United States Patent

[11] 3,630,308

[72] Inventor **Abe Ravin**
45 South Dahlia Street, Denver, Colo. 80222

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[54] **STETHOSCOPE**
11 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **181/24**
[51] **Int. Cl.** **A61b 7/02**
[50] **Field of Search** 181/24

[56] **References Cited**

UNITED STATES PATENTS

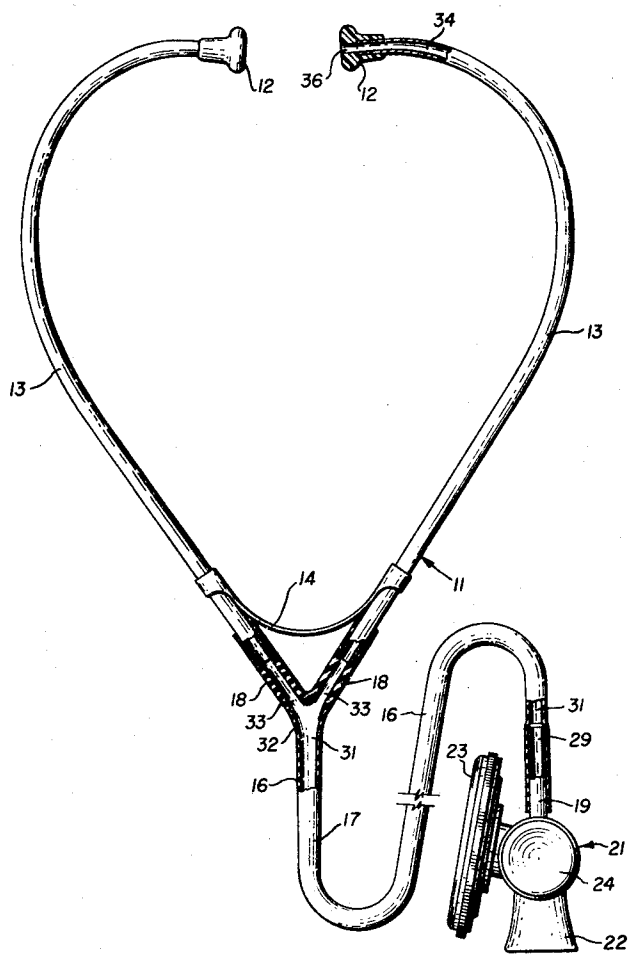
862,016	7/1907	Port	181/24
882,700	3/1908	Lewis	181/24
1,466,825	9/1923	Foord	181/24
2,258,743	10/1941	Dax	181/24
3,169,600	2/1965	Thomas	181/24
3,295,631	1/1967	Machlup	181/24
3,366,198	1/1968	Littmann	181/24
3,470,975	10/1969	Haiken	181/24
3,472,335	10/1969	Allen	181/24
2,515,471	7/1950	Ratzan	181/24
2,893,507	7/1959	Friedman	181/24
3,493,075	2/1970	Mendelson et al	181/24

FOREIGN PATENTS

858,598	1/1961	Great Britain	181/24

Primary Examiner—Stephen J. Tomsky
Attorney—C. B. Messenger

ABSTRACT: A stethoscope for improved auscultation providing small bell and diaphragm chest pieces selectively interconnectable to an air column channel having binaural branch ear tube components leading to the earpieces. Sound losses and attenuation are minimized by avoidance of abrupt changes in the volume and flow direction for the air columns and by a pivoting selector permitting direct flow connection of either chestpiece to the earpieces through a shorter air channel. Earpieces are movable to adjusted positions with respect to the ear tubes for improved fit, and the ear tube components are provided with tension adjustment features and are further pivotally mounted to facilitate storage.



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SHEET 1 OF 4

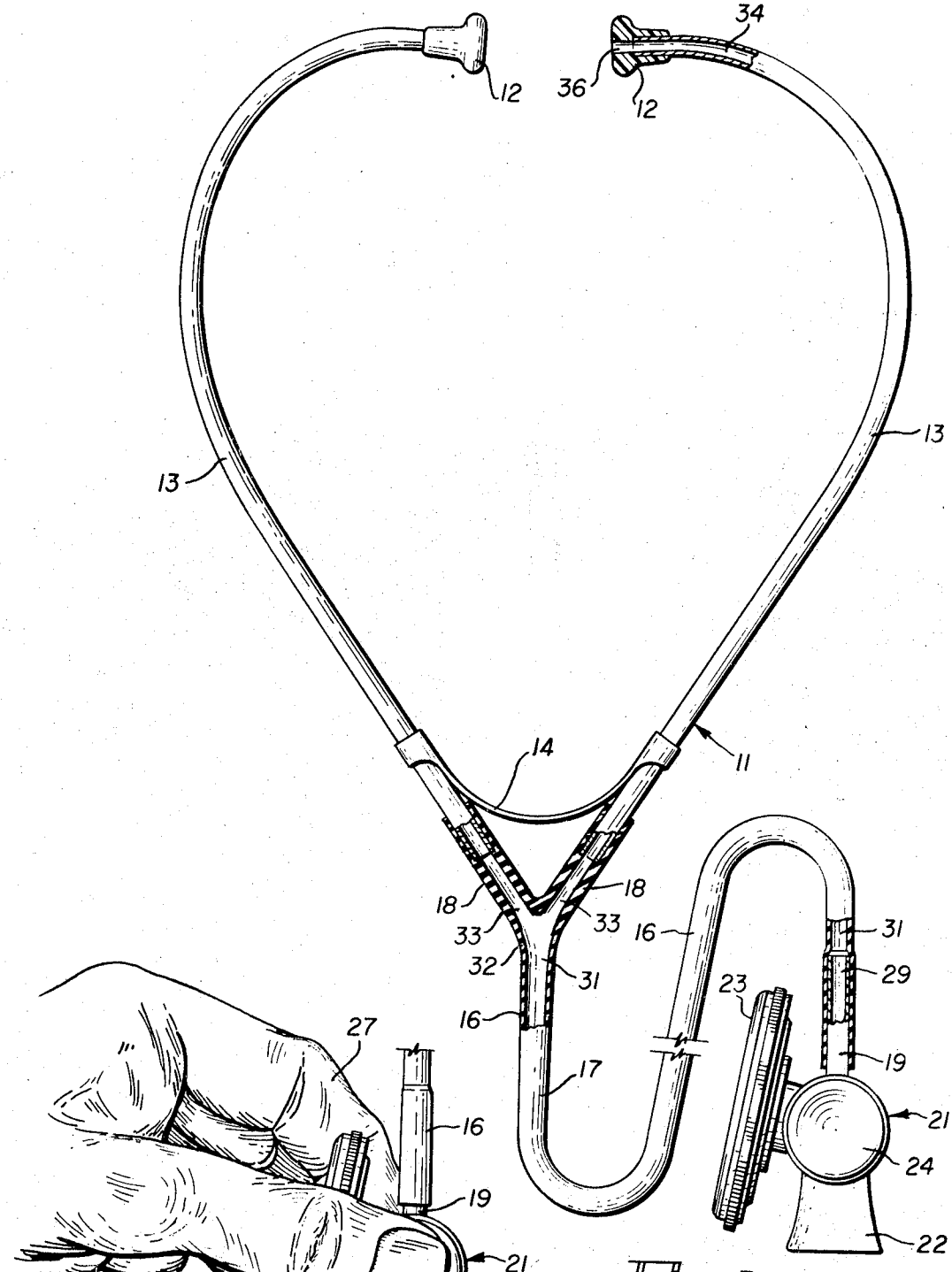


Fig_1

Fig_2

INVENTOR.
ABE RAVIN
BY
ATTORNEY

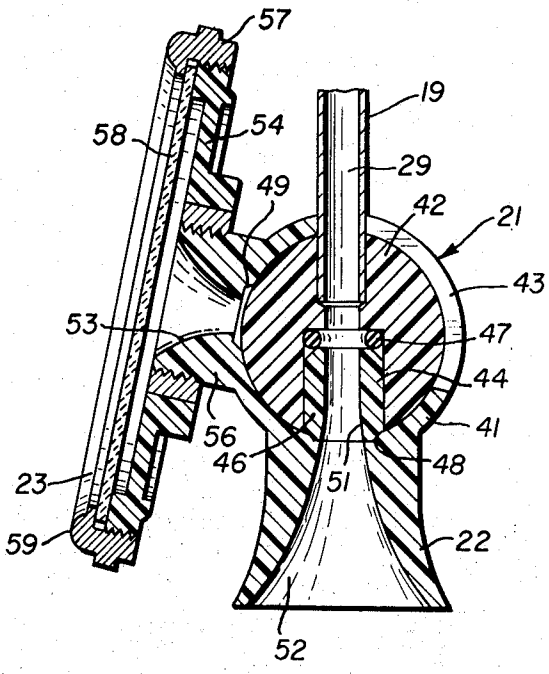


Fig_3

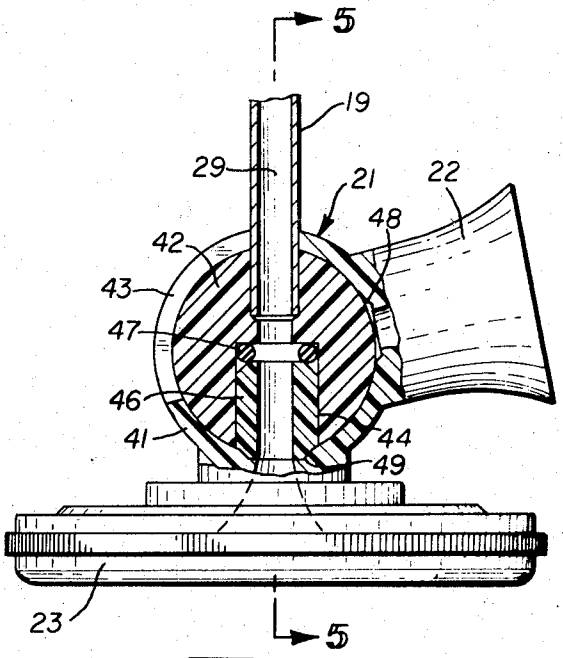


Fig_4

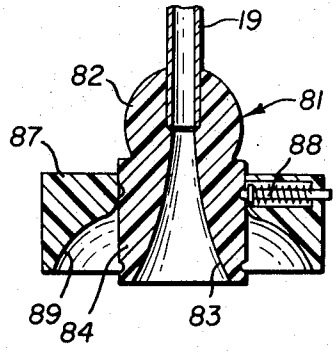


Fig_6

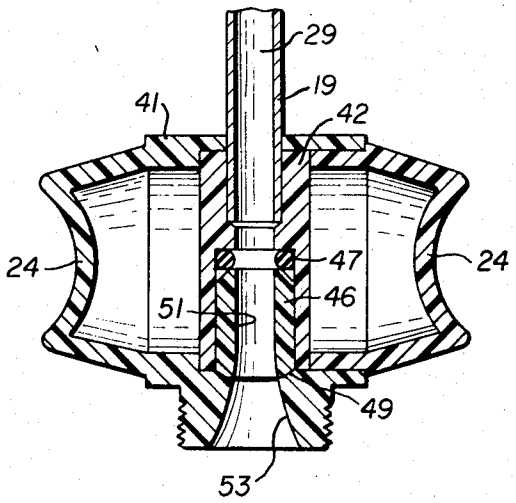


Fig_5

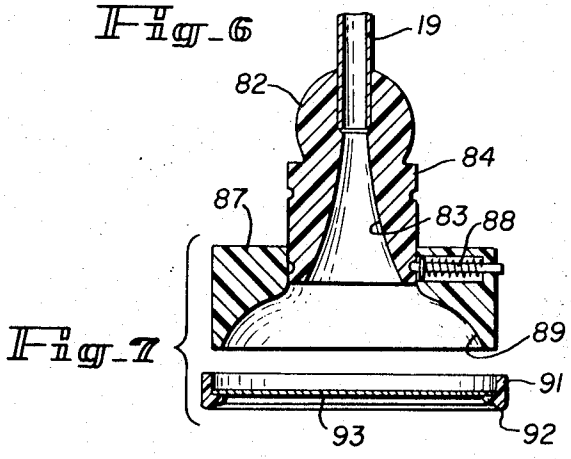


Fig_7

INVENTOR.
ABE RAVIN
BY
ATTORNEY

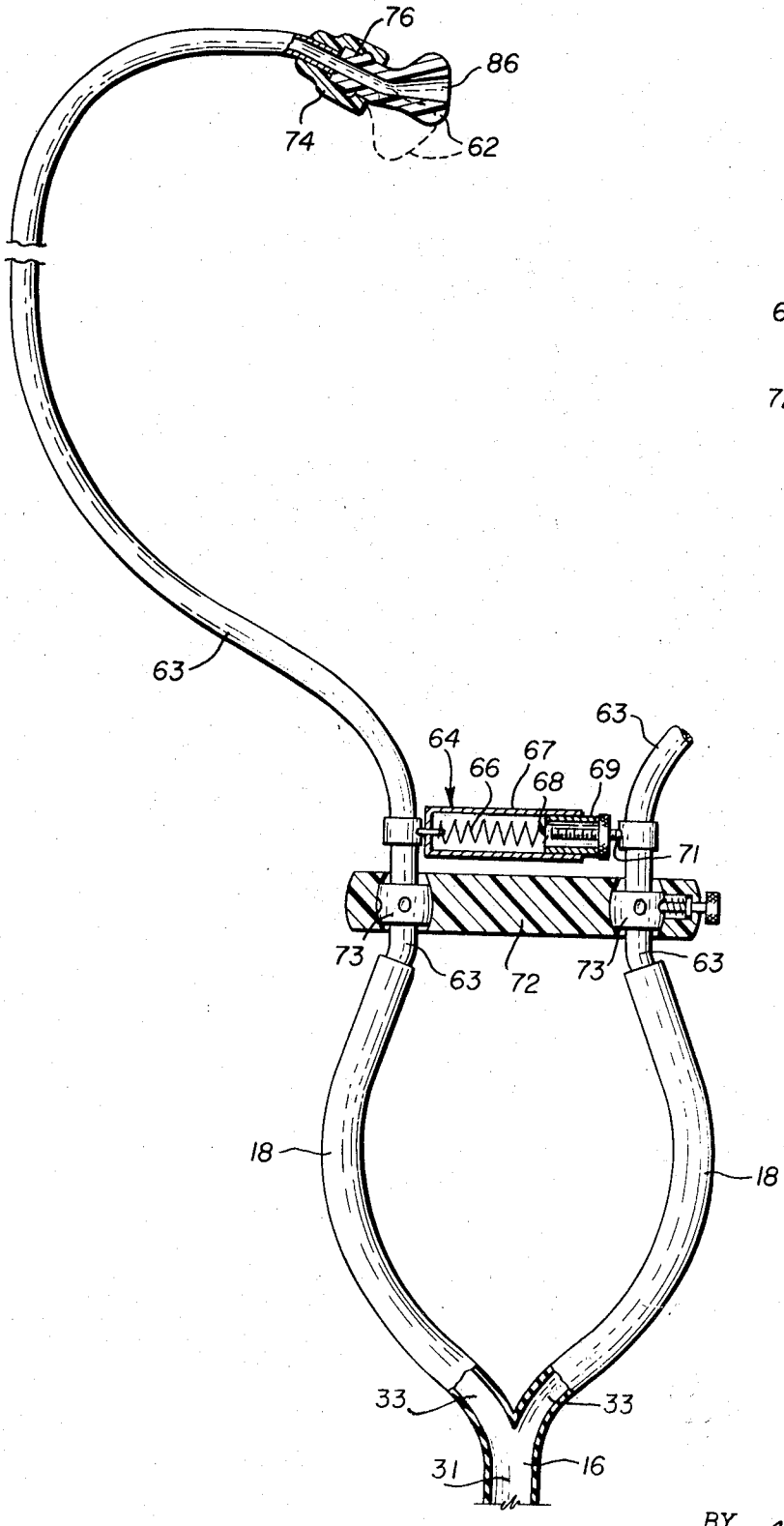


Fig-8

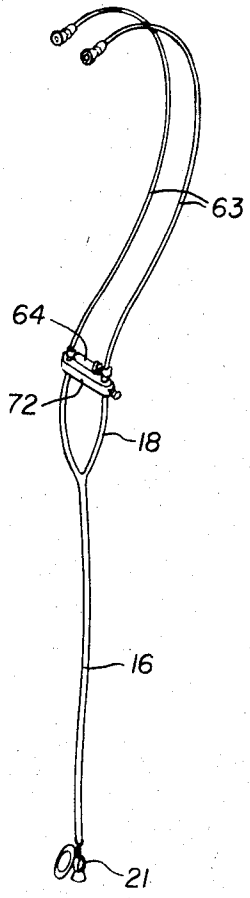


Fig-9

INVENTOR.
ABE RAVIN
BY
ATTORNEY

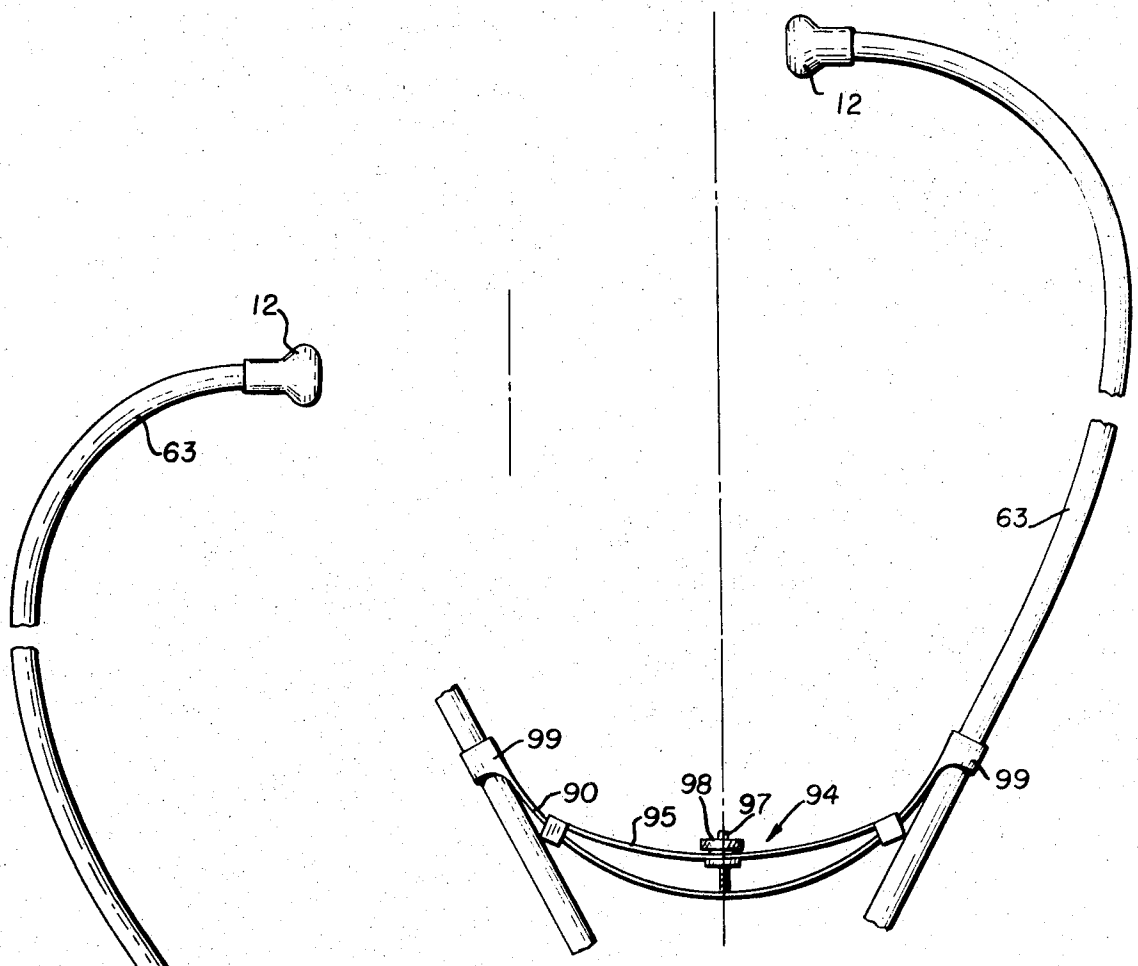


Fig. 11

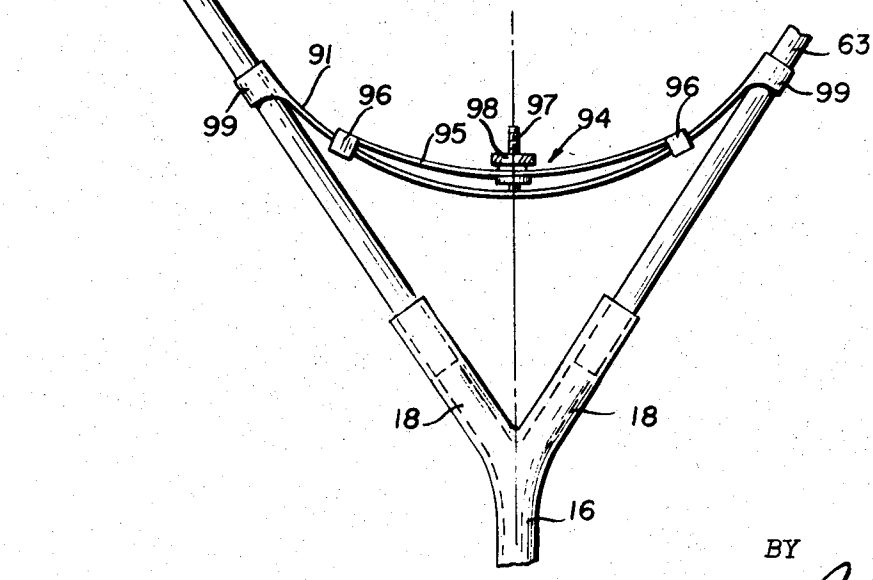


Fig. 10

INVENTOR.
ABE RAVIN
BY
ATTORNEY

STETHOSCOPE

BACKGROUND OF THE INVENTION

Stethoscopes have been used beneficially for many years. Knowledge concerning body and other functions that may be observed and diagnosed by auscultation has expanded substantially. Many different types of stethoscopes have been used, and various designs have been introduced to improve the utility and handling characteristics of stethoscope instruments. Regrettably, the sound transmission characteristics of some modern day stethoscopes is not an improvement. Undoubtedly there are benefits to be derived from the provision of a stethoscope that transmits sound with improved efficiency and that is also convenient to store, handle and use.

SUMMARY OF THE INVENTION

The present invention provides a stethoscope system utilizing two chest pieces that may be selectively interconnected with the ear tubes and ear pieces of a binaural stethoscope. The chest pieces are disposed on a single assembly, and a pivoting or rotatable selector valve is provided to interconnect either the bell-shaped or the diaphragm chest piece to the air channels of the ear tube and ear pieces. The valve selector is specifically designed so that the pickup sound pulses from the chest piece being used will be transmitted directly and without any severe angular bends to the ear piece. Sound attenuating bends or severe changes in the total cross-sectional area of the air column are avoided to minimize interferences with the sound movement patterns in the air column interconnecting the selected chest piece and the ear pieces. The selector valve is held efficiently in its selected position by detent means. The valve further provides surfaces facilitating manipulation of the chest pieces at time of use.

In a separate embodiment of the invention the ear tubes and ear pieces may be pivoted for more convenient storage and usage. The ear pieces themselves are likewise movable to angular positions so that better instrument-to-ear engagement is possible.

In a further embodiment of the invention, bell chest pieces of different size are provided for selective use in a design additionally providing a diaphragm type chest piece adapter. In such design all the bells and diaphragm components are directly connected to the ear tubes without use of an intermediate selector valve. Tension adjustment devices are provided to assure better ear contact pressures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an assembly illustration in partial section illustrating features of a first embodiment of the invention,

FIG. 2 is an elevation showing use of stethoscope chest pieces made in accordance with this invention,

FIG. 3 is a cross-sectional elevation showing features of a selector mechanism initially connected to a bell-shaped chest piece,

FIG. 4 is a side elevation similar to that of FIG. 3 showing the selector valve assembly of the FIG. 3 device in a diaphragm chest piece connecting position,

FIG. 5 is a partial cross-sectional elevation taken along the line 5—5 of FIG. 4,

FIG. 6 is a cross-sectional elevation through a separate embodiment of the invention,

FIG. 7 is a cross-sectional elevation showing the FIG. 6 embodiment in alternate position and with an additional diaphragm adapter piece,

FIG. 8 is an elevation in partial section showing features of a separate embodiment of the invention,

FIG. 9 is a perspective view showing the FIG. 8 embodiment in a storage position,

FIG. 10 is a partial elevation showing features of an alternate ear tube and tension adjustment assembly, and

FIG. 11 illustrates an alternate adjusted position for the assembly of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first preferred embodiment of the invention is shown in FIGS. 1–5. In FIG. 1 an assembled stethoscope 11 is illustrated which includes ear pieces 12, ear tubes 13 of symmetrical configuration, a spring yoke 14 for holding the head frames in engaged position on a user's ears, and an air tube 16 which includes a main tube 17 and separate binaural branches 18 disposed at the ear tube rear ends thereof. At the opposite end the tube 16 is joined to a standpipe 19 of chest piece selector assembly 21. The standpipe 19 may be moved into selective direct communication with either the bell chest piece 22 or a diaphragm chest piece 23. End grips 24 are provided at the lateral ends of the chest piece selector 21 to be conveniently gripped by the thumb 26 and forefinger 27 of the user so that either the bell 22 or diaphragm 23 may be conveniently held with a proper engaging pressure against the body of a patient.

In the illustration of FIG. 1 it should be noted that the inner passage 29 of the standpipe 19 is of the same cross-sectional area as the internal passage 31 of the air tube 16. At the transition or Y-branch 32 the air passage is split to provide binaural tubes 18, but at this point the cross-sectional area of the air column 31 in the tube 16 is equal to the total cross-sectional area of the separate channels 33 in the binaural branches 18. Again, the cross-sectional area of each binaural branch channel 33 is equal to the inner cross-sectional area of the passages 34 in the ear tube pieces 13. This cross-sectional size is continued at the ear piece 12 where the openings 36 are of size corresponding to the passages 34. With this arrangement the air column passages from the ear to the chest piece are of regulated size, and right-angle or severe bends are prevented that would tend to attenuate the sounds that are to be transmitted.

Detailed features of the chest piece selector 21 are shown in FIGS. 3, 4 and 5. In these figures it is seen that a main body 41 of external cylindrical or barrel-type configuration encloses a cylindrically formed valve element 42 into which the end of the standpipe 19 extends. A cut slot 43 is provided along a circumferential surface of body 41 so that the standpipe 19 and attached valving member 42 may be pivoted from the position shown in FIG. 3 to that shown in FIG. 4. A counterbore 44 is provided in the body of the valve disk or cylinder 42, and a socket pin or plunger 46 is reciprocally received in such bore. A resilient element or O-ring 47 is disposed in the bottom of the bore 44 so that the socket plunger 46 can move reciprocally against the resilience of the O-ring 47. In positions aligned with the bell 22 and the diaphragm 23, detent sockets 48 and 49 are provided. Accordingly, when the valve is in position aligned with the bell or diaphragm, the plunger 46 will be extended into a detent socket to hold the valve in desired position. At each of these positions, as illustrated in FIGS. 3 and 4, a central bore 51 in the plunger 46 will be properly aligned with and in direct communication with the central bore 29 of the standpipe 19 and with the central passage openings 52 and 53 of the bell and diaphragm chest pieces 22 and 23.

Each of these passages 52 and 53 has a widening or flared cross section away from the valve 42. This flared or trumpet shape is preferably continued into the bore 51 for the plunger 46. This arrangement for starting the flared shape within the confines of the valve structure itself makes it possible to further shorten the length of the total air column between the patient and the physician's ears. The potential shortening provided by this feature, while significant, is not equivalent however to the major shortening of the air column that is realized through provision of the selector valve arrangement shown in FIGS. 1–4. The described arrangement makes it possible for the physician to place the selected chest piece directly on the patient without any intervening bends being necessary in the air tube 16 due to an offset or angular positioning of the chest piece being used with respect to the axis of the air tube itself.

While the bell chest piece 22 is provided with a desirable trumpet shape, the diaphragm chest piece 23 for this embodiment of the invention is of relatively conventional construction. As in previous stethoscopes, this chest piece 23 is of an overall flat disk shape with a backplate 54 extending outwardly from a main support hub 56. A diaphragm engaging bezel 57 is threaded on the backplate 54 to hold the diaphragm 58 in position occluding the passage 53. For alternate usages, the diaphragm 58 and holder bezel 57 may, of course, be removed to provide direct communication to the passage 53 and, through valve component 42, to the standpipe 19. A shallow shoulder or ring 59 is provided on the bezel 57 so that the diaphragm 58 may be selectively held away from direct contact with the patient's skin for some auscultation operations. For other uses the application of a slight pressure will cause adequate deformation of the patient's flesh to bring the diaphragm into direct contact therewith.

The chest piece selector assembly 21 shown in FIGS. 1–5 is particularly well adapted for use with an alternate type of head frame assembly as shown in FIGS. 8 and 9. Here the air tube 16 and its binaural channels 18 are connected to ear tube pieces 63. A tension spring assembly 64 is disposed between the spaced apart ear tubes 63 to provide a tension force tending to hold the ear tubes and associated ear pieces 62 in position for use. The tension assembly 64 includes a spring 66 disposed within the housing 67 with its otherwise free end 68 engaged to an adjusting mechanism 69. When the knurled knob of the adjusting mechanism is rotated on the anchor screw 71, the tension in spring 66 will be increased or decreased. A spacer 72 is provided below the tension adjusting mechanism 64, and collars 73 on the ear tube pieces 63 are in engagement with the spacer 72. The cooperative form of the collars 73 and the spacer 72 permits rotation of the ear tubes 63 about two axes of rotational freedom. This freedom makes it possible to insert and remove the ear tubes from positions of ear contact, and it alternatively permits the ear tubes to be rotated to a storage position as shown in FIG. 9. When in the collapsed storage position shown in FIG. 9, the entire stethoscope can, of course, be conveniently stored in a physician's pocket or the like.

The ear pieces 62 illustrated in FIG. 8 incorporate a further improvement. As shown, the ear tube pieces 63 engage a pivot mount 74. Ear piece 62 is snapped into a receptacle 76 provided by the pivot mount 74, and ear piece 62 can then be rotated in such receptacle to alternate positions. As the ear piece is rotated, its bent shape as illustrated will allow orientation of the ear piece 62 at various adjusted angles. This angular position can then be separately adjusted by the user of the stethoscope to assure proper alignment of the air column passage 86 and the ear piece 62 with the air channels in the user's ear. Misalignment at this user-to-instrument interface has previously contributed to decreased sound reception with some previous stethoscope configurations. The rotary and pivoted combination provided by the ear pieces 62 and ear tubes 63 avoids previously necessary bending of stethoscope ear tubes to accommodate users having distinctive ear configurations.

A further embodiment of the invention is presented in FIGS. 6 and 7 where a modified type of chest piece is shown. Here chest piece 81 has a nonpivoting body 82 adapted to receive standpipe 19. The standpipe communicates directly with the trumpet shaped passage 83 of a smaller bell chest piece 84. A larger bell component 87 is reciprocally mounted on the external surface of the bell 84, and it may be moved to alternate positions, as shown in FIGS. 6 and 7. In either position it will be held in its selected position by a spring loaded pin 88. When the larger bell component 87 is moved forwardly, as shown in FIG. 7, contact with the patient is made by the enlarged ring 89. With the enlarged area of contact different sounds may be more readily observed in the patient. In instances where a diaphragm reading is still thought to be advantageous, a separate diaphragm adapter 91 may be engaged to the large bell component 87. Diaphragm adapter 91 is preferably made of resilient material so that it will be held in assembled relation by its own resilience. As in the previous configuration, a raised ring 92 is provided on diaphragm adapter 91 so diaphragm 93 may be selectively engaged or not engaged with the patient's skin.

A separate type of tension assembly 94 is shown in FIGS. 10 and 11. This assembly is used to increase or decrease the holding pressure exerted by the ear tubes to maintain the ear pieces 12 in connection with the stethoscope user's ears. Tension assembly 94 also makes it possible for an ear tube 63 to be pivoted or turned to a storage position as originally shown in FIG. 9. Tension assembly 94 includes a main spring element 90 extending between the ear tube pieces 63 and providing loops 99 that loosely engage the ear tubes 63. The main spring element 90 exerts an initial spring force tending to hold the ear pieces 12 in an at-rest position where the ear pieces would be closer together than the ears of a normal user. When the stethoscope is to be used, the ear pieces will, accordingly, be spread apart, and the spring 90 will exert a force tending to hold the ear pieces engaged in the user's ears.

Adjustments in this tension force may be made by changing the relative positions of the main spring 90 and an auxiliary spring 95. Spring 95 is provided with end clips 96 which loosely engage main spring 90 to permit relative reciprocal movement to alternate positions as illustrated in FIGS. 10 and 11. A threaded adjustment is provided to make such position changes. This adjustment includes a threaded stem 97 engaged to the main spring 90 and a knurled nut 98 rotatably mounted with respect to auxiliary leaf spring 95. With this tension adjustment assembly the pressure exerted on the user's ears by the ear pieces 12 may be changed until a best sound transmitting and instrument retention result is obtained. For this embodiment of the invention the main spring element 90 operates as a spacer with the auxiliary spring 95 providing the major changes in the ear engaging pressure.

All embodiments of the invention incorporate features which satisfy the major objectives in the stethoscope art. Through provision of directly aligned sound passages and further through provision of assemblies where the divergent shape of a bell or other chest piece component is continued into the selector mechanism itself, the overall length of the sound passages or air columns between the pickup component and the user's ear may be substantially shortened. With the shorter air columns a better sound transmission and lessened sound attenuation is realized. Further, the direct alignment of sound passages extending outwardly from the pickup component in a position normal to the patient contacting lip surfaces of the pickup components helps to prevent inadvertent contacts with the patient's or the physician's person or clothing. Such undesirable supplementary contact in other stethoscope designs often tends to muffle or distort the sound impulses being transmitted. Such contact further can be a source for the introduction of auscultation disturbing background noises.

In connection with the preservation of good sound signals, the provision of finger grips 24 is likewise of importance. Not only do these elements make it easier to properly position and hold the instrument, but they also prevent sound attenuation due to finger contact on the sound collecting and carrying bell pieces.

With the provision of stethoscopes incorporating the foregoing features and various combinations of such features improved auscultation will be possible.

I claim

1. A binaural stethoscope for use by individuals in connection with the examination of patents comprising ear tubes, ear pieces on said ear tubes for engagement with the user's ears, a chest piece assembly, a tube interconnecting said chest piece and ear tubes, a plurality of patient contacting sound pickup components disposed at alternate nonaxial positions on said chest piece with each of said components providing a bore sound passage of straight axis therethrough, patient contacting surfaces for each of said components with said surfaces being

disposed at positions normal to the position of said sound passages, and selector means having a straight axis sound passage therethrough for alternately interconnecting any of said pickup components to said tube, said pickup component and selector means being cooperatively arranged whereby all of the sound passages therethrough are directly aligned at periods of use to minimize attenuation of the auscultation sound signals that are to be observed.

2. Structure as set forth in claim 1 wherein the selector means is inclusive of a rotary element with the sound passage therethrough having an initial flared shape and wherein the sound passage of said rotary element may be selectively aligned with and interconnected to the sound passages of alternate sound pickup components.

3. Structure as set forth in claim 1 wherein said interconnecting tube provides a sound passage therethrough with said tube passage being aligned at periods of use with the sound passage of the selected pickup component and said selector means whereby the total length of sound channels from ear piece to pickup component is minimized.

4. Structure as set forth in claim 1 and further comprising a spacer for engaging said ear tubes, a resilient member likewise engaging said ear tube, and means for adjusting the force exerted by said resilient member whereby the engaging pressure for said ear pieces may be adjusted.

5. Structure as set forth in claim 4 wherein said resilient member is a spring.

6. Structure as set forth in claim 4 wherein separate ear tube pieces are used and wherein the engagement between said ear tube pieces and spacer permits rotation between said ear tube pieces and spacer whereby said ear tube pieces may be moved to alternate positions for use and storage.

7. Structure as set forth in claim 1 and wherein said ear

pieces are movable whereby the angular positioning of said ear pieces may be adjusted.

8. Structure as set forth in claim 7 wherein a pivot mount is provided to facilitate movement of said ear pieces.

9. In a stethoscope construction having ear tubes, ear pieces and a flexible interconnecting tube, a chest piece assembly comprising small and large sound pickup components disposed at nonaxial positions with each of said components providing a straight bore sound passage therethrough, patient contacting surfaces for each of said components with said surfaces being disposed at positions normal to the position of said sound passages, selector means having a straight axis sound conducting passage therethrough and adapted for interconnection to said sound pickup components, and means for selectively moving either of said pickup components into position for use and application to a patient's skin with said selector means, the sound conducting passages therethrough and the sound passages of the selected pickup component being directly aligned and in position normal to the patient's skin whereby sound attenuation due to angular passages and patient or user contact with stethoscope elements other than the contact surfaces is minimized.

10. Structure as set forth in claim 9 and further comprising a diaphragm adapter for application to the large sound pickup component.

11. Structure as set forth in claim 9 wherein the sound passages through said pickup components are of flared shape and wherein the selector means is inclusive of a rotary element with the sound passage therethrough having an initial flared shape for alignment with the sound passages of said pickup components.

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