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PRESELECTIVE TUNING FOR RADIO RECEPTION AND THE LIKE

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Fig. 1

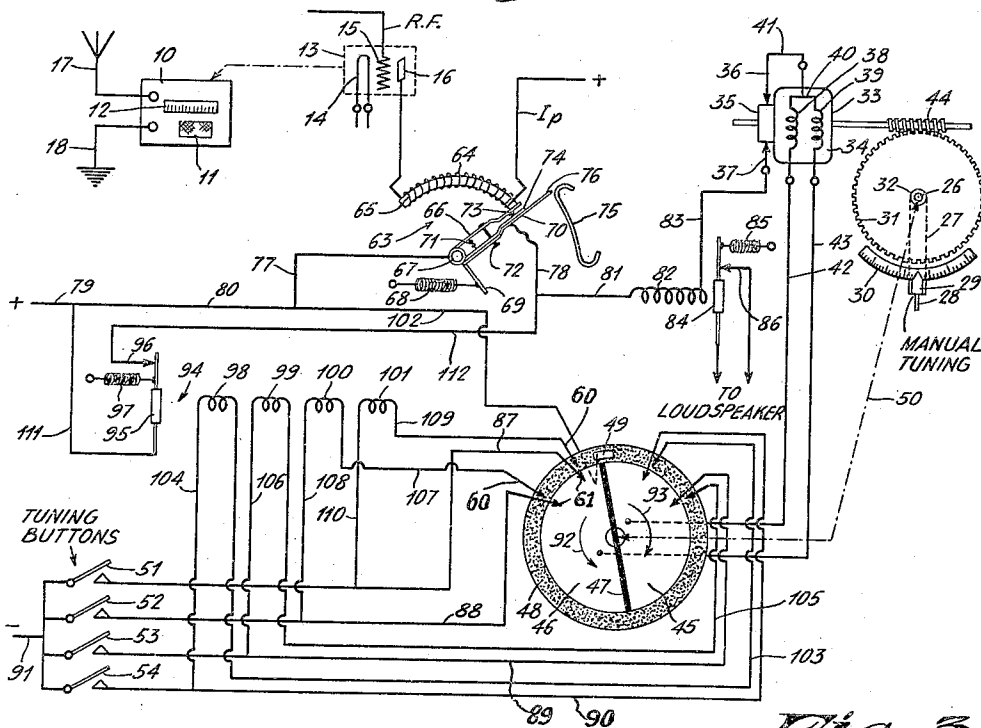


Fig. 2

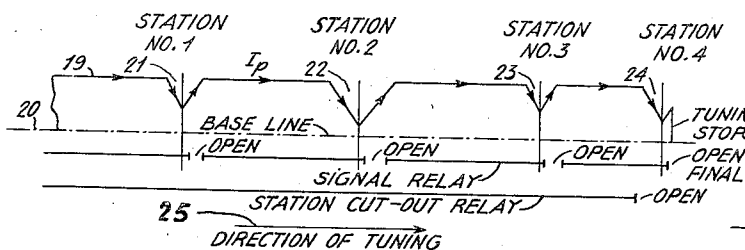


Fig. 3

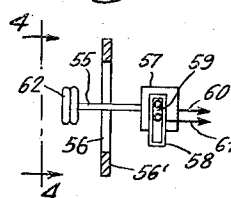


Fig. 4

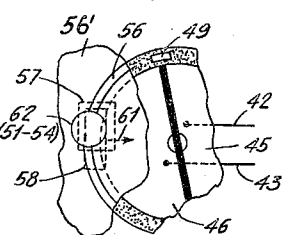
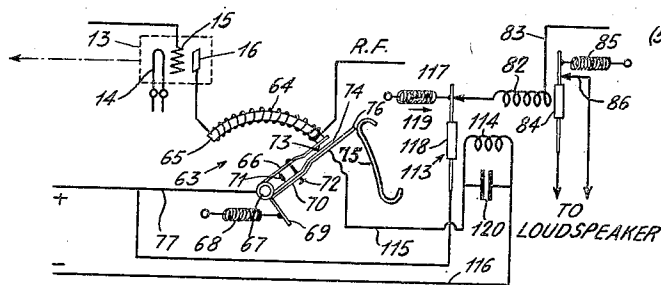


Fig. 5



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PRESELECTIVE TUNING FOR RADIO RE-
CEPTION AND THE LIKE

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This invention has to do with preselective tuning for radio reception and the like, that is, it has to do with tuning the receiving station by a preselective operation, so that the receiving set will automatically bring itself to the proper tuned condition to receive the desired incoming signals.

In connection with the foregoing, it is a feature of the invention to provide an arrangement in which the preselective tuning is accomplished to a desired station signal, as distinguished from tuning to a fixed stop, thereby ensuring that the tuning operation will be accomplished to the exact wave length or frequency of the selected incoming signal (or a very close approximation thereto), and compensating for the fact that the frequency of the incoming signals of such station may not always be truly represented by the position of such fixed stop.

In order that the foregoing feature may be more clearly understood and appreciated, it may be stated that the frequency of the signals of the station sought to be tuned vary slightly, so that the exact position where such station will be located on the tuning dial of the ordinary receiving set varies, such variation being slight, but of sufficient amount to sometimes interfere with exact tuning in the case of very selective receivers such as some of the better superheterodynes now in use. Furthermore, where the tuning is accomplished to a fixed stop, the position of such stop with respect to the dial is a matter of adjustment, and such adjusted position of the stop may not be exactly correct even for the assumed frequency of the station to be tuned. Or, in other cases, the position of the stop may become shifted, so that errors will occur.

This feature of the present invention will make it possible to ensure correct tuning to the desired station, since the final tuning operation is accomplished by means responsive to the frequency of the signals coming in from the station sought, and in case of variation of such frequency within the reasonable limits permitted by the construction of the device, the final tuning will take place to the exact frequency of the signals then being received, (within very close approximation), and a very fine and accurate tuning operation will be secured. Such final tuning will be performed irrespective of the exact position of any stop or button provided for selecting the station to be received, and an error in the positioning of such stop or button will not interfere with the final exact tuning to the station (within reasonable limits).

In connection with the foregoing it is a further object of the invention to provide an arrangement such that any one of a number of stations may be preselectively tuned by use of the proper one of several buttons provided for the several stations, the arrangement being such that the only operation necessary to bring a desired station into tune is the depression of the proper button to thereby cause the tuning mechanism to function to the selected station frequency, if the signals from such preselected station are coming in with proper volume or strength. In this connection, the arrangement is such that stations may be preselectively tuned which are quite close together, measured in frequency, provided the set is of sufficient selectivity to clearly tune them without interference, and provided that there is sufficient mechanical clearance between the tuning buttons needed for such proximate stations. That is to say, the arrangement is such that different stations may be preselectively tuned when they are not so close together as to make it impossible to distinguish between them in the mechanical placement of the tuning buttons.

In connection with the foregoing, it is a further object to provide an arrangement in which the tuning buttons may be adjusted back and forth without the need of using any special tools or special means for making such adjustments, so as to set the receiver to receive such different stations as may be desired. Thus, for example, in the case of an instrument which is provided with twelve tuning buttons for twelve stations, these buttons may be set back and forth into twelve station positions at one time, so that twelve different station frequencies may be selectively received, provided only that these frequencies are not too close together as already explained; and since the final tuning in the case of any station is accomplished automatically by the frequency of the station sought, the exact adjusted positions of the buttons in any adjustment is not material to ensure exact final tuning to the selected station (within limits).

Another feature of the invention is to provide an arrangement such that hand or mechanical tuning may be accomplished without interference from the preselective tuning mechanism, it being possible at any time for the user to simply take hold of the usual hand button and shift the same to whatever position he may desire for tuning a desired station, whether such station be also provided with an automatic tuning button or not. In other words, this feature

makes it possible for the user to take over manual control of the tuning at any time, either to bring in some station which is not provided with an automatic tuning button, or to bring in some station for which such automatic tuning button is provided. In any case the hand or manual tuning is performed with the same facility as would be the case had the automatic tuning equipment not been provided, and with the same accuracy of permissible tuning.

Another feature of the invention relates to the provision of an arrangement in which the automatic tuning to a preselected station is accomplished by use of instrumentalities already present in many receiving set or circuits, for detection of the instant of perfect tuning, and for the purpose of bringing the tuning equipment into response therewith. This feature relates to the use of the fact that the plate discharge current of the tubes in the radio frequency circuits varies with the tuning position, so that when the set is not tuned to receive an incoming signal such plate discharge current is of full strength, whereas, as the set is tuned to receive signals from a station the strength of this current falls as the position of exact tuning is approached, until finally the position of exact tuning is reached, whereupon such plate current is a minimum, and as the position of exact tuning is passed the plate current again rises to the full normal value, which is retained until the tuning has proceeded over to approach the next station which may be coming in with sufficient strength, whereupon the decrease of plate current again occurs to the minimum, and again rises, etc. It is thus evident that this plate current strength is an indication of the condition of exact tuning, and also that means may be provided for using such plate current strength to actuate the automatic tuning devices so as to bring about exact tuning automatically, by using the bottom of the V created by the reversal of plate current strength at the instant of exact tuning.

In connection with the foregoing, it will be evident that when tuning to a particular station from one at some relatively distant location on the tuning dial it will generally happen that various intermediate stations which are coming in with sufficient strength to cause tuning to occur, will have to be passed before reaching the station sought to be tuned, and it therefore becomes necessary to block out or cancel the effect of these intermediate stations in order to get past them and arrive at the desired destination, being the station sought. I have therefore provided means for blocking out all intermediate stations which may be on the air at the time of tuning, so that the effect of the plate current for tuning purposes will not become operative until the position of the station sought is approached closely enough to then permit the decrease of the plate current to bring about the exact tuning desired for such station. In other words, the effect of plate current tuning is eliminated until the tuning equipment has come over so close to the station sought that no intermediate station will probably interfere with the desired tuning operation, whereupon the plate current is made effective to bring about the final tuning operation with exactness.

A further feature of the invention is to provide an arrangement such that proper tuning will be accomplished from either end of the dial, and to any preselected station and in either direction of tuning, and also an arrangement such that at

no matter what setting the tuning means of the receiver may happen to be at any given instant, the receiver may be preselectively tuned to any other station in either direction, and with the desired accuracy of automatic tuning which has been heretofore referred to.

It is a further feature to provide a very simple arrangement, one embodying relatively few parts of quite simple and relatively rugged construction, and also an arrangement which can be installed at low cost in almost any of the types of receiving circuits which are in very extensive use at this time.

Other objects and uses of the invention will appear from a detailed description of the same, which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawing:

Figure 1 shows in schematic or diagrammatic form a portion of a receiving circuit having applied thereto a preselective tuning device embodying the features of the present invention.

Figure 2 shows diagrammatically a portion of the curve of plate current during the tuning operation,

Figure 3 shows a detail section through the receiver at the position of one of the tuning buttons.

Figure 4 shows a fragmentary section on the line 4-4 of Figure 3 looking in the direction of the arrows; and

Figure 5 shows a portion of a modified form of circuit in which a relay is provided for the motor current.

Referring first to Fig. 1, the receiving set is shown at 10. It includes the loud speaker 11, and the tuning dial 12, and also the usual circuits, tubes, condensers, coils, and other equipment depending on the circuit on which it is built. One of the tubes is shown at 13 diagrammatically, same including the usual filament 14, grid 15, and plate 16. The tube 13 will be understood to be one of the tubes of the regular receiving circuit, and is preferably a tube in the radio frequency portion of the circuit, and at such a position in the circuit where the plate current strength is relatively as large as possible. For example, this tube may be the last radio frequency amplifier in advance of the first detector of a superheterodyne receiver. The aerial of the receiving set is shown at 17, and the ground connection at 18.

The current flowing from the plate 16 of the tube 13, or drained therefrom, is shown diagrammatically in Fig. 2. This is the current shown by the line I_p , or designated 19. It is normally steady at a given strength above the base line 20. At the position of each station which may be momentarily on the air with sufficient strength there will be a reduction of the plate current strength as shown by the V's 21, 22, 23 and 24, corresponding to the stations Nos. 1, 2, 3 and 4, respectively. That is to say, when tuning in the direction of the arrow 25, to the right in Figure 2, as the station No. 1 is reached there will be a decrease of plate current strength into the V 21, until the condition of perfect tuning is attained, whereupon the bottom of the V is reached, whereupon the plate current strength will begin to rise again until it attains full strength, which condition is attained until station No. 2 is approached, whereupon another decrease of plate current strength occurs, etc., as shown in the figure. The amount of such decrease each time will depend largely on the strength of the incoming signals which occasion the decrease, but the de-

crease is very substantial in the case of a station to be tuned.

The tuning shaft of the receiving set is indicated at 26. This shaft is rotated to tune the receiving set in the customary manner, such rotation serving to operate the gang of condensers or other tuning means with which the set is provided. The usual tuning lever or rock arm 27 is indicated for manual tuning, the same being provided with the handgrip 28 which can be swung back and forth to rock the tuning shaft, and the usual pointer 29 is shown for giving indications over the scale 30 on which the tuning position is indicated. Thus the usual manual tuning means is provided, and the automatic means of the present invention is supplemental thereto.

On the shaft 26 there is indicated the worm wheel 31, said worm wheel being mounted on the shaft with a friction drive at the hub 32. The friction of this drive is sufficient to turn the gang tuning shaft when the worm gear is driven, but on the other hand, when manual tuning is resorted to the swinging of the arm 27 may be accomplished to rock the shaft 26, the worm gear remaining locked stationary and the friction connection permitting the necessary rocking of the shaft with respect to the worm gear.

There is provided a tuning motor 33. The same is small size, and is provided with the usual armature 34, commutator 35, and brushes 36 and 37. This motor is a direct current motor and is provided with two field windings 38 and 39. These windings are connected together at one side by the connection 40 which connection is in turn connected to the brush 36 by the lead 41. The other ends of the two windings are brought out as the leads 42 and 43. These two field windings are so wound that either one of them may be used singly, and when the current passes through one field winding the direction of motor rotation is contrary to the rotation when the other winding is used. In either case the motor acts as a series direct current motor.

The motor shaft carries the worm 44 which engages the worm gear 31. Thus the direction of swing of the tuning shaft 26 will depend on which field winding is being momentarily used.

There is provided a two part commutator including the segments 45 and 46 separated by the strip of insulation 47. These segments are connected to the terminals of leads 42 and 43 of the two field windings respectively. The commutator also includes an encircling ring of insulation 48 in which there is mounted the short contacting segment 49 opposite to one end of the insulation strip 47. The shaft of the commutator is drivingly connected to the tuning shaft 26 as indicated by the broken line 50, so that the commutator rotates in timed relation or in unison with the tuning shaft at all times. The commutator is therefore always in phase with the tuning shaft, but not necessarily with the worm gear 31 as the tuning shaft may at times be rotated relatively with respect to the worm gear, as in the case of manual tuning.

Tuning buttons are provided for as many stations as are desired to be preselectively tuned, one for each station, and for simplicity only four tuning buttons 51, 52, 53 and 54 for four stations are indicated on the drawing. Manifestly, in actual practice there may be either more or fewer stations provided for, and the number of tuning buttons will be increased or reduced accordingly. In practice also, each of these buttons may be of simple construction as indicated, so that it

must be held down in order to keep the circuit closed, or such button may be so constructed that it will remain depressed and in closed circuit condition once it has been depressed, until it is released by the depression of some other button or by a release key operated by the user. The details of such arrangements are not illustrated herein as they are not necessary to a comprehensive understanding of the present invention. Furthermore, each of these buttons is preferably carried by a stem such as 55, (see Figure 3,) which stem passes through a slot 56 in the case or panel 56' of the receiving set, and suitable securing means such as lock nuts or the like may be provided for securing each button in adjusted position, the details of which securing means are not illustrated herein as they are not necessary to a comprehensive understanding of the present invention. Each button stem 55 carries on its lower end a block of insulation 57 the position of which block is always fixed with respect to the stem 55. There is another block of insulation 58 adjacent to the block 57, and connected thereto by a pin and slot connection 59 so that the block 58 can shift slightly to either side of the medial line of the block 57. The block 57 carries a fine brush 60, and the block 58 carries a fine brush 61. The brush 60 bears against the commutator near its periphery so as to at times make contact with the segment 49, and the brush 61 bears against the commutator in position to make contact with either of the segments 45 and 46 depending on the position of rotation of the commutator. The above explained construction of the brush blocks and brushes is typical of all of the buttons indicated for the several stations to be automatically tuned. It will be understood that the circuit closing buttons shown at 51, 52, 53 and 54 may be built into or made a portion of each of the devices shown in Figures 4 and 3, or may be separate therefrom; but generally the circuit closing buttons or contacts 51, 52, 53 and 54 will be built into the heads 62 of the respective devices of Figures 3 and 4.

It will also be noted that the slot 56 around which the devices of Figures 3 and 4 are adjusted is curved or circular, and in general follows the edge portion on the commutator underneath so that the adjustments of the devices around the slot will at all times follow the edge of the commutator.

There is provided a station relay 63 which is subject to the plate current, and is actuated thereby. This relay includes the coil 64 which is connected into the plate circuit and acts on the curved armature 65. This curved armature is carried by the arm 66 pivoted at 67. A light spring 68 has one end connected to the end of a light arm 69 connected to the arm 66 so that the tendency is at all times to swing the arm 66 and the armature 65 outwardly from the coil 64, and therefore towards the right in Figure 1. Normally the full plate discharge current flowing through the coil is sufficient to draw the armature fully back into the coil as shown in Figure 1, and against the force of the light spring, but when the receiving set is tuned to an incoming station signal of sufficient strength for good reception the strength of the plate discharge current falls, as shown in Figure 2 at the V's and at such times the retaining force of the coil 64 is reduced so that the spring 68 will draw the arm 66 and armature 65 over towards the right an amount depending on the degree of such reduction.

There is provided another light arm 70 of insulating material pivoted with respect to the arm 66 so that the arm 70 may swing slightly towards and from the arm 66; and a very light spring 71 connects the arms 66 and 70 together. There is provided a limit pin 72 connected at one end to the arm 66 and working through the arm 70, so as to limit the amount of separation of the arms from each other; and the arm 66 carries a contact 73 which normally contacts the contact plate 74 carried by the arm 70, but when the two arms are slightly separated within the limit of separation allowed by the pin 72 the contact 73 breaks from the plate 74 to open the circuit.

There is provided a light friction spring member 75 of segmental form and of the same radius as the center 67, and there is a light friction extension 76 on the arm 70, which friction extension works against the friction segment 75 at all times except when the arms 66 and 70 are fully restored to the full plate discharge position shown in Figure 1. At such times the friction extension 76 moves past the friction segment 75 and is disengaged therefrom.

The arm 66 has connected thereto the line 77, and the contact plate 74 has connected thereto the line 78, such line connections being of great flexibility so as not to interfere with the free swinging of the arms as desired for the operations.

The current for the motor is delivered through the lines 79 and 80 (positive) and line 77 to the arm 66, thence through contact 73 and contact plate 74, through line 78. Line 78 connects to line 81 which connects to the brush 37 of the motor, either directly, or through the solenoid 82 of a loud speaker cut out relay 83 as shown in Figures 1 and 5. Such relay, when provided, has the armature 84, normally held away from the solenoid by the light spring 85 and against the contact 86, so that the loud speaker circuit is closed when the solenoid is not energized. However, whenever there is current flowing in the motor circuit so as to tune the receiver to a new station, the solenoid is energized and the loud speaker circuit is opened so as to kill the loud speaker, which condition continues until the motor current is interrupted, whereupon the relay 83 again closes the loud speaker circuit to deliver the program which has been tuned.

The brushes 61 of the several devices shown in Figures 3 and 4 are connected to the contacts of the buttons 51, 52, 53 and 54 by means of the lines 87, 88, 89 and 90 respectively; and the other sides of the buttons are connected to the negative or return side of the circuit 91 by suitable leads.

With the arrangements thus far described the following results and operations are possible;

Upon closing one of the buttons, for example 51, to tune a given station, the motor circuit is closed through one of its field coils, in this case the coil 39, since said coil is connected to the segment 46. The motor current flows through the contacts 73 and 74 of the relay 63, (assuming such relay to be in the full plate current discharge condition shown in Figure 1). The energizing of the field coil 39 will cause the motor to rotate in such direction as to turn the commutator in the direction of the arrow 92, thus carrying the insulating strip 47 towards the brush 61. This direction of rotation also tends to shift the brush 61 away from such insulating strip, due to the friction of the brush on the surface of the commutator. As the insulating strip approaches the position of the brush 61 the condition of

tuning is approached, and shortly before the insulating strip 47 reaches the brush 61 the V of the desired station is reached, assuming such station to be on the air with signals of sufficient strength to produce proper reception when tuning has been completed. When the V of such station is reached the armature of the relay 63 commences to move towards the right in Figure 1, and as it does so the contacts 73 and 74 remain closed together so as to continue supply of current to the motor, such supply being necessary to continue the tuning operation by the motor drive. During this outswinging of the armature of the relay 63 the friction between the friction extension 76 and the friction plate 75 insures contact of the contacts 73 and 74, and the friction of these members 76 and 75 is not sufficient to prevent the spring 68 from swinging the arm 66 outwardly.

Such outward swing will continue as long as the plate discharge current continues to fall, in other words during the descent into the V, and therefore the tuning operation will continue clear down to the condition of perfect tuning represented by the bottom of the V. Immediately thereafter the plate discharge current will commence to rise, due to ascent on the other side of the V. Such rising current will begin to draw the armature of the relay 63 back towards the left in Figure 1, and such backward movement will immediately be accompanied by a movement of the contact 73 away from the contact plate 74, due to the fact that the friction between the extension 76 and the member 75 will retain the arm 70 backwardly with respect to the arm 66, and against the force of the spring 71, thus opening the motor circuit and bringing the motor to rest at the station tuned position.

Reference to Figure 2 will show that such station tuning at the position of station #4, for example, occurs very slightly beyond the exact position of the bottom of the V since there must be a slight backward movement of the arm 66 to carry the contact 73 away from the contact plate 74, but in practice such amount of deviation from the exact bottom of the V will be small since the actual outward swing of the arms 66 and 70 may be quite large, for example as much as one inch in an instrument of workable size, and only a small backward movement will be necessary to open the circuit, for example, one thirty-second of an inch. Therefore the percentage error in tuning from the position of exact perfection will be very small.

Having tuned to one station in the manner just explained, it will be found that upon depression of the tuning button for some other station, either to the right or to the left of the one just so tuned, the operations will be similar; and the motor will rotate in the proper direction to bring about the desired tuning to such new station. In this connection, if the new station to be reached lies to the left in Figure 1, measured from the station of button 51, for example, if the new station be button 52, the direction of motor rotation will be counterclockwise as shown by the arrow 92, and will continue until the insulating strip 47 comes close to the brush 61 for the button 52. In case the newly selected station had been that for the button 53, lying to the right of the button 51 station, the direction of motor rotation would be clockwise, and would continue until the insulating strip 47 closely approached the brush 61 for such newly selected station. In each case the pin and slot connection shown in Figure 3

permits the desired amount of motor and commutator movement to take place without actually carrying the brush 61 over the insulation strip 47, for tuning to such station, but when another station is to be tuned so that another one of the brushes 61 is brought into play, the commutator will travel the desired distance for such new station, and the fact of travel of the insulation strip 47 past the position of the brush 61 for the first station will not interfere with the tuning of such newly selected station.

In the final tuning of any selected station, which final tuning is performed by the opening of the relay circuit by the relay 63 the continued rotation of the motor carries the commutator substantially to a position where the medial line of the insulating block 57 is in exact alignment with the insulating strip 47, but the brush 61 maintains contact with the commutator segment which it was contacting due to the fact that the insulating block 58 lags behind the block 57 an amount dependent on the lost motion of the pin and slot connection 59, so that delivery of current to the proper field winding of the motor continues until the end of the tuning operation.

It will now be seen that as soon as the bottom of the V of some station on the air with sufficient strength is reached and slightly passed, the motor operation will be discontinued, and therefore, with the arrangements so far described, such stopping might take place at the position of some station other than the station selected, and prior thereto, I have, however, provided means for passing any and all intermediate stations which may be on the air at the time, and continuing delivery of current to the motor until the selected station is finally reached. This means I shall now explain.

There is provided a relay 94, which may be designated as the station cut-out relay. Its function is to cut out the intermediate stations and ensure continued delivery of current to the motor until the selected station is closely approached, so that the operation of the relay 63 will be to cause station tuning at the selected station, and not at some intermediate and unselected station. This relay 94 includes the armature 95 which is normally drawn back against the contact 96 by means of the light spring 97. This relay also includes the coils 98, 99, 100 and 101, which coils correspond to the buttons 51, 52, 53 and 54 for the stations to be tuned. In other words, there is a coil for each of the tuning station buttons for which the receiver is equipped. The supply of current to any one of these coils will draw the armature back against the force of the spring 97 and open the circuit between the armature 95 and the contact 96.

The armature 95 and contact 96 of the relay 94 are bridged across the contacts 73 and 74 of the relay 63, so that when the relay 94 is closed due to non-energizing of the coils of said relay, the opening of the contacts 73 and 74 of the relay 63 will not discontinue supply of current to the motor, and thus the driving action of the motor will continue past the station which has caused the armature 95 to drop over momentarily, and the presence of such intermediate station on the air will not prevent the continued tuning action to take place. Finally, however, as the preselected station is approached, the coils of the relay 94, or rather, one of the coils thereof, will be energized so that said relay will then open its circuit, and discontinue such bridging action; and

then when the preselected station is approached, and the relay 63 permits its armature 65 to move to the right, the motor circuit will be finally opened and the tuning action will stop.

Each of the coils 98, 99, 100 and 101 of the relay 94 has one end connected to the brush 60 of the corresponding device of Figures 3 and 4, and the other end of such coil is connected to the lead 87, 88, 89 or 90 as the case may be which leads extend from the brushes 61 to the tuning button contacts. Therefore the coils 98, 99, 100 and 101, are bridged across the contacts or brushes 60 and 61 of the respective tuning buttons. The segment 49 of the commutator is connected to the positive side of the system by the lead 102 which has a flexible section for this purpose. Also, as already explained, the segment 49 lies just opposite to one end of the insulating strip 47, and preferably slightly overlies or extends past the two segments 45 and 46 so that as the commutator rotates with the tuning operation the brush 60 will come into engagement with the segment 49 before the brush 61 would override the commutator segment 45 or 46 as the case might be, and such overlap is sufficient to ensure final tuning by the relay 63 to the selected station. This action will be understood from the following explanation: Shortly before the V of the preselected station is reached the contact 69 engages the segment 49 and immediately the coil 98, 99, 100 or 101 as the case may be is energized, and the armature 95 of the relay 94 is drawn back to open the circuit between the contacts 95 and 96. This will discontinue the bridging action of the relay 94, and then when the relay 63 comes into action it will function to open the motor circuit at the proper time.

The leads for the relay coils 98, 99, 100 and 101 are shown at 103, 104, 105, 106, 107, 108, 109 and 110, respectively; and the bridging leads for the contacts 95 and 96 are shown at 111 and 112, respectively.

It should be noted that the several tuning buttons should be set as close to the correct positions within the slot 56 as may be possible corresponding to the stations to be tuned, and such setting may be within a very close approximation of the exactly correct positions. Then there will be assurance that the final tuning will be accomplished by the V of the station desired, and not some other near station. Generally, also the physical limitations of sizes of the buttons 51, 52, 53 and 54 in the slot 56 will be such as to actually prevent the attempted tuning of stations which are closer together than prohibited by the said physical limitations, unless two or more slots should be provided for accommodation of the consecutive buttons of the series. In any case, however, it will be seen that very fine or accurate final tuning will be accomplished, and that the actual final tuning operation is performed, not by the location of some fixed stop which has been placed by the user at the position which he assumes is correct, but such final tuning is performed by the incoming signal of the preselected station, and at a point which very closely approximates the point of exact perfection of the reception of the incoming signal, namely, close to the bottom of the V.

It will also be noted that in case of a shifting of the wave-length of the signal of the preselected station, with corresponding shift of frequency, the position of exact tuning will be correspondingly changed from the position of a fixed stop. Nevertheless, by the use of the present

invention the final tuning operation will take place automatically approximately at the position of the bottom of the V of the signals coming in from the so-preselected station, and therefore errors of judgment on the part of the user, and also errors of frequency (within reasonable limits) which take place in the operations of the sending station will be compensated for, and substantially exact tuning will be automatically performed by the control of the incoming signals themselves, as distinguished from a fixed stop.

I also wish to point out the fact that by the use of the variation of the strength of the plate discharge current as the preselected station is tuned it is possible to provide means for not only bringing about the tuning in the first place by use of such plate discharge current variation, but I am also enabled to provide means for maintaining the tuning to such preselected station after such original tuning has been accomplished, even though the frequency of the signals from such station may vary from time to time within considerable limits, since such variations of frequency from time to time will be accompanied by shifting of the V of such station back and forth, and means may be provided within or supplemental to the relay 63 for causing the tuning motor to follow such variations in either direction, and so to maintain the tuning to the such station unimpaired for a long interval of time, or indefinitely. Such supplemental means constitute the subject-matter of another and supplemental application for Letters Patent filed by me.

It will also be noted that in the arrangement of Figure 1, the motor current passes directly through the contacts 73 and 74 of the relay 63. Inasmuch as this relay is somewhat delicate in construction and response to the variations of plate discharge current, it may sometimes be desirable to make use of a supplemental relay which directly controls the motor current, and which supplemental relay is operated by the rather small current necessary therefor, and under control of the relay 63. I have therefore shown such an arrangement in Figure 5. In that case there is provided the relay 113 having the coil 114 which receives current through the lines 115 and 116 from the contacts 73 and 74 of the station relay 63. The relay 113 is normally open by reason of the spring 117 which draws the armature 118 over against the fixed stop 119; but when the relay coil 114 is energized by current from the relay contacts 73 and 74 due to operation of the relay 63, current is supplied to the tuning motor, and contrawise, when the relay contacts 73 and 74 of the relay 63 are opened, the contacts of the relay 113 separate and current for the tuning motor is discontinued.

In the arrangement of Figure 5 there is shown the condenser 120 across the contacts of the relay 113. This serves to take up the inductive current at the moment of opening the motor circuit, and thus reduces burning of contacts, etc. If desired, a similar condenser arrangement might be provided for the relay 63 of the arrangement of Figure 1.

While I have herein shown and described only certain embodiments of the features of my invention, still I do not intend to limit myself thereto, except as I may do so in the claims; but I contemplate the use of means to tune to a given station as distinguished to tuning to a fixed stop; and more particularly, I contemplate tuning to a preselected station by means of using the variation of discharge current of the plate

of a portion of the circuit, or some other variable current which varies from a normal or usual value at the position of tuning of each station which may be at the time on the air in strength sufficient for satisfactory tuning and reception.

I claim:

1. Means for tuning a radio receiver to a selected station having substantially a given frequency of radio frequency signals, comprising means to tune said receiver roughly to the tuning position for reception of such signals, means supplemental thereto operative to complete the tuning operation substantially to the exact frequency of the incoming signals, said last named means comprising means responsive to a change of plate discharge current of a radio frequency tube of the receiver and operative to discontinue the tuning operation substantially at the point of minimum plate discharge current of said tube.

2. Means for tuning a radio receiver to a selected station having substantially a given frequency of radio frequency signals, comprising means to tune said receiver roughly to the tuning position for reception of such signals, means supplemental thereto operative to complete the tuning operation substantially to the exact frequency of the incoming signals, said last named means comprising means responsive to strength of plate current of a radio frequency tube of the receiver in comparison to the normal plate current of such tube and operative to discontinue the tuning operation substantially at the point of minimum plate discharge current of said tube.

3. Means for tuning a radio receiver to a selected station having substantially a given frequency of radio frequency signals, comprising means to tune the receiver roughly to the tuning position for reception of such signals, means supplemental thereto operative to complete the tuning operation substantially to the exact frequency of the incoming signals, said last named means comprising means responsive to strength of plate discharge current of a radio frequency tube of the receiver in comparison to the normal plate discharge current of such tube and operative to discontinue the tuning operation substantially at a point of reversal of changing value of said plate discharge current.

4. Means for tuning a radio receiver having a single tuning device to a selected station from a position of complete non-tuning for such station, comprising means for operating the tuning device in the direction of reception of signals from such station, means for discontinuing operation of the tuning device at the position of the frequency of signals from such station, automatically by use of variation of plate discharge current of a tube of such receiver, and means for making ineffective said discontinuing means for the tuning device positions of all stations intermediate between the position of commencement and a position in close proximity to the position of exact tuning for the selected station.

5. Means for tuning a radio receiver to a preselected station from a non-tuned position, comprising in combination means for shifting the tuning devices towards the preselected station, said means including current operated devices, two switch members for delivering current to such shifting means, said switch members being connected in parallel with each other, one of said devices being a signal relay and the other being a station cut-out relay, means for actuating the signal relay at the position of reception of sig-

nals from each station intuned during the shifting of the tuning devices, the station cut-out relay being normally in closed circuit position, and means for actuating the station cut-out relay just prior to reaching the position of perfect tuning of signals from the preselected station.

6. Means for tuning a radio receiver to a preselected station from a non-tuned position, comprising in combination means for shifting the tuning devices towards the preselected station, said means including current operated devices, means under control of the shifting devices for discontinuing delivery of current to the shifting devices shortly prior to reaching the position of perfect tuning for signals incoming from the preselected station, other means for delivering current to the shifting devices, and means responsive to the signal received from stations tuned during the shifting operation for discontinuing delivery of current to the shifting devices by said other means, and operative substantially at the position of perfect tuning for signals incoming from each station so tuned during the tuning operations.

7. The combination in a radio receiving apparatus provided with a plurality of electron discharge tubes for amplifying and detecting signal currents and with only a single adjustable tuning means capable of tuning the apparatus to a plurality of signal frequencies, of a plurality of selector switches, each representing a different predetermined signal frequency, an electrical motor energized in response to the actuation of a particular selector switch for adjusting the tuning means to the predetermined signal frequency represented by the actuated selector

switch, and means controlled by signal currents in a circuit of one of the above mentioned discharge tubes for rendering the motor inoperative substantially at the instant of proper tuning means adjustment.

8. The combination according to the invention defined in claim 7 together with electromagnetic means connected in series with the motor circuit and controlled thereby for rendering the loudspeaker of the receiver inoperative as long as the motor circuit remains energized.

9. The combination in a radio receiving apparatus provided with a plurality of electron discharge tubes and with adjustable tuning means capable of tuning the apparatus to a plurality of signal frequencies, of a plurality of selector switches, each representing a different predetermined signal frequency, an electrical motor energized in response to the actuation of a particular selector switch for adjusting the tuning means to the predetermined signal frequency represented by the actuated selector switch, a pair of contacts controlled by an electron tube circuit of the apparatus for opening the motor circuit substantially at the instant of proper tuning means adjustment, said pair of contacts adapted to be alternately opened and closed upon successive operation of several selector switches representing non-adjacent signal frequency channels resulting in interrupted periods of motor operation, and relay means shunted across said pair of contacts operative to provide uninterrupted motor operation when selector switches representing non-adjacent signal frequency channels are operated successively.

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