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REPEATER FOR MULTIPLEX SYSTEMS

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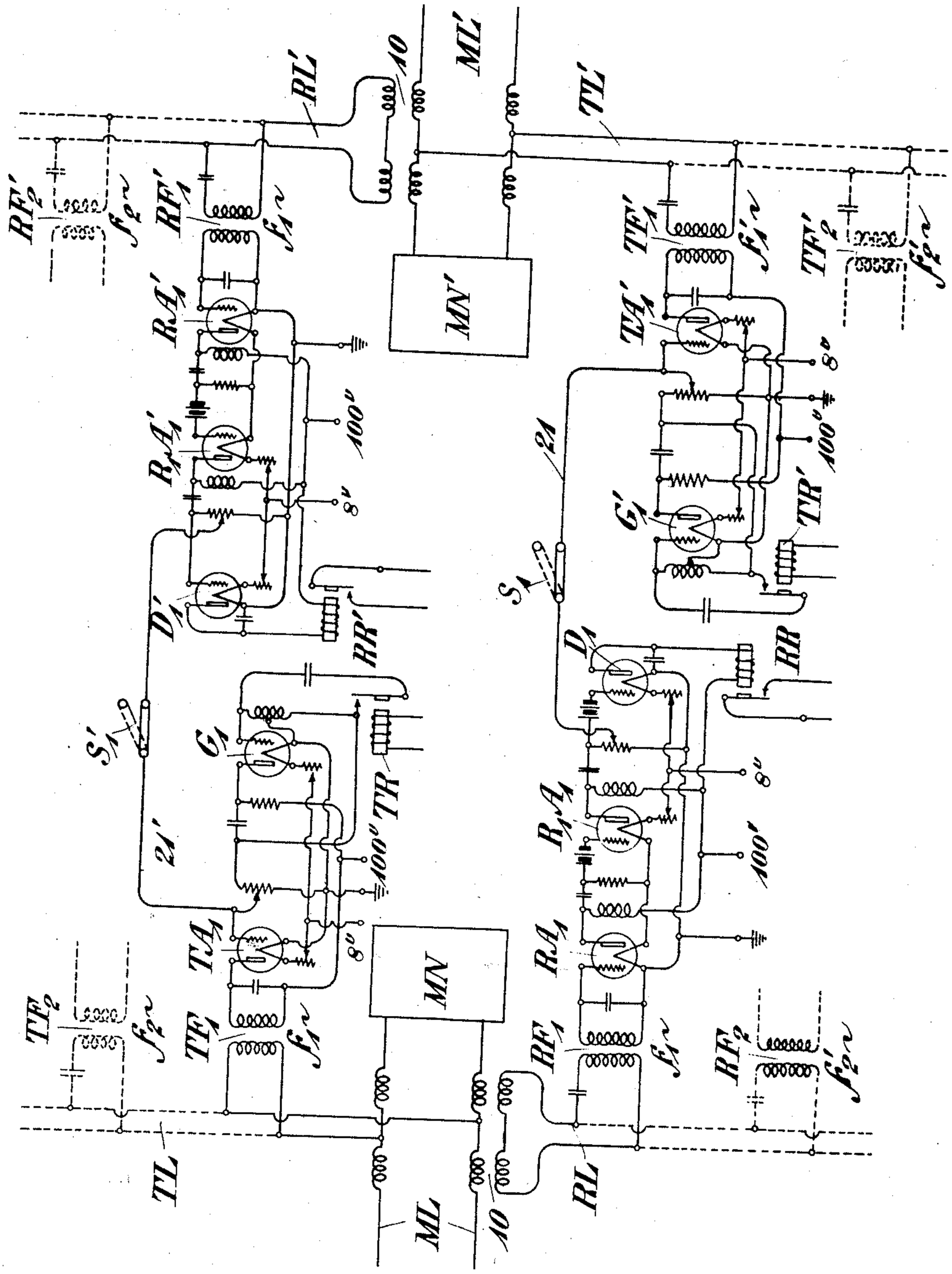

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REPEATER FOR MULTIPLEX SYSTEMS.

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To all whom it may concern:

Be it known that I, HERMAN A. AFFEL, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Repeaters for Multiplex Systems, of which the following is a specification.

This invention relates to multiplex signaling systems and more particularly to repeater arrangements for such systems.

One of the features of the invention resides in the provision of a repeater arrangement for a multiplex carrier system in which separate amplifiers are provided for amplifying each carrier frequency.

Another feature of the invention resides in the provision of a repeater arrangement for a multiplex carrier system in which a plurality of oppositely directed transmissions may simultaneously take place, the repeater arrangement being so organized that separate amplifiers will be provided for each carrier frequency in each direction.

Another feature of the invention resides in the provision of a repeater arrangement of the character described in the preceding paragraph, in which provision is made to separate oppositely directed transmissions into the proper group of amplifiers and to further separate the different frequencies of the group of one-way transmissions, in order that they may be applied to the proper amplifiers for amplification.

Still another feature of the invention resides in so arranging the transmitting channels associated with one outgoing line and the receiving channels associated with another incoming line at an intermediate station that the transmitting and receiving channels may be interconnected so that the amplifiers associated with the channels may constitute one-way repeaters for amplifying through carrier transmissions.

These features are realized in the organization set forth in the following description and illustrated in the accompanying drawing, the figure of which constitutes a circuit diagram of one embodiment of the invention.

In the drawing, ML and ML′ designate two carrier transmission lines entering an intermediate station, which may be either a terminal station for signaling in opposite directions, or a through repeater station for amplifying signals transmitted from one line to the other. A common transmitting circuit TL and a common receiving circuit RL are associated with the main line ML through a balanced transformer 10 and these circuits are rendered substantially conjugate by the provision of a balancing network MN, for balancing the main line ML. Similarly a common transmitting circuit TL′ and a common receiving circuit RL′ are associated with the main line ML′ through a balanced transformer 10′, an artificial line MN′ being provided for balancing the main line ML′.

A plurality of transmitting channels may be associated with the common transmitting circuit TL through filters such as TF_1 and TF_2. These filters may be of any desired character, such as tuned circuits resonant to the carrier frequency which it is desired to transmit. Similarly a plurality of receiving channels may be associated with the common receiving circuit RL through filters or tuned circuits such as RF_1 and RF_2, the tuned circuits being resonant to the carrier frequency which it is desired to receive in a particular channel. In a like manner the transmitting circuit TL′ is associated with transmitting channels through tuned circuits TF_1' and TF_2', while the receiving circuit RL′ is associated with receiving channels through tuned circuits such as RF_1' and RF_2'.

In order to supplement the separation between oppositely directed channels, which results from rendering the common transmitting and receiving circuits conjugate by means of the balancing artificial line, it may be desirable that the frequencies used for transmission in opposite directions should be different. The filters TF_1 and TF_2 are therefore indicated as being resonant at frequencies f_1 and f_2, respectively while the corresponding filters RF_1 and RF_2 in the receiving channels are indicated as being resonant at frequencies f_1' and f_2'. The filters TF_1' and TF_2', associated with the transmitting channels of the main line

ML′, may have assigned to them the same frequencies as filters RF_1 and RF_2, so also frequencies f_1 and f_2 corresponding to the frequencies to which the filters TF_1 and TF_2 are resonant may be assigned to the filters RF_1' and RF_2' associated with the receiving channels of the line ML′.

The transmitting channel related to the filter TF_1 includes a vacuum tube oscillator G_1 of well-known type, the circuit of which is controlled by a transmitting relay TR, so that telegraph signals may be translated into successions of trains of oscillations generated by the oscillator G_1. The frequency of this oscillator, of course, will correspond to the frequency of the filter TF_1. An amplifier TA_1 is also included in the channel, for amplifying the carrier frequencies to be transmitted. This amplifier may be of any wellknown type, but is illustrated as a vacuum tube amplifier.

The receiving channel associated with the filter RF_1 includes vacuum tube amplifiers RA_1 and R_1A_1 for amplifying received carrier frequencies and a detector D_1 for translating the received frequencies into telegraph signals. The detector may be of any well-known type, but is illustrated as a vacuum tube detector having in its output circuit receiving relay RR for repeating the received telegraphic signals into a local receiving circuit.

Similarly the channel associated with the filter TF_1' includes an oscillator G_1' controlled by a transmitting relay TR′ and an amplifier TA_1', while the receiving channel associated with the filter RF_1' includes vacuum tube amplifiers RA_1', R_1A_1' as well as a detector D_1' having in its output circuit a relay RR′. The circuits of the various vacuum tube arrangements shown are all well known in the art and need not be further described. It will be understood that similar apparatus will be associated with each of the other channels.

By means of the apparatus above described multiplex transmission may take place in either direction between the station illustrated and a distant station, over the line ML, and likewise two-way multiplex transmission may take place over the line ML′ between the station illustrated and another distant station. In order that the apparatus illustrated may be used for through repeating in connection with multiplex transmission taking place between the two distant stations over the lines ML and ML′ in tandem, means are provided for interconnecting corresponding transmitting and receiving channels of the two lines, thus a connection 21 may be provided between the output circuit of the amplifier R_1A_1 of the receiving channel associated with the filter RF_1 and the input circuit of the amplifier TA_1' of the transmitting channel associated with the filter TF_1'. This connection may be closed by means of a switch S_1. It will be noted that this connection does not disable the detector D_1, but merely diverts some of the output energy from the amplifier R_1A_1 to the amplifier TA_1'. The detector, therefore, still functions to record at the intermediate station the low frequency signals, while the high frequency carrier currents may be amplified by the amplifiers RA_1, R_1A_1, TA_1' and transmitted from the line ML to the line ML′. When thus operated on a repeater basis, the generator G_1 should be inoperative. Since the generator does not oscillate except when the transmitting relay TR′ is actuated, by merely leaving the circuit of the transmitting relay TR′ open the generator will be, in effect, disabled.

A similar connection 21′ is provided between the amplifier R_1A_1' and the amplifier TA_1, for repeating in the opposite direction, said connection including a switch S_1'. It will be understood, of course, that similar connections may be made between other transmitting and receiving channels which have assigned to them the same frequency.

Where the system is to be operated on a terminal basis, the switches such as S_1 and S_1' will be open. By operating the transmitting relay TR′, successive groups of carrier oscillations will be generated by the generator G_1', amplified by the amplifier TA_1' and transmitted through the filter TF_1' to the common transmitting circuit TL′. Similarly carrier frequencies from the other transmitting channels may be simultaneously imposed upon the circuit TL′ and the several carrier frequencies transmitted over the line ML′ to the distant station. Incoming carrier frequencies transmitted from the distant station will pass through the transformer 10′ to the common receiving circuit RL′ and the frequencies will then be separated into the proper receiving channels by the filters such as RF_1' and RF_2'. The frequency passed through the filter RF_1' is amplified by the amplifiers RA_1' and R_1A_1' and is then detected or translated into low frequency signaling impulses by means of the detector D_1', so that the receiving relay RR′ in the output circuit of the detector responds to the resultant direct current impulse and repeats said impulse to the local receiving circuit. Similarly outgoing transmissions may take place from the common transmitting circuit TL and over the main line ML to a distant terminal station, while incoming transmissions from such station will be received by the common receiving circuit RL. As these operations will be similar to those already described, no further description is necessary.

When it is desired to operate the appa-

ratus at the station illustrated, upon a through repeater basis, the switches such as S_1 and S_1' will be closed. Referring to the circuit 21, it will be seen that a high frequency connection extends from the plate of the amplifier R_1A_1 over the conductor 21 to the input or grid of the amplifier TA_1'. The return circuit is through the ground, as the filaments of both tubes are connected to ground. This connection acts as a shunt about the detector D_1. The circuit of the transmitting relay TR_1' should now be maintained open, so that the generator G_1' is inactive.

With the circuit in this condition, high frequency carrier currents incoming from the line ML are transmitted through the transformer 10 to the common receiving circuit RL and the various frequencies are selected by means of the filters RF_1, RF_2, etc. into the proper channels. The frequency passed through the filter RF_1 is amplified by the amplifiers RA_1 and R_1A_1 and part of the high frequency energy is then transmitted over the path 21 to the amplifier TA_1', said energy being further amplified by said amplifier TA_1' and transmitted through the filter TF_1' and over the circuit TL' to the main line ML'. Some of the high frequency energy from the output circuit of the tube T_1A_1 is also impressed upon the detector D_1 and is thereby translated into low frequency signals to actuate the receiving relay RR, so that the signals which are imposed upon the repeated carrier transmission may be recorded at the repeater station. This provides a simple method of monitoring the action of the repeaters.

The action of the channels interconnected through the switch S_1', as well as the remaining channels which are not illustrated, will be similar to that already described and need not be further referred to.

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

What is claimed is:

1. In a signaling system, a transmission line, means for simultaneously transmitting in one direction over said line a plurality of signals by means of carrier currents of a plurality of different frequencies, means for simultaneously transmitting in the opposite direction over said line a plurality of signals by means of carrier currents of a plurality of different frequencies, a one-way repeater in said line at an intermediate point for each carrier frequency transmitted in one direction, selective means on the input side of each repeater for selecting thereto the carrier frequency to be amplified thereby, and selective means on the output side of said repeater for preventing carrier frequencies transmitted in the opposite direction from being by-passed into said repeater, a one-way repeater in said line at an intermediate point for each carrier frequency transmitted in the opposite direction, a selective means on the input side of each repeater for selecting the carrier frequency to be amplified thereby, and a selective device on the output side of each repeater for preventing carrier currents transmitted in said first mentioned direction from being by-passed into said repeater.

2. In a signaling system, a transmission circuit over which a plurality of carrier frequencies may be transmitted, means for impressing signals on each carrier frequency, a one-way amplifier corresponding to each carrier frequency associated with said transmitting circuit at an intermediate point, selective means associated with the input side of each amplifier for selecting thereto the carrier frequency to be amplified, and selective means on the output side of each amplifier to prevent energy of other carrier frequencies from being by-passed into said repeater.

3. In a signaling system, a transmission circuit over which a plurality of alternating carrier currents may be simultaneously transmitted in opposite directions, means for impressing signals on each carrier current, a one-way amplifier for each carrier frequency transmitted, said amplifier being associated with said transmission circuit at an intermediate point, a selective circuit associated with the input side of each amplifier for selecting thereto a single carrier frequency transmitted in its direction of transmission, and selective devices associated with the output side of each amplifier for preventing carrier currents of other frequencies from being by-passed into the output of the amplifier.

4. In a signaling system, a transmission circuit over which a plurality of carrier frequencies may be simultaneously transmitted in the opposite direction, a group of repeaters in said circuit at an intermediate point for amplifying the carrier frequencies transmitted in one direction, a second group of repeaters for amplifying the various carrier frequencies transmitted in the opposite directions, means to separate the oppositely directed transmissions and apply them to the proper group of repeaters, and selective means to separate the various carrier frequencies and apply them to the proper amplifier of the group.

5. In a signaling system, a pair of transmission lines over which a plurality of carrier currents may be transmitted, an intermediate station at which said lines terminate, a plurality of channels for superposing a plurality of signals from said inter-

mediate station upon one of said lines for transmission to a distant station, a plurality of channels for receiving at said intermediate station a plurality of carrier frequencies transmitted over the other of said lines from another distant station, means associated with each of said first mentioned channels for translating low frequency signals into carrier frequencies, and means associated with said first mentioned channels for amplifying the carrier frequencies, means associated with said second mentioned channels for amplifying received carrier frequencies, means associated with said channels for translating the carrier frequencies into low frequency signaling currents, and means whereby the two sets of channels may be directly connected independently of said translating means, whereby the interconnected channels constitute through amplifiers for amplifying carrier currents transmitted from a distant station through said intermediate station to another distant station.

6. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, a plurality of transmitting channels associated at said intermediate station with one of said lines, a plurality of receiving channels associated at said intermediate station with the other of said lines, means associated with each transmitting channel for translating low frequency signals into carrier currents, detecting means associated with each receiving channel, amplifying means associated with at least one of said sets of channels and means for directly interconnecting the transmitting and receiving channels independently of said translating and detecting means, whereby the interconnected channels with their associated amplifiers constitute through repeaters for carrier frequencies transmitted from one distant station, through said intermediate station, to another distant station.

7. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, a plurality of transmitting channels associated at said intermediate station with one of said lines, a plurality of receiving channels associated at said intermediate station with the other of said lines, means associated with each transmitting channel for translating low frequency signals into carrier currents, detecting means associated with each receiving channel, amplifying means associated with at least one of said sets of channels, and means for directly interconnecting the transmitting and receiving channels independently of said translating and detecting means, without disabling said detectors, whereby said interconnected channels with the associated amplifiers constitute through repeaters for amplifying carrier currents transmitted from one distant station, through said intermediate station, to another distant station, while said detectors record the signals at the intermediate station.

8. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, means for transmitting a plurality of alternating carrier currents over said lines between said distant stations, each carrier current being transmitted from one distant station to the other at the same frequency throughout, means to impress signals upon each carrier current at one of said distant stations for transmission to the other, and means at said intermediate station for impressing signals upon said carrier currents at said intermediate station for transmission to said distant stations.

9. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, a plurality of alternating carrier current channels for signaling over said lines between said distant stations, each channel employing a carrier of the same frequency throughout the entire path from one distant station to the other, and means at said intermediate station for impressing signals upon each of said carrier currents at said intermediate station for transmission over said carrier channels to said distant stations.

10. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, a plurality of alternating carrier current channels for signaling over said lines between said distant stations, each of said channels employing alternating carrier currents of the same frequency throughout the entire path from one distant station to the other, and means at said intermediate station for impressing signals upon said carrier currents at said intermediate station for transmission in either direction to the distant terminal stations over each of said carrier channels.

11. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, means whereby a plurality of alternating carrier currents may be transmitted between said distant stations over said transmission lines, each alternating carrier current being transmitted at the same frequency from one distant station to the other, an amplifying repeater for said alternating carrier currents at said intermediate station, said repeater amplifying each of said alternating carrier currents without change in frequency, and means at said intermediate station for impressing signals upon said carrier channels through said repeater.

12. In a signaling system, an intermediate station, a pair of transmission lines extending in opposite directions to distant stations, a plurality of alternating carrier current channels superposed on said transmission lines for multiplex communication between said distant stations, each channel transmitting the same carrier frequency throughout the entire path from one distant station to the other, an amplifying repeater for said carrier channels at said intermediate station, and means at said intermediate station for impressing signals upon said carrier channels through said repeater.

In testimony whereof, I have signed my name to this specification this 29th day of September, 1919.

HERMAN A. AFFEL.