May 3, 1932. N. F. FRIGIOLA 1,856,756

METHOD OF TREATING WOOD AND WOODEN ARTICLE PRODUCED THEREBY

Filed Dec. 6, 1928

Fig. 1

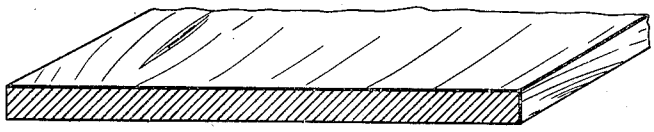


Fig. 2

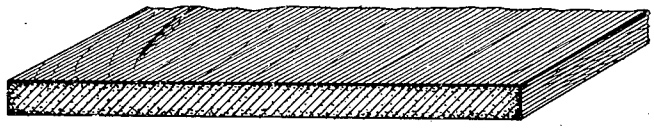


Fig. 3

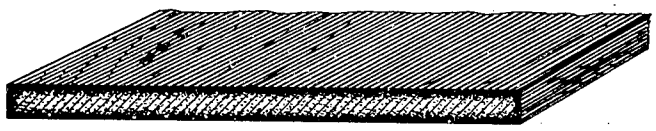
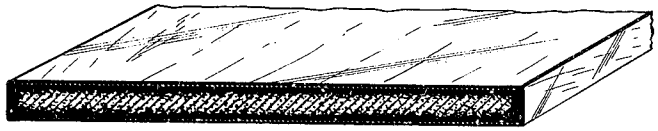


Fig. 4



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UNITED STATES PATENT OFFICE

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METHOD OF TREATING WOOD AND WOODEN ARTICLE PRODUCED THEREBY

Application filed December 6, 1928. Serial No. 324,125.

My present invention relates generally to the treatment of wood, and has particular reference to a method of rendering a wooden article non-inflammable. Coordinately, my invention relates to wooden articles generally, which have been subjected to such treatment.

It is a general object of my invention to provide a method for treating wood so as to render it capable of withstanding extreme temperatures and even direct flame, thereby providing wooden articles whose utility and value will have been obviously increased.

Another object is to provide a treatment which will not substantially affect the initial strength of the wood nor its other usual and well known characteristics upon which its satisfactory employment is predicated. Thus, a wooden article treated in accordance with my present invention has an appearance slightly different from that of the initial untreated wood but still attractive and unobjectionable.

Another object lies in providing a treatment which will produce a wooden article having a non-inflammable characteristic and having at the same time a long life while still retaining such characteristic.

A particular feature of my invention lies in a method of treatment whereby a continuing chemical action is initiated within the wood, and whereby such action is controlled in a predetermined manner. More particularly, the action is one which renders the wood non-inflammable by a process of carbonization, and the predetermined control is one wherein such carbonization is continually taking place in a retarded manner. Furthermore, the nature of the action is such that under conditions of heat, as for example when the wood is exposed to flame, an acceleration of the carbonization takes place, thereby serving to increase the non-inflammable characteristic at the very critical time when such characteristic is most needed.

Another feature of my invention lies in initiating and controlling such chemical action in such a manner that other factors which would normally increase combustibility are minimized, and conditions tending to reduce inflammability are set up.

Briefly, my invention is predicated upon the fact that carbonized wood, though not entirely unburnable, is nevertheless substantially non-inflammable and reacts somewhat as charcoal does to the direct application of flame. In other words, the wood treated in accordance with my invention will get hot and will glow under continued application of heat or flame, but will not burn with a flame, and after the heat is withdrawn, the glow will promptly die down and ultimately vanish.

Furthermore, my invention is predicated upon the capability of certain agents to carbonize carbohydrates such as the cellulose of the wood, by a process of gradual and relatively slow dehydration, the agent itself taking up the water which reduces the carbohydrate to carbon, and such water being then capable of evaporation so as to leave the agent free to continue its action.

For the attainment of the foregoing objects and such other objects as may hereinafter appear or be pointed out, I have devised a method whose general nature and effect will be more clearly understood upon reference to the accompanying drawings, in which—

Figure 1 is a cross-sectional view through a strip of wood, such as a shingle, as the same may be assumed to exist in its normal state;

Figure 2 is a similar view showing the effect of one step of my procedure;

Figure 3 is a similar view showing the effect of a further step; and

Figure 4 is a similar view showing the completely treated wooden article.

My treatment includes the step or steps of impregnating the wood with a pair of agents, one of which is capable of carbonizing the wood and the other of which is capable of retarding such carbonization. In carrying out my invention, the impregnation by the latter agent is accomplished first.

For example, the wooden article to be treated is placed in its raw unvarnished and uncoated state into a sealed container within which it is subjected, for about one hour, to

heat and vacuum treatment. Thus, the chamber or container may be heated by means of steam coils or the like, and a vacuum of about twenty-five inches of mercury may be created and sustained by means of a suitable vacuum pump. This treatment renders the wood more susceptible to thorough impregnation, drawing off a large amount of entrained moisture and air. Immediately following such treatment, the container is filled with the impregnating agent under a considerable pressure, the wooden article being completely immersed. Although almost any carbohydrate will do, I have found it preferable to employ a carbohydrate of the class which includes sugars generally, and starch. For example, ordinary commercial molasses is a satisfactory agent which not only has the proper chemical structure but which is inexpensive and of suitable liquid consistency for the contemplated purpose.

Where molasses is employed, it is subjected to a pressure of approximately eighty pounds per square inch and the wood is immersed for a period sufficiently long to effect a substantially thorough impregnation. For example, a cedar shingle which is approximately one-half inch in thickness is satisfactorily impregnated during a period of from twenty-four to forty-eight hours.

Figure 2 illustrates the condition of such a shingle after such impregnation. Although all the pores will have been substantially filled with the impregnating agent, the concentration of the latter will be somewhat greater around the marginal edges due to the fact that the impregnation has proceeded from the exterior of the article inwardly toward the interior thereof.

After the excess molasses or other carbohydrate has been drained from the chamber, the wood is again immersed in a liquid under pressure, which constitutes the carbonizing agent previously referred to. Although a number of agents may be satisfactory, provided they have the proper qualities and capabilities, I have found it preferable to employ a dilute solution of phosphoric acid. Such acid has the capability of reacting with carbohydrates, such as the molasses and the cellulose of the wood itself, to carbonize the latter by a process of dehydration. In addition, dilute phosphoric acid is capable of giving off its water and continuing its carbonizing action. Furthermore, dilute phosphoric acid is of a sufficiently clinging and nonvolatile character, and is sufficiently slow-acting, to accomplish my desired purpose in a highly satisfactory manner.

By subjecting the wood to the dilute phosphoric acid under pressure for a further period of from twenty-four to forty-eight hours, I have found that a carbonization will have taken place in an inwardly progressing manner from the exterior to the interior of the wooden article. In Figure 3 I have illustrated the approximate nature of the wood after such treatment. The wooden article is almost black adjacent to its exposed surfaces, this blackness representing an almost completed carbonization of the cellulose of the wood and the carbohydrate carried thereby. With a thirty per cent solution of phosphoric acid applied under a pressure of approximately eighty pounds for a period of from twenty-four to forty-eight hours, this almost black condition extends inwardly for approximately one-sixteenth of an inch. Beyond this, the color of the wood varies gradually from the almost black condition to an almost unaffected condition at the interior, representing various stages of carbonization due to the inwardly progressing action of the impregnating acid.

After draining the excess acid, I allow the wooden article to dry in air for approximately twenty-four hours and I have found it then to embody a comparatively smooth black surface which creates an oily sensation to the touch.

The final step in my method of treatment is illustrated in Figure 4, and consists in coating the entire wooden article with a suitable pigment, preferably a fire-resistant paint capable of drying in air.

The completed article has an attractive appearance practically identical with that of an untreated wooden article of the same character. Tests have proven that its various qualities of strength remain practically the same as those of an untreated article. Furthermore, its possibility of employment in the usual manner has not been impaired.

At the same time, drastic tests have demonstrated that the treated article is not inflammable. Upon subjecting the article to actual flame for even a considerable period, it has been caused to glow in the limited area subjected to the flame, such glow continuing as long as the flame is retained and rapidly diminishing after the flame has been removed Thereafter, the area which glowed is found to have become blackened, but otherwise, the article remains intact and suitable for continued use.

Although the chemical action underlying the successful accomplishment of the foregoing desirable results is no doubt of a rather complicated nature, I have been led to believe by investigation and tests that an action or actions somewhat as follows are at the basis of such result.

The molasses is a non-drying viscous material which is itself unreactive toward the wood and which fills in the pores of the wood, thereby eliminating its air content. The elimination of the air is one factor which diminishes the usual inflammability which would otherwise be present. Secondly, the molasses is a substance which is itself

carbonizable similar to the cellulose of the wood itself. In the third place, the molasses acts as an agent which retards carbonization under ordinary conditions and which facilitates a rapid increase of carbonization under heat or fire conditions.

The phosphoric acid is a non-volatile substance having a clinging capability which insures its constant presence over long periods of time. It is a carbonizing agent and is constantly acting upon the cellulose of the wood and the molasses to dehydrate and carbonize the latter. The water which the acid takes up dilutes the latter and diminishes its capability of further carbonization unless it is evaporated.

The pigment or similar outer coating excludes the atmosphere from the article and thereby serves to prevent evaporation of water from the acid under normal conditions. Such evaporation takes place, however, in a continuous but comparatively slow manner so that carbonization is continuously taking place in an inwardly progressing slow manner.

As soon as the article is subjected to heat or flame, the outer coating will in all likelihood crack, thereby exposing the impregnated wood. This exposure coupled with the presence of heat will accelerate the evaporation of water from the phosphoric acid, and this will in turn speed up the carbonization. The more heat that is applied, the more evaporation of water will take place and the more carbonization will be accomplished. As a result, creation of flame is absolutely prevented, the carbonized material being, in the worst case, caused to glow and to continue to glow. The action of any flame or heat is therefore localized, and after it has been withdrawn, the article may be recoated with a suitable pigment and continued in use. In the worst case, it may be completely replaced, but damage to adjacent articles, such as shingles, will be totally avoided.

In the light of the foregoing, the function of the molasses will be clear. In addition to eliminating air content, it retards rapid carbonization of the entire article which would take place if the molasses were not present. Such retardation causes the wooden article to retain its original strength for considerable periods of time. Furthermore, it provides for an increase of carbonization under the very conditions of fire during which such carbonization is most desired.

It will be obvious that changes in the details herein described and illustrated may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended that these details be interpreted as illustrative and not in a limiting sense.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is—

1. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood with a pair of agents, one of which is a non-volatile, hygroscopic acid of the character of dilute phosphoric acid capable of carbonizing the wood by dehydration thereof, and the other of which is a carbohydrate of the class wherein the hydrogen and oxygen are present in the proportion of 2 to 1, and which is itself carbonizable like the wood by said acid and capable of filling in the pores of the wood to retard the inwardly progressing carbonization.

2. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood with a viscous liquid carbohydrate of the class wherein the hydrogen and oxygen are present in the proportion of 2 to 1, and which is adapted to fill in the pores of the wood, impregnating the wood with a non-volatile, hygroscopic acid of the character of dilute phosphoric acid capable of carbonizing both the wood and the carbohydrate by dehydration, and coating the wood with an impervious pigment which normally prevents evaporation of water from said acid.

3. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood first with a sugar and then with a hygroscopic, non-volatile liquid agent of the character of dilute phosphoric acid capable of slowly carbonizing both the wood and the sugar by dehydration thereof.

4. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood first with a sugar and then with a hygroscopic, non-volatile liquid agent of the character of dilute phosphoric acid capable of slowly carbonizing both the wood and the sugar by dehydration thereof, and then coating the wood with an impervious layer which normally prevents evaporation of water from said hygroscopic agent and thereby retards said carbonization.

5. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood first with a sugar and then with a dilute non-volatile acid capable of slowly carbonizing both the wood and the sugar by dehydration of the latter.

6. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood first with molasses and then with a dilute non-volatile acid capable of slowly carbonizing both the wood and the molasses by dehydration of the latter.

7. The herein described method of treating

wood to render it non-inflammable, which comprises the step or steps of impregnating the wood first with molasses and then with dilute phosphoric acid, whereby the latter will slowly dehydrate the wood and the molasses to carbonize the latter, and whereby such action of the acid will be accelerated under heat due to the accelerated evaporation of water from the acid.

8. The herein described method of treating wood to render it non-inflammable, which comprises the step or steps of impregnating the wood first with molasses and then with dilute phosporic acid, and then coating the wood with a fire-resistant pigment, whereby the acid will slowly dehydrate the wood and the molasses to carbonize the latter, and whereby such action will be retarded by the pigment due to prevention by the latter of evaporation from the acid.

9. A wooden article impregnated with molasses which fills in the pores of the wood, and with dilute phosphoric acid, the latter being relatively concentrated adjacent to the surface of the article and adapted to slowly carbonize the wood and the molasses from said surface to the interior of the article.

10. A wooden article impregnated with a viscous liquid carbohydrate of the class which includes sugar, molasses, and starch, said carbohydrate filling in the pores of the wood, said wooden article being also impregnated with a dilute non-volatile acid adapted slowly to carbonize both the wood and the carbohydrate, and an impervious coating enveloping said impregnated article.

11. A wooden article impregnated with a viscous liquid carbohydrate of the class wherein the hydrogen and oxygen are present in the proportion of 2 to 1, and which fills in the pores of the wood, and with a dilute, non-volatile, hygroscopic carbonizing acid, the latter being relatively concentrated adjacent to the surface of the article and capable of inwardly and progressively slowly carbonizing the wood and the entrained carbohydrate by dehydration thereof.

In witness whereof I have signed this specification this 22d day of November, 1928.

NICHOLAS F. FRIGIOLA.