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TRANSMISSION OF SOUND AND IMAGES

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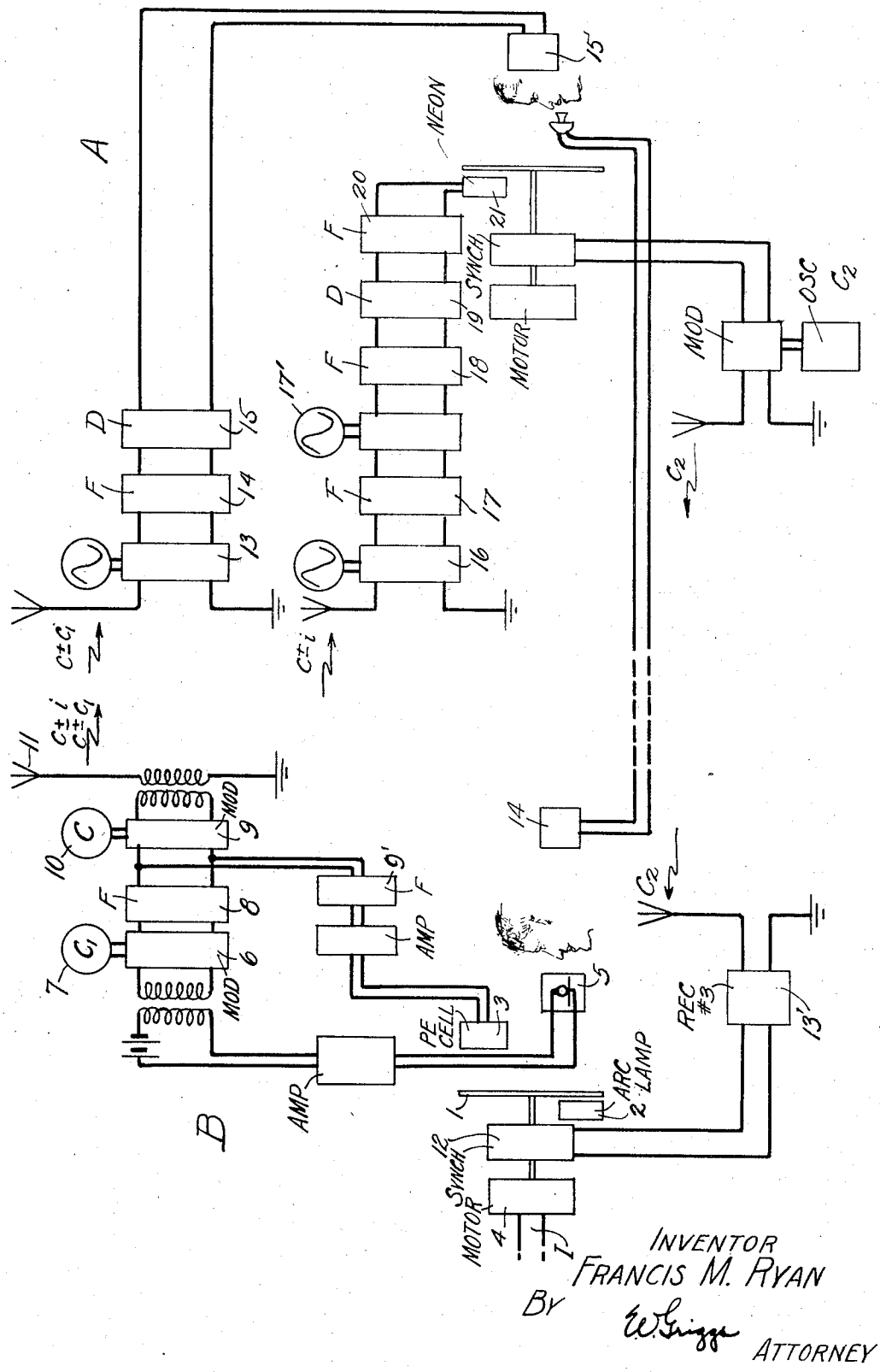

INVENTOR
FRANCIS M. RYAN
BY E. W. Griggs
ATTORNEY

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FRANCIS M. RYAN, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

TRANSMISSION OF SOUND AND IMAGES

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This invention relates to the art of electrical communication and has for an object the simultaneous transmission of an image of a distant speaker and of his speech in an efficient and economical manner.

Television, that is, the transmission to a remote point of an image of a distant object or scene is based upon the analysis of the remote scene point-by-point in a time sequence and the transmission of energy varying according to the variations from point-to-point of the light and shade characteristic of the scene. The transmitted energy is then utilized to control at a receiving point the building up or formation of a reconstructed image, the image being formed point-by-point in a time sequence corresponding to that of the analysis of the remote scene which is being scanned at the transmitting station. This requires at the transmitting station apparatus capable of analyzing point-by-point the scene to be transmitted and producing energy which varies correspondingly. It requires at the receiving station apparatus capable of reproducing an image point-by-point and for converting the received transmitted energy into variations of light with which to illumine the successive points. It further requires that the scanning apparatus at the transmitting station and the image reproducing apparatus at the receiving station be held in close synchronism and isochronism, so that for each point in the scene at the transmitting station there will be in the image produced at the receiving station a point corresponding not only in position but also in its illumination or light and shade characteristics. In order to produce the impression of a single continuous image the phenomenon of persistence of vision is brought into play. It is only necessary that the image at the receiving station be formed at least as frequently as 16 or more times per second in order to create the illusion that the image is continuous with respect to time. Although in the foregoing paragraphs analysis and reproduction of the picture have been discussed as a point-by-point problem, it will, of course, be understood that the points are in fact elemental areas which may be of any desired size depending upon the desired degree of detail and the requisite faithfulness to the original of the likeness or image to be reproduced. Such a system is briefly described at page 1 of the New York Times, published April 8, 1927.

According to the present invention a television system is combined with a telephone system in such manner as to permit one to both see and converse with a person at a remote point. This is accomplished by causing the speech or sound waves at the remote point to modulate an intermediate carrier frequency wave so that the resulting modulated waves will occupy a frequency range above that occupied by the image forming currents. The modulated intermediate frequency carrier waves and the image forming currents are then caused to simultaneously modulate a principal carrier of frequency suitable for radio transmission. At the receiving station the incoming energy is received and detected to separately reproduce speech currents and image forming currents corresponding to those produced at the transmitting station. The speech currents operate the telephone receiver and the image forming currents control reproduction of the image.

The novel features which are considered characteristic of the invention are pointed out with particularity in the appended claims. The invention itself, however, both as to details of its organization and its mode of operation will be best understood by reference to the following description taken in connection with the accompanying drawing which illustrates a combined telephone and television system designed to permit a person at station A to see and converse with another person at a remote station B.

The scanning apparatus of the television system may consist of a perforated rotating disc which permits pencils of light from a source of light of great intensity to sweep the object (in this case the countenance of the person at station B) in successive arcs and thus to traverse substantially its entire area. At any particular instant, a beam

or pencil of light incident upon the object strikes that object at a definite point or elemental area and the light reflected by the object depends upon the reflecting power of that particular point or elemental area upon which the beam or pencil is incident. One or more photoelectric cells so placed as to be screened from light except that reflected from the object will accordingly respond to variations in the reflected light to yield a varying electric current which may be transmitted to the distant point to reproduce an image. At the receiving station these image-forming currents may be caused to control the instantaneous illumination of a device such as a neon lamp. A perforated disc apparatus similar to that used at the transmitter may be placed in front of the neon lamp. An observer viewing the disc will see successive portions of the neon tube point-by-point in a time sequence and as the illumination from the tube is rising and falling in consonance with the reflected light at the transmitting station the observer will "see" an image of the distant object. Such a system is disclosed and claimed in application Serial No. 227,649, filed October 21, 1927, F. Gray.

The scanning and image reproducing apparatus may be held in synchronism by any suitable means. An example of such apparatus is diclosed and claimed in U. S. Patent 1,763,909, issued June 17, 1930, to H. M. Stoller-E. R. Morton.

It is apparent that the variations in the image current energy transmitted will have a frequency of greater or less range depending upon the total area of the image which it is desired to reproduce, the number of times per second in which it is to be scanned, and the area of the elemental "points." It has been found that satisfactory pictures may be transmitted using a frequency transmission range of from about 10 to about 20,000 cycles per second. In other words, the energy to be transmitted, which varies irregularly in accordance with the lights and shadows of the image as it is analyzed from point-to-point, consists of essential elemental components ranging from substantially zero to substantially 20,000 cycles per second.

Speech sounds, as is well known, comprise an essential range of from approximately 0 to 3,000 cycles and in the case of high quality speech or music it is frequently desirable to use a much broader range extending up to 5,000 or 6,000 cycles or even more. In addition to the energy for reproducing the image and the speech currents it is necessary to transmit additional energy for maintaining the transmitting and receiving apparatus in synchronism. In general it will be found desirable to utilize for this purpose currents of frequencies within the so-called voice frequency range. It will accordingly be apparent that the energy for transmitting the image and that for transmitting the speech will lie in frequency bands which overlap. One of the principal objects of this invention is to enable transmission of these energies over a single channel as for example by means of a single radio transmitter.

Referring to the drawing the person at station B is shown facing a scanning disc 1 behind which is a source 2 of intense light, a pencil or beam from which passes through the perforated disc and is reflected from the face of the speaker at that station upon one or more photoelectric cells 3. A driving motor 4 is provided with a shaft on which the disc 1 is mounted and causes the light pencils through the disc to completely scan the speaker at least 16 times per second. Accordingly photoelectric cell 3 sets up in its circuit currents having components of frequencies ranging from practically zero to over 20,000 cycles per second. At the same time, as the speaker at station B speaks, speech currents of approximately 100 to 3000 cycles per second are transmitted by microphone 5 to the input circuit of modulator 6 on which intermediate carrier frequency oscillations of 30,000 cycles per second (C_1) are impressed by oscillator 7. The resulting modulated speech currents are impressed through a selective circuit 8 on the input of a modulator 9 together with image forming currents from the photoelectric cell 3 transmitted through the selective circuit 9′ and the speech modulated wave and image currents accordingly modulate the radio carrier wave (C) supplied by oscillator 10. The radio carrier wave modulated by both speech and image forming currents is radiated from antenna 11. It will be understood that suitable amplifiers are provided wherever desirable and particularly in the circuit associated with the output of the photoelectric cell 3.

The motor 4 at station B is so designed that its normal speed is approximately that required to hold disc 1 in synchronism with the corresponding disc at station A. A synchronizing device 12 operated by energy from radio receiver 13′ holds the motor in exact synchronism with that at station A.

For simplicity of illustration a wire circuit is indicated connecting the microphone circuit at station A to the speech receiver 14 at station B.

The wave radiated from the transmitting station comprises separate groups of components, two of which represent speech modulated waves and a third a carrier wave modulated by image currents.

The receiving station comprises two receivers, one selective of one group of com-

ponents constituting a wave modulated by speech, and the other adapted to select the image-current modulated wave.

The speech modulated wave is combined in the device 13 with local oscillations to produce an intermediate frequency wave modulated by speech which is selected by the filter or tuned circuit 14 and detected by the detector 15 to produce the speech currents which are supplied to the telephone receiver 15′ used by the observer at the receiving station.

At the second radio receiver the incoming wave carrying the image currents is combined with locally supplied oscillations in the demodulator 16 to produce an image-current modulated wave of frequency different from the transmitted carrier, which is selected by the filter 17. The selected wave is combined with oscillations supplied by a local source 17′ to produce an image current modulated wave. This wave is selected by the filter 18 and detected in the detector 19 to yield the image currents which are selected by the filter 20 and supplied to the neon lamp 21 for controlling the reproduction of the image.

Wherever desirable amplifiers may be used, and such amplifiers may be three-electrode space discharge tubes.

By way of example, the following frequencies were used at the transmitting station, the carrier wave carrying the speech modulation was 30 kilocycles, the radio carrier wave 1575 kilocycles, and as a result the outgoing wave consisted of three groups of components based on 1545 kilocycles, 1575 kilocycles, and 1605 kilocycles.

The radio receiver for the speech modulated wave was selective of the wave based on 1545 kilocycles and the locally supplied oscillations were 1462 kilocycles, the intermediate frequency wave being 83 kilocycles. The receiver for the image-current modulated wave was tuned to select the wave based on 1575 kilocycles and the frequency of the locally supplied oscillations combined with this wave was 3545 kilocycles, and resulted in a modulated wave based on 5120 kilocycles. This wave was combined with oscillations of 5000 kilocycles to produce a modulated wave of 120 kilocycles.

While a particular system embodying specific details and frequency values has been described, for the purpose of disclosing the principles of the invention, it is to be understood that this invention is not limited to such specific details but only by the scope of the attached claims.

What is claimed is:

1. The method which comprises producing electric currents having a characteristic variation corresponding to the appearance of a speaker at a transmitting station, simultaneously producing other electric currents having a characteristic variation corresponding to his speech, simultaneously modulating the same carrier wave with both of said current variations in a manner such that the frequency bands covered by the respective modulations occupy different positions in the frequency spectrum and utilizing said wave at the receiving station in the production of an image of the speaker and in the reproduction of his speech so that an observer thereat may simultaneously see and hear said speaker at the transmitting station.

2. A communication system comprising means at a transmitting station for scanning the face of a speaker point by point, current controlling means for simultaneously receiving the voice of said speaker, means controlled by said scanning means for producing electric current variations corresponding to the appearance of said speaker, means controlled by said voice operated means for setting up current variations corresponding to the voice of said speaker, means for causing both said variations to simultaneously modulate the same carrier wave in a manner such that the frequency bands covered by the respective modulations occupy mutually exclusive positions in the frequency spectrum, means at a receiving station controlled by said carrier wave for producing an image of the face of said speaker, means at said receiving station controlled by said carrier current for reproducing the voice of said speaker, and means independent of said carrier for maintaining the scanning means at the transmitting station and said image producing means at the receiving station in exact synchronism.

3. An electric communication system for enabling a person at a receiving station to both see and hear a person at a distant transmitting station by means of speech and image variations carried by the same high frequency carrier wave, transmitted from the one station to the other, as modulations such that the frequency bands covered by the respective modulations occupy different positions in the frequency spectrum, comprising means for receiving said carrier wave and for obtaining therefrom low frequency speech and image variations like the originals at the transmitting station and each entirely separate from the other, means for impressing the speech variations upon a sound producing device, and means controlled by said image currents for setting up an image of the distant field of view.

4. In a television and sound transmission system having the signals confined within a continuous frequency band, means for producing and transmitting television signals grouped about a predetermined carrier frequency and occupying a relatively large portion of the frequency band, and means for simultaneously producing and transmitting related sound signals grouped about a sec-

ond predetermined sound carrier frequency separated from the television carrier and adjacent thereto and arranged to occupy a relatively small portion of the said frequency band.

5. In a television and sound transmission system having the signals confined within a continuous frequency band, means for producing and transmitting television signals grouped about a predetermined carrier frequency and occupying a relatively large portion of the frequency band, means for simultaneously producing variations corresponding to related sound signals, means for producing a carrier current of lower frequency than said first mentioned carrier and for modulating said carrier current with said sound signals, and means for modulating said first mentioned carrier with said sound modulated current in a manner such that the resultant modulation produced by the sound signals lies external to the frequency band covered by the television signals and adjacent thereto and arranged to occupy a relatively small portion of the said frequency band.

6. In a television and sound transmission system having the signals confined within a continuous frequency band, means for producing and transmitting television signals grouped about a predetermined carrier frequency and occupying a relatively large portion of the frequency band, means for simultaneously producing variations corresponding to related sound signals, means for producing a carrier current of lower frequency than said first mentioned carrier and for modulating said carrier current with said sound signals, means for modulating said first mentioned carrier with said sound modulated current in a manner such that the resulting modulation produced by the sound signals lies external to the frequency band covered by the television signals and adjacent thereto and arranged to occupy a relatively small portion of the said frequency band, means for receiving said continuous band and for obtaining therefrom low frequency sound and television signals like the originals at the transmitting station and each entirely separate from the other, means for impressing the sound signals upon a sound producing device, and means controlled by said television signals for setting up an image of the distant field of view.

7. In an electric communication system for transmitting television and sound signals by means of speech and image variations carried by the same high frequency carrier wave modulated by speech and image variations in a manner such that the frequency bands covered by the respective modulations occupy mutually exclusive but adjacent positions in the frequency spectrum, means for receiving said high frequency wave and for obtaining therefrom low frequency sound and image variations like the originals at the transmitting station and each entirely separate from the other, means for impressing the sound variations upon a sound producing device, and means controlled by said image variations for setting up an image of the distant field of view.

8. An electric communication system for enabling a person at a receiving station to both see and hear a person at a distant transmitting station by means of a high frequency carrier wave modulated by speech and image variations in a manner such that the frequency bands covered by the respective modulations occupy mutually exclusive positions in the frequency spectrum comprising means for receiving said carrier wave and for obtaining therefrom low frequency speech and image variations like the originals at the transmitting station and each entirely separate from the other, means for impressing the speech variations upon a sound producing device, and means controlled by said image currents for setting up an image of the distant field of view.

9. An electric communication system for enabling a person at a receiving station to both see and hear a person at a distant transmitting station by means of a high frequency carrier wave modulated by speech and image variations in a manner such that the frequency bands covered by the respective modulations occupy mutually exclusive positions in the frequency spectrum comprising means for receiving said carrier wave and for obtaining therefrom low frequency speech and image variations like the originals at the transmitting station and each entirely separate from the other, which includes means for separating said sound and image modulations, means for reproducing said sound variations, means for stepping up the frequency of said image modulation and for selecting one of the modulation products resulting therefrom, means for stepping-down the frequency of said selected product and selecting one of the modulation products resulting therefrom, and means for detecting the last mentioned selected modulation product to produce the image variations, means for impressing the speech variations upon a sound producing device, and means controlled by said image currents for setting up an image of the distant field of view.

10. In a television and sound transmission system having the signals confined within a continuous frequency band, means for producing and transmitting television signals grouped about a predetermined carrier frequency and occupying a relatively large portion of the frequency band, means for simultaneously producing variations corresponding to related sound signals, means for

producing a carrier current of lower frequency than said first mentioned carrier and for modulating said carrier current with said sound signals, means for modulating said first mentioned carrier with said sound modulated current in a manner such that the resultant modulation produced by the sound signals lies external to the frequency band covered by the television signals and adjacent thereto and arranged to occupy a relatively small portion of said frequency band, means for receiving said continuous band and for obtaining therefrom low frequency sound and television signals like the originals at the transmitting station and each entirely separate from the other, which includes means for separating said sound and image modulations, means for reproducing said sound variations, means for stepping-up the frequency of said image modulation and for selecting one of the modulation products resulting therefrom, means for stepping-down the frequency of said selected product and selecting one of the modulation products resulting therefrom, and means for detecting the last mentioned selected modulation product to produce the image variations, means for impressing the speech variations upon a sound producing device, and means controlled by said television signals for setting up an image of the distant field of view.

FRANCIS M. RYAN.