June 5, 1934. M. J. HUGGINS 1,961,220

RADIO APPARATUS

Filed April 22, 1930 2 Sheets-Sheet 1

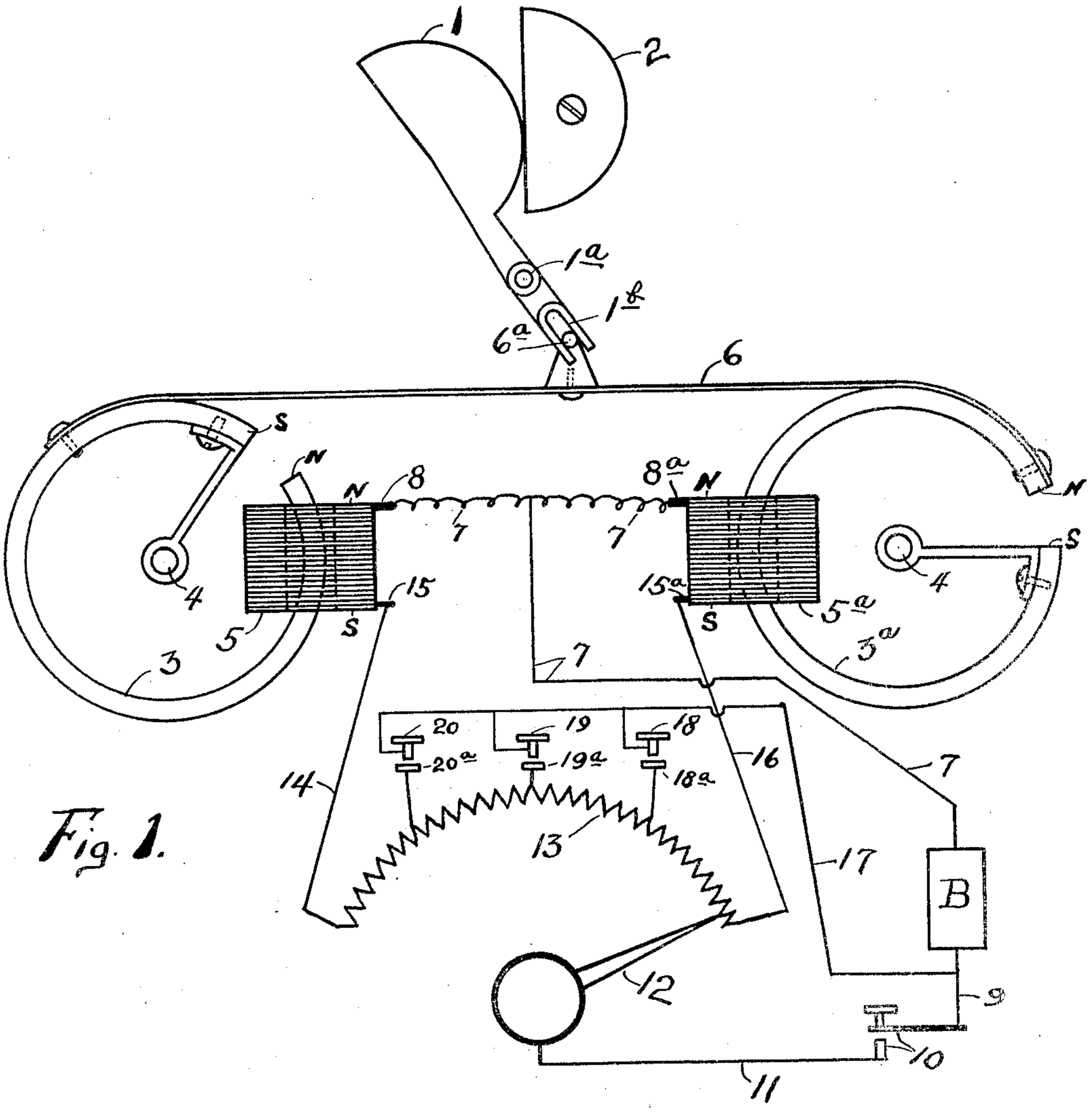

Fig. 1.

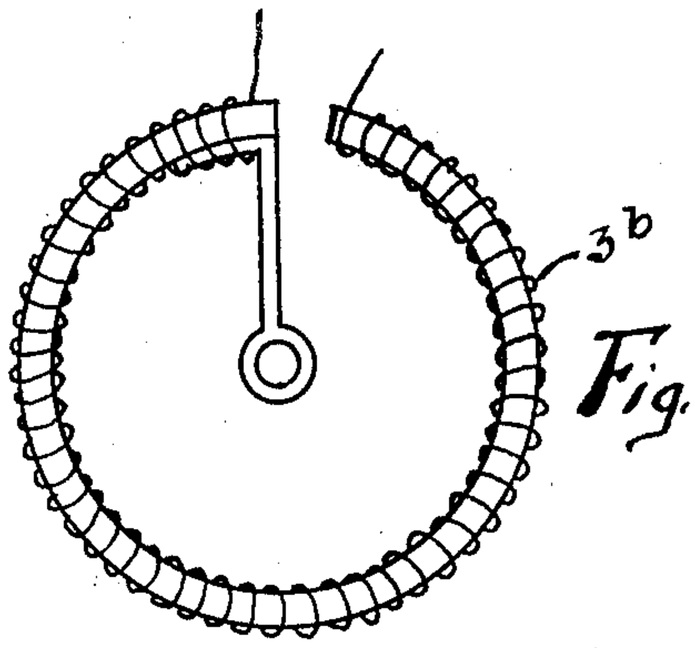

Fig. 2.

Inventor
Marion J. Huggins

June 5, 1934. M. J. HUGGINS 1,961,220

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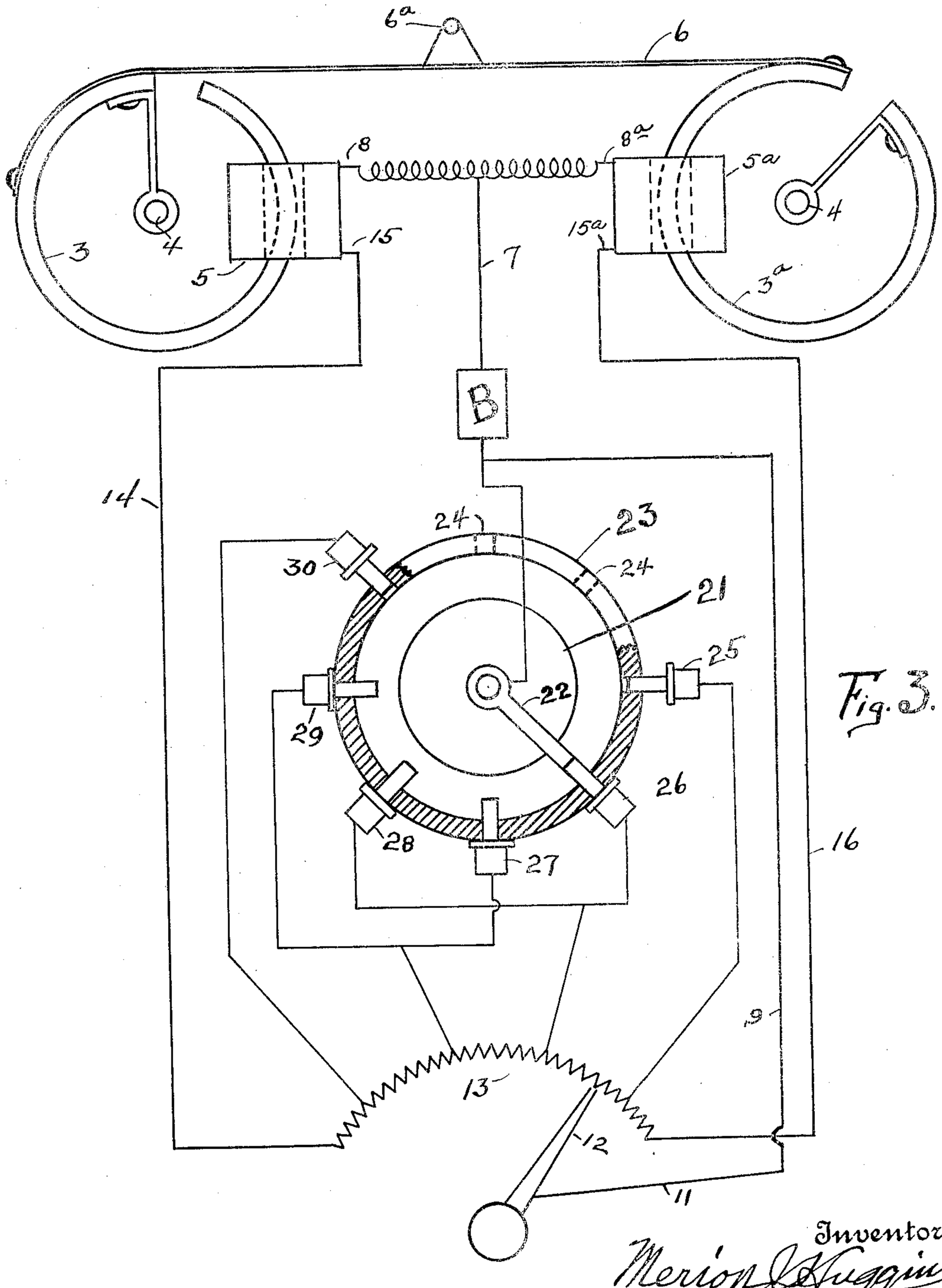

Fig. 3.

Inventor
Merion J. Huggins

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RADIO APPARATUS

Merion J. Huggins, Upper Saddle River, N. J.

Application April 22, 1930, Serial No. 446,366

7 Claims. (Cl. 250—20)

This invention relates to control means for radio apparatus and particularly to means to operate the means, such as variable condensers, to synchronize or tune the receiving circuits of the apparatus to resonance with the incoming transmitted radio frequencies, and it is an object of the invention to provide means to control said operating means at a place remote to the radio apparatus.

In the embodiment of the invention illustrated there is provided a pair of solenoids mounted adjacent to the radio apparatus and adapted to actuate a pair of arcuate armtures movable within the solenoids, said armatures being operatively connected to the movable tuning element of a variable condenser or condensers.

A further object of the invention is to provide selective control means to effect movement of the armatures and movable condenser element to a multiplicity of stable positions.

A still further object of the invention is to provide selective control means to effect movement of the armatures and movable condenser elements to a multiplicity of predetermined stable positions.

A still further object of the invention is to provide time operated selective control means to effect movement of the armatures and movable condenser element to a multiplicity of predetermined stable positions at a preselected time.

In the drawings accompanying and forming a part of this application, Fig. 1 is a diagrammatic view of the embodiment of the control means showing the same in connection with the movable or adjustable element of the condenser of the radio apparatus; and

Fig. 2 is a modification of the arcuate armatures shown in Fig. 1.

Fig. 3 is a diagrammatic view of the time operated selective control means.

In carrying out the embodiment of the invention as illustrated in Figs. 1 and 3, the operating means may be wholly or partially mounted adjacent the radio apparatus and operatively connected to the means employed to synchronize or tune the receiving circuits of the apparatus to resonance with transmitted radio frequencies, which means in the present instance embodies a plurality of stationary and movable metal plates 1 and 2, equivalent to a vario coil or a single or plurality of connected or ganged variable air condensers.

The invention as disclosed in Fig. 1 comprises a pair of actuating armatures 3, 3*a* of arcuate form each pivoted at 4 and each adapted to be rotatably oscillated about its axis by and through an associated solenoid 5, 5*a* the armatures preferably subtend through an arc not less than 180 degrees and in all positions thereof being under the magnetic influences of the solenoids. These arcuate armatures may be formed of soft iron, but in the present adaptation are of suitable hardened steel and magnetically polarized by being permanently magnetized. The armatures are preferably formed with a gap the ends being spaced sufficiently to admit of slipping the armature through its respective solenoid, and as a result of this gap the two ends of each armature exhibit marked magnetic polarity, N and S respectively.

The armatures 3, 3*a* are mechanically joined together in predetermined physical relation by means of, for instance, a flexible band 6 so that the two armatures must rotate or oscillate together. In some suitable manner these armatures are operatively connected to the movable tuning element 1, in this instance the element 1 is pivoted at 1*a* and its forked end 1*b* engages with a stud 6*a* secured to the flexible band 6. Various methods of arranging the armatures for unit rotation and connection to the tuning means may be resorted to beyond the method shown.

The electric current flow through the solenoid coils 5, 5*a* is so directed that it will produce a magnetic polarity at the ends of each solenoid the same in sign as the polarity of the associated ends of its armature. The proper polarity arrangement of solenoid and armature is indicated by the letters N and S. The purpose of so arranging the polarities of each solenoid and armature is to produce magnetic repulsion between the coil ends and armature ends. Thus with current flowing through the solenoids, if the armatures were free to do so, they would become positioned so that the polarized ends of each would be approximately equi-distant from the ends of its respective solenoid, or in approximately the position shown by solenoid 3*a* and armature 5*a* of Fig. 1.

The solenoids 5, 5*a* are adapted to be electrically energized by current from a source B, the current flow through said solenoids being controlled by a variable resistance 13 whereby the solenoids may be equally or differentially energized. A conductor 7 connects the current source B with terminal 8, 8*a* of solenoids 5, 5*a*. The other terminal of the source B is connected by a conductor 9 through circuit closer 10 and conductor 11 to a pivoted contact arm 12 in sliding contact with resistance unit 13. One end of the

resistance 13 is connected through conductor 14 to terminal 15 of solenoid 5, the other end of resistance 13 is connected through conductor 16 to terminal 15*a* of solenoid 5*a*. Thus when the circuit is closed at 10 the solenoids will be simultaneously equally or differentially energized according to the position of the contact arm 12 on resistance 13.

The magnetic forces of solenoid 5 and armature 3 tend to rotate armature 3 counter-clockwise, and the magnetic forces of solenoid 5*a* and armature 3*a* tend to rotate armature 3*a* clockwise, thus both armatures tend to rotate in opposite directions, and tend to move approximately half a revolution to position the armature ends equi-distant from the ends of the respective solenoids.

The forces and movement of each solenoid and armature coupled being in opposition, it follows that by moving contact arm 12 along resistance 13 the opposing energy of one solenoid will be increased and that of the other proportionately decreased with the result that the armature of the solenoid of greater energy will move against the opposing force of the other armature to a position where the forces of each are equal and opposite. The position of greatest repelling force is when either end of an armature is adjacent the end of its solenoid and the value of the repelling force decreases as the end of the armature moves away from the end of the solenoid. As the energy of one solenoid is increased it tends to position its armature with its ends equi-distant from the ends of said solenoid, but this movement also brings one end of the opposing armature nearer to its coil end and this armature movement effects a gradual increase in the opposing force, so that as the energy of one armature decreases as it approaches the equi-distant position that of the other increases as it is moved from the equi-distant position, and the armatures will come to rest at a relative position which will be at the point of equal and opposite forces, this point of equal and opposite forces being controlled by the variable resistance and current flow through the respective solenoid coils and relative to the differential energization of the respective solenoids.

Thus as arm 12 is moved along resistance 13 and the solenoids differentially energized the armatures will move to a multiplicity of stable positions and the tuning element 1 being operatively connected to the band 6 and thereby relatively positioned with respect to its associated fixed element 2 to vary the capacity of and tune the associated receiving circuit.

A shunt circuit is provided comprising a conductor 17 leading from current source B to a plurality of circuit closers 18, 19, 20 adapted to contact with elements 18*a*, 19*a*, 20*a* connected to resistance 13 at a plurality of predetermined points, and thus when the circuit is closed by any one of the circuit closers 18, 19, 20 the resistance in circuit with solenoids 5, 5*a* will be of a predetermined value and the armatures 3, 3*a* and tuning element 1 will move to a predetermined position.

Fig. 3 is a diagrammatic view of a time operated means for positioning the movable condenser elements to a multiplicity of predetermined manually pre-selected and time selected stable positions, and comprises a time operated device such, for instance as a synchronous electro-inductive or clock spring operated mechanism 21 with a pivoted arm 22 geared to make one revolution in twenty-four hours. A selector ring 23 of non-conducting material is fixed adjacent the arm 22. The ring 23 has a multiplicity of plug in or pin jack holes 24 corresponding, for instance, to every half hour of the twenty-four. A plurality of plug in pins 25, 26, 27, 28, 29, 30 are provided, four of which are fully plugged into the ring 23 and shown as protruding inwardly sufficiently to make contact with arm 22. Each plug in pin is attached by a flexible conductor to resistance 13 at a predetermined point so that the resistance in circuit with solenoids 5, 5*a* will be of a predetermined value. Arm 22 is connected to one terminal of a current source B and when arm 22 makes contact with a plug-in-pin at a predetermined hour or minute the current flow through resistance 13 and solenoids 5, 5*a* will be such as to so position the armatures 3, 3*a* and thereby actuate the condenser tuning element as to effect the tuning in of a pre-selected radio station and programme at a definite pre-selected time.

Pins 26, 28 are both connected to the same flexible conductor and therethrough to the same point on resistance 13, and pins 27, 29 are likewise both connected to the same conductor and to a predetermined point on resistance 13. Pins 26, 28 both represent one radio station and pins 27, 29 both represent another station. With a plurality of plug in pins on one conductor the same radio station can be preselected at a number of different hours. The flexibility of this time operated pre-selecting means is indicated by the fact that pin 26 is at the moment selecting a station and in time period succession pin 27 will select a different station, while later pin 28 will again select the same station as pin 26 had previously selected, and still later pin 29 will again select and tune in the same station as pin 27 previously selected.

With the necessary plug-in-pins on one conductor any desired number of programs can be preselected for one station over a given period of time, and the number of stations that can be thus preselected and the preselection time controlled will depend upon the number of conductor contacts made with resistance 13.

Fig. 2 presents a modification of the armatures 3, 3*a* and comprises an armature enclosed by a continuous current conducting coil 3*b*. This coil when suitably connected in circuit with the current source increases the magnetic flux density of the armature and the value of the magnetic forces.

Having thus described my invention, I claim:

1. In means to tune the receiving circuits of radio apparatus to resonance with transmitted frequencies, a pair of spaced electrodes one adjustable relative to the other interposed in the circuit of the radio apparatus, a pair of solenoids connected in circuit with and energized from a source of electricty, a pair of arcuate armatures supported to rotate about their axes and connected together and with the movable electrode to transmit the movement of the armatures to the electrode, and each armature being associated with and movable one independently of the other under the influence of an individual solenoid, resistance means connected in the circuit of the solenoids, and contact members connected with the source of electricity and selectively operative to connect different amounts of the resistance means in circuit with the solenoids to differentially vary the energization of the solenoids and individually move the armatures and the adjustable electrode to a multiplicity of stable positions.

2. In means to tune the receiving circuits of radio apparatus to resonance with predetermined transmitted frequencies, a pair of spaced electrodes one adjustable relative to the other interposed in the circuit of the radio apparatus, a pair of solenoids connected in circuit with and energized from a source of electricity and having axes extending parallelly of each other, a pair of arcuate armatures rotatable about their axes and connected to each other and the movable electrode to transmit the movement of the armatures to said electrode, and each armature being associated with and movable in and under the influence of an individual solenoid, and resistance means connected in the circuit of the solenoids and adapted to differentially vary the energization of the solenoids and move the armatures and adjustable electrode to a multiplicity of predetermined stable positions.

3. In means to tune the receiving circuits of radio apparatus to resonance with predetermined transmitted frequencies, a pair of spaced electrodes one adjustable relative to the other interposed in the circuit of the radio apparatus, a pair of solenoids connected in circuit with and energized from a source of electricity and having axes extending parallelly of each other, a pair of arcuate armatures rotatable about their axes and movable in and under the influence of an individual solenoid, means to flexibly connect the armatures and operatively connect the armatures with and transmit the movement thereof to the movable electrode, and resistance means connected in the circuit of the solenoids and adapted to vary the energization of the solenoids and move the armatures and adjustable electrode to a multiplicity of predetermined stable positions.

4. In means to tune the receiving circuits of radio apparatus to resonance with predetermined transmitted frequencies, a pair of spaced electrodes one adjustable relative to the other interposed in the circuit of the radio apparatus, a pair of solenoids connected with and energized from a source of electricity, a pair of armatures connected to the movable electrode and movable in and under the influence of the solenoids, resistance means connected in the circuit of the solenoids, contact members connected to different portions of the resistance means, and periodically actuated means connected to the source of electricity and adapted to successively engage the contacts and differentially energize the solenoids to position the armatures and the adjustable electrode to a multiplicity of predetermined stable positions at preselective intervals.

5. In means to tune the receiving circuits of radio apparatus to resonance with transmitted frequencies, a pair of spaced electrodes one of which is adjustable relative to the other interposed in the circuit of the radio apparatus, a pair of solenoids connected in circuit with and adapted to be energized from a source of electricity, a pair of arcuate armatures independently supported to have movement about their axes, means to connect the armatures to move in unison and operatively connect the armatures with and transmit the movement thereof to the adjustable electrode, and selectively operated means interposed in the circuit between the solenoids and source of electricity to effect differential energization of the solenoids one relative to the other and effect movement of the armatures and thereby of the adjustable electrode to a multiplicity of stable positions.

6. In means to tune the receiving circuits of radio apparatus to resonance with transmitted frequencies, a pair of spaced electrodes one of which is adjustable relative to the other interposed in the circuit of the radio apparatus, a pair of solenoids connected in circuit with and adapted to be energized from a source of electricity, a pair of arcuate armatures flexibly connected together and operatively connected with the adjustable electrode and movable in the solenoids, and periodically actuated means interposed in the circuit between the solenoids and source of electricity to control the energization of the solenoids and effect movement of the armatures and thereby of the adjustable electrode to a multiplicity of stable positions at predetermined periods of time.

7. In means to effect predetermined tuning of receiving circuits of radio apparatus to resonance with transmitted frequencies, a pair of spaced electrodes one of which is adjustable relative to the other interposed in the circuit of the radio apparatus, arcuate armatures supported to have movement about their axes and operatively connected to move in unison and with the adjustable electrode to transmit the movements of the armatures thereto, a solenoid for and in which each armature engages and movable therein under the influences of the magnetic forces generated by the solenoids, electric resistance means connected in the circuit of the solenoids, and means interposed in the circuit of the solenoids and resistance adapted to periodically close the circuit of and connect a predetermined amount of the resistance into one solenoid and cut out a proportional amount of the resistance from the other solenoid to differentially energize the solenoids and actuate the armatures and connected adjustable electrode to predetermined stable positions.

MERION J. HUGGINS.