May 3, 1927. 1,627,444

F. McCORMICK

METHOD OF TELEGRAPHY

Filed Dec. 10, 1925 4 Sheets-Sheet 1

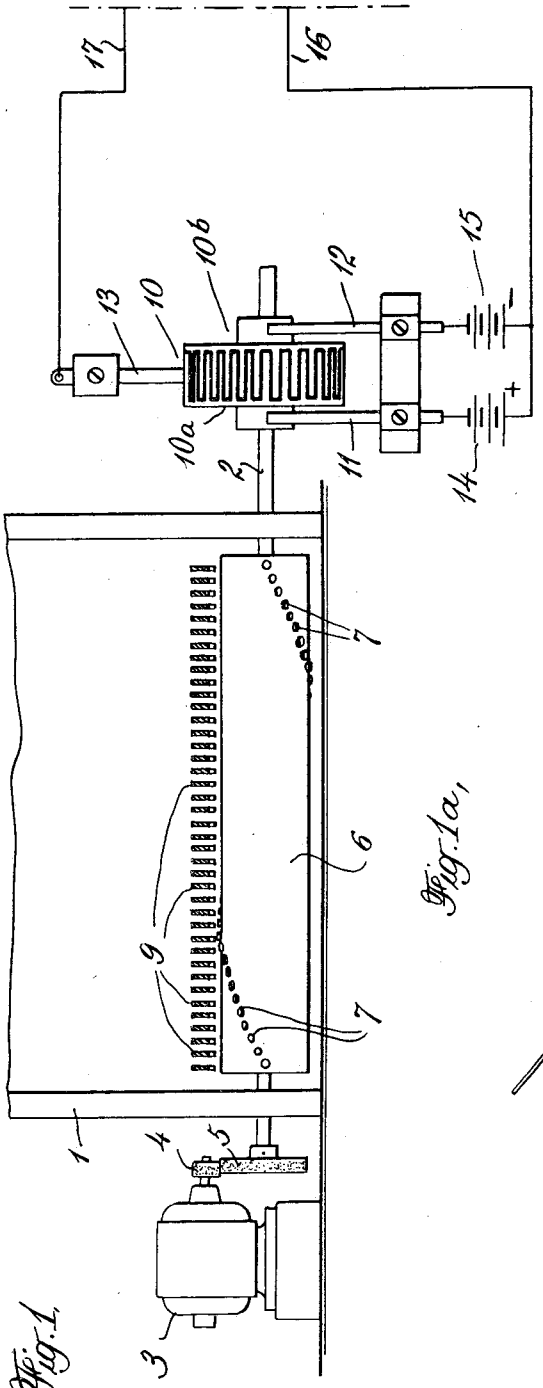

Fig. 1.

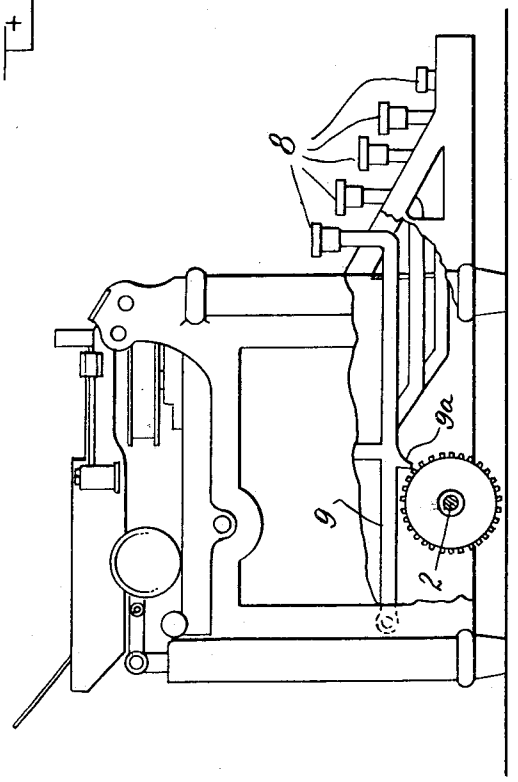

Fig. 1a,

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METHOD OF TELEGRAPHY

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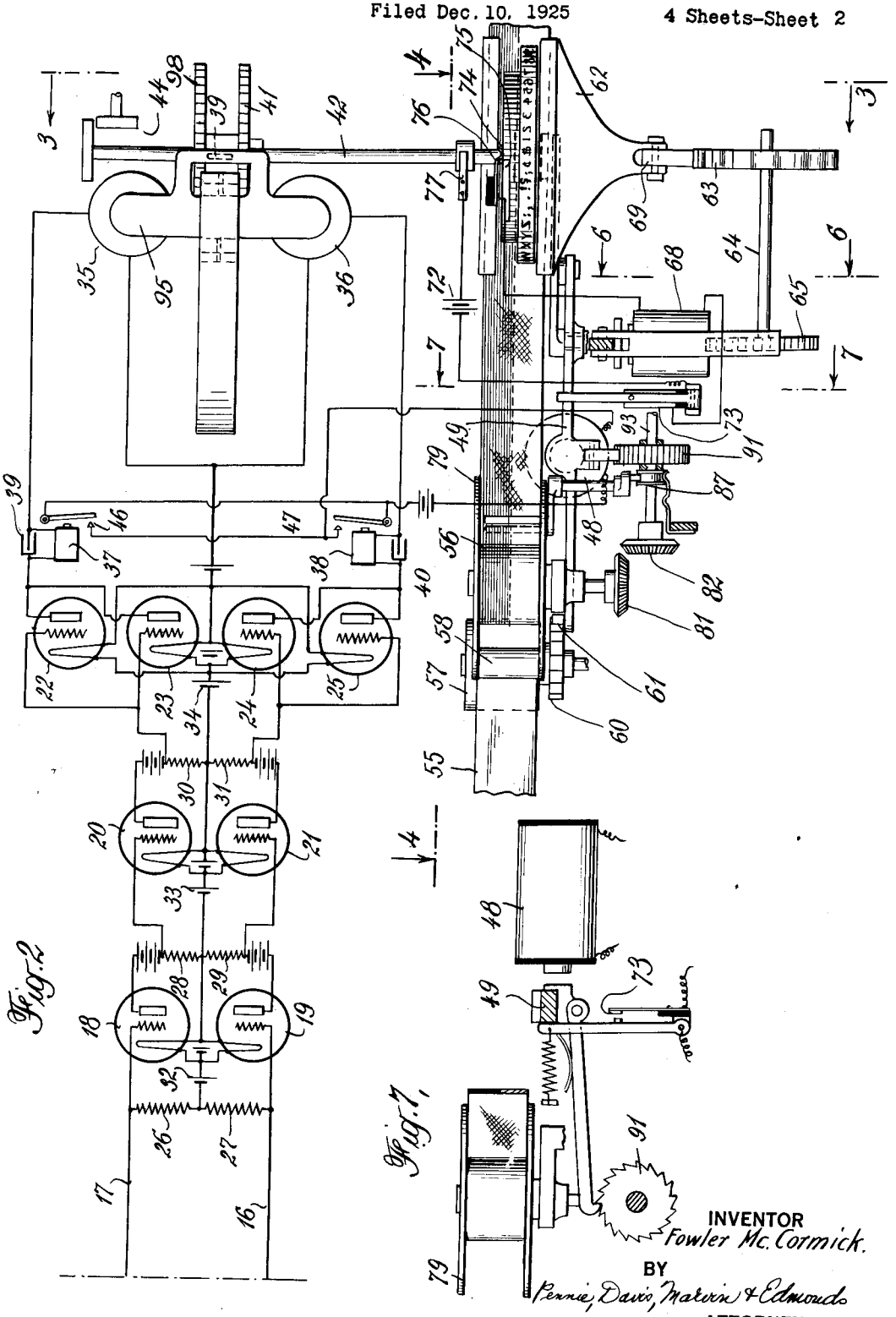

Fig. 2

Fig. 7.

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METHOD OF TELEGRAPHY

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Fig. 5,

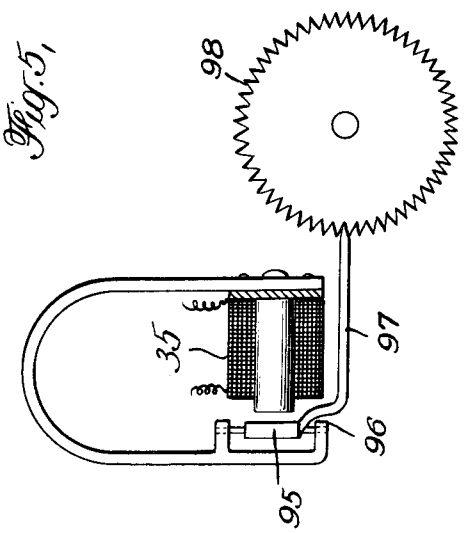
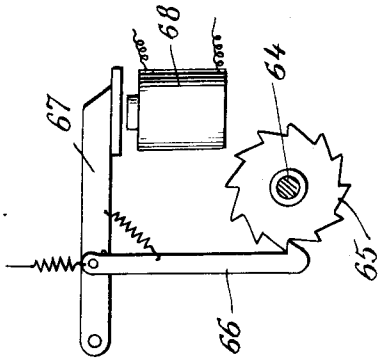


Fig. 6,



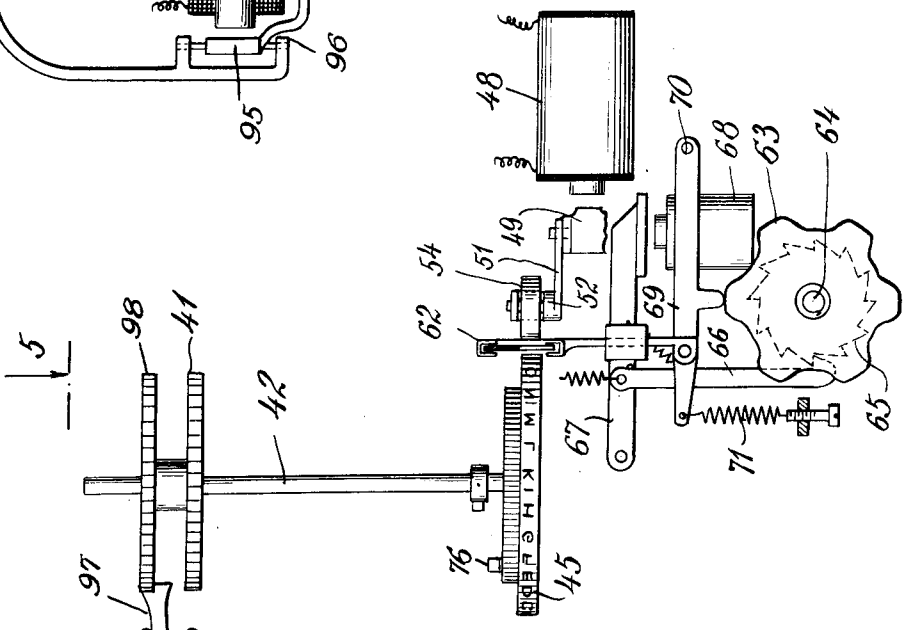
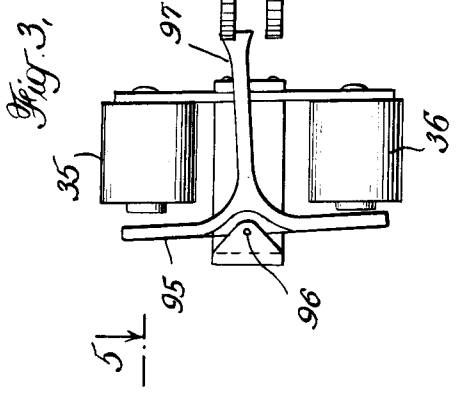


Fig. 3,



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METHOD OF TELEGRAPHY

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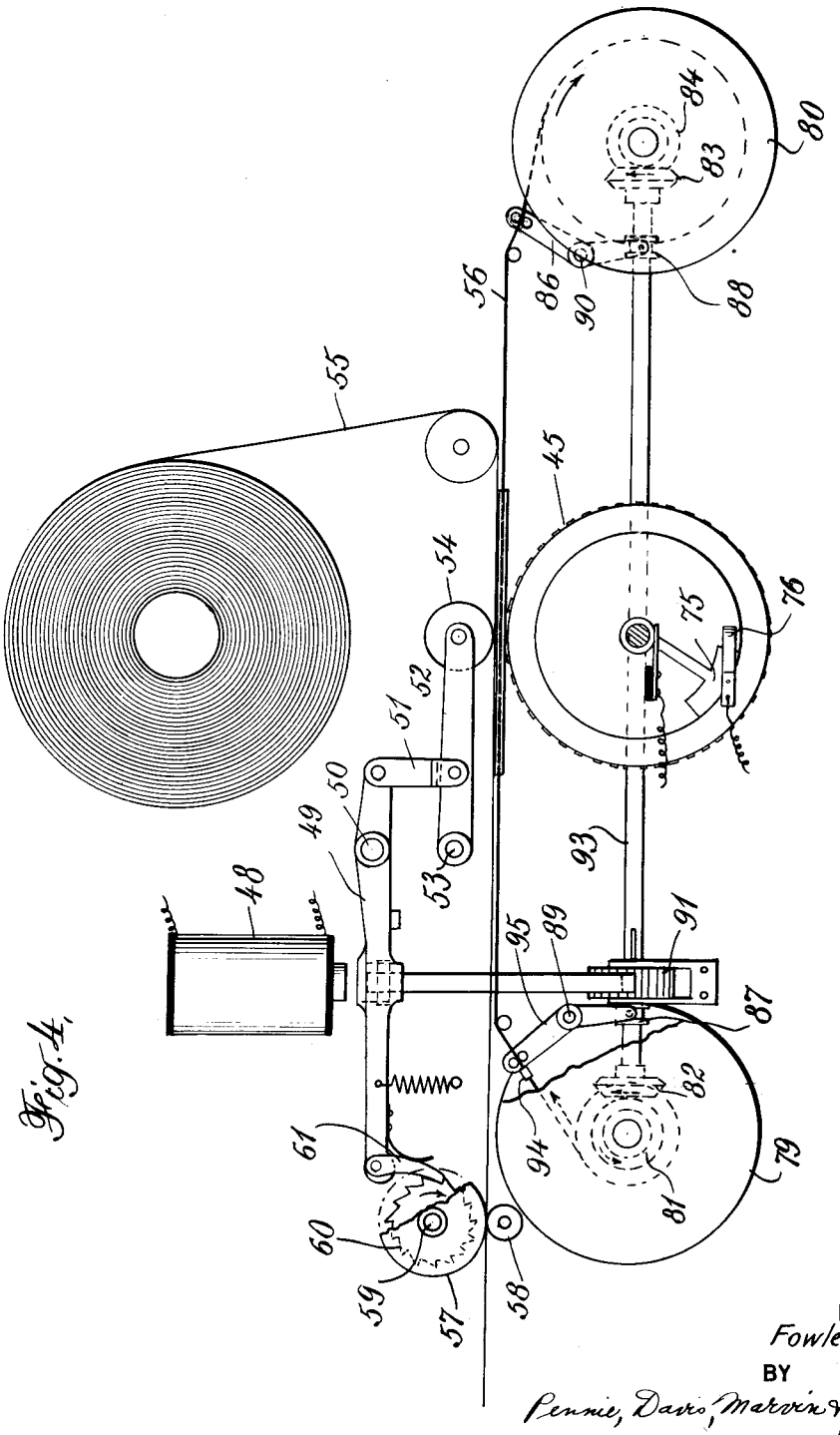

Fig. 4.

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Patented May 3, 1927. 1,627,444

UNITED STATES PATENT OFFICE.

FOWLER McCORMICK, OF CHICAGO, ILLINOIS.

METHOD OF TELEGRAPHY.

Application filed December 10, 1925. Serial No. 74,454.

The invention hereinafter described and claimed has for its object to effect certain improvements in electrically transmitted messages and particularly telegraphic and cable messages and mechanisms for automatically printing such messages.

Heretofore it has been common practice in sending cablegrams, and to some extent ordinary telegrams, to use the word "stop" at the end of each sentence. This, of course, adds materially to the transmission time and likewise to the cost per message. Furthermore, this practice often leads to confusion in the interpretation of telegraphic and cable messages.

With a view to obviating any necessity of using the word "stop", or similar expression, as a sentence terminator, I propose to have the adjacent sentences of such messages typed in different colors—for example, black and red. By so doing each sentence of a typewritten telegram or cablegram may be clearly and distinctly set off.

This invention provides a telegraph system applicable for both cable and land wire, wherein the messages are automatically printed at the receiving end, or, if desired, at both the transmitting and receiving ends, and wherein adjacent sentences are printed in different colors.

By the provision of arrangements whereby the messages are printed at the transmitting end of the system during the process of transmission, a facsimile of the transmitted message, that is the message as printed at the receiving end, will be made, so that the sender may be assured that his message has been sent correctly.

In addition to typing adjacent sentences of a message in different colors, it is contemplated that adjacent words may be typed in different colors in order to set them off. Likewise, it is contemplated that quoted matter and matter which is to be emphasized may be printed in different colors.

To the same end instead of using different colors for adjacent sentences or adjacent words, a change of some other character may be resorted to. For example, different kinds of type for adjacent sentences, words or quoted matter, etc., may be employed advantageously.

A printing telegraph system especially adapted for cable transmission, wherein adjacent sentences are printed in different colors in accordance with this invention, is illustrated, by way of example, in the accompanying drawings, wherein,

Fig. 1 represents the transmitting end of the system;

Fig. 1[a] is a side elevation of a transmitting typewriter;

Fig. 2 represents the receiving end of the system;

Fig. 3 is an elevational view taken along the line 3—3 of Fig. 2 and shows a part of the printing and color-changing mechanism at the receiving end of the system;

Fig. 4 is a view taken along the line 4—4 of Fig. 2;

Fig. 5 is a view taken along the line 5—5 of Fig. 3 and illustrates, in detail, the electromagnetic stepping mechanism which operates to rotate the type-wheel shaft;

Fig. 6 is a view taken along the line 6—6 of Fig. 2 and shows the electromagnetic step-by-step drive which operates the color changing mechanism; and

Fig. 7 is a view taken along the line 7—7 of Fig. 2.

In the system illustrated and hereinafter described in retail, arrangements are provided at the transmitting station whereby, normally, a continuous series of alternate positive and negative electrical impulses are impressed across a pair of cable conductors. These impulses are amplified at the receiving end of the cable by means of a suitable multistage vacuum tube amplifier. The amplified impulses at the receiving end are impressed upon an electromagnetic step-by-step escapement mechanism which controls the operation of a frictionally driven shaft. on which is mounted a type-wheel. At all times, when no signal is being transmitted, the type-wheel continues to rotate under the control of the escapement mechanism which operates continuously during the absence of signal or printing impulses.

In response to the actuation of a key, at the transmitting station, corresponding with a letter, numeral or other character which it is desired to transmit and print at the receiving station, the polarity changing device at the transmitting station is temporarily stopped. Thereupon an electrical im-

pulse of relatively long duration, compared with the normal impulses, is transmitted. At the receiving station there is, what may be conveniently termed, a printing electromagnet. This is under the control of a pair of slow-acting relays—the operation of either of which will close a circuit for the printing magnet. The printing magnet control relays, just referred to, are connected in circuit with the output of the receiving amplifier, but are designed to be so slow-acting that they are not operated by the short impulses normally transmitted. When, however, impulses of longer duration, such as those caused by operation of the transmitting keys, are received one or the other of the printing magnet control relays is energized for a long enough period to permit it to pull up its armature thereby closing a local circuit of the printing magnet.

At the same time the operation of the normally continuously acting electromagnetic step-by-step driving mechanism is interrupted and the type-wheel is accordingly brought to a standstill.

Energization of the printing magnet causes the immediate actuation of a printing roller, between which and the type-wheel, a paper tape and two-color typewriter ribbon are disposed. Whichever character on the type-wheel happens to be in the printing position when the printing magnet is energized is impressed on the paper tape. Means are provided for moving the paper tape longitudinally step-by-step—the tape being moved one step after each printing or spacing actuation of the printing magnet.

Whenever the type-wheel is stopped in a position with a period, question mark, exclamation mark or other sentence terminator in the printing position, and the printing magnet is actuated, a circuit is closed for the operation of an electromagnetic ribbon shifting device.

In Fig. 1, 1 represents a portion of the frame of a transmitting typewriter, an end view of which is shown in Fig. 1ª. Journaled in the frame of the transmitting typewriter is a shaft 2 which is normally rotated continuously by an electric motor 3, to which it is connected through the medium of a pair of engaged friction wheels 4 and 5. The friction drive shown is intended to represent only a conventional arrangement. A more suitable friction drive than that shown would ordinarily be provided in actual practice, but since the invention does not reside in the friction drive no attempt has been made to illustrate a more elaborate arrangement.

A cylindrical drum 6 is mounted on and rotates with shaft 2. Around the periphery of the drum 6 and arranged in a helical line, are a considerable number of radially projecting pins 7. Each one of the pins 7 corresponds with a letter, numeral, space or other character on the type-wheel at the receiving station. Each pin is angularly displaced from all the others.

Each of the transmitting typewriter keys 8 is connected with a key-bar 9 and each of the latter is provided with a projecting lug 9^a (Fig. 1^a) which is arranged in line with one of the projecting pins 7 and adapted to be moved into the path of its associated pin upon the corresponding key 8 being depressed. When a lug 9^a is moved into the path of its associated pin 7 the drum 6 and shaft 2 will rotate until the pin engages the lug whereupon they are brought to a sudden stop. The friction drive permits of this being done without stalling the driving motor 3.

A crown-wheel commutator 10, comprising two interengaged half-portions 10^a and 10^b, insulated from each other, and from the shaft 2, is mounted on the latter and rotatable therewith. It will be seen that alternate segments of the commutator thus formed are integral with one of the two like parts 10^a or 10^b and that the remaining segments are integral with the other half-portion of the commutator.

A brush 11 is in wiping engagement with the hub of the commutator part 10^a and another brush 12 is in wiping engagement with the hub of the other commutator part 10^b. A third brush 13 is arranged in wiping engagement with the commutator segments. As the commutator rotates, the brush 13 comes into contact with the half-portion 10^a and 10^b, alternately.

Two batteries 14 and 15 are connected respectively to the brushes 11 and 12. The negative terminal of the battery 14 is connected to the brush 11, while the positive terminal or battery 15 is connected to the brush 12. The other poles of the batteries 14 and 15 are connected in common to the cable conductor 16 and the brush 13 is connected to the cable conductor 17.

Normally, that is when no transmitting key 8 is depressed, the commutator 10 rotates continuously with the result that the voltages of batteries 14 and 15 are alternately impressed across the conductors 16 and 17. The number of segments on the commutator 10 corresponds with the number of pins 7 and likewise with the number of letters, numerals and other characters on the type-wheel at the receiving station. The shaft 2 rotates at a fairly rapid rate so that the duration of the normal impulses transmitted is very short.

In transmitting a message the keys 8 are operated, one at a time, and a copy of the message transmitted is transcribed, or may be transcribed by the transmitting typewriter at the transmitting station.

Whenever a transmitting key 8 is depressed and the commutator 10 thereby brought to a stop, the brush 13 is in contact with one of the commutator segments, and a current impulse from one or the other of the batteries 14, 15 of relatively long duration is impressed upon the cable conductors.

At the receiving end of the cable (see Fig. 2) a vacuum tube amplifier, preferably of the resistance coupled type is provided. This will usually be found necessary in order to bring the received impulses up to sufficient strength to operate the printing apparatus at the receiving end of the line.

A three stage push-pull resistance coupled vacuum tube amplifier of a type suitable for the purpose is illustrated in Fig. 2. The first two stages of this amplifier each comprise two three-electrode vacuum tubes 18, 19 and 20, 21, respectively. In the last stage of the amplifier four vacuum tubes 22, 23, 24 and 25 are shown. As many tubes or as many stages of amplification as may be found necessary may be employed. The amplifier illustrated is of a type which is sometimes referred to as a direct-current amplifier, since it is adapted to amplify impulses of long duration. Inasmuch as the vacuum tube amplifier shown is of a type which is well known in the art and since its operation will be readily understood by those skilled in the art, there seems to be no necessity for entering upon a detailed description thereof. It may be well to point out, however, that each of the elements 26 to 31, inclusive, is a high resistance element and that the batteries 32, 33 and 34 are grid biasing batteries which are preferably arranged to render their respectively associated control electrodes or grids of negative potential with respect to filament.

Each half of the divided output circuit of the last amplifier stage includes an electromagnet coil 35, 36 and the winding of a relay 37, 38, respectively. Relay 37 is inserted in series with the coil 35 and relay 38 is in series with the coil 36. It may be found desirable to provide condensers 39 and 40 in shunt to the winding of the relays 37 and 38, respectively, in order to provide a low impedance path for the impulses of short duration. Where these condensers are found to be unnecessary they may be omitted.

The electromagnet coils 35 and 36 are adapted to actuate an armature 95 which is pivoted at 96 (see Figs. 3 and 5). Integral with armature 95 is an escapement lever 97 which alternately engages the teeth of the two escapement wheels 98 and 41. These escapement wheels are rigidly mounted on a shaft 42 and are angularly displaced with respect to each other by half the pitch of their teeth. Shaft 42 is rotatably driven by friction drive 44, but its rotation is under the control of the escapement mechanism comprising the two escapement wheels 98, 41, escapement lever 97, armature 95 and electromagnet coils 35 and 36.

When an impulse of a given polarity is transmitted over the cable conductors a current flows through resistances 26 and 27 in series and a difference of potential is developed thereby across the extreme terminals of these resistance elements. Accordingly the potentials of the control electrodes of the amplifier tubes 18 and 19 are changed. The potential of one of these control electrodes becomes more negative while that of the other becomes more positive, when considered with respect to the potential of the filaments. Ordinarily these control electrodes are maintained at such a negative potential that in the absence of any received impulses no current will flow in the output circuits of amplifier tubes 18 and 19. The same is or may be true of the succeeding amplifier stages. It is evident then that, during the reception of any impulse, plate current flows in only one half of the divided output circuit of the last amplifier stage. The polarity of the received impulse determines in which half of the divided output circuit, current will flow. In response to successive alternations of the received impulses current flows alternately in the two halves of the divided output circuit of each amplifier stage and, accordingly, current flows alternately through coils 35 and 36 and through the windings of relays 37 and 38.

In response to the alternate energization of coils 35 and 36 the escapement lever 97 oscillates between escapement wheels 98 and 41 and permits the rotation of shaft 42. As long as the commutator 10 continues to rotate uniformly, that is, without interruption, the escapement lever 39 oscillates at a corresponding rate without interruption. As each segment of the commutator 10 comes into contact with the brush 13 one or the other of electromagnet coils 35, 36 is energized and the escapement lever 97 is moved out of engagement with one escapement wheel and into engagement with the other. This permits the rotation of shaft 42 through an angle corresponding to one-half the pitch of the teeth of the escapement wheels, the type-wheel is rotated just enough to move a succeeding character into the printing position.

When an impulse of relatively long duration is transmitted one of the coils 35, 36 is energized for a correspondingly relatively long period, with the result that the rotation of shaft 42 is interrupted for a period of time corresponding to the duration of the long impulse.

A type-wheel 45 is rigidly secured to shaft 42 and rotates therewith. Type representing all the letters of the alphabet, together with the numerals zero to 9 inclusive, and other

characters are provided on the periphery of the type-wheel. When a key 8 at the transmitting station corresponding with any numeral, letter or other character is pressed, the type-wheel 45 is automatically stopped in the manner previously described with the corresponding type-character in the printing position.

Upon receipt of an impulse of long duration, resulting from the operation of one of the transmitting keys, one or the other of the slow acting relays 37, 38 (depending upon the polarity of the impulse) is operated and closes a contact 46 or 47 in the local circuit of the printing magnet 48. An armature lever 49, adapted to be actuated in response to energization of printing magnet 48, is pivoted at 50 and connected through a link 51 to a lever arm 52, one end of which is pivoted at 53 and the other end of which carries a rubber printing roller 54.

A paper tape 55 is arranged to pass between type-wheels 45 and printing roller 54 and a two-color typewriter ribbon 56 is disposed between the paper tape 55 and the type-wheel 45.

The paper tape passes between two rubber rollers 57 and 58, the former of which is mounted on a shaft 59 to which is secured a ratchet wheel 60, adapted to be actuated by the pawl 61 which is carried by the armature 49. When the printing magnet 48 is energized and the armature 49 thereby actuated, the pawl 61 engages a fresh tooth. Upon deenergization of the printing magnet 48 the armature 49 is restored to its normal position and the ratchet wheel 60, together with roller 57, is rotated one step, while at the same time printing roller 54 is raised. The rotation of roller 57 moves the tape 55 longitudinally the proper distance for the spacing of the printed characters.

The typewriter ribbon 56 passes through a guide 62 which is adapted to be moved transversely of the ribbon thereby moving the ribbon into either of the two color positions, similarly to the action of the ribbon guide in an ordinary typewriter. The mechanism for operating the ribbon guide, for the purpose of changing colors is clearly represented in Fig. 3 wherein is shown the wheel-cam 63 which is mounted on a shaft 64 to which is secured a driving ratchet wheel 65. The wheel-cam 63, shaft 64 and ratchet wheel 65 are adapted to be rotated step-by-step by the driving pawl 66 which is pivotally connected to the armature 67 of an electromagnet 68 which may be conveniently referred to as the color changing magnet. The ratchet wheel 65 is rotated one step upon deenergization of the color changing magnet 68 which will be evident from an examination of Fig. 6. The ribbon guide 62 is pivotally connected to a cam-follower lever arm 69 which is pivoted at 70. A lug on the cam-follower lever arm 69 bears against the periphery of cam 63, being held in engagement therewith by the spring 71. Each time the shaft 64 is rotated one step the cam 63 is rotated through an angle corresponding to one half the pitch of its teeth. In Fig. 3 the cam-follower lever arm 69 is shown in engagement with one of the high points of the cam wheel. Upon shaft 64 being rotated one step from the position shown in Fig. 3 the cam-follower lever arm will move into a position wherein it engages the short radius of the periphery of the cam wheel. It is evident that by this operation the ribbon guide, together with the ribbon passing therethrough, is moved laterally so that the alternate half of the ribbon is brought into active position and, therefore, the color of the printed impression is changed.

It is only when a sentence terminating character such as a period or a question mark is transmitted that the color of the impression should change, except in special cases where it may be desired to print adjacent words in different colors. In the present instance it may be assumed, for the purpose of explanation, that it is desired only to print adjacent sentences in different colors.

It follows that the color changing magnet 68 should only be energized in response to the actuation of the printing magnet when printing a sentence terminator. In the circuit of the color changing magnet 68 are included a battery 72 and two series contacts 73 and 74, both of which have to be closed in order to complete the circuit for the color changing magnet. Contact 73 (see Fig. 7) is closed upon energization and operation of the printing magnet 48 while contact 74 is closed only when a sentence terminator such as a period, question mark or the like is in the printing position. This is provided for by means of a contact segment 75 (see Figs. 2 and 4) which rotates with the type-wheel and engages a brush 76 whenever a sentence terminator is in the printing position. Electrical connection with the segment 75 is made through a brush 77 which is in wiping engagement with a sleeve 78 on shaft 93—sleeve 78 being electrically connected to segment 75.

The typewriter ribbon 56 is carried by two rotatable ribbon spools 79 and 80 which are driven alternately by mitre gears 81, 82 and 83, 84. The shaft 85 which carries gears 82 and 83 is slidable longitudinally and only one of the gears 82, 83 is engageable with its mate at any one time. A pair of bell cranks 85, 86 engage individually, shifting sleeves 87, 88 which are carried by shaft 93. The bell cranks 85, 86 are pivoted at 89 and 90 respectively. A ratchet wheel 91 is ar-

ranged to drive shaft 93 and the latter is adapted to slide longitudinally therethrough. A driving pawl 92 drivingly engages the ratchet wheel 91 and is attached to armature 49 of the printing magnet. Upon each energization of the printing magnet the ratchet wheel 91, shaft 93 and gears 82, 83 are rotated one step. One or the other of the ribbon spools 79, 80 is thereupon rotatably driven one step. The spool driven depends upon which pair of mitre gears 81, 82 or 83, 84 happens to be engaged.

Near each end of the ribbon 56 there is attached thereto a metal clip 94 (only one being shown (see Fig. 4)). These metal clips operate to engage the bell cranks 85, 86 respectively and cause the shaft 93 to move longitudinally thereby disengaging one pair of mitre gears and engaging the other pair. In Fig. 4 the mitre gears 83, 84 are engaged while gears 81, 82 are shown disengaged. The ribbon spool 80 rotates, under these conditions, in the direction indicated by the arrow thereon. The clip 94 is shown, in Fig. 4, in engagement with bell-crank 85 and about to move the latter about its pivot 89, thereby effecting a longitudinal shift of shaft 93 and, consequently a reversal of the direction of movement of ribbon 56.

The utility of the present invention is not limited to wire transmission systems but is obviously applicable with suitable modifications to radio telegraph systems. It may also be adapted for carrier telegraph systems wherein high frequency signal currents are transmitted over wire lines. The invention should not, therefore, be construed as limited except by the scope of the appended claims.

I claim:

1. A signaling system comprising a transmitting station and a receiving station, means at said receiving station for printing received messages in plain language, said means being controllable from said transmitting station, and a color changing mechanism at said receiving station whereby any letter, word, phrase or sentence forming part of a transmitted message can be printed in a different color from that of the remainder of the message, said color changing mechanism being also controllable from said transmitting station, the arrangement being such that any desired portion or portions of a message can be transcribed in a different color from that of the remainder of the message at the will of the transmitting operator.

2. A printing telegraph system characterized in that transmitted messages can be printed at the receiving station in plain language and in a plurality of colors and that color changes can be effected at any desired points in the transcription of a message under the control of and at the will of the transmitting operator, said system comprising a transmitting station and an associated receiving station interconnected by a transmission line, step-by-step mechanism at said receiving station, means at said transmitting station for transmitting electrical impulses to operate said step-by-step mechanism, a plurality of type characters at said receiving station adapted to be moved individually in seriatim into a printing position in response to actuation of said step-by-step mechanism, a color changing mechanism at said receiving station, a local circuit including a source of current for operating said color changing mechanism, and circuit closing means included in said circuit, said circuit closing means being closed only when said step-by-step mechanism has been actuated into a predetermined position and an impulse of lengthened duration is received.

3. In a printing telegraph system a transmitting station and a receiving station in communicative relation thereto, a typing mechanism at said receiving station operable to type received messages in plain language, said typing mechanism being operable under the control of an operator at said transmitting station, a color changing mechanism at said receiving station by means of which a received message can be typed in a plurality of colors, and means at said transmitting station whereby an operator thereat can operate said color changing mechanism at will and whereby any part or parts of a message can be typed in a different color from the remainder of the message, said system being characterized in that individual letters, words, phrases and sentences forming parts of a message can be typed in a different color from that of the remainder of the message at the will of the transmitting operator.

4. A signaling system comprising a transmitting station and a receiving station, means at said receiving station for printing received messages, means at said receiving station for effecting color changes in printed received messages, an electrical impulse sending device at said transmitting station, said device being operable to transmit a continuous series of impulses to said receiving station, means for interrupting the continuity of impulses at said transmitting station in accordance with signals to be transmitted, and means at said receiving station operable in response to interruptions of the continuity of received impulses to control the operation of said printing means and said color changing means.

5. A signaling system comprising a transmitting station and a receiving station, a typing mechanism at said receiving station operable to print received messages, means at said transmitting station operable to transmit to said receiving station a con-

tinuous train of electrical impulses of substantially equal duration, means at said transmitting station operable to lengthen the duration of individual impulses in accordance with signals to be transmitted, said typing mechanism being operable to effect typing operations in response to impulses of lengthened duration, a color changing mechanism at said receiving station, said color changing mechanism being operable in response to impulses of lengthened duration following a predetermined operation of said typing mechanism.

6. A signaling system comprising a transmitting station and a receiving station, a mechanism comprising a type wheel at said receiving station, said mechanism being operable to print received messages, means at said transmitting station operable to transmit to said receiving station a continuous train of electrical impulses of substantially equal duration, said mechanism being operable to rotate said type wheel step-by-step in response to received impulses and under the control thereof, means at said transmitting station operable to lengthen the duration of individual impulses in accordance with characters forming elements of messages to be transmitted, said mechanism being operable to effect printing operations in response to received impulses of lengthened duration, a multi-color typewriter ribbon in cooperative relation to said typewheel and means operable to shift the relative position of said ribbon and typewheel for effecting color changes in the printed messages, said last mentioned means being operable in response to received impulses of lengthened duration following a predetermined positioning of said typewheel.

7. A signaling system comprising a transmitting station and a receiving station, a mechanism comprising a typewheel at said receiving station, said mechanism being operable to print received messages, means at said transmitting station operable to transmit to said receiving station a continuous train of electrical impulses of substantially equal duration, said mechanism being operable to rotate said typewheel step-by-step in response to received impulses and under the control thereof, means at said transmitting station operable to lengthen the duration of individual impulses in accordance with characters forming elements of messages to be transmitted, said mechanism being operable to effect printing operations in response to received impulses of lengthened duration, color-changing means in cooperative relation to said typewheel, electrical means for operating said color changing means, a circuit and source of current for said electrical means, and means operable to close said circuit in response to a received impulse of lengthened duration only when said typewheel is in a predetermined angular position.

8. In a printing telegraph system a transmitting station and a receiving station in communicative relation thereto, typing mechanism at said receiving station, said typing mechanism comprising a full set of type for printing received messages in plain language, mechanism at said transmitting station operable under the control of an operator thereat to transmit electrical impulses to said receiving station, means at said receiving station responsive to said electrical impulses for selectively operating said typing mechanism under the control of the transmitting operator, and color changing mechanism at said receiving station operable under the control of the transmitting operator, the arrangement being such that any letter, word, phrase, sentence or numeral forming part of a message can be typed at the receiving station in a different color from that of adjacent portions of the message, all under the control and at the will of the transmitting operator.

9. In a printing telegraph system a transmitting station and a receiving station, a line interconnecting said stations, means at said transmitting station for transmitting over said line a continuous series of electrical impulses of relatively short duration, typing means at said receiving station, said typing means comprising a mechanism operable step-by-step in response to received impulses to bring each of a series of type characters consecutively and individually into the printing position, a printing magnet actuable in response to received impulses of relatively long duration, said printing magnet when actuated being operable to effect the printing of whichever type character is in the printing position, means at said transmitting station operable manually to lengthen the duration of individual outgoing impulses, the arrangement being such that each transmitted impulse of short duration advances said mechanism one step but does not cause said printing magnet to be actuated, a color changing mechanism at said receiving station operable in response to certain impulses of lengthened duration received from said transmitting station whereby the color of the printed message can be changed at any time by the transmitting operator, a local circuit including a source of current for operating said color changing mechanism and switching means operable to close said circuit only in response to certain received impulses which are intended to effect a color change.

10. The method of reproducing in printed form a telegraphically transmitted message comprising a plurality of sentences, which consists in printing the several sentences as a continuous series of equally spaced words

and differentiating between adjacent sentences exclusively by printing them in different colors.

11. In a printing telegraph system, a transmitting station and a receiving station, multi-color printing apparatus at said receiving station operable to print received messages in a plurality of colors, and means at said transmitting station whereby any desired portion or portions of a transmitted message can be printed at said receiving station in either of a plurality of colors under the control of a transmitting operator.

In testimony whereof I affix my signature.

FOWLER McCORMICK.