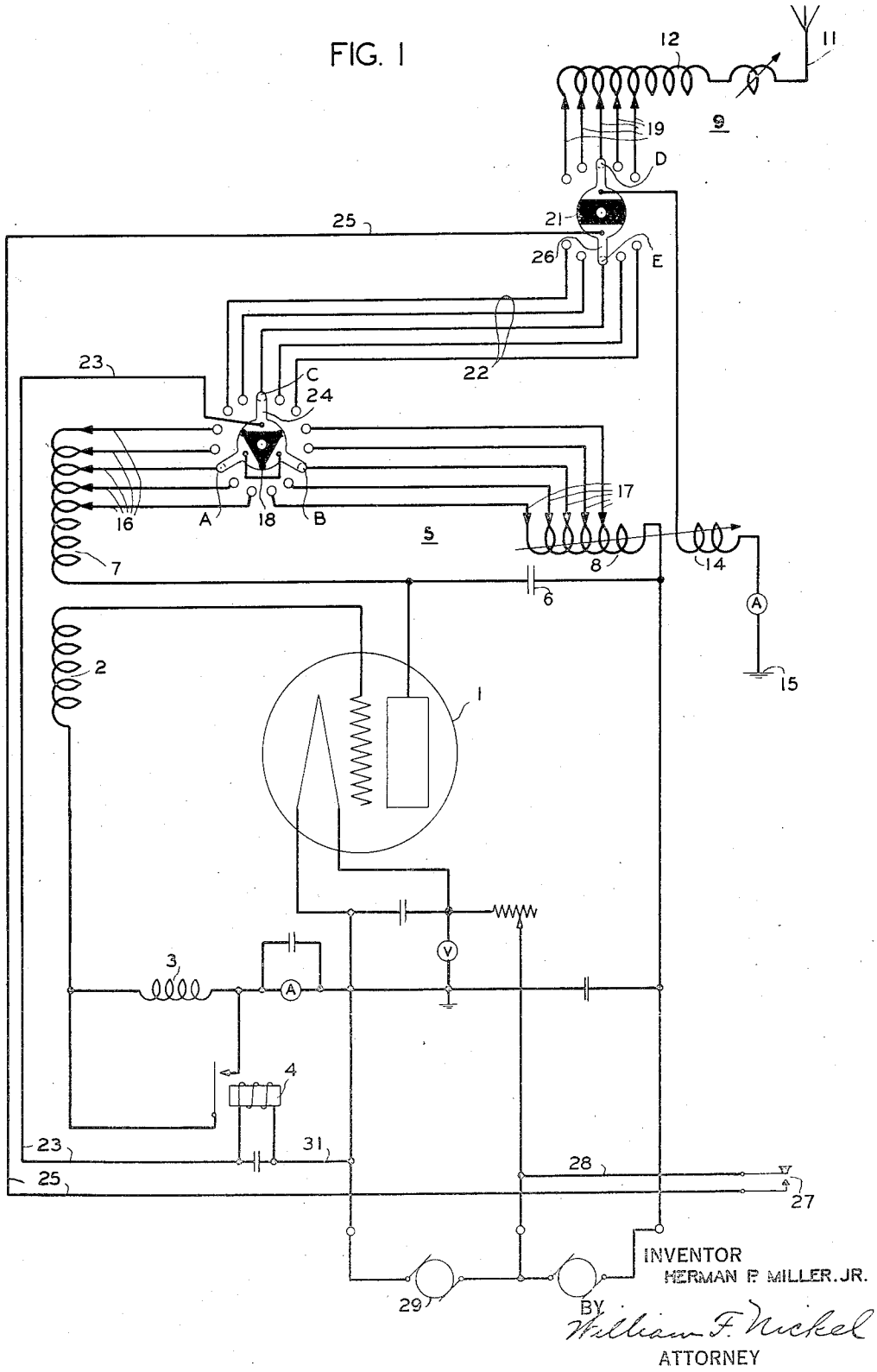
July 4, 1933. H. P. MILLER, JR 1,916,229

RADIO TRANSMITTER SYSTEM

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FIG. 1



July 4, 1933. H. P. MILLER, JR 1,916,229

RADIO TRANSMITTER SYSTEM

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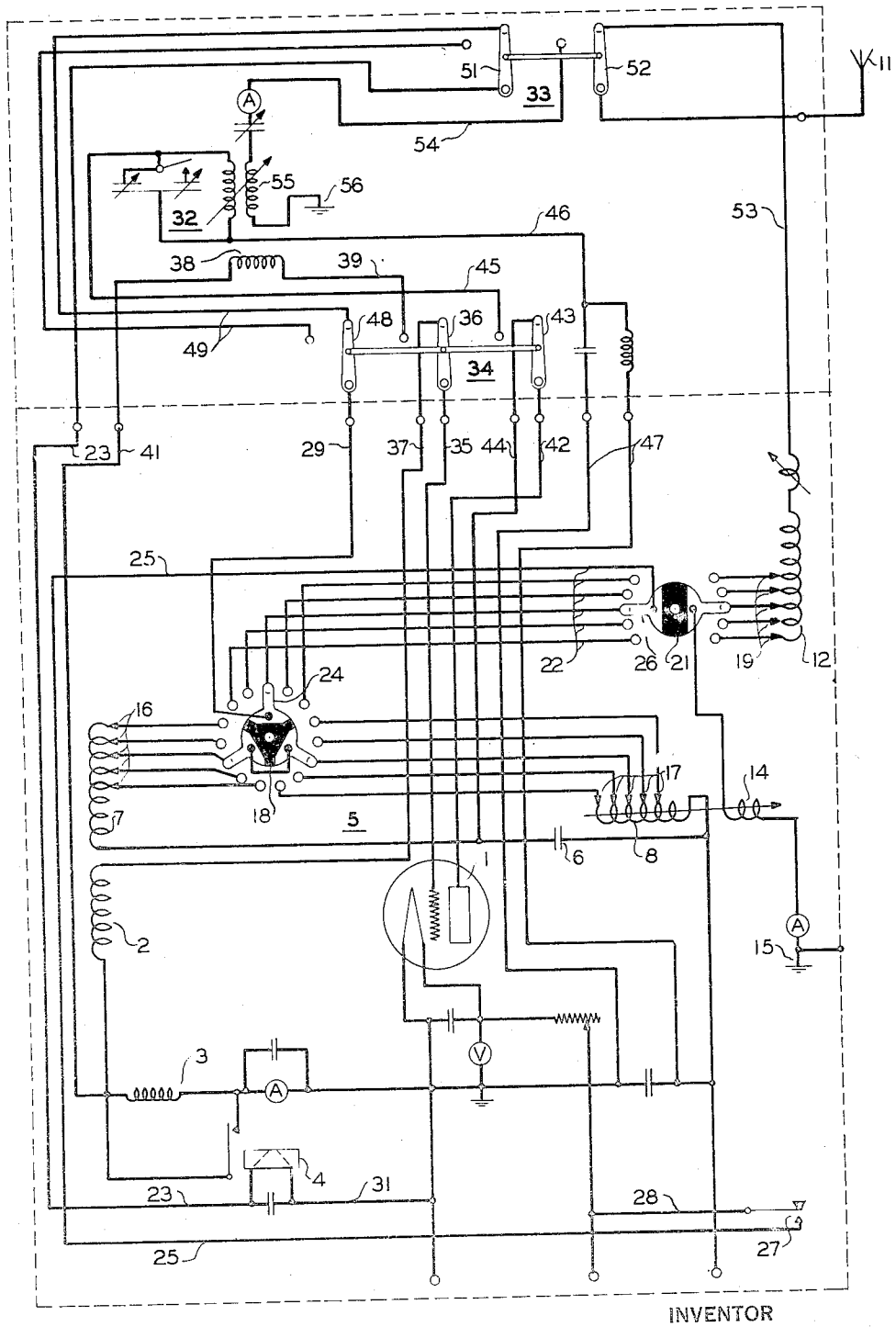


FIG. 2

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RADIO TRANSMITTER SYSTEM

Application filed July 1, 1930. Serial No. 465,201.

My invention relates to radio signaling systems, and particularly to protective devices incorporated therein.

An object of my invention is to provide, in a radio transmitter system, means for preadjusting various sets of members for the optimum generation respectively of several different frequencies, means for selecting the sets of devices adjusted to a desired frequency, and means for preventing the generation of oscillations until all of the various selecting members have been set for the desired frequency.

Another object of my invention is to provide a radio transmission system including interlocked wave-change switches so arranged that the generating members can function only when the wave-change switches are properly positioned.

A further object of my invention is to provide means in a radio transmission system for maintaining the energization of the tube and circuits during wave-changing operations, which will simultaneously prevent the generation of oscillations until the wave-change adjustments are completed.

Still other objects are the production of means for the selection of tuning taps on a plurality of resonant circuits appropriate for the desired wave length, combined with interlock means to insure proper setting of the selector switches. Still other objects are the production of a system containing a plurality of different resonant members, with change-over switches adapted to connect either resonant members to a vacuum tube member and to an antenna system, and interlock means adapted to prevent operation of the vacuum tube device until all of the switches are put into the proper position.

In the operation of a radio transmission system, it is desirable that the operator be able to transmit on any desired one of a number of different frequencies. It has been customary in the prior art to provide a plurality of adjustable taps upon the resonant inductances, with switching means for selecting the proper tap to generate at the desired frequency. This system is simple and convenient when but a single resonant circuit is involved. When, however, a resonant plate circuit is utilized, coupled to a resonant antenna circuit, it is necessary to adjust the tuning of both of the resonant circuits to match, which is most conveniently done by a plurality of wave-change switches having contact points connected to the various adjustable taps on the inductances. This system is, however, subject to the difficulty that unless the various switches are set on corresponding contacts, the transmitter does not function properly. The system of my invention provides means to suspend the operation of the keying system of the transmitter until the wave-change switches are properly set.

Also it has been found desirable to provide more than one resonant system in a transmitter, to permit of communication by means of the intermediate frequencies ranging from 600 kilocycles down, and another system for generation at frequencies ranging from 1500 kilocycles up. Because of the difference in electrical constants required to generate in these widely different frequency bands, it has been found desirable to provide completely separate and distinct resonant systems for the two frequencies, although both can be used with a single antenna and both can be energized from a single vacuum tube member.

My invention accordingly also provides change-over switches adapted to connect either the high frequency or the intermediate frequency circuits to the vacuum tube, and to the antenna, as desired, and interlocking means for preventing operation of the generator until all of the change-over switches are properly set. My invention further provides means for incorporating a plurality of adjustable taps in one or more of the resonant circuits to permit the choice of a variety of frequencies in a wave band by means of wave-change switches, and includes therein similar interlock means to prevent operation of the generator until the wave-change switches are properly set.

Other objects and structural details of my invention will be apparent from the following description when read in connection with the accompanying drawings, wherein

Figure 1 is a diagrammatic representation of circuits and apparatus embodying my invention in a vacuum tube system adapted to operate at intermediate frequencies, and

Fig. 2 shows an alternative embodiment adapted to operate at both intermediate frequencies and high frequencies.

Referring to Fig. 1, I provide a vacuum tube 1 connected to appropriate power and energizing sources as indicated. I further provide a grid inductance 2 and a keying choke 3, adapted to be shunted by a keying relay 4, energized during signal marking periods. I further provide a resonant plate circuit 5 containing a condenser 6, an inductance 7 coupled to the grid inductance 2 and a second inductance 8 coupled to the antenna system 9. The antenna system desirably consists of an aerial 11, a loading coil 12, a coupling coil 14, coupled to the plate circuit coil 8, and a ground connection 15.

Groups of adjustable taps 16 and 17 are provided on the inductance coils 7 and 8 respectively of the resonant circuit 5 and connected by leads to a wave-change switch 18, having a plurality of sets of contacts and contact arms and a set of auxiliary contacts and an auxiliary contact arm 24. The antenna loading coil 12 is likewise provided with a plurality of adjustable taps 19 and a switch 21 having a set of contacts and a contact arm and a set of auxiliary contacts and an auxiliary contact arm 26.

Lead wires 22 are connected to the auxiliary set of contacts in the switch 18, and to the auxiliary set of contacts in the switch 21. A lead wire 23 is connected to the coil of the keying relay 4, and connected to the auxiliary contact arm 24 which cooperates with the auxiliary set of contacts in the switch 18 to which the leads 22 are connected. Another lead wire 25 is connected to the auxiliary switch arm 26 of the switch 21, cooperating with the group of auxiliary contacts connected to the wires 22. The lead wire 25 is connected to the key 27 from which a lead 28 is connected to a source of power such as the filament generator 29. The circuit is completed from the source of power by a lead 31 as indicated between the other terminal of the source of power and the coil of the relay 4.

In the operation of my device, switch 18 may be set so that an arm bears upon contact A which is connected to one of the adjustable taps 16, while a connected arm bears upon the contact B which is connected to one of the adjustable taps 17. The auxiliary contact arm 24 then rests on contact C. At the same time, the switch 21 is adjusted so that an arm therein rests upon contact D which is connected to one of the adjustable taps 19 in the aerial circuit. The auxiliary contact arm 26 then rests on contact E connected to contact C. When the key is closed, the keying circuit is completed through the lead 28, the key 27, the lead 25, the auxiliary contact arm 26, one of the leads 22, the auxiliary contact arm 24, the lead 23, the coil of relay 4 and the lead 31 to the other terminal of the power source 29. The appropriate taps 16, 17 and 19 may then be adjusted to optimum radiation at the desired frequency.

The switches 18 and 21 may thereupon be shifted to other settings and appropriate adjustment made of other sets of taps for the generation of other frequencies. Thereafter both of the switches must be set in corresponding positions in order to complete the keying circuit through one of the leads 22 before the vacuum tube 1 can be set into oscillation, thereby preventing the generation of oscillations by the tube in the resonant circuit 5 at frequencies to which the antenna system 9 is not resonant, under which conditions there is no adequate signal output from the antenna, and there may be an injuriously high current in the local circuits.

The contacts and switch arms of the switch 18 may be made of such width that the contacts are bridged by the switch arm during wave-changing operations. They accordingly maintain the continuity of the plate circuit and prevent arcing during wave-changing operations. Such bridging is, however, undesirable in the case of other contacts such as those in switch 21 in which arcing would occur if changes were made while the tube was generating oscillations. My device thus prevents arcing at these contacts.

The system of the above described embodiment thus ensures proper setting of the wave-change switches and prevents operation of the vacuum tube when the setting is incorrect.

An alternative embodiment of the system of my invention is shown in Fig. 2, in which is incorporated a system for the generation of a plurality of intermediate frequencies similar to the system of Fig. 1, and in addition there is provided an auxiliary system for the generation of oscillations at a much higher frequency by the same vacuum tube generator.

In Fig. 2 the same numbers as are used in Fig. 1 indicate similar parts, including a vacuum tube 1, a grid inductance 2, a grid choke 3, a keying relay 4, a resonant plate circuit 5 including a condenser 6 and the inductances 7 and 8, and an antenna system including an aerial structure 11, an antenna inductance 12, an antenna coupling inductance 14 and a ground connection 15. Adjustable taps 16, 17 and 19 are likewise provided cooperating with wave-change switches 18 and 21, with contacts and connected lead wires 22 as before described. Lead wires 23, 25, 28 and 31, in circuit with the key 27 and auxiliary contact arms 24 and 26, are likewise provided as before.

In addition, a high frequency resonant cir-

cuit 32 is provided and a generator-tube change-over switch 34. The grid lead 35 from the tube 1 is connected to the arm 36 in the switch 34, one cooperating contact being connected by the lead 37 to the grid inductance 2, the other cooperating contact being connected to a high frequency grid coil 38 by means of the lead 39, the coil 38 being connected to the cathode circuit by a lead 41. The plate of the triode 1 is connected by a lead 42 to the arm 43 of the switch 34, having a cooperating contact and a lead 44 to the resonant intermediate frequency plate circuit 5. Another contact with which the arm 43 cooperates is connected by a lead 45 to the resonant circuit 32 and from it through lead 46, and leads 47, to the cathode circuit and the power supply. A third arm 48 is provided in switch 34, the three arms 36, 43 and 48 being mechanically connected. The arm 48 is connected by the lead 29 to the arm 24 in switch 18, and a pair of contacts are provided connected by leads 49 to contacts in the switch 33, cooperating with an arm 51 which is connected to the lead 23, and thereby to the coil of relay 4. The arm 52 of switch 33 is connected to the aerial 11 and cooperates with a pair of contacts, one of which is connected by a lead 53, to the aerial inductances 12 and 14 cooperating with the intermediate frequency circuit 5. The other contact cooperating with arm 52 is connected by a lead 54 to the coil 55 which is coupled to the high frequency resonant circuit 32 and connected to a ground 56.

In this embodiment of my invention, the taps 16, 17 and 19 may be adjusted as before, and the interlocking circuit is completed by way of the leads 22, the switch arms 24 and 26 and the circuits to the key and keying relay, the key relay then being operable only when the switches are set for connection to appropriately adjusted contacts. Also the keying relay is operable only if the tube switch 34 and the aerial switch 33 are both set in corresponding positions, either for operation of the intermediate frequency circuit 5 or the high frequency circuit 32. If either switch is set for operation of a resonant circuit different from that of the other, the keying circuit is opened and keying cannot be done.

It may be noted that when the switches 33 and 34 are set for generation of high frequency, keying is not possible unless the switches 18 and 21 are also set properly for the generation of an intermediate frequency. This is advantageous in that it ensures the maintenance of the intermediate frequency circuits in condition ready for use immediately upon operation of the change-over switches 33 and 34, thus permitting rapid and convenient alternation between intermediate and high frequencies. Alternatively, this feature may be dispensed with by obvious changes in the circuits, such as connecting the lead 23 directly to the arm 48 and the lead 25 directly to the arm 51 and opening one of the leads 49, connecting one of the opened circuit ends to the arm 24 and the other to arm 26, this being done in the lead 49 which is connected to the contact to which connection is made by the arm 48 when the switch 34 is set for intermediate frequency generation.

My invention has been disclosed in embodiments utilizing an electrical interlock system. These are not, however, the only possible embodiments, since similar results can be obtained by means of mechanical interlocks between the various switches and the keying relay, or a suitably constructed key.

The principle may likewise be extended to systems in which a power amplifier system is utilized, in which interlocks may be provided upon the master oscillator circuits and extended to include an interlock upon the power amplifier circuits. This embodiment requires merely a duplication of the essential switches disclosed in the previous embodiment in connection with similar resonant circuits.

By my invention I have thus produced a structure adapted for the generation of a plurality of frequencies in which is incorporated interlock means for permitting keying of the system only when all of the wave-change switches are properly set.

While I have shown and described several embodiments of the device of my invention, it is possible to produce still other forms thereof without departing from the inventive concept embodied therein and it is desired, therefore, that only such limitations shall be imposed upon the appended claims as are stated therein or required by the prior art.

I claim as my invention:

1. In a radio frequency generator system, a resonant circuit, a switch therein for varying the resonating frequency thereof and having a plurality of taps connected to said circuit, an oscillation generator connected to said circuit, means for controlling said oscillation generator, a load circuit coupled to said resonant circuit, a switch in said load circuit for varying the resonating frequency thereof and having a plurality of taps connected to said load circuit, and circuits including said switches for causing said first-named means to control said oscillation generator only when said switches are set on taps causing said resonant and load circuits to oscillate at the same resonating frequency.

2. In a radio frequency generator system, a resonant circuit, a switch therein for varying the resonating frequency thereof and having a plurality of taps connected to said circuit, an oscillation generator connected to said circuit, keying means for controlling the oscillation of said generator, a load circuit cou-

pled to said resonant circuit, a switch in said load circuit for varying the resonating frequency of said load circuit, and having a plurality of taps connected to said load circuit, and circuits including said switches for causing said keying means to control the oscillation of said generator only when said switches are set on taps causing said resonant circuit and said load circuit to oscillate at the same resonating frequency.

3. In a radio frequency generator system, a resonant circuit, a switch therein for varying the resonating frequency thereof and having a plurality of taps connected to said circuit, an oscillation generator connected to said circuit, keying means for controlling the oscillation of said generator, a load circuit coupled to said resonant circuit, a switch in said load circuit for varying the resonating frequency thereof and having a plurality of taps connected to said load circuit, and circuits including said switches for causing said keying means to control said generator only when said switches are set on taps causing said resonant and load circuits to oscillate at the same resonating frequency, said last-named means comprising a keying relay conditioned for operation through a plurality of circuits connected to said switches and in circuit with the keying means.

4. In a radio frequency generator system, a resonant circuit, a switch therein for varying the resonating frequency thereof, said switch having a plurality of taps connected to said circuit, an oscillation generator connected to said circuit, keying means for controlling the oscillation of said generator, an antenna circuit coupled to said resonant circuit, an antenna switch in said antenna circuit for varying the resonating frequency thereof, said antenna switch having a plurality of taps connected to said antenna circuit, and means for preventing said keying means from controlling said generator except when said switches are set on corresponding taps to cause said resonant and antenna circuits to oscillate at the same resonating frequency, said last-named means comprising a keying relay and a plurality of parallel circuits connected to said switches, said switches having auxiliary contact arms operable thereby and in circuit with the keying means, the keying relay and the parallel circuits.

5. In an oscillation generator system, an oscillation generator, a plurality of intercoupled resonant circuits, a switch in each circuit for varying the resonating frequency thereof, each switch having a contact arm and pluralities of contacts in circuit, and an auxiliary contact arm and pluralities of contacts without electrical connection to said resonant circuits, the corresponding points of said auxiliary contact groups being connected together, a keying means for controlling the oscillation of said generator, and a circuit including said keying means, said auxiliary contact arms and auxiliary contacts, which is open-circuited except when said switches are adjusted to corresponding positions.

In witness whereof, I hereunto subscribe my name this 24th day of June 1930.

HERMAN P. MILLER, JR.