R. D. PARKER AND B. P. HAMILTON.

ALTERNATING CURRENT SIGNALING SYSTEM.

APPLICATION FILED JUNE 26, 1918.

1,383,750.

Patented July 5, 1921.

2 SHEETS—SHEET 1.

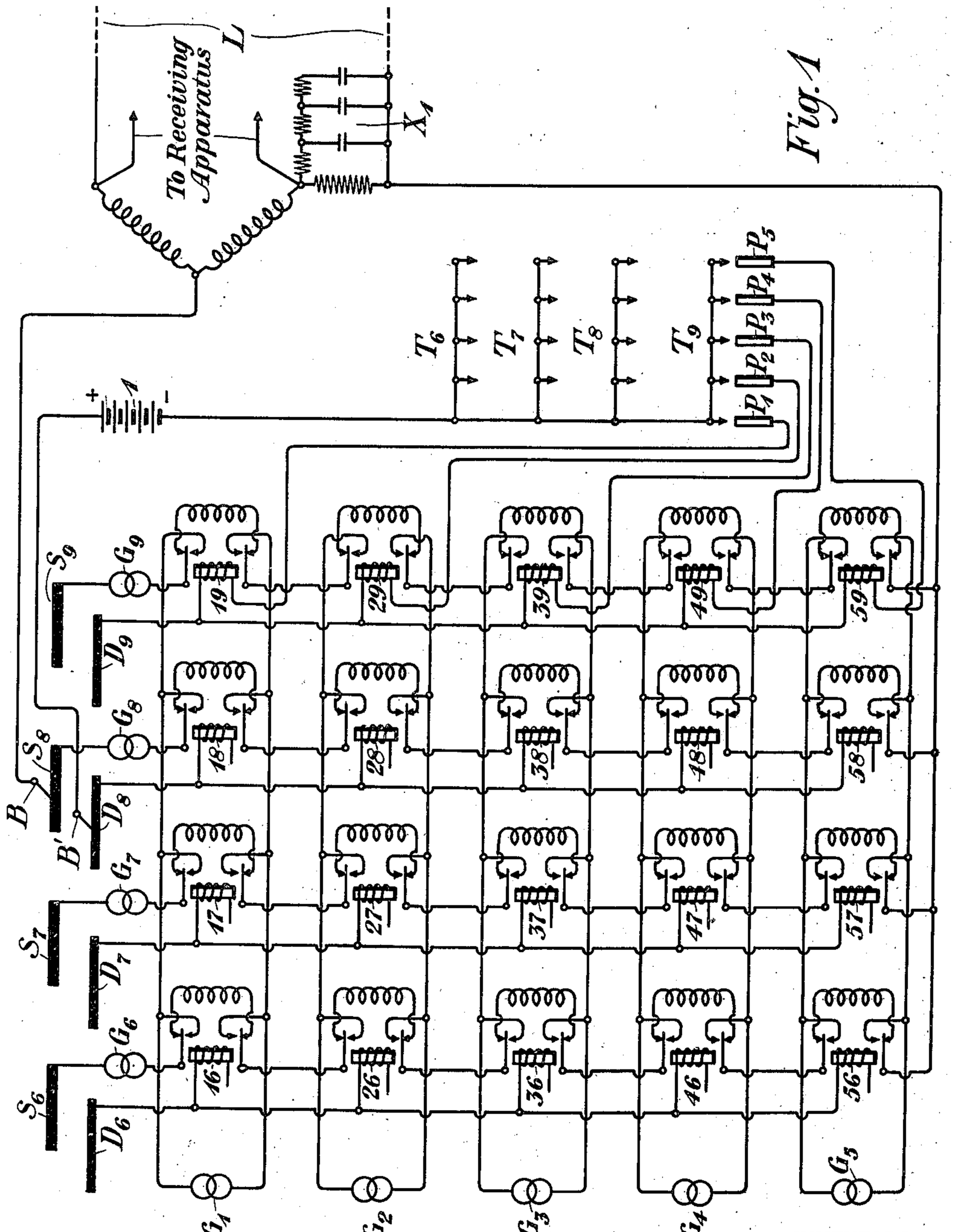

Fig. 1

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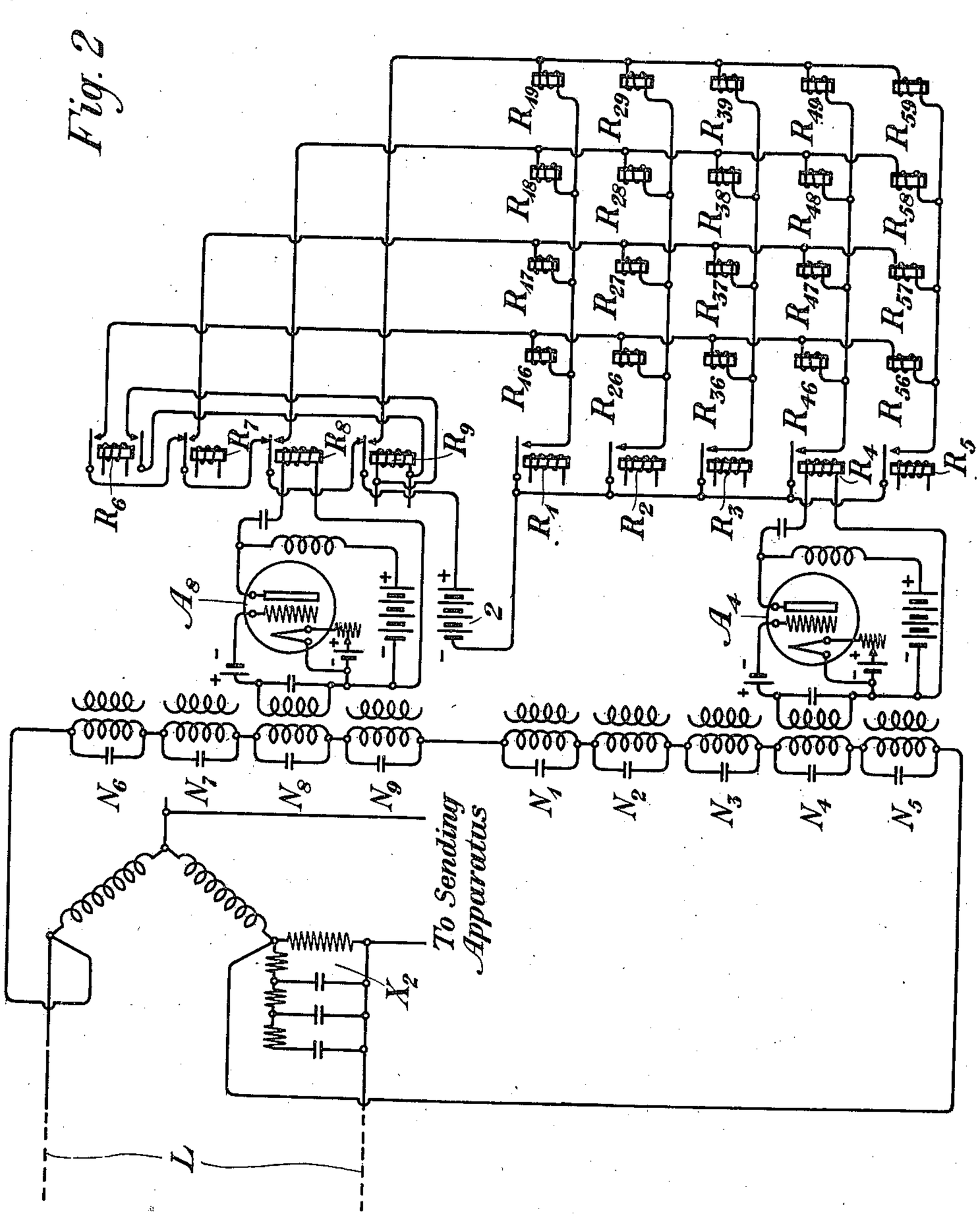
2 SHEETS—SHEET 2.

Fig. 2



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UNITED STATES PATENT OFFICE.

RALZEMOND D. PARKER AND BAXTER P. HAMILTON, OF BROOKLYN, NEW YORK, ASSIGNORS TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ALTERNATING-CURRENT SIGNALING SYSTEM.

1,383,750. Specification of Letters Patent. Patented July 5, 1921.

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To all whom it may concern:

Be it known that we, RALZEMOND D. PARKER and BAXTER P. HAMILTON, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Alternating-Current Signaling Systems, of which the following is a specification.

This invention relates to signaling systems and more particularly telegraph systems in which alternating currents are transmitted from a sending to a receiving station in order to control printing or other translating apparatus.

One object of this invention is to obtain a number of printing or signaling channels from a single circuit, so that the same circuit may be utilized for the transmission of a plurality of messages. Another object is to eliminate the necessity for synchronism between distributers at the ends of the line or circuit. Another object is to provide a signaling system in which under certain conditions a plurality of signaling channels are successively associated with a common transmission circuit without the use of rotating or other moving distributers. Another object is to provide a signaling system in which a main line may be provided with a number of branches leading to intermediate stations without necessitating synchronous distributers at intermediate receiving stations. A further object of the invention is to reduce the time interval necessary for the transmission of a signal combination. Still another object of the invention is the production of a printing system in which the selection of a character depends upon the transmission of a plurality of frequencies either simultaneously or successively, instead of upon the transmission of a succession of impulses of varied characteristics.

The foregoing results are accomplished, and other objects more fully appearing hereinafter are attained, by impressing upon the sending end of a line circuit a plurality of character selecting frequencies together with a channel selecting frequency, and by providing at the receiving end a channel selecting device responsive to the channel selecting frequency or frequencies, together with a plurality of character selecting devices responsive to the character selecting frequencies transmitted, said selecting devices controlling any one of several translating arrangements, depending upon the channel selected. By successively transmitting a plurality of channel selecting frequencies, each accompanied by the corresponding character selecting frequencies, the various channels are successively selected at the receiving station and the character selecting devices will respond to the character selecting frequencies to successively control the translating devices of a plurality of receiving channels. With such an arrangement it is also possible to provide the main line with branches or channels running to intermediate receiving stations provided with channel selecting devices, thereby eliminating the use of synchronized distributers at such stations. By simultaneously applying the several elements of a code combination to the line instead of transmitting them successively the time period necessary for the transmission of each character or signal may also be reduced.

The invention may now be more fully understood from the following description when read in connection with the accompanying drawings, Figure 1 of which constitutes a circuit diagram of a preferred form of transmitting arrangement, and Fig. 2 of which is a circuit diagram of a preferred form of receiving arrangement employed.

Referring to the drawings, the transmitting arrangement shown in Fig. 1 is connected to a line L extending to a distant station at which the receiving arrangement illustrated in Fig. 2 is located. The line L is duplexed in the usual manner, so that signals transmitted from the transmitting arrangement at one station will not affect the receiving apparatus at that station, the line L being balanced at the station of Fig. 1 by a network X_1 and being balanced at the station of Fig. 2 by a network X_2. At the transmitting station a distributer, preferably of the rotating type, is employed, said distributer having segments S_6, S_7, S_8 and S_9, each segment corresponding to one of four signaling channels to be hereinafter described. The distributer is also provided with segments D_6, D_7, D_8 and D_9 for the purpose of controlling local circuits associated with the transmitting channels. A brush B of the distributer is connected to the line L and a brush B′ is connected to a local circuit, said brushes being adapted to rotate successively over segments S_6 to S_9

inclusive and D_6 to D_9 inclusive, respectively.

Transmitters T_6, T_7, T_8 and T_9 are provided for the four signaling channels. These transmitters may be of any well known type and may be either tape actuated or keyboard actuated. Each transmitter comprises five sets of contacts which may be closed in various combinations depending upon the character to be selected. The contacts of the transmitter T_9 only are shown, it being understood that the contacts of all the transmitters are similar.

Associated with each of the channel segments S_6, S_7, S_8 and S_9 is a corresponding source of alternating current G_6, G_7, G_8 and G_9, each source having a frequency which is characteristic of a particular channel, the function of these sources being to select or render operative the corresponding channel at the other end of the line. A series of alternating current sources G_1, G_2, G_3, G_4 and G_5 is also provided for signaling purposes, each source having a different frequency, so that when any combination of signaling frequencies is applied to the line, together with a channel selecting frequency, receiving devices at the distant station and corresponding to the channel responsive to the channel selecting frequency, will be operated.

In order to apply the proper combination of frequencies to the line, four sets of five relays are provided, one set corresponding to each transmitting channel. Thus relays 16, 26, 36, 46 and 56 correspond to the channel associated with segment S_6, relay 16 being adapted to connect alternating current source G_1 to the segment S_6, relay 26 being adapted to connect the alternating current source G_2 to the segment S_6, and so forth. Similarly relays 17, 27, 37, 47 and 57 correspond to the channel associated with segment S_7, relays 18, 28, 38, 48 and 58 correspond to the channel associated with segment S_8 and relays 19, 29, 39, 49 and 59 correspond to the channel associated with segment S_9. Relays 19, 29, 39, 49 and 59, corresponding to the channel associated with segment S_9, have one terminal of each of their windings connected to the segment D_9 of the distributer. The other terminals of the windings are connected to the pin contacts P_1, P_2, P_3, P_4 and P_5 of the transmitter T_9. In a similar manner the other sets of relays are connected to the segments D_8, D_7 and D_6 of the distributer and to the pin contacts of the transmitters T_8, T_7 and T_6. The pin contacts of these three transmitters and the corresponding connections to the relays are omitted in order to avoid complicating the diagram, but it will be understood that the connections are similar to those described in connection with relays 19, 29, 39, 49, and 59.

Normally each transmitting channel extends from its corresponding segment through one of the sources G_6 to G_9 inclusive, and through a series of five impedance coils connected to the back contacts of the corresponding set of five relays, and thence over a common conductor to the network X_1. Upon actuating any transmitter, however, such as the transmitter T_9, certain of the contacts of the transmitter will be closed, and when the brush B′ of the distributer passes over the proper segment such as D_9, certain of the relays such as 19, 29, 39, 49 and 59, corresponding to the actuated contacts of the transmitter, will be energized to disconnect the corresponding inductances from the channel and substitute therefor a corresponding combination of the generators G_1 to G_5 inclusive. Consequently when the brush B passes over the corresponding channel segment such as S_9, a plurality of alternating currents from a combination of the generators G_1 to G_5 inclusive and a generator such as G_9 corresponding to the channel, will be impressed upon the line.

The brushes B and B′ are so arranged with respect to the corresponding channel and local segments of the distributer that the brush B′ makes contact with the local segment before the brush B makes contact with the corresponding channel segment. This is for the purpose of energizing the signal controlling relays of the generators before the channel is associated with the line to avoid the transient effects which would be produced by the opening and closing of the line due to the operation of any signal controlling relays after the brush B makes contact with the channel segment. The combination of frequencies from generators G_1 to G_5 inclusive is on the line until the brush B′ opens the circuit of the signaling relays of the channel upon leaving the corresponding local segment. Brush B then disconnects the line from the channel segments before the signal controlling relays can close the line again through their back contacts and the impedances associated with each relay to avoid transient effects similar to those mentioned above. By this arrangement the transmitters T_6, T_7, T_8 and T_9 may be operated either simultaneously or in any order, without any interference of signals, as the combination of frequencies determined by the actuation of any transmitter is not impressed upon the line until the brushes of the distributer pass over the segments of the channel corresponding to that transmitter.

At the receiving station shown in Fig. 2 a loop is bridged across the line in which receiving units N_6, N_7, N_8 and N_9 are included for selecting the proper receiving channel,

selecting units N_1, N_2, N_3, N_4 and N_5 being also included in the loop for selectively determining the signal to be received by any channel. A preferred arrangement of each selective receiving unit consists of a condenser and an inductance in parallel, the units being so tuned as to be selective of different frequencies. Thus units N_6 to N_9, inclusive are selective of the frequencies transmitted over the line from alternating current sources G_6 to G_9, inclusive, respectively. Similarly, the units N_1 to N_5, inclusive, are responsive to the frequencies transmitted from the alternating current sources G_1 to G_5, inclusive, respectively.

The receiving apparatus is further provided with a plurality of selective relays divided into four groups or sets of five relays each, each set of relays corresponding to one receiving channel. Thus relays R_{16}, R_{26}, R_{36}, R_{46} and R_{56} are associated with the first receiving channel which corresponds to the transmitting channel associated with the distributer segment S_6. In a similar manner relays R_{17} to R_{57} are associated with the second receiving channel, relays R_{18} to R_{58}, inclusive, are associated with the third receiving channel and relays R_{19} to R_{59}, inclusive, are associated with the fourth receiving channel. Each set of relays is adapted to be selectively operated to control a receiving printer unit which may be of any well known type and as it forms no part of the present invention, is not illustrated.

In order to determine which set of selective relays is to be operated, relays R_6, R_7, R_8 and R_9 are provided, these relays being associated with the tuned receiving units N_6, N_7, N_8 and N_9 preferably through transformers. Relays R_6 to R_9, inclusive, may be direct current relays associated with the receiving units N_6 to N_9, inclusive, through detectors, or they may be alternating current relays connected with the corresponding receiving units either directly through a transformer or indirectly through an amplifier. In order to simplify the diagram the connection for the relay R_8 only is shown, this relay being included in the output circuit of a vacuum tube amplifier A_8 of well known type, the input or grid circuit of which is inductively associated with the tuned receiving unit N_8. It will be understood, however, that the remaining relays R_6, R_7, and R_9 will be connected in the same way as the relay R_8.

In order to determine which selector relays of a given set are to be operated, relays R_1, R_2, R_3, R_4 and R_5 are provided. These relays, like the relays R_6 to R_9, inclusive, may be either direct or alternating current relays, but, as indicated in the case of the relay R_4, these relays are associated with the output circuits of vacuum tube amplifiers, such as A_4, the input or grid circuits of which are coupled through transformers to the corresponding tuned receiving units, such as N_4.

By means of this arrangement when a combination of frequencies, consisting of a plurality of selecting frequencies upon which is superposed a channel determining frequency, is transmitted over the line L, one of the relays R_6 to R_9, inclusive, corresponding to the channel determining frequency, is actuated to connect one pole of the battery 2 to the corresponding set of selector relays, while certain of the relays R_1 to R_5, inclusive, corresponding to the selecting frequencies are operated to connect the other terminal of the battery to individual relays of the set. As the brush B of the distributer at the transmitting station rotates over the channel segments S_6 to S_9, inclusive, the channel selecting relays R_6 to R_9, inclusive, are operated successively.

Relays R_7, R_8 and R_9 have their contacts so arranged that upon the operation of any one of these relays the circuit completed from one terminal of the battery 2 to the previously selected set of selector relays will be opened. This arrangement is provided for the purpose of avoiding the interference which would occur if the preceding channel selecting relay should happen to be slow in releasing. The relay R_6, which is always operated just after the relay R_9, has its contacts so arranged as to short circuit the relay R_9 so as to insure that said relay will be deenergized immediately to open the circuit previously closed for the last set of selector relays and complete the connection from the battery 2 over the several channel selector relays in series to the first set of selector relays.

The apparatus employed in connection with the invention will now be fully understood from a description of the operation. Assuming that the transmitter T_9 is actuated, thereby closing its contacts P_1, P_3 and P_5 to determine the character to be printed, as the brushes of the distributer rotate over the segments, channel selecting and character selecting frequencies will be transmitted to the line L as determined by the operation of the transmitters corresponding to each channel. As the brush B^1 makes contact with the segment D_9, corresponding to the fourth transmitting channel, a circuit will be closed from the positive terminal of battery 1 over brush B^1 segment D_9 and thence in parallel through the windings of relays 19, 39 and 59, and over the contacts P_1, P_3 and P_5 to the negative terminal of the battery. Relays 19, 39 and 59 are thereby energized to disconnect the corresponding impedance coils from the fourth transmitting channel and connect the alternating current sources G_1, G_3 and G_5 to said channel over the front contacts of said relays. As soon

as the brush B makes contact with the channel segment S_9, which occurs immediately after the energization of the relays 19, 39 and 59, the fourth channel is connected to the line L over the following circuit:

From line L, over the brush B, segment S_9, alternating current source G_9, upper front contact of relay 19, alternating current source G_1, lower front contact of relay 19, upper back contact of relay 29, through the impedance coil controlled by relay 29, lower back contact of relay 29, upper front contact of relay 39, alternating current source G_3, lower front contact of relay 39, upper back contact of relay 49, through the impedance coil corresponding to relay 49, lower back contact of relay 49, upper front contact of relay 59, alternating current source G_5, lower front contact of relay 59 to the network X_1.

A plurality of frequencies corresponding to alternating current sources G_9, G_1, G_3 and G_5 are now transmitted over the line L to the receiving arrangement shown in Fig. 2. The tuned receiving unit N_9, which is selective of the frequency generated by the alternating current source G_9, selects this frequency and transmits it through an amplifier (not shown), to the alternating current relay R_9, which is energized to disconnect the positive terminal of the battery 2 from the third set of selector relays if it had not been already disconnected therefrom by the deënergization of the relay R_8, and connect said terminal of the battery over the front contact of relay R_9 to the fourth set of selector relays. At the same time tuned receiving units N_1, N_3 and N_5, which are selective of the frequencies generated by alternating current sources, G_1, G_3 and G_5, transmit said frequencies to the alternating current relays R_1, R_3 and R_5 through amplifiers (not shown). Relays R_1, R_3 and R_5 are energized and connect the negative terminal of battery 2 to selector relays 19, 39, and 59. These three selector relays are now operated and control the selection of a character to be printed in a well understood manner.

As soon as the brush B^1 of the transmitting distributer leaves the segment D_9, the relays 19, 39, and 59 are deënergized to disconnect the corresponding alternating current sources from the fourth transmitting channel, and the brush passes to the segment D_6 to close a circuit of a combination of the relays 16 to 56, inclusive, determined by the transmitter T_6. The brush B as it passes from the segment S_9 disconnects the fourth transmitting channel from the line and the brush passes on to the segment S_6 to connect the first transmitting channel to the line. As soon as the brush B leaves the segment S_9, the combination of frequencies which had been impressed upon the line in response to the actuation of the transmitter T_9, no longer actuates the alternating current relays R_9, R_1, R_3 and R_5 and these relays are restored to normal with the consequent deenergization of selector relays R_{19}, R_{39} and R_{59}.

It will be understood that any convenient frequency range may be used with this system so long as the frequencies are sufficiently far apart to avoid interference and so long as the lower limit of the range is not so low as to reduce the working speed materially. It will be further understood that the general principles herein disclosed may be embodied in other organizations widely differing from that 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 sending station, a receiving station, a transmission circuit interconnecting said stations, a plurality of signaling channels at said sending station, means to successively associate said channels with said transmission circuit, corresponding channels at the receiving station permanently associated with said transmission circuit, and means at the sending station to transmit currents having different characteristics for each channel as successive channels are associated with the transmission circuit and means at the receiving station responsive to said currents to select the corresponding receiving channels.

2. In a signaling system, a sending station, a receiving station, a transmission circuit interconnecting said stations, a plurality of signaling channels at said sending station, means to successively associate said channels with said transmission circuit, means to associate with said transmission circuit currents of frequencies corresponding to said channels, there being a different frequency for each channel, channels permanently associated with said transmission circuit at the receiving stations and corresponding one to each of said channels at the sending station, and means at the receiving station responsive to the frequency corresponding to each channel at the sending station to select the corresponding channel at the receiving station.

3. In a signaling system, a sending station, a receiving station, a transmission circuit interconnecting said stations, a plurality of signaling channels at said sending station, a source of current variations associated with each channel for generating currents of different frequencies for each channel, means to successively associate the channels and the corresponding sources with the transmission circuit, a plurality of channels permanently associated with the transmission circuit at the receiving station, one corresponding to each channel at the send-

ing station, and means responsive to the frequency corresponding to each channel at the sending station to select the corresponding channel at the receiving station.

4. In a signaling system, a sending station, a receiving station, a transmission circuit interconnecting said stations, a plurality of signaling channels at said sending station, a source of channel selecting frequency associated with each channel, means to successively associate said channels with said transmission circuit, means to apply to each channel a combination of character selecting frequencies when it is associated with said transmission circuit, a plurality of sets of character selecting devices at the receiving station, one set corresponding to each channel at the sending station, and means responsive to the channel selecting frequency transmitted when a given channel is associated with the transmission line to render the corresponding set of character selecting devices responsive to the character selecting frequencies transmitted.

5. In a signaling system, a sending station, a receiving station, a transmission circuit interconnecting said stations, means at the sending station to successively apply channel selecting frequencies to the transmission circuit and to apply thereto simultaneously with each channel selecting frequency various combinations of character selecting frequencies, a plurality of sets of character selecting devices at the receiving station, and means at the receiving station responsive to a channel selecting frequency transmitted at a given time to render the set of character selecting devices corresponding to the channel selecting frequency transmitted responsive to the combination of character selecting frequencies transmitted simultaneously therewith.

6. In a signaling system a transmission line, a plurality of signaling channels, a source of current individual to each channel, each source having frequency characteristics different from those of the other sources, and means to successively associate said channels with said line to apply current from said sources to the line.

7. In a signaling system, a transmission line, a plurality of signaling channels, a plurality of sources of current common to said channels, a source of current individual to each channel, means to successively associate said channels with said line, and means to successively associate said individual source and various combinations of said common sources with said channels as they are associated with the line.

8. In a signaling system, a transmission line, a plurality of signaling channels, a plurality of sources of current of different frequencies common to said channels, a source of current individual to each channel, means to successively associate said channels with said line, and means to successively associate said individual sources and various combinations of said common sources with said channels as they are associated with the line.

9. In a signaling system, a transmission line, a plurality of signaling channels each having a channel selecting source of current of characteristic frequency individual thereto, a plurality of sources of current of different frequencies common to said channels, means to successively associate said channels with said line, and means to associate various combinations of said common sources with each channel when it is associated with the line.

10. In a signaling system, a transmission line, a plurality of signaling channels, a plurality of sources of current of different frequencies common to said channels and adapted to be associated with said channels in accordance with various code combinations, a source of current individual to each channel, means to successively associate said channels with said line, a plurality of code controlling arrangements, one corresponding to each channel, and means operating as the channels are associated with the line to successively associate said individual sources and common sources with said channel in accordance with code combinations determined by the corresponding code controlling arrangements.

11. In a signaling system, a transmission line, a plurality of signaling channels, a plurality of sources of current of different frequencies common to said channels and adapted to be associated with said channels in accordance with various code combinations, means to successively associate said channels with said line, a plurality of code controlling devices one corresponding to each channel, a plurality of sets of relays, one set corresponding to each channel and the relays in each set corresponding to said current sources, and means operating immediately before a given channel is associated with the line to operate a combination of the relays of the corresponding set determined by the corresponding code forming device, whereby a combination of said sources will be associated with the channel.

12. In a signaling system, a transmission line, a plurality of signaling channels, a plurality of sources of current of different frequencies common to said channels and adapted to be associated with said channels in accordance with various code combinations, means to successively associate said channels with said line, a plurality of code controlling devices one corresponding to each channel, a plurality of sets of relays, one set corresponding to each channel and

the relays in each set corresponding to said current sources, means whereby when a given channel is associated with the line, a combination of the relays of the corresponding set is operated to associate the current sources with the channel in a combination determined by the corresponding code controlling device, and means to restore said relays before the channel is disconnected from the line.

13. In a signaling system, a transmission circuit over which a plurality of frequencies may be simultaneously transmitted, a plurality of groups of selecting devices, means associated with said line and responsive to certain frequencies to select a group of selecting devices and means associated with said line and responsive to other frequencies to operate various combinations of devices of the group selected.

14. In a signaling system, a transmission circuit over which a plurality of frequencies may be simultaneously transmitted, a plurality of sets of selecting devices, a plurality of relays associated with said line each responsive to a definite frequency, certain of said relays operating to select a set of selecting devices and other of said relays operating to actuate various combinations of selecting devices of the set selected.

15. In a signaling system, a transmission circuit over which a plurality of frequencies may be simultaneously transmitted, a plurality of sets of translating devices, a plurality of frequency responsive devices associated with said line and each responsive to a definite frequency, certain of said frequency responsive devices operating to select a set of translating devices, and others of said frequency responsive devices operating to actuate various combinations of translating devices of the set.

16. In a signaling system, a transmission circuit over which a plurality of frequencies may be simultaneously transmitted, a plurality of sets of selecting devices, a plurality of relays associated with said line each responsive to a definite frequency, devices for amplifying and detecting frequencies transmitted from said line to each relay, certain of said relays operating to select a set of selecting devices and other of said relays operating to actuate various combinations of selecting devices of the set selected.

17. In a signaling system, a transmission circuit over which a plurality of frequencies may be simultaneously transmitted, a plurality of sets of selecting devices, a plurality of tuned units in said line, each unit comprising a capacity and inductance in parallel, and each unit being tuned to a definite frequency, frequency responsive means associated with each tuned unit, certain of said frequency responsive means operating to select a set of selecting devices and other of said frequency responsive means operating to actuate selecting devices of the set selected.

18. In a signaling system, a transmission line, a plurality of transmitting channels normally disconnected therefrom, a plurality of receiving devices, one corresponding to each transmitting channel and normally unconditioned to receive signals transmitted over said line, and means individual to each receiving device and responsive to the connection of a transmitting channel to the line to condition the corresponding receiving device to receive signals regardless of whether or not signals are transmitted from said channel.

19. In a signaling system, a transmission line, a plurality of transmitting channels associated therewith, means to impress upon said line frequencies characteristic of each channel, a plurality of receiving devices one corresponding to each transmitting channel and normally unconditioned to receive signals, and means responsive to the frequency characteristic of a particular transmitting channel to condition the corresponding signaling apparatus to receive signals regardless of whether or not signals are transmitted.

20. In a signaling system, a transmission line, a plurality of transmitting channels associated therewith, means associated with each channel to transmit signals over said line, a receiving device corresponding to each transmitting channel and normally unconditioned to receive signals transmitted over the line, means to impress upon the line frequencies characteristic of each channel, and means responsive to such frequencies to condition the receiving devices to receive signals regardless of whether or not signals are transmitted.

21. In a signaling system, a transmission line, a plurality of transmitting channels associated therewith, means associated with each channel to impress upon the line a frequency characteristic of the channel and a plurality of signaling frequencies, receiving devices associated with the line one corresponding to each transmitting channel, and selective means whereby each receiving device will respond to signaling frequencies transmitted from the corresponding transmitting channel only when the frequency characteristic of that channel is impressed upon the line.

In testimony whereof, we have signed our names to this specification this eighteenth day of June, 1918.

RALZEMOND D. PARKER.
BAXTER P. HAMILTON.