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[54] **INFORMATION SYSTEM UTILIZING PULSE DIP SIGNALS SUPERIMPOSED ON A CARRIER SIGNAL**

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[51] **Int. Cl.** **G08b 25/00,** H04q 9/00

[58] **Field of Search** 340/216, 310, 409, 163, 340/408

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[57] **ABSTRACT**

An information system or an alarm system, which is capable of time-division transmission of an information signal or signals fed from detectors by using a power line or another existing line in operation across which A.C. voltage is applied. Each detector is connected to an oscillator and modulator circuit which is adapted to superpose an information signal to transmit, when it is fed from the detector, on the A.C. voltage wave form in the form of dip signal having an individual address. By allocation of a particular address of the dip signal to respective detector, a receiver can readily identify the detector which has sent an information signal, according to the address of the signal received.

13 Claims, 5 Drawing Figures

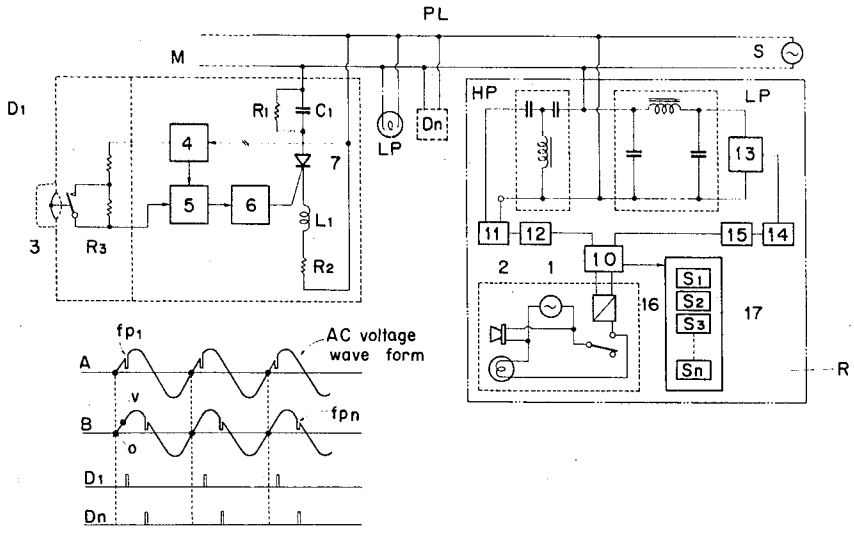
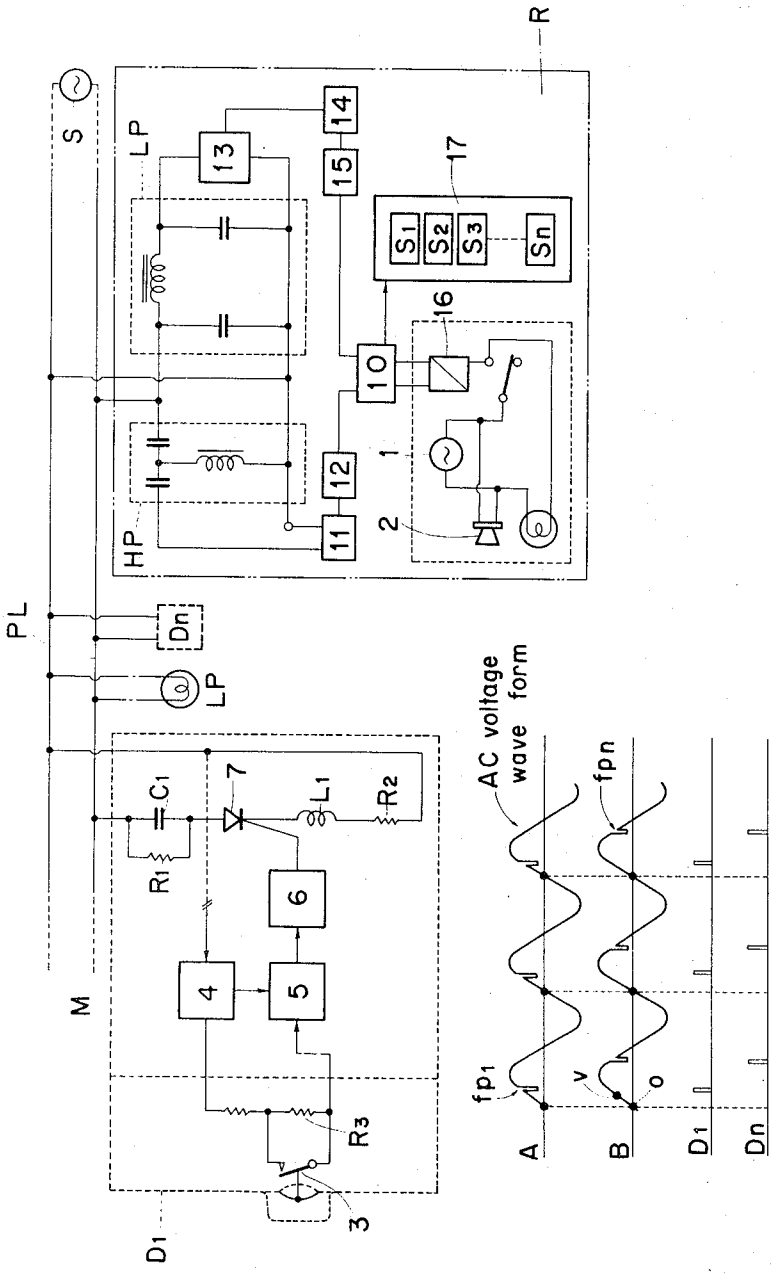


FIG. 1


R
S
LP
13
14
15
17
S1
S2
S3
Sn
16
10
12
11
1
2
HP
PL
Dn
LP
M
C1
7
L1
R2
R1
6
4
5
R3
3
D1
AC voltage wave form
fp1
fpn
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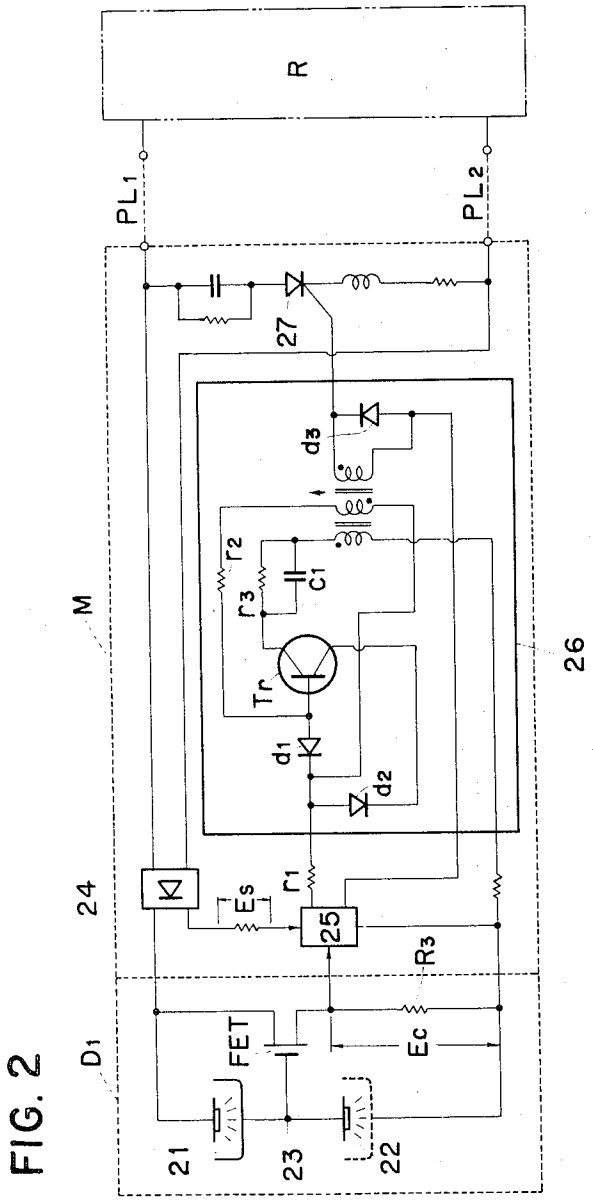


FIG. 2

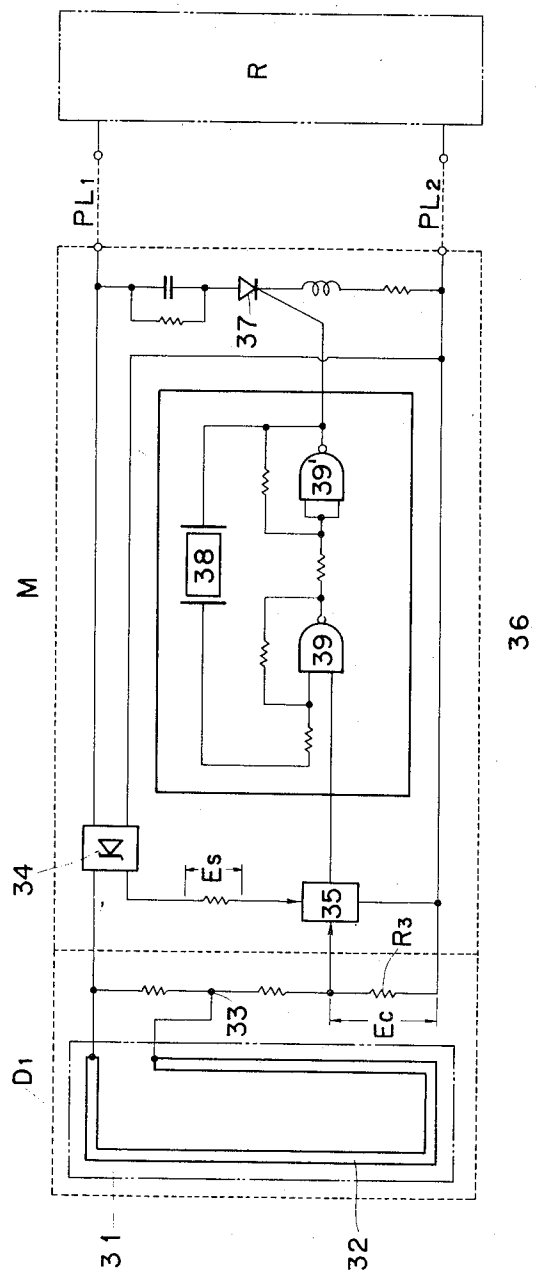


FIG. 3

FIG. 4(A)

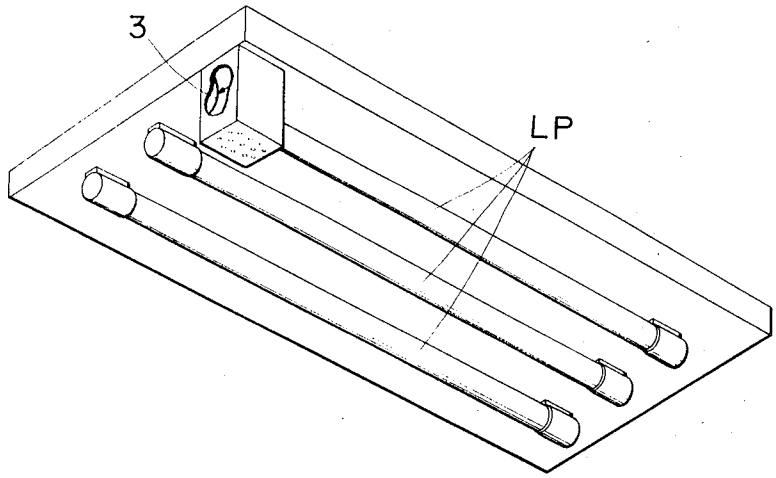
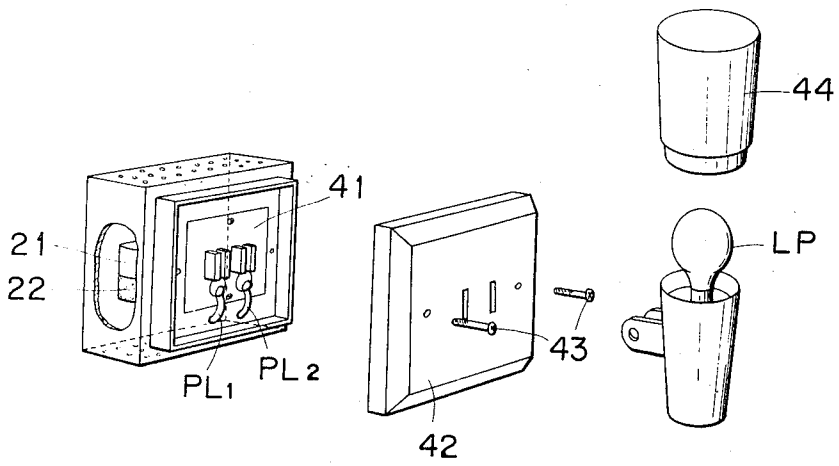


FIG. 4(B)



INFORMATION SYSTEM UTILIZING PULSE DIP SIGNALS SUPERIMPOSED ON A CARRIER SIGNAL

This invention relates to an information system or an alarm system, and more particularly to a circuit arrangement for an information system where a number of detectors are connected to a power line or another existing line in operation across which A.C. voltage is applied, for transmitting an information or an alarm signal therethrough in superposition on the A.C. voltage wave form, giving individual address to the signal from respective detector.

In a conventional information system such as a fire alarm, it is the general practice to provide a transmission line exclusively for transmitting an alarm signal to a monitor of a receiver by making or breaking a circuit through said transmission line, which is provided commonly for a number of detectors. With such a conventional system using a common transmission line for a plurality of detectors, however, it is difficult to readily locate the place of accident when an alarm signal in transmitted to the monitor of the receiver from one of the detectors connected. In other words, it is almost impossible to know exactly which detector is in operation when an alarm is actuated. It is only the circuit number of the transmission line that can be known in such a case. Moreover, when a number of detectors are operated simultaneously to give an alarm signal to the receiver, it cannot be known whether such an alarm signal involves fires in two or more different places. Therefore, the place or places of fire and the scale thereof remain unknown until they are actually traced through the circuit number or numbers of the detector or detectors in operation. Thus, in case a plurality of detectors are connected to a single signal transmission line, location of the accident requires considerably long time. In a large architectural structure such as a large building or a tunnel, a large number of circuits are to be provided, one for each floor or areal section to avoid the above mentioned difficulties. However, the provision of such a large numbers of circuits requires a large amount of costs and the installation of multichannel pilot wires in an existing architectural structure involves great difficulties. The present invention is made to solve the above-mentioned problems.

It is therefore an object of the present invention to provide a novel information system of multiplex transmission, whereby an information signal or an alarm signal from a detector may be transmitted to a receiver by way of a power line or another existing transmission line by superposing the signal on A.C. current in such a manner that the place involving a change detected can be readily known upon receipt of the signal.

It is another object of the present invention to provide an information transmitter which is capable of being incorporated into a terminal electrical appliance of a power line or another existing transmission line to facilitate the installation of the transmitter and to make the installation compact, enhancing its appearance.

According to the present invention, there is provided an information system comprising:

a plurality of transmitters connected to an A.C. power source by way of power lines thereof; and a receiver connected to said plurality of detectors by way of said power lines;

each of said transmitters having a detector adapted to operate upon detection of a change of information to be transmitted, a pulse oscillator controlled by said detector, and a modulator adapted to produce a pulse after a predetermined time delay particular to the respective transmitter, in synchronism with A.C. voltage applied by said power source for transmission to said receiver through said power lines;

said receiver being provided with a means for identifying the transmitter which has sent out said dip pulse according to the particular time location of the dip pulse received.

The present invention will be better understood from the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a block diagram of an information system according to the present invention and a diagram of a modulated signal and a pulse generated by an oscillator and modulator circuit employed in said system;

FIG. 2 is a circuit diagram of a transmitter employable in the present system;

FIG. 3 is another circuit diagram of a modified transmitter employable in the present system; and

FIGS. 4 (A) and 4 (B) are views showing different arrangements for mounting of a transmitter of the present invention on an electrical appliance.

In the drawings and the following descriptions, like portions or parts are denoted by like numerals or characters.

FIG. 1 shows in a block diagram an information system connected to an A.C. power source S by means of a power line and provided with a contact type detector. No more than one detector is shown in the drawing for simplicity of explanation. In the drawing, D_1 is a detector representative of a number of detectors $D_1 \sim D_n$ to be connected to the power lines PL.

A receiver R has another power source 1 for a monitor and an alarm indicator 2. Each of the detectors $D_1 \sim D_n$ has a contact 3 of a gas or a moisture sensitive element, heat sensitive element such as a bimetal, or a metal foil for sensing breakage of a window glass etc., which is adapted to be closed to form a loop including the power source 1 to energize the alarm indicator 2 upon detection of, for example, a fire.

Each of the detectors $D_1 \sim D_n$ is provided individually with an operating power source fed from the power line PL and connected to an oscillator and modulator circuit M which includes a voltage detector 4 adapted to synchronize with an A.C. wave form with reference to zero volt point 0 or a given volt point V (hereinafter referred to as "reference voltage point"), a timing circuit 5 controlled by a signal synchronized with the A.C. wave form and fed from said voltage detector 4, and a pulse oscillator 6 for periodically producing a pulse signal or producing a time division pulse (more specifically, a pulse modulation system wherein the pulse duration is constant and the time location can be varied) to control the firing phase of a thyristor 7 to trigger it, transmitting a dip signal on an A.C. wave form fed from the power line PL.

According to FIG. 1, the dipmodulation of the signal is carried out in a modulator circuit formed of the thyristor 7, a condenser C_1, resistors R_1 and R_2 and an inductance L_1 by dipping the A.C. wave form on the power line PL over a short period of time. Thus, when the contact 3 is closed upon detection of a particular

change to be detected, a resistor R_3 is short-circuited, varying bias voltages across the voltage detector **4** and the timing circuit **5.** The pulse modulation is thereby performed after a predetermined time delay from the reference point, giving an address particular thereto. For this pulse modulation f_{p1}~f_{pn}, a blocking oscillator, a monostable multivibrator, a D.C. chopper circuit, PFM circuit, a glass delay element, or a CR(L) multistage filter may be employed to produce corresponding pulses in detectors D_1~D_n as shown in FIG. **1.** The A.C. voltage wave form of the power line PL is dipped, as shown at A and B of FIG. **1,** over a short period of time in synchronism with the cycle of the zero volt point **0** or the given voltage point V of the A.C. wave form. The modulated waves f_{p1}~f_{pn} thus superposed on the A.C. voltage wave form and given individual addresses are transmitted to the receiver R through the power line PL.

The receiver R is provided with a low pass filter LP and a high pass filter HP connected to the power source S. The output of the high pass filter HP is sent to an AND gate of a logical circuit **10** via Schmidt or slicer circuit **12** after being decoded to a pulse signal through a detector **11.** Meanwhile, the output of the low pass filter LP is fed to said gate of the logical circuit **10** through a voltage detector **13** for detecting the reference voltage point synchronized with the power source voltage, a pulse generator **14** and a monostable multivibrator **15.** The output of the logical circuit **10** in turn actuates relay **16** and an individual one of the indicators S_1~S_n of an alarm display device **17,** which indicators are provided correspondingly to respective detectors D_1~D_n.

In this circuitry, when the detector D_1 senses change to be detected, the contact **3** is closed and thereby a modulated or dipped signal f_{p1}~f_{p2} is superposed on the AC voltage wave form of the power line PL for the transmission thereof to the receiver R where the signal is decoded and used to energize the relay **16** mounted in the alarm indicator which actuates an alarming means **2** in the known manner. As mentioned above, the pulse oscillator **6** functions, upon closing of the contact **3,** to produce a pulse signal f_{p1}~f_{pn}, modulating the A.C. voltage wave form in synchronism with the zero voltage point **0** or the reference voltage point thereof. The thus modulated signal is sent out across the power line PL by ON-OFF control of the thyristor **7** as a dip signal on AC voltage. Thus, the time division modulation can be easily performed by varying the firing phase of the thyristor **7** in relation to the line voltage wave form. Since the thyristor of a very small capacity will suffice due to extremely short pulse duration, the transmitter composition may be made very simple and compact. For this reason, the transmitter of the present invention can be incorporated into an electrical appliance as mentioned in detail later.

The dip signal on the AC wave form, being unable to pass through the low pass filter LP in the receiver R, is fed to the Schmidt circuit **12** via high pass filter HP and detector **11** where the signal is shaped and decoded. This decoded pulse is applied to the logical circuit **10.** The dip signal f_{p1}~f_{pn} superposed on AC wave form is, as mentioned above, synchronous with the wave form of the power source voltage. Meanwhile, the fundamental A.C. wave form passing through the low pass filter LP generates at **14** a reference pulse train synchronized with said A.C. wave form for discrimination of the decoded pulse. The thus produced reference pulse train is sent to the monostable multivibrator **15** to lengthen the pulse duration for ensuring the collation in the logical circuit **10,** with the decoded and shaped pulse from the Schmidt circuit **12,** to produce a final output. The operation of the logical circuit, or AND circuit, **10** is not effected in case no output signal produced by a timing pulse synchronized with the reference voltage point is applied even if the decoded pulse is applied. Thereby, possible misoperation due to external noise given to the power line is well prevented.

The output of the logical circuit **10** (AND circuit) drives the alarm displaying means **17.** S_1 of the displaying means **17** is driven only when a pulse signal having a dip signal f_{p1} arrives, making it possible to discriminate on the receiver that the detector informing the accident is D_1. In the same way, when the detectors D2, D3 . . . . Dn (not shown) operate, the corresponding displaying means S2, S3 . . . . Sn function accordingly, if they are provided with oscillators corresponding to the pulses f_{p2}, f_{p3} . . . . f_{pn}, individually.

FIG. 2 shows an embodiment of the present invention which employs a known ion type smoke detector D1 and a blocking oscillator circuit **26** in the oscillator and modulator circuit M. When smoke enters an outer ion room **22** of the detector D1, the junction point of said ion room **22** and an inner ion room **21** loses its potential balance, making a field-effect transistor FET conductive and thereupon the zener diode (not shown) becomes conductive by a voltage Ec of resistor R_3 to trigger a timing circuit **25** in the next stage. Said timing circuit **25** is closed by a signal from a voltage detector **24,** which is adapted to rectify the power source current and synchronize therewith in reference with the zero voltage point, due to the control voltage Ec. The above-mentioned oscillator circuit **26** subsequently effects time-division pulse modulation. This circuit is a kind of positive feedback oscillator circuit consisting of diodes *d*1, *d*2, and d3, a transformer *t*, resistors *r*1, *r*2 and *r*3, a condenser c1 and a transistor Tr, which initiates oscillation when sufficient bias voltage is applied by the control voltage Ec. The timing circuit **25** is made ready to operate by said control voltage Ec and its operation is started by a timing voltage Es of the voltage detector circuit **24.** The timing circuit **24** actuates the oscillator circuit **26** in response to the simultaneous presence of a detected signal from detector D1 and of detection of the A.C. wave form zero point source by voltage detector circuit **24.** This oscillator circuit **26** is advantageously employed to effect accurate synchronizing and accurate cyclic switching according to the time constant determined by a condenser *c*1 and a resistor *r*3. Processing of the dip signal on AC wave form emitted across the power lines PL1 , PL2 is conducted in the receiver in the same manner as in FIG. **1.**

In FIG. **3,** there is illustrated another embodiment of the present invention. The detector D1 has a metallic foil **32** attached to a window glass **31.** In this embodiment, are employed a crystal oscillator or a glass delay line and a NAND gate signal generator **36** in the oscillator and modulator circuit M connected to the detector D1.

If the window glass **31** is broken, said metallic foil **32** is accordingly broken to open an electrical circuit including said metallic foil **32.** Upon opening of said electrical circuit, the potential balance at the junction point **33** is lost and a timing circuit **35** of the following stage

is triggered. Said timing circuit **35** is closed by the control voltage Ec and a signal from a synchronizing signal transmitting circuit **34** including a zener diode which is adapted to rectify the current from the power source and detect the reference voltage. Thus, the NAND gate signal generator **36** effects cyclic modulation with the predetermined time delay.

The above-mentioned NAND gate signal generator **36** is formed of a NAND circuits **39** and **39'** as shown in FIG. **3**, wherein the output thereof is fed back to the input gate through a delay element **38** and a thyristor **37** is controlled according to a delay time predetermined by the control voltage Ec and the synchronized signal voltage Es. In other words, the output pulse of said NAND gate signal generator **36** triggers a thyristor **37** as explained referring to FIG. **2.** Such a NAND gate signal generator **36** is advantageously employed to easily generate accurate time-division pulses.

Though in the foregoing embodiment, a power line is employed for a transmission line, another existing line across which A.C. voltage is applied may be employed for the same purpose. FIG. **4** shows the transmitter of the present invention formed of the detector D1 and the oscillator and modulator circuit M and incorporated into an electrical appliance. FIG. **4** (A) shows the transmitter D1 + M having the contact **3** removably mounted on an open type fluorescent lamp assembly LP to be fixed to a ceiling and connected to the input terminal of the lamp assembly LP. FIG. **4** (B) shows the transmitter D1 + M having a smoke detector, connected to a terminal board **41** of a decorative electric lamp bracket thereby to be connected to the power lines PL1 and PL2 and covered with a decorative lid **42.** In this case, the transmitter D1 + M may be fixed to an electrical appliance by means of screws **43** by, so as to say, one operation. **44** designates a cap of the lamp assembly LP.

The transmitter of the present invention may thus be previously mounted on or incorporated into an electrical appliance, saving the space required for setting it and keeping good appearance. Accordingly, the installation of the transmitter can be effected automatically or simultaneously by installing such an electrical appliance, whereby extra work required for the transmitter installation can be eliminated.

For the detector of the present invention may be further employed a transducer for an air conditioner or various kinds of detecting means to effect, for example, automatic control of air-conditioning, automatic inspection of a meter, production management, motor controlling, etc. other than alarm information or information transmission.

According to the present invention, each one of the detectors is provided with a pulse oscillator generating a pulse having a predetermined address, under switching control of a data detecting circuit of the detector, a pulse-modulated signal in the form of a dip signal superposed on AC wave form through a power line commonly used for a number of detectors, while the receiver distinguishes the detector operated according to the address of the dip pulse or time-division pulse received, thus making it possible to carry out centralized control on the receiver and therefore to give immediate countermeasure instructions. The present invention, using a power line or existing transmission lines across which A.C. voltage is applied as a transmission line, has another feature that multiplex transmission is easily realized, without installing new transmission lines in addition to existing power lines. The monitor power source **1** in FIG. **1** may be used in place of the A.C. power source S. The present invention has a further feature that considerable reduction in the amount of installation work and in size of the device may be made possible due to the fact that a transmitter may be previously mounted integrally on an existing electrical appliance without impairing the appearance thereof.

From the foregoing description, operation and utility of the information system of the invention will be apparent. However, it should be understood that the foregoing is presented as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed in the appended claims.

What is claimed is:

1. An information system for monitoring changes at plural locations, comprising in combination:

a plurality of transmitters at respective locations and means connecting same to an A.C. power source by way of power lines thereof, each of said transmitters having a detector adapted to operate upon detection of a change of condition at a respective location, synchronizing means responsive to occurrence of a selected reference point in the A.C. voltage of said A.C. power source, pulse oscillator means controlled by said detector and said synchronizing means for providing a pulse after a timed interval, means including a thyristor connected across said power lines and responsive to said pulse from said pulse oscillator means for superposing a dip pulse on said A.C. voltage at a predetermined address thereon peculiar to the respective transmitter and for transmission through said power line;

a receiver connected to said plurality of transmitters for monitoring same through said power lines, said receiver including low pass means responsive to said A.C. voltage for establishing a train of reference pulses synchronized therewith, decoding means for decoding a dip pulse from said power lines, AND circuit means responsive to collation of any train pulse with said decoded dip pulse for providing an output and means responsive to said output for identifying the particular one of the plurality of transmitters which has sent out said dip pulse, in accordance with the address of the particular dip pulse received.

2. An information system as set forth in claim **1,** wherein said power lines are existing power transmission lines, and wherein said connecting means comprise electrical appliances, powered by said power lines and incorporating respective ones of said transmitters.

3. An information system as set forth in claim **1,** wherein said pulse oscillator means comprises a blocking oscillator in the respective transmitter.

4. An information system as set forth in claim **1,** wherein said pulse oscillator means comprises a glass delay line and a NAND gate signal generator in circuit therewith in the respective transmitter.

5. An information system as set forth in claim 1, in which said synchronizing means comprises means coupled to said power lines for detection of a said selected reference voltage point in the A.C. wave form and a timing circuit, said timing circuit receiving inputs from both said reference voltage detection means and said condition change detector for producing an output at said reference point in the A.C. voltage wave form when said condition change detector has been operated, the output of said timing circuit being applied to said pulse oscillator means.

6. An information system as set forth in claim 5, wherein said condition change detector includes a switch operable in response to a selected condition change and first voltage dropping means connected to a point between said switch and said timing circuit input and responsive to switching of said switch for triggering said timing circuit by application of a selected control voltage thereto, second voltage dropping means coupling said reference voltage detection means to said timing circuit for applying the output voltage of the voltage detection means to said timing circuit.

7. An information system as set forth in claim 6 in which said second voltage dropping means series connects a first output of said reference voltage detection means in a first input of said timing circuit, said switch and first voltage dropping means being serially connected, said switch being connected to said voltage detection means and a point intermediate said switch and said first voltage dropping means being connected to a second input of said timing circuit.

8. An information system as set forth in claim 5 in which said pulse oscillator means comprises a glass delay line and first and second NAND gates connected in series loop therewith, wherein a first input of the first NAND gate is connected to said timing circuit and is responsive to an output thereof for causing the second NAND gate to energize said glass delay line, said first NAND gate having a second input coupled to the output of said glass delay line and including means coupling said series pair of NAND gates to said thyristor for providing said pulse thereto after said timed interval.

9. An information system as set forth in claim 8 including a parallel R.C network and an inductor and means connecting same in series with the anode and cathode of said thyristor across said power lines for shunting said power lines momentarily upon gating on of said thyristor, so as to apply said dip pulse to said power lines.

10. An information system as set forth in claim 1 in which said low pass means comprises a low pass filter connected across said power lines for passing the A.C. voltage wave form therethrough but rejecting a dip pulse superposed thereon, means responsive to the output of said low pass filter for producing said train of reference pulses, such reference pulse train being synchronized with the A.C. wave form applied to said low pass filter and corresponding to said predetermined addresses of said transmitters, and means in series with said train producing means for insuring said collation by lengthening the pulses of said train and being connected to said AND circuit means for providing one of a pair of inputs thereto.

11. An information system as set forth in claim 10 in which said decoding means comprise a high pass filter coupled across said power lines in parallel with said low pass filter for extracting said dip pulse from superposed relation on the A.C. voltage across said power lines, a detector circuit for decoding said dip pulse and coupled to the output of said high pass filter, a Schmidt circuit driven by said detector circuit for shaping the decoded pulse and applying same to said AND circuit means.

12. An information system as set forth in claim 10 in which said identifying means includes a plurality of displaying means, one such displaying means being provided for each of said transmitters and being responsive to time location of a dip pulse at an address on the A.C. wave form corresponding to the respective transmitter address.

13. An information system as set forth in claim 12, including alarm means and a relay for actuating said alarm means, said relay being responsive to actuation of any of said display means by said AND circuit means for actuating said alarm, to thereby indicate a change of condition has occurred at at least one of said detectors.

* * * * *