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MANUAL MORSE MULTIPLEX SYSTEM

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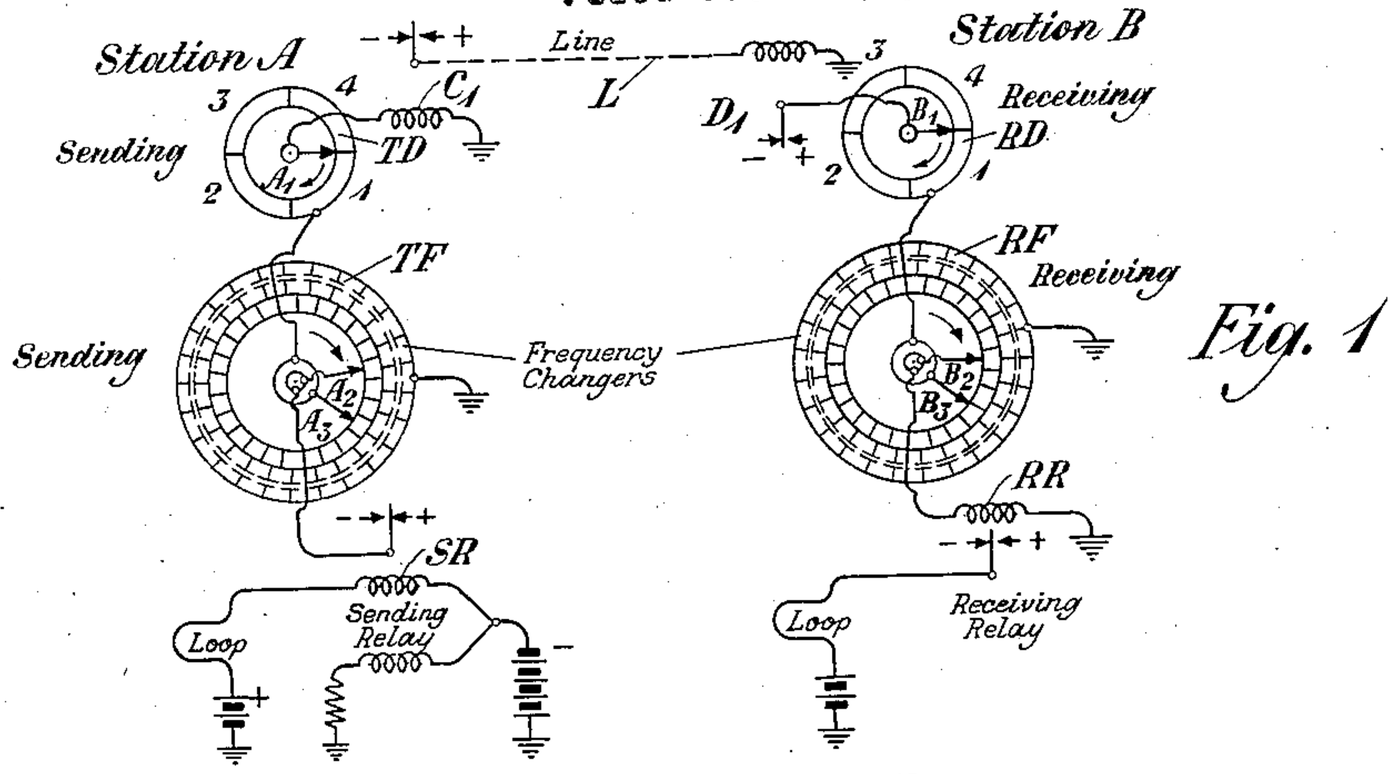

Fig. 1

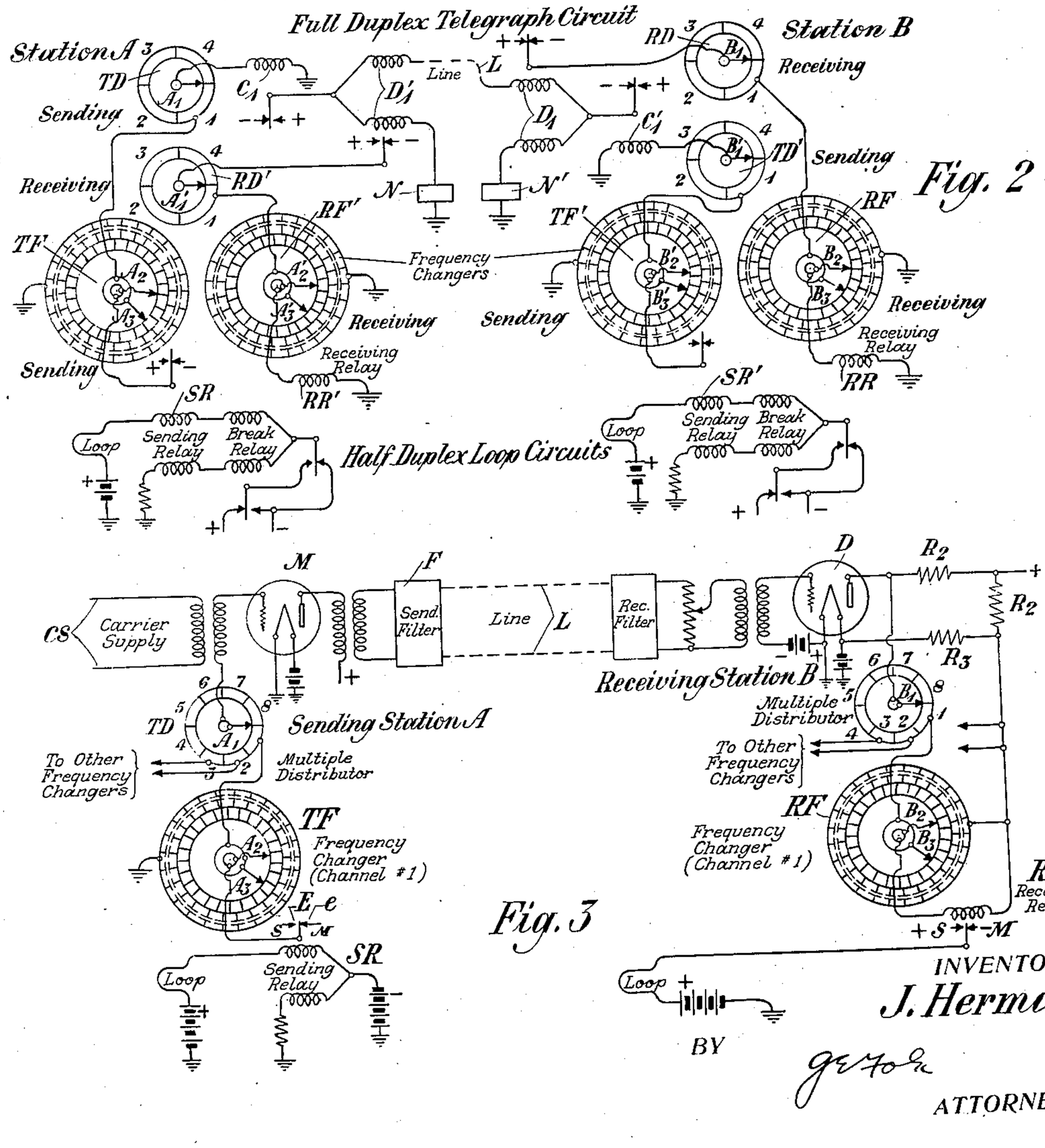

Fig. 2

Half Duplex Loop Circuits

Fig. 3

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MANUAL MORSE MULTIPLEX SYSTEM.

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This invention relates to multiplex telegraph systems employing distributors, and more particularly to systems of this type so arranged as to be adapted for manual operation. The development of carrier telegraph systems has made available a large number of high speed telegraph channels which are, at the present time, rather inefficiently used. This is because of the fact that these circuits are employed chiefly for manual operation, at comparatively slow speeds. The circuits themselves are however, capable of employing much higher speeds.

Multiplexing these circuits by ordinary distributor methods would eliminate the loss of efficiency, but the multiplex apparatus heretofore available requires the use of printers or other devices employing mechanical senders, and at the present time there is only a small demand for service of this type. The purpose of the present invention is to provide an arrangement whereby these multiplex channels may be terminated in such a way as to be suitable for hand operation. The channels so terminated have all the physical characteristics of continuous circuits from the standpoint of the operators and can also be used for printer operation the same as in continuous circuits. While the invention has its principal application to the high speed circuits rendered available by carrier systems, it is equally applicable to high speed channels of any other type.

The invention will now be more fully understood from the following detailed description thereof when read in connection with the accompanying drawing, Figure 1 of which shows the invention applied to an ordinary one-way telegraph channel; Fig. 2 of which shows the invention applied to an ordinary two-way channel; and Fig. 3 of which shows the invention applied to a carrier channel.

Referring to Fig. 1 of the drawing, two stations A and B are shown connected by a telegraph line L arranged to transmit from station A to station B. Multiplex distributors TD and RD, similar to those used for printer service, are located at these stations and are rotated in synchronism with each other in a manner well understood in the art. Each distributor face is provided with four equal segments, 1, 2, 3 and 4, corresponding to four multiplex channels to be derived from the high speed circuit L. The phase relationship of the distributors TD and RD is such that signals transmitted to the line while brush A_1 at station A is passing over a particular segment, such as segment 1, will be received on brush B_1 at station B, while that brush passes the first segment at that station.

Each of the distributor segments is connected to a frequency changer such as TF at station A and RF at station B. The function of the frequency changer is to convert the relatively low speed Morse signals from the operator at the sending end to a high speed for transmission over the line L, and in turn converting the high speed signals received from the line at the receiving station into low speed Morse signals for transmission to the local receiving loop. The frequency changers TF and RF are alike and each consists of a distributor face having a large number of segments, each segment being connected to a separate condenser. Two brushes, A_2 and A_3 in the case of the sending device and B_2 and B_3 in the case of the receiving device, are arranged to revolve at different speeds and make contact with these segments. The brushes A_2 and B_2 rotate at the same speed as the brushes A_1 and B_1. The brushes A_3 and B_3, on the other hand, revolve at such a speed that they make one complete revolution during the time that the brushes A_1 and B_1 pass over a given segment. In the case illustrated, in which there are four segments to the distributors, the frequency changing brushes A_3 and B_3 rotate at a speed four times as great as the other brushes. The brush A_2 is connected to the transmitting contact of the sending relay SR of the local loop, while the brush A_3 is connected to one of the segments of the distributor TD. At the receiving station, the brush B_2 is connected to the winding of the receiving relay RR by which signals are transmitted to the local loop and the brush B_3 is connected to the segment of the dist ibutor RD corresponding to the segment to which the brush A_3 at the transmitting station is connected.

The operation is as follows: the operator at station A, by opening and closing his key in the loop circuit, transmits Morse characters. This causes the operation of the sending relay SR whose contacts have positive and negative batteries connected to them.

brush A_1 as the latter passes over the first segment of the distributor TD. The signals thus translated in speed actuate the transmitting relay C_1 and are transmitted over the line L in a well-known manner to operate the receiving relay D_1 at station B. The latter impresses these signals on the brush B_1, and they are transmitted to the brush B_3 and stored up on the receiving frequency changer RF during the time that the brush B_1 passes over the first segment of the receiving distributor RD. The brush B_2 during four revolutions of the brush B_3 transmits the stored signals to the receiving relay RR, which in turn transmits the signals at reduced speed to the local loop. Transmission from the loop at station B in turn goes through the transmitting frequency changer TF', distributor TD', over the line L to be received by the receiving distributor RD' and passed through the frequency changer RF' and the receiving relay RR' to the loop.

Theoretically, arrangemnts such as above described can be considered perfect in operation provided a sufficently large number of segments and condensers are used in the frequency changers. For practical purposes, however, the number of such segments may be fairly small, especially if the distributors are operating at high speed. It should be noted here that the signaling frequency on the line is independent of the actual brush speed and depends only on the relative speed of the two brushes on the frequency changers, or the number of channels provided.

A modified system is illustrated in Fig. 3, which has certain theoretical advantages. It is capable of higher operating speeds than the arrangements of Figs. 1 and 2 and permits a large number of multiplex channels over a small number of carrier channels, the arrangement of Fig. 3 being particularly applicable to high speed carrier telegraph channels.

Comparing Fig. 3 with Fig. 1, it will be observed that the principal difference between the two is that a vacuum tube modulator M is substituted for the sending relay C_1 and the receiving relay D_1 is eliminated and a vacuum tube detector D substituted therefor. The sending relay SR, furthermore, has its contacts arranged to transmit either of the two negative voltages *e* or E to the brush A_2 in response to signals in the loop, the larger voltage (E) corresponding to the transmission of the spacing signal and the smaller voltage (*e*) to the transmission of the marking signal.

The condensers connected to the segments of the frequency changer TF are charged to these voltages by the low speed brush A_2 in response to the operation of the relay SR and are subsequently connected to the grid of the modulator M by the high speed brush A_3 during one-eighth of a revolution of the distributor TD, which in this case is arranged for the transmission of eight channels instead of four. The circuit during transmission by the high speed brush A_3 is from the grounded condenser of the frequency changer TF, over the brush A_3, first segment of the multiplex distributor TD, brush A_1, secondary winding of the carrier input transformer and the grid of the tube. Consequently, any voltage stored up on the condensers will be impressed upon the grid of the tube and will modulate the carrier current impressed upon the line through the modulator M from the carrier supply circuit CS. When the voltage (*e*) is applied to the grid, the tube will act as an amplifier and transmit the carrier current to the line L through the sending filter F. When the voltage (E) is applied to the grid, the space current in the tube will be practically zero and the carrier current will be, in effect, cut off from the line.

No provision has been made for the discharge of the condensers of the frequency changers while connected to the grid of the modulator tube M, since this would be both undesirable and unnecessary. The discharge occurs when the armature of the sending relay is again connected to the condensers by means of the low speed brush A_2, at which time the voltage automatically adjusts itself to the proper value for the new signal.

It is evident from the above description that the modulator tube performs the same function as the transmitting line relay C_1 in the arrangement of Fig. 1. It has the advantage of high speed, however, and will faithfully transmit short dots or spaces which a mechanical relay would be incapable of doing.

At the receiving station the detector tube D is connected into a Wheatstone bridge circuit. This bridge is composed of two equal resistance arms designated each R_2, a third resistance arm R_3, and the output impedance of the detector tube which may be assumed to be R_1. The resistance R_3 is of such a value that the voltage across the extremities of resistances R_2 will be equal and opposite for the conditions of normal carrier current received from the line and no current received from the line. These equal and opposite voltages are impressed upon the condensers of the various frequency changers such as RF by means of the brush B_1 of the multiplex distributor and the high speed brush B_3 of the frequency changer. The charges thus stored up on the condensers are discharged by means of the low speed brush B_2 and, as in Fig. 1, operate the receiving relay RR to transmit the signals to the loop. In this manner the mechanical repetition of the high speed signals by means of relays at the sending and receiving stations has

been eliminated and consequently much higher speeds of transmission will be possible.

If desired, instead of employing different carrier frequency channels upon the same line, each multiplexed in accordance with the present method, the invention might be applied to an ordinary telephone line (not necessarily) by using a single carrier frequency of, say, 1,000 cycles, which could be applied to the modulator tube and modulated by means of the multiplex apparatus illustrated in Fig. 3. The multiplex apparatus would be arranged to provide a sufficient number of channels to utilize any desired width of the telephone range for telegraph purposes. Such an arrangement would necessarily leave a large part of the available frequency range unused because of the limited speed at which distributors can operate so that it might be found more economical to use two or three wide band channels within the telephone range and a corresponding number of multiplex sets.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. The method of signaling, which consists in transmitting direct current telegraph impulses of variable duration at a certain dot rate, and translating the impulses into impulses having substantially the same wave form but a higher dot rate without overlapping successions of impulses from the same circuit.

2. The method of signaling, which consists in transmitting direct current telegraph impulses of variable duration, and translating the direct current impulses into substantially similar direct current impulses of variable duration having a higher dot rate without overlapping successions of impulses from the same circuit.

3. The method of signaling, which consists in transmitting direct current telegraph impulses of variable duration, storing up said impulses, and retransmitting the stored impulses in substantially their original wave form at a higher dot rate without overlapping successions of impulses from the same circuit.

4. The method of signaling, which consists in transmitting direct current telegraph signals of variable duration at a high dot rate over a transmission circuit, and translating said signals into waves of substantially the same form but having a lower dot rate to form continuous successions of signals without overlapping signals from the same circuit.

5. The method of signaling, which consists in transmitting direct current telegraph impulses of variable duration at a high dot rate over a transmission circuit, and translating said impulses into substantially similar direct current impulses of variable duration having a lower dot rate to form continuous successions of signals without overlapping signals from the same circuit.

6. The method of signaling, which consists in transmitting direct current impulses of variable duration at a high dot rate over a transmission circuit, storing said impulses, and retransmitting the stored impulses in substantially the same wave form as originally transmitted but at a lower dot rate to form continuous successions of signals without overlapping signals from the same circuit.

7. The method of signaling, which consists in continuously storing telegraph signals of variable duration and retransmitting at successive intervals in substantially their original wave form and without overlapping of successively stored groups of signals, all of the impulses stored in a given length of time within an interval shorter than the time required for storing.

8. The method of signaling, which consists in simultaneously and continuously storing telegraph impulses of variable duration from a plurality of circuits, and retransmitting at successive intervals in substantially their original wave form without overlapping signals from the same circuit, all of the impulses stored in a given length of time within a shorter interval than the time required for storing, the intervals used for retransmitting telegraph signals stored from one circuit intervening between the intervals used for retransmitting signals stored from another circuit.

9. The method of signaling, which consists in successively transmitting over a transmission circuit groups of telegraph signals of variable duration from different telegraph stations, successively storing the different groups, and simultaneously retransmitting the stored groups at a dot rate such that successive groups from the same station will be retransmitted as continuous and non-overlapping successions of signals in substantially their original wave form.

10. In a signaling system, means for transmitting direct current telegraph impulses of variable duration at a certain dot rate, and means for translating the transmitted impulses into impulses having substantially the same wave form but a higher dot rate without overlapping successive groups of impulses from the same circuit.

11. In a signaling system, means for transmitting direct current telegraph impulses of variable duration, and means for translating said direct current impulses into substan-

tially similar direct current impulses having a higher dot rate without overlapping successive groups of impulses from the same circuit.

12. In a signaling system, means for transmitting direct current telegraph impulses of variable duration, means for storing up said impulses, and means for retransmitting the stored impulses in substantially their original wave form but at a higher dot rate and without overlapping of successive groups from the same circuit.

13. In a signaling system, means for transmitting direct current telegraph signals of variable duration at a high dot rate over a transmission circuit, and means for translating said signals into continuous successions of waves of substantially the same form but having a lower dot rate and without overlapping of successive groups from the same circuit.

14. In a signaling system, means for transmitting direct current telegraph impulses of variable duration at a high dot rate over a transmission circuit, and means for translating said impulses into continuous successions of direct current impulses of substantially the same wave form but having a lower dot rate and without overlapping of successive groups from the same circuit.

15. In a signaling system, means for transmitting direct current impulses of variable duration at a high dot rate over a transmission circuit, means for storing said impulses without overlapping, and means for continuously retransmitting the stored impulses at a lower dot rate in substantially the wave form in which they were originally transmitted.

16. In a signaling system, means for continuously storing telegraph signals of variable duration, means for retransmitting at successive intervals and without overlapping of successive groups of signals from the same circuit, all of the impulses stored in a given length of time within an interval shorter than the time required for storing and substantially in their original wave form.

17. In a signaling system, means for simultaneously and continuously storing telegraph impulses of variable duration from a plurality of circuits, means for retransmitting at successive intervals and substantially in their original wave form, all of the impulses stored in a given interval of time without overlapping groups of impulses from the same circuit, the interval required for retransmitting a given number of impulses being shorter than the time required for storing, and the intervals used for retransmitting telegraph signals stored from one circuit intervening between the intervals used for retransmitting signals stored from another circuit.

18. In a signaling system, means for successively transmitting over a transmission circuit, groups of telegraph signals of variable duration from different telegraph stations, means for successively storing the different groups, and means for simultaneously retransmitting the stored groups in substantially their original wave form and at a dot rate such that successive groups from the same station will be retransmitted as continuous and non-overlapping successions of signals.

19. In a signaling system, means for producing telegraph impulses of different duration, means for storing a group of said impulses, and means for retransmitting all of the impulses of the stored group in substantially their original wave form and within an interval of time less than that required for storing the entire group without overlapping a preceding group from the same circuit.

20. In a signaling system, means for producing telegraph signals, storing means, a continuously rotating wiper associated with said storing means for continuously storing said signals, and another wiper associated with said storing means but operating at a higher rate of speed, said last mentioned wiper operating during certain of its rotations to retransmit during a single rotation all of the signals stored during more than one of its rotations.

21. In a signaling system, a plurality of circuits in which telegraph impulses of variable duration are generated, a storing means associated with each circuit for continuously storing up the signals generated therein, a transmission line, a rotary distributor associated therewith, and means whereby said rotary distributor transmits to the line, in substantially their original wave form and during successive intervals of time shorter than the time required for storing, the impulses stored from each of said circuits.

22. In a signaling system, a transmission line, a distributor associated therewith having a plurality of segments each corresponding to a signaling circuit, means for producing telegraph impulses of variable duration in each of said signaling circuits, a storing means for each circuit comprising a number of storing units, means for continuously storing the signals from each circuit on the corresponding storing means, means for connecting each storing means to a corresponding segment of said distributor, said means including arrangements whereby during the time each segment of the distributor is actively connected with the transmission line, all of the impulses stored up during a complete cycle of the distributor will be transmitted from said storing means to the line.

23. In a signaling system, means for transmitting telegraph impulses of variable duration in groups with intervals between the

groups, means for storing the successive groups, and means for retransmitting all of the impulses of a stored group in a space of time corresponding to the time required for receiving the original group plus the time of the interval between successive groups, so that the final transmission of the separated groups will be continuous.

24. In a signaling system, means for transmitting telegraph signals of variable duration in successive groups separated by intervals, storing means, a continuously rotating wiper associated with said storing means for storing the groups of signals at intervals, and another wiper associated with said storing means and operating at a slower rate of speed so as to retransmit groups of signals stored with intervals between groups at such a rate of speed that the retransmission will be continuous.

25. In a signaling system, a transmission circuit transmitting successive groups of telegraph signals of variable duration from one transmitter with successive groups of signals from other transmitters intervening therebetween, a storing means corresponding to each transmitter, a rotary distributor associated with the transmission circuit for transmitting the groups corresponding to different transmitters to the proper storing means, and means associated with each storing means for retransmitting the successive groups of stored impulses at a rate of speed such that the retransmission of impulses will be continuous.

26. In a signaling system, a transmission circuit over which successive groups of signals of variable duration corresponding to one transmitter intervene between successive groups of signals corresponding to other transmitters, a distributor associated with said transmission circuit and having a plurality of segments each corresponding to a transmitter, a storing means corresponding to each transmitter and comprising a number of storing units, means for connecting each storing means to a corresponding segment of the distributor, means to cause a given storing means to store successive groups of impulses corresponding to a given transmitter each time the storing means is connected to its corresponding segment, and means whereby successive groups stored on each storing means will be retransmitted at a rate of speed such that the time of retransmission of a group of signals will correspond to the time of storing the group plus the time of the interval between successive groups.

27. In a signaling system, a modulator, a carrier current supplied by said modulator, means for producing telegraph impulses, means for storing a group of said impulses, and means for retransmitting all of the impulses of the stored group to the modulator within an interval of time less than that required for storing the entire group, whereby the carrier frequency will be modulated in accordance with successive groups of impulses at a dot rate higher than the original impulses.

28. In a signaling system, a transmission circuit for transmitting a carrier frequency modulated in accordance with groups of telegraph impulses with intervals between groups, means for detecting the successive groups of impulses, means for storing the successive groups, and means for retransmitting the stored groups at a slower rate of speed so that the time of retransmission of a group will correspond to the time of storing the group plus the interval between successive groups.

In testimony whereof, I have signed my name to this specification this 11th day of October 1923.

JOSEPH HERMAN.