

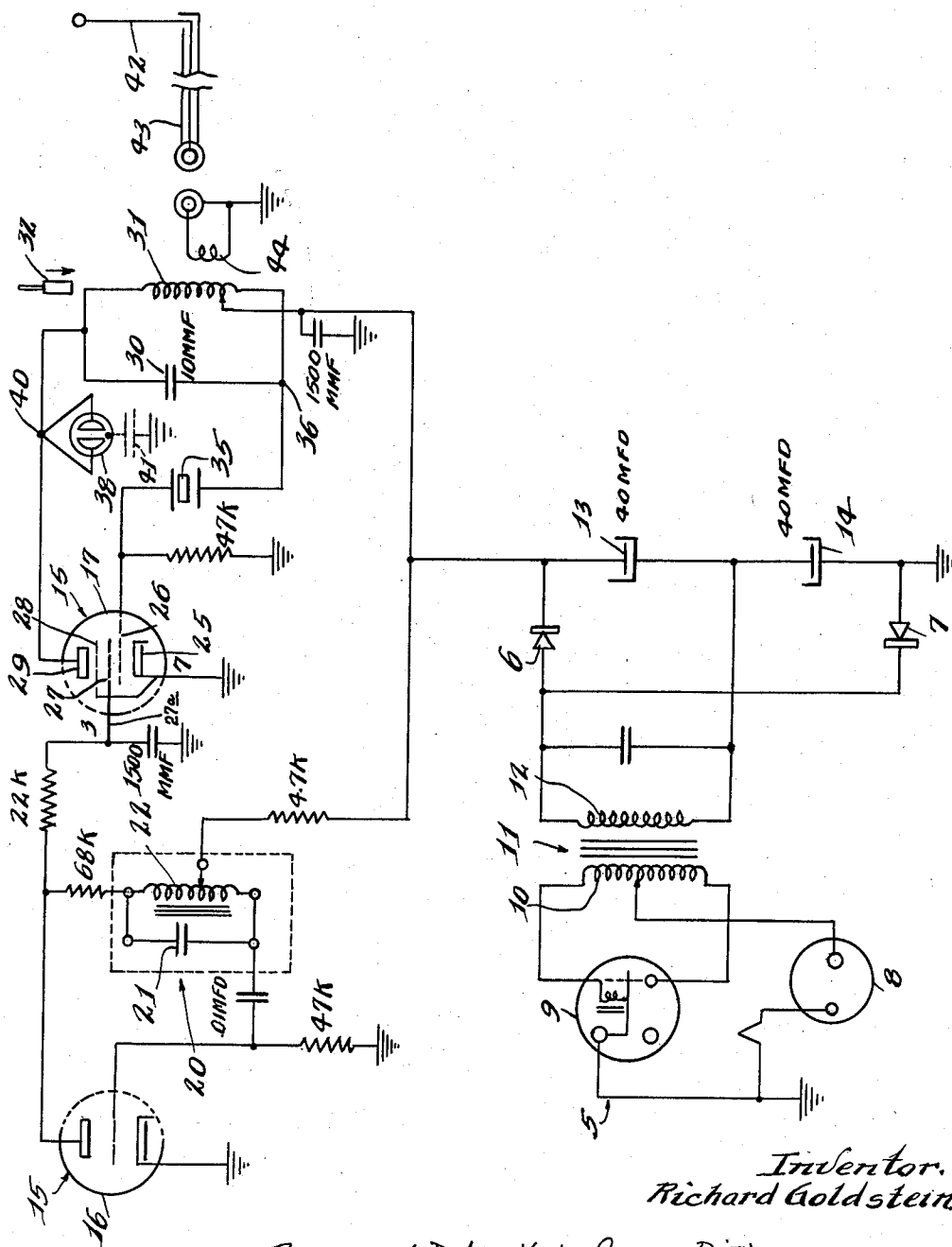
July 29, 1958

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2,845,536

RADIO FREQUENCY TRANSMITTER

Filed Nov. 8, 1954



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RADIO FREQUENCY TRANSMITTER

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Application November 8, 1954, Serial No. 467,314

3 Claims. (Cl. 250—36)

This invention relates to a radio frequency transmitter, and more particularly to a transmitter which comprises the transmitter component of a remote control apparatus.

The remote control apparatus embodying subject transmitter may have many uses. As one typical example, such remote control apparatus may operate a motor which is connected mechanically to a garage door. Subject transmitter is installed in an automobile and it transmits a signal to a receiver component installed in the garage. The receiver actuates a switch which in turn starts and stops the motor in response to signals received from the transmitter.

A receiver component designed to cooperate with subject transmitter forms the subject matter of my copending application entitled "Highly Discriminating R. F. Receiver," Serial No. 467,313, filed November 8, 1954.

One object of the invention is to provide a radio frequency transmitter wherein a frequency-stable R. F. carrier wave is modulated by a frequency-stable A. F. signal generated within the transmitter.

Another object is to provide a transmitter of this character wherein the circuit which determines the frequency of the A. F. signal is of the plug-in type whereby the frequency of the A. F. signal may be pre-selected or changed from time to time as may be necessary to avoid interference with like apparatus installed within the range of the transmitter. The plug-in circuits usable in the transmitter are pre-tuned, and corresponding pre-tuned circuits are used in the cooperating receiver.

Another object of the invention is to provide a radio frequency transmitter which has superior frequency accuracy. To this end the oscillator used in the transmitter is crystal-controlled.

Another object is to provide a transmitter of this character embodying an R. F. oscillator having a tuneable tank circuit which readily can be tuned for maximum output by non-technical individuals. The oscillator circuit includes a miniature neon glow lamp which glows continuously during operation of the oscillator. The tank circuit is tuned to resonance at the crystal frequency by maximizing the brightness of the glow lamp.

Still another object is to provide a transmitter having a characteristic that insures the prompt starting of stable oscillation. This characteristic is provided by the aforesaid neon glow lamp which thus has two functions in the transmitter. Prior to the start of oscillation, the stray capacitance contributed by the lamp is slightly less than that when the lamp is glowing. Therefore, before oscillation commences the tank circuit of the oscillator is tuned to a frequency slightly higher than the crystal frequency. This condition insures that oscillation will start when power is applied to the oscillator. As the oscillations reach operating amplitude the lamp strikes and the capacitance of the lamp increases. This increase automatically shifts the tank circuit toward its highest output adjustment, the condition desired for proper operation.

Still another object is to provide a transmitter of this

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character which utilizes only a single vacuum tube, is comparatively simple and inexpensive and can be expected to have a long, trouble-free life.

Other objects, advantages and details of the invention will be apparent as the description proceeds, reference being had to the accompanying schematic drawing wherein a circuit embodying the invention is shown. It is to be understood that the description and drawing are illustrative only and that the scope of the invention is to be measured by the appended claims.

Referring now to the single figure of the drawing, the illustrated transmitter includes a D. C. power supply 5 adapted for operation from a usual 6.0 volt automobile battery. Power supply 5 is a full-wave doubler utilizing two small selenium rectifiers 6 and 7. A battery plug 8 is connected to a 115 cycles per second vibrator 9 which feeds primary winding 10 of the power transformer 11. Transformer secondary 12 is connected to rectifiers 6 and 7 in conventional manner, capacitors 13 and 14 being connected to double the D. C. output voltage.

The transmitter as illustrated employs a single vacuum tube 15 of the 6U8 type containing a triode section 16 and a pentode section 17 in a single envelope.

Triode section 16 is arranged in a Hartley circuit which generates an A. F. signal used for modulating the R. F. output of the transmitter. The numeral 20 designates a plug-in channel selector comprising a tank circuit having capacitance 21 and inductance 22. As previously mentioned, a plug-in channel selector 20 is pre-tuned, there being a series of such channel selectors available for use in the transmitter.

In practice, ten pre-tuned channel selectors 20 are available, the frequencies thereof falling between 600 cycles per second and 4700 cycles per second. The frequencies are distributed between these limits on a logarithmic scale with a frequency ratio of 1 to 1.25 between any two adjacent frequencies. In the illustrated transmitter the accuracy of the modulating frequency is greater than plus or minus 1%.

Pentode section 17 of vacuum tube 15 forms part of an R. F. oscillator. Pentode section 17 includes the usual electrodes, namely cathode 25, control grid 26, screen grid 27 to which is applied the A. F. modulating signal from triode section 16 through conductor 27a, suppressor grid 28 and anode 29. Suppressor grid 28 is connected to cathode 25.

The R. F. oscillator includes a tank circuit comprising capacitance 30 and inductance 31. The tank circuit is tuneable by means of an adjustable slug 32 which cooperates with inductance 31.

A frequency-control crystal 35 designed to vibrate at 27,255 megacycles is connected between low potential terminal 36 of the tank circuit and control grid 26. This frequency is that of the class "C" citizens' band which has been assigned by the Federal Government for apparatus of the illustrated character. Crystal 35 provides a frequency accuracy of within plus or minus 0.04%, a tolerance within the required limits.

A miniature neon glow lamp 38 has both terminals connected to high potential terminal 40 of the tank circuit, said lamp, by virtue of its proximity to the chassis, contributing a small portion of the capacitance which resonates inductance 31. The portion of the capacitance contributed by lamp 38 is illustrated by capacitance 41 shown in dotted line. Glow lamp 38, as will be seen, has the dual functions of indicating when the tuneable tank circuit is adjusted to resonance at the crystal frequency and of providing reduced capacitance to de-tune the tuneable tank circuit slightly to insure that oscillation will start.

After the transmitter is energized, oscillation thereof

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causes glow tube 38 to strike. Tuning slug 32 then is adjusted to such position that glow tube 38 has maximum brightness. Maximum brightness, of course, indicates maximum R. F. voltage, a condition which shows that the tank circuit has been tuned to resonance at the crystal frequency. In addition, illumination of glow tube 38 indicates that the transmitter is generating an R. F. output wave.

The other and equally important function of glow tube 38 is to provide reduced capacitance when not glowing so as to de-tune the tank circuit slightly. In crystal-controlled oscillators of this type the output circuit should be resonated at a frequency slightly higher than the crystal frequency in order to insure proper operation. Although the output is then slightly less than when the tank circuit is tuned to exact resonance at the crystal frequency, the oscillator is more stable, particularly with regard to oscillation start when the transmitter is energized. The reason for this is that the tank circuit must appear as an inductive plate load in order that there be a negative conductance component of the tube input admittance to cancel the grid circuit losses. After oscillation has built up to a high value and is limited by non-linear tube characteristics, the tank circuit may be operated much closer to resonance at the crystal frequency.

During the build-up period of starting oscillation the R. F. voltage in the tank circuit is below that required for lamp 38 to strike. The stray capacitance contributed by the lamp is slightly less under this condition than when the lamp is glowing and therefore the tank circuit is tuned to a slightly higher frequency than the crystal frequency. Thus, starting is assured, and as the lamp strikes, the capacitance thereof increases slightly and the resonant frequency of the tank circuit automatically is shifted toward the highest output adjustment, that is, toward the crystal frequency. Adjustment of the tank circuit to achieve this condition is a consequence of resonating the tank for maximum brightness of the glow lamp.

The transmitter output is radiated by an antenna 42 connected by a coaxial cable 43 to an inductance 44 which is coupled to inductance 31 of the tank circuit.

From the above description it is thought that the construction and advantages of the invention will be readily apparent to those skilled in the art. Various changes in detail may be made without departing from the spirit or losing the advantages of the invention.

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

1. A radio-frequency transmitter including an audio-frequency oscillator having a plug-in tank circuit tuned to predetermined frequency; a radio-frequency oscillator including a crystal to insure predetermined frequency, a

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tuneable tank circuit and a neon glow lamp having both terminals connected to the radio-frequency high potential terminal of said tuneable tank circuit; said neon glow lamp being proximate to a circuit point of ground potential and having the dual functions of indicating by its brightest glow when said tuneable tank circuit has been tuned to provide maximum radio-frequency voltage and of providing reduced capacitance when not glowing to de-tune said tuneable tank circuit slightly to insure that oscillation will start; said audio-frequency oscillator being connected to said radio-frequency oscillator to modulate the radio-frequency output energy.

2. A radio-frequency transmitter including a radio-frequency oscillator comprising a vacuum tube having a cathode, control grid, screen grid and anode, a tuneable tank circuit having a radio-frequency high potential terminal and a radio-frequency low potential terminal, a neon glow lamp having both terminals connected to said high potential terminal of said tank circuit, a frequency-control crystal connected between said control grid and said low potential terminal of said tank circuit, and a source of modulating voltage connected to said screen grid, said neon glow lamp being proximate to a circuit point of ground potential and having the dual functions of indicating by its brightest glow when said tank circuit has been tuned to provide maximum radio-frequency voltage and of providing reduced capacitance when not glowing to de-tune said tank circuit slightly to insure that oscillation will start.

3. A crystal-controlled radio-frequency oscillator comprising a vacuum tube having a cathode, control grid and anode, a tuneable tank circuit having a radio-frequency high potential terminal and a radio-frequency low potential terminal, a neon glow lamp having both terminals connected to said high potential terminal, a frequency-control crystal connected between said control grid and said low potential terminal, said neon glow lamp being proximate to a circuit point of ground potential and having the dual functions of indicating by its brightest glow when said tank circuit has been tuned to provide maximum radio-frequency voltage and of providing reduced capacitance when not glowing to de-tune said tank circuit slightly to insure that oscillation will start.

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