April 4, 1950 R. H. DUNN ET AL 2,502,443

UNIVERSAL ELECTRONIC CODE SENDER

Filed Sept. 15, 1948 2 Sheets-Sheet 1

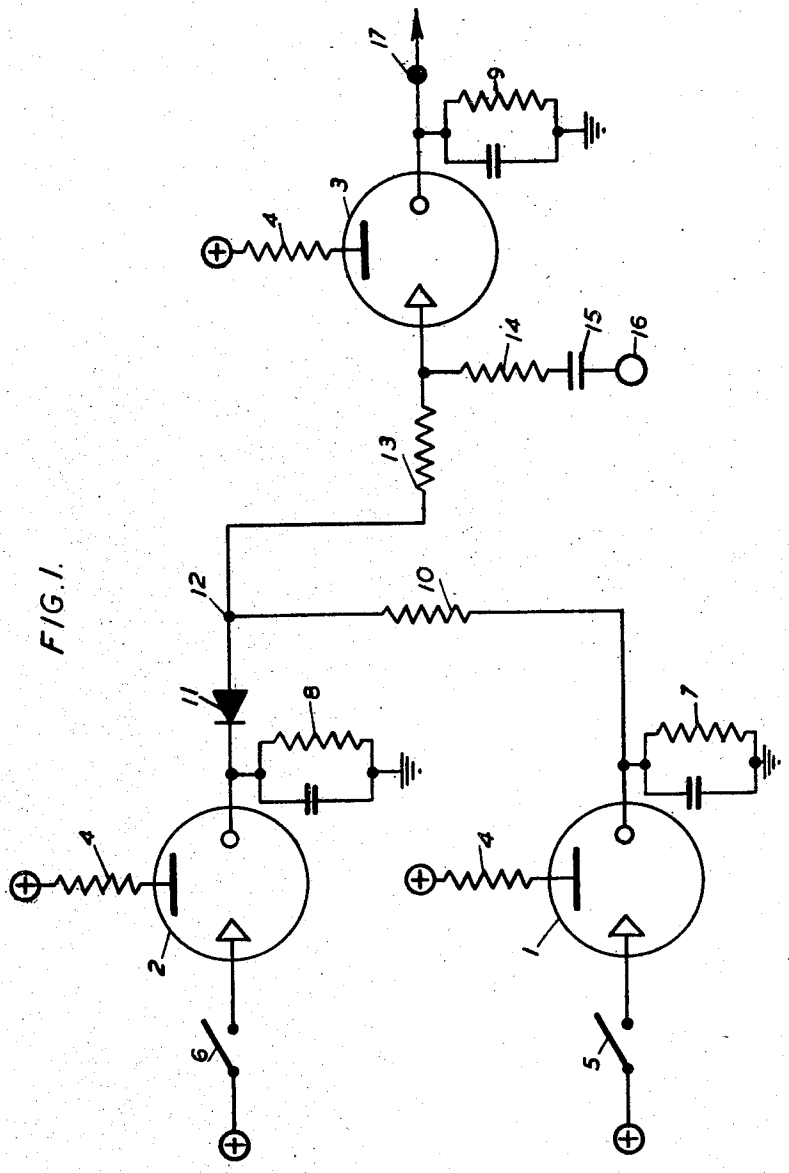


FIG. 1.

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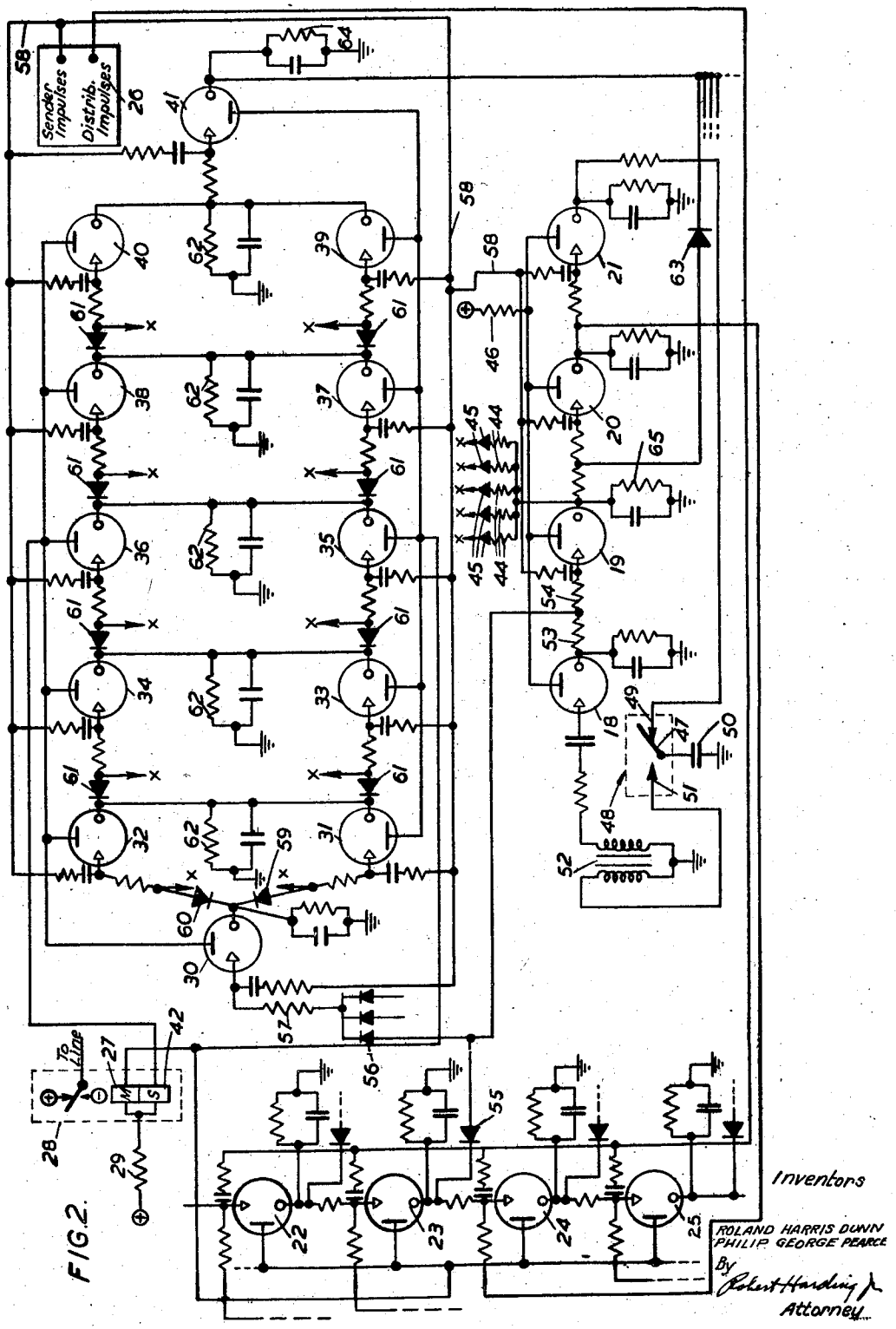


FIG. 2.

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2,502,443

UNIVERSAL ELECTRONIC CODE SENDER

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Application September 15, 1948, Serial No. 49,432
In Great Britain September 17, 1947

9 Claims. (Cl. 178—53.1)

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This invention relates to telegraph code transmitters. In known types of telegraph code transmitters the signals consisting of sequences of positive or negative electrical impulses are sent out by mechanical means acting to open or close contacts associated with a source of signaling current. In transmitters as used in printing telegraph systems the speed at which successive signal impulses follow one another is usually controlled by the speed at which a driving motor rotates and it is necessary for the receiving mechanism to be driven at approximately the same speed. Normally, in such systems, the driving motors are run continuously but the receiving mechanism is brought into action by the first element of each signal combination transmitted, this element being known as the "start" element and its function being to operate a clutch in the receiver to cause the receiving mechanism to engage with the continuously running motor. The last element transmitted of each signal combination is the "stop" element which causes the clutch to disengage. It can be seen that as the receiving mechanism is in effect started afresh for each signal combination, there is no necessity for the motor speeds at the two ends to be very closely synchronised. In printing telegraph systems it is common to employ a code in which each character to be transmitted is built up of five elements, hereinafter referred to as, "code elements," any one of which can be either positive or negative. This code of itself provides thirty-two possible combinations and it is usual to employ one of the combinations for providing a case shift combination which causes a mechanism to change the position of the printing means at the receiver thereby enabling each of the remaining combinations to be employed to transmit either of two alternative characters depending on the position of the case shift mechanism. The word "character" is used to denote any of the thirty-two possible combinations, even though some of these may be used to initiate functions, such as actuating a case shift mechanism and not represent a character to be recorded. In addition to the five elements forming each code combination, there is a start element preceding each code combination and a stop element following it, so that the complete signal combination representing each transmitted character is built up of a sequence of seven impulses. The terms "signal combination" and "code combination" are used in this sense throughout this description and in the appended claims.

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In the co-pending application of E. M. S. McWhirter, R. H. Dunn and P. W. Lennox, filed April 25, 1947, and bearing Serial No. 744,009, there is described a system by which telegraph code combinations are transmitted to convey to a control station intelligence concerning the positions and changes of meters or switches at an out-station. The transmitter therein described makes use of electric discharge devices of the kind known as three-electrode, cold-cathode tubes. In the embodiment described, it was only necessary to provide for a limited number of code combinations and certain simplifications resulted therefrom, but it was proposed to use selected combinations of the five-unit telegraph code. It was evident that by increasing the complexity of the transmitting circuits, increased numbers of code combinations could be sent. The object of the present invention is to provide improved means for sending out an increased number of possible code combinations, using cold cathode tubes in place of mechanical devices, without the complexity which would be involved in a mere multiplication of the circuits described in the above mentioned application.

In the co-pending application of E. M. S. McWhirter, R. H. Dunn and P. W. Lennox, filed April 25, 1947, and bearing Serial No. 744,010, there is described means for receiving code of the kind used in printing-telegraph systems in which the moving parts essential in the mechanical receiver, have been replaced by electric discharge devices suitably connected together. The invention therein described is primarily intended for receiving only a limited number of combinations, viz; five less than thirty-two; but it is pointed out that there is no difficulty in constructing a receiver employing the same principles for any desired number of combinations and a figure is given illustrating the connections required for receiving thirty-two different combinations. The receiver diagrammatically illustrated provides means not involving the use of any moving mechanical parts whereby any particular received five-element signal combination acts on a succession of electric discharge devices in such a way that a potential appears at one and one only of thirty-two output terminals corresponding to the thirty-two possible code combinations. The potentials can be caused to actuate relays or other devices to effect appropriate printing or other operations.

The present invention provides a transmitter for start-stop telegraph signals consisting of combinations of marking and spacing elements com-

prising a chain of cold-cathode electric discharge devices, one device for the start element of a combination, one device for the stop element of a combination, a pair of devices consisting of a marking device and a spacing device for each code element of the combination, means for causing the start device, one of each code pair of devices, and the stop device to become conducting sequentially for equal periods of time, means for determining which device of each code pair of devices shall become conducting during the corresponding periods, and means for causing the transmission of a spacing element when either the start device or the spacing device of any code pair becomes conducting and means for causing the transmission of a marking element when either the stop device or the marking device of any code pair becomes conducting.

The transmitter about to be described is built up of three-electrode gas-filled tubes suitably connected together through resistances, condensers, rectifiers, etc., providing means whereby the operation of a contact, possibly by the depression of a selected key on a keyboard, initiates a chain of operations which results in a coded signal corresponding to any selected one of the thirty-two possible combinations to be transmitted. The principle can equally well be applied to codes in which each code combination consists of more or less than five code elements so long as all code combinations in the code contain the same number of code elements.

All the tubes used in the circuit to be described are three-electrode gas-filled tubes. Each tube is provided with an anode, a control electrode and a cathode, and thus there is a control gap between the control electrode and the cathode and a main gap between the anode and the cathode. A certain minimum voltage is necessary between the control electrode and the cathode to ionise the gas and render the control gap conducting and when the control gap becomes conducting the main gap between the anode and the cathode also becomes conducting provided the anode is at a sufficiently high positive potential with respect to the cathode. When the main gap has thus been made conducting the tube is said to have been fired and once a gap has been made conducting a lower potential difference across it will sustain it in a conducting state than the potential necessary to initiate the discharge. When the potential drop across the gaps has been reduced to a point at which conduction ceases the tube is found to be extinguished.

The transmitter requires the following five distinct assemblies of equipment:

(1) An impulse generator delivering two sets of direct current impulses at regular intervals, the repetition rate of the impulses of each set being the same but the impulses of one set being timed to occur half-way between the impulses of the other set. These impulses can be provided by many forms of generator, mechanised or otherwise and no description of such a generator is necessary.

(2) A character circuit consisting of a plurality of three-electrode gas-filled tubes, this circuit being brought into action by the closing of a contact corresponding to the desired character. One such character circuit is required for each character to be transmitted.

(3) A selector circuit consisting of a chain of three-electrode gas-filled tubes so connected as to form the familiar electronic counting chain. In such a chain of tubes, it is arranged that each impulse from an impulse generator causes one tube to fire, the preceding tube in the chain being simultaneously extinguished, so that in normal conditions the tubes forming the chain are fired sequentially and only one is conducting at a time. Such a chain is described in British Patent Specification No. 566,156. The characteristics of the tubes permit of considerable variation in the way the connections are made to produce a counting chain.

The selector or distributor chain in the present case must contain one tube for each character circuit: i. e., to provide for the transmission of thirty-two characters there must be thirty-two tubes in the chain.

(4) A sender circuit comprising a plurality of similar tubes, there being two tubes for each element of the code: i. e., ten tubes in the case of a five-unit code with, in addition, a start-tube and a stop-tube.

(5) A telegraph transmitting relay actuated by the sender circuit for sending out the coded signals into the transmission line or circuit.

The transmitter is built up by combining the above five distinct assemblies into a circuit which is used as a "gate circuit."

This is essentially a device employing gas discharge tubes in such a way that when either of two particular tubes has been fired and remains conducting, no further action occurs until the second tube is fired, whereupon the combined action of the two tubes puts a primary potential on the control electrode of a third tube, and "opens the gate" so that the third tube will be fired when a potential is applied to its control electrode, as for instance by the application of an impulse from an impulse generator. Thus the "gate circuit" provides means whereby a desired action can only be initiated by an impulse when two previous requirements have already been met.

The following descriptions of one embodiment of the invention will make clear how the various assemblies referred to above can be utilised to form a code sender capable of transmitting any selected code combination of the five-unit code. For a clear understanding of the invention to be obtained the description should be read in conjunction with the accompanying drawings in which:

Fig. 1 shows one form of "gate circuit";

Fig. 2 shows essential circuits of the transmitter described.

The circuit shown in Fig. 1 employs the principles of the "gate circuit" applied to the embodiment of the present invention herein described.

In the figure are shown three tubes 1, 2, 3 of which tubes 1 and 2, are the particular tubes both of which must be fired before tube 3 becomes primed. The anode of each tube is shown connected to a source of positive potential through a resistance 4. The control electrodes of tubes 1, 2 are shown for the purposes of the explanation as being connected to sources of positive potential through keys 5, 6 respectively. The cathodes of all three tubes 1, 2, 3 are connected to ground through resistances 7, 8, 9 respectively, each resistance being in parallel with a condenser.

In addition, the cathode of tube 1 is connected through a resistance 10 and a rectifier 11 to the cathode of tube 2. The rectifier 11 is connected in the sense which results in its presenting a low resistance to currents flowing from the positively charged cathode of tube 1 to ground through resistances 10 and 8. Resistance 10 is of value

high compared with the forward resistance of rectifier 11 but low compared with its backward resistance. The junction of resistance 10 and rectifier 11 at point 12 is also connected to the control electrode of tube 3 through resistance 13. The control electrode of tube 3 is also connected through a resistance 14 and a condenser 15 to a source of direct current impulses applied at terminal 16. The cathode of tube 3 is connected to an output terminal 17.

To understand the working of this "gate circuit," consider the effects when keys 5 and 6 are closed one after the other. When key 5 is closed the positive potential applied to the control electrode of tube 1 fires the tube, as explained above, and current passes through resistance 7 to ground and also through resistance 10, rectifier 11 and resistance 8 to ground. As resistance 10 is large compared with resistances 7 and 8 and that of rectifier 11, there is only a small rise of potential at point 12 this potential being much too small to prime tube 3. If now key 6 is closed tube 2 will be fired and current will pass from its cathode through resistance 8 to ground. The potential at the point where resistance 8 is joined to rectifier 11 will be raised so that current from the cathode of tube 1 will no longer flow through resistance 8 to ground. Thus the potential of point 12 will be raised to a level determined by the relative values of resistance 7 and the internal resistance between anode and cathode in tube 1. Resistance 7 is selected of such a value that the resulting positive potential applied to the control electrode of tube 3 is still not sufficient to fire this tube but only to prime it. In this case potential will be maintained on the control electrode of tube 3 so long as tubes 1 and 2 remain conducting. If now an impulse of suitable voltage is applied to terminal 16 this will pass through condenser 15 and resistance 14 to the control electrode of tube 3 and the impulse potential added to the pre-existing priming potential derived from the combined action of tubes 1 and 2 will fire tube 3, whereupon a positive potential will appear at the output terminal 17 connected to the cathode of tube 3 and can be utilised to initiate further desired action. Gate circuits on this principle are employed in several ways in carrying out the present invention. It is to be understood that keys 5, 6 have only been introduced into the description for illustration: in the actual circuits the firing of tubes 1, 2 will usually be brought about by potentials derived from the firing of other three-electrode tubes.

The component parts of the complete transmitter circuit can now be considered.

In Figure 2, there is shown a "character circuit" consisting of tubes 18, 19, 20, 21 and associated components. There is one such "character circuit" for each character it is desired to transmit. There is also a distributor chain of which only four tubes 22, 23, 24, 25 are shown. There is in practice one distributor tube for each character circuit, i. e. 32 distributor tubes for the total possible 32 combinations of the five unit code. The distributor chain is normally acting as a counting chain under the control of the distributor impulses from an impulse generator 26 applied through a suitable resistance and condenser connected in series, to the control electrode of each of the distributor tubes simultaneously.

Normally one tube in the chain will be conducting and will be applying priming potential to the control electrode of the next tube in the chain so that the impulse although applied to all the control electrodes will only fire the tube which has been primed, i. e. the one next in the chain to the one which is already conducting. The anodes of all the distributor tubes are connected together and through the marking winding 27 of a telegraph relay 28 and a resistance 29 to a source of positive potential. The value of resistance 29 is so selected that when any one tube in the distributor chain is fired by an impulse applied to its control electrode the drop of voltage extinguishes any other tube in the chain which may have been conducting. The tube which has just been fired is not however extinguished by the momentary drop in anode voltage because the ionisation is maintained by the potential applied to its control electrode from the preceding tube, (which potential does not die away absolutely instantaneously) aided by the impulse potential. Thus, the distributor chain functions as a normal counting chain, the tubes firing sequentially under the control of the distributor impulses from the generator. So long as any tube in the distributor chain is conducting, current will be flowing through the "mark" winding 27 of relay 28 and the armature of the relay will be held against the marking contact (+) as shown and will be transmitting a marking signal to the line. This is the normal rest signal used in five unit code working.

There is also shown in the figure, the sender circuit consisting of 12 tubes, 30, 31 . . . 41 inclusive, with associated components. All the odd numbered tubes in this circuit have their anodes connected together and through the mark winding 27 of relay 28 and resistance 29 to the source of positive potential. Similarly, the anodes of all the even numbered tubes are connected through the space winding 42 of relay 28 and resistance 29 to the source of positive potential. As will be described below, it is arranged that all tubes in the counting chain are extinguished when the sender circuit comes into operation, therefore it can be seen that when it is further arranged that only one of the tubes of the sender circuit is conducting at a time, either a "mark" or a "space" signal will be sent to line according as to whether it is an odd or an even-numbered tube which is conducting. At this point it may be explained that tube 19 in each of the character circuits (the operation of which will be described below) has its cathode connected through five parallel systems, consisting of five resistances 44 in series with five rectifiers 45, to the control electrodes of five of the ten tubes numbered 31 to 40, in the sender circuit. The actual sender tubes so connected with each character circuit are determined by the character which it is desired to transmit. Thus when tube 19 in a character circuit is fired, priming potential is applied to the trigger electrodes of five of the ten sender tubes 31 to 40: the actual tubes primed being such that when the sender circuit is set into operation by impulses from the impulse generator, the primed tubes will fire sequentially and transmit five signal elements, usually some mark and some space elements, determined by the permanently wired connections between the particular character circuit energised and the sender circuit.

The points of connection between the character circuit and the sender circuit are indicated in the figure by the letter x to avoid complicating the drawing with additional lines.

Now that the various distinct portions of the circuit have been described, the actual operation of the code transmitters can be explained.

The normal condition when no signal is being

sent, is, that the distributor chain tubes are firing sequentially and the current through their anodes is holding the armature of telegraph relay 28 in the marking position and a marking signal is being transmitted to line. The tube 21 of each character circuit is conducting as this is the condition to which the circuit returns after each operation. The anodes of tubes 18 to 21 are connected together and through a common resistance 46 to a source of positive potential. As tube 21 is conducting and the armature 47 of contact-making device 48 is in its rest position against contact 49, connected to the cathode of tube 21, condenser 50, which is connected between armature 47 and ground, becomes charged to a high, positive potential. Contact making device 48, which may, for example, represent the contact on a keyboard, is operated when it is desired to transmit the character corresponding to the particular character circuit selected. When armature 47 is pressed against contact 51, condenser 50 is discharged through the impulsing transformer 52 and an impulse is applied to the control electrode of tube 18. This tube is fired and a positive potential appears on its cathode. Tube 21 is extinguished by the firing of tube 18 as the anodes are both fed through common resistance 46. The cathode of tube 18 is connected to the control electrode of tube 19 through resistances 53 and 54 the value of resistance 54 being much higher than that of resistance 53. The common point between resistances 53 and 54 is connected through a rectifier 55, to the cathode of one of the distributor tubes, in this case tube 23. The said common point is also connected through a rectifier 56 (the purpose of which will be explained later) and a high resistance 57 to the control electrode of tube 30 in the sender circuit. The resistance 53 is high compared with the forward resistance of rectifier 55. The arrangement therefore is that of the "gate circuit" described above and only a small positive potential is applied to the control electrodes of tubes 19 and 30 until distributor tube 23 is fired in the normal course by the action of the counting chain. When tube 23 is so fired, the potential applied to the control electrodes of tubes 19 and 30 is raised so that these tubes become primed and ready to be fired by the next impulse from the generator. The "sender" impulses used to control the character and sender circuits are applied to the circuits through conductors 58 and are impulses in the series, timed to fall half-way between the "distributor" impulses which control the distributor circuit. When the next sender impulse arrives, it fires tubes 19 and 30. The firing of tube 30 draws anode current through the space winding 42 of the relay 28 and owing to the voltage drop in resistance 29, distributor tube 23 is extinguished and the priming potential is thereby removed from the control electrode of tube 24 before the next distributor impulse arrives, so that the tube 24 does not fire and the distributor chain is stopped, none of its tubes being conducting.

The firing of tube 30 also sends spacing current to line this being the start element preceding the five element code combination forming the character. The firing of tube 19 extinguishes tube 18 in the usual manner and applies priming potential to tube 20 and also to the selected five tubes out of the ten tubes 31 to 40 according to the permanent wiring connections marked x between the character circuit and the sender circuit.

Assume that the x connections from the cathode of tube 19 of the particular character circuit are made to tubes 31, 34, 35, 38 and 40. Tube 32 will not be primed because the potential on its control electrode is derived from tube 30 only. This potential arises from the current flow through tube 30 which goes to ground through the resistance connected to its cathode and in parallel therewith through rectifier 60 in the reverse direction, and then through the connections x to some of the character circuits and resistances corresponding to resistance 65, to ground. The reverse resistance of rectifier 60 is high compared with that of the connections x through the character circuits (of which there are sixteen in parallel) and hence the potential to which the control electrode of tube 32 is raised is insufficient to prime that tube. On the other hand, the potential of the control electrode of tube 31 will be raised to a value that will prime that tube, since both tubes 30 and 19 have been fired, as will be clear from the explanation of the gate circuit given above. It will also be clear that the potential impressed from the cathode of tube 19 on the remaining four selected tubes out of the eight tubes 33 to 40 will, at this time, be insufficient to prime any of those tubes.

The sender circuit now operates as a sequence of gate circuits as follows: Tubes 19 and 30 are conducting and tube 31 is primed; on the receipt of the next sender impulse, which is applied over conductor 58 to the control electrodes of all the signal element tubes in the sender circuit, tube 31 fires. This sends a mark signal to line, extinguishes tube 30 and applies potential over two rectifiers 61 to the control electrodes of tubes 33 and 34. This potential is insufficient to prime the tubes as explained above owing to the shunting action of the sixteen x connections to ground through resistance 65. Tube 19 in the character circuit remains conducting and therefore applying potential to the selected tube 34. When tube 31 is fired therefore, tube 34 becomes primed and on the receipt of the next sender impulse, tube 34 is fired, sending spacing current to line, extinguishing tube 31 and priming selected tube 35.

Similarly tubes 38 and 40 become primed and fired in turn. Thus, the selected code combination is sent to line by the sequential firing of the selected tubes under the control of the sender impulses from the generator 26. Each signal element tube remains conducting from the instant it is fired by one impulse until it is extinguished by the next impulse, so that the duration and timing of the signals are precisely determined by the repetition rate of the impulse generator.

When the next code element tube 40 is fired, it primes tube 41 which therefore fires on the receipt of the next sender impulse, sending a mark signal to line, this being the stop element. The firing of tube 41 extinguishes tube 40, and by the usual "gate circuit" connection against rectifier 63 stops current from tube 19 going to ground through resistance 64 associated with tube 41. Tube 20 is therefore primed and fires on the receipt of the next sender impulse, extinguishing tube 19. The firing of tube 20 primes distributor tube 24, which therefore fires on the next distributor impulse and starts the distributor chain counting again. Tube 20 also primes tube 21, which fires on the receipt of the next sender impulse extinguishing tube 20. Tube 21 remains conducting until armature 47 is again actuated to activate the particular character circuit.

It is necessary that tube 20 should be extinguished as otherwise tube 24 of the distributor would remain primed and would endeavor to start a counting cycle on the receipt of each distributor impulse and thus prevent the distributor chain functioning. The purpose of rectifier 45 in the circuits connecting tube 19 of each character circuit to the appropriate code element sender tubes will be appreciated when it is remembered that there are thirty-two character circuits and that therefore the control electrode of each sender tube is connected in parallel with the cathodes of each of sixteen replicas of the tube 19 shown. If the rectifiers 45 were not introduced into the circuits therefore, each control electrode of the sender tubes would be permanently connected to ground through 16 replicas of resistance 65 associated with tube 19 and the required potential to prime the sender tubes would not be developed. The rectifiers 45 present a high resistance and restrict the current flowing back to ground over these paralleled circuits.

The rectifiers 56 between the cathode of tube 18 and the control electrode of tube 30 serve an exactly similar purpose.

The embodiment of the invention described makes use of particular methods of connecting cold-cathode tubes in order to obtain sequential firing under the control of an impulse generator and also of "gate circuits" functioning to determine in what order the tubes shall be fired according to the signal combination it is desired to transmit.

It is to be understood that cold-cathode tubes can be connected together in other ways to obtain sequential firing and that the effects obtained by the use of the "gate circuit" illustrated in Figure 1 can be obtained by other means without departing from the spirit of the invention.

What we claim is:

1. A transmitter for start-stop telegraph signals consisting of combinations of marking and spacing elements comprising a chain of cold-cathode electric discharge devices, one device for the start element of a combination, one device for the stop element of a combination, a pair of devices consisting of a marking device and a spacing device for each code element of the combination, means for causing the start device, one of each code pair of devices, and the stop device to become conducting sequentially for equal periods of time, means for determining which device of each code pair of devices shall become conducting during the corresponding periods, and means for causing the transmission of a spacing element when either the start device or the spacing device of any code pair becomes conducting and means for causing the transmission of a marking element when either the stop device or the marking device of any code pair becomes conducting.

2. A transmitter as claimed in claim 1 in which marking and spacing windings of an electromagnetic telegraph relay are connected in series with devices allotted respectively to marking and spacing elements of a signal combination.

3. A transmitter as claimed in claim 2 in which each of said devices comprises an anode, a cold-cathode and a control electrode and said windings are connected in the circuit between a common source of potential and a common resistance and the anode-cathode path of the respective devices.

4. A transmitter as claimed in claim 3 comprising means operable when a signal combination is to be transmitted for connecting a priming potential to the control electrodes of the devices required to be made conducting during the transmission of said combination and an impulse generator for supplying an evenly spaced series of impulses to said devices whereby a series of said devices representing the start element, the required code elements and the stop element, become conducting sequentially for equal periods of time.

5. A transmitter for start-stop telegraph signals consisting of combinations of marking and spacing elements comprising an impulse generator, a closed counting chain of electric discharge devices, said devices normally being sequentially rendered conducting on alternate impulses from said impulse generator and each rendered non-conducting when the succeeding tube becomes conducting, there being one of said discharge devices for each code combination to be transmitted, a common sender circuit consisting of a plurality of electric discharge devices so connected that when any one of them is conducting a corresponding marking or spacing signal element is transmitted, there being one such device to transmit the start element of each signal combination, one pair of devices for each element of the code combination so connected that only one device in each pair can be operative during the transmission of any one code combination and one devise to transmit the stop element of each signal combination, a character circuit consisting of a plurality of electric discharge devices, for each code combination required to be transmitted, selectively operable means for initiating the operation of any selected character circuit, interconnecting means whereby upon the operation of said selected character circuit and upon the appropriate discharge device in said counting chain becoming conducting, said start device, certain pre-selected discharge devices and said stop device in the sender circuit become conducting sequentially on the occurrence of the other alternate impulses from said impulse generator whereby a pre-selected signal combination of marking and spacing elements is transmitted, said character circuit also causing the counting chain to cease from its counting action during the transmission of said signal combination and to resume its action after the transmission of the final element of each signal combination.

6. A transmitter as claimed in claim 5 in which said interconnecting means provides a connection between that discharge device of any of said character circuits which first becomes conducting after the actuation of any one of said selectively operable means and the start device of said common sender and also a connection between that discharge device of said closed connecting chain corresponding to the selected character circuit and the start device of said common sender circuit whereby when both said first device in said character circuit and said corresponding device in said closed counting chain have become conducting said start device in said common sender will become conducting upon the application thereto of an impulse from said impulse generator.

7. A transmitter as claimed in claim 6 in which said interconnecting means provide connections between that discharge device of said character circuit which becomes conducting second in order after the actuation of said operable means and each of the discharge devices of said common sender circuit corresponding to the code elements

of the selected code combination and which also provides connections between the start device of said common sender circuit and the device of said common sender which should next become conducting to effect the transmission of the first code element of the selected combination and which also provides connections interconnecting the devices in the common sender circuit corresponding to the code elements in such a way that when said second in order device in the character circuit is conducting and when also the start device or any device corresponding to a code element in the common sender circuit is conducting the next device in the common sender circuit will become conducting upon the application thereto of an impulse from said impulse generator, means also being provided whereby when any device of the common sender circuit becomes conducting, any other device of said common sender circuit becomes non-conducting.

8. A transmitter as claimed in claim 6 in which said connections between the first device of said character circuits and said start device and also between said first device and said corresponding device of said counting chain and also said connections between said start device and said devices in the common sender circuit corresponding to the first code element and also said interconnections between said device in the common sender circuit corresponding to the successive code elements include unidirectional conducting members presenting a resistance which is very high when currents pass through them in one direction compared with the resistance when currents pass through them in the other direction.

9. A transmitter as claimed in claim 8 in which said unidirectional members form part of a "gate circuit" as defined.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,361,766	Wilkerson	Oct. 31, 1944
2,412,642	Hadekel	Dec. 17, 1946