Aug. 16, 1932. P. G. VON HILDEBRANDT 1,872,533

PROCESS OF MAKING WOOD FIBER INSULATING MATERIAL

Filed Nov. 20, 1928

Fig. 1.

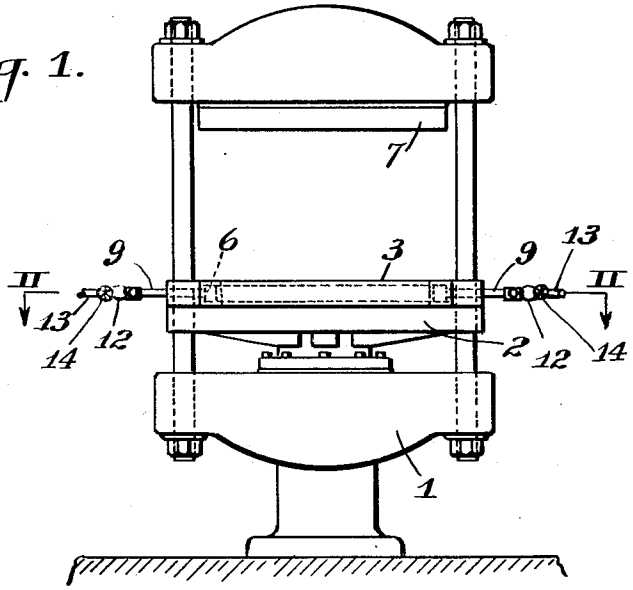



Fig. 3.

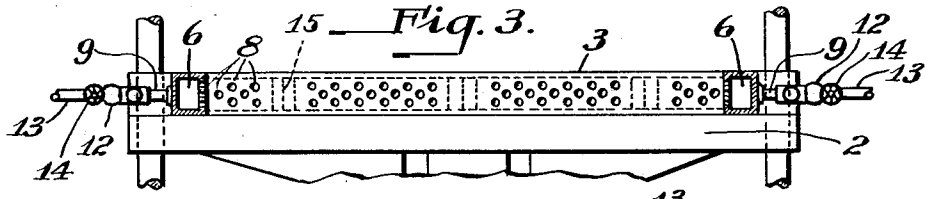
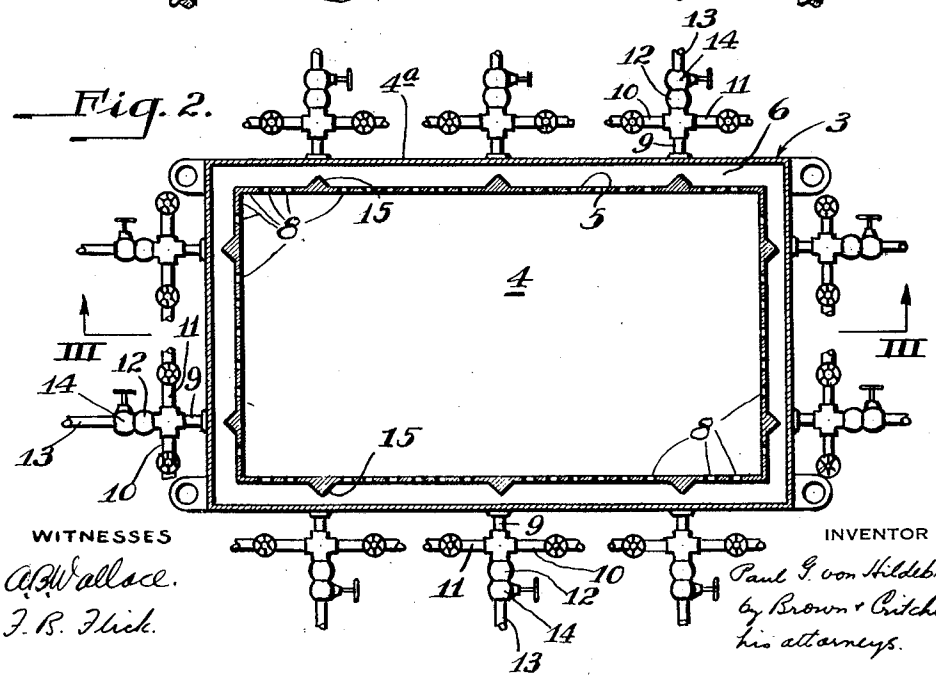



Fig. 2.




WITNESSES

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# UNITED STATES PATENT OFFICE

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## PROCESS OF MAKING WOOD FIBER INSULATING MATERIAL

Application filed November 20, 1928. Serial No. 320,603.

The invention relates to porous articles formed from cellulose fiber, and especially to insulation board formed from pure cellulose fibers chemically prepared from wood.

An object of the invention is to provide a highly porous article composed of cellulose fiber, which is light, strong and of substantially uniform density throughout, is highly porous and a good insulating material, and which is of grainless and uniform structure.

A further object is to provide fiber board of the type referred to which consists of substantially pure cellulose fiber chemically prepared from wood, and which is made without binder of any kind.

Still another object is to provide a process of forming cellulose fiber into board without binder, to produce a coherent, light, highly porous board of the type referred to, which is especially adapted for insulating purposes.

The invention may be described in connection with the accompanying drawing in which Fig. 1 is a front elevation of a press used in the practice of the invention; Fig. 2 a horizontal section through the die taken on line II—II, Fig. 1; and Fig. 3 is a vertical section of the die taken on line III—III, Fig. 2.

Fiber board is usually made by flowing a fiber pulp over a screen or other foraminous structure which permits the water to flow away as quickly as the pulp is applied, and the felted mass is then compacted, in a press or between rolls. The water flows away rapidly as the pulp runs on the screen, or on the mat built up thereon, and the fibers are consequently deposited at random, and lie more or less upon one another. Thus they do not have an opportunity to intermesh, and the article formed would be weak. For this reason the common practice heretofore has been to artificially bond the fibers. This has been accomplished by using fiber containing some of the gums or other naturally occurring incrustants which were not removed in fibration, or various binders were added to the fiber. In either case, the material is heated during pressing to coalesce the binder and bond the fibers.

The use of binders in boards of this type is disadvantageous, partly because the binder tends to increase the density and reduce the insulating power. Also, some of the binders, and especially some of the residual matters in impure fiber, are attractive to rodents or other vermin, which eat these substances and thus destroy the integrity of the board. And in the case of many binders, the application of wet plaster, or accumulation of moisture by "sweating" or in other ways, tends to soften the binders and impair the strength and stiffness, or other properties, of such boards.

I have found that by uniformly suspending a suitable fiber in an inert suspending medium, such as water, in a closed die, and while thus suspended, expressing a major portion of the water and compacting the fiber, there is produced a highly porous insulating board of superior quality without the use of any binder, and without heating during the board-forming operation. Preferably the suspension of fiber does not entirely fill the die, and air is forced into the die under pressure before compacting begins, this step assisting in the production of the improved board.

The benefits of this invention are apparently due to a uniform and regular distribution of the longer and shorter fibers, which are positioned in all directions in the suspension. The suspending medium may be considered to act as a matrix supporting the fibers in that manner, and as it is progressively expressed in the compacting operation, the fibers to a large extent retain the suspended distribution. Consequently, the fibers are mechanically entangled to a high degree, and the longer fibers, disposed in all directions, form a supporting framework, and produce a highly porous, resilient, interlocked structure.

Wood fiber is preferably used in the practice of this invention, and it is preferred to use substantially pure cellulose fibers prepared in accordance with the fibration process disclosed and claimed in a copending application, Serial No. 320,601, filed by me November 20, 1928, now Patent No. 1,803,443, issued May 5, 1931. In accordance with that

process, wood of any kind, and especially wood waste, including bark and other parts which are normally refuse so far as making pulp is concerned, is first treated to incipiently attack the incrustants and open the grain, preferably by digestion with milk of lime. As thus softened, the wood is digested with a reagent to remove the balance of the incrustants, preferably caustic soda, while maintaining it compact by means of mechanical pressure. The fiber produced is soft, strong and long, the majority of the fibers retaining their natural length. Because of these characteristics, this fiber is preferred, but fiber produced in other ways may be used if desired, it being understood that the benefits of the invention arise in part from the use of raw material containing a proportion of long fibers.

In the preferred practice of the invention the fiber suspension is formed in a pressing die adapted to retain the suspending medium until forcibly expressed by the action of the press. This may be done in various forms of apparatus, but that shown in the accompanying drawing is preferred.

The apparatus shown comprises a commonly used form of press, indicated generally by the numeral 1, provided with a vertically movable ram-operated table 2 which carries a die 3. This die comprises a box-like pressing chamber 4 formed between inner walls 5 integral with the base. An annular conduit 6 surrounds the inner walls 4. In pressing, a platen 7, connected to the head of the press, cooperates with the die to close chamber 4, preferably by making a fluid-tight sliding fit with inner walls 4. The inner walls are provided with a plurality of perforations 8 to permit passage of fluid between the chamber and conduit, and preferably small enough to retain fiber.

The die is provided with fluid outlets operative only at a predetermined pressure, and also with means for the introduction of suspending medium and air into the die. These means are preferably combined, in the manner shown in Fig. 2. To this end the outer walls 4*a* of conduit 6 are tapped and threaded to receive a plurality of regularly spaced nipples 9, three being arranged on each side and two on each end in the die shown. By means of suitable fittings, the nipples are connected to valved air supply pipes 10, and valved water supply pipes 11, this liquid being preferably used to suspend the fiber. Each nipple is also provided with a pressure-responsive fluid outlet valve 12, which preferably consists of a spring-impelled one-way valve connected to a drain pipe 13. A gate valve 14 may be inserted in pipes 13 if desired. The outlet valves are selected to prevent fluid from escaping from the pressing chamber until the pressure created in compacting the fiber reaches the proper point.

In order to uniformly float the fiber in the die, when the suspending medium is introduced, baffles 15 are formed on walls 5 inside conduit 6 opposite nipples 9, so that water or other fluid entering the conduit is deflected and uniformly distributed.

In the preferred practice of the invention, the die and platen are not heated. A charge of moist fiber, preferably containing about 25 per cent of water, is placed in chamber 4. The table and die are raised to bring platen 7 into the chamber to close the die, and water at tap temperature is introduced into the chamber from pipes 11. The water, being uniformly distributed by the baffles, floats the fiber mass in chamber 4, and uniformly suspends and distributes the individual fibers. When the fiber has been properly suspended, the water is shut off, and compressed air is introduced from pipes 10. As soon as the pressure is equalized, the air is cut off, and the press is operated to progressively bring platen 7 further into the die. As the platen moves into the die, the pressure is increased, and valves 12 open to permit water and air to escape, and at the same time the fibers are compacted. The press is operated to express the major portion of the water in forming a board of the desired thickness, and in general it is desirable that the pressed board retain about 30 per cent of moisture.

The moist, pressed boards are removed from the die and dried at about 100° C., the drying being conducted so as to prevent warping of the boards. Because of the structure described hereinabove, and because of the large amount of water removed from the board in drying, a highly porous structure is obtained.

The boards produced in accordance with the invention are characterized by possessing a uniform, grainless structure, in which the fibers are quite regularly distributed, and in which they lie in all directions, so that the board has substantially the same strength in all directions. Also, it is of practically uniform density throughout. The boards are stiff and strong enough for all insulating purposes. For the reasons previously explained, these boards are highly porous. The long fibers are supported in all directions, and are locked among themselves and by short fibers. This produces a resilient construction, which is desirable. Owing to the great porosity of these articles, they are superior, both for sound and heat insulating purposes, to the materials commonly used.

No binder of any kind is used in the production of these boards. That is, they do not contain added binder, and no use is made of natural binder. In fact, as previously explained, it is preferred to use pure cellulose fiber which is substantially free from incrustants. For this reason there is no tend-

ency for the board to weaken, and the profound entanglement of long and short fibers alone gives great coherence.

It will be understood that the invention is not limited to the production of flat boards, nor to the apparatus described, and that the form shown can equally well be used by making the platen movable instead of the die.

Material described but not claimed herein is claimed in separate applications copending herewith.

I claim:

1. A process of forming porous insulating board from wood fiber comprising placing moist fiber in a cold closed die provided with a movable platen, partially filling the die with cold water to uniformly distribute the fiber, injecting air under pressure into the die, and applying pressure to the contents of the die by said platen to express a portion of the air and water and compact the fiber to form a board of the desired thickness, said board as thus pressed containing about 30 per cent of water, and the fibers being bonded only by mechanical entanglement.

2. A process of preparing porous insulating board from chemical wood fiber comprising placing the fiber in a cold die provided with fluid outlets effective only at a predetermined pressure, and having a movable platen, partially filling the die with cold water, injecting air into said die, and operating said platen to apply pressure to the contents through the air space above said water to express the major portion of the water and air and compact the fibers to form a board of the desired thickness, said board being of substantially uniform density, grainless and being bonded only by mechanical entanglement of the fibers.

3. A process of forming porous insulating board from pure cellulose fiber chemically prepared from wood, comprising placing moist pulp composed of fibers of varying length in a cold die provided with fluid outlets effective only at an elevated pressure and closed at the top by a vertically movable platen, injecting water into the die to suspend and uniformly distribute the fibers, the amount of water being insufficient to fill said die, injecting air into the die, and while thus suspended depressing the platen to express the major portion of the water and air from said outlets and to compact the fibers, said board being bonded solely by mechanical entanglement of the fibers and being of uniform density and grainless structure.

4. A process of forming porous cellulose fiber insulating board, comprising forming a uniform free suspension of said fiber in water in a closed die, injecting air under pressure into said suspension in the die, and while thus suspended mechanically expressing the major portion of said water and air and compacting the fiber to form a board of the desired thickness in which the fibers are bonded solely by mechanical entanglement.

5. A process of forming porous cellulose fiber insulating board, comprising placing moist fiber in a cold closed die, partially filling said die with cold water and injecting air under pressure to form a uniform free suspension of said fiber therein, and mechanically expressing a portion of the water and air from the suspension in the die and compacting the fiber to form a board of the desired thickness containing about thirty per cent of water as thus formed, the fibers in the board being bonded solely by mechanical entanglement.

In testimony whereof, I hereunto sign my name.

PAUL G. VON HILDEBRANDT.