July 29, 1941. G. SMITH 2,251,075

RADIO RECEIVER

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Fig. 1.

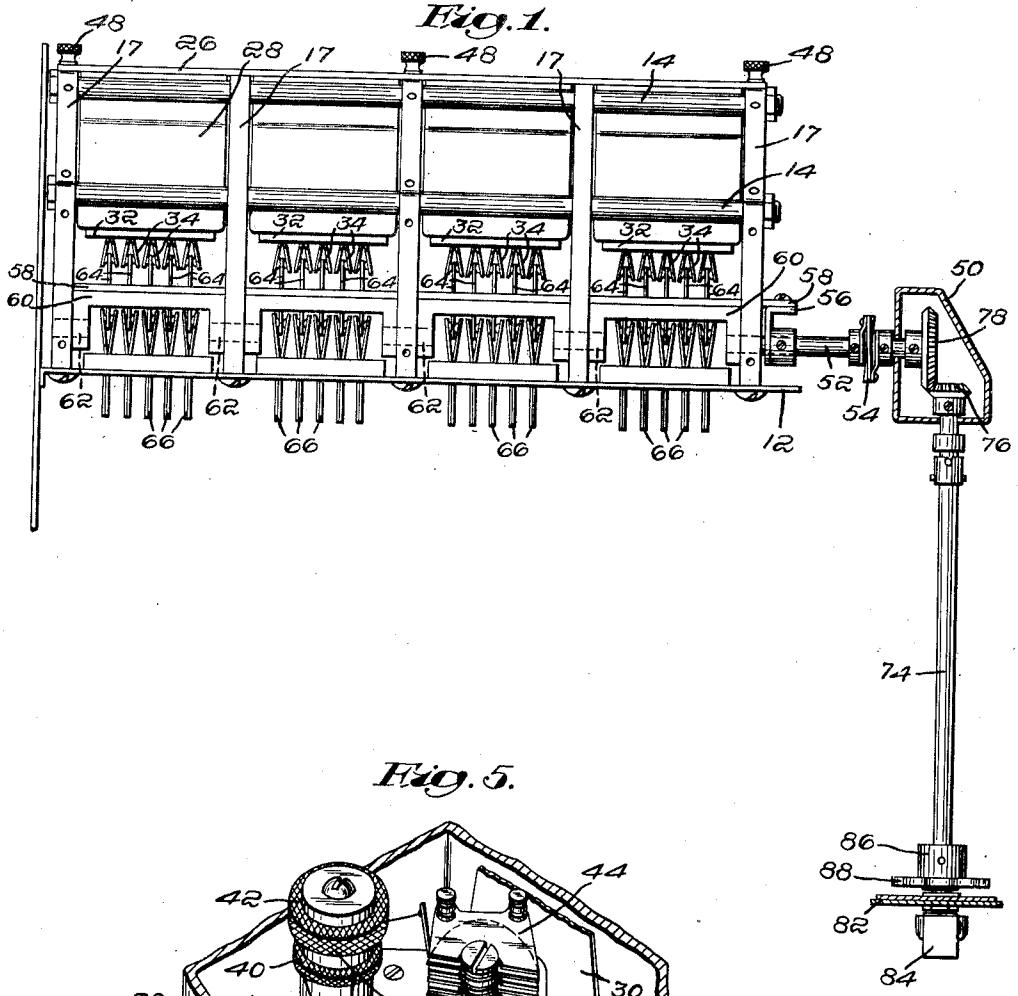

Fig. 5.

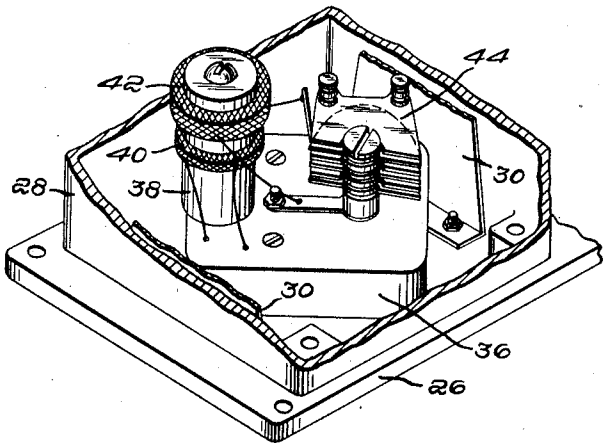

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Fig. 2.

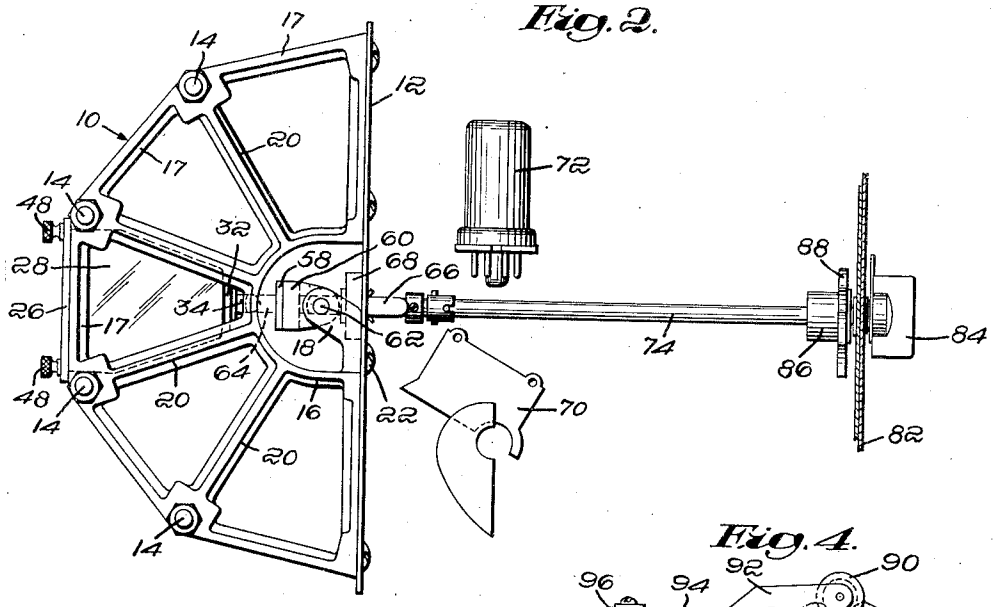


Fig. 4.

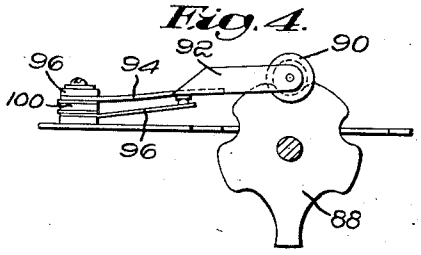


Fig. 3.

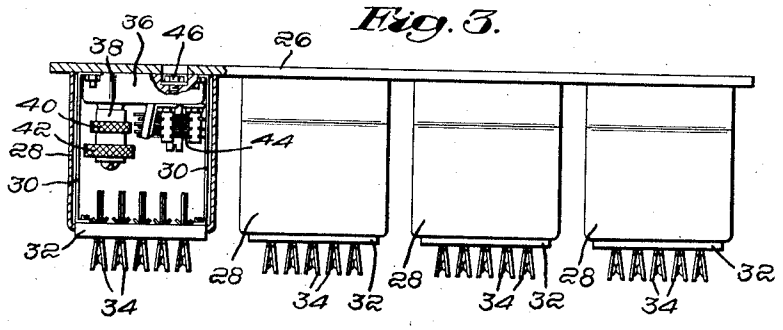
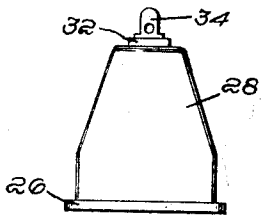


Fig. 6.



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RADIO RECEIVER

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Fig. 7.

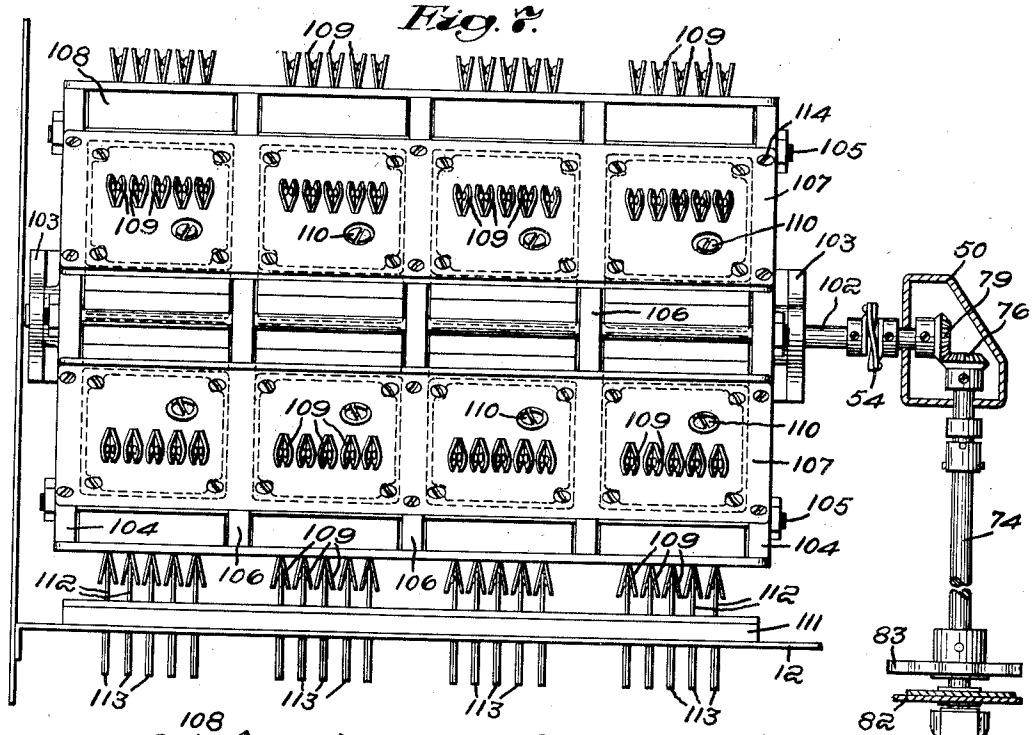

Fig. 8.

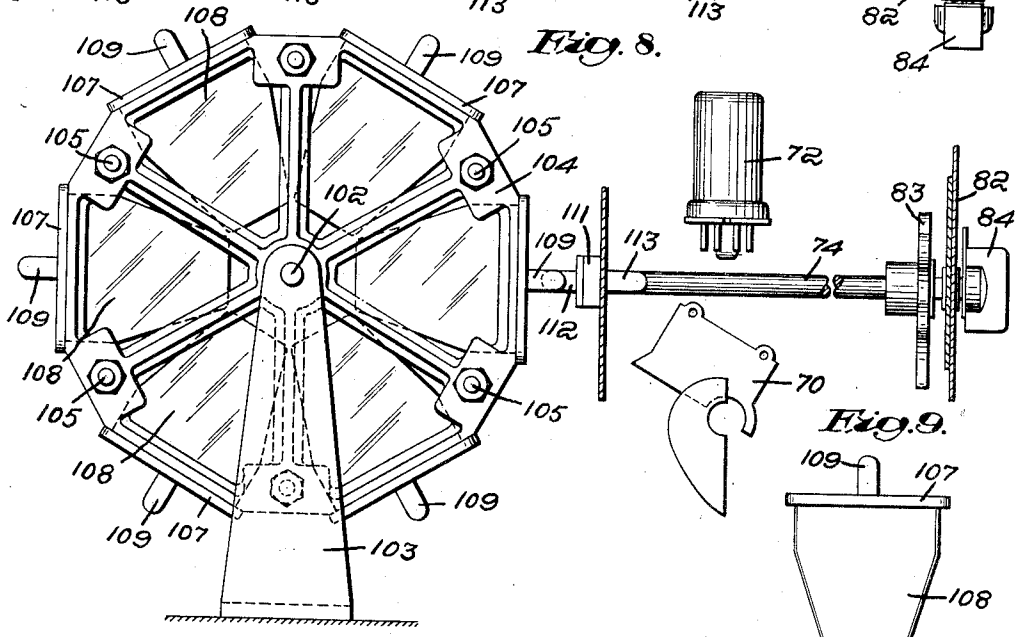

Fig. 9.

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Patented July 29, 1941 2,251,075

UNITED STATES PATENT OFFICE

2,251,075

RADIO RECEIVER

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Application July 11, 1939, Serial No. 283,854

3 Claims. (Cl. 250—40)

This invention relates to radio receivers and in particular consists in a novel mechanism for changing the coils in a receiver in order to shift from one frequency band to another.

Modern communication receivers are designed to be operated with interchangeable sets of coils so that one receiver can cover a wide range of frequencies by being connected to different sets of coils for the different frequency bands.

It is important that the leads connecting the tubes, coils, and tuning condenser be as short and direct as possible and also of constant characteristics. At high frequencies the inductance of the leads will be appreciable in comparison with the coil inductance, so that any change in the inductance of the leads due to a change in the position of the leads or switch parts will seriously affect the calibration of the receiver. Furthermore, the distributed capacity of the leads is in parallel with the tuning condenser, so that it must be held to a low value to avoid reducing the tuning range. In addition, the inductance and capacitance contributed by the leads will not be as low in losses as that provided by the coils and condensers, so that it is desirable to concentrate all the inductance in the coils and all the capacitance in the condensers, so far as possible, in order to achieve high selectivity.

The ordinary communication receiver is provided either with accommodations for one set of plug-in coils, in which case there may be as many as 50 sets which may be employed in order to cover a wide range of frequencies, or with four or five sets of coils permanently built into the receiver with mechanism for switching from one set of coils to another. In the first instance the receiver is flexible but inconvenient to operate, since one set of coils must be removed and another set inserted whenever the range of frequencies is to be changed. In the latter instance the range can be changed easily, but the receiver is limited to the range of frequencies attainable by the sets of coils built into it.

The most important object of my invention is to provide a receiver equipped for holding a substantial number of easily removable sets of coils together with mechanism for switching from one set to another. With this novel combination, it is possible to insert in the receiver a number of sets of coils which will cover all the frequency ranges used for a certain type of operation such as amateur bands, airline communication bands, etc. However, the sets of coils can be easily and quickly replaced with a number of different sets of coils permitting operation of another type. In other words, my invention results in a receiver combining the advantages of the plug-in coil receiver and the receiver employing a limited number of built-in sets of coils.

Another object of my invention is to provide adequate stage shielding. For this purpose I provide individual shields for each coil to prevent feed back and general instability between the various stages of the receiver. Furthermore the shields are adequate to prevent disconnected coils from affecting the coils connected in the circuit, when the natural frequency of a disconnected coil is approached.

One important feature of the invention resides in mechanism for changing the coils, or switching to different bands, utilizing leads which are not only short but are also of uniform length. Another feature of the invention resides in coils so placed that the trimmer condensers associated with them can be easily adjusted with a socket wrench while the coils are in operation.

An important advantage of my novel construction is that a number of sets of coils covering certain frequency ranges can be inserted in the receiver and selectively connected in the circuit and yet be easily replaced with other sets of coils covering different frequency ranges.

These and other features of the invention will be more readily understood and appreciated from the following detailed description of a preferred embodiment thereof, selected for purposes of illustration and shown in the accompanying drawings, in which:

Fig. 1 is a plan view of portions of a receiver including the coil holders, rotary switch member and circuit contacts,

Fig. 2 is an end view of the support for the sets of coils and showing diagrammatically the location of the condensers and tubes,

Fig. 3 is a plan view of a coil holder sectioned in part to show the disposition of one of the coils,

Fig. 4 is a view in end elevation of the cam controlled switch member,

Fig. 5 is a view in perspective of a coil mounted in its shielded holder,

Fig. 6 is a view in end elevation of one of the coil holders,

Figs. 7 and 8 are respectively plan and end elevation views of a modified mechanism, and

Fig. 9 is a view in end elevation of one of the coil holders used with the modified mechanism.

Before proceeding to a description of the drawings, I wish it to be understood that the circuit used in the receiver forms no part of the invention and that I contemplate the use of any cir-

cuit or types of coils which may be conveniently employed by those skilled in the art.

The coil holding structure is designed to be permanently secured to the chassis of the receiver and, as shown in Figs. 1 and 2, includes a semi-cylindrical skeleton frame of cast aluminum or other suitable material indicated generally by the reference numeral 10. The frame 10 presents a series of longitudinally disposed receptacles consisting of a plurality of transverse sections or pockets spaced and secured together by longitudinal struts 14, and each section comprises a semi-circular hub member 16 from which an apertured bearing 18 extends inwardly and from which radial spokes 20 extend outwardly, being joined at their outer ends by the struts 14 and by lateral spaces 17. Two of the spokes 20 are vertical and are tapped in four places so that they may be secured to a partition 12 which is part of the chassis of a receiver. The bearing 20 is also tapped for a securing screw 22 which provides further anchorage for the frame 10 against the partition 12.

The frame 10 illustrated in Figs. 1 and 2 provides accommodations for five sets of four coils each. The gangs of coils are assembled in holders each consisting of a base plate 26 to which are screwed four shields 28 of aluminum, or other suitable material, forming wedge shaped compartments open at their small ends. Two U-shaped sheet metal supports 30 are screwed to the base plate 26 inside each compartment 28 and at their upper ends support a block 32 of Bakelite or other insulating material apertured to receive four sets of contact members 34. The blocks 32 just fill the open ends of the shields 28.

Within the shields 28 and secured to the base plate 26 are a series of coils, one of which is shown in Fig. 5, consisting of an insulated base 36, a form 38 (upon which is wound a primary coil 40 and a secondary coil 42), and a trimmer condenser 44 to which the terminals of the secondary coil 42 are connected. No further details of the coil construction are necessary here inasmuch as the coils themselves form no part of the invention. It should be stated, however, that the condenser 44 may be adjusted by turning a nut 46 on the end of the rotor shaft of the condenser.

The nut 46 is located on the bottom of the base 36 and a hole is provided in the base plate 26 so that the condenser 44 may be adjusted from the outside of the shield 28 while the coil is in operation. The coil holders are held in the frame by thumb screws 48 which secure the base plate 26 to the lateral spacers 17.

Secured to the partition 12 adjacent one end of the frame 10 is a gear box 50 one side of which provides a bearing for a shaft 52 which carries a crank 56 on its outer end, a universal joint 54 being employed to provide for angular adjustment of the shaft 52. A long bar 58 of Bakelite is arranged axially in the frame 10 and is connected at one end to the outer end of the crank 56. Secured at spaced intervals to the bar 58 are four short U-shaped blocks 60 also of Bakelite and provided with apertures engaging pivot pins 62 passing through the bearings 18. The bar 58 and the blocks 60 are apertured to receive contact members 64 which extend outwardly on both sides of the bar 58 and the blocks 60. On one side the ends of the contacts lie in the axis of rotation of the pins 62 and the shaft 52. The assembly of the blacks 60 with the bar 58 and the pins 62 and the contacts 64 may conveniently be termed a "switch member" 55. These ends are constantly connected to other contacts 66 which are held in short blocks 63 of Bakelite which are secured to the partition 12, the latter being provided with holes through which the other ends of the contacts 66 pass.

It will be understood that when the shaft 50 is rotated, the outer ends of the contacts 64 are turned from one line of coil contacts 34 to another. The contacts 64 may be termed circuit contacts since fixed leads connect them with the variable tuning condensers, tubes, and other elements in the receiver. A condenser 70 and a tube 72 are shown diagrammatically in Fig. 2 and their location illustrates how closely they can be associated with the circuit contacts 64 and thus with the coil contacts 34. Furthermore the length of the leads from the coils to the circuit contacts 64 is uniform for all coils and for all sets of coils.

For controlling the movement of the shaft 52 a shaft 74 is provided. At one end the shaft 74 carries a bevel gear 76 located in the gear box 50 and in mesh with a larger bevel gear 78. The other end of the shaft 74 extends through the front wall 82 of the receiver and carries a handle 84.

Inside the wall 82 and secured on the shaft 74 is a hub 86 carrying a disk 88 divided at its edge into a plurality of segments providing an insulating cam surface for a roller cam follower 90. The cam roller 90 is journalled in one end of an arm 92 which is U-shaped in cross section and secured to a spring contact member 94. The other end of the arm 94 is fast under a post 96, and another spring contact member 98 is also secured to the post 96 but insulated from the arm 94 by an insulating washer 100. The spring contacts, which may be in the plate power circuit, are closed except when the roller 90 is on the high portions of the cam track on the disk 88, at which times the contacts are forced apart.

While not essential to the operation of the receiver, the use of the cam operated switch is a very desirable feature. For example it is poor practice to open the grid circuit of an electronic tube while power is applied to the plate as it is injurious to the cathode. In shifting from one range to another the grid circuit of the first detector tube would be open while the switch member was passing from one set of contacts to the next, for example, and the switch described would automatically shut off plate power during the transition. Furthermore, such a switch can be arranged to prevent undesirable noise in the loudspeaker or earphones during the switching operation, since it can operate at any convenient point in the power supply circuit, for example, in the lead from the rectifier tube in which case the power supply filter would protect the receiver circuits from surges when the switch was opened.

The roller 90 also acts as a detent to cause the shaft 52 to come to rest when the contacts 64 are in precise connection with one set of contacts 34. When it is considered that some receivers can be tuned appreciably when the switch control knob is moved slightly, it will be obvious that the detent action of the roller 90 is important in maintaining exact calibration. Furthermore the effect of any slight variation in the detent action is minmized by the design of the switch contact arms which keeps the path of the current substantially unchanged.

Now that one embodiment of my invention has been described in detail it will be apparent to those skilled in the art that, in one aspect, the

salient features of my invention consist in the frame 10 providing a series of parallel sectioned pockets converging toward a common longitudinal axis at which is provided a rotatable contact member arranged to be selectively engaged with contacts presented to the axis by the sets of coils held in the frame. This structure combines the flexibility of a receiver using plug-in coils with the coil shifting ease of a receiver equipped with a plurality of built-in coils.

The pockets, as will be understood, are defined by the radial spokes 20, the longitudinal struts 14, and the lateral spacers 17 and these pockets converge inwardly toward the longitudinal axis of symmetry of the frame. The coil holders and coils are complete, self-contained units arranged to be conveniently slipped into or removed from the respective pockets. They are removably retained in place by the thumb screws 48 and can be easily and quickly replaced by other sets of coils so that one receiver can cover an extremely wide range of frequencies.

It is also important to note that each coil in each set is carefully and completely shielded by the wedge shaped compartments 28 in which it is enclosed so that feed back and general instability due to coupling between the various stages of the receiver is effectually prevented.

A second embodiment of my invention is illustrated in Figs. 7–9. This differs from that already described principally in that the frame or cage containing the removable coil holders, instead of being stationary and associated with a rotatable switch member, is itself rotatable and associated with a stationary switch member located adjacent to its periphery instead of its axis.

The rotatable frame is supported in the chassis of the receiver upon a horizontal shaft 102 extending between a pair of upstanding bracket members 103 and comprises skeleton end spiders 104 of substantially hexagonal shape spaced and connected by longitudinal rods 105. Three intermediate spiders 106 divide the frame into four transverse sections, the construction of the frame being such as to provide six longitudinal pockets spaced radially about the shaft 102 as an axis. The shaft 102 is interrupted to receive a universal joint 54 and carries at its outer end a bevel gear 79 meshing with a second bevel gear 76 and both enclosed in the gear box already referred to in Fig. 1. The mechanism for rotating the shaft 102 and the frame carried thereby is identical to that already described in connection with the rotation of the switch shaft 52 except that in this instance a cam disk 83 having six notches is provided in place of the five-notched disk 88 shown in Fig. 4. Each one of the notches in the disk 83 corresponds to one of the six longitudinal pockets in the rotatable frame and cooperates with a follower cam roll 90 to register one of these pockets in horizontal position as shown in Fig. 8 and to interrupt momentarily the power supply circuit during the transition of the frame from one position to another.

The equipment for the mechanism shown in Figs. 7 and 8 includes an assortment of holders each comprising a base plate 107 carrying four shields 108 forming wedge shaped compartments in each of which is enclosed a coil and trimming condenser of the same general construction as illustrated in Fig. 5 except that the terminals 109 project outwardly from the base plate 107 instead of through the small end of the shield. Moreover the adjusting screw 110 for each condenser is arranged in registration with an opening in the base plate 107 so that it may be conveniently reached from outside the apparatus for adjusting the condenser as may be required.

The switch member cooperating with the rotary frame comprises a stationary bar 111 disposed longitudinally and located adjacent to one side of the rotary frame at substantially the level of its shaft 102. The switch bar 111 is provided with a series of inwardly extending contact blades 112 each of which is arranged to receive one of the contacts 109 when the frame is rotated to make the connection. The switch bar 111 is also provided with a series of corresponding outwardly extending contact blades 113 for connection with the circuits of the receiver.

As in the construction of Figs. 1 and 2 the coil holders are removably secured in their respective pockets by screws 114 threaded into the endmost spiders 104. Accordingly by removing its four screws anyone of the holders may be slipped out of its pocket and replaced by another holder having a set of coils for a different band of frequencies. Thus six coil holders of four coils each are at all time available and any selected holder may be brought into operative position by turning the handle 84. On the other hand any one or all of the holders in the frame may be removed and others substituted according to the band of frequency in which the receiver is to be used.

In both illustrated embodiments of the invention all the contacts are short and of uniform length, as previously stated, and the trimmer condensers associated with the coils may conveniently be adjusted through the apertures in the base plates of the coil holders while the coils are in operation. Finally, the provision of the cam-actuated switch results in a more efficient and generally satisfactory receiver.

Radio is a field which is famous for infinite variation, and my invention is broader in scope than might be gathered from an inspection of the drawings. The frame 10 of Fig. 1 as shown provides accommodations for five sets of four coils each (three R. F. coils and one oscillator coil) and the frame of Fig. 7 provides for six sets, but the number of sets and the number of coils in each gang is a matter of choice and may be varied according to the type of receiver with which they may be used.

Having thus described and illustrated my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A coil shifting mechanism for radio receivers, comprising a supporting frame providing parallel series of pockets, means for holding a plurality of coils in said pockets with their inner ends converging to a common axis, contacts extending to the axis from the coils, circuit contacts disposed adjacent said axis, and a long bar of insulating material provided with through and through contacts and rotatable in said axis, one end of the contacts in the bar being constantly connected to said circuit contact, and the other end of the contact in the bar being arranged selectively to engage the contacts extending from the coils.

2. A coil shifting mechanism comprising an arcuate frame providing a series of pockets, means for holding a plurality of coils in said pockets with their inner ends converging to a common axis, contacts extending toward the axis from the coils, circuit contacts disposed in said axis, a long bar of insulating material disposed for rotation about said axis, a series of contacts disposed in said bar and protruding from both sides

thereof, one end of each contact in the bar being constantly engaged with one of said circuit contacts, and the other end of each contact in the bar being arranged selectively to engage the contacts extending from the coils.

3. A coil shifting mechanism for radio apparatus, comprising a supporting frame having members defining a series of parallel wedge-shaped pockets, a series of wedge-shaped coil holders maintained in said pockets and provided with contacts extending toward the axis of the frame, a series of circuit contacts secured to the frame adjacent the axis thereof, a plurality of U-shaped blocks of insulating material mounted for rotation about the axis of the frame, a long bar of insulating material secured to said U-shaped blocks, a crank secured to said long bar, and through and through contacts secured in and passing through said U-shaped blocks and said long bar, one end of each of the latter contacts being constantly engaged with one of said circuit contacts and the other end arranged selectively to engage the contacts extending from said coil holders.

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