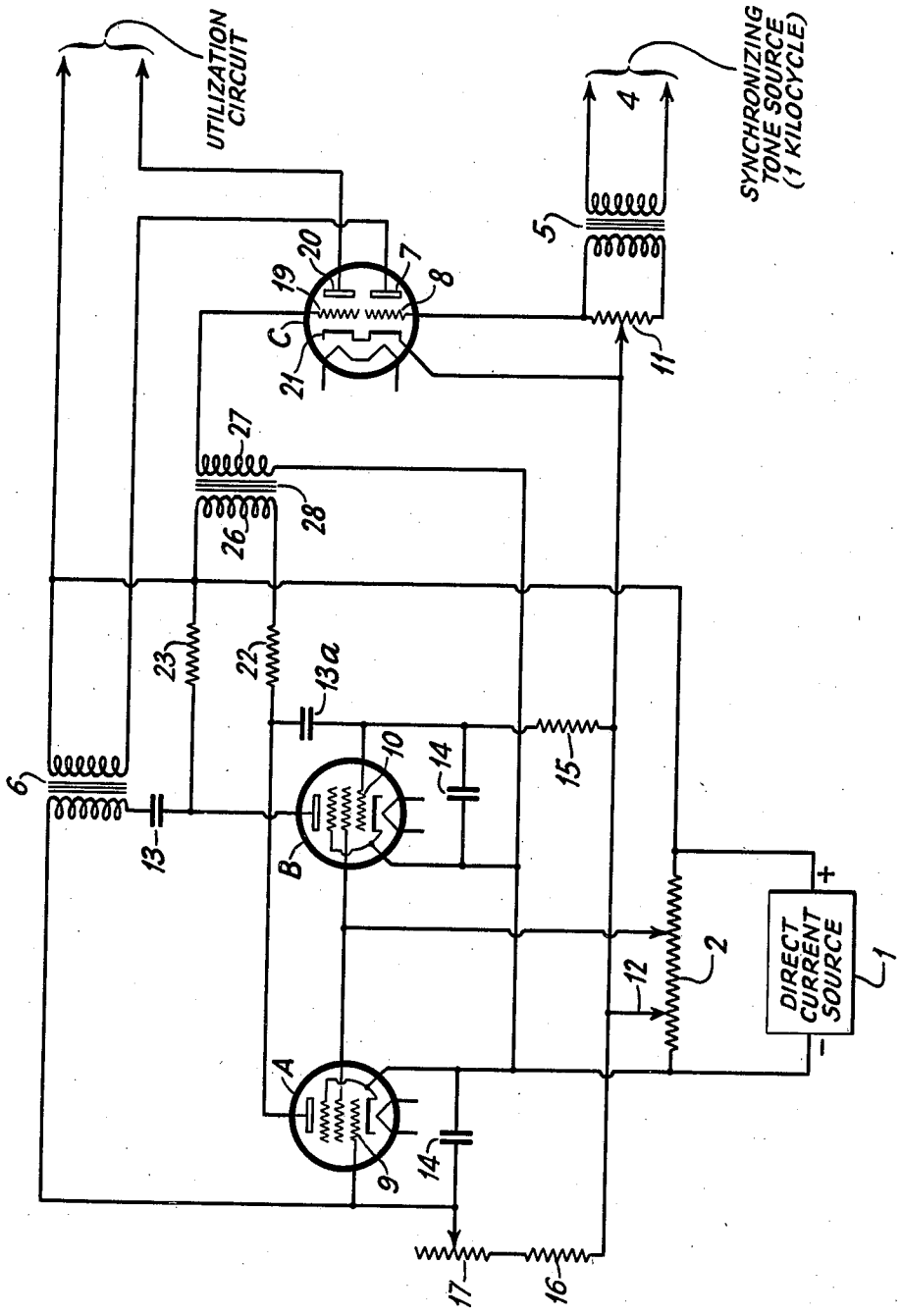
Jan. 27, 1942. J. L. FINCH 2,271,186

SHORT DOT GENERATOR

Filed June 7, 1939



INVENTOR.
JAMES L. FINCH

BY H. B. Brown

ATTORNEY.

Patented Jan. 27, 1942 2,271,186

UNITED STATES PATENT OFFICE

2,271,186

SHORT DOT GENERATOR

James L. Finch, Patchogue, N. Y., assignor to Radio Corporation of America, a corporation of Delaware

Application June 7, 1939, Serial No. 277,867

5 Claims. (Cl. 250—36)

This invention relates to electronic oscillation generators and more particularly to a system for generating short dots such as may be used in radio apparatus for transmitting and other purposes.

In order to explore the propagation characteristics of the ether it is often advisable to transmit very short impulses which are received and studied at a mobile receiving station. My invention relates to a method of generating and controlling these short impulses. My invention makes use of the well known multivibrator circuit which establishes the recurring frequency of the pulses. I also make use of a time constant circuit employing a resistance and a reactance in series for determining the length of these pulses. Means are provided for synchronizing the multivibrator circuit frequency with a source of constant frequency tone. This improves the accuracy of the spacing of the pulses transmitted.

According to past practice it has been very difficult to obtain a reliable source of dot impulses such as would meet certain requirements. If mechanical contacts were used there was a tendency for the time intervals to vary between the opening and succeeding closing of such contacts. Another difficulty encountered in former practice was to obtain impulses of sufficient brevity at a relatively low repetition rate in order to meet certain accurate timing requirements.

It is an object of my invention, therefore, to overcome these difficulties and to provide a more accurate and reliable source of dot impulses.

My invention will now be described in detail, reference being made to the accompanying drawing, the sole figure of which represents a circuit diagram of a preferred embodiment.

Referring to the drawing, I show a conventional source of direct current 1 having positive and negative output leads to a potentiometer 2 from which suitable voltages can be obtained to meet all requirements.

The circuit arrangement employs a multivibrator oscillator of more or less conventional type. This oscillator preferably includes two pentode tubes A and B. The frequency of oscillation is established by the value of the blocking condensers 13 and 13_a, and the resistors 15, 16 and 17. The resistor 17 is made adjustable for accurate calibration of the instrument.

A synchronizing tone source 4 is impressed on the control grid of the tube A through a transformer 5. The tone source energy is, however, amplified by means of the lower triode of a double triode tube C.

In the particular circuit illustrated, which conforms to apparatus actually constructed, the multivibrator frequency, and hence the short dot repetition frequency, can be set for fifty dots per second, and a one-kilocycle synchronizing tone can be used. Thus the multivibrator circuit oscillates at a frequency one-twentieth of the synchronizing tone frequency.

As before stated, the resistor 17 is made variable so that small adjustments of the multivibrator frequency can be accomplished. The level of the synchronizing tone can be adjusted by means of a potentiometer 11. This level is determined empirically so as to reliably lock the multivibrator frequency and to definitely fix that frequency.

The amplified tone frequency as heretofore mentioned is impressed upon the primary of a transformer 6. This primary is in circuit between the positive side of the direct current source 1 and the anode 7 of the double triode tube C. The grid 8 of this tube is fed with the unamplified tone frequency energy. One terminal of the secondary of the transformer 6 is connected to a tap on the resistor 17 and also to the grid 9 of the tube A. The other terminal of the secondary of the transformer 6 is coupled by means of a capacitor 13 to the anode of tube B. A corresponding capacitor 13_a couples the anode of tube A with the control grid 10 of tube B. Suitable positive bias potential is obtained for the control grids 9 and 10, in the one case through resistors 16 and 17, and in the other case through resistor 15, with respect to the cathode potential of the tubes A and B. Both biases, however, are influenced by the position of the tap 12 on the potentiometer 2.

During a cycle of the oscillation of the multivibrator the plate current through tube A tends to suddenly drop to a low value and an instant later it tends to suddenly rise to a definite higher value. This current is passed through the primary winding 26 of transformer 28. The reactance of this transformer prevents the current from changing instantly. While the current in tube A is changing, a voltage is set up across the secondary winding 27. This voltage is impressed on the grid 19 of the upper triode of tube C. The upper triode of tube C is biased beyond cutoff by virtue of the potential drop in potentiometer 2 between the tap 12 and the negative terminal of the source 1. During the interval when winding 27 impresses a positive

voltage on the grid of this triode its plate circuit becomes conductive. During the interval when negative voltage is impressed on this grid it has no effect on the plate circuit since it is already biased beyond cutoff.

It will be observed from the above description that the multivibrator operates to impress short dot impulses upon the control grid 19 of the upper triode in the tube C. The anode 20 is connected through a utilization circuit back to the cathode 21 through the direct current source 1 and the potentiometer tap 12. This utilization circuit may, if desired, be a keying circuit for a transmitter, and when so used the keying circuit consists usually of one or more electron discharge tubes under control of impulses derived from the anode 20 of the tube C. When the upper triode of the tube C becomes conductive the first transmitter tube (not shown) becomes blocked. Conversely, when the upper triode section of the tube C becomes blocked the first transmitter tube in the utilization circuit is rendered conductive.

The relative value of the inductance of winding 26 and of the resistance including resistance 22 of the plate circuit of tube A determines the length of time that the grid 19 in tube C remains positive and this in turn determines the length of the interval during which the upper triode in tube C is rendered conductive for the purpose of blocking the transmitter tube in the utilization circuit. The blocking of the transmitter tube is designated as a marking dot, whereas the conductive condition of the transmitter tube is referred to as a space interval.

The operation of the multivibrator as used in connection with this invention is well known in the art, as is also the method of locking it in step with a synchronizing tone. Briefly this operation is as follows:

At a particular instant in the oscillation cycle tube A becomes conductive. This causes the plate voltage to drop and, this plate being coupled to the grid 10 of tube B through capacitor 13_a, grid 10 also goes negative and blocks tube B. Current now flows into capacitor 13_a from potentiometer 12 through resistor 15 and raises the voltage on grid 10. At the end of a period of about half the duration of one cycle grid 10 becomes more positive than cutoff and tube B starts to conduct. The plate current increase in tube B causes the plate voltage to drop due to increased IR drop in resistor 23. This regenerates through tube A acting as an amplifier to make grid 10 still more positive and the plate current of tube B to go to the maximum permitted by the circuit constants.

Similar changes take place in tube A, due to tube B suddenly becoming conductive, as described above for tube B. However, in this case as the voltage on grid 9 rises toward the cutoff point, the superimposed 1000 cycle voltage from transformer 6 causes tube A to become conductive on one of its peaks, and this causes the oscillator frequency to hold at a definite sub-multiple of 1000 cycles.

My invention is capable of modification in many respects to meet different requirements. Such modifications will readily suggest themselves to those skilled in the art. The invention itself has been found to be of considerable value in testing work, particularly on telegraph communications channels. The novelty of the arrangement is defined by the claims.

I claim:

1. A short dot keying device comprising a synchronizing source for producing a wave the frequency of which is a multiple of the frequency of the dots to be generated, a generator of the multivibrator type embodying two electron discharge tubes A and B, having output circuits and control electrodes, control circuits for said tubes, the control circuit for tube A being inductively coupled to said synchronizing source and electrostatically coupled to the output circuit of tube B, the output circuit for tube A being electrostatically coupled to the control electrode of tube B and including the primary winding of a transformer, an electronic amplifier having an input circuit which includes the secondary winding of said transformer, a utilization circuit in the output of said electronic amplifier, and means for limiting the conductive state of said amplifier to a period commensurate with the short keying dots and for maintaining said amplifier biased to cut-off during the remaining period of conductivity of tube A.

2. A system for producing a periodic succession of short dot impulses with relatively long spacing intervals therebetween, which comprises, a synchronizing source, time constant means having a time constant which is a multiple of the frequency of said source, electronic means having two space current paths, means including said time constant means for intercoupling said space paths to cause substantially constant current to flow in the two said paths alternately at a frequency which is a sub-harmonic of said synchronizing source, means for coupling said synchronizing source to one of said space current paths of said electronic means, transformer means connected in series with the other of said space current paths, an amplifier, means for connecting said transformer to control said amplifier, and means including biasing means for said amplifier for limiting the conductive periods of said amplifier in accordance with potential surges arising in said amplifier control means at moments of transition between one and another state of conductivity in one of said space current paths, to produce said short dot impulses.

3. A short dot keying device in combination with a multivibrator and a source of synchronizing impulses, said keying device comprising one triode section of a double triode discharge tube, the control electrode of said section being normally biased to cut-off and having an inductive coupling element in circuit therewith, said multivibrator comprising two discharge tubes A and B, each having input and output circuits, the input circuit of tube A being electrostatically coupled to the output circuit of tube B and the input circuit of tube B being electrostatically coupled to the output circuit of tube A, said source of synchronizing impulses being of a frequency harmonically related to the frequency of said multivibrator, means including an amplifier comprising another section of said double triode discharge tube for feeding impulses from said synchronizing source to the input circuit of tube A, means including resistive and reactive elements for producing spacing intervals of constant duration which are long compared to said dot impulses, and an inductance in the output circuit of tube A, said inductance being coupled to said inductive coupling element.

4. A multivibrator comprising two electronic devices A and B, each having output circuits and control electrodes, resistive control circuits for

each device, the control circuit for device A including the secondary of a transformer, a twin triode discharge tube, a synchronizing tone source, one of the triodes of said twin discharge tube having a control grid coupled to said tone source and having an output circuit including the primary of said transformer, a second transformer having a primary and a secondary, its primary being disposed in the output circuit of discharge device A, the second triode of said twin discharge tube having an input circuit which includes the secondary of said second transformer; and means cooperative with the resistive control circuits for each device for fixing the frequency of said multivibrator at a subharmonic of said tone source, said means comprising two capacitors one connected between the anode of device A and the control electrode of device B, the other connected between the anode of device B and the control electrode of device A.

5. Apparatus for producing a periodic succession of short sharp impulses separated by relatively long spacing intervals comprising, a source of alternating current a predetermined number of cycles of which is commensurate in time with the periodicity of said impulses, an oscillator of the multivibrator type having a discharge device characterized by cross-coupled input and output electrodes for two discharge paths, and circuits for said electrodes such that a conductive state in each path results in the application of a cut-off control bias to a discharge in the other path, and an interruption of the discharge in one path renders the other path conductive, means for amplifying and transforming the energy from said alternating current source and applying the same as a synchronizing control potential in one of said discharge paths, a transformer having its primary winding in the output circuit for that one of said discharge paths, an electronic amplifier having an input circuit which includes a secondary winding on said transformer, and a useful output circuit on which said short sharp impulses are impressed, and means including time constant elements in circuit with the primary of said transformer and arranged to fix the frequency of said oscillator so as to induce control potentials in the secondary of said transformer at the desired periodicity of said impulses.

JAMES L. FINCH.