

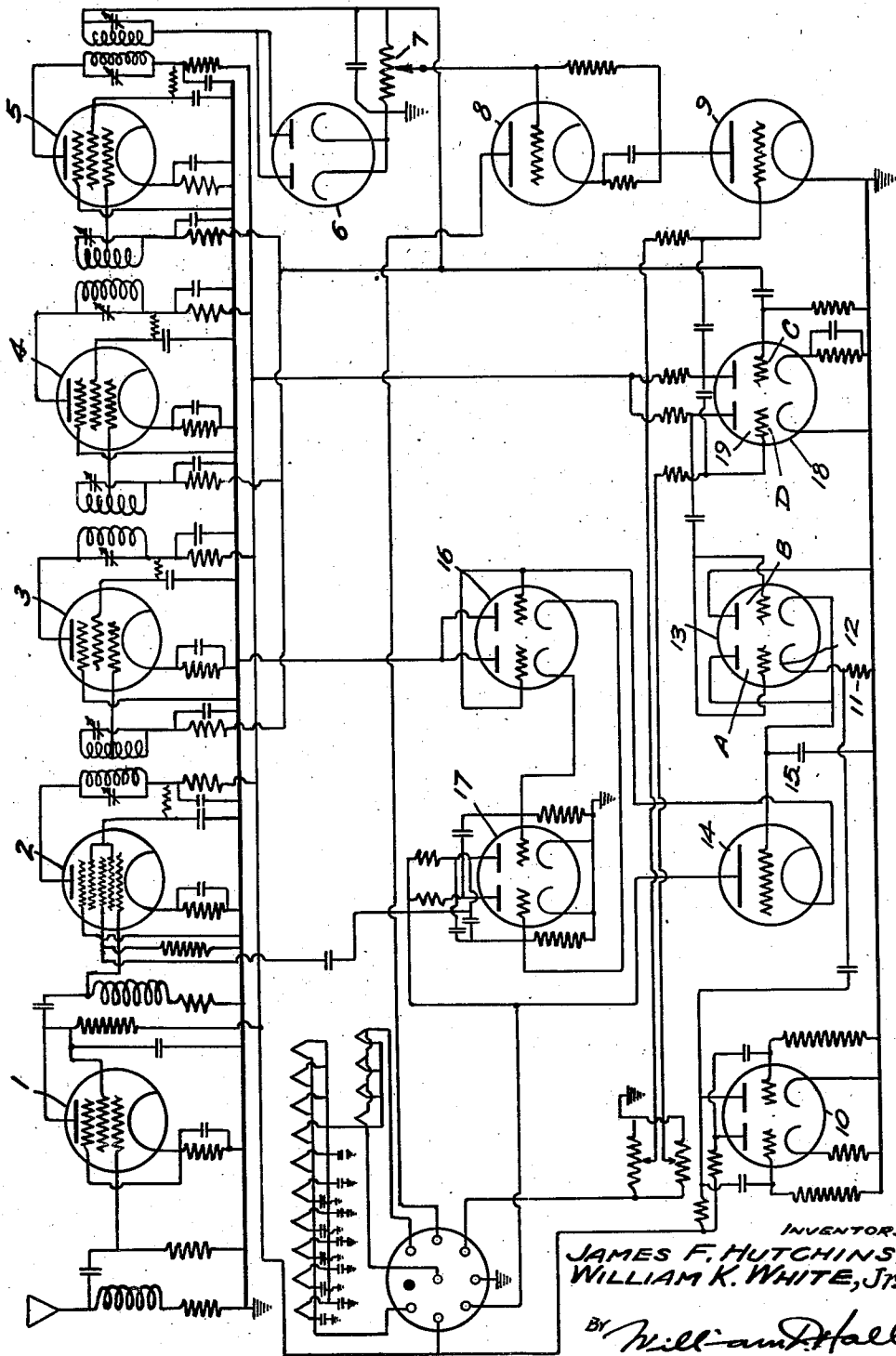
Oct. 29, 1946.

J. F. HUTCHINS ET AL

2,410,075

RAPID FREQUENCY CHANGE RADIO RECEIVER

Filed Jan. 31, 1944



INVENTORS
JAMES F. HUTCHINS
WILLIAM K. WHITE, JR.

By *William D. Hall.*
ATTORNEY

UNITED STATES PATENT OFFICE

2,410,075

RAPID FREQUENCY CHANGE RADIO
RECEIVERJames F. Hutchins and William K. White, Jr.,
San Antonio, Tex.

Application January 31, 1944, Serial No. 520,458

4 Claims. (Cl. 250-20)

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

1

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

This invention relates to improvements in radio receivers subjected to rapid frequency changes.

It is an object of the invention to provide a radio receiver having means to convert into intelligible reception a carrier wave which skips or sweeps from one frequency to another in a manner not necessarily predetermined but which is modulated by pulses of a predetermined pulse rate and a predetermined pulse width.

A further object is the provision of a receiver capable of opening itself to the reception of transmissions of the above mentioned type to the exclusion of other types.

These and other objects are attained by the novel circuit and arrangement of parts hereinafter described and illustrated by the accompanying drawing, forming a part hereof, and in which is shown a schematic diagram of the circuit employed.

Referring to the drawing, the receiver is shown to include a conventional section comprising a stage 1 of radio frequency, a first detector 2, three stages, 3, 4, 5, of intermediate frequency, and diode second detector 6.

Audio signal voltage is taken at 7 from the second detector 6 in a conventional manner, and is applied to the grid of the first audio tube 8. The cathode of tube 8 is not at ground potential but is connected to the plate of an audio blocking tube 9. The cathode of audio blocking tube 9 is at ground potential, and its grid is biased to just below cut-off so that plate current will flow in tubes 8 and 9 when a positive voltage is applied to the grid of tube 9.

The portion of the receiver which produces the sweep voltages includes a twin triode tube 10 used as a multi-vibrator to produce a wave similar to a sine wave. This multi-vibrator tube 10 will produce waves other than near sine-waves, but it has been found that a near-sine wave is the type best suited for this receiver. The frequency sweep voltage produced by multi-vibrator tube 10 and the associated circuit is impressed across a resistor 11, of approximately one megohm, connected between ground and cathode 12 of a twin triode locking tube 13. The triode including cathode 12 will be hereinafter designated as triode A, and the other triode as triode B.

During the negative half-cycle of the sweep voltage impressed across the one megohm re-

2

sistor 11, the plate of triode A assumes a like negative potential below ground as there is no current flowing between cathode and plate. The plate of triode A is connected directly to the grid of tube 14, which is simply a voltage phase inverter. A fixed condenser 15 connected to the plate of triode A will rise and fall in potential in the same manner as the potential of the plate of triode A rises and falls. Its action in so far as causing the receiver to lock on a definite frequency of incoming signal will be hereinafter described.

The output voltage of inverter tube 14 is connected to the grids of a twin triode tube 16, which functions in the same manner as two variable resistances. The conventional part of the receiver employs a multi-vibrator oscillator tube 17 associated with the first detector 2. The frequency of this multi-vibrator tube 17 can be controlled by varying the values of the two grid bias resistors connected to the two grids of the tube. It is apparent that if these resistances can be made to vary simultaneously with the varying in frequency of an incoming signal, the receiver can be made to follow instantaneously any incoming signal that jumps from one frequency to another. In order to accomplish this, the plates and cathodes of tube 16 are connected, as shown in the diagram, to the multi-vibrator oscillator tube 17 in such a way as to cause the plates and cathodes of tube 16 to act in the manner of a variable resistance when connected in parallel with the grid bias resistance of each triode portion of the oscillator tube 17. Varying the cathode to plate resistance of tube 16 will cause the oscillator tube 17 to produce a corresponding change in oscillator signal frequency, and cause the receiver to sweep a band of frequencies. Briefly stated, the receiver is made to sweep a band of frequencies by the near-sine wave output voltage of the multi-vibrator tube 10 applied to tube 16 through the locking tube 13 and phase inverter tube 14, causing a change in grid-bias resistance in each grid-cathode portion of the oscillator tube 17.

As mentioned above, the receiver, among other things, will receive a pulsed signal only. The "pulse discriminator" section of the receiver begins with the negative automatic volume control taken from the diode detector 6. This negative voltage is impressed upon the grid of triode C of a twin-triode discriminator tube 18. The word discriminator has been chosen as the name of tube 18 as its action causes the receiver to discriminate between a pulsed and a non-pulsed signal. The positive voltage pulses produced on

the plate of triode C of tube 18 are fed to the grid 19 of triode D of the tube. This grid 19 is biased sufficiently beyond cut-off so that only the peaks of the positive voltage produced by the plate of triode C will allow plate current to flow in the plate of triode D. It is, therefore, the action of discriminator tube 18 to allow output plate voltage in triode D only during large peaks produced by the pulsed negative voltage audio signal impressed on the grid of triode C. These pulsed voltages are fed from the plate of triode D of tube 18 to the two grids of the locking tube 13, causing plate current flow to cease in both sections of the locking tube 13, thereby removing the near-sine wave voltage of the multi-vibrator tube 19 from the oscillator tube 17. This causes the oscillator tube 17 to stop varying in frequency, and therefore, causes the receiver to lock on the incoming signal if the voltage produced by the multi-vibrator 16 can be maintained at the point it had reached at the time the locking tube 13 was blocked out of the circuit. This is accomplished by means of the fixed condenser 15 which is connected between ground and the plate of triode A of tube 13. This condenser has been rising and falling in charge as the multi-vibrator near-sine wave voltage has been rising and falling in value, and has been discharged by electrons leaking off to ground through triode B of tube 13. The charge of the condenser can be maintained by blocking this leak off path. The leak off path is blocked by the output plate voltage of discriminator tube 18 causing the grid of triode B of tube 13 to become strongly negative. The condenser 15 is now required to maintain its charge, and it will cause the grid bias of the voltage phase inverter tube 14, and in turn the voltage impressed on tube 16, to be maintained, which fixes the frequency of the oscillator 17, and causes the entire receiver to lock on the incoming signal.

The receiver described above will receive radiations that are pulsed and that vary in frequency. The receiver sweeps a band of frequencies, and will open itself up only to a carrier with extremely high amplitude pulses. This presents two changes from the conventional types of radio communication. The first change is in the use of a transmitter that varies rapidly in frequency in an unpredetermined manner and in having a receiver that will sweep the frequency band in which the transmitter is varying and receive these transmissions and convert them into intelligible signals. The second change is in having a transmitter that transmits pulses of predetermined frequency and having a receiver that will discriminate in such manner as to receive these pulses only to the exclusion of other signals.

The invention having been described, what is claimed is:

1. In a receiver for receiving radio signals which sweep rapidly over a band of different frequencies, a conventional super-heterodyne radio receiving circuit having a first detector and a second detector, a multi-vibrator oscillator connected to the first detector, a second multi-vibrator producing a near-sine wave voltage, means controlled by said voltage to affect the oscillator

to cause the receiver to sweep over a band of frequencies, means associated with the second detector to operate only upon the reception of pulses of predetermined frequency and amplitude, and means affected by the operation of said last mentioned means to render the second multi-vibrator ineffective and lock the oscillator at a definite frequency.

2. A device for converting into intelligible reception a carrier wave sweeping from one frequency to another in an indefinite manner and modulated by pulses of a predetermined pulse frequency and amplitude, comprising a conventional type of super-heterodyne radio receiver circuit including a first detector, an oscillator tube connected to said first detector, a multi-vibrator producing a near-sine wave voltage, a triode tube upon which said voltage is impressed, said triode tube being connected to the oscillator tube to vary the grid-bias resistance of the oscillator tube to cause the oscillator to follow the wave of the multi-vibrator and cause the receiver to sweep over a band of frequencies, a discriminator tube connected to said circuit to operate only upon the reception of pulses of a predetermined frequency and amplitude, and means to render the multi-vibrator ineffective and lock the oscillator at a definite frequency when said discriminator tube is placed in operation.

3. In a device for receiving pulses of a predetermined repetition rate and amplitude, a radio circuit, an oscillator tube connected to said circuit, a second tube connected to the oscillator tube and adapted to function as a variable resistance, a multi-vibrator producing a voltage having a predetermined wave shape, a locking tube connected to the multi-vibrator, a phase inverter connected to the locking tube and second tube to cause the second tube to act as a variable resistance and vary the grid-bias of the oscillator tube to cause the receiving circuit to sweep over a band of frequencies, a discriminator tube connected to the circuit and arranged to operate only upon the reception of pulses of a predetermined repetition rate and amplitude, and means connecting the locking tube and discriminator tube to discontinue the operation of the locking tube and lock the device at a definite frequency when the discriminator tube is placed in operation.

4. A device for receiving pulsed radio frequency signals of predetermined repetition rate and amplitude which sweep rapidly over a band of different carrier frequencies, comprising a super-heterodyne receiver including a first detector, an oscillator connected to said first detector, means including a second oscillator to vary said first oscillator to cause the receiver to sweep over a band of carrier frequencies, means to cause said receiver to become operative to produce a signal output only upon the reception of pulses of a predetermined repetition rate and amplitude, and means conditioned by said last mentioned means to render said second oscillator ineffective and to lock said first oscillator at a definite carrier frequency.

JAMES F. HUTCHINS.
WILLIAM K. WHITE, JR