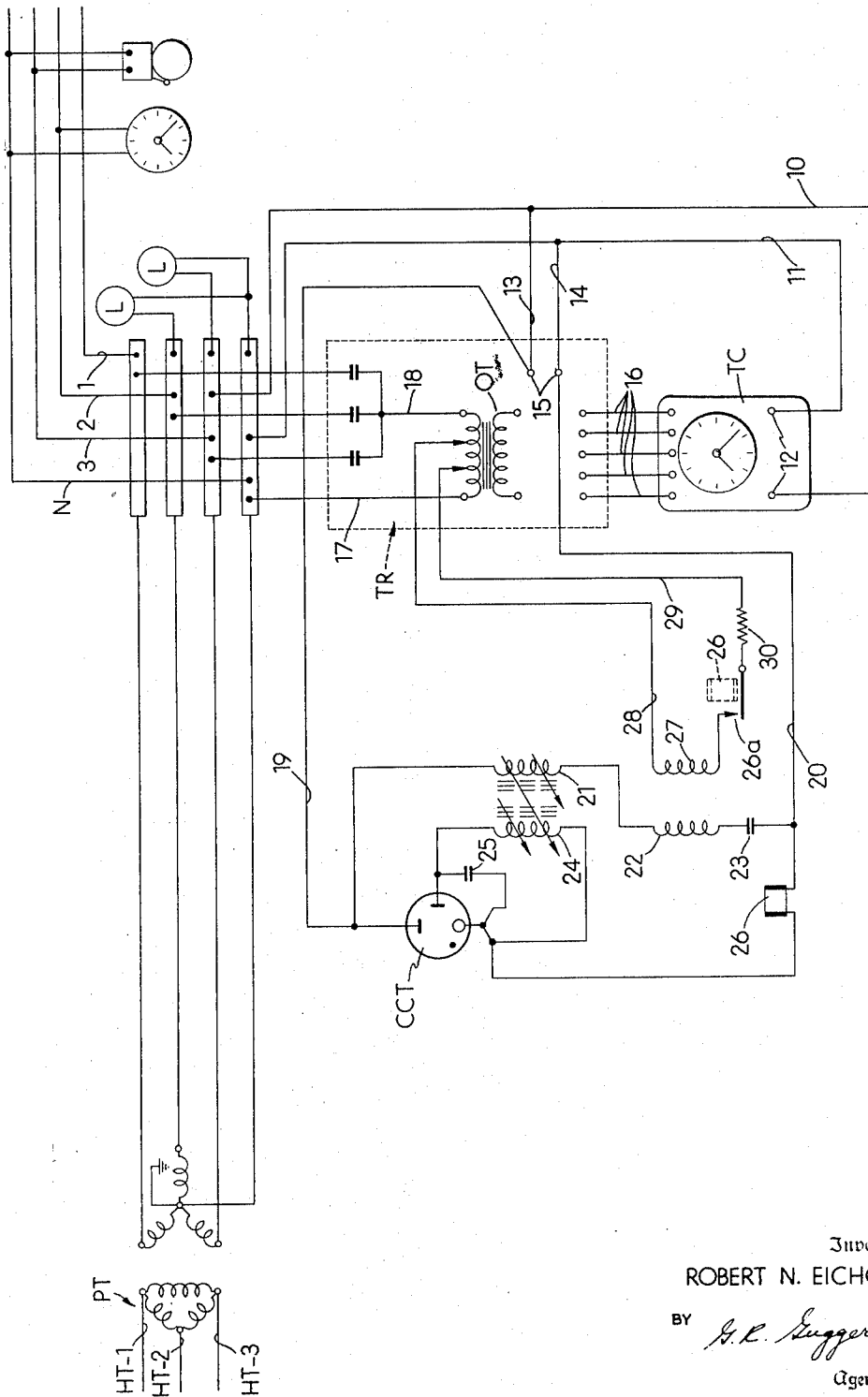


Sept. 9, 1952

R. N. EICHORN
SIGNAL VOLTAGE REGULATOR FOR POWER LINE
HIGH-FREQUENCY TRANSMITTERS
Filed April 13, 1951

2,610,241



Inventor
ROBERT N. EICHORN

BY *G. R. Eagger*
Agent

UNITED STATES PATENT OFFICE

2,610,241

SIGNAL VOLTAGE REGULATOR FOR POWER
LINE HIGH-FREQUENCY TRANSMITTERS

Robert N. Eichorn, Johnson City, N. Y., assignor
to International Business Machines Corpora-
tion, New York, N. Y., a corporation of New
York

Application April 13, 1951, Serial No. 220,953

4 Claims. (Cl. 177—352)

1

The present invention relates to signal voltage regulating means and more particularly to a means for limiting the output voltage of signal transmitters used in regulating electric time systems.

Electric time systems that are governed by electronic regulation make use of an electronic supervisory signal to test automatically for synchronism of individual synchronous motor-driven time indicating clocks with a master control clock every hour. This is accomplished by allowing the master control clock to turn an electronic transmitter on hourly causing it to transmit a supervisory carrier current signal. The transmitter is connected to a local alternating current power system and the transmitted signal is available for any selective tuned electronic receiving units such as time indicating clocks equipped with electronic receivers and which may be connected to conventional lighting circuits.

In some time system installations transmitters are used which in addition to sending a supervisory signal may also send upwards to three additional carrier current frequencies which may be used to energize audible signal devices such as bells or buzzers which may be connected in the lighting circuits along with the time indicating clocks. This type of arrangement is generally found in most school installations.

In such school installations it is often necessary to install the signal transmitter at a considerable distance, such as fifty feet or more, from the lighting power transformer. This causes the impedance of the power circuit to exceed recommended limits of variation. This high impedance increases the signal voltage due to the decreasing shunt-effect of the transformer secondary winding and permits signal dissipation principally by the load rather than by the transformer. Consequently when the time system is operating under a nearly no-load condition the signal causes cross-channel interference particularly in the receiver units which are located nearest to the transmitter.

Accordingly it is the principal object of the invention to provide in an electric time system an automatic method of loading the secondary side of the output transformer of the signal transmitter to prevent cross-channel interference during a nearly no-load time of operation.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawing, which discloses, by way of example, the principle of

2

the invention and the best mode, which has been contemplated, of applying that principle.

In the accompanying drawing the single figure is a circuit diagram of a signal system embodying the invention and shows schematically only sufficient equipment of a standard electric time system to enable the invention to be understood.

The operation of the standard electric time system to which the invention is applied will first be briefly explained and thereafter the manner in which the invention is applied thereto will be set forth.

Power is supplied to the electric time system over the three-phase high tension conductors HT1, HT2 and HT3 which are delta-connected to the primary of the power transformer PT. The secondary of this transformer is Y-connected to bus bars which serve to distribute power to the low tension leads 1, 2, and 3. The neutral point of the Y connection is connected to a bus bar which is connected to the neutral conductor N. The various time indicating clock units and audible signal devices are connected between any one of the phase leads and the neutral conductor. These time indicating clock units, sometimes referred to as secondary clocks, are well-known and it will suffice for purposes of the present invention to but briefly describe their operation.

The clocks are operated by a continuous running synchronous motor which may receive power from the power transformer PT of a conventional lighting circuit. Each clock is provided with an electronic receiver which may be tuned to receive supervisory signals from a signal transmitter TR for the purpose of time correction. The supervisory signal from the transmitter is fed over the same power system which supplies the power for operating the synchronous motors of the clocks. Upon receipt of the supervisory signal a clutch magnet is energized which will trip a suitable latch type clutch device and thereby operate in conjunction with the synchronous motor to drive the clock hands through a correction cycle. The clocks may have other receiver units which may be tuned to receive audible signals from the transmitter TR to operate a buzzer or bell. In the absence of any supervisory signal the clocks will run as an ordinary synchronous motor wall clock.

The transmitter TR is a conventional type signal transmitter consisting of a power supply, an oscillator section, an amplifier section and an output section. It is capable of transmitting four different carrier current frequencies, one

of which would be the supervisory signal and the other three would be signals for controlling audible signal devices. The usual keying relays are provided for causing the transmitter to transmit a signal of desired frequency which in the present application ranges from 3500 cycles to 6000 cycles. Power is supplied to the keying relays of the transmitter by a master time control device TC after which it is fed through the usual oscillator tube and parallel push-pull amplifying circuit to provide a usable signal having the desired frequency and considerable power. The amplified signal is put across the tapped secondary of an open core output transformer OT which is connected to the alternating current distribution system through coupling capacitors.

The master time control device TC may be the conventional type of master clock which is used to regulate time indicating clocks. The master clock includes a marine escapement clock movement which is driven by a synchronous motor connected to a two line source of alternating current. Suitable cam controlled contacts are operated by the clock movement to emit a corrective signal to the transmitter TR once each hour. This signal is of four seconds duration and is transmitted two seconds before the 58th minute to two seconds after the 58th minute.

The time system installation to which the present invention is applied is schematically shown in the drawing and it should be noted that in this type of installation the bus bars are rather remotely located from the power transformer PT. This is a typical condition in some schools where the power distribution panel may be located in the basement of the school building and the power transformer may be located several hundred feet away on a pole. The bus bars distribute power, by means of the usual feeder lines, to the various loads L which may be the school lights, electric ovens in a home-making class room, electric heaters, etc., as well as the secondary clocks and bells or buzzers of the time system.

The transmitter output signal appears across the secondary of the tapped output transformer OT which is coupled through capacitors to the bus bars of the local power system. To obtain the maximum transmitter signal power transfer to the distribution system, the impedance of the transmitter is properly matched to the load impedance by selecting various tap connections to the transmitter output transformer. An optimum impedance match is obtained when the output signals are near the same level for all frequencies.

It has been determined that in such a system where the transmitter sends a plurality of signals of different frequencies, if the signal strength should exceed a predetermined voltage it may cause cross-channel operation because of the inability of an individual receiver to reject a signal on an adjacent channel.

Past experience has shown that cross-channel interference can occur in systems where the transmitter is connected to the lighting power system more than approximately fifty feet from the power transformer especially during a nearly no-load operation when the load, such as the school lights, heaters, etc., is removed from the power system causing the transmitter output signals to increase in voltage. Since the reflected impedance of the power transformer secondary winding is high at the remote point of signal in-

section, the high signal voltage is dissipated principally by the load rather than by the transformer winding and interference may result. This condition does not exist when the transmitter is connected to the lighting power system less than approximately fifty feet from the power transformer because of the stabilizing effect of the constant low impedance of the nearby power transformer secondary winding.

The present invention provides a means for preventing cross-channel interference by automatically putting a resistive load across the secondary side of the output transformer of the transmitter whenever the signal voltage exceeds a certain predetermined voltage. The resistance serves to limit the output signal voltage delivered to the individual receiver units to the value of the predetermined voltage or less.

Referring to the drawing, the wires 10 and 11 are arranged to bring power from the bus bars to the 110 volt power input terminals 12 of the master time control device TC. Also wires 13 and 14 are connected between said wires 10 and 11 and the power input terminals 15 of the transmitter TR to heat the various tube filaments present in the well-known oscillator and amplifier sections therein and to make rectified high voltage available for the keying operations. When the time control device TC keys the transmitter TR over the control wires 16 a signal will be superimposed on the 110 volt lines 17 and 18. The signal will be distributed throughout the clock system and fed back over the wires 10 and 11 to the input terminals 15 of the transmitter TR and superimposed on a pair of wires 19 and 20 connected to said terminals 15. Connected across wires 19 and 20 is a series resonant circuit comprising coils 21, 22 and capacitor 23. The coils are of the powdered iron adjustable core type and are tuned so that the resonant combination offers high impedance to all unwanted frequencies and minimum impedance to the desired frequency.

Inductively coupled to the coil 21 is a coil 24 which is connected between the starter anode and the cathode of a three-electrode cold cathode gas discharge tube CCT. A capacitor 25 is connected between the starter anode and the cathode of tube CCT to form a parallel resonant combination with the coil 24. The coils 21 and 24 are inductively coupled so that a signal in excess of a predetermined voltage will result in sufficient voltage being developed across the parallel resonant combination and starter anode to cause tube CCT to conduct. When tube CCT conducts, a relay coil 26 will be energized.

A coil 27, wound on the same core as coil 21, is connected by the leads 28 and 29 to experimentally determined taps of the output transformer secondary winding. Also included in this circuit is a suitable resistance 30 and the normally open points 26a of relay 26. It follows then that when relay 26 is energized due to an excessive signal, the normally open relay points 26a will close causing the coil 27 to be energized and placing the resistance 30 across the taps of the secondary winding of the output transformer to decrease the output signal voltage. A value of resistance is chosen which will decrease the output voltage to a predetermined voltage level or less.

Since coil 27 is wound on the same core as coil 21, sufficient voltage will be induced through coil 24 to sustain tube CCT in a conductive state for the duration of the transmitted signal. This

condition is desirable as tube CCT would otherwise alternately extinguish and reignite whenever the contacts 26a placed the load 30 across the output winding and reduced the signal voltage. This would cause relay 26 to chatter.

The coil 22 is wound on the same core as coil 24 to provide a closer coupling and to keep the sensitivity relatively uniform over the range of signal frequencies used.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a signalling system having a power source and a transmitter connected to said power source including an output transformer and means for generating high frequency signals in said transformer, signal voltage regulating means comprising a series resonant circuit responsive to signals generated by the transmitter, a three-electrode cold cathode gas discharge tube, a parallel resonant circuit connected to the starting electrode of said tube and inductively coupled to said series resonant circuit for causing said tube to conduct when said series resonant circuit responds to a signal which is above a predetermined voltage level, a relay connected in circuit to the main electrodes of said tube, a resistance circuit adapted to be connected across the secondary of the transmitter output transformer, and contacts in said resistance circuit under control of said relay for connecting said resistance circuit to effect a decrease in the output signal voltage of the transmitter to at least the predetermined voltage level.

2. In a signalling system having a power source and a transmitter connected to said power source including an output transformer and means for generating high frequency signals in said transformer, signal voltage regulating means comprising a three-electrode cold cathode gas discharge tube connected in circuit across the power input terminals of the transmitter, a series resonant circuit having a first coil, a second coil and a capacitor connected in series and tuned to a desired signalling frequency, a parallel resonant circuit connected between the starter electrode and the cathode of said tube, a coil in said parallel resonant circuit inductively coupled to said first coil of said series resonant circuit so that signals above a predetermined voltage level will develop sufficient voltage in said parallel resonant circuit to cause said tube to conduct, a circuit adapted to be connected across the secondary of the transmitter output transformer and including a resistor and a pair of contacts, and a relay connected in said tube circuit for controlling said contacts to connect said last named circuit to effect a decrease in the output signal voltage of the transmitter to at least the predetermined voltage level.

3. Signal voltage regulating means according to claim 2 which includes a coil in the circuit connected across the secondary of the transmitter output transformer, said coil being inductively coupled to the first coil of said series resonant circuit to sustain operation of said tube for the duration of the transmitted signal.

4. Signal voltage regulating means according to claim 2 characterized by having the coil in said parallel resonant circuit inductively coupled to the second coil in said series resonant circuit to keep the sensitivity relatively uniform over the range of signal frequencies used.

ROBERT N. EICHORN.

No references cited.