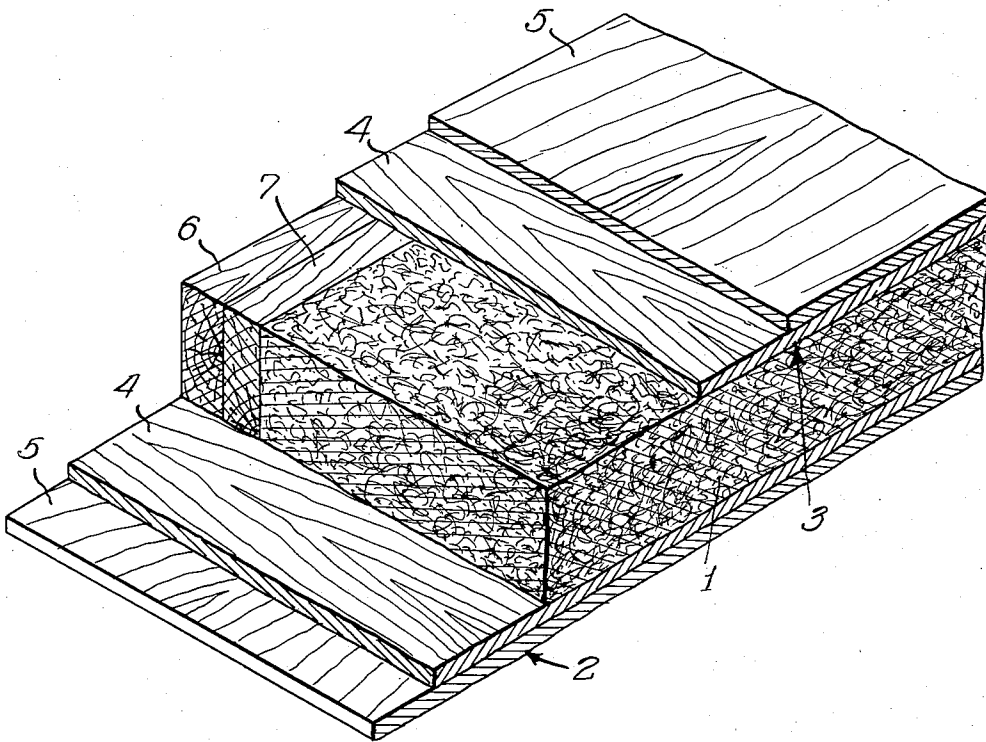


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L. A. ROPELLA

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FIREPROOF DOOR CORE OF PHENOL FORMALDEHYDE, WOOD
CHIPS AND DIAMMONIUM PHOSPHATE
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INVENTOR.
Leonard A. Ropella,
BY *George F. Haight &*
George H. Simmons
Attys

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FIREPROOF DOOR CORE OF PHENOL FORMAL- DEHYDE, WOOD CHIPS AND DIAMMONIUM PHOSPHATE

Leonard A. Ropella, Marshfield, Wis., assignor to Roddis
Plywood Corporation, Marshfield, Wis., a corporation
of Wisconsin

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3 Claims. (Cl. 260—17.2)

This invention relates to fireproof panels and has for its principal object the provision of a new and improved device of this kind.

This application is a continuation-in-part of my co-pending application Serial No. 293,878, filed June 17, 1952 now abandoned.

It is a main object of the invention to provide a fireproof panel composed of wood and incorporating a plurality of layers or plies at least one of which is fireproofed.

Another object of the invention is to provide a fireproof panel door faced with plies of wood capable of being finished in harmony with the surroundings in which the door is to be used.

Another object of the invention is to provide a fireproof panel core composed mainly of waste wood, such as chips.

Another object of the invention is to provide a fireproof panel core composed of wood chips and a binder and compressed to a final density greater than the density of the wood in the chips, and to a final density greater than the sums of the densities of the ingredients in the core.

Further objects of the invention not specifically mentioned here will be apparent from the detailed description and claims which follow, reference being had to the accompanying drawing in which a preferred embodiment of the invention is shown by way of example and in which:

The single figure of the drawing is a perspective view of a section of a fireproof panel door incorporating the teachings of the invention with parts cut away for clarity.

Fireproof panels, such as doors, wall or partition facing panels and the like, to meet the requirements of the Underwriters Laboratory, must not fail when subjected to flames rising to 1700° F. during a period of one hour, during which the temperature on the cool side of the panel must not rise more than 250° F. from the original room temperature. While some warpage of a panel during this test is permitted, such warpage must not exceed a distance equal to twice the thickness of the panel. Furthermore, after the completion of such a test, the panel must withstand the impact of water from a hose located twenty feet away and at thirty pounds nozzle pressure for one minute without disintegration of the panel.

In the prior art of which I am aware, numerous efforts have been made to construct a door for use in homes, hospitals, public buildings and the like, which will qualify as a fireproof door under Underwriters' specifications and at the same time present a harmonious appearance with its surroundings. Such doors or panels must be faced with a finish lumber and plywood lends itself readily to such use, the facing ply being composed of finish wood that accepts finishes to harmonize with the surroundings in which the panel is to be used.

In the manufacture of plywood veneered panels and the

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like, there is accumulated at the mill substantial quantities of chips and sawdust which are usually burned in the boiler plant of the mill to supply steam and power needed in the operations. Most generally the accumulation of such waste material exceeds the requirements of the boiler house for the production of useful steam and consequently the boilers are operated inefficiently and much of the material is dissipated as unburned carbon in smoke rising from the chimney.

The present invention seeks to utilize such waste material in the production of fireproof cores for doors, panels and the like.

The waste material most readily available to applicant was wood of density between 0.38 and 0.40, and from this material a number of experimental panels were made. The wood was run through a chipper and then sized on shaker screens, with only the chips which passed through a ½" mesh screen and retained upon a ¼" mesh screen being used. The chips thus prepared were mixed with a thermosetting binder in amounts varied from test to test, and with a fireproofing agent likewise varied in amount. The mixture was then placed in a suitable mold and subjected to heat high enough to set the binder and to pressure sufficient to form a desired density in the finished material. The cores thus formed were finished to desired dimensions and facings were applied to complete the panel.

As will be seen in the drawing, the core 1 is provided with facing plies 2 and 3 each of which consists of a cross band member 4, the grain of which extends transversely of the panel, and a facing panel 5 composed of a finish wood such as walnut, mahogany, oak or birch, disposed with its grain running longitudinally of the panel. The cross band plies 4 may be somewhat thicker than the facing plies 5 and are composed of a wood selected for its physical characteristics, including strength, rather than for its ability to accept a finish.

Panels constructed as above, when subjected to the tests specified by the Underwriters Laboratory, performed as follows:

Example 1

Core:

Wood chips ½-¾" mesh—initial density 0.38-0.40
Binder—phenol formaldehyde 8% of weight of chips
Fireproofing—none
Cure—35 minutes at 350° F.—pressure to form core density of 0.60
Finish thickness—1½ inches

Facing:

Cross ply—¼ inch
Face ply—½ inch
Test: Subjected to flames building up to 1700° F. in 60 minutes
Results:
Temperature on cool side rose 250° F. in 54 minutes
Failure by too rapid temperature rise
Condition at end of test: Considerable warpage—some burn through near edges—practically the entire core was charred

Example 2

Core:

Wood chips as in Example 1
Binder—as in Example 1
Fireproofing—diammonium phosphate crystals 5% of weight of chips
Cure—as in Example 1—density 0.60
Facing: As in Example 1
Test: As in Example 1
Results: Temperature on cool side rose 250° F. in 62 minutes

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Condition at end of test:

Warpage a little less than Example 1

No burn through—charring of core less than Example 1

Panel withstood hose test

The tests on the panels of Examples 1 and 2 show that the addition of a fireproofing material such as diammonium phosphate crystals slows up the temperature rise on the cool side of the panel, reduces charring of the core and burn through noticeably, but produces but little reduction in the tendency of the panel to warp.

In effort to reduce warping, test panel #3 was constructed.

Example 3

Core:

Wood chips—as in Example 1

Binder—as in Example 1

Fireproofing—diammonium phosphate crystals 10% of weight of chips

Cure—as in Example 1—density 0.64

Facing: As in Example 1

Test: As in Example 1

Results: Temperature on cool side of panel rose 250° F. in 63.5 minutes

Condition at end of test:

Warping showed a little improvement

No burn through

Panel withstood the hose test

Increasing the fireproofing crystals from 5% to 10%, and increasing the density to 0.64, lengthened the time required for a 250° F. temperature rise on the cool side of the panel. Warping was decreased a little but was still greater than desired.

To determine the effect of increasing the amounts of both the binder and fireproofing crystals, additional tests were run.

Example 4

Core:

Wood chips—as in Example 1

Binder—phenol formaldehyde—10% of weight of chips

Fireproofing—diammonium phosphate crystals 12% of weight of chips

Cure—as in Example 1—density 0.61

Facing: As in Example 1

Test: As in Example 1

Results: Temperature on cool side rose 250° F. in 60 minutes

Condition at end of test:

Outer ½ inch on cool side showed no charring—remainder charred but intact—warping increased

The hose test was passed successfully

Notwithstanding that the amounts of binder and fireproofing crystals were increased, the rate of temperature rise on the cool panel and warping both increased. Believing that the low density might be responsible for this result, the test was repeated.

Example 5

Core: Formula as in Example 4, with density increased to 0.62

Facing and test: As in Example 4

Results: Temperature on cool side rose 250° F. in 62.75 minutes

Condition at end of test:

Outer ½ inch on cool side showed no charring—remainder charred but intact

Warping less than in Example 4

Hose test passed successfully

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Example 6

Core: Formula as in Example 4, with density increased to 0.64

Facing and test: As in Examples 4 and 5

Results: Temperature on cool side rose 250° F. in 63.5 minutes

Condition at end of test:

Outer ½ inch on cool side showed no charring—remainder charred but intact

Warping less than in Example 5

Hose tests passed successfully

From the results of tests 4, 5 and 6, it appears that an increase in density increases the length of time required for a temperature rise of 250° F. on the cool side of a panel and decreases the tendency of the panel to warp. With the kind of waste wood available for use in such panels, which wood has a density of 0.38–0.40, a density of 0.64 is maximum that can be obtained on a commercial scale in the production of panels for doors and the like. Even with a density in the core of 0.64, the panels under test showed a tendency to warp that was greater than desired.

It was postulated that by adding an inert mineral filler, such as clay or bentonite, to the core, in lieu of a part of the wood chips therein, a higher density might be obtained without substantially increasing any of the other ingredients, and that such a panel would retain the desirable characteristic of slow temperature rise on the cool face and would not warp as much as the previous samples. To this end, Example 7 was run.

Example 7

Core:

Wood chips ½–¾" mesh—wood density 0.38–0.40
Binder—phenol formaldehyde—8% of weight of chips

Fireproofing—diammonium phosphate crystals—15% of weight of chips

Inert mineral filler—15% of weight of chips

Cure—35 minutes at 350° F.—pressure to form core density of 0.70

Facings:

Cross ply 1/20 inch

Face ply 1/20 inch

Test: Subjected to flames building up to 1700° F. in 60 minutes

Results—Temperature rise on cool side in 60 minutes was 200° F. There was no warping of the core and no charring at the edges of the panel. The hose test was passed successfully.

Thus by adding an inert mineral filler such as clay to the core, the rate of rise of temperature on the cool side of the panel was decreased to such an extent that at the end of a 60-minute test the temperature rise was but 200° F. which is well below the allowable maximum of the Underwriters' specifications. Warping was virtually entirely eliminated and there was no burn through or charring at the edges of the sample.

Phenol formaldehyde resins, commonly known as Bakelite, with wood fillers, are known to char without melting or flaming. Diammonium phosphate is well known as a fire-proofing agent acting when subjected to temperatures to release ammonia. The combination of the two elements in the formation of the cores as above releases some of the ammonia when the core is subjected to temperatures sufficiently high to set the resin. It is postulated that at least a part of the ammonia so released permeates the wood and resin, thereby enhancing the fireproof qualities of the product.

The cores of the present invention produce results that are more than the mere sum of the results to be expected from the individual ingredients. The addition of an inert mineral filler and compression of the core to a density greater than the densities of the ingredients, enhances the resistant properties. The core will char under the heat

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of the flames on test, but the coherence of the ingredients is high enough to maintain the core intact even though charred, and to have sufficient strength to withstand the impact of water in the hose test. The uncharred portion of the core adjacent the facing on the cool side of the panel, and that facing, add to the strength of the panel. The core shows very little or no warping.

From the foregoing, it will be apparent that through the teachings of the invention waste materials heretofore disposed of by burning are utilized in the formation of a fireproof core for panels and doors, which exceeds the minimum requirements of the Underwriters Laboratory for a rating of fireproof. A highly satisfactory product is thus obtained.

While I have chosen to illustrate my invention by showing and describing a preferred embodiment of it, I have done so by way of example only, as there are many modifications and adaptations which can be made by one skilled in the art within the teachings of the invention.

Having thus complied with the statutes, and shown and described a preferred embodiment of my invention, what I consider new and desire to have protected by Letters Patent is pointed out in the appended claims.

What I claim is:

1. A rigid core for fireproof doors and panels comprising wood chips of $\frac{1}{2}$ to $\frac{3}{8}$ inch mesh having a density

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between 0.38 and 0.40; a thermosetting phenol formaldehyde condensation product binder amounting to 8% of the weight of the chips; inert mineral filler from the group consisting of clay and bentonite amounting to 15% of the weight of the chips; diammonium phosphate crystals amounting to 15% of the weight of the chips, said core after setting of the binder having a density of 0.70.

2. A rigid core for fireproof doors and panels comprising: chips of wood of density between 0.38 and 0.40; a thermosetting phenol-formaldehyde condensation product binder in amount of from 8-10% of the weight of the chips; bentonite amounting to 15% of the weight of the chips; diammonium phosphate crystals in amount of from 5-15% of the weight of the chips; which core after setting of the binder has a final density of 0.70.

3. A core as specified in claim 2, in which the wood chips are small enough to pass through a one-half inch mesh screen and large enough to be retained upon a one-eighth inch mesh screen.

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