May 28, 1957 H. F. DALGLISH 2,793,526

HUMIDITY MEASURING DEVICE

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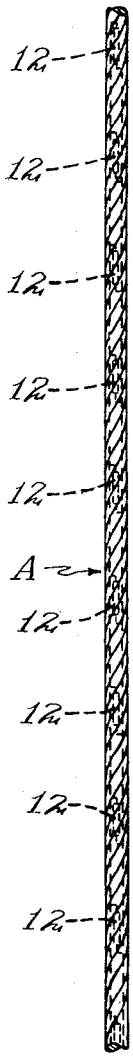



Fig. 4

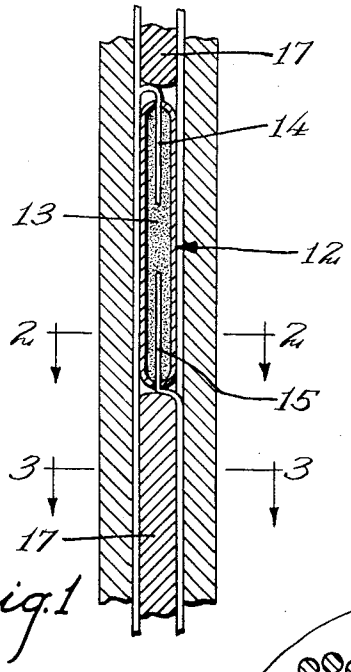



Fig. 1

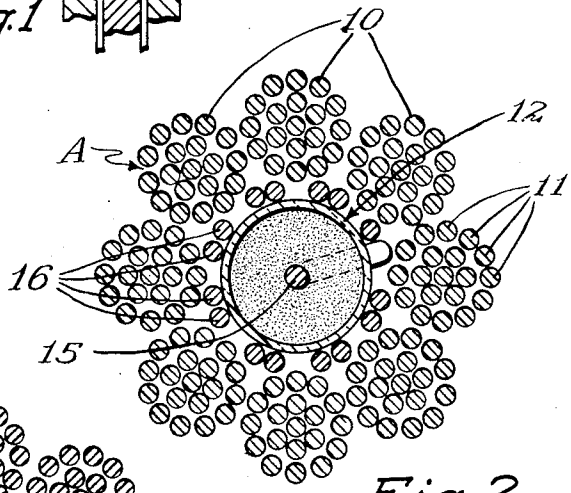



Fig. 2

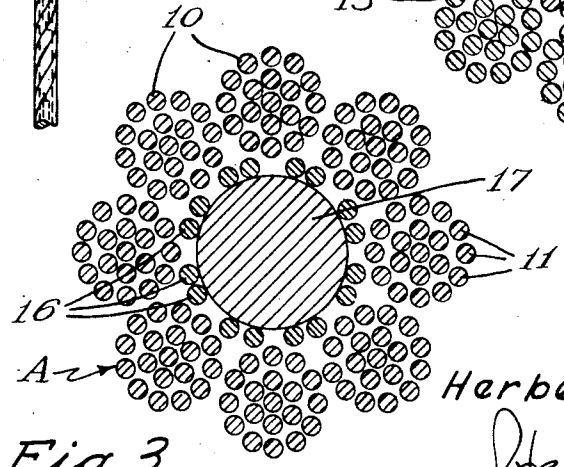



Fig. 3

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HUMIDITY MEASURING DEVICE

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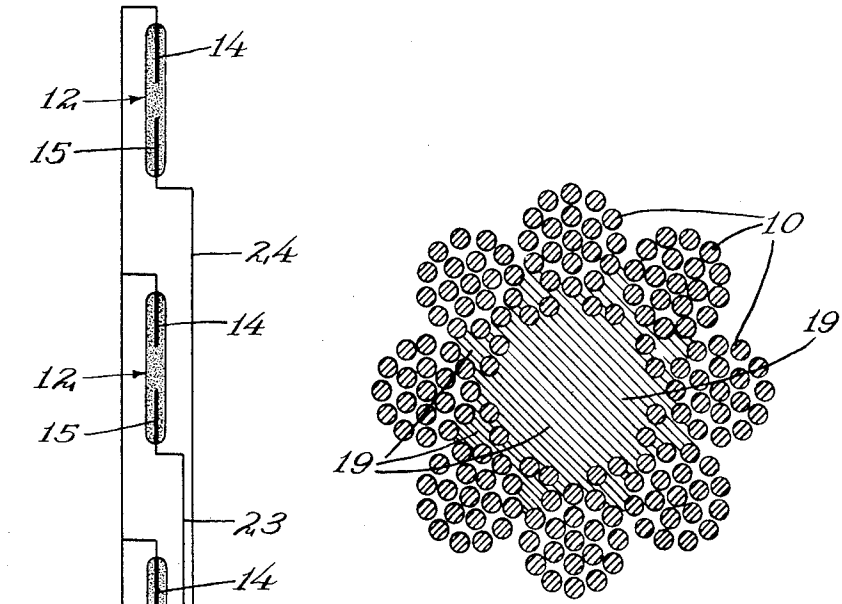



Fig. 6




Fig. 5

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# HUMIDITY MEASURING DEVICE

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Application February 8, 1954, Serial No. 408,574

5 Claims. (Cl. 73—73)

This invention relates to an improvement in humidity test cables and deals particularly with apparatus for testing humidity within a body of hydrocarbon material or the like.

In the storage of various hydrocarbon materials it is desirous to know the humidity at various points throughout this body. However, materials of this type are likely to shift about in position and, therefore, difficulty is experienced in providing the necessary reading. For example, when grain is stored in elevators of considerable depth the humidity of the material is of utmost importance in indicating the quality of the grain. However, the action of the grain when inserted into the elevator or removed therefrom tends to injure or destroy circuits of usual type. If such circuits are enclosed in rigid housings they are not readily susceptible to the humidity conditions in surrounding bodies of material. It is necessary that ambient air affect the measurement and this is impractical in a rigid housing unless it is perforated throughout its length. Rigid housings are much more susceptible to the action of forces such as those produced by the swirling of grain within the elevator as it is inserted and withdrawn. The present structure is designed to obviate these difficulties.

These and other objects and novel features of the invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification:

Figure 1 is a longitudinal sectional view diagrammatically through a wire rope cable showing the arrangement of the parts.

Figure 2 is a cross sectional view showing the arrangement of the conductors relative to the cable and the humidity measuring capsules therein.

Figure 3 is a sectional view through the wire rope cable at a point intermediate the capsules showing the core which fills intermediate the capsules.

Figure 4 illustrates diagrammatically the manner in which a series of humidity measuring capsules may be mounted in a wire rope cable.

Figure 5 is a diagrammatic view showing a wiring diagram which may be used for the indication of humidity at various points throughout the length of the cable.

Figure 6 is a sectional view through a modified form of construction.

At the outset it should be understood that in using the term wire rope cable it is not desired to limit the structure to any particular form of wires encircling the core of the apparatus. The cable may be formed of wires which are twisted, laid or braided and their particular formation is not important in the present invention.

The humidity measuring device A includes a wire rope cable having a series of angularly spaced strands 10, each strand being formed of a plurality of twisted wires 11. The twisting of the wires provides small spaces between the wires. The strands when twisted are not entirely in contact so that the cable is porous to a certain extent.



The cable thus formed is provided with a core constructed as best shown in Figure 1 of the drawings. The core includes a series of longitudinally spaced capsules 12 formed of a woven or punctured plastic material as a vinyl polymer or other resinous material containing a hydroscopic salt or like agent which varies in electrical conductivity in proportion to the moisture content of the material. Accordingly, when there is more moisture in the air the material 13 which is a hydroscopic salt as calcium chloride or the like within the capsule 12 becomes more or less electrically conductive.

Each capsule 12 also includes a pair of spaced wires or electrodes 14 and 15. The spacing between these electrodes is normally uniform in all of the capsules so as to provide a predetermined length of material 13 between these electrodes. The electrodes 15 provide a means of determining the humidity when properly connected to measure the varying resistance between the electrodes.

As shown in Figure 2 of the drawings, the capsules 12 are of smaller outside diameter than the inner diameter of the wire rope strands 10 and conductors such as illustrated by the numeral 16 encircle the capsules 12. These conductors 16, illustratively representative of conductors 20, 21, 22 and 24, connect the electrodes of the various spaced capsules at an end of the cable to form independent circuits so that the humidity may be measured at various points by each capsule throughout the length of the cable. In usual construction one wire of each capsule electrode is common throughout the cable while the other electrode is connected by individual conductors leading to the cable end.

As shown in Figures 1 and 3 of the drawings, a core or filler 17 extends between the various capsules 12 so as to provide a core of uniform size. This filler 17 may be of any suitable flexible material of about the same outside diameter as the capsule 12. In actual practice material such as cotton rope and the like has been used for this purpose. With such an arrangement the wires usually extend about the periphery of the filler as well as about the periphery of the capsules 12.

Figure 6 of the drawings shows a modified form of construction in which the interior of the cable is extruded with a material through which moisture may pass. In other words, in the arrangement shown in Figure 6, the interior of the cable is filled with a material which is either porous to provide passage of air therethrough or else is of material which will conduct moisture to the capsules and which will not seal the capsules so that they will not react properly to ambient humidity conditions. The filling material 19 which may be, for example, a porous nylon, Formvar (found in ASTM) or other insulating material as a silicone wax (Teflon) shown in Figure 6 will encircle the capsules and will fill the space between the various conductors within the cable strands.

With the arrangement illustrated, it is possible to measure humidity at various points throughout the length of the cable. As indicated in Figure 5 of the drawings a common wire such as 20 is connected to one electrode 14 of each of the capsules 12. Conductors 21, 22, 23 and 24, extend from the other electrodes 15 to the end of the cable. A suitable humidity measuring apparatus is employed, this apparatus being shown diagrammatically in the figure. A battery 25 is connected to the common wire 20 and a potentiometer or variable resistance 26 and a milliampere meter 27 are connected in series between the other terminal of the battery and a switch 29. The various conductors 21, 22, 23 and 24, are connected to switch terminals 34, 33, 32, and 31, respectively. These terminals can be selectively connected to the other switch terminal 35. The humidity is measured in the uppermost

cell 12 illustrated in Figure 5, for example, by connecting the switch terminals 31 and 35, as shown in dotted line.

I have found that any control cable is of considerable value in determining the physical condition of grain at various elevations through a bin or tank. The cable may similarly be used for numerous other purposes where it is desirable to measure humidity at various spaced points. The structure is simple in nature, inexpensive to produce and serves a novel and unusual purpose.

In accordance with the patent statutes, I have described the principles of construction and operation of my humidity measuring device, and while I have endeavored to set forth the best embodiment thereof, I desire to have it understood that obvious change may be made within the scope of the following claims without departing from the spirit of my invention.

I claim:

1. A humidity measuring cable including a plurality of separate humidity sensitive elements formed of materials of variable resistance dependent upon the humidity, conductors connected to each said element to form an independent circuit to each said element, a flexible wire cable pervious to air, and means supporting said elements in longitudinally spaced relation within said cable, whereby said elements may sense humidity of air outside of the cable, and whereby the humidity at any of said elements may be determined.

2. The structure described in claim 1 and including a core filling between said elements.

3. The structure described in claim 1 and including a core within said cable between said elements, said core being of substantially equal diameter to said elements.



4. A humidity measuring cable including a plurality of humidity sensitive variable resistance means, a hollow air pervious cable enclosing said means at substantially equally spaced positions along the length of said cable, and independent conductor means in said cable connected to said each humidity sensitive means and extending longitudinally of said cable to an end thereof, said conductors forming an independent circuit to each said humidity sensitive means, whereby the humidity may be independently sensed at any of said positions throughout the length of the cable from said one end thereof.

5. A humidity measuring cable including a series of spaced humidity sensitive capsules capable of independently measuring humidity by changes in electrical resistance, means enclosing said elements, said last named means comprising a flexible cable pervious to air, and conductor means connected to each of said elements and extending to one end of said cable and forming an independent circuit to each capsule whereby the resistance of each said element may be measured from said one end of said cable.


**References Cited in the file of this patent**

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,285,421 | Dunmore | June 9, 1942 |
| 2,526,636 | Colman | Oct. 24, 1950 |
| 2,663,190 | Ilgenfritz | Dec. 22, 1953 |
| 2,742,780 | Feigal | Apr. 24, 1956 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 275,036 | Great Britain | Aug. 4, 1927 |
| 692,641 | Germany | June 24, 1940 |