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COMMUNICATION WITH MOVING VEHICLES

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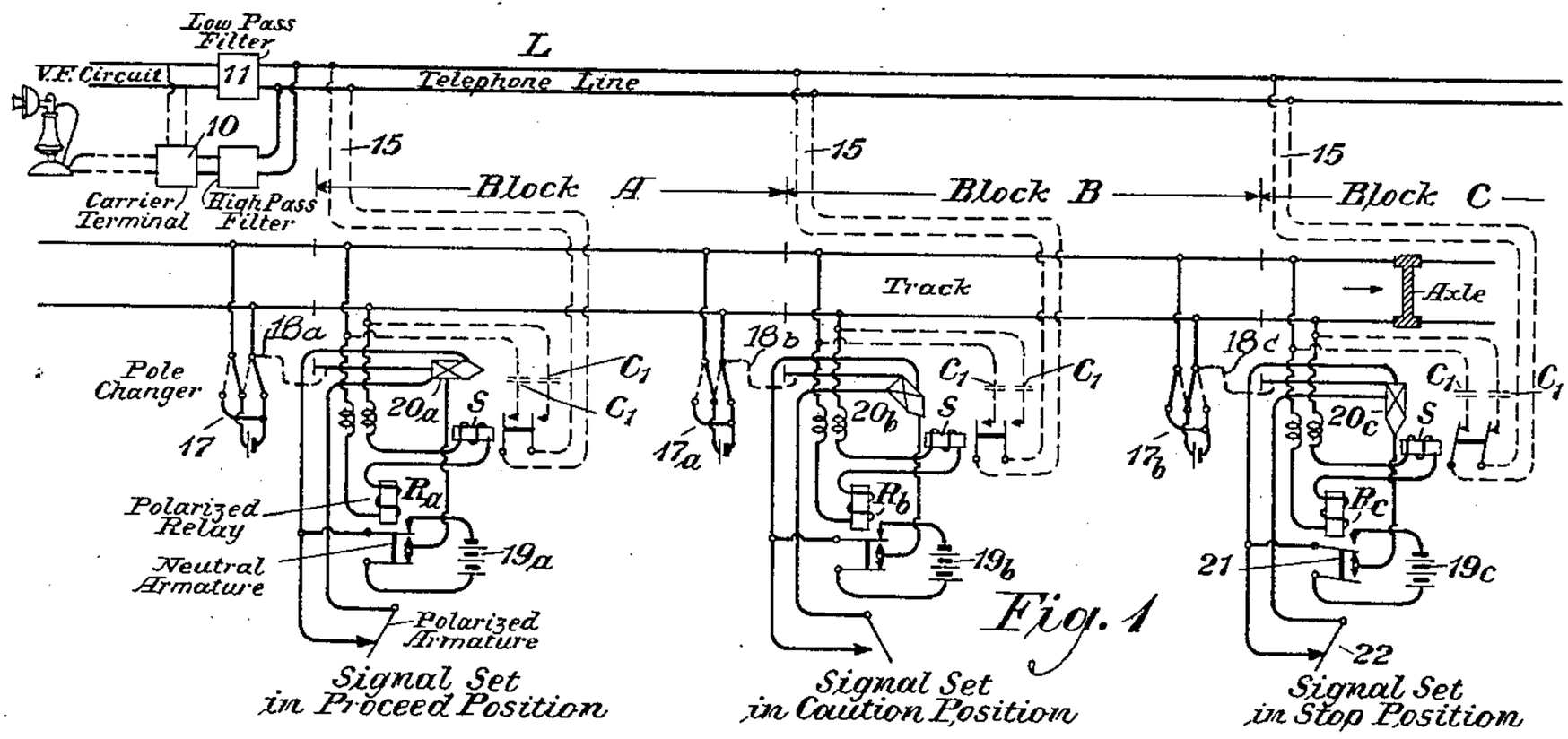

Fig. 1

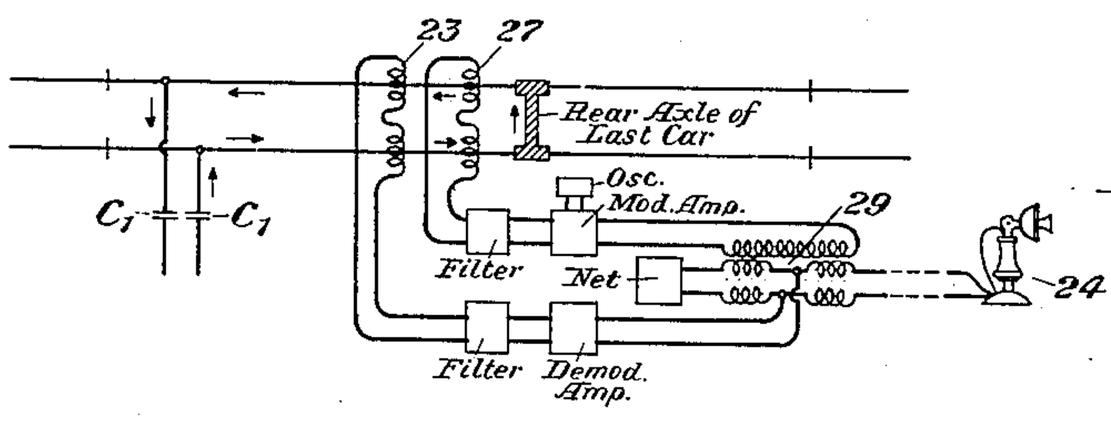

Fig. 2

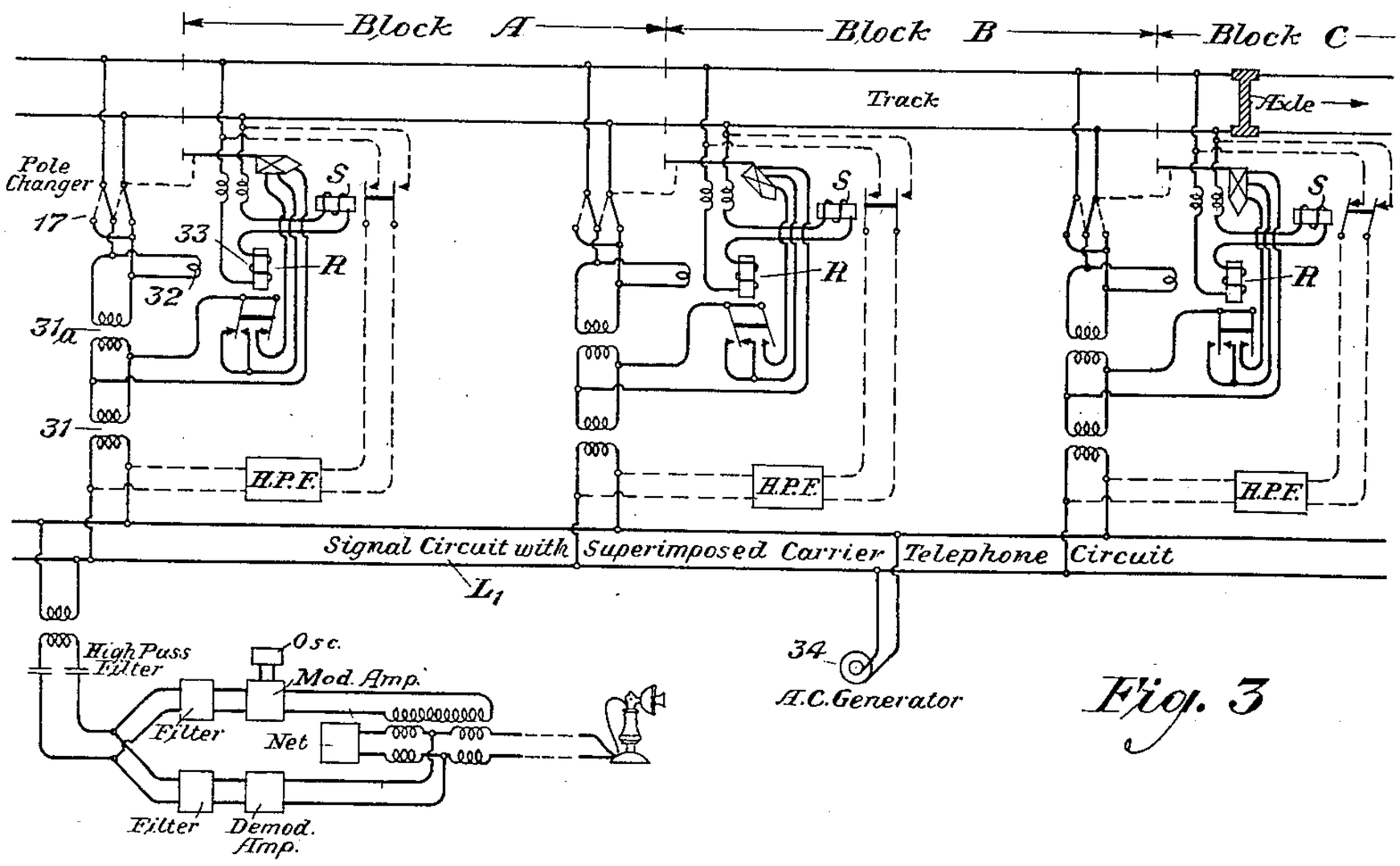

Fig. 3

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COMMUNICATION WITH MOVING VEHICLES

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Application September 10, 1931, Serial No. 562,179
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4 Claims. (Cl. 246—8)

This invention relates to telephone communication with moving vehicles and more especially with trains. Its object is to provide a system in which the coupling between a train circuit and a fixed circuit shall remain substantially constant and free from such irregularities as occur when the coupling is directly with a transmission line on poles along the route, such irregularities arising largely because of varying distance between the pole line and the track. A further object is to provide a system in which the space to be bridged between the train circuit and the fixed circuit is less than when coupled directly to the transmission line. Still a further object is to reduce the amount of power supplied to the signaling channels by reducing the attenuation in the various portions of the signal channel.

Broadly, these objects are attained by using the conductors of the pole line for bringing the voice frequency signals to any one of a number of quite widely spaced stations along the route at which the message is shifted to a carrier frequency and superposed on the same or adjacent transmission circuits on the pole line. Circuit taps are led from this transmission line to the track, one at each block junction in a block signaling system and the rails of a block are used in series as part of the path of the high frequency circuit. On the trains, in the rear of the end car, are located coupling coils so mounted as to be in inductive relation wih the rails. There may be one set of these coupling coils for both transmitting and receiving or there may be separate sets of coils one for transmitting and one for receiving. These coils are connected to the necessary modulators, demodulators and amplifiers and thence to a telephone set, all of which are located on the train. In order to reduce attenuation losses, only those blocks occupied by trains have the circuits to the rails completed and the control of this feature resides in and is operated by the block signaling system.

The invention will be better understood by reference to the following specification and accompanying drawing in which Figure 1 shows a preferred form of circuit for the stationary portion of our signaling system; Fig. 2 shows the circuit of the train with which communication is to be maintained and Fig. 3 is a modification of Fig. 1 wherein AC currents instead of DC currents are used in the block signaling system.

Referring more particularly to Fig. 1, there is shown a portion of track comprising three blocks and paralleling this track is shown a transmission line L with a fixed station 10 to which the voice frequency signals may be brought over the voice frequency circuit L paralleling the track or from some other remote point. Such fixed stations would be provided at intervals along the route of some fifty or one hundred miles separation, the route thus constituting a plurality of sections. While it is not necessary to do so, we find it desirable, in order to obtain better inductive coupling with the train, to shift the voice frequency message to a carrier frequency at the station 10. The resulting carrier frequency signal is then superposed on the transmission line L which carries the voice frequency message or on other transmission lines carried by the same pole line. In order to confine the modulated carrier wave to the section of the line involved, suitable blocking devices such as low-pass filters 11 would be introduced as needed at each fixed station 10.

A plurality of tapping circuits 15 come from the line L, one for each block of the railroad, it being understood that such blocks would, in general be of a length of about a mile. In order to minimize attenuation losses, however, we provide means whereby only those blocks occupied by a train shall have the connection completed from the line L to the tracks and the provision whereby this is attained will now be described.

The figure shows a typical block signaling circuit supplied with direct current, one of these circuits being shown for each of the three blocks of the figure. The elements necessary for this circuit and their function will be best understood by describing the operation of the system. If, for instance, the train enters block C in which the circuit condition was that shown in block A, then current from a battery and pole changer 17 at the remote end of block C is short-circuited through the axles of the train and a relay R_C which was formerly activated is now released and circuit from battery 19_C is broken, whereupon the signal 20_C is set to stop position. The relay R_C is a polarized relay with a double armature 21 and a polarized armature 22, the latter changing only on reversal of current. The moving of the signal 20_C shifts the pole changer 17_b in the block B mechanically to the left-hand position shown in the figure, this being accomplished by any suitable mechanism indicated by 18. Before the train left the block B, the signal 20_b had also been in stop position but upon the shifting of the pole changer 17_b current is reversed through the relay R_b so operating the two armatures as to shift the signal to the caution position. Such motion of this signal, however, brings the pole changer 17_a into its normal position, whereupon

the signal 20_a is set in the proceed position. This system of block signaling is well known in the art and does not, in itself, constitute a part of our invention. In each of these circuits, however, and in series with each R relay, is introduced an additional relay S which, when the relay S is excited, breaks the circuit connection 15 from the line L to the rails of the given block. Since the R and S relays are excited for all blocks except those occupied by a train, it will be seen that the only blocks to which circuit is completed from line L to the track are those in which a train is present and when circuit is so completed as in block C, the carrier signal is brought to the block at the junction point and high frequency current may flow through these rails and through an axle of the train. Condensers C_1 are preferably introduced in the lines 15 to keep out the direct current supply of the relays R and S. As the train now proceeds from block to block in the direction indicated by the arrow, each succeeding circuit comes into action as indicated and finally returns to its normal position two blocks in the rear of the train. It is obvious that the function of the S relays could be performed by the R relays through additional armatures thereon.

Fig. 2 shows the cooperating circuit on the moving train. In this figure, there are shown two sets of coils carried by the train at the rear and preferably as close to the track circuit as is feasible. The one set of coils 23 picks up the high frequency signal from the track and passes it through a filter and demodulator amplifier to a telephone set 24. For signaling in the reverse direction, voice frequency from the set 24 passes to an oscillator-modulator-amplifier equipment of the same or a different carrier frequency through a filter to the set of coils 27 from whence the signal is transferred to the rails and accompanying circuit to the subscriber connected to station 10. In this figure we have shown the usual type of hybrid coil connection 29 for two-way signaling, this being old in the art.

From the description of the invention as thus given, it is seen that a two-way telephone channel may be established between the train and a remote subscriber under circumstances which keep to a minimum attenuation losses and the sudden and large changes in transmission level characteristic of previous systems for communication with moving trains. Various changes or additions can be made to the invention as thus far described. For example, it will be recognized that as the train recedes from the junction point, there will be a drop in transmission level due to attenuation losses resulting from imperfect insulation of the track. Since, however, the block sections are comparatively short, such loss will not be excessive and furthermore may be substantially reduced by automatic means for changing the gain of the amplifiers in such a manner as described in connection with the application of Affel and Green, Serial No. 396,893, filed October 2, 1929. Also, to reduce the shunt loss due to the conductors 15 attached to the telephone line at each block, we may locate the S relays on the telephone pole lines.

It is evident that with the train running in the direction indicated, it will be necessary to carry the coils 23 and 27 to the rear of the last axle of the train. These coils may, on the other hand, be placed in the front of the train but in that event, it will be necessary also to make the connection of the block signaling circuit at the other end of the block which will require certain rearrangements of operation in order that the system shall function in the proper order. It will also be noted that whenever the rear axle of the last car on the train is in one block and the coupling coils are coupled to the rails of the next block in the rear, no energy will be received by the coils. The time interval for this condition will usually be extremely short but, if so desired, we may overcome this defect by making the S relays of the slow-release type or, as an alternative, the connections may be arranged so that carrier frequency energy is fed simultaneously to the block containing the train and the block to the rear, or additional blocks if advisable.

Fig. 3 shows a modification of Fig. 1 in which the block signaling system is operated by alternating current instead of direct current. In this case the batteries associated with the pole changers 17 are replaced by transformers 31 and 31_a and the R and S relays are AC operated relays. In this figure, as a further modification, we have also shown the modulated carrier frequency signal as superposed on the signal circuit L_1 which provides AC power from a generator 34 for the block signaling system. The signal arrangement shown in this figure is a common form of three-position alternating current control signaling circuit, the R relays comprising a permanently connected AC winding 32 and the winding 33 in which the phase of the current is controlled by the position of the pole changer associated with the same block. The S relays, added in series with the R relays, operate simultaneously with them to connect the carrier telephone circuit to the track in the particular block in which the train is located. A high pass filter or its equivalent is included in each telephone tap circuit to exclude the block signal frequency. With these exceptions, the operation of the system as a whole is the same as that described in connection with Figs. 1 and 2 and will be readily understood from that description.

In the case of more than one train operating on the same track, comunication may be effected by a party-line arrangement or by the use of different carrier frequency channels, separation being obtained by filters located at the terminal point on the trains. Where a number of trains are running on several different tracks, it might be preferable to use different pairs of the line wires carried on pole lines and to employ different carrier frequency channels, as will be apparent to those skilled in the art.

While the invention has been described as showing the rails of a given block connected in series through an axle of the train for the carrier frequency as well as the block signaling circuit, it is evident that the carrier frequencies may be connected to a rail circuit comprising the two rails in parallel with a ground or a separate wire return. Such a circuit may be employed for communication in one or in both directions and has the advantage that it permits the placing of the coupling coils at any point along the train instead of to the rear of the last axle.

A fixed station may serve the section of transmission between itself and the next fixed station in one direction or may serve a section of the same length with the station at the middle. In the latter case the low pass filters 11, or their equivalent, would be placed midway between stations.

What is claimed is:

1. In a system for communicating with moving trains and cooperating with a block signaling

system, a transmission line along the train route, a source of voice frequency signals, fixed stations along said route, means for shifting incoming voice frequency signals to a carrier frequency and superposing the carrier frequency message on the transmission line, means for impressing the carrier frequency signals on the blocks occupied by a train, and a device on the train for picking up the carrier frequency signal in its block.

2. In a system for communicating with moving trains and cooperating with a block signaling system, a transmission line along the train route for voice frequency signals, fixed stations along said route for shifting the voice frequency signal to a carrier frequency and superposing the carrier frequency message on the transmission line, connections from the transmission line to the rails of each block, a device on the trains for picking up the high frequency signal, and means for activating only those blocks occupied by a train.

3. In a system for communicating with moving trains and cooperating with a block signaling system, a transmission line along the train route for voice frequency signals, fixed stations along said route for shifting the voice frequency signal to a carrier frequency and superposing the carrier frequency message on the transmission line, connections from the transmission line to the rails of each block, a device on the trains for picking up the high frequency signal, and means controlled by the block signaling system for activating only those blocks occupied by a train.

4. In a system for communication with moving trains, and cooperating with a block signaling system, a transmission line along the train route for voice frequency signals, fixed stations along the route separated by a distance large compared to the length of a block, means at the stations for receiving a subscriber's message and for shifting it to a carrier frequency and superposing the carrier frequency message on the transmission line, means for confining the modulated carrier frequency wave from any one fixed station to a section of transmission line adjacent that fixed station, a plurality of taps on this section one for each block adapted to connect the transmission line to any block in that section, and means controlled by the block signaling system for activating only those blocks adjacent to the train.

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