Nov. 5, 1935. W. S. LEMMON 2,019,864

COMMUNICATION SYSTEM

Filed Feb. 23, 1934 4 Sheets-Sheet 1

FIG.1.

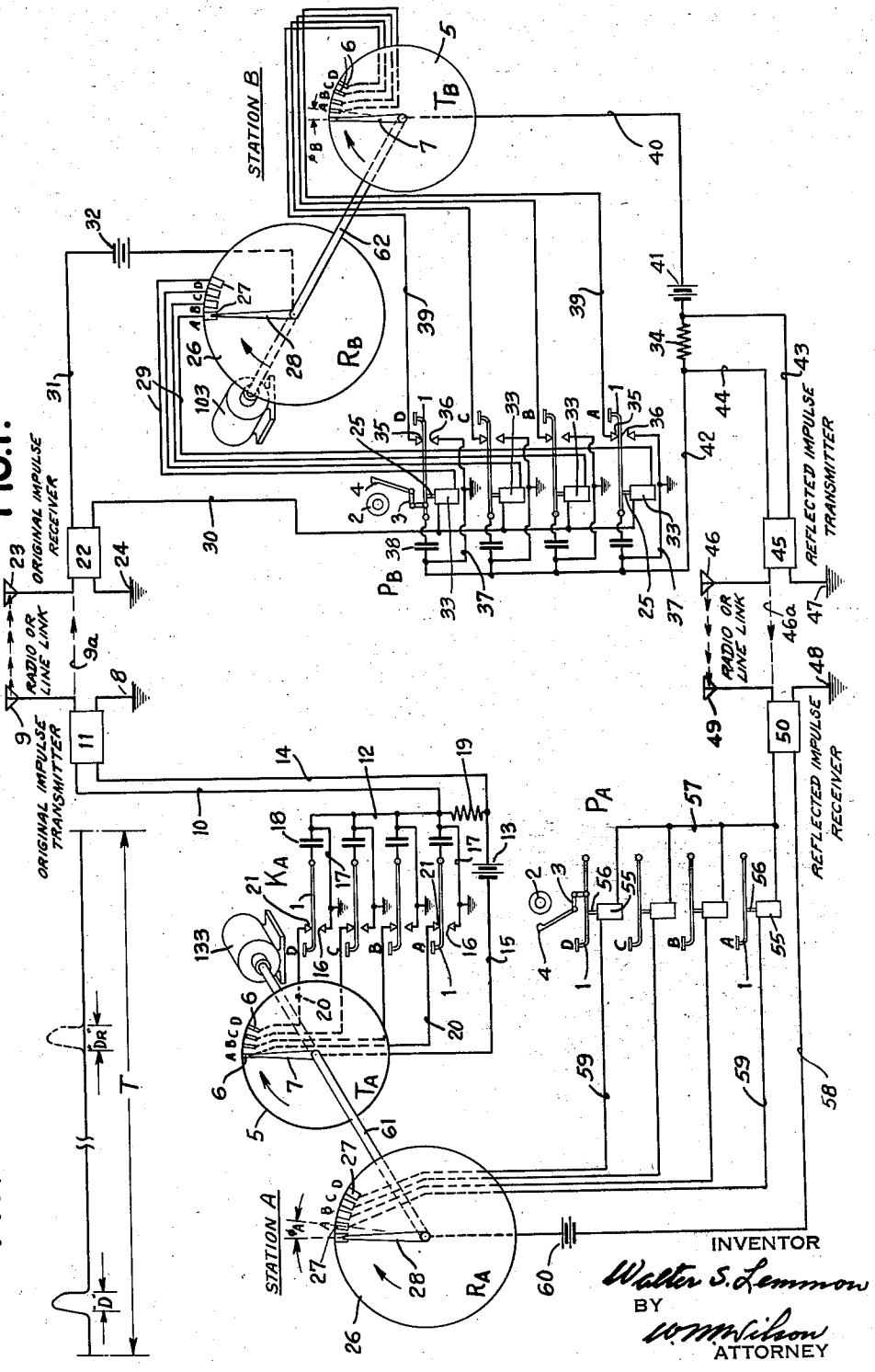

FIG.2.

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COMMUNICATION SYSTEM

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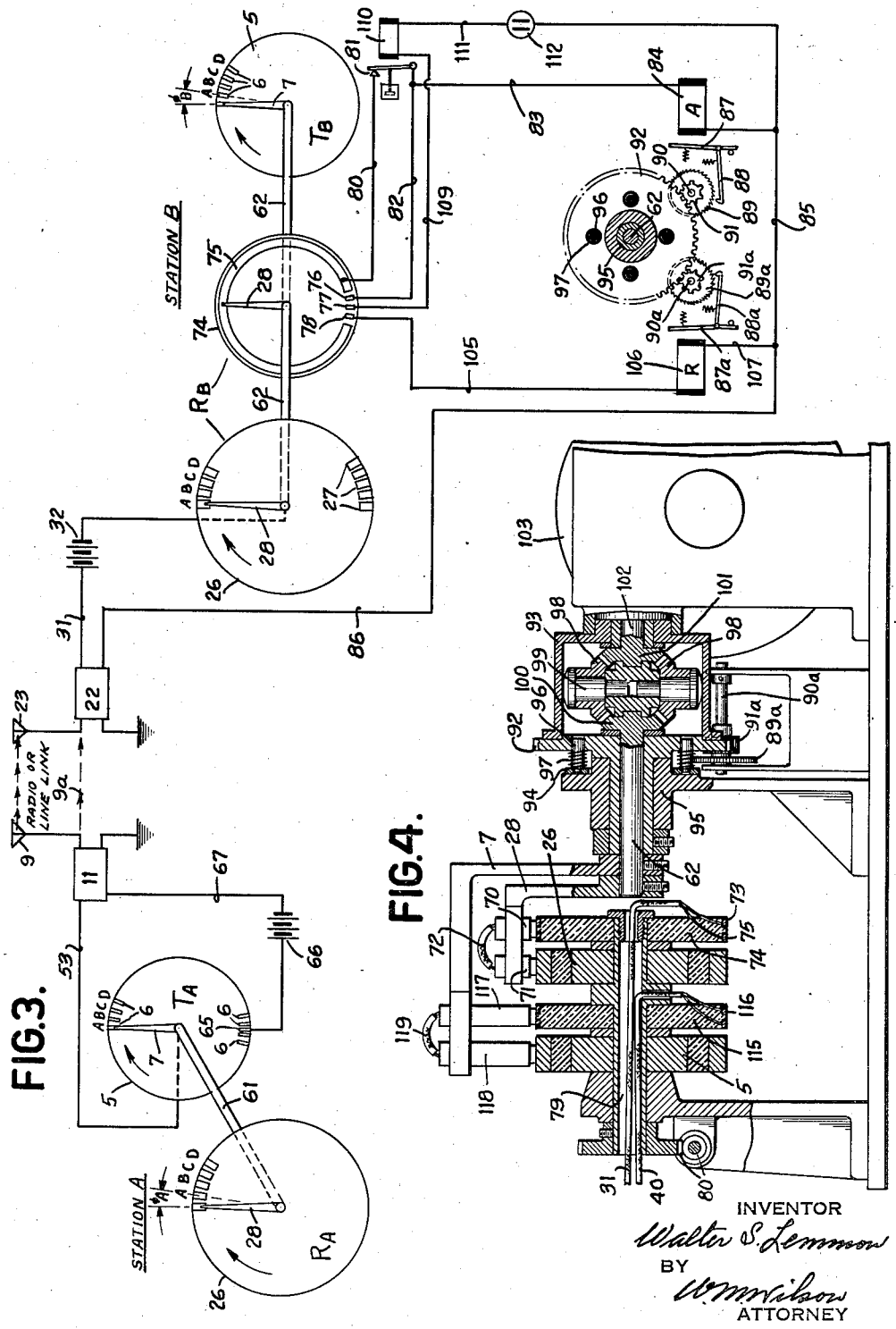

FIG.3.

FIG.4.

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COMMUNICATION SYSTEM

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FIG. 5.

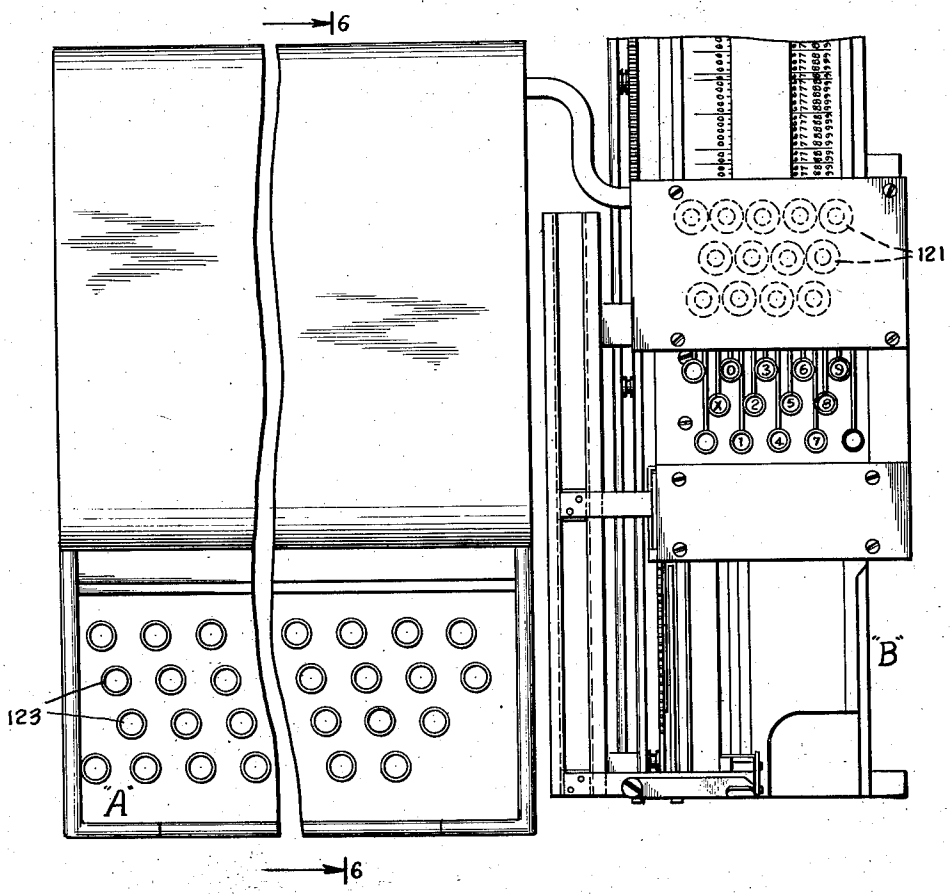
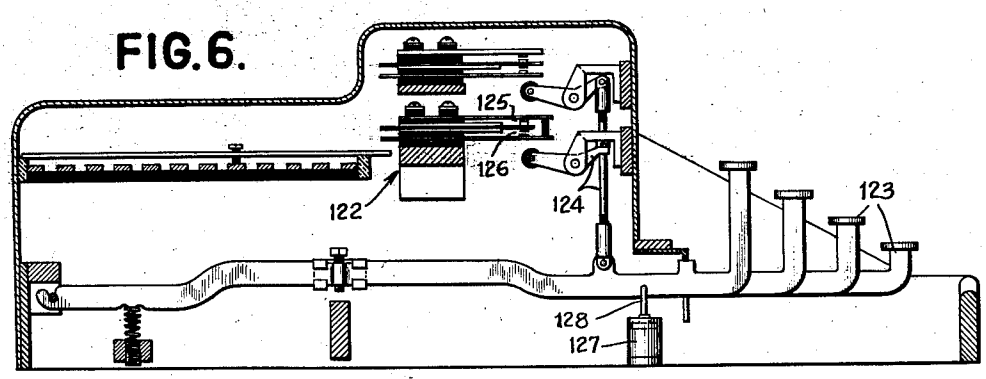


FIG. 6.



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COMMUNICATION SYSTEM

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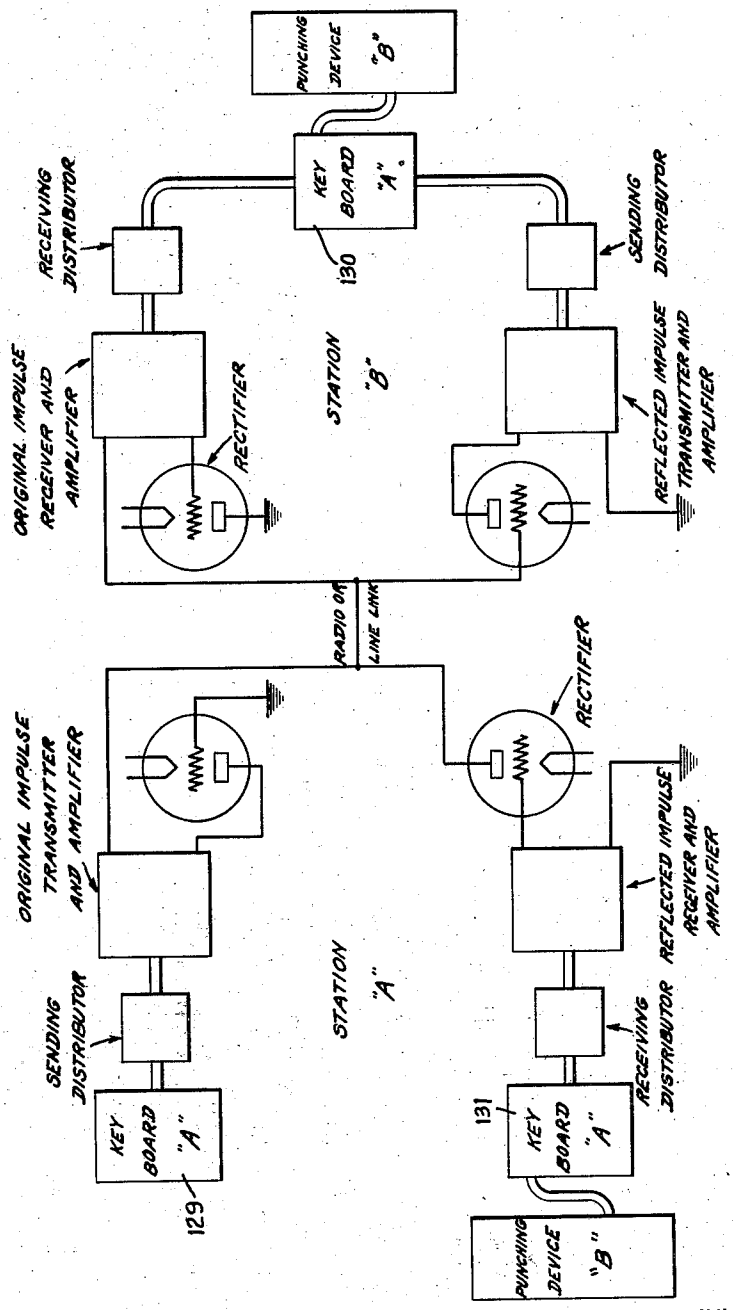
FIG. 7.



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Patented Nov. 5, 1935 2,019,864

UNITED STATES PATENT OFFICE

2,019,864

COMMUNICATION SYSTEM

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Application February 23, 1934, Serial No. 712,467

18 Claims. (Cl. 178—23)

The present invention relates to a novel communication system wherein the intelligence conveyed is received at the transmitter identical to its reception at the receiver.

The invention can be applied to various modes and methods of communication systems, and is adaptable to such as radio, carrier current or line system of transmission, etc. Two preferred embodiments of the invention are included and pertain to (1) a code of communication whereby transmission of graphic intelligence is accomplished by tele-typewriting equipment and (2) a system of transmission of intelligence by the punched card method.

The invention embodies the use of synchronized contact disks or distributors at the transmitting and receiving stations for completing the transmitting and receiving circuits, respectively. At the sending station, the impulse is not transmitted until contact of the revolving arm is made at the particular contact of the distributor corresponding to the actuated key or button for the character to be sent; and at the instant of contact, the impulse is transmitted and caused to register the same character at the receiving station, due to the synchronism of the distributors. The registration of the received character causes a reflected or echo impulse corresponding to said character, to be sent back over the line or radio link to the sending station where this echo signal causes the same character to be registered, due to the synchronism of other distributors set slightly out of phase with respect to corresponding synchronized distributors controlling the original impulse.

In the present invention the character impulses are shown to be transmitted by the depression of key bars. On depression of a bar, a condenser that has been charged previously is caused to discharge and when the bar is released and when the revolving arm of its distributor makes contact, the condenser circuit is completed through the transmitting circuit, charging the condenser, as a result of which an impulse is transmitted. The transmitting apparatus comes into play on the return rather than on the depression of a bar, because of this the duration of the impulses are not unequal as in a manually operated transmitting machine, which inequality would result in confused reception at the rapidly acting receiving mechanisms.

In the present system of tele-typewriting, tele-registering and other modes of transmission of intelligence to a distant point, the information to be transmitted is simultaneously registered at both the transmitting station and receiving station. It is frequently desirable to have a registration or record at the transmitting station, not of what is transmitted, but of what is actually received at the distant station. It is an object of the present invention for the provision of registering the actual information received at a distant station, at the transmitting station by means of a system of reflected or echo signals.

Another object of the invention is the provision for compensating means, at both the transmitting station and receiving station, in synchroism, for the time lag in the mechanism which acts as the register of the original message and also for the electrical lag in the line, and line apparatus or radio apparatus.

Another object of the invention is the provision for the register of the original impulse, signal or message as the source or point of origin for the reflected or echo signal.

Another object of the invention is the provision for sending the reflected signal during the same timed interval of the signal to be reflected.

Still another object of the invention is the provision for the selection of the proper reflected signal simultaneously while the signal to be reflected is registered.

Further and other objects and advantages will be hereinafter set forth in the accompanying specification and claims, and shown in the drawings, which by way of illustration show what is now considered to be the preferred embodiment of the invention.

In the drawings:

Fig. 1 is a diagrammatic illustration of the transmitting and receiving apparatus and circuit connections therefor. As indicated in the figure transmission of signals may be effected either by radio, carrier current or line circuit.

Fig. 2 represents the electrical impulse of a signal transmitted during a timed interval and the impulse of a signal reflected back to the transmitting station during the same timed interval.

Fig. 3 is a diagrammatic view illustrating sending and receiving synchronizing apparatus including a partial transverse vertical section taken on the line 3—3 of Fig. 4.

Fig. 4 is a fragmentary side elevation partly in section illustrating a portion of the receiving synchronizing apparatus.

Fig. 5 is a top plan view of keyboard and punching device as a complete unit.

Fig. 6 is a sectional view through the keyboard showing the contact devices and solenoids, section taken on line 6—6 of Fig. 5.

Fig. 7 is a schematic circuit layout showing application of reflected signal systems to card punching devices.

Referring to Fig. 1, in the one preferred embodiment of my invention conventional or modified typewriters of the well known type are used. The transmitting apparatus K_A for the original impulse to be conveyed includes only the keyboard of the typewriter unit, so that the printing mechanism P_A of the sending station instead of being controlled by sending keyboard at station "A" is controlled by the operation of the printing mechanism of the receiving machine P_B at station "B". Inasmuch as the keyboard unit K_A and the printing unit P_A, even though used for separate functions, are similar in construction and operation as a complete unit as shown in P_B, and are well known in the art, the following description included will suffice.

The sending keyboard K_A has the usual series of lettered and numbered pivoted key bars 1. Each of the key bars is comprised in a branch condenser circuit; from a contact 16 disposed respectively beneath the key bars 1, and normally spaced from the latter when the bars are in their normal or raised position, line 17 is extended separately from each lower contact to an individual condenser 18, said condenser in turn connected to each key bar so that upon depressing key bar 1, the corresponding condenser 18 if charged, is discharged. A common conductor 12 extending from one side of the battery 13 and including resistance 19 is branched separately to each condenser. The sending circuit embodies a conductor 14 from one side of the battery to a transmitter 11 and a line 15 extending from the other side of the battery 13 to a rotary contact arm 7. The other side of transmitter 11 is connected to resistance 19 by line 10.

The rotary contact arm 7 is driven in direction indicated by motor 133 which is in synchronism with the similar device at the other end of the transmission circuit (and will be described hereinafter) and engages in rather rapid succession a series of spaced contacts 6 carried on a fixed contact disk 5. Contacts 6 correspond respectively to the various characters on the type bars 1 and by conductors 20 extending separately from the contacts on the disk 5 to fixed contacts 21 positioned over the key bars 1, the sending circuit for the original impulse to be transmitted is completed. The latter contacts 21 are engaged by the corresponding bars 1 when the latter are in raised or released position and at such time close a sending circuit consisting of the condenser charging circuit, battery 13, resistance 19, conductor 12, condenser 18, corresponding bar 1, contact 21, conductor 20, corresponding contact 6, arm 7, conductor 15 to the other side of battery 13.

The radio or line transmitter 11 has one of its output terminals connected to an antenna 9 or line 9a, respectively, and its other output terminal 8 grounded in the usual manner. The input terminals are connected in parallel to the condenser charging circuit described by line 10 extending to one side of resistance 19 and line 14 to other side of said resistance.

Thus, in the operation of the device as thus far described, it will be seen that the depression of a key bar 1, first breaks the corresponding sending circuit at the contact 21 and closes one of the branch condenser circuits, short circuiting and discharging the corresponding condenser 18. On return of the bar 1 into engagement with its contact 21, the sending circuit will be closed when the arm 7 reaches the corresponding contact 6 on the disk 5. The closing of the sending circuit in this manner causes the corresponding condenser 18 to be charged by battery 13, charging current pulse causes drop across resistance 19 which sends actuating impulse to transmitter 11.

The receiving circuit for the original impulse includes a receiver and amplifier 22 having one of its input terminals grounded at 24 and its other input terminal connected to either an antenna 23 or line link 9a, adapted to receive the impulse sent out from the transmitter 11 in the usual manner.

The unit P_B adapted to print the impulse as transmitted by sending keyboard K_A simultaneously, while printing the character corresponding to impulse received, also sends out an echo or reflected signal through a transmitting distributor T_B to the printing unit P_A at the sending station, as will be described hereinafter.

The unit P_B is a conventional or modified typewriter of the well known type having a series of lettered and numbered pivoted key bars 1, being the same type as described for the sending keyboard K_A. Over the bars is mounted a roll 2 held in a slidable carriage (not shown) in the usual manner so that it is moved one space on depression of any key bar. Each key bar has associated therewith a type bar 4 adapted to strike against the roll 2 on depression of the corresponding key bar. This action is effected through a suitable linkage 3 between each key bar and the corresponding type bar.

Beneath each of the key bars 1 is a solenoid 33 adapted to operate on a plunger 25 in the form of a finger depending from the bar, so that when a given solenoid is energized by the means presently to be described, the corresponding key bar will be depressed to actuate the corresponding type lever 4. The receiving circuit is governed by the receiving distributor comprising a disk 26 carrying spaced contacts 27 corresponding in number and position to the contacts 6 on the transmitting distributor T_A. A contact arm 28 rides over the contacts 27 and is driven by a motor 103 in direction indicated by arrow in synchronism with the motor driving the contact arm 7 of distributor T_A so that the said arms 7 and 28 are in engagement with similarly identified contacts at any instant.

The contacts 27 separately are connected to its corresponding solenoid by lines 29, a common conductor 30 extends from the receiver 22 and is connected to the remaining terminals on all the solenoids 33. The receiving circuit is completed by conductor 31 extending from the receiver 22 to the contact arm 28 and including battery 32.

On reception of an impulse at the receiver and amplifier 22 the receiving circuit is completed instantaneously which includes the battery 32, arm 28, any contact 27 and the particular solenoid 33 corresponding to the contact 27 which happens to be engaged by the arm 28. Upon completion of said circuit the particular said solenoid is energized causing the character corresponding to the contact 27 to be printed on the roll 2 at station "B". The characters printed at the receiving station will appear in the same order in which they are sent inasmuch as the arms 7 and 28 are in synchronism and always in like relationship to the contacts engaged thereby, and since the impulse is transmitted only when the arm 7 at the sending station "A" engages the con-

tact 6, corresponding to the key which has been depressed.

It will be noticed that the receiving contacts 27 are of greater length circumferentially than the sending contacts 6. The latter are made as short as possible in order that the transmitted impulse may be instantaneous. The longer receiving contacts 27, however, serve to hold the receiving circuit described closed for an interval sufficient to enable energization of the solenoids 33 and operation of the type bars 4 as well as to allow for slight inaccuracies in the synchronism of the transmitting and receiving arms 7 and 28 respectively.

The energization of solenoid 33 in unit P_B corresponding to the character sent at station "A" causes the key bar 1 to be depressed in turn causing the type bar 4 to record the character sent, said typebar also upon being depressed breaks contact 35, similarly located as contact 21 in keyboard K_A, and closes contact 36, causing the charged condenser 38 to be short circuited and discharged, as similarly explained in connection with keyboard K_A. Upon release or return of said key bar it engages the contact 35 completing a charging circuit through line 39, contact 6 and arm 7 of distributor T_B, line 40, battery 41, resistance 34, common conductor 42, corresponding condenser 38 to contact 6 on disk of distributor T_B and corresponding type bar. The said charging circuit is connected in parallel to transmitter 45 by lines 43 and 44 extending to resistance 34. The output of the transmitter 45 is connected to an antenna 46 or line link 46*a* and ground 47 in the usual manner. Thus, upon release or return of said keybar and contact of said rotary contact arm with corresponding contact on distributor T_B a reflected signal or impulse is set up by the charging of said corresponding condenser and through the sending circuit to transmitter 45, said impulse identical in character to the original impulse received at unit P_B, is transmitted back to station "A" by radio or line link in the usual manner.

The receiving circuit for the reflected impulse from station "B" includes a receiver and amplifier 50 having one of its input terminals grounded at 48 and its other input terminal connected to either an antenna 49 or line link 46*a*, adapted to receive the said impulse sent out from the transmitter 45 in the usual manner.

The unit P_A adapted to print the reflected impulse is a conventional or modified typewriter similar in construction and operation as unit P_B described. The registration of the character corresponding to the received impulse is accomplished in a like manner previously described, namely, the energization of solenoid 55 beneath the key bar 1 depresses said key bar by means of plunger 56 and in turn through linkage 3 and actuated typebar 4, the character is printed on a record on roll 2.

A common conductor 57 extending from the output side of receiver branches separately to solenoids 55 which in turn are connected individually to spaced elongated contacts 27 carried on disk 26 of receiving distributor R_A at station "A" similar to receiving distributor R_B. Rotary contact arm 28 in synchronism with contact arm 7 of transmitting distributor T_B is connected to the other output terminal of receiver 50 by line 58 including battery 60. On reception of an impulse at the receiver 50, the receiving circuit at station "A" is completed instantaneously which includes battery 60, arm 28, any contact 27 and the particular solenoid 55 corresponding to the contact 27 which happens to be engaged by the arm 28. The characters printed will appear in the same order in which they are sent inasmuch as the arms 28 of distributor R_A and 7 of distributor T_B are always in like relationship to the contacts engaged thereby, and since the impulse is transmitted only when the arm 7 of distributor T_B engages the contact 6 of distributor T_B corresponding to the key which was depressed by solenoid 33 of unit P_B.

Thus it is seen from the above description, that an impulse is caused to be sent from transmitter 11 by the operation of keyboard K_A discharging the electrical storage devices namely, the condensers and by contact arm 7 of distributor T_A completing the condenser charging circuit by its engagement with the contact 6 on disk of distributor T_A, corresponding to depressed key on unit K_A; said impulse received over transmission link by receiver 22 causes a character to be printed by unit P_B identical to received impulse when rotary contact arm 28 of distributor R_B engages a contact 27 of distributor R_B and completes the circuit to the corresponding solenoid 33 of unit P_B; and simultaneously while said character is recorded, printing unit P_B sets up a like impulse to be reflected to station "A" by the return of selected key bar closing a contact in a charging circuit at station "B" and by a rotary arm 7 of distributor T_B in synchronism with arm 28 of distributor R_B completing the sending circuit by engaging a contact 6 corresponding in character to the character recorded by unit P_B; so that the condenser, corresponding to said depressed key bar, previously discharged by depression of said key bar, is charged causing an impulse to be reflected by transmitter 45 back to station "A" by radio or line link; said reflected impulse through receiver 50 causes a character to be printed on unit P_A, which is identical with the character printed by unit P_B, when the circuit to the key bar actuating solenoids is completed by the rotary arm 28 of distributor R_A, engaging a contact on distributor R_A corresponding to said solenoid to be selected.

In this manner it is possible to simultaneously set up a character to be recorded at the sending station of what actually was received at the receiving station while the transmitted character is recorded at the receiving station, and thus have a record at the sending station not of the message transmitted, but of the message as actually received and recorded at the receiving station. To accomplish the above procedure of reflecting an impulse to the sending station "A" identical to the character recorded at the receiving station "B", it is necessary to compensate in some manner for the time lag in the mechanism of the printing and keyboard units of P_B as well as the electrical lag in the line and line or radio apparatus. It also is seen that the transmitting rotary contact arm of distributor T_B for the transmission of the reflected impulse must be in synchronism with the rotary contact arm of distributor R_B for the reception of the original impulse, so that the said arms are in engagement with contacts representing identical characters and maintain this identical relationship constantly. A similar relationship between the rotary arms 7 and 28 of transmitting distributor T_A and of receiving distributor R_A respectively must be maintained so that the distributors T_A and R_A are in constant synchronism with distributors R_B and T_B respectively.

The following description will set forth my preferred embodiment of means for compensating for the time lag referred to and means for maintaining the synchronism referred to above and similar to synchronizing system disclosed in my copending application, Serial No. 684,362 filed August 9, 1933.

Referring to Figs. 3 and 4, the transmitting distributor T_A comprises a disk or commutator ring 5 and a multiplicity of character contacts 6 as described before, including a phase control contact 65. The phase control contact is connected to the input side of original impulse transmitter 11 by conductor 67 including battery 66. The other input terminal of the transmitter is connected by conductor 53 to the brushes of rotary contact arm 7. The battery 66 is effective to produce an impulse through the transmitting means 11 each time the rotary arm 7 wipes across the contact 65. The said arm rotates at a uniform speed and hence the control impulses are sent out at uniform time intervals. Between successive control impulses the rotary arm wipes across all of the character contacts 6 in predetermined order, completing a circuit through the transmitter as its brushes touch each contact which is adapted to be selectively charged, and such contact that was discharged and then charged as the arm wipes across it causes an impulse to be sent out by line link 9*a* or from antenna 9 as previously disclosed. Such an impulse will obviously be timed with reference to the phase control impulse in accordance with the position of the particular character contact which is charged.

At station "B" the receiving distributor R_B comprises a disk or commutator 26 with a multiplicity of elongated character contacts 27 corresponding in position with each character contact of the transmitting disk T_A. The brushes of rotary arm 28 are connected to output side of original impulse receiver 22 by conductor 31 including battery 32.

The rotary arm 28 carries two brushes 70 and 71 connected to one another by conductor 72. The conductor 31 is connected to a solid collector ring 73 with which the brush 70 is in continuous contact. The ring 73 is mounted upon disc 74 which also carries a ring segment 75 and contacts 76, 77, 78. The brush 70 wipes across the ring segment 75 and contacts 76, 77, 78 as it rotates. The brush 71 as it rotates wipes across character contacts 27 carried by disc 26. Discs 26 and 74 are fast upon a hollow shaft 79 and may be manually adjusted with the shaft as desired by worm wheels indicated at 80, said adjustment ordinarily a fixed adjustment and not disturbed in normal operation.

When the apparatus is first set in operation no character impulses are transmitted. If the control impulses come through when the brush 70 is in contact with the ring segment 75 a circuit is set up for stepping the arm 28 forward. This operation is repeated in each cycle until the impulse comes through with the brush 70 in engagement with 77. When brush 70 is in engagement with contact 76 the arm 28 is stepped forward still the same. When the control impulse is transmitted to contact 77 the transmitting and receiving distributors T_A and R_B respectively are in phase and no corrective step required, instead a signal indicating lamp is energized to indicate this desired condition. Should the speeds of the distributors T_A and R_B be different, any lagging of R_B will cause brush 70 to engage contact 76 so that a corrective step is to restore the inphase relationship, any gaining of R_B the brush 70 will transmit the control impulse to the contact 78 and this will produce a backward corrective step; as follows:

The impulse transmitted through the brush 70 to ring segment 75 is carried through conductor 80, armature 81, conductors 82 and 83, coil 84 of advancing electromagnet A, and conductors 85 and 86 to receiver 22. Said impulse energizing magnet A attracting its armature 87, causing pawl 88 attached thereto to rotate ratchet 89 fast upon shaft 90 which in turn has a pinion 91 fast upon it. Pinion 91 meshes with gear 92, which is co-axial with shaft 62 of arm 28, and which is fast with a differential housing 93. The gear 92 and the housing 93 are normally held against rotation by friction members 94 bearing against frame member 95. Friction members 94 are supported upon plungers 96 slidably mounted in gear 92 and impelled outward against frame member 95 by springs 97. Pinions 98 mesh with a pinion 100 which is fast on shaft 62 and with a pinion 101 fast on shaft 102 which is driven from motor 103. The effect of rotating ratchet 89 a single step is to turn the housing 93, which carries the pinion 98, through a small angle, and thus to advance the shaft 62 relative to shaft 102. When an impulse is transmitted through contact 76 the effect is the same as that just described for the transmission through the ring segment 75, the impulse then transmitted directly by conductor 82 to conductor 83 and magnet A.

When the control impulse is transmitted to contact 78 and then by conductor 105 to coil 106 of retarding magnet R, conductor 107 and conductor 86 to receiver 22, energization of coil 106, attracts armature 87*a*, with attached pawl 88*a* to rotate ratchet 89*a*. Rotation of said ratchet rotates in turn shaft 90*a* and pinion 91*a* to rotate gear 92 and the connected housing 93 in a direction opposite to that in which ratchet 89 rotates said gear and housing.

This causes shaft 62 to be retarded relative to shaft 102 and causes rotary arm 28 to be returned to an in-phase condition so that the control impulse is delivered to contact 77. The control impulse from contact 77 passes through conductor 109, through coil 110 of relay controlling armature 81, conductor 111, luminous electrical discharge tube 112, conductors 85 and 86 to receiver 22. Tube 112 is energized signaling to operator that rotary arm 28 is running in-phase with rotary arm 7 of distributor T_A and so continues to be energized so long as the synchronism is maintained. Relay 110 is energized attracting its armature 81 and by reason of the fact that the control impulses come through so frequently that the slow acting armature, by virtue of attached dash pot does not have an opportunity to return and make contact closing circuit from ring segment 75, thus rendering said circuit inoperative as soon as the in-phase operation is secured and is maintained inoperative throughout the time when the character impulses are received. Since the character impulses are not transmitted until synchronism has been secured, it is not possible for said impulses to come through and pass through the ring segment 75 to interfere with the maintenance of the in-phase condition.

It is seen that upon depression of any character on keyboard K_A a character impulse is sent out from transmitter 11, received at receiver 22 and through receiving distributor R_B causing a character to be recorded by unit P_B, in turn, said

unit P_B setting up an impulse, similar in character to impulse received, to be reflected through transmitting distributor T_B and transmitter 45 back to station "A" through receiving distributor R_A and recorded by unit P_A.

Transmitting distributor T_B must be in synchronism with receiving distributor R_A at station "A" also in synchronism with receiving distributor R_B at station "B" when character impulses are transmitted, said transmitting distributor T_B also must set up an impulse, originating from unit P_B to be reflected to station "A", a certain timed period after original impulse is received at receiving distributor R_B and unit P_B, to compensate for time lag in the mechanism of unit P_B, which acts as the recorder of the original impulses and also the point of origin for the signal to be reflected. Distributor R_A must also compensate for the electrical lag in the line and line or radio apparatus.

To accomplish this rotating arm 7 of transmitting distributor T_B is mounted on the same shaft 62 as rotating arm 28 of receiving distributor R_B, (Fig. 4). The rotary arm 28 of receiving distributor R_A at station "A" is in like manner mounted on shaft 61 upon which shaft rotary arm 7 of distributor T_A is mounted. The stationary disk or commutator 5 of transmitting distributor T_B at station "B" is mounted on the some hollow shaft 79 as the disks of receiving distributor R_B. Receiving distributor R_B as explained above consists of two separate disks 26 and 74, similarly transmitting distributor T_B consists of two separate disks 5 and 115 mounted on said shaft 79. A solid collector ring 116 is mounted on disk 115 so that the conductor 40 fastened to collector ring 116 is in constant engagement with brush 117 carried by rotary arm 7 of transmitting distributor T_B and so as to establish a circuit to character contacts mounted on disk 5.

A conductor 119 connects brush 118 to brush 117, brush 118 wiping over character contacts 6 of disk 5 of transmitting distributor T_B at a uniform speed and charging the character contacts 6 selectively so as to transmit the echo signal back to station "A". The disk 5 carrying the character contact 6 of transmitting distributor T_B is set slightly out of phase with its coaxial disk 26 of receiving distributor R_B. This angular displacement represented by ϕ_B depends on the time lag in the mechanism of the unit P_B and must be adjusted to correspond to said time lag accordingly. The greater the time lag the greater the angle of displacement ϕ_B as controlled by the setting of disk 5. Disk 5 when properly set with the correct angle of displacement will be so positioned that when the rotating arm 28 of disk R_B wipes over the character contact "A" causing the unit P_B to record the received character and simultaneously close upper contact 35 of key bar "A", rotating arm 7 of transmitting distributor T_B will wipe over the corresponding character contact on disk 5 namely "A". In this manner correct synchronism of the respective transmitting and receiving distributors will be maintained and provision made for compensation of the time lag of unit P_B. Disk 26 of receiving distributor R_A is similarly mounted on a hollow shaft (not shown) so that the same angular displacement ϕ_A is maintained to correspond with angle ϕ_B at station "B", or any additional angular displacement necessary to compensate for electrical lag of line and line or radio apparatus, thus when rotary arm 7 of distributor P_B wipes over character contact "a", rotary arm 28 of distributor R_A, which is in synchronism with said rotary arm 7 of distributor T_B, wipes over the corresponding character contact "A" at station "A" at the same time.

In this manner the same character is caused to be recorded by unit P_A at station "A" as is caused to be recorded by unit P_B at station "B".

In the type of tele-printing system developed for the use of timed impulses there is an unused portion of this timed interval. Referring to Fig. 2, T represents the timed interval required for the rotating arm of a receiving distributor to make one complete revolution. During this revolution an impulse is received, for example, "D" at the receiving station to be recorded. The time length required for this character impulse in the particular timed interval is approximately 1/46th (whenever the standard number of characters present on a standard typewriter keyboard are used) of the time interval for a complete revolution of the rotating arm. So that during this remaining unused portion of the timed interval "T" other character impulses could be caused to be transmitted in timed relationship with each other so as to continue to be separate timed impulses. It is this inactive portion of the timed interval "T" that may be used for the transmission of the echo or reflected signal.

It is seen that the signal to be reflected is not set up until after the original impulse has energized the corresponding solenoid of the character selected to be transmitted. After transmission of the original impulse during the particular timed interval "T", the signal to be reflected is set up and transmitted back to the sending station. Since the length of the timed impulse reflected "D_R" is equal to the original impulse or 1/46th of the timed interval "T", there is a timed space available in the timed interval "T" to transmit the signal to be reflected to the sending station during the same timed interval as the original signal is transmitted.

Utilizing this inactive portion of the timed interval "T" for the purpose of transmitting the reflected signal, thus, in this manner only one wire link or radio link need be used for transmission of both the original signal impulse and the echo signal impulse. Whenever one line or radio link is used for such duplex operation, rectifiers or any of the other well known methods, are used in the individual transmitting and receiving apparatus in the usual manner to block out the undesired signal impulses, namely so that the transmission of the original impulse at the sending station does not affect the recording apparatus at the sending station and vice versa.

In Fig. 7, a schematic circuit layout shows another embodiment of my invention using punching devices for perforating tabulating records controlled by a keyboard similar to that used on typewriting machines and to the type described hereinbefore. The device in general includes a keyboard section designated "A" (Figs. 5 and 7) and a punching section designated "B". The punching section "B" in its general characteristics is similar to devices already in use, consisting of the usual electric key punch for punching the tabulating cards, and is fully shown and described in the patent of J. T. Schaaff No. 1,821,078. The principle of operation utilized with punches of this character is to provide a plurality of punches controlled by individual selecting magnets 121. These selecting magnets, when energized effect the selection of the punches

corresponding to a particular index point position on the card desired to be perforated.

In the operation of the punching device, a punching operation is effected upon one column of the card, then the card is displaced relatively to the punches and a second punching operation is performed in another column on the card. The arrangement of the parts is such that the feed of the card takes place after each punching operation. The punching device is controlled by a conventional or modified typewriter keyboard and is fully shown and described in the patent to J. W. Bryce No. 1,880,408. The operation of the keys effects the selection of the desired combinations of punches and thereafter the punching operation itself is performed by the power derived from a translating device in the punching attachment. Since the operating details of such perforating mechanism are now well known in the art and fully shown in the above said patents and not pertinent to my invention, further description of its operation is not necessary.

The keyboards are equipped with the same devices and connected in the sending and receiving circuits in the same manner as described with reference to the tele-printing devices. In Fig. 6 are shown the individual contacts **122** operated by depression of each key bar **123**, so that depression of a key bar through linkage **124** causes contact points **125** to open and **126** to close. These contacts connected in the sending circuit to the transmitter, discharge its respective condenser when the corresponding key bar is depressed and closes the charging circuit when the key bar is returned to cause an impulse to be transmitted by its corresponding distributor and transmitter as previously explained in reference with Fig. 1.

The keyboard at station "B" in addition to the contacts **122** for sending the reflected impulse back to station "A" has a solenoid **127** attached to each key bar **123**, so that upon being energized, through its linkage **128** depresses the corresponding key bar similarly as previously described.

It is seen, therefore, when the tele-printing devices are replaced by the typewriter controlled punching devices, that the depression of a key of the sending keyboard **129** at station "A", through its distributor and transmitter will send out an impulse to be received at station "B" through its receiver and receiving distributor and thus energize the solenoid of a key bar of keyboard **130** corresponding to the said depressed key bar. Depression of said key bar at station "B" will cause the punching device to punch a hole in a record contained in punching device "B" and at the same time the depression of the key bar will through its corresponding contacts **122** and the sending distributor and transmitter set up an impulse to be received at station "A", so that the said impulse reflected and received at station "A" through its receiver and distributor will energize a solenoid in keyboard **131** to depress a key bar, the character of which is the same as the character of the key bar depressed at station "B". Depression of said key bar at station "A" will cause the punching device there to punch a hole in a record contained therein which will represent and be a verifying record of the data as received and punched at station "B".

The reflected impulse is sent from station "B" to station "A" during the same timed interval that the original impulse is transmitted from station "A" to station "B" as previously explained.

The two systems of transmitting intelligence disclosed operate in a similar manner relating to the transmission of the controlling impulses, whereas, the method of registering the impulse in one system is by printing the character on a record, whereas, in the second system the method of registering the impulse is by perforating a card or record.

The disclosed invention is suitable for other applications, such as facsimile transmission and operation of tele-control apparatus at a distance, etc.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to the several modifications, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is as follows:

1. In a communication system, a sending station including transmission and reception units, a receiving station including reception and transmission units, the transmission unit of the sending station having means for transmitting character impulses including means to initiate a single impulse for each character during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the selected character to be transmitted, the reception unit of the receiving station having means for receiving such impulses, means controlled by the reception unit of the receiving station for causing the transmission unit of the receiving station to retransmit such impulses, the reception unit of the sending station being adapted to receive such retransmitted impulses.

2. In a communication system, a sending station including transmission and reception units, a receiving station including reception and transmission units, the transmission unit of the sending station having means for transmitting character impulses including means to initiate a single impulse for each character during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the selected character to be transmitted, the reception unit of the receiving station having means for receiving such impulses, means controlled by the reception unit of the receiving station for automatically causing the transmission unit of the receiving station to generate impulses duplicate in characteristics to said impulses received by the reception unit of said receiving station.

3. In a communication system, a station including transmission and reception units with means in the transmission unit for sending impulses representing intelligence including means to initiate a single impulse for each form of intelligence during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the intelligence to be transmitted, and with means in the reception unit nonsensitive to aforesaid impulses but sensitive to reflected impulses, a second, remote station having reception and transmission units with means in the reception unit nonsensitive to the reflected impulses, but sensitive to the first aforementioned impulses and with means in the trans-

mission unit for sending the reflected impulses and means controlled by the reception unit of the second said station to automatically cause its transmission unit to send reflected impulses similar to the aforesaid impulses representing intelligence corresponding to the intelligence received at the second station, and means included in the reception unit of the first said station to receive the said reflected impulses.

4. In a communication system, a station including a transmission unit with means for sending impulses representing intelligence including means to initiate a single impulse for each form of intelligence during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the intelligence to be transmitted and a reception unit with means sensitive only to reflected impulses, a second, remote station including, a reception unit sensitive only to first aforementioned impulses and a transmission unit for automatically sending reflected impulses similar to the aforementioned impulses representing intelligence corresponding to intelligence received at the second station, a synchronizing unit at the second station operating said transmission and reception units at that station in synchronism, and means included in said synchronizing unit to control transmission of the said impulses to be reflected.

5. In a communication system, a station including a transmission unit with means for sending impuises representing intelligence including means to initiate a single impulse for each form of intelligence during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the intelligence to be transmitted, a reception unit with means sensitive only to reflected impulses and a synchronizing unit operating said transmission and reception units in synchronism, a second, remote station including a reception unit sensitive only to the first aforementioned impulses, a transmission unit for automatically sending reflected impulses representing intelligence corresponding to intelligence received at the second station, and a second synchronizing unit at second station operating said transmission and reception units in synchronism with means included in said second synchronizing unit to control transmission of impulses to be reflected to the first said station, and means included in the said synchronizing unit at the first station to control the reception of the said reflected impulses from the second station.

6. In a communication system, a station including a transmission unit with means for sending impulses representing intelligence including means to initiate a single impulse for each form of intelligence during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the intelligence to be transmitted, and a reception unit with means for registering impulses, said reception unit sensitive only to reflected impulses, a second remote station including a reception unit sensitive only to the first aforementioned impulses with means for registration of impulses representing intelligence and including a transmission unit with means for sending the reflected impulses including means controlled by the reception unit of the second station for automatically causing said transmission unit at that station to generate impulses similar to the aforementioned impulses duplicate in character to said impulses received by the reception unit of the second station, and a synchronizing unit at the second station operating the transmission and reception means at that station in synchronism and means included in said synchronizing unit to control transmission of the impulses registered at the first said station and which are identical in character to characters registered at the second said station.

7. In a communication system, a station including a transmission unit with means for sending character impulses including means to initiate a single impulse for each character during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the selected character to be transmitted, a remote station including a reception unit with means for reception of said impulses and including a transmission unit with means to send reflected impulses similar to the aforementioned impulses and automatically operated by reception unit at the second station, and means included in the second station to compensate for the time lag in the apparatus in the said reception unit so that the said impulses to be reflected are set up identical in character to the impulses received at the second station.

8. In a communication system, a station including a transmission unit with means for sending character impulses including means to initiate a single impulse for each character during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the selected character to be transmitted, and a reception unit sensitive only to reflected impulses with means for registration of impulses, a synchronizing unit operating said transmission and reception units in synchronism, a second remote station including a reception unit with means for registration of the first aforementioned impulses, and a transmission unit with means for sending reflected impulses similar to the aforementioned impulses and automatically operated by the reception unit at the second station, and means included in the said synchronizing unit to compensate for electrical transmission lag and electrical lag in the corresponding sending and receiving units so that registration of impulses at the first station will be the same as impulses registered at the second station.

9. In a communication system, a station including a transmission unit with means for sending character impulses sucessively, including means to initiate differentially timed impulses during predetermined timed intervals to represent different characters, each by a single impulse, and controlling means cooperating therewith to select the times at which the single character impulses are initiated in accordance with the different characters to be transmitted, and including a reception unit with means sensitive only to reflected impulses, a second, remote station including a reception unit with means sensitive only to the first aforementioned impulses, a transmission unit operated by said reception unit to send the reflected impulses, and a synchronizing unit at the second station operating the said transmission and reception units in synchronism and means included in the said synchronizing unit to establish a transmission circuit from the transmission unit at the second station

to the reception unit at the first station during the same timed interval the impulses are sent from the transmission unit of the first station to the reception unit at the second station.

10. In a communication system, a station including a transmission unit with means for sending character impulses successively, including means to initiate differentially timed impulses during predetermined timed intervals to represent different characters, each by a single impulse, and controlling means cooperating therewith to select the times at which the single character impulses are initiated in accordance with the different characters to be transmitted, a second remote station including a reception unit with means for receiving said impulses, and a transmitting unit with means operated by the said reception unit to send impulses identical in character to impulses received at the second station, and means coacting with the transmission unit at the second station to establish a circuit to send impulses identical in character to the said received impulses from the transmission unit at the second station during the same timed interval the impulses are sent from the transmission unit of the first station to reception unit of the second station.

11. In a communication system, a station including a transmission unit with means for sending character impulses successively, and including means to initiate differentially timed impulses during predetermined timed intervals to represent different characters, each by a single impulse, and controlling means cooperating therewith to select the times at which the single character impulses are initiated in accordance with the different characters to be transmitted, and a reception unit sensitive only to reflected impulses with means for the registration of impulses, a second, remote station including a reception unit with means for registering the first aforementioned impulses and a transmission unit operated by the said reception unit with means for sending reflected impulses identical in character to impulses received at the second station, and a synchronizing unit operating the said transmission and reception units at the second station in synchronism and means included in the said synchronizing unit to transmit impulses registered at the first said station during the same timed interval of transmission of and similar in character to the impulses received at the second station.

12. In a communication system, a station including a transmission unit with means for sending character impulses including means to initiate a single impulse for each character during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the selected character to be transmitted, and a reception unit sensitive only to reflected impulses, and a synchronizing unit co-acting with the said transmission and reception units, a second remote station including a reception unit with means for receiving the first aforementioned impulses, and a transmission unit operated by the reception unit with means for sending reflected impulses identical in character to impulses received at the second station, and a second synchronizing unit at the second station co-acting with the said transmission and reception units at that station, means included in the synchronizing unit at the first station and means included in the synchronizing unit at the second station to operate simultaneously to send impulses from the second station and received at the first station identical in character to impulses received at the second station.

13. In a communication system, a station including a transmission unit with means for sending impulses, and a synchronizing unit to send a phase control impulse at a predetermined point in a timed cycle, a second station including a reception unit with means for receiving the said first named impulses, and a transmission unit operated by the said reception unit to send impulses identical in character to the received impulses, and a second synchronizing unit at the second station to receive the said phase control impulses, and means included in the second synchronizing unit to select impulses identical in character to the said received impulses and bearing a certain timed relationship to the said phase control impulse.

14. In a communication system, a station including a transmission unit with means for sending impulses during a timed interval, and a synchronizing unit to send a phase control impulse at a predetermined point in a timed cycle, a second station including a reception unit with means for receiving the first said impulses, and a transmission unit operated by the said reception unit to send impulses identical in character to said received impulses, and a second synchronizing unit at the second station to receive the said phase control impulses, and means included in the second synchronizing unit to select impulses identical in character to the said received impulses and to be sent during the same timed interval the first mentioned impulses were sent and received at the second station, and to bear a certain timed relationship to the said phase control impulses.

15. In a communication system, a station including a transmission unit with tele-registering means for sending character impulses, and a reception unit sensitive only to reflected signals with tele-registering means for registration of such impulses, a second station including a reception unit sensitive only to first aforementioned impulses with tele-registering means for registration of such impulses and including a transmission unit with tele-registering means including selectively operated electro storing devices for sending reflected impulses and operated by the said registering means of the second said reception unit, and selective means operated by said electro storing devices to cause the transmittal of impulses identical in character to impulses received at the second station, and means included in the tele-registering means at the first station to register said transmitted impulses from the second station.

16. In a communicating system a station including a transmission unit with tele-registering means for sending character impulses, and a reception unit with tele-registering means for receiving reflected impulses, a second station including a reception unit with tele-registering means for registration of first aforementioned impulses, and a transmission unit with tele-registering means including selectively operated electro storing devices for sending the reflected impulses and operated by the reception unit at the same station, and including a transmitting distributor adapted to operate said electro storing devices, and means included in said distributor to cause the electro storing devices to set up impulses identical in character to impulses registered at the second station, said impulses set up at the

second station transmitted to and registered at the first station.

17. In a communication system, a station including a transmission unit with tele-registering means for sending character impulses successively, and including means to initiate differentially timed impulses during predetermined timed intervals to represent different characters, each by a single impulse, and controlling means cooperating therewith to select the times at which the single character impulses are initiated in accordance with the different characters to be transmitted, and a reception unit sensitive only to reflected impulses with tele-registering means for registration of such impulses, and a transmitting and a receiving distributor adapted to control the transmission and reception of impulses respectively, a second station including a reception unit sensitive only to the first mentioned impulses with tele-registering means for registration of such impulses, and a transmission unit with tele-registering means adapted to be operated by the said reception unit at the second station and with means included in said transmission unit to send impulses to the first station identical in character to said received impulses, and including a receiving and a transmitting distributor adapted to control the reception and transmission of impulses respectively and means included in the transmitting distributor at the second station to control the impulses set up and identical in character to said received impulses and to be sent to the first said station during the same timed interval, the said received impulse sent from the first station, and similar means included in the receiving distributor at the first station to control registration during the same timed interval of said impulses set up and transmitted.

18. In a communication system, a station including a transmission unit with means for sending character impulses including means to initiate a single impulse for each character during a predetermined timed interval and means cooperating therewith to control the initiation of the impulses at differential times therein determining the selected character to be transmitted, and a reception unit with means for receiving reflected impulses and including a transmitting and a receiving distributor adapted to control the transmission and reception of impulses respectively, a second station including a reception unit with means for sending the reflected impulses similar to the aforementioned impulses and operated by said reception unit at the same station, and including a receiving and a transmitting distributor adapted to control the reception and transmission of said impulses respectively, and means similar in the said distributors at both stations to adjust the phase relationship of the transmitting and the corresponding receiving distributor at the same station to compensate for the time lag in said apparatus to send impulses from the first station to be received at the second station and reflected from the second station to the first station.

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