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Shacklock

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[54] **STETHOSCOPES**

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[73] Assignee: **Chas. F. Thackray Limited,** Yorkshire, England

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[30] **Foreign Application Priority Data**

June 29, 1971 Great Britain 30,388/71

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

[51] **Int. Cl.** **A61b 7/02**

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

[56] **References Cited**

UNITED STATES PATENTS

1,708,398	4/1929	Pilling	181/24
2,505,124	4/1950	Lepeschkin	181/24
3,035,656	5/1962	Kebel	181/24
3,109,508	11/1963	Cefaly	181/24
3,152,659	10/1964	Littmann	181/24

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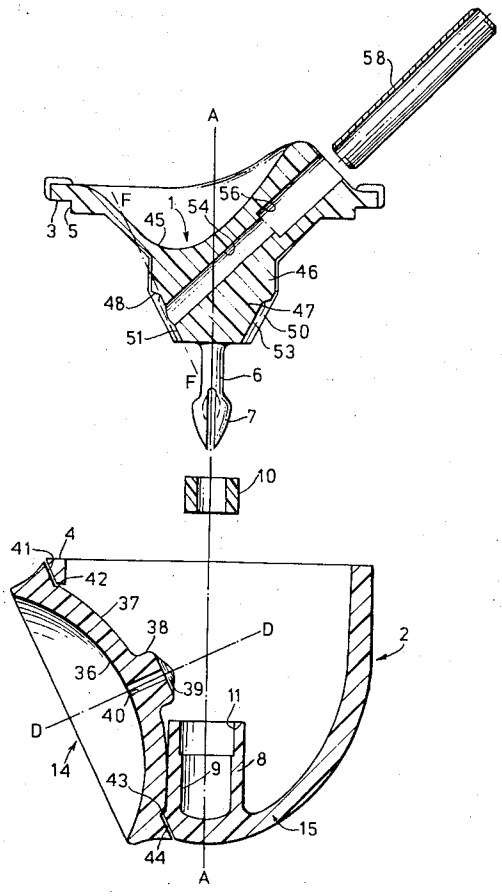
Attorney—Richard K. Stevens et al.

[57] **ABSTRACT**

A stethoscope chest piece comprising a coupling element fitted within a sounding element, the two elements being relatively rotatable about a common axis; the coupling element having at least one air passage therethrough which is capable of being connected at one end to one or more listening tubes and which at its other end opens into a surface which lies in a male surface of revolution about the axis; the sounding element having three or more listening devices each oriented in different directions and each having an air passage therethrough, the air passage of each listening device opening at one end thereof into a surface, and the surfaces of all the listening devices lying in a common female surface of revolution about the axis, the male and the female surfaces of revolution being complementary so that on relative rotation of the elements about the axis the or each air passage through the coupling can be placed in communication with the air passage of any selected one of the listening devices.

11 Claims, 8 Drawing Figures



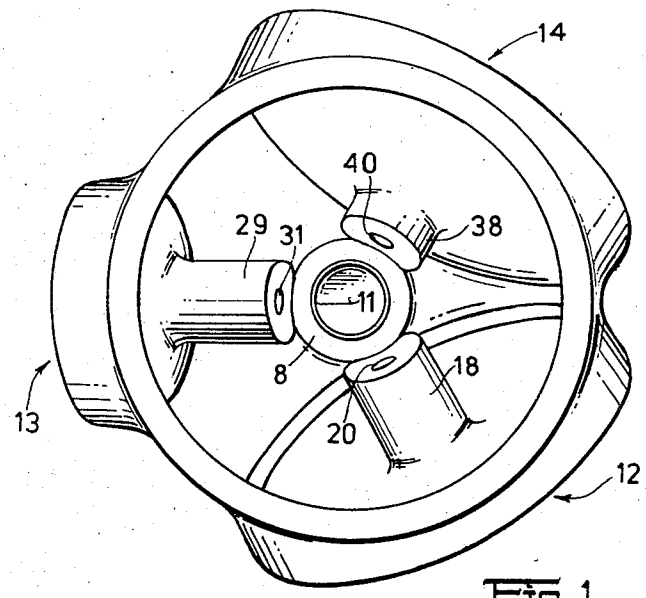


Fig. 1.

Fig. 2.

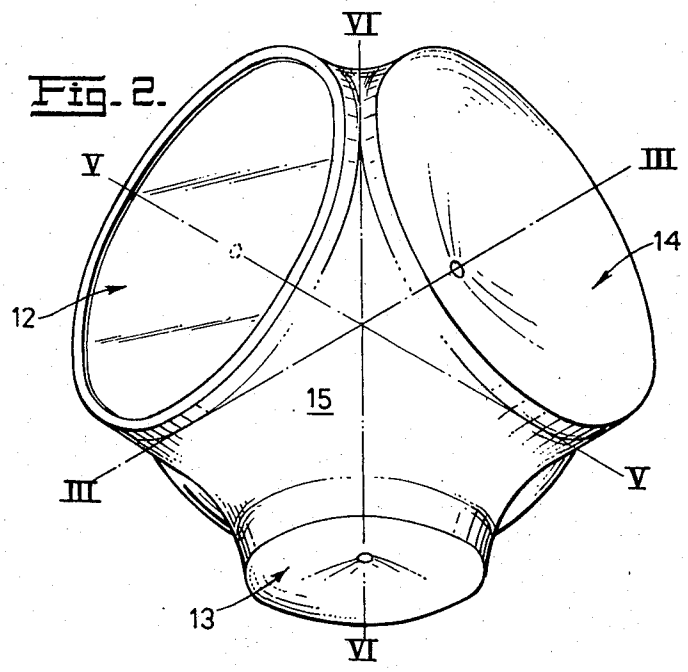
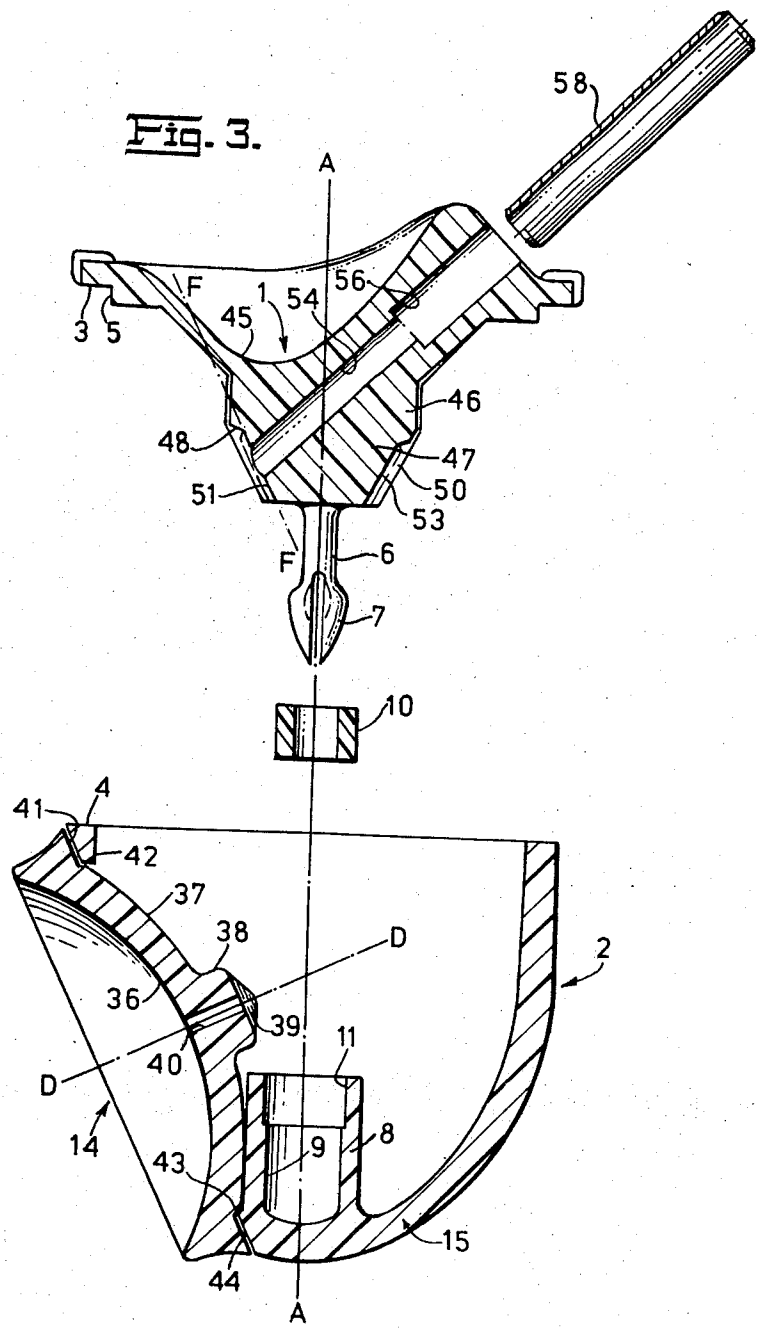


Fig. 3.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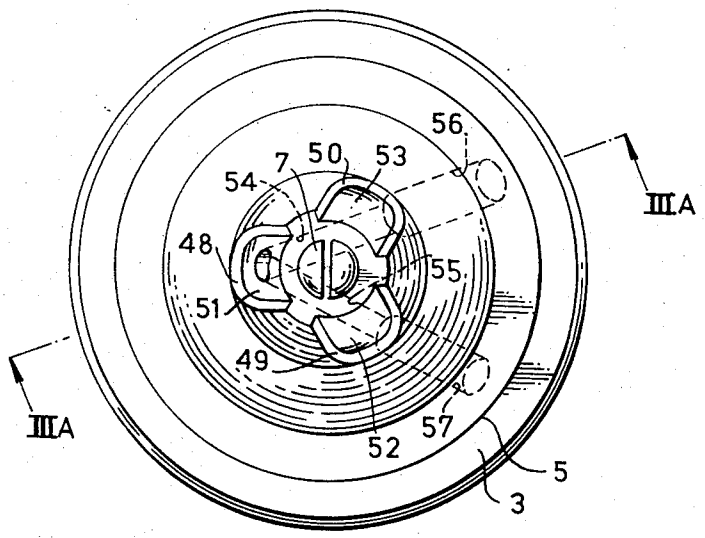
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Fig. 4.

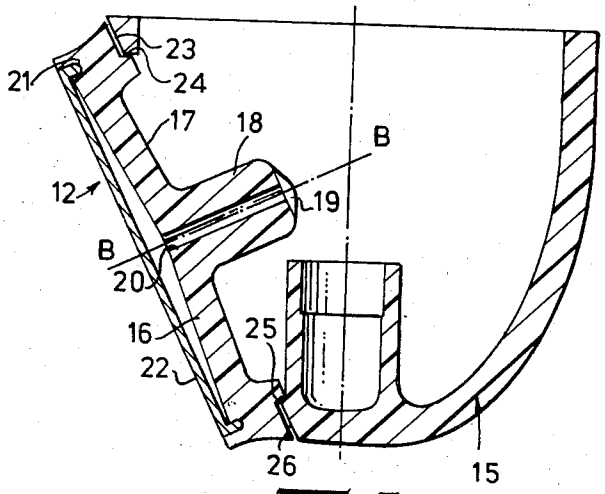
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Fig. 5.

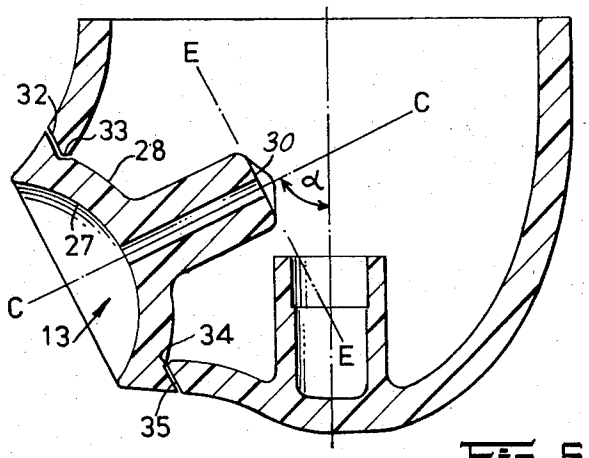

Fig. 6.

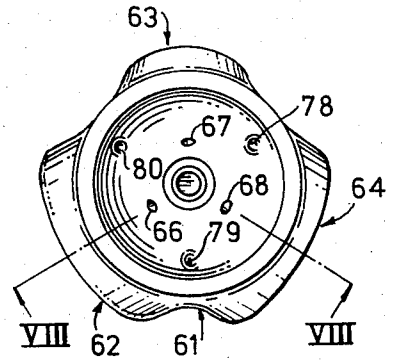

Fig. 7.

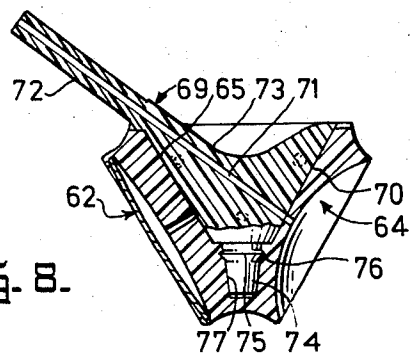

Fig. 8.

STETHOSCOPES

This invention relates to stethoscopes, and particularly to the so-called chest piece of a stethoscope.

The chest piece for stethoscopes comprises a listening device which is usually either in the form of a so-called bell device or in the form of a diaphragm device. Stethoscopes are made incorporating both a bell device and a diaphragm device in one chest piece, means being provided for connecting either listening device to, and isolating the other from, the listening tubes. It is often desirable to have bell devices of different shapes and sizes to provide alternative listening areas, and stethoscopes are known having interchangeable or convertible bells to provide different listening devices.

The main object of this invention is to provide an improved form of chest piece comprising a plurality of separately selectable listening devices.

According to the present invention a stethoscope chest piece comprises a coupling element fitted within a sounding element, the two elements being relatively rotatable about a common axis; the coupling element having at least one air passage therethrough which is capable of being connected at one end to one or more listening tubes and which at its other end opens into a surface which lies in a male surface of revolution about said axis; the sounding element having three or more listening devices each oriented in different directions and each having an air passage therethrough, the air passage of each listening device opening at one end thereof into a surface, and said surfaces of all the listening devices lying in a common female surface of revolution about said axis, said male and said female surfaces of revolution being complementary so that on relative rotation of the elements about said axis the or each air passage through the coupling can be placed in communication with the air passage of any selected one of the listening devices.

Using a chest piece according to the invention it will be seen that any one of the listening devices may be selected merely by rotating the sounding element on the coupling element until the air passage from the selected listening device is in communication with the or each air passage through the coupling element. The air passages from the other listening device or devices may be obturated by parts of the coupling element so as not to cause any interference with the sound from the selected listening device.

The number of listening devices provided on the sounding member may vary. The preferred number is three, comprising a diaphragm device and large and small bell devices. Alternatively it is possible to provide more than three devices. Preferably each listening device has an axis of symmetry and these axes are equally spaced around the axis of rotation of the elements. Thus for three devices the axes of symmetry would include angles of 120°.

Preferably, the male and female surfaces of revolution are each frusto-conical, the or each air passage through the coupling element makes an acute angle with the axis of revolution, and the axes of symmetry of all the listening devices each make an acute angle with the axis of revolution, with the listening devices facing away from the larger diameter end of the frusto-conical surfaces.

Each listening device may be made as a separate part and secured to a sounding element body having holes

for receiving the various listening devices. Alternatively the sounding element may be formed as a unitary moulding.

Conveniently the two elements are held against relative axial movement by means of an axial stem extending from the coupling element, the stem engaging in an axial bore in the sounding element and having a deformable head engageable behind a lip in the axial bore. This arrangement leads to a simple assembling operation, and the deformable head allows the coupling member to be withdrawn by applying an excessive force. It will be apparent that alternative means may be used for preventing this relative axial movement.

In order that the invention may be more readily understood specific embodiments of chest pieces in accordance therewith will now be described in more detail, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a plan view of a sounding element of a first embodiment of chest piece;

FIG. 2 is an inverted plan view of the sounding element of FIG. 1;

FIG. 3 is a cross section taken on the line III—III of FIG. 2 together with a section through a coupling element on line IIIA—IIIA of FIG. 4, so forming an exploded view of the chest piece;

FIG. 4 is an underneath plan view of the coupling element;

FIG. 5 is a cross section taken on the line V—V of FIG. 2;

FIG. 6 is a cross section taken on the line VI—VI of FIG. 2;

FIG. 7 is a plan view of a second embodiment of a chest piece according to the invention; and

FIG. 8 is a section on line VIII—VIII of FIG. 7 with a coupling element in position.

In the embodiment shown in FIGS. 1 to 5 of the drawings the chest piece comprises a coupling element 1 and a sounding element 2. The coupling element 1 fits within the sounding element 2 with a flange 3 of the coupling element in engagement with a rim 4 of the sounding element and a shoulder 5 of the coupling element lying within the inner diameter of the wall of the sounding element. The two elements are relatively rotatable about a common axis A—A. The coupling element has an axial stem 6 having an enlarged deformable head 7, and the sounding element is formed with an axial boss 8 having a bore 9. A collar 10 fits in the counterbore section 11 of the bore 9 and is secured therein by an adhesive. On assembly of the chest piece the head 7 is forced through the bore of the collar 10 and springs back to its natural position after passing through the collar 10. In this condition the head 7 engages behind the collar 10 so holding the coupling element axially in position within the sounding element.

The sounding element is shown as having three listening devices, a diaphragm device 12, a small bell device 13 and a large bell device 14. Each of these devices is constituted by a separate moulding which is assembled together with a body section 15 to form the complete sounding element. The diaphragm device 12 (FIG. 5) has an axis of symmetry B—B and has an outer face 16 which is substantially of frusto-conical form. From the inner face 17 there projects a stem 18 terminating in a surface 19. An air passage 20 extends through the stem 18 and opens into the surface 19. The device 12 is formed with an annular channel 21 in which is held a

diaphragm 22. The device has an annular rim 23 lying in a plane normal to the axis B—B, the rim merging into an annular shoulder 24. This shoulder 24 is located within a circular hole 25 on the body section, the hole being bounded by an annular rim 26 and the diaphragm device is secured to the body section 15 by adhesive between the rims 23 and 26.

The small bell device 13 (FIG. 6) is generally dish shaped and has a concave surface 27 facing away from the axis A—A and a convex face 28 from which extends a stem 29. The stem terminates in a surface 30 into which opens an air passage 31. The small bell device is symmetrical about an axis C—C and has an annular rim 32 and shoulder 33. The shoulder 33 fits within a circular opening 34 in the body section 15 and the rim 32 abuts an annular rim 35 on the body section, the small bell device being secured to the body section by adhesive between the rims 32 and 35.

The large bell device 14 (FIG. 3) is similar in construction to the small bell device, having a concave outer surface 36, a convex inner surface 37, a stem 38 terminating in a surface 39 into which an air passage 40 opens, an annular rim 41 and shoulder 42. The device is symmetrical about axis D—D. The shoulder 42 fits within a circular hole 43 in the body section 15 and the large bell device is secured to the body section by adhesive between the rim 41 and a mating rim 44 on the body section.

The surfaces 19, 30 and 39 at the ends of the stems 18, 29 and 38 are all identical in shape and lie equidistant from the axis of rotation A—A. The three surfaces all lie in the frusto-conical surface that would be generated by rotating the generatrix E—E (FIG. 6) about the axis A—A. The axes B—B, C—C and D—D of the three listening devices all make normal acute angles α with the axis A—A and when seen in plan view each of the axes B—B, C—C and D—D makes an angle of 120° with the other two axes.

The coupling element 1 is formed with a dished upper surface 45 and a body section having a generally circular cylindrical part 46 and a generally frusto-conical part 47. Three cut-outs 48–50 are made in the frusto-conical part 47, the cut-outs being of substantially inverted U-shape and having center lines spaced apart by 120°. Each cut-out has an angular extent equal to that of each of the three surfaces 19, 30 and 39 in the ends of the stems 18, 29 and 38. The surfaces 51–53 of the cut-outs all lie in a common frusto-conical surface formed by rotation of a generatrix F—F about the axis A—A, the generatrix F—F extending parallel to a generatrix of the frusto-conical surface of the body part 47. Two air passages 54 and 55 extend through the body of the coupling element and open into the surface 51 of cut-out 48, the corresponding surfaces of the other cut-outs being continuous.

The other ends of the air passages 54 and 55 are formed with countersink sections 56 and 57 respectively, each of which receive a connector such as 58, secured in the respective countersink section in any suitable manner, for example by an adhesive or by a screw thread connection. From the two connectors such as 58 listening tubes (not shown) extend to the ear pieces of the stethoscope.

Use of the chest piece as shown in FIGS. 1 to 6 will now readily be understood. In an operative position of the stethoscope the end surfaces 19, 30, 39 of the stems of the listening devices engage in the U-shaped cut-outs 48, 49, 50 so positively locating the coupling element and the sounding element in that particular angular relationship. The air passages 54 and 55 thus open into the appropriate one of the air passages 20, 31 and 40, and the user of the stethoscope can thus hear the sound collected by the appropriate listening device. The air passages of the other two listening devices are obturated by the surfaces 52 and 53 to prevent interference. The fact that the air passages 54 and 55 converge towards the selected listening device always gives immediate visual indication of the connected device. The configuration of the chest piece avoids any sharp bends in the connected air passages through the stem of the selected listening device and through the coupling element. The well 45 in the surface of the coupling element is conveniently shaped to accomodate the thumb of the user so that pressure may be applied to press the selected listening device against the patient's body.

To change the selected listening device the sounding element is rotated relative to the coupling element, whereupon the resilient head 7 of the stem 6 allows a slight axial displacement between the coupling and the sounding elements, sufficient to allow the end surfaces 19, 30, 39 of the stem to ride up out of the cut-outs 48, 49, 50 and on to the frusto-conical surface of body part 47. Rotation of the sounding element is continued until the desired angular relationship is reached, whereupon the end surfaces 19, 30, 39 engage different ones of the cut-outs 48, 49, 50 to locate the sounding element in its new position.

Turning now to FIGS. 7 and 8 this shows a chest piece of similar shape to that already described but formed in a somewhat different manner. In this embodiment the sounding element shown generally as 61 is a single unitary moulding defining three listening devices, a diaphragm device 62, small bell device 63 and a large bell device 64 and defining an inner surface 65 which is of female frusto-conical form. Air passages 66, 67 and 68 lead from the three sounding devices respectively to open into the surface 65. The coupling element shown generally as 69 has a male frusto-conical surface 70 which is complementary to and fits within the surface 65. The coupling element is formed with a through air passage 71 which also extends into a tube 72 integral with the element 69. The element 69 has a dished upper surface 73 at the wider end of the cone and at the narrower end of the cone is formed with an axial stem 74 having an enlarged head 75 which can be press fitted to be retained behind an undercut lip 76 in an axial bore 77 in the sounding element. When axially retained in this way the sounding member may be rotated on the coupling member to align any one of air passages 66 to 68 with the air passage 71. In order positively to locate the coupling member in any desired one of the three possible positions the female surface 65 is formed with three detents 78 to 80 and the male surface 70 is formed with a pip or spring-loaded ball (not shown) which may engage any selected one of the detents. This chest piece is used in identical manner to the one already described.

In each of the chest pieces described the axes (e.g., B—B, C—C, D—D) of the three listening devices are spaced equiangularly, but this is not necessary and the angles between these axes may differ. In particular, it may be advantageous to have the angle between the axes of the diaphragm and the large bell devices greater than that between any other two axes.

The chest pieces described each have three listening devices, but it will be understood that four or more may alternatively be provided, each on a different downwardly and outwardly sloping surface of a sounding element. Whatever the number of listening devices, a full or partial frusto-conical form for the mating surfaces of the coupling and sounding elements is not essential, and other surfaces of revolution could be used. In particular these surfaces may be cylindrical, a sounding element having three listening devices then being generally triangular in plan with a listening device on each surface of the triangle.

Many different alternative arrangements are possible for the means locking the coupling and sounding elements against axial separation while still allowing relative retation, and for the means for positively locating the air passage through the coupling element in alignment with any selected listening device air passage. In particular a detent locating device may be used in the arrangement shown in FIGS. **3** and **4**, the cut-outs **48** to **50** in the body section **47** then not being necessary. Such a detent device could be located to act between flange **3** and rim **4**. A detent device or some similar arrangement would have to be used if the axes of the three listening devices are other than equally spaced. The form of the coupling element of FIGS. **7** and **8** may be varied to divide the air passage therethrough within the body of the coupling element, and to lead two tubes such as **72** from the coupling element so that two separate listening tubes to the ear pieces may be connected. A single air passage may be formed through the coupling element of FIGS. **3** and **4**, rather than the two passages shown. A decorative bezel may, if desired, be placed between the coupling and sensing elements.

Both the coupling and the sensing elements are desirably moulded from plastics materials, either thermosetting or thermoplastic. Polycarbonate plastics are at present preferred.

What I claim is:

1. A stethoscope chest piece comprising a sounding element, a coupling element fitted within said sounding element, the two elements being relatively rotatable about a common axis, said coupling element having a first air passage therethrough and first and second ends, said first end being associated with a listening tube so as to connect said first air passage to said tube, said second end having a first surface that lies in a male surface of revolution about said axis, said first air passage opening into said first surface, said sounding element having three listening devices, each said device being oriented in different directions and having a second air passage therethrough, each said device including an end having a second surface that lies in a female surface of revolution about said axis, all said female surfaces being common to the second surfaces of said devices, each said second air passage opening into said second surface, said male and female surfaces of revolution being complementary so that on relative rotation of said elements about said common axis said first air passage is placed in communication with the second air passage of any selected one of the listening devices, said first air passage making an acute angle with the common axis, all said listening devices having axes of symmetry that make an acute angle with the common axis wherein said first air passage is in substantial alignment with a selected second air passage so as to avoid sharp bends between said first and second passages.

2. A stethoscope chest piece according to claim **1** in which said three listening devices include a diaphragm device and two bell devices of different diameters.

3. A stethoscope chest piece according to claim **1** in which the axes of symmetry of said listening devices are substantially equally spaced around the axis of rotation of the elements.

4. A stethoscope chest piece according to claim **1** in which the male and female surfaces of revolution are each frusto-conical, with the listening devices facing away from the larger diameter end of the frusto-conical surfaces.

5. A stethoscope chest piece according to claim **1** in which each listening device is made as a separate part and is secured to a sounding element body having holes in which the listening devices may be located.

6. A stethoscope chest piece according to claim **5** in which each listening device is substantially dish-shaped, having a concave surface facing away from the axis of revolution, and a stem extending from the convex surface and terminating in said surface lying in the female surface of revolution, the second air passage extending through the stem.

7. A stethoscope chest piece according to claim **5** in which the surface into which said first air passage through the coupling element opens is one of three surfaces arranged substantially equiangularly about the axis of revolution, the other two surfaces being continuous for obturating passages of the listening devices.

8. A stethoscope chest piece according to claim **7** in which each of said three, substantially equiangular surfaces is formed by a substantially inverted U-shaped cut-out in a body part of the coupling element.

9. A stethoscope chest piece according to claim **1** in which the sounding element is a unitary moulding and is formed with a continuous female surface of revolution into which female surface the second air passages of all the listening devices open, and the coupling element has a continuous male surface of revolution into which the first air passage opens.

10. A stethoscope chest piece according to claim **1** in which the coupling element and the sounding element are held against relative axial movement by an axial stem extending from the coupling element and engaging in an axial bore in the sounding element, the stem having a deformable head engageable behind a lip in the axial bore.

11. A stethoscope chest piece according to claim **1** and including means for positively locating the sounding and coupling elements in each of their respective relative angular positions wherein the first air passage through the coupling element is in communication with the second air passage of a listening device.

* * * * *