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M. SULTZER

MULTIPLEX SELECTING CIRCUITS

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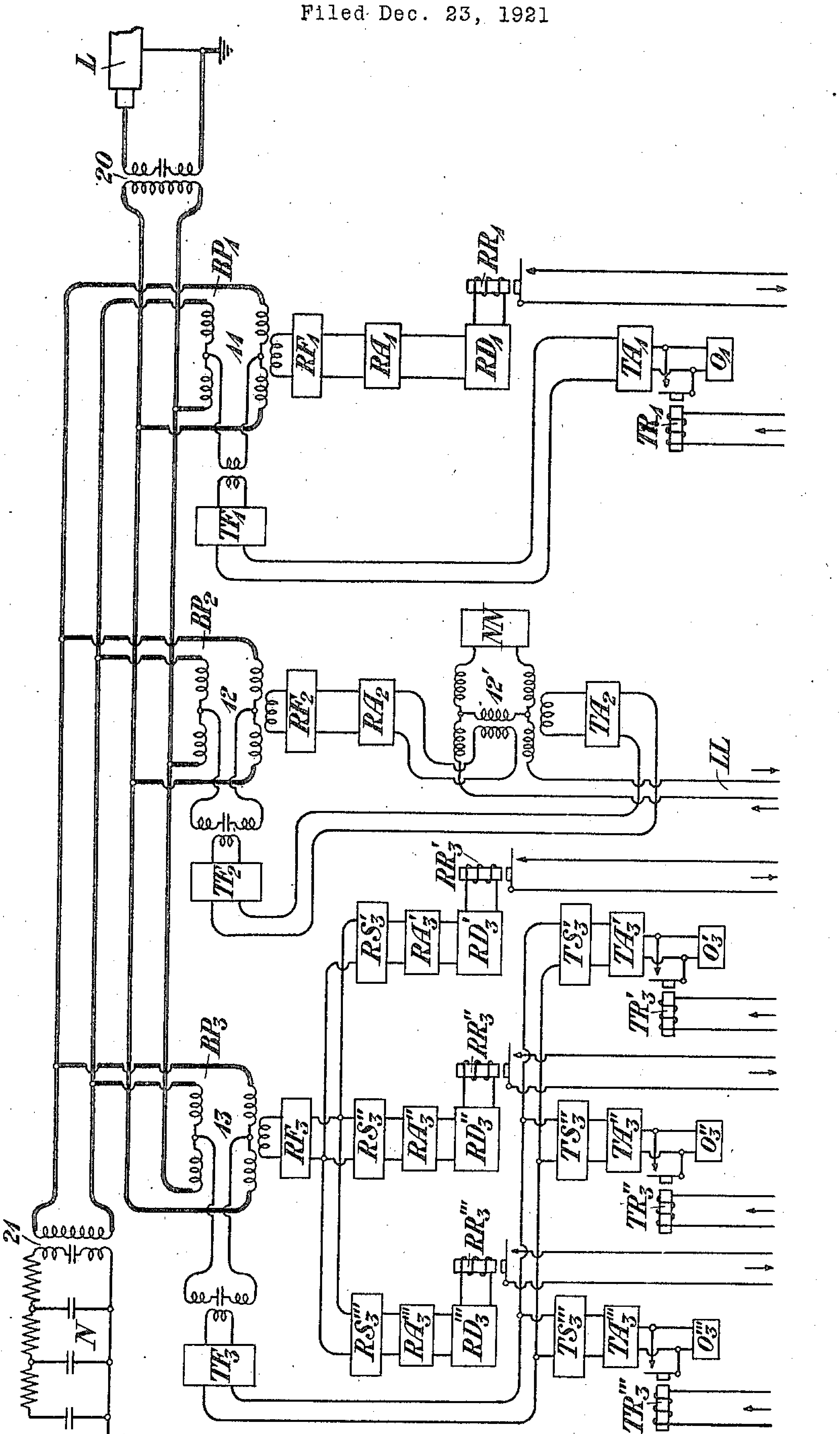

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MULTIPLEX SELECTING CIRCUITS.

Application filed December 23, 1921. Serial No. 524,484.

To all whom it may concern:

Be it known that I, MORTON SULTZER, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Multiplex Selecting Circuits, of which the following is a specification.

This invention relates to multiplex signaling, and more particularly to selective arrangements for multiplex signaling channels.

It has heretofore been proposed to provide a multiplex signaling circuit by arranging parallel bridged paths between the main signaling line or circuit and the balancing network, each parallel path corresponding to a signaling channel and being provided with a hybrid coil or other form of balanced translating element for associating a transmitting and receiving circuit with each path. On either side of the hybrid coil or equivalent device a selecting filter is placed for selecting the signaling currents into the proper channels.

In accordance with the present invention, it is proposed to arrange the selecting filters one in the transmitting circuit associated with each bridged path and one in the receiving circuit associated with each bridged path, without providing filters in the paths themselves.

This arrangement has the advantage that, without any increase in the number of selective units, it is possible to transmit and receive in connection with each bridged path at a different frequency, thereby supplementing the discrimination between oppositely directed transmissions due to balance by additional discrimination due to the use of different frequencies for transmitting in opposite directions.

Another advantage that is inherent in the arrangement of this invention is that the filters themselves need not be so designed as to balance each other. In the previous arrangement above described, the filter in the network side of the bridged path must be constructed to exactly balance the filter in the line side of the path. By arranging the filters in the local transmitting and receiving portions of the circuit beyond the hybrid coil, no balance between the two filters is necessary.

Another advantage of the improved arrangement is that the same results can be accomplished by using cheaper filters. If the filter is included in the bridged path so that it is directly associated with the line, its impedance may have to be relatively small, for example, somewhere in the neighborhood of 100 ohms or so. This would require the construction of a filter using inductances and capacities of inconvenient sizes. By arranging the filter back of the hybrid coil, the filters may have an impedance of several thousand ohms, owing to the fact that the impedance may be stepped down by using a hybrid coil having an inequality ratio. This permits of using filters made up of inductances and capacities of sizes such that they can be manufactured economically.

It is also possible by means of this arrangement to group several channels so as to transmit through a common filter which is arranged beyond the hybrid coil, using supplemental selective devices to discriminate between the grouped channels. For example, where one of the bridged paths is used for ordinary telephone transmission and another for an alternating telegraph circuit employing frequencies below the telephone range, a third bridged path may have several telegraph channels employing carriers above the voice range branching from its transmitting and receiving channels.

The invention may now be more fully understood from the following description, when read in connection with the accompanying drawing, the figure of which shows a circuit arrangement embodying the principles of the invention.

Referring to the diagram, L designates a transmission line, such, for example, as an ocean cable, which may be grounded through one winding of a transformer 20. A balancing network N may be provided for balancing the cable L, and the transformer 21 is associated with the balancing network for the purpose of balancing the transformer 20. Bus bars lead from the windings of the transformers 20 and 21, and parallel bridged paths BP_1, BP_2, BP_3, etc., may be connected between the bus bars, so that, in effect, the several paths are bridged in parallel between the cable L and balancing network N. Hybrid coils 11, 12 and 13 are included in the bridged paths as indicated.

A transmitting channel, including a band filter TF_1, is connected to neutral points of the hybrid coil 11 and includes suitable transmitting apparatus. As illustrated, the transmitting apparatus is of a type employed in connection with alternating current telegraphy and comprises a source of alternating current O_1, an amplifier TA_1, and a transmitting relay TR_1. The source O_1 may be, for example, a well-known type of vacuum tube oscillator adapted to generate a frequency which may serve as a carrier for the telegraph signals. This frequency may, if desired, be below the range of frequencies employed in ordinary telephone transmission. The amplifier TA_1 may be a vacuum tube amplifier of well-known type. The transmitting relay TR_1 is arranged to short-circuit the connections between the oscillator O_1 and the amplifier, thereby, in effect, interrupting the transmission of oscillations from the oscillator O_1 and thereby controlling the telegraph signals to be imposed upon the carrier.

A corresponding receiving channel is associated with the secondary winding of the hybrid coil 11 and includes a band filter RF_1, a receiving amplifier RA_1, a receiving detector RD_1 and a receiving relay RR'. The receiving amplifier RA_1 may be a vacuum tube amplifier similar to the amplifier TA_1, and the detector RD_1 may be any well-known form of detector, such, for example, as the vacuum tube. Each of the filters TF_1 and RF_1 is arranged to pass a band of frequencies in the neighborhood of the carrier employed, having sufficient width to allow for the side band resulting from the interruption of the carrier frequencies. Different carriers may be employed for transmitting and receiving by arranging the filters TF_1 and RF_1 in the transmitting and receiving channels beyond the hybrid coil, rather than including them in the bridged path BP_1 on either side of the hybrid coil, as has heretofore been the practice.

The bridged path BP_2 may be used for the transmission of ordinary telephone waves, and for this purpose the hybrid coil 12 has associated with it transmitting and receiving channels, including the band filters TF_2 and RF_2 respectively. These band filters may be arranged to pass a band of frequencies corresponding to the frequencies employed in ordinary telephonic transmission. The transmitting and receiving channels may also include amplifiers TA_2 and RA_2, which may be of the vacuum tube type or of any other well-known type. The transmitting and receiving channels are associated with the low frequency telephone line LL through a low frequency hybrid coil 12′, the low frequency line LL being balanced by the balancing network NN.

The third bridged path BP_3, as illustrated, is used for telegraph signaling by means of carrier frequencies above the voice range and is further illustrated as providing for the superposition of a plurality of channels on the one bridged path. A common transmitting circuit for the several channels is connected to neutral points of the hybrid coil 13 through a band filter TF_3, which is so designed as to pass a range of frequencies encompassing the frequencies assigned to the several superposed transmitting channels while suppressing frequencies lying without this range. Branched from this common channel are three telegraph transmitting channels, each including selective devices, such as TS_3', TS_3'' and TS_3'''. These selective devices may be band filters, but are preferably simple tuned circuits of a well-known type. The channels also include amplifiers TA_3', TA_3'' and TA_3''', as well as oscillators O_3', O_3'' and O_3''', these elements being similar to the oscillator O_1 and amplifier TA_1 already described. The oscillators may be short-circuited by means of the transmitting relays TR_3', TR_3'' and TR_3''' to control the imposition of telegraph signals upon the carrier frequency generated by the oscillators.

A common receiving channel is associated with the secondary winding of the hyrid coil 13 through a band filter RF_3 designed to pass frequencies covering a range of sufficient width to accommodate the carrier frequencies assigned to a plurality of receiving channels, while suppressing frequencies lying without this range. The several receiving channels are superposed upon the common channel through individual selecting devices RS_3', RS_3'' and RS_3''', which may be band filters, but are preferably simple tuned circuits. The individual channels also include receiving amplifiers RA_3', RA_3'' and RA_3''', receiving detectors RD_3', RD_2'', and RD_3''', together with receiving relays RR_3', RR_3'', and RR_3'''. These amplifiers and detectors may be similar to the amplifier and detector RA_1 and RD_1 previously described.

By arranging the band filters, such as TF_3 and RF_3 in the transmitting and receiving channels respectively, it is not necessary that the transmitting and receiving filters be arranged to balance each other, as would be necessary if they were included on either side of the hybrid coil. This also enables the use of cheaper filters, for example, the filter TF_3, if included in the bridged path, would necessarily have to be designed to have a relatively small impedance, if the line circuit L with which it is associated directly has a low impendance. This would require unusual sizes of inductances and capacities with a corresponding increase in the cost. By arranging the filter in the transmitting channel, however, it may be designed for a very much higher impedance, owing to the fact that its impedance will be steped down through the transformer assaciating it with the hybrid coil. More convenient sizes of inductances and capacities may therefore be used in constructing this filter, with a corresponding saving in cost. The same holds true for the filter RF_3 as its impedance may be stepped down through the hybrid coil itself by designing the hybrid coil to have an inequality ratio.

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 inventions as defined in the following claims.

What is claimed is:

1. In a signaling system, a main line circuit, a balancing network, a plurality of bridged paths interconnecting said main line and network, a transmitting channel and a receiving channel associated with each bridged path, each transmitting and receiving channel including a filter.

2. In a signaling system, a main line circuit, a balancing network, a plurality of bridged paths interconnecting said main line and network, a transmitting channel and a receiving channel associated with each bridged path, each transmitting and receiving channel including a filter, certain of the filters associated with corresponding transmitting and receiving channels being arranged to transmit non-overlapping bands.

3. In a signaling system, a main line circuit, a balancing network, a plurality of bridged paths interconnecting said main line and net work, a transmitting channel and a receiving channel associated with each bridged path, each transmitting and receiving channel including a filter, the filters associated with transmitting and receiving channels connected to certain branches being arranged to transmit bands having the same frequency limits and the filters associated with the transmitting and receiving channels of other paths being arranged to transmit non-overlapping bands.

4. In a signaling system, a main line circuit, a balancing network, a plurality of bridged paths interconnecting said main line and network, a common transmitting circuit and a common receiving circuit associated with each bridged path, a filter included in the common transmitting and receiving circuits, a plurality of transmitting channels associated with the common transmitting circuit and a plurality of receiving channels associated with the common receiving circuit.

5. In a signaling system, a main line circuit, a balancing network, a plurality of bridged paths interconnecting said main line and network, a common transmitting circuit and a common receiving circuit associated with each bridged path, a filter including in the common transmitting and receiving circuits, a plurality of transmitting channels associated with the common transmitting circuit, a plurality of receiving channels associated with the common receiving circuit and selective devices in the individual channels beyond the points of their junction with the common circuits.

In testimony whereof, I have signed my name to this specification this 19th day of December, 1921.

MORTON SULTZER.