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E. E. CLEMENT

RADIO DISTRIBUTING SYSTEM

Original Filed Sept. 25, 1924

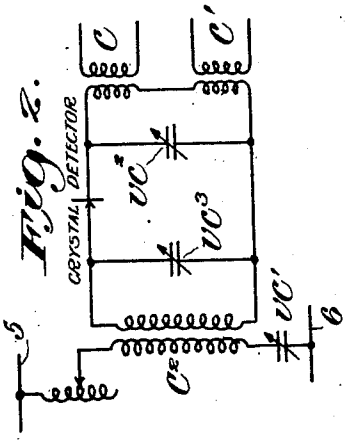


Fig. 2.

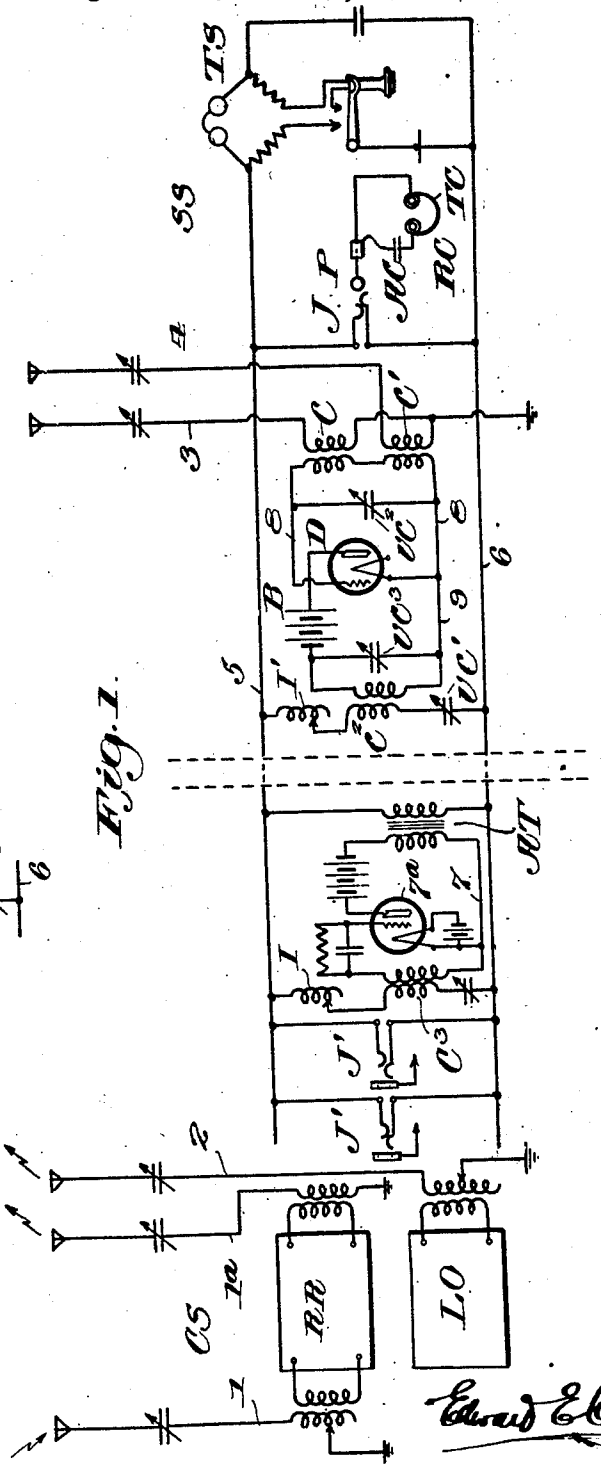


Fig. 1.

Inventor

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UNITED STATES PATENT OFFICE.

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RADIO DISTRIBUTING SYSTEM.

Application filed September 25, 1924, Serial No. 739,832. Renewed February 11, 1926.

To all whom it may concern:

Be it known that I, EDWARD E. CLEMENT, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Radio Distributing Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to radiophone exchange systems and has for its object to simplify and improve methods of controlling the broadcast distribution of intelligence.

Briefly stated, the invention comprises a radio-wire system, in which two sets of waves are radiated at different frequencies, preferably from the central station, and both sets are received at each subscriber's station, and by means of a special mechanism, the combined or resultant potentials are impressed upon the subscriber's circuit, whereby oscillations at a frequency equivalent to the beat or differential between the two primary frequencies, will be produced in the subscriber's line to central, which is tuned to said beat frequency. The oscillations thus set up in this resonating circuit are of long wave length, preferably of the order of 10,000 meters, which corresponds to a frequency of 30 kilo cycles per second. I do not restrict myself to this particular frequency of wave length, but in the average local subscriber's telephone circuit, I have found such wave lengths to be suitable. At the central station end of the line, a detector, with or with amplifiers, (both radio and audio), receives the radio oscillations, detects and rectifies the same, and returns corresponding audio frequency waves over the line to the subscriber's station, where they are rendered intelligible by suitable receiving apparatus, not responsive to the primary or beat waves.

I shall describe and illustrate the wave transformation herein as being from primary to beat wave frequency, and then through a central office detector to audio frequency, so that audio frequency waves will flow back through the subscriber's line. With this specific form of the invention, the subscriber needs no special receiving apparatus, and may even use his ordinary telephone receiver for receiving the modulations brought in on the radio carrier waves. It is obvious however, that instead of using this very simple arrangement, I may cause the beat waves produced at the substation to oscillate in the line, so as to affect and be amplified by a radio amplifier tube or tubes, that is to say, in one or more stages, at the central station, and sent back over the line thus amplified, to be picked up by the subscriber, and detected, rectified and rendered audible at his station in the usual way.

Certain advantages inhere in this arrangement at the central office. One is in respect to the simplicity of line connections, since all radio transmission is through the ether, and the only terminal attachments necessary are multipled taps across the lines, each containing the tuning elements, and one coil of a coupler. At both ends of the line, these are the only elements that need physical attachment thereto, and the tuning is such that audio frequency telephone currents or battery currents are entirely unaffected thereby. Another advantage at the central office is the concentration of detector tubes and circuits at central with the battery supply and where constant inspection and care are rendered easy and simple.

This system is intended to be used for distant receiving and distribution or for local broadcasting. For distant receiving the central office apparatus includes a tuned receiving antenna circuit and a relay transmitter, which sends out the same radio waves amplified; also a local heterodyning transmitter with a properly tuned aerial. The modulations in this case are carried on the relayed waves, and the local heterodyne waves may be unmodulated. Where local broadcasting is desired however, a second modulated local oscillator circuit is provided, which takes the place of the relay transmitter for distant waves. Thus with two local oscillators, it follows that either train of waves or both may be modulated, and this affords means to give out local programs limited to the subscribers only, without interfering with individual subscriber's reception of distant stations when practiced with independent apparatus.

My invention is illustrated in the accompanying drawings, in which—.

Fig. 1 is a diagram showing a complete

equipment for practicing the invention, with vacuum tube detectors used at both the subscribers' and central stations.

Fig. 2 is a similar diagram of a fragment of the subscriber's circuit showing a crystal detector used in place of the vacuum tube.

Referring to Fig. 1, at the central station are indicated a radio receiving and relaying apparatus RR and local oscillator LO. The radio relaying apparatus RR has tuned antenna circuits 1 and 1^a, the local oscillator has a tuned antenna circuit 2. The radio relay may send out its local reinforced waves on a separate aerial, or on the antenna 1 or the antenna 2, as found expedient in practice. It is quite obvious that interference between these trains of waves can produce no ill effect, since they are intended to heterodyne at the subscriber's station and in the subscriber's wired line circuit. At the subscriber's station 3 is one antenna circuit tuned to the frequency transmitted by the radio relay RR, and 4 is a similar antenna circuit tuned to the frequency of the central office local oscillator LO. If it be desired to avoid tuning entirely at the subscriber's station, it may be done in the following manner: provide the radio relay set RR with either audio or radio means (such as a primary heterodyne circuit) to change the frequency of the modulated waves received from distant stations over the antenna 1, so that they will always go out locally on a constant wave length. In such case, the local oscillator LO would also be tuned for a constant wave length, and it necessarily follows that the tuning of the subscriber's antennæ 3 and 4 may then be for constant wave lengths as well as that of any local resonating circuit connected therewith.

At the subscriber's station I have shown the usual telephone set TS and a jack J bridged across the line to receive a plug P constituting the terminal of a local receiving circuit RC containing the telephone receiver TC and talking condenser AC, the purpose of this being to prevent closing the line for battery current while listening to the relayed and amplified audio frequency currents coming from central.

At the central station J'—J' represent the ordinary standard switchboard terminals of any desired type, to which the line 5—6 is connected for telephone communication with the subscriber's station SS. The dotted lines in the middle of the figure represent that portion of the line which extends between the subscriber's station and the central office. Across the ends I bridge tuning elements I—I' and VC—VC', and coupler coils C^2 and C^3. The line circuit is tuned by means of these devices, and is maintained in oscillation during receiving.

At the subscrber's station the detector tube D has its grid circuit 8 coupled through the coils C and C' to the antenna circuits; and its plate circuit 9 coupled to the line through the coils C^2. The input circuit 8 of the tube may be tuned by means of bridged condenser VC^2, to the mean frequency of the waves received from the two antenna circuits 3 and 4, and the output circuit 9 including one side of the coupler C^2 is tuned by means of the condenser VC^3 to the beat frequency, the other side of the coupler C^2 being similarly tuned by condenser VC'. As usual in heterodyning circuits, the coupler C^2 acts as a tuned filter to pass only the beat or long waves to line. The central office coupler C^3 has its secondary coil connected to the grid circuit of a detector tube 7^a, whose plate circuit 7 is connected to the primary of an audio frequency transformer AT, the secondary of which is bridged across the line wires 5—6. The long or beat waves sent over the line from the subscriber's station are thus demodulated and audio frequency waves are fed back over the line to the subscriber's station, where they become intelligible in the receiving instrument TC or its equivalent. It is obvious that any desired number of stages of superaudio frequency amplification, or audio frequency amplification may be inserted before and after the detector tube 7^a. This use however of an amplifier per line or a plurality of amplifiers per line in a system for distributing broadcast matter, is not claimed herein, being described and claimed in my copending application Serial No. 89,410, filed February 19, 1926.

Fig. 2 shows a form of crystal detector circuit which may be used at the subscriber's station instead of the vacuum tube detector circuit of Fig. 1. In this case the couplers C—C' and C^2 are tuned as before, to the mean of the received frequencies and to their beat frequency respectively.

What I claim is:

1. In a radiophone exchange system, a central station and subscribers' stations and wired line circuits interconnecting them, means to transmit modulated waves at radio frequency, means at the central station to transmit waves at heterodyning frequencies therefor, means at the subscribers' stations for receiving both frequencies, means causing them by heterodyning to produce in the subscriber's line circuit a beat frequency, and means in said circuit at the central station for detecting and rendering intelligible to the subscriber the modulations carried upon original carrier waves, and transferred therefrom to the beat waves.

2. In a radiophone exchange system, a central station and subscribers' stations with wired line circuits interconnecting them, means for transmitting modulated radio waves over the area containing the subscrib-

ers' stations, means at the central station for relaying and amplifying said waves, means also at the central station for producing and radiating waves at heterodyne frequencies, means at a subscriber's station for receiving both the original and heterodyning waves and impressing their oscillating potentials upon the subscribers' line circuit so as to produce modulated beat frequency waves therein, means connected to the line at the central station to demodulate the same and transfer the modulations to the line circuit, and means at the subscribers' station responsive to said modulations.

3. In a radiophone exchange system, a central station and subscribers' stations with wired line circuits interconnecting them, means for transmitting modulated radio waves over the area containing the subscribers' stations, means at the central station for relaying and amplifying said waves, means also at the central station for producing and radiating waves at heterodyne frequencies, means at the subscribers' stations for receiving both the original and heterodyning waves, means including a detector for impressing the oscillating potentials of said waves upon the subscribers' line circuits so as to produce modulated beat frequency waves therein, detector means for said beat waves connected with a subscriber's line at the central station, and means at the subscriber's station responsive to said modulations.

In testimony whereof I hereunto affix my signature.

EDWARD E. CLEMENT.