July 6, 1948. C. E. CLEETON 2,444,429

PULSE TYPE TELEGRAPH TRANSMITTER AND RECEIVER

Filed May 15, 1940

FIG. 1

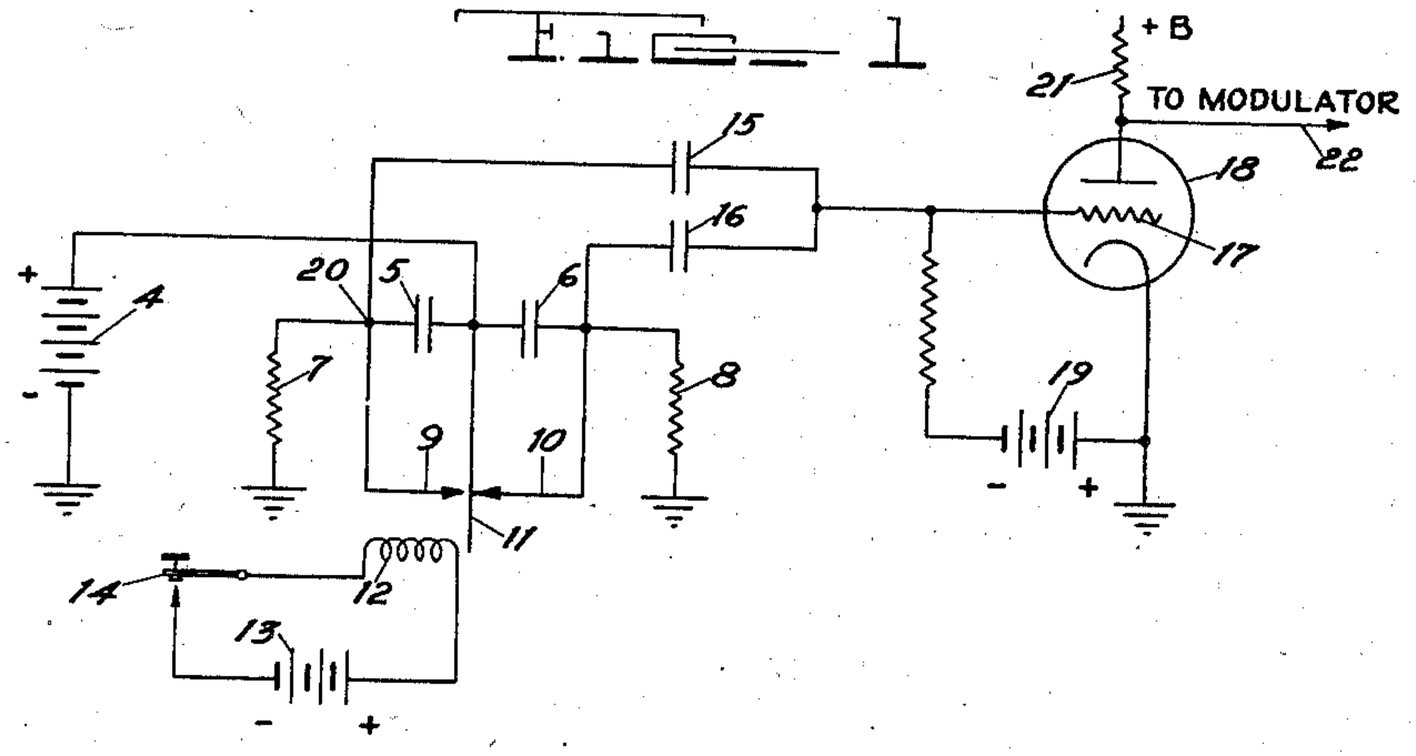


FIG. 2

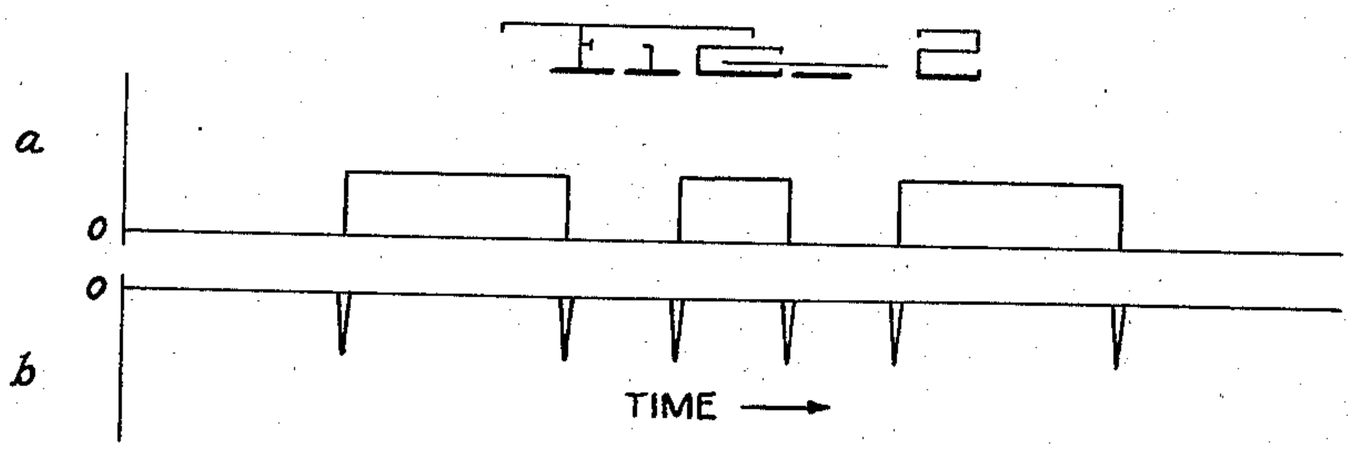
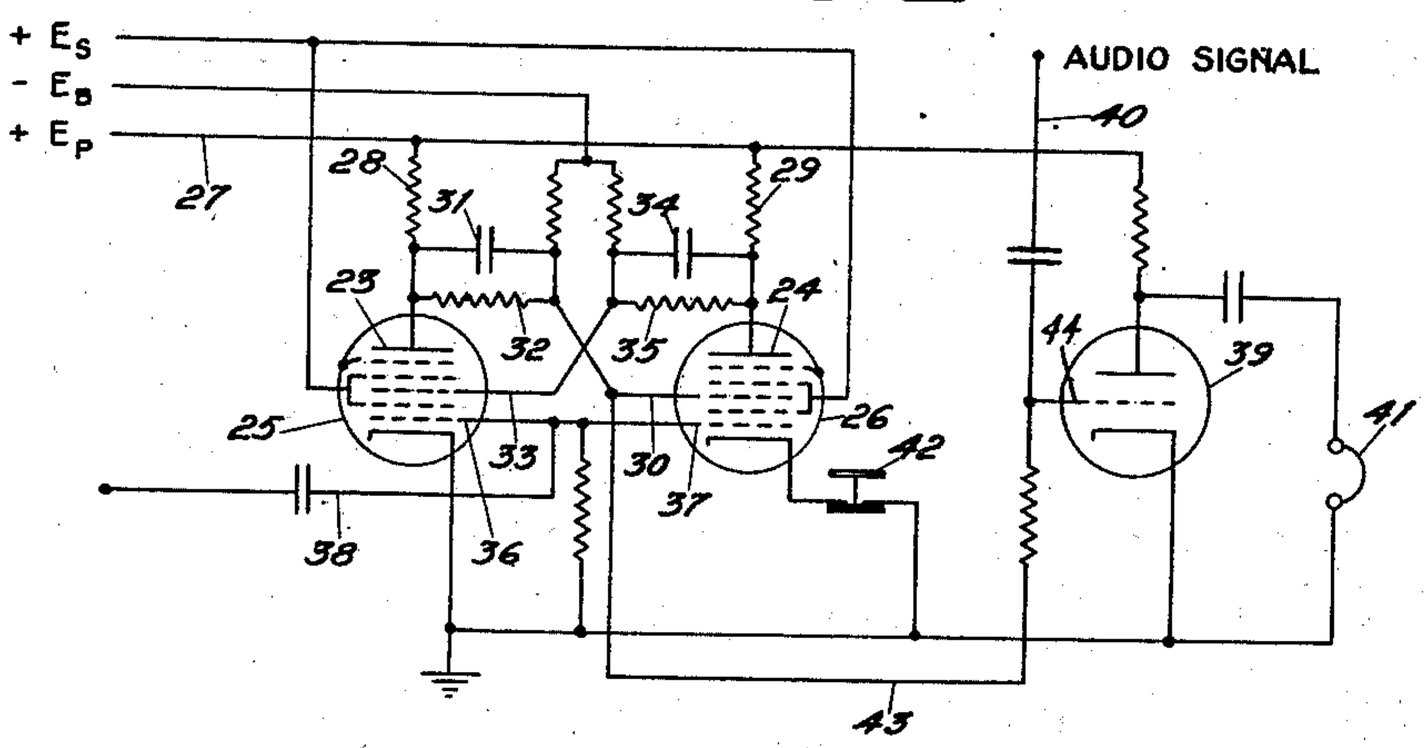


FIG. 3



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Patented July 6, 1948

2,444,429

UNITED STATES PATENT OFFICE

2,444,429

PULSE TYPE TELEGRAPH TRANSMITTER AND RECEIVER

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Application May 15, 1940, Serial No. 335,316

5 Claims. (Cl. 178—68)

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

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This invention relates to a communication system wherein short pulses are utilized to mark the beginning and the end of a dot or a dash in code transmission, and to means for receiving the transmitted pulses and converting them into dot and dash signals.

One object of this invention is to provide a simple device for deriving a voltage pulse when a key is closed and another pulse when the key is opened.

Another object is to provide receiving means wherein a discernible signal will be initiated upon reception of one pulse of a pair and terminated when the second pulse of the pair is received, thus making the duration of the signal equal to the time interval between the pulses of the pair.

A further object is to provide a code communication system having a considerable degree of secrecy.

In the drawings:

Fig. 1 is a schematic showing of apparatus for producing a pulse when the key is closed and a second pulse when the key is opened;

Fig. 2 shows graphically the relation of the pulses and the final code signals, preferably audio signals; and

Fig. 3 depicts a circuit arrangement for converting the pulses derived from the sending apparatus in Fig. 1 into audio signals.

As used herein, the expression "signal element" is a generic term denoting either a dot or a dash in any conventional code.

Referring now to Fig. 1, the source of current 4, shown as a battery, has its negative side grounded and its positive side connected to one terminal of each of two capacitors 5 and 6, the other terminals of these capacitors being connected to ground through resistors 7 and 8, respectively. Relay contact 9 is connected between capacitor 5 and resistor 7 and contact 10 is connected between capacitor 6 and resistor 8, while movable armature 11 is connected between capacitors 5 and 6 and is biased to lie in circuit closing relation with the contact 10. Relay solenoid 12 is in series with a source of current 13 and a key 14. Coupling capacitors 15 and 16 are respectively connected between capacitor 5 and resistor 7, and capacitor 6 and resistor 8. The grid 17 of tube 18 is connected to both of capacitors 15 and 16, the tube 18 being biased to cutoff, or substantially so, by battery 19.

The operation of the device shown in Fig. 1 is as follows: When armature 11 lies against contact 10 the capacitor 5 charges up through resistor 7. Closing the key 14 energizes solenoid

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12 which attracts armature 11 and moves it into circuit closing relation with contact 9, thereby discharging capacitor 5 and changing the potential at point 20 from ground potential to substantially that of source 4 and a positive pulse is transmitted through capacitor 15 to grid 17, causing tube 18 to become transiently conducting which gives rise to an IR drop across anode resistor 21 and a negative pulse is sent out over connecting lead 22.

While the circuit is closed through contact 9, capacitor 6 charges up through resistor 8 and when key 14 is released the armature 11 swings back to contact 10 and discharges capacitor 6 thus giving rise to a second positive pulse that is transmitted through capacitor 16 to grid 17 and a second negative pulse is sent out over lead 22 in the manner above described. It is obvious that the time interval between the two pulses of the pair is determined by the time during which key 14 is held closed and thus the interval between the pulses of a pair can be made to correspond to the duration of a dot or a dash.

Fig. 3 discloses means to be utilized at the receiver for converting the pairs of pulses into dot and dash signals. Fundamentally, the circuit of Fig. 3 is a locked electronic relay or "scale-of-two" counter. Anodes 23 and 24 of tubes 25 and 26 are connected to a common anode supply lead 27 through the respective anode resistors 28 and 29. The anode 23 of tube 25 is connected to grid 30 of tube 26 through capacitor 31 and resistor 32 in parallel and the anode 24 of tube 26 is likewise connected to grid 33 of tube 25 through capacitor 34 and resistor 35 in parallel. It is thus apparent that when tube 25 passes current the IR drop across resistor 28 will be applied to grid 30 to hold tube 26 non-conducting and in like manner the IR drop across resistor 29 when tube 26 is conducting will be applied to grid 33 and hold tube 25 non-conducting. When either tube is non-conducting the voltage applied to the grid 30 or 33 as the case may be, of the other tube is such as to render the other tube conducting.

Grids 36 and 37 of tubes 25 and 26 are connected in common to input lead 38 that may be connected to any receiver or amplifier adapted to respond to the short pulses transmitted from the sending apparatus controlled by the circuits of Fig. 1. Grid 44 of output tube 39 is connected to grid 30 of tube 26 whereby when tube 25 is conducting the high potential drop across resistor 28 holds tube 39 blocked but when tube 26 is conducting the positive anode potential of tube 25 on grid 44 makes tube 39 conducting. Input

lead 40 is connected to grid 44 to apply thereto a signal voltage, preferably in the audio range but the value of this signal is insufficient to cause tube 39 to pass current when tube 25 is conducting and therefore the audio signal appears in the indicating device 41, shown as a pair of head phones, only when the tube 26 is conducting.

The operation of the receiving device in Fig. 3 is as follows: Key 42 in the cathode circuit of tube 26 is opened to break the cathode circuit and insure that tube 25 will be initially conducting which, as above described, holds output tube 39 non-conducting. When the first negative pulse of a pair is received over input 38 tube 25 is blocked and tube 26 becomes conducting. The rise of potential on anode 23 is transmitted over lead 43 to grid 44 which unblocks tube 39 and the audio signal fed into tube 39 over lead 40 is discernible in the headphones 41. Tube 39 continues to conduct until the second pulse of a pair comes in over input 38 which blocks tube 26 and throws conductivity back to tube 25. The IR drop across resistor 28 is then applied to grid 44 and tube 39 ceases to conduct and the audio signal is cut off, thus terminating the signal element represented by the two pulses of the pair. It is thus apparent that the duration of signal in headphones 41 is equal to the time interval between the pulses, that is, equal to the time that key 14 is held closed.

One advantage of this system is that the amplitude of the signal in phones 41 is constant because it is locally generated and is not affected with noise or static. A further advantage is that, owing to the extremely short duration of the pulses, the transmitter output may be many times as great as when the transmitter is keyed on continuously and thus the sensitivity of the receiving circuits may be reduced to suppress most of the background noise. A still further advantage is the considerable degree of secrecy resulting from the fact that intelligible signals cannot be derived from the transmitted pulses unless apparatus corresponding to Fig. 3 is used at the receiving end.

In Fig. 2 the graph *b* shows the negative pulses that are sent out at the closing of the key 14 and at the opening thereof, while graph *a* depicts the output signals heard in phones 41 corresponding to the pairs of pulses.

The invention herein described and claimed may be used and/or manufactured by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A pulse system for code communication, comprising a tube having an anode, a cathode and a grid; an anode resistor connecting said anode to a positive supply source, means to bias said tube at least substantially to cut-off in the absence of a signal, a first and a second storage capacitor connected in series, a source of current connected at its positive side to a point between said capacitors and at its other side to ground, a respective resistor connecting the other side of each said storage capacitor to ground, a respective contact and coupling capacitance connected between each said storage capacitor and the respective resistor, common means connecting said coupling capacitors to said grid, a movable armature connected to a point between said storage capacitors and movable into circuit closing position against either of said contacts but biased to lie against one of said contacts, a relay coil disposed to move said armature against the other said contact when energized, means including a key operable to form a closed circuit to energize said relay coil, whereby a storage capacitor is discharged each time said armature is moved against one of said contacts and a positive pulse is applied to said grid to render said tube transiently conductive and output means connected to said anode, whereby a negative keying pulse is derived each time said tube becomes conductive.

2. A pulse system for code communication, comprising the combination of apparatus as set forth in claim 1 with means to receive and translate transmitted signals corresponding to the said keying pulses including a first and a second relay tube each having at least two grids, a cathode and an anode; an anode resistor connecting each relay tube anode to a positive supply, a resistor and a capacitor in parallel connecting the second grid of each relay tube to the anode of the other relay tube whereby the potential drop across the anode resistor when either tube passes current holds the other relay tube non-conducting; a signal output tube having a cathode, grid and anode, means to apply to the grid of said control tube the potential on the second grid of said second relay tube whereby said control tube and said second relay tube are made simultaneously conductive or non-conductive, means to apply an audio signal voltage to the grid of said control tube, said first relay tube being initially conductive, whereby a negative pulse applied to said input renders said first relay tube non-conductive and said second relay tube and said control tube conductive, and a subsequent negative pulse applied to said input renders said first relay tube conductive and said second relay tube and said control tube non-conductive, and signal translating means connected across said control tube to respond to said audio signal while said control tube is conductive.

3. A pulse system for code communication, comprising apparatus to respond to received signal pulses, including a first and a second relay tube each having at least two grids, a cathode and an anode; an anode resistor connecting each relay tube anode to a positive supply, a resistor and a capacitor in parallel connecting the second grid of each relay tube to the anode of the other relay tube whereby the potential drop across the anode resistor when either tube passes current holds the other relay tube non-conducting; a signal output tube having a cathode, grid and anode, means to apply to the grid of said control tube the potential on the second grid of said second relay tube whereby said control tube and said second relay tube are made simultaneously conductive or non-conductive, means to apply an audio signal voltage to the grid of said control tube, said first relay tube being initially conductive, whereby a negative pulse applied to said input renders said first relay tube non-conductive and said second relay tube and said control tube conductive, and a subsequent negative pulse applied to said input renders said first relay tube conductive and said second relay tube and said control tube non-conductive, and signal translating means connected across said control tube to respond to said audio signal while said control tube is conductive.

4. A pulse system for code communication, comprising two contacts, an armature movable into and away from circuit closing relation with

each said contact, a respective capacitor connected to each said contact, means to charge either said capacitor when the respectively connected contact is in open circuit relation with said armature, means connecting said armature to both said capacitors whereby either capacitor discharges when its respectively connected contact is in circuit closing relation with said armature, said armature being biased to closed circuit relation with one of said contacts, a solenoid, means including a key to energize said solenoid to move said armature to the other said contact, a tube biased to non-conduction in the absence of signal, means coupling said capacitors to said tube to apply a positive potential to render said tube transiently conducting when one said capacitor is discharged upon closing the circuit through the said other capacitor by closing said key and to apply another positive potential to render said tube transiently conducting when the said one capacitor is discharged upon opening said key, and means in circuit with said tube to provide a keying pulse each time said tube becomes conducting.

5. Means to receive code signals whereof each signal element is transmitted as a pair of pulses, the interval between pulses of a pair being definitive of the respective element, comprising an electronic relay having a pair of vacuum tubes regeneratively interconnected to support either of two stable states, one of said states existing when one of said tubes is conducting and the other thereof is non-conducting, the other of said states existing when said other of said tubes is conducting and said one of said tubes is non-conducting, said relay being further arranged to change rapidly from either one of said states to the other in response to an input pulse applied thereto, an output amplifying means operatively connected to said relay and adapted to be held

inoperative in response to the existence of one of said states and operative in response to the other of said states, means to apply to said output amplifying means a signal varying at an audio frequency to produce an audio output when said output amplifying means is rendered operative, and means for applying the pulses defining said signal elements to said electronic relay for changing the state thereof whereby the first pulse of a pair will render said output amplifying means operative, and the second pulse of a pair will render said output amplifying means inoperative.

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