March 28, 1939. K. SCHÜSSLER 2,152,329

DUPLEX COMMUNICATION APPARATUS

Filed April 19, 1937

Fig. 1

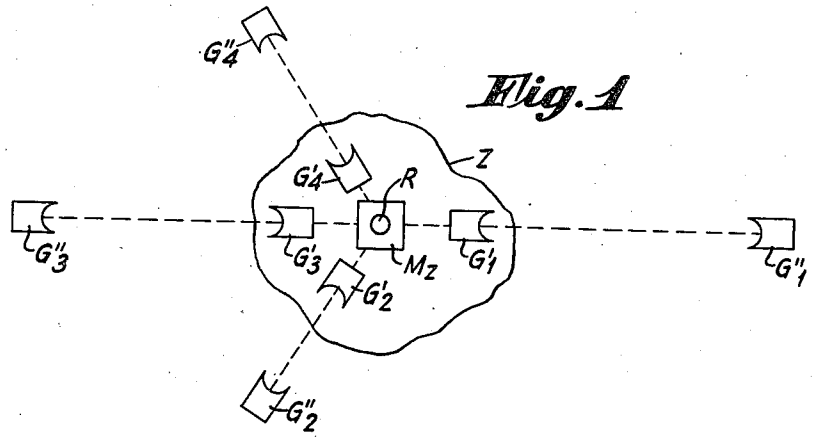


Fig. 2

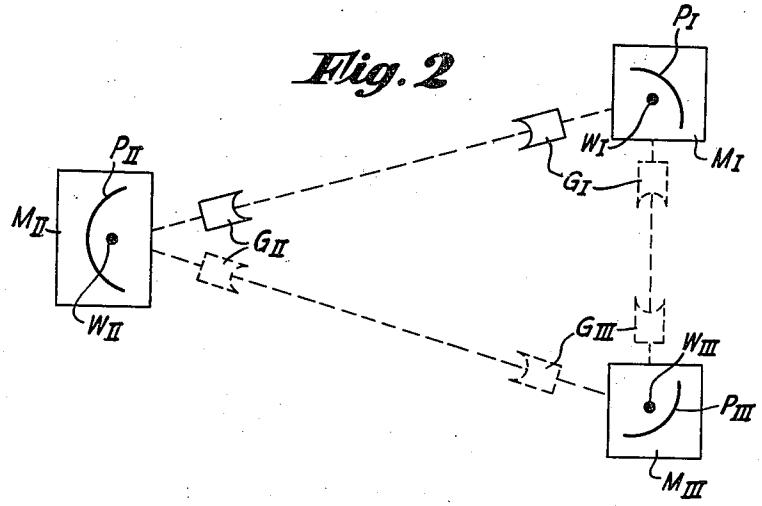
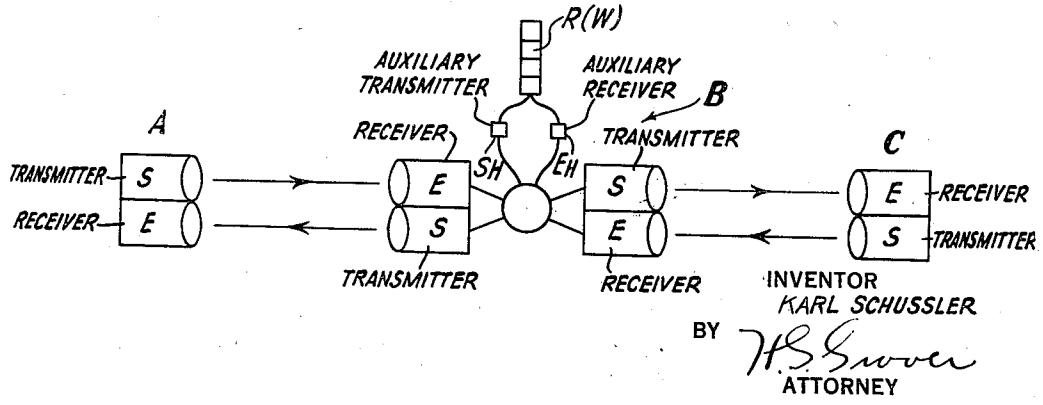


Fig. 3



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DUPLEX COMMUNICATION APPARATUS

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6 Claims. (Cl. 250—11)

The present invention relates to duplex or two-way radio communication on short waves, preferably for full-automatic stations from which or by way of which traffic is feasible in different directions.

It is known from actual operation of duplex equipment or two-way equipment that at the relay stations furnished, for instance, with only one transmitter and one receiver outfit, the direction of signal transmission may be reversed by the aid of relay devices (see French Patent No. 742,519) in such a way that the apparatus turned towards the calling or ringing station is worked as a receiver and the other apparatus as a transmitter, and vice versa.

Now, the shortcoming inherent in equipment of this kind is that all existing apparatus must be permanently operative inasmuch as the station, during the intervals between signal transmission, must be ready for reception towards different sides. Moreover, a connection once established is liable to be disturbed undesirably by a third station that is calling. Now, by the present invention these drawbacks are obviated.

The present arrangement designed for duplex or mutual communication on short waves between two or more stations comprising the use of directional antennae operating with comparatively reduced radiation or beam angles for signal transmission has this outstanding characteristic that, in addition to the directive aerials, an antenna having a comparatively wide radiation angle or preferably a non-directional antenna producing a beam only in the vertical sense, is provided.

This wide-apertured or non-directional antenna, during the intermissions or intervals between signal transmissions during which the sending and receiving apparatus are inoperative, is united with a receiving apparatus so that signals may be picked up no matter from what direction they may arrive.

Furthermore, while signalling work is proceeding, a busy signal or permanent signal is sent out by way of the wide-apertured or non-directional antenna of the operating stations so that useless calls from other points or exchanges not participating in an actual connection may be avoided.

The basic idea of the invention may be applied both to so-called central as well as the so-called line systems.

A better understanding of the invention may be had by referring to the following description which is accompanied by a drawing, wherein Figs. 1, 2 and 3 show several embodiments of the present invention.

Fig. 1 shows the arrangement and its underlying idea applied to a central system. Roughly, midway or centrally to the various intercommunicating stations is a central station Z comprising a non-directional antenna R which is united with an apparatus M_Z operating normally as a receiver. Around the non-directional antenna are mounted directional outfits G'_1 to G'_4 which are turned towards the correspondent stations G''_1 to G''_4, respectively. Now, if an outside station G'' desires to talk with central station Z or beyond the latter with one of the other stations G'', the particular station G'' which wishes to talk has its transmitter ring central by way of its non-directional antenna R.

Either manually or automatically, in response to this call or ring, the transmitters and receivers required for the desired connection are rendered operative and cut in. Supposing that all stations work on one and the same wave, and that station G''_1 is connected by way of Z with station or exchange G''_4, it may happen that the station G''_2 while communications are proceeding between G''_1 and G''_4 also makes attempts to get a connection. The said station G''_2 thus will ring central and in case of full automatic operation, by sending out a corresponding number of impulses, will attempt also to get connection, say with G''_4.

In order that disturbances in an already existing connection caused by a third outside station may be precluded, the non-directional antenna R, while communications are proceeding, is used for the purpose of sending out a sort of busy signal in order that futile attempts from a third station to get a connection may be avoided.

Fig. 2 shows an exemplified embodiment of the basic idea of the invention in connection with a so-called line system. Three stations M_I, M_{II}, and M_{III} are to be mounted, for instance, at the corners of a triangle. Each station shall be assumed to be equipped with only a radio frequency outfit G_I, G_{II} or G_{III}, respectively, for signal transmission which is pivotal or revolvable, and moreover a fixed wide-apertured antenna W_I, W_{II} or W_{III}, respectively, having a solid or horizontal beam angle. This may be achieved, for instance, by the use of a reflector P_I, P_{II} or P_{III}, which has been so chosen that the antenna is able simultaneously to pick up signals from the directions under consideration or is able to transmit in these directions. Wide-apertured antennae W_I, W_{II} and W_{III} are united with appa-

ratus which, in quiescent or inoperative state work as receivers, and which are kept in working readiness.

The following considerations shall be predicated upon the assumption that the various stations are fully automatic in nature. If, then, station M_I calls station M_{II}, the radio frequency apparatus G_{II} pursuant and in response to the characteristic call signals will be changed from the particular position of rest it happened to occupy and be directed toward station I, and the equipment be cut in. At the same time, the wide-apertured antenna W_{II} is changed over to an auxiliary transmitter which causes a busy signal to be sent out. However, a distinct auxiliary transmitter could also be dispensed with and a certain amount of energy may be separated from the radio frequency apparatus G_{II}, be separately rectified, and put on the wide-apertured radiator or antenna.

After termination of the conversation, station M_I sends out a sort of clearing signal with the result that the radio frequency apparatus G_{II} of station M_{II} is disconnected, and the wide angle antenna is reconnected to the receiver apparatus. As already pointed out, initiation of a connection, that is to say, connection of transmission equipment and adjustment of the directional antennae is accomplishable by the intermediary of relays, switch mechanism, or the like, which are fed with operating impulses by way of the wide-apertured antenna or non-directional antenna.

In the exemplified embodiments so far discussed, with the exception of the central station Z, only one set of radio frequency apparatus has been provided at the various stations so that duplex communication has to proceed on one and the same wave. Of course, in case of two-way traffic, it is optional to use one or different waves for the various directions of communication.

Fig. 3 shows an installation which will satisfy even the severest requirements. At each of the head or terminal stations A and C are provided a transmitter S and a receiver E, while two of each are provided at the intermediate station B. The non-directional antenna R or the wide angled antenna W may selectively be connected with a distinct auxiliary receiver E_H or auxiliary transmitter S_H. In particular instances, of course, simultaneous signalling to all subscribers may be insured by way of the non-directional radiator.

The length of the wave may be chosen ad lib, in fact it may be chosen to conform to existing technical requirements.

Methods of manually and automatically making the required switching arrangements mentioned above are well known in the art and need not be described herein. For manual switching, attention is invited to United States Patent No. 1,804,548, as being illustrative of the manner in which manual switching may be achieved. For automatic switching, attention is invited to such arrangements as described in United States Patents Nos. 1,795,652, 1,856,224 and 1,856,714 as illustrating various ways and means of achieving automatic switching; United States Patent No. 2,063,534 shows in Fig. 4, by way of example, an automatic rotatable antenna system which is employed in connection with a gear and motor for achieving an automatic antenna directing system.

What is claimed is:

1. A short wave communication system comprising a first station and a second station, each of said stations having a relatively narrow angle directive antenna positioned to communicate with the directive antenna at the other station, a third station for communicating with either one of said first and second stations, and a relatively wide angle antenna located at each of said first and second stations adapted to radiate signals when said stations are in communication with each other, for indicating a busy condition to said third station.

2. A short wave communication system comprising a first station and a second station, each of said stations having a directive antenna positioned to communicate with the directive antenna at the other station, a third station for communicating with either one of said first and second stations, and a non-directional antenna located at each of said first and second stations adapted to radiate signals when said stations are in communication for indicating a busy condition to said third station.

3. A short wave communication system comprising a first station and a second station, each of said stations having a directive antenna positioned to communicate with the directive antenna at the other station, and a third station for communicating with one of said first two stations, and a non-directional antenna located at at least one of said first and second stations for radiating a busy signal to said third station when said first and second stations are in communication.

4. A short wave communication system having a first station equipped with both a relatively narrow angle antenna and a wide angle antenna, receiving and transmitting apparatus at said station, said wide angle antenna being coupled to said receiving apparatus in the absence of communication between said station and a second station, and means at said first station responsive to a predetermined signal received over said wide angle antenna from said second station for disconnecting said last antenna from said receiving apparatus and for connecting same to said transmitting apparatus, whereby a busy signal is sent out over said wide angle antenna.

5. A short wave communication system having a first station equipped with both a relatively narrow angle antenna and a wide angle antenna, receiving and transmitting apparatus at said station, said wide angle antenna being coupled to said receiving apparatus in the absence of communication between said station and a second station, and means at said first station responsive to a predetermined signal received over said wide angle antenna from said second station for disconnecting said last antenna from said receiving apparatus and for connecting same to said transmitting apparatus, whereby a busy signal is sent out over said wide angle antenna, and additional means at said first station also responsive to said predetermined signal for automatically directing the position of said narrow angle antenna to communicate with said second station.

6. A short wave communication system comprising a first station and a second station, each of said stations having a directive antenna positioned to communicate with the directive antenna at the other station, and a third station for communicating with one of said first two stations, and a wide angle antenna located at at least one of said first and second stations for radiating a busy signal to said third station when said first and second stations are in communication.

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