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H. A. AFFEL

CARRIER RECEIVING SYSTEM

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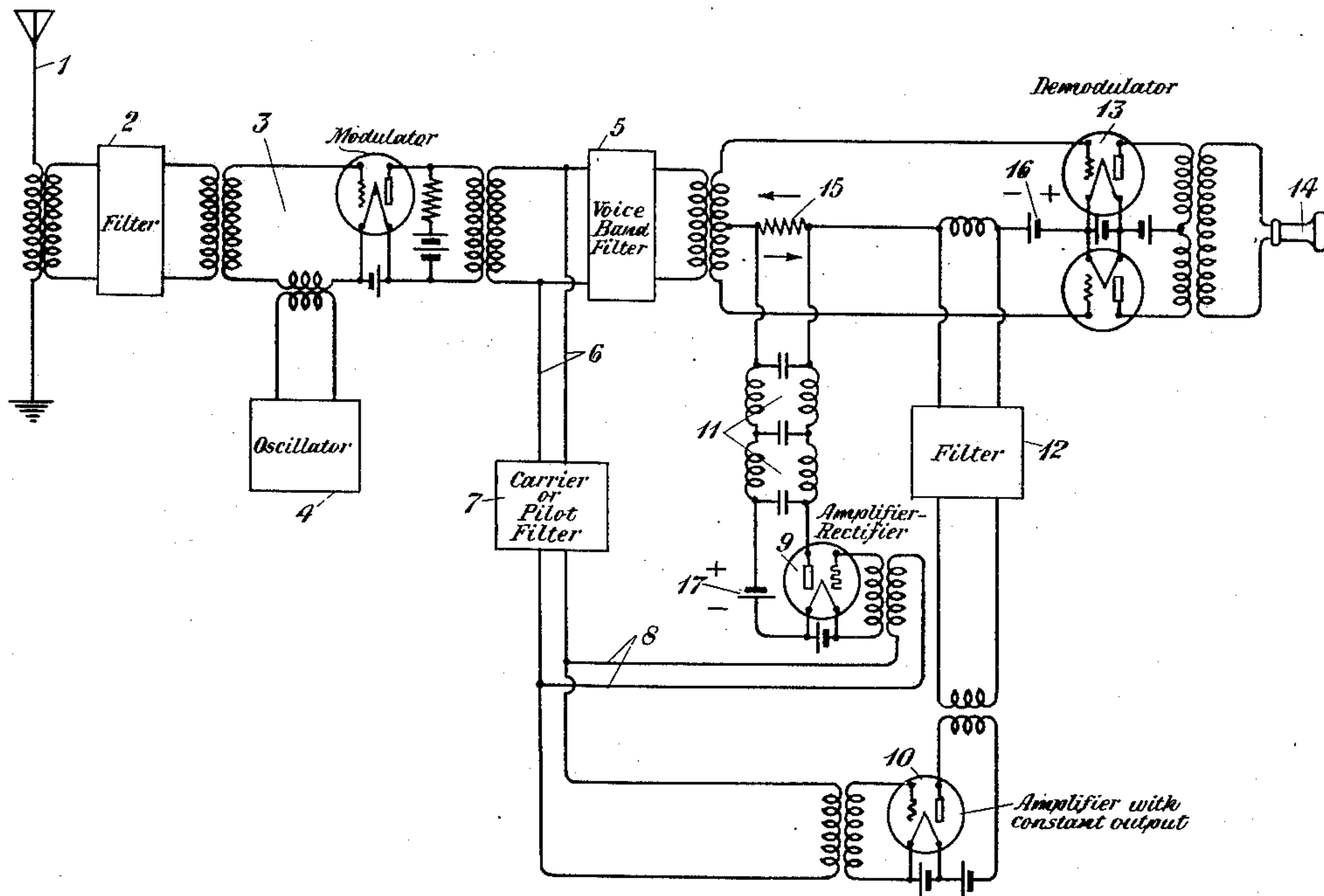


Fig. 1

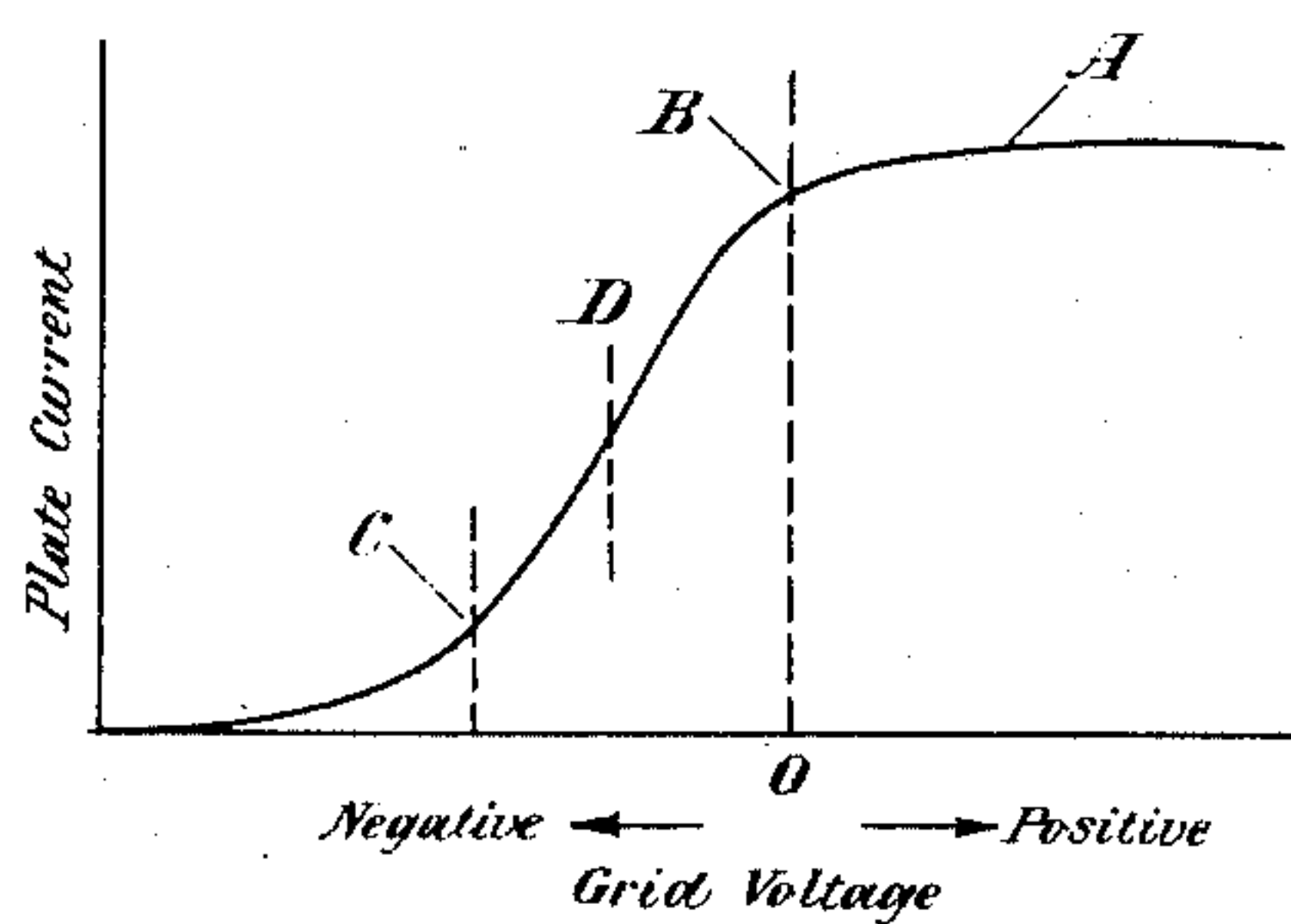


Fig. 2

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UNITED STATES PATENT OFFICE.

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CARRIER-RECEIVING SYSTEM.

Application filed March 23, 1926. Serial No. 96,887.

This invention relates to arrangements for stabilizing the overall transmission equivalent of long distance carrier or radio telephone circuits, or in other words, to compensate for the fluctuations in transmission or fading effects experienced in such circuits. The invention is particularly applicable to the case of a very long circuit, such as a transatlantic circuit, using relatively low frequencies and carrier suppression method of operation.

In accordance with the arrangements of this invention, at the transmitting station, instead of providing for complete suppression of the carrier, sufficient carrier current is permitted to flow into the transmitting antenna circuit to provide a pilot frequency which is used at the receiving circuit as a means of stabilizing the output thereat. This pilot frequency is also utilized at the receiving station to provide the necessary demodulating frequency. In addition to stabilizing the receiver output and overcoming fading effects, or fluctuations in transmission, the arrangements of the invention present other distinct improvements over former systems in that the transmitted carrier current required for the above mentioned purposes need only be relatively weak as compared to the carrier current which would be transmitted to the line in a regular carrier transmission type of system, in which case the carrier energy must represent several times the voice energy in order to insure sufficient carrier in a self-detection type demodulator for good quality speech. By permitting only a relatively small amount of carrier to flow as compared with the side-band energy, a very beneficial result will be apparent with respect to the amplifiers at the transmitting station, as the capacity of these amplifiers will be governed substantially by the useful side-band energy alone. Other features and purposes of the invention will appear more fully from the following detailed description thereof.

The invention may be more fully understood from the following description, together with the accompanying drawing, in the Figures 1 and 2 of which the invention is illustrated. Fig. 1 is a circuit diagram of a receiver circuit embodying the invention, while Fig. 2 illustrates graphically the operating characteristics of one of the demodulators.

As has been previously pointed out, the carrier component at the transmitting station will not be completely suppressed and a portion thereof will accordingly be received at the antenna 1 of Fig. 1. This incoming energy will be transmitted through a circuit including the filter 2, which is provided for the purpose of discriminating against the incoming frequencies of other stations which are not wanted and which might overload the modulator 3 into which the desired signal is next led. This modulator circuit 3 is provided with the oscillator 4 which provides a beating frequency which will cause a step-down of the radio signal frequency to a relatively low frequency, say for example, of the order of 5000 cycles. This is done because at this lower frequency selecting circuits can be made to effectively operate with only a hundred cycles or so available for separating the side band and carrier frequencies. The stepped-down signal is then led into two selective circuits, one of which includes the filter 5 which will transmit a side band, and another of which, the circuit 6, includes the filter 7 which will transmit the carrier or pilot frequency. The side band is transmitted through filter 5 to the input of a duplex vacuum tube demodulator 13 of the type illustrated in the United States Patent No. 1,343,306, to J. R. Carson. The output circuit of the demodulator 13 is associated with a receiver circuit including the receiver 14.

The carrier or pilot frequency is transmitted over the circuit 6 which includes the filter 7, which will pass the carrier frequency as stepped down, but will not pass the side-band frequencies. This carrier or pilot frequency is now employed for two purposes. It is transmitted to the input of an amplifier 10, which has its constants so arranged, as is well known in the art, as to be of the overload type with substantially constant output for varying input energy. Hence, regardless of fluctuations in transmission and fading effects, the output energy from the tube 10 will be constant. In the output circuit of tube 10 will be provided a filter 12 to suppress harmonics of the pilot frequency which might be caused by the action of a tube of this type. This constant pilot frequency will then be applied to the demodulator circuit as shown, to which the side band frequencies have been transmitted.

ted and demodulation will take place in a well-known manner.

Another portion of this pilot or carrier frequency is transmitted over circuit 8 to an amplifier-rectifier tube 9. The pilot frequency is hereby rectified and then transmitted through the low pass filter 11 and through a resistance 15 included in the grid circuits of the demodulator 13, whereby it may control the potential of the grids. In other words, the pilot frequency is utilized in this manner to control the effective gain of the demodulator circuit. This may be more fully understood from reference to Fig. 2, wherein is shown graphically a curve A illustrating the operating characteristics of the demodulator 13. At point B on the curve the grid voltage is zero. At a point such as C near the knee of the curve, the grid voltage is negative. It is at this point that the demodulator operates at optimum value. Accordingly it will be seen that any decrease in the negative voltage to a point such as D would cut down the effective gain of the demodulator. Consequently, the grid battery 16 is adjusted so that the demodulator will function at optimum value when the incoming energy is of normal magnitude. Any increase in the incoming energy above normal would result in an increased flow of current in the plate circuit of the rectifier tube 9. It will be seen that the connections to resistance 15 are such that the voltage drop through that resistance due to current flowing in the output of the rectifier tube will oppose the voltage of the battery 16. This is indicated by the arrows. Accordingly, an abnormal increase in the incoming energy will serve to so increase the current opposing that of the grid battery that the negative grid voltage will be reduced, for example, to a point such as D, and the demodulator gain will be cut down. Conversely the gain will be increased in the case of an incoming weak signal. In this manner the received carrier acting as a pilot channel is utilized both for purposes to gain control and synchronization.

While the invention has been illustrated in certain specific forms which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. The combination of a carrier transmitting station wherein the carrier frequency is only partially suppressed and a carrier receiving station comprising a modulator for

reducing the frequency of the incoming signal wave, a selective circuit associated with the output of said modulator and adapted to transmit the side band component of said reduced signal wave, a second selective circuit associated with the output of said modulator and adapted to transmit the carrier component of said reduced signal wave, a demodulator having its input circuit associated with said side band selective circuit, a rectifier associated with said second selective circuit whereby said carrier component may be rectified, and means to apply said rectified carrier component current to the grid circuit of said demodulator so that the voltage of said rectified current will oppose the normal grid voltage.

2. The combination of a carrier transmitting station wherein the carrier frequency is only partially suppressed and a carrier receiving station comprising a modulator for reducing the frequency of the incoming signal wave, a selective circuit associated with the output of said modulator and adapted to transmit the side band component of said reduced signal wave, a second selective circuit associated with the output of said modulator and adapted to transmit the carrier component of said reduced signal wave, a demodulator having its input circuit associated with said side band selective circuit, an amplifier having a constant output characteristic included in said second selective circuit, means to associate the output of said amplifier with said demodulator so that the carrier component transmitted therethrough will operate as a beating frequency, a rectifier associated with said second selective circuit whereby said carrier component may be rectified, and means to apply said rectified carrier component current to the grid circuit of said demodulator so that the voltage of said rectified current will oppose the normal grid voltage.

3. The method of stabilizing the volume output of a receiving set in a carrier system in which the transmitted carrier is partially suppressed, which consists in separating at said receiving set the carrier component and the side band component, subjecting the side band component to demodulation, rectifying the carrier component, and utilizing the voltage of the rectified carrier component to oppose the grid voltage utilized for demodulating said side band component.

In testimony whereof, I have signed my name to this specification this 22nd day of March, 1926.

HERMAN A. AFFEL.