

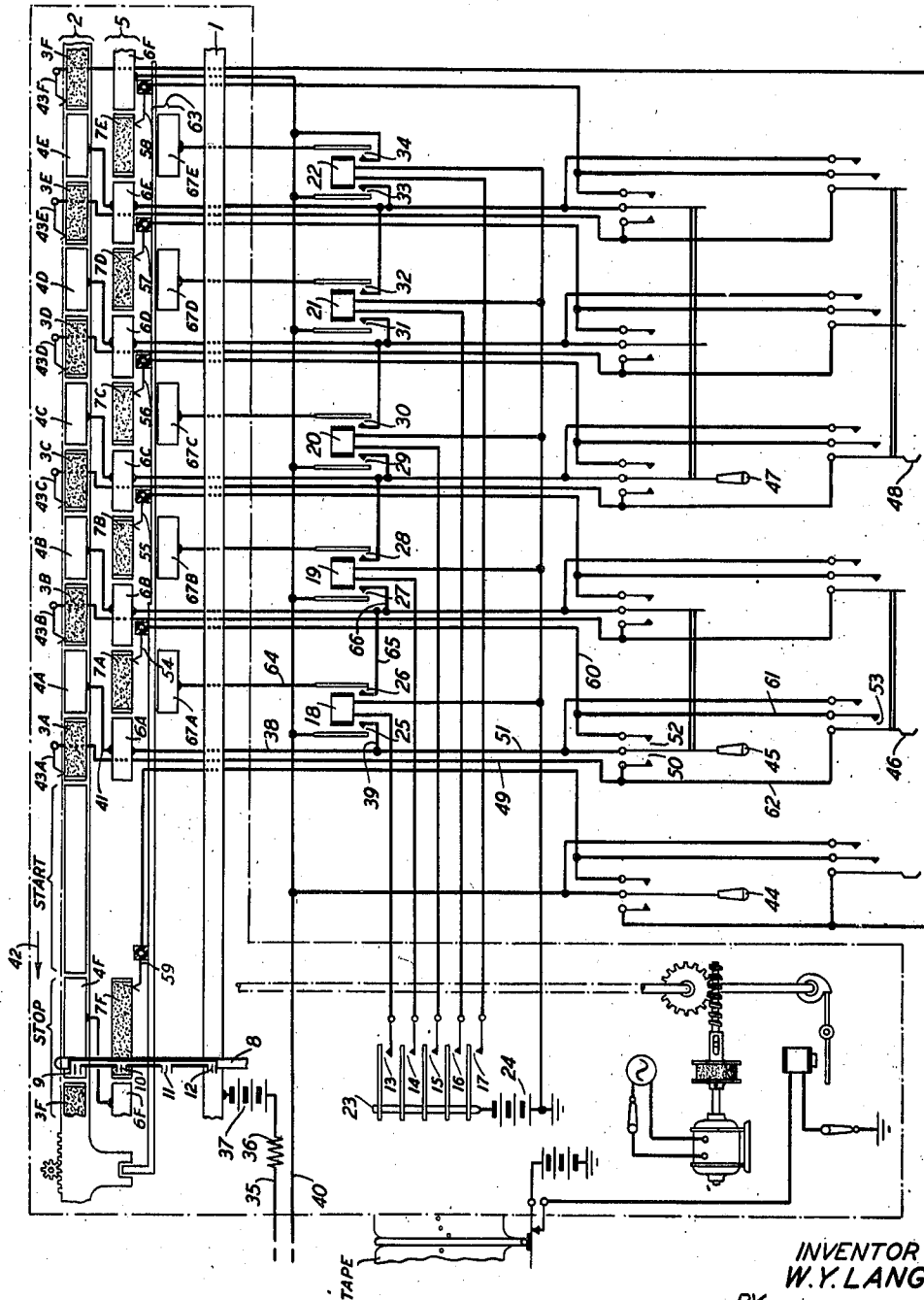
Feb. 15, 1944.

W. Y. LANG

2,341,996

TELEGRAPH SIGNAL TRANSMITTER FOR SENDING SHAPED IMPULSES

Filed Oct. 20, 1939



INVENTOR
W. Y. LANG

BY

G. W. Adam
ATTORNEY

UNITED STATES PATENT OFFICE

2,341,996

TELEGRAPH SIGNAL TRANSMITTER FOR
SENDING SHAPED IMPULSES

Wilmarth Y. Lang, Towaco, N. J., assignor to Bell
Telephone Laboratories, Incorporated, New
York, N. Y., a corporation of New York

Application October 20, 1939, Serial No. 300,300

7 Claims. (Cl. 178-17)

This application relates to telegraph signal transmitters and particularly to an improved rotary type transmitter distributor for use primarily in transmitting shaped telegraph signals. This shaping may be of various kinds for various purposes such as to send a shaped signal of special wave form to improve the form of the received signal or to produce signals which simulate distorted signals received over a telegraph line. The improved transmitter, when employed to shape signals may be utilized in a wide range of applications largely in testing, particularly in the laboratory.

A general object of this invention is the improvement of telegraph signal transmitters for the transmission of special wave forms.

A more specific object of this invention is the improvement of telegraph signal transmitting devices of the type known as rotary distributors.

A further more specific object of this invention is to facilitate the generation of signals having various wave shapes simulating those received over various telegraph lines for use in determining the capabilities and limitations of telegraph receiving devices such as telegraph receiving printers.

A feature of this invention is the provision of improved means for shaping the form of telegraph signals.

A specific feature of this invention is the use of a material of high specific resistivity relative to the specific resistivity of copper, to provide, in conjunction with a traveling contact, a compact variable high resistance which is used to shape the ends of signal elements.

Material which has a high specific resistivity and suitable wearing qualities in resisting the abrasion of traveling contacts may be employed as high resistance segments on a rotary distributor in the manner described below to provide a telegraph signal transmitter for transmitting signals having a variety of shapes simulating those received in actual practice over a telegraph line. A number of such materials are well known in the electrical art.

The invention will be more fully understood from the following detailed description and reference to the single figure of the associated drawing which shows the signal transmitter of this invention.

A modified tape-driven start-stop rotary telegraph transmitter distributor is used for the signal transmitting device of the invention herein. The tape-driven start-stop rotary telegraph transmitting distributor is well known in the tele-

graph art. Such a distributor is described in detail in E. F. Watson Patent 2,055,567, September 29, 1936. In its usual form it consists of a motor-driven contact brush arm arranged to sweep across the edges of a plurality of concentric copper rings. One of the rings generally is continuous and another ring or a plurality of rings comprise a plurality of segments spaced from the solid ring and each segment spaced from the other, to form what is essentially a motor-driven interrupting device for an electric current. The various segments are bridged to the solid ring or are open dependent on the codes set up on the tape by the perforator. In the tape-driven start-stop distributor, slack introduced by feeding a punched tape closes a pair of contacts. This, in turn, energizes a magnet to withdraw a lever from engagement with a stop cam on the motor-driven brush arm shaft. The arm rotates through a friction clutch under the influence of a motor drive, bridging the gap between the solid ring and the segmented ring or rings as long as the punched tape continues to be fed. When the magnet circuit is opened the tape feeding stops by the lever being interposed in the path of the stop cam to stop rotation. The above described operation of the apparatus herein is the same as in Patent 2,055,567 and will not therefore be explained in complete detail.

In the single figure herein the modified transmitter distributor is shown with its rings developed instead of circular, so that the invention may be better understood. The starting and stopping mechanism is suggested but the perforator and the system of levers which control the contact tongues are omitted as they are well known in the art and their operation is fully described in the above-mentioned patent. It is to be understood that physically the worm driven gear shown in Fig. 1 rotates the indicated shaft, which in turn rotates brush arm 8 around the face of the distributor in the same manner as in Patent 2,055,567.

In the drawing, the ring 1 is a solid copper annular ring, mounted on the face of a rotary start-stop telegraph transmitter distributor. The segmented ring 2 is arranged to transmit a start impulse which is a no current or open circuit impulse, five signal elements which may be current or no current in any combination and a stop impulse which is always a current impulse. The ring therefore has a start segment which is open and, in order to transmit the five units which form the character and the stop impulse, all of which may be shaped, it has six high re-

sistance segments 3A to 3F, inclusive, and six copper segments 4A to 4F, inclusive. It may be observed that the start segment is not provided with associated high resistance segments as the start impulse is always an open circuit signal and is not modified. Physically the segments are arranged in the form of a ring concentric with the solid ring 1 and spaced therefrom. Each segment is spaced from the other. Similarly, the ring 5 comprises six copper segments 6A to 6F, inclusive, and six high resistance segments 7A to 7F, inclusive. The segments of ring 2 are arranged so that they may be rotated as a unit, thus displacing the segments with respect to those in ring 5 which remain fixed. This may be performed by rigidly securing the segments of ring 2 to the ring. The ring may be of insulating material, but preferably it is of metal from which the segments are insulated. The ring is displaced by means of the rotatable pinion shown at the top left of the drawing. The pinion rotates on a shaft fixed to the distributor face. It coacts with spur teeth on a portion of the periphery of annular ring 2. Contacts 54 to 59 rotate in unison with ring 2. They may be rigidly secured to ring 2, in which case they would engage the upper surface of their cooperating segments. Preferably, however, segments 54 to 59 are mounted on an individual rotatable ring, having on its periphery a radial spur which engages in a radial notch between the bifurcated ends of a radial arm extending from the inner circumference of annular ring 2 as is also shown at the top left of the drawing. Contacts 54 to 59 are, of course, insulated from the ring on which they are mounted. As the pinion is rotated, in any convenient manner, annular ring 2 carrying its segments and the contact ring carrying contacts 54 to 59 are rotated in unison. As indicated, the rings are in their normal undisplaced position. In this position a high resistance segment, such as 3A of ring 2, is opposite a copper segment such as 6A of ring 5. As the rotary arm 8 sweeps over the face of the distributor, while the segments of ring 2 are in their undisplaced position, the brushes 9 and 10 of arm 8 will engage segments such as 3A and 6A simultaneously throughout the length of each segment. Brushes 9, 10, 11 and 12 of arm 8 are interconnected electrically, so that as arm 8 passes over the segments of the several rings they are interconnected while the brushes are in engagement with each and the segments are connected to the solid ring 1. The transmitter distributor is arranged so that, in the transmission of a signal, a pair of segments on ring 2, such as 3A and 4A, cooperate with a pair of segments on ring 5, such as 6A and 7A.

In order to transmit a signal of normal length, with square ends front and rear, ring 2 is fixed in its normal undisplaced position as indicated in the figure. The manner in which such a signal is transmitted will now be described. Contacts 13 to 17, inclusive, control the operation of relays 18 to 22, inclusive. If contact 13 is actuated so that it engages its cooperating tongue on bar 23, a circuit is closed from ground, through battery 24, bar 23, contact 13 and the winding of relay 18 to ground, operating relay 18 and closing contacts 25 and 26. Similarly, the actuation of contacts 14 to 17, inclusive, operate relays 19 to 22, inclusive, to close contacts 27 to 34, inclusive. When the arm is released with relay 18 operated, a circuit may be traced from conductor 35 through current limiting resistance 36, battery 37, solid ring 1, to brush 12. When the arm 8

has rotated sufficiently to engage copper segment 6A, the circuit is extended through a conductor connecting brush 12 and brush 10, segment 6A, conductors 38 and 39, contact 25 of relay 18 which is closed and conductor 40. Conductors 35 and 40 may be connected to a telegraph line which is to be tested or it may be connected to a telegraph receiving device, such as a printer to test the operation of the printer for different received signals.

When brush 10 engages segment 6A, the current in the circuit just traced rises instantly to its full value. During the interval that brush 8 remains in engagement with segment 6A, current of full value continues to flow. The brushes 9 and 10 on arm 8 are wide enough so that they bridge the spaces between successive segments. Before brush 10 leaves segment 6A, brush 9 engages segment 4A. During the interval that brush 9 is sweeping across segment 4A, the circuit between solid ring 1 and conductor 38 remains closed through segment 4A and conductor 41 which is connected to segments 4A and 6A. If we assume that only relay 18 is operated, as soon as brush 9 sweeps off segment 4A, the current through conductors 35 and 40 drops immediately to zero, as all other paths interconnecting conductors 35 and 40 are open. Thus a single pulse of current having square-shaped ends front and rear may be transmitted. It should be observed that neither of high resistance segments 3A nor 7A play any part in the transmission of this signal, as they are connected electrically in circuit only when signals having sloping ends are to be transmitted.

Similarly, if any other of the contacts 14 to 17, inclusive, is actuated for this condition, the corresponding relays 19 to 22 will close a path between conductors 35 and 40 corresponding to the path above traced for the transmission of a similar signal. A number of the contacts 13 to 17 may be operated simultaneously. Signals with square-shaped ends will then be transmitted for each contact which is actuated. The circuit will be open and no current will flow for each unoperated contact.

In order to transmit a signal having a sloping front end, a square rear end and of the same length as in the case above, the armatures of keys 44, 45 and 47 are actuated to the left and ring 2 is rotated to the left to a new position so that it is displaced in the direction of the arrow 42 with respect to ring 5 which remains fixed. As the ring 2 is rotated, brushes 43A to 43F, inclusive, remain fixed, so that they each make contact, after the displacement of ring 2, with some point on high resistance segments 3A to 3F respectively, between the ends of each segment, dependent on the amount of the displacement. Now if we assume that arm 8 is released, brush 9 will first engage the left-hand end of high resistance segment 3A. At this instant a circuit may be traced from conductor 35, through resistance 36, battery 37, ring 1, brush 12, brush 9, through a portion of high resistance segment 3A dependent on the amount of the displacement, brush 43A, conductor 49, contact 50 of key 45, conductor 51, conductor 39, contact 25 of relay 18, to conductor 40. As the brush 9 sweeps toward brush 43A, the length of the high resistance segment effectively in circuit is reduced. When brush 10 engages copper segment 6A, the circuit through brush 10, segment 6A and conductor 38 to conductor 39 is substituted for the circuit heretofore traced from brush 43A to conductor 39.

The brush 10 continues to sweep across the copper segment 6A and then the brush 9 contacts copper segment 4A over which it sweeps to the end of the segment. Thus it may be observed that during the transmission of the first portion of the signal there is a variable high resistance in the circuit. The variable resistance effectively in circuit at the start of the signal is a maximum for the given displacement. The variable resistance is reduced to zero as the brush 2 traverses the distance from the left-hand end of segment 3A to the position of brush 43A. From that time to the end of the signal, while brush 10 is traversing copper segment 6A and brush 9 is traversing copper segment 4A, the resistance in the circuit remains substantially unchanged and maximum current is transmitted. It may be observed, too, that the total over-all length of the signal remains the same as for the previous case. The duration of the signal is fixed by the length of time required for the brush to traverse two successive segments in the same ring, namely, segments 3A and 4A. Attention is called to the fact that during the transmission of the signal just described, high resistance segment 7A is not effectively in circuit as the path through it is open at contacts 52 and 53 of keys 45 and 46, respectively.

Similarly, signals with sloping fronts but unchanged in over-all length may be transmitted as desired by the actuation of contacts 14 to 17, inclusive, while ring 2 is displaced to the left and the armatures of keys 44, 45 and 47 are actuated to the left.

To transmit signals having a square front and a sloping end and unchanged in over-all length, the armatures of keys 44, 45 and 47 are actuated to the right while ring 2 remains displaced to the left as for the previous case. For this condition the high resistance segments 3A to 3F of ring 2 play no part as the circuits through each of them is open at the corresponding contacts of the keys. If we again assume that contact 13 is closed and relay 18 operated, when brush 10 engages the left-hand end of copper segment 6A, the current rises squarely to its full value. It remains at full value until brush 9 has swept off copper segment 4A. The signal does not end at this instant, however, as the circuit is extended through brush 10 which is in engagement with segment 7A. Although ring 5 as heretofore stated remains fixed in position at all times, brushes 54 to 59, inclusive, are rotated as ring 2 is rotated being displaced the same amount as ring 2. As brush 10 sweeps over the right-hand portion of high resistance segment 7A, beyond the point where displaced brush 54 makes contact therewith, an increasing amount of this resistance is inserted in series with brush 54. From brush 54 the circuit extends through contact 52 of key 45, conductors 51 and 39 and contact 25 of relay 18 to conductor 40. As a result of this resistance the current at the end of the signal will be progressively decreased. The slope of the decrease will depend on the displacement of ring 2 and brush 54 as well as the voltage of battery 37 and the total circuit resistance including resistance 37. The duration of the total signal for this condition is equal to the time required for arm 8 to traverse two successive segments of the same ring, namely, segments 6A and 7A of ring 5 and is therefore the same as for the preceding signals.

Similarly, by the actuation of any other or others of contacts 14 to 17, inclusive, signals having a square front and a sloping end and of

standard length may be transmitted in any desired combination.

It is possible also with the arrangement herein to transmit signals having a sloping front and a sloping end. To do this ring 2 is again displaced to the left as indicated by arrow 42 and the keys are arranged so that first a high resistance segment is connected in circuit to provide the sloping front. Then a copper segment is introduced to maintain the current at full value. Thereafter a second high resistance segment is introduced to provide a sloping end. The circuit arrangement to effect this condition will now be described.

Ring 2 is displaced to the left. The armatures of keys 44, 45 and 47 are operated to the left. The armatures of keys 46 and 48 are actuated to the right. Again assuming that contact 13 is actuated and that relay 18 is operated, when brush 9 engages high resistance segment 3A, a circuit may be traced from conductor 35, through resistance 36, battery 37, ring 1, brush 12, brush 9 to the left-hand end of segment 3A. There is a portion of displaced high resistance segment 3A in series with stationary brush 43A, depending on the amount of the displacement. The circuit extends through this portion of segment 3A to brush 43A and thence through conductor 49, contact 50 of key 45, conductors 51 and 39 and contact 25 of operated relay 18 to conductor 40. The arm 8 continues in its rotation and the amount of the high resistance segment 3A in circuit is reduced until brush 9 is opposite brush 43A, when the high resistance segment 3A electrically in circuit has been reduced to zero. At this instant brush 10 engages copper segment 6A and the circuit extends from conductor 35, resistance 36, battery 37, ring 1, brush 12, brush 10, conductors 38 and 39 and contact 25 to conductor 40. For a time if ring 2 is sufficiently displaced, the brushes 9 and 10 make contact simultaneously with segments 6A and 4A and then brush 10 sweeps off the right-hand end of segment 6A while brush 9 remains in engagement with segment 4A. During this interval, the circuit between ring 1 and conductor 39 is completed through brush 12, brush 9, copper segment 4A, conductor 41, copper segment 6A to conductor 38. When brush 9 sweeps off segment 4A, brush 10, which has been in engagement meanwhile with the left-hand portion of segment 7A, which has been short-circuited by the low resistance copper path just described, becomes effective. Brush 54 and similar brushes on ring 5, as described above are rotated in unison with ring 1, the same amount as ring 1. When brush 10 is opposite the displaced position of brush 54, none of the high resistance of segment 7A is effectively in circuit. But as brush 10 continues to rotate to the end of the segment, an increasing length of the right-hand portion of high resistance segment 7A is inserted in series with brush 54. During this interval the circuit is completed through brush 54, conductors 60 and 61, contact 53, conductor 62, contact 50, conductors 51 and 39 and contact 25 to conductor 40. This provides a signal with a front sloping upwardly to a uniform full current middle portion and an end sloping downwardly.

Again the amount of slope at both ends is dependent upon the amount of the displacement of ring 1, the total resistance of the circuit and the voltage impressed on the circuit. It should be pointed out that the over-all duration of the signal is greater than for the previously described

signals for the same speed of rotation of the arm 8. Further, it should be apparent that for this condition it is not possible to send successive single signal elements with slope at each end because of overlap. Except for this limitation it is possible through the operation of the various contacts to transmit any desired signal elements having slope at each end. It is possible, also, in a manner to be described below, to transmit a signal comprising a plurality of elements having a front sloping upwardly to full current, a uniform full current extended middle portion and a sloping end. And, in general, it is possible to send a signal comprising a plurality of elements having an extended middle portion with square front and rear ends as desired to simulate signals received from actual telegraph lines in practice and by means of the simulated signals to test their effect on an actual receiving printer or other telegraph mechanism.

The function of the copper segments on ring 63 is to bridge the gap between successive signals, when it is desired to send current pulses of a duration longer than a single element and to maintain the current at full value during the transition from the copper segment of ring 2 to the copper segment of ring 5. As an illustration of this when successive contacts are actuated such as 13 and 14 so that relays 18 and 19 are operated, a circuit is closed so that brush 11 engages copper segment 67A of ring 63 and a circuit is extended through conductor 64, contact 26, conductors 65 and 66 and contact 27 to conductor 40. Similarly a circuit may be traced for the operation of any two successive contacts. Whenever successive contacts of the group 13 to 17 are actuated therefore segments 67A to 67E, inclusive, depending on which contacts may be operated function to transmit full current during the transition interval.

As an alternative arrangement for that shown in the drawing and described above, a start-stop rotary telegraph distributor may be provided in which instead of shaping the signal ends by switching means, this is performed mechanically. In this alternative arrangement, a full length copper segment is provided for each signal element to be transmitted. Each copper segment comprises a large number of relatively thin individual substantially rectangular copper blocks assembled into a solid conducting unit segment. The segments are disposed so that the rotating brush contacts the top surface of each individual thin block comprising a unit in succession. Disposed opposite each of these thin individual copper blocks is a corresponding thin high resistance alloy block and mechanical means such as a group of fixed screws and traveling nuts are provided for pressing out or withdrawing any of the copper segments as required and pressing in or drawing into position its corresponding high resistance alloy block for each copper block so withdrawn.

What is claimed is:

1. In a telegraph system, a signal transmitter, means in said transmitter, comprising a conducting segment and a contact conditioned to traverse said segment, for transmitting signals at a first time having substantially square wave fronts and means also in said transmitter for transmitting signals at a second time having sloping wave fronts.
2. In a telegraph system, in combination, a rotary distributor, a first segment on said distributor of low specific resistivity, a second segment on said distributor of high specific resistivity and means also on said distributor for establishing alternate paths for the conduction of electric current through one or the other of said segments.
3. In a telegraph system, in combination, a signal transmitter, a copper segment on said transmitter, a segment having a high specific resistivity relative to said copper segment also on said transmitter, means on said transmitter for establishing an electrical conducting path through said copper segment at a first time, and means also on said transmitter for establishing an electrical conducting path through said high specific resistivity segment at a second time.
4. In a telegraph system, in combination, a signal transmitter, first segments of low specific resistivity and second segments of high specific resistivity, both thereon, a first means on said transmitter for transmitting signal elements of a first wave shape therefrom, comprising a circuit through said segments of low specific resistivity and a second means also on said transmitter of transmitting signal elements of a second wave shape comprising a circuit through said segments of high specific resistivity.
5. In a telegraph system, a telegraph signal transmitter, means in said transmitter, comprising a conducting segment and a contact conditioned to traverse said segment, for transmitting a telegraph signal with a wave shape having a sloping front, and means in said transmitter for varying the slope of said front.
6. In a telegraph system, a telegraph signal transmitter, means in said transmitter, comprising a conducting segment and a contact conditioned to traverse said segment, for transmitting a telegraph signal with a wave shape having a sloping end, and means in said transmitter for varying the slope of said end.
7. In a telegraph system, a telegraph signal transmitter, means in said transmitter, comprising a conducting segment and a contact conditioned to traverse said segment, for transmitting a telegraph signal with a wave shape having a sloping front, means for transmitting a telegraph signal with a wave shape having a sloping end, means in said transmitter for varying said slope of said front, and means in said transmitter for varying said slope of said end.

WILMARTH Y. LANG.