

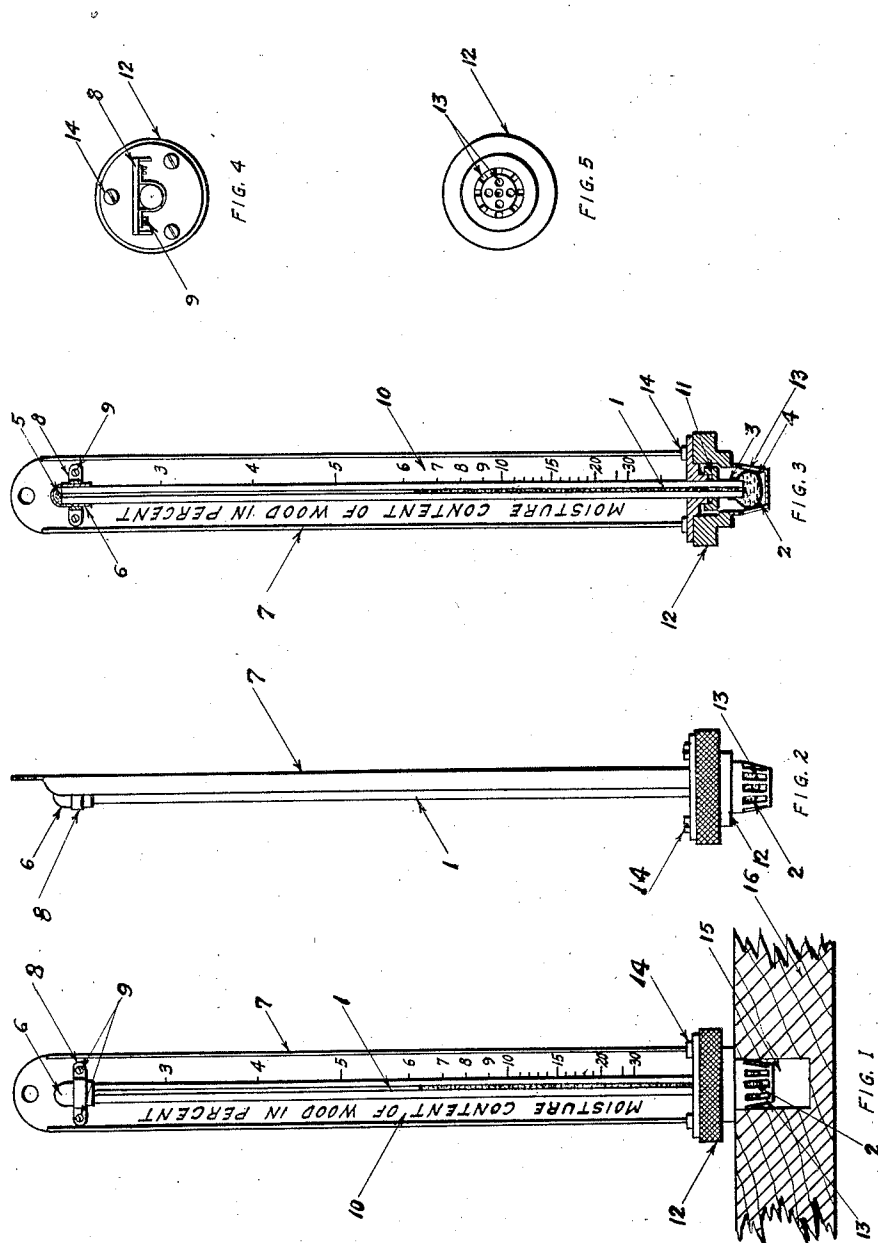
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MOISTURE INDICATING INSTRUMENT FOR WOOD

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MOISTURE-INDICATING INSTRUMENT FOR WOOD.

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(GRANTED UNDER THE ACT OF MARCH 3, 1883, AS AMENDED APRIL 30, 1928; 370 O. G. 757.)

This application is made under act of March 3, 1883, chapter 143 (22 Stat. 625) and the invention herein described and claimed may be used by the Government of the United States or any of its officers or employees in the prosecution of work for the Government or by any other person in the United States without the payment to me of any royalty thereon.

My invention relates to a new and improved moisture indicating instrument particularly for wood, although with slight modification it may be used for air, textiles, grain, cereals, paper and so forth, which is inexpensive, accurate and easily used.

The moisture content of hygroscopic substances in an air dry condition fluctuates with prevailing humidity conditions. Thus a low relative humidity will reduce the moisture content and a high humidity will increase the moisture content. By controlling the humidity the moisture content of wood and other hygroscopic substances may be regulated. Conversely, if wood is placed in a small tight container the humidity in the container will be controlled by moisture in the wood. Further, if a hole is drilled in a piece of wood and closed tightly the humidity obtaining within the opening will correspond to the moisture content of the wood whatever that may be if the wood is in an air dry condition or below the fiber saturation point. This principle is made use of in the development of the instrument about to be described.

It is important for woodworkers to know the moisture content of the wood they are using in order to guard against defects arising from shrinking and swelling during and after fabrication. The common method of determining moisture content by oven drying is cumbersome, expensive and requires a considerable time to make the measurements. A carefully regulated oven is necessary as well as an accurate scale. In the oven method, moisture discs, which consist of thin pieces of wood cut out of the wood are weighed, oven dried for about a day and reweighed. The difference between the oven dry weight and the original weight is assumed to be the moisture content and is usually expressed as a percentage of the oven dry weight. The difference in weight is not

always entirely due to moisture differences, however, since other volatile materials such as oils may be driven from the wood by the heat. This is a source of considerable inaccuracy in some cases.

It is the purpose of the new device to provide a means of measuring the moisture content in the course of a few minutes with an inexpensive instrument that can be carried in the pocket. Furthermore the measurements may be made without injuring the board materially. A hole $\frac{1}{2}$ inch in diameter may be drilled on the back of the board or edge of the piece for the insertion of the instrument. The instrument is provided with a direct reading scale so that no tables or curves are necessary to interpret the results.

This instrument may be used to measure the moisture content of other materials, for instance, it may be provided with a flattened perforated shield so that it may be inserted between sheets of paper, with a sharp pointed perforated shield it may be inserted in bales of hygroscopic material such as cotton or wool or it may be provided with a fine screen shield for burying in grain, cereals or flour. In each case a special calibration would be necessary.

The device as applied to the measurement of moisture in wood may be best described by referring to the attached drawing, in which—Figure 1 is a front vertical view of the instrument shown inserted in a block of wood; Figure 2 is a side view; Figure 3 is a vertical section on the center line; Figure 4 is a top view; and Figure 5 is the bottom view.

Similar numerals refer to similar parts throughout the several views.

The instrument consists of a glass capillary tube (1) at the base of which is attached a bag (2) made from a very thin hygroscopic membrane derived from the intestines of cat-tle and known as bottle capping stock or goldbeater's skin, or from other suitable sources such as films of cellulose acetate. The bag is secured in place by a suitable wrapping of thread (3) and filled with the proper amount of mercury (4). At the upper end of the capillary tube is a mercury lock which consists of a chamois skin pad (5) and a viscose cap (6). The chamois skin

pad is placed over the top of the capillary and the viscose cap in a wet condition is slipped over it and permitted to dry and in so doing it shrinks tightly over the end of the tube holding it securely in place. A few needle pricks are made in the top of the cap (6) to permit the passage of air. This lock (6) prevents the formation of pressure in the capillary as the mercury rises or falls in the column. The chamois skin pad provides a satisfactory barrier to prevent the leakage of mercury during shipment or in handling.

The capillary tubing is supported on a channel frame (7) and held by means of clamps (8) held in place by screws (9). A scale (10) is provided which shows directly the moisture content of the wood. The capillary tubing (1) is fastened to the upper part of the instrument by means of the stuffing box (11). The bulb is protected by means of a base and housing (12) which provides a smooth surface so that the instrument may be easily but snugly inserted in the wood so as to close the opening. The housing is further provided with ventilating holes (13) which permit the air to circulate about the bulb of the instrument. The upper portion of the instrument is fastened to the base by means of screws (14). A cap may be provided, if desired, to cover the bulb of the instrument when it is not in use.

The instrument is used by drilling a hole of the proper diameter (15) into but not through the wood (16) to be tested. The instrument is inserted so that the shoulder of base (12) is tightly pressed against the wood and the bearing surface below the shoulder is perfectly tight so that there will be no air passage between the inside and outside of the hole. The closing of the hole will cause the humidity of the air in the hole to approach equilibrium with the moisture content of the wood whatever that may be. This humidity or moisture in the space causes the thin membrane (2) to contract or expand forcing the mercury up or down the column. If the moisture content is high the bag will enlarge and the mercury will drop by the force of gravity. If the membrane dries out it will force the column upward in a like manner. A period of 5 or 10 minutes is required for the atmosphere in the hole and the mercury bag to adjust themselves to the moisture content of the wood.

The instrument is calibrated by placing an arbitrary scale along the capillary tube, inserting the instrument in holes in small blocks of non-resinous wood at different moisture

contents covering a range from 5 to 25 per cent, allowing it to stand 10 minutes in each hole and the height of the mercury column measured with the arbitrary scale. After the readings have been taken the blocks are weighed, oven dried and reweighed to obtain the loss in weight or moisture. The moisture content is then expressed as a percentage of the oven dry weight. These points are plotted on suitable coordinate paper and a smooth curve drawn through them. From this curve the important points may be plotted on the instrument scale and thus made direct reading.

In designing the instrument the effect of temperature on the height of the mercury in the glass tube has been eliminated by using a suitable combination of size of bulb, quantity of mercury and diameter of bore. As an example, I have found that this is accomplished in an instrument having a bulb containing 2 grams of mercury and a bore of .25 millimeters. The instrument can be used through a wide range in temperature without seriously affecting its accuracy.

Having thus described my invention, I claim:

1. An instrument of the character described, a capillary tube, a hygroscopic membrane capable of shrinking and swelling and containing mercury, attached to one end of the capillary tube, a chamois skin pad at the other end of the capillary tube, a viscose cap adapted to hold said pad in place on the capillary tube, a scale adjacent said tube, a support adapted to hermetically engage the capillary tube and the object to be tested, and a housing for said membrane on said support.

2. An instrument of the character described, a capillary tube, a bag of hygroscopic material, and containing mercury, the bag being capable of shrinking and swelling with changes of the humidity of the atmosphere surrounding the bag, said bag being attached to one end of the tube, the relative dimensional characteristics of the bore in said tube and the bag being such that the mercury does not rise nor fall in said tube due to temperature changes, a chamois skin pad at the other end of the capillary tube, a viscose cap adapted to hold said pad in place on the capillary tube and thus prevent loss of mercury, a scale adjacent said tube, a support adapted to hermetically engage the capillary tube and the object to be tested, and an apertured housing for said bag on said support.

In testimony whereof I affix my signature.
MATTHEW ELBRIDGE DUNLAP.