

Sept. 18, 1945.

B. MINSKY

2,385,221

ELECTRICAL STETHOSCOPE

Filed March 4, 1944

2 Sheets-Sheet 1

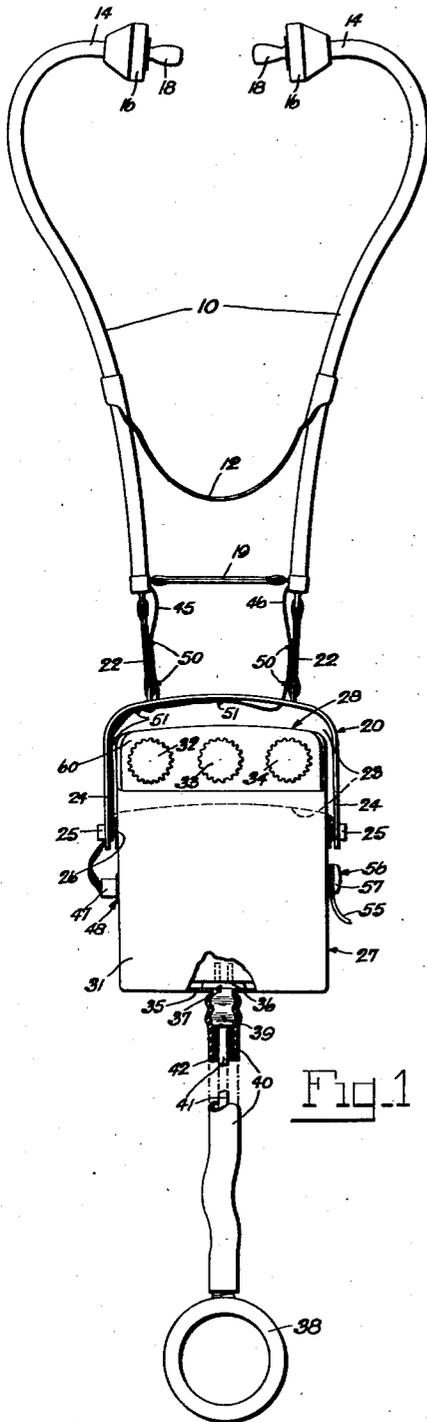


Fig. 1

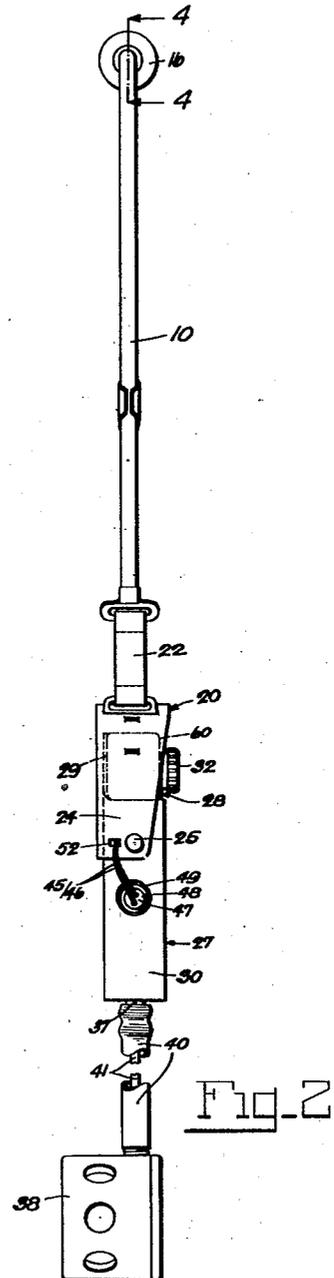


Fig. 2

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2 Sheets-Sheet 2

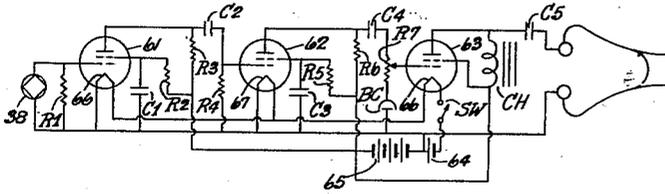


Fig. 3

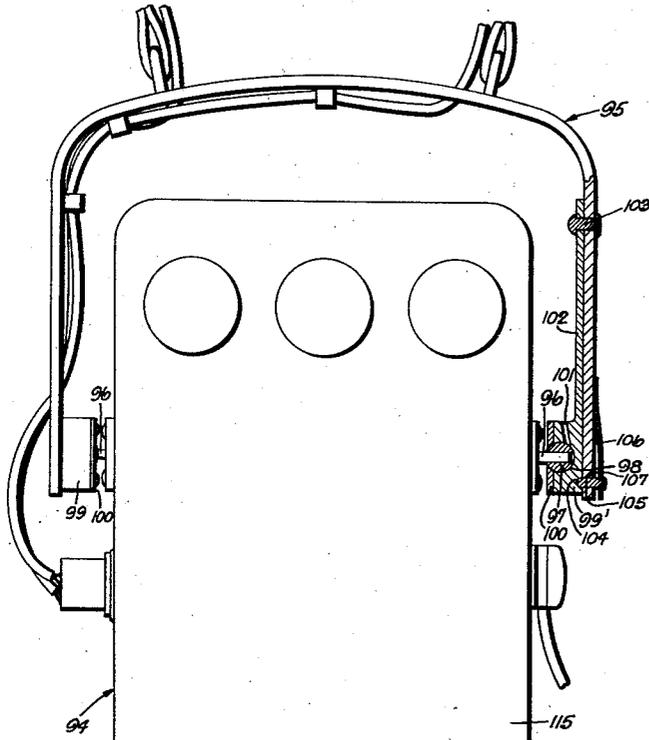


Fig. 5

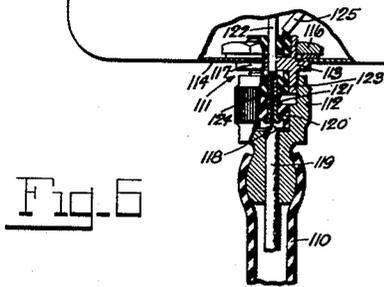
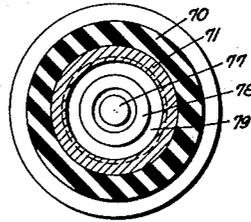


Fig. 6

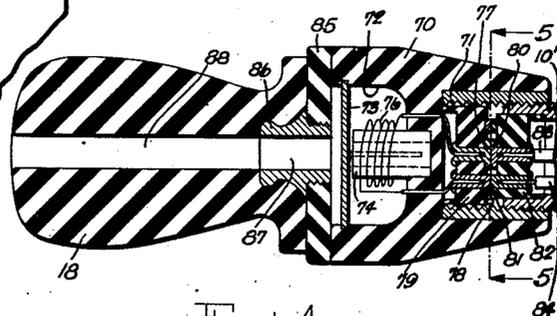


Fig. 4

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ELECTRICAL STETHOSCOPE

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4 Claims. (Cl. 181-24)

This invention relates to electrical stethoscopes and more particularly to an electrical stethoscope of the portable type.

It is the primary aim and object of the present invention to devise an electrical stethoscope which has as nearly as possible the characteristic appearance of, and is of approximately the same light weight as, the conventional air conductor type stethoscope used for general auscultative examination.

It is a more specific object of the present invention to construct the electrical stethoscope so that electrical units thereof may be separately detached for a check, repair or replacement.

It is also among the objects of the present invention electrically to transmit the sounds picked up from their inception by the stethoscope substantially to the ears of the physician using the stethoscope.

The foregoing and other objects of the invention, together with means whereby the latter may be carried into effect will best be understood from the following description of an illustrative embodiment shown in the accompanying drawings: in which,

Fig. 1 is a front elevation of an electrical stethoscope embodying the present invention.

Fig. 2 is a side elevation of the same stethoscope.

Fig. 3 is a wiring diagram of an amplifier which may be used in the present stethoscope.

Fig. 4 is a greatly enlarged, fragmentary section taken on the line 4-4 of Fig. 2.

Fig. 5 is a section taken on the line 5-5 of Fig. 4.

Fig. 6 is a fragmentary front elevation, partly in section, of an electrical stethoscope embodying the present invention in a modified form.

Referring to Figs. 1 and 2 of the drawings, the reference numeral 10 denotes a pair of conventional ear tubes which are yieldingly connected by a bent leaf spring 12. Mounted on the upper end 14 of each tube 10 is an ear phone 16 (to be described hereinafter) having a projecting ear piece 18. A strap 19 of any suitable flexible material such as leather, for instance, connects the lower ends of the ear tubes 10 and prevents approach of the ear phones 16 at the upper ends of the ear tubes beyond the relative disposition shown in Fig. 1. A frame 20 is suspended from the lower ends of the ear tubes 10 by straps 22 in the manner indicated in Figs. 1 and 2. The straps 22 are preferably of a non-metallic flexible material such as leather, for instance. The frame 20 is in the present instance U-shaped in

front elevation (Fig. 1), and has preferably an integral back wall 23 to lend added rigidity to the frame. Suitably mounted in the parallel legs 24 of the frame 20 are aligned bearings 25 which are preferably non-wearing jewel bearings. Journalled in the bearings 25 of the frame 20 are studs 26 on a casing 27 which is open at the top. Received in the casing 27 is an amplifier unit 28 (to be described hereinafter). The back wall 29 of the casing 27 preferably extends upwardly to the top of the amplifier unit 28, while the side walls 30 and the front wall 31 of said casing do not reach to the top of the amplifier unit so as to expose certain control knobs 32, 33 and 34 on the latter. The amplifier unit 28 is slidable into the casing 27 from the top thereof and may be as readily removed therefrom. Mounted on the bottom wall 35 of the casing 27 is the male member 36 of a conventional two-prong shielded cable connector 37 whose cooperating female member (not shown) is retractible from the male member 36 and mounted in the amplifier unit 28. The cable connector 37 forms part of the electrical connection between the amplifier unit 28 and a special type of piezo-electric microphone 38 used for general auscultative examinations and known to the trade as "stethophone." Thus, the microphone 38 is electrically connected with the amplifier unit 28 when the latter is in the casing 27 and the members of the cable connector 37 engaged, and the microphone is disconnected from the amplifier unit by the simple expediency of removing the latter from its casing 27 and thereby withdrawing the female member of the connector 37 from the male member 36 thereof. The male member 36 of the connector 37 has a shank 39 which extends to the outside of the casing 27 and is preferably shaped as shown in Fig. 1 to securely receive one end of a flexible tube 40 which the microphone 38 is suspended and which is preferably of rubber. A shielded electric cable 41 whose wires connect the microphone 38 with the male member 36 of the connector 37, preferably extends through the suspension tube 40 which may be provided with an internal wire sheath 42 to serve as an additional shield for the cable 41.

The electrical connections between the amplifier unit 28 and the ear phones 16 include shielded electric cables 45 and 46 which preferably pass through the ear tubes 10 and are connected with the male member 47 of a conventional, shielded multi-prong cable connector 48 whose cooperating female member (not shown) is mounted in the amplifier unit 28. The male

member 47 of the connector 38 is retractible from the female member thereof and, when engaged with the latter, extends through an aperture 49 in the casing 27. The portions of the cables 45 and 46 between the ear tubes 10 and the connector 48 are preferably guided along the straps 22 and the frame 20 by loops 50 on the former and similar punched-out tongues 51 of the latter. Shortly before its connection with the male member 47 of the connector 48, the cables 45 and 46 extend from the inside to the outside of the frame 20 through an aperture 52 in the latter. On removal of the male member 47 of the connector 48 from the female member thereof, the electrical connection between the ear phones 16 and the amplifier unit 28 is interrupted and the latter may be removed from its casing 27 without any obstruction from the male member 47 of the connector 48, as will be readily understood.

A source of electric power in the form of an "A" battery and a "B" battery (neither shown in Figs. 1 and 2) is connected with the amplifier unit 28 through an electric cable 55 and a conventional multi-prong cable connector 56 whose male member 57 is directly connected with the wires of the cable 55 and retractible from the cooperating female member thereof. The "A" and "B" batteries may be conveniently carried in a suitable case (not shown) strapped to the user's belt, for instance.

The amplifier unit 28 comprises a housing 60 (Figs. 1 and 2) for the chassis (not shown) on which the electrical components of the amplifier are mounted. Since numerous standardized circuits may be used for the amplifier and since the amplifier circuit does not form a part of the present invention, I do not limit the use of the present stethoscope with an amplifier of any particular circuit. A circuit which may be used for the amplifier is, by way of example, shown in Fig. 3. In this circuit, the piezo-electric microphone 38 is shown connected to the grid of the first or input stage which consists of a high gain, high impedance, audio-frequency amplifier in the form of a pentode tube 61. The second or intermediate stage consists of another pentode interstage audio-frequency amplifier 62. The third or output stage consists of an audio-frequency power output amplifier tube 63. These tubes 61 to 63 may be operated either as a resistance-capacity coupled, or a transformer-coupled, audio voltage amplifier unit operated according to either of the well-known classes "A," "B" or "AB." The A and B batteries 64 and 65 constitute the direct current source for the unit. In the present instance, the filaments 66 of the input and output tubes 61 and 63 are connected in series, whereas the filament 67 of the interstage tube 62 is connected in parallel with the filaments 66 of the other tubes 61 and 63. The circuit shown in Fig. 3 operates according to class A with a single-ended output arrangement. The components of the first two stages further comprise condensers C1 to C4, inclusive, and resistors R1 to R6, inclusive, and the components of the output stage further comprise a condenser C5, a plate choke CH, a bias cell BC, a main switch SW which is operated by the control knob 33 (Fig. 1), and a volume control R7 which is operated by the control knob 32 (Fig. 1). Also included in the circuit, but not shown in Fig. 3, may be a conventional frequency-response filter which would be used to limit the amplifier from full response to a predetermined cut-off level. The filter would preferably be operated by the

control knob 34 (Fig. 1). The ear phones 16 receive the output of the last stage.

Since the ear phones 16 are identical in construction, only one will be described in detail with special reference to Fig. 4. Each ear phone comprises a body 70 of any suitable insulating material in which is pressfitted or otherwise secured an internally threaded, metallic sleeve 71 which is screwed over the adjacent threaded end of one of the ear tubes 10. Mounted in a cavity 72 in the body 70 is a diaphragm 73. Behind this diaphragm is a core 74 which is mounted in the body 70 and is of a material which holds no residual magnetism. Surrounding the core 74 is a solenoid coil 76 the ends of which are suitably connected with concentrically arranged contacts 77 and 78 (see also Fig. 5). These contacts are mounted on an insulating terminal disc 79 which is suitably secured in the sleeve 71. Cooperating with the contacts 77 and 78 are similarly arranged contacts 80 and 81, respectively, which are mounted on an insulating terminal disc 82 suitably secured in the adjacent end of the ear tube 10' on which the earphone is screwed. The contacts 80 and 81 are connected with the wires 83 and 84 of the cable 46, for instance (Figs. 1 and 4), which passes through the ear tube 10' to the amplifier unit 28. Suitably mounted on the body 70 of the earphone is an insulating cover 85 which closes the cavity 72 and carries a metal tip 86 over which an ear piece 10 is snapped in place. The tip 86 and ear piece 10 are provided with sound-conducting bores 87 and 88, respectively. It is evident from the preceding description that the earphones 16 may be readily removed from their respective ear tubes 10 for a check, repair or replacement by simply unscrewing them from the latter, and that the earphones are electrically connected with, and disconnected from, their respective cables 45 and 46 on screwing them on, respectively unscrewing them from, their respective ear tubes.

The stethoscope described greatly resembles a conventional air-conductor type stethoscope in appearance, size and weight. The amplifier between the ear tubes 10 and the suspended microphone 38 and a few cables leading to the amplifier constitute the only noticeable departure in the appearance of the present stethoscope from that of a conventional air-conductor type stethoscope. The weight and size of the present stethoscope may readily be made to resemble that of a conventional air conductor type stethoscope, the amplifier unit being made small in size and of light weight. The technique involved in the professional use of the present instrument does not in the slightest deviate from that involved in the professional use of the conventional air-conductor type stethoscope. For the foregoing reasons, the present instrument appeals greatly to the physician not only because it fills an urgent need of the medical profession for a stethoscope having greatly improved acoustic performance, but also because it is in its application, appearance, weight and size so much like the highly developed air-conductor type stethoscope to which every physician is used. The separate removability of various electrical units from the present instrument not only facilitates the initial assembly of the latter but also a check, repair or replacement of these electrical units.

While in the stethoscope shown in Figs. 1 and 2 the amplifier unit is removably carried in a special casing 27, the amplifier unit 94 of the stethoscope shown in Fig. 6 is directly carried by the

the frame 95 which may be suspended from the ear tubes in the same fashion as the frame 20 in Fig. 1. To this end, the amplifier unit 94 is provided with opposite studs 96 which are received in ball-shaped bearings 97, preferably jewel bearings, which swivel in ball-shaped sockets 98 in bearing brackets 99. A retainer plate 100 holds each bearing 97 in its socket 98, and each bearing bracket 99 has a drilled hole 101 through which lubricant is conducted to its bearing. One of the bearing brackets 99 is firmly mounted on the frame 95 and the other bearing bracket, to wit 99', is integral with an arm 102 which is pivoted at 103 to the frame 95. The bearing bracket 99' is provided with a depression 104 with which normally registers a detent 105 on one end of a leaf spring 106, the other end of which is spotwelded on, or otherwise secured to, the frame 95. The detent 105 extends through a hole 107 in the frame 95 and is normally urged by the spring 106 into the depression 104 in the bearing bracket 99', thereby locking the latter in place on the frame 95. To remove the amplifier unit 94 from the frame 95 for a check, repair or replacement, the free end of the leaf spring 106 is manipulated to cause withdrawal of the detent 105 from the depression 104, whereupon the arm 102 with the bearing bracket 99' is swung outwardly from the frame 95 until the swivel bearing 97 in the bearing bracket 99' clears the stud 96 which it bore. The amplifier unit 94 is thereupon removed from the fixed bearing 99. To mount the amplifier unit in the frame 95 is equally simple and requires no further description.

The "stethophone" to be used with the instrument shown in Fig. 6 is removably suspended from the amplifier unit 94 by means of a flexible rubber tube 110 and an electrical connector 111 whose members 112 and 113 are metallic, and hence, conductive. The suspension tube 110 is mounted on the male member 112 of the connector 111 in the manner shown in Fig. 6, and the female member 113 of said connector threadedly receives said male member 112 and is mounted on the bottom wall 114 of the amplifier casing 115 by a nut 116 which is screwed on said member 113 and draws an annular shoulder 117 on the latter into firm engagement with said bottom wall 114 of the amplifier casing. Leading from the microphone (not shown) are a signal conductor 118 and a shield 119, both of which preferably pass through the suspension tube 110. The signal conductor 118 extends through an insulating terminal disc 120 in the connector member 112 and terminates in a contact point 121, while the shield 119 is connected with the con-

ductor member 112. The grid wire 122 of the first stage of the amplifier extends through an insulating terminal disc 123 and terminates in a contact point 124 which engages the contact point 121 when the connector members 112 and 113 are connected. A wire 125, which leads from the filament of the first tube of the amplifier, is connected with the male member 113 of the connector 111 to complete the microphone circuit.

I claim:

1. An electrical stethoscope comprising, in combination, yieldingly connected ear tubes, a frame, non-metallic flexible straps by which said frame is suspended from one end of said ear tubes, an amplifier carried by said frame, an ear phone mounted on the other end of each ear tube, an ear piece projecting from each ear phone, a piezo-electric microphone, a flexible hose by which said microphone is suspended from said casing, and electrical connections passing through said ear tubes and hose, respectively, and connecting said amplifier with said ear phones, and microphone, respectively.

2. The combination in an electrical stethoscope as set forth in claim 1, in which said amplifier is removably carried in said frame, and each of said connections includes separable electrical connectors.

3. In an electrical stethoscope, the combination of yieldingly connected ear tubes, a frame, non-metallic flexible straps by which said frame is suspended from one end of said ear tubes, an ear phone mounted on the other end of each ear tube, an ear piece projecting from each ear phone, an open casing swivelled on said frame, an amplifier removably carried in said casing, a piezo-electric microphone, a flexible hose by which said microphone is suspended from said casing, and electrical connections passing through said ear tubes and hose, respectively, and connecting said amplifier with said ear phones and microphone, respectively.

4. In an electrical stethoscope, the combination of yieldingly connected ear tubes, a frame, non-metallic flexible straps by which said frame is suspended from one end of said ear tubes, an ear phone mounted on the other end of each ear tube, an ear piece projecting from each ear phone, an amplifier removably swivelled on said frame, a piezo-electric microphone, a flexible hose by which said microphone is suspended from said amplifier, and electrical connections passing through said ear tubes and hose, respectively, and connecting said amplifier with said ear phones and microphone, respectively.

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