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SOUND LOCATING APPARATUS

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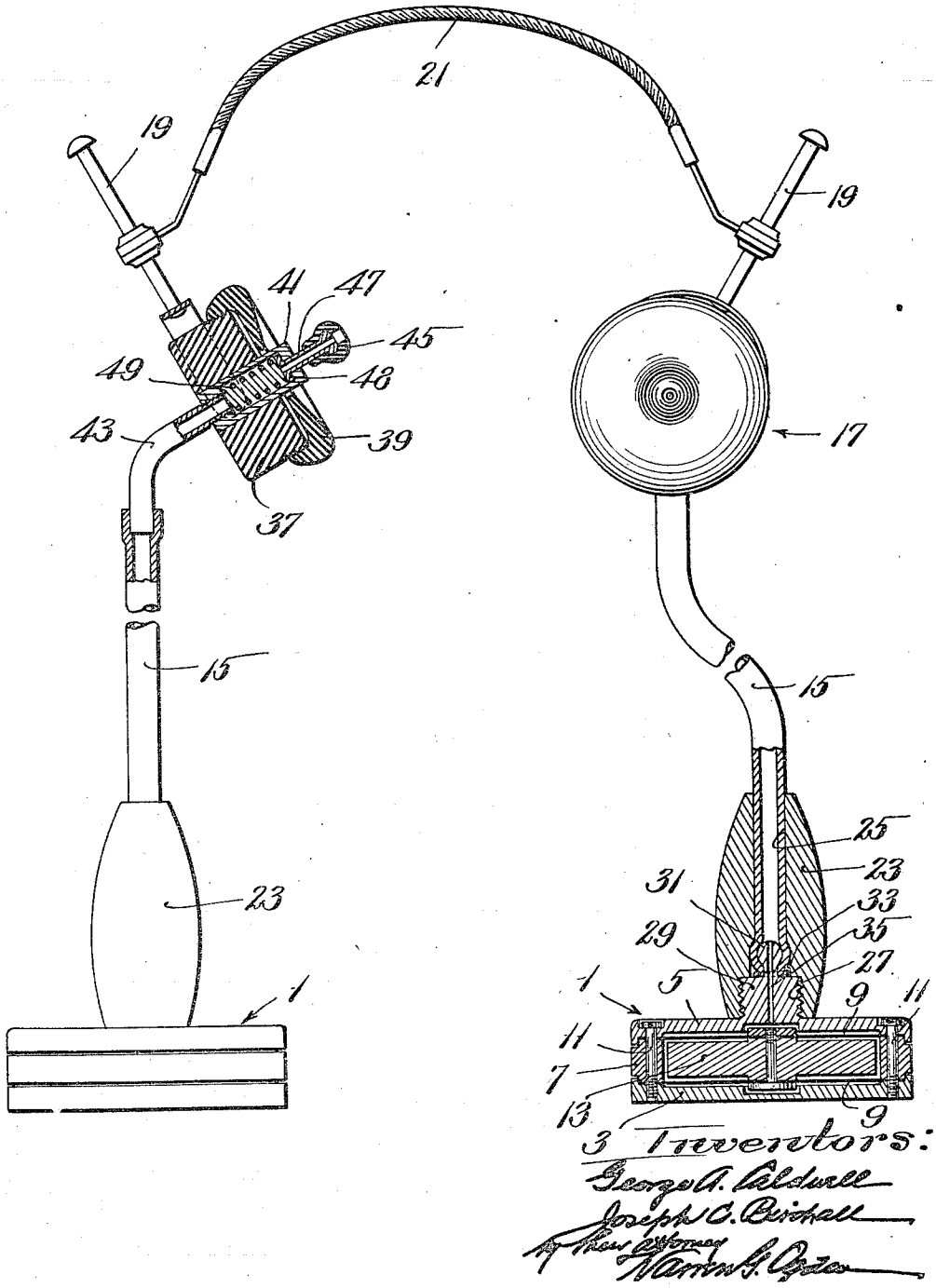

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SOUND-LOCATING APPARATUS

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The invention to be hereinafter described relates to apparatus for locating underground sounds. It has a great variety of uses including locating leaks in water pipes, sounds caused in mining operations, and mine rescue work.

This apparatus comprises a pair of geophones connected by tubes with ear pieces conveniently carried by a head band as in telephony. The apparatus takes advantage of the principle that the ear recognizes the direction from which sound comes. In using the apparatus the two geophones are moved about against the surface through which the vibrations are coming, until a point is found where the sounds have the same intensity in both ears. The direction in which the sound comes will be perpendicular to a line connecting the two geophones. Similarly, whether the sound be in front of or back of the observer is readily determined.

The geophone is a highly sensitive instrument, and will pick up sounds foreign to those desired to be detected. One of the purposes of the invention, therefore, is to provide an ear piece having a construction which materially reduces if not wholly eliminates these foreign sounds. Accordingly, one feature of the invention provides the block of the ear piece with an air chamber for promoting efficiency of operation of the apparatus.

The length of the auditory duct varies with different people, and while the nipple of the ear piece should come close to the ear drum, it should not press injuriously against it. A further feature of the invention provides an ear piece having provision permitting the nipple readily to yield on reaching efficient contact with the ear drum.

A still further feature of the invention provides a handle construction for each geophone to facilitate manipulation thereof in moving them from one location to another on a street when finding a leak in a water main.

The character of the invention will be best understood by reference to the following description of the preferred form thereof shown in the accompanying drawing, wherein is a view of the complete apparatus in elevation, one geophone and one ear piece being shown in section.

In the embodiment of the invention illustrated in the drawing, the apparatus is shown as comprising a pair of geophones 1, each consisting of a base plate 3, a cap plate 5, and an iron ring 7 between said plates with mica or metal diaphragms 9 interposed between the ring and cover plates, the assembly being secured together by screw bolts 11, and having a lead weight 13 suspended within the interior of the case between the two diaphragms.

The geophone constructed as above described is essentially a seismograph, and its advantages have been known since experiments were first conducted by the French during the World War. It is the subject of a U. S. Department of the Interior bulletin. When the instrument is placed on the ground and there is any noise in the vicinity, energy is transmitted as wave motion to the earth, and the earth waves shake the geophone case. The lead weight remains comparatively motionless, and thus relative motion occurs between the instrument case and the weight, causing the air in the case to be compressed and rarified. The air pulsations, in the present instance, are transmitted through rubber tubes 15 to ear pieces 17 mounted on pins 19 connected by curved head springs 21 as in telephone head pieces.

Heretofore, to connect the tube with the geophone, the latter had a small nipple on the cap plate inserted into the tube. To provide a more secure connection of the tube with the geophone and to facilitate manipulation thereof, a handle 23 is provided having a bore 25 receiving an end portion of the tube, and a counterbore 27 threaded onto a boss 29 projecting centrally from the cap plate, and capped by a nipple 31 for insertion in the lower end of the tube. A wire wrapping 33 may be applied to the tube to securely connect it to the nipple, and both boss and nipple have a bore 35 communicating with the tube and the interior of the geophone case. By means of this handle the geophone may readily be grasped by the hand

on stooping, without undue exertion, and then moved from place-to-place.

Each of the ear pieces 17 comprises a block 37 preferably of hard rubber. Threaded to this block and overlying one face thereof is a cap 39 for engagement with the ear. As illustrated the block has a bore, of greater cross-section than the tube, within which there may be housed a metal cylinder 41 forming an enlarged air chamber. One end of the cylinder 41 has a hole threaded to one end of a connecting elbow tube 43, the opposite end of said tube being inserted within the upper end of the rubber tube 15. The air chamber cylinder may project through the central opening in the ear cap 39. A relatively soft perforated nipple 45 adapted for insertion into the auditory duct is mounted on the outer end of a hollow stem 47 projecting through the cylinder end wall, and having a plunger 48 at its inner end within the cylinder. A coiled spring 49 within the cylinder tends to yieldingly hold the plunger at the outer end of the cylinder and will yield to adapt the ear piece to the dimensions of the user's head and thus prevent uncomfortable or injurious pressure of the nipple against the ear drum.

As an example of the use of the apparatus, it may be considered that it is desired to find the location of a leak in a water main the evidence of which may appear on the surface of the street at some distance from the point where the main is damaged. To accomplish this, the geophones may be placed successively on two adjacent hydrants, and observations taken until the leak is located between two of them. Then the geophones may be placed on a fitting on the branch pipe leading to a residence shut-off valve, and several of these between said hydrants are tested until the leak is located by sound between two of them. Finally the geophones may be placed on the street or roadway beneath which the water main is located within the area last determined, and the apparatus, having the improved features above described, will enable determination of the position of the leak in the water main within very fine limitations.

We believe that the greatly increased efficiency of our apparatus is due to the provision of the special features of construction that have hereinbefore been described. One of these features is the air chamber which for convenience is formed within the ear block although it is within the scope of the invention to locate it at any point between the geophone and the nipple entering the auditory duct. The geophone is so sensitive that the shock from a direct passage to the ear is considerable. Its sensitivity also enables it to pick up many sounds foreign to the particular one sought to be detected. An enlarged air chamber intermediate the geophone and the ear causes the waves transmitted to cushion or be smoothed out to such an extent that the shock on the ear is adequately moderated, making it much easier for the operator to select or distinguish the particular sound for which he is listening. In practice, for water leak finding, the tests are preferably made early in the morning when street traffic is lightest and there is general quiet. Another novel feature consists in the use of a block on the tube the bulk of which acts to conserve the energy of the vibrations transmitted by the geophone, prevents their dissipation and gives them a better chance to reach the ear. It is probable that there is some absorption of the vibrations by the block so that they are softened which is highly advantageous to the operator. An apparatus constructed in accordance with the principles herein given prevents dissipation of the sound waves or holds them in the place where they should be with the advantage of elimination of distortion.

While the sound wave transmitter has been named in the description and claims as a "geophone" this is not to be construed as a term of limitation since the employment of any equivalent instrument in the combinations defined by the claims would fall within their intended scope.

The nature of the invention having been indicated and its preferred embodiment having been specifically described, but recognizing that changes may be made in the construction of such embodiment without departing from its spirit and scope, what is claimed as new, is:

1. Apparatus for locating sounds comprising a pair of geophones, a head gear having a pair of ear pieces, and tubes connected to the geophones and ear pieces, each of said ear pieces comprising a block containing an air chamber communicating with its tube, a plunger in the air chamber having a hollow stem projecting from the chamber, a nipple on the stem for insertion in the auditory duct, and a spring tending to move the plunger toward an end of the chamber and yieldable to prevent undue pressure of the nipple on the ear drum when the head gear is in use.

2. In apparatus for locating sounds comprising a geophone, an ear piece and a tube connecting the geophone and ear piece, said ear piece comprising a block containing an enlarged bore communicating with the tube, a hollow stem communicating with the bore, and a nipple on the stem for insertion in the auditory duct.

3. In apparatus for locating sounds comprising a geophone, an ear piece and a tube connecting the geophone and ear piece, said ear piece comprising a block containing an air chamber of greater cross-section than the tube and communicating therewith, a cap on the block shaped for close engagement with the ear, a hollow stem communicating with the air chamber and extending beyond the

cap, and a nipple on the stem for insertion in the auditory duct.

4. In apparatus for locating sounds comprising a geophone, an ear piece and a tube connecting the geophone and ear piece, the provision of an enlarged air chamber intermediate the geophone and the ear piece surrounded by a block of considerable bulk to overcome distortion and prevent dissipation of the energy of the vibrations transmitted by the geophone.

5. In apparatus for locating sounds comprising a geophone, a tube for conducting vibrations transmitted by the geophone, a block at the end of the tube for bearing against the ear of the operator, and a nipple for entering the auditory duct yieldingly mounted in said block.

6. In apparatus for locating sounds comprising a geophone, an ear piece and a tube connecting the geophone and ear piece, said ear piece comprising a block with a central bore, a cylinder in the bore communicating with the tube, a plunger in the cylinder having a hollow stem, a nipple on the stem for insertion in the auditory duct, and a coil spring in the cylinder urging the plunger toward one end of the cylinder and yieldable to allow movement of the plunger within the cylinder.

7. In apparatus for locating sounds comprising a geophone, an ear piece and a tube connecting the geophone and ear piece, said geophone having a handle projecting from the top thereof containing a bore through which the tube passes from the geophone to the ear piece.

8. In apparatus for locating sounds comprising a geophone, an ear piece and a tube connecting the geophone and ear piece, said geophone having a boss projecting centrally from its casing provided with a bore communicating with the interior of the geophone, a handle secured to the boss having a bore receiving the tube, and means for securing the tube to the boss within the handle.

In testimony whereof we affix our signatures.

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