ORIGINAL
CLERK'S OFFICE
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LUTHER D. Clerk
By Deputy Clerk

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF GEORGIA
ATLANTA DIVISION

SCIENTIFIC-ATLANTA, INC. a Georgia corporation, Plaintiff, v. SIRIUS SATELLITE RADIO, INC. a Delaware corporation, Defendant.	Civil Action File No.: 1:04-CV-0282 JURY TRIAL DEMANDED

BBM

COMPLAINT FOR PATENT INFRINGEMENT

The plaintiff, Scientific-Atlanta, Inc. ("S-A"), for its complaint against the defendant Sirius Satellite Radio, Inc. hereby demands a jury trial and alleges as follows:

NATURE OF ACTION

1. This is an action in which S-A seeks damages and injunctive relief under the patent laws of the United States, 35 U.S.C. § 1 *et seq.*, for infringement of each of U.S. Patent Nos. 5,239,540 and 6,055,244 (collectively the "patents-in-suit") resulting from the defendant's actions and conduct, as set forth herein.

FORMS RECEIVED
Consent to US Mag.
Pretrial Instructions
Title VII NTC

THE PARTIES

2. S-A is a corporation organized under the laws of the State of Georgia, having its principal place of business at 5030 Sugarloaf Parkway, Lawrenceville, Georgia, 30044.

3. Sirius Satellite Radio, Inc. is a corporation organized under the laws of the State of Delaware, having its principal place of business at 1221 Avenue of the Americas, 36th Floor, New York, New York 10020 ("Sirius"). S-A is informed and believes that Sirius is doing business in the State of Georgia and in this Judicial District.

JURISDICTION AND VENUE

4. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a).

5. Personal jurisdiction exists over defendant, on information and belief, by virtue of its actions and those of its agents which directly infringe or which induce or knowingly contribute in the infringement of S-A's patents-in-suit, within this state and/or their systematic and continuous contact with this state and/or the sale of infringing products in this state, pursuant to, *inter alia*, the Georgia long-arm stature, Official Code of Georgia Annotated § 9-10-91 (1995).

6. Venue is proper in this district in accordance with 28 U.S.C. §§ 1391 and 1400(b).

PLAINTIFF

7. S-A is engaged in the business of designing, manufacturing and selling advanced terrestrial and satellite network products and systems to deliver voice, video and data communications services. Over the years, S-A has developed and patented various novel inventions and improvements for use in the display of various kinds of information on its products. S-A has designed and manufactures an extensive line of equipment used in subscription television systems, including terrestrial and satellite transmission equipment and television set-top boxes that are used by subscription television subscribers to, among other things, unscramble cable transmissions and convert them into signals and data useable by the subscriber's television set ("S-A Equipment"). Among the features incorporated, enabled or implemented in the S-A Equipment is the ability to listen to digital music presented to the listener along with information describing the artist, song title and other descriptive information.

DEFENDANT

8. Sirius is engaged in the business of broadcasting digital-quality audio from orbiting satellites throughout the continental United States for a monthly

subscription fee. On information and belief, Sirius delivers 60 streams of 100% commercial-free music in virtually every genre, and over 40 streams of news, sports, weather, talk, comedy, public radio and children's programming.

9. On information and belief, Sirius has since its inception, used substantial resources to develop its satellite radio system. On information and belief, its satellite radio system consists of its FCC license, satellite system, national broadcast studio, terrestrial repeater network and satellite telemetry, tracking and control facilities.

10. On information and belief, Sirius had, as of December 15, 2003, approximately 200,000 subscribers for its digital satellite radio service. On information and belief, the Sirius digital satellite radio service includes the transmission of information relating to the artist, song title and other descriptive information along with the broadcast of a digital signal, including an audio signal to its subscribers. On information and belief, Sirius's primary source of revenue is the fees it collects from its subscribers.

11. On information and belief, Defendant, through agreements with leading consumer electronics manufacturers such as Kenwood, Panasonic, Audiovox, Clarion, and Jensen, provides radio devices capable of receiving its digital radio service, including transmitted descriptive information.

12. Defendant through such consumer electronics manufacturers sells digital satellite radios in the United States, including the Northern District of Georgia.

13. On information and belief, defendant has agreements to install its digital satellite radios capable of receiving its digital satellite radio service, including transmitted descriptive information, in Ford, Chrysler, BMW, Mercedes-Benz, Jaguar, Volvo, Mazda, Land Rover, Dodge, Jeep, MINI, Volkswagen, Audi, Nissan, and Infiniti vehicles, along with trucks from Freightliner and Sterling. Defendant's radios also are available in new Monaco Coach recreational vehicles, Thunderbird Formula powerboats, and on John Deere agricultural equipment.

14. Such automobile manufacturers include Defendant's digital satellite radio in automobiles they sell in the United States, including the Northern District of Georgia.

INFRINGED PATENTS

15. United States Patent No. 5,239,540 entitled "Method and Apparatus for Transmitting, Receiving and Communicating Digital Data Signals With Corresponding Program Data Signals Which Describe the Digital Data Signals," issued August 24, 1993 to Scientific-Atlanta, Inc. as the assignee of the inventors, Luis A. Rovira and William E. Wall (the '540 Patent"). S-A is the owner of the

entire right, title and interest in and to the '540 Patent. A copy of the '540 Patent is attached as Exhibit A.

16. The '540 Patent generally relates to a novel system and method for transmitting, receiving and communicating program data signals with digital data signals.

17. United States Patent No. 6,055,244 entitled "Method and Apparatus for Communicating Different Types of Data in a Data Stream," issued April 25, 2000 to Scientific-Atlanta, Inc. as the assignee of the inventors, William E. Wall, Jay C. McMullan, Jr., and Luis A. Rovira (the '244 Patent"). S-A is the owner of the entire right, title and interest in and to the '244 Patent. A copy of the '244 Patent is attached as Exhibit B.

18. The '244 Patent generally relates to a novel method for constructing a data stream that combines program data, header information, and another type of data.

19. On information and belief, defendant has, without authority, infringed, contributed to the infringement of and/or actively induced the infringement of, the claims of the patents-in-suit within the United States and in this judicial district.

20. Defendant has had notice of the patents-in-suit and their infringement, contributory infringement, and/or inducement of infringement of the patents-in-suit (defendant's "infringing acts") have been knowing and willful.

21. S-A has been damaged by defendant's infringing acts, and will continue to be damaged if defendant is not enjoined by this Court from further infringing acts.

22. Defendant's infringing acts have been without express or implied license by S-A, and are in violation of S-A's rights.

COUNT 1

Infringement of U.S. Patent No. 5,239,540

23. S-A incorporates and re-alleges paragraphs 1-22 above.

24. Through the conduct alleged above, defendant has, and continues to, infringe, contribute to the infringement of, and/or induce the infringement of the '540 Patent by making, using, selling, and/or offering for sale products, including but not limited to, digital satellite radio equipment and services, without authorization of S-A.

25. S-A has not authorized defendant to make, use, sell and/or offer for sale products covered by the claims of the '540 Patent.

26. The defendant's infringement, contributory infringement, and/or induced infringement of the '540 Patent has been done willfully and with knowledge of the '540 Patent.

27. By reason of defendant's infringement, contributory infringement, and/or induced infringement of the '540 Patent, defendant has caused and continues to cause S-A to suffer damage and irreparable harm. On information and belief, defendant's infringement, contributory infringement, and/or induced infringement of the '540 Patent will continue unless enjoined by this Court.

28. S-A has no adequate remedy at law for defendant's infringement, contributory infringement, and/or induced infringement of the '540 Patent.

COUNT 2

Infringement of U.S. Patent No. 6,055,244

29. S-A incorporates and re-alleges paragraphs 1-22 above.

30. Through the conduct alleged above, defendant has, and continues to, infringe, contribute to the infringement of, and/or induce the infringement of the '244 Patent by making, using, selling, and/or offering for sale products, including but not limited to, digital satellite radio equipment and services, without authorization of S-A.

31. S-A has not authorized defendant to make, use, sell and/or offer for sale products covered by the claims of the '244 Patent.

32. The defendant's infringement, contributory infringement, and/or induced infringement of the '244 Patent has been done willfully and with knowledge of the '244 Patent.

33. By reason of defendant's infringement, contributory infringement, and/or induced infringement of the '244 Patent, defendant has caused and continues to cause S-A to suffer damage and irreparable harm. On information and belief, defendant's infringement, contributory infringement, and/or induced infringement of the '244 Patent will continue unless enjoined by this Court.

34. S-A has no adequate remedy at law for defendant's infringement, contributory infringement, and/or induced infringement of the '244 Patent.

DEMAND FOR A JURY TRIAL

35. S-A demands a jury trial, pursuant to Fed. R. Civ. P. 38(b), as to all issues which may be tried by a jury.

REQUEST FOR RELIEF

WHEREFORE, S-A prays that the Court:

A. Enter judgment that defendant has infringed, contributorily infringed or knowingly induced infringement of the patents-in-suit;

B. Preliminarily and permanently enjoin defendant from further acts of infringement of the patents-in-suit;

C. Enter judgment awarding S-A damages adequate to compensate for defendant's infringement of the patents-in-suit;

D. Enter judgment that defendant's infringement of the patents-in-suit has been knowing and willful;

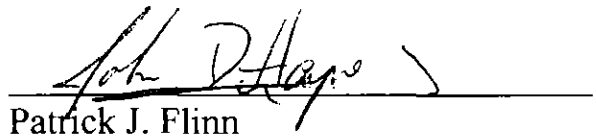
E. Enter judgment increasing the damages for infringement of the patents-in-suit to three times the amount found by the jury or assessed by the Court against the defendant;

F. Enter judgment declaring this to be an exceptional case and awarding S-A its attorney fees pursuant to 35 U.S.C. §285; and

G. Enter judgment awarding S-A costs, prejudgment interest, and such further relief as the Court deems just and proper.

This 2nd day of February, 2004.

Respectfully submitted,



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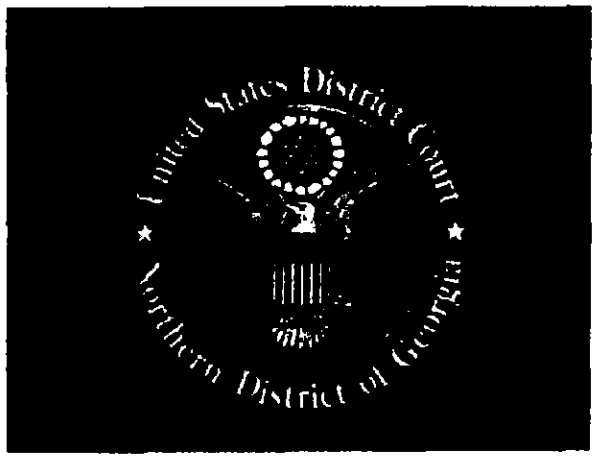

EXHIBIT ATTACHMENT

A

(To be scanned in place of tab)

United States Patent [19]

Rovira et al.

[11] **Patent Number: 5,239,540**

[45] **Date of Patent: Aug. 24, 1993**

[54] **METHOD AND APPARATUS FOR TRANSMITTING, RECEIVING AND COMMUNICATING DIGITAL DATA SIGNALS WITH CORRESPONDING PROGRAM DATA SIGNALS WHICH DESCRIBE THE DIGITAL DATA SIGNALS**

[75] Inventors: **Luis A. Rovira; William E. Wall, Jr.**, both of Atlanta, Ga.

[73] Assignee: **Scientific-Atlanta, Inc.**, Norcross, Ga.

[21] Appl. No.: **618,744**

[22] Filed: **Nov. 27, 1990**

[51] **Int. Cl.**[5] **H04J 3/00**

[52] **U.S. Cl.** **370/77**; 370/73; 455/45; 455/66

[58] **Field of Search** 370/71, 73, 76, 77, 370/110.1, 110.4, 111, 69.1; 358/84, 86, 140, 141; 455/45, 66

[56] **References Cited**

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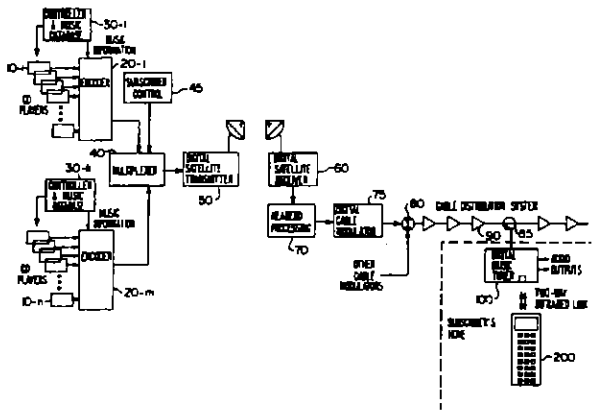
Primary Examiner—Douglas W. Olms
Assistant Examiner—Shick Hom
Attorney, Agent, or Firm—William A. Marvin; Frederick W. Powers, III

[57] **ABSTRACT**

An apparatus and method is described for transmitting, receiving and communicating program data signals which are combined with digital data signals. Preferably, the present invention compresses 30 digital audio signals, multiplexes them with title, track, artist, record label, year, etc., program information, and transmits the combined signals via satellite to a receiving station. The receiving station demultiplexes the signals and sends them via a cable distribution system to a subscriber's digital music tuner. This tuner further demultiplexes and decodes the signals so that the digital audio signals may be converted to analog and output for listening, while the corresponding data signals are communicated to the subscriber. In an alternative preferred embodiment, the program data signals are transmitted to a remote control receiver where they are displayed. The system described in the present invention may be used for transmitting video, software or games with program data to subscribers.

22 Claims, 8 Drawing Sheets



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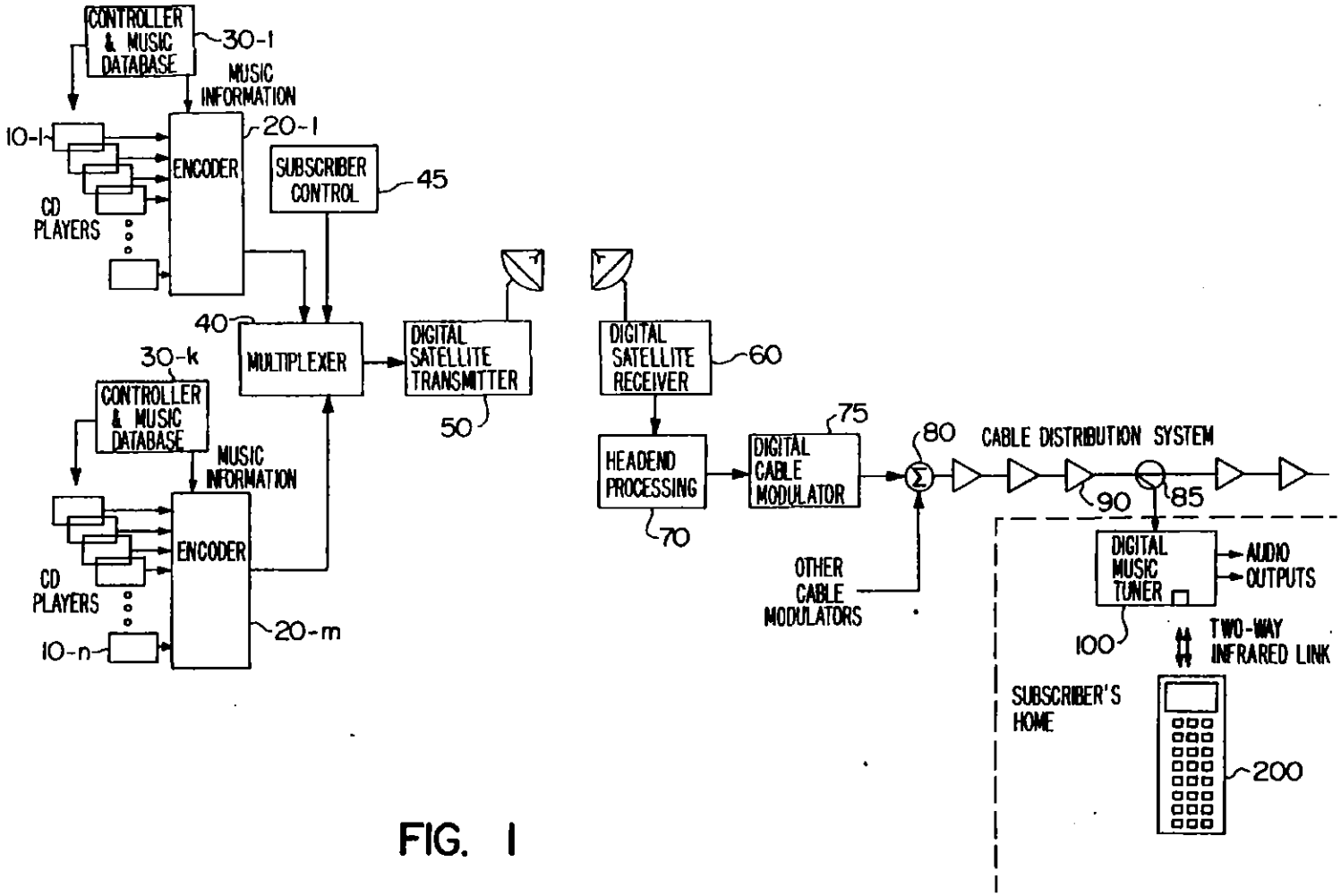
CONTROLLER & MUSIC DATABASE
30-1
MUSIC INFORMATION
10-1
ENCODER
20-1
SUBSCRIBER CONTROL
45
CD PLAYERS
40
MULTIPLEXER
DIGITAL SATELLITE TRANSMITTER
50
30-k
CONTROLLER & MUSIC DATABASE
MUSIC INFORMATION
ENCODER
CD PLAYERS
10-n
20-m
DIGITAL SATELLITE RECEIVER
60
HEADEND PROCESSING
70
75
DIGITAL CABLE MODULATOR
80
CABLE DISTRIBUTION SYSTEM
90
85
OTHER CABLE MODULATORS
DIGITAL MUSIC TUNER
AUDIO OUTPUTS
100
TWO-WAY INFRARED LINK
SUBSCRIBER'S HOME
200

FIG. 1

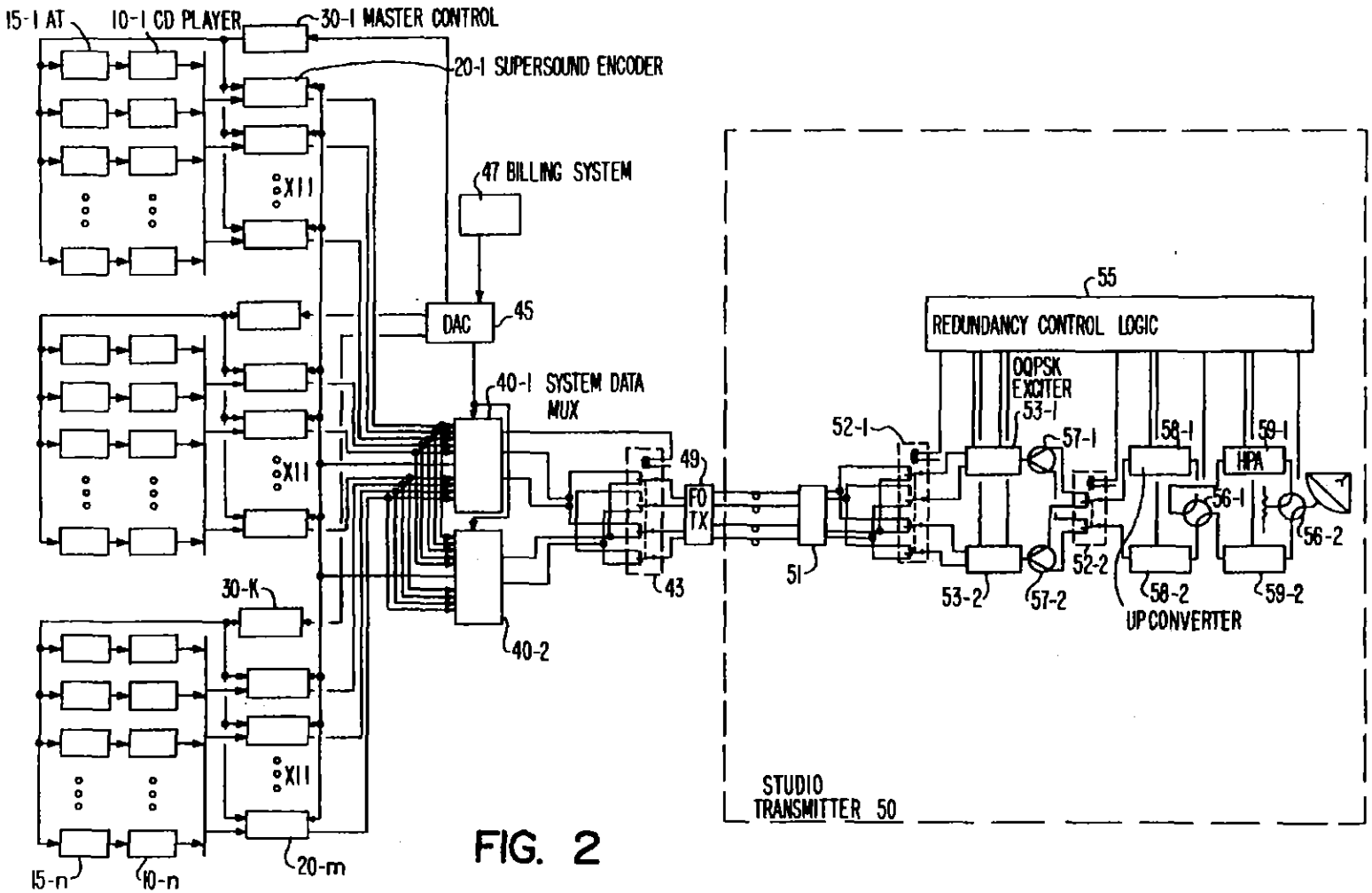
15-1 AT
10-1 CD PLAYER
30-1 MASTER CONTROL
20-1 SUPERSOUND ENCODER
47 BILLING SYSTEM
X11
DAC
45
40-1 SYSTEM DATA MUX
49
FO TX
43
40-2
30-K
X11
X11
15-n
10-n
20-m
55
REDUNDANCY CONTROL LOGIC
QQPSK EXCITER
53-1
52-1
57-1
58-1
59-1
HPA
56-1
56-2
51
52-2
53-2
57-2
58-2
59-2
UPCONVERTER
STUDIO TRANSMITTER 50

FIG. 2

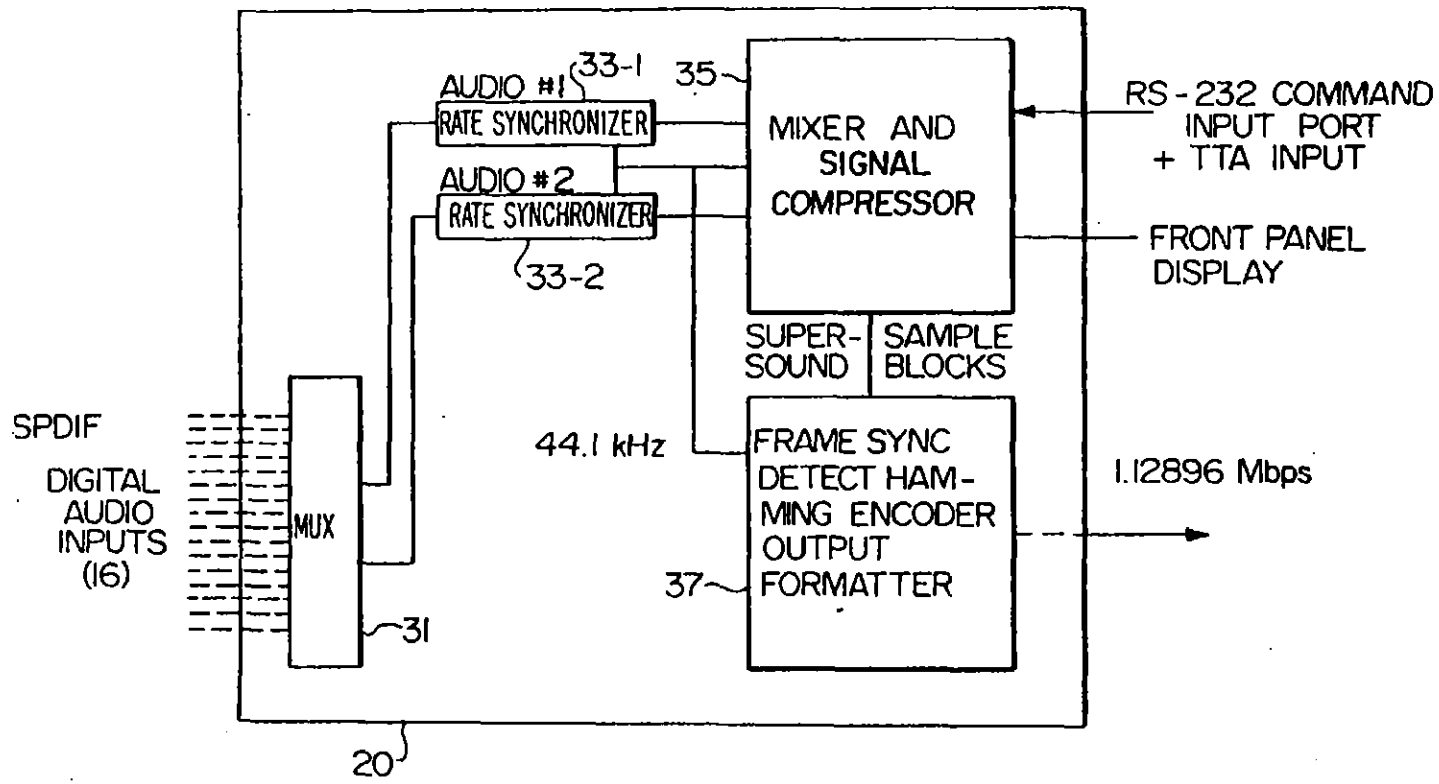
AUDIO #1
33-1
RATE SYNCHRONIZER
AUDIO #2
RATE SYNCHRONIZER
33-2
35
MIXER AND SIGNAL COMPRESSOR
RS-232 COMMAND INPUT PORT + TTA INPUT
FRONT PANEL DISPLAY
SUPER-SOUND
SAMPLE BLOCKS
SPDIF
DIGITAL AUDIO INPUTS (16)
MUX
31
44.1 kHz
FRAME SYNC DETECT HAM-MING ENCODER OUTPUT FORMATTER
37
1.12896 Mbps
20

FIG. 3

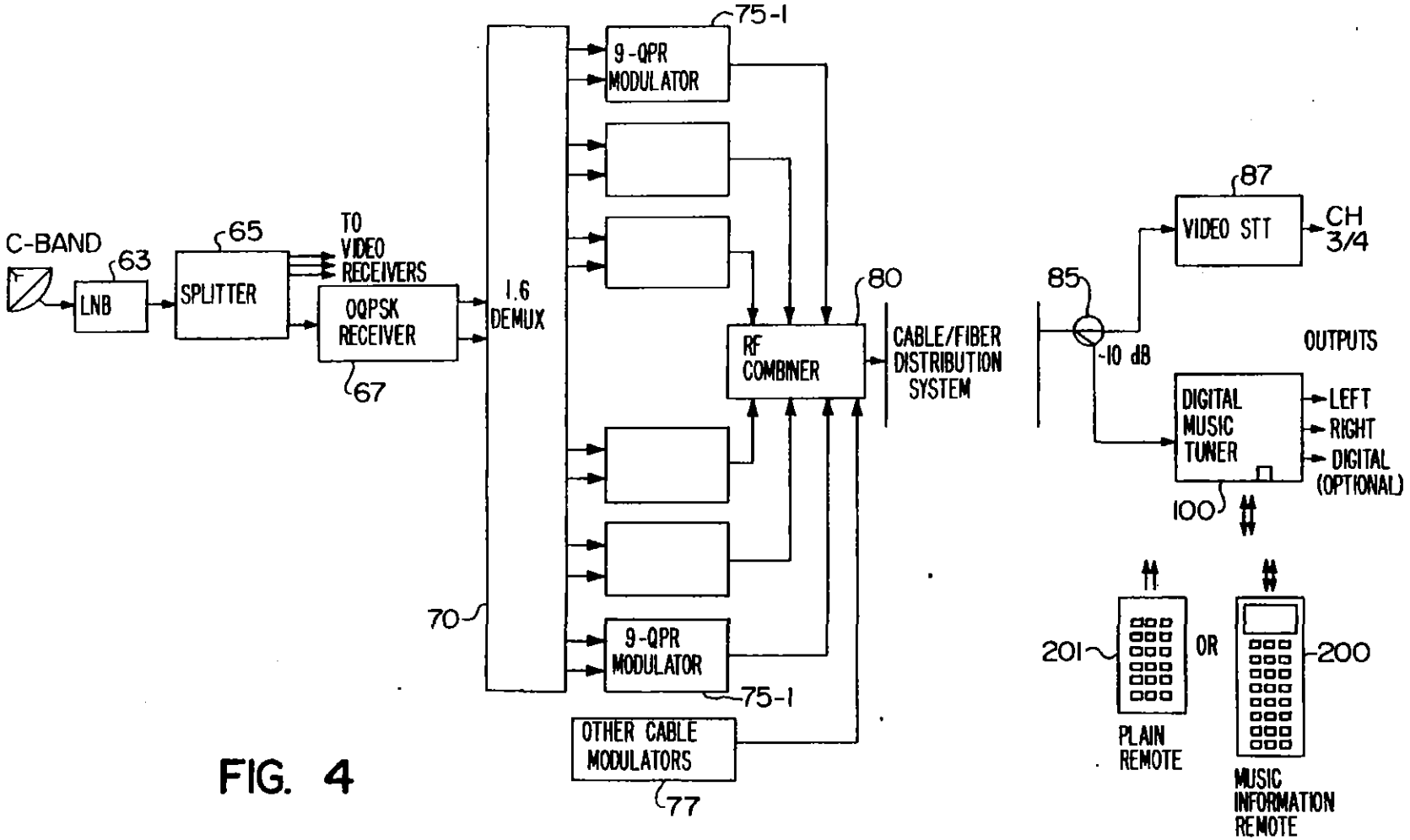
C-BAND
63
LNB
65
SPLITTER
TO VIDEO RECEIVERS
QQPSK RECEIVER
67
1.6 DEMUX
70
75-1
9-QPR MODULATOR
9-QPR MODULATOR
75-1
OTHER CABLE MODULATORS
77
80
RF COMBINER
CABLE/FIBER DISTRIBUTION SYSTEM
87
VIDEO STT
CH 3/4
85
-10 dB
OUTPUTS
DIGITAL MUSIC TUNER
LEFT
RIGHT
DIGITAL (OPTIONAL)
100
201
OR
200
PLAIN REMOTE
MUSIC INFORMATION REMOTE

FIG. 4

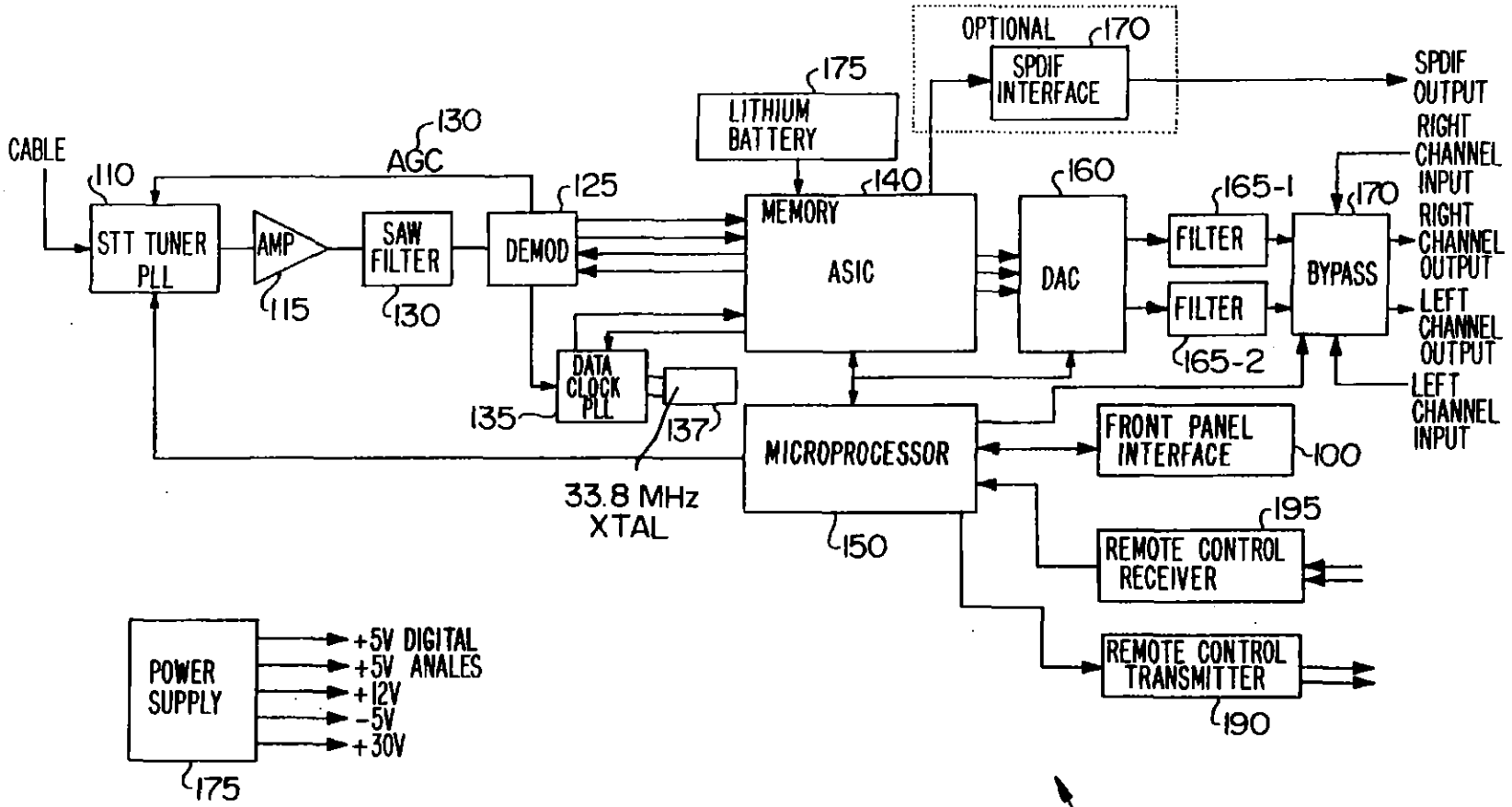
CABLE
110
STT TUNER PLL
AMP
115
SAW FILTER
130
AGC
130
DEMOD
125
DATA CLOCK PLL
135
137
33.8 MHz XTAL
LITHIUM BATTERY
175
MEMORY
ASIC
140
MICROPROCESSOR
150
OPTIONAL
170
SPDIF INTERFACE
SPDIF OUTPUT
DAC
160
FILTER
165-1
FILTER
165-2
BYPASS
170
RIGHT CHANNEL INPUT
RIGHT CHANNEL OUTPUT
LEFT CHANNEL OUTPUT
LEFT CHANNEL INPUT
FRONT PANEL INTERFACE
100
REMOTE CONTROL RECEIVER
195
REMOTE CONTROL TRANSMITTER
190
POWER SUPPLY
175
+5V DIGITAL
+5V ANALES
+12V
-5V
+30V
100

FIG. 5

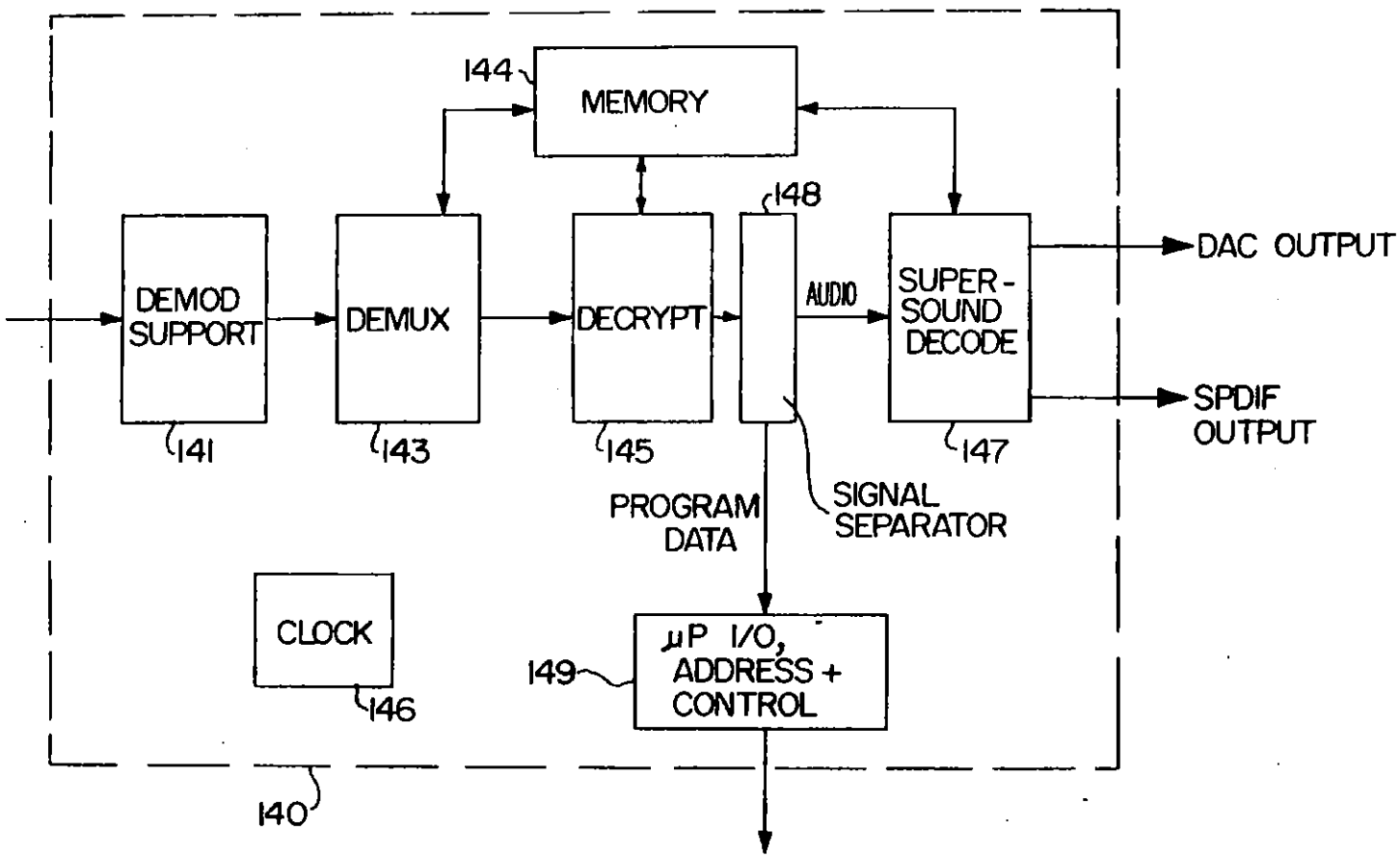
144
MEMORY
148
DEMOD SUPPORT
DEMUX
DECRYPT
AUDIO
SUPER-SOUND DECODE
DAC OUTPUT
SPDIF OUTPUT
141
143
145
147
PROGRAM DATA
SIGNAL SEPARATOR
CLOCK
146
149
µP I/O, ADDRESS + CONTROL
140

FIG. 6

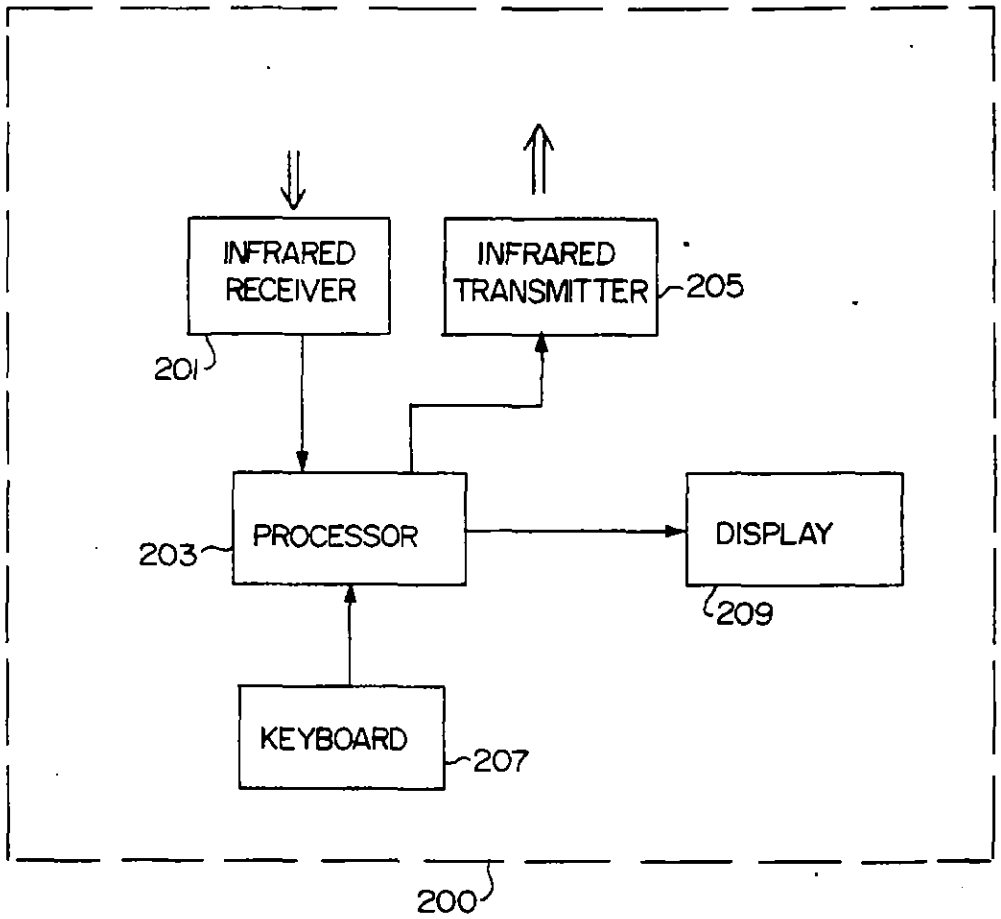
INFRARED RECEIVER
201
INFRARED TRANSMITTER
205
PROCESSOR
203
DISPLAY
209
KEYBOARD
207
200

FIG. 7

FIG. 8

FIELD	BIT SIZE	DEFINITIONS
<SI>	1	Start of TITLE Field
<TITLE>	24	TITLE Information
<DLE>	1	Start of TRACK Field
<TRACK>	24	TRACK Information
<DCI>	1	Start of ARTIST Field
<ARTIST>	24	ARTIST Information
<DC2>	1	Start of LP LABEL Field
<LP LABEL>	24	LP LABEL Information
<DC3>	1	Start of COMPOSER Field
<COMPOSER>	24	COMPOSER Information
<DC4>	1	Start of SONG ID Field
<SONG ID>	10	SONG ID Information
<COPY PROTECT>	1	Copy protect ('Y'= On, 'N'= Off)
<PLAYTIME>	4	(0000–9999) # of Seconds the Current Selection Will Play

METHOD AND APPARATUS FOR TRANSMITTING, RECEIVING AND COMMUNICATING DIGITAL DATA SIGNALS WITH CORRESPONDING PROGRAM DATA SIGNALS WHICH DESCRIBE THE DIGITAL DATA SIGNALS

TECHNICAL FIELD

The present invention relates to the field of digital signal transmission and more particularly, to transmitting digital signals accompanied by program content data so that listeners/viewers may see a display of the program content data as they are listening/viewing the performance, without interrupting the performance.

BACKGROUND OF THE INVENTION

Presently, program content information, for example, song title, artist, record label, etc., is communicated to the customer/listener by announcers' disc jockeys (DJs). In the case of video programs transmitted by broadcast means, video text messages are presented between programs and during interruptions of programs. In the case of many premium services, it is undesirable to interrupt programs for presentation of program content information. It may also be undesirable to have any form of announcer or DJ between program or selection of music.

Those such announcers or interruptions of program may be undesirable in some services. Nevertheless, it is highly desirable to communicate program content information. Frustration of customers, and possible loss of revenue due to subscription cancellation can occur if a subscriber has no method of knowing the title, composer or artist of the particular selection of music. To the music industry, identification of recording label and identification number is critical to sale of the recordings. Currently, a subscriber viewing a premium video program must consult a separate listing, tune to a different channel, or wait till the end of the program for its identification.

Similarly, the cable television industry is currently introducing audio-only services. Program content information is printed in a separate listing. These cable "radio stations" may play a continuous succession of musical selections without commercial interruptions. These services may not use a "disc-jockey" to identify the musical or other selections. Instead, under the present invention, data channels will contain information about the music being played.

In one embodiment of the present invention, a display of this data has been envisioned that has been termed an "electronic DJ". This display could be built into the subscriber terminal itself, or it could be a separate display unit that would connect to a port on the rear panel of the terminal.

The problem with such displays is that, unless they are very large and therefore costly, they cannot be easily placed within reading distance of the listener. Long cables for the display would be difficult to route in a typical living room, and we need only look at the success of VCR wired remote controls to convince ourselves that such a tethered display would not be optimum.

Wireless remote controls have brought great convenience to the control of consumer products. Highly intelligent remote controls with liquid crystal displays are available. Programmable and universal "learning" remote controls are available that assume the functions of multiple other controls. These remote controls receive information from each other, and display the functions available to the user.

It can be a frustrating experience to enjoy a piece of music on the radio, only to have the station fail to identify the piece. To lovers of music, having such information as music title, composer, artist and record label is vital. Without this information, the service will be reduced to the level of generic background music.

SUMMARY OF THE INVENTION

The problems and related problems of transmitting and providing a display of program content data are solved by the principles of the present invention. In furtherance of these principles, it is an object of the present invention to provide program information to subscribers without interrupting the program.

It is an object of the present invention to transmit and provide program information for digital audio transmitted to subscribers, where the program information is combined with the digital audio.

It is a further object of the present invention to provide program data to subscribers of video information.

It is another object of the present invention to provide program information to subscribers where the information is communicated through a remote control unit.

It is a further object of the present invention to provide a system where digital program information is combined with digital audio/video signals which are transmitted via satellite, coaxial cable, or other means to subscribers.

It is another object of the present invention to provide program data corresponding to audio/video signals to subscribers with disabilities.

In accordance with these and other objects, apparatus for encoding according to the present invention comprises: a plurality of means for producing digital signals; a plurality of means for producing a plurality of program data signals, each program data signal corresponding to one digital signal; and, at least one encoding means, coupled to the plurality of means for producing digital and program data signals, for encoding the plurality of program data signals with the plurality of digital signals to produce a plurality of combined digital and program data signals.

Additionally, under these and other objects, a method is disclosed for encoding program information into a digital data stream comprising the steps of: producing a plurality of digital signals; producing a plurality of program data signals, each program data signal corresponding to one digital signal; and encoding the plurality of program data signals with the plurality of digital signals to produce a plurality of combined digital and program data signals.

Conversely, under the above and other objects, an apparatus is disclosed for communicating progra information corresponding to a track of digital data from a signal containing a plurality of digital and program information signals comprising: first receiving means for receiving an encoded signal containing a plurality of digital signals and a plurality of program data signals, each program data signal corresponding to one digital signal; at least one selecting means, coupled to the first receiving means, for selecting one digital signal and one corresponding program data signal from the received

signal; at least one decoding means, coupled to the selecting means, for decoding the selected one digital signal and the one corresponding program data signal so as to separate the corresponding program data signal from the selected one digital signal; transmitting means, coupled to the decoding means, for transmitting the one corresponding program data signal; second receiving means, coupled to the transmitting means, for receiving the one corresponding program data signal; and, communicating means, coupled to the second receiving means, for communicating the one corresponding program data signal.

Similarly, a method under the above objects is disclosed for communicating program information corresponding to a track from signal containing a plurality of digital and program information signals comprising the steps of: receiving an encoded signal containing a plurality of digital signals and a plurality of program data signals, each program data signal corresponding to one digital signal; selecting one digital signal and one corresponding program data signal from the received encoded signal; decoding the selected one digital signal and the one corresponding program data signal so as to separate the corresponding program data signal from the selected one digital signal; transmitting the one corresponding program data signal to a communicator; receiving the transmitted one corresponding program data signal; and, communicating the received one corresponding program data signal via the communicator.

Finally, under the objects of the present invention, a handheld apparatus for communicating program information corresponding to digital data is disclosed comprising: receiving means for receiving a program data signal corresponding to a digital track; processing means, coupled to the receiving means, for processing the received program data signal; and, communicating means, coupled to the processing means, for communicating the processed program data signal.

The communicating means under the present invention could take the form of a standard remote control, i.e. a hand-held unit with a display of some sort. The display could be a liquid crystal or other suitable technology. A benefit of having the display in a remote unit under the present invention is that the cost of the display need not be included in the base unit. The display can be a value-added extra-cost feature. It can thus be seen as a means of increasing revenue, or of making the service more affordable to those not desiring the feature.

The communicating means under the present invention could also take the form of a table-mounted unit. It could use a larger display than might be possible on a hand-held remote. It could also use ac power instead of batteries and thus power a brighter and larger display more suitable for low light viewing. The control and display functions could be separated into two individual units.

The base subscriber terminal could automatically update the remote display/control unit whenever there has been a change in programming. This, however, may result in brief intervals during which the use of other remote controls might be disrupted. Instead, the communications may be structured such that for information to be sent from the base subscriber terminal, it must be polled from the remote unit. Memory could be used in either the base unit or the remote to store information on previous selections. This information could be recalled by the user on demand.

The communications link between the base subscriber terminal and the remote unit could use radio frequencies, infrared, visible light, acoustical transmission through air, or other wireless means. The concept could also be extended to carrying the information on the household power lines, telephone wires, coaxial cable, fiber-optic cable or means other than the direct connection of a cable to the base unit.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the present invention may be appreciated from studying the following detailed description together with the drawings in which:

FIG. **1** is a blocked diagram of the overall system in the present invention;

FIG. **2** shows a detailed block diagram of the encoding and transmitter portion of the present invention;

FIG. **3** shows a block diagram of the encoding portion of the present invention;

FIG. **4** shows a block diagram of the receiving portion of the present invention;

FIG. **5** shows a block diagram of the digital music tuner;

FIG. **6** shows a block diagram of the application specific integrated circuit shown in FIG. **5**;

FIG. **7** shows a block diagram for the remote communication device of the present invention; and,

FIG. **8** shows a diagram of a simplified frame format using the present invention.

DETAILED DESCRIPTION

Referring to FIG. **1**, a block diagram of an overall system in the present invention is described. The present invention will be described with respect to transmitting audio signals with program data. However, those skilled in the art will recognize that the present invention may, instead of transmitting audio with corresponding program data, transmit any of the following, with corresponding program data: television, games, software, video, and other combinations of audio/video or software information.

Compact disc players **10-1** through **10-*n*** provide a plurality of digital audio signals to the present invention. These CD players may be the so called "jukebox" type wherein up to sixty or more compact discs may be stored and accessible by the player.

The digital audio signals from CD players **10-1** through **10-*n*** are input to encoders **20-1** through **20-*n*** which will be described in greater detail with reference to FIG. **3**. Controller and music database **30-1** through **30-*k*** controls the output of CD players **10-1** through **10-*n*** and any respective selection of compact discs within these players and also provides a database containing program data with a one to one correspondence to the tracks contained on the compact discs. This program data includes title, track, artist, publisher, composer, song identification and play time information blocks for each song contained on a compact disc. These program data signals could also include other information relevant to describing the particular track contained on a compact disc, as those skilled in the art can appreciate. For example, if the information were historical audio data, information on the time and place such data was first conceived or transmitted may also be contained within this program information. Additionally, if the digital signals transmitted contained video information, the corresponding program data signals would relate to the video program being transmitted,

for example, the title, actors, director, publisher, year, or other relevant information.

The plurality of digital audio signals inputted by the CD players **10-1** through **10-*n*** are combined in encoders **20-1** through **20-*n*** with the program data signals inputted by controller and music databases **30-1** through **30-*k***. The combined signals from encoders **20-1** through **20-*n*** are then inputted into multiplexer **40** which combines the signals into a serial digital data stream.

Additional signals may be combined with the digital audio and program information signals. Subscriber control **45** contains information on various subscribers who may receive the digital audio data produced by the present invention. This subscriber information stored in subscriber control **45** is multiplexed with the digital audio and program data signals in multiplexer **40**, producing a serial digital data stream containing digital audio, program information, and national subscriber information.

The serial digital audio/program data stream from multiplexer **40** is input into the digital satellite transmitter **50** and broadcast, via satellite, to digital satellite receiver **60**. However, those skilled in the art will realize that any delivery system, not just satellite transmission, may be used, such as cable television (CATV), microwave distribution (MDS or MMDS), telephone systems, terrestial broadcasts, and other coaxial or optical cable lines.

The previously described transmitter section will be more fully discussed with reference to FIG. **2**, while the following receiver section will be more fully described with reference to FIG. **4**. Digital satellite receiver **60** transfers the digital data to headend processing **70** which in turns converts and sends the information to digital cable modulators **75**. The digital audio data is then added with signals from other cable modulators in summing circuit **80** and sent over a cable distribution system.

The cable distribution system includes line amplifiers **90** for boosting the signal and compensating for any line loss. System tap **85** directs the combined signal to a subscriber's premises and into digital music tuner **100**. Digital music tuner **100**, more fully described with respect to FIG. **5**, selects the channel containing the digital audio and program data signals. Additionally, digital music tuner **100** separates the digital audio signal from the program information signal. The digital audio signal is converted to analog, amplified and output on a subscriber's audio electronics, while the program information signal is processed and sent to a local display or remote using information display **200**. The demultiplexing and decoding of the signals is discussed more fully with reference to FIG. **6**. These displays then communicate to the subscriber the particular program information corresponding to an audio track currently being listened to by the subscriber. The remote music information display is more fully described with respect to FIG. **7**.

TRANSMITTING SECTION

Referring to FIG. **2**, a block diagram of the studio and transmitter, or uplink, section of the present invention is described. Compact disc players **10-1** through **10-*n*** are driven by microcomputers **15-1** through **15-*n***. Microcomputers **15-1** through **15-*n*** could be IBM Model AT microcomputers. These microcomputers are in turn controlled by the studio sequencing master controllers **30-1** through **30-*k***. These master controllers **30-1** through **30-*k*** include a database containing the program information described above. These master controllers are preferably IBM Model PS/2 microcomputers or other computers containing a 386 type microprocessors.

The digital audio output from CD players **10-1** through **10-*n*** is input into encoders **20-1** through **20-*n*** along with program information supplied by master controllers **30-1** through **30-*k***. Encoders **20-1** through **20-*n*** combined the digital audio signals with the program data signals and output the combined signal to system data multiplexers **40-1** and **40-2**. Preferably, the outputs of **30** encoders **20-1** through **20-30** are input into multiplexers **40-1** and **40-2** where the signals are time division multiplexed. Multiplexers **40-1** and **40-2** may include error correction encoding using, for example, Hamming encoding or Bose Chaudhuri Hocquenghen (BCH) encoding, or other error correcting/encoding methods known by those skilled in the art.

Billing system **47** includes subscriber information of the present invention and national control information and may be comprised of an IBM Model PS/2 microcomputer. The subscriber information and other billing system data would be contained within a large database within billing system **47**. Typical billing system data could include, for example, identity, location, etc. for subscribers and their current billing status. Billing system information from billing system **47** is input into the system manager digital audio controller **45**. System manager **45** is preferably comprised of a series 8500 System Manager manufactured by Scientific Atlanta or a similar product. System manager digital audio controller **45** controls master controllers **30-1** through **30-*k***. Additionally, the system manager **45** may also input subscriber data from the subscriber database within billing system **47** into multiplexers **40-1** and **40-2**.

The subscriber information may be combined with the digital audio and program signals through multiplexers **40-1** and **40-2**. Multiplexers **40-1** and **40-2** provide the master clock to all the decoders **20-1** through **20-*n*** and to satellite exciters **53-1** and **53-2**. The output of multiplexers **40-1** and **40-2** is a 34 megabits per second (Mbps) data stream comprising the preferred 30 channels outputted by the 30 encoders **20-1** through **20-30**.

Relay circuit **43** provides fault protection so as to switch the system to multiplexers **40-2** and **40-2** from multiplexer **40-1** in event of a fault. The outputs from multiplexers **40-1** and **40-2** are two coaxial cables, for plus and minus balanced connections. These balanced coaxial cables are used from the output of multiplexers **40-1** and **40-2** through satellite transmitting and receiving electronics. The combined signal from multiplexer **40-1** passes through relay **43** into fiber-optic transmitter **49**. Fiber-optic transmitter **49** transports the signal from the studio to the transmitter site and into fiber-optic receiver **51**. The output of the fiber-optic receiver drives an offset quadrature phase shift keying (OQPSK) satellite modulator **50**. The signals is then up converted, amplified and transmitted to the satellite, as more fully described below.

The signals are received from fiber-optic transmitter **49** into fiber-optic receiver **51** in transmitter **50**. From fiber-optic receiver **51** the signals pass through fault protection relay **52-1** into OQPSK Exciter **53-1**. The digital signals from OQPSK exciter **53-1** enter splitter **57-1** and through fault protection relay **52-2**. Thereafter, the signals pass through an upconverter **58-1**. From upconverter **58-1** the signals pass through switch **56-1**

into high powered amplifier 59-1 and once again through switch circuit 56-2 and then transmitted. The transmitting is preferably performed via a satellited. The transmission may also occur via coaxial cables or fiber-optic cables.

Redundancy control logic 55 controls transmitter 50, so in the event of a fault, redundant circuitry is activated. Specifically, redundancy control logic 55 controls relays 52-1 and 52-2 and switches 56-1 and 56-2 so as to switch to redundant exciter 53-2 and splitter 57-2, redundant up converter 58-2 and high powered amplifier 59-2.

Referring to FIG. 3, a more detailed block diagram of an encoder 20-1 is described. Outputs from CD players 10 are input to multiplexer 31. Preferably, the outputs from 16 CD players 10-1 through 10-16 are input into multiplexer 31 where their signals are combined and output as two channels to rate synchronizers 33-1 and 33-2. The rate synchronized signals are then input into mixer and signal compressor 35. Mixer and signal compressor 35 preferably uses the data compression format described in U.S. Pat. No. 4,922,537, incorporated herein by reference. Mixer and data compressor 35 is controlled by input signals from master controller 30-1 which also inputs the program data signals corresponding to the digital audio signals. The digital audio signals are compressed, program data signals are mixed therewith, and then the mixed signal is input into frame sync detector and output formatter 37. Circuit 37 may also include circuitry to encrypt the mixed and compressed signals using, for example, the Data Encryption Standard (DES) or using other similar encryption techniques known in the art. Circuit 37 may include error correction encoding using, for example, Hamming encoding or Bose Chaudhuri Hocquenghen (BCH) encoding, or other error correcting/encoding methods known by those skilled in the art. Hamming encoding is disclosed in *Electronic Engineers Reference Book*, edited by F. Mazda, page 32/10, incorporated herein by reference.

The audio data is clocked into and out of circuits 33-1, 33-2, 35 and 37 at a rate 44.1 kilosamples per second. The mixed compressed and encrypted signals are output of circuit 37 at 1.12896 Mbps in Applicant's preferred embodiment.

RECEIVING SECTION

Referring to FIG. 4, the mixed, compressed and encrypted signal is received in the C-band via satellite receive antenna and amplified and block converted in a low-noise block converter 63, along with other satellite distributed signals. The signal is output in the L-band at 950 to 1450 megahertz and input into splitter 65 where the audio signal is input into OQPSK receiver 67. Receiver 67 demodulates the OQPSK information and provides one 34 Mbps signal stream containing the preferred 30 satellite distributed channels. The 34 Mbps signal is output of receiver 37 at 34 megahertz clock rate into demultiplexer 70. Preferably, demultiplexer 70 is a 1:6 demultiplexer which separates the single data stream into six channels containing 5.6 Mbps digital audio and program data each. These six channels contain five stations each.

The signals are clocked at 11 megahertz to modulators 75-1 through 75-6. Each modulator 75-1 through 75-6 is a nine state quadrature partial response (9-QPR) modulator capable of handling five stations and each occupying a 3 megahertz bandwidth. Those skilled in the art will appreciate that one may also use phase shift key modulation or other modulation methods known in the art with fewer or greater numbers of states.

The modulated signals from modulators 75-1 through 75-6 are combined in radio frequency combiner 80 along with other modulated signals from other cable modulators 77. Modulators 75-1 through 75-6 digitally filter the data, quadrature partial response (QPR) modulate and convert the data to the selected output frequency for combining with other modulated channels 77 in the present cable television system. Each block of five stereo pairs occupies 3 megahertz of band width and can be carried in half of one 6 megahertz video channel of the present cable television system. Since the present system uses a common 6 megahertz video channel, no modifications of current CATV distribution system equipment is required.

The combined signals from RF combiner 80 are distributed over a coaxial cable or fiber-optic distribution system into a subscriber's home. Directional coupler 85 directs most of the signal to video set top terminal 87. A sample of the signal is sent from directional coupler 85, at a loss of 10 decibels to digital music tuner 100. Tuner 100 is controlled by either a plain remote 201 or a music information display remote 200. Additionally, tuner 100 outputs left and right analog audio signals, and may also output an optional digital signal output.

Referring to FIG. 5, a block diagram of digital music tuner 100 is shown. The digital audio and program data signal is inputted from directional coupler 85 into set top terminal tuner 110. This tuner preferably includes phase locked loop circuitry. The signal from tuner 110 is amplified by amplifier 115 and filtered by saw filter 120 before being demodulated by demodulator 125. Tuner 110 converts the selected radio frequency channel to a demodulation intermediate frequency. The output of demodulator 125 is QPR demodulated to produce a 5.6 Mbps data stream containing five stereo pair of digital audio data to applications specific integrated circuit (ASIC) 140. Demodulator 125 also provides an automatic gain control signal 130 to tuner 110 to maintain constant signal level. Additionally, demodulator 125 provides data to clock recovery phase locked loop (PLL) 135. Data clock PLL 135 contains a 33.8 megahertz crystal 137 from timing purposes.

This timing signal is sent to ASIC 140, which will be discussed in greater detail with reference to FIG. 6. ASIC 140 provides a digital audio output to interface 170. Interface 170 uses the Sony-Philips digital interface format (SPDIF). Similarly, the digital audio signals are input from ASIC 140 to digital to audio converter 160. From digital to audio converter 160, the analog left and right audio signals are filtered through filters 165-1 and 165-2 and input into bypass 170. Bypass 170 allows additional audio components (e.g., a CD player or tape deck) to be switchably connected with the digital music tuner 100.

Microprocessor 150 controls phase locked loop of tuner 110, ASIC 140, digital to analog converter 160 and bypass 170. The program data signal from ASIC 140 is sent to microprocessor 150 where it is stored in internal memory of the microprocessor, and may be displayed on front panel interface 180 or transmitted through remote control transmitter 190. Remote control receiver 195 may select particular program data information or audio channels through microprocessor 150.

Power supply **175** would supply both positive five volts digital and analog power, and a negative five volt supply to the system. Positive 12 volt and positive 30 volt power supply signals are also provided from power supply **175**. Additionally, tuner **100** would preferably have input means, e.g., push buttons or toggle switches, on the exterior of its housing (not shown). These input means would allow selection of channels, stations, display of program data, and display of particular information blocks contained in the program data signal. Additional selections or inputs may be provided as those skilled in the art recognize.

Referring to FIG. **6**, a more detailed block diagram of ASIC **140** is provided. The signal from demodulator **125** is input into demodulator support circuit **141** which comprises logic circuitry (e.g., flip-flops) required in demodulation of the signal. The signal from demodulator support circuit **141** is then input into demultiplexer **143** which separates the 5.6 Mbps data stream to select one of five stereo pairs of digital audio signals. This signal is then sent to decrypting circuit **145**. The decrypted signal is then separated in signal separator **148** where program data is sent to microprocessor in/out circuit **149** while audio data is sent and decoded in circuit **147**. Decoder **147** uses the data decompression technique described in U.S. Pat. No. 4,922,537, incorporated herein by reference.

Microprocessor in/out, address and control circuit **149** interfaces with microprocessor **150**. All circuits within ASIC **140** are driven by clock **146**. Memory **144** stores bits of data to support the demultiplexing, decrypting and decoding functions occurring in circuits **143**, **145** and **147** respectively. The memory may be of a nonvolatile type such as an EPROM or similar ROM memory or may be a volatile type RAM memory supported by battery **171**, preferably a lithium type battery. Such a battery **175** would prevent loss of data stored in memory **144**.

REMOTE DISPLAY UNIT

Referring to FIG. **7**, a block diagram of the remote music information display unit **200** is shown. Program data signals are received by receiver **201** from remote control transmitter **190**. Preferably, infrared transmitter and receivers **190**, **195**, **201** and **205** are used. However, radio frequency, ultrasonic, wire, fiber-optic cables or other means could be used as those skilled in the art can appreciate. The received signal is then input into processor **203** which processes and sends the program data signal to display **209** for communicating program data corresponding to currently playing audio track to a subscriber. Display **209** may be a liquid crystal display, a light emitting diode, a braille reader, a voice synthesizer or a cathode-ray tube or any other communicating device as may be appreciated by those skilled in the art. Audible or tactile communicating means would allow communication of the program data signals to subscribers with disabilites, as would the use of a remote unit.

Input means shown as keyboard **207** may receive program data selection commands or audio track commands from a subscriber which are sent to processor **203**. Keyboard **207** may also include means to allow a subscriber to control volume, power, channel selection, station selection, display, or other suitable subscriber commands that those skilled in the art appreciate. Processor **203** then converts and transmits the subscriber command signal to transmitter **205** which is received by remote control receiver **195**. The received signal from receiver **195** is input into microprocessor **150** where appropriate signals are sent therefrom to ASIC **140** and tuner **110** so as to bring about the subscriber's desired audio track, audio channel or program information.

Repeaters could be placed throughout a dwelling to extend the range of the display/control unit. Additionally, processor **203** could contain memory for storing various information, particularly program information.

In an alternative embodiment, the remote display unit may display only a code number representing the program data signals, whereby a subscriber may reference the number in printed material for a full description of the currently playing audio track. The printed material could be a publication which would rotate monthly or weekly as the programs on respective stations change. Such a system would allow for a smaller display on the remote unit, and thus be less costly to a subscriber. Such a printed publication would also allow a subscriber to determine which programs were playing on the various channels.

Additionally, the remote display unit or turner **100** could display, upon a subscriber's request, program data corresponding to data being transmitted on channels not currently being listened to/viewed by the subscriber. In this way, a subscriber may scan what is being broadcast on alternate channels while listening to a currently playing channel.

DATA FORMAT

The preferred thirty stereo audio stations are multiplexed as follows. Groups of five stations are formatted into a frame of data. Six such frames are interleaved bit by bit for transmission over the satellite. Each such frame containing five stations has a header. This header is used by the headend demultiplexer **70** to deinterleave the satellite received data into six frames of five stations each. The header is also used in the ASIC **140** to synchronize on the frame. A second header contains subscriber control transaction data. This second header would preferably include channel and subscriber transaction data as previously described with respective billing system **47**. The headers include additional bits for error detection.

Following the headers, compressed audio data with its associated program data is sent. Audio data for each station includes a seven bit "k factor" and a three bit "exponent" for each block of nine samples as described in previously referenced U.S. Pat. No. 4,922,573. Five such k factor and exponent blocks for each station are included in each frame.

The audio and program data for the five stations in the frame are interleaved bit by bit. That is, the first bit is sent for station No. 1, followed by the first bit for station No. 2 and so on until the first bit of each station has been sent. Then the second bit of each station is sent and so on. After the last audio data bits in each block of nine samples have been sent, the program data bits are sent in the same manner. Thus, the program data for each station is multiplexed in the frame with its associated station so that when the frame is demultiplexed or rearranged, the program information for that station is kept with its station. The advantage of multiplexing the program information with the audio data is that one may easily process the combined signal without fear of scrambling channels of audio data with their respective program information. Error correction and detection bits are also sent with the audio data and the program data.

Power supply **175** would supply both positive five volts digital and analog power, and a negative five volt supply to the system. Positive 12 volt and positive 30 volt power supply signals are also provided from power supply **175**. Additionally, tuner **100** would preferably have input means, e.g., push buttons or toggle switches, on the exterior of its housing (not shown). These input means would allow selection of channels, stations, display of program data, and display of particular information blocks contained in the program data signal. Additional selections or inputs may be provided as those skilled in the art recognize.

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Two program data bits are sent in the same block together with every nine compressed samples (100 bits) of audio data. This effectively provides a data channel of about 9800 baud used to transmit program data information. The information is sent in ASCII representation, but could easily be sent in other formats such as EBCDIC as would be apparent to those skilled in the art. FIG. 8 shows the program information as preferably sent and the size of each field in the present embodiment. Other information can be sent, such as music classification for selection of station by music type, special event announcements, or other such information, known by those skilled in the art.

We claim:

1. A method of generating a digital data stream including program data information and program selection information for transmission, comprising the steps of:

producing a plurality of digital program data signals, each of which corresponds to the contents of a program selection;

producing a plurality of digital program selection signals, each of which corresponds to one of said program data signals and describes the attributes of the associated program selection;

encoding the plurality of digital program data signals with the plurality of digital program selection signals into a plurality of digital combined signals, each of said combined digital signals being arranged in blocks of a predetermined number of bits of a program data signal and a predetermined number of bits of an associated program selection signal, whereby each program selection signal remains associated with its corresponding program data signal during transmissions therewith; and

multiplexing the plurality of digital combined signals into the data stream.

2. The method of claim 1 wherein the transmission occurs via a satellite.

3. The method of claim 1 wherein the transmission occurs via coaxial cable.

4. The method of claim 1 wherein the multiplexing is time division multiplexing.

5. The method of claim 1 further comprising the step of compressing the plurality of digital combined signals to produce a plurality of compressed digital combined signals.

6. The method of claim 1 further comprising the step of encrypting the plurality of digital combined signals.

7. The method of claim 1 further comprising the step wherein subscriber data signals are multiplexed with the digital combined signals.

8. The method of claim 1 wherein the digital program data signals are digital audio signals.

9. The method of claim 8 wherein the program selection signals include at least one of a title, a track, an artist, a publisher, a composer, a song identification, and a play time information block.

10. The method of claim 1 wherein the digital program data signals are digital video signals.

11. The method of claim 1 wherein the digital program data signals are software.

12. An apparatus for generating a digital data steam including program data information and program selection information for transmission by a transmission means, comprising:

means for producing a plurality of digital program data signals, each of which corresponds to the contents of a program selection;

means for producing a plurality of digital program selection signals, each of which corresponds to one of said program data signals and describes the attributes of the associated program selection;

means for encoding the plurality of digital program data signals with the plurality of digital program selection signals into a plurality of combined digital signals, each of said combined digital signals being arranged in blocks of a predetermined number of bits of a program data signal and a predetermined number of bits of an associated program selection signal, whereby each program selection signal remains associated with its corresponding program data signal during transmissions therewith; and

means for multiplexing the plurality of digital combined signals into the data stream.

13. An apparatus according to claim 12 wherein the transmission means comprises a satellite.

14. The apparatus according to claim 12 wherein the transmission means comprises coaxial cable.

15. The apparatus according to claim 12 wherein the multiplexing means uses time division multiplexing.

16. The apparatus according to claim 12 further comprising the step wherein subscriber data signals are multiplexed with the digital combined signals.

17. The apparatus according to claim 12 further comprising at least one compression means, coupled to the encoding means, for compressing the digital combined signals to produce a plurality of compressed digital combined signals.

18. The apparatus according to claim 12 further comprising at least one encrypting means, coupled to the encoding means, for encrypting the plurality of digital combined signals.

19. The apparatus according to claim 12 wherein the digital program data signals are digital audio signals.

20. The apparatus according to claim 12 wherein the program selection signals include at least one of a title, a track, an artist, a publisher, a composer, a song identification, and a play time information block.

21. The apparatus according to claim 12 wherein the digital program data signals are digital video signals.

22. The apparatus according to claim 12 wherein the digital program data signals are digital software signals.

* * * * *

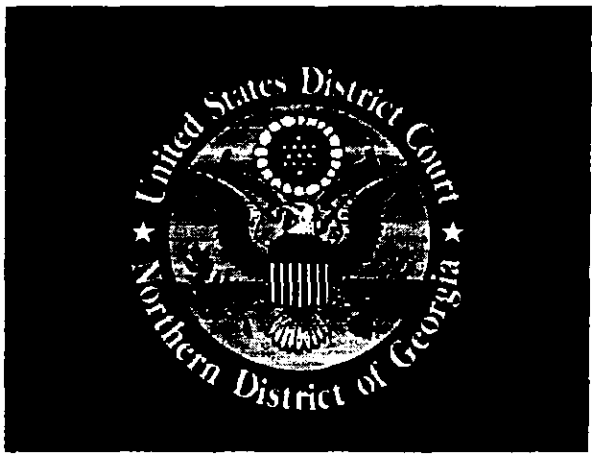

EXHIBIT / ATTACHMENT

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United States Patent [19]

Wall, Jr. et al.

[11] **Patent Number: 6,055,244**

[45] **Date of Patent: Apr. 25, 2000**

[54] **METHOD AND APPARATUS FOR COMMUNICATING DIFFERENT TYPES OF DATA IN A DATA STREAM**

[75] Inventors: **William Edgar Wall, Jr.**, Atlanta; **Jay Cauthern McMullan, Jr.**, Doraville; **Luis Agustin Rovira**, Atlanta, all of Ga.

[73] Assignee: **Scientific-Atlanta, Inc.**, Norcross, Ga.

[21] Appl. No.: **08/449,844**

[22] Filed: **May 24, 1995**

Related U.S. Application Data

[63] Continuation of application No. 08/171,453, Dec. 22, 1993, abandoned, which is a continuation of application No. 08/056,560, May 3, 1993, Pat. No. 5,406,558, which is a division of application No. 07/618,744, Nov. 27, 1990, Pat. No. 5,239,540.

[51] **Int. Cl.**[7] **H04H 1/08**

[52] **U.S. Cl.** **370/487**; 370/326; 370/345; 370/498; 455/154.1; 455/158.4; 455/186.1

[58] **Field of Search** 370/71, 73, 77, 370/94.1, 99, 110.1, 485, 486, 498, 476, 522, 326, 345, 487, 349, 474; 358/342, 332, 335; 380/10, 19, 20; 455/45, 46, 66, 158.4, 158.5, 186.1, 186.2, 154.1

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Primary Examiner—Douglas W. Olms
Assistant Examiner—Shick Hom
Attorney, Agent, or Firm—Kenneth M. Massaroni; Hubert J. Barnhardt, III; Kelly A. Gardner

[57] **ABSTRACT**

An apparatus and method is described for transmitting, receiving and communicating program data signals which are combined with digital data signals. Preferably, the present invention compresses 30 digital audio signals, multiplexes them with title, track, artist, record label, year, etc., program information, and transmits the combined signals via satellite to a receiving station. The receiving station demultiplexes the signals and sends them via a cable distribution system to a subscriber's digital music tuner. This tuner further demultiplexes and decodes the signals so that the digital audio signals may be converted to analog and output for listening, while the corresponding data signals are communicated to the subscriber. In an alternative preferred embodiment, the program data signals are transmitted to a remote control receiver where they are displayed. The system described in the present invention may be used for transmitting video, software or games with program data to subscribers.

3 Claims, 9 Drawing Sheets

FIELD	*SIZE*	*DEFINITIONS*
<SI>	*1*	*Start of TITLE Field*
<TITLE>	*24*	*TITLE Information*
<DLE>	*1*	*Start of TRACK Field*
<TRACK>	*24*	*TRACK Information*
<DC1>	*1*	*Start of ARTIST Field*
<ARTIST>	*24*	*ARTIST Information*
<DC2>	*1*	*Start of LP LABEL Field*
<LP LABEL>	*24*	*LP LABEL Information*
<DC3>	*1*	*Start of COMPOSER Field*
<COMPOSER>	*24*	*COMPOSER Information*
<DC4>	*1*	*Start of SONG ID Field*
<SONG ID>	*10*	*SONG ID Information*
<COPY PROTECT>	*1*	*Copy protect ('Y'= On, 'N'= Off)*
<PLAYTIME>	*4*	*(0000–9999) # of Seconds the Current Selection Will Play*

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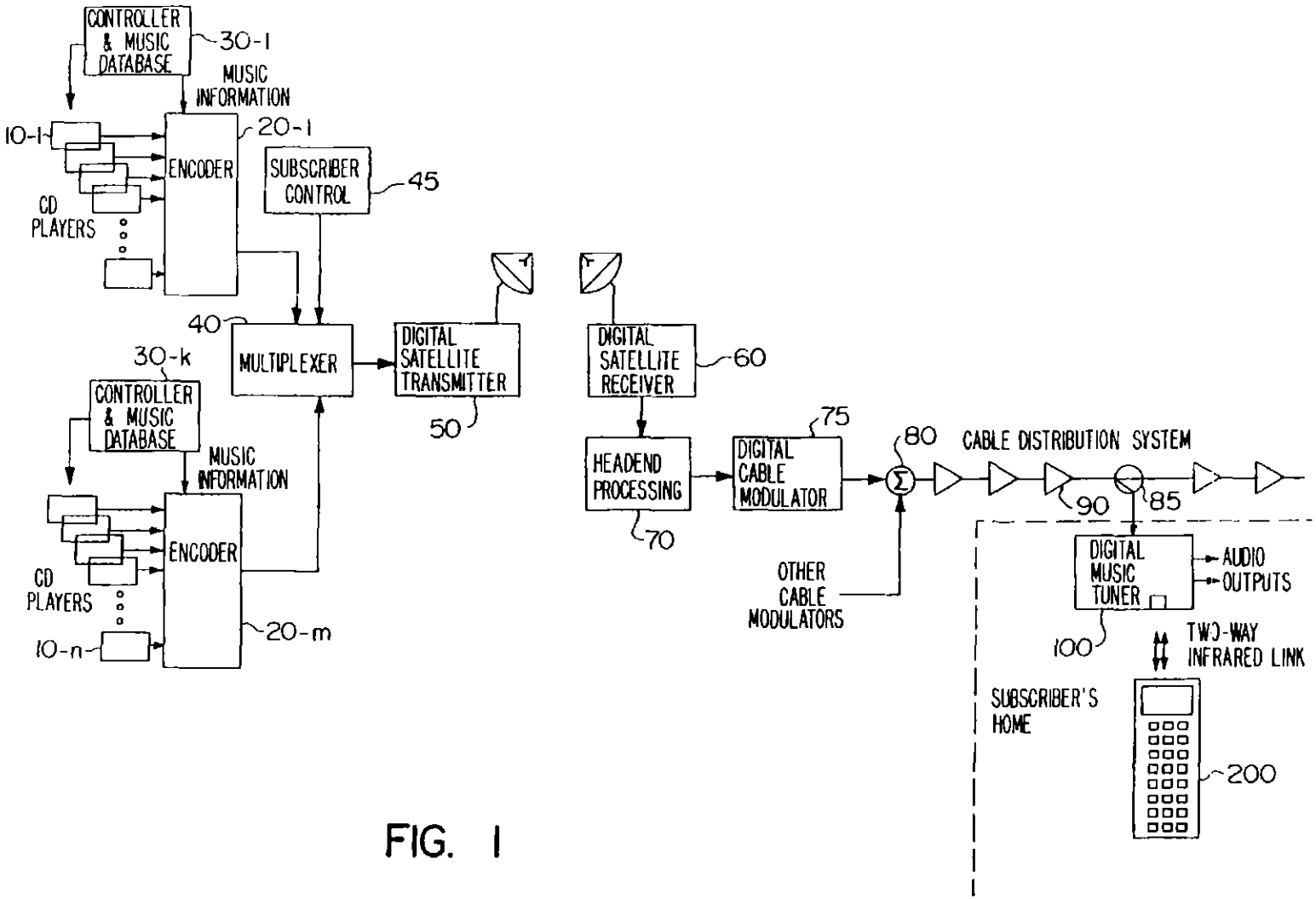
CONTROLLER & MUSIC DATABASE
30-1
MUSIC INFORMATION
10-1
20-1
ENCODER
SUBSCRIBER CONTROL
45
CD PLAYERS
40
MULTIPLEXER
DIGITAL SATELLITE TRANSMITTER
50
30-k
CONTROLLER & MUSIC DATABASE
MUSIC INFORMATION
ENCODER
CD PLAYERS
10-n
20-m
DIGITAL SATELLITE RECEIVER
60
HEADEND PROCESSING
70
75
DIGITAL CABLE MODULATOR
80
CABLE DISTRIBUTION SYSTEM
OTHER CABLE MODULATORS
90
85
DIGITAL MUSIC TUNER
AUDIO OUTPUTS
100
TWO-WAY INFRARED LINK
SUBSCRIBER'S HOME
200

FIG. 1

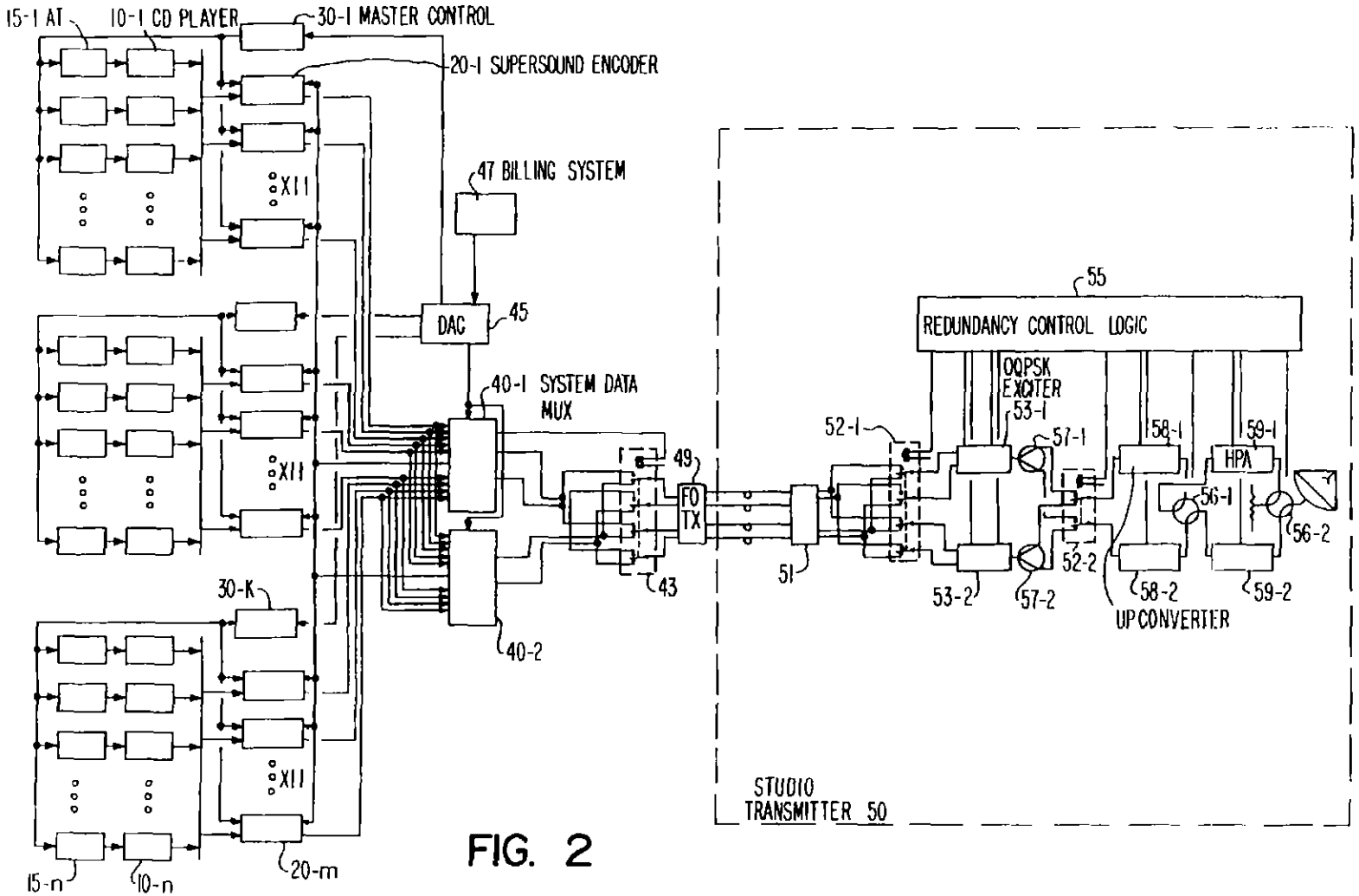
15-1 AT
10-1 CD PLAYER
30-1 MASTER CONTROL
20-1 SUPERSOUND ENCODER
47 BILLING SYSTEM
DAC
45
40-1 SYSTEM DATA MUX
40-2
49
43
FO TX
51
52-1
52-2
53-1
53-2
55
REDUNDANCY CONTROL LOGIC
OQPSK EXCITER
57-1
57-2
58-1
58-2
59-1
59-2
HPA
56-1
56-2
UPCONVERTER
STUDIO TRANSMITTER 50
30-K
20-m
15-n
10-n
XII

FIG. 2

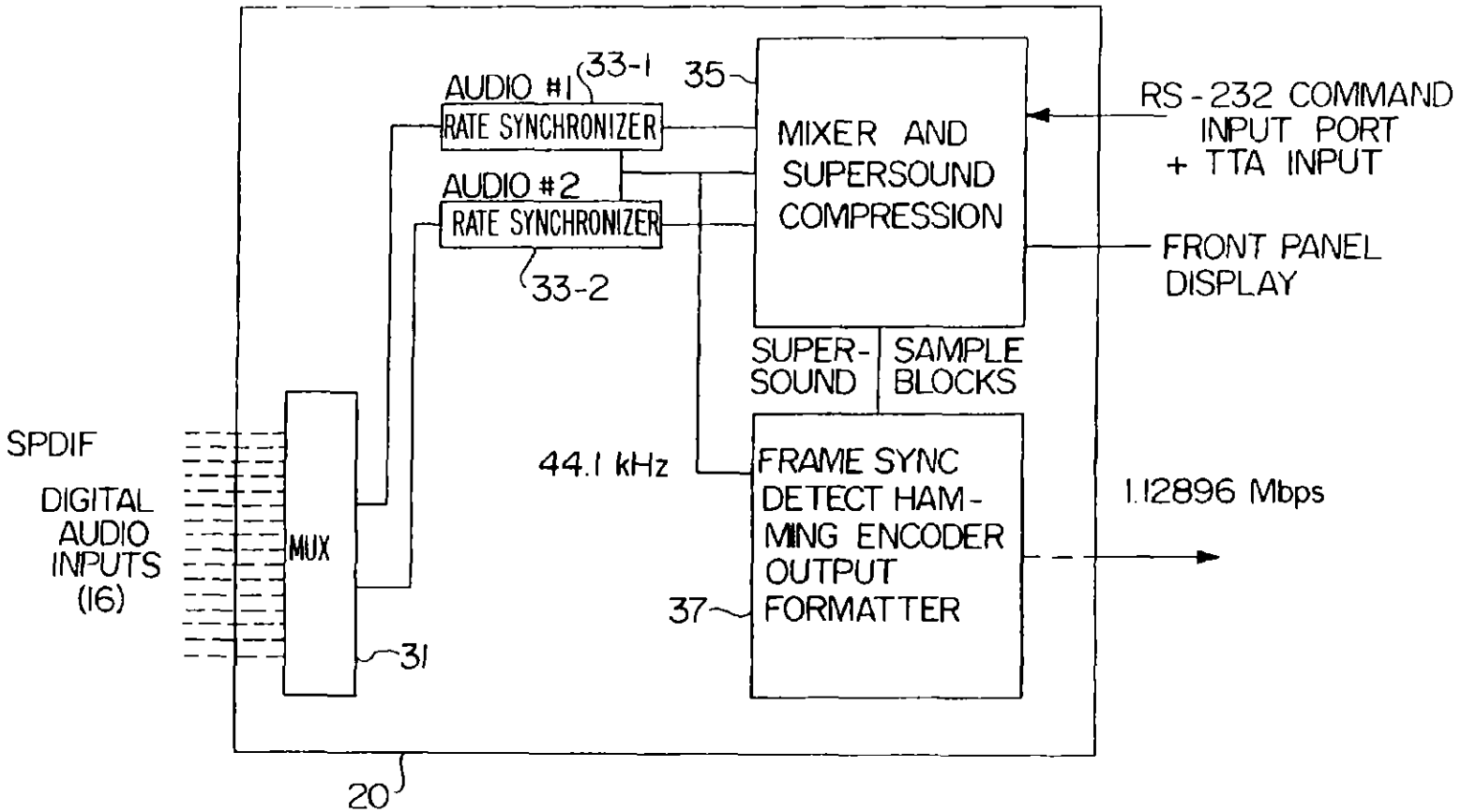
AUDIO #1
33-1
35
RATE SYNCHRONIZER
MIXER AND SUPERSOUND COMPRESSION
RS-232 COMMAND INPUT PORT + TTA INPUT
AUDIO #2
RATE SYNCHRONIZER
33-2
FRONT PANEL DISPLAY
SUPER-SOUND
SAMPLE BLOCKS
SPDIF
DIGITAL AUDIO INPUTS (16)
MUX
44.1 kHz
FRAME SYNC DETECT HAM-MING ENCODER OUTPUT FORMATTER
1.12896 Mbps
37
31
20

FIG. 3

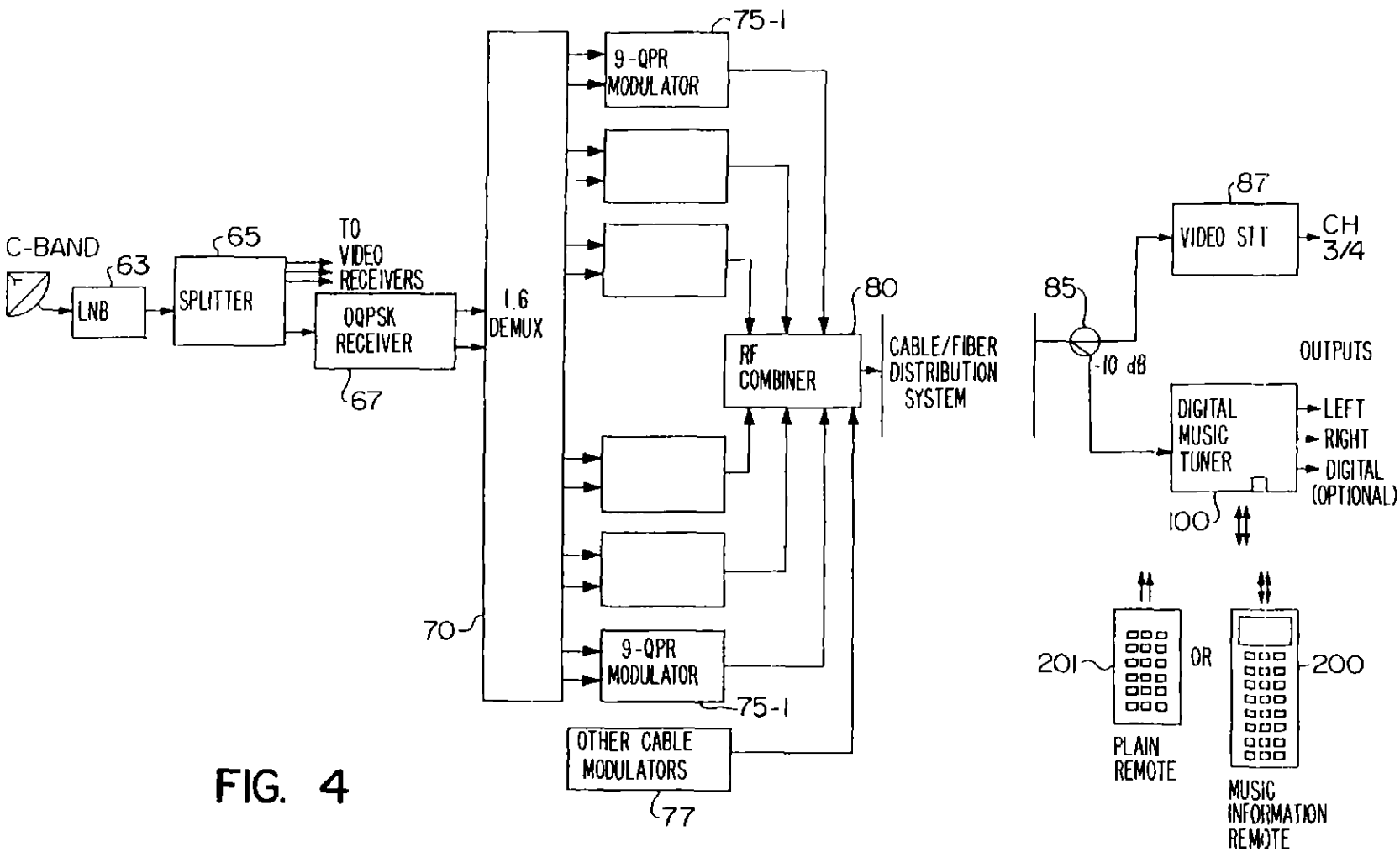
C-BAND
63
LNB
65
SPLITTER
TO VIDEO RECEIVERS
QQPSK RECEIVER
67
1.6 DEMUX
70
75-1
9-QPR MODULATOR
75-1
9-QPR MODULATOR
OTHER CABLE MODULATORS
77
80
RF COMBINER
CABLE/FIBER DISTRIBUTION SYSTEM
87
VIDEO STT
CH 3/4
85
-10 dB
OUTPUTS
DIGITAL MUSIC TUNER
LEFT
RIGHT
DIGITAL (OPTIONAL)
100
201
PLAIN REMOTE
OR
200
MUSIC INFORMATION REMOTE

FIG. 4

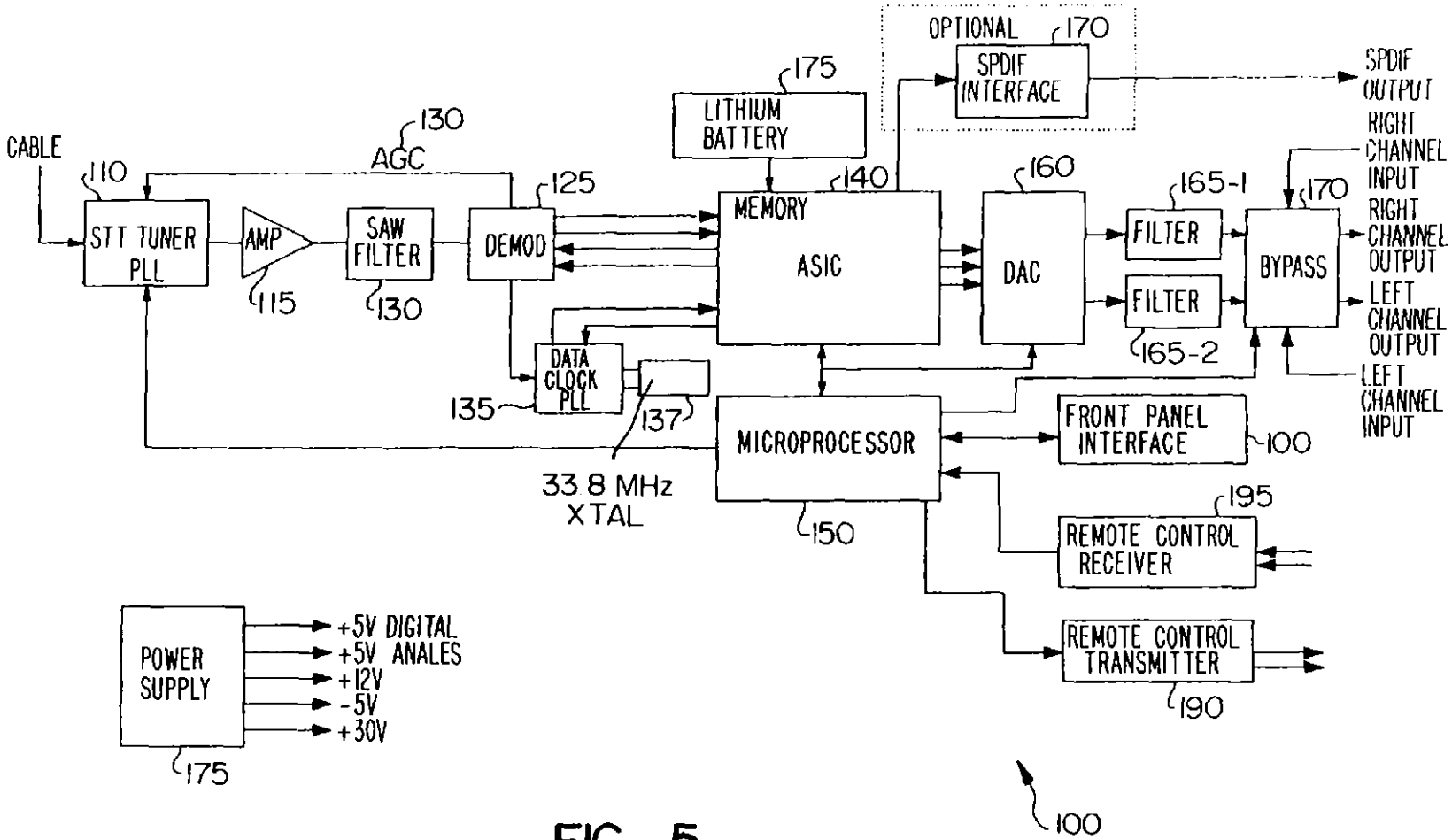
CABLE
110
STT TUNER PLL
AMP
115
SAW FILTER
130
AGC
130
DEMOD
125
LITHIUM BATTERY
175
OPTIONAL
170
SPDIF INTERFACE
SPDIF OUTPUT
MEMORY
ASIC
140
DAC
160
FILTER
165-1
FILTER
165-2
BYPASS
170
RIGHT CHANNEL INPUT
RIGHT CHANNEL OUTPUT
LEFT CHANNEL OUTPUT
LEFT CHANNEL INPUT
DATA CLOCK PLL
135
137
33.8 MHz XTAL
MICROPROCESSOR
150
FRONT PANEL INTERFACE
100
195
REMOTE CONTROL RECEIVER
REMOTE CONTROL TRANSMITTER
190
POWER SUPPLY
+5V DIGITAL
+5V ANALES
+12V
-5V
+30V
175
100

FIG. 5

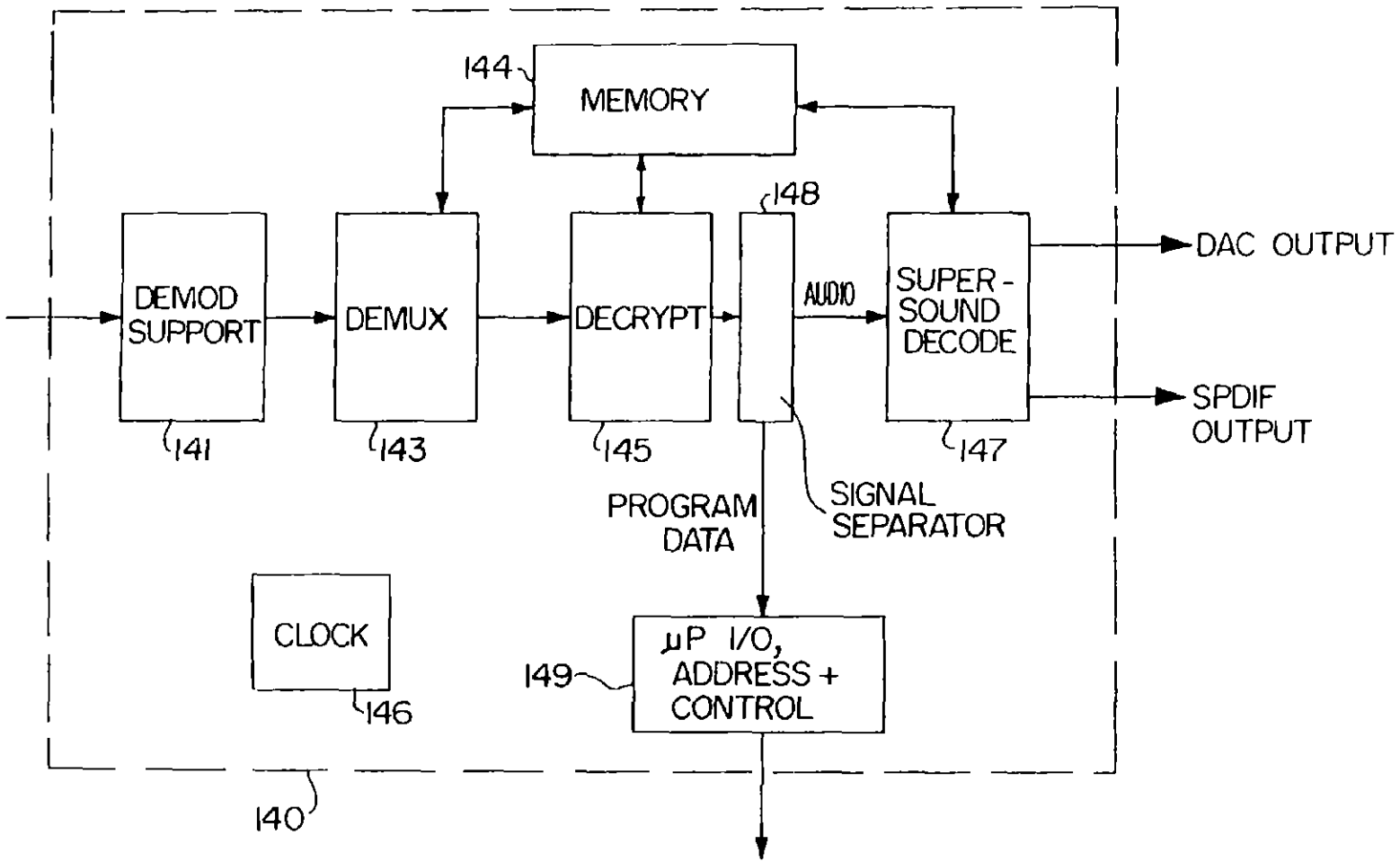
144
MEMORY
148
DEMOD SUPPORT
DEMUX
DECRYPT
AUDIO
SUPER-SOUND DECODE
DAC OUTPUT
SPDIF OUTPUT
141
143
145
147
PROGRAM DATA
SIGNAL SEPARATOR
CLOCK
146
149
µP I/O, ADDRESS + CONTROL
140

FIG. 6

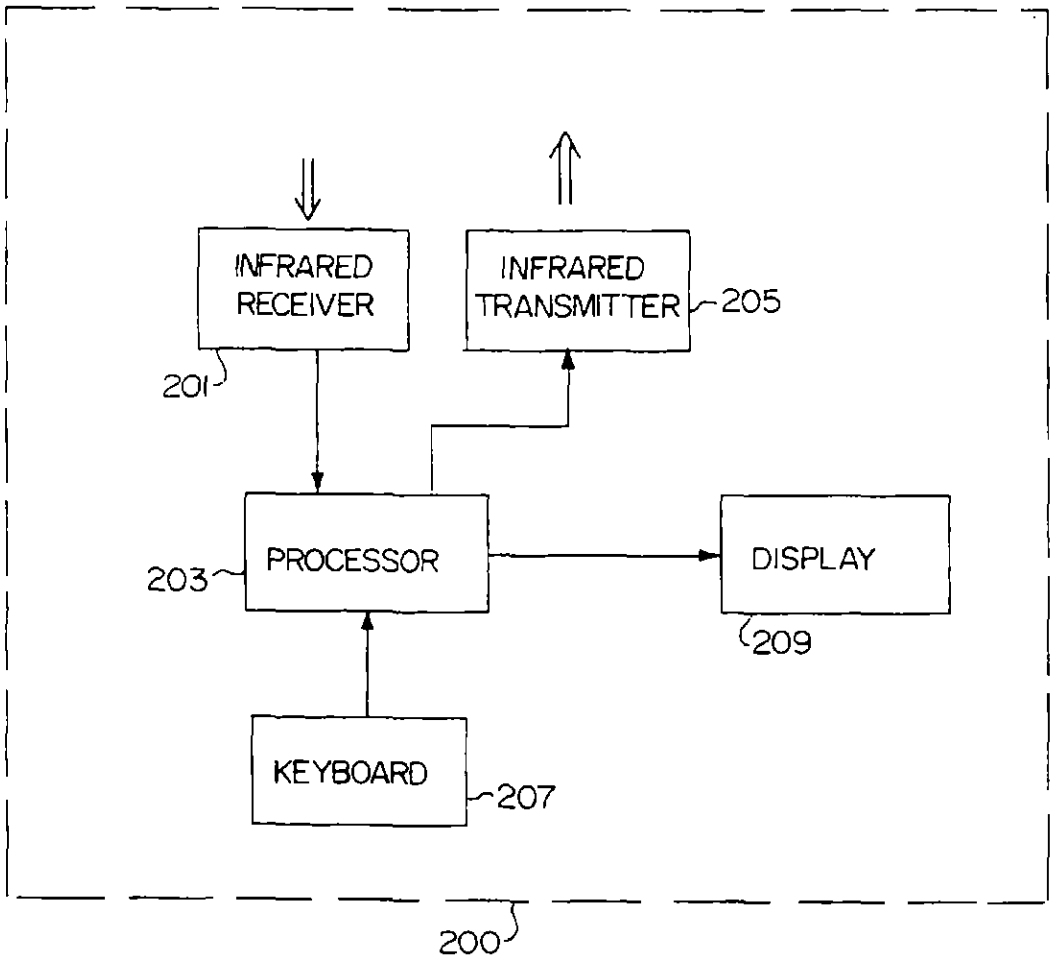
INFRARED RECEIVER
201
INFRARED TRANSMITTER
205
PROCESSOR
203
DISPLAY
209
KEYBOARD
207
200

FIG. 7

FIG. 8

FIELD	SIZE	DEFINITIONS
<SI>	1	Start of TITLE Field
<TITLE>	24	TITLE Information
<DLE>	1	Start of TRACK Field
<TRACK>	24	TRACK Information
<DC1>	1	Start of ARTIST Field
<ARTIST>	24	ARTIST Information
<DC2>	1	Start of LP LABEL Field
<LP LABEL>	24	LP LABEL Information
<DC3>	1	Start of COMPOSER Field
<COMPOSER>	24	COMPOSER Information
<DC4>	1	Start of SONG ID Field
<SONG ID>	10	SONG ID Information
<COPY PROTECT>	1	Copy protect ('Y'= On, 'N'= Off)
<PLAYTIME>	4	(0000–9999) # of Seconds the Current Selection Will Play

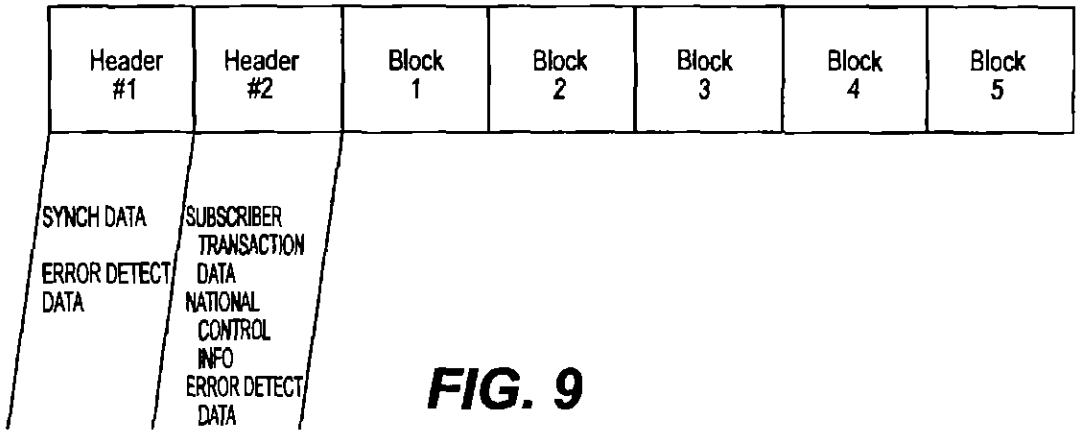
Header #1
Header #2
Block 1
Block 2
Block 3
Block 4
Block 5
SYNCH DATA
ERROR DETECT DATA
SUBSCRIBER TRANSACTION DATA
NATIONAL CONTROL INFO
ERROR DETECT DATA

FIG. 9

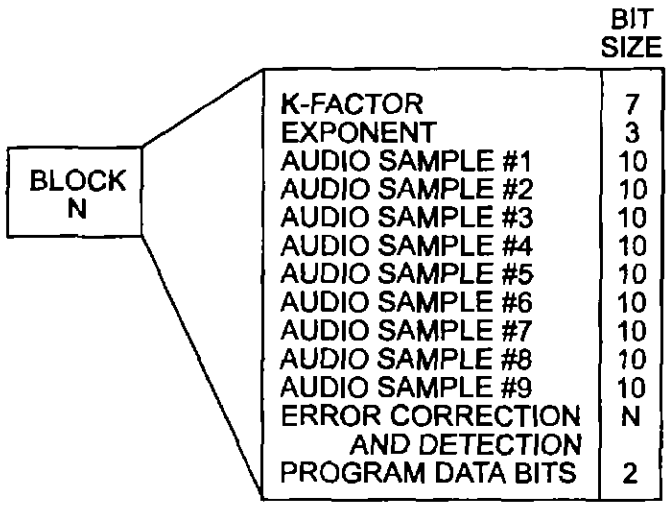
BIT SIZE
BLOCK N
K-FACTOR 7
EXPONENT 3
AUDIO SAMPLE #1 10
AUDIO SAMPLE #2 10
AUDIO SAMPLE #3 10
AUDIO SAMPLE #4 10
AUDIO SAMPLE #5 10
AUDIO SAMPLE #6 10
AUDIO SAMPLE #7 10
AUDIO SAMPLE #8 10
AUDIO SAMPLE #9 10
ERROR CORRECTION AND DETECTION N
PROGRAM DATA BITS 2

FIG. 10

METHOD AND APPARATUS FOR COMMUNICATING DIFFERENT TYPES OF DATA IN A DATA STREAM

This application is a continuation of Ser. No. 08/171,453 filed Dec. 22, 1993, now abandoned, which is a continuation of Ser. No. 08/056,560 filed May 3, 1993, now U.S. Pat. No. 5,406,558, which is a division of Ser. No. 07/618,744 filed Nov. 27, 1990, now U.S. Pat. No. 5,239,540.

TECHNICAL FIELD

The present invention relates to the field of digital signal transmission and more particularly, to transmitting digital signals accompanied by program content data so that listeners/viewers may see a display of the program content data as they are listening/viewing the performance, without interrupting the performance.

BACKGROUND OF THE INVENTION

Presently, program content information, for example, song title, artist, record label, etc., is communicated to the customer/listener by announcers' disc jockeys (DJs). In the case of video programs transmitted by broadcast means, video text messages are presented between programs and during interruptions of programs. In the case of many premium services, it is undesirable to interrupt programs for presentation of program content information. It may also be undesirable to have any form of announcer or DJ between program or selection of music.

Those such announcers or interruptions of program may be undesirable in some services. Nevertheless, it is highly desirable to communicate program content information. Frustration of customers, and possible loss of revenue due to subscription cancellation can occur if a subscriber has no method of knowing the title, composer or artist of the particular selection of music. To the music industry, identification of recording label and identification number is critical to sale of the recordings. Currently, a subscriber viewing a premium video program must consult a separate listing, tune to a different channel, or wait till the end of the program for its identification.

Similarly, the cable television industry is currently introducing audio-only services. Program content information is printed in a separate listing. These cable "radio stations" may play a continuous succession of musical selections without commercial interruptions. These services may not use a "disc-jockey" to identify the musical or other selections. Instead, under the present invention, data channels will contain information about the music being played.

In one embodiment of the present invention, a display of this data has been envisioned that has been termed an "electronic DJ". This display could be built into the subscriber terminal itself, or it could be a separate display unit that would connect to a port on the rear panel of the terminal.

The problem with such displays is that, unless they are very large and therefore costly, they cannot be easily placed within reading distance of the listener. Long cables for the display would be difficult to route in a typical living room, and we need only look at the success of VCR wired remote controls to convince ourselves that such a tethered display would not be optimum.

Wireless remote controls have brought great convenience to the control of consumer products. Highly intelligent remote controls with liquid crystal displays are available. Programmable and universal "learning" remote controls are

available that assume the functions of multiple other controls. These remote controls receive information from each other, and display the functions available to the user.

It can be a frustrating experience to enjoy a piece of music on the radio, only to have the station fail to identify the piece. To lovers of music, having such information as music title, composer, artist and record label is vital. Without this information, the service will be reduced to the level of generic background music.

SUMMARY OF THE INVENTION

The problems and related problems of transmitting and providing a display of program content data are solved by the principles of the present invention. In furtherance of these principles, it is an object of the present invention to provide program information to subscribers without interrupting the program.

It is an object of the present invention to transmit and provide program information for digital audio transmitted to subscribers, where the program information is combined with the digital audio.

It is a further object of the present invention to provide program data to subscribers of video information.

It is another object of the present invention to provide program information to subscribers where the information is communicated through a remote control unit.

It is a further object of the present invention to provide a system where digital program information is combined with digital audio/video signals which are transmitted via satellite, coaxial cable, or other means to subscribers.

It is another object of the present invention to provide program data corresponding to audio/video signals to subscribers with disabilities.

In accordance with these and other objects, apparatus for encoding according to the present invention comprises: a plurality of means for producing digital signals; a plurality of means for producing a plurality of program data signals, each program data signal corresponding to one digital signal; and, at least one encoding means, coupled to the plurality of means for producing digital and program data signals, for encoding the plurality of program data signals with the plurality of digital signals to produce a plurality of combined digital and program data signals.

Additionally, under these and other objects, a method is disclosed for encoding program information into a digital data stream comprising the steps of: producing a plurality of digital signals; producing a plurality of program data signals, each program data signal corresponding to one digital signal; and encoding the plurality of program data signals with the plurality of digital signals to produce a plurality of combined digital and program data signals.

Conversely, under the above and other objects, an apparatus is disclosed for communicating program information corresponding to a track of digital data from a signal containing a plurality of digital and program information signals comprising: first receiving means for receiving an encoded signal containing a plurality of digital signals and a plurality of program data signals, each program data signal corresponding to one digital signal; at least one selecting means, coupled to the first receiving means, for selecting one digital signal and one corresponding program data signal from the received encode signal; at least one decoding means, coupled to the selecting means, for decoding the selected one digital signal and the one corresponding program data signal so as to separate the corresponding pro-

gram data signal from the selected one digital signal; transmitting means, coupled to the decoding means, for transmitting the one corresponding program data signal; second receiving means, coupled to the transmitting means, for receiving the one corresponding program data signal; and, communicating means, coupled to the second receiving means, for communicating the one corresponding program data signal.

Similarly, a method under the above objects is disclosed for communicating program information corresponding to a track from signal containing a plurality of digital and program information signals comprising the steps of: receiving an encoded signal containing a plurality of digital signals and a plurality of program data signals, each program data signal corresponding to one digital signal; selecting one digital signal and one corresponding program data signal from the received encoded signal; decoding the selected one digital signal and the one corresponding program data signal so as to separate the corresponding program data signal from the selected one digital signal; transmitting the one corresponding program data signal to a communicator; receiving the transmitted one corresponding program data signal; and, communicating the received one corresponding program data signal via the communicator.

Finally, under the objects of the present invention, a handheld apparatus for communicating program information corresponding to digital data is disclosed comprising: receiving means for receiving a program data signal corresponding to a digital track; processing means, coupled to the receiving means, for processing the received program data signal; and, communicating means, coupled to the processing means, for communicating the processed program data signal.

The communicating means under the present invention could take the form of a standard remote control, i.e. a hand-held unit with a display of some sort. The display could be a liquid crystal or other suitable technology. A benefit of having the display in a remote unit under the present invention is that the cost of the display need not be included in the base unit. The display can be a value-added extra-cost feature. It can thus be seen as a means of increasing revenue, or of making the service more affordable to those not desiring the feature.

The communicating means under the present invention could also take the form of a table-mounted unit. It could use a larger display than might be possible on a hand-held remote. It could also use ac power instead of batteries and thus power a brighter and larger display more suitable for low light viewing. The control and display functions could be separated into two individual units.

The base subscriber terminal could automatically update the remote display/control unit whenever there has been a change in programming. This, however, may result in brief intervals during which the use of other remote controls might be disrupted. Instead, the communications may be structured such that for information to be sent from the base subscriber terminal, it must be polled from the remote unit. Memory could be used in either the base unit or the remote to store information on previous selections. This information could be recalled by the user on demand.

The communications link between the base subscriber terminal and the remote unit could use radio frequencies, infrared, visible light, acoustical transmission through air, or other wireless means. The concept could also be extended to carrying the information on the household power lines, telephone wires, coaxial cable, fiber-optic cable or means other than the direct connection of a cable to the base unit.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages of the present invention may be appreciated from studying the following detailed description together with the drawings in which:

FIG. **1** is a blocked diagram of the overall system in the present invention;

FIG. **2** shows a detailed block diagram of the encoding and transmitter portion of the present invention;

FIG. **3** shows a block diagram of the encoding portion of the present invention;

FIG. **4** shows a block diagram of the receiving portion of the present invention;

FIG. **5** shows a block diagram of the digital music tuner;

FIG. **6** shows a block diagram of the application specific integrated circuit shown in FIG. **5**;

FIG. **7** shows a block diagram for the remote communication device of the present invention; and,

FIG. **8** shows a diagram of a simplified frame format using the present invention.

FIG. **9** illustrates the composition of the data frame of the present invention.

FIG. **10** illustrates the composition of the data block portion of the data frame of FIG. **9**.

DETAILED DESCRIPTION

Referring to FIG. **1**, a block diagram of an overall system in the present invention is described. The present invention will be described with respect to transmitting audio signals with program data. However, those skilled in the art will recognize that the present invention may, instead of transmitting audio with corresponding program data, transmit any of the following, with corresponding program data: television, games, software, video, and other combinations of audio/video or software information.

Compact disc players **10**-**1** through **10**-n provide a plurality of digital audio signals to the present invention. These CD players may be the so called "Jukebox" type wherein up to sixty or more compact discs may be stored and accessible by the player.

The digital audio signals from CD players **10**-**1** through **10**-n are input to encoders **20**-**1** through **20**-n which will be described in greater detail with reference to FIG. **3**. Controller and music database **30**-**1** through **30**-k controls the output of CD players **10**-**1** through **10**-n and any respective selection of compact discs within these players and also provides a database containing program data with a one to one correspondence to the tracks contained on the compact discs. This program data includes title, track, artist, publisher, composer, song identification and play time information blocks for each song contained on a compact disc. These program data signals could also include other information relevant to describing the particular track contained on a compact disc, as those skilled in the art can appreciate. For example, if the information were historical audio data, information on the time and place such data was first conceived or transmitted may also be contained within this program information. Additionally, if the digital signals transmitted contained video information, the corresponding program data signals would relate to the video program being transmitted, for example, the title, actors, director, publisher, year, or other relevant information.

The plurality of digital audio signals inputted by the CD players **10**-**1** through **10**-n are combined in encoders **20**-**1** through **20**-n with the program data signals inputted by

controller and music databases **30-1** through **30-k**. The combined signals from encoders **20-1** through **20-n** are then inputted into multiplexer **40** which combines the signals into a serial digital data stream.

Additional signals may be combined with the digital audio and program information signals. Subscriber control **45** contains information on various subscribers who may receive the digital audio data produced by the present invention. This subscriber information stored in subscriber control **45** is multiplexed with the digital audio and program data signals in multiplexer **40**, producing a serial digital data stream containing digital audio, program information, and national subscriber information.

The serial digital audio/program data stream from multiplexer **40** is input into the digital satellite transmitter **50** and broadcast, via satellite, to digital satellite receiver **60**. However, those skilled in the art will realize that any delivery system, not just satellite transmission, may be used, such as cable television (CATV), microwave distribution (MDS or MMDS), telephone systems, terrestrial broadcasts, and other coaxial or optical cable lines.

The previously described transmitter section will be more fully discussed with reference to FIG. **2**, while the following receiver section will be more fully described with reference to FIG. **4**. Digital satellite receiver **60** transfers the digital data to headend processing **70** which in turns converts and sends the information to digital cable modulators **75**. The digital audio data is then added with signals from other cable modulators in summing circuit **80** and sent over a cable distribution system.

The cable distribution system includes line amplifiers **90** for boosting the signal and compensating for any line loss. System tap **85** directs the combined signal to a subscriber's premises and into digital music tuner **100**. Digital music tuner **100**, more fully described with respect to FIG. **5**, selects the channel containing the digital audio and program data signals. Additionally, digital music tuner **100** separates the digital audio signal from the program information signal. The digital audio signal is converted to analog, amplified and output on a subscriber's audio electronics, while the program information signal is processed and sent to a local display or remote using information display **200**. The demultiplexing and decoding of the signals is discussed more fully with reference to FIG. **6**. These displays then communicate to the subscriber the particular program information corresponding to an audio track currently being listened to by the subscriber. The remote music information display is more fully described with respect to FIG. **7**.

Transmitting Section

Referring to FIG. **2**, a block diagram of the studio and transmitter, or uplink, section of the present invention is described. Compact disc players **10-1** through **10-n** are driven by microcomputers **15-1** through **15-n**. Microcomputers **15-1** through **15-n** could be IBM Model AT microcomputers. These microcomputers are in turn controlled by the studio sequencing master controllers **30-1** through **30-k**. These master controllers **30-1** through **30-k** include a database containing the program information described above. These master controllers are preferably IBM Model PS/2 microcomputers or other computers containing a 386 type microprocessors.

The digital audio output from CD players **10-1** through **10-n** is input into encoders **20-1** through **20-n** along with program information supplied by master controllers **30-1** through **30-k**. Encoders **20-1** through **20-n** combine the digital audio signals with the program data signals and output the combined signal to system data multiplexers **40-1** and **40-2**. Preferably, the outputs of 30 encoders **20-1** through **20-30** are input into multiplexers **40-1** and **40-2** where the signals are time division multiplexed. Multiplexers **40-1** and **40-2** may include error correction encoding using, for example, Hamming encoding or Bose Chaudhuri Hocquengben (BCH) encoding, or other error correcting/encoding methods known by those skilled in the art.

Billing system **47** includes subscriber information of the present invention and national control information and may be comprised of an IBM Model PS/2 microcomputer. The subscriber information and other billing system data would be contained within a large database within billing system **47**. Typical billing system data could include, for example, identity, location, etc. for subscribers and their current billing status. Billing system information from billing system **47** is input into the system manager digital audio controller **45**. System manager **45** is preferably comprised of a series 8500 System Manager manufactured by Scientific Atlanta or a similar product. System manager digital audio controller **45** controls master controllers **30-1** through **30-k**. Additionally, the system manager **45** may also input subscriber data from the subscriber database within billing system **47** into multiplexers **40-1** and **40-2**.

The subscriber information may be combined with the digital audio and program signals through multiplexers **40-1** and **40-2**. Multiplexers **40-1** and **40-2** provide the master clock to all the encoders **20-1** through **20-n** and to satellite exciters **53-1** and **53-2**. The output of multiplexers **40-1** and **40-2** is a 34 megabits per second (Mbps) data stream comprising the preferred 30 channels outputted by the 30 encoders **20-1** through **20-30**.

Relay circuit **43** provides fault protection so as to switch the system to multiplexers **40-2** and **40-2** from multiplexer **40-1** in event of a fault. The outputs from multiplexers **40-1** and **40-2** are two coaxial cables, for plus and minus balanced connections. These balanced coaxial cables are used from the output of multiplexers **40-1** and **40-2** through satellite transmitting and receiving electronics. The combined signal from multiplexer **40-1** passes through relay **43** into fiber-optic transmitter **49**. Fiber-optic transmitter **49** transports the signal from the studio to the transmitter site and into fiber-optic receiver **51**. The output of the fiber-optic receiver drives an offset quadrature phase shift keying (OQPSK) satellite modulator **50**. The signal is then up converted, amplified and transmitted to the satellite, as more fully described below.

The signals are received from fiberoptic transmitter **49** into fiber-optic receiver **51** in transmitter **50**. From fiber-optic receiver **51** the signals pass through fault protection relay **52-1** into OQPSK Exciter **53-1**. The digital signals from OQPSK exciter **53-1** enter splitter **57-1** and through fault protection relay **52-2**. Thereafter, the signals pass through an upconverter **58-1**. From upconverter **58-1** the signals pass through switch **56-1** into high powered amplifier **59-1** and once again through switch circuit **56-2** and then transmitted. The transmitting is preferably performed via a satellited. The transmission may also occur via coaxial cables or fiber-otic cables.

Redundancy control logic **55** controls transmitter **50**, so in the event of a fault, redundant circuitry is activated. Specifically, redundancy control logic **55** controls relays **52-1** and **52-2** and switches **56-1** and **56-2** so as to switch to redundant exciter **53-2** and splitter **57-2**, redundant up converter **58-2** and high powered amplifier **59-2**.

Referring to FIG. **3**, a more detailed block diagram of an encoder **20-1** is described. Outputs from CD players **10** are input to multiplexer **31**. Preferably, the outputs from **16** CD players **10-1** through **10-16** are input into multiplexer **31** where their signals are combined and output as two channels to rate synchronizers **33-1** and **33-2**. The rate synchronized signals are then input into mixer and signal compressor **35**. Mixer and signal compressor **35** preferably uses

The signals are clocked at 11 megahertz to modulators **75-1** through **754**. Each modulator **75-1** through **75-6** is a nine state quadrature partial response (9-QPR) modulator capable of handling five stations and each occupying a 3 megahertz bandwidth. Those skilled in the art will appreciate that one may also use phase shift key modulation or other modulation methods known in the art with fewer or greater numbers of states.

The modulated signals from modulators **75-1** through **75-6** are combined in radio frequency combiner **80** along with other modulated signals from other cable modulators **77**. Modulators **75-1** through **7-56** digitally filter the data, quadrature partial response (QPR) modulate and convert the data to the selected output frequency for combining with other modulated channels **77** in the present cable television system. Each block of five stereo pairs occupies 3 megahertz of band width and can be carried in half of one 6 megahertz video channel of the present cable television system. Since the present system uses a common 6 megahertz video channel, no modifications of current CATV distribution system equipment is required.

The combined signals from RP combiner **80** are distributed over a coaxial cable or fiber-optic distribution system into a subscriber's home. Directional coupler **85** directs most of the signal to video set top terminal **87**. A sample of the signal is sent from directional coupler **85**, at a loss of 10 decibels to digital music tuner **100**. Tuner **100** is controlled by either a plain remote **201** or a music information display remote **200**. Additionally, tuner **100** outputs left and right analog audio signals, and may also output an optional digital signal output.

Referring to FIG. **5**, a block diagram of digital music tuner **100** is shown. The digital audio and program data signal is inputted from directional coupler **85** into set top terminal tuner **110**. This tuner preferably includes phase locked loop circuitry. The signal from tuner **110** is amplified by amplifier **115** and filtered by saw filter **120** before being demodulated by demodulator **125**. Tuner **110** converts the selected radio frequency channel to a demodulation intermediate frequency. The output of demodulator **125** is QPR demodulated to produce a 5.6 Mbps data stream containing five stereo pair of digital the data compression format described in U.S. Pat. No. 4,922,537, incorporated herein by reference. Mixer and data compressor **35** is controlled by input signals from master controller **30-1** which also inputs the program data signals corresponding to the digital audio signals. The digital audio signals are compressed, program data signals are mixed therewith, and then the mixed signal is input into frame sync detector and output formatter **37**. Circuit **37** may also include circuitry to encrypt the mixed and compressed signals using, for example, the Data Encryption Standard (DES) or using other similar encryption techniques known in the art. Circuit **37** may include error correction encoding using, for example, Hamming encoding or Bose Chaudhuri Hocquenghen (BCH) encoding, or other error correcting/encoding methods known by those skilled in the art. Hamming encoding is disclosed in *Electronic Engineers Reference Book*, edited by F. Mazda, page 32/10, incorporated herein by reference.

The audio data is clocked into and out of circuits **33-1**, **33-2**, **35** and **37** at a rate of 44.1 kilo samples per second. The mixed compressed and encrypted signals are output of circuit **37** at 1.12896 Mbps in Applicant's preferred embodiment.

Receiving Section

Referring to FIG. **4**, the mixed, compressed and encrypted signal is received in the C-band via satellite receive antenna and amplified and block converted in a low-noise block converter **63**, along with other satellite distributed signals. The signal is output in the L-band at 950 to 1450 megahertz and input into splitter **65** where the audio signal is input into OQPSK receiver **67**. Receiver **67** demodulates the OQPSK information and provides one 34 Mbps signal stream containing the preferred 30 satellite distributed channels. The 34 Mbps signal is output of receiver **37** at 34 megahertz clock rate into demultiplexer **70**. Preferably, demultiplexer **70** is a 1:6 demultiplexer which separates the single data stream into six channels containing 5.6 Mbps digital audio and program data each. These six channels contain five stations each. audio data to applications specific integrated circuit (ASIC) **140**. Demodulator **125** also provides an automatic gain control signal **130** to tuner **110** to maintain constant signal level. Additionally, demodulator **125** provides data to clock recovery phase locked loop (PLL) **135**. Data clock PLL **135** contains a 33.8 megahertz crystal **137** from timing purposes.

This tamp signal is sent to ASIC **140**, which will be discussed in greater detail with reference to FIG. **6**. ASIC **140** provide a digital audio output to interface **170**. Interface **170** uses the Sony-Philips digital interface format (SPDIF). Similarly, the digital audio signals are input from ASIC **140** to digital to audio converter **160**. From digital to audio converter **160**, the analog left and right audio signals are filtered through filters **165-1** and **165-2** and input into bypass **170**. Bypass **170** allows additional audio components (e.g., a CD player or tape deck) to be switchably connected with the digital music tuner **100**.

Microprocessor **150** controls phase locked loop of tuner **110**, ASIC **140**, digital to analog converter **160** and bypass **170**. The program data signal from ASIC **140** is sent to microprocessor **150** where it is stored in internal memory of the microprocessor, and may be displayed on front panel interface **180** or transmitted through remote control transmitter **190**. Remote control receiver **195** may select particular program data information or audio channels through microprocessor **150**.

Power supply **175** would supply both positive five volt digital and analog power, and a negative five volt supply to the system. Positive 12 volt and positive 30 volt power supply signals are also provided from power supply **175**. Additionally, tuner **100** would preferably have input means, e.g., push buttons or toggle switches, on the exterior of its housing (not shown). These input means would allow selection of channels, stations, display of program data. and display of particular information blocks contained in the program data signal. Additional selections or inputs may be provided as those skilled in the art recognize.

Referring to FIG. **6**. a more detailed block diagram of ASIC **140** is provided. The signal from demodulator **125** is input into demodulator support circuit **141** which comprises logic circuitry (e.g., flip-flops) required in demodulation of the signal. The signal from demodulator support circuit **141** is then input into demultiplexer **143** which separates the 5.6 Mbps data stream to select one of five stereo pairs of digital

audio signals. This signal is then sent to decrypting circuit **145**. The decrypted signal is then separated in signal separator **148** where program data is sent to microprocessor In/out circuit **149** while audio data is sent and decoded in circuit **147**. Decoder **147** uses the data decompression technique described in U.S. Pat. No. 4,922,537, incorporated herein by reference.

Microprocessor in/out, address and control circuit **149** interfaces with microprocessor **150**. All circuits within ASIC **140** are driven by clock **146**. Memory **144** stores bits of data to support the demultiplexing, decrypting and decoding functions occurring in circuits **143**, **145** and **147** respectively. The memory may be of a nonvolatile type such as an EPROM or similar ROM memory or may be a volatile type RAM memory supported by battery **175**, preferably a lithium type battery. Such a battery **175** would prevent loss of data stored in memory **144**.

Remote Display Unit

Referring to FIG. **7**, a block diagram of the remote music information display unit **200** is shown. Program data signals are received by receiver **201** from remote control transmitter **190**. Preferably, infrared transmitter and receivers **190**, **193**, **201** and **205** are used. However, radio frequency, ultrasonic, wire, fiber-optic cables or other means could be used as those skilled in the art can appreciate.

The received signal is then input into processor **203** which processes and sends the program data signal to display **209** for communicating program data corresponding to currently playing audio track to a subscriber. Display **209** may be a liquid crystal display. a light emitting diode. a braille reader, a voice synthesizer or a cathode-ray tube or any other communicating device as may be appreciated by those skilled in the art. Audible or tactile communicating means would allow communication of the program data signals to subscribers with disabilities, as would the use of a remote unit.

Input means shown as keyboard **207** may receive program data selection commands or audio track commands from a subscriber which are sent to processor **203**. Keyboard **207** may also include means to allow a subscriber to control volume, power, channel selection, station selection, display, or other suitable subscriber commands that those skilled in the art appreciate. Processor **203** then converts and transmits the subscriber command signal to transmitter **205** which is received by remote control receiver **195**. The received signal from receiver **195** is input into microprocessor **150** where appropriate signals are sent therefrom to ASIC **140** and tuner **110** so as to bring about the subscriber's desired audio track, audio channel or program information.

Repeaters could be placed throughout a dwelling to extend the range of the display/control unit. Additionally, processor **203** could contain memory for storing various information, particularly program information.

In an alternative embodiment, the remote display unit may display only a code number representing the program data signals, whereby a subscriber may reference the number in printed material for a full description of the currently playing audio track. The printed material could be a publication which would rotate monthly or weekly as the programs on respective stations change. Such a system would allow for a smaller display on the remote unit, and thus be less costly to a subscriber. Such a printed publication would also allow a subscriber to determine which programs were playing on the various channels.

Additionally, the remote display unit or tuner **100** could display. upon a subscriber's request, program data corresponding to data being transmitted on channels not currently being listened to/viewed by the subscriber. In this way, a subscriber may scan what is being broadcast on alternate channels while listening to a currently playing channel.

Data Format

The preferred thirty stereo audio stations are multiplexed as follows. Groups of five stations are formatted into a frame of data. Six such frames are interleaved bit by bit for transmission over the satellite. Each such frame containing five stations has a header. This header is used by the headend demultiplexer **70** to deinterleave the satellite received data into six frames of five stations each. The header is also used in the ASIC **140** to synchronize on the frame. A second header contains subscriber control transaction data. This section header would preferably include channel and subscriber transaction data as previously described with respective billing system **47**. The headers include additional bits for error detection.

Following the headers, compressed audio data with its associated program data is sent. Audio data for each station includes a seven bit "k factor" and a three bit "exponent" for each block of nine samples as described in previously referenced U.S. Pat. No. 4,992,537. Five such k factor and exponent blocks for each station are included in each frame.

The audio and program data for the five stations in the frame are interleaved bit by bit. That is, the first bit is sent for station No. 1, followed by the first bit for station No. 2 and so on until the first bit of each station has been sent. Then the second bit of each station is sent and so on. After the last audio data bits in each block of nine samples have been sent, the program data bits are sent in the same manner. Thus, the program data for each station is multiplexed in the frame with its associated station so that when the frame is demultiplexed or rearranged, the program information for that station is kept with its station. The advantage of multiplexing the program information with the audio data is that one may easily process the combined signal without fear of scrambling channels of audio data with their respective program information. Error correction and detection bits are also sent with the audio data and the program data.

Two program data bits are sent in the same block together with every nine compressed samples (100bits) of audio data. This effectively provides a data channel of about 9800 baud used to transmit program data information. The information is sent in ASCII representation, but could easily be sent in other formats such as EBCDIC as would be apparent to those skilled in the art. FIG. **8** shows the program information as preferably sent and the size of each field in the present embodiment. Other information can be sent, such as music classification for selection of station by music type, special event announcements, or other such information, known by those skilled in the art.

We claim:

1. A method for transmitting different types of data in a single data stream comprising the steps of:

generating program data for insertion into said data stream;

generating program selection data which describes the attributes of said program data for insertion into said data stream, wherein said program selection data includes at least one of a title, a track number, an artist, a publisher, a composer, a song identification, and a play time information block;

generating another type of data for insertion into said data stream;

combining said program data with said program selection data to form data groups;

generating a header containing data from said another type of data;

combining said header with said data groups to form a unit; and

constructing said data stream by joining a plurality of successive units for transmission.

2. Apparatus for communicating different types of digital data to a receiver comprising:

first means for generating program selection data which describes attributes of program data for insertion into a data stream, wherein said program selection data includes at least one of a title, a track number, an artist, a publisher, a composer, a song identification, and a play time information block;

second means for generating another type of data for insertion into said data stream;

third means for generating said program data for insertion into said data stream;

means operatively associated with said first and third means for combining said program data with said program selection data to form data groups;

means operatively associated with said second means for generating a header containing data from said another type of data;

means for combining said header with a plurality of data groups to form a unit; and

means for constructing said data stream by joining a plurality of successive units for transmission.

3. A digital data receiver for receiving a data stream containing successive headers including data of a first type, with each header followed by a plurality of mixed data groups including digital data and program selection data which describes the attributes of said digital data, said receiver comprising:

first means for detecting said program selection data from successive mixed data groups contained in a received data stream, wherein said program selection data includes at least one of a title, a track number, an artist, a publisher, a composer, a song identification, and a play time information block;

second means for detecting data of the first type from successive headers contained in the received data stream;

means responsive to the detected data of the first type and the detected program selection data for recovering the digital data from the received data stream; and

means for reproducing a program from the recovered digital data.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,055,244
DATED : April 25, 2000
INVENTOR(S) : Wall et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 8,
Line 30, delete "tamp" and insert -- timing --
Line 61, delete "FIG. 6." and insert -- FIG. 6, --

Column 9,
Line 22, delete "193" and insert therefore -- 195 --
Line 67, delete "display." and insert therefore -- display,--

Column 10,
Line 16, delete "section" and insert therefore -- second --
Line 43, delete (100bits) and insert therefore -- (100 bits) --

Signed and Sealed this

Thirtieth Day of April, 2002

Attest:

Attesting Officer

JAMES E. ROGAN
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,055,244
DATED : April 25, 2000
INVENTOR(S) : Wall et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1,
Line 36, delete "title." and insert therefore -- title, --
Line 37, delete "industry." and insert therefore -- industry, --

Column 2,
Line 64, delete "encode" and insert therefore -- encoded --

Column 3,
Line 66, delete "cable. fiber-optic" and insert therefore -- cable, fiber-optic --

Column 6,
Line 50, delete "fiberoptic" and insert therefore -- fiber-optic --

Column 7,
Line 8, insert -- the data compression format described in United States Patent No. 4,922,537, incorporated herein by reference. Mixer and data compressor 35 is controlled by input signals from master controller 30-1 which also inputs the program data signals corresponding to the digital audio signals. The digital audio signals are compressed, program data signals are mixed therewith, and then the mixed signal is input into frame sync detector and output formatter 37. Circuit 37 may also include circuitry to encrypt the mixed and compressed signals using, for example, the Data Encryption Standard (DES) or using other similar encryption techniques known in the art. Circuit 37 may include error correction encoding using, for example, Hamming encoding or Bose Chaudhuri Hocqenghen (BCH) encoding, or other error correcting/encoding methods known by those skilled in the art. Hamming encoding is disclosed in Electronic Engineers Reference Book, edited by F. Mazda, page 32/10, incorporated herein by reference.

The audio data is clocked into and out of circuits 33-1,33-2, 35 and 37 at a rate of 44.1 kilosamples per second. The mixed compressed and encrypted signals are output of circuit 37 at 1.12896 Mbps in Applicant's preferred embodiment.

Receiving Section

Referring to Fig. 4, the mixed, compressed and encrypted signal is received in the C-band via satellite receive antenna and amplified and block converted in a low-noise block converter 63, along with other satellite distributed signals. The signal is output in the L-band at 950 to 1450 megahertz and input into splitter 65 where the audio signal is input into OQPSK receiver 67. Receiver 67 demodulates the OQPSK information and provides one 34 Mbps signal stream containing the preferred 30 satellite distributed channels. The 34 Mbps signal is output of receiver 37 at 34 megahertz clock rate into demultiplexer 70. Preferably, demultiplexer 70 is a 1:6 demultiplexer which separates the single data stream into six channels containing 5.6 Mbps digital audio and program data each. These six channels contain five stations each. --

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PATENT NO. : 6,055,244
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INVENTOR(S) : Wall et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 7 con't,
Line 19, delete "7-56" and insert therefore -- 75-6 --
Line 30, delete "RP" and insert therefore -- RF --

Column 7, lines 50-67 and Column 8, lines 1-23,
Delete "the data compression format described in United States Patent No. 4,922,537, incorporated herein by reference. Mixer and data compressor 35 is controlled by input signals from master controller 30-1 which also inputs the program data signals corresponding to the digital audio signals. The digital audio signals are compressed, program data signals are mixed therewith, and then the mixed signal is input into frame sync detector and output formatter 37. Circuit 37 may also include circuitry to encrypt the mixed and compressed signals using, for example, the Data Encryption Standard (DES) or using other similar encryption techniques known in the art. Circuit 37 may include error correction encoding using, for example, Hamming encoding or Bose Chaudhuri Hocqenghen (BCH) encoding, or other error correcting/encoding methods known by those skilled in the art. Hamming encoding is disclosed in Electronic Engineers Reference Book, edited by F. Mazda, page 32/10, incorporated herein by reference.

The audio data is clocked into and out of circuits 33-1, 33-2, 35 and 37 at a rate of 44.1 kilosamples per second. The mixed compressed and encrypted signals are output of circuit 37 at 1.12896 Mbps in Applicant's preferred embodiment.

Receiving Section

Referring to Fig. 4, the mixed, compressed and encrypted signal is received in the C-band via satellite receive antenna and amplified and block converted in a low-noise block converter 63, along with other satellite distributed signals. The signal is output in the L-band at 950 to 1450 megahertz and input into splitter 65 where the audio signal is input into OQPSK receiver 67. Receiver 67 demodulates the OQPSK information and provides one 34 Mbps signal stream containing the preferred 30 satellite distributed channels. The 34 Mbps signal is output of receiver 37 at 34 megahertz clock rate into demultiplexer 70. Preferably, demultiplexer 70 is a 1:6 demultiplexer which separates the single data stream into six channels containing 5.6 Mbps digital audio and program data each. These six channels contain five stations each."

Column 8,
Line 30, delete "tamp" and insert -- timing --
Line 61, delete "FIG. 6." and insert -- FIG. 6, --

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,055,244
DATED : April 25, 2000
INVENTOR(S) : Wall et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 9,
Line 22, delete "193" and insert therefore -- 195 --
Line 67, delete "display." and insert therefore -- display, --

Column 10,
Line 16, delete "section" and insert therefore -- second --
Line 43, delete "(100bits)" and insert therefore -- (100 bits) --

This certificate supersedes Certificate of Correction issued April 13, 2002

Signed and Sealed this

Twentieth Day of August, 2002

Attest:

Attesting Officer

JAMES E. ROGAN
Director of the United States Patent and Trademark Office