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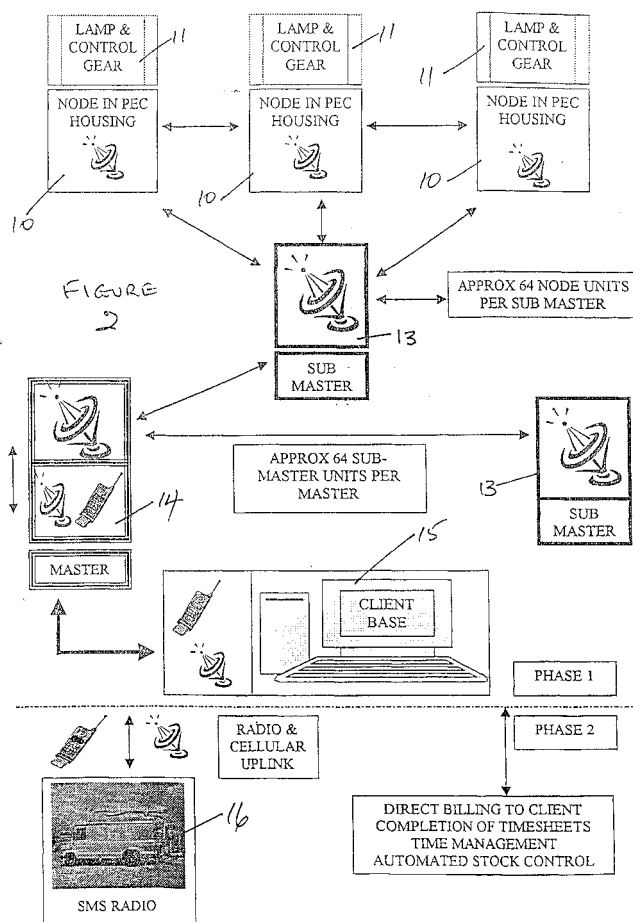
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(54) **Street lighting management system**

(57) A street lighting management system includes modules (10) for mounting on the street lights and for transmitting data to sub-master units (13) which collate the information and transmit it to a master unit (14).



Description**Field of the Invention**

[0001] This invention relates to a management system for street lighting.

[0002] The current street lighting infra-structure within the United Kingdom consists of approximately 7.5 million units with the day-to-day operational performance of the whole system monitored on a manual basis.

[0003] With the current requirements for performance monitoring and value for money, together with an increasing demand for improved service and reliability in all sections of the economy, there is a need for an intelligent management system for street lighting.

[0004] It is accordingly an object of the present invention to provide such a system.

[0005] A more specific object of the present invention is to provide a street lighting management system which will provide customers with an improved level of service while, at the same time, giving the lighting contractor an opportunity to operate in a more efficient and competitive manner.

Summary of the Invention

[0006] According to the present invention there is provided a street lighting management system which includes:-

- a) a plurality of modules for mounting on the street lights, each module including information collating means and data transmitting means in the form of a radio frequency transmitter,
- b) a plurality of sub-master units for receiving and collating the data transmitted by the modules, each sub-master unit including data transmitting means in the form of a radio frequency transmitter, and
- c) a master unit for receiving and interpreting the data transmitted by the sub-master units,

and in which the modules are arranged in series so that communication is effected between a plurality of modules and then with the associated sub-master unit.

[0007] The modules are preferably in the form of units which can be mounted on the street lights in place of (or instead of) the photocell units currently employed.

[0008] Each module preferably includes means for monitoring and recording the voltage consumed by the associated lamp, the current supplied to the associated lamp and the corresponding power factor. Each module preferably also includes a switching facility and means for turning the associated lamp on and off and changing the operating period of the lamp.

[0009] The master unit is preferably linked to a computer having a memory for storing all the data transmitted by the modules and by the sub-master units.

[0010] The computer is preferably linked to or incor-

porates a data base containing billing information.

Brief Description of the Drawings

[0011]

Figure 1 is a flow chart showing the mode of operation of part of the street lighting management system,

Figure 2 is a flow chart showing the mode of operation of the system as a whole, and

Figure 3 is a sectional view of a module forming part of the street lighting management system.

Description of the Preferred Embodiment

[0012] Current street lighting systems include a photo-cell unit which is contained within a housing installed in a recess at the top of the street light. The system of the present invention involves the use of node units or modules 10 which are installed in the street lights in place of the photo-cell units and are arranged in communication with the lamps and control gear 11 of the street lights.

[0013] Each node unit or module 10 includes a radio transmitter and receiver 12 which is arranged to receive data from the node unit or module 10 mounted in the preceding street light and to transmit data to the node unit or module 10 mounted in the succeeding street light, the node units or modules 10 being arranged in sequence with up to eight branches of sixty four node units or modules 10 arranged in communication with a sub-master unit 13.

[0014] Each node unit or module 10 is an essentially autonomous, 100% self-contained, lighting control, monitoring and telemetry station. Communication is effected using an encrypted protocol containing an IP style address frame, over the licence-exempt radio data channel in the UHF band. Each node unit or module 10 communicates via its neighbours using a token passing scheme, permitting large distances to be covered using only low transmitter power levels. Each of the node units or modules 10 thus communicates, via the network of node units or modules 10, with its associated sub-master unit 13.

[0015] Each node unit or module 10 is capable of switching and monitoring a single load (either a single lamp or multiple lamps) of, typically, up to 500 Watts. Lamp switching is normally limited to on and off, but provision can be made in the protocol for "on", "off", "part-time", "road sign", "street lamp" and "dim" states.

[0016] Monitoring is primarily used to determine the onset of bulb failure. The voltage, current and power factor at the bulb are measured and analysed within the node unit or module 10 to determine the operational status of the bulb(s). On/off switching is under the control

of a message received from the associated sub-master unit 13 and, in the event of total communications failure, each node unit or module 10 will default to local control and default to switch the bulb(s) on.

[0017] Each of the sub-master units 13 includes a radio transmitter and receiver and the sub-master units are arranged in sequence so that each sub-master unit 13 can communicate with its respective preceding and succeeding sub-master units 13 and with a master unit 14. The master unit 14 includes a radio transmitter and receiver and communicates with a computer 15 which is programmed with data concerning the client base and cost information enabling direct billing to the client or clients, completion of time sheets, time management and automated stock control.

[0018] The computer 15 is linked to a radio transmitter and receiver enabling it to communicate with each of the master units 14 forming the complete system and with any operational units 16, for example, maintenance vehicles.

[0019] Each node unit or module 10 includes monitoring means arranged to receive an activate pulse 17 as indicated and, after a predetermined time delay, to carry out monitoring procedures for monitoring and recording the voltage supplied to the associated lamp, the current consumed by the associated lamp and the corresponding power factor. Each node unit or module 10 also has a switching capability.

[0020] The information obtained by the monitoring procedures is passed to a microprocessor 18 which collates the information which it receives and compares the received information with information obtained during the previous monitoring process. If the newly received data differs from the previous data, a unique identifier (specific to that particular node unit or module 10) is added to the newly received data and such data is transmitted via the associated radio transmitter and receiver 12 to the next node unit or module 10 in the sequence and, in due course, to the associated sub-master unit 13 and then to the associated master unit 14.

[0021] The master unit 14 transfers all the information which it receives to the computer 15, the memory of which then retains collated data concerning each of the street lights within the entire system. This data can be accessed to provide all the information required by the managers of the street lighting system

[0022] Each node unit or module 10 also includes a timing facility for turning the associated lamp on and off and for changing the operating period of the lamp. Each node unit or module 10 normally receives an hourly "on/off" signal to turn the lamp on or off but, if no "on/off" signal is received in a period of, for example, four hours, the timing facility automatically sends an "on" signal to the associated lamp.

[0023] As shown in Figure 3, each node unit or module 10 includes a housing 20 having a base 21 which carries a sealing gasket 22 and from which electrical contacts 23 extend downwardly for connection to the

control circuit of the associated street light. There is an antenna 24 within the housing 20, which also contains a transformer 25 and a relay 26, in addition to a printed circuit board 27 and the radio transmitter and receiver 12.

[0024] Each of the sub-master units 13 will typically scan all the associated modules 10 during the day at a nominal rate of one per minute. In the event of receipt of a command from the master unit or station 14, each sub-master unit 13 will interrupt its scanning routine and broadcast the request from the master station 14 to its associated modules 10 or up-load the day's data or failure reports back to the master station 14. Each sub-master unit 13 will be responsible for holding the information concerning the scanning operations carried out during an entire day in dedicated banks of memory registers on a module-by-module basis.

[0025] The overall system includes a facility for turning all the lamps on and off at pre-selected times, depending on the time of year, and for monitoring the performance of the lamps. In practice, the power consumption of a lamp will tend to increase prior to failure of a lamp and a feed-back can be obtained of the particular lamps which are not operational, i.e. have failed and require replacement, plus those which have not yet failed but are likely to fail in the reasonably near future.

[0026] The advantages of the system of the present invention include the following:-

- a) a reduction in administration costs,
- b) faulty component identification is facilitated,
- c) improved routing and programming of works,
- d) a reduction in costly abortive calls,
- e) no need for costly night-time inspections,
- f) automatic stock replenishment, and
- g) a direct billing facility.

Claims

1. A street lighting management system which includes:-

- a) a plurality of modules for mounting on the street lights, each module including information collating means and data transmitting means in the form of a radio frequency transmitter,
- b) a plurality of sub-master units for receiving and collating the data transmitted by the modules, each sub-master unit including data transmitting means in the form of a radio frequency transmitter, and
- c) a master unit for receiving and interpreting the data transmitted by the sub-master units,

and in which the modules are arranged in series so that communication is effected between a plurality of modules and then with the associated

sub-master unit.

2. A system as claimed in Claim 1, in which the modules are in the form of units which can be mounted on the street lights in place of (or instead of) the photocell units currently employed. 5
3. A system as claimed in Claim 1, in which each module includes means for monitoring and recording the voltage supplied to the associated lamp, the current consumed by the associated lamp and the corresponding power factor. 10
4. A system as claimed in Claim 3, in which each module includes switching means and means for turning the associated lamp on and off and changing the operating period of the lamp. 15
5. A system as claimed in any one of the preceding claims, in which the master unit is linked to a computer having a memory for storing all the data transmitted by the modules and by the sub-master units. 20
6. A system as claimed in Claim 5, in which the computer is linked to or incorporates a data base containing billing information. 25

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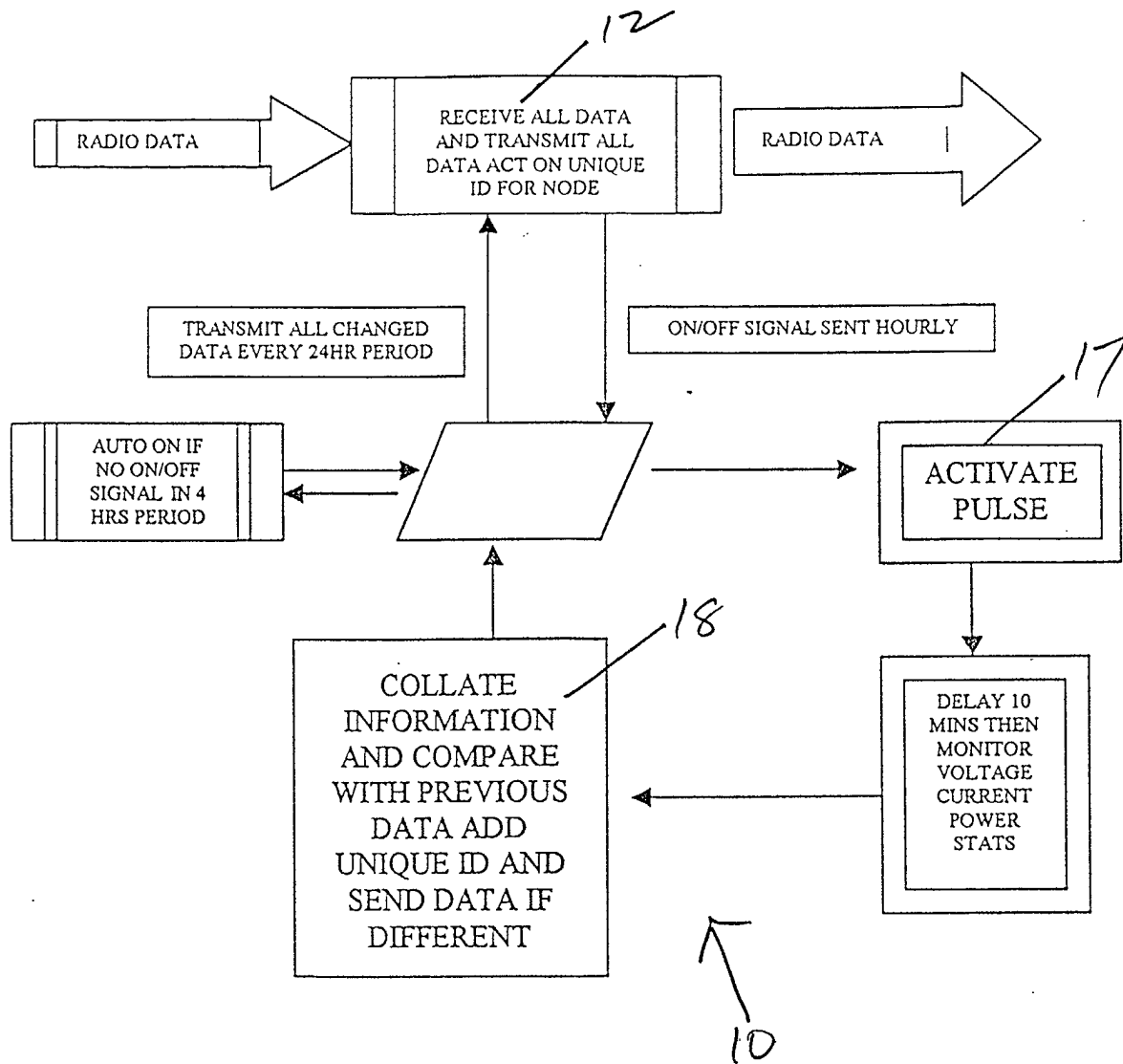
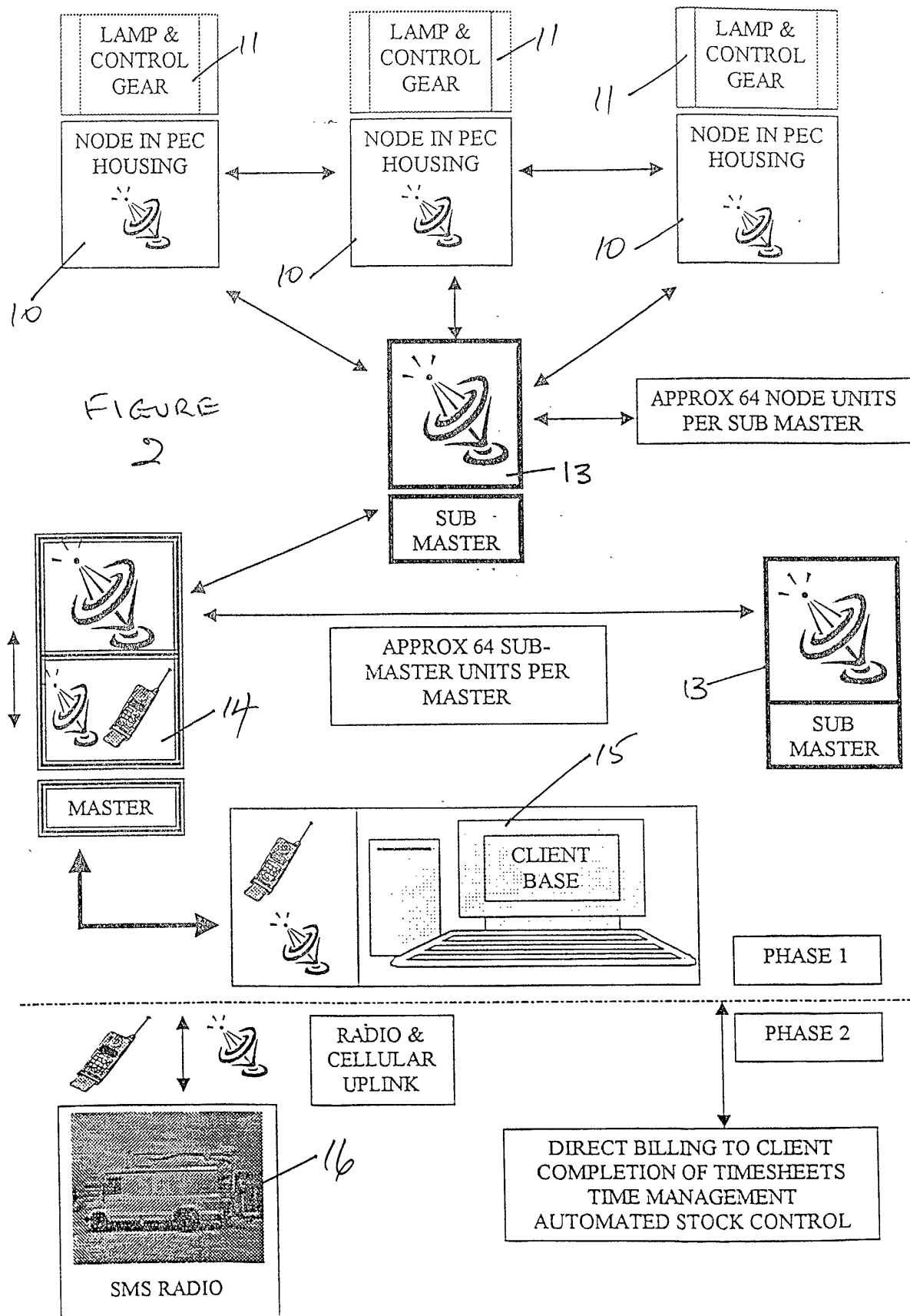


FIGURE 1



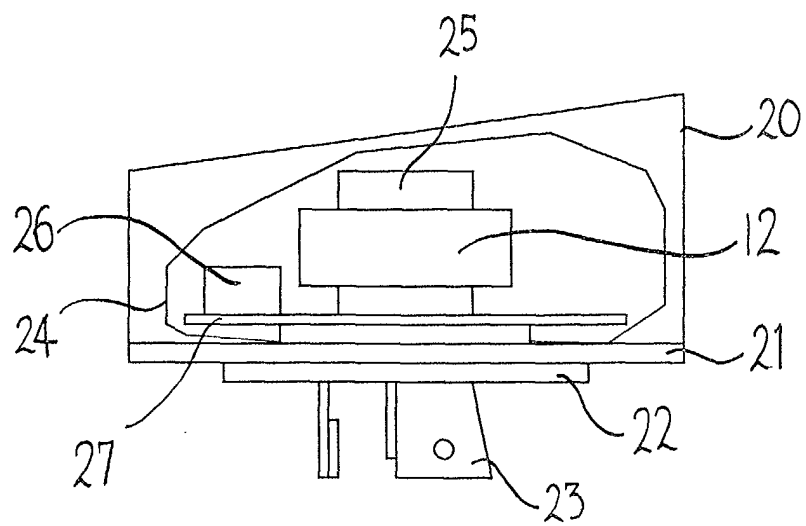


FIGURE 3.