

REPLACED SHEETS		SC
✓	Description : paged 1 to paged 10	
✓	Figure(s) : paged 1 to paged 10	
✓	Table(s) : paged 1 to paged 10	
✓	Form : paged 1 to paged 10	
REPLACED SHEETS		

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TELEVISION RECEIVER LOUDSPEAKER DEVICE

This invention relates to a loudspeaker device for a television receiver.

5 Certain conventional television receivers and loudspeaker devices therefor are constructed as shown for example in figures 1 to 4 of the accompanying drawings.

In the television receiver, shown in figure 1, loudspeakers SP_L, SP_R are embedded within the front sides of a cabinet CT substantially flush with and at left and right sides of a front surface of a Braun tube BR, that is, a television screen surface. In a separate type television receiver, shown in Figure 2, the cabinet CT is separated from loudspeaker boxes or enclosures BX_L, BX_R and loudspeakers SP_L, SP_R are provided within the loudspeaker boxes BX_L, BX_R substantially flush with a television screen surface. In the type of television receiver shown in Figure 3, loudspeakers SP_L, SP_R are embedded within a cabinet CT at the back of the television screen surface, that is, at the back of a Braun tube BR. Finally, in the type of television receiver shown in Figure 4, loudspeakers SP_L, SP_R are embedded within the lateral sides of a cabinet CT at the lateral sides of a Braun tube BR.

In recent years, in addition to high picture quality and a large screen surface, demand has arisen for high sound quality. It is desirable that the sound of a television receiver appears to be radiated from the vicinity of the displayed picture. A further design consideration is that it is also desirable that, even if the screen has a large surface, the cabinet of the receiver itself should not be excessively increased in bulk.

These conflicting demands have been difficult to reconcile with the types of conventional television receivers, shown in figures 1 to 4. For example, with the television receiver and the loudspeaker devices shown in

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Figure 1, where the loudspeakers SP_L, SP_R are arranged substantially flush with the television screen surface, although the sense of compatibility of the sound with respect to the television picture may be achieved, the size of the loudspeaker devices SP_L, SP_R is limited by the size of the cabinet CT and hence sound of high sound quality cannot be produced in the low frequency part of the spectrum. In other words, with the television receiver of recent years, as shown in Figure 1, the surface of the television receiver in its entirety as viewed from the front side is not increased, that is, the size of the cabinet CT is not increased, although the screen surface is enlarged, as a result of which the size of the loudspeakers SP_L, SP_R and those of their magnetic circuits and their enclosures are limited and hence the high sound quality cannot be achieved. With the television receiver shown in figure 2, in which the loudspeaker boxes BX_L, BX_R are formed as separate components, even though good sound quality may be achieved, the overall size of the loudspeaker boxes BX_L, BX_R and the size of the cabinet CT, summed together, is necessarily increased. With the television receiver shown in Figure 3, in which the loudspeakers SP_L, SP_R are arranged at the back of the television screen at the rear lateral sides of the Braun tube BR, permitting the size of the loudspeakers SP_L, SP_R to be increased, since these loudspeakers are arranged at a certain angle with respect to the television screen surface, the sound is radiated in a direction conforming to that angle and hence the sense of ambience and compatibility with the television picture cannot be produced. Finally, with the television receiver shown in figure 4, the loudspeakers SP_L, SP_R are directed completely to lateral sides, so that the sense of ambience and compatibility with the television picture becomes worse than in the case of the television receiver shown in figure 3.

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In view of the above described status of the art,



it is an object of the present invention to provide a loudspeaker device for a television receiver by means of which the sound of high quality producing the sense of ambience and compatibility with the television picture may
5 be obtained without enlarging the size of the receiver cabinet, or which at least provides the public with a useful choice.

According to the present invention there is provided a loudspeaker unit of or for a television receiver
10 comprising loudspeaker means provided rearwardly of the television screen surface, sound reflector means for reflecting at least a portion of the sound from said loudspeaker means substantially in a forward direction from said television screen surface, and acoustic lens means
15 provided on a surface substantially coplanar with said television screen surface for controlling the radiating direction of the sound.

The sound reflector means are provided for covering at least the central voice coil region of the
20 loudspeaker means and approximately 20% to 70% and preferably 30% to 60% of the total sound radiating surface of the loudspeaker means.

Since the loudspeaker unit is provide at the back of the television screen surface (the phosphor surface of
25 the Braun tube), the screen surface can be increased without limitations placed by the loudspeaker unit, while the sound radiated from the loudspeaker unit can be reflected in a forward direction by a reflector plate, and diffused by an acoustic lens, the foremost part of which lies in a plane
30 coplanar with the television screen surface, the sound producing the sense of ambience and compatibility with the television picture may be obtained. Specifically, the loudspeaker unit is provided at the back of the screen surface and at least a portion of the sound from the
35 loudspeaker unit is reflected in a substantially forward



direction from the screen surface and radiated by the acoustic lens the forward end of which is arranged in a plane substantially coplanar with the screen surface, so that the well-defined sound image may be produced and the
5 sound of high quality producing the sense of ambience and compatibility with the television picture may be obtained.

The invention will be further described by way of non-limitative example with reference to the accompanying drawings, in which:-

10 Figures 1 to 4 are schematic side views showing various types of conventional television receivers.

 Figure 5 is a schematic plan view showing a loudspeaker unit for a television receiver according to a preferred embodiment of the present invention, with portions
15 of the loudspeaker unit and the television receiver being broken away.

 Figure 6 is an enlarged schematic plan view of the loudspeaker unit, with a portion thereof being broken away.

 Figure 7 is a schematic plan view showing a
20 reflector plate and the sound radiating front surface of a loudspeaker.

 Figure 8 is a front view showing the state in which the loudspeaker and the reflector plate are actually mounted in the loudspeaker unit.

25 Figure 9 is a perspective view showing an acoustic lens.

 Figure 10 is a partial perspective view showing an acoustic lens and a mesh plate actually mounted on a receiver cabinet.

30 Figure 11 is a perspective view of a television receiver fitted with the loudspeaker unit of the present invention, with a portion of the receiver being broken away to show the structure of the loudspeaker unit.

 Referring to the drawings, an embodiment of the
35 present invention will be explained in detail.



As shown in the schematic plan view of figure 5, the loudspeaker unit for the television receiver of the present embodiment is comprised of left and right full-audio-range stereophonic loudspeakers SP_L, SP_R arranged at the back of a television screen surface or at the rear lateral sides of a Braun tube BR, reflector plates RF_L, RF_R for reflecting at least a portion of the sound from the loudspeakers SP_L, SP_R in a substantially forward direction from the screen surface, and acoustic lenses L_L, L_R , the forward end of which is disposed in a plane substantially coplanar with the screen surface and which is adapted for controlling the directivity of the radiated sound. The sound from the loudspeakers SP_L, SP_R may also be monaural or stereo, depending upon the type of transmission being received and the audio processing circuitry of the receiver.

It is noted that the loudspeakers SP_L, SP_R are not provided in a plane coplanar with the television screen surface, but are provided rearwardly thereof, at the rear lateral sides of the Braun tube BR within the receiver cabinet CT. That is, the loudspeakers SP_L, SP_R are provided at the rear lateral sides of the Braun tube BR where a wider area or space may be conserved depending on the shape of the Braun tube BR, so that the sound radiating surface or gauge and the capacities of the magnetic circuit and loudspeaker boxes BX_L, BX_R may be chosen to be larger. Since the gauges of the loudspeakers SP_L, SP_R and the capacities of the magnetic circuit and the loudspeaker boxes BX_L, BX_R are chosen to be larger with the present embodiment, the sound quality of, for example, the low-frequency sounds may be improved, while the cabinet CT may remain small-sized.

Meanwhile, since the loudspeakers SP_L, SP_R of the present embodiment are arranged at the rear lateral sides of the Braun tube BR depending on the shape of the Braun tube, the sound radiating surfaces of the loudspeakers SP_L, SP_R are disposed at an angle with respect to the television screen



surface. If the sound from these loudspeakers SP_L, SP_R is directly taken out to outside in this case, it becomes difficult to produce the sense of ambience or the sense of compatibility with the television picture on account of sound directivity and the like. With this in view, with the loudspeaker unit of the present embodiment, the sound from the loudspeakers SP_L, SP_R is adapted to be directed forwardly from the television screen surface by means of the reflector plates RF_L, RF_R and the acoustic lenses L_L, L_R .

Referring to figure 6, showing the right-side loudspeaker SP_R and a near-by region, sound waves radiated from the loudspeaker SP_R are transmitted through the reflector plate RF_R and the acoustic lens L_L , comprised of mid plates (lens plates) L_{R1}, L_{R2} and L_{R3} , and thereby modified in their travelling and diffusing directions, as indicated by sound waves $W1$ to $W4$. A sound wave $W5$, which is not transmitted through these reflector plates RF_R or the acoustic lens L_R , is radiated to outside through a meshed plate M_R having a large number of orifices in the form of a netting or a honeycomb.

It is noted that the reflector plate RF_R is disposed so as to overlies, as viewed from the front, at least a inner region of the voice coil VC of the associated loudspeaker drive unit, as shown in figure 7 showing the projection of the reflector plate on the front sound radiating surface of the loudspeaker SP_R . By arranging the reflector plate RF_R so as to overlies at least the inner space of the voice coil VC , the mid to high frequency sounds, radiated from the central region of the loudspeaker SP_R , that is the voice coil VC and the near-by region, and exhibiting high directivity with respect to the front surface of the loudspeaker SP_R , are reflected by the reflector plate RF_R so as to be modified in their proceeding direction. The reflector plate RF_R is so oriented that the sound reflected thereby is directed forwardly of the



television screen surface. If the entire sound radiating surface of the loudspeaker SP_R is covered by the reflector plate RF_R , the sound undergoes suppression and deterioration of sound quality. Given this consideration, the area of the sound radiating surface of the loudspeaker SP_R covered by the reflector plate RF_R is selected in the present embodiment to be approximately 20% to 70% and preferably 30% to 60% of the total sound radiating surface of the loudspeaker SP_R . In addition, the area of the central region of the sound radiating surface of the loudspeaker SP_R covered by the reflector surface RF_R is preferably about twice the area of the inner space of the voice coil VC. Meanwhile, the reflector plate RF_R may be designed so that its angle of orientation may be modified as desired for changing the direction of sound reflection in a desired manner.

By using the above described reflector plate RF_R , the sound radiated from the loudspeaker SP_R , in particular, the mid to high frequency sounds which exhibit greatest directivity, may be radiated in a forward direction from the television screen surface, while being also directly radiated to outside by means of the meshed plate M_R , without producing sound suppression. On the other hand, the low frequency sounds from the loudspeaker SP_R are radiated to the outside by means of the reflector plate RF_R and the acoustic lens L_R , while being also radiated directly to outside by means of the meshed plate M_R , similarly to the mid to high frequency sounds. Since low frequency sounds directly radiated to outside by means of the meshed plate M_R are also turned round towards the front side of the screen surface to produce the low frequency sound producing the sense of ambience and compatibility with the displayed picture.

It is noted that the reflector plate RF_R may be molded of synthetic resins exhibiting high surface hardness



and low inner losses, such as acrylonitrile-butadiene-styrene (ABS) or styrene. In this manner, the mid to high frequency sound may be reflected effectively.

Figure 8 shows the loudspeaker SP_R and the reflector plate RF_R actually built into the loudspeaker unit which is viewed from the front side of the loudspeaker SP_R . In figure 8, DT_R indicates a duct for taking out the sound within the loudspeaker box BX_R to outside.

The acoustic lens L_R is used for controlling sound directly, that is, the direction and diffusion of the emitted sound. Specifically, the direction of the proceeding sound may be modified as a function of the length of the gap between the mid plates (lens plates) L_{R1} , L_{R2} and L_{R3} , that is, the distance between the inlet and the outlet of the sound or the length of the sound path. In addition, a semicircular notch C is provided in a central region of each of the mid plates L_{R1} , L_{R2} and L_{R3} for expanding the sound from the loudspeaker SP_R , that is, for converting the planar wave into a cylindrical wave or a spherical wave. It is noted that, considering the sound emanating from the loudspeaker SP_R in figure 6, the sound wave $W1$ schematically represents the sound wave travelling through a space between the mid plate L_{R1} and the wall surface of the cabinet towards the Braun tube BR , the sound wave $W2$ the sound wave travelling through the space between the mid plates L_{R1} and L_{R2} , the sound wave $W3$ the sound wave once reflected by, for example, the reflective plate RF_R to travel subsequently through the space between the mid plates L_{R2} and L_{R3} and the sound wave $W4$ the sound wave once reflected by the reflector plate RF_R to travel subsequently through the space between the mid plate L_{R3} and the outer wall surface of the cabinet CT . However, the sound waves $W1, W2$ may be occasionally reflected by the reflector plate RF_R , while the sound waves $W3, W4$ may be transmitted directly through the gaps of the acoustic lens without having been once reflected by the



reflector plate RF_R . The sound direction may be changed as desired by changing the length of each sound duct of the acoustic lens L_R . For example, with the mid plate L_{R1} of the maximum length, the mid plate L_{R3} of the minimum length
 5 and the mid plate L_{R2} of an intermediate length, the sound emanating from the acoustic lens L_R is directed towards the centre of the television screen surface. On the other hand, by reversing the relation of the sound duct lengths, the sound from the acoustic lens L_R is directed away from the
 10 centre of the television screen surface. The sound direction may also be changed by changing the mounting angles of the mid plates.

With the use of the above described acoustic lens L_R , it becomes possible to produce the expanded sound with
 15 improved directivity by aligning the wave fronts of the mid to high frequency sounds which are strongly directive and radiated in the form of an acute beam. Meanwhile, the sound radiated towards the front side FW and the sound surrounding the television receiver SW are shown schematically by
 20 chain-dotted lines in figure 5.

The acoustic lens L_R and the meshed plate M_R are shown assembled to the cabinet CT in figure 10 which is a perspective view partially broken away.

With the above described television receiver
 25 loudspeaker unit arranged by arranging the loudspeakers SP_L, SP_R on the rear lateral sides of the Braun tube BR, the sound radiating surfaces or gauges of the loudspeakers SP_L, SP_R and the capacities of the magnetic circuit and the loudspeaker boxes BX_L, BX_R may be enlarged to enable the
 30 sound quality of the low frequency sounds, for example, to be improved. On the other hand, by reflecting at least a portion of the sound from the loudspeakers SP_L, SP_R by the reflector plates RF_L, RF_R and radiating the sound towards the front side of the television screen surface by the acoustic
 35 lenses L_L, L_R , the forward sides of which are arranged



substantially on the same surface as the television screen surface, the sound from the loudspeakers SP_L, SP_R above all, the strongly directive mid to high frequency sound, may be radiated towards the front side of the television screen surface to provide a more definite sound image and more expanded mid to high frequency sounds. Besides, since the sound from the loudspeakers SP_L, SP_R is radiated directly to outside through the meshed plates M_L, M_R for preventing sound suppression as well as providing a sense of ambience having an extended sound field and producing low frequency sound compatible with the displayed picture.

Meanwhile, the television receiver of the present embodiment is shown in perspective in figure 11, partly broken away, in which the sound from the loudspeaker SP_R is radiated not only forwardly but also laterally of the television screen surface, as indicated by chain-dotted lines therein.

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CLAIMS

1. A loudspeaker unit of or for a television receiver comprising loudspeaker means provided rearwardly of the television screen surface, sound reflector means for reflecting at least a portion of the sound from said loudspeaker means substantially in a forward direction from said television screen surface, and acoustic lens means provided on a surface substantially coplanar with said television screen surface for controlling the radiating direction of the sound.
2. A loudspeaker unit as claimed in claim 1 wherein said loudspeaker means comprise left and right side loudspeakers for stereophonic and/or monaural sound reproduction.
3. A loudspeaker unit as claimed in claim 2 wherein said left and right side loudspeakers are arranged at an obtuse angle with respect to the television screen surface.
4. A loudspeaker unit as claimed in claim 1, 2 or 3 wherein said sound reflector means form a part of a cabinet of the television receiver.
5. A loudspeaker unit as claimed in any one of claims 1 to 4 wherein said sound reflector means covers an area about 30% to 60% of the entire sound radiating surface of said loudspeaker means.
6. A loudspeaker unit as claimed in any one of claims 1 to 5 wherein said loudspeaker means are enclosed within associated loudspeaker boxes.



ABSTRACT

A loudspeaker unit for a television receiver includes loudspeakers SP_L, SP_R arranged at the back of a television screen surface, sound reflectors for reflecting the sound from the loudspeakers substantially in a forward direction from the television screen surface, and acoustic lenses provided on a surface coplanar with the television screen surface for controlling the sound radiating direction. High quality sound with a sense of ambience and compatibility with the television picture may be produced without enlarging the size of the television receiver cabinet.

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FIG.1

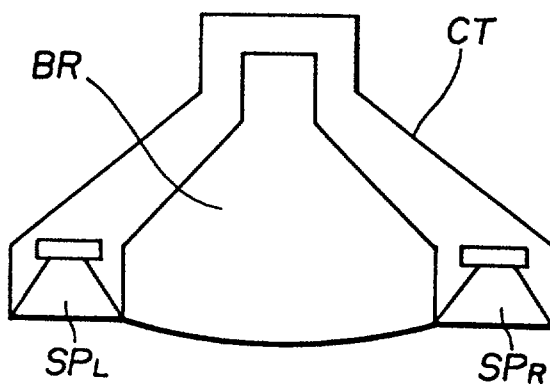
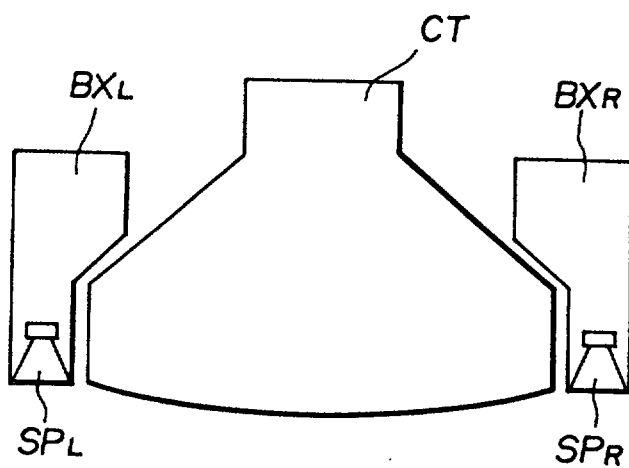
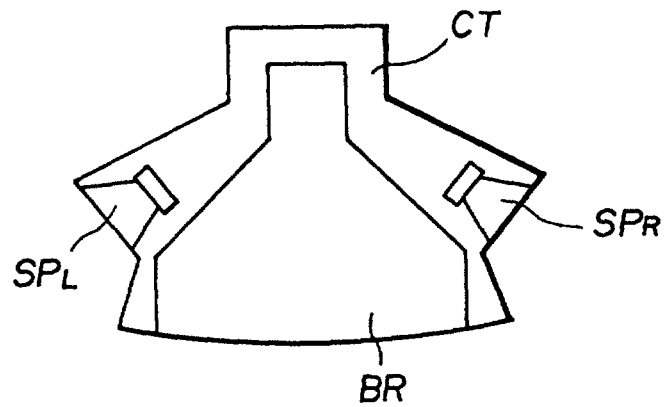
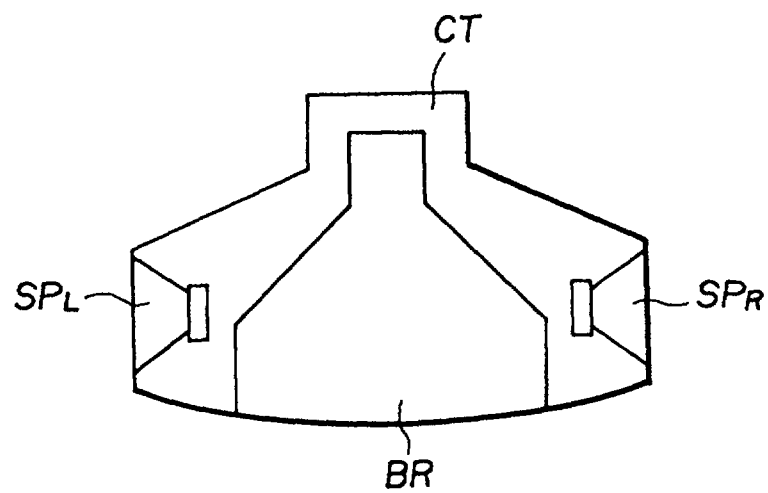


FIG.2



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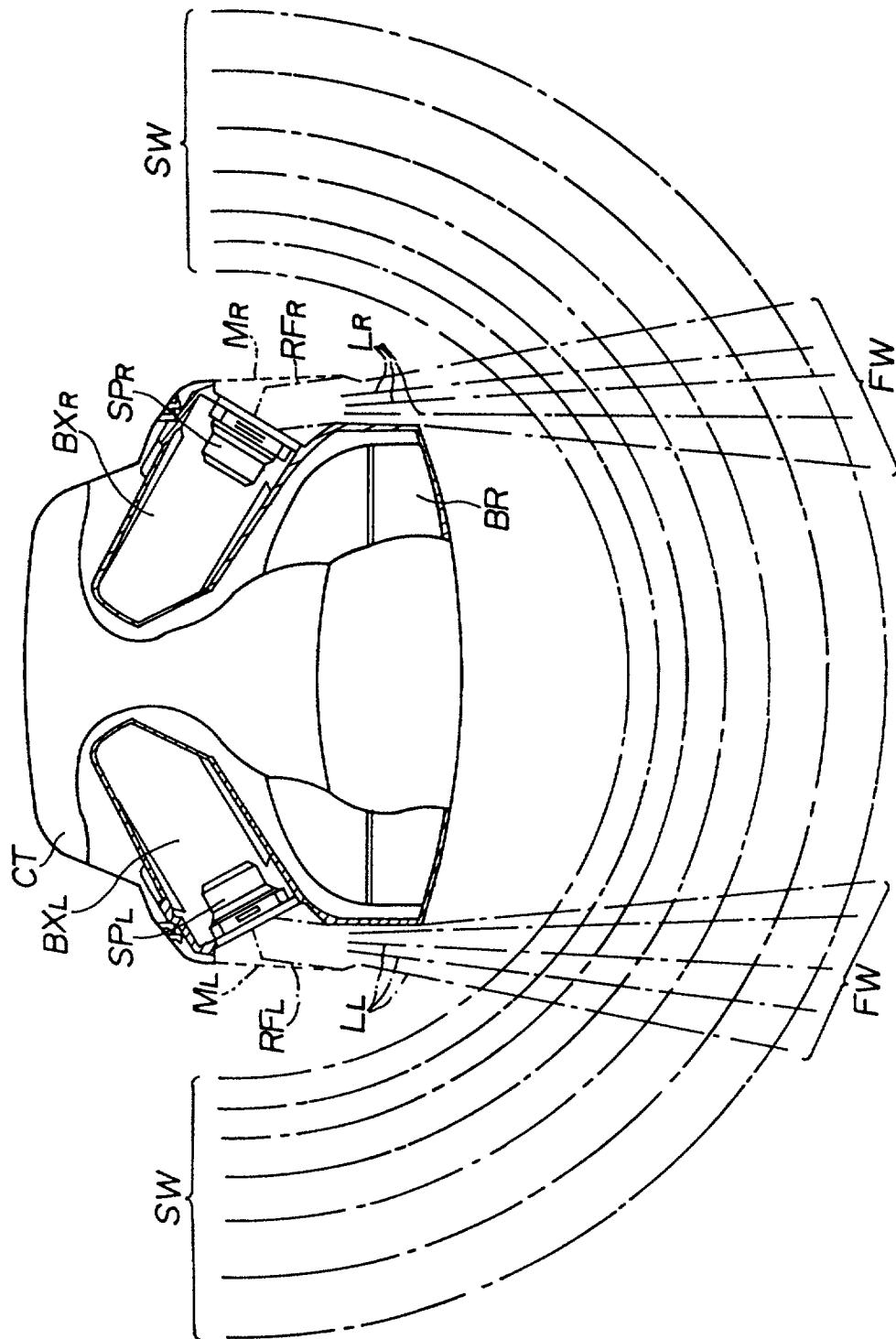
FIG. 3**FIG. 4**

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FIG. 5

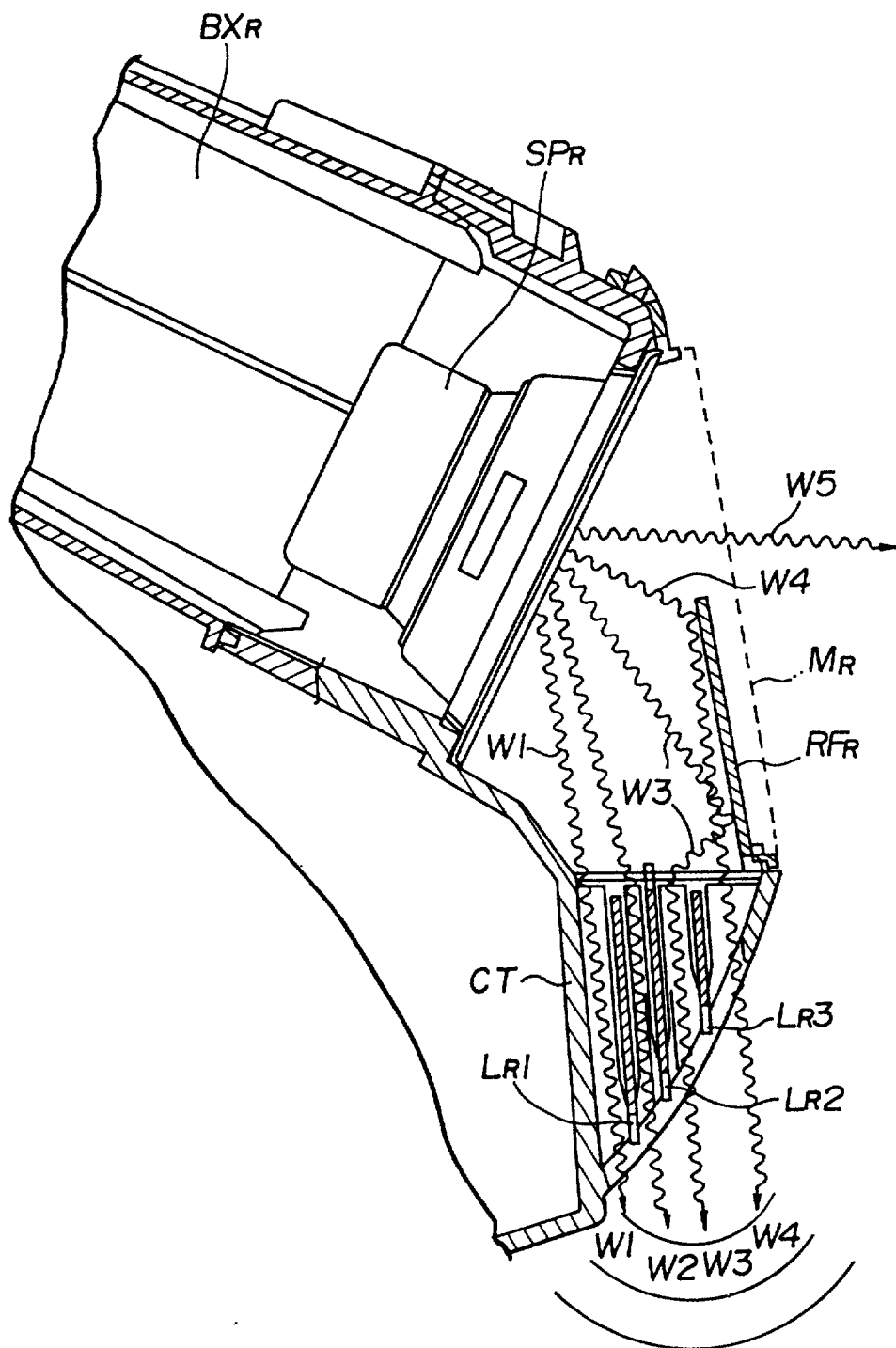


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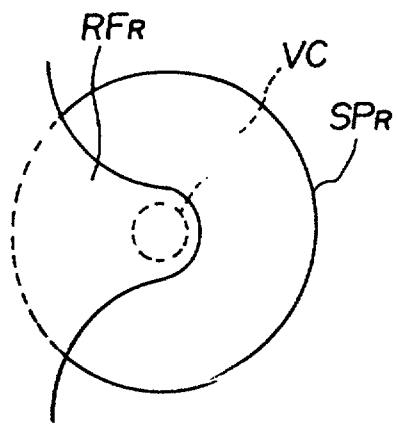
FIG. 6



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FIG. 7



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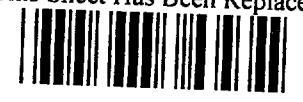


FIG. 9

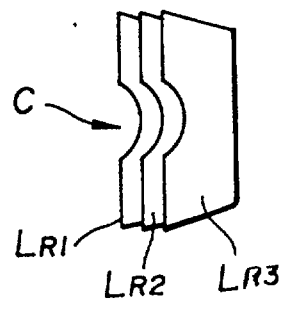


FIG. 10

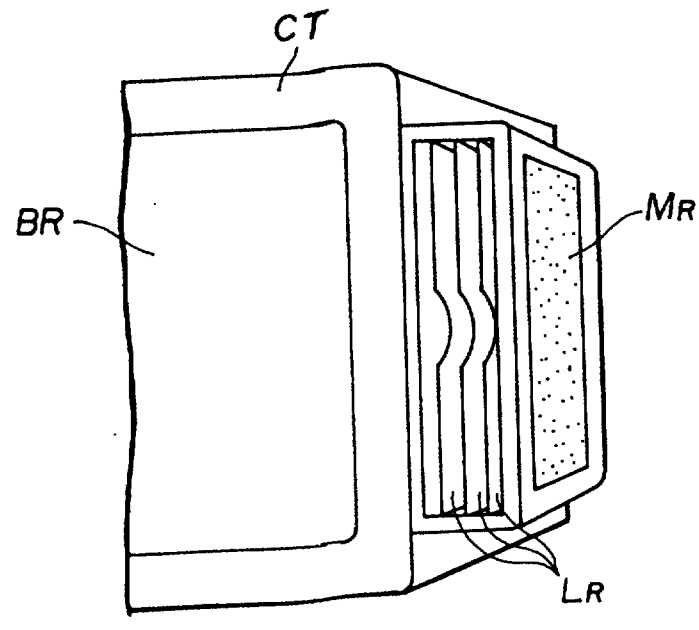
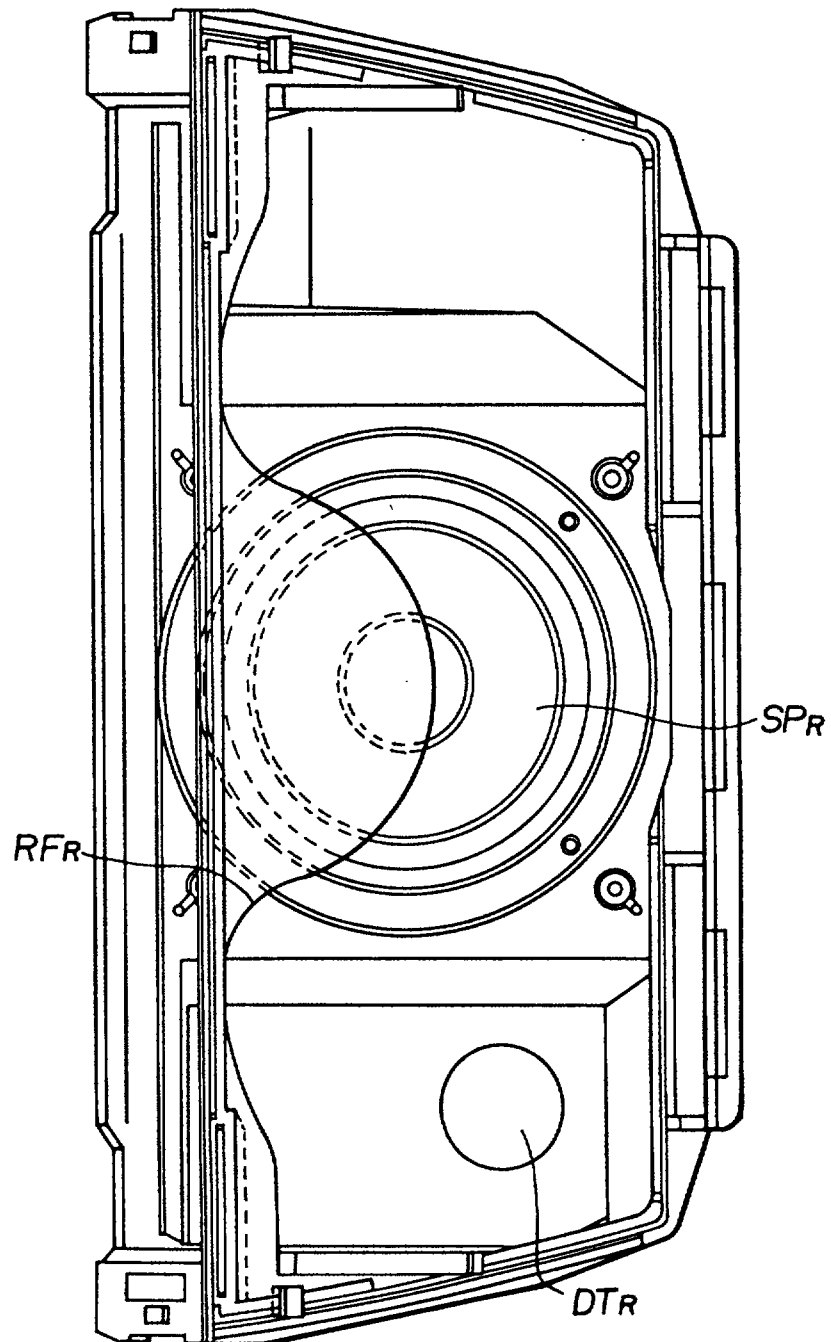


FIG. 8

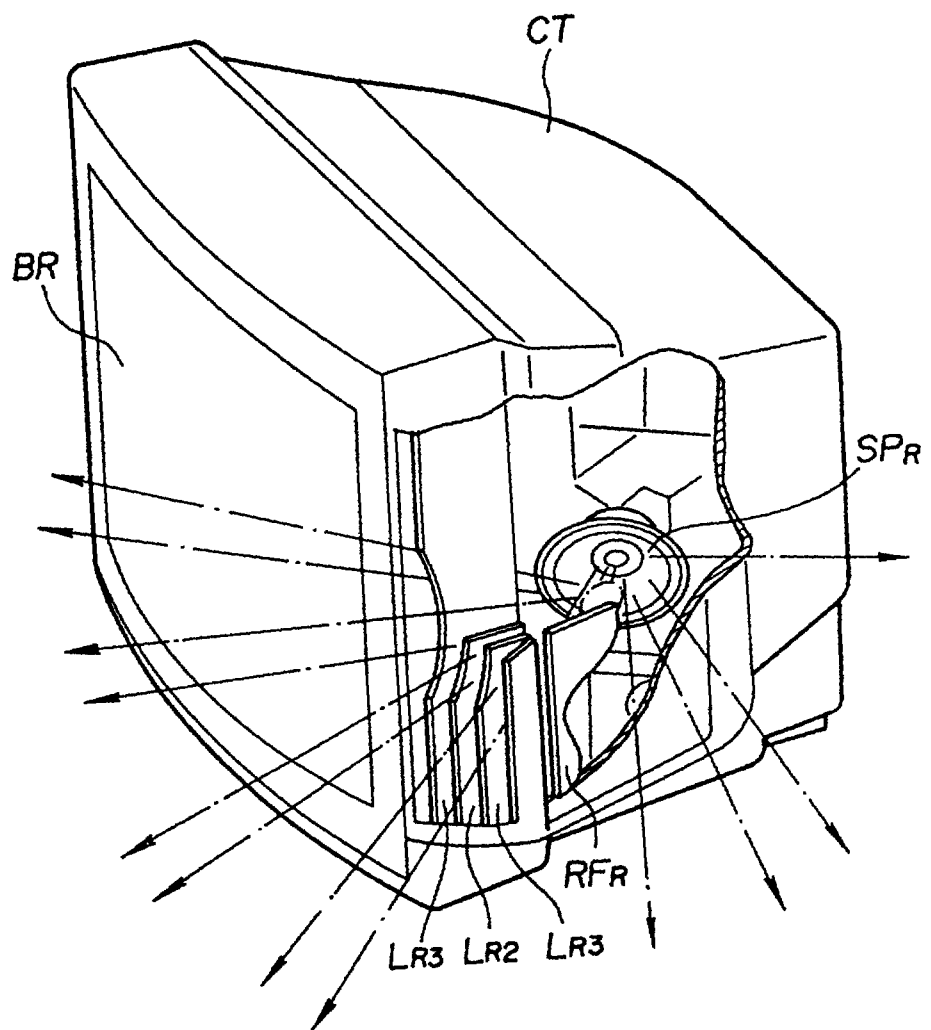


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FIG. 11



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TELEVISION RECEIVER LOUDSPEAKER DEVICE

This invention relates to a loudspeaker device for a television receiver.

5 Certain conventional television receivers and loudspeaker devices therefor are constructed as shown for example in figures 1 to 4 of the accompanying drawings.

In the television receiver, shown in figure 1, loudspeakers SP_L, SP_R are embedded within the front sides of a cabinet CT substantially flush with and at left and right sides of a front surface of a Braun tube BR, that is, a television screen surface. In a separate type television receiver, shown in Figure 2, the cabinet CT is separated from loudspeaker boxes or enclosures BX_L, BX_R and loudspeakers SP_L, SP_R are provided within the loudspeaker boxes BX_L, BX_R substantially flush with a television screen surface. In the type of television receiver shown in Figure 3, loudspeakers SP_L, SP_R are embedded within a cabinet CT at the back of the television screen surface, that is, at the back of a Braun tube BR. Finally, in the type of television receiver shown in Figure 4, loudspeakers SP_L, SP_R are embedded within the lateral sides of a cabinet CT at the lateral sides of a Braun tube BR.

In recent years, in addition to high picture quality and a large screen surface, demand has arisen for high sound quality. It is desirable that the sound of a television receiver appears to be radiated from the vicinity of the displayed picture. A further design consideration is that it is also desirable that, even if the screen has a large surface, the cabinet of the receiver itself should not be excessively increased in bulk.

These conflicting demands have been difficult to reconcile with the types of conventional television receivers, shown in figures 1 to 4. For example, with the television receiver and the loudspeaker devices shown in

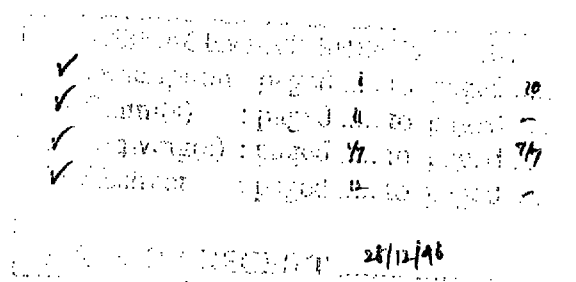


Figure 1, where the loudspeakers SP_L, SP_R are arranged substantially flush with the television screen surface, although the sense of compatibility of the sound with respect to the television picture may be achieved, the size of the loudspeaker devices SP_L, SP_R is limited by the size of the cabinet CT and hence sound of high sound quality cannot be produced in the low frequency part of the spectrum. In other words, with the television receiver of recent years, as shown in Figure 1, the surface of the television receiver in its entirety as viewed from the front side is not increased, that is, the size of the cabinet CT is not increased, although the screen surface is enlarged, as a result of which the size of the loudspeakers SP_L, SP_R and those of their magnetic circuits and their enclosures are limited and hence the high sound quality cannot be achieved. With the television receiver shown in figure 2, in which the loudspeaker boxes BX_L, BX_R are formed as separate components, even though good sound quality may be achieved, the overall size of the loudspeaker boxes BX_L, BX_R and the size of the cabinet CT, summed together, is necessarily increased. With the television receiver shown in Figure 3, in which the loudspeakers SP_L, SP_R are arranged at the back of the television screen at the rear lateral sides of the Braun tube BR, permitting the size of the loudspeakers SP_L, SP_R to be increased, since these loudspeakers are arranged at a certain angle with respect to the television screen surface, the sound is radiated in a direction conforming to that angle and hence the sense of ambience and compatibility with the television picture cannot be produced. Finally, with the television receiver shown in figure 4, the loudspeakers SP_L, SP_R are directed completely to lateral sides, so that the sense of ambience and compatibility with the television picture becomes worse than in the case of the television receiver shown in figure 3.

In view of the above described status of the art,

it is an object of the present invention to provide a loudspeaker device for a television receiver by means of which the sound of high quality producing the sense of ambience and compatibility with the television picture may
5 be obtained without enlarging the size of the receiver cabinet, or which at least provides the public with a useful choice.

According to the present invention there is provided a loudspeaker unit of or for a television receiver
10 comprising loudspeaker means provided rearwardly of the television screen surface, sound reflector means for reflecting at least a portion of the sound from said loudspeaker means substantially in a forward direction from said television screen surface, and acoustic lens means
15 provided on a surface substantially coplanar with said television screen surface for controlling the radiating direction of the sound.

The sound reflector means are provided for covering at least the central voice coil region of the
20 loudspeaker means and approximately 20% to 70% and preferably 30% to 60% of the total sound radiating surface of the loudspeaker means.

Since the loudspeaker unit is provide at the back of the television screen surface (the phosphor surface of the Braun tube), the screen surface can be increased without
25 limitations placed by the loudspeaker unit, while the sound radiated from the loudspeaker unit can be reflected in a forward direction by a reflector plate, and diffused by an acoustic lens, the foremost part of which lies in a plane
30 coplanar with the television screen surface, the sound producing the sense of ambience and compatibility with the television picture may be obtained. Specifically, the loudspeaker unit is provided at the back of the screen surface and at least a portion of the sound from the
35 loudspeaker unit is reflected in a substantially forward

direction from the screen surface and radiated by the acoustic lens the forward end of which is arranged in a plane substantially coplanar with the screen surface, so that the well-defined sound image may be produced and the
5 sound of high quality producing the sense of ambience and compatibility with the television picture may be obtained.

The invention will be further described by way of non-limitative example with reference to the accompanying drawings, in which:-

10 Figures 1 to 4 are schematic side views showing various types of conventional television receivers.

Figure 5 is a schematic plan view showing a loudspeaker unit for a television receiver according to a preferred embodiment of the present invention, with portions
15 of the loudspeaker unit and the television receiver being broken away.

Figure 6 is an enlarged schematic plan view of the loudspeaker unit, with a portion thereof being broken away.

Figure 7 is a schematic plan view showing a
20 reflector plate and the sound radiating front surface of a loudspeaker.

Figure 8 is a front view showing the state in which the loudspeaker and the reflector plate are actually mounted in the loudspeaker unit.

25 Figure 9 is a perspective view showing an acoustic lens.

Figure 10 is a partial perspective view showing an acoustic lens and a mesh plate actually mounted on a receiver cabinet.

30 Figure 11 is a perspective view of a television receiver fitted with the loudspeaker unit of the present invention, with a portion of the receiver being broken away to show the structure of the loudspeaker unit.

Referring to the drawings, an embodiment of the
35 present invention will be explained in detail.

As shown in the schematic plan view of figure 5, the loudspeaker unit for the television receiver of the present embodiment is comprised of left and right full-audio-range stereophonic loudspeakers SP_L, SP_R arranged at the back of a television screen surface or at the rear lateral sides of a Braun tube BR, reflector plates RF_L, RF_R for reflecting at least a portion of the sound from the loudspeakers SP_L, SP_R in a substantially forward direction from the screen surface, and acoustic lenses L_L, L_R , the forward end of which is disposed in a plane substantially coplanar with the screen surface and which is adapted for controlling the directivity of the radiated sound. The sound from the loudspeakers SP_L, SP_R may also be monaural or stereo, depending upon the type of transmission being received and the audio processing circuitry of the receiver.

It is noted that the loudspeakers SP_L, SP_R are not provided in a plane coplanar with the television screen surface, but are provided rearwardly thereof, at the rear lateral sides of the Braun tube BR within the receiver cabinet CT. That is, the loudspeakers SP_L, SP_R are provided at the rear lateral sides of the Braun tube BR where a wider area or space may be conserved depending on the shape of the Braun tube BR, so that the sound radiating surface or gauge and the capacities of the magnetic circuit and loudspeaker boxes BX_L, BX_R may be chosen to be larger. Since the gauges of the loudspeakers SP_L, SP_R and the capacities of the magnetic circuit and the loudspeaker boxes BX_L, BX_R are chosen to be larger with the present embodiment, the sound quality of, for example, the low-frequency sounds may be improved, while the cabinet CT may remain small-sized.

Meanwhile, since the loudspeakers SP_L, SP_R of the present embodiment are arranged at the rear lateral sides of the Braun tube BR depending on the shape of the Braun tube, the sound radiating surfaces of the loudspeakers SP_L, SP_R are disposed at an angle with respect to the television screen

surface. If the sound from these loudspeakers SP_L, SP_R is directly taken out to outside in this case, it becomes difficult to produce the sense of ambience or the sense of compatibility with the television picture on account of sound directivity and the like. With this in view, with the loudspeaker unit of the present embodiment, the sound from the loudspeakers SP_L, SP_R is adapted to be directed forwardly from the television screen surface by means of the reflector plates RF_L, RF_R and the acoustic lenses L_L, L_R .

Referring to figure 6, showing the right-side loudspeaker SP_R and a near-by region, sound waves radiated from the loudspeaker SP_R are transmitted through the reflector plate RF_R and the acoustic lens L_L , comprised of mid plates (lens plates) L_{R1}, L_{R2} and L_{R3} , and thereby modified in their travelling and diffusing directions, as indicated by sound waves $W1$ to $W4$. A sound wave $W5$, which is not transmitted through these reflector plates RF_R or the acoustic lens L_R , is radiated to outside through a meshed plate M_R having a large number of orifices in the form of a netting or a honeycomb.

It is noted that the reflector plate RF_R is disposed so as to overlies, as viewed from the front, at least a inner region of the voice coil VC of the associated loudspeaker drive unit, as shown in figure 7 showing the projection of the reflector plate on the front sound radiating surface of the loudspeaker SP_R . By arranging the reflector plate RF_R so as to overlies at least the inner space of the voice coil VC , the mid to high frequency sounds, radiated from the central region of the loudspeaker SP_R , that is the voice coil VC and the near-by region, and exhibiting high directivity with respect to the front surface of the loudspeaker SP_R , are reflected by the reflector plate RF_R so as to be modified in their proceeding direction. The reflector plate RF_R is so oriented that the sound reflected thereby is directed forwardly of the

television screen surface. If the entire sound radiating surface of the loudspeaker SP_R is covered by the reflector plate RF_R , the sound undergoes suppression and deterioration of sound quality. Given this consideration, the area of the sound radiating surface of the loudspeaker SP_R covered by the reflector plate RF_R is selected in the present embodiment to be approximately 20% to 70% and preferably 30% to 60% of the total sound radiating surface of the loudspeaker SP_R . In addition, the area of the central region of the sound radiating surface of the loudspeaker SP_R covered by the reflector surface RF_R is preferably about twice the area of the inner space of the voice coil VC. Meanwhile, the reflector plate RF_R may be designed so that its angle of orientation may be modified as desired for changing the direction of sound reflection in a desired manner.

By using the above described reflector plate RF_R , the sound radiated from the loudspeaker SP_R , in particular, the mid to high frequency sounds which exhibit greatest directivity, may be radiated in a forward direction from the television screen surface, while being also directly radiated to outside by means of the meshed plate M_R , without producing sound suppression. On the other hand, the low frequency sounds from the loudspeaker SP_R are radiated to the outside by means of the reflector plate RF_R and the acoustic lens L_R , while being also radiated directly to outside by means of the meshed plate M_R , similarly to the mid to high frequency sounds. Since low frequency sounds directly radiated to outside by means of the meshed plate M_R are also turned round towards the front side of the screen surface to produce the low frequency sound producing the sense of ambience and compatibility with the displayed picture.

It is noted that the reflector plate RF_R may be molded of synthetic resins exhibiting high surface hardness

and low inner losses, such as acrylonitrile-butadiene-styrene (ABS) or styrene. In this manner, the mid to high frequency sound may be reflected effectively.

Figure 8 shows the loudspeaker SP_R and the
 5 reflector plate RF_R actually built into the loudspeaker unit which is viewed from the front side of the loudspeaker SP_R . In figure 8, DT_R indicates a duct for taking out the sound within the loudspeaker box BX_R to outside.

The acoustic lens L_R is used for controlling sound
 10 directively, that is, the direction and diffusion of the emitted sound. Specifically, the direction of the proceeding sound may be modified as a function of the length of the gap between the mid plates (lens plates) L_{R1} , L_{R2} and L_{R3} , that is, the distance between the inlet and the outlet
 15 of the sound or the length of the sound path. In addition, a semicircular notch C is provided in a central region of each of the mid plates L_{R1} , L_{R2} and L_{R3} for expanding the sound from the loudspeaker SP_R , that is, for converting the planar wave into a cylindrical wave or a spherical wave. It
 20 is noted that, considering the sound emanating from the loudspeaker SP_R in figure 6, the sound wave W1 schematically represents the sound wave travelling through a space between the mid plate L_{R1} and the wall surface of the cabinet towards the Braun tube BR, the sound wave W2 the sound wave
 25 travelling through the space between the mid plates L_{R1} and L_{R2} , the sound wave W3 the sound wave once reflected by, for example, the reflective plate RF_R to travel subsequently through the space between the mid plates L_{R2} and L_{R3} and the sound wave W4 the sound wave once reflected by the reflector
 30 plate RF_R to travel subsequently through the space between the mid plate L_{R3} and the outer wall surface of the cabinet CT. However, the sound waves W1, W2 may be occasionally reflected by the reflector plate RF_R , while the sound waves W3, W4 may be transmitted directly through the gaps of the
 35 acoustic lens without having been once reflected by the

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reflector plate RF_R . The sound direction may be changed as desired by changing the length of each sound duct of the acoustic lens L_R . For example, with the mid plate L_{R1} of the maximum length, the mid plate L_{R3} of the minimum length
 5 and the mid plate L_{R2} of an intermediate length, the sound emanating from the acoustic lens L_R is directed towards the centre of the television screen surface. On the other hand, by reversing the relation of the sound duct lengths, the sound from the acoustic lens L_R is directed away from the
 10 centre of the television screen surface. The sound direction may also be changed by changing the mounting angles of the mid plates.

With the use of the above described acoustic lens L_R , it becomes possible to produce the expanded sound with
 15 improved directivity by aligning the wave fronts of the mid to high frequency sounds which are strongly directive and radiated in the form of an acute beam. Meanwhile, the sound radiated towards the front side FW and the sound surrounding the television receiver SW are shown schematically by
 20 chain-dotted lines in figure 5.

The acoustic lens L_R and the meshed plate M_R are shown assembled to the cabinet CT in figure 10 which is a perspective view partially broken away.

With the above described television receiver
 25 loudspeaker unit arranged by arranging the loudspeakers SP_L, SP_R on the rear lateral sides of the Braun tube BR , the sound radiating surfaces or gauges of the loudspeakers SP_L, SP_R and the capacities of the magnetic circuit and the loudspeaker boxes BX_L, BX_R may be enlarged to enable the
 30 sound quality of the low frequency sounds, for example, to be improved. On the other hand, by reflecting at least a portion of the sound from the loudspeakers SP_L, SP_R by the reflector plates RF_L, RF_R and radiating the sound towards the front side of the television screen surface by the acoustic
 35 lenses L_L, L_R , the forward sides of which are arranged

substantially on the same surface as the television screen surface, the sound from the loudspeakers SP_L, SP_R above all, the strongly directive mid to high frequency sound, may be radiated towards the front side of the television screen surface to provide a more definite sound image and more expanded mid to high frequency sounds. Besides, since the sound from the loudspeakers SP_L, SP_R is radiated directly to outside through the meshed plates M_L, M_R for preventing sound suppression as well as providing a sense of ambience having an extended sound field and producing low frequency sound compatible with the displayed picture.

Meanwhile, the television receiver of the present embodiment is shown in perspective in figure 11, partly broken away, in which the sound from the loudspeaker SP_R is radiated not only forwardly but also laterally of the television screen surface, as indicated by chain-dotted lines therein.

CLAIMS

1. A loudspeaker unit of or for a television receiver comprising loudspeaker means provided rearwardly of the television screen surface, sound reflector means for reflecting at least a portion of the sound from said loudspeaker means substantially in a forward direction from said television screen surface, and acoustic lens means provided on a surface substantially coplanar with said television screen surface for controlling the radiating direction of the sound.
2. A loudspeaker unit as claimed in claim 1 wherein said loudspeaker means comprise left and right side loudspeakers for stereophonic and/or monaural sound reproduction.
3. A loudspeaker unit as claimed in claim 2 wherein said left and right side loudspeakers are arranged at an obtuse angle with respect to the television screen surface.
4. A loudspeaker unit as claimed in claim 1, 2 or 3 wherein said sound reflector means form a part of a cabinet of the television receiver.
5. A loudspeaker unit as claimed in any one of claims 1 to 4 wherein said sound reflector means covers an area about 30% to 60% of the entire sound radiating surface of said loudspeaker means.
6. A loudspeaker unit as claimed in any one of claims 1 to 5 wherein said loudspeaker means are enclosed within associated loudspeaker boxes.



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ABSTRACT

TELEVISION RECEIVER LOUDSPEAKER DEVICE

A loudspeaker unit for a television receiver includes loudspeakers SP_L, SP_R arranged at the back of a television screen surface, sound reflectors for reflecting the sound from the loudspeakers substantially in a forward direction from the television screen surface, and acoustic lenses provided on a surface coplanar with the television screen surface for controlling the sound radiating direction. High quality sound with a sense of ambience and compatibility with the television picture may be produced without enlarging the size of the television receiver cabinet.

Figure 5

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FIG.1

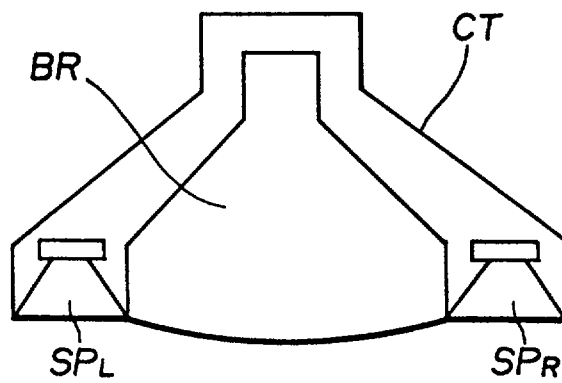
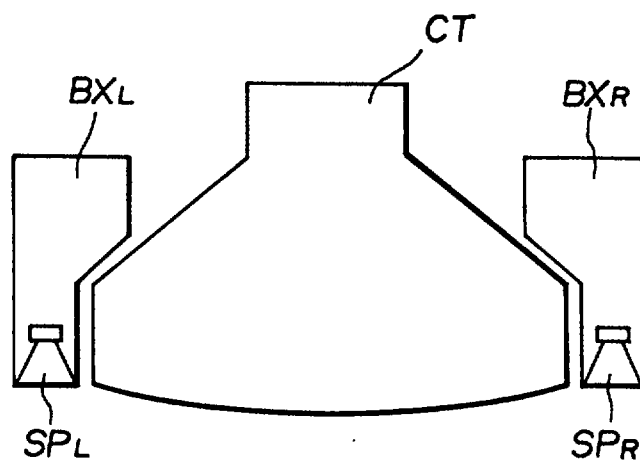


FIG.2



2/7

FIG. 3

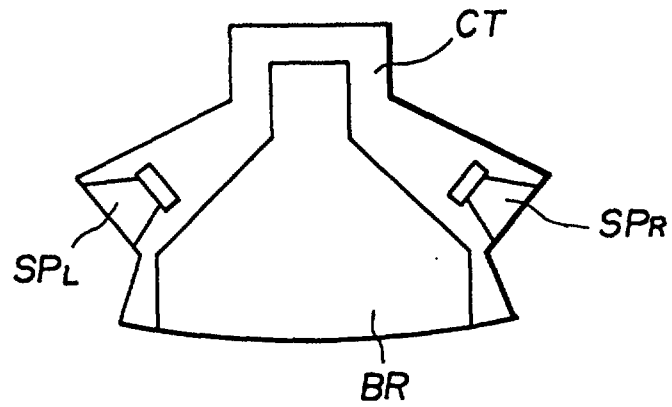
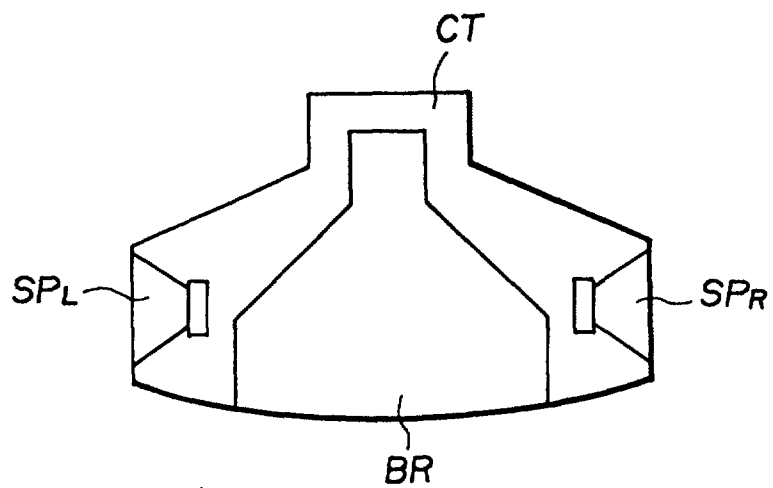


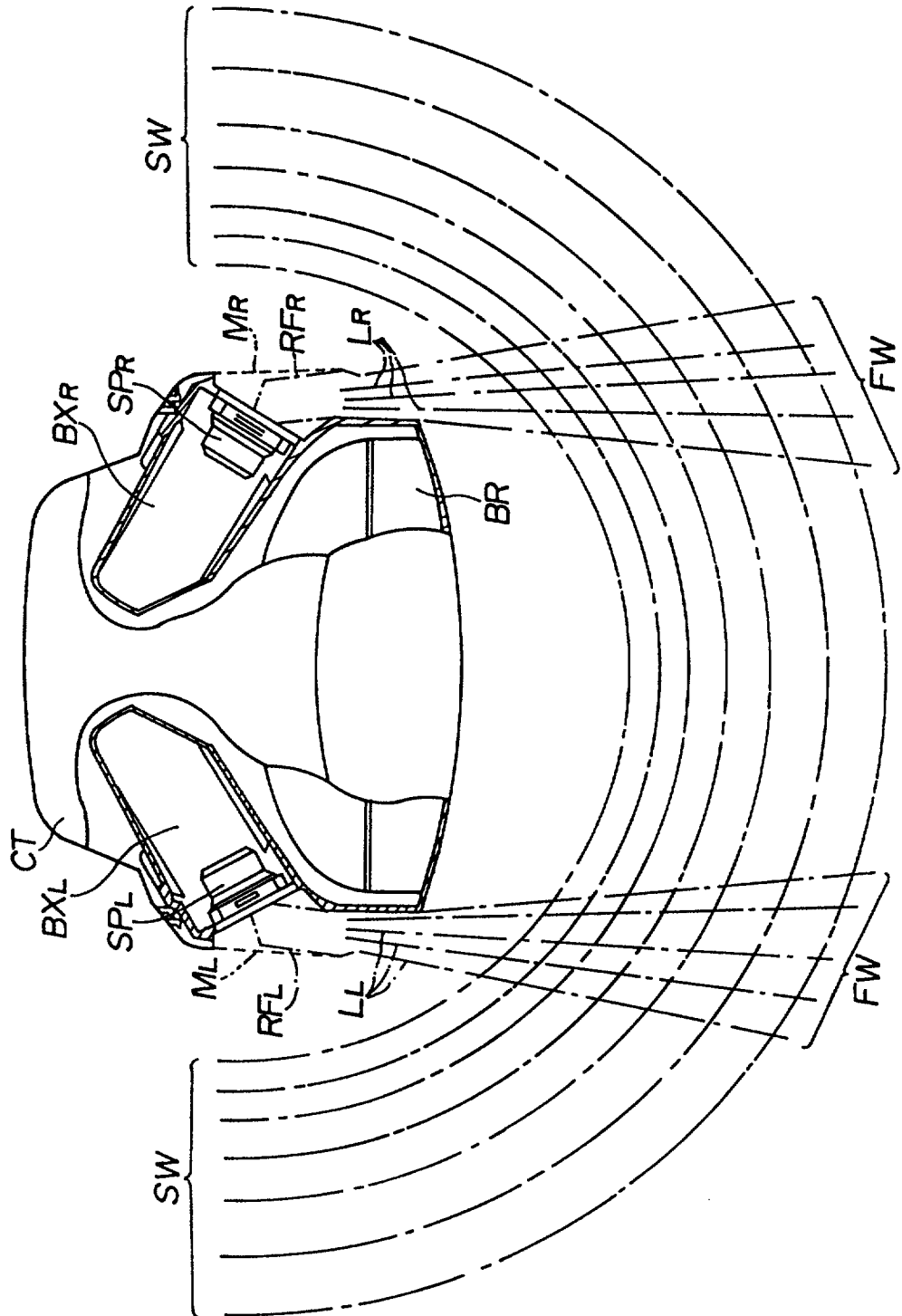
FIG. 4



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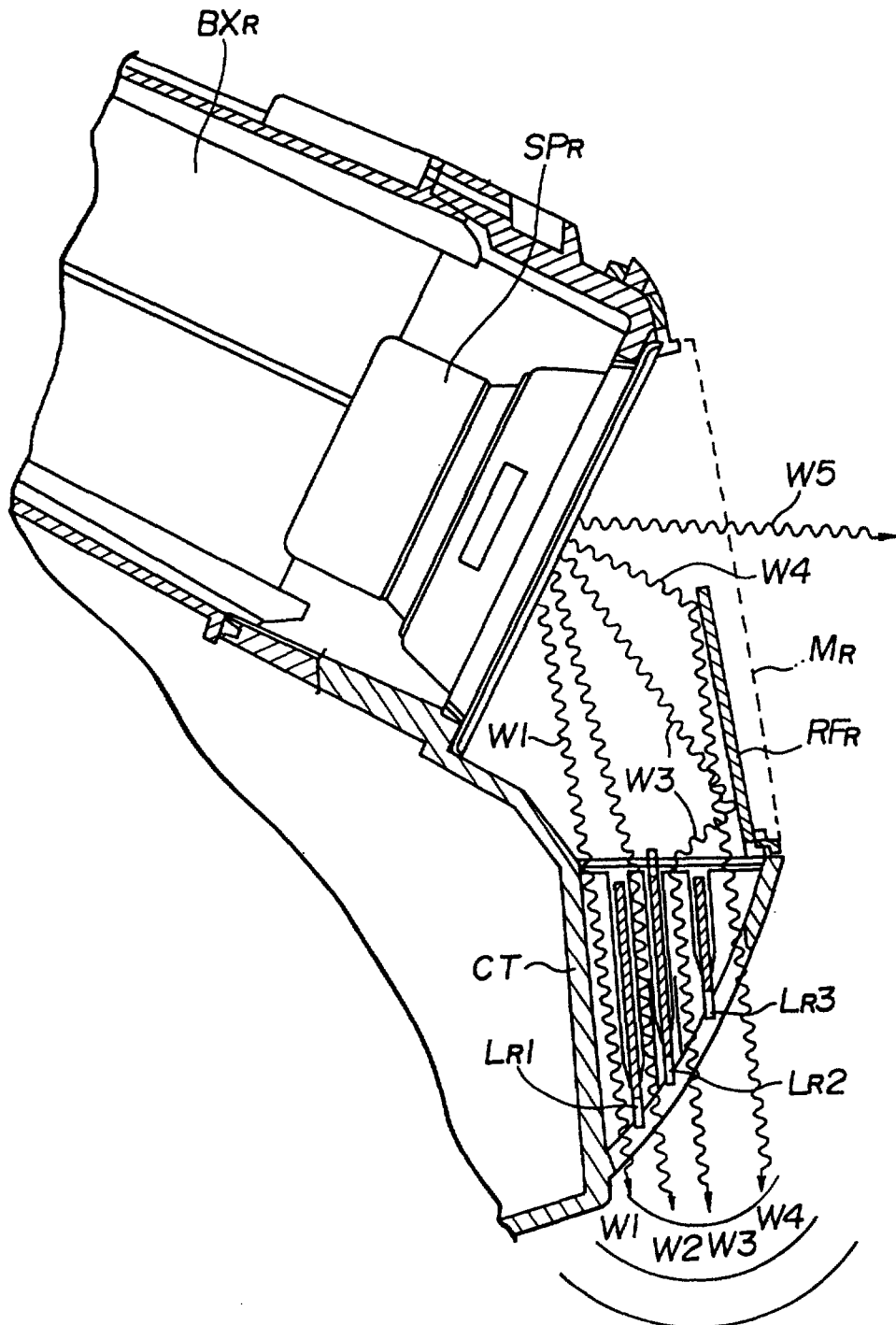
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FIG. 5



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FIG. 6

5/7

FIG. 7

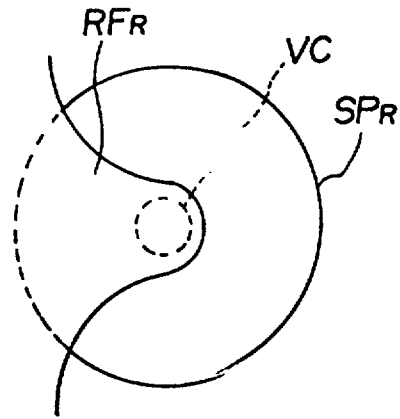


FIG. 9

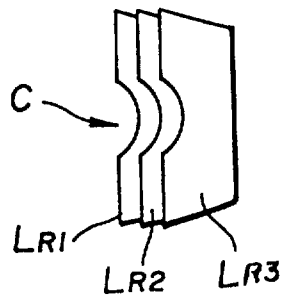
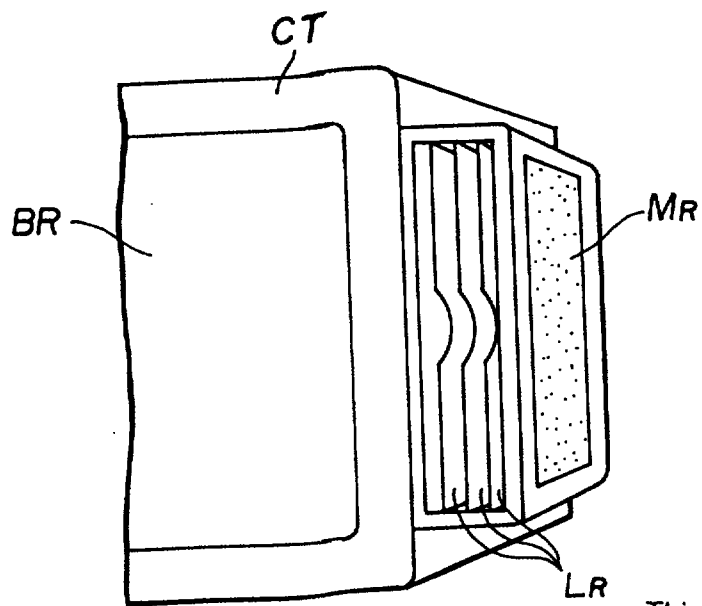


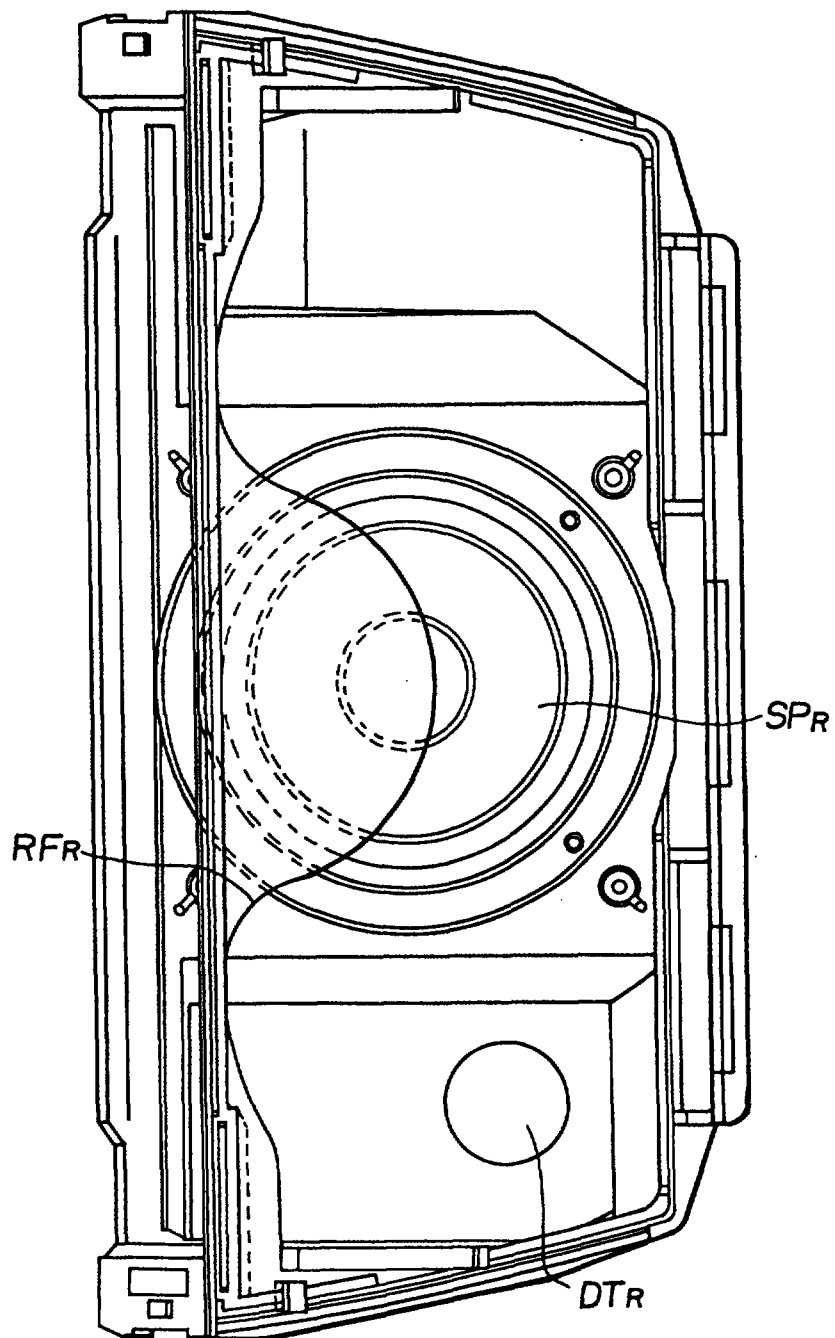
FIG. 10



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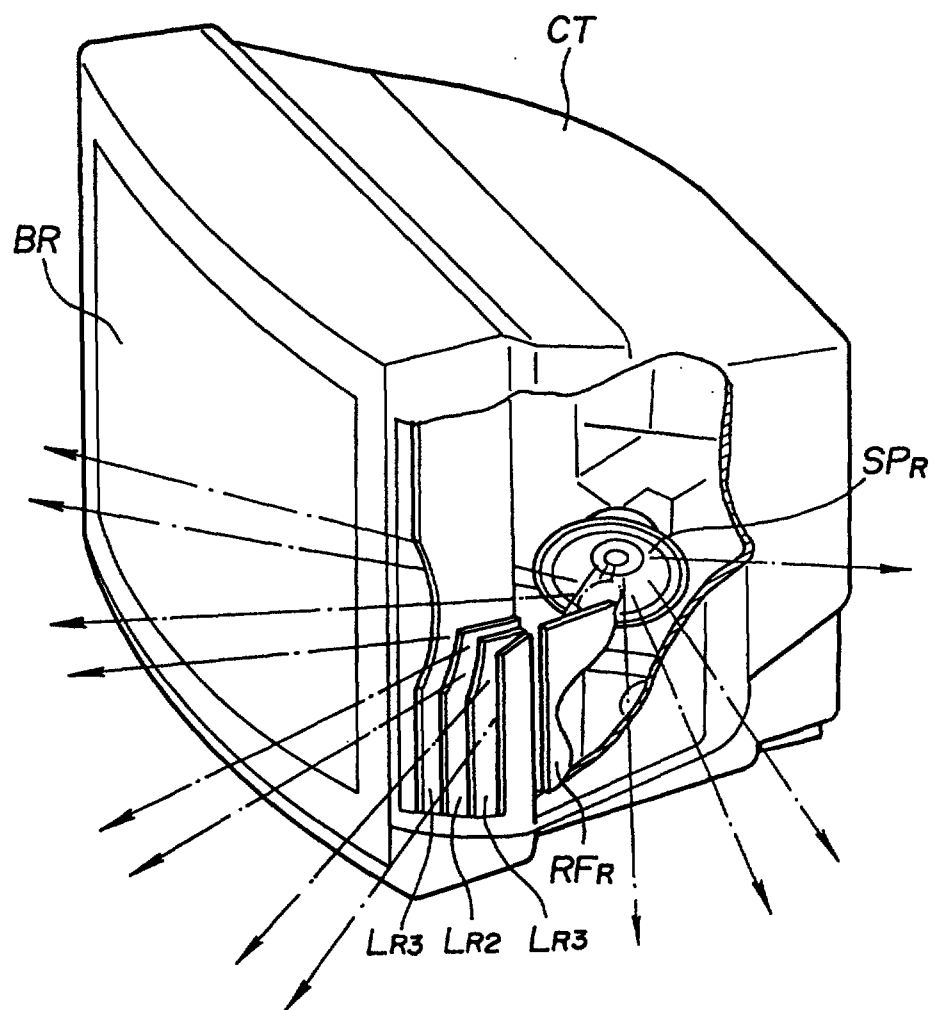
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FIG. 8



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FIG. 11

TEXT OF THE ABSTRACT

TELEVISION RECEIVER LOUDSPEAKER DEVICE

A loudspeaker unit for a television receiver includes loudspeakers (SP_L, SP_R) arranged at the back of a television screen surface, sound reflectors (RF_R, RF_L) for reflecting the sound from the loudspeakers (SP_L, SP_R) substantially in a forward direction from the television screen surface, and acoustic lenses (L_R, L_L) provided on a surface coplanar with the television screen surface for controlling the sound radiating direction. High quality sound with a sense of ambience and compatibility with the television picture may be produced without enlarging the size of the television receiver cabinet (CT).

Fig. 5

