

[54] **SELECTIVE FREQUENCY
STETHOSCOPE STRUCTURE**

[72] Inventor: **Ronald J. Collins**, Golden Valley,
Minn.

[73] Assignee: **Bio Data, Inc.**, Minneapolis,
Minn.

[22] Filed: **July 30, 1971**

[21] Appl. No.: **167,680**

[52] U.S. Cl.181/24

[51] Int. Cl.A61b 7/02

[58] Field of Search.....181/24

[56] **References Cited**

UNITED STATES PATENTS

2,389,868 11/1945 Olson181/24

2,632,521 3/1953 Eaton181/24

Primary Examiner—Stephen J. Tomskey

[57] **ABSTRACT**

A selective frequency range stethoscope consisting of a housing embodying a sound producing chamber, a sound conducting chamber or channel and a rotatable backing plate having passages both formed therein and operatively associated therewith for the selective passage of a frequency range of sound between said chambers. One of said passages is particularly adapted to pass a predominantly low frequency range of sound, one of said passages is adapted to pass a predominantly high frequency range of sound and one of said passages is adapted to pass a full range of sound.

6 Claims, 7 Drawing Figures

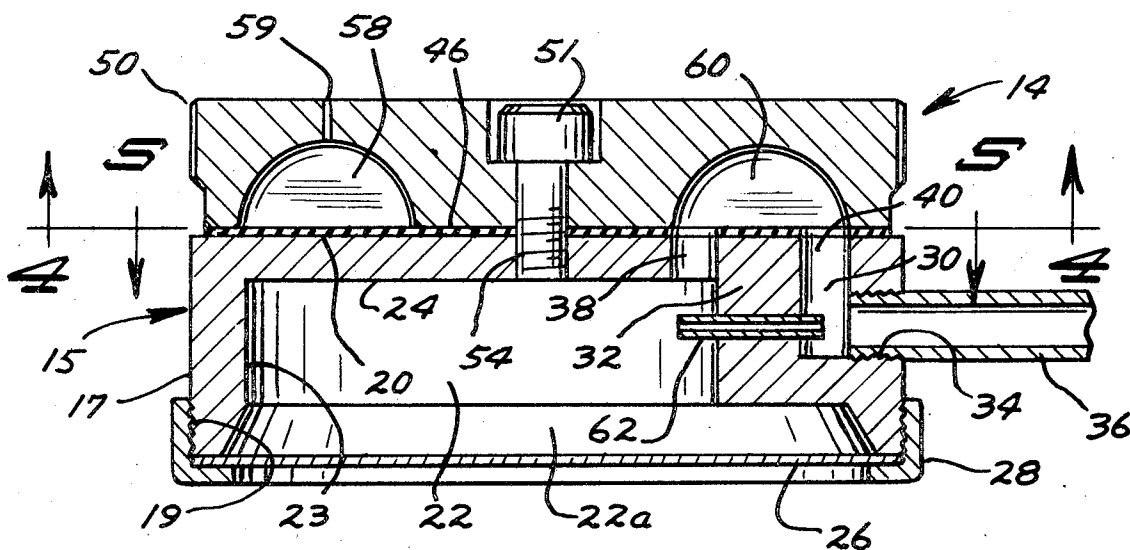
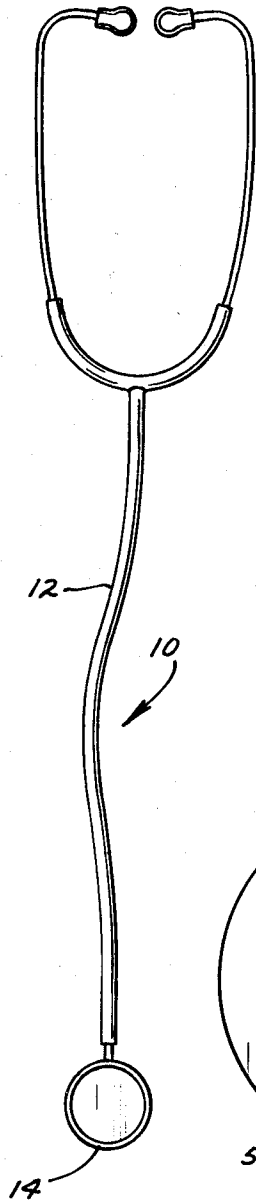
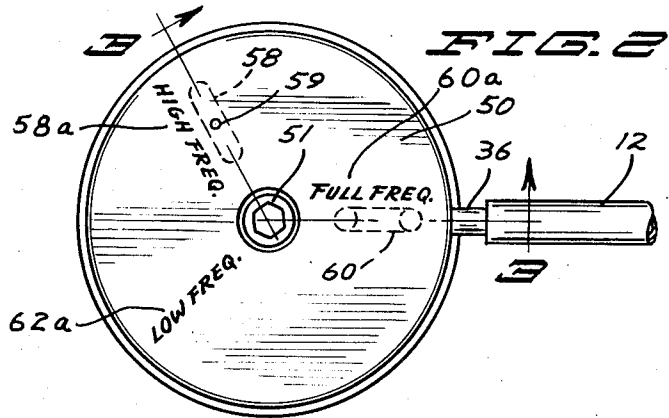
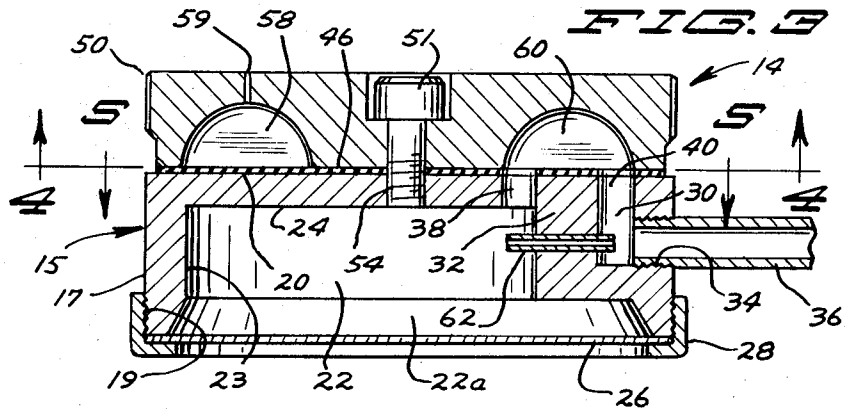
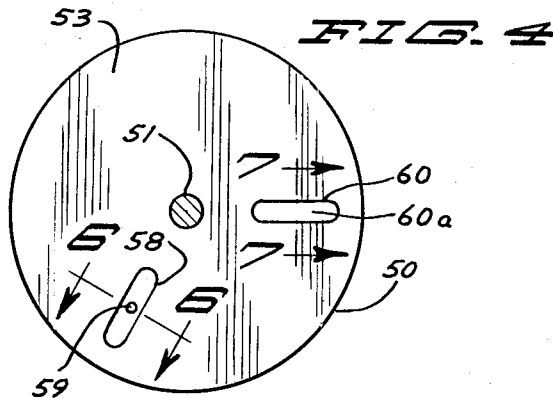
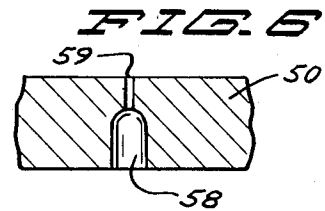
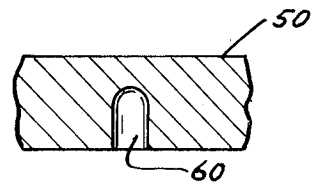
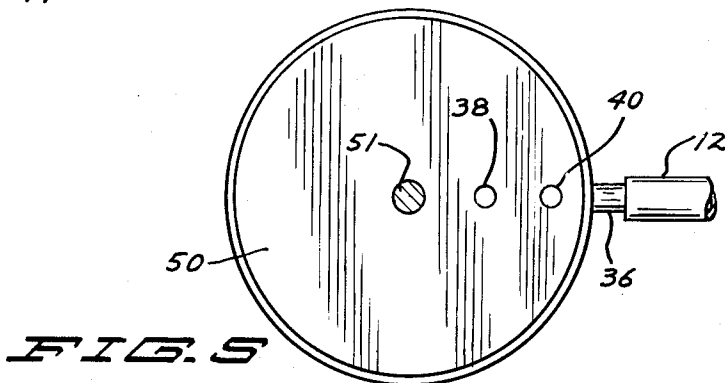


FIG. 1



INVENTOR.
RONALD J. COLLINS

BY
Reif and Gregory
ATTORNEYS

SELECTIVE FREQUENCY STETHOSCOPE STRUCTURE

BACKGROUND AND SUMMARY OF THE INVENTION

A stethoscope of common usage provides for a column of air extending from the body wall of a person to the ears of the user to transmit acoustical energy or sound. It is desirable to have such a device which is capable of transmitting selective portions of the full range of sound passing through the stethoscope such as a high frequency portion or a low frequency portion of the sound resulting from the movement of the body wall. A device such as this, for example, permits a user to be better able to detect various sounds in one frequency range by attenuating sounds of other frequency ranges that may be masking the very sounds the user is trying to detect.

The structure herein provides a simple mechanical means to permit the passage to the ears of the user a selection of either a low frequency range of sound or a high frequency range of sound or a full range of sound transmission, as may be desired.

Reference is had to U.S. Pat. No. 2,389,868 issued to H. F. Olson wherein a plurality of openings are made in a rigid tubular insert which forms an intermediate portion of an ear tube of a stethoscope, said insert having an enclosed tubular member thereabout and resonating chambers therein whereby the user may rotate the outer tubular member to align the chambers therein with certain of said openings in said tubular insert to filter out or attenuate certain frequencies of sound depending upon the size of the opening and the volume of the particular chamber communicating therewith.

Further with respect to the Olson patent, Olson characterizes his chambers as constituting Helmholtz resonators and hence it must be assumed that they operate to attenuate certain specific frequencies or a very narrow band of frequencies of sound. He states that with the size of the opening and volume of the chamber being properly chosen, the resonating chambers should each filter out certain frequencies. It is questioned whether the ear would be able to detect the absence of any small band of frequencies which may be selected for attenuation by the Olson device from a spectrum of sound frequencies.

The structure herein disclosed distinguishes clearly from Olson in utilizing a different principle for selecting a frequency range. The structure herein is set forth as being selective between an upper or high frequency range of sound and a low frequency range of sound based upon the impedance to the passage of a frequency range of sound through a particular air mass. This requires the selection of a particularly designed channel or passage for the transmission of sound in which either a high or low frequency range of sound shall pass with relatively less attenuation.

The invention disclosed herein embodies structure completely contained within the housing or sound pick-up portion of the stethoscope and provides for the convenient selection of a frequency range to pass through said stethoscope by the simple rotation of the backing plate of the housing which is the portion thereof upon which the hand of the operator will rest in placing the device against the chest wall of a patient.

It is one of the objects of the invention herein to provide a simply constructed stethoscope arranged to transmit a selected range of frequencies of sound. It is another object of the invention herein to provide a stethoscope structure having connection with the sound pick-up portion thereof a sound conducting channel and means passing from the sound producing chamber of said pick-up to the sound conducting channel thereof a certain selected range of frequencies of sound.

It is more generally an object of the invention herein to provide a stethoscope device comprising a housing portion having a sound producing chamber, a sound conducting channel running to an ear tube and a rotatable backing plate having a plurality of channels both formed therein and operatively associated therewith for selective communication between said sound producing chamber and said sound conducting channel, said channels being arranged and adapted to provide for the passage therebetween of different ranges of frequency of sound.

These and other objects and advantages of the invention will be set forth in the following description made in connection with the accompanying drawings in which like reference characters refer to similar parts throughout the several views and in which

FIG. 1 is a top plan view of the whole device;

FIG. 2 is a broken view in plan on an enlarged scale;

FIG. 3 is view in section on an enlarged scale taken on line 3—3 of FIG. 2 as indicated;

FIG. 4 is a view in horizontal section taken on line 4—4 of FIG. 3 as indicated;

FIG. 5 is a view in horizontal section taken on line 5—5 of FIG. 3 as indicated;

FIG. 6 is a broken view in vertical section showing a detail of structure; and

FIG. 7 is a broken sectional view showing a detail of structure similar to that of FIG. 6.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawings, the structure comprising the stethoscope herein is indicated generally by the reference numeral 10.

Said stethoscope comprises a binaural ear tube member 12 hereafter referred to as an ear tube and a chest piece or sound pick-up member 14. Said sound pick-up member comprises the subject matter of the invention herein and consists of a housing 15 shown here as being cylindrical in form. Said housing has an outer side wall 17 having an externally threaded upper rim portion 19 and has a bottom wall 20 which will be further described.

Recessed axially within said housing is a chamber 22 circular in cross section as defined by a side wall 23 and is here shown having an outer shallow chamber portion 22a of greater diameter and being at the open side of said housing 15. Said chamber has an inner bottom wall 24.

Overlying said chamber portion 22a and said rim portion 19 is a diaphragm 26 which may be formed of a thin plastic material chosen for suitable flexibility. Said diaphragm is shown secured by an angular threaded ring 28 of a type commonly known as a bezel.

A sound conducting chamber 30 is also formed within said housing separated from said chamber 22 by

an inner wall or web 32. Extending outwardly of said chamber 30 through wall 17 is a threaded opening 34 having an outwardly extending nipple 36 secured therein. Said binaural or ear tube 12 will have an end portion frictionally fitted over said nipple.

Extending from said chamber 22 through said wall 20 is a passage 38 and extending from said chamber 30 through said wall 20 is a passage 40. Said passages 38 and 40 are shown separated by said web 32.

Overlying said bottom wall 20 and having openings therein in register with said passages 38 and 40 is a thin self lubricating gasket 46 formed of a thin sheet material such as Teflon.

Overlying said bottom wall 20 and said gasket thereon is a cylindrical end cap member 50 of some thickness which is rotatably secured to said wall by a bolt 51 which is threaded into a tapped well 54 recessed into said wall 20 shown. Said bolt is here shown located centrally of said housing 15.

Said cap member 50 is shown of solid structure having radial channels therein as hereinafter described to provide communication between said chambers 22 and 30.

Formed into the innerside wall 53 of said member 50 are shown a pair of radial channels 58 and 60. Said channels are of a length to extend from passage 38 to passage 40 and overlie the same when in register therewith for communication therebetween. By rotation of said cap member 50 said channels are positioned to be in register with said passages 38 and 40.

In addition to the channels 58 and 60 there is a third channel 62 for communication between the chambers 22 and 30 and the channel is formed by a tube being disposed through the web 32 and is as shown. Said channel 62 will be further described. Said channels may be referred to hereafter for purposes of explanation as tubes.

Said channels are respectively identified with reference to the passage of sound therethrough. Said channel 58 is identified with the passage of High Frequency range of sound, said channel 60 is identified with the passage of a Full Frequency range of sound and said channel 62 is identified with the passage of a Low Frequency range of sound. The indicia indicating said frequency ranges of sound appears on the outer surface of said cap 50 as shown in FIG. 3 with the reference numerals 58a, 60a and 62a respectively indicating said indicia. Said indicia provides a reference for positioning said cap 50 with respect to the use of said channels 58, 60 and 62 and said indicia for purposes herein will be moved by rotation of the cap member 50 into alignment with the nipple 36 being used as a reference point.

The channels 58, 60 and 62 are to be clearly distinguished from resonant chambers. Resonant chambers acting on the order of a resonator such as a Helmholtz resonator are designed to select certain frequencies. The invention herein relates to passing a range of frequency of sound and more particularly relates to passing the higher or lower frequency portions of the range of sound in addition to passing the full range of the sound picked up. The channels as will be described are particularly designed for this purpose.

Within its hearing range with respect to sound present, the ear will detect or perceive in the

predominating sound. It is known in the art that the ability of the ear to detect the presence of one sound may very well be affected by the presence of another sound of a different frequency. Thus, a high frequency sound of low frequency intensity may not be detected over a low frequency sound high intensity or the converse of the same whichever applies. With the frequency ranges herein referred to being sufficiently remote from one another at the higher and lower portions of said range can be attenuated by the channels 58 and 62, as will be described, to enable the ear to hear the portion of the range of sound not attenuated.

With respect to the channels 58 and 60, these channels may be variously formed as to their specific configuration. With particular reference to the channel 60, with this channel positioned to connect the passages 38 and 40, a full range of sound is passed into the chamber 30 and therefrom to the ear tube. The cross sectional area of said channel will be such as to be the same as the cross sectional area of the ear tube. Hence the wave front in said channel 60 will be the same as that present in the ear tube and the full range of sound which can be conducted by the ear tube will pass through said channel 60.

It is to be understood that for purposes herein, when reference is made hereinafter to the air mass within the channels 58, 60 and 62 that included is the air mass within the ear tube 12 and extended to and including the impedance of the ears of the user.

It is well known in the art that an air mass within a tube has inertance and provides impedance to the movement of sound waves therethrough and that that impedance to the movement of sound waves therethrough varies directly with the frequency of the sound.

The channel 58 is indicated here as being identical to said channel 60 with the exception that said channel 58 has a tubular aperture 59 of small cross sectional area opening into the atmosphere. Said aperture 59 contributes an acoustical element of inertance which due to its frequency dependent impedance characteristics shunt the lower frequency sounds to the atmosphere while confining relatively higher frequency sounds to pass through the channel 58 and the ear tube 12. As above indicated, the channel 60 in having the same cross sectional area as the ear tube passes the full range of sound that will pass through the ear tube. With respect to channel 58 however, the tubular aperture 59 brings about the change above described.

The high frequency range of sound encounters lesser impedance in passing through the air mass of said channel 58 to the ears of the user than is present for it in the inertance of the air mass of said bleed tube 59. Hence the high frequency portion of the sound produced in said chamber 22 is passed by said channel 59 through the chamber 30 and therefrom through the ear tube.

With respect to the passage of a low frequency range of sound, said cap 50 is rotated to cover or seal off the passages 38 and 40. During the time that either the channels 58 or 60 are being utilized, the impedance presented by the inertance in said channels is sufficiently less than that presented by the inertance in the channel 62, that the sound produced in said chamber 22 bypasses said channel 62. However, with the passages 38 and 40 sealed off, the channel 62 becomes

operative. Channel 62 will be carefully designed to attenuate effectively the high frequency range of the sound present. For purposes herein it has been found that the channel 62 will effectively perform to obtain such a result by having such bore size and a corresponding length as to provide sufficient inertance to attenuate the high frequency range of sound present in accordance with known principles well developed in the art. The frequency dependent impedance present is such that the lower frequency range of sound passes through but the high frequency portion of the sound present becomes significantly attenuated sufficiently so that the ear detects the lower frequency sounds that might otherwise be masked by the higher frequency sounds present.

The operation of the structure herein described is believed to be obvious from the description above given. The reference point for rotation of said end cap 50 is in position of said nipple 36. With the Low Frequency indicia positioned at this point, the passages 38 and 40 are sealed off although it is obvious that said passages will always be sealed off at such time when the channels 58 and 60 are not positioned to connect said passages.

The structure herein has been very successful in operation and it has been found that the distinction between the passage of lower frequency range and higher frequency range of sounds is clearly evident to the ear and represents a significant accommodation to the hearing ability of users.

It will of course be understood that various changes may be made in the form, details arrangement and proportions of the parts without departing from the scope of the invention herein which, generally stated, consists of a device capable of carrying out the objects above set forth, in the parts and combination of parts disclosed.

What is claimed is

- 1, A stethoscope structure having in combination, a housing,
 - a first chamber within said housing comprising a sound producing chamber and having one side open to the atmosphere,
 - a second chamber within said housing,
 - an outlet from said second chamber to the atmosphere,
 - a tubular member connected to said outlet comprising hearing means,
 - a plate member overlying said housing,
 - said first and second chambers each having a passage running outwardly thereof and underlying said plate member,
 - said plate member having channels formed therein each adapted to provide communication between said passages of said first and second chambers,
 - means movably securing said plate member to said housing whereby said plate member may be moved to alternatively align said channels therein with said passages,
 - one of said channels being constructed and arranged to have substantially the same cross sectional area as the bore of said tubular member to provide for passage therethrough from said first chamber of substantially the same range of sound as would pass through said tubular member,

one of said channels having substantially the same cross sectional area as said first mentioned channel and having an aperture therein open to the atmosphere, said aperture being adapted to shunt off the low frequency range portion of the sound passing through said channel and to have the high frequency range portion of said sound pass to said second chamber,

a third channel comprising a tubular member extending from said first chamber to said second chamber, said channel being so constructed to have a cross sectional area such that with respect to the length thereof, the inertance of the air mass within said channel attenuates the higher frequency range portion of sound produced in said first chamber passing therethrough the lower frequency range of said sound and said third channel being arranged and adapted to have the air mass therein provided such impedance as to render said channel inoperative when either said first or second mentioned channels are aligned to connect the passages of said first or second chambers.

2. A stethoscope structure having in combination
 - a housing,
 - a chamber within said housing comprising a sound producing chamber and having one side thereof open to the atmosphere,
 - a second chamber within said housing having an outlet to the atmosphere,
 - a tubular member comprising hearing means being connected to said outlet,
 - a first passage running outwardly from said first chamber,
 - a second passage running outwardly from said second chamber,
 - a plate member movably carried by said housing and having the underside thereof overlying said first and second passages,
 - said plate member having channels formed in said underside thereof adapted upon alignment by movement of said plate member to provide communication between said first and second passages,
 - one of said channels having a cross sectional area of such extent as that of said tubular member that the same full frequency range of the sound produced in said first chamber that would pass through said tubular member is transmitted to said second passage,
 - a second of said channels having a cross sectional area equal to that of said first mentioned channel and having intermediate the ends thereof a tubular aperture to the atmosphere, said aperture being arranged as to cross sectional area and length as to shunt off to the atmosphere the low frequency range portion of the sound generated in said first chamber and to pass to said second chamber the high frequency range portion of said sound,
 - a tubular member running from said first to said second chamber forming a third channel, said third channel having a cross sectional area on the order of one half of the cross sectional area of said first mentioned channel, said cross sectional area being such that with respect to the length thereof, the inertance of the air mass therein attenuates the

7

high frequency portion of the range of sound produced in said first chamber and passes to said second chamber the low frequency portion thereof, and

said cross sectional area of said third channel with respect to the length thereof, the inertance of the air mass therein provides such impedance to passage of sound therethrough relative to that of said first and second channels that said third channel becomes inoperative at such times as either said first or second channels are aligned to connect said passages of said first and second chambers.

3. The structure set forth in claim 1, including a diaphragm seated onto said housing and overlying said open side of said first chamber.

4. The structure set forth in claim 1, wherein said plate member has a pair of radial channels formed in the underside thereof and means rotatively secure said plate.

8

5. The structure set forth in claim 1, wherein said aperture of said second mentioned channel forms a tubular passage and has a cross sectional area such that the air mass therein presents less impedance to the passage of a low frequency range portion of sound therethrough than presented by the impedance of the air mass within said second channel.

6. The structure set forth in claim 1, wherein said tubular member forming said third channel has a cross sectional area on the order of one half of the cross sectional area of the bore of said tubular member and a correspondingly determined length such that there is such impedance therein that with communication open between said first and second chambers, sound produced in said first chamber bypasses said tubular member.

* * * * *

20

25

30

35

40

45

50

55

60

65