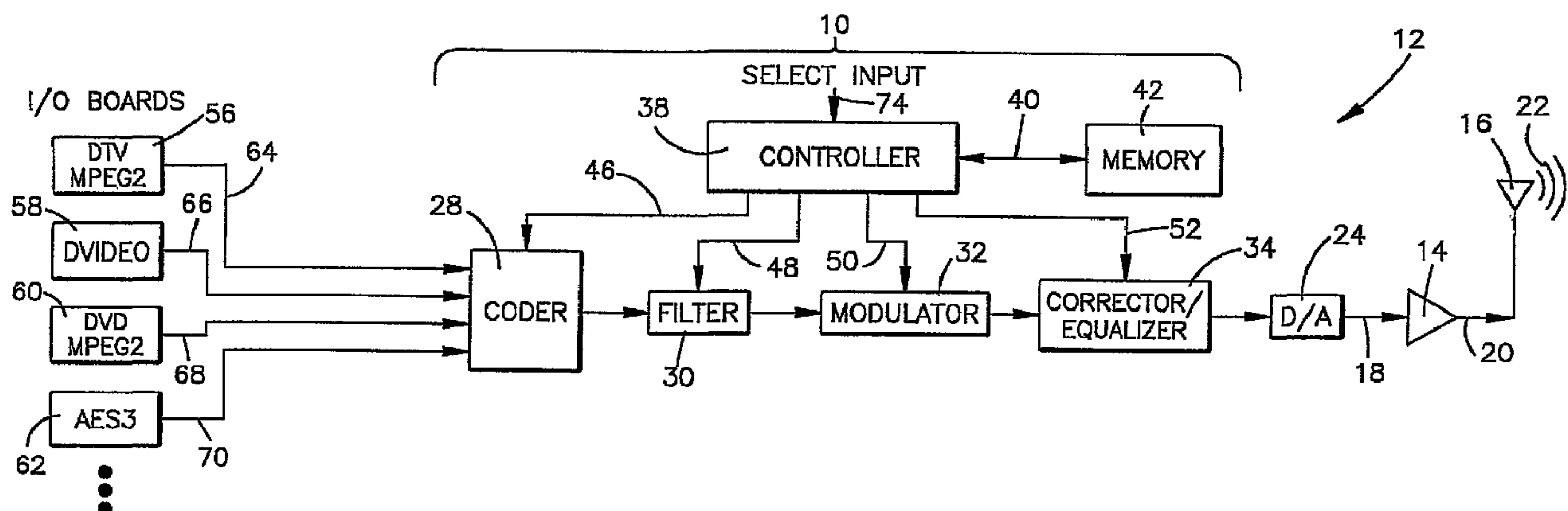




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(57) Abrégé/Abstract:

An exciter (10) is located along an information stream path of a transmission system (12). The exciter (10) supplies an information signal as a drive to an amplifying arrangement (14). A coder (28), programmable to be operative in any of several formats, outputs the information signal that conveys data in a desired code arrangement. A filter (30), programmable to be operative in several formats, confines the information signal energy to a predetermined channel bandwidth. A modulator (32), programmable to be operative several formats, modulating the information signal. A corrector/equalizer (34), programmable to be operative in several formats, pre-corrects the modulated signal for errors induced in the transmission system. A controller (38) provides program control of the coder (28), the filter (30), the modulator (32), and the corrector/equalizer (34).



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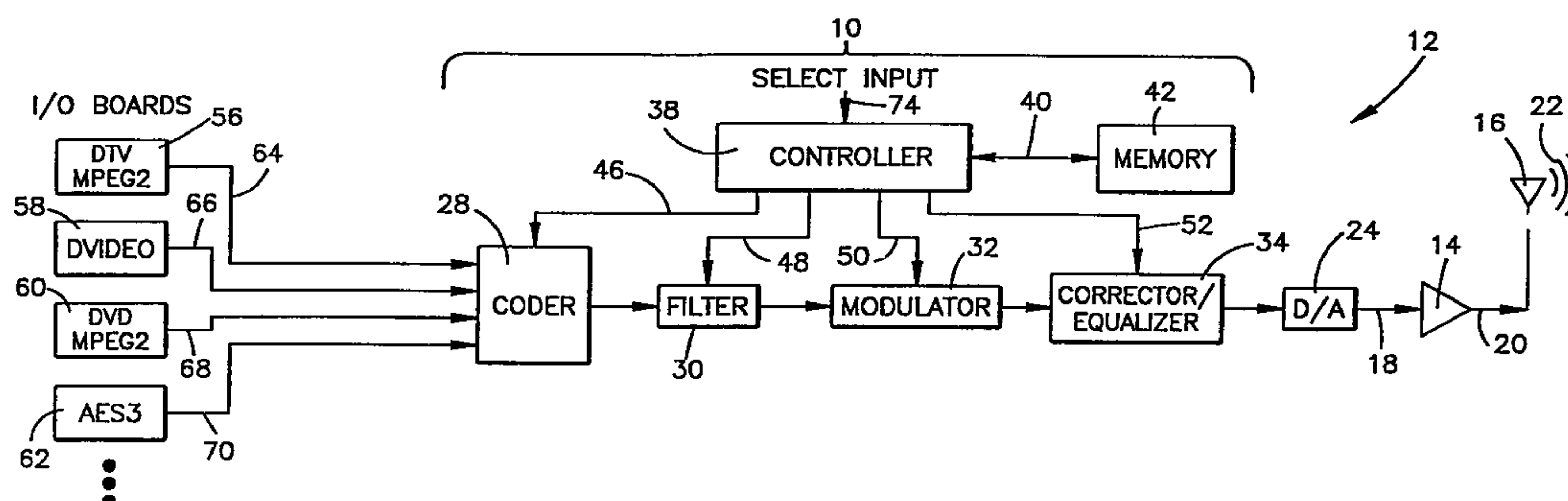
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(54) Title: CONFIGURABLE EXCITER FOR INFORMATION TRANSMISSION SYSTEMS



(57) Abstract: An exciter (10) is located along an information stream path of a transmission system (12). The exciter (10) supplies an information signal as a drive to an amplifying arrangement (14). A coder (28), programmable to be operative in any of several formats, outputs the information signal that conveys data in a desired code arrangement. A filter (30), programmable to be operative in several formats, confines the information signal energy to a predetermined channel bandwidth. A modulator (32), programmable to be operative several formats, modulating the information signal. A corrector/equalizer (34), programmable to be operative in several formats, pre-corrects the modulated signal for errors induced in the transmission system. A controller (38) provides program control of the coder (28), the filter (30), the modulator (32), and the corrector/equalizer (34).

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CONFIGURABLE EXCITER FOR INFORMATION TRANSMISSION SYSTEMS

The present invention relates to communication systems, and is particularly directed to an exciter useable for a plurality of communication formats.

With the advent of digital television ("DTV") broadcasting, it is apparent that there will
5 be at least two format standards utilized. Within the United States, the Federal Communication Commission ("FCC") has adopted an eight vestigial sideband ("8VSB") format. Elsewhere within the world, a coded orthogonal frequency division and multiplexing ("COFDM") format has been adopted.

Also, current analog television systems exist under either the National Television System
10 Committee ("NTSC", U.S. and Japan) format or the Phase Alternation by Line ("PAL", elsewhere) format. Further, various other transmission formats exist. Examples of such transmission formats include Frequency Modulation ("FM"), Amplitude Modulation ("AM"), Digital Audio Broadcast ("DAB"), Quadrature Amplitude Modulation ("QAM"), Code Division Multiple Access ("CDMA"), and Time Division Multiple Access ("TDMA").

15 Each of these different types of transmission use various types of modulation, occupy different bandwidths, and/or operate on different frequencies (channels). Digital systems that would be used within each of these types of transmission systems differ in their implementation details. For example, a comparison of the 8VSB and COFDM digital television formats indicate that there are differences relating to data rates, parity bits, block size and other parameters.

20 However, despite the differences, transmission systems of the various formats have certain characteristics that are common. From the standpoint of a manufacturer of broadcast transmission equipment, it would be beneficial to capitalize on the common aspects of the various types of transmission formats. This would allow a manufacturer to capitalize on economies of scale regarding manufacture of various transmission format systems.

25 In accordance with one aspect, the present invention provides an exciter, located along an information stream path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement. Coder means outputs the information signal that conveys data and a desired code arrangement. Filter means restricts the energy of the signal to a predetermined channel bandwidth. Modulator means modulates the baseband information
30 signal. Corrector/equalizer means pre-corrects the modulated signal for errors induced in the transmission system. At least two of the coder means, the filter means, the modulator means, and the corrector/equalizer means are programmable to be operative in any of several I/O

formats. Controller means provides program control of at least two of the coder means, the filter means, the modulator means, and the corrector/equalizer means.

Advantageously, the present invention includes an exciter, located along an information stream path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement, said exciter comprising coder means for outputting the information signal that conveys data in a predetermined code arrangement, filter means for restricting the information signal energy to a predetermined channel bandwidth, modulator means for modulating the information signal, corrector/equalizer means for pre-correcting the modulated signal for errors induced in the transmission system, characterized in that at least two of said coder means, said filter means, said modulator means, and said corrector/equalizer means being programmable to be operative in any of several I/O formats, and controller means for providing program control of said at least two of said coder means, said filter means, said modulator means, and said corrector/equalizer means, in which said at least two of said coder means, said filter means, said modulator means, and said corrector/equalizer means are said coder means and said filter means the present invention provides an exciter, located along an information stream path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement. Filter means, programmable to be operative in any of several I/O formats, confines the signal energy to a predetermined channel bandwidth. Modulator means, programmable to be operative in any of several I/O formats, modulates the baseband signal. Corrector/equalizer means, programmable to be operative in any of several I/O formats, pre-corrects the modulated signal for errors induced in the transmission system. Controller means provides program control of the filter means, the modulator means, and the corrector/equalizer means. The present invention includes an exciter, located along an information stream path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement, said exciter comprising filter means, programmable to be operative in any of several I/O formats, for restricting the information signal energy to a predetermined channel bandwidth, modulator means, programmable to be operative in any of several I/O formats, for modulating the information signal, characterized in that corrector/equalizer means, programmable to be operative in any of several I/O formats, for pre-correcting the modulated signal for errors induced in the transmission system, controller means for providing program control of said filter means, said modulator means, and said corrector/equalizer means.

Conveniently, the present invention provides an exciter, located along an information

stream path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement. Coder means, programmable to be operative in any of several I/O formats, outputs the information signal that conveys data and a desired code arrangement. Modulator means, programmable to be operative in any of several I/O formats, modulates the
5 baseband signal. Corrector/equalizer means, programmable to be operative in any of several I/O formats, pre-corrects the modulated signal for errors induced in the transmission system. Controller means provides program control of the coder means, the modulator means, and the corrector/equalizer means.

Suitably, the present invention provides an exciter, located along an information stream
10 path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement. Coder means, programmable to be operative in any of several I/O formats, outputs the information signal that conveys data and a desired code arrangement. Filter means, programmable to be operative in any of several I/O formats, confines the signal energy to a predetermined channel bandwidth. Corrector/equalizer means, programmable to be operative
15 in any of several I/O formats, pre-corrects the modulated signal for errors induced in the transmission system. Controller means provides program control of the coder means, the filter means, and the corrector/equalizer means.

Moreover, the present invention provides an exciter, located along an information stream path of a transmission system, for supplying an information signal as a drive to an amplifying
20 arrangement. Coder means, programmable to be operative in any of several I/O formats, outputs the information signal that conveys data and a desired code arrangement. Filter means, programmable to be operative in any of several I/O formats, confines the signal energy to a predetermined channel bandwidth. Modulator means, programmable to be operative in any of several I/O formats, modulates the baseband signal. Controller means provides program
25 control of the coder means, the filter means, and the modulator means.

Moreover the present invention provides an exciter, located along an information stream path of a transmission system, for supplying an information signal as a drive to an amplifying arrangement. Coder means, programmable to be operative in any of several I/O formats, outputs the information signal that conveys data and a desired code arrangement. Filter means,
30 programmable to be operative in any of several I/O formats, confines the signal energy to a predetermined channel bandwidth. Modulator means, programmable to be operative in any of several I/O formats, modulates the baseband signal. Corrector/equalizer means, programmable to be operative in any of several I/O formats, pre-corrects the modulated signal

for errors induced in the transmission system. Controller means provides program control of the coder means, the filter means, the modulator means, and the corrector/equalizer means.

The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

5 Fig. 1 is a schematic illustration of a first embodiment of a system having an exciter in accordance with the present invention;

Fig. 2 is a chart illustrating several example types of transmission format with associated programming specifics; and

Fig. 3 is a schematic illustration of a second embodiment in accordance with the present
10 invention.

One representation of an exciter 10 is schematically shown in Fig. 1 within a broadcast transmission system 12. The system 12 includes a power amplifier arrangement 14 and a broadcast transmission antenna 16. The power amplifier 14 amplifies an analog input 18 and outputs a stimulus signal 20 to the antenna 16, such that the antenna broadcasts a signal 22
15 having the desired strength characteristics. Located upstream of the power amplifier 14 is a digital-to-analog ("D/A") converter 24. The exciter 10 is located upstream of the D/A converter 24 and operates in the digital domain.

The exciter 10 includes a coder component 28 for processing data. The processing may include randomizing, interleaving, block coding (e.g., Reed Solomon encoding), and
20 convolutional coding (e.g., Trellis encoding). Also, the processing may include symbol formatting, or other types of data encoding.

Located downstream of the coder 28 is a filter component 30 that confines the signal energy to a predetermined channel bandwidth. The filtering may include low-pass filtering, bandpass filtering, vestigial sideband filtering, and may be performed in the time domain or in
25 the frequency domain. If frequency domain processing is used, a discrete Fourier transform is required.

A modulator component 32, located downstream of the filter 30, modulates the information signal onto a carrier frequency. This may include complex up-conversion or other processing (e.g., Fast Fourier Transform).

30 A corrector/equalizer component 34 is located downstream of the modulator 32 and upstream of the D/A converter 24. The corrector/equalizer 34 compensates for distortion of the information signal that occurs elsewhere in the system 12. For example the power amplifier 14 can distort the information signal. The compensation that occurs within the corrector/equalizer

34 may include correction of non-linear distortion, or equalization of linear distortion.

Each of the coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34 is comprised of a Digital Signal Processor ("DSP") component or a programmable logic device ("PLD", e.g., FPGA or EPLD) that is programmed to accomplish the associated function. Programming for
5 each of the coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34 is provided from a controller 38. Specifically, the controller 38 accesses 40 a memory 42 to receive stored program information. The controller 38 is operatively connected 46-52 to the coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34, respectively, to provide program information to these four components.

10 The coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34 each have a certain degree of generic attributes. Specifically, the coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34 are not predisposed (e.g., configured) or "ear-marked" for a particular transmission (broadcast) format. The transmission format that is utilized within the four components of the exciter 10 is dependent upon the format for which the system 12 that
15 includes the exciter will be utilized.

A plurality of input/output (I/O) boards 56-62 is connected to provide respective inputs 64-70 into the coder 28. I/O boards within the disclosed embodiment are hardwire boards that are provided for a DTV MPEG2 format, a DVIDEO format, a DVD MPEG2 format, an AES3 format. It is to be appreciated that different and/or additional I/O boards may be provided for
20 different formats. Thus, it is to be appreciated that the coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34 are programmable by the controller 38 to process the information signal coming from any of the several different format inputs. The programming is initiated via a select input 74 provided by an operator (not shown) of the system 12.

Fig. 2 is a chart illustrating example types of transmission systems and the associated
25 different programming characteristics. For example, within a DTV transmission system, the I/O format is typically MPEG2. Within the configurable exciter 10, the coder 28 is programmed for transport/transmission formatting, the filter 30 is programmed to perform a Nyquist filter function (e.g., a root-raised-cosine function). The modulator 32 is programmed to provide complex up-conversion, and the corrector/equalizer 34 is programmed to provide linear and
30 non-linear correction.

To provide a transmission system for NTSC, the I/O format is DVIDEO. Within the configurable exciter 10, the coder 28 is programmed to provide NTSC/PAL video formatting. The filter 30 is programmed to provide Vestigial Sideband Filtering (VSBF). The modulator 32

is programmed to provide complex up-conversion, and the corrector/equalizer 34 is programmed to provide linear and non-linear correction.

To provide a transmission system for COFDM, the I/O format is MPEG2. The coder 28 is programmed to provide transport/transmission formatting. The filter 30 is programmed to provide a filtering function based upon the Fast Fourier Transformation that is programmed to occur within the modulator 32. The corrector/equalizer 34 is programmed to provide linear and non-linear correction, but within the frequency domain.

To provide a transmission system for FM, the I/O format is digital audio in the AES3 standard format. The coder 28 is programmed to perform a stereo generator function with FM stereo output. The filter 30 is programmed to provide a low-pass filtering. The modulator 32 is programmed for direct digital FM conversion using direct digital synthesis ("DDS").

Fig. 3 illustrates an embodiment that has a modification to permit automatic control. In other words, an operator need not select the type of system that the exciter is programmed to handle. In Fig. 3, the system is designated 12' and the exciter is designated 10' to indicate the modification from the embodiment of Fig. 1. Components of the embodiment of Fig. 3 that are identical to the corresponding components of the embodiment of Fig. 1 are identified by identical reference numbers.

In the embodiment of Fig. 3, an auto-select function portion 78 receives the inputs 64-70 from the various I/O boards 56-62. Dependent upon which I/O board (e.g., 56) is actively outputting its signal (e.g., 64), the auto-select function 78 provides a signal 80 to the controller 38. In response to the signal 80, the controller 38 accesses the memory 42 and provides programming to the coder 28, the filter 30, the modulator 32, and the corrector/equalizer 34, similar to the embodiment shown in Fig. 1.

The system is to be capable of handling DTV format signals, the digital signal processors must have sufficient capability to handle such high speed, high rate signals. For example, processing within a DTV modulator requires thousands of megaflops of processing power.

In addition, the input rates could be dictated by the types of format that requires the greatest amount. DTV and COFDM systems require approximately 20 Mb/s input rate. Thus, if the system is to be able to handle DTV and COFDM systems, the input rates of approximately Mb/s would be an upper range.

From a manufacturing standpoint, a single fixed platform could be manufactured, and then programmed for the desired application. From a customer's standpoint, modifications to the system can be accomplished merely upon a change of the programming that would be

provided by the controller. Further, it should be appreciated that even within a single type of format (e.g., DTV), changes to the system can be accomplished merely by reprogramming. Thus, the present invention has several advantages over "hardwired" systems.

An exciter (10) is located along an information stream path of a transmission system (12).

5 The exciter (10) supplies an information signal as a drive to an amplifying arrangement (14). A coder (28), programable to be operative in any of several I/O formats, outputs the information signal that conveys in a desired code arrangement. A filter (30), programmable to be operative in any of several I/O formats, confines the information signal energy to a predetermined channel bandwidth. A modulator (32), programmable to be operative in any of several I/O

10 formats, modulating the information signal. A corrector/equalizer (34), programmable to be operative in any of several I/O formats, pre-corrects the modulated signal for errors induced in the transmission system. A controller (38) provides program control of the coder (28), the filter (30), the modulator (32), and the corrector/equalizer (34). Thus, the exciter (10) is configurable to handle several formats, such as MPEG2, DVIDEO, and AES3.

15

Claims:

1. An exciter, for location along an information stream path of a transmission system, for supplying an information signal as a drive to an
5 amplifying arrangement, said exciter comprising
 coder means for outputting the information signal that conveys data in a predetermined code arrangement,
 filter means for restricting the information signal energy to a predetermined channel bandwidth,
10 modulator means for modulating the information signal, and
 corrector/equalizer means for pre-correcting the modulated signal for errors induced in the transmission system,
 characterized in that filter means is located downstream of said coder means on said information stream path, said modulator means is
15 located downstream of said filter means on the information stream path, correcting/equalizer means is located downstream of said modulator means on the information stream path;
 each of said coder means, said filter means, said modulator means, and said corrector/equalizer is programmable to be operative in any of
20 several I/O formats; and said exciter comprises controller means for providing program controls, said coder means, said filter means, said modulator means, and said corrector/equalizer.
2. An exciter as claimed in claim 1, characterized in that said coder
25 means, said filter means, said modulator means, and said corrector/equalizer means each includes a programmable logic device.

3. An exciter as claimed in claim 1, characterized in that said coder means, said filter means, said modulator means, and said corrector/equalizer means are each programmable to be operative for an MPEG2 format.

5

4. An exciter as claimed in claim 1 characterized in that said coder means, said filter means, said modulator means, and said corrector/equalize means are each programmable to be operative for a DVIDEO format.

10

5. An exciter as claimed in claim 1, characterized in that said coder means, said filter means, said modulator means, and said corrector/equalizer means are each programmable to be operative for a AES3 format.

15

6. An exciter as claimed in claim 1, characterized in that said coder means is configured to be connected to a plurality of inputs,

said controller means including means for providing programming to said coder to process information from one of the plurality of inputs.

7. An exciter as claimed in claim 6, including means for automatically detecting which of the plurality of inputs is active and for providing a signal indicative of the active input to said controller means, said controller means including means for using the signal indicative of the active input to provide said programming control to said coder

means, said filter means, said modulator means, and said corrector/equalizer means.

8. An exciter as claimed in claim 6 characterized in that said
5 controller means includes means for receiving an input from an operator for selecting an I/O format, said controller means including means for using the selected I/O format to provide said programming control to said coder means, said filter means, said modulator means, and said corrector/equalizer means.

10

9. An exciter as claimed in claim 1, including memory means storing program information, said controller means is configured to access said memory means to retrieve programming information for use in programming said coder means, said filter means, said modulator means,
15 and said corrector/equalizer means, said controller means includes means for providing programming to each of said coder means, said filter means, said modulator means, and said corrector/equalizer means, said modulator means, and said corrector/equalizer means being capable of having programming changed independent of programming of the others
20 of said coder means, said filter means, said modulator means, and said corrector/equalizer means.

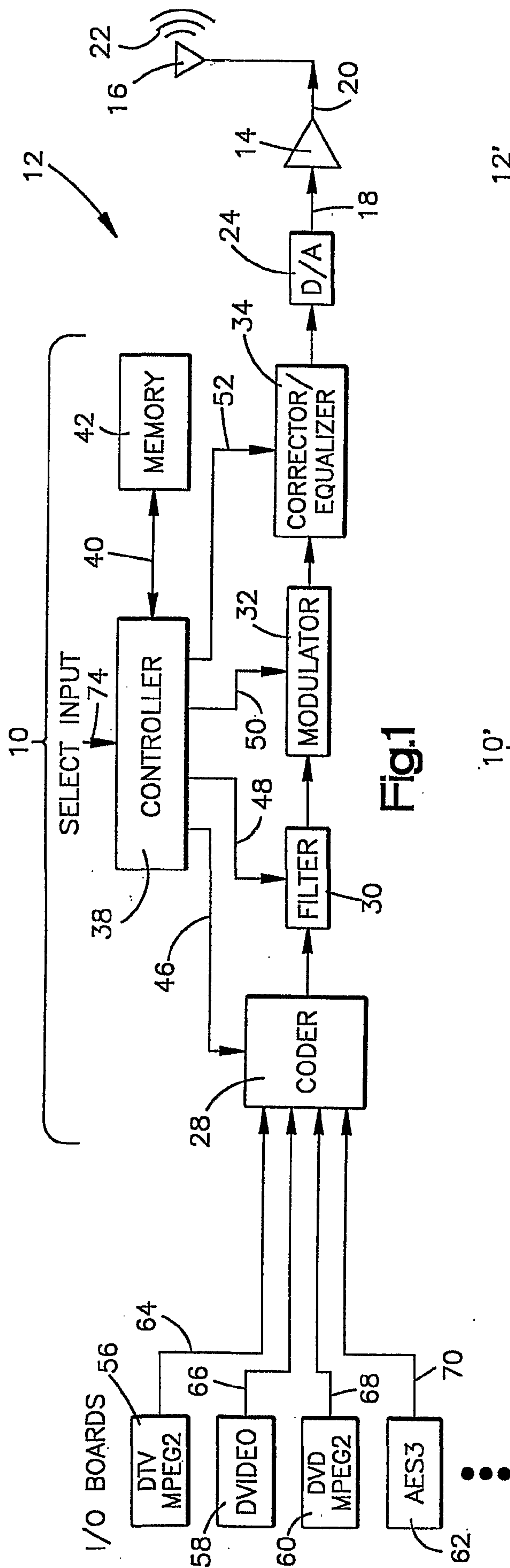


Fig.1

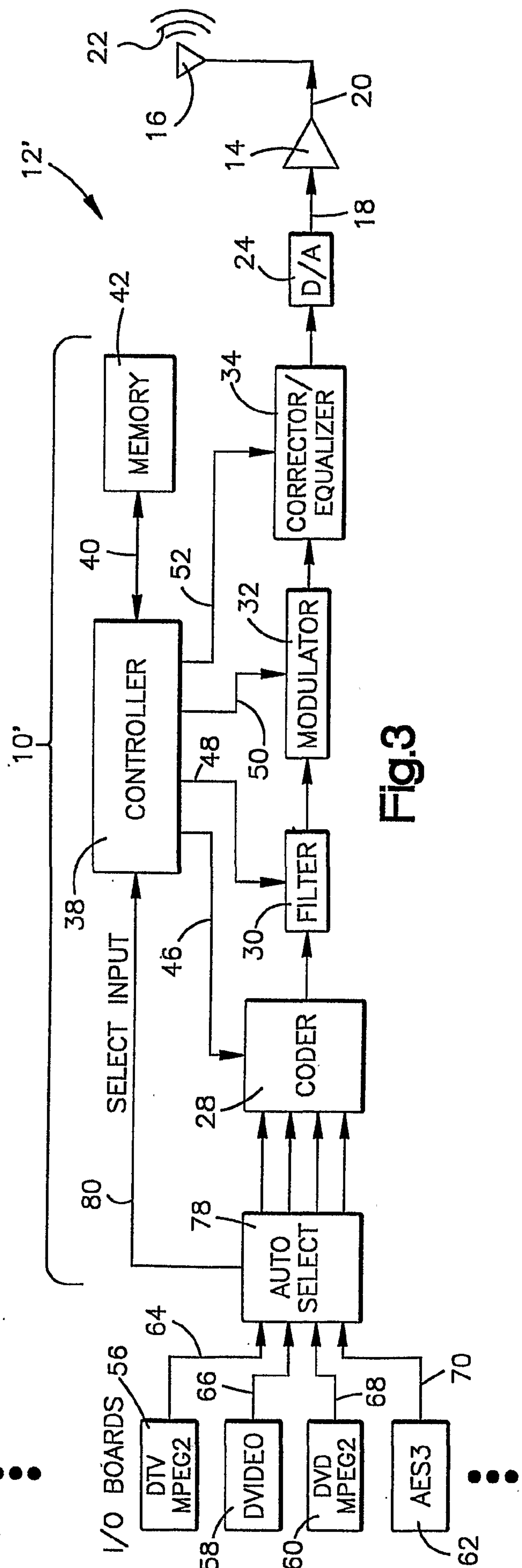


Fig.3

TYPE	I/O FORMAT	CODING	FILTER	MODULATOR	CORRECTION/ EQUALIZATION
DTV	MPEG2	TRANSPORT/ TRANSMISSION	NYQUIST (ROOT RAISED COSINE)	COMPLEX UPCONVERSION	LINEAR AND NON-LINEAR
NTSC	DVIDEO	NTSC/PAL FORMATTING	VSBF	COMPLEX UPCONVERSION	LINEAR AND NON-LINEAR
COFDM DVD	MPEG2	TRANSPORT/ TRANSMISSION	FFT	FFT	LINEAR AND NON-LINEAR (FREQ. DOMAIN)
FM	AES3	STEREO	LPF	DDS	PHASE ADJUSTMENT

Fig.2

