Jan. 14, 1930. H. A. AFFEL ET AL 1,743,588

CARRIER TRANSMISSION SYSTEM FOR PRINTING TELEGRAPHY

Original Filed Aug. 29, 1919 3 Sheets-Sheet 1

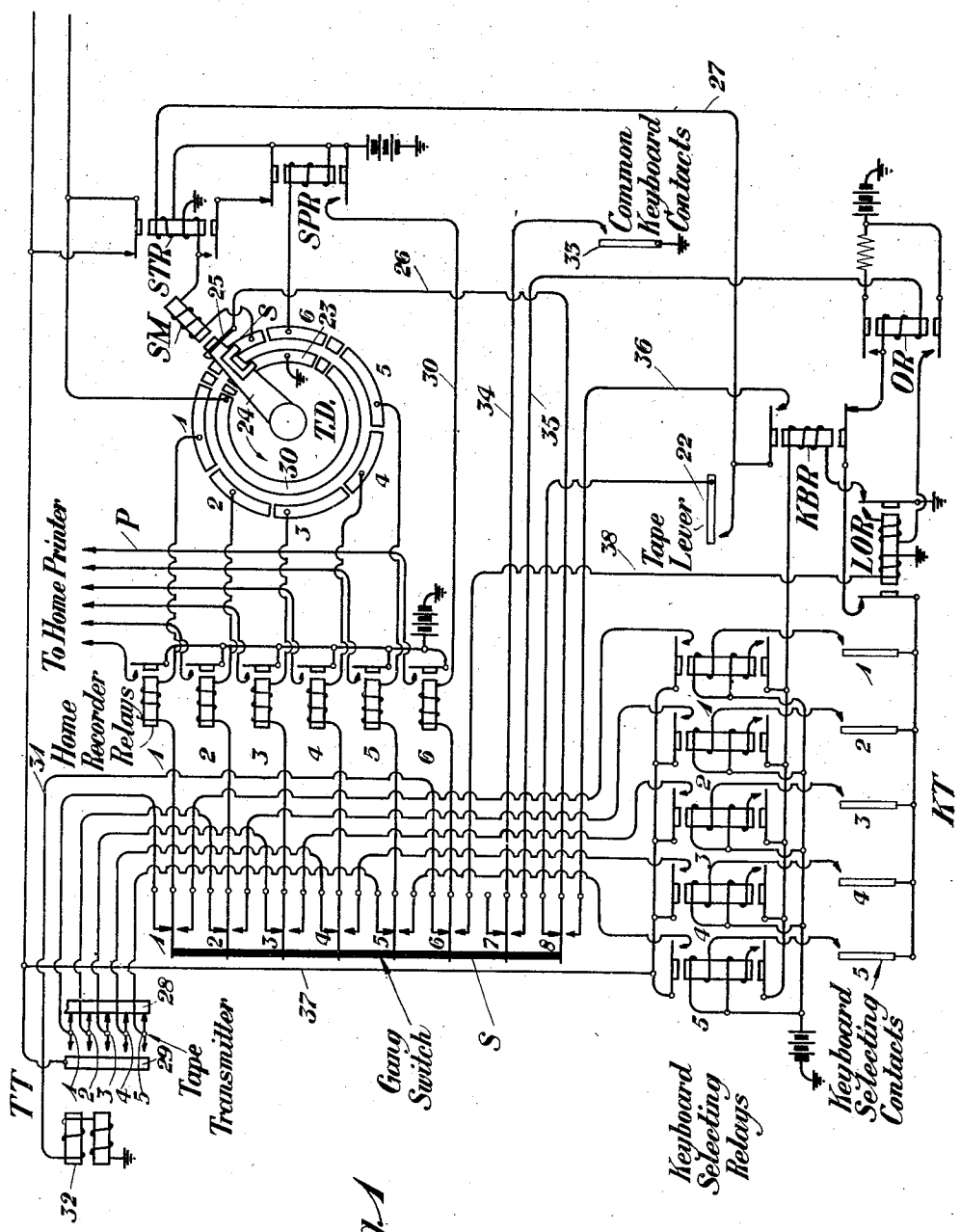


FIG. 1

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CARRIER TRANSMISSION SYSTEM FOR PRINTING TELEGRAPHY

Original Filed Aug. 29, 1919 3 Sheets-Sheet 2

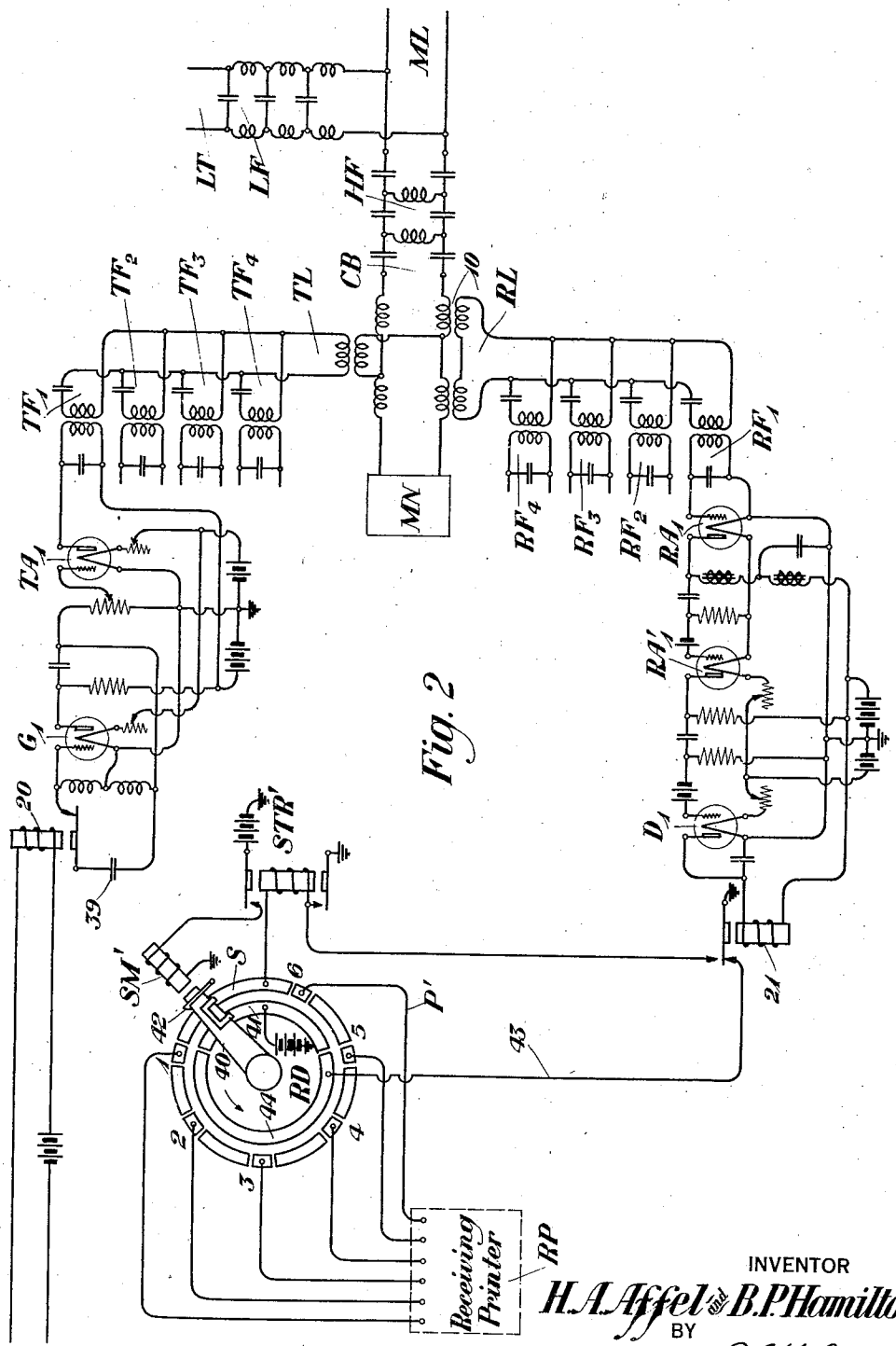


Fig. 2

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CARRIER TRANSMISSION SYSTEM FOR PRINTING TELEGRAPHY

Original Filed Aug. 29, 1919 3 Sheets-Sheet 3

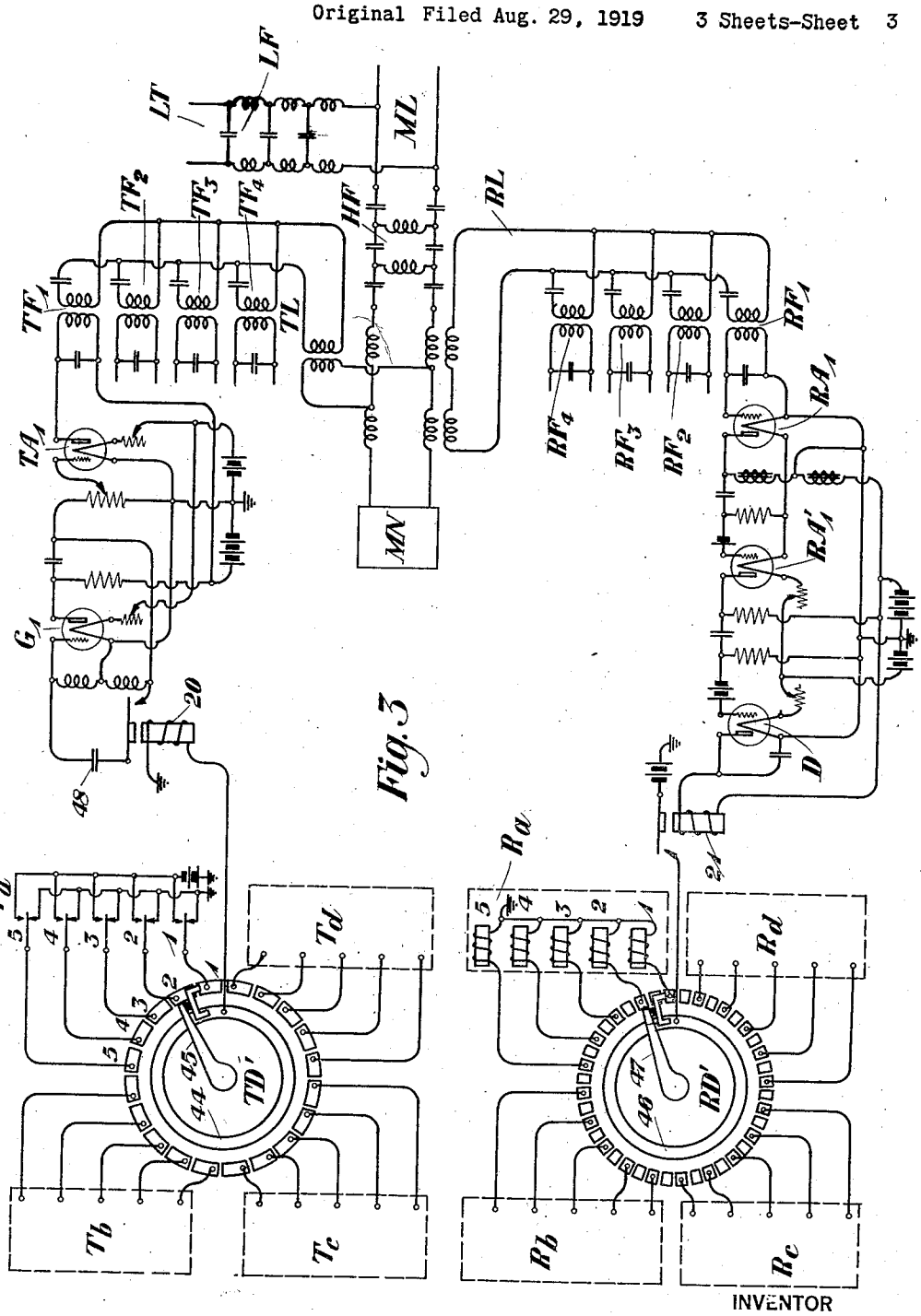


Fig. 3

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UNITED STATES PATENT OFFICE

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CARRIER TRANSMISSION SYSTEM FOR PRINTING TELEGRAPHY

Application filed August 29, 1919, Serial No. 320,667. Renewed November 25, 1929.

This invention relates to multiplex transmission and more particularly to multiplex systems in which carrier currents are employed for the transmission of signals.

Multiplex transmission by means of carrier currents is accomplished by superimposing upon a transmission circuit such as a wireless antenna, or an ordinary wire transmission line, such as a telephone or telegraph line, a plurality of carrier currents of different frequencies, said carrier currents being used for the selective transmission of telephone or telegraph signals by imposing thereon by modulation or otherwise the low frequency currents representing the signal to be transmitted.

It is one of the objects of this invention to adapt a multiplex system of this character to the transmission of printing telegraph messages. A further object of the invention has reference to further increasing the capacity of a multiplex carrier system by utilizing each channel for the transmission of a plurality of printing telegraph messages.

These objects, as well as other objects more fully hereinafter appearing may be accomplished by associating with each transmitting channel of a carrier system means for translating low frequency impulses into carrier oscillations, and by providing transmitting apparatus including the distributor of a printing telegraph arrangement, said apparatus being so arranged as to transmit to the translating apparatus code combinations of impulses corresponding to characters to be printed. For receiving purposes each channel is provided with means for translating carrier oscillations into corresponding code combinations of low frequency impulses which in turn are transmitted through a distributor to a receiving printer.

Where printing apparatus, such as the so-called start-stop printer, is to be used, one printing channel will ordinarily be associated with each carrier channel. A greater number of printing channels may, however, be associated with each carrier channel, especially where printers of the multiplex type are employed. In this case at the sending station a distributor will be provided for each carrier channel having associated therewith a plurality of code transmitters, the distributor operating to successively transmit to the carrier translating means successive code combinations of impulses from the several transmitters. Similarly, for receiving purposes, a distributor will be provided having a corresponding plurality of printing means associated therewith, said distributor functioning to transmit to the corresponding printers successive groups of impulses corresponding to code combinations.

The invention may now be more fully understood by reference to the following description when read in connection with the accompanying drawings, Figures 1 and 2 of which when taken together constitute a simplified diagram of an embodiment of the invention employing one printer channel for each carrier channel, while Figure 3 constitutes a simplified diagram of a system in which a plurality of printing channels may be associated with each carrier channel.

Referring to Figures 1 and 2, a transmission line ML is illustrated, which line may be an ordinary wire telephone line, terminating in a terminal telephone circuit LT. In order that the line may be employed for multiplex carrier transmission a carrier branch CB is provided, said branch having included therein a high pass filter HF, for the purpose of excluding low frequency signaling currents. A low pass filter LF is included between the main line ML and the low frequency terminal circuit LT, for the purpose of excluding from the low frequency circuit high frequency carrier oscillations. The filters HF and LF are of the general type, illustrated and described in United States patents to George A. Campbell Nos. 1,227,113 and 1,227,114, dated May 22, 1917. The filter LF is designed in accordance with the principles of said Campbell patents so as to freely transmit a band of frequencies extending from zero to the upper limit of frequencies employed in ordinary telephonic transmission, while substantially suppressing frequencies above said upper limit. Conversely, the filter HF is designed to freely transmit frequencies above the upper limit employed

in ordinary telephonic transmission while substantially suppressing frequencies below said limit.

The carrier branch CB is associated with a common transmitting circuit TL and a common receiving circuit RL, through a balanced transformer arrangement 10, having associated therewith an artificial line MN to balance the apparatus on the main line side of the transformer so that the circuits TL and RL are rendered substantially conjugate with respect to each other; that is, the circuits TL and RL are so related that a disturbance arising in one will not affect the other. The common transmitting circuit TL is associated with a plurality of transmitting channels through selecting circuits which in this case are illustrated as sharply tuned circuits TF_1, TF_2, TF_3, TF_4, etc. In a similar manner the receiving circuit RL is associated with a plurality of receiving channels through selecting circuits which are also illustrated as sharply tuned filters RF_1, RF_2, RF_3, RF_4, etc.

In the drawing the transmitting and receiving carrier apparatus for one transmitting and receiving channel only is illustrated. The transmitting apparatus comprises a vacuum bulb oscillator G_1 adapted to generate high frequency oscillations of the frequency assigned to the corresponding carrier channel. An amplifier TA_1 is provided between the oscillator G_1 and the tuned circuit arrangement TF_1 in order to amplify the generated oscillations. The circuit of the oscillator G_1 is controlled by a relay 20 controlled by the printing telegraph transmitting apparatus hereinafter described. The corresponding apparatus of the receiving channel comprises vacuum bulb amplifiers RA_1 and RA_1' and a vacuum bulb detector D_1, in the output circuit of which is a direct current relay 21 for transmitting to the receiving printer apparatus hereinafter described, the low frequency impulses corresponding to the code combinations arising at the sending station.

The transmitting relay 20 is under the control of the transmitting apparatus illustrated in Figure 1 which comprises a start-stop distributor TD for transmitting to the relay 20 code combinations of impulses corresponding to a character to be printed. The code combinations may be set up either by a tape transmitter schematically indicated at TT, or by a keyboard transmitter schematically indicated at KT. Gang switch S is provided for shifting the distributor circuits to either the tape transmitter or the keyboard transmitter.

The receiving printer apparatus controlled by the receiving relay 21 comprises a receiving distributor RD of the start-stop type for transmitting the code combinations of impulses received by the relay 21 to a corresponding receiving printer RP which may be of any well-known character. Since the details of the printer constitute no part of the present invention, said element is merely indicated schematically.

Further details of the apparatus may now be more fully understood from a description of the operation of the apparatus. With the gang switch in the position indicated in Figure 1, the transmitting apparatus is under the control of the tape transmitter and assuming that a sufficient amount of tape has been perforated to permit the tape lever 22 to be closed a circuit is completed as follows:

From grounded segment 23 of the inner ring of the distributor TD, brush arm 24, releasing pawl 25 of the starting magnet SM, conductor 26, eighth contact of the gang switch, tape lever 22, conductor 27, upper winding of starting relay STR to battery. Starting relay STR upon being energized completes a locking circuit from ground through its lower winding, over its lower front contact and over the upper back contact of stop relay SPR to battery.

The transmitting relay 20 is in a normally closed circuit which is under the joint control of the upper contact of the start relay STR and the segments of the outer ring of the distributor TD in a manner hereinafter described. The system herein illustrated requires the transmission to the transmitting relay 20 of seven impulses for each character to be transmitted. The first or starting impulse is for the purpose of setting the receiving distributor into operation and always corresponds to an open circuit condition. The next five impluses may correspond to either open or closed circuit conditions in any order and determine the character to be printed. The seventh impulse is always a closed circuit impulse and is for the purpose of stopping the apparatus or restoring it to normal.

The start relay STR upon being energized as above described opens the circuit of the relay 20, thereby transmitting the starting impulse. At the same time a circuit for the starting magnet SM is completed from battery over the upper back contact of relay SPR, lower front contact of relay STR, through the winding of magnet SM, over the starting segment S, brush arm 24 to grounded segment 23 of the inner ring of the distributor. Starting magnet SM is energized and releases the brush arm 24 which now rotates over the various segments of the distributor.

As soon as the brush arm 24 passes from the starting segment S the starting magnet SM is de-energized so that its releasing pawl 25 is ready to engage the brush arm at the end of its rotation. As the relay STR is locked up so as to hold open its upper contact, the open or closed circuit condition of the transmitting relay 20 is now determined by the segments of the outer ring of the distributor and the contacts of the tape transmitter TT.

Let it be assumed that the tape transmitter is set so that its first, third and fifth contacts

are shifted from the bus-bar 28 to the live bus-bar 29. As the brush arm 24 passes over the first segment of the outer ring of the distributor TD, a closed circuit impulse will be transmitted to the relay 20 from battery over the segment 30 of the inner ring of the distributor, brush arm 24, first segment of the outer ring, through the winding of the first home recorder relay, over the first contact of the gang switch, first contact of the tape transmitter TT, bus-bar 29 and through the winding of relay 20 to battery. The first character determining impulse thus transmitted to the relay 20 is therefore a closed circuit impulse.

The brush arm now passes to the second segment of the distributor which is connected through the second home recorder relay and the second contact of the gang switch to the second contact of the tape transmitter. Since the second contact of the tape transmitter is not shifted into contact with the bus-bar 29, the circuit of the relay 20 is not closed and the second code forming impulse corresponds to an open circuit condition.

As the brush arm passes to the third segment of the distributor a circuit for relay 20 is completed over the brush arm from the segment 30 of the inner ring to the third segment of the outer ring, through the winding of the third home recorder relay, third contact of the gang switch, third contact of the tape transmitter and over bus-bar 29 to the relay 20. The third character determining impulse is therefore a closed circuit impulse.

In a similar manner, as the brush arm passes over the fourth and fifth segments of the distributor, an open circuit condition followed by a closed circuit impulse is transmitted to the relay 20. The fifth home recorder relay is at the same time actuated.

The brush arm upon passing to the sixth segment of the distributor closes a circuit from grounded segment 23, over the brush arm 24, sixth segment of the outer ring of the distributor, through the winding of stop relay SPR to battery. At its upper contact stop relay SPR opens the locking circuit of the start relay STR which is accordingly deenergized and at its upper back contact closes the circuit of relay 20 to transmit the final closed circuit impulse of the series. At its lower front contact stop relay SPR closes a circuit from battery, over the conductor 30, through the sixth home recorder relay, sixth contact of the gang switch S, over conductor 31 and through the winding of the tape transmitter magnet 32 to ground. The tape transmitter magnet operates in a well-known manner to move the tape forward and set up a new combination upon the transmitter. The sixth home recorder relay closes a printing circuit leading to the home printer (not shown) to print the character determined by the operation of the first, third and fifth home recorder relays in a well understood manner.

The brush arm 24 now passes to the start segment S of the distributor and comes to rest in engagement with the releasing pawl 25. If the tape lever 22 is still closed, the starting circuit originally described is completed over the brush arm 24 and the pawl 25 so that the distributor is again released and operates to transmit the succeeding combination of impulses.

When the keyboard transmitter is used for determining the code combinations to be transmitted, the operation is slightly different from that above described. In this instance, the gangswitch is shifted to its alternative position, thereby shifting the connections of the code segments of the distributor from the tape transmitter TT to the keyboard transmitter KT.

Assuming that in the operation of a given key of the keyboard the first, third and fifth of the keyboard selecting contacts are closed and that at the same time the common keyboard contact 33 (which is actuated each time a key is depressed) is closed, a circuit is completed from ground, over contact 33, conductor 34, seventh contact of the gang switch S, conductor 35, winding of overlap relay OR, lower back contact of keyboard relay KBR, left hand back contact of lockout relay LOR, and thence in parallel over the first, third and fifth keyboard contacts through the upper windings of the first, third and fifth keyboard selecting relays, to battery. The overlap relay OR and the first, third and fifth keyboard selecting relays are actuated over the circuit above traced, the keyboard selecting relays completing locking circuits from battery, through their lower windings, over their lower front contacts, through the winding of relay KBR, and over the right hand back contact of relay LOR to ground. The relay KBR is now energized and at its lower contact opens the initial energizing circuit for the keyboard selecting relays. These selecting relays being now locked up, store the core combination set up by the keyboard selecting contacts and these contacts may be actuated to set up a different combination without disturbing the combination previously set up.

The overlap relay OR upon being energized, completed a locking circuit from battery, over its upper front contact, through its winding, over conductor 35, seventh contact, of the gang switch, conductor 34 and over common keyboard contact 33 to ground. The overlap relay therefore remains locked up so long as the key which has just been depressed is held down. Relay KBR upon being energized, completes the starting circuit for the transmitting distributor TD from

grounded segment 23, brush arm 24, releasing pawl 25, conductor 26, eighth contact of gang switch S in its alternate position, conductor 36, upper front contact of relay KBR, conductor 27, through the winding of relay STR to battery.

The starting relay STR operates in a manner already described to cause the release of the distributor TD and to transmit the starting impulse to the relay 20. As the brush arm passes over the first segment of the outer ring of the distributor, a closed circuit impulse is transmitted to the relay 20 over a circuit from battery, segment 30, brush arm 24, first segment of the outer ring of the distributor, first home recorded relay, first contact of the gang switch in its alternate position, upper front contact of the first keyboard selecting relay, conductor 37, through the winding of transmitting relay 20, to battery. This impulse constitutes the first impulse of the group of five character determining impulses.

As the brush arm continues its rotation, similar circuits are completed over the third and fifth segments of the outer ring of the distributor and the upper front contacts of the third and fifth keyboard selecting relays, thereby energizing the third and fifth home recorder relays in addition to the first home recorder relay and transmitting closed circuit impulses to the relay 20. Open circuit conditions occur as the brush passes over the second and fourth segments.

As the brush passes over the sixth segment of the distributor, a circuit previously described is completed for the stop relay SPR which opens the locking circuit of the relay STR, thereby transmitting the final closed circuit impulse to the relay 20. The relay SPR over its lower front contacts completes a circuit from battery, over the conductor 30, through the winding of the sixth home recorder relay, sixth contact of the gang switch in its alternate position, and over the conductor 38, through the left hand winding of the lockout relay LOR, to ground. The sixth home recorder relay closes a printing circuit for the home printer so that the combination determined by the actuation of the first, third and fifth home recorder relays is printed in a well known manner.

The lockout relay LOR at its left hand contact opens at another point the initial energizing circuit for the keyboard selecting relays which, it will be remembered, was traced over the actuated keyboard selecting contacts. At its right hand contact, relay LOR opens the locking circuit of the keyboard selecting relays which are restored to normal. The operation from this point depends on whether or not the operator has held down the key originally actuated or whether it has been released before the lockout relay LOR was actuated. If the key is still depressed, the common keyboard contact 33 still remains closed and the overlap relay OR will, therefore, still remain locked up. Consequently when the lockout relay LOR is energized, a locking circuit is closed from ground, over the right hand front contact and through the right hand winding of relay LOR, and over the lower contact of the overlap relay OR to battery. The lockout relay LOR, therefore, holds open the initial energizing circuit of the keyboard selecting relays so long as the key is maintained depressed, thereby preventing the possibility of the same combination being set up and transmitted again because of the slow operation on the part of the operator.

If, on the other hand, the operator had already restored the key, the common keyboard contact would have opened, thereby deenergizing the overlap relay OR so that the lockout relay would not be locked up but would simply operate momentarily to open the circuit of the keyboard relay and the locking circuit of the keyboard selecting relays. If, in the meantime, the operator had again actuated either the same key or another key to set up a new combination on the keyboard selecting contacts, the new combination would be transferred to the keyboard selecting relays as soon as the lockout relay LOR and the keyboard KBR are deenergized.

We will now consider the operation of translating the impulses corresponding to a code combination into carrier oscillations for transmission to the distant station. The relay 20, it will be remembered, is normally energized and consequently maintains the grid circuit of the oscillating tube G_1 closed through the condenser 39, so that the oscillator normally generates high frequency oscillations of the frequency assigned to the channel which oscillations are amplified by the amplifier TA_1 and transmitted through the sharply tuned circuit TF_1 to the common transmitting circuit TL. Oscillations of different frequencies from other transmitting channels may, at the same time, also be impressed upon the circuit TL. The oscillations appearing in this circuit are then transmitted to the artificial line MN, and to the main line ML through the high frequency filter HF, being prevented from entering the low frequency terminal circuit LT by means of the filter LF. The oscillations impressed upon the line ML are transmitted thereover to the distant station.

When the transmitting relay 20 is deenergized in response to the first starting impulse, the grid connection of the oscillator G_1 through condenser 39 is opened and high frequency oscillations either cease to be generated or the frequency of the oscillations is altered so that substantially little or no current flows upon the line through the tuned

circuit TF_1, with the result that the receiving distributor at the distant station is released in a manner which will become apparent later. The next five impulses which constitute the character determining impulses were described in the case assumed as consisting of a closed circuit impulse, an open circuit condition, another closed circuit impulse, another open circuit condition and an additional closed circuit impulse. For each closed circuit impulse a series of high frequency oscillations are generated by the oscillater G_1 and after being amplified are transmitted over the main line ML to the distant station in a manner already described.

The last impulse of each group of seven is always a closed circuit impulse so that in the particular case herein described the relay 20 remains continuously energized during the sixth and seventh impulses and high frequency oscillations from the oscillator G_1 are transmitted to the distant station so long as the last impulse continues, which will, of course, be until the sending distributor is released for the transmission of the next code combination.

In order to understand the receiving operations taking place at the distant station in response to the transmission of high frequency oscillation in the manner just described, the operation of the apparatus associated with the receiving channel illustrated in Figure 2 will be considered. Let it be assumed that the same code combination as that already described is to be transmitted from the distant station. Normally high frequency oscillations of the frequency corresponding to the tuned circuit RF_1 will be received from the line ML in the common receiving circuit RL, which circuit may at the same time also be receiving high frequency oscillations corresponding to other channels. The frequency corresponding to the particular channel illustrated will be transmitted through the tuned circuit RF_1 and amplified by the vacuum tube arrangements RA_1 and RA_1', and then rectified or detected by the tube D_1 so that a direct current flows in the output circuit of the tube D_1 having a value sufficient to maintain the receiving relay 21 energized.

In response to the starting impulse, the oscillations corresponding to the receiving channel illustrated will cease to be transmitted over the line ML so that the relay 21 is deenergized. A circuit is thereby completed from ground, over the back contact of relay 21, through the winding of the start relay STR', over the start segment S of the distributor, brush arm 40 and segment 41 of the distributor, to battery. The start relay STR' is locked up over its lower front contact and at its upper front contact completes the circuit of the start magnet SM'. The latter withdraws the releasing pawl 42 from the brush arm 40, releasing the brush which, upon passing from the start segment S, unlocks the start relay STR' which in turn causes the deenergization of the start magnet SM' so that the pawl 42 is again in position to engage the brush arm 40 at the completion of its revolution.

The brush arm 40 of the receiving distributor RD now passes over the first segment of the outer ring of the distributor at an instant coinciding with the transmission of the first selecting impulse originating at the distant station which, in the case under consideration, is a closed circuit impulse. During this period, therefore, high frequency oscillations will be transmitted over the line ML and through the tuned circuit RF_1 to the translating apparatus, whereby the relay 21 is energized. A momentary circuit is, therefore, completed from ground, over the front contact of relay 21, over conductor 43, segment 44, brush arm 40 and first segment of the outer ring of the distributor to the first selecting relay (not shown) of the receiving printer RP.

The brush arm 40 next rotates over the second segment of the outer ring of the distributor RD. At this moment an open circuit condition occurs and consequently no high frequency oscillations pass through the tuned circuit RF_1. The relay 21 is, therefore, deenergized and no circuit is completed over the second segment of the outer ring of the distributor to the corresponding selecting relay of the printer.

As the brush arm 40 passes over the third and fourth segments of the distributor, closed circuit and open circuit intervals occur respectively so that for the third segment a selecting relay of the receiving printer is operated, while for the fourth segment the corresponding relay is unactuated.

The fifth character determining impulse and the last impulse of the code combination constitute practically a continuous closed circuit impulse in the case described. Consequently, while the brush arm 40 is passing over the fifth and sixth segments of the outer ring of the distributor, high frequency oscillations pass through the tuned circuit RF_1 and the receiving relay 21 is actuated. A circuit is therefore completed over the front contact of said relay and over the fifth segment of the distributor for the fifth selecting relay of the receiving printer. As the brush arm passes over the sixth segment, a circuit is completed from battery, over segment 41, brush arm 40, sixth segment of the outer ring of the distributor and over the conductor P' to the receiving printer to print the combination set up on the selecting relays of the printer in a well understood manner.

The brush arm now passes to the segment S of the distributor and comes to rest in engagement S of the distributor and comes to

rest in engagement with the pawl 42 until, in response to the next starting impulse, the receiving relay 21 again falls off to release the distributor.

It will be understood that transmission may take place simultaneously from the printers associated with all of the transmitting channels at the station indicated and corresponding receiving printers at the distant station. Also received transmissions arising at the distant station may be simultaneously transmitted over the main line ML to each of the receiving channels indicated in Figure 2. Finally it should be noted that due to the conjugate relation of the common transmitting circuit TL and the common receiving circuit RL the two sets of transmissions in opposite directions may take place simultaneously.

In order to further increase the number of signalling channels which may be operated over a single line, the arrangement illustrated in Figure 3 may be provided. The high frequency portion of the apparatus in this figure is identical with that illustrated in Figure 2 and need not be further described. Each high frequency channel has associated with it, however, instead of a single printer, a multiplex printing arrangement so that four printers may be operated over each channel. For this purpose transmitting distributor TD′ and receiving distributor RD′ of the continuously rotating type are provided, a transmitting distributor being associated with each transmitting channel, and a receiving distributor being associated with each receiving channel. Similar distributors rotating in synchronism therewith will be provided for the corresponding channels at the distant station. The transmitting distributor TD′ includes twenty segments on its outer ring divided into four groups of five each. The first group is associated with a tape transmitter T_a schematically illustrated as comprising a set of five contacts adapted to be connected either to battery or to ground. The other three groups of five segments each are connected to corresponding transmitters T_b, T_c and T_d.

The receiving distributor RD′ is illustrated as comprising twenty live segments in its outer ring, separated by a corresponding number of dead segments. The live segments are divided into four groups of five each, the first group of five being connected to the selecting relays of a receiving printer schematically indicated at R_a. The remaining three groups of five segments each are connected to receiving printers R_b, R_c and R_d. But five segments are provided for each sending and receiving unit since, owing to the fact that the distributors at the distant stations are continuously operated in synchronism, no starting and stopping impulses are necessary and consequently only the five code impulses determining the character need be transmitted.

The transmitting distributor TD′ is provided with an inner ring 44 connected to the transmitting relay 20 so that as the brush arm 45 passes over the segments of the outer ring, impulses may be transmitted to said relay. Similarly, the receiving distributor RD′ is provided with an inner ring 46 connected to the front contact of the receiving relay 21, so that the impulses received by said relay may be transmitted to the various segments of the outer ring as the brush arm 47 rotates.

Further details of the apparatus may now be understood from a description of the operation:

Assuming that the transmitter T_a is operated to shift its first, third and fifth contacts to their alternate positions, as the distributor arm 45 rotates over the corresponding first, third and fifth segments of the outer ring of the distributor, the circuit of the relay 20 will be closed, but the circuit of said relay will be opened as the brush arm passes over the second and fourth segments. The transmitting relay 20 is thereupon operated to close the grid circuit of the oscillator G_1 through the condenser 48 each time said relay is energized, thereby causing the oscillator to generate corresponding groups of oscillations of the frequency corresponding to this particular channel. These high frequency oscillations are amplified by the amplifier TA_1 and transmitted through the sharply tuned circuit TF_1 to the common receiving circuit TL. Oscillations of frequencies corresponding to other transmitting channels may at the same time be impressed upon the circuit TL for transmission over the main line ML to the distant station.

The receiving operation at the distant station may be understood from a consideration of the receiving operation at the station illustrated in response to the transmission of a similar code combination from the distant station. Assuming that at the distant station the transmitter corresponding to the receiving printed RA transmits closed circuit impulse to its transmitting relay while its brush arm is passed over its first, third and fifth segments, three successions of high frequency oscillations will be received from the main line ML and transmitted through the sharply tuned circuit RF_1. At the same time oscillations of other frequencies may be received from the main line ML and transmitted to the other receiving channels. The three successions or groups of oscillations transmitted through the tuned circuit RF_1 are amplified by the tubes RA_1 and RA_1' and rectified or detected by the tube D_1 so that three direct current energizing impulses are received by the relay 21, each impulse being separated by deenergized periods corresponding to the

open circuit condition, while the brush arm of the distant distributor was passing over the second and fourth segments.

The first of these received pulses occurs just as the brush 47 is passing over the first receiving segment of the first group of five segments of the outer ring of the distributor RD'. A circuit is therefore completed from ground, over the front contact of relay 21, inner ring 46, brush arm 47 and first segment of the outer ring to the first selecting relay of the receiving printer R_a. As the brush 47 passes over the third and fifth segments, similar circuits are completed for the third and fifth selecting relays, so that the receiving printer R_a prints the character corresponding to the actuation of the transmitter at the distant station. As the brush arm passes over the next group of five receiving segments, relay 21 will receive impulses corresponding to a combination set up on another transmitter at the distant station and similar operations take place for each quadrant of the distributor.

It will, therefore, be seen that for each transmitting channel, four printer transmitters may be provided, while for each receiving channel a corresponding number of printers may be provided. The particular number assigned to each high frequency channel may, of course, be variable, four being illustrated simply because it conforms to the common printer practice. It will also be understood that high frequency transmission may take place for all channels simultaneously in both directions without interference, so that for the case illustrated sixteen separate transmissions may take place over the line ML in one direction and a corresponding number of transmissions take place over the line in opposite direction. By increasing either the number of high frequency channels or the number of printer channels assigned to each high frequency channel, the total number may be further increased.

It will also be obvious that while the invention has been disclosed as embodied in certain forms which are considered desirable from a practical standpoint, 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. In a signaling system, a transmission circuit adapted to transmit carrier oscillations, Baudot code determining means, a vacuum tube translating device associated with said transmission circuit, means to impress a carrier frequency of constant amplitude upon the circuit of said vacuum tube translating device, a transmitting distributor for transmitting to said vacuum tube translating device Baudot code combinations of impulses determined by said code determining means, means whereby the impulses thus transmitted operate through the circuit of said vacuum tube translating device to determine the transmission to said transmission circuit of carrier oscillations modified in accordance with said code combinations, a vacuum tube detector associated with said transmission circuit for translating the carrier oscillations transmitted over said circuit into code combinations of impulses corresponding to the original Baudot code combination, printing means responsive to Baudot code combinations to print characters, and a receiving distributor for distributing the detected impulses to said printing means.

2. In a signaling system, a transmission circuit adapted to transmit carrier oscillations, a plurality of carrier channels extending over said circuit, a vacuum tube translating device associated with each channel, means whereby carrier oscillations of different frequencies may be supplied to the circuits of the vacuum tube translating devices of the several channels, Baudot code determining means for each channel, a transmitting distributor for each channel for transmitting to the vacuum tube translating device of each channel Baudot code combinations of impulses determined by said code determining means, said Baudot code combinations of impulses controlling through said vacuum tube translating device the transmission of carrier oscillations modified in accordance with the code combinations to said transmission circuit, means to separate carrier oscillations transmitted over said transmission circuit and having different frequencies corresponding to different transmitting channels into corresponding receiving channels, a vacuum tube detector associated with each receiving channel to translate the oscillations selected into that channel into Baudot code combinations of impulses corresponding to the original Baudot code combinations set up in the corresponding transmitting channel, printing means associated with each receiving channel to print characters corresponding to the detected Baudot combinations, and receiving distributors for each channel for distributing to the printing means the Baudot code combnations detected by the detector of that channel.

3. In a signaling system, a transmission circuit adapted to transmit carrier oscillations, means to generate a carrier frequency of constant amplitude, translating means for controlling said carrier frequency of constant amplitude in accordance with low frequency impulses, means to impress the controlled oscillations upon said transmission circuit, a plurality of Baudot code determining means, and a transmitting distributor for successively transmitting to said translating means the several independent code combi-

nations of impulses individually determined by each of said code determining means, said impulses controlling said carrier oscillations through said translating means.

4. In a signaling system, a transmission circuit adapted to transmit carrier oscillations, means to generate a carrier frequency of constant amplitude, translating means for controlling said carrier frequency of constant amplitude in accordance with low frequency impulses, means to impress the translated oscillations upon said transmission circuit, a plurality of Baudot code determining means, a transmitting distributor for successively transmitting to said translating means the several independent code combinations of impulses individually determined by each of said code determining means, said impulses controlling said carrier oscillations through said translating means, means to translate high frequency oscillations transmitted over said transmission circuit into impulses corresponding to the original code combinations, a plurality of printing means for printing characters corresponding to code combinations, and a receiving distributor for successively distributing code combinations of the translated impulses to the corresponding printing means.

5. In a signaling system, a transmission circuit adapted to transmit carrier oscillations, a plurality of carrier channels extending over said transmission circuit, means to generate a carrier frequency of constant amplitude for each channel, translating means associated with each channel for controlling the carrier oscillations of the frequency assigned to the channel in accordance with low frequency impulses, means to impress the controlled oscillations from the several channels upon said transmission circuit, a plurality of Baudot code determining means for each channel, and a transmitting distributor for successively transmitting to said translating means the several independent code combinations of impulses individually determined by each of the code determining means associated with each channel, said impulses controlling said carrier oscillations through said translating means.

6. In a signaling system, a transmission circuit adapted to transmit carrier oscillations, a plurality of carrier channels extending over said transmission circuit, means to generate a carrier frequency of constant amplitude for each channel, translating means associated with each channel for controlling the carrier oscillations of the frequency assigned to the channel in accordance with low frequency impulses, means to impress the controlled oscillations from the several channels upon said transmission circuit, a plurality of Baudot code determining means for each channel, a transmitting distributor for successively transmitting to said translating means the several independent code combinations of impulses individually determined by each of the code determining means associated with each channel, said impulses controlling said carrier oscillations through said translating means, means to separate carrier oscillations of different frequencies transmitted over said transmission circuit into receiving channels corresponding to the several frequencies, means associated with each channel to translate said oscillations into impulses corresponding to the original code combinations, a plurality of printing means associated with each channel for printing characters corresponding to code combinations, and a receiving distributor associated with each channel for successively distributing to the several printing means of each channel code combinations of translated impulses corresponding to the several printing means.

7. In a system of high frequency telegraphy, a transmitter comprising an electron tube oscillator, a grid control circuit therefor, means for variably modifying said grid circuit through each of a definite number of successive definite time intervals for each character signal to thereby transmit energy in corresponding combinations of impulses and means for receiving said impulses, means for amplifying said impulses, a relay actuated by said impulses and a type printer controlled by said relay whereby said impulses select particular characters and cause said characters to be printed.

8. In a system of high frequency telegraphy, a transmitter comprising an electron tube oscillator for generating continuous oscillations, means for variably modifying the transmission of said oscillations during each of a definite number of successive time intervals for each signal to thereby produce a characteristic succession of impulses, means for receiving said impulses, means for amplifying said impulses and a selective relay operated by said impulses and adapted to control a circuit to an automatic printer having means controlled by said combinations of impulses for selecting characters and causing same to be printed.

9. In a system of high frequency telegraphy, the combination at a transmitter of an electron tube oscillator and selectively controlling means therefor arranged to place said oscillator, for each character signal transmitted, in either one of two conditions during each of a definite number of successive time intervals of definite duration, to thereby produce a characteristically timed succession of impulses for each character signal; at a receiver, an electron tube apparatus for receiving and amplifying the transmitted signals, an electron tube relay responsive to the amplified impulses of the signals, a magnet controlled by said relay, and a printer mechanism selectively controlled by said

magnet for printing characters in accordance with the signals.

10. In a system of high frequency telegraphy, means to generate continuous oscillations, a control circuit therefor, means for variably modifying said control circuit through each of a definite number of successive definite time intervals for each character signal to thereby transmit energy in corresponding combinations of impulses, means for receiving said impulses, means for amplifying said impulses, a relay actuated by said impulses and a type printer controlled by said relay whereby said impulses select particular characters and cause said characters to be printed.

11. In a system of high frequency telegraphy means for generating continuous oscillations, means for variably modifying the transmission of said oscillations during each of a definite number of successive time intervals for each signal to thereby produce a characteristic succession of impulses, means for receiving said impulses, means for amplifying said impulses and a selective relay operated by said pulses and adapted to control a circuit to an automatic printer having means controlled by said combinations of impulses for selecting characters and causing same to be printed.

12. In a signaling system, a transmission circuit adapted to transmit high frequency oscillations, printer code determining means, a modulator associated with said transmission circuit, means to impress high frequency oscillations of constant amplitude upon said modulator, a transmitting distributor for transmitting to said modulator printer code combinations of impulses determined by said code determining means, means whereby the impulses thus transmitted operate through the circuit of said modulator to determine the transmission to said transmission circuit of high frequency oscillations modified in accordance with said codes combinations, a receiving circuit for receiving such oscillations, means associated with said receiving circuit for translating received high frequencies oscillations into code combinations of impulses corresponding to the original printer code combination, printing means responsive to said printer code combinations to print characters and a receiving distributor for distributing the translated impulses to said printing means.

In testimony whereof, we have signed our names to this specification this 27th day of August 1919.

HERMAN A. AFFEL.
BAXTER P. HAMILTON.