

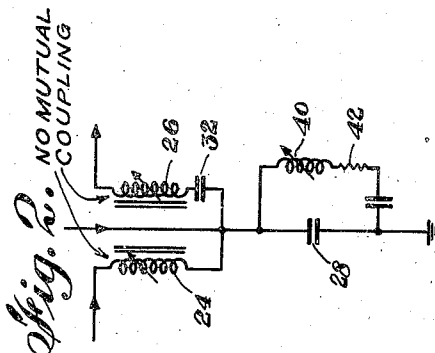
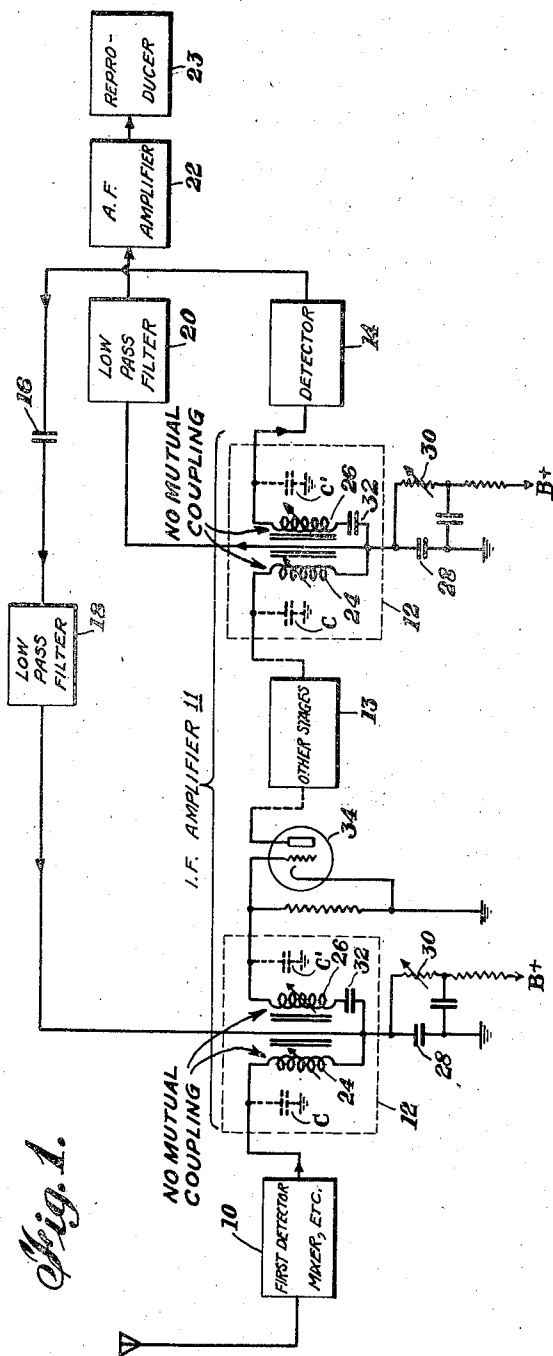
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RADIO RECEIVING APPARATUS

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## RADIO RECEIVING APPARATUS

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1

This invention relates to improvements in amplifiers, and more particularly to a novel reflex amplifying system for radio receivers.

An object of this invention is to provide a novel and improved reflex amplifier.

Another object of this invention is to provide a novel radio receiving circuit in which the high frequency amplifier tubes serve to amplify the low audio frequencies.

A further object of this invention is to provide a reflex amplifier in which the lower audio frequencies are passed through and are amplified by the radio frequency amplifier without mutual interference.

A still further object of this invention is to provide a reflex amplifier in which the input, output and inter-stage coupling devices of the radio frequency amplifier are adapted to pass both the normal high frequencies and the low audio frequencies without mutual interference.

More specifically, the present invention is directed to the use of direct capacitive coupling means in a radio frequency amplifier which is also used to amplify reflexed audio frequency currents.

An illustrative embodiment disclosing one form of the invention together with a modified circuit detail thereof is shown in the accompanying drawing in which:

Fig. 1 is a circuit diagram, partially in block form illustrating a preferred embodiment of the present invention; and

Fig. 2 is a partial circuit diagram of a modified coupling device adapted to be used in the circuit shown in Fig. 1.

The present invention is directed to improvements in what are known in the art as reflex amplifiers, and in Fig. 1 I have illustrated by way of example the application of my invention to a superheterodyne receiver. Such a circuit may consist of a first detector, mixer, local oscillator and the like, indicated at 10, the output of which is passed through an intermediate frequency amplifier, generally indicated at 11, to a second detector 14. In accordance with the present invention the audio frequency output derived from the detector 14 is fed back to the intermediate frequency amplifier 11 through a de-coupling condenser 16 and a low-pass filter 18. After the audio frequency currents pass through and are amplified by the intermediate frequency amplifier in a manner to be described in more detail hereinafter, such amplified audio frequency output is taken from the output of the intermediate frequency amplifier, passed through another low-pass filter 20 through an audio frequency ampli-

2

fier 22 (if desired) and thence to a suitable reproducer 23.

The intermediate frequency amplifier 11, according to the present invention, may consist of one or more stages. The input to the intermediate frequency amplifier passes through a direct capacitive coupling device 12, while the output from the intermediate frequency amplifier consists of a similar coupling device, as does also the coupling between any intermediate stages, such as indicated generally at 13. The direct capacitive coupling device in accordance with the present invention may consist of two inductors 24 and 26 spaced apart so that there will be no mutual coupling between them, the actual coupling taking place through a common connection which is connected to ground through a common condenser 28. The inductors 24 and 26 may be adjustable so that with their inherent capacities C and C', together with the condenser 28, the circuit will be tuned to the intermediate frequency band desired. In this respect the coupling in the intermediate frequency amplifier will act in the usual manner. If the low audio frequency is fed, however, to the midpoint between the two coils, to which the condenser 28 is connected, this point will represent an appreciable impedance for low frequencies. At such low frequencies, however, the impedance of the individual coils is negligible and the coupling is effected solely through the capacitor 32. For low frequency currents the capacitor 28 may be bypassed by a variable resistor 30 to control the low frequency coupling characteristics, this resistor serving at the same time as a D. C. path for the anode current of the previous high frequency or mixer stage. The type of coupling device described, therefore, serves both as coupling means for the relatively high intermediate frequency currents and also for the relatively low frequency audio currents which then are derived, preferably from the last coupling device between the intermediate frequency amplifier and the second detector 14. The low-pass filter 20 is used to prevent passage of the high frequency currents from the output of the intermediate frequency amplifier to the audio frequency reproducer, while the low-pass filter 18 is used to prevent the high frequency currents derived from the input of the intermediate frequency amplifier, being impressed upon the detector circuit. In order to prevent the high plate voltages from being applied to the grid of the intermediate frequency amplifier tube 34, or to the input of the detector tube (not shown), condensers 32 may be inserted between the in-

ductor winding 26 and the common point connecting that inductor to the inductor 24 and the condenser 28.

In place of using an adjustable resistor 30, the condenser 28 may be shunted by a variable inductor 40 and a resistor 42, as shown in Fig. 2. By proper adjustment of the inductor 42, the over-all circuit for low frequencies may be shunt peaked, making the low frequency circuit have a flat band-pass characteristic. Other known forms of band-pass (low frequency) compensation could be used, if desired.

While the present invention has the general advantage of all reflex circuits in permitting the reduction of the number of required tubes, it has the further advantage of permitting the use of several high frequency amplifying stages as audio frequency stages by utilizing special coupling means which will couple the amplifier both for high and low frequencies without mutual interference.

While I have disclosed this invention specifically in connection with a superheterodyne receiver, it will be obvious to those skilled in this art that the invention is equally applicable to a multi-stage tuned radio frequency receiver. Furthermore, in a superheterodyne receiver, the intermediate frequency could be coupled back through the radio frequency amplifying stage in the same manner as described with respect to the reflexing of the audio frequency. In this case it is clear that the filter networks 18 and 20 would be suitably dimensioned. The design of the inductor coils used in each of the coupling devices is not critical except that there should be no mutual inductance between the coils. The coils may be provided with variable movable powdered iron cores for tuning purposes, or they may be tuned in other manners known to the art.

Accordingly, while I have described above the principles of my invention in connection with specific apparatus, together with a particular modification thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects and the accompanying claims.

I claim:

1. Radio receiving apparatus including, in combination, a high frequency amplifier having one or more relatively high frequency amplifying stages, each of said stages including input and output direct capacitative coupling means, comprising a pair of uncoupled inductors having a common connection and a common condenser connecting said common connection to ground, an

input circuit connected to said high frequency amplifier through the first said input coupling means, a detector connected to the output coupling means of said high frequency amplifier, means connecting the output circuit of said detector to the common connection of one of said input coupling means of an amplifying stage, a signal reproducing device, a low-frequency pass filter, and means connecting said signal reproducing device to the common connection of an output coupling means following said one input coupling means through said low-pass filter.

2. The combination according to claim 1, in combination with a second low-pass filter intermediate connected between the output of said detector and the said common connection of the input coupling means to an amplifying stage.

3. The combination according to claim 1, in combination with variable impedance means in shunt with the common condenser of each coupling means.

4. The combination according to claim 1, in which the inductors and common condenser of each coupling means are tuned to the said high frequency band, in combination with a variable inductance in shunt with said common condenser forming a flat band-pass filter dimensioned to shunt peak the circuit for the low frequency detector output.

5. The combination according to claim 1, in which the detector output is fed to the input coupling means of the first high frequency amplifier stage, and the signal reproducing device is connected to the output coupling means of the last amplifier stage.

6. Radio receiving apparatus including, in combination, a high frequency amplifier having one or more relatively high frequency amplifying stages, each of said stages including input and output direct capacitative coupling means, comprising a pair of uncoupled inductors having a common connection and a common condenser connecting said common connection to ground, an input circuit connected to said high frequency amplifier through the first said input coupling means, a detector connected to the output coupling means of said high frequency amplifier, means connecting the output circuit of said detector to the common connection of one of said input coupling means of an amplifying stage, a signal reproducing device, a low-frequency pass filter, and means connecting said signal reproducing device to the common connection of an output coupling means following said one input coupling means through said low-pass filter.

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