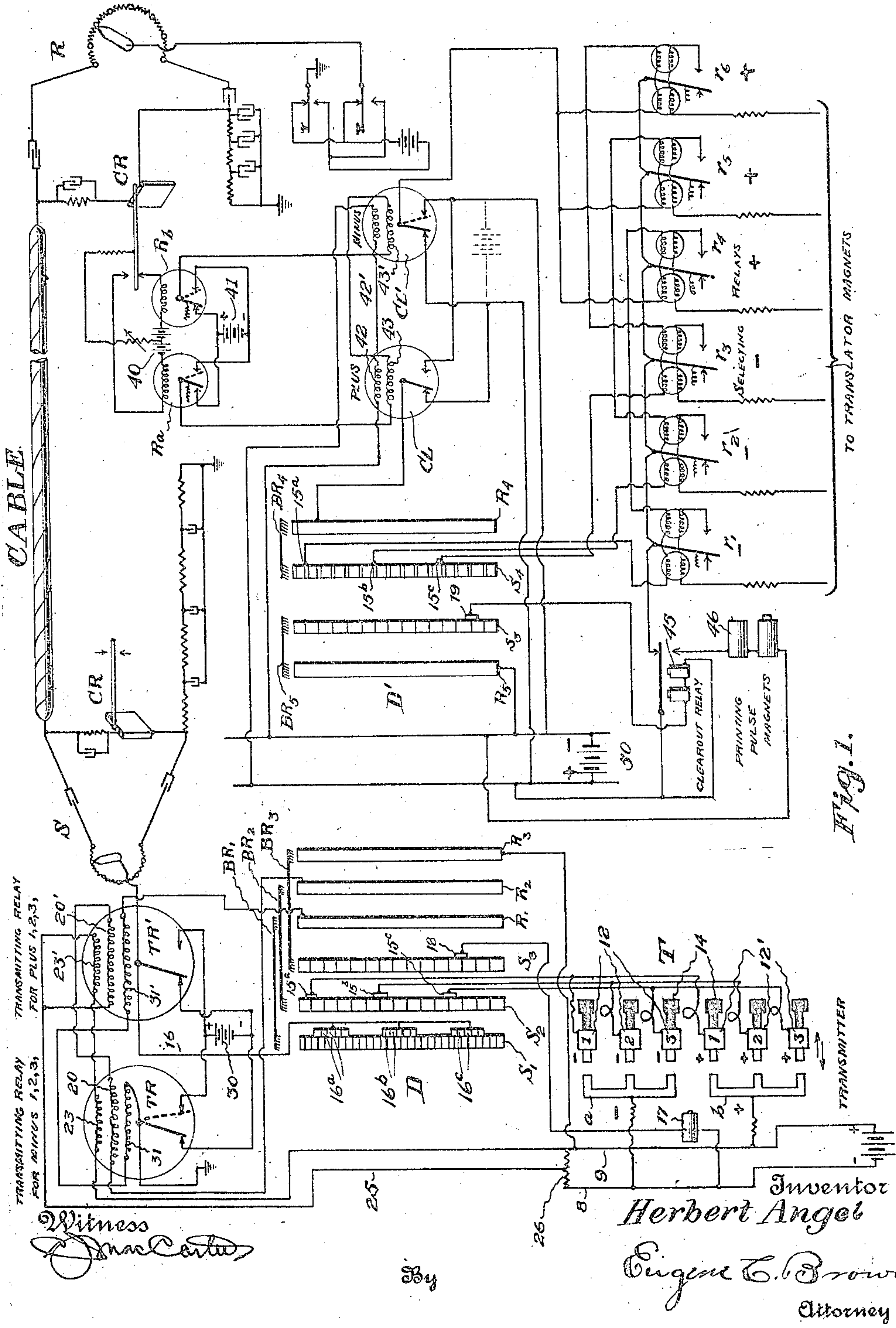


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1,431,865.

Patented Oct. 10, 1922.

2 SHEETS—SHEET 1.



1,431,865.

2 SHEETS--SHEET 2.

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CABLE TELEGRAPHY.

Application filed June 7, 1919. Serial No. 302,429.

To all whom it may concern:

Be it known that I, HERBERT ANGEL, a subject of the United Kingdom of Great Britain and Ireland, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Cable Telegraphy, of which the following is a specification.

This invention relates to a method of and apparatus for operating cable or ocean telegraphy wherein the code signals are sent into the cable automatically by a tape transmitter and at the receiving end are selectively transmitted to the actuating magnets of a printing telegraph apparatus.

Ocean cable operation, as at present practiced, requires the received messages to be translated by an operator, and may, therefore, be considered as semi-automatic, whereas on land lines both the transmission and receiving of messages is entirely automatic, the messages being translated and recorded by means of an electrically operated telegraphic printer, the more important lines being operated on the multiplex system employing a sending and receiving distributor operating synchronously at each end of the line.

One of the purposes of my invention is to provide a method of ocean cable operation employing the fundamental principles of the multiplex system on land lines, whereby the code characters may be automatically transmitted and received rapidly and accurately. A further object is to provide an automatic system of ocean telegraphy especially adapted for the employment of three-unit code characters, which is the minimum number of impulses that can be used for each character.

It is well known that reversed current impulses sent rapidly through a long submarine cable are the most clearly defined at the distant end of the cable since each following current has the effect of neutralizing the preceding one. This principle may be utilized when a five-unit code is employed if succeeding impulses of like sign are suppressed in the transmission and are then re-introduced at the receiving end. On the other hand, while in the three-unit code certain of the characters require succeeding current impulses of like sign or polarity, yet the time required to transmit a char-

acter of three impulses is only three-fifths of that required for a five-unit character and consequently the time period for each impulse may be lengthened somewhat and still permit a more rapid transmission of the code characters. In this manner the wave distortion due to the cumulative effect of succeeding impulses of like sign may be minimized, especially if the cable is grounded for an instant between succeeding impulses. The necessity for grounding between successive impulses of like sign is rendered unnecessary when the method of cable operation disclosed in U. S. application of Joseph W. Milnor, Serial No. 254,401 is employed.

I have found that the distortion of the wave form of the impulse transmitted through the cable occurs mainly at the beginning and ending of the current wave and I, therefore, arrange the parts of the receiving apparatus so that the selecting relays which transmit the current impulses to the recording device or printer, shall be connected only during the intermediate portion of each current impulse. This results in a clear definition of the positive and negative character impulses. I also provide for the grounding of the cable for an instant between successive impulses to minimize or nullify the cumulative effect of successive impulses of like sign.

In order that this invention may be clearly understood and properly carried into effect it will now be described with reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrating one form of apparatus which may be employed; Fig. 2 is a chart showing the positive, negative and zero impulses corresponding to each letter and character of the three-unit code; and Fig. 3 is a plan view of a section of tape perforated to indicate the characters of the code.

In the diagram the ground connections at either end of the cable and the arrangement of the cable receiving relay CR in the bridge connection for duplex working are illustrated in the usual conventional manner. For the sake of clearness only the transmitting apparatus is indicated at the sending station S and only the receiving apparatus at the receiving station R, but it is to be understood that both apparatuses would

be installed at each end of the cable for duplex or multiplex operation.

The method of sending a signal or combination of signals is similar to that in the multiplex system. A transmitting tape is first perforated to indicate the characters of the message by means of a keyboard perforator adapted for the three-unit code. The perforated tape is then fed through the transmitter, advancing the space of one character for each revolution of the sending distributor.

The automatic transmitter, indicated diagrammatically at T, is of the well-known type, such as described in U. S. Patent No. 1,298,440 granted to G. R. Benjamin March 25, 1919. In the transmitter as modified for use in the three-unit code system, the stationary contacts are arranged in two groups *a*, *b* of three connected contacts, each connected respectively to the negative and positive bus bars 8 and 9. The contacts may be designated minus 1, minus 2, minus 3, and plus 1, plus 2 and plus 3, corresponding to the positions of the perforations extending transversely across the tape to indicate the code characters by their various combinations.

The six movable contact tongues 12, 12', cooperate with the minus and plus groups of stationary contacts and are normally held against the back stops 14. When a tape is fed through the transmitter, one, two or three of the movable contacts will be moved into contact with the corresponding stationary contacts *a*, *b*, depending upon which of the selecting pins of the transmitter (not shown) are in alignment with perforations in the tape, as is understood by those familiar with transmitters of this type. If, however, a blank space is fed through the transmitter, no contacts will be made. The movable contacts are electrically connected in pairs, the minus and plus contacts of each of the three positions being thus connected. The combinations of minus, plus and zero impulses of the code characters are so arranged that only one movable contact of each pair can be moved for any code character, i. e. if the negative contact of one of the three positions is moved, the corresponding positive contact will not be moved because the tape will never be punched on the positive and negative sides with perforations corresponding to the same position. Each pair of movable contacts is connected with one of the contacts 15^a, 15^b and 15^c of the distributor D. After the current impulses corresponding to code character perforations on the tape have been transmitted in sequence to the transmitting relays by the rotation of the brushes on the distributor, a current is transmitted through the contact 18 on the distributor to actuate the transmitter magnet 17, which operates to retract the movable contacts 12, 12'

against their back stops 14, and simultaneously move the tape forward to bring the next set of perforations opposite the selecting pins of the transmitter.

The rotary distributor D which connects the contacts of the transmitter T with transmitting relays TR, TR', operates synchronously with the corresponding distributor D' at the receiving station, the segmented and plain contact rings being shown for convenience in the developed form. The plain or continuous rings R₁, R₂, and R₃ are connected by the rotating brushes BR₁, BR₂, BR₃ with the segmented rings S₁, S₂ and S₃, respectively. The rings S₂ and S₃ are shown as having fifteen segments each, while the ring S₁ is provided with thirty segments.

The brushes may be assumed to be in horizontal alignment and to move simultaneously. As the brush BR₂ engages the first segment of ring S₂, it connects the minus and plus contacts 1 through the contact block 15^a with ring R₂ which is in circuit with the coils 20, 20' of the transmitter relays, the return conductor 25 being connected to the intermediate or neutral point in the potentiometer coil 26, across the bus bars 8, 9. Consequently, if at this instant the minus 1 contact of the transmitter is in contact with the minus bar *a*, a minus or negative current will flow through the relay coils 20, 20', causing the armature tongue of relay TR to swing over against the right hand contact while the tongue of the relay TR' remains against the left hand contact since its coil is connected reversely. This movement of the tongue of relay TR causes a negative current to be sent into the cable from the cable battery 30. In order that the impulse may be prolonged after the brush BR₂ leaves the two segments connected by the contact 15^a, the brush BR₁ closes a circuit through the battery 30 and the locking coils 31, 31', of the relays, thereby causing the tongue of TR to remain against the right hand contact while the brush BR₁ is passing over the segments of ring S₁ which are connected by contact blocks 16^a.

The tongues of the relays TR and TR' are normally held against the left hand contacts under the pull of the coils 23, 23' which are constantly energized but are weaker than either of the other coils. As soon, therefore, as the brush BR₁ leaves the last segment of ring S₁ connected to contact block 16^a, thereby breaking the circuit through coils 31, 31', the tongue of relay TR will swing back against the left hand contact so that the cable will again be grounded through the tongues of the two relays.

When the brush BR₂ passes over the segment of ring S₂ connected to contact block 15^b, the minus and plus contacts 2 of the transmitter T will be connected with

relay coils 20 and 20' and a negative or positive current will flow therethrough if the minus contact or the plus contact of the transmitter is against the corresponding block *a* or *b*. If, however, there was no perforation of the tape corresponding with the position 2, no current will flow through the relay coils and their tongues will remain against the left hand contacts.

The cable will, therefore, remain grounded for this second position, or as it is usually termed, zero current will be transmitted to the cable.

When the brush BR_2 passes over the segment of ring S_2 connected to contact block 15^c, the minus and plus contacts 3 of the transmitter will be connected in circuit with the relay coils 20, 20'. If the plus contact 3 is in contact with the transmitter bar *b* at this instant, a positive current impulse will flow through the coils 20, 20' and the tongue of relay TR' will move over against the right hand contact, thereby causing a positive current impulse to be sent through the cable from battery 30. As the brush BR_1 passes over the segments of ring S_1 connected to contact block 16^c a circuit will be closed through the locking coils 31, 31' to hold the tongue of relay TR' toward the right for a period after the brush BR_2 has left the segments of ring S_2 connected with contact block 15^c, thereby prolonging the current impulse sent into the cable. During this interval when the last impulse is being sent into the cable, the brush BR_3 contacts with contact block 18 of the segment ring S_3 thereby energizing transmitter magnet 17, which actuates the transmitter, causing the movable contacts to shift against their back stops 14, and simultaneously moving the tape forward to bring the next succeeding set of perforations into alignment with the transmitter selecting pins. The latter immediately enter the perforations of the tape thereby causing the corresponding minus and plus contacts to move over into contact with the transmitter bars *a*, *b*, in readiness to transmit current impulses to the transmitting relays as the brushes of the distributor again traverse the contact rings.

In the diagram I have shown the ring S_1 divided into thirty segments, that is, ten for each of the three impulses of a code character, and six segments of each group are connected or strapped together by means of the contact blocks 16^a, 16^b and 16^c, respectively. Each impulse is, therefore, prolonged over 60% of the time which may be allotted to an impulse. This may be increased or decreased merely by adding or removing the strapping members to the contact blocks 16^a, 16^b, 16^c. Thus if eight segments are strapped together, the impulses will occupy 80% of the possible

time allotted to an impulse and if ten blocks are connected together, the impulses will occupy 100% of the time allotted to an impulse and there would then be no interval between the separate impulses of a code character. This adjustment of the number of parts of each contact block forms a very convenient method of determining the length of the impulses of the code characters.

Consider now the operation of the apparatus at the receiving end of the cable. The cable relay CR swings against one contact or the other in response to the positive and negative current impulses and remains in unoperated position when the current is zero. The relays R_a , R_b , are normally biased against their left hand back stops in any suitable manner, and are energized from the battery 40 in response to the movements of the relay CR . They are very sensitive and operate quickly and with precision the instant a circuit is closed through battery 40 by the cable relay.

The control relays CL and CL' which transmit the positive and negative impulses respectively to the selecting relays through the distributor D' are preferably provided with biasing coils 42, 42' through which a weak current constantly flows to normally bias the armature tongues against the left hand back stops.

As previously stated, the distributors at the sending and receiving stations are operated in synchronism by synchronizing and phase correcting apparatus such as disclosed in patent to Rothermel No. 1,253,889. If, therefore, a negative current is sent from the contact minus 1 of the transmitter T at the instant the brush BR_2 is passing over the segments of ring S_2 connected to block contact 15^a, the tongue or relay TR will move over against its front contact and send a minus current impulse from battery 30 into the cable. At the receiving end R , the cable relay CR will close the circuit from battery 40 through the coil of relay R_b , causing its armature tongue to swing over against its front contact as indicated in dotted lines. A current will flow from battery 41 through the back stop and tongue of relay R_a , through the coils 43, 43' of relays CL and CL' , and return to battery through the front contact and tongue of relay R_b . The coils of relays CL and CL' are reversely connected so that the current thus impressed will cause the tongue of relay CL' (which responds to minus or negative impulses) to swing over against its front stop, as indicated in dotted lines. A minus current will then be sent from battery 50 through the actuating coils of selecting relays r_1 and r_2 as the brush BR_1 passes over the segment of ring S_1 connected at 15^a to the conductor connected to the coils of said selecting relays. Inasmuch

as the coils of the selecting relays r_1 and r_2 are reversely connected, only the tongue of relay r_1 which responds to minus impulses, will be operated.

5 The receiving segments 15^a , 15^b and 15^c of the segmented ring S_4 of the distributor D' are much narrower than the corresponding segments of rings S_1 and S_2 of the distributor D at the sending station, since a current im-
10 pulse of very short duration from the local battery or generator 50 is sufficient to actuate the selecting relays. Furthermore, these receiving segments of ring S_4 are so arranged with respect to the transmitting
15 segments of rings S_1 and S_2 that the impulses transmitted to the selecting relays occupy an intermediate part of the time interval of the transmitted signal current. The marking impulse transmitted by the
20 distributor at the receiving station therefore occurs when the transmitted current impulse or wave has reached its most steady and accurate form, since the variations and in-
25 accuracies occur mainly during the first and last parts of the current wave.

In order that the armature tongues of the selecting relays shall remain in their oper-
ated positions, after the brushes of the distributor D' have moved off of the corre-
30 sponding segments, so that the entire code character may be set up on the selecting magnets and to provide for an overlap in order that the printer operation may take place at the same time that the impulses
35 for the succeeding code character are being received, the selecting relays are provided with locking coils in the circuit leading to the translator magnets which is closed through the tongues of the relays and the
40 front contacts. This holding or locking circuit is maintained through the armature of the clear-out relay 45 until the latter is energized as the distributor brush BR_3 passes over the segment of ring S_3 connected to contact
45 block 19. As the locking circuit is broken at the back stop of the clear out relay, a circuit is closed at its front stop through the printing pulse magnet 46.

The foregoing detailed description of the
50 manner of operating my system of ocean telegraphy adapted for use with three-unit code characters will make clear to engineers the advantages which this system possesses over prior methods of operating cables. Not
55 only is both the transmission and receiving of messages made entirely automatic, but the time required for the transmission is materially shortened which is a very important factor in the commercial operation of cable
60 telegraphy. Moreover, the marking intervals occupy only a portion of the time interval of the transmitted signal impulses, thus providing larger intervals for charac-
65 teristic irregularities in cable signalling and for the operation of the synchronizing and

phase correcting devices and thereby contributing to greater accuracy in the operation of the system.

I claim:—

1. A synchronous telegraph system 70 wherein the code signals are automatically transmitted and received, comprising a tape-controlled transmitter, a pair of transmitting relays operating respectively to connect the line or cable with the positive or nega- 75
tive pole of an electric source, and a distributor having segments connected to contacts of said transmitter and connected in sequence to the coils of said relays, said segments being less in number than said 80 contacts.

2 A synchronous telegraph system as set forth in claim 1, each of said distributor segments being connected to a plurality of 85 said transmitter contacts.

3. A synchronous telegraph system wherein the code signals are automatically transmitted and received, comprising an automatic tape-controlled transmitter transmitting re- 90
lays operating respectively to connect the line or cable with the positive or negative pole of an electric source, a distributor provided with segmented members having elements connected to said transmitter and successive- 95
ly connected in circuit with the coils of all of said relays, and means for maintaining said relays in operated position for a pre-determined period after the transmitter has been disconnected therefrom.

4. A synchronous telegraph system where- 100
in the code signals are automatically transmitted and received, comprising an automatic tape-controlled transmitter, transmitting relays operating respectively to connect 105
the line or cable with the positive or negative pole of an electric source, a distributor provided with segments connected to said transmitter and successively connected in circuit with the coils of said relays, and an 110
additional segmented member on said distributor having segments connected to hold- ing coils on said relays, and a brush mov-
able over said additional member and op- 115
erating to maintain a circuit through the holding coil of the actuated relay to prolong the current impulse transmitted to the cable.

5. An automatic telegraph system, com- 120
prising synchronously operated current distributors at the transmitting and receiving stations, a pair of relays interposed between the distributors and the cable, a tape-con- 125
trolled transmitter having connected pairs of contacts, the members of each pair cooperat- ing respectively with contacts connected to
opposite poles of an electric source, and a pair of selecting relays arranged in reverse- 130
ly connected pairs and adapted to transmit positive or negative impulses to the trans-
lator magnets of a printer, the distributors

having active segments equal only to the number of pairs of transmitter contacts.

6. A synchronous telegraph system wherein the code signals are automatically transmitted and received, comprising an automatic tape-controlled transmitter, a pair of transmitting relays respectively operating to connect the line or cable with the positive or negative pole of an electric generator, a distributor provided with segmented members having elements connected to said transmitter and successively connected in circuit with the coils of said relays, means for maintaining said relays in operated position for a predetermined period after the transmitter has been disconnected therefrom, receiving apparatus comprising a cable relay and auxiliary relays operating respectively to transmit positive and negative impulses, a pair of selecting relays arranged in reversely connected pairs, operating to transmit respectively positive or negative impulses to the translator magnets of a printer, and a distributor operating synchronously with the first-named distributor to connect said auxiliary relays to said selecting relays for shorter time intervals than said transmitting relays are connected to the cable.

7. A telegraph system wherein the cable signals are automatically transmitted and received, comprising synchronously operated current distributors at the transmitting and receiving stations, a pair of relays interposed between the distributors and the cable, and means for prolonging the current impulses transmitted to the cable a predetermined interval after the termination of the operating impulse from the distributor to the relay.

8. A telegraph system wherein the cable signals are automatically transmitted

and received, comprising synchronously operated current distributors at the transmitting and receiving stations, a pair of relays interposed between the distributors and the cable, means for prolonging the current impulses or signals transmitted to the cable a predetermined interval after the termination of the operating impulse from the distributor to the relay, and means for causing each impulse sent through the distributor at the receiving station to occupy only an intermediate portion of the interval of the corresponding transmitted signal.

9. A synchronous telegraph system wherein the signals are automatically transmitted and recorded and the code characters are composed of combinations of positive, negative and zero current impulses, comprising an automatic tape-controlled transmitter having sets of stationary contacts directly connected respectively to the positive and negative poles of a generator, a plurality of pairs of connected contacts movable individually into contact with said stationary contacts under the control of the perforated characters in the tape, a distributor having segmented members separated elements of which are connected in sequence to said pairs of movable contacts, a pair of relays corresponding respectively to positive and negative current impulses, and operating to connect the cable with corresponding poles of a generator, and brushes movable over the members of said distributor and operating to connect the actuating coils of the relays successively with said separated elements.

In testimony whereof, I affix my signature.

HERBERT ANGEL.