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2,278,788

TELEVISION TRANSMISSION SYSTEM

Filed June 14, 1939

2 Sheets-Sheet 1

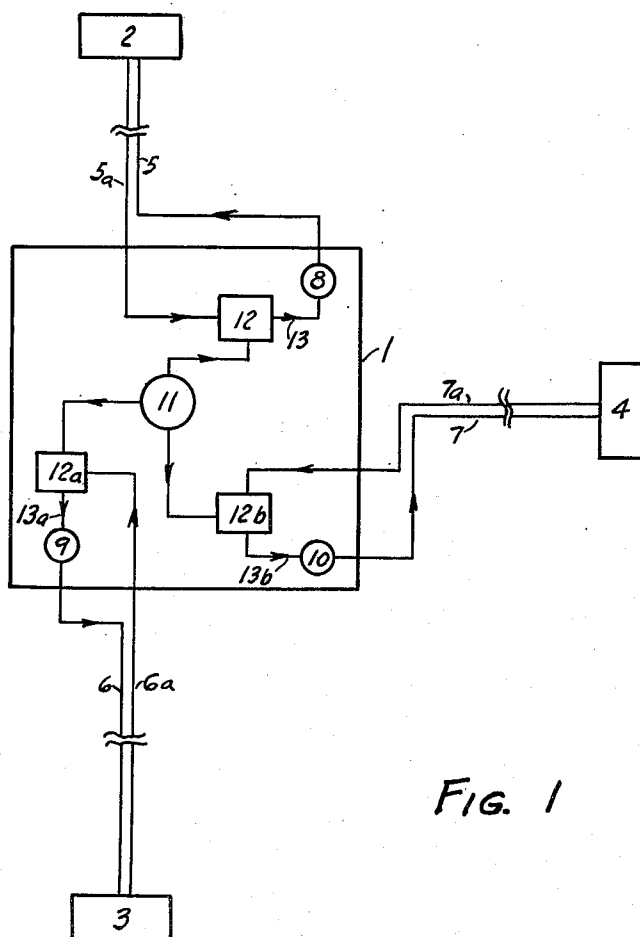


FIG. 1

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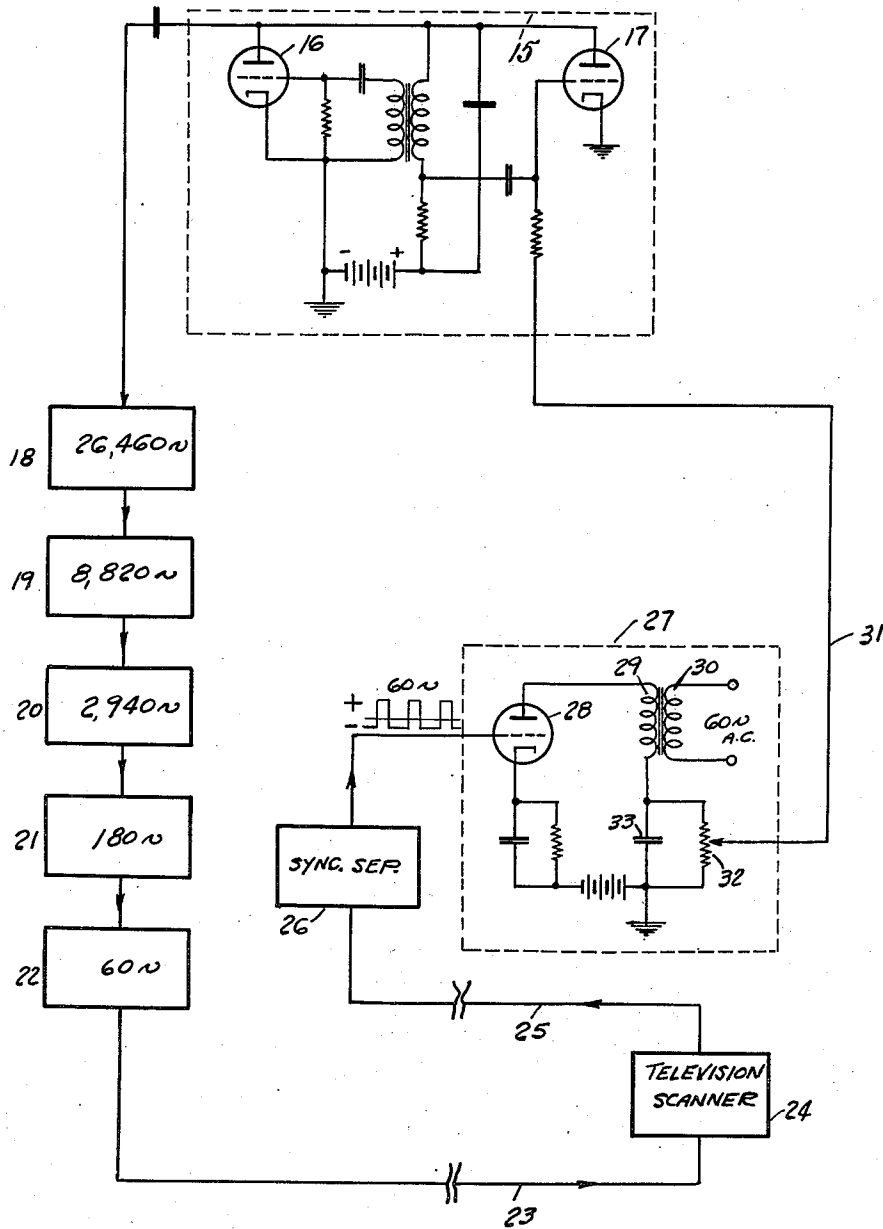


FIG. 2

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TELEVISION TRANSMISSION SYSTEM

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In Germany June 14, 1938

5 Claims. (Cl. 178—69.5)

My invention relates to a method of television transmission, and particularly to a system in which it is desired to transmit from a wireless transmitter picture signals produced by television scanners spaced at different considerable distances from the transmitter.

In such systems the scanners are usually synchronized by wire from a master impulse generator at the transmitter. The synchronizing signals are superimposed upon the picture signals at the scanner and the composite signal transmitted by wire to the transmitter. If the scanners are located at considerable and different distances from the transmitter, it will be appreciated that the returning synchronizing signals will no longer be in phase with the master impulses or with respect to each other, due to the various degrees of phase delay incurred by transmission over different lengths of wire lines.

This is particularly inconvenient in case it is desired to switch from the transmission of picture signals supplied from one scanner to that of signals from another scanner. It has been proposed to employ phase-delay networks in lines arriving from the scanners in order to be able to make the phase of the synchronizing impulses returning from the different scanners the same. This method, however, has the great disadvantage that such delay networks, through which the picture signals are also fed, cause appreciable distortion of the latter. Furthermore, such networks must be carefully and accurately balanced. The danger also exists that the constants of such networks are changed by exterior influences such as temperature, humidity and the like.

It is the object of this invention to overcome the above disadvantages; to provide a method by means of which the synchronizing impulses returning from all scanners are made to have the same phase; to provide a method by means of which compensation of the phase delay of the synchronizing impulses due to the transmission over wire lines takes place before transmission; and to provide a method by means of which the phase correctness can be automatically regulated.

Referring to the drawings, Fig. 1 shows a schematic layout while Fig. 2 shows circuit means by way of example for carrying out the invention.

Broadly considered, this invention provides for having available at the transmitter a master signal, to generate at the transmitter synchronizing signals which are transmitted by wire to the individual scanners and back again, to compare the phase of returning synchronizing signals with

that of the master signal and to regulate the phase of the synchronizing signal generator so that the phases of the master signal and of the returning synchronizing signal are in a predetermined relation, which is the same for the synchronizing impulses returning from all scanners. This regulation may be done by observation and manual readjustment, or automatically by deriving from the phase comparison a regulating voltage and using this voltage to regulate the phase of the synchronizing signal generator. Thus in this manner the phase delay due to wire transmission is compensated for before transmission of the synchronizing signals.

The invention shall now be explained more in detail in connection with the drawings. Fig. 1 schematically shows a layout embodying my invention. Central station 1 may be at the transmitter. This, however, is not necessary inasmuch as block 1 indicates the junction point of the communication channels to the individual scanners with the common transmission channel to the wireless transmitter. Thus, block 1 may indicate a mixing desk, a switching arrangement or the like. Picture scanners 2, 3 and 4 are located at various distances of considerable difference from junction point 1. Synchronizing impulse generators 8, 9 and 10 are preferably of the type having a master impulse generator at double line-scanning frequency and a number of frequency-dividing stages by means of which line-synchronizing and framing impulses are derived from this master frequency. Blocks 12, 12a and 12b are means of phase comparison. The master signal generator 11 in a preferred embodiment of the invention is merely a terminal of the 60-cycle alternating current power mains. Leads 13, 13a and 13b connect the respective phase comparators with their associated synchronizing impulse generators, while wires 5, 5a, 6, 6a, 7 and 7a connect television scanners 2, 3 and 4 with their respective associated synchronizing impulse generators and phase comparators.

Thus, Fig. 1 shows three separate scanner channels, each comprising a synchronizing impulse generator, a lead through which synchronizing impulses are fed to the scanner, a lead through which the returning synchronizing impulse is fed to the phase comparator, a lead feeding the master signal to the phase comparator, and a lead feeding the regulating voltage produced by the phase comparator to the synchronizing impulse generator. Common to all three channels is the master signal source 11. Pref-

erably the master signal is of the same frequency as the framing impulses, whereby the phase of this signal is compared with that of the returning framing impulses by the phase comparator. Hereby a regulating voltage is produced which is fed to the synchronizing impulse generator, thus adjusting the phase of the latter in such a manner that the returning framing impulses, and thereby also the line-synchronizing impulses, will be in a different predetermined phase relation with the master signal. It will be understood that in this manner, by comparing the returning framing impulse with a master signal of the same frequency, the phase of the outgoing framing signal produced by the synchronizing impulse generator is so controlled and advanced to such a degree that the phase delay incurred in wire transmission is compensated for at least in part so that the framing impulses returning from all scanners will arrive in the same phase. Inasmuch as the line-synchronizing signals are in a rigid phase relation with the framing impulses if produced by synchronizing generators, as briefly described above, the phase of the line-synchronizing impulses will be shifted in the same manner as that of the framing impulses.

While I have shown in Fig. 1 separate synchronizing impulse generators and phase comparators for each television scanner channel, this is not absolutely necessary. If all synchronizing impulse generators and phase comparators are identical, it is also possible to operate a system with a multitude of scanners with only two synchronizing impulse generators and phase comparators, inasmuch as only one set of apparatus is required for the signals being transmitted by wireless, while the other set is required for preparing another scanner channel to which it is desired to switch over.

Fig. 2 shows, by way of example, in more detail a means for carrying out the method in accordance with my invention. Block 15 indicates a sine-wave oscillator comprising an oscillator tube 16 and a frequency-regulating tube 17 to which a regulating voltage is applied through lead 31. It will be understood that any oscillator circuit allowing frequency control by means of a regulating voltage can be used as well. Oscillator 15 is made to oscillate with double line frequency which, according to present standards, is 26,460 cycles. The generated sine-wave is applied to a device 18, indicated by block diagram only, which converts the sine wave into a square-top wave of the same frequency. This square-topped wave is fed through a chain of frequency dividers 19, 20, 21 and 22, the output of which is a 60-cycle square-topped framing impulse. Such frequency-dividing chains are well known in the television art and may comprise a plurality of multivibrator circuits tuned to different frequencies and each synchronized by the preceding impulse generator operating at a higher frequency. Inasmuch as various devices of this type are well known in the art, it is not deemed necessary to explain these in further detail as any well-operating chain can be used for this purpose. The line-scanning frequency is preferably derived from the square-topped impulses of 26,460 cycles produced by device 18 by means of a frequency division of 1 to 2. This is not shown because it is not deemed essential to the invention. It will, however, be understood that such a chain will produce line-synchronizing impulses at a frequency of 13,230 cycles and framing impulses at 60 cycles which

are in a rigid phase relation with respect to each other.

The output of divider 22, which is a 60-cycle preferably square-topped framing impulse, is fed through lead 23 to a television scanner 24 placed at a distance from the afore-described apparatus. This television scanner may be of any of the various types and may use a picture analyzing device such as, for instance, the Farnsworth image dissector. As described above, it is required to return the framing impulse to the above-described apparatus. For this purpose a separate lead 25 may be used. It is also possible to superimpose the framing impulses upon the picture signals and transmit both as a composite television signal. They may also be transmitted by means of an auxiliary carrier generated at the television scanner. Line-synchronizing impulses may also be superimposed upon the picture signals and framing signals. The specific way in which the framing impulses are returned is not material so long as return lead 25 carries returning 60-cycle framing impulses. In case a composite television signal is returned, a synchronizing separator 26 may be provided, the output of which must be a positive 60-cycle square-topped impulse. In case an auxiliary carrier is made use of, it is, of course, necessary to provide a rectifier. Such means, being well known in the art, are not believed to require any detailed explanation. The returning positive 60-cycle framing impulse is then fed to the control grid of tube 28 in phase comparator 27. In the plate circuit of tube 28 there is connected a transformer primary winding 29 in series with a shunt-connected resistor 32 and smoothing condenser 33. The master signal mentioned earlier in this description with a frequency of 60 cycles is fed to the secondary winding 30 of the same transformer. This master signal is preferably sinusoidal and can be derived directly from the 60-cycle power mains as it is common to interlock the television scanning pattern with the alternating-current power mains.

Phase comparator 27 operates as follows: The cathode of tube 28 is so biased that no plate current can flow in the absence of a positive 60-cycle square-topped impulse upon the grid. Upon arrival of such an impulse, the tube draws current and a voltage drop is produced across resistor 32. The time constant of the shunt combination of 32—33 is so chosen that the voltage across resistor 32 is substantially direct. It is, of course, also possible to replace condenser 33 by more elaborate filtering means should this be found necessary. It is evident that the plate current in tube 28 is a function of the instantaneous grid voltage as well as the instantaneous plate voltage, which latter is cyclically varied by means of the induced voltage from the transformer secondary winding. Thus as the duration of the 60-cycle impulses is only a fraction of $\frac{1}{60}$ second, it may readily be seen that the plate current in tube 28 will vary in accordance with the phase relation between the 60-cycle sine wave applied to transformer secondary winding 30 and the 60-cycle impulses applied to the control grid of tube 28. Thus a direct current regulating voltage is generated across resistor 32, the magnitude of which varies in accordance with the phase shift between the 60-cycle sine wave and the square-topped impulses. This voltage is fed through lead 31 to the control grid of regulator tube 17 of the master sine-wave oscillator 15, thus regulating its frequency and phase in such a manner that the phase relation between the 60-cycle

master sine wave and the returning framing impulses automatically adjusts itself to the same relation regardless of the length of leads 23 and 25, that is, the distance of the scanner from the impulse generating equipment or, in other words, the phase delay incurred by the wire transmission.

While I have explained my method of television transmission in connection with some specific means, I am well aware that this method can be carried out by other means within the scope of the appended claims and I do not wish to be limited to the apparatus above described.

What I claim is:

1. In a television system, apparatus including a source of a master signal, a source of synchronizing signals and a phase comparator, a television scanner remote from said apparatus, means for transmitting said synchronizing signals to said scanner, means for returning said synchronizing signal from said scanner to said apparatus and specifically to said phase comparator, means for applying said master signal to said comparator, means for deriving from said comparator a regulating voltage in accordance with the phase difference between said returning synchronizing signal and said master signal, and means for controlling said source of synchronizing signals with said regulating voltage.

2. In a television system, apparatus including a source of a master signal, a source of synchronizing signals, said master signal and said synchronizing signals having the same frequency, and a phase comparator, a television scanner remote from said apparatus, means for transmitting said synchronizing signals to said scanner, means for returning said synchronizing signals from said scanner to said apparatus and specifically to said phase comparator, means for applying said master signal to said comparator, means for deriving from said comparator a regulating voltage in accordance with the phase difference between said returning synchronizing signals and said master signal, and means for controlling said source of synchronizing signals with said regulating voltage.

3. In a television system including apparatus for generating synchronizing signals located at a first point and a television scanner at a second point remote from said apparatus, the method of operation comprising the steps of generating synchronizing signals at said first point, transmitting said signals to said second point, returning said signals to said first point, and controlling the phase of said signals at the point of generation in such a manner as to compensate for at least a portion of the phase delay incurred by said signals in transmission between said points.

4. In a television system including apparatus for generating synchronizing signals located at a first point and a television scanner at a second point remote from said apparatus, the method of operation comprising the steps of generating synchronizing signals at said first point, transmitting said signals to said second point, returning said signals to said first point, and advancing the phase of said signals at the point of generation in such a manner as to compensate for at least a portion of the phase delay incurred by said signals in transmission between said points.

5. In a television system including separate apparatus for generating a master signal and synchronizing signals, said apparatus being located at a first point, and a television scanner located at a second point remote from said first point, the method of operation comprising the steps of generating a master signal and synchronizing signals at said first point, transmitting said synchronizing signals to said second point, returning said synchronizing signals to said first point, comparing the phases of said master signal and said returning synchronizing signals, adjusting the value of a regulating voltage in accordance with the phase shift between said master signal and said returning synchronizing signals, and controlling the phase of said synchronizing signals at the point of generation in accordance with said regulating voltage, so as to compensate for at least a portion of the phase delay incurred by said signals in transmission between said points.

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