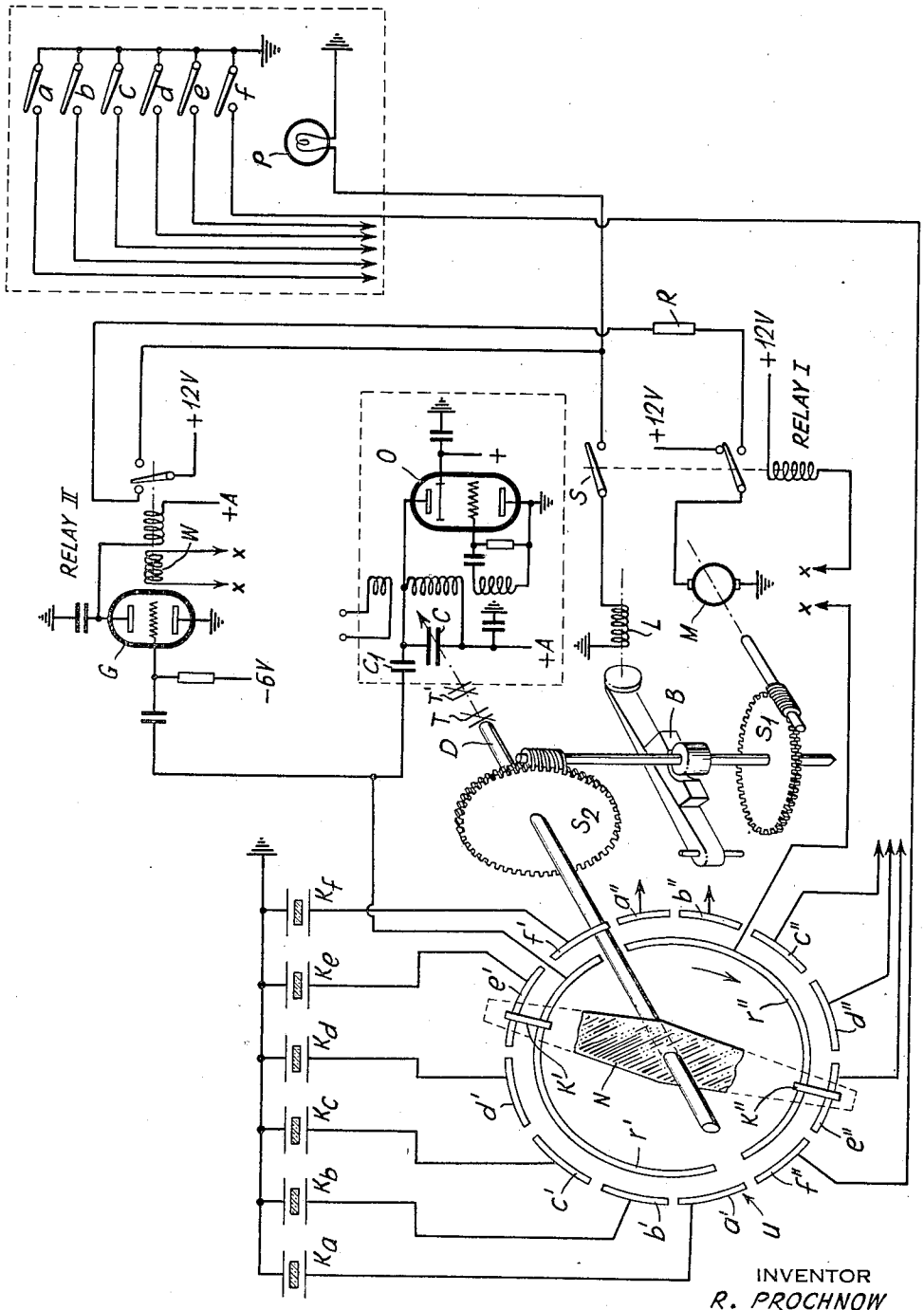
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TUNING ARRANGEMENT WITH SELECTIVE SETTING OF PREDETERMINED FREQUENCIES

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TUNING ARRANGEMENT WITH SELECTIVE SETTING OF PREDETERMINED FREQUENCIES

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In many instances it is desirable to have radio apparatus receive signals from only a small number of particular transmitting stations and to carry out the tuning adjustment or setting without the necessity of cumbersome manipulation.

In order to provide an automatic selective setting to predetermined frequencies, so-called "push-button receivers" have already been proposed in which the circuits of the receiver instead of being continually tuned are tuned in steps through successive switching-in of block condensers or coil parts. In a receiver having several circuits, this kind of setting would become extremely complicated, so that in many cases it cannot be used. In a receiver in which the tuning means is constituted by variable condensers which are uni-controlled and adjustable by rotation, it is known that the tuning adjustment to certain predetermined transmitters can be facilitated by replacing the usual manual operating knob with certain mechanical stopping means. In such receiver however, the tuning means undergoes unavoidable thermic changes resulting in a drifting of the frequency corresponding to the tuning adjustment occasioned by the mechanical stopping means. A prevailing accurate adjustment to the carrier wave of the transmitter desired to be received is not possible without resorting to frequent subsequent calibration or compensating adjustment.

These disadvantages are avoided in a tuning arrangement, in accordance with the invention, in which the oscillations appearing in the tunable circuits are passed across filter or resonance circuits fixedly tuned to a respective predetermined frequency and selectively usable for the automatic setting, and the resonance jump of the oscillation amplitude serves for releasing the arrangement effecting the slowing up or stopping of the variable tuning means.

An example of construction is shown in the accompanying drawing which is to be considered only as a diagrammatic showing. Herein is shown a superheterodyne receiver having a high sensitivity whose tuning is varied by variable condensers T, T' of one or several preliminary circuits (not shown) and condenser C of the oscillatory circuit of the local oscillator O. The variable condensers may be mounted on a common shaft connected with the drive shaft D. For the setting, the shaft D is coupled with the motor M across the two worm drives S_1 and S_2. For establishing the "stopping points" six oscillatory quartz crystals K_a, K_b . . . to K_f are used. The natural frequencies of these six crystals correspond to the carrier frequencies of six fixed transmitters in the sense that the natural frequency of each quartz crystal is equal to the frequency of the local oscillator at exact tuning of the receiver to a definite transmitter to which this quartz crystal has been assigned; in other words the said natural frequency is spaced from the carrier frequency of said transmitter a frequency interval which is equal to the intermediate frequency.

The effect of these quartz crystals is such, when the receiver is adjusted to resonance, that they short-circuit the oscillator oscillations transferred from the anode of the local oscillator O to the grid of the detector tube G connected in detector circuit, whereby the switching contact of the relay I is moved from the position shown into the opposite position. Consequently, the circuit for the displacement motor M will be interrupted across the resistor R and at the same time the relay coil L of the electromagnetic brake B receives current. However, this action occurs only when the switching contact of the relay I and the switching contact S coupled herewith are in the lower position. In the opposite position the circuit for the electromagnetic coil is interrupted by the switch S while the motor M is placed directly at the positive pole of a voltage source of, for instance, 12 volts whose negative pole is grounded.

The proper coaction of the relays is effected by the rotary switch U containing two sets of six contact segments each, numbered a' to f' and a'' to f'', two half ring contacts r' and r'' and the double sliding contact N mounted on the drive shaft D. In each switching position the gliding contact K' connects an upper segment with the upper ring r', thereby placing a quartz crystal between the transmission line passing from the oscillator to the detector G and to ground. In each switching position, the gliding contact K'' connects a lower segment with the lower ring r'', and closes thereby the circuit for the relay I across a definite switch among the six selective switches a to f. These selective switches may take the form of any suitable push-button switches, and preferably such that when operating any one switch the previously operated one is automatically released from its operated or closed position.

The six contact segments appearing in two series need not have identical sizes. A single segment is to be so arranged that one of the frequencies to be adjusted to lies approximately in the center of the tuning range defined by the segment.

The functioning of the arrangement can be

readily understood. When switching in a main switch (not shown) the receiver may be connected and the displacement motor M may start moving. It may be assumed that the rotors of the variable condensers afford a continual rotation in the same direction; or else in the case where the rotors are movable through only approximately 180° it is necessary that at the ends of the range the motor be automatically reversed.

For instance, if the listener desires to hear a certain transmitter he may depress the key *f*. The gliding contact N may then happen to be upon the segments *e'* and *e''* as shown, and hence the quartz crystal K_e switched in, and in a definite position corresponding to the accurate tuning to the transmitter appertaining to the selector *e*, the relay II will be released for a moment. Since, however, the relay I is without current, the displacement motor continues moving. Only when the segments *f'* and *f''* are reached does the relay I respond, closing on the one hand the contact S and disconnecting on the other hand the direct connection between the positive pole of the 12 volts D. C. source and motor M which will now be excited across the relay switch II and the resistor R, therefore continuing to move at greatly reduced speed. Now, as soon as the oscillator frequency is equal to the natural frequency of the quartz crystal K_f, the relay II will be released from the position shown so that the motor will be disconnected and the electromagnetic brake switched in. At the same time the indication bulb P will be illuminated.

The accuracy of the setting can be brought to a very high degree, since the natural frequency of the quartz crystal can be accurately established and maintained constant, and the resonance curve is very pointed or peaked. The danger due to the rotary shaft D continuing to move over a substantial distance following the braking moment of the detector tube G can be overcome by choosing a very short response period of the relay II and of the electromagnetic brake, while the reduced speed of the motor determined by the resistor R, and after all the rotary masses of the entire drive arrangement, are maintained very small. It is suitable furthermore to insert between the motor armature and the condenser shaft ahead of the magnetic brake a yieldable coupling in which the energy of movement of the rapidly rotating drive shaft will be dissipated. Eventually, the coupling may also be so designed that it will be decoupled automatically at the same time in which the braking sets in.

As soon as the oscillator frequency deviates from the natural frequency of the quartz crystal K_f, due to a frequency variation of any cause, the contact of relay II will be closed again and the motor drive will again start automatically. If this condition is to be avoided a second winding W may furthermore be arranged as shown for instance on the relay II, and which is connected in series to the relay coil I. However, the direction of the winding is to be so chosen that the field of the auxiliary winding weakens that of the main winding of the relay II such that the field of the main winding passed by the plate current of the detector tube G will just be high enough to hold the contact, but not so high that the latter will be closed again once it is released. In this way an automatic re-starting, following the completion of the setting, is rendered impossible.

Only when another selector such as *b* for instance, is depressed, will the selector contact *f* be released so that the relay I and the auxiliary winding W will no longer have current. Consequently, the brake B will be released, the motor starting again at normal speed, whereby the relay II is rendered sensitive again and responds to that the setting performance begins anew.

The arrangement of the details represented in the circuit diagram may in an airplane receiver be chosen for instance in the following manner. The instrument board is equipped with the setting arrangement, the latter containing only the six selector switches *a* to *f* and furthermore the main operating switch, the telephone connection and an operating means for the tone correction in the case of telegraphy reception, not shown in the figure. The oscillator obviously is arranged in the receiving apparatus. The other parts may also be built into the receiver or combined within a separate control apparatus set up directly adjacent the receiver, and mechanically connected in combination with the latter through the shaft coupling of the drive shaft D with the shaft of the variable condenser, while electrically coupled by means of the connection carrying the oscillator oscillations. Receiver and control apparatus may be mounted at any suitable place of the airplane, and remotely controlled from the instrument board in the manner explained.

In place of quartz crystals obviously also oscillatory circuits, possibly without losses and consisting of fixed capacitances and inductances, may be provided. These circuits may likewise be constructed for a very high constancy by using suitable parts, and as compared with the quartz crystals they have the advantage of lower cost.

In the present arrangement the oscillator frequency was resorted to as criterion for the tuning to the desired fixed frequency. It is obvious that also the received oscillations may be used accordingly. The use of the oscillator wave on the one hand has the advantage that the available voltage always has the same and rather large amplitude, while on the other hand it affords a tuning to a definite transmitter also at times in which the latter is not in operation. This feature is of great importance in many cases.

The arrangement according to the invention may also offer advantages where the shaft of the tuning means is operated by hand. The correct setting may for instance then be indicated in that the further turning of the operating knob suddenly meets resistance owing to a braking action. Also in this way a setting to certain, predetermined transmitters can be essentially facilitated.

Finally, the principle of setting in accordance with halting positions may also be applied in a similar manner to the remote operation of transmitters.

What I claim is:

1. A radio receiver having variable tuning means, a plurality of manually operated selector keys, a motor under the control of said selector keys for effecting adjustment of said variable tuning means to one of a plurality of predetermined broadcasting stations, selector switch mechanism electrically connected to the selector keys, and a plurality of frequency responsive means each corresponding to one of the selector keys also associated with the selector switch mechanism, said selector switch mechanism being operatively connected to the variable tuning

means and under the control of said motor for determining the desired tuning means adjustment.

2. A radio receiver having variable tuning means, a plurality of manually operated selector keys, a rotary switch mechanism operatively connected to the variable tuning means, electrical connections between the selector keys and the rotary switch mechanism, a motor under the control of said selector keys and the switch mechanism for effecting adjustment of said variable tuning means to one of a plurality of predetermined broadcasting stations, a plurality of frequency responsive means each corresponding to one of the selector keys associated with the switch mechanism, the position of the rotary switch determining which of the frequency responsive means is effective, and means under the control of the frequency responsive means which is effective for deenergizing motor at substantially the desired tuning means adjustment.

3. A radio receiver having variable tuning means, a motor for selectively and automatically actuating said tuning means to definite settings which correspond to predetermined broadcast stations, a selector mechanism having two series of fixed contacts each series arranged in an arc of a circle, a contact arm movable with the tuning means and adapted to successively contact the contacts of one series and simultaneously the corresponding contacts of the other series, a sharply selective circuit connected to each contact of one series, said circuits being responsive to different frequencies, a manually operated selector key connected to each contact of the other series, means under control of the selector key contacts operative upon a rough adjustment of the tuning means to a predetermined selected station for reducing the speed of the motor, and means under control of the contacts connected to said circuits operative upon the fine adjustment of the tuning means for breaking the motor circuit.

4. In a radio receiving set, mechanism for automatically adjusting the set to one of a plurality of predetermined transmitting stations, comprising means for receiving radio frequency oscillations, means for producing local oscillations, means for tuning said receiving set to render it responsive to received radio frequency oscillations from a selected predetermined station, and means including a plurality of sharply-tuned resonant circuits each responsive to a different predetermined locally-produced oscillation frequency for controlling said tuning means.

5. In a radio receiving set, mechanism for automatically adjusting the set to one of a plurality of predetermined transmitting stations, comprising means for receiving radio frequency oscillations, means for producing local oscillations, means for tuning said receiving set to render it responsive to received radio frequency oscillations from a selected predetermined station, and means including a plurality of piezo-electric crystals each responsive to a different predetermined locally-produced oscillation frequency for controlling said tuning means.

6. A radio receiver of the superheterodyne type having a first detector and a local oscillator, mechanism for automatically adjusting the receiver to any one of a plurality of predetermined stations, comprising means for varying the frequency of the local oscillator, and control means associated with said local oscillator frequency varying means including a plurality of piezo-electric crystals each responsive to a different predetermined local oscillator frequency for controlling said varying means.

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