May 22, 1962 A. P. KEBEL 3,035,656

STETHOSCOPE

Filed March 11, 1960

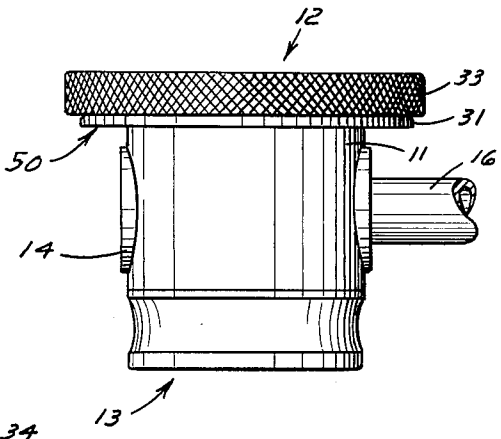


fig. 1

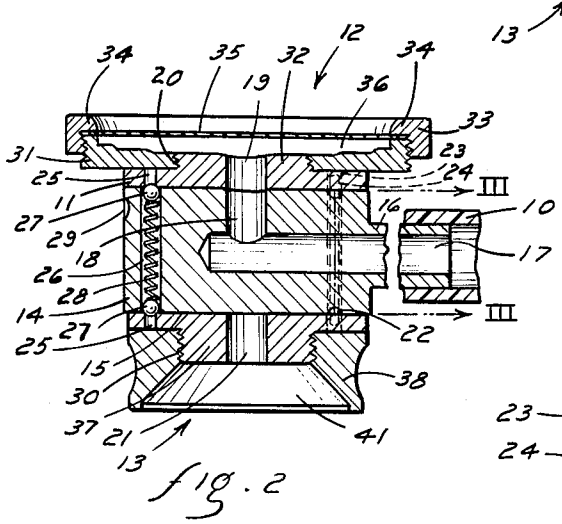


fig. 2

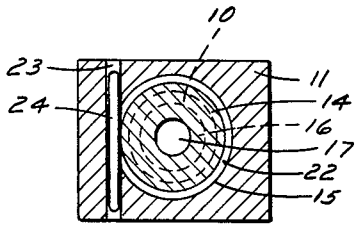


fig. 3

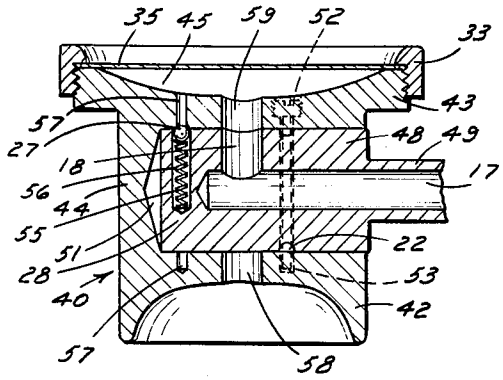


fig. 4

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STETHOSCOPE

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This invention relates to a stethoscope, particularly to a stethoscope head characterized by the simplicity of its construction, by its having more than one sound-receiving member and by its ability to be indexed positively in position with any desired one of the sound-receiving members connected by way of suitable conduits with the binaurals.

A stethoscope is one of the instruments used most frequently by a physician. In general, a stethoscope comprises a sound-receiving member, such as the members conventionally referred to as a bell or diaphragm, which in use is placed in contact with the part of the body nearest the place where a sound may originate. The bell or diaphragm is connected by suitable conduit means, e.g. by rubber tubing, to conventional ear tips or aurals designed to fit into the ears of the operator whereby the sound vibrations are carried or "piped" from the bell or diaphragm to the operator's ears. The ear tips are frequently mounted at the ends of metal tubes, a pair of such tubes and the accompanying tips generally being referred to as "binaurals." Often two or more sound-receiving elements are associated with the head, a valve arrangement being provided in the stethoscope head by means of which any one of the sound-receiving members may, in turn, be brought into direct communication with the ear tips by way of the conduits referred to.

Although stethoscopes of the general kind just referred to are in common use by physicians, those hitherto available include certain disadvantageous features which it has not until now been possible to overcome. Generally, the stethoscope head comprises several parts which are assembled and held together with screws. Inasmuch as the parts are small, the screws employed are also small and are very likely to be lost when the stethoscope head is disassembled for cleaning and sterilization, as should be done frequently. Any loosening of the screws during prolonged use of the instrument is apt to lead to unreliable results. Also, and of particular importance is the fact that no satisfactory means has been devised for locking the moving parts of the stethoscope head with respect to one another in a position such that a desired one of the sound-receiving members is in usable position with the locking device being such that not only is there no danger of the parts becoming dislocated during use, but also such that any one of the other sound-receiving elements can be brought into operating position without the use of special tools. Inasmuch as the reliability of the results obtained using a stethoscope depends upon a proper functioning of the instrument at all times, it is apparent that any improvement in stethoscope heads which would overcome the difficulties just referred to would be of considerable value.

The stethoscope head of the present invention, which will be described in detail presently, is of simple and economical construction, can be fashioned from lightweight materials and is devoid of elements or parts which require the use of special tools to assemble or disassemble the head. It is conveniently equipped with both conventional bell and diaphragm sound-receiving elements and is easily adjustable to bring the individual sound-receiving elements into operating position, as desired, and to lock the parts of the head positively and automatically against accidental displacement from the operating position. Although when so adjusted the parts are locked positively against accidental displacement from their adjusted relationship, the locking arrangement does not interfere with the readjustment of the head, when desired, to bring another sound-receiving element into operating position.

Certain advantages of the invention are apparent from the accompanying drawing wherein, in the interest of clarity, certain features are shown on a somewhat exaggerated scale and wherein:

FIGURE 1 is a side elevation of a stethoscope head embodying features of the invention;

FIGURE 2 is a sectional elevation of the stethoscope head of FIGURE 1;

FIGURE 3 is a partial sectional elevation taken along the line III—III of FIGURE 2; and

FIGURE 4 is a sectional elevation of a stethoscope head showing certain alternative arrangements of the parts.

As illustrated in FIGURES 1 and 2, one modification of the stethoscope head of the invention comprises a valve body **11**, which is conveniently cylindrical in form and of suitable length. One end of the valve body is equipped with a diaphragm sound-receiving element and the other end is equipped with a bell sound-receiving element, the diaphragm and bell elements being essentially conventional and being illustrated, generally, at **12** and **13**, respectively, of FIGURES 1 and 2. A valve **14**, conveniently a cylindrical plug valve, is positioned to rotate around its longitudinal axis in a valve bore **15** extending transversely through the valve body **11** and located between the diaphragm and bell elements **12** and **13**. The valve **14** terminates at one of its ends outside the valve body **11** in the form of an extension **16** of suitable length and, generally, of reduced diameter, by means of which the valve can be connected with rubber tubing to a conventional stethoscope fork and binaurals in conventional manner, the conventional fork and aural members not being shown in the drawing. The extension **16** and the adjacent portion of the valve **14** are drilled longitudinally to provide an axial sound-conducting valve bore **17** which extends the length of the extension **16** and for roughly one-half the length of the valve **14**. The valve **14** is also drilled transversely from one side at approximately its midpoint to provide a transverse sound-conducting valve bore **18** which intersects the bore **17**.

As illustrated in FIGURES 1 and 2, the diaphragm sound-receiving element **12** at one end of the valve body **11** can comprise a circular base **31** having a central internally threaded bore **20** which engages threads formed exteriorly around an axial projection **32** of the valve body **11**. The base **31** is of suitable diameter and is preferably concave or stepped on its surface opposite the valve body **11** to provide a diaphragm chamber **36**. The rim of the base **31** is threaded exteriorly to receive an interiorly threaded ring **33** which has an inwardly extending circular lip **34** adapted, when the ring engages the base **31** threadably, to clamp a suitable flexible diaphragm **35** of suitable diameter tightly between it and the upper edge of the base **31**. The base **31** can conveniently be knurled on its face opposite the ring **33**, e.g. on the surface indicated by the arrow **50** of FIGURE 1, to facilitate unscrewing of the parts **31** and **33** when desirable or necessary. The axial projection **32** and the valve body **11** are drilled axially to provide a first axial sound-conducting valve body bore **19** communicating with the diaphragm chamber **36** at one of its ends and with the valve bore **15** at its other end. It will be noted that, in the modification illustrated, the base **31** of the diaphragm element when installed on the threaded projection **32** of the valve body **11** is seated snugly against the end of the valve body around the projection **32**.

The end of the valve body **11** opposite the projection **32** is also provided with an exteriorly threaded axial projection **37** similar to or, if desired, identical with the projection **32**. A suitable bell sound-receiving element **38** is provided with a central bore **30** which is threaded internally and adapted to engage the exterior threads of the projection **37** and encircle a bell chamber **41**. The

projection 37 and the valve body 11 are drilled axially to provide a second axial sound-conducting valve body bore 21 which communicates at one of its ends with the bell chamber 41 and at its other end with the valve bore 15, it being noted that the bore 21 and the bore 19 opposite it have a common longitudinal axis. It is also convenient for the bell element 38 when it engages the projection 37 threadably to be seated snugly on the end surface of the valve body 11 around the projection 37.

According to the invention, means are provided both for retaining the valve 14 at its proper position longitudinally in the valve bore 15, but so that it can be rotated therein to bring the transverse valve bore 18 alternately into communication with the bore 19 or the bore 21, as desired, and, also, to provide against accidental rotation of the valve 14 once it is indexed with the transverse bore 18 in communication with either the bore 19 or the bore 21. It is thus possible, by rotating the valve 14 in its bore 15, to provide for conduction of sound waves from the diaphragm sound-receiving element 12, e.g. by way of the bores 19, 18 and 17, to the binaurals and to be sure that the instrument remains locked in the best possible adjustment for reception of sound waves in this fashion until the instrument is deliberately adjusted otherwise. By rotating the valve 14 through 180 degrees in the bore 15, sound waves are conducted, e.g. by way of the bores 21, 18 and 17, from the bell sound-receiving element 13 to the binaurals with the assurance that this adjustment of the instrument will not be disturbed accidentally.

To provide against undesired longitudinal displacement of the valve 14 in the bore 15, a suitable groove 22 is provided which encircles the valve plug 14 in a plane transverse to the rotational axis of the valve. A suitable pin-retaining bore 23 is formed in the valve body, conveniently so that it extends longitudinally thereof in the same plane as that in which the groove 22 lies, which intersects the circular groove 22 when the valve 14 is properly positioned in the bore 15, as is shown more particularly in FIGURE 3. A suitable pin 24 is provided which, when inserted in the bore 23, rests in the groove 22 and effectively retains the valve 14 in the bore 15 and prevents its movement longitudinally therein, but without interfering with its rotation. Dislodgment of the pin 23 from the bore 24 can be prevented by suitably forming the diaphragm base member 31 and the bell member 38 to cover the ends of the bore 24 when they engage the respective projections 32 and 37 threadably.

To provide for positive locking of the valve 14 with the bore 18 in communication with the bore 19, or the bore 21, as desired, the valve 14 is drilled transversely to provide a primary indexing bore 26 which extends through it. The valve body 11 is also drilled to provide a secondary indexing bore 25 therein which is preferably located with a section of it lying on each side of the valve bore 15 and in a location such that its longitudinal axis when prolonged through the valve more intersects the longitudinal axis of the valve bore. The primary and secondary indexing bores are located with their longitudinal axis in the same plane which extends transversely with respect to the axis of rotation of the valve 14 when the latter is located in its proper position in the valve bore 15.

It is convenient and preferred that the longitudinal axes of the primary indexing bore 26 and of the transverse sound-conducting valve bore 18 be parallel with one another and that both intersect the rotational axis of the valve 14 and, further, that the longitudinal axes of the first axial sound-conducting valve body bore 19, as well as of the second sound-conducting valve body bore 21 and the secondary indexing bore 25 be parallel with one another and that both, when prolonged, intersect the longitudinal axis of the valve bore 15. However, it will be apparent that the apparatus will function equally well with any other arrangement of these several bores provided that when the longitudinal axes of the transverse bore 18 and of the axial bore 19, or of the axial bore 21 as the case may be, are coextensive, the longitudinal axes of the primary indexing bore 26 and of the secondary indexing bore 25 are also coextensive. The primary indexing bore 26 is somewhat larger in diameter than the secondary indexing bore 25 to accommodate a pair of balls 27 which can enter completely into the bore 26 but which are too large to enter completely into the bore 25. A suitable spring 28, conveniently a coil spring under compression, is located in the primary indexing bore 26 between the balls 27 and serves to urge them away from one another into pressure contact with the wall of the valve bore 15.

With the valve 14 positioned properly longitudinally and rotated to bring the transverse bore 18 into communication with the bore 19, the primary indexing bore 26 is in communication at each of its ends with sections of the secondary indexing bore 25. The pressure of the spring 28 on the balls 27 urges them into the adjoining sections of the bore 25 as far as they can go. However, because the balls 27 each have a diameter greater than the diameter of the bore 25, the balls can enter only partially into the ends of the sections of the bore 25. With the balls 27 engaging the bore 25 in this manner, the valve 14 is locked positively in its indexed position with the bore 19 in communication with the bores 18 and 17 and the stethoscope is thus in condition for use employing the diaphragm sound-receiving element 12 without any danger of the adjustment being disturbed during normal usage.

Should it then be desired to employ the stethoscope, but to utilize the bell element 13 rather than the diaphragm element 12, it is only necessary to rotate the valve 14 through 180 degrees in the bore 15, this being effected readily by grasping the valve body 11 with one hand and the valve extension 16 with the other hand and rotating the valve 14 in either direction with respect to the valve body 11. Because the diameter of the bore 25 is less than the diameter of the balls 27, the exertion of sufficient rotative force on the valve 14 causes the balls to compress the spring 28 and to enter entirely into the bore 26, after which they roll along the wall of the bore 15 until the valve has been rotated through 180 degrees and the bore 18 is in communication with the bore 21. The balls 27 then again drop into the ends of the sections of the bore 25, but in the reverse manner from that previously occupied, and the valve 14 is locked in its properly indexed position for use of the bell sound-receiving element 13 rather than the diaphragm sound-receiving element 12. As a matter of convenience, an indicating means, such as a small indentation 29 containing a drop of enamel, can be provided in the surface of the end of the valve plug 14 to indicate whether the valve is in its proper rotational location for use of either the bell or the diaphragm element.

A modification of stethoscope head of the invention including certain alternative arrangements of the parts is illustrated in FIGURE 4. According to the modification of FIGURE 4, a bell sound-receiving element 42 and the base 43 of a diaphragm sound-receiving element are formed as integral sections of a single part of the apparatus, indicated generally by the reference numeral 40, a further section 44 of the part 40 functioning as a valve body in a manner similar to the valve body 11 of FIGURES 1 and 2. The base 43 is formed with its surface opposite the bell member 42 of a suitably concave contour to provide a diaphragm chamber 45, a suitable diaphragm 35 being clamped across the chamber 45 by a diaphragm-retaining ring 33 which engages the base 43 threadably.

The plug valve 48 and its extension 49 correspond in function to the valve 14 and extension 16 of FIGURES 1 and 2, and are provided with axial and transverse sound-conducting bores 17 and 18 in the same manner as in the modification of FIGURE 2. The valve 48 rotates in a

valve bore 51 but in this instance the bore 51 and valve 48 extend only a part of the way through the valve body section 44 rather than entirely through it as in the modification of FIGURES 1 and 2.

The valve plug 48 is provided with an encircling groove 22 which, with the valve seated in the bore 51, is engaged by a valve-retaining pin 52 located in a suitable pin-retaining bore 53 which opens at one end into the diaphragm chamber 45 and which intersects the groove 22 after the fashion of the bore 23 of FIGURES 2 and 3. In this instance, however, the end of the pin 52 is threaded externally and engages an internally threaded section of the wall of the bore 53 to retain the pin in the bore. The bore 53 need not extend entirely through the part 40, thus presenting a neater appearance.

As in the modification of FIGURE 2, the valve 48 of FIGURE 4 is provided with a primary indexing bore 56 in which are located a spring 55 and a single ball 27. The ball 27 engages the ends of the sections of a secondary indexing bore 57 drilled longitudinally in the part 40 with one of its ends opening into the diaphragm chamber 45 and with sections of the bore lying on either side of the valve bore 51. As in the modification of FIGURE 2, the secondary indexing bore 57 has a diameter less than that of the ball 27 so that the ball can enter only part way into the ends of the sections of the bore 57, thus serving to lock the valve plug 48 in either of its indexed positions for use of the diaphragm or bell sound-receiving elements, as desired, but not preventing its rotation upon the application of suitable rotative force to the extension 49 to change the setting of the valve from one of its indexed positions to another. The part 40 is further provided with a sound-conducting bore 58 connecting the bell 42 with the valve bore 51 and with a diaphragm bore 59 connecting the diaphragm chamber 45 with the valve bore 51, the axes of the bores 18, 58 and 59 being located with respect to one another to provide for communication of the bore 18 with the bore 59 when the valve 48 is locked by the ball 27 in one of its indexed positions and with the bore 58 when it is locked in the other of its indexed positions.

The diaphragm 35 can be of any suitable material and dimensions, such as a thin circular disc of metal or of a relatively rigid plastic, which is adapted to gather and transmit sound waves to the air contained within the diaphragm chamber. Such discs are conventional in the art. Discs of different materials and having different vibrational characteristics can be kept on hand and used interchangeably as desired. Furthermore, when employing the modification of FIGURE 2, a collection of entire diaphragm and bell sound-receiving elements having differing characteristics can be kept on hand and substituted for one another as occasion and the desires of the operator demand.

I claim:

1. In a stethoscope head comprising a valve body having a plurality of sound-receiving elements associated therewith, the combination including: a valve positioned rotatably in a valve bore in the valve body; an axial sound-conducting bore in the valve communicating by way of suitable sound-conducting bores in the valve and valve body with each of the sound-receiving elements separably upon suitable rotation of the valve; means to secure the valve against longitudinal movement in the valve bore; and means, including a spring-tensioned ball located in a primary indexing bore in the valve adapted, when the valve has been rotated to a position to bring the longitudinal bore into communication with a sound-receiving element, to enter partially, under urging of the spring, into a suitably located secondary indexing bore in the valve body having a diameter less than that of the ball, whereby the valve is locked in the said position against accidental rotation.

2. The combination as claimed in claim 1 wherein the means for securing the valve against longitudinal movement in the valve bore includes: a pin-retaining bore in the valve body intersecting a circumferential groove in the valve surface and a retaining pin located in the bore and in the intersected section of the groove, the groove and the bore each lying in a plane transverse to the axis of rotation of the valve.

3. The combination as claimed in claim 1 including an axial extension of the valve extending outside the valve body, the axial bore of the valve extending through the valve extension.

4. In a stethoscope head comprising a valve body having a plurality of sound-receiving elements associated therewith, the combination including: a valve positioned rotatably in a valve bore in the valve body; an axial sound-conducting bore in the valve communicating by way of suitable sound-conducting bores in the valve and valve body with each of the sound-receiving elements separately upon suitable rotation of the valve; a primary indexing bore extending transversely in the valve having therein a spring-tensioned ball, the spring urging the ball against the surface of the valve bore during rotation of the valve; a secondary indexing bore in the valve body communicating with the valve bore at a point to receive the ball when the valve is rotated to a position to bring a sound-receiving element into communication with the axial sound-conducting bore, the diameter of the secondary indexing bore being less by a predetermined amount than that of the spring-tensioned ball, whereby the ball can enter partially, but incompletely, into the secondary indexing bore and whereby the valve is locked in said position against accidental rotation.

5. In a stethoscope head, the combination including: a valve body having a pair of sound-receiving elements associated therewith on opposite sides thereof; a valve positioned rotatably in a valve bore in the valve body extending transversely of the body between the sound-receiving elements; an axial sound-conducting bore in the valve communicating by way of suitable bores in the valve and in the valve body with each of the sound-receiving elements separately upon suitable rotation of the valve; means to secure the valve against longitudinal movement in the valve bore; a primary indexing bore extending transversely through the valve and intersecting the rotational axis thereof; a secondary indexing bore in the valve body having sections communicating with the valve bore on opposite sides thereof and having its longitudinal axis coincident with the longitudinal axis of the primary indexing bore upon rotation of the valve through increments of 180 degrees each; a pair of balls located in the primary indexing bore having between them a spring means urging them into pressure contact with the wall of the valve bore during rotation of the valve, the primary indexing bore having a diameter sufficiently great to accommodate the balls entirely within the bore and the secondary indexing bore having a diameter less by a predetermined amount than the diameter of the balls whereby upon rotation of the valve through each increment of 180 degrees each of the balls can enter partially, but not completely, into a section of the secondary indexing bore and lock the valve against accidental further rotation, the primary and secondary indexing bores being arranged with respect to the bores connecting the sound-receiving elements and the axial sound-conducting bore to provide for locking of the valve against accidental rotation when the axial sound-conducting bore is in communication with one of the sound-receiving elements.

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