

March 17, 1942.

J. R. WILKERSON

2,276,533

TELEGRAPH SYSTEM

Filed June 3, 1939

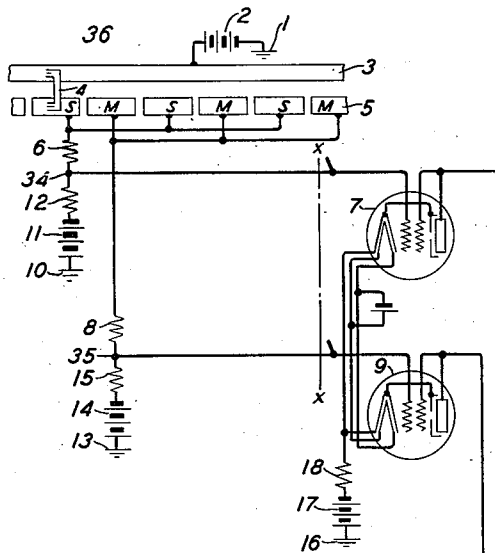


FIG. 1.

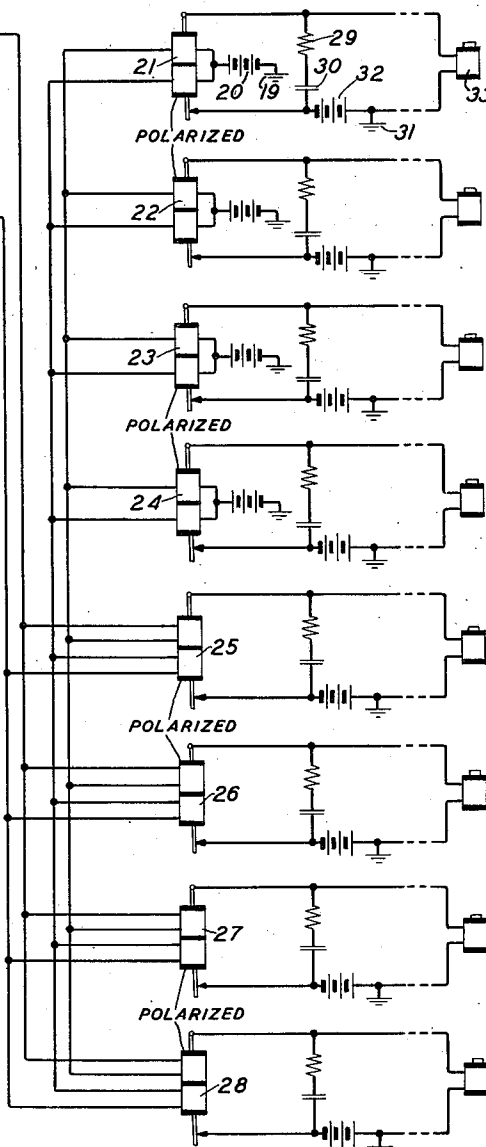
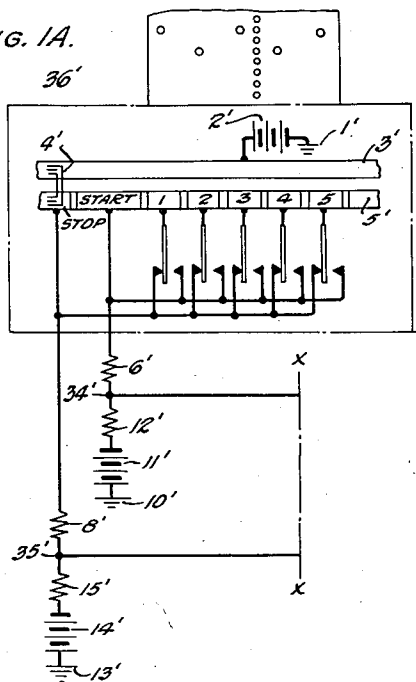


FIG. 1A.



INVENTOR
J. R. WILKERSON
BY
J. W. Schmied
ATTORNEY

UNITED STATES PATENT OFFICE

2,276,533

TELEGRAPH SYSTEM

Jefferson R. Wilkerson, Brooklyn, N. Y., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application June 3, 1939, Serial No. 277,134

5 Claims. (Cl. 178-69)

This invention relates to telegraph systems and particularly to a device for transmitting telegraph signals from a single telegraph transmitter to a large number of telegraph receivers simultaneously. Various devices for accomplishing this purpose are well known in the communication industry. The invention herein is an improved means for performing this function.

An object of this invention is improved transmission of telegraph communication from a single transmitter to a plurality of receivers.

A further object of this invention is to improve the character of the telegraph signals in a circuit comprising a common or multiple telegraph sender and a plurality of receivers.

A further object of this invention is to provide means tending to compensate for variations in the characteristics of vacuum tubes due to ageing, etc., when such tubes are used in a multiple telegraph sender circuit.

In the operation of telegraph and teletypewriter systems it frequently becomes necessary to transmit communication signals to a large number of outlying points from a common sender as in the distribution of news, stock quotations, police alarms, etc., by means of wire networks or radio telegraph networks. In such cases it is desirable that a single transmitting source, or multiple sender as it is known in the art, be used to serve as many connected lines as possible, without impairment of the transmitted signals beyond permissible limits and without overloading the common transmitting device beyond its operable current carrying capacity.

It is obvious that as the number of lines with which the common sender is connected may be increased, in an operable system, the number of such senders required is reduced. In the testing of lines also it is desirable for reasons of economy to make it possible to interconnect as many lines as possible to a common signaling source.

A single transmitter connected to the input circuit of a plurality of pairs of high vacuum tubes, one of said pairs being used to transmit marking and the second spacing signals is being suggested for use in such service. The output circuit of one of each of said pairs of tubes is connected in series to a first winding in each of a group of polar relays to control armatures on said relays transmitting marking signals to receiving circuits in series with said armatures. The output circuit of the other of each of said pairs of tubes is connected in series to a second winding on each of said groups of polar relays to control the transmission of spacing signals through said armature.

It is essential to the satisfactory operation of said circuits that the output of said tubes remain stable. The invention herein provides means tending to stabilize the output of said tubes.

A feature of this invention is an arrangement for compensating for variations in the characteristics of a vacuum tube due to ageing, etc., when such tube is used in the transmission path of a telegraph circuit.

A further feature of this invention is an arrangement wherein two high vacuum electron discharge devices are used, one for transmitting marking and the other for transmitting spacing signals in a telegraph transmission circuit and wherein a single means common to both of said devices is employed to compensate for variations in the characteristics of either or both of said devices.

A further feature of this invention is an arrangement for compensating for the impedance of the relays in the plate circuits of the vacuum tubes which would otherwise tend to round the wave shape of the current in their windings.

These and other features will be made apparent in the detailed description and claims hereinafter when read with reference to the associated drawing, in which Fig. 1 shows a single transmitter distributor arranged to function as a test signal transmitter so as to transmit alternate marking and spacing signals to a plurality of receiving circuits and Fig. 1A shows an alternative embodiment of the invention, in which the transmitting distributor is arranged to transmit signals under control of a tape punched in accordance with a code, such as the five element Baudot code.

Fig. 1 of the drawing discloses a single transmitting device which controls the potential impressed between the grid and cathode of a pair of high vacuum discharge devices. One of said discharge devices transmits marking signals and the second transmits spacing signals through the windings of a plurality of polar relays connected in the output circuits of the devices. A resistance connected in parallel between ground and the cathodes of each pair of tubes is used to stabilize each tube.

In Fig. 1 of the associated drawing, a circuit may be traced from ground 13 to the positive pole of battery 14, through said battery to the negative pole of said battery and through resistance 15, to junction point 35, where a parallel circuit is formed. One branch of said parallel circuit extends to the grid of tube 9. The second branch extends through resistance 8 to all of

the M or marking segments of segmented ring 5 of the transmitting distributor 36. These segments, for the condition shown, are all open, as the brush 4 is on an S or spacing segment, bridging the gap between said spacing segment and the solid conducting ring 3 of the distributor, which ring is connected to the positive pole of battery 2 and through said battery to ground 1.

A circuit may also be traced from ground 19 to the negative pole of battery 20, through said battery to the positive pole thereof, through the bottom winding of relay 21, through the bottom winding of relay 25, to the anode of tube 9. The bottom windings of relays 22, 23 and 24 are in parallel with the bottom winding of relay 21. The bottom windings of relays 26, 27 and 28 are in parallel with the bottom winding of relay 25. The battery 20 and ground 19, shown connected to the windings of relay 21, are the same as the battery and ground connected to the windings of relays 22, 23 and 24 and to the solid conducting ring 3 of transmitting distributor 36.

A circuit may also be traced from ground 10, to the positive pole of battery 11, through said battery to the negative pole thereof, through resistance 12, to junction point 34. Here a parallel circuit is formed. One branch of said parallel circuit extends to the grid of tube 7. The other branch extends through resistance 6, to all of the S or spacing segments of segmented ring 5 of distributor 36. Conducting brush 4 of the distributor is in contact with the left-hand S segment of ring 5 and bridges the insulating gap between said segment and solid conducting ring 3. Ring 3 is connected to the positive pole of battery 2, through said battery to its negative pole and to ground 1 as heretofore traced. A circuit may also be traced from ground 16 to the positive pole of battery 17 through said battery to its negative pole and resistance 18 to the cathodes of tubes 7 and 9 in parallel. Batteries 11, 14 and 17 and their respective grounds are identical. Another circuit may be traced from ground 19 through battery 20, through the top winding of relay 21, the top winding of relay 25, to the anode of tube 7. The top windings of relays 22, 23 and 24 are in parallel with the top winding of relay 21. The top windings of relays 26, 27 and 28 are in parallel with the top winding of relay 25.

It may be assumed that the voltage of negative battery 11, 14 and 17 is 130 volts and the voltage of positive battery 2 and 20 is also 130 volts.

When brush 4 is on an S segment, a potentiometer is formed between ground 1, battery 2, resistance 6, resistance 12, battery 11 and ground 10. Resistance 6 is smaller in value than resistance 12 and their ratios are such that a positive potential, which it may be assumed is 25 volts, is impressed between the grid of tube 7 and ground. The potential of the cathode of tube 7 is positive with respect to negative battery 17 by an amount equal to the drop through resistance 18, but the relative potentials of the grid and cathode of tube 7 for this condition are such that tube 7 conducts. When tube 7 conducts, due to the ratio of the resistance between the cathode of tube 7 and ground through resistance 18 and negative battery 17 to the resistance between the cathode of tube 7 and ground through tube 7, the relay windings and positive battery 20, the potential between the cathode of tube 7 and ground is established at some such value as positive 30 volts. The grid of tube 7 is therefore

volts negative with respect to the cathode of tube 7. Since the cathode of tube 9 is in parallel with the cathode of tube 7, the cathode of tube 9, when tube 7 is conducting is also 30 volts positive with respect to ground. Since the grid of tube 9 is 130 volts negative with respect to ground, for this condition, the grid of tube 9 is 160 volts negative with respect to the cathode of tube 9 and tube 9 is therefore non-conducting while tube 7 conducts.

When tube 7 conducts, a current, which we may assume is approximately 40 milliamperes, passes through the tube and 10 milliamperes is supplied through the top windings of each relay in the circuit heretofore traced. The effect of this current is to operate each relay armature to the left, breaking the current in each loop and transmitting a spacing signal to the distant receiving magnets in unison. The loop for magnet 33 may be traced from ground 31 through battery 32 to the contact of relay 21 from which the armature has separated. The loop extends from said armature over the top loop conductor to the distant local station through receiving magnet 33 and back over the bottom loop conductor to ground 31 at the central station.

When brush 4 has swept across the first S segment and engages the insulating spacer separating the first S and M segments, the path through resistance 6, forming one arm of the potentiometer heretofore traced, is disconnected from the grid of tube 7 and the voltage of said grid becomes negative 130 volts with respect to ground. The voltages impressed on the grids, cathodes, and anodes of tubes 7 and 9 are now essentially identical. Both tubes will conduct but since the negative potential of their grids with respect to their cathodes is now equal to the voltage drop across resistance 18 their currents will be quite small. Their plate currents act in opposition upon the relays but, since the potentials impressed on one tube are affected by the characteristics of the other, they may not be equal. Their difference, however, by virtue of the fact that both currents are small, will be quite small compared with the currents which flow when the brush is on a marking or spacing segment. In addition the transmitting distributor 36 is so constructed and adjusted that the time required for the brush 4 to travel from a marking segment to a spacing segment is small. The bias introduced due to any unbalance is therefore negligible.

When brush 4 engages the first M segment of ring 5, a potentiometer is formed for the grid of tube 9 including resistance 8, resembling the potentiometer described for the grid of tube 7. The same voltage conditions described for the grid and cathode of tube 7 when tube 7 was made conducting apply now for the grid and cathode of tube 9 and tube 9 conducts. While tube 9 conducts, the cathode of tube 7, which is in parallel with the cathode of tube 9, is maintained at the same potential with respect to ground as the cathode of tube 9, which it may be assumed is 30 volts positive, and tube 7 is maintained non-conducting. When tube 9 conducts, the bottom windings of all relays are energized, as were the top windings when tube 7 conducted. The effect of energizing all bottom windings is to actuate the armatures of all of said relays to the right to engage their respective contacts. This closes all loop circuits and energizes all receiving magnets to transmit a marking signal to all local stations in unison.

As the conducting brush 4 sweeps over the succeeding alternate spacing and marking segments, the cycle described above is repeated.

As is generally known, as high vacuum tubes age the current passed through their output circuits tends to change for the same grid, cathode, anode voltage conditions. It is essential, if perfect marking and spacing signals are to be impressed on the relays, that the current in the output circuit of tubes 7 and 9 be of the same magnitude. It is possible to achieve this in any circuit at the outset, by choosing a pair of tubes in which the output current is identical for the given voltage conditions. It is particularly pointed out that, in the invention herein, applicant's circuit arrangement tends to compensate automatically for changes in the output of either tube by changing the cathode grid voltage relationship to maintain current of substantially uniform magnitude in the output circuit of each tube. The manner in which the circuit functions to achieve this is as follows.

It will be assumed that the voltage drop across resistance 18 with the normal current output for each tube is 160 volts. For this condition the voltage of the cathode of each tube is 30 volts positive with respect to ground. It has been pointed out that the voltage of the grid of each tube is 25 volts positive with respect to ground when the tube is conducting. If the output current of either tube increases by an amount of 1 percent, for example, the drop across resistance 18 is increased 1 per cent or 1.6 volts. The voltage of the cathode would then become 31.6 volts positive with respect to ground. The grid of said tube would then become 6.6 volts negative with respect to the cathode. This would be an increase of over 30 per cent in the difference in negative potential of the grid with respect to the cathode, which would tend to decrease the output current of the tube. Conversely, if the output of a tube tended to decrease, the drop across resistance 18 would be reduced. The positive potential of the cathode of said tube with respect to ground would be reduced and the negative potential of the grid with respect to the cathode would be decreased, which would tend to increase the output current of said tube.

When a signal is initiated the inductance of the relays in the plate circuits of the vacuum tubes would tend to prevent sudden changes of current and thus the wave of the current driving the relays would rise slowly to its steady-state value. The effect of the circuit embodied in this invention is to stabilize against changes of current produced by changes in the impedances of the vacuum tubes or any impedances in their plate circuits. This circuit will, therefore, stabilize against the rounding of wave shape due to the inductive impedance of the relays and the current will increase very rapidly to its steady-state value.

It is also pointed out that variations and resulting compensations in one tube do not affect the voltage conditions nor output of the second tube of the pair while said second tube is functioning. This is so because the resistance 18, though connected in parallel to the cathodes of both tubes, is effective to change the potential between the grid and the cathode of each tube independently as it becomes conducting. If the output current of one tube remains unchanged, the potential drop across resistance 18 remains constant and the potential between the grid and the cathode of that tube while it is conducting

remains unaffected by variations in the second tube.

The tape controlled code transmitter per Fig. 1A may be substituted for the alternate marking and spacing test signal transmitter shown to the left of line XX of Fig. 1.

The armatures associated with the five character forming elements of the transmitter are actuated independently to the left or right depending upon whether a hole has been punched in a corresponding position on the tape, or whether the corresponding position in the tape is unpunched. If the armature associated with a particular segment is actuated to the left, a circuit may be traced from ground 1' through battery 2', ring 3', brush 4' through the particular segment, as the brush engages the segment, through the corresponding armature and its associated left-hand contact and resistance 8' to junction point 35', which connects to the grid of tube 9 in parallel with the path through resistance 15' and negative battery 14' to ground 13'. If the armature is actuated to engage with its right-hand contact, the circuit extends through resistance 6' to junction point 34', which connects to the grid of tube 7 in parallel with the path through resistance 12' and negative battery 11' to ground 10'.

Either tube 7 or tube 9 will be activated. As has been shown above, the activation of tube 7 energizes the top windings of the relays, actuates their armatures to the left and transmits a spacing signal. The activation of tube 9 energizes the bottom windings of the relays, restores their armatures to their respective right-hand positions and closes each receiving circuit to transmit a marking signal. It is noted that the start segment is fixedly connected to the grid of tube 7 so that it transmits an open or spacing signal. The stop segment is permanently connected to the grid of tube 9 so that it transmits a closed or marking signal. The operation is otherwise the same as described for Fig. 1 above.

What is claimed is:

1. In a telegraph system, a single telegraph transmitter arranged to transmit the same telegraph code signals simultaneously to a plurality of telegraph receiving circuits through individual telegraph receiving relays, each controlling one of said circuits, a telegraph path directly interconnecting said transmitter and said relays, a first individual channel in said path for transmitting a marking signal only, in a first direction, to each of said relays, a second individual channel in said path for transmitting a spacing signal only, also in said first direction, to each of said relays, a high vacuum discharge device in each of said channels, means connected to each of said channels for transmitting current of substantially the same magnitude in said channels for said marking and spacing signals and automatic regulating means, comprising a single lumped resistance connected directly from cathodes on said devices, said cathodes being connected in parallel, to negative battery, responsive to changes in the output current of said devices, tending to stabilize the magnitude of the current transmitted for each of said signals as said current tends to vary.

2. In a telegraph system, a telegraph path, a plurality of individual one-way transmitting channels in said path, common transmitting means connected to said path for generating signal elements of a plurality of types, means directly interconnecting said transmitting means

and said channels for impressing one of said types only on each of said channels, a high vacuum discharge device individual to each of said channels, and automatic regulating means connected in the input circuit of each of said devices, responsive to changes in the magnitude of the current in the output circuit of each of said devices, to maintain said signal elements uniform in magnitude as the outputs of said devices tend to vary.

3. A multiple telegraph sender comprising a single telegraph transmitter distributor connected to a plurality of telegraph receiving channels, a first high vacuum discharge device intermediate said sender and said channels for transmitting pulses of current simultaneously to said channels as marking signals only, a second high vacuum discharge device intermediate said sender and said channels for transmitting pulses of current simultaneously to said channels as spacing signals only, a cathode on each of said devices and automatic means for maintaining said current pulses uniform in magnitude, as said pulses tend to vary in magnitude, responsive to changes in the magnitude of said pulses comprising a single path, including a single lumped resistance, connected from negative battery to said cathodes arranged in parallel.

4. In a direct current telegraph system, a multiple telegraph transmitter, a first telegraph channel connected to said transmitter, a first high vacuum discharge device in said channel, a first anode and a first cathode in said first device, a second telegraph channel connected to said transmitter, a second anode and a second cathode in said second device, a plurality of tele-

graph relays, each of said relays having a first winding and a second winding, an output circuit for said first device extending from said first anode through each of said first windings in parallel, an output circuit for said second device, extending from said second anode through each of said second windings in parallel, means for transmitting a pulse of current from said first device through said first windings as a marking signal, means for transmitting a pulse of current from said second device, through said second windings as a spacing signal, said pulses being subject to variations in magnitude and automatic regulating means comprising a single path, including a single lumped resistance, connected from negative battery to said cathodes arranged in parallel, responsive to changes in the magnitude of said pulses to stabilize the magnitude of said pulses as said magnitude tends to vary.

5. In a telegraph system, a telegraph transmitting device, means connected to said device for transmitting current pulses through a first channel as marking signals only, means also connected to said device for transmitting current pulses, of the same polarity and substantially the same magnitude as said marking signals, through a second channel as spacing signal only, a high vacuum space discharge device in each of said channels, a cathode in each discharge device and a single circuit branch, extending from the negative pole of a battery, through a single resistance only, directly to said cathodes arranged in parallel to maintain the magnitude of said signals constant.

JEFFERSON R. WILKERSON.