

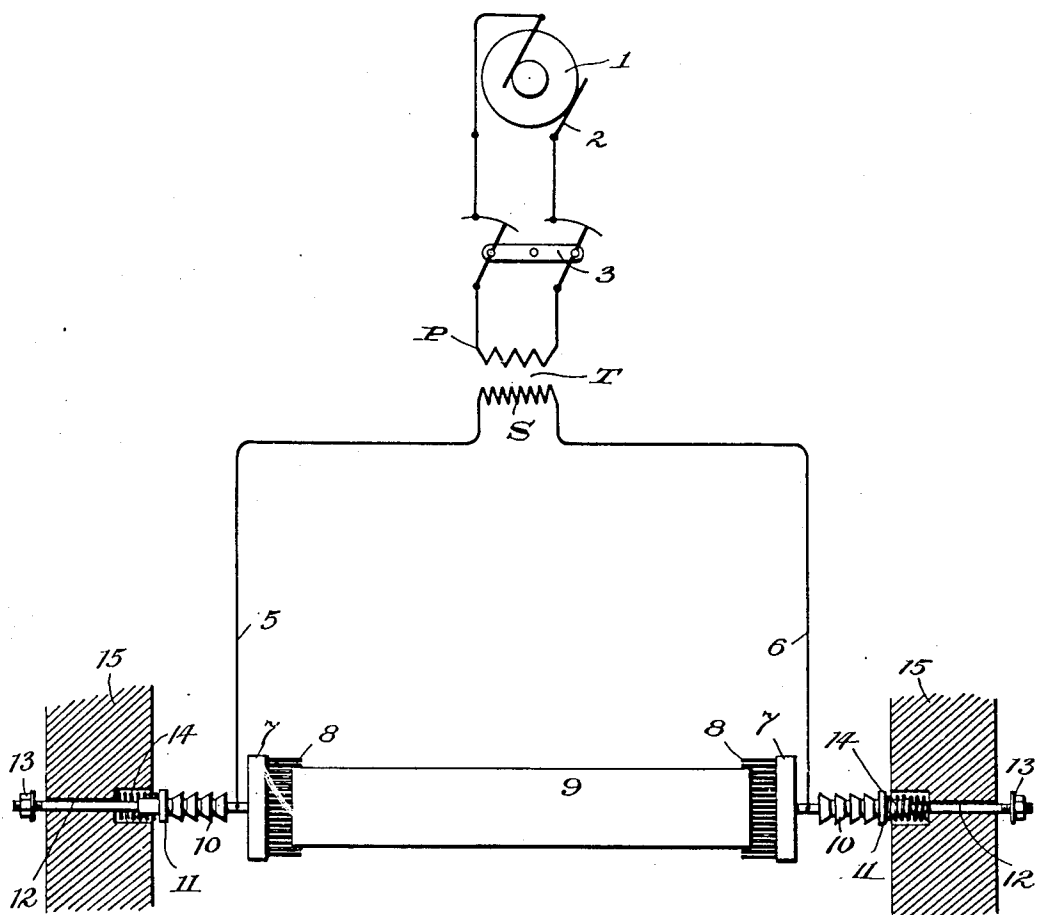
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ELECTROTHERMIC PROCESS OF TREATING HIGH RESISTANCE MATERIAL

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UNITED STATES PATENT OFFICE

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ELECTROTHERMIC PROCESS OF TREATING HIGH RESISTANCE MATERIAL

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This invention relates to an electrothermic process of treating high resistance materials and is generally applicable to the treatment of any material having high electrical resistance and containing substantial amounts of volatile material.

One application to which this process is particularly adapted is in the drying or seasoning of green wood. Wood as it finds application in the arts and industries requires seasoning in order to remove the moisture which it contains and to prevent its warping after it is in the finished state. In its green and dry states wood is a very poor conductor of heat. When green it is a partial conductor of electricity, but when dry it is practically a non-conductor of electricity. Ordinary methods of seasoning wood are necessarily slow processes due to this property of poor heat conductivity.

In the usual air drying process commonly known as "seasoning", the moisture contained in the wood slowly escapes by diffusion and transpiration, both of which processes are materially influenced by the degree of compactness and porosity of the wood structure. During ordinary drying processes the outside surface of the wood dries first and shrinks, forming a dense layer which is more or less impervious to the moisture contained in the inner layers of the wood. This case hardening process materially lengthens the time required for the wood to season and encourages cracking and warping which always occur unless the wood conditioning operations are carried out slowly, uniformly and with extreme care.

I have discovered that the drying process can be materially shortened if the whole body of the woody material is raised to a temperature sufficient to evaporate the contained moisture and to establish a high vapor velocity outwardly through the ducts and openings in the wood. Such a process which may be said to raise the temperature of the entire body equally or substantially so throughout, prevents case hardening and accelerates the transpiration velocity through the cell walls and the woody tissue.

My process consists in establishing an elec-

trical potential difference between opposing faces of the wood and over a substantial area of its surface and may be carried out by passing the electric current in a direction parallel to or across the grain of the wood. In most cases the current is preferably applied parallel to the fibre of the wood, because in this direction less resistance is encountered. When an electrical potential is applied in this manner the electrical energy is largely converted into heat according to the well known equation:

$$H = KC^2R = KCE = K \frac{E^2}{R}$$

(where H equals heat units; C equals current in amperes; R equals resistance in ohms; E equals electromotive force in volts; and K is a reduction factor). By this process the current may be regulated properly so as to raise the temperature of the entire mass of material to any desired degree, thereby causing the contained moisture to be rapidly evaporated and expelled.

This process is also applicable to bending, shaping or molding wood into various irregular forms. If it is desired to use green wood or partially seasoned wood, the current is applied to the material until the contained moisture is substantially removed by evaporation and the wood fibers are uniformly softened throughout. When the entire mass is plastic and flexible it may be shaped and held in any desired irregular shape. After shaping, the heating process may be continued until the material is entirely dry or the material may be held in its shaped position while the temperature is allowed to fall to normal. Ordinarily, the process of shaping timbers is carried out by heating and softening the wood in steam for several hours before it is shaped or molded. After the molding process it is then held in its new form and allowed to cool and dry. By my process the length of time required for such operations is materially reduced.

The accompanying drawing is a diagrammatic view showing one form of apparatus which is well adapted for carrying out processes embodying my invention.

Referring to this drawing, the reference character 1 designates a suitable source of high voltage electricity, here shown as a generator of the alternating current type, although a direct current source may also be used. This machine supplies current from brushes 2 through a switch 3 to the primary P of a step-up transformer T. The secondary S of this transformer is connected to electrodes 7 by means of line wires 5 and 6. When a unidirectional current is employed it is best obtained by rectifying the high voltage alternating current by any of the well known means.

In carrying out the process, it is necessary that the electrodes be freely pervious to gases and vapors so as to allow their ready escape and for this purpose electrodes 7 comprise a body portion of electrically conductive material carrying a series of metallic bristles 8 covering the entire surface thereof at closely spaced intervals. Each of these electrodes is rigidly connected to a bank of insulators 10 which are in turn attached to a supporting rod 12 having an enlarged head 11 cooperating with a compression spring 14. Each rod 12 passes through an opening in a suitable support 15 and is normally urged outward from this opening by the action of spring 14. A nut and washer 13 secured to the end of rod 12 prevent the electrode from being pushed entirely through the supports 15 by the reaction of the spring.

Mounted between the two electrodes 7 and contacting closely with the extending ends of bristles 8 is a block of material 9 to be treated. As here shown, this material is a wooden cross tie which is to be seasoned prior to impregnation with creosote oil or other preservative. It will be clear that electrodes 7 and tie 9 complete the secondary circuit of transformer T, but that due to the presence of the two banks of insulators 10, the current is confined to this circuit.

Although I have shown the electrodes 7 as carrying a series of metallic bristles 8, this particular structure is merely illustrative since the only requirement is that each electrode shall contact with the high resistance material at a great number of closely spaced points, and that the current pass through practically the entire cross sectional area of the material to be treated and cause a temperature rise throughout this material.

When this tie 9 is placed in position between the two electrodes 7, the compression springs 14 react between the stationary supports 15 and the blocks 11 carried by rods 12, and force the bristles 8 into very close electrically conducting contact with the ends of the tie. When the switch 3 is closed, high voltage alternating current is supplied to these electrodes and circulates through the secondary circuit of transformer T, this circuit being completed by the cross tie 9. The

tie 9 may be weighed prior to the starting of the process and it may be removed and weighed at suitable intervals during the process, in order to determine definitely when the desired condition of the tie is reached. After the length of time required has been determined by treating several ties, the approximate time required will be known and then the weighing process may be dispensed with.

In preparing ties for use by railroads, such ties are commonly subjected to a long air seasoning process throughout a period of twelve to eighteen months. During this time between 20% and 30% of the original weight of the wood is lost due to evaporation of the contained moisture, and the wood develops deep cracks and checks over practically the entire surface. After the seasoning process, the wood is impregnated with creosote oil or other preservative. By the use of my process the time required for this treatment may be reduced to hours as compared with months by the former process.

I have found that in the creosoting of ties my process may be advantageously carried out in the following manner: An oak tie having dimensions of 7" by 9" by 8½' has a total overall electrical resistance between its ends of between 15,000 and 25,000 ohms and has a weight of between 250 and 300 pounds. If a current of between 1 and 2 amperes is applied at a potential difference of between 15,000 and 50,000 volts, the temperature of the whole tie can be brought to the boiling point of water in about 5 minutes and may then be subsequently carried higher if desired, so that a considerable steam pressure is developed inside of the wood causing the water to rapidly distill away and the wood to dry in a very short time. The steam under pressure escapes through the pores of the wood, carrying with it the enclosed gases and air, and after the process is complete the wood is relatively free from cracks or checks which result from drying by most other processes. When the tie is sufficiently dry as determined by its loss of weight, it can be immersed in either hot or cold creosote oil or other preservative and left until sufficient preservative has been absorbed. Condensation of the steam in the wood as the temperature falls, causes an effective pressure amounting approximately to one atmosphere when the wood reaches atmospheric temperature, and this pressure forces the oil into the wood quickly and effectively. This absorption process may be carried out under atmospheric pressure, or at a higher pressure if it is desired.

Some woods, such for example as white oak, hemlock, Douglas fir, are very difficult to treat with preservative or fire-proofing material because of their slight porosity. These woods resist treatment because the

pores or ducts through which the oil enters the wood in the more easily treated species, are plugged by tyloses and it is not possible to apply an external pressure sufficient to force the oil into the wood without physical injury to the wood structure. By my process of heating and seasoning, it is possible to develop in the wood a high internal steam and gas pressure which disrupts the tylose plugs and thus renders the wood porous, so that it can be readily impregnated with preservative or fire-proofing material.

To prevent gross disruption of the wood by the high internal pressure developed in the heating I may place the electrodes on opposite sides of the timber and support them to resist the splitting of the wood by internal pressure. The other sides may be held between insulating retaining blocks. In the case of cross ties or similar timber, other ties or timbers may be employed as insulating retainers. In this operation the wood is heated by the electric current across the grain. The ends are thus exposed for the free exit of the steam and gases as they escape from the interior of the wood following the disruption of the tylose plugs, or other duct obstructing formations.

I have referred to the use of an electrical potential difference of the order of from 15,000 to 50,000 volts and by this I mean to imply that the exact potential difference employed is subject to considerable variation, depending upon the condition and properties of the matter being treated. This process can be carried out by the use of either direct current or alternating current, and in the case of alternating current the frequency may be of any value which produces effective heating of the material to be treated.

I have discovered that woody material dried in this manner is not only relatively free from cracks and checks, but is otherwise more durable than when dried by other processes. The electricity appears to exercise a preserving action on the woody fibers so that they are more resistant to moisture and decay.

What is claimed is:

1. The process of treating woody material containing volatile matter, which consists in establishing an electrical potential difference of the order or from 15,000 to 50,000 volts between opposite faces of a body of such material, until the temperature is such as to drive off the volatile matter.

2. The process of treating wood containing duct obstructing formations and volatile matter, which consists in establishing a high difference of electrical potential of the order of several thousand volts between opposite faces of a body of wood, and maintaining such potential difference until the rise in temperature causes the duct obstructing formations to be removed and the moisture to be expelled.

3. The process of drying a mass of wood

in its natural state, which consists in applying and maintaining without arc discharge, a potential difference of the order of several thousand volts to opposite faces of the mass at a current density sufficient to raise the temperature of the wood to the evaporation point of the moisture therein, and continuing such application until the pressure and steam generated expel the duct obstructing formations in the wood and drive off the moisture contained in the wood cells.

4. The process of treating a mass of wood in its natural state, which consists in applying a potential difference of at least several thousand volts to opposite faces of the mass and regulating such voltage to obtain a current density sufficient to raise the temperature of the mass to the evaporation point of the moisture therein, and continuing such application to obtain evaporation in the wood cells and to expel the duct obstructing formations in the wood and drive off the moisture and vapor by expiration.

In testimony whereof I have signed my name to this specification.

IRA H. DERBY.

CERTIFICATE OF CORRECTION.**Patent No. 1,899,233.****February 28, 1933.****IRA H. DERBY.**

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 52, claim 1, for "or" read "of"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of March, A. D. 1933.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.