METHOD FOR MEASURING THE MOISTURE CONTENT OF WOOD

Filed Dec. 31, 1962

Fig. 1.

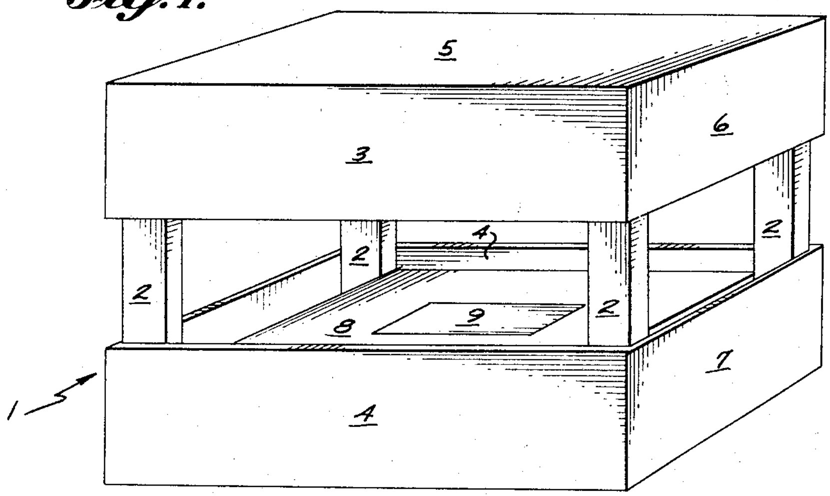


Fig. 2.

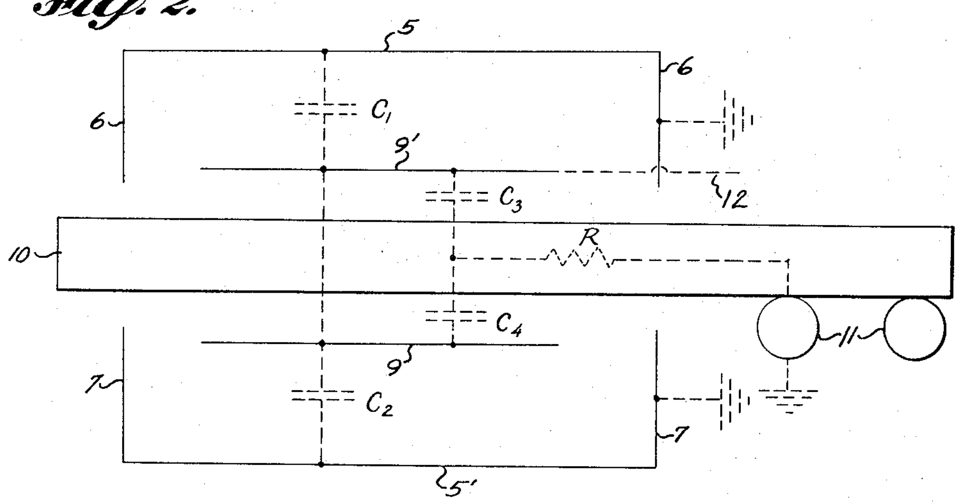
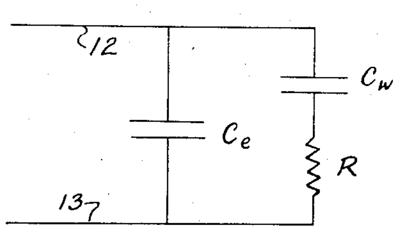


Fig. 3.



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METHOD FOR MEASURING THE MOISTURE CONTENT OF WOOD

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1 Claim. (Cl. 324—65)

This invention relates to a moisture detector for wood. Specifically, this invention relates to a capacitance-type moisture detector that rapidly measures the water concentration in wood employing a pair of electrodes that are not in physical contact with the wood.

Heretofore, the prior art has suggested many types of moisture detecting meters. One type is the resistance meters which consist of probes driven into wood and a suitable readout electrical circuit. These meters are slow, not suitable for high speed scanning and leaves holes in the wood.

Another type is the power loss meters that consist of electrodes which contact the wood surface setting up an electrical field in the wood and a suitable readout electrical circuit therefor. These meters are sensitive to the degree of contact with the wood surface and to the wood thickness. Accordingly, greater thickness in the wood results in decreased accuracy.

Capacitance-type moisture meters have been developed that consist of two electrodes either in contact with or at a fixed distance to the wood. These meters are supposed to measure the increase in capacitance due to the presence of a dielectric other than air adjacent to the electrodes. Generally speaking, wood has a dielectric constant of about 2, water 80 and air 1. Consequently, the gauges or meters are dependent on wood density and thickness as well as moisture content. They are also quite sensitive to the distance between the wood surface and the electrodes, which means that a wet pocket in the middle of a thick wood sample may not be detected. Accuracy is in doubt if the electrode-to-wood distance varies as is the case with rough sawn lumber.

An object of this invention is to provide a capacitance-type moisture detector that accurately determines the water content in wood regardless of the shape or size of the wood.

Another object of this invention is to provide a capacitance-type moisture detector that accurately determines the water content of wood regardless of its distribution within the wood.

Another object of this invention is to provide a capacitance-type moisture detector that is provided with a pair of elecrodes that do not physically contact the wood and is suitable for accurately determining the water concentration in wood at a high speed scanning rate.

Briefly described, this invention consists of a pair of shielded electrodes mounted a fixed distance apart such that the wood to be measured can pass between them without touching them. The electrodes are connected to any conventional electrical circuit that allows the increase of capacitance due to the presence of water in wood to be indicated as an output voltage or current. The two shielded electrodes are connected together electrically so that the volume between them is essentially a field-free region. As wood containing water is moved into this volume, an electrical charge is induced in the wood. The amount of charge induced depends on the conductivity, and hence, the moisture content of the wood. This invention allows moisture contents to be measured on rough or surfaced lumber, is relatively insensitive to wood position in the space between electrodes, is especially sensitive to non-uniform moisture distribution resulting in water concentrations inside a piece of lumber, and allows rapid measurement without physical contact with the lumber surface.

These and other objects and advantages will become manifestly clear to those skilled in the art when taken in conjunction with the detailed description and the drawings wherein:

FIGURE 1 is a perspective view of the sensing head of the capacitance-type moisture meter embodying the present invention.

FIGURE 2 is a schematic illustration of the electrode assembly and electrical circuit analog therefor.

FIGURE 3 is a simplified wiring diagram used with the sensing head of the moisture meter.

Referring generally to the drawings, in FIGURE 1 the capacitance-type moisture meter is generally indicated at **1**. The capacitance-type moisture detector **1** is generally rectangular in form and is comprised of four upright support members **2** formed of a suitable material, such as wood. Upper and lower connecting side plates or boards **3** and **4** extend between the upright supports **2** as well as upper and lower end plates or shields **6** and **7** between the upright supports **2** to form a box-shaped housing for the moisture detector. Top and bottom cover plates **5** and **5'** are connected to the respective side and end plates to properly shield the electrodes **9** and **9'** that are supported on a suitable non-conductor plate **8** connected to the upper side plates **3** and lower side plates **4**.

It should be noted that the side connecting upper plates **3** and lower plates **4** are formed of a wood material or any other suitable structural material and the top cover plate and bottom cover plate **5** and **5'** and also the upper and lower end plates **6**, **7** are formed of aluminum, stainless steel, copper or other suitable conducting material. Also, the support member **8** is formed of glass, a resin sheet material such as "Plexiglas" or other suitable non-conducting material and the electrodes **9** and **9'** are formed of aluminum, stainless steel, copper or other suitable conducting material. Moreover, there is also connected to the upper members **3** and **6** another support member, not shown, having an electrode **9'** connected thereto.

In use, the two electrodes **9** and **9'** are connected together electrically. Also, the two shield members **5** and **5'** are connected together electrically. In this manner, the two electrodes **9** and **9'** become variable potential electrodes and the two shield members **5** and **5'** become ground potential electrode members. The two sets of electrodes are then connected to the "unknown" terminals of a standard impedance bridge.

With this circuit, an electrode to ground capacitance C_1 and C_2 is created and an electrode to wood capacitance C_3 and C_4 is created. Since the shields **5** and **5'** are connected together and the electrodes **9** and **9'** are also connected together, the circuit then reduces to a total electrode to ground capacitance C_e that is equal to the sum of C_1 and C_2 and a total electrode to wood capacitance C_w that is equal to the sum of C_3 and C_4. As can be seen, the internal resistance R of the wood is connected in series with C_w which is connected to the signal-in lead **12** and grounded by lead **13**.

Then the wood **10** is passed between the electrodes **9** and **9'** on conveyor rollers **11** which are grounded. In this manner, an electrical charge is induced into the wood **10**. Due to the presence of moisture or water within the wood, the flow of current between the electrode and wood will vary in accordance with the resistance of the wood. The flow of current between the electrode and wood can be readily measured by the impedance bridge, not shown, to indicate the quantity of moisture in the wood.

The variables involved in this apparatus are the electrode size, shape and spacing. The electrode to wood capacitance depends on the area of the wood between the electrodes **9** and **9'** and the distance from the wood to the electrodes. The dimension of the electrodes **9** and **9'** is greater than the maximum width of lumber to be metered, and the spacing between the electrodes **9** and **9'** is more than twice the maximum thickness of the lumber to be metered. Accordingly, the size, shape and spacing of the electrodes **9** and **9'** can be predetermined for successful operation. Moveover, the generator voltage and the frequency of the impedance bridge can be readily determined since the impedance bridge is driven by a 10 kilocycle per second signal and the output voltage is observed by an oscilloscope, a voltmeter or other similar voltage indicating device as is well-known in this art.

Accordingly, it is seen that the invention set forth above places the electrode arrangement with the electrodes of the same potential spaced above and below the wood and the wood behaving as a semigrounded plate. The relatively large wood-to-electrode spacing makes minor variations in lumber dimensions insignificant. Since the wood surface does not contact the electrodes **9** and **9'**, the moisture meter **1** is not influenced by surface dryness but is influenced by the moisture in the interior of the wood which is desired to be measured.

While specific details of a preferred embodiment have been set forth above, it will be apparent that many changes and modifications may be made therein without departing from the spirit of the invention. It will therefore be understood that what has been described herein is intended to be illustrative only, and is not intended to limit the scope of the invention.

What is claimed is:

A method of measuring the moisture content of a wood sample, comprising the steps of:

providing opposed, spaced electrodes having a hollow measurement site between them;

positioning a portion of said sample within said measurement site but spaced from said electrodes;

grounding said sample;

applying an alternating current potential between said electrodes and ground, such that the potential applied to said electrodes at any instanst is of the same magnitude and same polarity; and

measuring the flow of current between said electrodes and ground, whereby the measured current can be related to the internal resistance of said wood sample and to the moisture content thereof.

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