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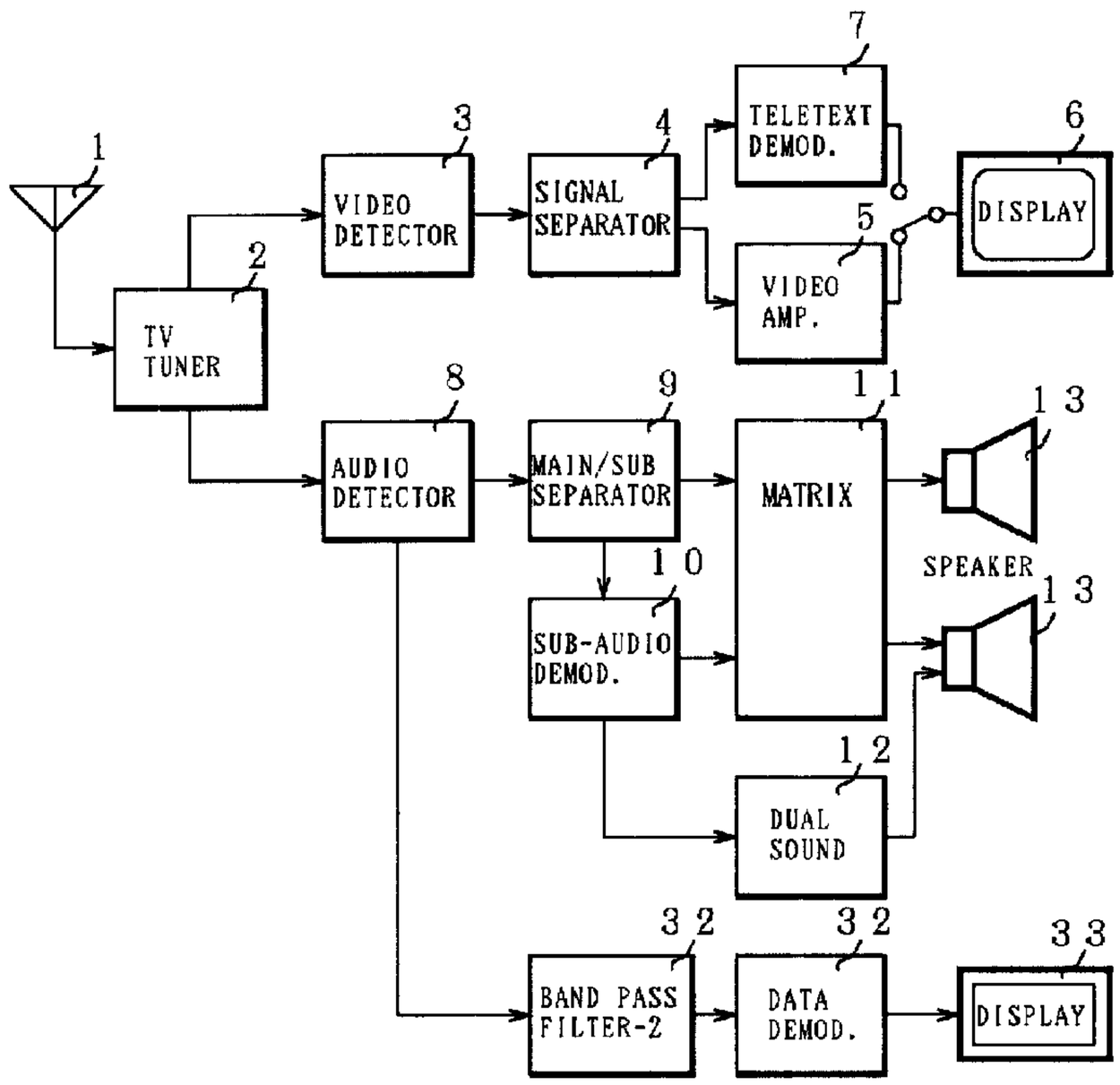
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(54) Title: RECEIVER FOR TELEVISION MULTIPLEX BROADCASTING



(57) Abrégé/Abstract:
A receiver which receives two-channel multiplex broadcasting using second sound band of television broadcasting. Two-channel data and/or facsimile data broadcast by multiplexing the data upon the second sound broadcasting band of a television broadcast wave composed of a video band, a main sound band, and the second sound band are displayed, printed, or outputted. The receiver may be a receiver having no display for displaying television picture, a receiver having such a display, and a receiver having a device for displaying and printing data multiplexed upon the second sound band of an FM-broadcast wave in addition to the display. In addition, the receiver may be a receiver which only displays multiplexed data, a receiver which only prints the data, a receiver which only outputs the data, and a receiver which displays, prints, and outputs the data.

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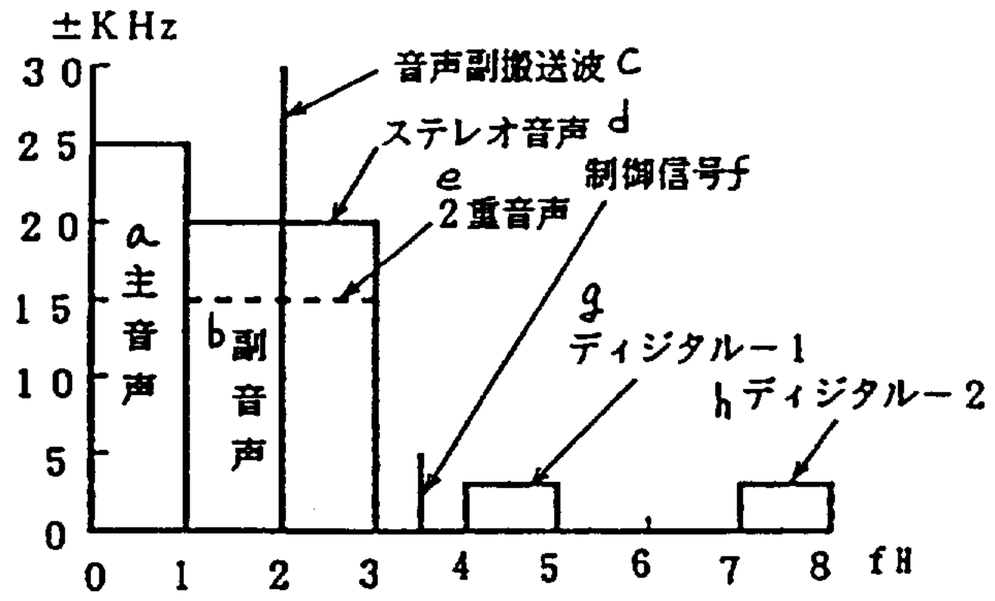
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(54)Title: RECEIVER FOR TELEVISION MULTIPLEX BROADCASTING

(54)発明の名称 テレビジョン多重放送受信装置

(57) Abstract

A receiver which receives two-channel multiplex broadcasting using second sound band of television broadcasting. Two-channel data and/or facsimile data broadcast by multiplexing the data upon the second sound broadcasting band of a television broadcast wave composed of a video band, a main sound band, and the second sound band are displayed, printed, or outputted. The receiver may be a receiver having no display for displaying television picture, a receiver having such a display, and a receiver having a device for displaying and printing data multiplexed upon the second sound band of an FM-broadcast wave in addition to the display. In addition, the receiver may be a receiver which only displays multiplexed data, a receiver which only prints the data, a receiver which only outputs the data, and a receiver which displays, prints, and outputs the data.



a ... main sound
b ... second sound
c ... sound subcarrier
d ... stereophonic sound
e ... dual sound
f ... control signal
g ... digital 1
h ... digital 2

SPECIFICATION

RECEIVER FOR TELEVISION MULTIPLEX BROADCASTING

FIELD OF THE INVENTION

The present invention relates to a receiver for receiving multiplexed data and multiplexed facsimile data, broadcast in addition to sound multiplex broadcasting and teletext broadcasting which have been so far broadcast multiplexed to the television broadcasting.

BACKGROUND ART

In the so-called information-oriented era as we are today, attention is focused on data broadcasting for broadcasting digital data and also on facsimile broadcasting for broadcasting image data in addition to sound or picture as broadcast so far.

The broadcasting as described above can be executed via dedicated media such as a broadcasting satellite. However, in order to effectively utilize radio wave resources, technical development is positively concentrated on multiplex broadcasting, which utilizes the radio wave of audio broadcasting or television broadcasting already existing.

As the multiplex broadcasting utilizing broadcasting wave, there are stereo broadcasting, sound multiplex broadcasting, teletext broadcasting, facsimile broadcasting and data broadcasting.

Among these types of multiplex broadcasting, stereo broadcasting based on FM broadcasting wave and television broadcasting wave is now executed in practical application in Japan. Also, sound multiplex broadcasting and teletext broadcasting based on television broadcasting wave are also in practical application. In U.S.A., facsimile broadcasting based on FM broadcasting wave is in practical application, while the broadcasting based on television broadcasting wave is under study in Japan. In Japan, data broadcasting based on FM broadcasting wave is now being practiced,

and the broadcasting based on television broadcasting wave is considered as the subject for future study and development.

Here, an example of the multiplex broadcasting in particular using the television wave is taken on radio wave of NTSC color television broadcasting, which is now adopted in Japan and U.S.A.

As shown in Fig. 1, radio wave of NTSC color television broadcasting comprises video carrier with bandwidth of 5.5 MHz (i.e. 4.25 MHz above center frequency of video carrier and 1.25 MHz under) and audio carrier with bandwidth of 0.5 MHz having center frequency at 4.5 MHz above the video carrier (i.e. $\pm$ 0.25 MHz). Thus, total bandwidth is 6 MHz.

Among the types of multiplex broadcasting as described above, in the teletext broadcasting based on television broadcasting wave, data is transmitted in multiplex utilizing vertical blanking interval in television video signal contained in the video carrier. In FM stereo broadcasting, FM data broadcasting, FM facsimile broadcasting, television stereo broadcasting, television audio multiplex broadcasting and television facsimile broadcasting, programs are broadcast via sub-carrier in the audio band.

Now, description will be given on the multiplex broadcasting based on sub-carrier according to the report of the Facsimile Broadcasting Committee of the Telecommunication Technical Council on television audio multiplex broadcasting and television facsimile broadcasting (February 16, 1989).

Fig. 2 shows a modulation spectrum according to the television multiplexed facsimile broadcasting system. In this figure, audio carrier is represented on axis of abscissa (having horizontal scanning frequency, i.e. fH = 525 lines x 59.94 Hz/2 = 15.73425 KHz as a unit), and deviation to the main carrier (having KHz as a unit) is represented on axis of ordinate.

In this multiplex broadcasting modulation spectrum, the center frequency of main audio carrier is 0 fH, and the center frequency of audio sub-carrier for sub audio, used for stereo and dual sound, is 2 fH. In this case, deviation of the stereo sound is considered to be $\pm$ 20 KHz, and deviation of dual sound is $\pm$ 15 KHz. Also, the

center frequency of sub−carrier for control signal to control sub audio is at 3.5 fH.

The center frequency of sub−carrier for analog facsimile is at 6 fH, and frequency range is from 4 fH to 8 fH. Because the analog facsimile may impair sound multiplex broadcasting, it is not possible to multiplex the facsimile signal during sound multiplex broadcasting. For this reason, it is now attempted to have audio multiplex and analog facsimile at the same time by deleting the frequency range from 4 fH to 5 fH.

In contrast to the analog facsimile, the center frequency of sub−carrier for digital facsimile is at 4.5 fH in view of impairment to sound multiplex broadcasting, and operating frequency range is 1 fH (i.e. from 4 fH to 5 fH), and frequency deviation of main carrier is ± 2 KHz. For modulation system, Quadrature Phase Shift Keying (Quadrature PSK) is adopted.

Fig. 3 represents a block diagram of a conventional type television receiver, which receives TV stereo sound, TV dual sound and TV teletext data in addition to TV pictures.

This television receiver comprises a TV tuner, a TV video processor and a TV audio processor.

The TV tuner comprises a TV tuner 2, which is connected to a TV antenna 1.

The TV video processor comprises a video detector 3 connected to the TV tuner 2, a signal separator 4 connected to the video detector 3, a video amplifier 5 and a teletext data demodulator 7 each connected to the signal separator 4, and a TV picture display unit 6 such as a cathode ray tube, which is switched over to the video amplifier 5 or to the teletext data demodulator 7.

The TV audio processor comprises a TV audio detector 8 connected to the TV tuner 2, a TV main/sub audio separator 9 connected to the TV audio detector 8, a TV sub audio demodulator 10 connected to the TV main/sub audio separator 9, a TV stereo matrix circuit 11 connected to the TV main/sub audio separator 9 and to the TV sub audio demodulator 10, a TV dual sound circuit 12 connected to the TV sub audio demodulator 10, and speakers 13 and 13 connected to the TV stereo matrix circuit 11 and to the TV dual sound circuit 12.

When TV signal is received by the TV antenna 1, video signal and audio signal are tuned and selected by the TV tuner 2. The video signal thus selected is detected by the video detector 3 and is further separated to a synchronization signal and a video signal at the signal separator 4. The video signal is displayed on the TV picture display unit 6 via the video amplifier 5.

The teletext data multiplexed on the synchronization signal is picked up from the separated synchronization signal and is demodulated at the teletext data demodulator 7. Further, it is converted to the video signal and is displayed on the TV picture display unit 6.

On the other hand, the TV audio signal is detected by the TV audio detector 8 and is separated to a main audio signal and a sub audio signal at the TV main/sub audio separator 9. In case the sub audio is of TV stereo sound, stereo sound is picked up from the main audio signal and the sub audio signal demodulated at the TV sub audio demodulator 10 by the TV stereo matrix circuit 11. In case the demodulated sub audio is of TV dual sound, the sub audio signal demodulated at the TV sub audio demodulator 10 is picked up via the TV dual sound circuit 12. These audio signals are then converted to sound via the speakers 13 and 13.

Fig. 4 represents a block diagram of a conventional type television receiver for receiving TV multiplexed facsimile data signal in addition to stereo sound, dual sound and teletext data signals together with pictures.

This television receiver comprises a TV tuner, a TV video processor, and a TV audio/multiplexed–facsimile–data processor.

Among these component elements, the arrangement and the operation of the TV tuner and the TV video processor as well as the arrangement and the operation for processing TV stereo sound and TV dual sound are the same as the arrangement and the operation of the television receiver shown in Fig. 3, and detailed description is not given here.

To the TV audio detector 8, a first band–pass filter 14 allowing a first sub–carrier of 4.5 fH to pass is connected. To the first band–pass filter 14, a TV multiplexed facsimile data demodulator 15 is connected, and a TV multiplexed

facsimile data printer 16 is connected to the TV multiplexed facsimile data demodulator 15.

The first sub-carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band-pass filter 14 as it passes through. The first sub-carrier selected by the first band-pass filter 14 is sent to the TV multiplexed facsimile data demodulator 15. At the TV multiplexed facsimile data demodulator 15, TV multiplexed facsimile data is demodulated from the sent first sub-carrier, and the TV multiplexed facsimile data thus demodulated is printed by the TV multiplexed facsimile printer 16.

Fig. 5 shows a block diagram of a conventional type receiver for receiving FM multiplexed facsimile data together with stereo audio of the FM broadcasting.

The receiver comprises an FM tuner, and an FM audio/multiplexed-facsimile-data processor.

The FM tuner comprises an FM tuner 18 connected to an FM antenna 17.

The FM audio/multiplexed-facsimile-data processor comprises an FM detector 19 connected to the FM tuner 18, an FM main/sub audio separator 20 connected to the FM detector 19, an FM sub audio demodulator 21 connected to the FM main/sub audio separator 20, an FM stereo matrix circuit 22 connected to the FM main/sub audio separator 20 and to the FM sub audio demodulator 21, and the speakers 13 and 13 connected to the FM stereo matrix circuit 22. Further, a third band-pass filter 23 allowing sub-carrier for FM facsimile data to pass is connected to the FM detector 19. An FM multiplexed facsimile data demodulator 24 is connected to the third band-pass filter 23, and an FM multiplexed facsimile data printer 25 is connected to the FM multiplexed facsimile data demodulator 24.

In this receiver, FM broadcasting signal received by the FM antenna 17 is tuned and selected by the FM tuner 18. The audio signal thus tuned and selected is detected by the FM detector 19 and is separated to a main audio signal and a sub audio signal at the FM main/sub audio separator 20. From the main audio signal and the sub audio signal, stereo audio is picked up by the FM stereo matrix circuit 22, and these audio signals are converted to sound by the speakers 13 and 13.

The sub-carrier for FM facsimile data multiplexed on the FM audio signal is selected by the third band-pass filter 23 as it passes through. The sub-carrier for FM facsimile data selected by the third band-pass filter 23 is sent to the FM multiplexed facsimile data demodulator 24. The FM multiplexed facsimile data is demodulated from the sub-carrier thus sent at the FM multiplexed facsimile data demodulator 24, and the demodulated facsimile data is printed by the FM multiplexed facsimile printer 25.

Fig. 6 shows a block diagram of a conventional type receiver for receiving FM multiplexed data broadcast together with stereo sound of FM broadcasting.

This receiver comprises an FM tuner and an FM audio/multiplexed-data processor.

Among these component elements, the arrangement and the operation of the FM tuner and of processing for FM stereo sound are the same as those of the receiver shown in Fig. 5, and detailed description is not given here.

To the FM detector 19, a fourth band-pass filter 26 allowing sub-carrier for FM data to pass is connected. An FM multiplexed data demodulator 27 is connected to the fourth band-pass filter 26, and an FM multiplexed data display unit 28 is connected to the FM multiplexed data demodulator 27.

The sub-carrier for FM data multiplexed on audio signal is selected by the fourth band-pass filter 26 as it passes through. The sub-carrier for FM data selected by the fourth band-pass filter 26 is sent to the FM multiplexed data demodulator 27. The FM multiplexed data is demodulated from the sent sub-carrier at the FM multiplexed data demodulator 27, and the demodulated FM multiplexed data is displayed on the FM multiplexed data display unit 28.

Incidentally, the data broadcast utilizing the FM broadcasting wave as described above is now being used in practical application, and the data broadcast utilizing the television broadcasting wave is under study for future application.

The center frequency of sub-carrier in the multiplexed facsimile broadcasting using the television wave, being scheduled for practical application, is at 4.5 fH. The operating frequency bandwidth is to be 1 fH (i.e. from 4 fH to 5 fH), and the

frequency deviation of main carrier is to be ± 2 KHz, and Quadrature Phase Shift Keying (Quadrature PSK) is to be adopted for demodulation.

In addition, it has been also attempted to have the center frequency of the sub−carrier at 7.5 fH. However, it is considered that the video signal may be impaired although there is not much hindrance to audio multiplexed broadcasting.

For this reason, only one program may be broadcast in the multiplex broadcasting, which can be multiplexed in addition to the stereo broadcasting and audio multiplex broadcasting as practiced so far for the multiplex broadcasting utilizing the sub audio of television, and it is not possible to multiplex two−channel facsimile broadcasting, two−channel data broadcasting or one−channel facsimile broadcasting and data broadcasting.

Also, there is an analog facsimile system, in which the center frequency of sub−carrier is at 6 fH, and frequency bandwidth is set from 4 fH to 8 fH. However, this analog facsimile may impair sound multiplex broadcasting, and it is not possible to multiplex the facsimile signal during the audio multiplex broadcasting. For this reason, it has been attempted to use audio multiplexing and analog facsimile at the same time by deleting the frequency bandwidth from 4 fH to 5 fH, but this is not yet practically applied.

As digital facsimile signal is binary data as in the case of digital data signal, and the digital data signal can be handled in the same manner as the digital facsimile signal. On the data broadcasting using sub−carrier of 4.5 fH of the digital facsimile broadcasting multiplexed on television audio bandwidth, reference is shown in "A Proposal to Broadcast a Data Broadcast by use of Multiple Broadcasting System" by Kouji Sasano (Broadcasting System, 31st Conference of Commercial Broadcasting Engineering, pp.22−23, Japan Commercial Broadcasting Federation, November 9, 1994). On the setting of frequency deviation of data signal sub−carrier to ± 2 KHz and ± 3 KHz, reference is shown in "A Report for the Addition of a Third Subcarrier in the TV Audio" by Kouji Sasano, (ITE '94: ITE Annual Convention, pp.359−360, Institute of Television Engineers, July 29, 1994).

In case the center frequency of sub−carrier is set to 7.5 fH, it has been

considered that video signal may be impaired, while there is less impairment to sound multiplex broadcasting.

The present inventors have performed various types of experiments on these problems and found that no impairment occurs to the video signal in case sub-carrier of the center frequency at 7.5 fH is performed digital modulation in Quadrature Phase Shift Keying system with frequency deviation of main carrier of ± 2 to 3 KHz. Based on this finding, in a prior application, Japanese Patent Application No.6-122388, the present inventors proposed a television multiplex broadcasting system in which sub-carrier of 7.5 fH is modulated by facsimile or data digital signal with Quadrature PSK system.

According to the above multiplex broadcasting system, it is possible to carry out two-channel multiplex broadcasting by simultaneously executing multiplex broadcasting using sub-carrier of 4.5 fH. This is also described in "The Measurements of the Interference on the over all TV Signal from a Digital Signal and a Third Subcarrier in the Audio Portion of the TV Signal" by Kouji Sasano, (Broadcasting System, 31st Conference of Commercial Broadcasting Engineering, pp.26-27, Japan Commercial Broadcasting Federation, November 9, 1994).

In the television multiplexed digital broadcasting system, consideration is given to impairment to sound multiplex broadcasting and impairment to video signal, and frequency deviation of sub-carrier with the center frequency at 7.5 fH is set to ± 2 to 3 KHz. For this reason, no special problem occurs in case a program of television digital multiplex broadcasting, which is a data program, is received by a television receiver fixed at a place where electric field strength of a certain degree is assured. However, in case of a mobile receiver such as the receiver on an automobile, the receiver is at a place where sufficient electric field strength is not assured, and it is not possible to have electric field with stabilized strength, and thus, because bit error rate and page error rate caused by crashing of eye pattern increase, it is very difficult to receive the multiplexed data program as described in "TV Audio MPX-Data-Broadcast and Mobile Reception" by Kouji Sasano and Akeshi Kondo, (ITE Technical Report, Institute of Television Engineers, August 24,

1995).

In view of the above facts, the present inventors have performed receiving experiments under various conditions of television multiplex broadcasting and found that no impairment occurs to sound multiplex broadcasting or video signal if frequency deviation of data multiplex sub-carrier with the center frequency at 7.5 fH is within ± 30 KHz, and that stabilized data receiving can be assured even under such conditions that it is not possible to receive multiplex data program because it is at the place where sufficient electric field strength cannot be assured or electric field with stable strength cannot be maintained in case of a mobile receiver such as the one on an automobile.

Further, no problem occurs in case the condition of frequency deviation is set to ± 20 KHz, but even when it is extended to ± 30 KHz, there is no practical problem although there may be some impairment.

The present inventors have performed various types of experiments on multiplex broadcasting utilizing sub audio of television and confirmed that no impairment occurs to video signal in case multi-valued digital modulation such as Quadrature PSK system with frequency deviation of main carrier of ± 30 KHz is performed to the sub-carrier even in case sub-carrier with the center frequency of 7.5 fH is used.

DISCLOSURE OF THE INVENTION

In the present application, it is proposed to provide a receiver to be used in multiplex broadcasting system, in which sub-carrier of 7.5 fH is modulated with multi-valued digital system on digital facsimile or digital data signal.

Further, it is proposed to provide a receiver, in which received digital data signal is not only displayed or printed, but also transferred to a device such as personal computer, word processor, etc., which can process the digital data.

In this case, by simultaneously executing multiplex broadcast using sub-carrier of 4.5 fH, it is possible to carry out two-channel digital multiplex broadcasting.

Also, by broadcasting each of the channels in two-channel digital multiplex broadcasting, it is possible to perform one channel each of data broadcasting and facsimile broadcasting in addition to two-channel data broadcasting or two-channel facsimile broadcasting.

Thus, in accordance with a first aspect of the invention, there is provided a receiver for multiplex broadcasting for receiving multiplex broadcast by multiplexing two-channel data to a sub-carrier of 4.5 fH and a sub-carrier of 7.5 fH of a broadcasting sub audio band of television broadcasting wave, which comprises a video band, a main audio band and a sub audio band, comprising:

a band-pass filter for demodulating data multiplexed on said sub-carrier of 4.5 fH; and

a band-pass filter for demodulating data multiplexed on said sub-carrier of 7.5 fH.

In accordance with a second aspect of the invention, there is provided a multiplex broadcasting system for broadcasting by multiplexing data to a sub-carrier of 7.5 fH of said broadcasting sub audio band of television broadcasting wave, which comprises a video band, an main audio band and a sub audio band.

The embodiments of the invention of the present application have a form of a television set, which can receive television pictures, or a form of a radio set, which cannot receive television pictures.

In case of an embodiment in form of a radio set, it is also possible to display or print only programs of digital data broadcasting or digital facsimile broadcasting without reproducing sound.

Further, the multiplexed broadcast data is sent to a data processing device such as a personal computer, word processor, display phone, etc. without turning the

data to pictures using a display unit and the like, and it is displayed without change by the display mechanism of the data processing device, or is processed after editing it.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a standard diagram of radio waves for NTSC color television broadcast;

Fig. 2 is a diagram of modulation spectrum of television multiplex broadcast facsimile based on NTSC system;

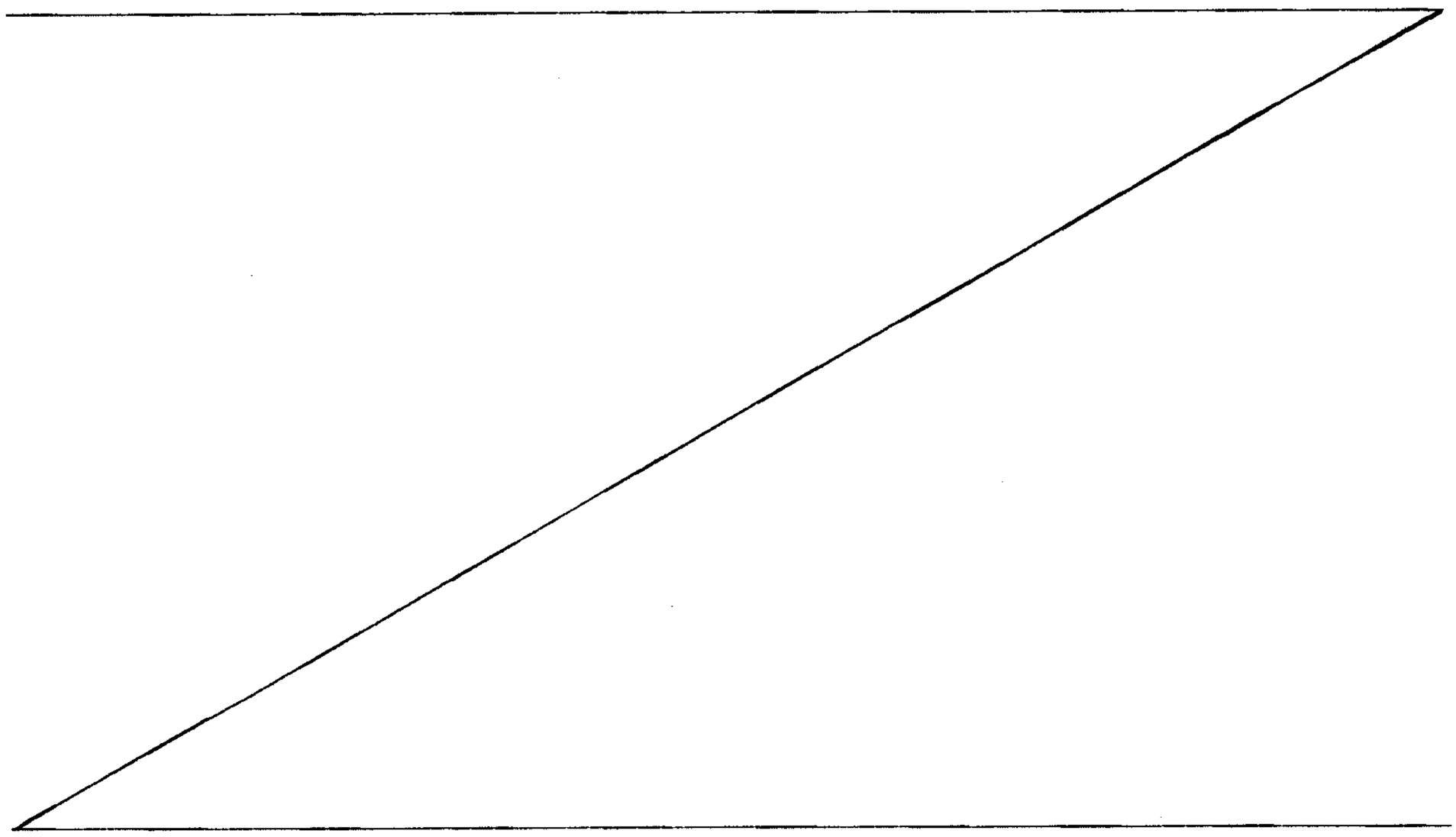
Fig. 3 is a block diagram of a conventional type television receiver;

Fig. 4 is a block diagram of a conventional type television multiplexed facsimile receiver;

Fig. 5 is a block diagram of a conventional type FM multiplexed facsimile receiver;

Fig. 6 is a block diagram of a conventional type FM multiplexed data receiver;

Fig. 7 is a diagram of modulation spectrum of television multiplex broadcast



used in the present invention based on NTSC broadcasting system;

Fig. 8 is a diagram of another modulation spectrum of television multiplex broadcast used in the present invention based on NTSC broadcasting system;

Fig. 9 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed data;

Fig. 10 is a block diagram of a television receiver of an embodiment of the present invention for outputting one-channel multiplexed data to a data processing device;

Fig. 11 is a block diagram of a television receiver of another embodiment of the present invention for receiving one-channel multiplexed data;

Fig. 12 is a block diagram of a television receiver of an embodiment of the present invention for receiving two-channel TV multiplexed data;

Fig. 13 is a block diagram of a television receiver of an embodiment of the present invention for outputting two-channel TV multiplexed data to a data processing device;

Fig. 14 is a block diagram of a television receiver of an embodiment of the present invention for receiving two-channel TV multiplexed facsimile;

Fig. 15 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and one-channel multiplexed data;

Fig. 16 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and for outputting one-channel multiplexed data to a data processing device;

Fig. 17 is a block diagram of a television receiver of another embodiment of the present invention for receiving two-channel TV multiplexed data;

Fig. 18 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and one-channel multiplexed data;

Fig. 19 is a block diagram of a television receiver of an embodiment of the

present invention for receiving two-channel TV multiplexed data;

Fig. 20 is a block diagram of a television receiver of an embodiment of the present invention for outputting two-channel TV multiplexed data to a data processing device;

Fig. 21 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and one-channel multiplexed data;

Fig. 22 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and for outputting one-channel multiplexed data to a data processing device;

Fig. 23 is a block diagram of a receiver for outputting FM multiplexed data to a data processing device;

Fig. 24 is a block diagram of a receiver for receiving FM multiplexed data and one-channel TV multiplexed data;

Fig. 25 is a block diagram of a receiver for outputting FM multiplexed data and one-channel TV multiplexed data;

Fig. 26 is a block diagram of a receiver for receiving FM multiplexed facsimile and one-channel TV multiplexed facsimile;

Fig. 27 is a block diagram of a receiver of an embodiment of the present invention for receiving FM multiplexed data and two-channel TV multiplexed data;

Fig. 28 is a block diagram of a receiver of an embodiment of the present invention for outputting FM multiplexed data and two-channel TV multiplexed data to a data processing device;

Fig. 29 is a block diagram of a receiver of an embodiment of the present invention for receiving FM multiplexed data and one-channel TV multiplexed facsimile as well as one-channel TV multiplexed data; and

Fig. 30 is a block diagram of a receiver of an embodiment of the present invention for receiving one-channel TV multiplexed facsimile and for outputting FM multiplexed data and one-channel TV multiplexed data to a data processing device.

BEST MODE FOR CARRYING OUT THE INVENTION

In explaining the embodiments of the present invention, description will be given first to two–channel multiplex broadcasting system utilizing the television broadcasting wave.

Fig. 7 represents a modulation spectrum, in which sub–carrier with center frequency of 4.5 fH and sub–carrier with center frequency of 7.5 fH in two–channel multiplex broadcasting system utilizing the television broadcasting wave are performed multi–valued digital modulation such as Quadrature PSK system with frequency deviation of main carrier within $\pm$ 2 KHz. In this figure, audio carrier is represented on axis of abscissa using horizontal scanning frequency (fH = 525 lines x 59.94 Hz/2 = 15.73425 KHz as a unit). Deviation to main carrier is represented on axis of ordinate using KHz as a unit.

In this multiplex broadcasting modulation spectrum, the center frequency of main audio carrier is 0 fH, and the center frequency of audio sub–carrier for sub

audio (i.e. for stereo and dual sound) is 2 fH. In this case, deviation of stereo sound is ± 20 KHz, and deviation of dual sound is ± 15 KHz. The center frequency of sub−carrier for control signal for controlling the sub audio is at 3.5 fH.

The center frequency of a first sub−carrier (digital−1) to multiplex the signal is at 4.5 fH, and operating frequency bandwidth is 1 fH (i.e. from 4 fH to 5 fH). The center frequency of second sub−carrier (digital−2) is at 7.5 fH, and operating frequency bandwidth is 1 fH (i.e. from 7 fH to 8 fH). Multiplexing of the signal is performed with multi−valued digital modulation such as Quadrature PSK, and the frequency deviation of main carrier is ± 2 KHz.

Fig. 8 shows a modulation spectrum, in which sub−carrier with the center frequency of 4.5 fH is performed multi−valued digital modulation such as Quadrature PSK system with frequency deviation of main carrier of ± 2 KHz in two−channel multiplex broadcasting system utilizing the television broadcasting wave, and sub−carrier with the center frequency of 7.5 fH is performed multi−valued digital modulation such as Quadrature PSK system with frequency deviation of main carrier of ± 30 KHz.

Similar to the modulation spectrum shown in Fig. 7, the center frequency of main audio carrier is 0 fH in this multiplex broadcasting modulation spectrum, and the center frequency of audio sub−carrier for sub audio (i.e. for stereo and dual sound) is 2 fH. In this case, deviation of stereo sound is ± 20 KHz, and deviation of dual sound is ± 15 KHz. The center frequency of sub−carrier for control signal to control the sub audio is at 3.5 fH.

The center frequency of a first sub−carrier (digital−1) to multiplex the signal is at 4.5 fH, and operating frequency bandwidth is 1 fH (i.e. from 4 fH to 5 fH). The center frequency of a second sub−carrier (digital−3) is at 7.5 fH, and operating frequency bandwidth is 1 fH (i.e. from 7 fH to 8 fH). Multiplexing of the signal is performed with multi−valued digital modulation such as Quadrature PSK, and frequency deviation of main carrier is ± 30 KHz.

There is no special restriction to the combination of the signals to be broadcast in this multiplex broadcasting as far as they are the signals, for which digital

modulation can be performed. Typical examples are character data and facsimile data, and in addition, binary data such as computer program, picture data other than facsimile data, or digital audio data can be handled.

In the following, description will be given on embodiments of the present invention referring to the accompanied drawings. First, description will be given on a television receiver for receiving TV multiplexed facsimile data signal and/or TV multiplexed data signal in addition to stereo sound, dual sound and teletext data signals together with pictures.

Fig. 9 represents a block diagram of a television receiver for receiving TV multiplexed data, which is multiplexed using a first sub-carrier of 4.5 fH and a second sub-carrier of 7.5 fH in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

This television receiver is provided with functions to demodulate and display TV multiplexed data multiplexed using the second sub-carrier of 7.5 fH instead of the conventional functions to demodulate and print facsimile signals multiplexed using the first sub-carrier of 4.5 fH as shown in Fig. 4.

The television receiver comprises a TV tuner, a TV video processor, and a TV audio/multiplexed-data processor.

Among these component elements, the arrangement and the operation of the TV tuner and the TV video processor as well as the arrangement and the operation for processing TV stereo sound and TV dual sound are the same as those of the conventional television receiver as shown in Fig. 3, and detailed description is not given here.

To the TV audio detector 8, a second band-pass filter 31 allowing the second sub-carrier of 7.5 fH to pass is connected. A TV multiplexed data demodulator 32 is connected to the second band-pass filter 31, and a TV multiplexed data display unit 33 is connected to the TV multiplexed data demodulator 32.

Instead of or together with the TV multiplexed data display unit 33, a printer to print the TV multiplexed data may be used.

When television signal is received by the TV antenna 1, video signal and audio

signal are tuned and selected by the tuner 2. The video signal thus tuned and selected is detected by the video detector 3 and it is further separated to synchronization signal and video signal at the signal separator 4, and video signal is displayed on a display unit 6 via a video amplifier 5.

The teletext signal multiplexed on the synchronization signal is picked up from the separated synchronization signal, and it is demodulated at the teletext demodulator 7, and further converted to video signal and is displayed on the display unit 6.

A second sub-carrier of 7.5 fH multiplexed on TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the TV multiplexed data demodulator 32. At the TV multiplexed data demodulator 32, TV multiplexed data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 33.

In the television receiver shown in Fig. 9, the received TV multiplexed data is displayed on a TV multiplexed data display unit. In contrast, the television receiver shown in Fig. 10 is designed in such manner that the received TV multiplexed data can be outputted to a data processing device such as a personal computer. Therefore, in case the television receiver shown in Fig. 10 is used, it is possible to store the received multiplexed data and to utilize the data again or to edit the received multiplexed data when necessary.

The basic arrangement of this television receiver is the same as that of the television receiver shown in Fig. 9. Thus, description on the same arrangement and components is not given here, and only the difference will be explained. To the second band-pass filter 31 of the television receiver, the TV multiplexed data demodulator 32 is connected. On the TV multiplexed data demodulator 32, a connection terminal 44 is provided instead of the TV multiplexed data display unit 33 provided in the television receiver of Fig. 9, and a personal computer 45 is connected to this connection terminal 44. The personal computer 45 as shown here is given only as an example, and other data processing device such as PDA (personal

digital assistants), electronic notebook, word processor, etc. may be connected.

Fig. 11 represents another block diagram of a television receiver for receiving TV multiplexed data multiplexed using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH as shown in Figs. 7 and 8, in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

In this television receiver, TV multiplexed data is not displayed on the TV multiplexed data display unit 33 of the television receiver for receiving TV multiplexed data as shown in Fig. 9, but the multiplexed data is displayed on a TV picture display unit such as a cathode ray tube for displaying television pictures.

This television receiver, like the television receiver shown in Fig. 9, comprises a TV tuner, a TV video processor and a TV audio/multiplexed-data processor. However, unlike the television receiver of Fig. 9, the TV multiplexed data demodulator 32 is connected to a TV format converter 34 instead of the TV multiplexed data display unit 33. In this TV format converter 34, TV multiplexed data is converted to a format, which can be displayed by the cathode ray tube, and it is synthesized with television picture or teletext picture and is displayed, or it is displayed alone on the TV picture display unit 6.

Because the other arrangement is common to both, detailed description is not given here.

Fig. 12 represents a block diagram of a television receiver for receiving two-channel TV multiplexed data signal using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH shown in Figs. 7 and 8 in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

This television receiver is provided with the functions to demodulate and display one-channel TV multiplexed data using the second sub-carrier of 7.5 fH shown in Fig. 10, and in addition, with functions to demodulate and display one more channel of TV multiplexed data using the first sub-carrier of 4.5 fH.

This television receiver comprises a TV tuner, a TV video processor, and a TV audio/multiplexed-signal processor.

Among these component elements, the arrangement and the operation of the

TV tuner and the TV video processor as well as the arrangement and the operation to process TV stereo sound and TV dual sound are the same as those of the conventional type television receiver as shown in Fig. 3, and detailed description is not given here.

To the TV audio detector 8, a first band–pass filter 14 allowing the first sub–carrier of 4.5 fH to pass and a second band–pass filter 31 allowing the second sub–carrier of 7.5 fH to pass are connected. A first TV multiplexed data demodulator 36 is connected to the first band–pass filter 14, a second TV multiplexed data demodulator 37 is connected to the second band–pass filter 31, a TV multiplexed data display unit 38 is connected to the first TV multiplexed data demodulator 36, and a TV multiplexed data display unit 39 is connected to the second TV multiplexed data demodulator 37.

Instead of the two TV multiplexed data display units 38 and 39, one TV multiplexed data display unit may be used, and this TV multiplexed data display unit may be connected by switching over to the first multiplexed data demodulator 36 and the second multiplexed data demodulator 37 and may display by switched, or it may be connected to the both and display both at the same time.

Also, instead of or together with the TV multiplexed data display units 38 and 39, a printer to print the TV multiplexed data may be used.

The first sub–carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band–pass filter 14 as it passes through, and the first sub–carrier selected by the first band–pass filter 14 is sent to the first TV multiplexed data demodulator 36. At the first TV multiplexed data demodulator 36, TV multiplexed data is demodulated from the sent first sub–carrier, and the demodulated TV multiplexed data is displayed on the first TV multiplexed data display unit 38.

Also, the second sub–carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band–pass filter 21 as it passes through, and the second sub–carrier selected by the second band–pass filter 31 is sent to the second TV multiplexed data demodulator 37. At the second TV multiplexed data demodulator 37, TV multiplexed data is demodulated from the sent second sub–carrier, and the

demodulated TV multiplexed data is displayed on the second TV multiplexed data display unit 39.

In the television receiver shown in Fig. 12, two–channel TV multiplexed data is displayed on the TV multiplexed data display units 38 and 39. In contrast, the television receiver shown in Fig. 13 is designed in such manner that the received two–channel TV multiplexed data can be outputted to a data processing device such as a personal computer. Therefore, in case the television receiver of Fig. 13 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

Basic arrangement of this television receiver is the same as that of the television receiver of Fig. 12, and description is not given here for common to the both, and only the difference will be described. To the first band–pass filter 14 of this television receiver, a first TV multiplexed data demodulator 36 is connected, and the first TV multiplexed data demodulator 36 is provided with a connection terminal 46 instead of the first TV multiplexed data display unit 38 of Fig. 12, and a personal computer 48 is connected to the connection terminal 46. Also, a second TV multiplexed data demodulator 37 is connected to the second band–pass filter 31, and the second TV multiplexed data demodulator 37 is provided with a connection terminal 47 instead of the second TV multiplexed data display unit 39 of Fig. 12, and a personal computer 49 is connected to the connection terminal 47.

The personal computers 48 and 49 shown here are given only as examples, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be connected.

Fig. 14 represents a block diagram of a television receiver for receiving two–channel TV multiplexed facsimile data using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH shown in Figs. 7 and 8 in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

This television receiver is provided with functions to demodulate and display two–channel TV multiplexed facsimile data using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH as shown in Fig. 12, instead of the functions to

demodulate and display two-channel TV multiplexed data using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH.

This television receiver comprises a TV tuner, a TV picture processor and a TV audio/multiplexed-signal processor.

Among the component elements, the arrangement and the operation of the TV tuner and the TV video processor as well as the arrangement and the operation to process TV stereo sound and TV dual sound are the same as those of the conventional type television receiver shown in Fig. 3, and detailed description is not given here.

To the TV audio detector 8, a first band-pass filter 14 allowing the first sub-carrier of 4.5 fH to pass and a second band-pass filter 31 allowing the second sub-carrier of 7.5 fH to pass are connected. A first TV multiplexed facsimile data demodulator 40 is connected to the first band-pass filter 14, a second TV multiplexed facsimile data demodulator 41 is connected to the second band-pass filter 31, a TV multiplexed facsimile data printer 42 is connected to the first TV multiplexed facsimile data demodulator 40, and a TV multiplexed data display unit 43 is connected to the second TV multiplexed data demodulator 41.

Instead of the two TV multiplexed facsimile data printers 42 and 43, one TV multiplexed facsimile data printer may be used, and this TV multiplexed facsimile data printer may be switched over and connected to the first TV multiplexed facsimile data demodulator 40 and the second multiplexed facsimile data demodulator 41.

Also, instead of or together with the TV multiplexed facsimile data printers 42 or 43, a display unit for displaying TV multiplexed facsimile data may be used.

The first sub-carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band-pass filter 14 as it passes through, and the first sub-carrier selected by the first band-pass filter 14 is sent to the first TV multiplexed facsimile data demodulator 40. At the first TV multiplexed facsimile data demodulator 40, TV multiplexed facsimile data is demodulated from the sent first sub-carrier, and the demodulated TV multiplexed facsimile data is printed by the TV multiplexed

facsimile data printer 42.

The second sub−carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band−pass filter 31 as it passes through and the second sub−carrier selected by the second band−pass filter 31 is sent to the second TV multiplexed facsimile data demodulator 32. At the second TV multiplexed facsimile data demodulator 32, the TV multiplexed facsimile data is demodulated from the sent second sub−carrier, and the demodulated TV multiplexed facsimile data is printed by the TV multiplexed facsimile data printer 43.

Fig. 15 represents a block diagram of a television receiver for receiving one−channel TV multiplexed facsimile data and one−channel TV multiplexed data using the first sub−carrier of 4.5 fH and the second sub−carrier of 7.5 fH shown in Figs. 7 and 8 in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

This television receiver is provided with functions to demodulate and print one−channel TV multiplexed facsimile data using the first sub−carrier of 4.5 fH and to demodulate and display one−channel TV multiplexed data using the second sub−carrier of 7.5 fH instead of the functions to demodulate and print two−channel TV multiplexed facsimile data using the first sub−carrier of 4.5 fH and the second sub−carrier of 7.5 fH shown in Fig. 14.

This television receiver comprises a TV tuner, a TV video processor, and a TV audio/multiplexed−signal processor.

Among these component elements, the arrangement and the operation of the TV tuner and the TV video processor as well as the arrangement and the operation to process TV stereo sound and TV dual sound are the same as those of the conventional type television receiver shown in Fig. 3, and detailed description is not given here.

To the TV audio detector 8, a first band−pass filter 14 allowing the first sub−carrier of 4.5 fH to pass and a second band−pass filter 31 allowing the second sub−carrier of 7.5 fH to pass are connected. A TV multiplexed facsimile data demodulator 15 is connected to the first band−pass filter 14, a TV multiplexed data

demodulator 32 is connected to the second band–pass filter 31, a TV multiplexed facsimile data printer 16 is connected to the TV multiplexed facsimile data demodulator 15, and a TV multiplexed data display unit 33 is connected to the TV multiplexed data demodulator 32.

Instead of or together with the TV multiplexed facsimile data printer 16, a display unit to display the TV multiplexed facsimile data may be used.

Instead of or together with the TV multiplexed data display unit 33, a printer for printing the TV multiplexed data may be used.

The first sub–carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band–pass filter 14 as it passes through, and the first sub–carrier selected by the first band–pass filter 14 is sent to the TV multiplexed facsimile data demodulator 15. At the TV multiplexed facsimile data demodulator 15, TV multiplexed facsimile data is demodulated from the sent first sub–carrier, and the demodulated TV multiplexed facsimile data is printed by the TV multiplexed facsimile data printer 16.

The second sub–carrier of 7.5 fH multiplexed on the TV audio signal is selected by a second band–pass filter 31 as it passes through, and the second sub–carrier selected by the second band–pass filter 31 is sent to the TV multiplexed data demodulator 32. At the TV multiplexed data demodulator 32, TV multiplexed data is demodulated from the sent second sub–carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 33.

In the television receiver shown in Fig. 15, the received TV multiplexed data is displayed on the TV multiplexed data display unit 33. In contrast, the television receiver shown in Fig. 16 is designed in such manner that the received TV multiplexed data can be outputted to a data processing device such as a personal computer. Therefore, in case the television receiver of Fig. 16 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

The basic arrangement of this television receiver is the same as that of the

television receiver shown in Fig. 15, and description is not given here on common to the both, and only the difference will be described. To the second band-pass filter 31 in the television receiver, a TV multiplexed data demodulator 32 is connected, and the TV multiplexed data demodulator 32 is provided with a connection terminal 44 instead of the TV multiplexed data display unit 33 of Fig. 15, and a personal computer 45 is connected to the connection terminal 44.

The personal computer 45 shown here is given only as an example, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be used.

Fig. 17 represents another block diagram of a television receiver for receiving two-channel TV multiplexed data using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH shown in Figs. 7 and 8 in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

In this television receiver, the TV multiplexed data is not displayed on the TV multiplexed data display units 38 and 39 of the television receiver for receiving the TV multiplexed data as shown in Fig. 12, but multiplexed data is displayed on a TV picture display unit such as a cathode ray tube for displaying television picture.

This television receiver, like the television receiver shown in Fig. 12, comprises a TV tuner, a TV video processor, and a TV audio/multiplexed-data processor. However, unlike the television receiver of Fig. 12, the first TV multiplexed data demodulator 36 and the second TV multiplexed data demodulator 37 are switched over and connected to a TV format converter 34 instead of being respectively connected to the TV multiplexed data display unit 38 and the TV multiplexed data display unit 39. At the TV format converter 34, the TV multiplexed data is converted to a format, which can be displayed by the cathode ray tube, and it is displayed after being synthesized with TV pictures or teletext pictures, or it is displayed alone on the TV picture display unit 6.

The other arrangement is common to aforementioned arrangements, and detailed description is not given here.

Fig. 18 shows another block diagram of a television receiver for receiving

one–channel TV multiplexed facsimile data and one–channel TV multiplexed data using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH shown in Figs. 7 and 8 in addition to TV stereo sound, TV dual sound and TV teletext data together with TV pictures.

In this television receiver, the data demodulated from one–channel TV multiplexed data is not displayed on the TV multiplexed data display unit 33 using the second sub–carrier of 7.5 fH in the television receiver as shown in Fig. 15, but the data is displayed on a TV picture display unit such as a cathode ray tube, which displays television pictures.

Like the television receiver shown in Fig. 15, this television receiver comprises a TV tuner, a TV video processor, and a TV audio/multiplexed–signal processor. Unlike the television receiver shown in Fig. 15, to the TV multiplexed data demodulator 32, a TV format converter 34 is connected instead of the TV multiplexed data display unit 33 being connected. At the TV format converter 34, the TV multiplexed data is converted to a format, which can be displayed by the cathode ray tube, and it is displayed after being synthesized with television picture or teletext picture, or it is displayed alone on the TV picture display unit 6.

The other arrangement is common to aforementioned arrangements, and detailed description is not given here.

Fig. 19 to Fig. 20 each represents a block diagram of a receiver for receiving two–channel TV multiplexed data using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH in addition to receiving of audio of television broadcasting and receiving of TV stereo sound and TV dual sound.

The receiver shown in Fig. 19 comprises a TV tuner, and a TV audio/multiplexed–data processor.

The TV tuner comprises a TV tuner 2 connected to a TV antenna 1.

The TV audio/multiplexed–data processor comprises a TV audio detector 8 connected to the TV tuner 2, a TV main/sub audio separator 9 connected to the TV audio detector 8, a TV sub audio demodulator 10 connected to the TV main/sub audio separator 9, a TV stereo matrix circuit 11 connected to the TV main/sub audio

separator 9 and the TV sub audio demodulator 10, a TV dual sound circuit 12 connected to the TV sub audio demodulator 10. The TV stereo matrix circuit 11 and the TV dual sound circuit 12 are connected to speakers 13 and 13.

To the TV audio detector 8, also a first band-pass filter 14 allowing the first sub-carrier of 4.5 fH to pass and a second band-pass filter 31 allowing the second sub-carrier of 7.5 fH to pass are connected. A first TV multiplexed data demodulator 36 is connected to the first band-pass filter 14, a second TV multiplexed data demodulator 37 is connected to the second band-pass filter 31, and TV multiplexed data display units 38 and 39 are connected to the first TV multiplexed data demodulator 36 and the second TV multiplexed data demodulator 37 respectively.

Instead of or together with the two TV multiplexed display units 38 and 39, a display unit for displaying the TV multiplexed data may be used.

In this receiver, the television broadcast signal is received by the TV antenna 1 and audio signal is tuned and selected by the TV tuner 2. The audio signal thus tuned and selected is detected by the TV audio detector 8, and it is separated to a main audio signal and a sub audio signal by the TV main/sub audio separator 9. In case the sub audio is of stereo, stereo audio is picked up from the main audio signal and the sub audio signal demodulated by the TV sub audio demodulator 10 by the TV stereo matrix circuit 11. In case the demodulated sub audio is of dual sound, the sub audio signal demodulated by the TV sub audio demodulator 10 is picked up via the TV dual sound circuit 12, and these audio signals are converted to sound at the speakers 13 and 13.

The first sub-carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band-pass filter 14 as it passes through, and the first sub-carrier selected by the first band-pass filter 14 is sent to the first TV multiplexed data demodulator 36. At the first TV multiplexed data demodulator 36, TV multiplexed data is demodulated from the sent first sub-carrier, and the demodulated TV

multiplexed data is displayed on the TV multiplexed data display unit 38.

The second sub-carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the second TV multiplexed demodulator 37. At the second TV multiplexed data demodulator 37, TV multiplexed data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 39.

Although two TV multiplexed data display units 38 and 39 are used in this embodiment, it may be designed in such manner that one TV multiplexed data display unit may be used by switching over or data may be displayed on one TV multiplexed data display unit at the same time.

In the receiver shown in Fig. 19, two-channel TV multiplexed data received is displayed on the TV multiplexed data display units 38 and 39. In contrast, the receiver shown in Fig. 20 is designed in such manner that the received two-channel TV multiplexed data can be outputted to a data processing device such as a personal computer. Therefore, in case the receiver of Fig. 20 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

Basic arrangement of this receiver is the same as that of the receiver of Fig. 19, and description is not given here on common to the both, and only the difference will be described. The first TV multiplexed data demodulator 36 is connected to the first band-pass filter 14 of the receiver, and the first TV multiplexed data demodulator 36 is provided with a connection terminal 46 instead of the first TV multiplexed data display unit 38 of Fig. 19, and a personal computer 48 is connected to the connection terminal 46. The second TV multiplexed data demodulator 37 is connected to the second band-pass filter 31, and the second TV multiplexed data demodulator 37 is provided with a connection terminal 47 instead of the second TV multiplexed data display unit 39 of Fig. 19, and a personal computer 49 is connected to the connection terminal 47.

The personal computers 48 and 49 shown here are given only as examples, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be used.

Fig. 21 represents another block diagram of a receiver for receiving one–channel TV multiplexed facsimile data and one–channel TV multiplexed data using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH in addition to receiving of audio of television broadcasting and receiving of TV stereo sound and TV dual sound.

This receiver is provided with functions to demodulate and print one–channel TV multiplexed facsimile data using the first sub–carrier of 4.5 fH and to demodulate and display one–channel TV multiplexed data using the second sub–carrier of 7.5 fH instead of the functions to demodulate and print two–channel TV multiplexed facsimile data using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH as shown in Fig. 14.

This receiver comprises a TV tuner, and a TV audio/multiplexed–data processor.

Among these component elements, the arrangement and the operation of the TV tuner and of processing the TV stereo sound and TV dual sound are the same as those of the receiver shown in Fig. 14, and detailed description is not given here.

To the TV audio detector 8, a first band–pass filter 14 allowing the first sub–carrier of 4.5 fH to pass and a second band–pass filter 31 allowing the second sub–carrier of 7.5 fH to pass are connected. A TV multiplexed facsimile data demodulator 15 is connected to the first band–pass filter 14, a TV multiplexed data demodulator 32 is connected to the second band–pass filter 31, a TV multiplexed facsimile data printer 16 is connected to the TV multiplexed facsimile data demodulator 15, and a TV multiplexed data display unit 33 is connected to the TV multiplexed data demodulator 32.

Instead of or together with the TV multiplexed facsimile data printer 16, a display unit for displaying the TV multiplexed facsimile data may be used.

Instead of or together with the TV multiplexed data display unit 33, a printer

for printing the TV multiplexed data may be used.

The first sub-carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band-pass filter 14 as it passes through, and the first sub-carrier selected by the first band-pass filter 14 is sent to the TV multiplexed facsimile data demodulator 15. At the TV multiplexed facsimile data demodulator 15, TV multiplexed facsimile data is demodulated from the sent first sub-carrier, and the demodulated TV multiplexed facsimile data is printed by the TV multiplexed facsimile data printer 16.

The second sub-carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the TV multiplexed data demodulator 32. At the TV multiplexed data demodulator 32, TV multiplexed data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 33.

In the receiver shown in Fig. 21, the received TV multiplexed data is displayed on the TV multiplexed data display unit 33. In contrast, the receiver shown in Fig. 22 is designed in such manner that the received TV multiplexed data can be outputted to a data processing unit such as a personal computer. Therefore, in case the receiver shown in Fig. 22 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

Basic arrangement of this television receiver is the same as that of the television receiver of Fig. 21. Thus, description is not given here on common to the both, and only the difference will be described. To the second band-pass filter 31 in the television receiver, the TV multiplexed data demodulator 32 is connected, and the TV multiplexed data demodulator 32 is provided with a connection terminal 44 instead of the TV multiplexed data display unit 33 of Fig. 21, and a personal computer 45 is connected to the connection terminal 44.

The personal computer 45 shown here is given as an example, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which

can process data, may be connected.

Next, description will be given on a receiver for receiving multiplexed data multiplexed on the FM broadcast and multiplexed data multiplexed on the sub-carrier of the television broadcast in addition to receiving of audio of television broadcast and FM broadcast and receiving of stereo sound and dual sound. Prior to the explanation, a brief description will be given on a conventional type receiver for receiving FM multiplexed data broadcast together with stereo sound of the FM broadcast.

The receiver shown in Fig. 23 comprises an FM tuner and an FM audio/multiplexed-data processor.

Among these component elements, the arrangement and the operation of the FM tuner and of the processing of FM stereo sound are the same as those of the receiver shown in Fig. 5, and detailed description is not given here.

To the FM detector 19, a third band-pass filter 23 allowing the sub-carrier for FM data to pass is further connected. To the third band-pass filter 23, an FM multiplexed data demodulator 24 is connected, and the FM multiplexed data demodulator 24 is provided with a connection terminal 50, and a personal computer 51 is connected to the connection terminal 50.

The personal computer 51 shown here is given as an example, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be connected.

Fig. 24 represents a block diagram of a receiver for receiving multiplexed data multiplexed on the FM broadcast and multiplexed data multiplexed using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH of the television broadcast as shown in Figs. 7 and 8 in addition to receiving of audio of the FM broadcast and television broadcast and receiving of stereo sound and dual sound.

This receiver comprises an FM tuner, an FM audio/multiplexed-data processor, a TV tuner and a TV audio/multiplexed-data processor.

The FM tuner comprises an FM tuner 18 connected to an antenna 34 for both FM and TV.

The FM audio/multiplexed–data processor comprises an FM detector 19 connected to the FM tuner 18, an FM main/sub audio separator 20 connected to the FM detector 19, an FM sub audio demodulator 21 connected to the FM main/sub audio separator 20, an FM/TV stereo matrix circuit 35 connected to the FM main/sub audio separator 20 and to the FM sub audio demodulator 21, and speakers 13 and 13 connected to the FM/TV stereo matrix circuit 35.

To the FM detector 19, a fourth band–pass filter 26 allowing the sub–carrier for FM data to pass is connected. An FM multiplexed data demodulator 27 is connected to the fourth band–pass filter 26, and an FM multiplexed data display unit 28 is connected to the FM multiplexed data demodulator 27.

The television tuner comprises a TV tuner 2 connected to the FM/TV antenna 34.

The TV audio/multiplexed–data processor comprises a TV audio detector 8 connected to the TV tuner 2, a TV main/sub audio separator 9 connected to the TV audio detector 8, a TV sub audio demodulator 10 connected to the TV main/sub audio separator 9, an FM/TV stereo matrix circuit 35 connected to the TV main/sub audio separator 9 and to the TV sub audio demodulator 10, a TV dual sound circuit 12 connected to the TV sub audio demodulator 10. Speakers 13 and 13 are connected to the FM/TV stereo matrix circuit 35 and the TV dual sound circuit.

To the TV audio detector 8, a second band–pass filter 31 allowing the second sub–carrier of 7.5 fH to pass is connected. A TV multiplexed data demodulator 32 is connected to the second band–pass filter 31, and a TV multiplexed data display unit 33 is connected to the TV multiplexed data demodulator 32.

Instead of or together with the TV multiplexed display unit 33, a printer for printing the TV multiplexed data may be used.

In this receiver, the FM broadcast signal received by the FM/TV antenna 34 is tuned and selected by the FM tuner 18. The FM audio signal thus tuned and selected is detected by the FM detector 19 and is separated to a main audio signal and a sub audio signal by the FM main/sub audio separator 20. From the main audio signal and the sub audio signal, stereo audio is picked up by the FM/TV stereo

matrix circuit 35, and these audio signals are converted to sound at the speakers 13 and 13.

The sub-carrier for FM multiplexed data multiplexed on the audio signal is selected by the fourth band-pass filter 26 as it passes through, and the sub-carrier for FM multiplexed data selected by the fourth band-pass filter 26 is sent to the FM multiplexed data demodulator 27. At the FM multiplexed data demodulator 27, FM multiplexed data is demodulated from the sub-carrier thus sent, and the demodulated FM multiplexed data is displayed on the FM multiplexed data display unit 28.

On the television broadcast signal received by the FM/TV antenna 34, audio signal is tuned and selected by the TV tuner 2. The audio signal thus tuned and selected is detected by the TV audio detector 8 and is separated to a main audio signal and a sub audio signal at the TV main/sub audio separator 9. In case sub audio is of stereo, stereo audio is picked up from the main audio signal and the sub audio signal demodulated at the TV sub audio demodulator 10 by the FM/TV stereo matrix circuit 35. In case the demodulated sub audio is of TV dual sound, the sub audio signal demodulated at the TV sub audio demodulator 10 is picked up via the TV dual sound circuit 12. These audio signals are converted to sound at the speakers 13 and 13.

The second sub-carrier of 7.5 fH multiplexed on TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the TV multiplexed data demodulator 32. At the TV multiplexed data demodulator 32, TV multiplexed data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 33.

In the embodiment shown in Fig. 24, the FM multiplexed data display units 28 and TV multiplexed data display unit 33 are used, whereas it is possible to use a data display unit by switching over or to display data on one data display unit at the same time.

In the receiver shown in Fig. 24, the received FM multiplexed data is

displayed on the FM multiplexed data display unit 28, and received TV multiplexed data is displayed on the TV multiplexed data display unit 33. In contrast, the receiver shown in Fig. 25 is designed in such manner that the received FM multiplexed data and TV multiplexed data can be outputted to a data processing device such as a personal computer. Therefore, in case the receiver shown in Fig. 25 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

The basic arrangement of this television receiver is the same as that of the television receiver shown in Fig. 24. Thus, description will not be given here on common to the both, and only the difference will be described. To the second band–pass filter 31 of the TV tuner, a TV multiplexed data demodulator 32 is connected. The TV multiplexed data demodulator 32 is provided with a connection terminal 44 instead of the TV multiplexed data display unit 33 of Fig. 24, and a personal computer 45 is connected to the connection terminal 44. To the fourth band–pass filter 26 of the FM tuner, an FM multiplexed data demodulator 27 is connected, and the FM multiplexed data demodulator 27 is provided with a connection terminal 50 instead of the FM multiplexed data display unit 28 of Fig. 24, and a personal computer 51 is connected to the connection terminal 50.

The personal computers 45 and 51 shown here are given merely as examples, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be connected.

Fig. 26 represents a block diagram of a receiver for receiving multiplexed facsimile broadcasting of the FM broadcast and the television broadcast in addition to receiving of audio of FM broadcast and television broadcast and to receiving of stereo sound and dual sound.

This receiver comprises an FM tuner, an FM audio/multiplexed–facsimile processor, a TV tuner and a TV audio/multiplexed–facsimile processor.

Among these component elements, the arrangement of FM tuner and of processing FM stereo sound as well as the arrangement and the operation of the TV tuner and of processing TV stereo sound and TV dual sound are the same as those

of the receiver shown in Fig. 24, and detailed description is not given here.

To the FM detector 19, a third band-pass filter 23 allowing the sub-carrier for FM facsimile data to pass is connected. An FM multiplexed facsimile data demodulator 24 is connected to the third band-pass filter 23, and an FM multiplexed facsimile data printer 25 is connected to the FM multiplexed data demodulator 24.

To the TV audio detector 8, a second band-pass filter 31 allowing the second sub-carrier of 7.5 fH to pass is connected. A TV multiplexed facsimile data demodulator 15 is connected to the second band-pass filter 31, and a TV multiplexed facsimile data printer 16 is connected to the TV multiplexed facsimile data demodulator 15.

The sub-carrier for FM multiplexed facsimile data multiplexed on the audio signal is selected by the third band-pass filter 23 as it passes through, and the sub-carrier for FM multiplexed facsimile data selected by the third band-pass filter 23 is sent to the FM multiplexed facsimile data demodulator 24. At the FM multiplexed facsimile data demodulator 24, FM multiplexed facsimile data is demodulated from the sent sub-carrier, and the demodulated FM multiplexed facsimile data is printed by the FM multiplexed facsimile data printer 25.

The second sub-carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the TV multiplexed facsimile data demodulator 15. At the TV multiplexed facsimile data demodulator 15, TV multiplexed facsimile data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed facsimile data is printed by the TV multiplexed facsimile data printer 16.

In the embodiment shown in Fig. 26, the FM multiplexed facsimile data printer 25 and the TV multiplexed facsimile data printer 16 are used, whereas one facsimile data printer may be used by switching over.

Also, instead of or together with the FM multiplexed facsimile data printer 25 and the TV multiplexed facsimile data printer 16, a display unit for displaying the TV multiplexed facsimile data may be used.

Fig. 27 represents a block diagram of a receiver for receiving multiplexed data multiplexed on the FM broadcast and two–channel multiplexed data multiplexed using the first sub–carrier of 4.5 fH and the second sub–carrier of 7.5 fH multiplexed on TV audio signal of the television broadcast, in addition to receiving of audio of FM broadcast and television broadcast and receiving of stereo sound and dual sound.

This receiver comprises an FM tuner, an FM audio/multiplexed–data processor, a TV tuner, and a TV audio/multiplexed–data processor.

The FM tuner comprises an FM tuner 18 connected to an antenna 34 for both FM and TV.

The FM audio/multiplexed–data processor comprises an FM detector 19 connected to the FM tuner 18, an FM main/sub audio separator 20 connected to the FM detector 19, an FM sub audio demodulator 21 connected to the FM main/sub audio separator 20, an FM/TV stereo matrix circuit 35 connected to the FM main/sub audio separator 20 and to the FM sub audio demodulator 21, and speakers 13 and 13 connected to the FM/TV stereo matrix circuit 35.

A fourth band–pass filter allowing the sub–carrier for FM multiplexed data to pass is connected to the FM detector 19, an FM multiplexed data demodulator 27 is connected to the fourth band–pass filter 26, and an FM multiplexed data display unit 28 is connected to the FM multiplexed data demodulator 27.

The television tuner comprises a TV tuner 2 connected to the FM/TV antenna 34.

The TV audio/multiplexed–data processor comprises a TV audio detector 8 connected to the TV tuner 2, a TV main/sub audio separator 9 connected to the TV audio detector 8, a TV sub audio demodulator 10 connected to the TV main/sub audio separator 9, an FM/TV stereo matrix circuit 35 connected to the TV main/sub audio separator 9 and the TV sub audio demodulator 10, and a TV dual sound circuit 12 connected to the TV sub audio demodulator 10. The TV dual sound circuit 12 is connected to speakers 13 and 13.

To the TV audio detector 8, a first band–pass filter 14 allowing the first

sub–carrier of 4.5 fH to pass and a second band–pass filter 31 allowing the second sub–carrier of 7.5 fH to pass are connected. A first TV multiplexed data demodulator 36 is connected to the first band–pass filter 14, a second TV multiplexed data demodulator 37 is connected to the second band–pass filter 31, and TV multiplexed data display units 38 and 39 are connected to the first TV multiplexed data demodulator 36 and the second TV multiplexed data demodulator 37 respectively.

Instead of or together with the TV multiplexed data display units 38 and 39, a printer for printing the TV multiplexed data may be used.

In this receiver, the FM broadcast signal received by the FM/TV antenna 34 is tuned and selected by the FM tuner 18. The audio signal thus tuned and selected is detected by the FM detector 19 and is separated to a main audio signal and a sub audio signal by the FM main/sub audio separator 20. Stereo audio is picked up from the main audio signal and the sub audio signal by the FM/TV stereo matrix circuit 35, and these audio signals are converted to sound at the speakers 13 and 13.

The sub–carrier for FM data multiplexed on the audio signal is selected by the fourth band–pass filter 26 as it passes through, and the sub–carrier for FM data selected by the fourth band–pass filter 26 is sent to the FM multiplexed data demodulator 27. At the FM multiplexed data demodulator 27, FM multiplexed data is demodulated from the sent sub–carrier, and the demodulated FM multiplexed data is displayed on the FM multiplexed data display unit 28.

On the television broadcast signal received by the FM/TV antenna 34, audio signal is tuned and selected by the TV tuner 2. The audio signal thus tuned and selected is detected by the TV audio detector 8 and is separated to a main audio signal and a sub audio signal at the TV main/sub audio separator 9. In case the sub audio is of stereo, stereo audio is picked up from the main audio signal and the sub audio signal demodulated by the TV sub audio demodulator 10 by the FM/TV stereo matrix circuit 35. In case the demodulated sub audio is of TV dual sound, sub audio signal demodulated by the TV sub audio demodulator 10 is picked up via the TV dual sound circuit 12. These audio signals are converted to sound at the speakers 13 and

13.

The first sub-carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band-pass filter 14 as it passes through, and the first sub-carrier selected by the first band-pass filter 14 is sent to the first TV multiplexed data demodulator 36. At the first TV multiplexed data demodulator 36, TV multiplexed data is demodulated from the sent first sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 38.

The second sub-carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the second TV multiplexed data demodulator 37. At the second TV multiplexed data demodulator 37, TV multiplexed data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 39.

In this embodiment, two TV multiplexed data display units 38 and 39 are used, whereas one TV multiplexed data display unit may be used by switching over or the data may be displayed on one TV multiplexed data display unit at the same time.

In the receiver shown in Fig. 27, the received FM multiplexed data is displayed on the FM multiplexed data display unit 28, and the two-channel TV multiplexed data is displayed on the first TV multiplexed data display unit 38 and the second TV multiplexed data display unit 39. In contrast, the receiver shown in Fig. 28 is designed in such manner that FM multiplexed data and TV multiplexed data which are received can be outputted to a data processing device such as a personal computer. Therefore, in case the receiver of Fig. 28 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

The basic arrangement of this television receiver is the same as that of the television receiver shown in Fig. 27. Thus, description is not given here on common to the both, and only the difference will be described. To the first band-pass filter 14 of the TV tuner, a first TV multiplexed data demodulator 36 is

connected, and the first TV multiplexed data demodulator 36 is provided with a connection terminal 46 instead of the TV multiplexed data display unit 38 of Fig. 27, and a personal computer 48 is connected to the connection terminal 46. Also, a second TV multiplexed data demodulator 37 is connected to the second band-pass filter of the TV tuner, and the second TV multiplexed data demodulator 37 is provided with a connection terminal 47 instead of the TV multiplexed data display unit 39 of Fig. 27, and a personal computer 49 is connected to the connection terminal 47. To the fourth band-pass filter 26 of the FM tuner, a FM multiplexed data demodulator 27 is connected, and the FM multiplexed data demodulator 27 is provided with a connection terminal 50 instead of the FM multiplexed data display unit 28 of Fig. 24, and a personal computer 51 is connected to the connection terminal 50.

The personal computers 48, 49 and 51 shown here are given merely as examples, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be connected.

Fig. 29 represents another block diagram of a receiver for receiving one-channel TV multiplexed facsimile data and one-channel TV multiplexed data using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH in addition to receiving of audio of FM broadcast and television broadcast and to receiving of stereo sound and dual sound.

This receiver is provide with functions to demodulate and print one-channel TV multiplexed facsimile data using the first sub-carrier of 4.5 fH and to demodulate and display one-channel TV multiplexed data using the second sub-carrier of 7.5 fH instead of the functions to demodulate and print the two-channel TV multiplexed facsimile data using the first sub-carrier of 4.5 fH and the second sub-carrier of 7.5 fH shown in Fig. 27.

This receiver comprises an FM tuner, an FM audio/multiplexed-signal processor, a TV tuner and a TV audio/multiplexed-signal processor.

Among these component elements, the arrangement and the operation of the FM tuner and of processing FM stereo sound as well as the arrangement and the

operation of the TV tuner and of processing TV stereo sound and TV dual sound are the same as those of the receiver shown in Fig. 24, and detailed description is not given here.

A fourth band-pass filter 26 allowing the sub-carrier for FM multiplexed data to pass is connected to the FM detector 19, an FM multiplexed data demodulator 27 is connected to the fourth band-pass filter 26, and an FM multiplexed data display unit 28 is connected to the FM multiplexed data demodulator 27.

To the TV audio detector 8, a first band-pass filter 14 allowing the first sub-carrier of 4.5 fH to pass and a second band-pass filter 31 allowing the second sub-carrier of 7.5 fH to pass are connected. A TV multiplexed facsimile data demodulator 15 is connected to the first band-pass filter 14, a TV multiplexed data demodulator 32 is connected to the second band-pass filter 31, a TV multiplexed facsimile data printer 16 is connected to the TV multiplexed facsimile data demodulator 15, and a TV multiplexed data display unit 33 is connected to the TV multiplexed data demodulator 32.

Instead of or together with the TV multiplexed facsimile data printer 16, a display unit for displaying TV multiplexed facsimile data may be used.

Also, instead or of together with the TV multiplexed data display unit 33, a printer for printing TV multiplexed data may be used.

The sub-carrier for FM data multiplexed on the audio signal is selected by the fourth band-pass filter 26 as it passes through, and the sub-carrier for FM data selected by the fourth band-pass filter 26 is sent to the FM multiplexed data demodulator 27. At the FM multiplexed data demodulator 27, FM multiplexed data is demodulated from the sent sub-carrier, and the demodulated FM multiplexed data is displayed on the FM multiplexed data display unit 28.

The first sub-carrier of 4.5 fH multiplexed on the TV audio signal is selected by the first band-pass filter 14, and the first sub-carrier selected by the first band-pass filter 14 is sent to the TV multiplexed facsimile data demodulator 15. At the TV multiplexed facsimile data demodulator 15, TV multiplexed facsimile data is demodulated from the sent first sub-carrier, and the demodulated TV multiplexed

facsimile data is printed by the TV multiplexed facsimile data printer 16.

The second sub-carrier of 7.5 fH multiplexed on the TV audio signal is selected by the second band-pass filter 31 as it passes through, and the second sub-carrier selected by the second band-pass filter 31 is sent to the TV multiplexed data demodulator 32. At the TV multiplexed data demodulator 32, TV multiplexed data is demodulated from the sent second sub-carrier, and the demodulated TV multiplexed data is displayed on the TV multiplexed data display unit 33.

In the embodiment shown in Fig. 29, the FM multiplexed data display unit 28 and the TV multiplexed data display unit 33 are used, whereas one data display unit may be used by switching over or the data may be displayed at the same time.

In case the data multiplexed in the FM broadcast is facsimile data, a third band-pass filter 23, an FM multiplexed facsimile data demodulator 24 and an FM multiplexed facsimile data printer 25 may be used instead of the fourth band-pass filter 26, the FM multiplexed data demodulator 27 and the FM multiplexed data display unit 28.

In the receiver shown in Fig. 29, the received FM multiplexed data is displayed on the FM multiplexed data display unit 28, and the TV multiplexed data is displayed on the TV multiplexed data display unit 33. In contrast, the receiver shown in Fig. 30 is designed in such manner that FM multiplexed data and the TV multiplexed data can be outputted to a data processing unit such as a personal computer. Therefore, in case the receiver shown in Fig. 30 is used, it is possible to store the received multiplexed data and to utilize it again or to edit the received multiplexed data when necessary.

The basic arrangement of this television receiver is the same as that of the television receiver shown in Fig. 29. Thus, detailed description is not given on common to the both, and only the difference will be described. To the second band-pass filter 31 of the TV tuner, a TV multiplexed data demodulator 32 is connected. The TV multiplexed data demodulator 32 is provided with a connection terminal 44 instead of the TV multiplexed data display unit 33 of Fig. 29, and a

computer 45 is connected to the connection terminal 44. To the fourth band-pass filter 26 of the FM tuner, an FM multiplexed data demodulator 27 is connected. The FM multiplexed data demodulator 27 is provided with a connection terminal 50 instead of the FM multiplexed data display unit 28, and a personal computer 515 is connected to the connection terminal 50.

The personal computers 45 and 51 shown here are given merely as examples, and other PDA (personal digital assistants), electronic notebook, word processor, and the like, which can process data, may be connected.

In the above, description has been given on embodiments, in which teletext signal multiplexed on the video signal and stereo sound and dual sound multiplexed on the audio signal are all reproduced, whereas it is needless to say that the functions can be adequately reduced or switched over.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a standard diagram of radio waves for NTSC color television broadcast;

Fig. 2 is a diagram of modulation spectrum of television multiplex broadcast facsimile based on NTSC system;

Fig. 3 is a block diagram of a conventional type television receiver;

Fig. 4 is a block diagram of a conventional type television multiplexed facsimile receiver;

Fig. 5 is a block diagram of a conventional type FM multiplexed facsimile receiver;

Fig. 6 is a block diagram of a conventional type FM multiplexed data receiver;

Fig. 7 is a diagram of modulation spectrum of television multiplex broadcast used in the present invention based on NTSC broadcasting system;

Fig. 8 is a diagram of another modulation spectrum of television multiplex broadcast used in the present invention based on NTSC broadcasting system;

Fig. 9 is a block diagram of a television receiver of an embodiment of the

present invention for receiving one-channel multiplexed data;

Fig. 10 is a block diagram of a television receiver of an embodiment of the present invention for outputting one-channel multiplexed data to a data processing device;

Fig. 11 is a block diagram of a television receiver of another embodiment of the present invention for receiving one-channel multiplexed data;

Fig. 12 is a block diagram of a television receiver of an embodiment of the present invention for receiving two-channel TV multiplexed data;

Fig. 13 is a block diagram of a television receiver of an embodiment of the present invention for outputting two-channel TV multiplexed data to a data processing device;

Fig. 14 is a block diagram of a television receiver of an embodiment of the present invention for receiving two-channel TV multiplexed facsimile;

Fig. 15 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and one-channel multiplexed data;

Fig. 16 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and for outputting one-channel multiplexed data to a data processing device;

Fig. 17 is a block diagram of a television receiver of another embodiment of the present invention for receiving two-channel TV multiplexed data;

Fig. 18 is a block diagram of a television receiver of an embodiment of the present invention for receiving one-channel multiplexed facsimile and one-channel multiplexed data;

Fig. 19 is a block diagram of a television receiver of an embodiment of the present invention for receiving two-channel TV multiplexed data;

Fig. 20 is a block diagram of a television receiver of an embodiment of the present invention for outputting two-channel TV multiplexed data to a data processing device;

Fig. 21 is a block diagram of a television receiver of an embodiment of the

present invention for receiving one–channel multiplexed facsimile and one–channel multiplexed data;

Fig. 22 is a block diagram of a television receiver of an embodiment of the present invention for receiving one–channel multiplexed facsimile and for outputting one–channel multiplexed data to a data processing device;

Fig. 23 is a block diagram of a receiver for outputting FM multiplexed data to a data processing device;

Fig. 24 is a block diagram of a receiver for receiving FM multiplexed data and one–channel TV multiplexed data;

Fig. 25 is a block diagram of a receiver for outputting FM multiplexed data and one–channel TV multiplexed data;

Fig. 26 is a block diagram of a receiver for receiving FM multiplexed facsimile and one–channel TV multiplexed facsimile;

Fig. 27 is a block diagram of a receiver of an embodiment of the present invention for receiving FM multiplexed data and two–channel TV multiplexed data;

Fig. 28 is a block diagram of a receiver of an embodiment of the present invention for outputting FM multiplexed data and two–channel TV multiplexed data to a data processing device;

Fig. 29 is a block diagram of a receiver of an embodiment of the present invention for receiving FM multiplexed data and one–channel TV multiplexed facsimile as well as one–channel TV multiplexed data; and

Fig. 30 is a block diagram of a receiver of an embodiment of the present invention for receiving one–channel TV multiplexed facsimile and for outputting FM multiplexed data and one–channel TV multiplexed data to a data processing device.

DESCRIPTION OF REFERENCE NUMERALS

1, 17, 34	antennas
2, 18	tuners
3	video detector
4	signal separator

5	video amplifier
6	picture display unit
7	teletext data demodulator
8, 19	audio detectors
9, 20	main/sub audio separators
10, 21	sub audio demodulators
11, 22, 35	stereo matrix circuits
12	dual sound circuit
13	speaker
14, 23, 26, 31	band−pass filters
15, 24, 40, 41	multiplexed facsimile data demodulators
16, 25, 42, 43	multiplexed facsimile data printers
27, 32, 36, 37	multiplexed data demodulators
28, 33, 38, 39	multiplexed data display units
44, 46, 47, 50	connection terminals
45, 48, 49, 51	personal computers

WHAT IS CLAIMED IS:

1. A receiver for multiplex broadcasting for receiving multiplex broadcast by multiplexing two-channel data to a sub-carrier of 4.5 fH and a sub-carrier of 7.5 fH of a broadcasting sub audio band of television broadcasting wave, which comprises a video band, a main audio band and a sub audio band, comprising:

a band-pass filter for demodulating data multiplexed on said sub-carrier of 4.5 fH; and

a band-pass filter for demodulating data multiplexed on said sub-carrier of 7.5 fH.

2. A receiver for multiplex broadcasting for receiving multiplex broadcast by multiplexing two-channel data to a sub-carrier of 4.5 fH and a sub-carrier of 7.5 fH of a broadcasting sub audio band of television broadcasting wave, which comprises a video band, a main audio band and a sub audio band, comprising a device for demodulating data multiplexed on said sub-carrier of 7.5 fH.

3. A receiver for multiplex broadcasting for receiving multiplex broadcast by multiplexing data to a sub-carrier of 7.5 fH of a broadcasting sub audio band of television broadcasting wave, which comprises a video band, a main audio band and a sub audio band, comprising a device for demodulating data multiplexed on said sub-carrier of 7.5 fH.

4. A receiver for multiplex broadcasting according to claims 1, 2 or 3, compring a device for demodulating teletext broadcasting signal multiplexed on a scanning line in vertical blanking interval of a video signal.

5. A receiver for multiplex broadcasting according to claim 1, 2, 3 or 4, further comprising a device for demodulating data multiplexed on a sub audio band of FM broadcasting wave, which comprises a main audio band and a sub audio band.

6. A receiver for multiplex broadcasting according to claim 1, 2, 3, 4 or 5, comprising a display unit for displaying said demodulated data.

7. A receiver for multiplex broadcasting according to claim 1, 2, 3, 4 or 5, comprising a printer for printing said demodulated data.

8. A receiver for multiplex broadcasting according to claim 1, 2, 3, 4 or 5, comprising a signal output unit for outputting said data demodulated or said teletext signal demodulated.

9. A receiver for multiplex broadcasting according to claim 1, 2, 3, 4, 5, 6, 7 or 8, further comprising a TV picture display unit for displaying television pictures and a speaker for converting audio signal to sound.

10. A receiver for multiplex broadcasting according to claim 9, wherein said TV picture display unit further comprises a TV format converter for displaying said data demodulated or said teletext signal demodulated.

11. A multiplex broadcasting system for broadcasting by multiplexing data to a sub-carrier of 7.5 fH of said broadcasting sub audio band of television broadcasting wave, which comprises a video band, a main audio band and a sub audio band.

12. A multiplex broadcasting system according to claim 11, for broadcasting by multiplexing data to a sub-carrier of 4.5 fH of a broadcasting sub audio band.

13. A multiplex broadcasting system according to claim 11 or 12, wherein said sub-carrier of 7.5fH is modulated by multi-valued digital modulation within ~~frequency~~ deviation of ± 30 KHz.

14. A receiver for multiplex broadcasting, comprising a device for demodulating data multiplexed on a sub-carrier of 7.5 fH of a broadcasting sub audio band of television broadcasting wave, which comprises a video band, a main audio band and a sub audio band.

15. A receiver for multiplex broadcasting according to claim 4 or 5, comprising a display unit for displaying said demodulated teletext signal.

16. A receiver for multiplex broadcasting according to claim 4 or 5, comprising a printer to printing demodulated teletext signal.

Fig.1

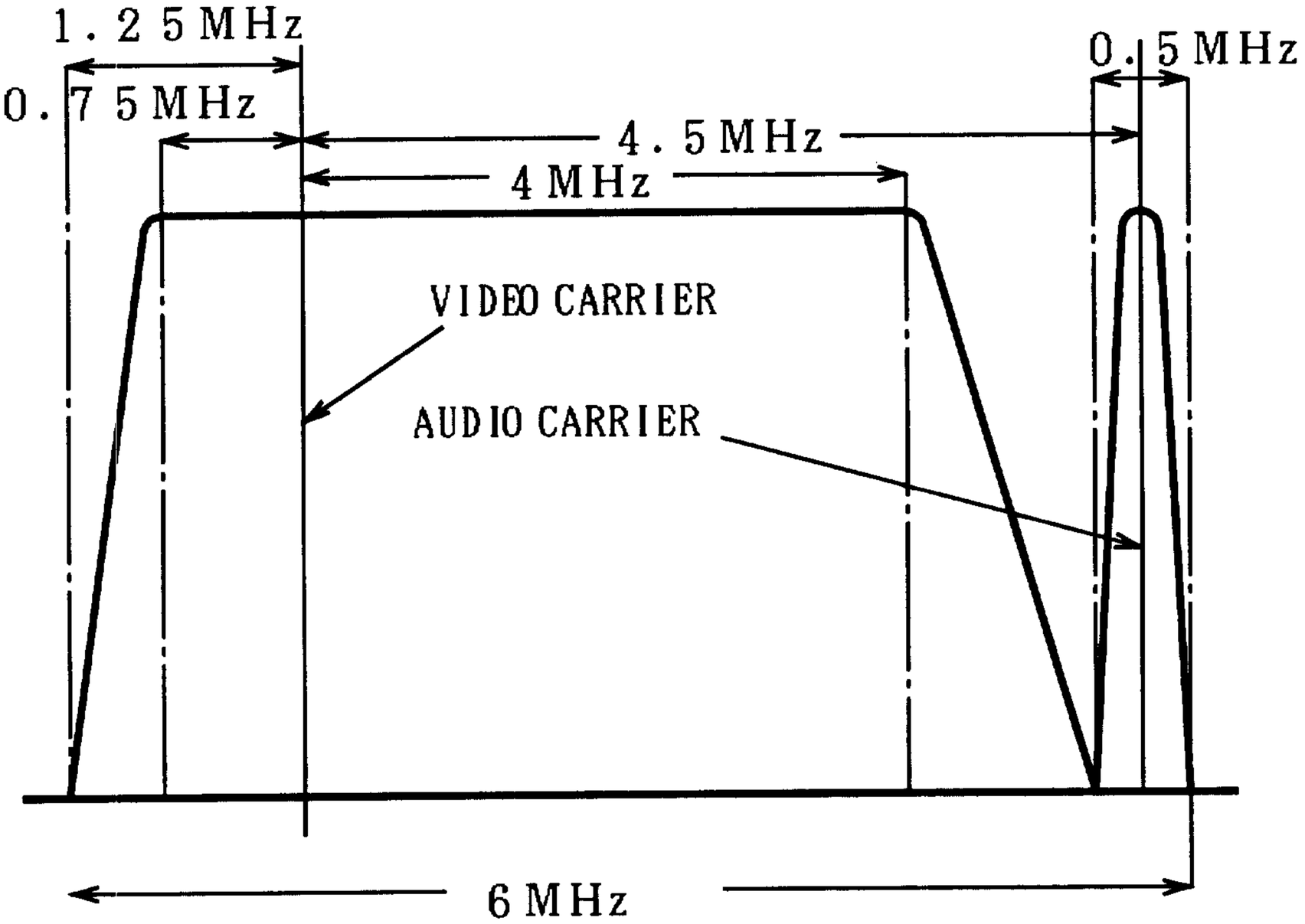

1.25MHz
0.75MHz
4.5MHz
4MHz
0.5MHz
VIDEO CARRIER
AUDIO CARRIER
6MHz

Fig.2

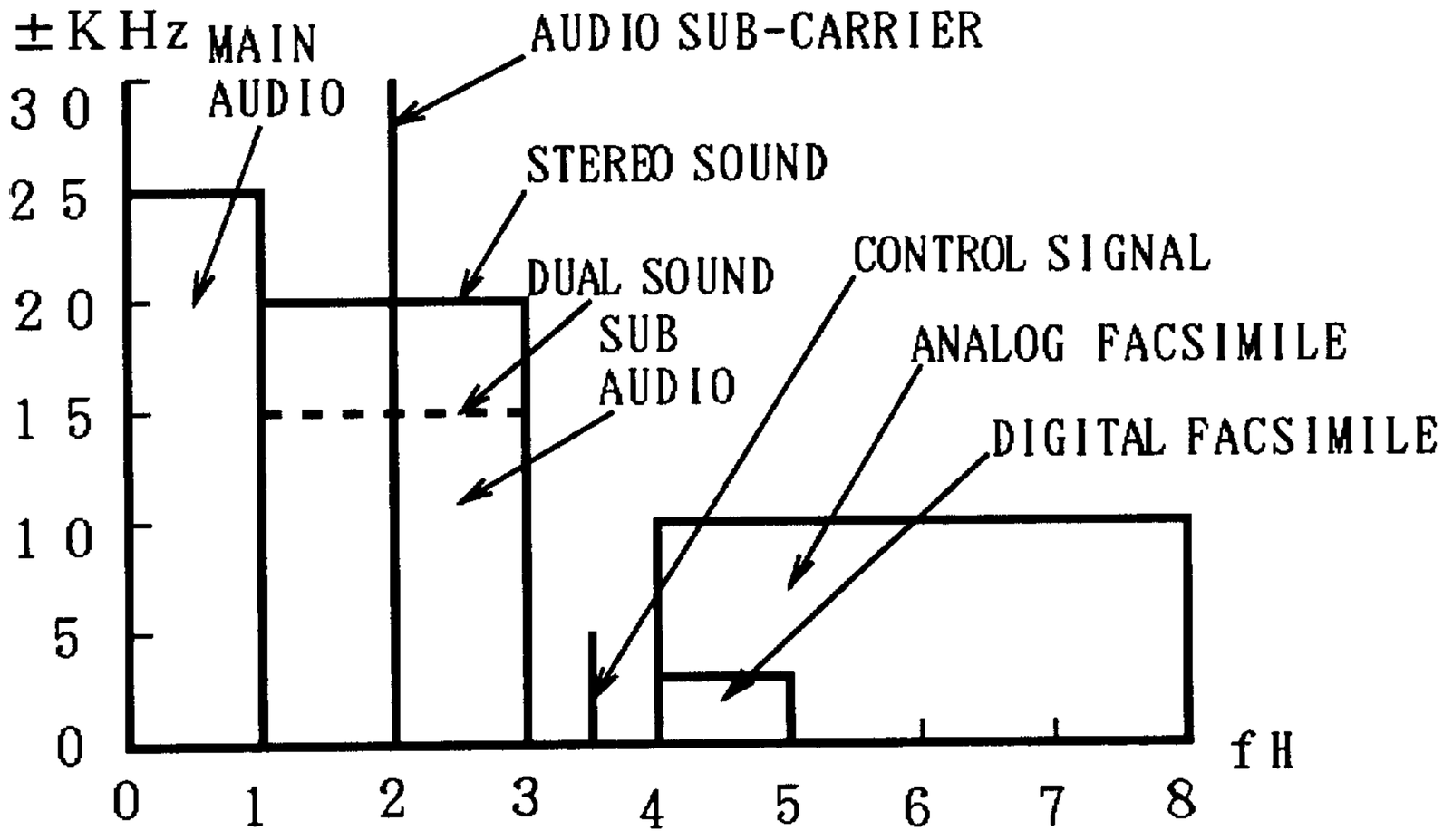

±KHz
MAIN AUDIO
AUDIO SUB-CARRIER
STEREO SOUND
DUAL SOUND
SUB AUDIO
CONTROL SIGNAL
ANALOG FACSIMILE
DIGITAL FACSIMILE
30
25
20
15
10
5
0
0
1
2
3
4
5
6
7
8
fH

Fig.3

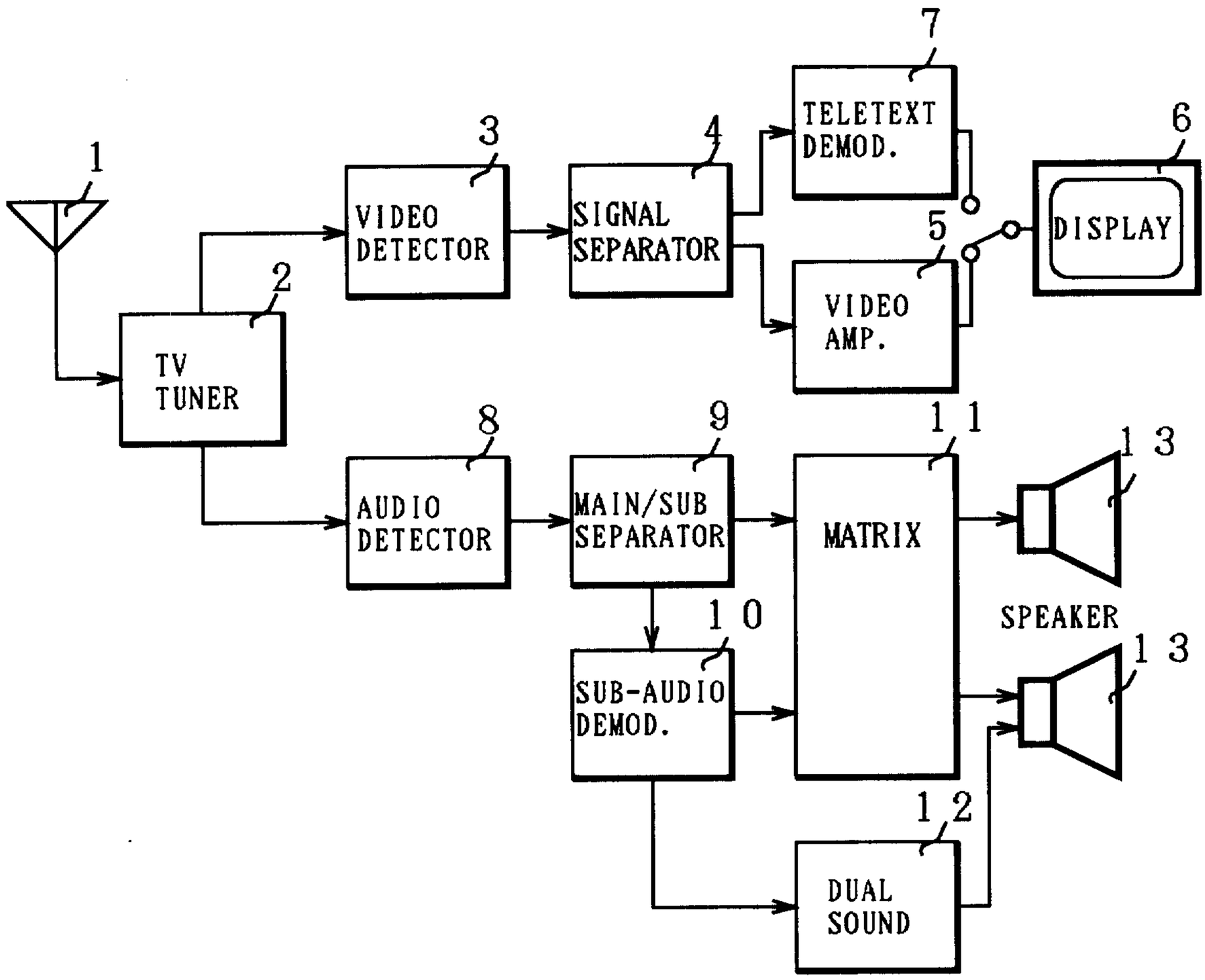

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
6
DISPLAY
5
VIDEO AMP.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
13
10
SUB-AUDIO DEMOD.
12
DUAL SOUND

Fig.4

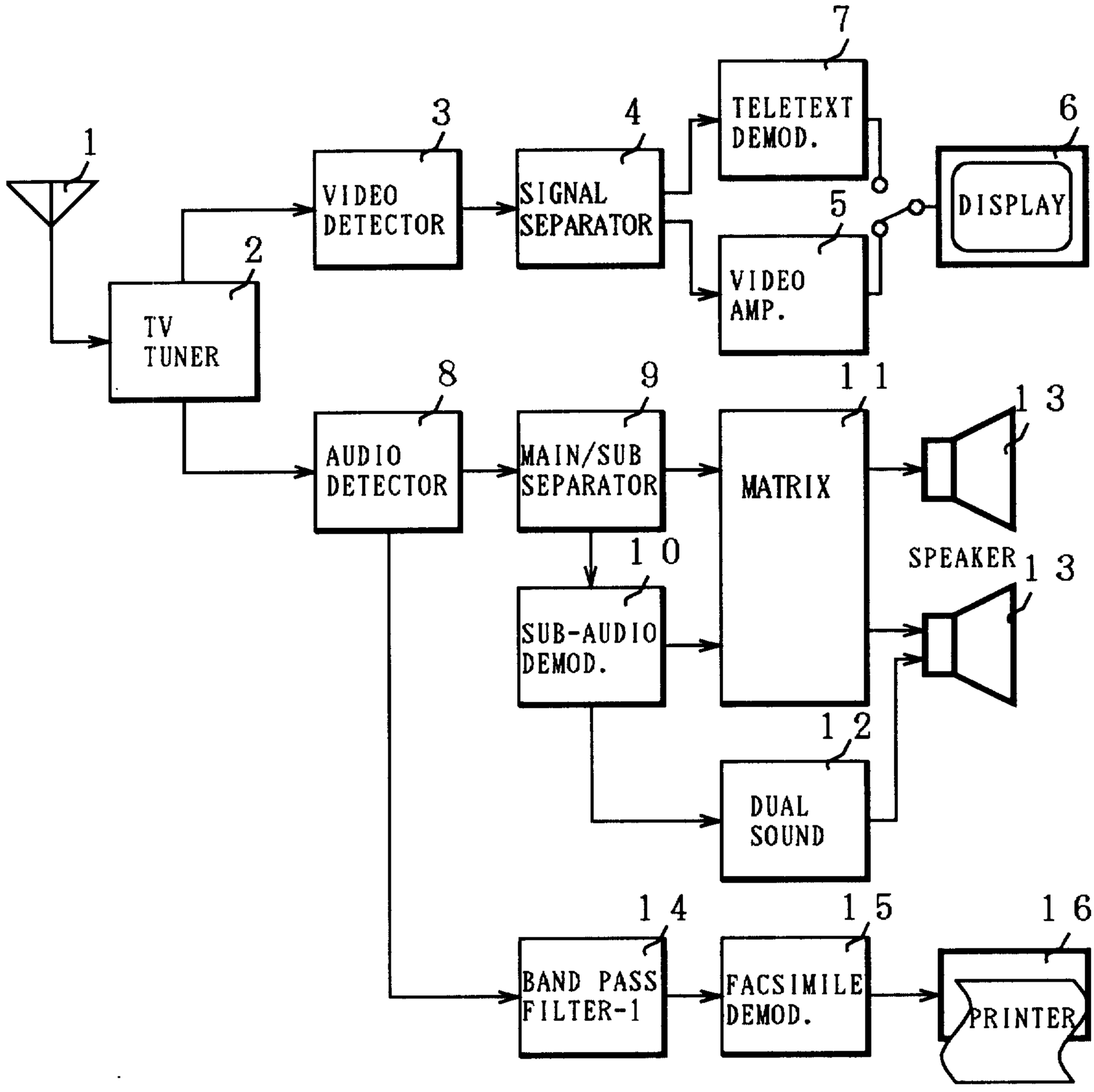

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
5
VIDEO AMP.
6
DISPLAY
7
TELETEXT DEMOD.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
12
DUAL SOUND
13
SPEAKER
13
14
BAND PASS FILTER-1
15
FACSIMILE DEMOD.
16
PRINTER

Fig.5

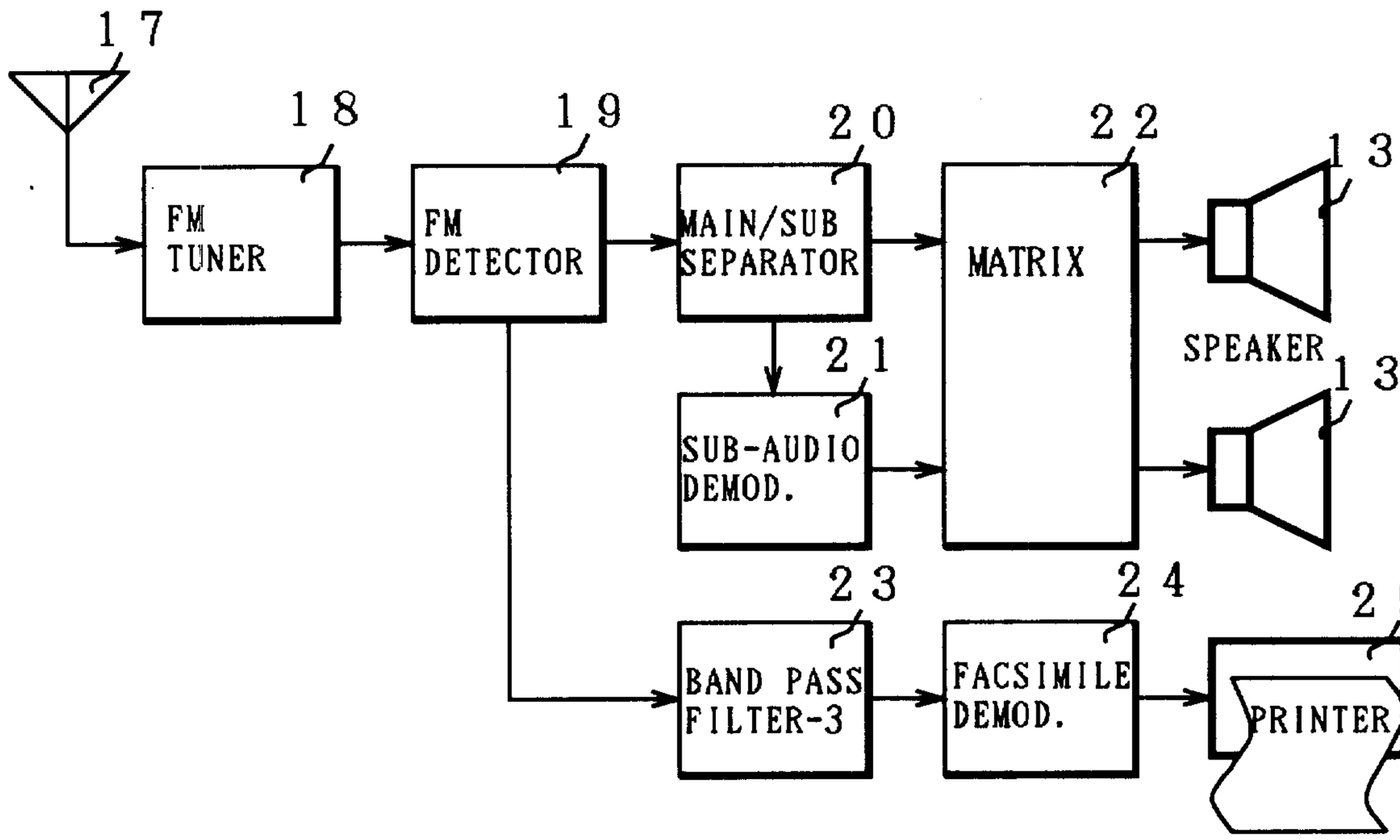

17
18
19
20
22
13
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
SPEAKER
21
SUB-AUDIO DEMOD.
13
23
24
25
BAND PASS FILTER-3
FACSIMILE DEMOD.
PRINTER

Fig.6

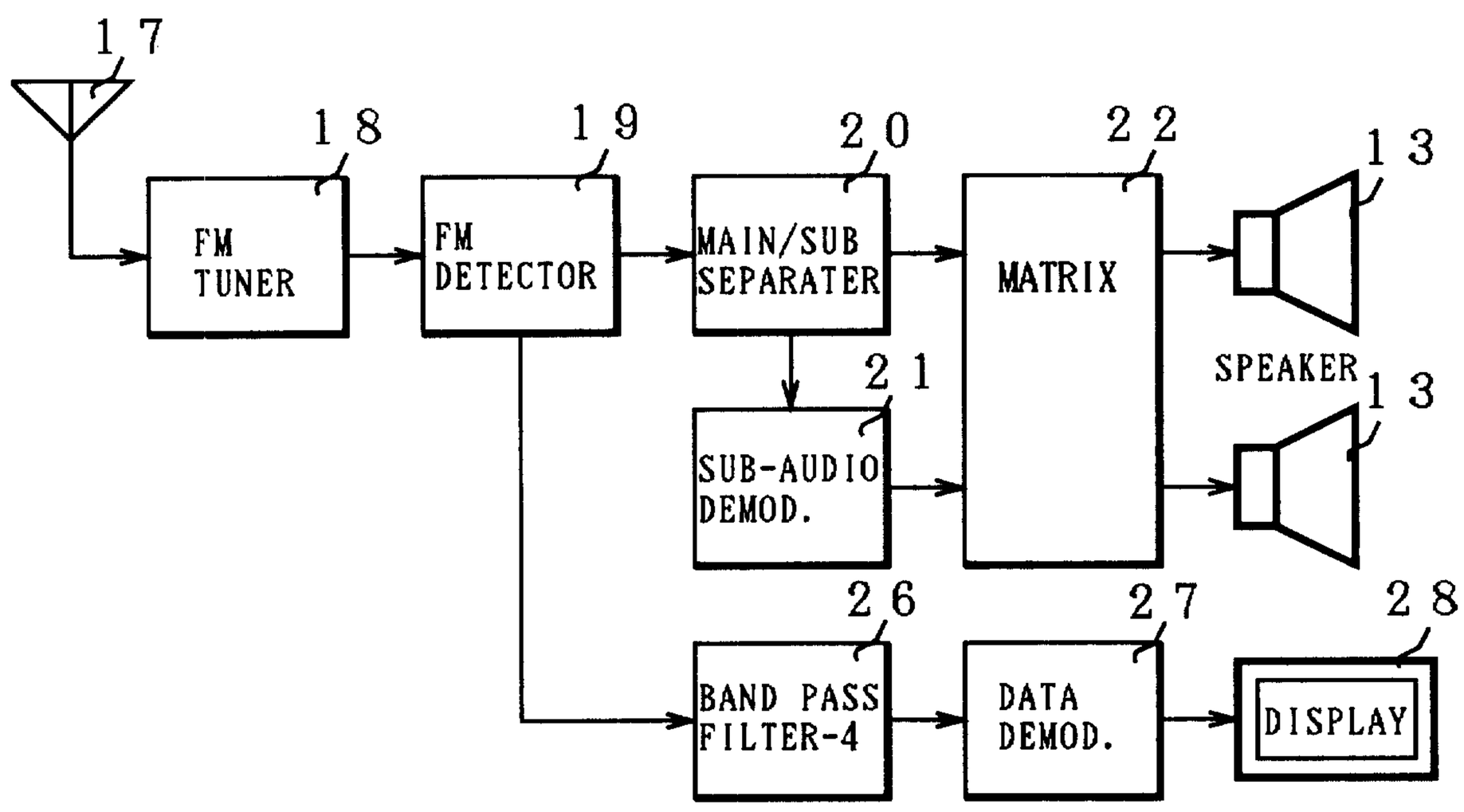

17
18
19
20
22
13
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATER
MATRIX
SPEAKER
21
SUB-AUDIO DEMOD.
13
26
27
28
BAND PASS FILTER-4
DATA DEMOD.
DISPLAY

Fig.7

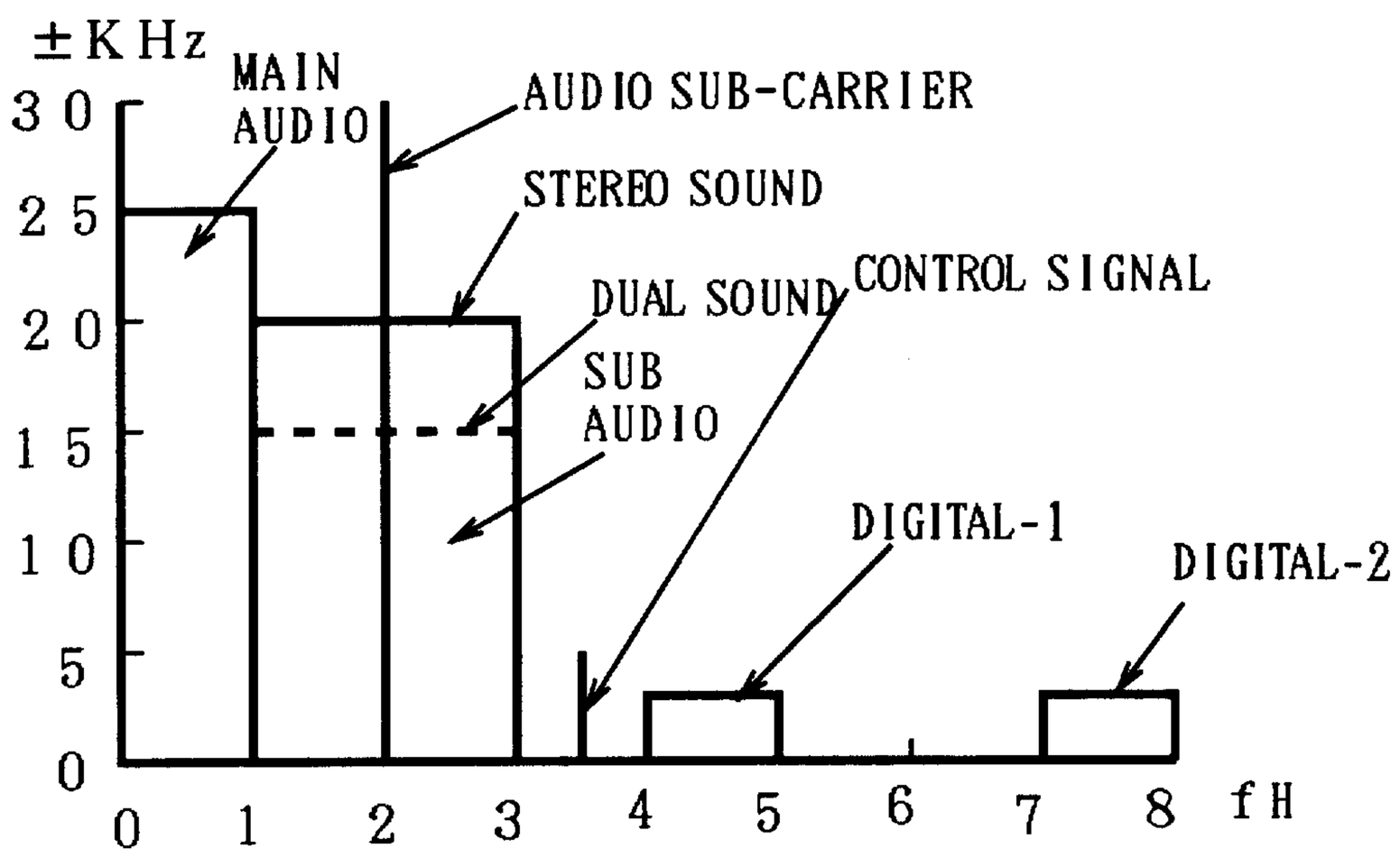

±KHz
30
25
20
15
10
5
0
MAIN AUDIO
AUDIO SUB-CARRIER
STEREO SOUND
DUAL SOUND
SUB AUDIO
CONTROL SIGNAL
DIGITAL-1
DIGITAL-2
0 1 2 3 4 5 6 7 8 fH

Fig.8

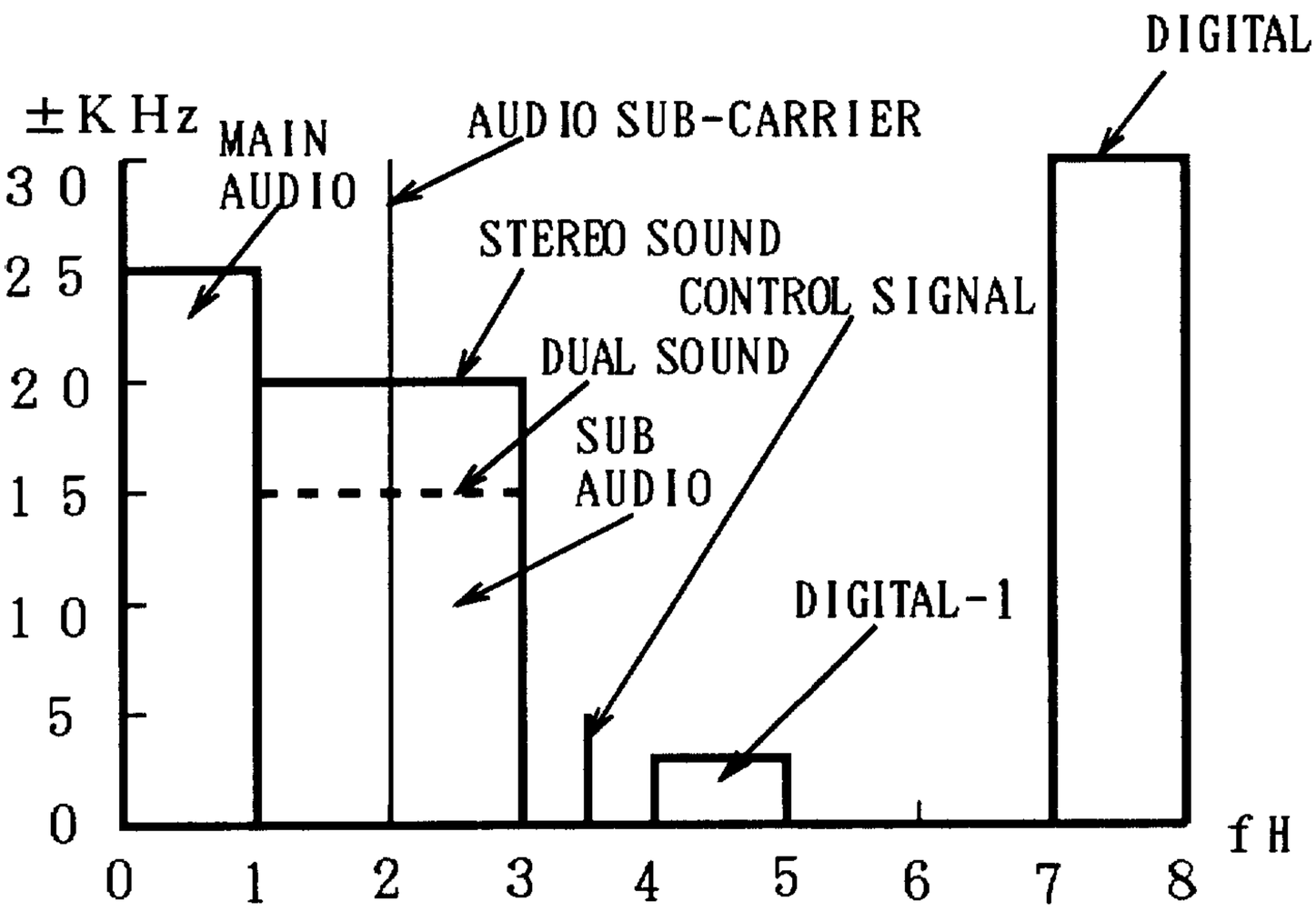

±KHz
30
25
20
15
10
5
0
MAIN AUDIO
AUDIO SUB-CARRIER
STEREO SOUND
DUAL SOUND
SUB AUDIO
CONTROL SIGNAL
DIGITAL-1
DIGITAL-3
0 1 2 3 4 5 6 7 8 fH

Fig.9

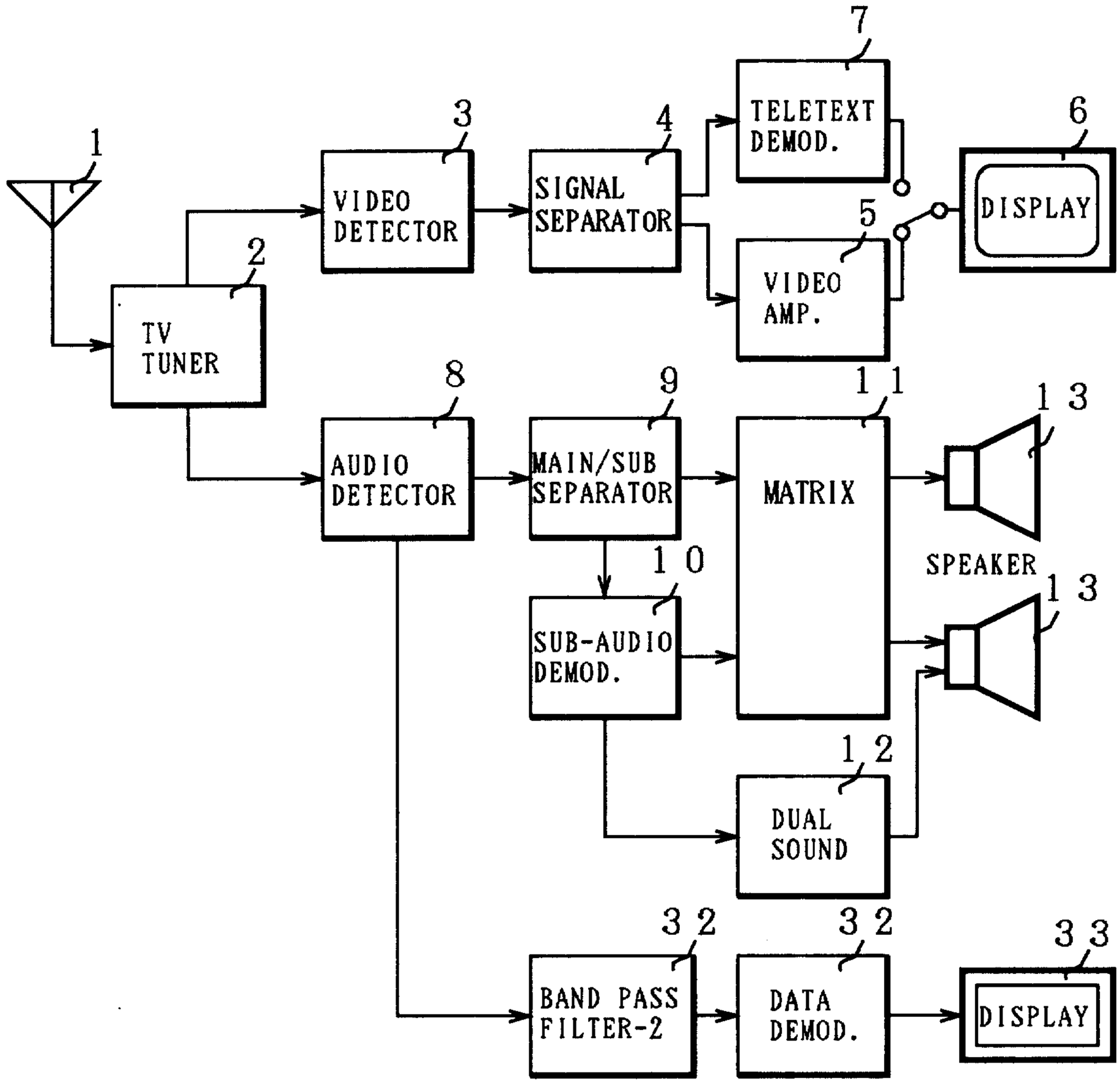

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
6
DISPLAY
5
VIDEO AMP.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
13
10
SUB-AUDIO DEMOD.
12
DUAL SOUND
32
BAND PASS FILTER-2
32
DATA DEMOD.
33
DISPLAY

Fig.10

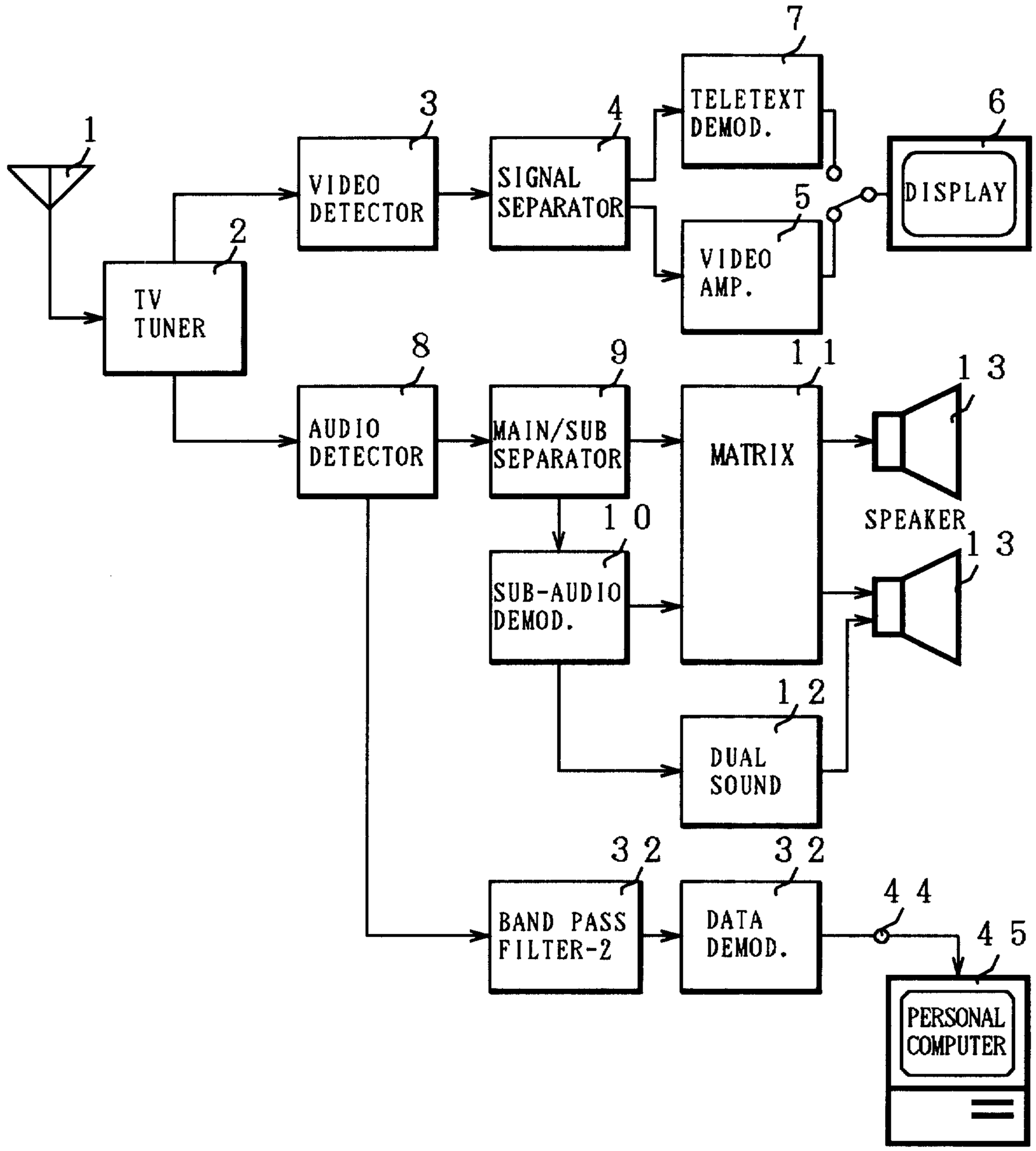

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
6
DISPLAY
5
VIDEO AMP.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
10
SUB-AUDIO DEMOD.
13
12
DUAL SOUND
32
BAND PASS FILTER-2
32
DATA DEMOD.
44
45
PERSONAL COMPUTER

Fig.11

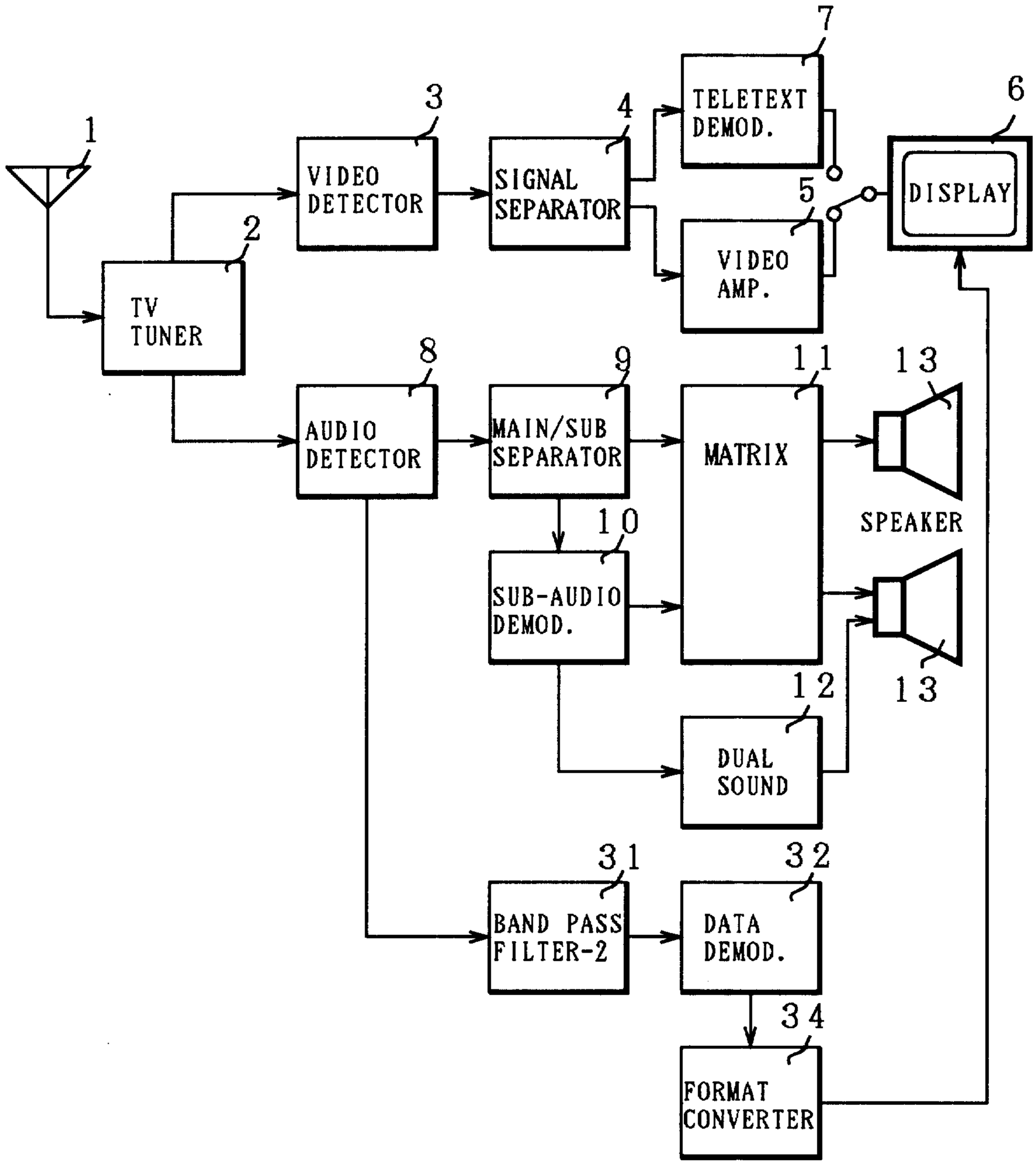

1
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TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
5
VIDEO AMP.
6
DISPLAY
7
TELETEXT DEMOD.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
12
DUAL SOUND
13
SPEAKER
31
BAND PASS FILTER-2
32
DATA DEMOD.
34
FORMAT CONVERTER

Fig.12

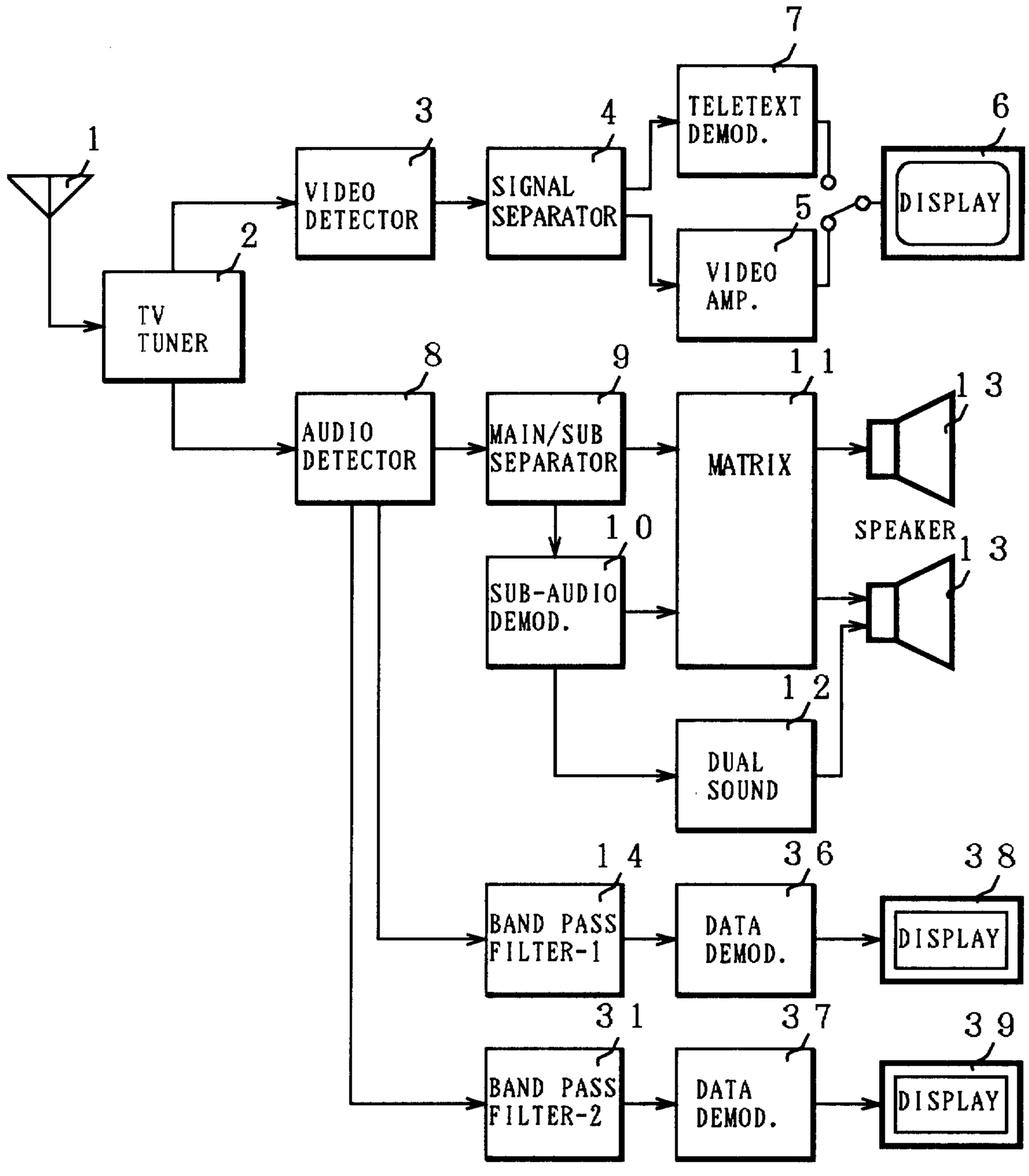

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
5
VIDEO AMP.
6
DISPLAY
7
TELETEXT DEMOD.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
12
DUAL SOUND
13
SPEAKER
13
14
BAND PASS FILTER-1
36
DATA DEMOD.
38
DISPLAY
31
BAND PASS FILTER-2
37
DATA DEMOD.
39
DISPLAY

Fig.13

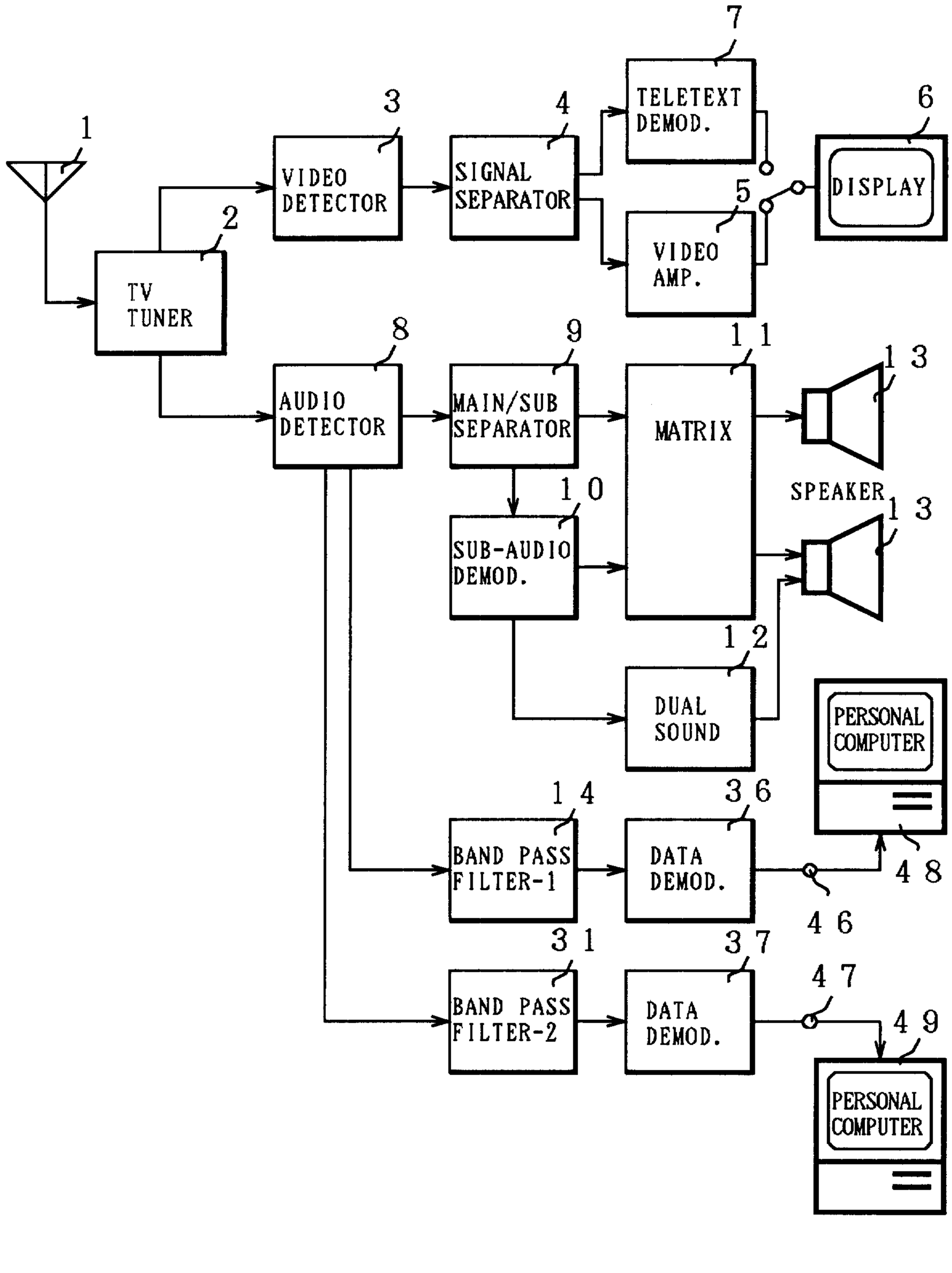

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14
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36
37
46
47
48
49
TV TUNER
VIDEO DETECTOR
SIGNAL SEPARATOR
TELETEXT DEMOD.
VIDEO AMP.
DISPLAY
AUDIO DETECTOR
MAIN/SUB SEPARATOR
MATRIX
SPEAKER
SUB-AUDIO DEMOD.
DUAL SOUND
PERSONAL COMPUTER
BAND PASS FILTER-1
DATA DEMOD.
BAND PASS FILTER-2
DATA DEMOD.
PERSONAL COMPUTER

Fig.14

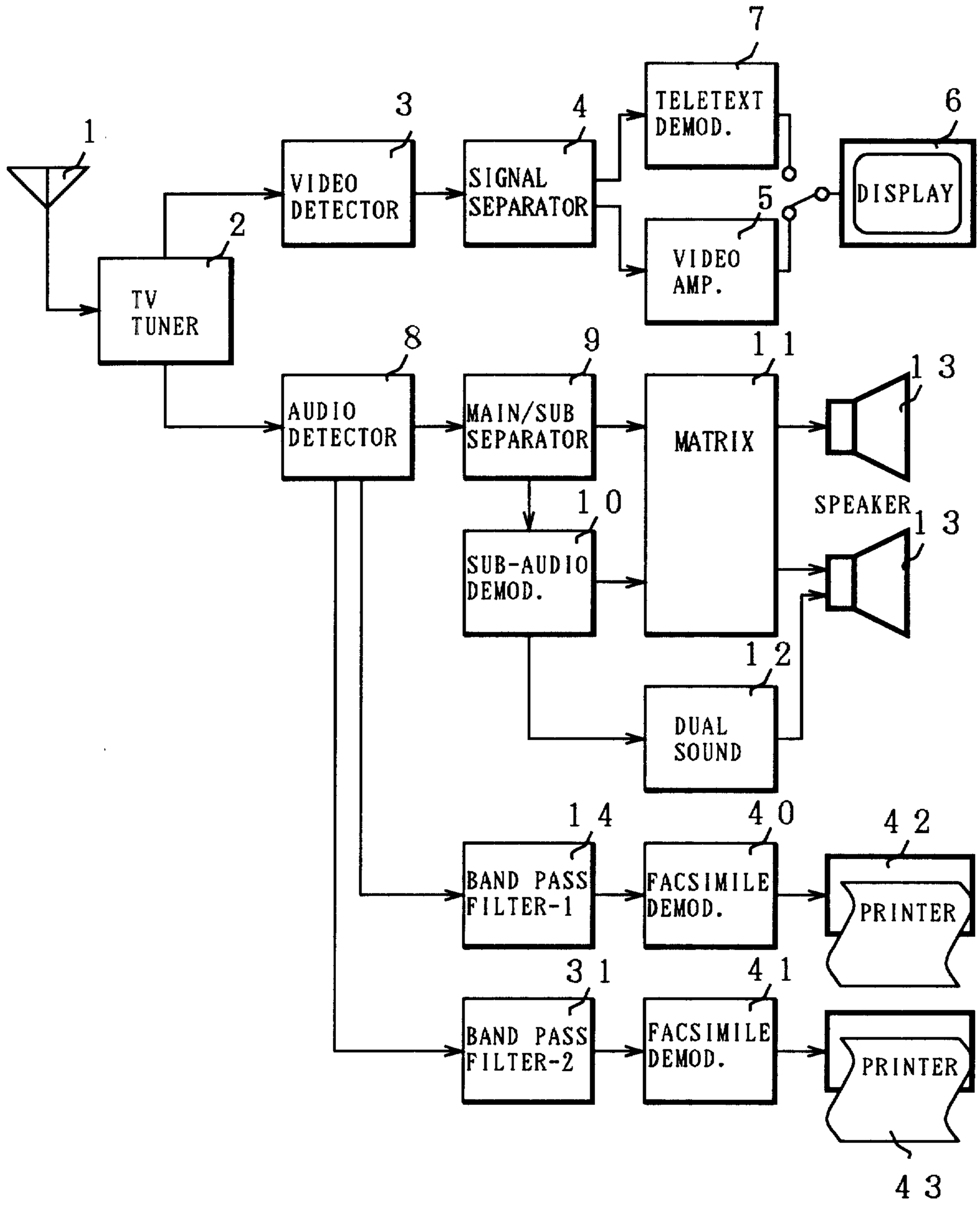

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
5
VIDEO AMP.
6
DISPLAY
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
13
SPEAKER
13
12
DUAL SOUND
14
BAND PASS FILTER-1
40
FACSIMILE DEMOD.
42
PRINTER
31
BAND PASS FILTER-2
41
FACSIMILE DEMOD.
PRINTER
43

Fig.15

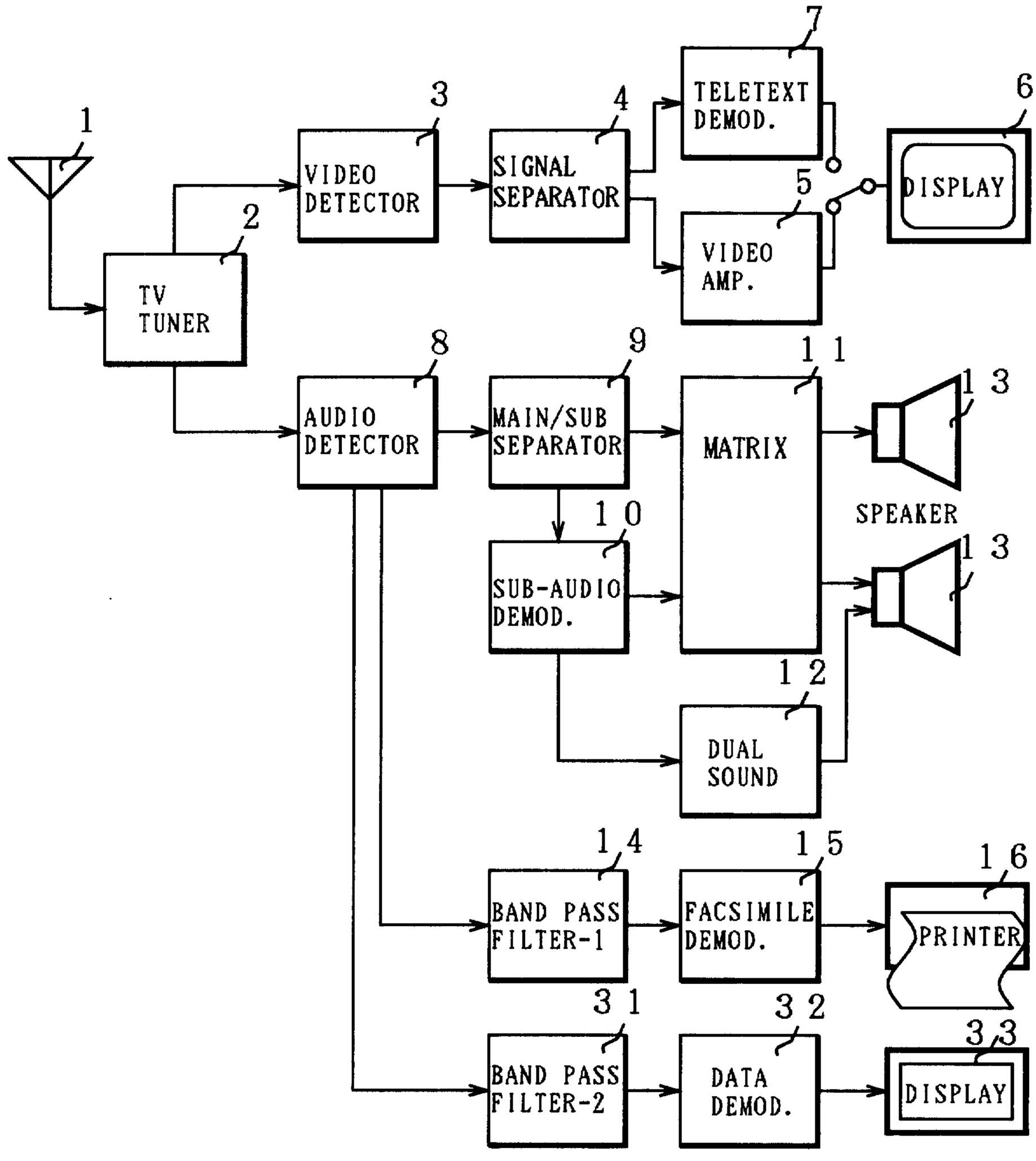

1
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TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
5
VIDEO AMP.
6
DISPLAY
7
TELETEXT DEMOD.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
12
DUAL SOUND
13
SPEAKER
13
14
BAND PASS FILTER-1
15
FACSIMILE DEMOD.
16
PRINTER
31
BAND PASS FILTER-2
32
DATA DEMOD.
33
DISPLAY

Fig.16

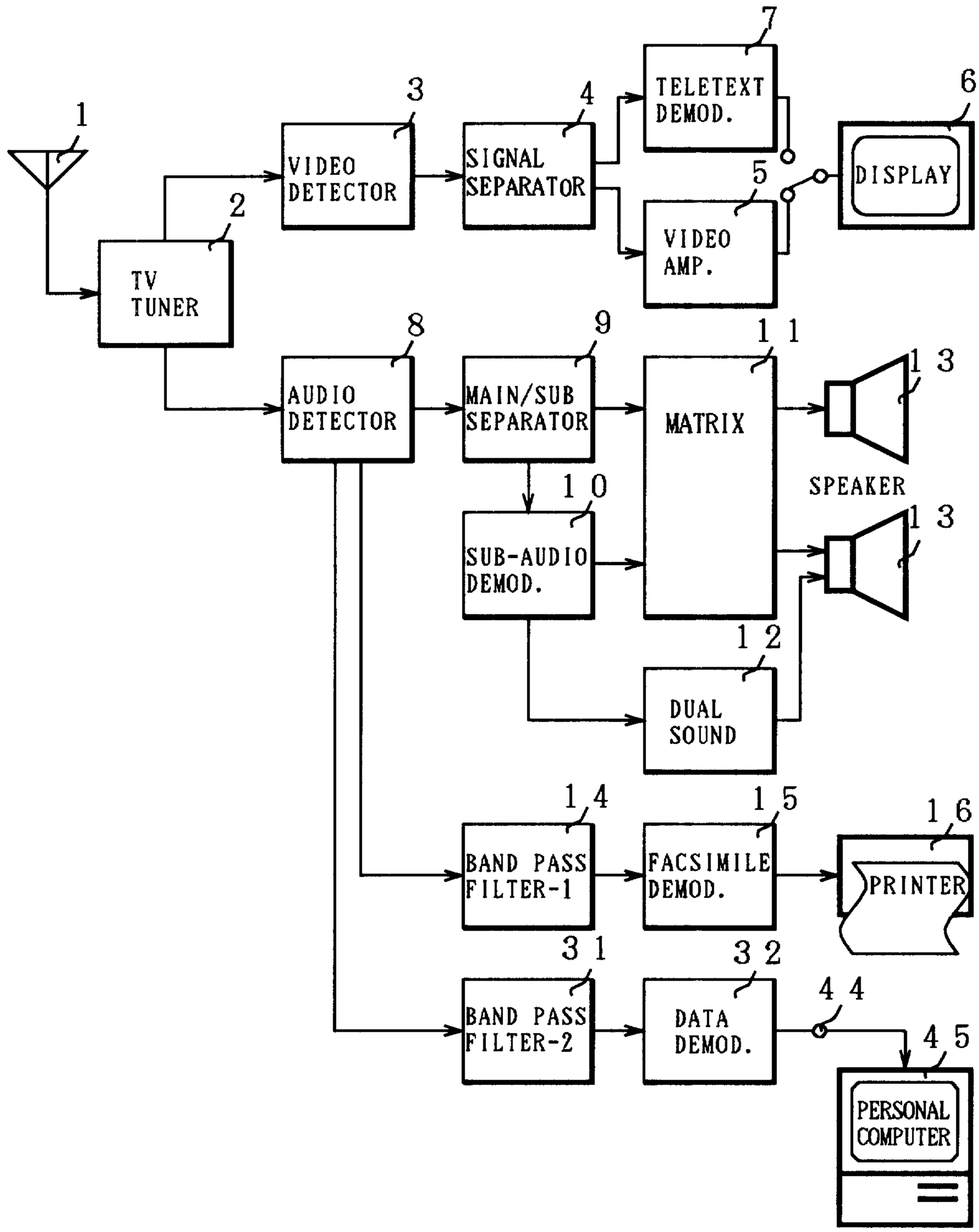

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
5
VIDEO AMP.
6
DISPLAY
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
13
SPEAKER
13
12
DUAL SOUND
14
BAND PASS FILTER-1
15
FACSIMILE DEMOD.
16
PRINTER
31
BAND PASS FILTER-2
32
DATA DEMOD.
44
45
PERSONAL COMPUTER

Fig.17

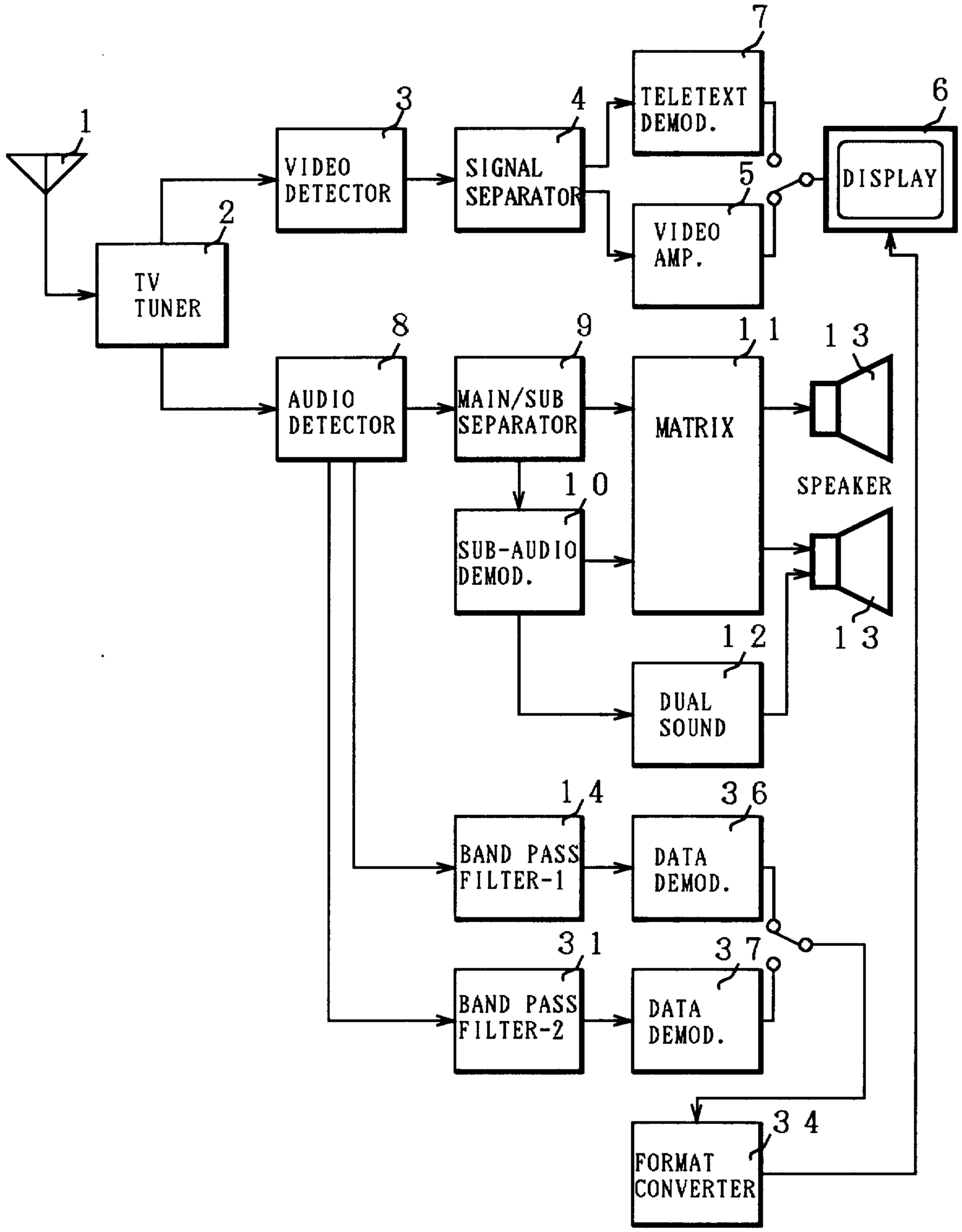

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
5
VIDEO AMP.
6
DISPLAY
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
13
SPEAKER
13
12
DUAL SOUND
14
BAND PASS FILTER-1
36
DATA DEMOD.
31
BAND PASS FILTER-2
37
DATA DEMOD.
34
FORMAT CONVERTER

Fig.18

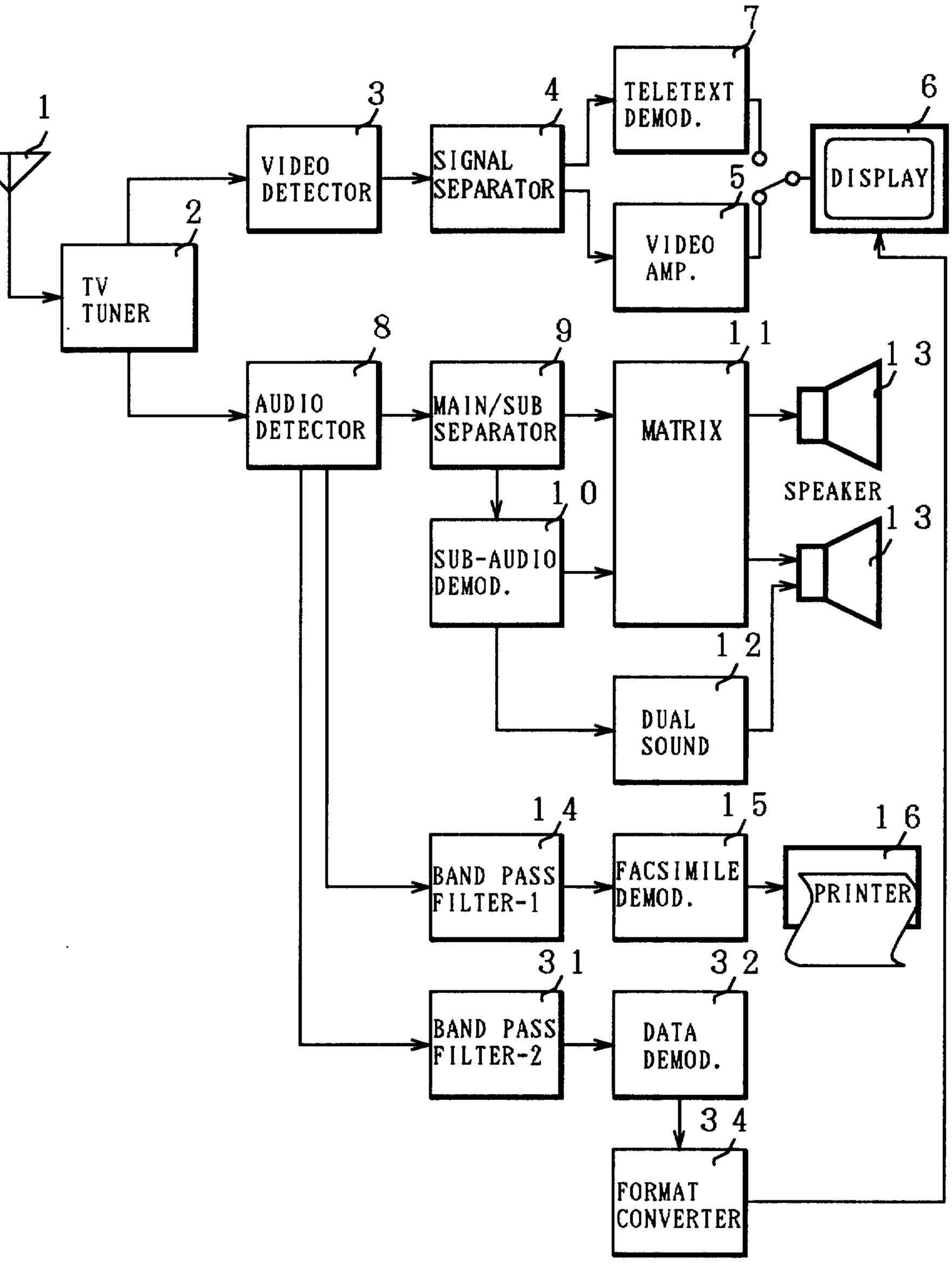

1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
7
TELETEXT DEMOD.
5
VIDEO AMP.
6
DISPLAY
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
13
10
SUB-AUDIO DEMOD.
12
DUAL SOUND
14
BAND PASS FILTER-1
15
FACSIMILE DEMOD.
16
PRINTER
31
BAND PASS FILTER-2
32
DATA DEMOD.
34
FORMAT CONVERTER

Fig.19

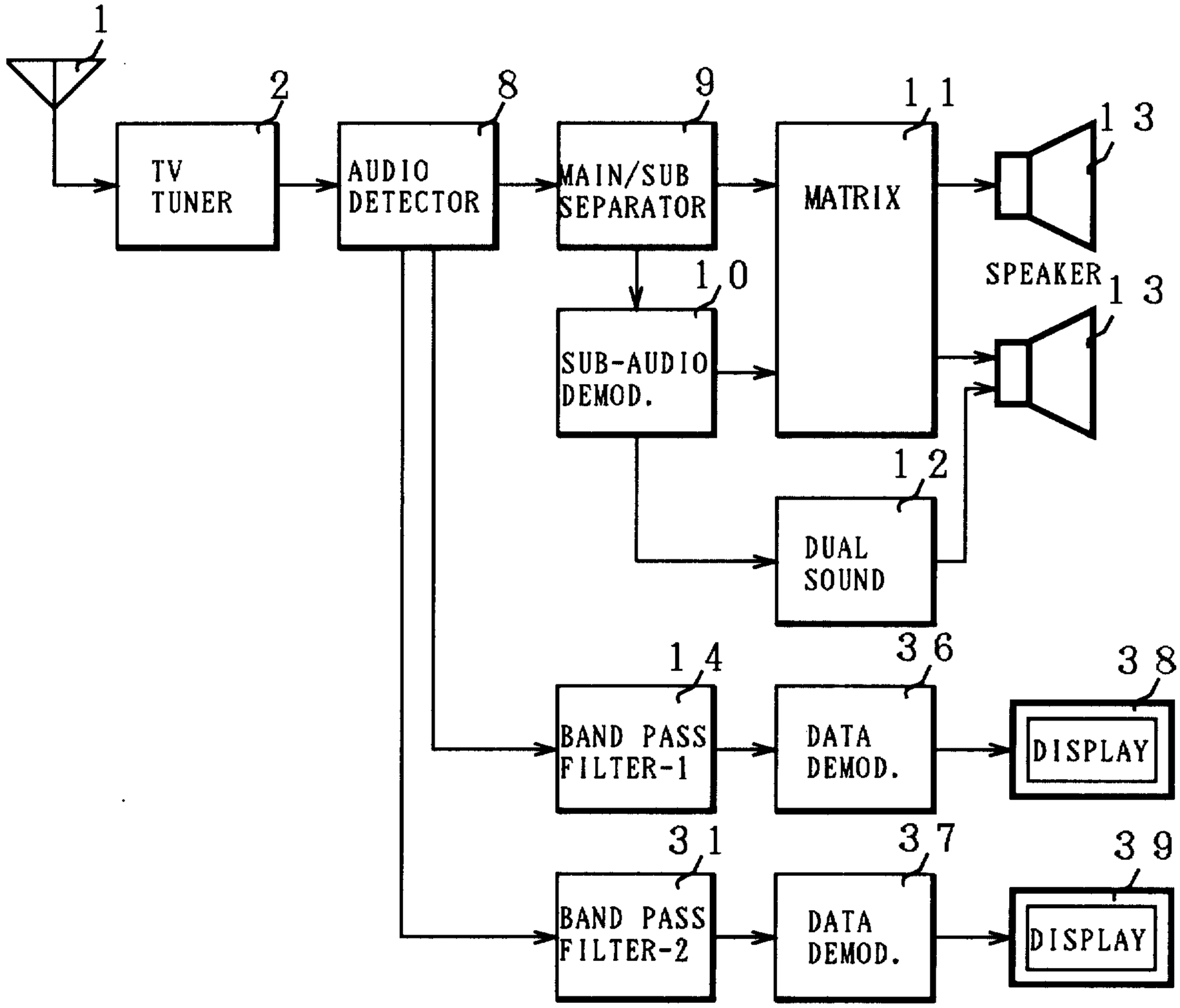

1
2
TV TUNER
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
10
SUB-AUDIO DEMOD.
13
12
DUAL SOUND
14
BAND PASS FILTER-1
36
DATA DEMOD.
38
DISPLAY
31
BAND PASS FILTER-2
37
DATA DEMOD.
39
DISPLAY

Fig.20

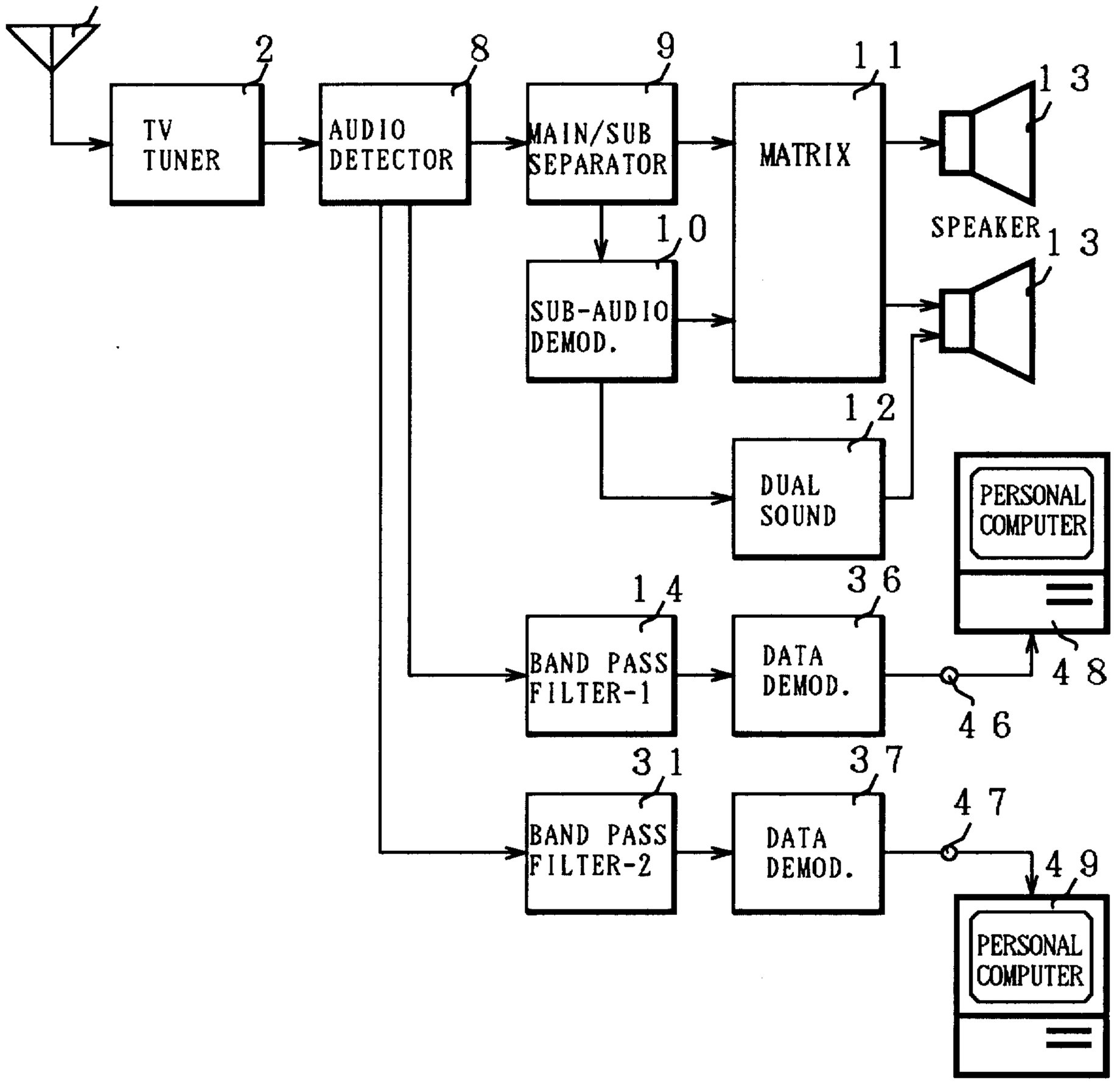

1
2
TV TUNER
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
10
SUB-AUDIO DEMOD.
13
12
DUAL SOUND
PERSONAL COMPUTER
14
BAND PASS FILTER-1
36
DATA DEMOD.
48
46
31
BAND PASS FILTER-2
37
DATA DEMOD.
47
49
PERSONAL COMPUTER

Fig.21

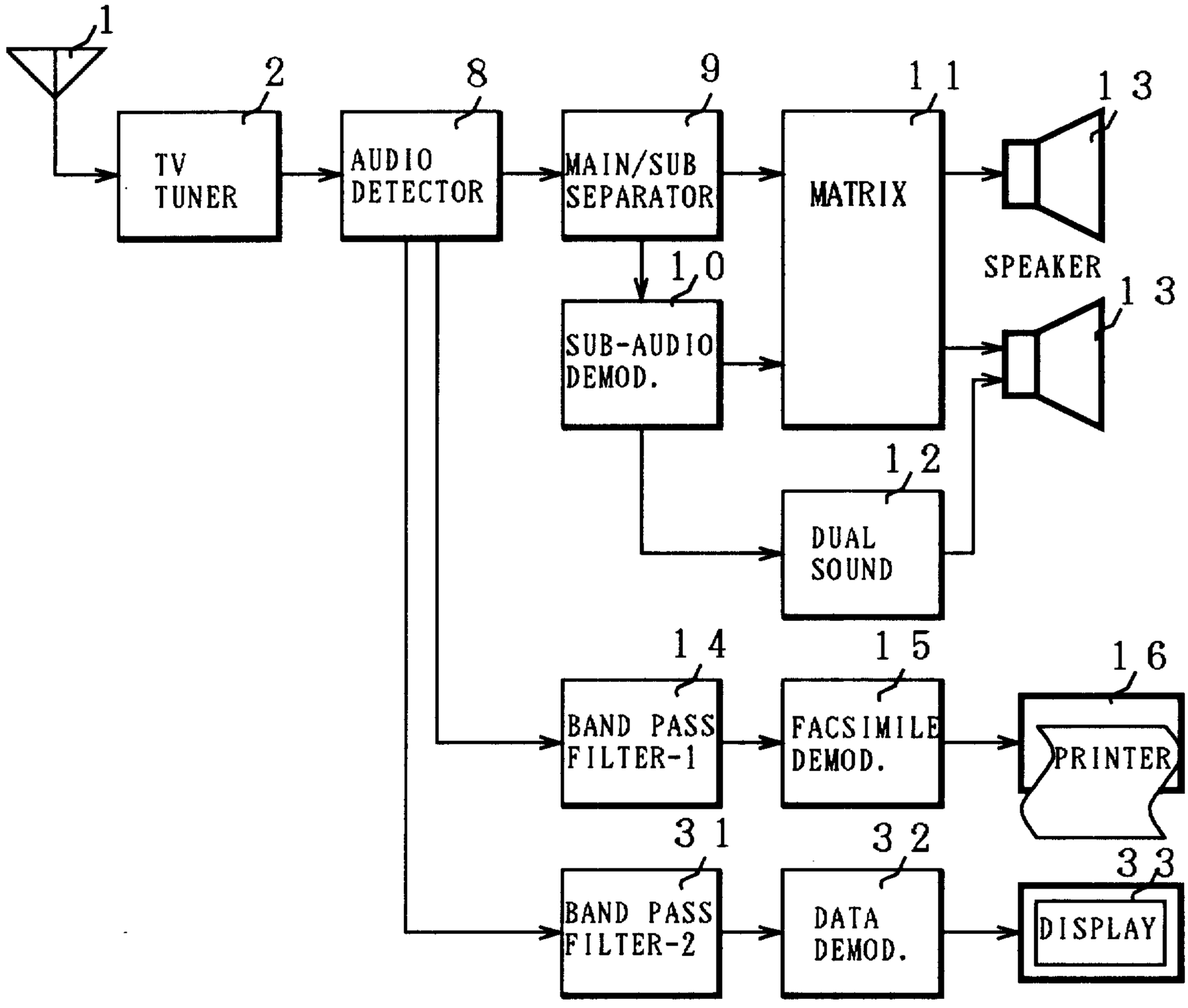

1
2
TV TUNER
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
10
SUB-AUDIO DEMOD.
13
12
DUAL SOUND
14
BAND PASS FILTER-1
15
FACSIMILE DEMOD.
16
PRINTER
31
BAND PASS FILTER-2
32
DATA DEMOD.
33
DISPLAY

Fig.22

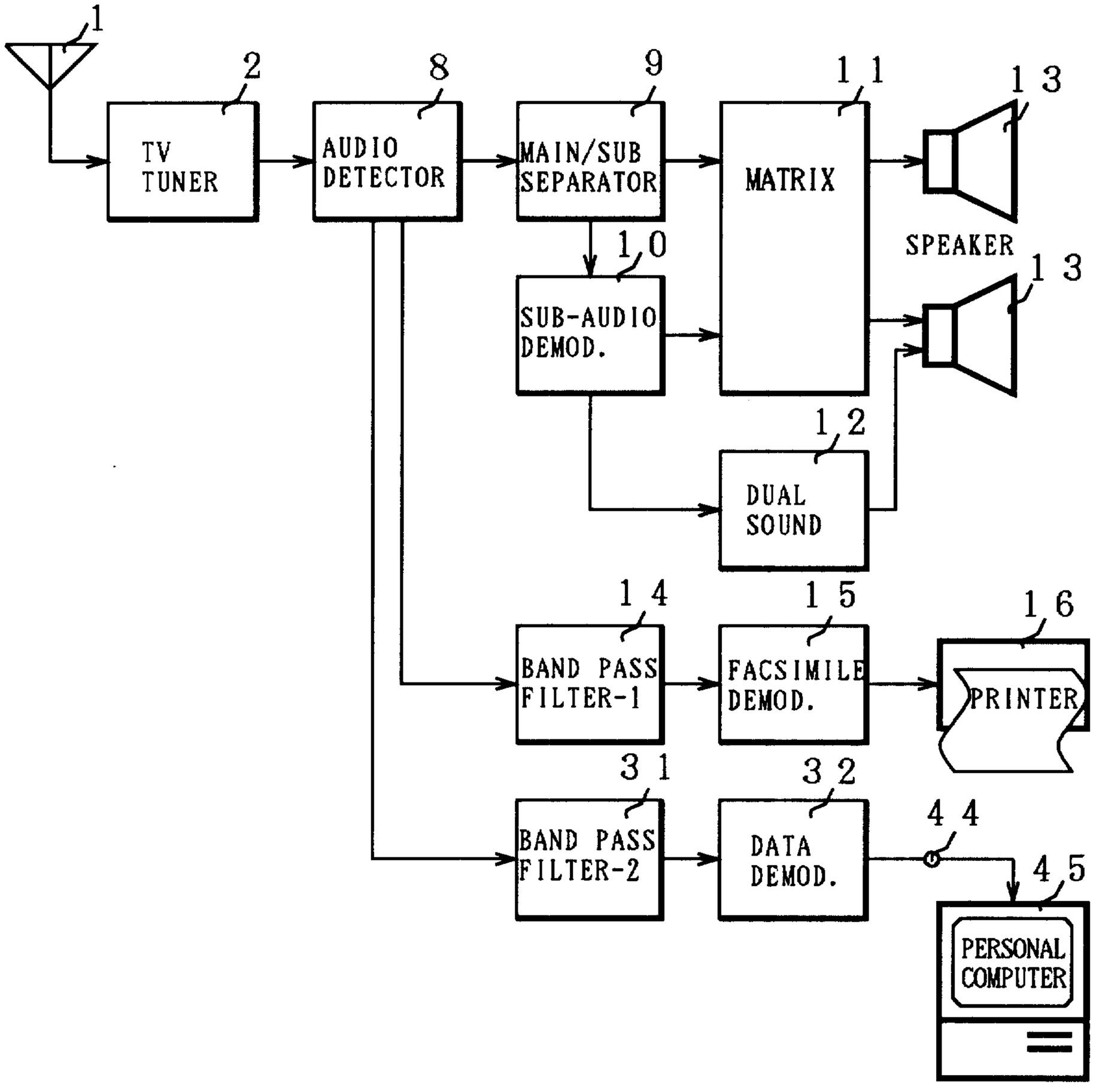

1
2
TV TUNER
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
11
MATRIX
13
SPEAKER
10
SUB-AUDIO DEMOD.
13
12
DUAL SOUND
14
BAND PASS FILTER-1
15
FACSIMILE DEMOD.
16
PRINTER
31
BAND PASS FILTER-2
32
DATA DEMOD.
44
45
PERSONAL COMPUTER

Fig.23

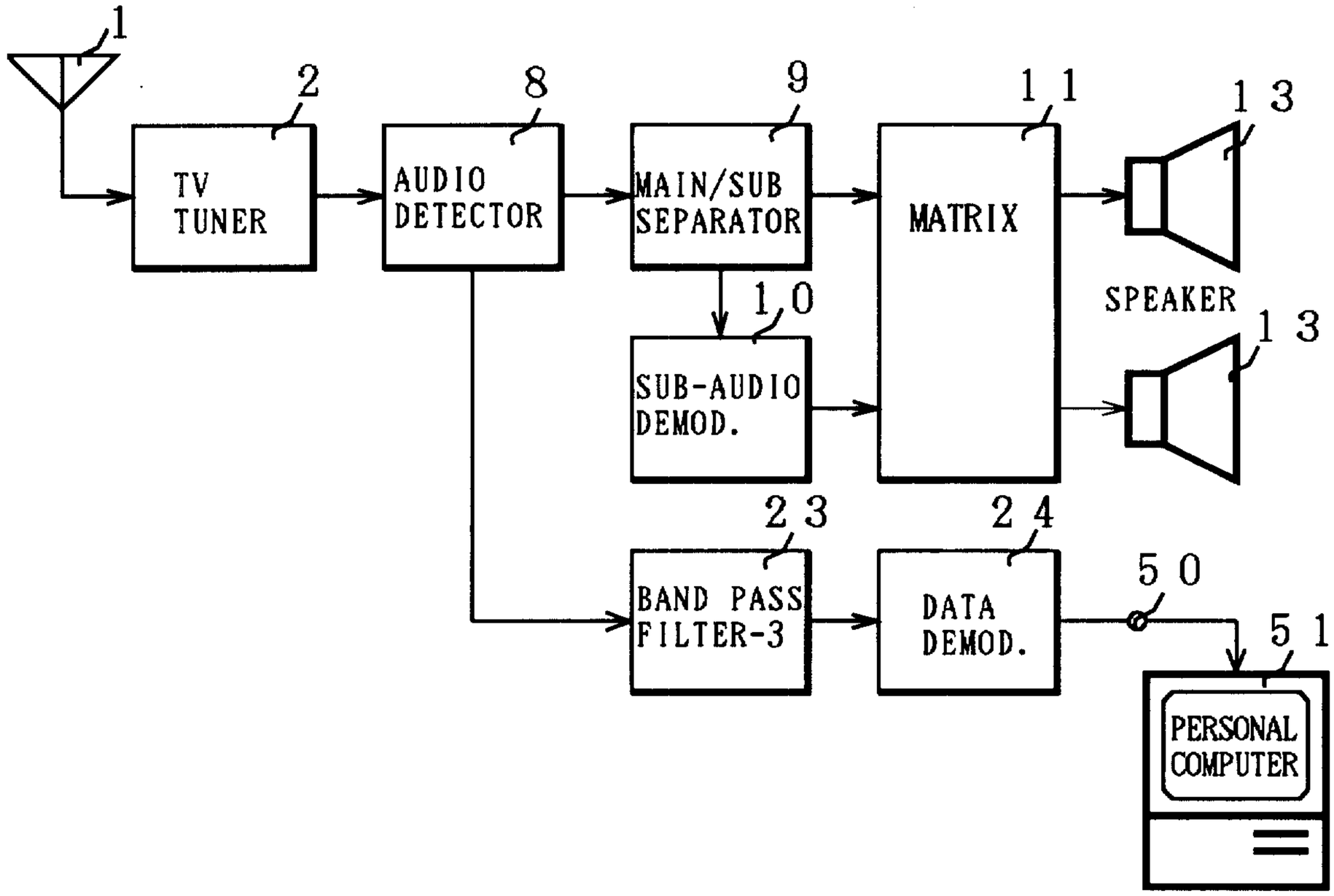

1
2
TV TUNER
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
13
SPEAKER
13
23
BAND PASS FILTER-3
24
DATA DEMOD.
50
51
PERSONAL COMPUTER

Fig.24

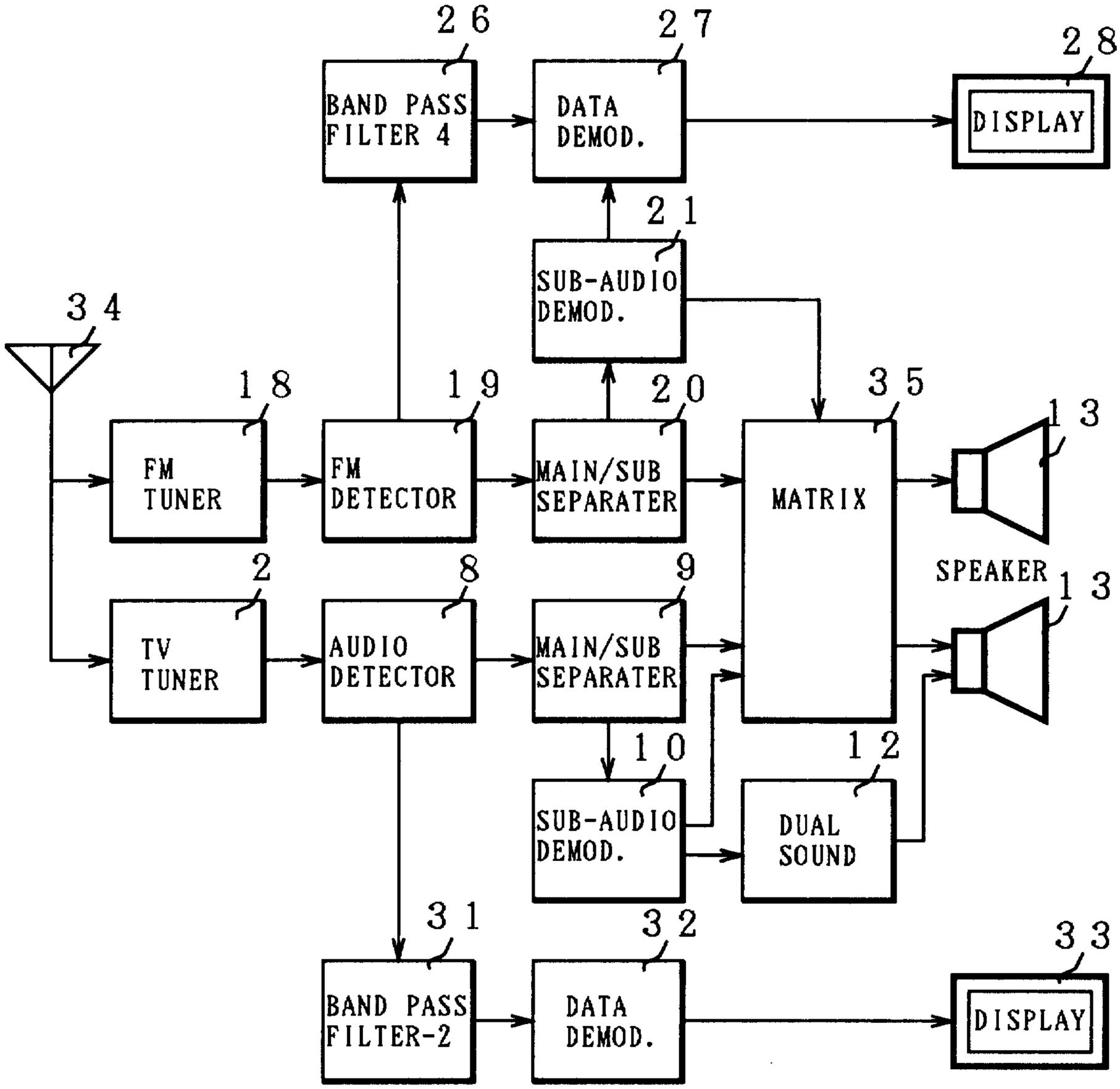

26
27
28
BAND PASS FILTER 4
DATA DEMOD.
DISPLAY
21
SUB-AUDIO DEMOD.
34
18
19
20
35
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATER
MATRIX
13
SPEAKER
2
8
9
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATER
13
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
31
32
33
BAND PASS FILTER-2
DATA DEMOD.
DISPLAY

Fig.25

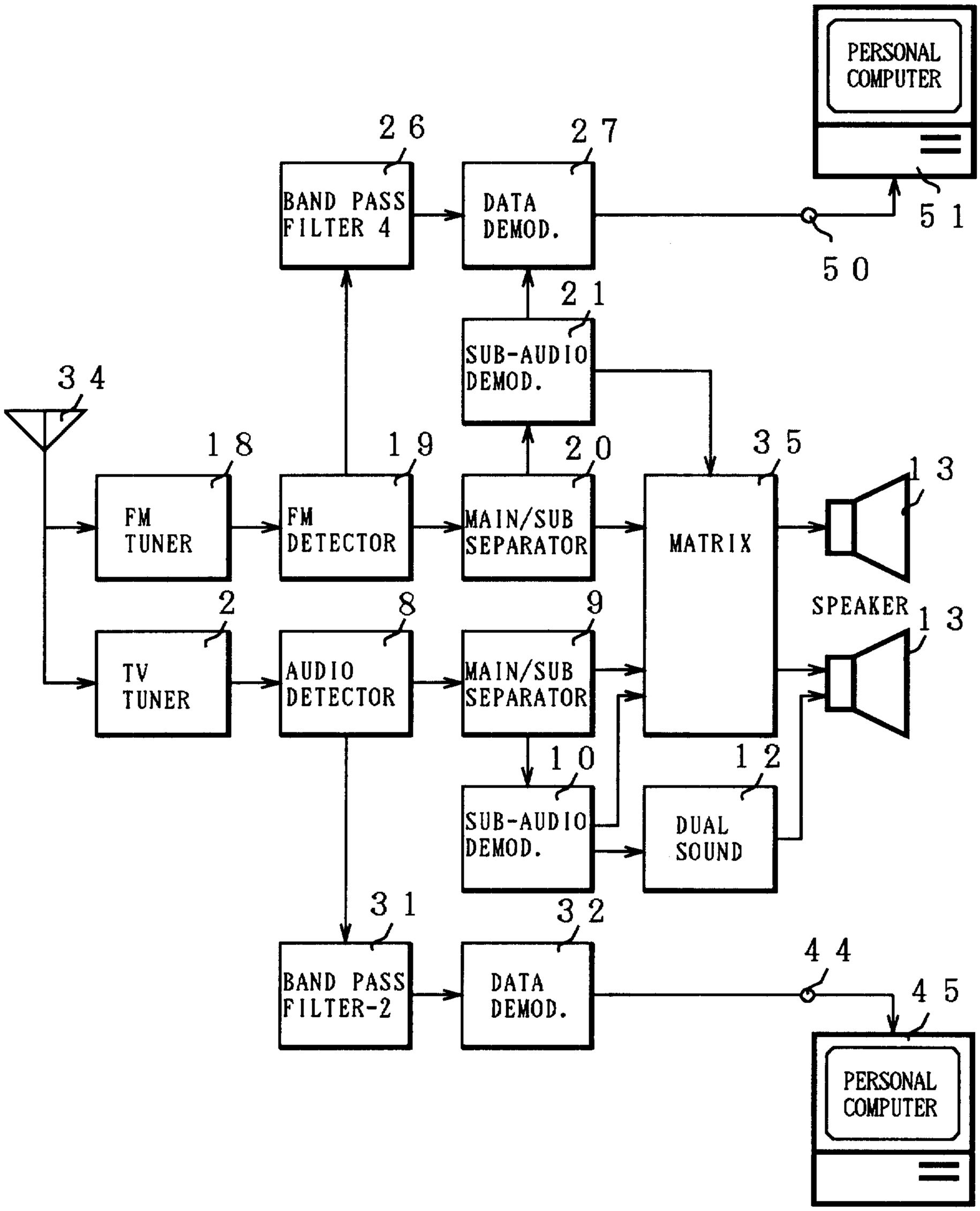

PERSONAL COMPUTER
26
27
BAND PASS FILTER 4
DATA DEMOD.
51
50
21
SUB-AUDIO DEMOD.
34
18
19
20
35
13
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
SPEAKER
2
8
9
13
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATOR
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
31
32
44
45
BAND PASS FILTER-2
DATA DEMOD.
PERSONAL COMPUTER

Fig.26

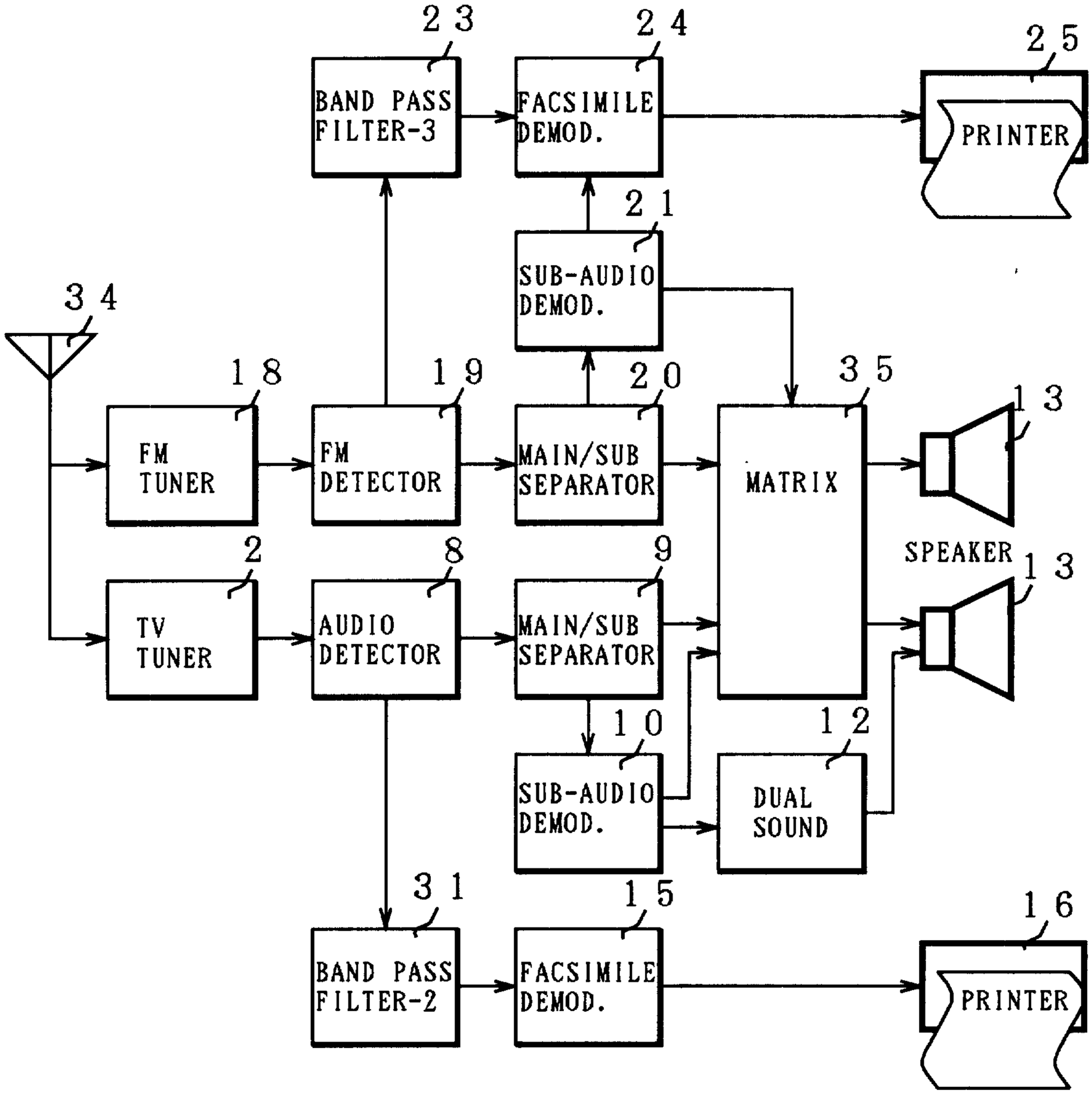

23
24
25
BAND PASS FILTER-3
FACSIMILE DEMOD.
PRINTER
21
SUB-AUDIO DEMOD.
34
18
19
20
35
13
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
SPEAKER
2
8
9
13
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATOR
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
31
15
16
BAND PASS FILTER-2
FACSIMILE DEMOD.
PRINTER

Fig.27

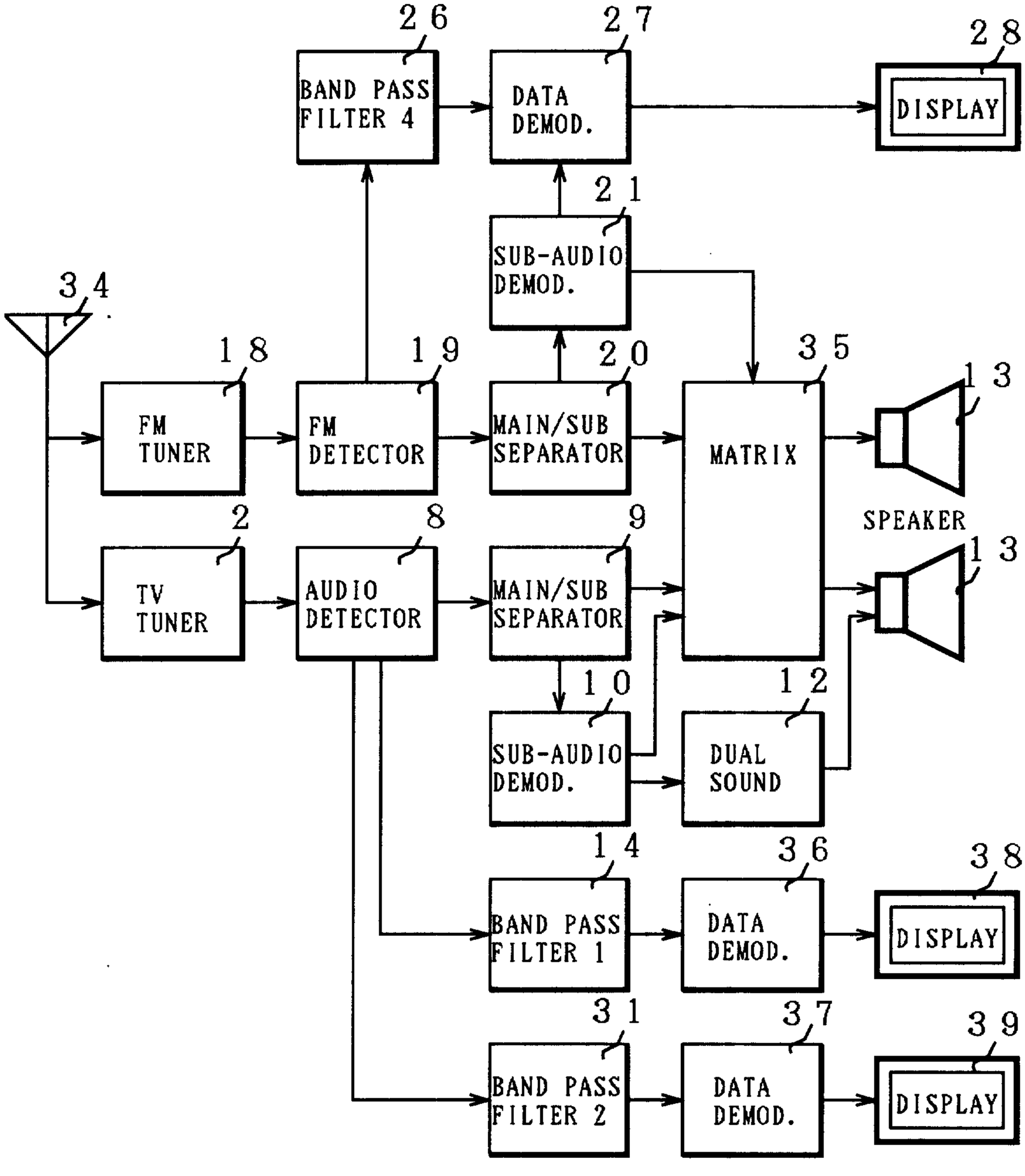

26
27
28
BAND PASS FILTER 4
DATA DEMOD.
DISPLAY
21
SUB-AUDIO DEMOD.
34
18
19
20
35
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
13
SPEAKER
2
8
9
13
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATOR
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
14
36
38
BAND PASS FILTER 1
DATA DEMOD.
DISPLAY
31
37
39
BAND PASS FILTER 2
DATA DEMOD.
DISPLAY

Fig.28

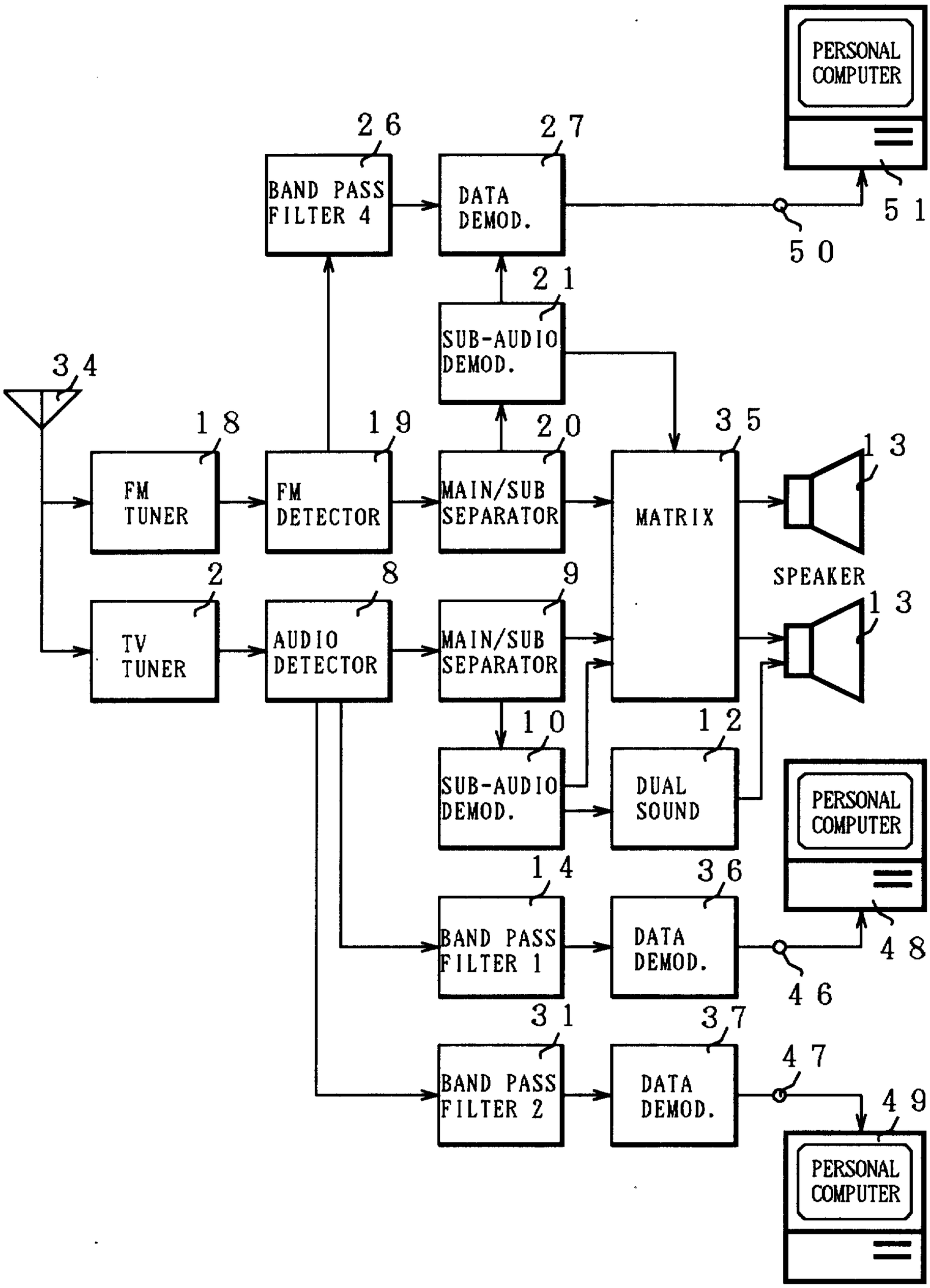

PERSONAL COMPUTER
26
27
BAND PASS FILTER 4
DATA DEMOD.
51
50
21
SUB-AUDIO DEMOD.
34
18
19
20
35
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
13
SPEAKER
2
8
9
13
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATOR
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
PERSONAL COMPUTER
14
36
BAND PASS FILTER 1
DATA DEMOD.
48
46
31
37
47
49
BAND PASS FILTER 2
DATA DEMOD.
PERSONAL COMPUTER

Fig.29

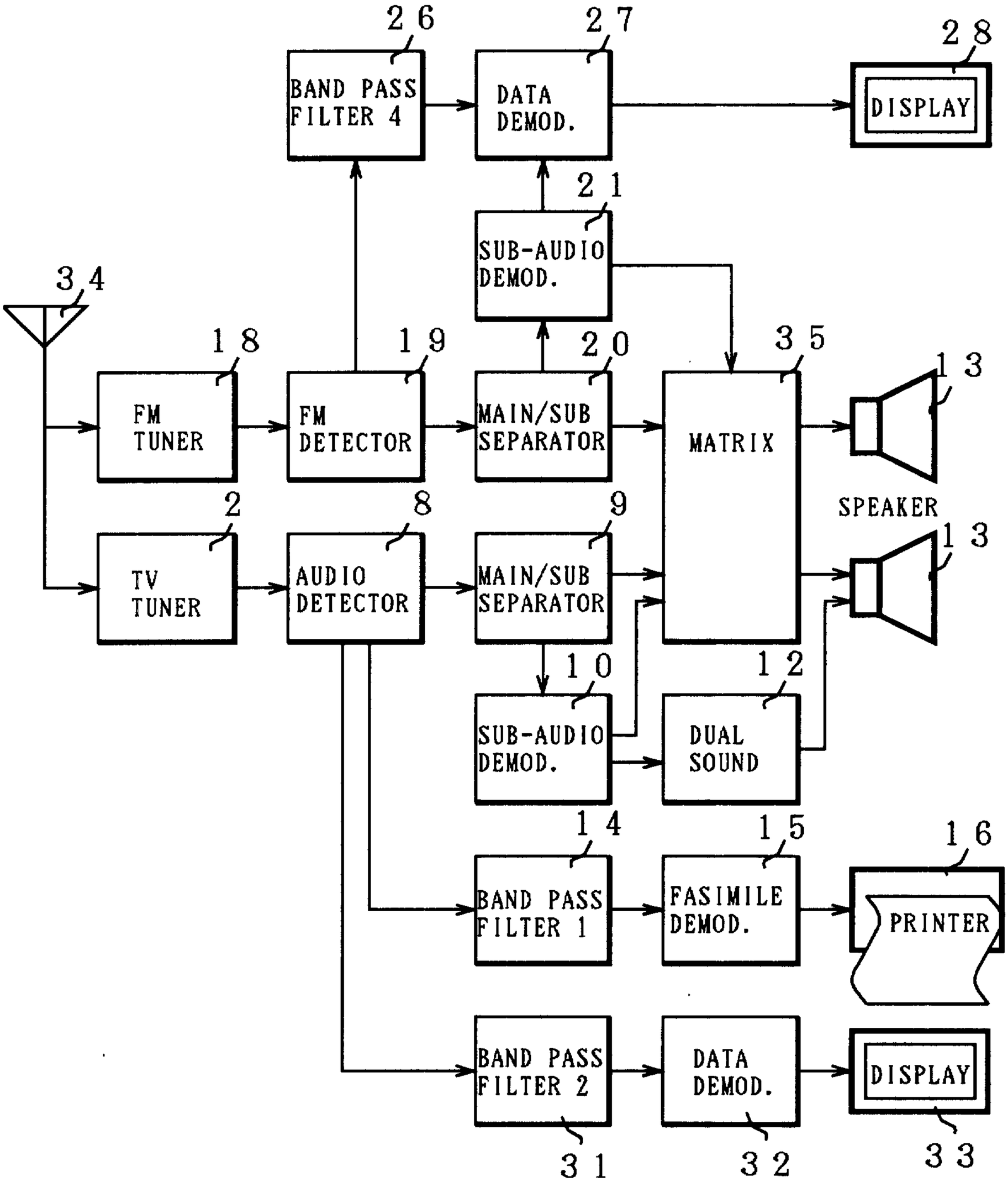
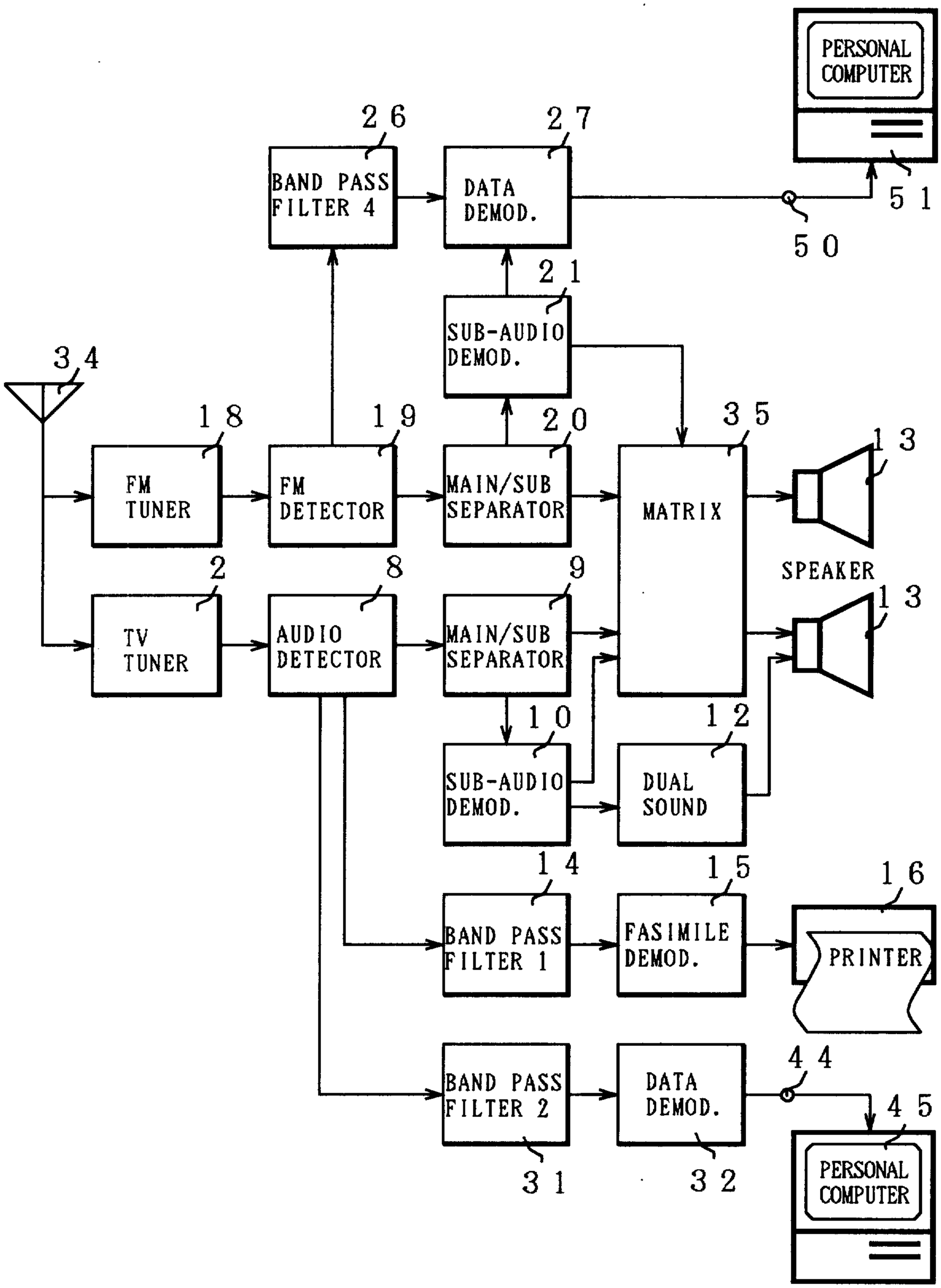
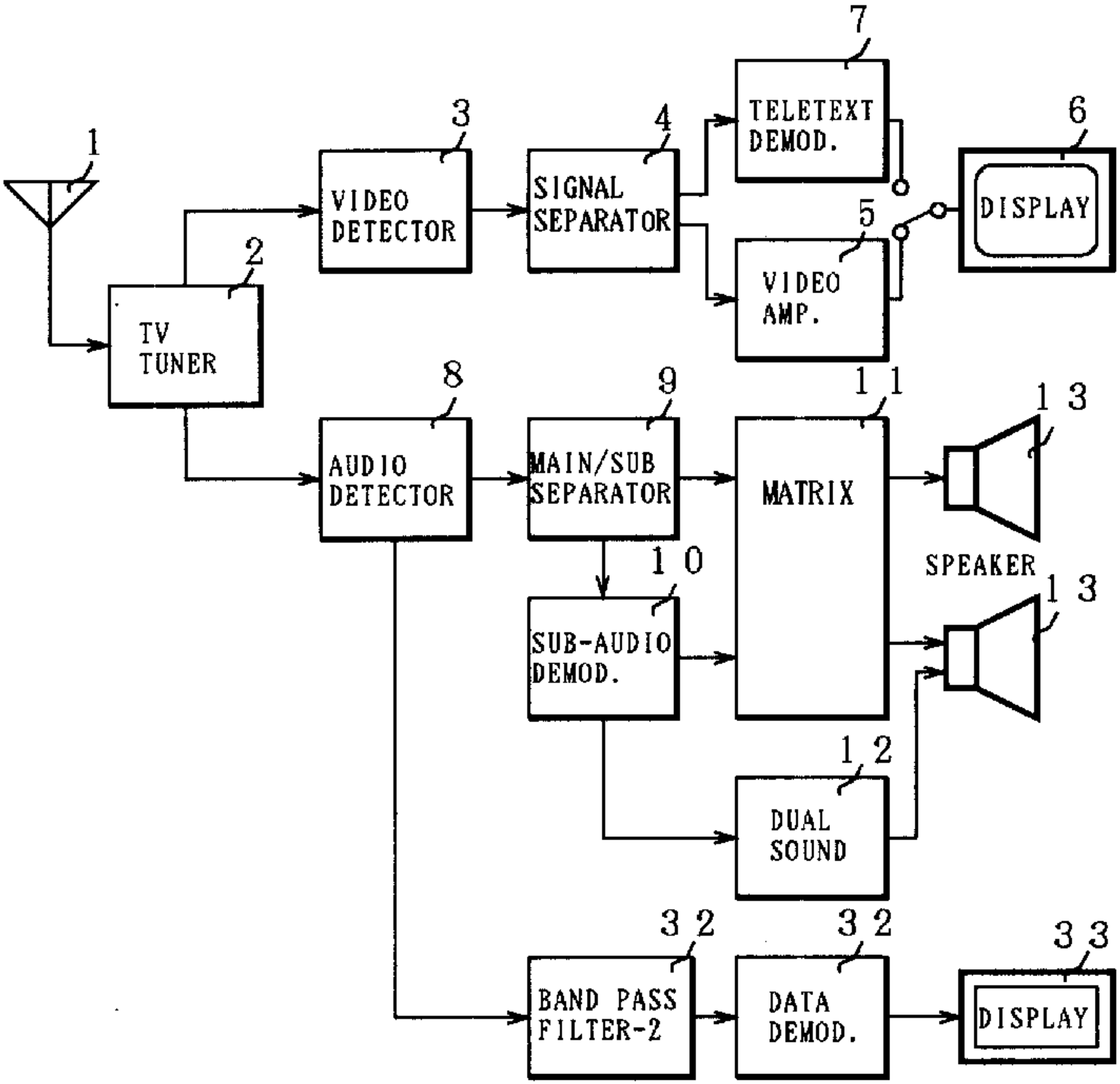

26
27
28
BAND PASS FILTER 4
DATA DEMOD.
DISPLAY
21
SUB-AUDIO DEMOD.
34
18
19
20
35
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
13
SPEAKER
2
8
9
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATOR
13
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
14
15
16
BAND PASS FILTER 1
FASIMILE DEMOD.
PRINTER
BAND PASS FILTER 2
DATA DEMOD.
DISPLAY
31
32
33

Fig.30


PERSONAL COMPUTER
26
27
BAND PASS FILTER 4
DATA DEMOD.
51
50
21
SUB-AUDIO DEMOD.
34
18
19
20
35
FM TUNER
FM DETECTOR
MAIN/SUB SEPARATOR
MATRIX
13
SPEAKER
2
8
9
13
TV TUNER
AUDIO DETECTOR
MAIN/SUB SEPARATOR
10
12
SUB-AUDIO DEMOD.
DUAL SOUND
14
15
16
BAND PASS FILTER 1
FASIMILE DEMOD.
PRINTER
44
45
BAND PASS FILTER 2
DATA DEMOD.
PERSONAL COMPUTER
31
32


1
2
TV TUNER
3
VIDEO DETECTOR
4
SIGNAL SEPARATOR
5
VIDEO AMP.
6
DISPLAY
7
TELETEXT DEMOD.
8
AUDIO DETECTOR
9
MAIN/SUB SEPARATOR
10
SUB-AUDIO DEMOD.
11
MATRIX
12
DUAL SOUND
13
SPEAKER
13
32
BAND PASS FILTER-2
32
DATA DEMOD.
33
DISPLAY