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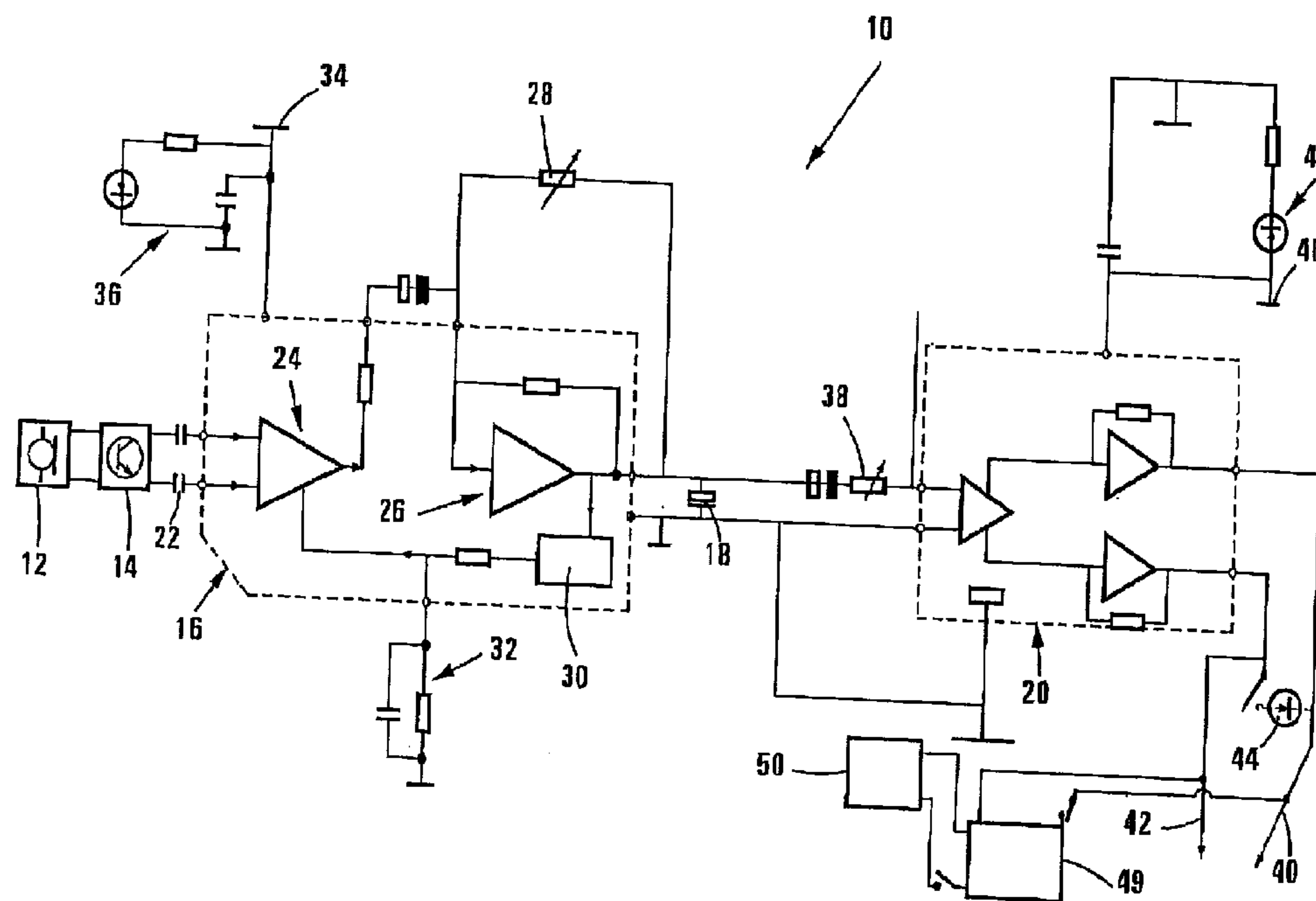
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(54) **APPAREIL AUDITIF POUR AUSCULTATION MEDIATE**

(54) **A HEARING APPARATUS FOR USE IN MEDIATE
AUSCULTATION**



(57) A hearing apparatus for use in mediate auscultation comprises an electrically operated microphone that can generate signals representative of sounds picked-up thereby. In use, signals so generated are amplified and filtered by a first amplifier arrangement to produce signals representing only body sounds picked-up by the microphone, a second amplifier arrangement amplifying these filtered signals and permitting the sounds represented by these signals to be listened to by means of listening means such as earphones and a loudspeaker. Provision also is made for displaying body sounds in a suitable format and also for recording body sounds.

ABSTRACT

A hearing apparatus for use in mediate auscultation comprises an electrically operated microphone that can generate signals representative of sounds picked-up thereby. In use, signals so generated are amplified and filtered by a first amplifier arrangement to produce signals representing only body sounds picked-up by the microphone, a second amplifier arrangement amplifying these filtered signals and permitting the sounds represented by these signals to be listened to by means of listening means such as earphones and a loudspeaker. Provision also is made for displaying body sounds in a suitable format and also for recording body sounds.

THIS INVENTION relates to a hearing apparatus for use in mediate auscultation.

5 A stethoscope is a form of hearing instrument which is commonly used for mediate auscultation, typically for listening to the operation of a person's or an animal's heart and lungs to determine the condition thereof. Different forms of stethoscopes, as well as their mode of operation and use, are well known and, as such, are not described further herein.

10 The hearing apparatus of the invention is provided for listening to the body sounds conventionally listened to by means of conventional stethoscopes, e.g. the sounds associated with the operation of the heart, lungs, and other parts of a person's or an animal's body. Any reference hereinafter to body sounds accordingly must be interpreted as a reference to such body sounds. Also, for simplicity, reference shall hereinafter merely be made to a person's body and the sounds associated with the operation of the heart, lungs, and other parts of a person's body and
15 such reference must be interpreted to include a reference to an animal's body also and the sounds associated with the body parts of an animal's body.

It is known also that the sensitivity to body sounds of known stethoscopes is not totally satisfactory in all respects and that more sensitive apparatus could enhance

the use of mediate auscultation for diagnosing different body conditions. Therefore, it is an object of this invention to provide a hearing apparatus that can be more effectively used for mediate auscultation.

5 According to the invention there is provided a hearing apparatus for use in mediate auscultation, which comprises

a microphone which can be pressed against the body of a person for picking up body sounds and for generating signals representative of the sounds picked up thereby;

10 a first amplifier arrangement for amplifying signals representing sounds picked up by the microphone;

a high frequency sound eliminator for eliminating predetermined high frequency sound signals from the signals amplified by the first amplifier arrangement; and

15 a second amplifier arrangement for amplifying the remaining signals after the elimination of the predetermined high frequency signals, the second amplifier arrangement including at least one signal output for a listening means whereby output signals can be converted to sounds that can be listened to by the listening means.

20 The microphone may be of a type particularly sensitive to low sounds emitted within the body of a person. As such, the microphone may be an electrically operated microphone electrically linked to a suitable power source.

The hearing apparatus may include a low sound transistor, disposed between the microphone and the first amplifier arrangement, for providing preliminary amplification of signals representing sounds picked up by the microphone.

5 The first amplifier arrangement may comprise a two stage amplification arrangement and may be operatively linked to a sound filter unit for separating and eliminating predetermined signals being amplified, e.g. signals representing background sounds picked-up by the microphone.

10 Still further, the hearing apparatus may include an automatic gain control unit operatively linked with the first amplifier arrangement, the automatic gain control unit providing for detecting of major sound fluctuations in respect of sounds picked up by the microphone, for example, sound fluctuations resulting from extraneous sounds not associated with body sounds picked up by the microphone, and for ensuring that such sound fluctuations are effectively eliminated. A timer forming part of the automatic gain control unit may be provided to render the gain control unit effective for the duration of major sound fluctuations being detected and for a predetermined time period thereafter, e.g. for approximately half a second thereafter.

20 The high frequency sound eliminator may be a suitable frequency response restrictor that will eliminate the required high frequency signals not associated with body sounds.

25 The second amplifier arrangement may provide for the final amplification of signals representing body sounds, which signals have all the signals associated with extraneous sounds substantially eliminated therefrom. Also, the second amplifier arrangement may provide either a single signal output for cooperating with a suitable listening means, or may include two or more signal outputs permitting,

for example, the simultaneous use of two or more listening means and/or the recordal of sounds by a suitable sound recording means.

5 The second amplifier arrangement also may be linked to a visual display unit such as a light emitting diode, that will be energised in response to the intensity of signals amplified by the second amplifier arrangement. Alternatively, or in addition, the second amplifier arrangement may be linked to a visual display unit such as a liquid crystal display unit which can provide a visual display of body sounds in a suitable format for interpretation by the user of the hearing apparatus.

10 The hearing apparatus may include as part thereof a listening means for listening to sounds effectively filtered and amplified as defined above. The listening means may be a listening means in the form of headphones, earphones, a loud speaker, a combination thereof, or the like.

15 Further according to the invention, each of the first amplifier arrangement and the second amplifier arrangement may have a power source, the power source preferably being associated with a battery check whereby the required power supply to the hearing apparatus can be monitored.

Also, the hearing apparatus may include a volume control for controlling the volume of sounds listened to by the listening means.

20 The hearing apparatus also may include an integrated circuit which has the ability to store the output from the apparatus, e.g. a memory chip. This will enable a user of the apparatus to review auscultatory findings of the apparatus at a later time.

Generally, the first and second amplifier arrangements may comprise conventional amplifier circuits, e.g. integrated amplifier circuits, or may comprise circuits specially designed for the purpose.

5 All the components and parts of the hearing apparatus, excluding the listening means, may be located within a suitable housing, the microphone and the controls of the hearing apparatus being located externally on the housing in a suitably accessible location which will facilitate the use of the apparatus. Also, the outputs of the second amplifier arrangement may be located where they are accessible externally of the housing, to permit listening means, or the like, to be
10 operatively connected thereto.

Further features of the hearing apparatus of the invention, including the mode of use thereof and the benefits associated with the use thereof, are described in more detail hereinafter, by way of example, with reference to the accompanying diagrammatic drawings. In the drawings:

15 Figure 1 represents a circuit diagram of a hearing apparatus, in accordance with the invention; and

Figure 2 represents two visual display formats that can be associated with a visual display unit of the hearing apparatus of Figure 1.

Referring to the diagram, the circuitry of a hearing apparatus, in accordance with
20 the invention, is designated generally by the reference numeral 10. The circuitry 10 includes generally an electric microphone 12, a low noise transistor 14, a first integrated circuit, designated by the reference numeral 16, providing a first amplifier arrangement, a frequency response restrictor 18 and a second integrated circuit, designated generally by the reference numeral 20, providing a second
25 amplifier arrangement.

The entire circuitry 10 is housed within a suitable housing (not shown) with the microphone 12 being exposed to permit it to be pressed against the body of a person for picking-up body sounds. The microphone 20 is particularly sensitive to low sounds emitted within the body of a person and provides for the conversion of sounds picked-up into electric signals which can be filtered and amplified as described hereafter.

Optionally, the housing incorporates also features which can assist to minimize, or eliminate completely, extraneous sounds from being picked-up, during use of the apparatus. For example, a circular structure (not shown) of rubber or of another compressible material, may surround the microphone 12. Thereby, when the microphone is pressed against the body of a person, a physical barrier is defined which can prevent extraneous sounds from being picked-up by the microphone.

Still further features may be associated with the housing which can facilitate use of the apparatus on animals in particular. For example, the microphone 12 may define an exaggerated protrusion which will enable proper placement of the microphone on an animal's body, reducing in particular interference from the animals hair.

The low noise transistor 14 fulfils an initial amplification function of signals generated by the microphone 12, the amplified signals being transmitted to the first amplifier arrangement via pre-amp inputs 22. The first amplifier arrangement includes a pre-amplifier 24 and a main amplifier 26, the output of the pre-amplifier 24 being transmitted to the main amplifier 26 which itself has a sensitivity control unit 28 connected in parallel therewith. The sensitivity control unit serves as a filter for filtering signals representing extraneous sounds picked up by the microphone 12, i.e. sounds not associated with actual body sounds. The first amplifier arrangement includes also an automatic gain control unit 30 which

serves to detect major sound fluctuations and which effectively eliminates these sound fluctuations, a timer circuit 32 serving to effectively block the sounds passing through the first amplifier arrangement for the duration of such major sound fluctuations and for a period of, for example, one half a second thereafter.

5 The first amplifier arrangement includes its own power source 34 and an associated battery check circuit 36 to provide for its effective operation.

The output of the first amplifier arrangement 16 is connected to the frequency response restrictor 18 whereby high frequency sound signals are eliminated, again serving to filter the sounds picked up by the microphone 12, particularly to
10 eliminate signals associated with extraneous sounds. The filtered sound signals are fed to the second amplifier arrangement via a volume control unit 38, the second amplifier arrangement providing for the amplification of the filtered sound signals to a desired level, so that by connecting a suitable listening means to an output of the second amplifier arrangement, the body sounds can be listened to
15 for the purpose of diagnosing the condition of the body parts listened to.

As illustrated, the second amplifier arrangement provides for a first output 40 and a second output 42, thus permitting two people to listen to amplified sounds simultaneously or, alternatively, for permitting particular sounds to be recorded. A light emitting diode 44 connected in line with the output 40 provides a visual
20 display, the light emitting diode being energised to different intensity levels in response to the intensity of signals amplified by the second amplifier arrangement. The volume control unit 38 permits volume control over sounds listened to via either output 40 or 42. The second amplifier arrangement includes also its own power source 46 which is associated with a battery check unit 48 which can
25 ensure the required power supply to the second amplifier arrangement for its proper operation.

Optionally, and as illustrated, the hearing apparatus can include a display unit 49, the unit 49 comprising an analog-digital converter integrated circuit, a liquid crystal display controller/microprocessor and a liquid crystal display. The liquid crystal display includes a built-in back light to be used in poor lighting conditions.

- 5 The display unit 49 can provide a visual display of the body sounds picked-up by the apparatus, Figure 2 illustrating two possible display formats which will enable a user to interpret the displays of the display unit. Within the displays as illustrated, the x - axis represents time whereas the y - axis represents a graphic display of the body sounds picked up. The vertical lines displayed accordingly
- 10 may correspond with body sounds present and the length of the lines may be proportional to the intensity of the sounds that have been amplified. By way of example in relation to heart sounds picked-up, the single lines 52 may represent normal heart sounds, whereas the group of lines 54 may represent abnormal heart sounds associated with a heart murmur.
- 15 The graphic display described above may be continuously updated to represent the body sounds detected and amplified at any particular time. This updating may take place by scrolling of the screen or by clearing the screen when it is fully used up and then repeating the exercise.

20 Furthermore, the analog-digital converter integrated circuit of the display unit 49 can be linked to a memory unit 50, the memory unit 50 enabling the electronic storage of output signals for later review and consideration.

The housing for the circuitry 10 clearly will make provision also for connecting listening means to the outputs of the second amplifier arrangement as well as for a control knob, or the like, which can serve to control the volume control unit 38.

25 The power sources 34 and 46 may take the form of batteries and, as such, the

housing may provide for access to such batteries in order to permit their replacement.

5 It is believed that the circuitry 10 will provide for a particularly suitable hearing apparatus for use in mediate auscultation, the first amplifier arrangement essentially serving both to provide initial amplification of sound signals picked-up by the microphone 12, while eliminating signals associated with certain extraneous noises, the elimination of extraneous sound signals being carried out further by the frequency response restrictor which will serve particularly to eliminate predetermined high frequency signals which cannot be associated with
10 body sounds. The second amplifier arrangement provides particularly for amplification of the filtered sound signals which will represent essentially only body sounds picked up by the microphone 12, which can hence be listened to for the purpose of auscultation. It is believed that by the amplification as described, mediate auscultation can be carried out significantly more effectively insofar as
15 sounds that could not be properly heard with the aid of conventional stethoscopes may become clearly audible with the aid of the hearing apparatus and the relevance of such sounds can thus be properly assessed in order to diagnose associated body conditions.

20 The integrated circuits 16 and 20 representing respectively the first amplifier arrangement and the second amplifier arrangement both can be pre-manufactured circuits or can be circuits specially designed for the purpose. The arrangements for eliminating extraneous sound signals also can vary greatly with the objective being to effectively "purify" the sounds picked-up in order to ensure thereby that only body sounds eventually are listened to by the person carrying out the
25 auscultation.

CLAIMS

1. A hearing apparatus for use in mediate auscultation, which comprises

a microphone which can be pressed against the body of a person for
picking up body sounds and for generating signals representative of the
sounds picked up thereby;

a first amplifier arrangement for amplifying signals representing sounds
picked up by the microphone;

a high frequency sound eliminator for eliminating predetermined high
frequency sound signals from the signals amplified by the first amplifier
arrangement; and

a second amplifier arrangement for amplifying the remaining signals after
the elimination of the predetermined high frequency signals, the second
amplifier arrangement including at least one signal output for a listening
means whereby output signals can be converted to sounds that can be
listened to by the listening means.
2. A hearing apparatus as claimed in Claim 1, in which the microphone is of
a type sensitive to low sounds emitted within the body of a person.
3. A hearing apparatus as claimed in Claim 2, in which the microphone is an
electrically operated microphone electrically linked to a suitable power
source.
4. A hearing apparatus as claimed in Claim 1, which includes a low sound
transistor, disposed between the microphone and the first amplifier

arrangement, for providing preliminary amplification of signals representing sounds picked up by the microphone.

5. A hearing apparatus as claimed in Claim 1, in which the first amplifier arrangement comprises a two-stage amplification arrangement that is operatively linked to a sound filter unit for separating and eliminating predetermined signals being amplified.
5
6. A hearing apparatus as claimed in Claim 1, which includes an automatic gain control unit operatively linked with the first amplifier arrangement, the automatic gain control unit providing for detecting of major sound fluctuations in respect of sounds picked up by the microphone.
10
7. A hearing apparatus as claimed in Claim 6, in which the automatic gain control unit includes a timer for rendering the gain control unit effective for the duration of major sound fluctuations being detected and for a predetermined time period thereafter.
8. A hearing apparatus as claimed in Claim 1, in which the high frequency sound eliminator is a frequency response restrictor that will eliminate the required high frequency signals not associated with body sounds.
15
9. A hearing apparatus as claimed in Claim 1, in which the second amplifier arrangement includes at least two signal outputs permitting the simultaneous use of at least two listening means and/or the recordal of sounds by a suitable sound recording means.
20
10. A hearing apparatus as claimed in Claim 1, in which the second amplifier arrangement is linked to a visual display unit such as a light emitting diode,

that will be energised in response to the intensity of signals amplified by the second amplifier arrangement.

- 5 11. A hearing apparatus as claimed in Claim 1, in which the second amplifier arrangement is linked to a visual display unit such as a liquid crystal display unit which can provide a visual display of body sounds in a suitable format for interpretation by the user of the hearing apparatus.
12. A hearing apparatus as claimed in Claim 1, which includes a listening means as part thereof.
- 10 13. A hearing apparatus as claimed in Claim 12, in which the listening means is in the form of either one or more of headphones, earphones, a loud speaker and a combination thereof.
- 15 14. A hearing apparatus as claimed in Claim 1, in which each of the first amplifier arrangement and the second amplifier arrangement has a power source, the power source being associated with a battery check whereby the required power supply to the hearing apparatus can be monitored.
15. A hearing apparatus as claimed in Claim 1, which includes a volume control for controlling the volume of sounds listened to by the listening means.
16. A hearing apparatus as claimed in Claim 1, which includes an integrated circuit which has the ability to store the output from the apparatus.
- 20 17. A hearing apparatus as claimed in Claim 1, in which the components and parts, excluding the listening means, is located in a housing, the microphone and the controls of the hearing apparatus being located

externally on the housing in a suitably accessible location which will facilitate use of the apparatus.

- 5 18. A hearing apparatus as claimed in Claim 17, in which each output of the second amplifier arrangement is located where it is accessible externally of the housing, to permit listening means, or the like, to be operatively connected thereto.

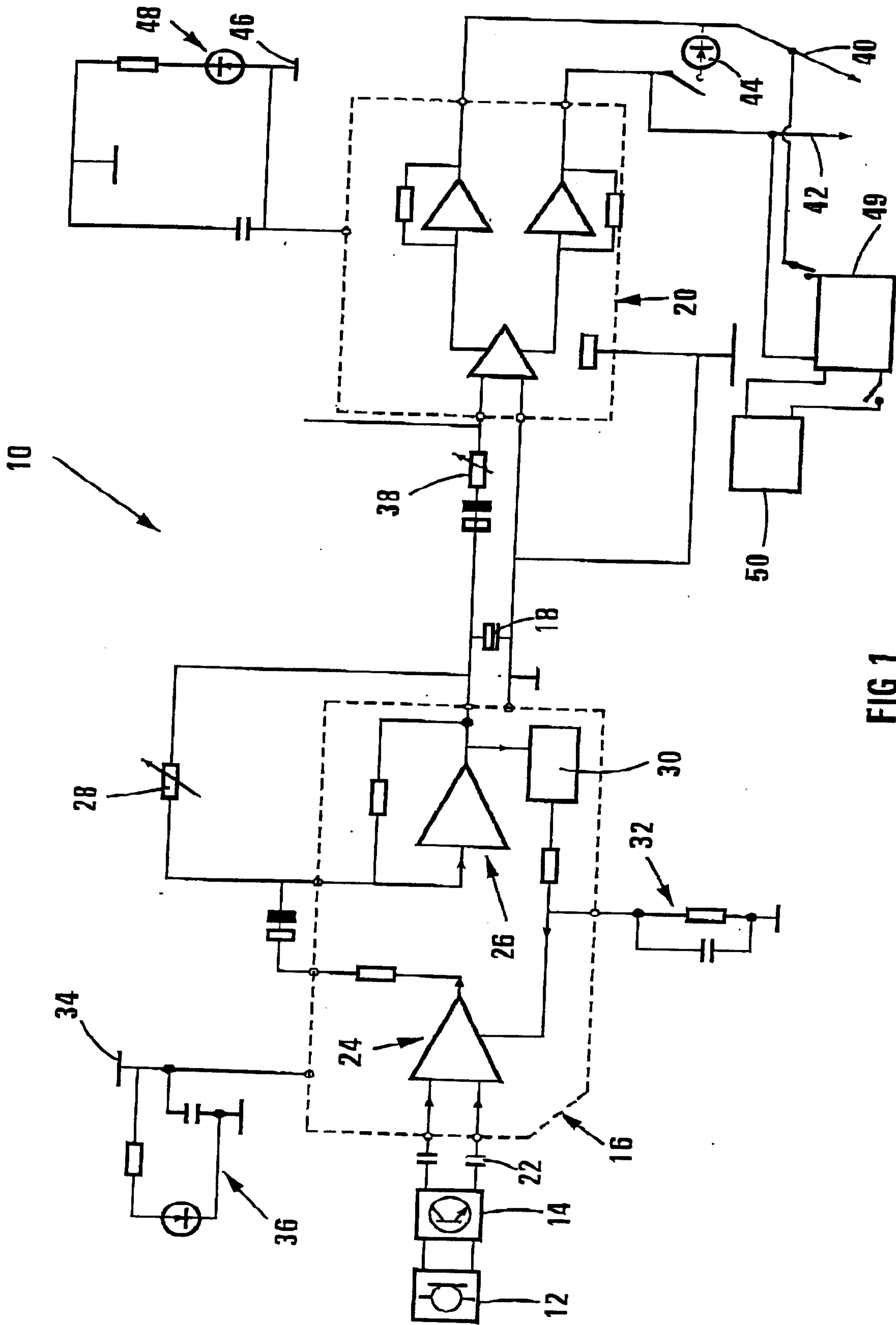


FIG 1

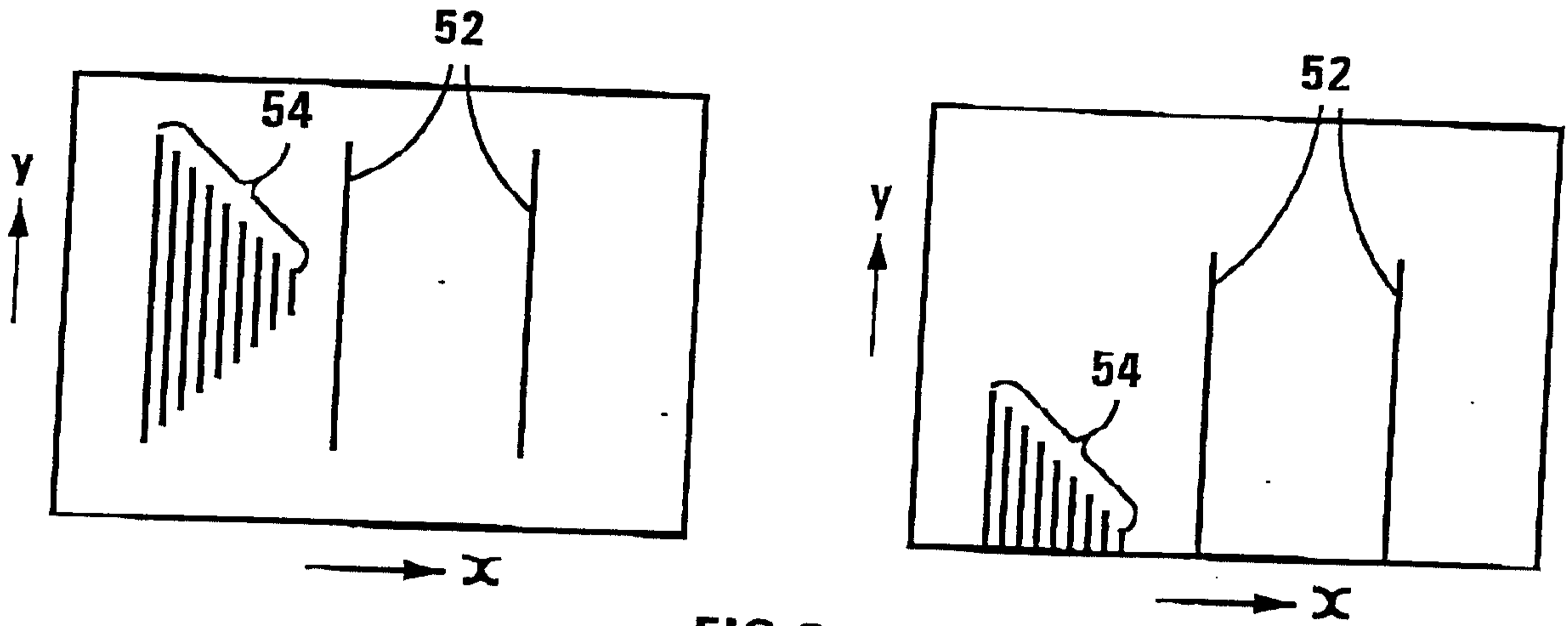


FIG 2