

STORING DATA RELATING TO TELEVISION VIEWING

1 According to the present invention, there is
provided an arrangement for storing data received from a
television viewing monitoring system and for transmitting
said data to a remote computer by means of a telephone
5 line of a public telephone network, the arrangement
comprising:

a memory for storing said data;

resettable time measuring means for measuring the
passage of time and for defining a plurality of data
10 access slots in each of successive periods of time;

interrogation detection means for detecting an
incoming call and for determining whether the call is
from the remote computer;

switch means actuatable to connect to the
15 telephone line selectively one of a) a telephone
instrument for normal operation, and b), during a data
access slot, the interrogation detection means; and

transmission means actuatable to transmit data
from the memory to the computer via the telephone line,
20 the arrangement being such that, when an incoming call is
determined as not being from the remote computer, the
telephone instrument is connected to the telephone line
for the remainder of the current data access slot and the
detection means is reconnected to the telephone line
25 during the next available data access slot, and, when the
call is determined as being from the computer, the
transmission means is actuated to transmit data, and
connection of the detection means to the telephone line
is inhibited during those data slots of a period which
30 follow successful transmission of data to the computer
in an access slot of that period.

Reference is made to the following British Patent
Applications:

British Patent Application No. 8413344 relating to
35 channel detection;

1 British Patent Application No. 8413347 relating to
transmission of data; and

British Patent Application No. 8413348 relating to
people monitoring.

5 For a better understanding of the present
invention, and to show how the same may be carried into
effect, reference will now be made, by way of example, to
the accompanying drawings, in which:-

Figure 1 is a block diagram of a television
10 monitoring system;

Figure 2 is a block diagram of a television
channel detection unit;

Figure 3 shows a practical embodiment of part of
the detection unit shown in Figure 2;

15 Figures 4a and 4b show a practical embodiment of
another part of the detection unit shown in Figure 2;

Figure 5 is a block diagram of a people monitoring
unit;

Figure 6 shows a practical embodiment of the
20 people monitoring unit of Figure 5;

Figure 7 shows an embodiment of a remote handset
for use in the people monitoring unit of Figure 5;

Figure 8 is a block diagram of an embodiment of a
mains transmission unit;

25 Figures 9a to 9f are graphs illustrating the
operation of the mains transmission unit of Figure 8;
and

Figure 10 is a block diagram of a meter which
records information from a mains supply line, and
30 transmits the information at night by way of a public
telephone network.

Figure 1 shows a block diagram of a television monitoring system comprising a television channel detection unit 1; a people monitoring unit 2; a mains transmission unit 3; and a central receiving station 4.

The television channel detection unit 1 will now be described in detail with reference to Figures 2 to 4.

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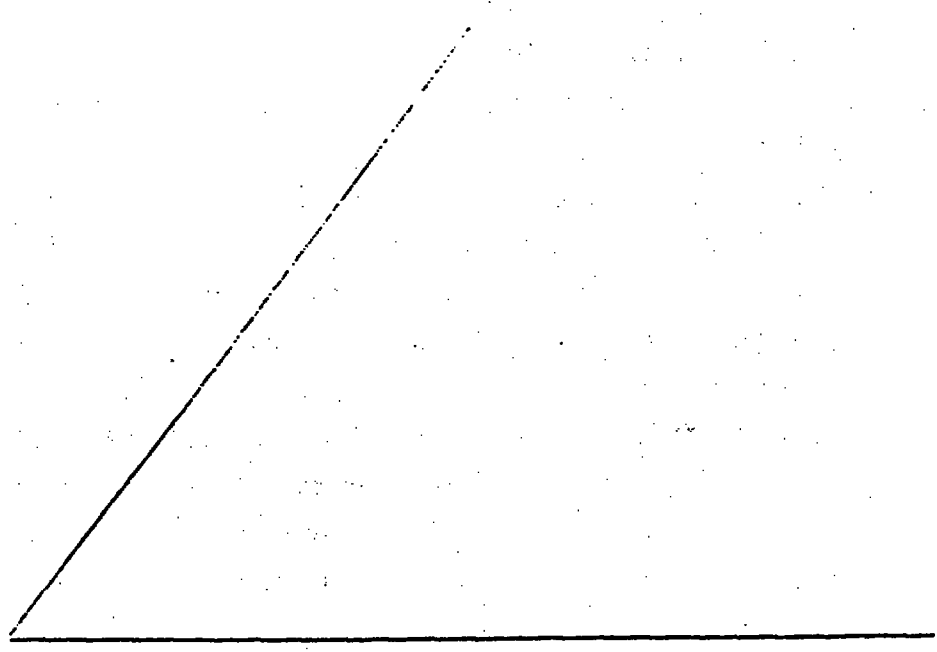
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The unit 1 is designed to sense ultra or very high frequency radiation from a tuner 10 in a domestic television receiver 12 and so determine if the channel to which the television receiver is tuned is one of a multiplicity of channels which have been preset into the detection unit 1. A different binary coded word is produced for each channel detected. A pick-up probe 14 is in the vicinity of a local oscillator of the television receiver 12 to be monitored. The inductively coupled signal is fed into a modified variable capacitance diode tuned tuner 16. A standard television tuner could be used, provided that the frequency range is extended to cover the range of the local oscillator frequency radiated from the TV receiver. The signal from the tuned tuner is amplified using a conventional I.F. amplifier and surface acoustic wave (S. A.W.) filter 18, for example one made by Mullard or Plessey. A d.c. voltage is produced from a detector 20 when the tuner 16 is tuned to the radiated frequency of the TV receiver 12. The unit 1 is programmed to look for preset frequencies by applying different tuning voltages to variable capacitance diodes within the tuner 16. The output of the detector 20 is connected to a low frequency oscillator 21 and an analogue tuning voltage is generated from a binary number using digital to analogue conversion. Binary numbers are stored in a non-volatile store memory chip 24 and each number is addressed in sequence from an address counter 25. The output of the memory 24 is connected to a digital to pulse width converter 22. The output mark to space ratio of the converter is therefore a function of the addressed binary number. the resulting repetitive pulse train is averaged in an integrating amplifier 26 to produce a d.c. tuning voltage which is proportional to the stored binary

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number. The tuner 16 can therefore be tuned by varying the binary number in the memory 24.

To set up the detection unit to receive different frequencies, an external plug-in unit is used. This external unit enables a particular store address to be selected and the memory 24 contents to be incremented or decremented to tune to the required frequency. The procedure is repeated for all the required frequencies.

In operation, the memory 24 is addressed in sequence from the address counter 25 until a voltage is detected. The address counter 25 is then halted and the tuner 16 is locked to the detected frequency. The binary store address number is used to identify the detected television channel number.

To preserve the memory 24 contents when power to the detection unit is switched off, either a battery powered random access memory (RAM) or an electrically alterable read only memory (EAROM) can be used. The address numbers that represent the detected television channels are outputted to the mains transmission unit 3.

Figure 3 shows a practical implementation of the tuner 16 (by way of example one made by Thomson CSF of type MTS 200) and the amplifier and S.A.W. filter 18 (by way of example one of type SW153A) and detector 20, and a practical implementation of another part of the detection unit 1 is shown in Figures 4a and 4b. The function of the address counter 25 and digital to pulse width converter 22 is achieved in one integrated circuit IC2 of type AV-3-8211 made by General Instruments. The memory 24 is an electrically alterable read only memory (EAROM) type ER1400 IC1 and the integrating amplifier is designed around integrated circuit IC3. The integrated circuit IC2 also provides band switching information for tuner 16 to have multiband operation, tuner

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16 normally being in a condition for Band A operation unless +12 volts is applied to either of the lines marked Band UHF and Band B for it to be set to the corresponding one of these conditions.

5 Advantages of the above-described unit 1 are that only known required frequencies are looked for; and there is no direct electrically conductive connection between the unit and the television set.

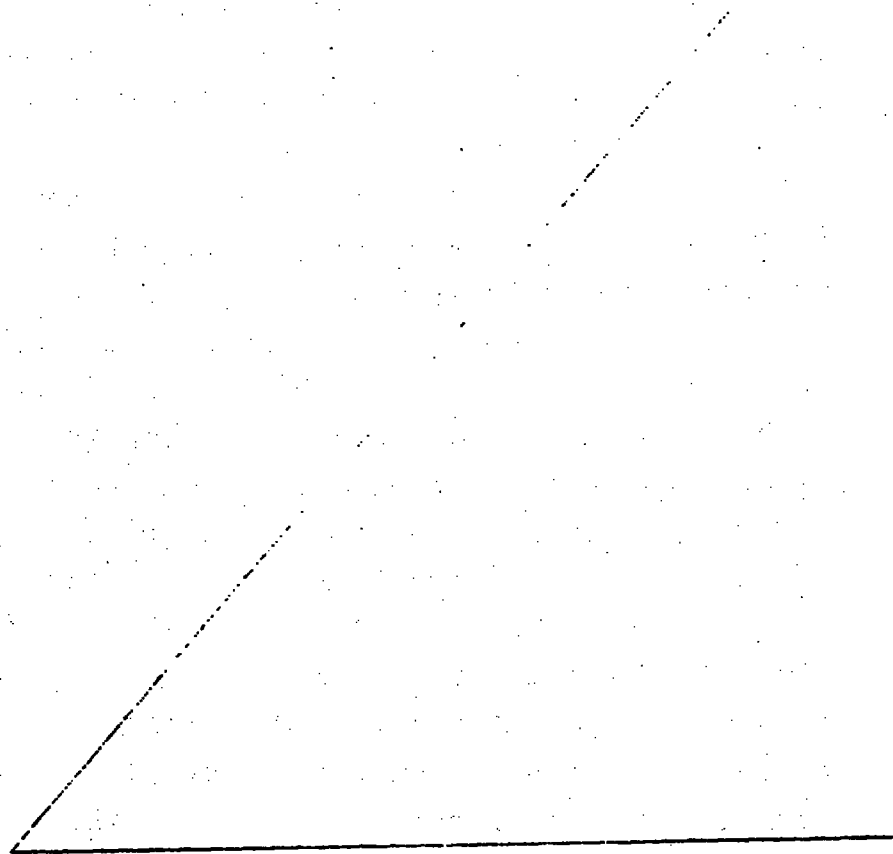
10 Figures 5 to 7 illustrate an embodiment of the people monitoring unit 2. In order to monitor the viewing habits of people within a particular room, a push-button system is employed. Each person, who will at some time view the television set, is allocated a number. In the unit to be described
15 the number of users is limited to eight. _____

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As shown in Figure 5, buttons 30 are housed in a self contained battery powered handset 32 placed in a convenient position within the room. When a person starts to view the television receiver, the button 30 assigned to that person is momentarily pressed. An infra-red 34, or ultrasonic 36, transmitter emits signals which are received by an infra-red 34a, or ultrasonic 36a, detector in a remote receiver unit 33. A data link is thereby established between the handset 32 and the remote receiver unit 33 and a code unique to the number of the depressed button is received, decoded in decoder 38 and stored in one of eight bistables, e.g. eight D flip-flops 40. The output of that bistable is displayed as an identical number on a vacuum fluorescent display 42. When the viewer ceases to view, the same button is momentarily depressed and the appropriate bistable 40 in the receiver unit 33 is reset via the data link 34, 34a or 36, 36a and the displayed number is cleared. The outputs of the eight bistables 40, which represent the people status, are connected to the mains transmission unit 3 and are sent as part of a 16 bit word to the central recorder 4.

The facility of choosing between an infra-red or an ultrasonic data transfer between the handset 32 and the receiver unit 33 has been incorporated so that the option exists to select a mode which does not interfere with any existing remote control system which may already be in use by the viewer.

Other features are also included in the receiver unit to remind viewers to update or check the input data and to reduce erroneous operation. These features include the features that

(a) all the eight display digits will flash if the television receiver is on and no people viewing data is entered;

(b) a reminder is activated every 10 minutes and the displayed digits are flashed for about 10 seconds;

5 (c) all people inputs are inhibited if the television receiver is switched off; and

(d) switches 44 are provided within the unit so that any of the eight people inputs can be masked out.

10 The receiver unit 33 can be integral with the mains transmission unit 3 or can be as an add-on unit connected via a multi-way cable.

Figure 6 shows a practical embodiment of a people detection unit and display board in the infra-red mode, as selected by switch S1, the coded
15 signal being ~~detected~~ by the sensor D3 and amplified by transistor TR2 which also sets the d.c. bias. Resistors R20, R21 and diode D4 prevent overload under conditions of high input signal. The signal is a.c. coupled from the collector of TR2 via C9
20 to the integrated amplifier IC5. The amplified signal on pin 3 of IC5 is stretched, by the network D1, R1 and C4, and DC shifted by transistor TR1, so as to be compatible with the pulse position modulation decoder IC11. VR1, R9 and C8 set the
25 internal time reference for the decoder IC11. The binary coded signals which are present on A, B, C, D (IC11), when any of the push buttons on the handset are depressed, are decoded by IC17 into eight individual signals. These signals can be masked
30 by the switches S2a - S2h.

The eight bistables IC12 - IC16 are used to store the people status. The integrated circuits IC20 and IC40 generate multiplexed signals for the vacuum fluorescent display, the high voltage
35 drives being provided by transistors TR3 to TR17.

The counter IC10 and IC9 (connected as two bistables) provides timing logic and divide a 3 Hz

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clock to generate a flashing reminder for $\frac{32}{3}$ seconds after a delay of 682 seconds. Also a continuous flashing of the display occurs after $\frac{128}{3}$ second if the television receiver is on and no people are set into any of the eight bistables as detected by the 8-input AND gate IC14.

A light dependent resistor LDR1 sets the intensity of the display to allow for varying ambient light conditions.

When the ultrasonic mode is selected by S1, the signal is amplified as before except that the network C1, C2, C3, R2, R3, R4 forms a twin-tee filter network tuned to the resonant frequency of the ultrasonic transducer X1.

In Figure 6, integrated circuits IC1 and IC3 are of type CD4011B; IC2 and IC17 are of type CD4028B; IC4 is of type CD4543B; IC5 is of type TDA4050B; IC6 and IC8 one of type CD4071B; IC7 is of type CD4025B; IC9 is of type CD4001B; IC10 is of type CD4040B; IC11 is of type ML926; IC12, IC13, IC15 and IC16 are of type CD4013B; and IC14 is of type CD4068B.

The design of the remote handset shown in Figure 7 is centred around the integrated circuit IC101, type SL490, which produces a different pulse position modulated signal when any of the push buttons, PB1 - PB8, are depressed. Resistors VR1, R102 and capacitor C102 set the pulse train clock frequency.

In the infra-red mode, selected by S1a and b, the coded pulse train is a.c. coupled via a capacitor C105 to transistors TR103, TR104 and TR105, forming a cascaded amplifier. The power transistor TR105 provides high current pulses to drive the infra-red emitting diodes LED1 and LED2.

In the ultrasonic mode IC101 also produces a 40kHz pulsed carrier, inhibited in the infra-red mode by switch S1b and set by VR2, R104 and C104.

This carrier is amplified in a push-pull amplifier formed by TR101 and TR102 to drive the transducer X1. The drive to the base of TR104 is short-circuited by switch S1b.

5 One embodiment of the transmission unit 3 will now be described with reference to Figures 8 and 9.

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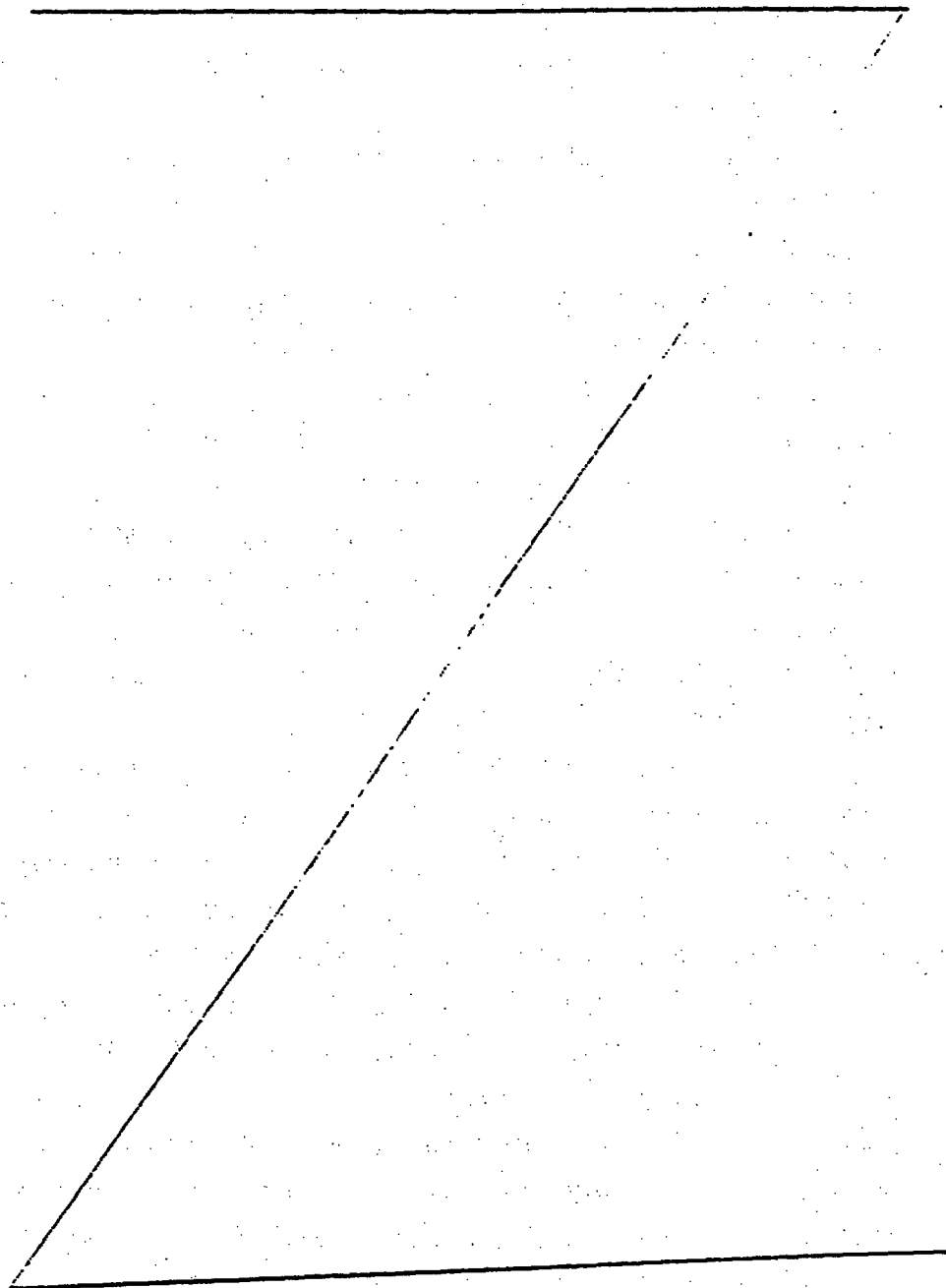
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This unit 3 is designed to accept data from the people monitoring unit 2 and from the television channel detection unit 1 and to transmit the data via an existing domestic house wiring system to a central receiving station 4.

As shown in Figure 8, a sine-wave output on the secondary of a mains transformer T1 which is connected to a power supply 53 is connected to the input of a zero-crossing detector 50 and a voltage transition is generated each time the input waveform passes through zero. This transition is used as a reference to phase-lock a voltage controlled oscillator 52 at a predetermined carrier frequency, e.g. 51.2 KHz. This frequency is divided by binary dividers in a 14 stage binary divider 54 and the output, 50 Hz, is used as an error signal for the phase-locked oscillator 52. Thus, all the outputs from the binary dividers 54 are phase-locked to the mains supply at 50 Hz. Outputs of the binary dividers at 200 Hz and 100 Hz are decoded in a time slot generator 56 to gate the carrier frequency, in this case 51.2 KHz, into a particular time slot selected by switch S51. In this particular application the data is sent as a 16 bit word, preceded by 16 bits (i.e. 16 mains half cycles) when no carrier is sent. This enables the receiver 4 to detect the start of the 16 bit data word, the first bit of which is always present. The data from the people monitoring unit 2 and television channel detection unit 1 is parallel-loaded into a shift register 58 during the 16 blank half cycles and is sent out in serial form at a rate of, for example, one bit per 10 mS. The output from the time slot generator 56 is a 2.5 mS long burst of 51.2 KHz carrier which is gated on or off depending on the data stored in the shift register 58. The data word is repeated as long as the system is switched on.

The gated carrier is amplified in power amplifier 60 and isolated from the mains supply by a tuned transformer T2. A band pass filter 62 is included to remove any harmonics which could cause radio interference.

In this particular application, the mains transmission signal is inhibited when the television receiver is switched off, by way of input 64 to the time slot generator 56.

The carrier frequency (in this example 51.2 kHz) need not be a multiple of 50 Hz, and need not necessarily be phase-locked to the mains supply frequency. This system has been described with reference to one of four transmitters which all use the same carrier frequency; however, different frequencies could be used for each transmitter but this would complicate the receiver input filter design.

Each transmitter sends data in a unique time slot, referenced to the zero crossing point in the mains supply waveform. Thus only one transmitter is on at any given time, and as each transmitter is time-locked to the mains supply waveform, the receiving station 4 knows when to sample the mains supply to detect data from a particular transmitter 3.

The signal can be sent through the mains wiring by using any two conductors from the three that may be available, i.e. (1) line and neutral, (2) line and earth, (3) neutral and earth.

A different frequency could be sent by a transmitter when not sending a digital '1', which would mean that one of two frequencies was always present at the receiver. This would result in a reduced error count when interfering signals were present, and would enable a system of automatic level control to be used at the receiver to compensate for signal level variations due to load

condition changes on the mains supply. However, such an arrangement would be more complex and therefore more expensive than that hereinabove described.

5 Figures 9a-d show typical data received from each of four transmitters; Figure 9e shows the 50 Hz mains signal with a superimposed 51.2kHz signal; and Figure 9f shows the 51.2 kHz signal at the output of a receiver input filter.

10 Advantages of the unit 3 are that television sets can be moved from point to point by simply plugging into any mains socket without any modification of the system; only a two wire system is used; radio frequency interference is reduced to a
15 minimum; all transmissions are synchronized to the mains supply; and where there is a plurality of such units 3 in different households, a single frequency is used for all units, and all units are asynchronous.

20 It is possible to have a meter which records information from a mains supply line, in a similar manner to that which has been described, and then transmits the information to a central computer by way of a public switched telephone network. In
25 view of the fact that the load on the public telephone network is likely to be reduced at night, such transmission usually occurs at night. Such a meter will now be described with reference to Figure 10.

30 The meter is of a double insulated construction and is connected to a mains supply by way of a two core mains cable 70. The mains supply is first passed through a protective fuse 71 and an interference suppression filter 72, before feeding the primary of a mains transformer 73 and the primary
35 of a 51 kHz tuned transformer 74 through a 50 Hz blocking capacitor 75. The mains transformer 73

provides the power required by a vacuum fluorescent clock display and driver electronics 76. It also provides power to a battery charger 77 which maintains a battery 78 in a fully charged condition when the mains supply is present. Display electronics, in the form of an ambient light level compensator 79, varies the brilliance of the display 76 in response to changes of the ambient light level. The zero-crossings of the mains transformer 73 secondary voltage are sensed in a zero-crossing detector 89 and fed to a computer system 80 to

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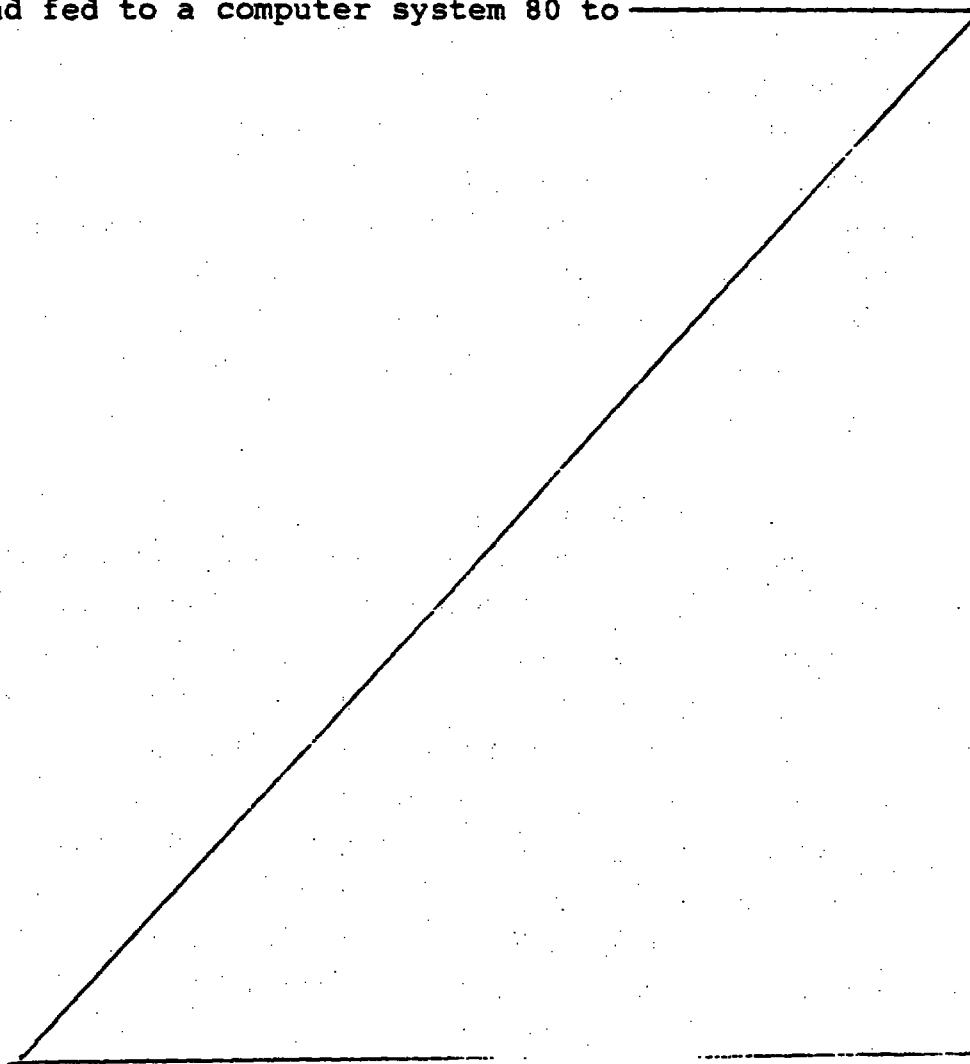
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provide a reference signal related to the mains supply zero-crossings.

5 The signal which passes through the 51 kHz tuned transformer 74 is fed to a comparator with hysteresis 81 the output of which clocks a divider circuit 82. Should a 51 kHz signal be present on the mains wiring at a level in excess of about 60 mV peak to peak, the divider output toggles at 51 kHz; otherwise, the divider output is static, apart
10 from occasional state changes caused by noise on the mains supply. The computer system 80 counts the number of state changes of the divider 82 output during certain intervals of time defined by their relation to the mains zero-crossings. Should the
15 number of state changes in such an interval exceed a preset threshold, the 51 kHz signal is deemed to be present on the mains wiring during that interval.

The battery 78 is float-charged from the mains, and powers all the electronic circuits apart from
20 the display and driver electronics 76. It is protected against accidental short-circuiting by a fuse. The meter can maintain recorded information, keep track of the passage of time, attach and detach itself from the telephone line at the appointed
25 times and answer calls from the central computer when so attached without mains power. The computer system 80 is normally switched off, when the mains supply is absent, to conserve the battery charge. A crystal controlled pulse generator 83; a power
30 control latch 84; a seconds counting latch 85; and a CMOS memory 86 are, however, powered at all times.

The pulse generator 83 sets both latches 84, 85 at one second intervals and supplies a reference frequency to clock the computer system 80. The power
35 control latch 84 is also set when ring current is detected on the telephone line 87. When the power control latch 84 is set, a voltage regulator and

delay generator 88 is enabled and the computer system 80 is powered from its regulated output. The delay generator ensures that the computer system 80 is not released until the circuits have had time to stabilise after they have been switched on. The computer system 80 resets the power control latch 84 when the computer system 80 requires to turn itself off. The seconds counting latch 85 is reset by the computer system 80 whenever it is found to be set and the internal computer time is advanced by one second. Should the computer program fail due to some transient electrical disturbance, the seconds counting latch 85 will no longer be reset regularly. This condition is detected by an auto-restart time 102 and the computer system is powered off and restarted in the normal manner, thus saving the battery from damage due to deep discharge and allowing the meter to resume its normal operation. The CMOS memory 86 retains stored information when power is removed from the computer system.

A latching relay 90 in the meter is operated by a pair of power drivers 91 feeding separate coils in the relay 90. These power drivers 91 are driven directly by the computer system 80. If the detach driver is momentarily activated, the telephone instrument 92 is connected to the telephone line 87 by the latching relay 90 and the telephone system operates in the normal manner. If the attach driver is momentarily activated the telephone instrument is disconnected from the line 87, its input is short-circuited and a meter ring detector 93 is connected across the line. When ring current is present on the telephone line 87 in this condition, the computer system 80 is powered up, if it is not already powered, and a signal from the ring detector 93 informs the computer system 80 that ring current is present. Ring current does not pass through the

telephone instrument 92 and its bell does not ring.

5 The computer system 80 validates the presence
of ring current for 800ms and then turns on a power
driver 81 to operate a line seize relay 94. This
10 relay 94 disconnects the ring detector 93 from the
telephone line 87 and connects a line holding
inductor and an a.c. coupled signal transformer 95
to the line. Carrier signals present on the telephone
15 line are coupled through the signal transformer 95
to an active line hybrid 96 which amplifies the
received signal and separates it from the transmitted
signal. The amplified signal is passed through a
receive filter 97 which removes out-of band inter-
ference and is then squared up by a limiting
20 amplifier 98. The computer system 80 then directly
demodulates the resultant signal.

 The modulated signal which is transmitted to
the telephone line is generated by the computer system
80 as a sequence of timer output pulses
25 corresponding to the zero-crossings of the outgoing
signal. These timer output pulses toggle a divider
circuit 99 and the resultant output is fed to a trans-
mit filter 100 through a variable level generator
101. The computer system controls the output of
30 the level generator 101 to compensate for the var-
iation in gain of the transmit filter 100 between
a 2100 Hz echo suppression tone and the transmit
carrier frequency. The transmit filter 100 suppresses
the harmonics in the level generator 101 output.
35 The filter output 100 is fed through a 600 ohm match-
ing resistor in the active line hybrid 96 to the
signal transformer 95 which couples it to the
telephone line 87.

 In a system for monitoring the viewing habits
40 of a plurality of households, each of the households
would be installed with such a meter. The system
is such that an existing telephone line of each house-

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hold is used by the system without significantly diminishing the household's enjoyment of its telephone service. This is achieved by several means, the chief of which is by operating only in a period in the early part of the morning. The telephone instrument of each household operates normally outside of half-hour intervals in this part of the morning, in which the meter is connected to the telephone line. In addition, once a meter has been successfully interrogated it detaches itself from the telephone line for the rest of the night. For those households who are accorded some degree of priority this will typically mean that they lose the full use of their telephone for only a few minutes each night.

Should someone attempt to call a household whilst its meter is connected to the telephone line, the meter will answer the call with a continuous tone to indicate that the telephone call has been answered by a machine. When the call is terminated, or after about 25 seconds, the meter will detach itself from the telephone line until the next half-hour time slot. If a second attempt is made to call the household, within half an hour of the first call, the call will be routed to the telephone instrument in the normal manner.

Should a member of a household wish to make an outgoing call whilst the meter is connected to the telephone line, he must unplug the meter's telephone cord from the wall socket. A variant of the meter system allows for the automatic handover to the telephone instrument when the handset is raised to make an outgoing call.

Another important feature of the system is that the telephone calls are originated by the central computer system. In addition, the origination of calls centrally from the central computer rather

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than the meters allows the system to progress calls as quickly as possible. More meters can be interrogated per central telephone line and the time that each meter spends on the telephone line is minimised.

5 There is a "holiday" button on the rear of each meter. In essence this button is used to indicate to the data collection system that a potential viewer is away on holiday. This is accomplished by the viewer pressing the "holiday" button before departing
10 on holiday. A display of AM 0:00 indicates that the button has been sensed by the meter. In this condition the meter will report to the central computer that "holiday" status is true. When the viewer returns from holiday, in response to his
15 tuning on the television set, the meter displays time in the normal manner and will report to the central computer that "holiday" status is false.

 The system is designed to collect audience data from the remote meters. It comprises a central
20 master computer (with a standby), associated communications equipment and optionally one or more slave computers connected to the master computer via private lines. Meters in households are interrogated (polled) over the public switched telephone
25 network from the central computer and the slave computers.

 The central computer is connected to several 300 baud modem/dialler pairs for meter polling, several 1200 baud modem/dialler pairs for communication with slaves, a disc drive for data and program
30 storage, a tape drive for data backup and data interchange with an IBM system, a printer and a visual display unit console. The slave computers are connected to several 300 baud modem/dialler pairs
35 for meter polling and a 1200 baud modem for communication with the central computer. Polling is

initiated by command to the central computer. Additional commands may be issued to obtain reports from the system and to produce data tapes. A directory containing information on the meters to be polled is passed before each run from an IBM (RTM) computer to the central computer. After overnight data collection, data tapes are produced on command, as well as an updated directory tape. These tapes are returned to the IBM (RTM) computer for processing.

10 Polling occurs overnight, the central computer allocating work to and receiving data from the slave computers. The slave computers are dialled at the beginning of data collection and remain in contact with the central computer until data collection has ceased. The time available for polling is divided into eight half-hour time slots as mentioned above. Meters are divided into two classes, designated even and odd. Even meters are connected to the telephone line during even time

20 slots. Odd meters are similarly connected during odd time slots. Once a meter has been successfully polled, it will not reconnect itself to the telephone line during the remainder of the night. All data interchange over telephone lines is error checked.

25 When errors are detected, recovery procedures ensure that any detected corrupt information results in attempts to correctly retransmit that information. This applies to transmissions between the central computer and the slaves and between the meter and

30 the central or slave computer. Data collection by the central computer is stored immediately on disc and tape. Data collected by a slave from a meter is retained in the memory of the slave until that meter is disconnected from the telephone line. The

35 data is then transmitted to the central computer where it is stored on disc and tape.

CLAIMS

- 1 1. An arrangement for storing data received from a television viewing monitoring system and for transmitting said data to a remote computer by means of a telephone line of a public telephone network, the arrangement
5 comprising:
a memory for storing said data;
resettable time measuring means for measuring the passage of time and for defining a plurality of data access slots in each of successive periods of time;
10 interrogation detection means for detecting an incoming call and for determining whether the call is from the remote computer;
switch means actuatable to connect to the telephone line selectively one of a) a telephone
15 instrument for normal operation, and b) during a data access slot, the interrogation detection means; and
transmission means actuatable to transmit data from the memory to the computer via the telephone line, the arrangement being such that, when an incoming call is
20 determined as not being from the remote computer, the telephone instrument is connected to the telephone line for the remainder of the current data access slot and the detection means is reconnected to the telephone line during the next available data access slot, and, when the
25 call is determined as being from the computer, the transmission means is actuated to transmit data, and connection of the detection means to the telephone line is inhibited during those data slots of a period which follow; successful transmission of data to the computer
30 in an access slot of that period.
2. An arrangement as claimed in claim 1, wherein the interrogation detection means is such as to detect the presence of ring current on the telephone line.
3. An arrangement as claimed in claim 1 or 2, wherein
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1 the transmission means comprises a variable output level
generator whose output level is controlled by the control
unit, a filter for filtering the output of the variable
output level generator and a transformer coupled to the
5 telephone line.

4. An arrangement as claimed in claim 1,
substantially as hereinbefore described with reference
to, and as illustrated in, Figure 10 of the accompanying
drawings.

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