all frequencies within the broadcast band with adequate precision. A larger or smaller number of commutator segments may be employed, however, as determined by the requirements in each particular case; for example, it will be clear that the number of commutator segments should be equal to the same number or to an integral multiple number of angular positions of the motor armature 11. This being true, obviously the relationship may be reversed and the number of angular positions of the motor armature 11 made equal to an integral multiple of the number of segments.

It will be noted that in Fig. 3 the commutator segments are electrically connected in three sets, each of the ten corresponding segments of the three sets being connected together in parallel. With a thirty-segment commutator as shown, the motor armature 11 would make ten complete revolutions for each revolution of the contact member 38, the latter corresponding in function to the contact member 20 of Fig. 2. It will be seen that the motor armature 11 assumes the same position whenever the contact member connects to any one of the corresponding segments of the three sets.

With only thirty commutator segments as shown, it would generally be necessary, covering a frequency band as wide as the broadcast band now in use in the United States, to rotate the contact member 38 through at least two or three complete revolutions in order to advance the tuning condensers through an angle of 180°. Otherwise the steps would be too large to give the essential tuning precision. In Fig. 3 the dial 2 is indicated as being geared to the contact-member shaft. In this case, the knob would preferably be applied directly to the contact-member shaft, although it could alternatively be arranged as indicated in Fig. 2. The automatic locking device shown in Fig. 3 is identical with that of Fig. 2 as hereinbefore described, and the same applies to all of the other elements.

It will be evident that the remote control apparatus requires but little space and may, if desired, be incorporated as a part of the loud speaker structure. The radio receiver, per se, may be set up in any convenient place—usually where space is not at a premium—such as the cellar or attic—and being out of sight it can be housed in a very simple and inexpensive enclosure, or the component parts may be simply mounted on a board or panel with no enclosure.

What is claimed is:

1. Remote control apparatus for a radio receiver comprising a commutator having a plurality of conductive segments, a contact

member operable to engage said segments successively, an electromagnetic locking device operable when de-energized to restrain said contact member against operation, and mechanism for positively locking said device in its restraining position while said electromagnetic device is de-energized.

2. Remote control apparatus for a radio receiver comprising a commutator having a plurality of conductive segments, a rotatable contact member operable to engage said segments successively and individually, a ratchet rotatable with said contact member and a detent operable to engage said ratchet and thereupon prevent further rotation of said contact member while thus engaged, an electromagnet operable when energized to withdraw said detent from engagement with said ratchet, and mechanism for positively locking said detent in its engaged position while said electromagnet is deenergized.

In testimony whereof I affix my signature.

ROY E. THOMPSON.