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MICROPHONE FOR CONDUITS

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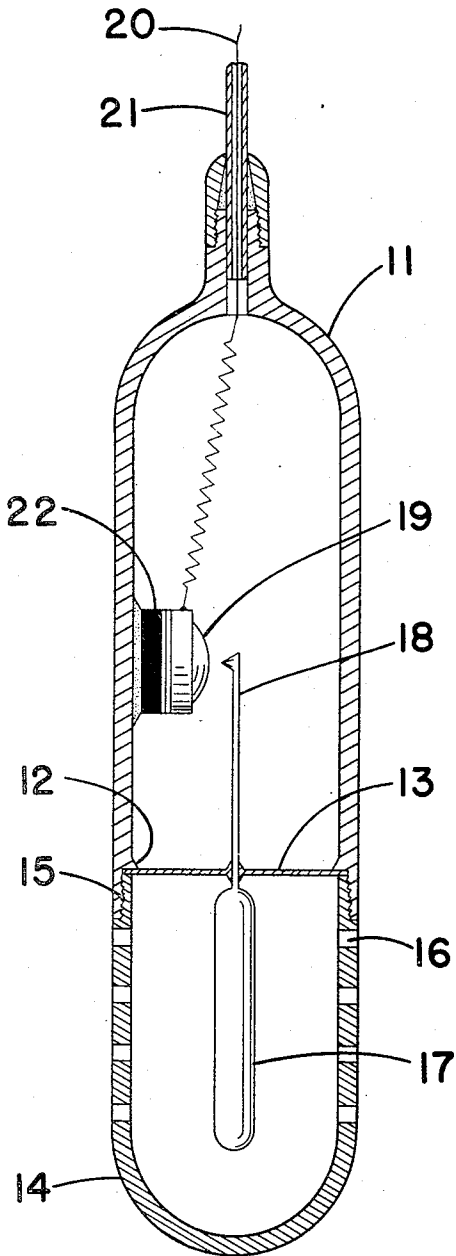


FIG. 1.

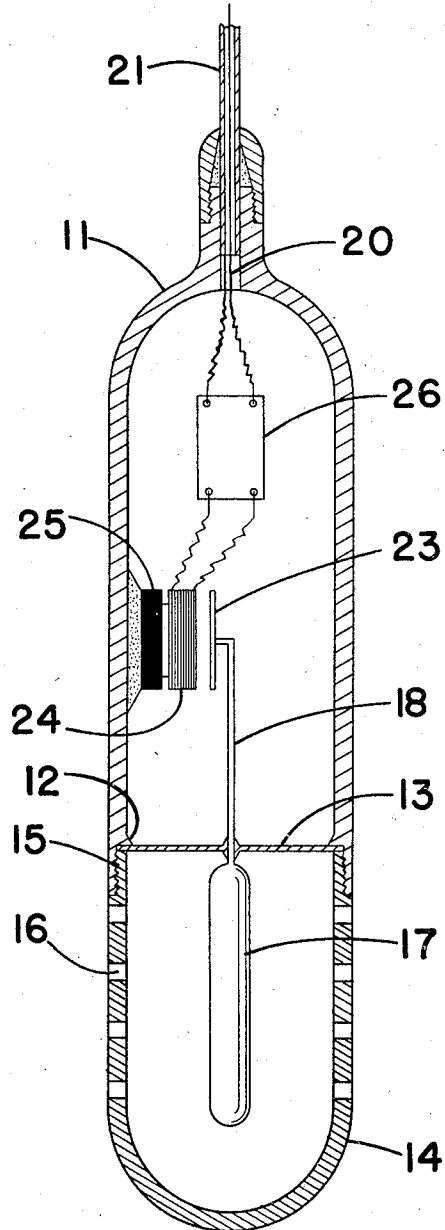


FIG. 2.

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MICROPHONE FOR CONDUITS

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The present invention is directed to a device for receiving acoustical vibrations in conduits.

It is often desirable to determine the point of entrance or exit of fluid from a conduit by utilizing the vibrations set up by the passage of fluid. As a particular example it has recently been found desirable to log bore holes, either cased or non-cased, by the acoustical method to determine the points at which fluid enters or leaves the bore of the well. This operation has been found useful in fixing the location of leaks in casing and also in determining the point of entrance of water in oil wells producing large quantities of the water. Another use of such devices in bore holes is in determining whether or not there is channeling in the wells when water flooding is utilized in the recovery of petroleum.

The acoustical device of the present invention has been found particularly useful when applied to flowing wells making large amounts of water and to fields in which water flooding is being applied. The device is characterized in having a sharp response to horizontal signals so that the points of entrance of fluid into the bore hole may be determined very precisely. Although the device is sensitive to noises originating adjacent thereto, the effect of other noises in the same acoustical range, but vertically removed therefrom, is substantially eliminated.

Other objects and advantages of the present invention may be seen from the following description taken with the drawing in which Figs. 1 and 2 are elevations, partly in section, of embodiments of the present invention.

Referring now to the drawing and first to Fig. 1, a container 11 is provided at its lower end with an inwardly extending ledge 12. A diaphragm 13 is arranged below said ledge with the periphery thereof forced against the ledge to make a pressure-tight seal by the upper edge of end member 14. It will be seen that member 14 is secured to upper section 11 by mating screw threads 15 and gives the container a general stream line effect to allow its rapid movement along the bore of wells. Horizontally extending perforations 16 pierce the member 14, thereby exposing the lower surface of diaphragm 13 to the fluid in which container 11 is emersed.

Secured to diaphragm 13 is a downwardly extending vane or finger 17. This vane is preferably cylindrical in shape and arranged to be particularly receptive to horizontally traveling vibrations passing through perforations 16. The upper end of vane 17 is not actually in contact with the diaphragm, but is secured to a vertical-

ly extending rod 18 which passes through the diaphragm and extends upwardly to contact a carbon button microphone 19. This microphone is electrically connected to conventional indicating equipment (not shown) arranged at the surface of the earth. It will be understood that the device of the present invention will be suitably suspended by a cable containing the required conductors for transmitting the signals from the carbon microphone. In the drawing the lower end of a single conductor armored cable is illustrated, numeral 20 indicating the insulated conductor and numeral 21 the metallic cable sheath.

It is important that the carbon button microphone 19 be isolated from the case 11 so that it will not pick up well vibrations or vertical vibrations from the diaphragm. Accordingly, a suitable means such as a rubber mounting 22 is provided to eliminate these undesirable vibrations.

It will be understood that the arrangement above described is extremely sensitive to horizontal vibrations, but is substantially insensitive to vertical vibrations. For example, in a device in which casing 11 is $1\frac{1}{2}$ inches in diameter and other parts in proportion, the noises produced by a channeling formation during water flooding of fields has substantially no effect when the vane 17 is vertically separated therefrom by less than a foot. That is to say, if a porous formation 6 inches thick is taking a great deal of water, the device will pick it up very clearly when it is adjacent thereto, but will transmit no signal at all if it is as much as 6 inches above or below the stratum.

It will be understood that the device may be modified and the principles of the invention retained. Such a modification is illustrated in Fig. 2 in which like parts are given the same numbers as the embodiment illustrated in Fig. 1. In Fig. 2 actuating rod 18 carries magnetic permeable member 23 arranged adjacent coil of wire 24 mounted on rubber member 25 to insulate it from the case. The coil of wire 24 is connected to a suitable amplifier 26 which, in turn, feeds to the surface through conductors including conductor 20 of the cable and the metallic sheath 21. In this embodiment horizontal vibrations change the position of member 23 with respect to coil 24 and these changes in the magnetic permeability of the coil induce an electric current which is amplified and transmitted to the surface as a signaling means.

While I have disclosed specific embodiments of the present invention, it will be apparent to the worker skilled in the art that various changes

might be made without departing from the scope of the invention. It may be desired, for example, to render the device insensitive to vertical fluctuations in mud pressure, since it is intended to record mainly horizontal variations. This may easily be done by providing in Fig. 1 a second diaphragm similar to 13 above the microphone 22, perforating the wall 11 above said second diaphragm and filling the space between the diaphragms with oil or a similar fluid.

The nature and objects of the present invention having been thus described and illustrated, what is claimed as new and useful and is desired to be secured by Letters Patent is:

1. An acoustical device for logging conduits comprising, in combination, an elongated container, a diaphragm mounted transversely in said container, an actuating rod perpendicular to the plane of said diaphragm arranged with one end extending through said diaphragm and the other end in contact with a carbon button, and a vane arranged perpendicular to said diaphragm with one end secured to the end of the actuating rod passing through said diaphragm, said container being provided with horizontally extending perforations adjacent said vane.

2. A device for acoustically logging bore holes comprising, in combination, an elongated container, a diaphragm transversely arranged in said container, an actuating rod perpendicular to the plane of said diaphragm with one end ex-

tending therethrough and the other end provided with a magnetical permeable member, a vane secured to the end of said actuating rod passing through said diaphragm perpendicular to the plane of said diaphragm and a coil arranged in said container adjacent said magnetical permeable member and feeding to an electrical potential indicating means, said container being provided with horizontally extending perforations adjacent said vane.

3. A device for acoustically logging bore holes comprising, in combination, an elongated container, a diaphragm transversely arranged in said container with its periphery secured thereto to divide said container into a first and a second compartment, an actuating rod perpendicular to the plane of said diaphragm and secured thereto with an end of said rod extending into the first and an end extending into the second compartment, said ends being free to vibrate, a means in the first compartment arranged to produce an electrical signal which is a function of the vibration of the end of the rod extending into the first compartment and a vane in the second compartment perpendicular to the plane of the diaphragm and secured to the actuating rod, the wall of that portion of the container defining the second compartment being provided with horizontally extending perforations adjacent said vane.

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