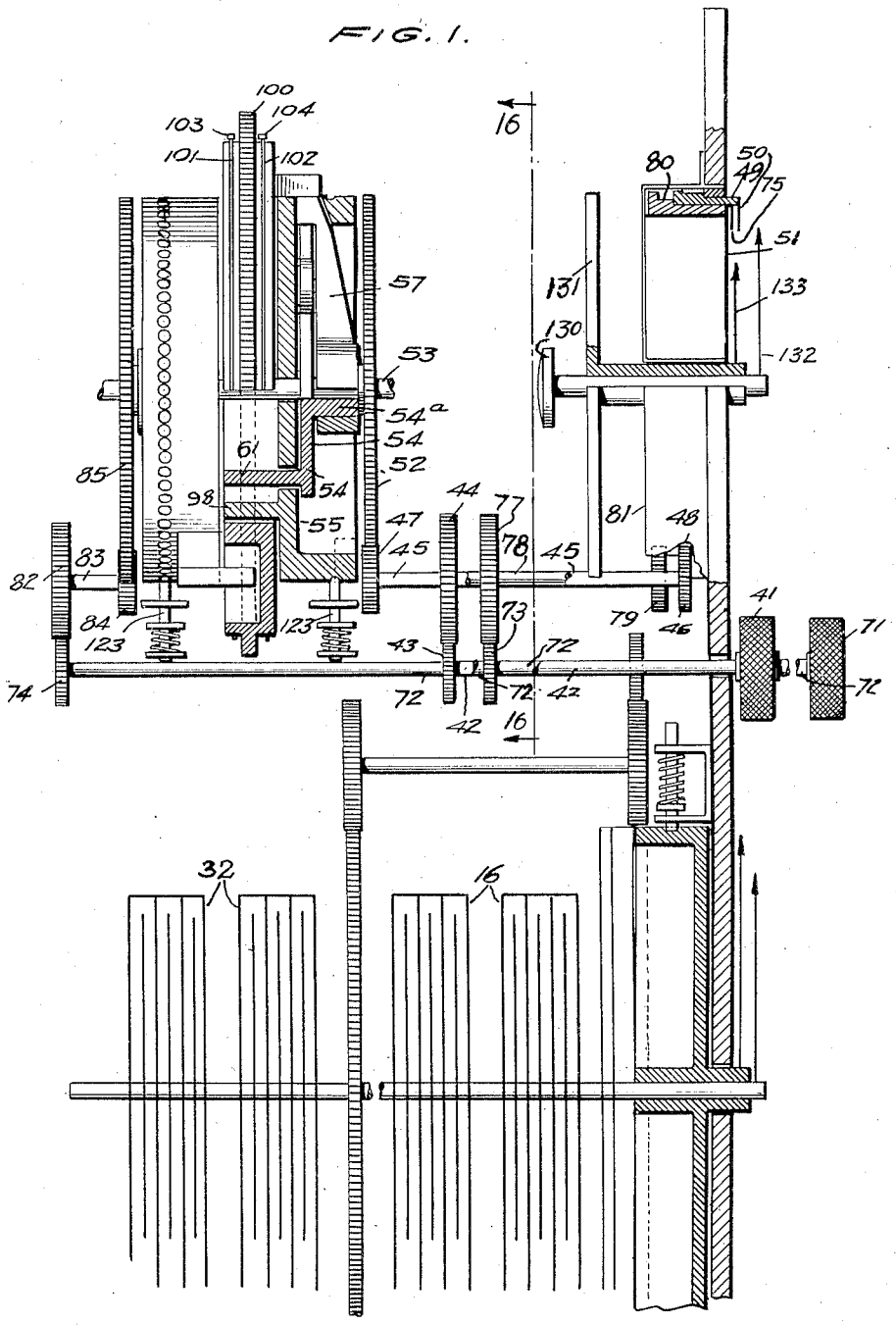
Jan. 9, 1945. H. C. GOODWIN 2,366,726

TIME CONTROLLED SELECTOR MECHANISM FOR RADIO RECEIVERS

Filed April 25, 1942 5 Sheets-Sheet 1

FIG. 1.



INVENTOR

HENRY C. GOODWIN

BY William D. Hall.

ATTORNEY

Jan. 9, 1945. H. C. GOODWIN 2,366,726

TIME CONTROLLED SELECTOR MECHANISM FOR RADIO RECEIVERS

Filed April 25, 1942 5 Sheets-Sheet 2

FIG. 14.

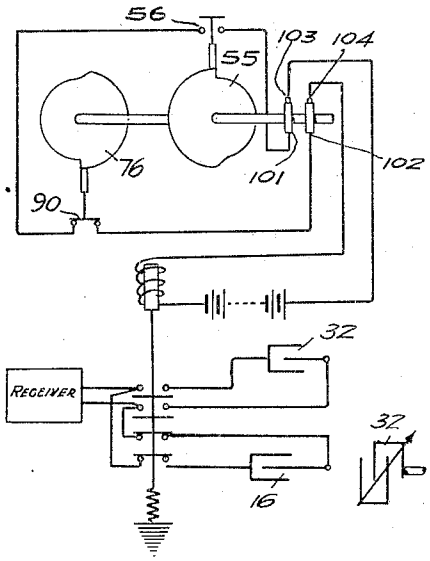
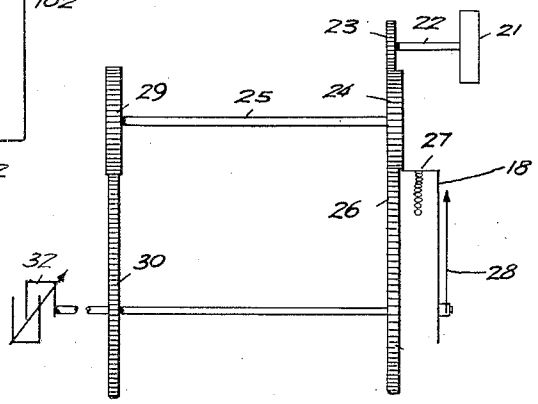


FIG. 3.



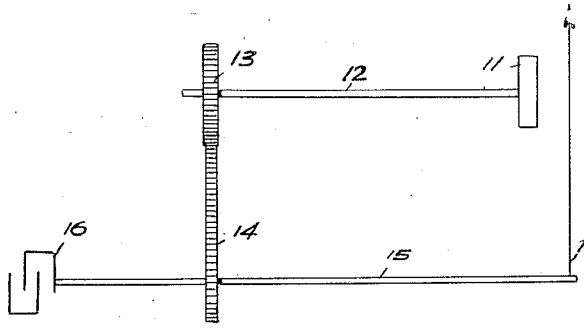


FIG. 2.

FIG. 11.

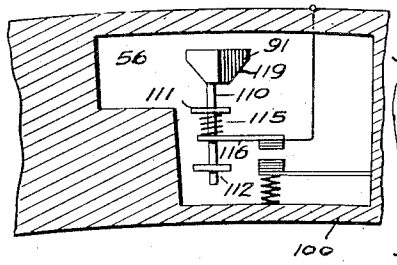
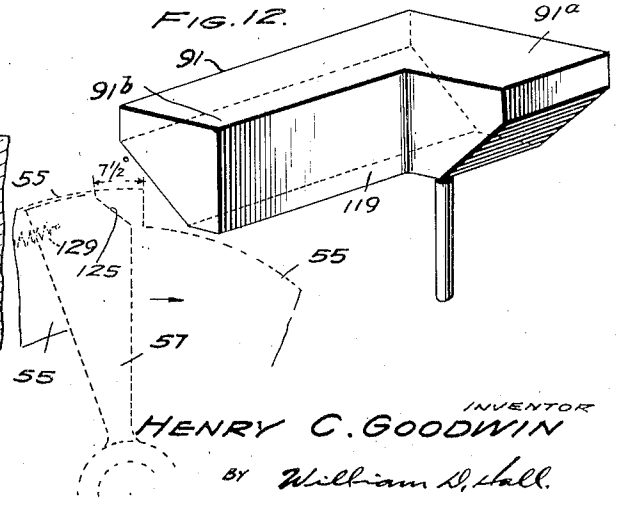


FIG. 12.



INVENTOR
HENRY C. GOODWIN
BY William D. Hall.
ATTORNEY

Jan. 9, 1945. H. C. GOODWIN 2,366,726

TIME CONTROLLED SELECTOR MECHANISM FOR RADIO RECEIVERS

Filed April 25, 1942 5 Sheets-Sheet 3

FIG. 4.

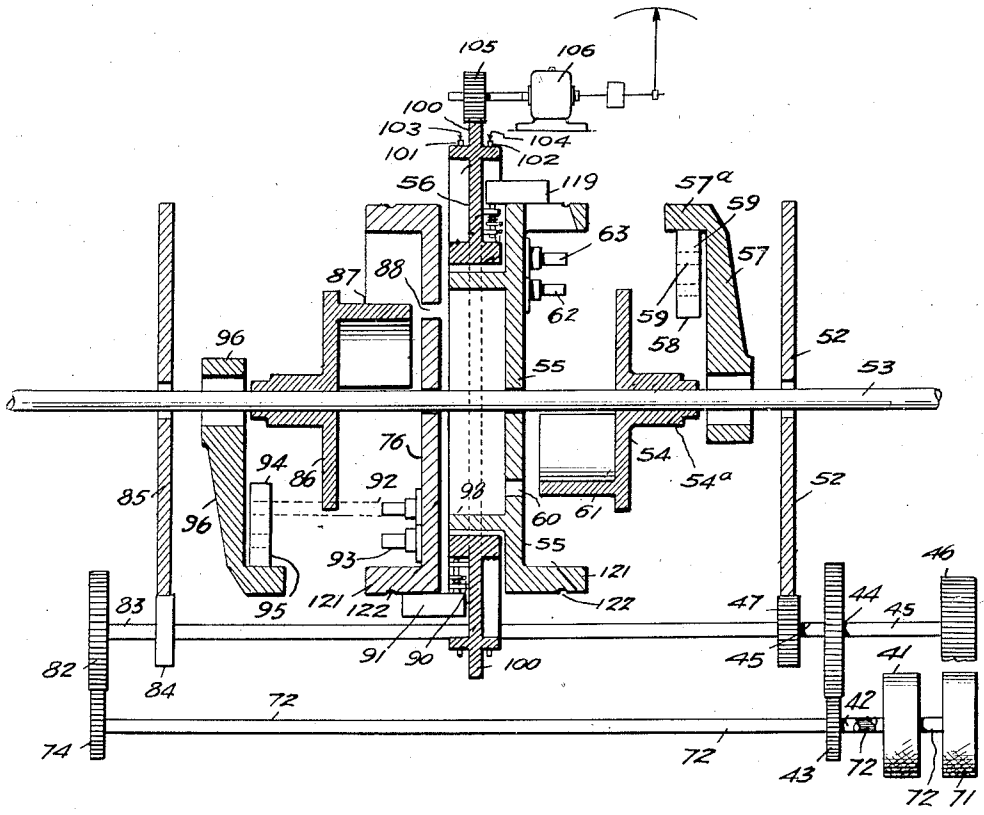


FIG. 5.

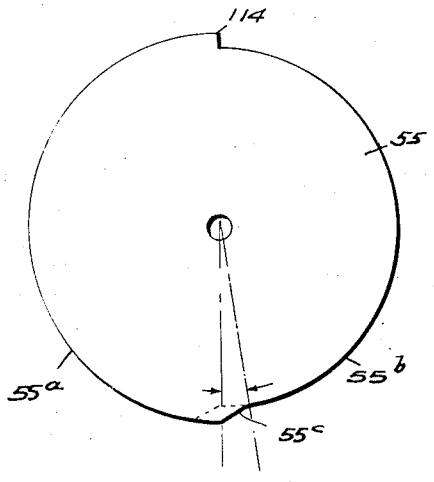
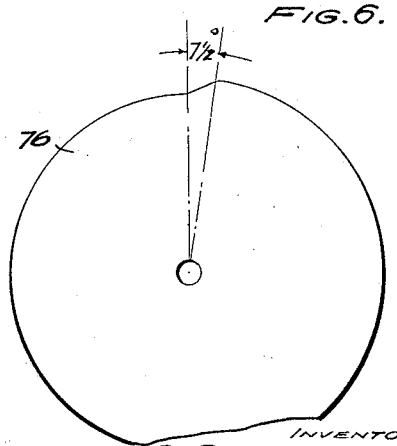


FIG. 6.



INVENTOR
HENRY C. GOODWIN
BY William D. Hall.
ATTORNEY

Jan. 9, 1945. H. C. GOODWIN 2,366,726

TIME CONTROLLED SELECTOR MECHANISM FOR RADIO RECEIVERS

Filed April 25, 1942 5 Sheets-Sheet 4

FIG. 13.

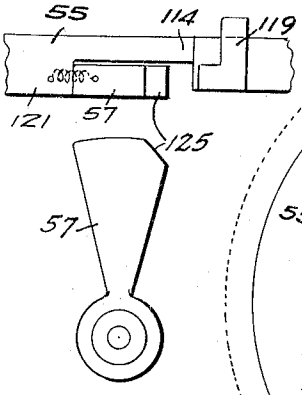


FIG. 7.

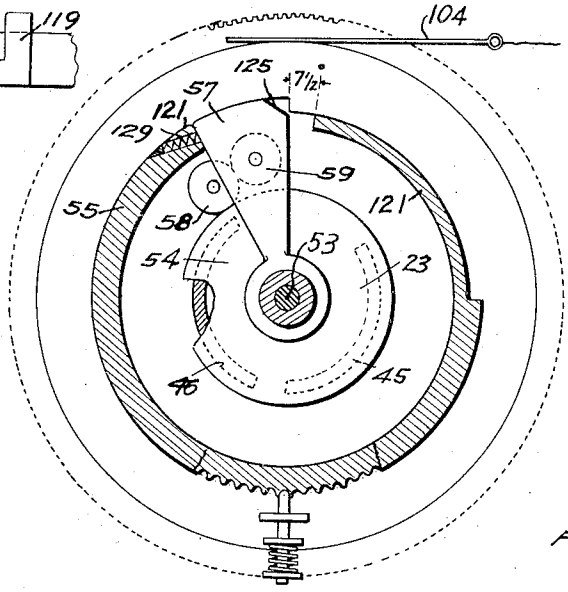


FIG. 10.

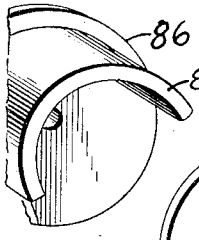
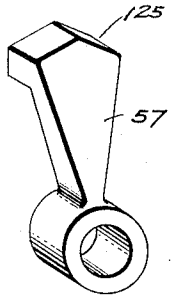


FIG. 9.



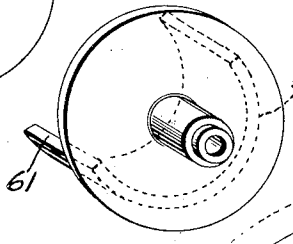
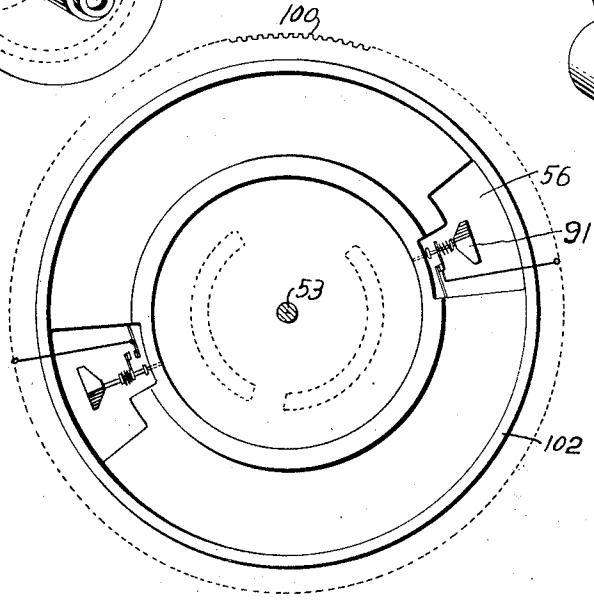


FIG. 8.



INVENTOR
HENRY C. GOODWIN
BY William D. Hall.
ATTORNEY.

Jan. 9, 1945. H. C. GOODWIN 2,366,726

TIME CONTROLLED SELECTOR MECHANISM FOR RADIO RECEIVERS

Filed April 25, 1942 5 Sheets-Sheet 5

FIG. 15.

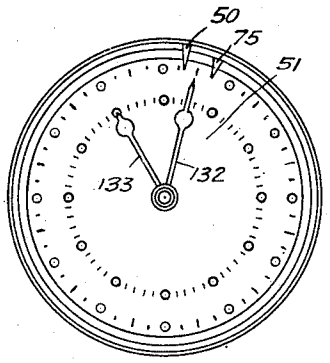
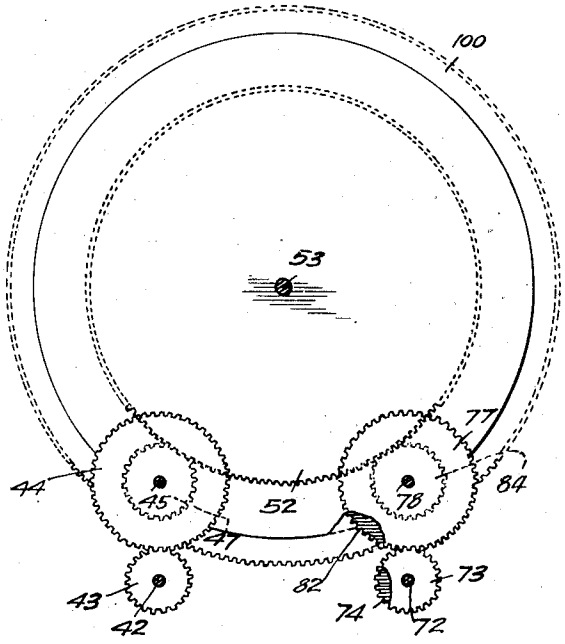


FIG. 16.



INVENTOR
HENRY C. GOODWIN
BY William D. Hall.
ATTORNEY

Patented Jan. 9, 1945 2,366,726

UNITED STATES PATENT OFFICE

2,366,726

TIME CONTROLLED SELECTOR MECHANISM FOR RADIO RECEIVERS

Henry C. Goodwin, Galveston, Tex.

Application April 25, 1942, Serial No. 440,442

11 Claims. (Cl. 250—20)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to time-clock controlled apparatus for radio receivers.

One object of my invention is to provide a pre-selecting apparatus for a radio receiver, by means of which a pre-selected program may be tuned in automatically at the receiver for the duration of the program.

Another object of my invention is to pre-set the tuning adjustments of a receiver for a desired pre-selected program, and to pre-set the starting and stopping points of that pre-selected program.

In order to selectively tune in a desired future program, I provide an auxiliary condenser, for the tuning circuit, with characteristics identically corresponding to the characteristics of the main condenser of the tuning circuit, so the tuning position of the auxiliary condenser, when indicated on the main dial of the receiver, will correspond to the same tuning position of the main condenser.

With such an auxiliary condenser the tuning condition of the receiver can be pre-set without interfering with the immediate operation of the receiver, and, at the same time, the proper tuning condition can be established for the frequency of the desired future program.

Suitable time-clock controlled terminal switches are provided to co-operatively control an operating circuit for a transfer switch, which operates to disconnect the main condenser and to substitute the auxiliary condenser in the tuning circuit. Each terminal switch is arranged to be controlled by an adjustably positionable cam, that is positioned to be controlled by a clock-operated mechanism at a pre-selected time, thereby to control the starting and the stopping of the selected program.

The construction of the selector mechanism, embodying my invention, and the manner in which it operates, is illustrated in the accompanying drawings, in which:

Figure 1 is a side view, partially in elevation and partially in section, of the selector apparatus;

Figure 2 is a schematic view, illustrating the mechanical arrangement of the various elements for tuning the main condenser;

Figure 3 is a similar schematic view, illustrating the functional arrangement of the elements for adjusting the auxiliary condenser, with the adjustment indicator related to the same indicating dial as in Figure 2;

Figure 4 is an exploded side sectional view, illustrating the functional arrangement of the various elements for selectively positioning the program starting and stopping cams;

Figure 5 is a plan view of the starting cams;

Figure 6 is a plan view of the stopping cams;

Figure 7 is a transverse sectional view through the selector, showing the relation between the switch-lifter and the associated cams;

Figure 8 is a transverse sectional view through the selector, showing the disposition of the starting and the stopping switches, on the timing gear;

Figure 9 is a perspective view of the switch lifter;

Figure 10 is a perspective view of the two cam-operating gears;

Figure 11 is a side elevational view of a portion of the timing gear, showing the construction and the disposition of one of the switches;

Figure 12 is a perspective view of a rider or side-arm on the switch stem for operating a switch;

Figure 13 is a schematic plan view showing the relationship of a cam, a switch, and the switch-lifter; and

Figure 14 is a diagram of the circuit controlled by the timing switches to effect the substitution of the auxiliary condenser in the tuning circuit.

Figure 15 is front view of the dial structure.

Figure 16 is a vertical cross-section on line 16—16 of Figure 1.

Figure 1 shows a side view, partially in elevation, and partially in section, of the selector apparatus, the condensers and the indicators. The arrangement and the co-operative relationship of the parts will be understood better in connection with the following description of the other figures:

As shown schematically in Figure 2, the normal tuning elements are illustrated, simply, as comprising a tuning knob 11 on a shaft 12, to operate a gear 13 that meshes with a gear 14, which latter is on a shaft 15 for the main condenser 16. The condenser shaft 15 also carries an indicating pointer 17 that cooperates with a main indicating dial 18, to show the relative position of the condenser and to indicate the corresponding station or frequency to which the circuit is tuned at that position of the condenser.

In Figure 3, the various auxiliary elements are illustrated that operate the auxiliary condenser,

by means of which a future program may be selected, to be tuned in at some later time.

As shown in Figure 3, an adjusting knob 21, on a shaft 22, rotates a gear 23. Gear 23 meshes with a gear 24 on a shaft 25. Gear 24, in addition to rotating the shaft 25, also meshes with a gear 26 that is here illustrated as being part of, or formed on, a ring 27 that carries an indicator or pointer 28, that cooperates with the same main dial or scale 18 which shows the adjustment or position of the main condenser 16, in Figure 2. The shaft 25 also carries a gear 29 that meshes with a gear 30 on the shaft 31 of the auxiliary condenser 32.

After the auxiliary condenser 32 has been preset to tune in a pre-determined frequency, the timing equipment is pre-set to control the starting point and the terminating point for that pre-selected program or frequency. That timing equipment is shown schematically and functionally in Figure 4, as an exploded view of the corresponding part of Figure 1.

As shown in Figure 4, a time-starting adjusting knob 41 is mounted on a shaft 42 driving a gear 43. Gear 43 meshes with a gear 44 on a shaft 45 which supports and drives two other gears 46 and 47.

Gear 46 operates a time-indicating pointer, and gear 47 operates a gear train to position the starting cam. Pointer gear 46, shown in Figure 1, meshes with a gear 48, fitted on, or made part of, a ring 49, which carries and operates an indicating pointer 50 that is movable with respect to a clock face 51.

The cam gear 47, in the gear train controlled by the starting knob 41, meshes with a gear 52, arranged to be keyed on a cam-operating gear 54 that is loose on a supporting shaft 53. The gear 54 operates a cam 55 whose function is to control the operation of the starting switch 56, and the time of the closure of that switch.

The cam-operating gear 54 also controls a switch-lifter 57 to permit free adjustment of the cam 55 past the switch 56.

In order that the switch-lifter 57 may function properly, it must be caused to move a short distance in advance of the cam-operating gear 54, when the latter is rotated in a forward direction. In that direction, the switch-lifter 57 must raise the switch 56 out of the way of the cam ledge. In the reverse direction such lifting action on the switch is unnecessary, since the cam surface changes gradually.

In order to cause such advance movement of the switch lifter 57, ahead of the cam-operating gear 54, that cam-operating gear 54 drives two idler pinions 58 and 59, to angularly advance the switch lifter 57, before gear 54 acts directly on the starting cam 55 through an integral arcuate segment 61 mounted concentrically on the side of gear 54, and disposed to fit into a slot 60 in the cam 55.

The idlers 58 and 59 are small rubber discs, and are respectively rotatably disposed on pivot shafts 62 and 63 that are supported on, and secured to, the cam 55.

As shown in Figures 1 and 4, the switch lifter 57 floats loosely on an extended hub section 54—*a* of cam operating gear 54. That gear 54 frictionally engages idler 58 and rotates idler 58 to rotate the other idler 59 which engages the under surface of the peripheral ring 57—*a* of the switch-lifter 57, and oscillates the switch-lifter through a small angle to lift the arm of its cooperating terminal switch 56 out of the path of the control cam 55 during the time when the cam is being selectively positioned for future automatic operation.

The cam operator gear 54 embodies the arcuate segment 61, disposed on the side wall of the gear 54 concentrically with the gear axis. That arcuate segment 61 serves as a driving element for the starting control cam 55, which controls the operation of the program starting switch 56. The driving arcuate segment is made to subtend an arc at least seven and one-half degrees less than the arc subtended by the slot 60 in the cam 55. That space provides the lost motion necessary to permit and enable the switch-lifter to be moved the desired distance in advance of the cam during adjustments of the cams in their timing positions.

Figure 4 shows also how the termination point of the pre-selected program is similarly controlled and pre-determined by an adjustable gear train and a cam 76.

In Figure 4, a program-stop adjusting knob 71 is mounted on a shaft 72, that carries two gears 73 and 74. Gear 73 controls a time-indicating pointer 75, and gear 74 controls a gear train to the stop cam 76. As shown in Figure 1, the gear 73 meshes with a gear 77 on a shaft 78 that carries a second gear 79 meshing with a gear 80 that is mounted on or made part of a ring 81 that carries the indicating pointer 75 that co-operates with the clock face 51 to indicate the cut-off terminal position of the time interval of the pre-selected program.

The cam-control gear 74 on the shaft 72 with the adjusting knob 71, meshes with a gear 82 on a shaft 83 that carries a second gear 84 meshing with a gear 85 that is arranged to be keyed to a cam-operating gear 86 that is loose on the supporting shaft 53. That gear 86 embodies an integral arcuate segment 87 that fits into a similarly shaped arcuate slot 88 in the cut-off or stop cam 76, that is provided to operate the cut-off switch 90 to control the termination of the operating interval of the pre-selected program.

As in the case of the cam for the starting switch, the stop cam 76 carries two pivot shafts 92 and 93, for two idlers 94 and 95, to operate a switch-lifter 96 for the cut-off switch 90.

In addition to the elements already described in Figures 1 and 4, a ring or circular shelf 98 is provided for a timing gear 100. The ring shelf 98 may be mounted on either cam 55 or 76, and is shown by way of example, mounted on cam 55. Ring shelf 98 also serves as a spacer between the two cams.

The timing gear 100 carries the starting switch 56 and the cut-off switch 90; and also carries two conducting slip rings 101 and 102 to permit electrical connections to be made to the two switches from an external circuit, through contact brushes 103 and 104. The timing gear 100 is driven by a pinion 105, and a motor 106.

In each switch, as shown in Figure 11, the contacts are controlled by a spring-biassed stem 110, mounted for axial motion between two guide plates 111 and 112 supported on gear 100. The starting switch 56 is constructed to be held normallp open by its cam 55; and the cut-off switch 90 is constructed to be held normally closed by its cam 76. Each switch operates to its reverse or opposite position, when it moves past, the drops over the ledge 144 of its cam, shown in Figures 5, 6 and 7. That operation, in each case, is effected by a biasing spring 115, reacting against the rear guide plate 11, and pressing forward on a

pressure plate 116, pinned to, or otherwise secured onto, the switch stem 110. The upper end of the stem of switch 56 carries an arm or rider 119; and the upper end of the stem of switch 90 carries the arm or rider 91, as in Figure 12.

Each arm or rider extends laterally, parallel to the axis of rotation of timing gear 100, over the face of its associated cam, and beyond the cam to a short distance into the path of the associated switch-lifter 57 or 96.

In order to balance out the stresses of the biassing springs of the two switches 56 and 90, the switches are preferably disposed on diametrically opposite sides of the axis of timing gear 100. For symmetry and ease of assembly, the two switches are also disposed on opposite sides of the central plane of the timing gear 100; consequently, the cams are also disposed with their ledges diametrically opposite.

In order to prevent rotational shifting of the cams by the frictional contact of the switch arms or riders 91 and 119 against the associated cam faces, each cam is provided with a holding and positioning ring 121, that has equally spaced depressions 122 in its periphery, into which a spring-biased stop 123 extends. The spring is sufficient to hold the cam against causal displacement by the switch-riders, but not against a manual setting operation. The spacing between centers of the depressions 122 is so related to the gear train ratios, as to correspond to a time interval of fifteen minutes, with each depression center disposed to correspond to the beginning of a fifteen-minute interval.

The ledge of the cam, and each switch-rider, and the timing gear and its drive, are so related that the rider will drop off the ledge at the beginning of a fifteen-minute interval. The cam is held in stable stopped position by its stop in one of the grooves 122.

As shown in the schematic exploded view of Figure 4, the cam elements 55 and 76 are loosely mounted on the supporting and centering shaft 53. The force applied to adjusting knob 41 rotates gear 52, which is keyed to cam-operating gear 54 and therefore operates that gear 54, and moves cam 55 with it. When the cam 55 is moved clockwise, as viewed Figure 7, the switch-lifter 57 lifts the switch arm or rider 119, bp means of the inclined front corner edge 125, so the cam 55 can move under and clear the arm.

To enable the switch-lifter 57, by starting switch 56, to move in advance of the cam actuation by the cam-operating gear 54, the idler gears 58 and 59 move the switch-lifter 57 through an angle of seven and one-half degrees before the arc segment 61, on cam-actuating gear 54, operatively engages the front wall of the slot 60 in the cam 55, into which the arc segment 61 extends.

In similar manner, the switch-lifter 96 for the cut-off switch 90 is controlled by the idlers 94 and 95, to raise the switch 90 out of the way of cam 76 when the cam 76 is to be selectively positioned.

As shown in Figure 7, and in Figure 13, the side arm 57—*a* of the switch lifter 57 is nested in an arcuate space in the ring 121 of the cam 55. That space subtends an angle sufficient to accommodate the switch-lifter, plus a space of at least seven and one-half degrees to permit some lost motion between the switch-lifter and the ring 121 of cam 55. The switch-lifter 57 is normally biased to its rear position by a spring 129 on the cam 55, and may be advanced through the angle of 7½ degrees, without movement of cam 55, to enable inclined surface 125 to slide under the side-arm, or rider, 119 attached to the operating stem of start switch 56. That side-arm 119 is thus raised out of the way of the ledge 114 of cam 55, so the cam may be moved clock-wise past the switch side arm 119. The biasing spring 129 then restores the switch lifter 57 to normal back position against the ring 121 of cam 55.

By means of the arrangement shown in Figure 4, the switch-lifter 57 may be slipped over the hub extension of cam-operating gear 54 before the gear 52 is keyed onto cam-operating gear 54.

Each switch-lifter operates its own switch arm to raise that arm out of the way of the associated cam ledge, thus permitting free rotation in either direction for adjustments.

As already explained, the two cams 55 and 76 are oppositely disposed on the supporting shaft 53. The cam surfaces have the contours shown in Figures 5 and 6. As indicated in Figure 5, the cam edge of large diameter on cam 55 extends a full half-circle, while the large diameter cam edge of cam 76 extends through an arc that is seven and one-half degrees short of a half-circle.

The cams are respectively positioned, as desired, and are held against casual displacement by the spring-biased stop plungers 123 extending into the grooves 122 in the cam rings 121.

The timing action is then controlled bp the movement of the switches around the cam circles, by the timing gear 100, operated by the clock motor 106. As previously explained, and as shown in Figure 11, starting switch 56 is normally held open by its cam, and closes when the switch arm 91 or 119 drops over the cam ledge 114.

The switch arm 91, shown in more detail in Figure 12, embodies a head portion 91—*a*, secured to the top of the operating stem, and a side-arm or lifting portion 91—*b*, which rides over the cam edge surfaces and controls the position of the switch 56.

As shown in Figure 11, the switch 56 is held in raised position, with contacts open, by the side-arm 91—*b* resting on the high arc 55—*a* of cam 55. When the side arm moves over the ledge 114 of cam 55, the side 91—*b* is dropped to the low arc 55—*b* of cam 55, by the biasing spring 115, and the switch contacts are closed.

The closure of starting switch 56 completes an energizing circuit to the operating coil of a transfer switch, that is thereupon operated to disconnect the main condenser 16, and to substitute the auxiliary condenser 32 in the tuning circuit. That condition continues until the timing gear is moved around to bring the arm of the cut-off switch 90 to the ledge of cut-off cam 76. The switch 90 is held in its normal closed position. When the switch arm 119—*b* drops off the high arc of cam 76, switch 90 is moved to its open position, to open the circuit of the coil of transfer switch, whereupon the transfer switch operates to disconnect the auxiliary condenser and to reconnect the main condenser to the tunning circuit.

In order to insure proper control of the transfer switch by operating only one timing switch at any one time, the two cams are shaped as shown in Figures 5 and 6, with one cam having a short overlapping interval, thereby assuring operation of either switch while the other switch is still held in position. Thereby positive make and break of the control circuit is assured.

By means of the indicating pointer 50, the time

of the starting operation is shown. Likewise, by the pointer 75, the time of termination is shown, on the face 51, of the clock that is operated by the clock motor 106. For simplicity, in Figure 1, only the gears 130 and 131 are shown, that support the minute hand 132 and the hour hand 133.

Figure 15 shows the face of the clock dial 51, the minute hand 132, the hour hand 133, the starting indicating pointer 50 and the stopping indicating pointer 75.

Figure 16 is a cross-sectional view on line 16—16 of Figure 1, and shows the spacing of shafts 42 and 72 and the way in which gears 43 and 74 mesh with the gears 44 and 82 so as to drive gears 52 and 85 respectively upon manual adjustment of the knob 41 and 71 which are seen in Figure 1.

I claim:

1. In combination with a radio receiving set provided with a main tuning condenser, a frequency pre-selector, said pre-selector comprising an auxiliary condenser arranged to be customarily manually operated to pre-select a station having a tuning range substantially the same as said main tuning condenser; and time-clock controlled means for substituting the auxiliary condenser for the main condenser when a pre-selected frequency is to be tuned in.

2. In combination with a radio receiving set provided with a main tuning condenser, a frequency pre-selector, said pre-selector comprising an auxiliary condenser having a tuning range substantially the same as said main tuning condenser; manually adjustable means for rapidly pre-setting the auxiliary condenser, separately from the main condenser, to a position to tune in a pre-selected frequency; and time-clock controlled means for disconnecting the main condenser and connecting in the auxiliary condenser.

3. In combination with a radio receiving set provided with a main tuning condenser, a frequency pre-selector, said pre-selector comprising an auxiliary condenser having a tuning range substantially the same as said main tuning condenser; manually adjustable means for rapidly pre-setting the auxiliary condenser, separately from the main condenser, to a position to tune in a pre-selected frequency; and time-clock controlled means for disconnecting the main condenser and connecting in the auxiliary condenser. comprising a transfer switch for connecting either condenser to the receiving set circuits; and time-clock controlled means for operating the transfer switch to connect one condenser to the receiving circuits, and for controlling the duration of that connection.

4. In combination with a radio receiving set provided with a main tuning condenser, a frequency pre-selector, said pre-selector comprising an auxiliary condenser having a tuning range substantially the same as said main tuning condenser; readily manually adjustable means for customarily pre-setting the auxiliary condenser, separately from the main condenser, to a position to tune in a pre-selected frequency; and time-clock controlled means for disconnecting the main condenser and connecting in the auxiliary condenser, comprising a starting switch; a separate cut-off switch; and means controlled by the two switches for effecting the connecting and the disconnecting operations.

5. In combination with a radio receiving set provided with a main tuning condenser, a frequency pre-selector, said pre-selector comprising an auxiliary condenser having a tuning range substantially the same as said main turning condenser; readily manually adjustable means for customarily pre-setting the auxiliary condenser, separately from the main condenser, to a position to tune in a pre-selected frequency; and time-clock controlled means for disconnecting the main condenser and connecting in the auxiliary condenser, comprising a starting switch; a separate cut-off switch; a cam for controlling the operation of each switch; a timing means with an indicating face; and means for pre-setting the time point of operative effectiveness of each cam on its switch relative to a selected time setting on said face.

6. In combination with a radio receiving set provided with a main tuning condenser, a frequency pre-selector, said pre-selector comprising an auxiliary condenser having a tuning range substantially the same as said main tuning condenser; readily manually adjustable means for customarily pre-setting the auxiliary condenser, separately from the main condenser, to a position to tune in a pre-selected frequency; and time-clock controlled means for disconnecting the main condenser and connecting in the auxiliary condenser, comprising a starting switch; a separate cut-off switch; a cam for controlling the operation of each switch; a timing means with an indicating face; means for pre-setting the time point of operative effectiveness of each cam on its switch relative to a selected time setting on said face; and switching means controlled by each cam for controlling the starting and the stopping points of the selected time interval for connecting the auxiliary condenser to the receiver.

7. In combination with a radio receiving set provided with a main tuning condenser, time-clock controlled selector apparatus, said apparatus comprising an auxiliary condenser having a tuning range substantially the same as said main tuning condenser; an indicating dial to show the receiver setting; means for pre-setting the auxiliary condenser independently of the main condenser, with an indicator related to the indicating dial to show the auxiliary condenser setting; a transfer switch for disconnecting the main condenser from the receiver circuit, and substituting the auxiliary condenser in that circuit; an electric control circuit to energize and to operate the transfer switch; a start switch and a stop switch for the control circuit; means for separately positioning each switch along a timing path; and a time-clock controlled switch operator movable along said path to operate the switches for starting and for stopping operations, thereby to control the energization of the control circuit for, and the consequent operation of, the transfer switch.

8. An automatic radio station selector comprising, a radio receiver, tuning apparatus forming a part of said receiver, manually adjustable means for moving said tuning apparatus to various positions so as to tune the receiver to different stations, electric circuit connections controlling the connection into and disconnection from operative position of said tuning apparatus, a starting switch forming a part of said circuit connections, a stopping switch forming another part of said circuit connections, manually adjustable cam means controlling the operations of said switches, and manually operated switch lifters mechanically interconnected with said cam means so as to lift said switches off said cams and thereby

permit operation of said cam means in either direction.

9. A frequency pre-selector for a radio-receiving set provided with a main tuning condenser, said pre-selector comprising: an auxiliary condenser having a corresponding adjustment curve; readily manually adjustable means for customarily pre-setting the auxiliary condenser, separately from the main condenser, to a position to tune in a pre-selected frequency; and time-clock controlled means for disconnecting the main condenser and connecting in the auxiliary condenser, comprising, a starting switch; a separate stopping switch; a pair of cams each controlling the operation of one of said switches; timing means for moving said switches and thereby controlling the time of operation of each of said switches; manually operable means for presetting the time point of operative effectiveness of each cam on its switch; and switch lifting means provided with a limited amount of lost motion relative to said manually operable means to lift either of said switches before the cam controlled thereby is moved and thus allow movement of said manually operable means in either direction.

10. In a time-clock controlled selector mechanism for a radio receiver having a manually adjustable tuning element: an electric circuit arranged to connect said tuning element into operative condition and to disconnect it therefrom, a plurality of switches forming parts of said circuit, a plurality of cams each adapted to control the operation of one of said switches, a plurality of cam-operating gears each having a limited amount of lost motion relative to one of said cams and arranged, after making said lost motion, to thereafter operate said cam, to a position to set the time of operation of said switch, and a plurality of switch-lifters each mechanically connected to one of said cam-operating gears so as to be moved thereby, during said lost motion, and thus to lift the co-operating switch off the cam which controls the said switch.

11. Means for turning on a radio receiver which has been tuned to a selected station and for turning it off again, said means comprising a tuning mechanism forming part of said receiver, an auxiliary tuning mechanism forming another part of said receiver, and having substantially the same characteristics as the first, a manually rotatable knob having mechanical connection with said auxiliary tuning mechanism so as to tune it, an electric switch and circuit arrangements whereby said switch connects one tuning mechanism to the receiver and disconnects the other, electro-magnetic means arranged to shift said switch from one position to the other, a normally-closed switch and a normally-open switch connected in circuit with said electro-magnetic means, cams controlling the opening and closing of said normally-open and said normally-closed switches, manually operable means for separately adjusting the points at which said cams cause said switches to operate, and motor means providing relative movement between said cams and the co-operating switches.

HENRY C. GOODWIN.