IMPROVEMENTS IN OR RELATING TO WIRED BROADCASTING SYSTEMS.
The present invention relates to wired broadcasting systems by which a number of television or other programmes may be transmitted through a distribution network to a plurality of subscribers who are able to select desired programmes.

Various systems have been proposed to make a number of television transmissions available to subscribers, and a system which has been developed by the applicants which offers a number of advantages over alternative systems is described in British Patent Specification No. 1272594 based on the use of programme exchanges serving a group of subscribers each of whom has his own individual vision circuit to the programme exchange, provided by a twisted pair of conductors with interstitial conductors associated with each pair for the transmission of signals for controlling switch means at the programme exchange whereby any of a number of programmes may be selected by the subscriber and applied to the twisted pair vision circuit for transmission to that subscriber. In general a number of such programme exchanges distributed over the network area receive a number of colour transmissions through a trunk network from a central programme station, commonly referred to as the transmitter.

Such a system is extremely versatile and may be used not only for the transmission of vision signals from the programme exchanges to the individual subscribers, but a wide range of other facilities can be provided.
Thus for example information or instructions originating at the subscriber's premises can be transmitted through the programme exchanges to central equipment, and if
required vision signals can be so transmitted. Systems of this kind could be used for simple selective signals to be passed from the subscriber to a central station, for example for alarm circuits or for remote reading of gas, electricity and water meters. Also signals may be transmitted to the subscriber for the control of heating, lighting and safety functions. Apart from these comparatively simple operations involving little more than signalling conditions, this equipment can also make use of the vision channels for subscription television, for assessing programme popularity, for subscriber polling purposes, and for computer assisted teaching and information retrieval systems, in which various signals have to be transmitted from the subscribers to a central station.

Certain of these additional facilities however require the transmission of more information than can easily be transmitted over the wired network by direct current signalling methods or by step-by-step switching methods, in which methods signals are transmitted over the interstitial pair of conductors extending between each subscriber and the programme exchange to which he is connected.
Accordingly the present invention provides a wired broadcasting system in which each of a group of subscribers stations is connected to a programme exchange as herein defined through a signal path which comprises a twisted pair of high frequency television signal conductors having associated therewith a further pair of conductors each of which is located in a respective one of the intersticies of the high frequency television signal conductors, comprising means actuable by the respective subscribers for applying control signals to the intersticial pair of conductors for controlling switch means at the programme exchange so that a subscriber may apply to his high frequency conductor pair any of a number of programmes available at the programme exchange, a central data processing station coupled through the vision transmission circuits of the system to the subscriber stations, means associated with the subscriber stations for responding to information or data signals received from said central data processing station, and a signal path including the intersticial pair of conductors for returning information or data signals to the central data processing station from the subscriber stations.

The term "programme exchange" is used herein to mean a central location from which programmes for transmission are distributed to all the subscribers in a distribution area.
The transmission of information between the subscriber's station and the central data processing station may be effected by the repeated transmission of a train of pulsed binary signals utilizing frequency shift 0/1 signals transmitted over the vision network in a frequency band selected so that interference with the vision circuits is avoided or can be eliminated by suitable circuit devices.

The central data processing station may be arranged to transmit binary frequency shift signals into the vision circuits at the nearest convenience point so that the signals transmitted by the central data processing station reach every subscriber via the selection switch provided at the subscriber's station, these signals in effect interrogating the subscriber's stations in every position of the subscribers' selector switches, even with a particular selector switch in the off position in which no vision signal has been selected and the television equipment is out of use.

In order that the invention may be more readily understood, one embodiment thereof will now be described, by way of example only, with reference to the accompanying drawing which is a block schematic diagram of a wired broadcasting system in accordance with the present invention.

In the wired broadcasting system shown in the drawing a central programme station 1 is connected to programme exchanges, two of which are shown at 2 and 3 respectively by means of a truck network which may typically comprise a plurality of co-axial cables four of which are shown at 4, 5, 6 and 7 although in a practical system many more, perhaps of the order of
thirty or forty would be used. Each cable of the truck network is arranged to convey one television programme between the central programme station 1 and each of the programme exchanges 2, 3. At each programme exchange a plurality of subscriber stations 8 - 15 are provided with programme selection switches by means of which they may effectively derive signals from any one of the four trunk cables. Each subscriber station is connected to its respective programme exchange by means of a cable having a twisted pair of high frequency television signal conductors suitable for the transmission of high frequency television signals having associated therewith an interstitial pair of audio frequency and control signal conductors. The subscribers programme selection switches are arranged to be connected to derive signals from one of the trunk cables whether or not the corresponding subscriber station is operative. Accordingly, signals injected into the trunk cables will reach every subscriber station irrespective of the state of the terminal equipment. A central data processing station 24 is arranged to inject information or data signals into the trunk network at any convenient point. As shown in the drawing this is, in this example, between the central programme station 1 and the first programme exchange 2. These information or data signals will be transmitted through the network to every subscriber irrespective of the state of his terminal equipment. Conveniently, the information or data signals comprise frequency shift binary representative pulse signals which after reception by the subscriber are returned in modified form to the central data processing station 24.
overseparate circuits extending between the programme exchanges 2, 3 and the central data processing station 24. Conveniently, the information or data returned by the subscribers equipment to the central data processing station 24 has a frequency double that of the interrogating signal and modifies or adds thereto various characters as determined by the subscribers equipment and/or by the programme exchanges.

Each programme exchange 2, 3, is separately linked to the central data processing station 24 through a multiple-circuit cable 25, 26. These cables 25, 26 are twelve-pair cables each pair of which is used on a time division multiplex basis sequentially to transmit the signals from the subscribers of a group of say 28 subscribers connected to the programme exchange, assuming the case of a programme exchange intended to serve 336 subscribers in all.

At the programme exchanges 2, 3 each pair of the twelve-pair cables 25, 26, is connected to the rotor connection of a continuously driven stepping switch shown diagrammatically at 27, 28, the stationary contacts of which are each connected to the interstitial pair of a corresponding one of the 28 subscribers. The continuously driven switches 27, 28 may have a number of unused positions, for example, eight positions in the case of a 36-way switch used with 28 subscribers, and these eight positions are adapted by connecting some of the stationary contacts to suitable potential sources to transmit a code signal into the respective pair of the twelve-pair cable to identify at the central data processing station 24 the particular group of 28 subscribers associated with that switch.
Thus the central data processing station 24 interrogates all the subscribers over the vision channels at a very high rate and the signal received by each subscriber is stored together with any desired information from the subscriber, ready for transmission to the central data processing station at that time when a transmission path extends to it from that subscriber's station.

The information or data signal fed into the trunk cable of each different vision programme differs in respect of the initial part of the message to define the programme channel. It will be appreciated that the information or data returned to the central data processing station through the pairs of the twelve-pair cable will thus identify the programme to which the subscriber is connected at the particular instant concerned, and additional information inserted by the subscriber's equipment will identify the particular subscriber, enabling computer-like systems at the central data processing station to perform any required operation, for example, billing or programme popularity determination.

Even if the subscriber's equipment is switched off, the equipment will still be switched to derive signals from one of the trunk cables so that an appropriate response continues to be received from the subscriber's equipment. The selector switches 27, 28, at the programme exchanges may be connected to each subscriber for say 250 ms every few seconds, say up to 20 or 30 secs. and during this connection the central data processing station is able to receive the return message set up by the immediately preceding.
equipment will identify the particular subscriber, enabling computer-like systems at the central processing station to perform any required operation, for example, billing or programme popularity determination.

Even if the subscriber’s equipment is switched off, the equipment will still be switched to derive signals from one of the trunk cables so that an appropriate response continues to be received from the subscriber’s equipment. The selector switches 27, 28, at the programme exchanges may be connected to each subscriber for say 250 mS every few seconds, say up to 20 or 30 secs. and during this connection the central processing station is able to receive the return message set up by the immediately preceding interrogation of the subscriber over the trunk cable to which his equipment is switched. The subscriber’s equipment includes means 29 - 36 for responding to and modifying the information or data signals. This equipment includes means to serve as a buffer store, for example, a magnetic core or solid state logic store or, in a simple arrangement, a switch or knob set by the subscriber in response to voting or opinion seeking or forming part of an instructional system.

The frequency shift signals used may be as follows:

0 = 110 KHz
1 = 140 KHz

This frequency shift signal is doubled in frequency at the subscriber’s station and it is these frequency shift signals which are returned on a time multiplex basis to the central processing station through the
interrogation of the subscriber over the trunk cable to which his equipment is switched. The subscriber's equipment includes means 29 - 36 for responding to and modifying the information or data signals. This equipment includes means to serve as a buffer store, for example, a magnetic core or solid state logic store or, in a simple arrangement, a switch or knob set by the subscriber in response to voting or opinion seeking or forming part of an instructional system.

The frequency shift signals used may be as follows:

0 = 110 KHz
1 = 140 KHz

This frequency shift signal is doubled in frequency at the subscriber's station and it is these frequency shift signals which are returned on a time multiplex basis to the central processing station through the selector switches, 27, 28, at the programme exchanges and through the twelve-pair cables 25, 26. It will of course be understood that twelve-pair connecting cables 25, 26, may be replaced by a carrier wave system with say twelve carrier frequencies spaced by nominal 80 KHz intervals carried by a single, common cable.

The message transmitted from the central data processing station may comprise the following groups of signals or "words".

A = 3 bits, which is the master reset signal for subscriber located memory stores and may include a timing function for synchronizing remote signalling oscillators.

B = 10 bits, including a parity bit, which labels the vision
channel, e.g. 0 to 35 and also provides information on the type of television programme, e.g. free, educational, or fee-paying and may also provide pricing information.

C = 16 bits (including parity) which is specifically allocated to subscribers' addresses and also provides means for addressing students' "frame snatch" equipment in connection with teaching and library application, to permit a stationary picture to be held for study, or to permit a student to reply by selective switch operation.

D = 10 bits; this carries the basic instruction from the processing equipment to subscriber's local stores and conditions the subscriber's equipment to deal with the specific function, i.e. any of the various services for which the equipment is designed.

E = 16 bits with parity; this is a data shift signal which empties or samples the subscriber's buffer store, which may be a core or solid state logic store, or may be a button set by subscriber in response to voting or opinion-seeking or teaching vision picture or sound messages.

The complete five word 55-bit message is accepted continuously by all subscribers' equipment but returned to the central processing station from each subscriber in 250 mS dwell times repeated say every 30 secs. The minimum bit rate for at least two messages (one repeat) is therefore:

\[
\frac{110}{250 \text{ mS}} = 440 \text{ bauds}
\]

for any subscriber's output signal.
The minimum bit rate for signal processing equipment to sample say 30,000 subscribers for urgent functions, with a 30 second recurring cycle is:

\[
\frac{55}{30} = 55,000 \text{ bauds}
\]

The central processing station 24 will produce and transmit a message sequence for each vision channel available. All messages at any moment will only differ in word B information (programme or channel labelling), i.e. words A and C to E will be common.

All returned signals to the central data processing stations pass through the selector switch 27, 28, at the programme exchange and the multi-circuit cables 25, 26.

The message sequence received at a particular subscriber will be modified in two ways before return to the central data processing station via the programme exchange.

1. The carrier frequency is doubled,

2. The message format is modified by the information and instructions added by the subscriber or subscribers' equipment.

A typical message format will include the following words:-

A. As transmitted.

B. A signal indicating that the subscriber's receiver is in use.

C. First 8 bits blank (awaiting labelling at
exchange for selector indentification) and
the second 8 bits carry the information
derived from the use of the subscriber's
equipment.

D. As transmitted.

E. The data called up by D from the subscriber's
store.

An overriding alarm facility to warn of damage to the
cable in burglary or fire may be provided. This alarm
operates automatically when a test programme
fails to obtain any information from a particular
subscriber when other subscribers in the same group of 28 subscribers
are returning signals normally.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A wired broadcasting system in which each of a group of subscribers stations is connected to a programme exchange as herein defined through a signal path which comprises a twisted pair of high frequency television signal conductors having associated therewith a further pair of conductors each of which is located in a respective one of the intersticies of the high frequency television signal conductors, comprising means actuable by the respective subscribers for applying control signals to the intersticial pair of conductors for controlling switch means at the programme exchange so that a subscriber high may apply to his/frequency conductor pair any of a number of programmes available at the programme exchange, a central data processing station coupled through the vision transmission circuits of the system to the subscriber stations, means associated with the subscriber stations for responding to information or data signals received from said central data processing station, and a signal path including the intersticial pair of conductors for returning information or data signals to the central data processing station from the subscriber stations.

2. A wired broadcasting system as claimed in claim 1, comprising a plurality of programmes exchanges to each of which a respective group of subscribers stations are connected, and wherein separate signal paths are provided for returning information or data from each programme exchange to the central data processing station.
3. A wired broadcasting system as claimed in claim 2, wherein the return signal paths between the programme exchanges and the central data processing station are shared between a plurality of subscriber stations each of which is arranged to be connected thereto in sequence.

4. A wired broadcasting system as claimed in any one of the preceding claims which includes means for transmitting the information or data as binary representative frequency shift signals.

5. A wired broadcasting system as claimed in claim 4, wherein the frequency of said signals is arranged to lie outside the frequency band or bands occupied by vision signals in the system.
6. A wired broadcasting system as claimed in any one of the preceding claims, wherein the transmission of information or data is effected by the repeated transmission of a train of signals.

7. A wired broadcasting system as claimed in claim 6, wherein said signals are modified by information or data responsive equipment at each subscriber station.

8. A wired broadcasting system as claimed in claim 7, wherein means are provided at each subscriber station to store information or data signals received from the central data processing station until a signal path is available for returning said stored information in modified form to said central processing data station.

9. A wired broadcasting system as claimed in claim 4 or any one of claims 5 to 8 when appended thereto, wherein the frequency shift signals have frequencies of 110 KHz and 140 KHz respectively.

10. A wired broadcasting system as claimed in claim 7 or 8, wherein the information or data responsive equipment at the subscriber station is effective to double the frequency of the data signals prior to their return to the central data process station.

11. A wired broadcasting system substantially as described and with reference to the accompanying drawing.

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