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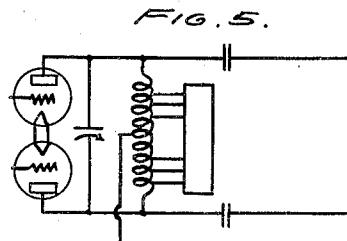
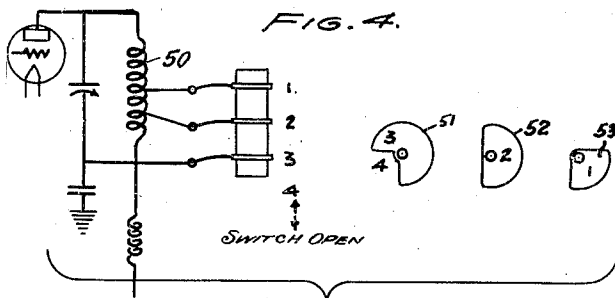
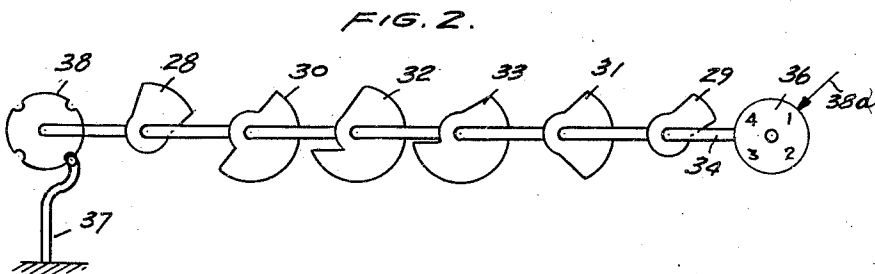
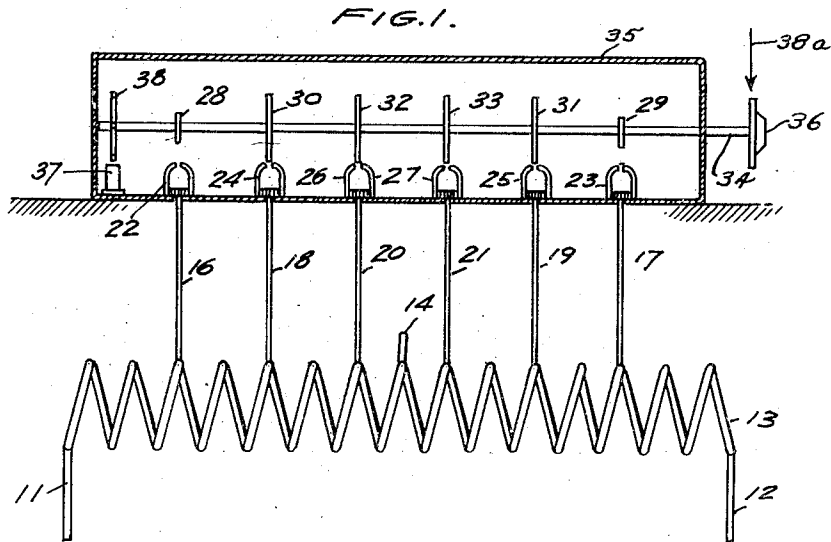
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2,493,746

SHORTING SYSTEM FOR RADIO COILS

Filed Aug. 3, 1945

2 Sheets-Sheet 1



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FIG. 3.

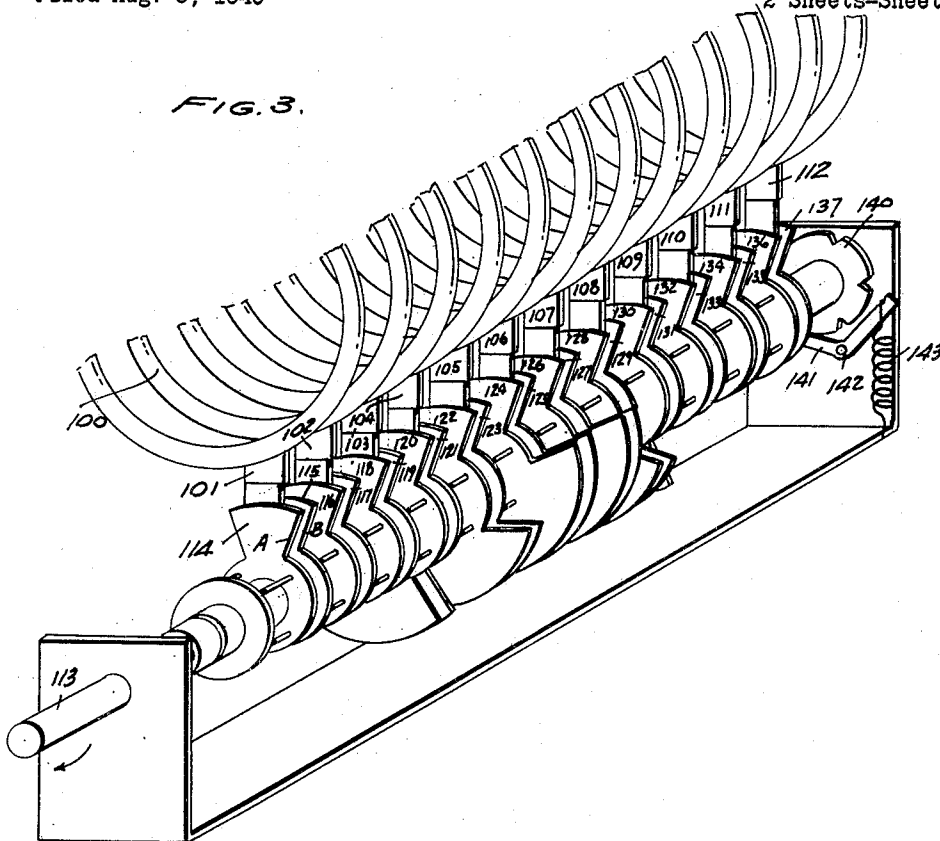


FIG. 6.

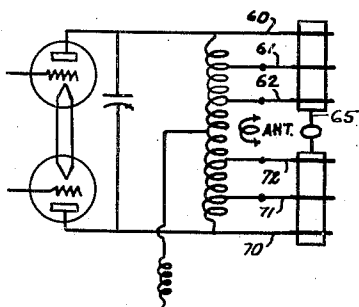
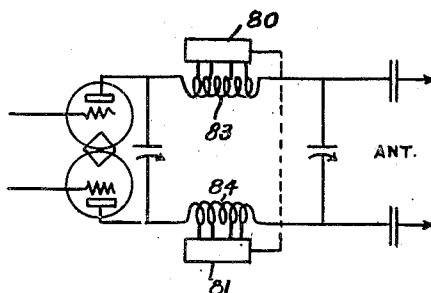


FIG. 7.



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UNITED STATES PATENT OFFICE

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SHORTING SYSTEM FOR RADIO COILS

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2 Claims. (Cl. 171-242)

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

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

This invention relates to an improved switch means for varying the tank circuit inductance in radio transmitters.

The invention described herein is particularly adapted for use in amplifier stages of radio transmitters. This switch has been found particularly useful in the Army Net Control Radio Station WAR, Fort Myer, Virginia, where it is now extensively used in the place of prior art systems found to have serious disadvantages. In the prior art it is known that a shorting bar may be placed across the taps to be shorted, but this has the disadvantage in that much time is spent in changing from one length of the bar to another, making it necessary to change by use of a wrench. At the same time the changing from one length of the bar to another causes the coil to sag and change its shape. Large transmitters used by the Army and commercially adapted to operate over a wide frequency spectrum have used various means of shorting inductance of coils, but no switch or coil shorting method except the present invention has been used that is entirely satisfactory.

Figure 1 illustrates a side view of one embodiment of my invention.

Figure 2 shows the relative arrangement of the shaft and the several switch blades constituting the inventive part of Figure 1.

Figure 3 illustrates a preferred form of my invention in perspective; the details of the push-pull transmitter circuit being omitted.

Figure 4 illustrates a single ended transmitter incorporating the invention.

Figure 5 shows a push-pull amplifier circuit incorporating the invention.

Figure 6 shows another push-pull amplifier circuit incorporating the invention.

Figure 7 shows a push-pull amplifier of a pi-network incorporating the invention.

In Figure 3 is shown an improved form of my invention. This figure shows the main tank coil 100 of a push-pull radio transmitter. This coil is solely supported by the leads thereto as will later appear in connection with Figure 2. The coil 100 has taps 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, and 112 on successive turns thereof. These taps are in the form of contact plates and project vertically downward from the tank coil and between the switch blades mounted

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on the shaft 113. For example, switch blades 114 and 115 are on opposite sides of contact bar 101. Similarly switch blades 116 and 117 are on opposite sides of contact bar 102; while the switch blades 118 and 119 are on opposite sides of contact bar 103.

Switch blades 114 and 115 have a segmental angle of approximately 45 degrees. Switch blades 116 and 117 are similar to blades 114 and 115 except they have a somewhat larger segmental angle, for example 99 degrees. The same may be said for switch blades 118 and 119 except they have a segmental angle of approximately 153 degrees. The same may be said for switch blades 120 and 121 except they have a segmental angle of approximately 207 degrees. The same may be said for switch blades 122 and 123 except they have a segmental angle of approximately 261 degrees, and the same may be said for switch blades 124 and 125 except they have a segmental angle of 215 degrees. The segmental angle of switch blades 126 and 127 is the same as that of blades 124 and 125. Switch blades 128 and 129 are the same as those of 122 and 123; the blades 130 and 131 are the same as 120 and 121; the blades 132 and 133 are the same as 118 and 119; the blades 134 and 135 are the same as 116 and 117; the blades 136 and 137 are the same as blades 114 and 115.

The shaft 113 at its rear end has a cam 140 having a latch 141 pivoted at 142 and held in place by a pull spring 143. When the shaft 113 is rotated latch 141 engages the slots in cam 140 and holds the shaft in the several positions in which it is desired for the apparatus to operate.

When the shaft 113 is in the position shown, bars 101 through 112 inclusive are all connected together by the switch blades 114 through 137 inclusive and therefore only those turns of the coil 100 which are at the two ends thereof are not shorted and are the only turns effective in creating inductance from the main tank coil. However, when it is desired to change the frequency of the transmitter to a different band the shaft 113 may be rotated clockwise to its next position in which switch blades 114 and 115 disengage bar 101 and switch blades 136 and 137 disengage bar 112. Therefore, two additional turns of the tank coil are effective in introducing inductance into that tank coil. In the third position of clockwise rotation of shaft 113 all of the following switch blades are disengaged from their respective contactor bars 114, 115, 116, 117, 134,

135, 136, and 137. Therefore additional turns of the main tank coil at the opposite ends thereof become effective in introducing inductance into the main tank circuit. For example, when the switch is rotated clockwise to the next operative position the following switch blades are not in contact with their respective contactor bars 114, 115, 116, 117, 118, 119, 132, 133, 134, 135, 136 and 137. Therefore, additional turns of the main tank coil become effective at the opposite ends thereof in introducing inductance into the main tank circuit.

Referring particularly to Figure 1 coil 13 is shown with its supporting copper tubes 11 and 12. By means of tubes 11 and 12 coil 13 may be mounted directly to a conventional tank circuit condenser. Coil 13 is a helical copper tube with a tap at its center 14.

The coil 13 constitutes the main plate tank circuit of the final push-pull amplifier of a radio transmitter. In order to provide for push-pull operation of the amplifier, the coil 13 is tapped in its center at 14, the tap 14 being suitably connected in the push-pull amplifier circuit. Three turns from the left end of the coil 13 is a tap 16 and similarly, three turns from the right end of coil 13 is a tap 17, five turns from the left end of the coil 13 is a tap 18 and five turns from the right end of the coil 13 is a tap 19, seven turns from the left end of coil 13 is a tap 20, and seven turns from the right end of the coil 13 is a tap 21. It is understood that the location of each of the taps recited above is optional and more or less taps suitably positioned on the coil may be used without departing from the principle and mode of operation of the invention described herein.

There is provided a supporting metal frame work 35 fixed at its lower end so that it and the condenser to which it may be fastened constitute the sole support for coil 13. Mounted on the metal frame work 35 and insulated therefrom are the several switch contacts 22, 23, 24, 25, 26 and 27 which respectively electrically connect with the several copper tubing leads 16, 17, 18, 19, 20 and 21. The leads 16 to 21 inclusive are supported by the metal frame work 35, although insulated therefrom, and these several leads help in the support of the coil 13. Mounted on the shaft 34, which is carried by the metal frame work 35 are the switch blades 28, 29, 30, 31, 32, and 33 which are adapted to respectively engage and disengage the several switch contacts 22, 23, 24, 25, 26 and 27 as will hereinafter appear.

The shaft 34 carries a dial 36 which is adapted to be rotated to four distinct positions, numbered 1, 2, 3, and 4 on the dial. The several positions are indicated by the pointer 38A. Supported by the frame work 35 is a spring element 37 which is adapted to engage the cam 38 to hold the shaft 34 in the said several four distinct positions in a well known way. The notches in the cam 38 are so positioned that when the dial 36 is turned to position "1" as indicated by the pointer 38A, none of the several switch blades 28, 29, 30, 31, 32 or 33 are in engagement with any of the switch contacts 22, 23, 24, 25, 26 and 27.

However, when the dial 36 is rotated to position "2" as indicated by the pointer 38A on the dial 36, all of the switch blades 28, 29, 30, 31, 32 and 33 are in engagement with their respective complimentary switch contacts 22, 23, 24, 25, 26 and 27. In this position all of the coil 13 between the tap 16 and the tap 17 is shorted out, leaving

only a small portion of the coil in the circuit and thereby causing the push-pull radio transmitter to operate at a high radio frequency, in contrast to the low frequency that is obtained when the dial 36 was in position "1" as indicated by the pointer 38A.

When the dial 36 is rotated to position "3" as indicated by the pointer 38 on the dial 36, switch blades 28 and 29 are no longer in contact with their respective complimentary switch contacts 22 and 23. However, switch blades 30, 31, 32, and 33 are in engagement with their respective switch contacts 24, 25, 26 and 27. Hence, the coil 13 is shorted between the tap 18 and the tap 19. Thus in position "3" the frequency at which the radio transmitter operates is lower than the frequency at which it operated when the dial 36 was in position "2".

When the dial 36 is rotated to position "4" as indicated by the pointer 38, only the switch blades 32 and 33 are in engagement with switch contacts. In this position switch blades 32 and 33 are in contact with switch contacts 26 and 27 but switch blades 28, 29, 30 and 31 are not in contact with any switch contact and, therefore, only that portion of the coil 13 which is between the tap 20 and the tap 21 is shorted out. Hence, the effective portion of the coil 13 includes all of that from the left end to tap 20 and all of that beyond tap 20 and 21 to and inclusive, to the right end of coil 13.

It is apparent from this invention that when turns of the coil are being shorted out a wiping contact of the switch blades is employed. This has the advantage that the switch blades are constantly kept clean during operation of the switch. Furthermore, by using this invention and particularly segments of the circle as switch blade elements it is possible as more turns are shorted out and the inductance is changed to keep the unused portion of the coil shorted at several points preventing voltages from building up between the turns.

The switch induces a minimum of stray capacity and is designed to make the circuit balanced from the lowest to the highest frequency. The switch can be adapted for use on both single-ended and push-pull amplifiers.

Figure 4 shows the device of the invention used in connection with a single-ended transmitter. The main tank coil 50 of the transmitter is successively shorted by the switch blades 51, 52 and 53 as the switch is rotated from the open position 4 through positions 1, 2 and 3. The adaptation of the invention to the single-ended amplifier is clearly obvious when taken in connection with the foregoing description of the invention in connection with a push-pull transmitter.

Figure 5 shows the device of Figure 2 as connected to a conventional push-pull amplifier.

Figure 6 illustrates the invention as applied to a push-pull amplifier shorting taking place first at the ends of the tank coil instead of in the middle thereof. In Figure 6 the shape of the several switch segments is such that in the 3rd position no shorting whatsoever takes place. In position 2 segments short leads 60—61 and 70—71. In position 1 the switch segments short the leads 60—61 and 62 and 70—71 and 72.

In Figure 7 there is shown a push-pull amplifier with a pi-network. Two switches are employed for each tank coil. The two switches 80 and 81 are ganged together with the shaft 82. The tank coils 83 and 84 are shorted to a greater

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or lesser extent by the switches 80 and 84. Switches 80 and 84 are constructed in similar fashion to the switch of Figures 2 and 3 except configuration of the segments is such that as the switch is progressively rotating a greater amount of the two coils are shorted.

When shorting in a push-pull amplifier, one switch can be used if the shorting is done from the center of the coil to the hot portion (as shown in Figure 2) but if the shorting is done from the hot end of the coil to the cold two switches will be required as shown in Figure 6. In the form shown in Figure 6 the switches must be connected by an insulating shaft such as 65.

The switch principle can be used in constructing switches for extremely low power tank circuits or for transmitters employing many kilowatts of power. The principle of the invention renders the system extremely efficient due to its low resistance, low capacity and the physical size in comparison with previous band changing systems of equal flexibility.

I claim to have invented:

1. In a radio transmitter, a main helical tank coil, first and second taps thereon equally spaced from the center of such coil and on opposite sides of said center, third and fourth taps on said coil equally spaced from the center of such coil and respectively on opposite sides of said center and farther therefrom than the first and second taps, fifth and sixth taps on said coil equally spaced from the center of such coil and respectively on opposite sides of said center and farther therefrom than the third and fourth taps, each of said taps including conducting means electrically and mechanically attached to the coil and extending a short distance therefrom, and rotary switch means comprising six segmental switch blades of conducting material which respectively are arranged to engage and disengage said taps respectively, the first and second blades having a large segmental angle and engaging said first and second taps throughout said angle, the third and fourth blades having a segmental angle smaller than that of the first and second blades and engaging said third and fourth taps, the third and fourth blades being so positioned as respect the first and second blades that when the third and fourth blades engage

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the third and fourth taps respectively that the first and second blades engage the first and second taps respectively, said fifth and sixth blades having smaller segmental angles than that of the third and fourth blades and engaging said fifth and sixth taps throughout such small angle, the fifth and sixth blades being so related to the first, second, third and fourth blades that whenever the fifth and sixth blades engage the fifth and sixth taps respectively that the first, second, third and fourth blades are respectively in engagement with the first, second, third and fourth taps.

2. In a radio transmitter, a helical main tank coil, first and second taps on said coil equally spaced from the center thereof and on opposite sides of said center, third and fourth taps on opposite sides of the center of said coil and equally spaced from said center and farther from said center than the first and second taps, said taps constituting short electrical bars extending from said coil, a rotatable shaft parallel to the center line of said helical tank coil and positioned near said taps, and first, second, third and fourth switch blades mounted on said shaft and in engagement with said first, second, third and fourth taps respectively, said switch blades having leading edges parallel to each other and the third and fourth switch blades having a smaller segmental angle than the first and second blades, whereby the inner turns of the coil are shorted whenever the more removed turns of the coil are shorted.

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