Oct. 1, 1940. E. OOSTERHUIS 2,216,517

NOISE SUPPRESSION CIRCUITS

Filed July 30, 1938

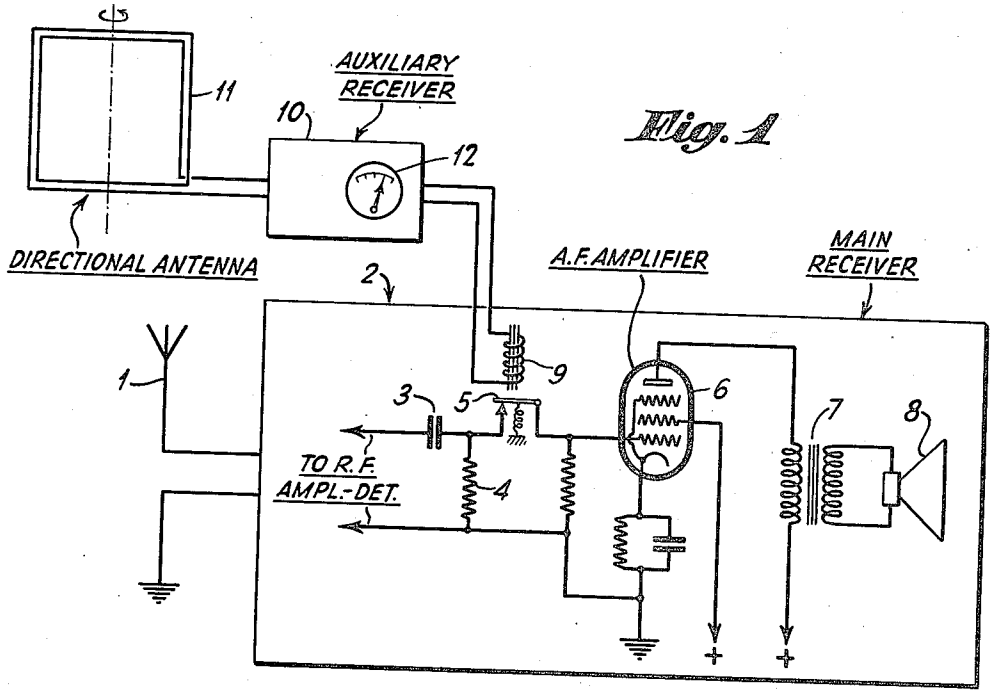

Fig. 1

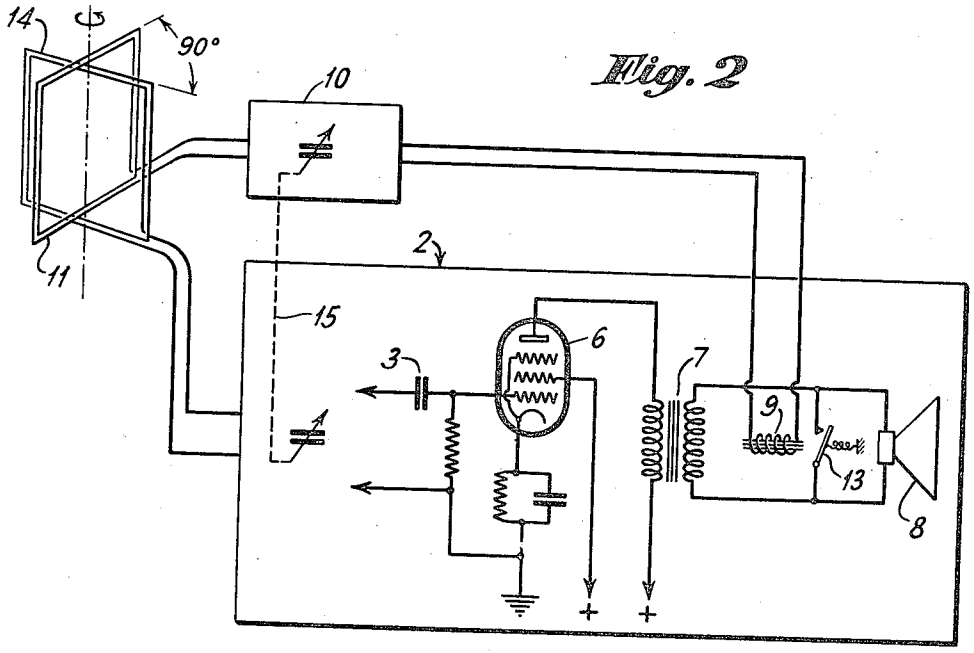

Fig. 2

INVENTOR.
EKKO OOSTERHUIS

BY H. S. Brown

ATTORNEY.

Patented Oct. 1, 1940 2,216,517

UNITED STATES PATENT OFFICE

2,216,517

NOISE SUPPRESSION CIRCUITS

Ekko Oosterhuis, Eindhoven, Netherlands, assignor, by mesne assignments, to Radio Corporation of America, New York, N. Y., a corporation of Delaware

Application July 30, 1938, Serial No. 222,093
In Germany September 21, 1937

9 Claims. (Cl. 250—20)

This invention relates to a radio-receiving device comprising means for suppressing disturbances of short-duration such as atmospheric disturbances and disturbances caused by operating switches, or by sparks of commutator motors and of the current collectors of electrically operated vehicles.

For obviating such disturbances it is known to render a radio-receiver inoperative substantially throughout the duration of a disturbance. In this case the disturbance is not reproduced by the loudspeaker and interruption of the reception is not perceived by the human ear due to its very short duration. For this purpose the receiver may, for instance, be equipped with a mechanical or electric relay by which the signal transmitting path is interrupted or short-circuited as soon as the amplitude of the input voltage of the receiver exceeds a definite threshold-value. To ensure that the relay is operated only by the disturbances and not by the signal to be received the threshold value should correspond at least to the maximum amplitude of the signal to be received, i. e. with 100% modulation of the signal the threshold amplitude should be equal to at least double the signal carrier-wave amplitude. Thus, disturbances whose amplitude is smaller than double the carrier wave amplitude of the signal to be received cannot be avoided by this arrangement.

In order that disturbances having a smaller amplitude can also be suppressed it has been proposed to control the device, by which the receiver is rendered inoperative, by means of an auxiliary receiver tuned to a wave length which is not used for signals. The auxiliary receiver receives only the disturbances so that the threshold value can be materially reduced. It is presumed for correct operation of such a device that the disturbances received by the auxiliary receiver are the same as those received by the principal receiver. Owing to the aperiodic character of the disturbances this requirement is usually met in a satisfactory manner, if the difference between the signal frequency and the tuning frequency of the auxiliary receiver be not too large.

The use of an auxiliary receiver for suppressing disturbances is hampered by the fact that at the present state of the broadcast range there is hardly a wave length that is not used by some transmitter or other. For this reason the auxiliary receiver must be tuned to a frequency outside the broadcast range, the difference between the signal frequency and the tuning frequency of the auxiliary receiver being usually great so that the disturbances received by the auxiliary receiver no longer correspond to the disturbances occurring in the principal receiver and freedom from disturbances cannot be ensured in an efficacious manner.

According to the invention this drawback is avoided by equipping the auxiliary receiver with a directional antenna. This measure permits the auxiliary receiver to be tuned to a wave length used by a signal, the directional antenna being in each instance adjusted so that the signal in question is not received by the auxiliary receiver. When making use of the measure according to the invention the auxiliary receiver may consequently be tuned to a frequency which only slightly differs from the frequency of the signal to be received or even completely corresponds thereto, thus ensuring sufficient conformity between the disturbances picked up by the auxiliary receiver and the principal receiver.

The invention will be more clearly understood by reference to the accompanying drawing representing, by way of example, two forms of construction thereof.

In the arrangement shown in Fig. 1 the oscillations picked up by the non-directional antenna 1 are supplied to the principal receiver 2. The low-frequency oscillations occurring after demodulation are, if desired after low-frequency amplification, supplied through a coupling condenser 3 to the resistance 4 whose terminals are connected through the intermediary of the relay-contact 5 to the input circuit of the final tube 6. The output circuit of the tube 6 comprises the primary winding of the transformer 7 to whose secondary winding is connected the loudspeaker 8. When receiving a disturbance the relay 9 opens the contact 5 and thus renders the principal receiver inoperative so that the disturbance will not be reproduced by the loudspeaker 8. The coil of the relay 9 is connected to the output terminals of an auxiliary receiver 10 which is equipped with a directional antenna 11. The auxiliary receiver 10 is preferably furnished with an indicating device 12 chosen from known tuning indicators.

After tuning the principal receiver 1 the auxiliary receiver is tuned with the aid of the tuning indicator 12 to a signal whose frequency only slightly differs from the frequency to which the principal receiver is tuned. If desired, the auxiliary receiver may be tuned to the same frequency as the principal receiver to which end the tuning means of the two receivers may be coupled together mechanically. After the auxiliary re-

ceiver has been tuned to a signal the frame antenna 11 is brought into the position wherein the tuning indicator indicates a minimum value. In this case the signal to which the auxiliary receiver is tuned is not taken up so that the auxiliary receiver picks up the disturbances only.

Fig. 2 shows an arrangement wherein a separate adjustment of the auxiliary receiver may be dispensed with. In this arrangement the principal receiver 2 is also equipped with a frame antenna 14 which is rigidly connected to the frame antenna 11 of the auxiliary receiver, the two antennae being arranged at right angles to one another. The tuning means of the two receivers are mechanically coupled together, as is schematically illustrated by means of the dotted line 15. After the principal receiver has been tuned to the desired signal the antenna-system 11, 14 is so adjusted that the principal receiver is supplied with a maximum input voltage, which may be easily ascertained from the volume or by means of a tuning indicator. Due to this the frame antenna 11 is positioned automatically at right angles to the direction of incidence of the signal to be received, so that the auxiliary receiver does not pick up a signal but disturbances. Upon receiving a disturbance the relay 9 inserted in the output circuit of the auxiliary receiver closes the contact 13 so that the loudspeaker 8 is short-circuited and the disturbance is not reproduced.

What is claimed is:

1. In combination with a main radio receiver provided with a signal collector and means for tuning the receiver to a desired carrier frequency, an arrangement for suppressing disturbances of short duration comprising an auxiliary receiver, said auxiliary receiver being provided with a directional antenna and means for tuning the auxiliary receiver to a frequency of the order of said desired carrier frequency, said directional antenna being adjusted to pick up a minimum of signal energy, and means responsive to the output of said auxiliary receiver for impairing the operation of said main receiver substantially throughout the duration of a disturbance.

2. In combination with a main radio receiver provided with a signal collector and means for tuning the receiver to a desired carrier frequency, an arrangement for suppressing disturbances of short duration comprising an auxiliary receiver, said auxiliary receiver being provided with a directional antenna and means for tuning the auxiliary receiver to a frequency of the order of said desired carrier frequency, said directional antenna being adjusted to pick up a minimum of signal energy, and means responsive to the output of said auxiliary receiver for impairing the operation of said main receiver substantially throughout the duration of a disturbance, and a common means for adjusting said main and auxiliary receiver tuning means to tune the two receivers to said desired carrier frequency.

3. In combination with a main radio receiver provided with a signal collector and means for tuning the receiver to a desired carrier frequency, an arrangement for suppressing disturbances of short duration comprising an auxiliary receiver, said auxiliary receiver being provided with a directional antenna and means for tuning the auxiliary receiver to a frequency of the order of said desired carrier frequency, said directional antenna being adjusted to pick up a minimum of signal energy, and means responsive to the output of said auxiliary receiver for impairing the operation of said main receiver substantially throughout the duration of a disturbance, said main receiver collector being a directional antenna adjusted to receive maximum desired signal carrier energy.

4. In combination with a main radio receiver provided with a signal collector and means for tuning the receiver to a desired carrier frequency, an arrangement for suppressing disturbances of short duration comprising an auxiliary receiver, said auxiliary receiver being provided with a directional antenna and means for tuning the auxiliary receiver to a frequency of the order of said desired carrier frequency, said directional antenna being adjusted to pick up a minimum of signal energy, and means responsive to the output of said auxiliary receiver for impairing the operation of said main receiver substantially throughout the duration of a disturbance, said main receiver collector and auxiliary receiver signal antenna being of the loop type and arranged at right angles to one another.

5. In combination with a main radio receiver provided with a signal collector and means for tuning the receiver to a desired carrier frequency, an arrangement for suppressing disturbances of short duration comprising an auxiliary receiver, said auxiliary receiver being provided with a directional antenna and means for tuning the auxiliary receiver to a frequency of the order of said desired carrier frequency, said directional antenna being adjusted to pick up a minimum of signal energy, and means responsive to the output of said auxiliary receiver for impairing the operation of said main receiver substantially throughout the duration of a disturbance, said main receiver having an audio transmission network, and said responsive means acting to impair the transmission through said audio network.

6. In combination with a main radio receiver provided with a signal collector and means for tuning the receiver to a desired carrier frequency, an arrangement for suppressing disturbances of short duration comprising an auxiliary receiver, said auxiliary receiver being provided with a directional antenna and means for tuning the auxiliary receiver to a frequency of the order of said desired carrier frequency, said directional antenna being adjusted to pick up a minimum of signal energy, and means responsive to the output of said auxiliary receiver for impairing the operation of said main receiver substantially throughout the duration of a disturbance, said main receiver collector and auxiliary receiver antenna being provided by a pair of rigidly interconnected frame antennae arranged at right angles to each other.

7. A receiving system comprising a main receiver, means for tuning the main receiver to a desired signal frequency, means for collecting a substantial amount of signal energy and undesired disturbances, an auxiliary receiver having means for tuning it to said desired frequency, rotatable loop antenna means connected to the auxiliary receiver input for collecting a relatively slight amount of signal energy and at least as much disturbances as said main receiver, and means responsive to the auxiliary receiver output energy for rendering the main receiver inoperative for periods substantially corresponding to the duration of disturbances.

8. In combination, a pair of independent receivers, means for tuning the receivers substantially to a common signal frequency, means for

impressing a maximum magnitude of signal energy accompanied by undesired disturbances upon one receiver and a relatively small magnitude of signal energy accompanied by said disturbances on the second receiver, said impressing means comprising a pair of adjustable signal collectors arranged in substantially quadrature phase relation, and means responsive to the output energy of the second receiver for impairing the operation of the first receiver for the duration of said disturbances.

9. In combination with a pair of receivers, means for tuning the receivers over a desired range of signal frequencies, a signal collector arrangement for the receivers comprising a pair of loop antennae arranged at right angles to each other, each antenna being connected to the input of an associated one of the receivers, and means responsive to the output energy of one receiver for impairing the operation of the other receiver.

EKKO OOSTERHUIS.