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Filed Jan. 13, 1934

2 Sheets-Sheet 1

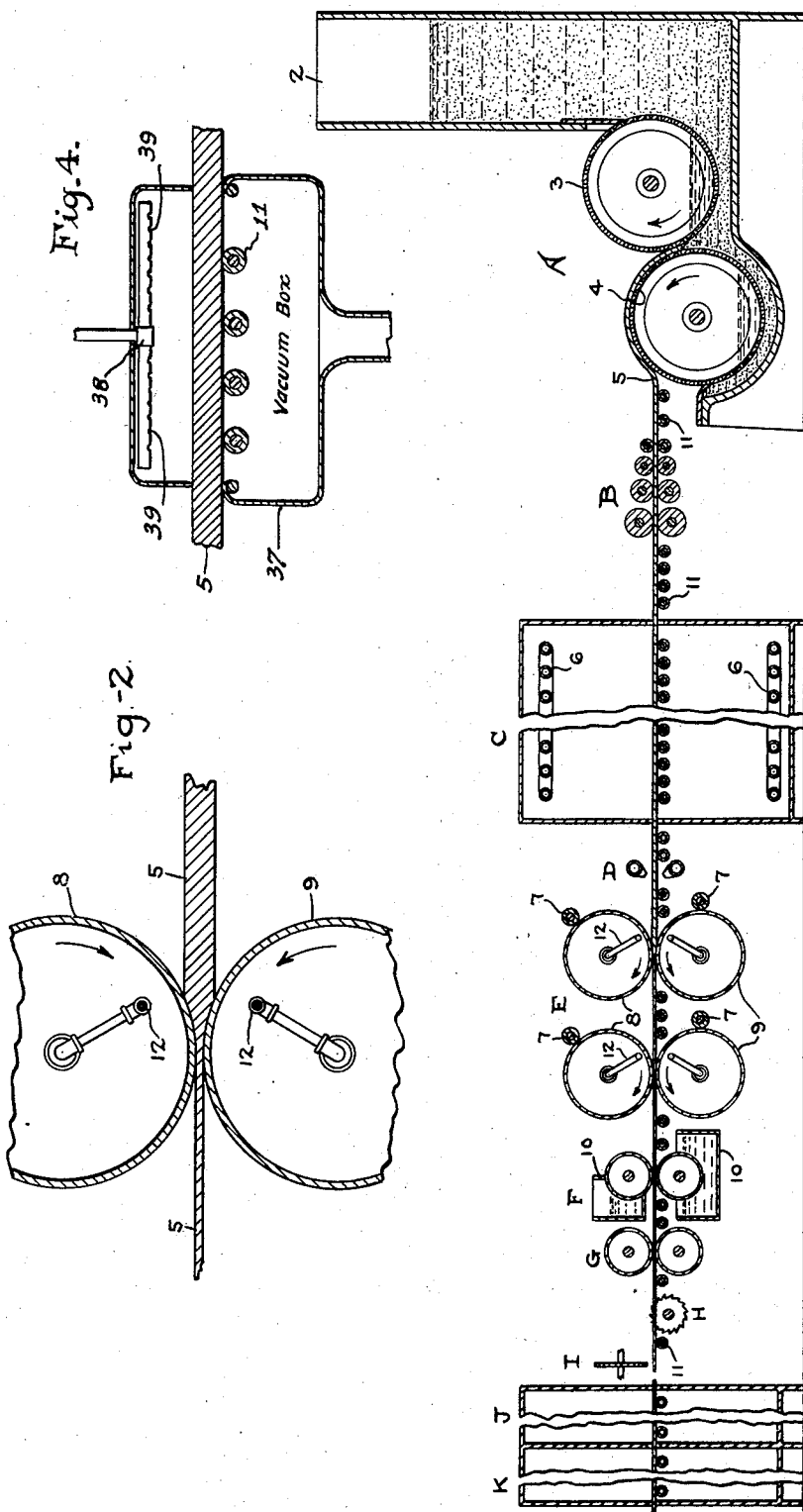


Fig. 1.

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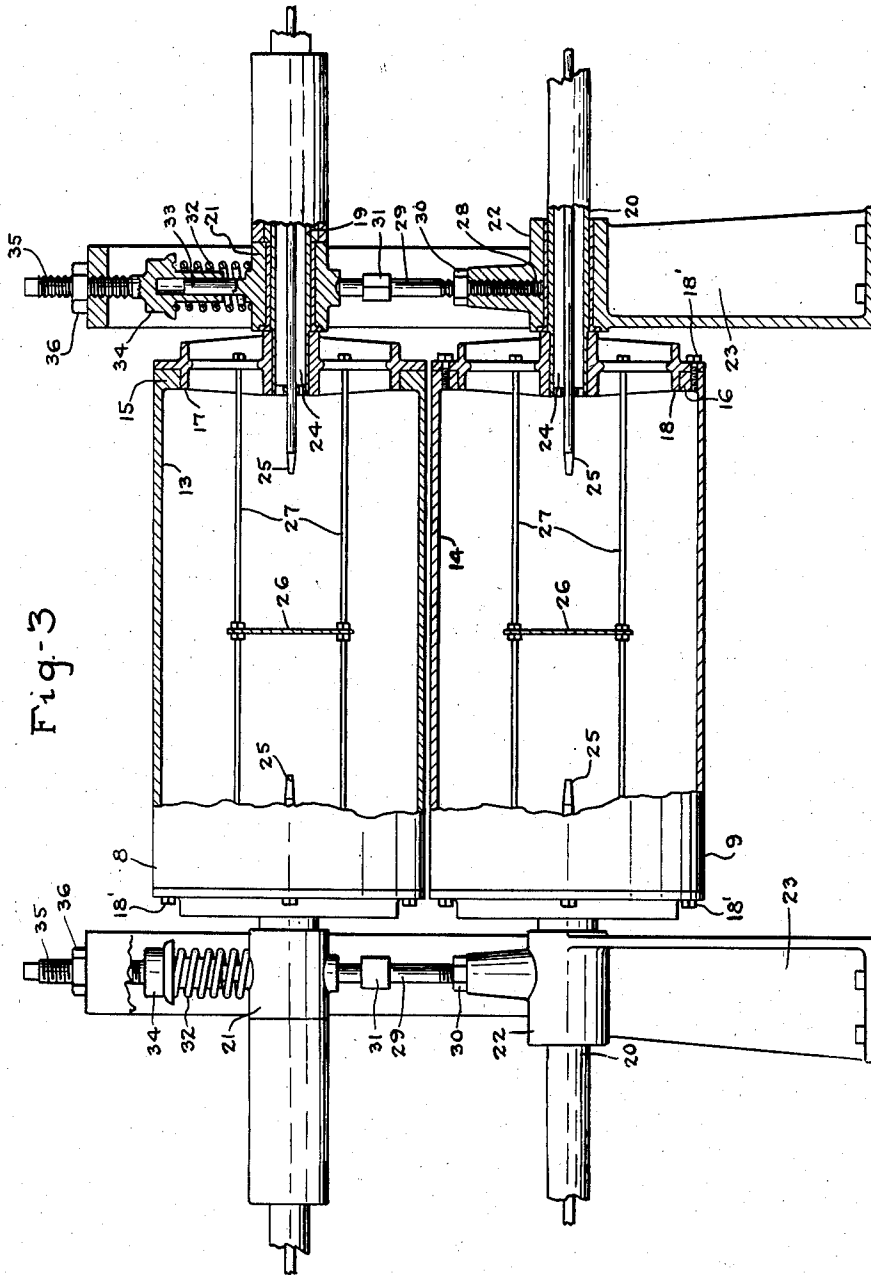
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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APPARATUS FOR AND PROCESS OF MAKING SYNTHETIC PRODUCTS

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Application January 13, 1934, Serial No. 706,555

22 Claims. (Cl. 92—21).

This invention relates generally to an apparatus for and process of making synthetic products which are hard, stiff, board like and particularly to board like bodies which have high tensile strength, which are highly non-water absorbent and which have a small coefficient of expansion in the presence of moisture.

Another object of the invention is in making of composition boards or sheets adapted for use in construction of buildings and for various other purposes.

A further object of the invention is to provide an improved process of forming composition boards or sheets from fibrous pulp stock which consists in subjecting the fibrous pulp stock to elements to form a web, subjecting the web to pressure to remove surplus fluid, applying heat and pressure to compact and unite the fibrous web, severing the web transversely and subjecting the severed portions to cooling.

A further object is to provide an apparatus of the class described including heated pressing rolls which receive the fibrous web and compact it into a hard, stiff, water resistant body.

A further object of the invention is the production of synthetic bodies which are evenly colored and of a uniform thickness.

A further object of the invention is the continuous production of a sheet of the type described in any desired length, width and thickness.

The invention relates to the production of hard, stiff bodies by first forming from fibrous pulp stock a continuous web or sheet, squeezing the surplus moisture from the web or sheet, passing the web through a drier to dry the web, passing the web through heated rolls to compact and unite the web into a homogeneous body, trimming or severing the sheet longitudinally, severing the web into any desired length, and passing the severed portions through cooling apparatus from which the finished product is removed.

The invention also relates to the production of an endless sheet from fibrous pulp stock, passing the fibrous sheets through squeezing rolls to remove surplus moisture, passing the wet sheet through rolls to dry, compact and unite the fibrous sheet into a hard, stiff, water resistant body, severing the body into any desired length and width, passing the severed portions through humidifying and cooling means to complete the operation.

The invention also relates to making fibrous products which will not be attacked by insects, fungi and the like.

In carrying out the process water proofing material may be added to the fibrous pulp so that

the finished products will have greater water resistant qualities. The water proofing material may be either vegetable or mineral oils. The water resistant material is preferably mixed with the fibrous pulp stock but it may be added to the sheet after it is formed and so far as this process is concerned it is not material at what time the water resistant material is added.

And still further object of the invention is to provide an improved method and apparatus by which synthetic bodies may be produced efficiently, economically and continuously. By the use of the improved method and apparatus none of the apparatus is permitted during the manufacture to remain idle.

If desired the hard sheet may be tempered and the tempering material may be forced into the sheet by the use of heated rolls but it is to be understood that the tempering may be done without the use of the heated rolls although it has been found preferable to use such rolls.

When the fibrous sheet is dried prior to pressing it has been found highly desirable to spray the surfaces of the sheet with water just prior to the introduction into the heated pressing rolls.

Satisfactory hard, water resistant board may be produced without spraying the surface of the dried sheet.

With the foregoing and other objects in view the invention consists of the novel construction, combination and arrangement of parts hereinafter more specifically described and illustrated in the accompanying drawings wherein is shown embodiments of the invention and also in the novel steps of the process herein-after to be more fully described but it is to be understood that changes, variations and modifications may be resorted to which fall within the scope of claims hereunto appended. In the accompanying drawings which illustrate embodiment of invention and form a part of the specification:

Figure 1 is a view diagrammatically illustrating an apparatus for making composition boards or sheets and includes a felting machine, squeezing rolls, drier, pressing means severing devices, humidifying and cooling devices.

Figure 2 is a sectional view of the rotative pressing members with portion broken away showing a fibrous sheet passing there-through.

Figure 3 is a view of the pressing rolls, with part broken away, illustrating one means of heating.

Figure 4 is a view diagrammatically illustrating vacuum means for incorporating toxic agent into a wet formed sheet.

To fully understand the advantages of the novel arrangement of the apparatus and novel steps of the process as well as the new products reference will be made to the method and apparatus used heretofore in the production of synthetic bodies. In the known process of making synthetic products which are hard and stiff it is necessary to sever the wet sheet into sections and to place such severed sections in a heated hydraulic press where they are subjected to heat and pressure for a period ranging from 14 to 30 minutes. The size of the product is of a necessity limited to the size of the hydraulic press. According to the process herein-after to be more fully described the fibrous sheet after being formed is passed through one or more pairs of heated rolls which compact, unite and cause the fibrous material to cohere into a homogeneous mass. The sheet thus produced can be severed into sections of any desired size. The synthetic product of the character mentioned is produced rapidly and the qualities of the product as to tensile strength, uniformity of thickness and color is far superior to any heretofore produced.

In making synthetic products from fibrous vegetable substance, preferably wood, the vegetable substance is mechanically disintegrated or fiberized into long, coarse fibers such as are commonly used in the manufacture of insulating bodies. Although it is preferred that mechanically disintegrated material be used, highly satisfactory results have been obtained by the use of what is commonly known as chemical pulp, semi-chemical pulp or a mixture of the mechanically prepared and chemically treated pulp and/or semi-chemically treated pulp.

It has been found highly desirable that some binder be commingled with the pulp before the fibrous sheet is formed, also, if an insect and fungi proof board is desired some toxic agent should be thoroughly commingled with the pulp stock or introduced into the sheet prior to drying. It is preferred that the toxic agent be a creosote derivative, but it is to be understood that any suitable toxic agent may be used. The toxic agent if commingled with the pulp or added to the sheet after being formed by vacuum means will be thoroughly distributed through the finished product. The fibrous pulp is formed into a relatively thick sheet depending upon the thickness of the finished product and the sheet so formed is subjected to a squeezing device to remove the surplus water. It is not absolutely essential that the surplus water be squeezed from the sheet although the efficiency of the drier is increased if the surplus water is removed prior to the drying. The sheet after being subjected to the squeezing action to remove the surplus water is passed through a drier. The sheet when discharged from the drier may be bone dry but it is preferred that it have moisture contents ranging from $\frac{1}{2}\%$ to 10% preferably 5 or 6%.

In one embodiment of invention here shown, there is illustrated in Figure 1, an apparatus for carrying out the improved process of making synthetic bodies such as boards, sheets, or the like. This apparatus is shown comprising a suitable felting machine A, pressing or squeezing device B, drying device C, nozzles D for spraying the surface of the sheet, rolls E for compacting the sheet, rolls F for spreading liquid on the surface of the sheet, heated rolls G, longitudinal trimming or cutting device H, cutting device I, for transversely severing the sheet, a humidifying chamber J and a cooling chamber K.

The felting machine here shown comprises a suitable tank 2 into which fibrous pulp stock is delivered from a suitable means, not shown. The pulp is deposited on the surface of and fed upwardly between the cylinders 3 and 4 and is thereby formed into a web or sheet 5, which then passes through the pressing or squeezing device B to remove surplus liquid or water. The sheet is then passed into a drier C in which are suitably located heated coils 6. After the sheet leaves the drier it passes between the spray nozzles D where the surfaces of sheet are wet. There are a number of advantages obtained by spraying the sheet. One is that the finished product will have a highly polished, and what may be termed glass-smooth surface. The sheet then passes into the heated rotative pressing means to compact, harden and unite the sheet into a homogeneous body.

The surface of the rotative pressing means are maintained in a polished and cleaned condition by means of rolls 7. The sheet after leaving the pressing means passes between the rolls F which are so mounted and arranged in liquid containers 10 that they spread upon the surface of the sheet a liquid substance for tempering the sheet. The sheet is then passed through heated rolls G to evenly distribute the tempering material over the surface and cause the material to penetrate the body of the sheet. The sheet is first trimmed or cut longitudinally and thereafter the sheet is transversely severed at intervals by means of cutting device E. The severed portions pass into a humidifying chamber where they are treated and from this chamber they pass into a cooling device where they are thoroughly cooled and when discharged from the cooling device are ready for shipment. The steps of humidifying and cooling may be reversed, that is the products may be cooled and then passed into a humidifying chamber. The sheet and the severed portions are caused to be advanced from the felting device through the cooler by means of driven rolls 11, or by an endless conveyer or other suitable means.

In Figure 2 is shown the sheet passing through the pressing rolls wherein the sheet is compacted into a homogeneous body. The action of the pressing rolls upon the relatively thick fibrous sheet is to gradually compact the sheet into the pre-determined thickness and the simultaneous application of heat and pressure causes the fibrous material to coalesce and become welded together so that the pressed sheet is hard, stiff and homogeneous.

The exact action that takes place while the sheet is passed between the pressing rolls is not known but the products are far superior to the products produced by a hydraulic press. This may be due in part to the fact that atmospheric air is not excluded from the sheet but for a relatively short time if excluded at all.

The pressing rolls may be heated by gas burners 12 as shown in Figure 2 wherein the flames impinge directly against the inner surfaces of the rolls. The rolls may as readily be heated by electrical means or in fact by any suitable means desired.

The pressure to which the sheet is subjected depends upon the desired density of the finished product. Pressures from 10,000 to 50,000# per foot of width of the sheet being pressed gives very satisfactory results but variations in the pressure above and below these amounts may be resorted to.

When preparing the pulp vegetable oils such as tung oil, soy bean oil, cotton seed oil may be and preferably is commingled with the pulp or a mineral oil such as petrolatum may be commingled with the pulp. The best results thus far obtained have resulted from the use of $\frac{1}{2}$ to 10% of tung oil or soy bean oil, although it is to be understood that the invention is not limited to the use of any particular oil but broadly comprehends the production of hard, stiff, water resistant, homogeneous synthetic bodies which are compacted and united by the means of heated rotative members.

The pressing rolls E, may be of any desired size and highly satisfactory results have thus far been obtained by using rolls 40" in diameter and also rolls 60" in diameter. The pressing rolls should be heated to a temperature ranging from 300° F. to 700° F. The temperature to which the rolls are heated depends in part upon the speed at which the rolls are to be rotated, upon the qualities of the board desired and upon the pressure to which the sheet being pressed is subjected. The uniformity of color of synthetic bodies also depends upon maintaining the pressing temperature substantially constant.

In Figure 3 the pressing rolls 8 and 9 are disclosed as comprising drum like members 13 and 14 having flanges 15 and 16 respectively and these flanges are adapted to rest upon shoulders of end members 17 and 18. The end members in this embodiment are constructed in the form of a spider but if the rolls are heated by steam or electrical means the ends will be closed. The end members 17 and 18 are rigidly secured to the drum members 13 and 14 by bolts 18' or in any suitable manner.

Suitably secured to the end members 17 and 18 and extending outwardly therefrom are shafts 19 and 20 which are supported in suitable bearings 21 and 22. The bearings 21 and 22 are supported by suitable frame members 23. If desired additional supporting means may be provided although it is not essential that such additional supporting means be used. The rolls are caused to rotate at the desired speed by any suitable means, not shown.

Shafts 19 and 20 have openings 24 extending therethrough and heating means extending through such openings. In Figure 3 oil burners 25 are disclosed as the heating means. The flames from the burners 25 are adapted to impinge against baffle plate 26 and be deflected therefrom against the inner surfaces of the rolls. The baffle plate 26 is supported by means of rods 27 which are suitably secured to the end members 17 and 18.

To insure uniformity of thickness of the sheet and to permit different thicknesses of sheets to be produced means are provided for spacing the rolls at the desired distance apart. This means may be mounted directly upon the rolls themselves or it may be a separate unit. In Figure 3 there is disclosed the preferred form of the device for accomplishing this purpose.

In bearing member 22 is threaded opening 28 in which is adapted to be adjustably secured member 29 which has a thread end for cooperating with the thread opening 28. For locking the member 29 in the adjusted position lock-nut 30 is provided. So that a wrench can be used to adjust the member 29 enlarged portion 31 is provided.

The bearing 21 rests directly upon the upper end of member 29. Thus when member 29 is adjusted to any desired position the uniformity of the sheet being pressed is insured.

So that the desired pressure on the rolls may

be obtained means for applying pressure must be provided and in Figure 3 is disclosed one means of obtaining this result. Made integral with a bearing 21 and extending therefrom is pin member 33. Adapted to slidably engage this pin is member 34, which secures in place the spring member 32. To permit the pressure to be varied member 34 is provided with a threaded portion 35 which extends through the frame member 23 and is adapted to cooperate with threaded opening therein. After the desired pressure has been obtained lock-nut 36 is secured in place.

As shown in Figure 4 the toxic agent may be incorporated into the wet formed sheet by vacuum means. This may be accomplished by any desired arrangement but the arrangement disclosed in Figure 4, in which the vacuum box 37, is arranged beneath the sheet and a spray member consisting of pipes 38, having a series of apertures 39, therein. The toxic agent, such as the coal tar product, is melted with rosin and formed into a soap. This is mixed with a suitable liquid such as water so that it may be readily sprayed upon the surface of the sheet. The vacuum being located on the opposite side of the sheet causes the toxic agent which has been sprayed in finely divided streams upon the surface of the sheet to be drawn into such sheet.

The temperature at which the pressing rolls are to be heated depends in part on the qualities of the products desired, the pressure at which the sheet being pressed is subjected and the speed at which the pressing means are rotated.

It has been discovered that under certain conditions a fibrous sheet having certain vegetable oils disseminated therethrough that the oil will harden, oxidize or vulcanize under the rotating of the pressing rolls at a suitable speed when a suitable temperature and pressure is used. It has also been discovered that if certain mineral oils are incorporated in a fibrous sheet and the sheet subjected to heat and pressure that the water resistant qualities of the sheet is greatly improved. The action of the oils is believed to be that of hardening, oxidizing or vulcanizing but whatever action takes place the qualities of the products produced are far superior in tensile strength, water resistance and hardness.

The sheet when discharged from the pressing rolls may be severed into the desired length and width but it is preferred that the sheet be subjected to further treatment.

It is preferred that the sheet after being discharged from the pressing rolls is passed through rolls where a liquid material is applied to the surface of the sheet. This material may be gloss oil or the like and it is applied for the purpose of tempering the sheet. To obtain the best results from the tempering material the sheet is passed through heated rolls which causes the tempering material to be evenly spread over the surface, to penetrate and to smooth the surface of the sheet. The sheet is then trimmed or severed longitudinally by any suitable means and after being trimmed or severed longitudinally is divided transversely into the desired length.

In producing synthetic products of the character mentioned it is desirable that the moisture contents of the finished product be as high as 5 to 9% as a synthetic product which contains less moisture than this when exposed to atmospheric air of ordinary humidity has a tendency to absorb moisture therefrom.

The synthetic products absorb very little moisture when stored and such bodies normally pre-

serve their shape but when the synthetic bodies are secured in position as for example on a wall or otherwise exposed to atmospheric air they absorb moisture therefrom and sometimes expand and buckle or warp. Although in some instances the synthetic bodies will buckle or warp when not secured in position.

Normally warping or buckling of synthetic products is due to the fact that after being secured in place they absorb moisture which causes them to expand. Being secured in place the expansion is restricted to a certain extent and this results in what is commonly known as warping. There have been efforts made heretofore to produce non-warpable boards but such efforts have proved extremely difficult to carry out or highly unsatisfactory. When synthetic products are treated according to the process here-in set forth the tendency of such products to warp is reduced to a minimum.

After the compacted sheet has been severed the severed portions are passed into a humidifying chamber, preferably a steam chamber, where they absorb 5 to 9% of moisture. The severed portions are advanced through the humidifying chamber in a horizontal position while all the surfaces are uniformly exposed to the humid air. The bodies when delivered to the humidifying chamber are in a relatively hot condition and rapidly absorb the desired amount of moisture.

After the severed portions have absorbed the desired amount of moisture they are passed into a cooling chamber and it is preferred that such chamber be provided with means for forcing atmospheric air therethrough. When the severed portions are discharged from the cooling chamber they are ready for use.

The synthetic products may have a wire screen impression on one surface if desired and this may be accomplished by placing screen around the roller press members in a manner disclosed in my co-pending application filed January 13, 1934, Serial Number 706,556. The sheet after being discharged from the heated pressing rolls is subjected to tempering operation to increase certain qualities, particularly the hardness of the synthetic products. The sheet is then severed into any desired dimensions and the severed portions passed through a humidifying chamber which is preferably a steam chamber and thence through a cooling means.

It is to be understood that certain steps of the process may be altered as to the sequence in which they are performed and that certain steps may be omitted and yet obtain synthetic products which are hard, grainless, homogeneous and highly water resistant.

If desired, vegetable oil in excess of what is required to bond or cement the fibrous material together may be commingled with the pulp and the oil in excess of what is required to cement the fibrous material together can be utilized to temper the board. If this method is followed additional surface tempering material may be applied to the sheet in a manner as previously described.

If desired the sheet may be severed prior to pressing and it is to be understood that the invention comprehends severing the sheet at any time during the operation that it is found desirable.

Having thus described the invention what I claim is:

1. A process for producing hard, insecticide proof, synthetic bodies which comprises forming a continuous sheet from fibrous pulp stock having

commingled therewith a toxic agent, squeezing the sheet to remove the surplus water, drying the sheet to remove substantially all the moisture, compacting the sheet under heat and pressure by means of rotatable members, tempering the sheet, severing the sheet transversely, passing the severed portions through a humidifier and finally passing the severed portions through a cooling means.

2. A process for producing synthetic bodies which comprises forming a sheet from fibrous pulp stock, squeezing the sheet to remove the surplus water, passing the sheet through at least one pair rotatable members which are heated to compact and unite the sheet into a homogeneous body, applying liquid material to the surface of the sheet, passing the sheet through heated rolls, severing the sheet transversely, passing the severed portions through a humidifying chamber and finally passing the sheet through a cooling means.

3. A process for producing non-warpable synthetic bodies which includes forming a sheet from fibrous pulp stock pressing the sheet under heat and pressure and passing the sheet through a humidifying means wherein all the surfaces of the sheet are uniformly exposed to the humid air.

4. The process for producing non-warpable synthetic bodies which comprises forming a sheet from fibrous pulp stock, compacting the sheet under heat and pressure and passing the sheet horizontally through a humidifying means.

5. A process for producing non-expandable synthetic bodies which comprises forming a sheet from fibrous pulp stock, pressing the sheet under heat and pressure by means of rolls, severing the sheet transversely and passing the severed portions horizontally through a humidifying chamber wherein all the surfaces of the severed portions are uniformly exposed to the humid air.

6. An apparatus for making synthetic products from fibrous material which includes rotatable rolls for compacting and uniting the fibrous material into a homogeneous body and means for heating the rolls and baffle plates secured within rolls and against which the heating medium is adapted to impinge.

7. In an apparatus of the class described rotatable, hollow, cylindrical members; means for internally heating said rotatable members, spring means for applying pressure to the upper cylindrical members; and means for adjustably spacing rolls at a pre-determined distance apart, said adjusting means operatively connected to one rotatable member and operatively contacting another rotatable member.

8. In an apparatus of the class described rotatable pressing rolls, means for adjustably spacing the rolls at a pre-determined distance apart, means for locking the adjusting means in the adjusted positions and means for heating the rolls to a temperature sufficient to produce synthetic products which are substantially homogeneous.

9. A process for the production of synthetic bodies which comprises forming a sheet from fibrous pulp stock having commingled therewith a vegetable drying oil, passing the sheet through a drier to reduce the moisture contents to below 10%, passing the sheet through rotatable members which are heated to compact and unite the sheet into a homogeneous body, applying liquid material to the surface of the sheet while in a relatively hot condition, passing the sheet through heated rolls, and finally passing the sheet through a humidifying chamber.

10. A process for producing synthetic bodies which comprises forming a sheet from fibrous pulp stock, passing the sheet through a drier, and finally passing sheet through heated rotatable members, which are in the range of 40 to 60 inches in diameter, and wherein pressure within the range of 10 to 50 thousand pounds per foot of width is applied.

11. The process of producing hard, fungi and insecticide proof board like, synthetic bodies which comprises forming sheet from fibrous pulp stock having commingled therewith an oil of the class described herein and an insecticide and fungi resisting agent, drying the sheet to remove substantially all the moisture and subjecting the dry sheet to the application of heat and pressure.

12. A fungi and insect toxic pulp board resulting from the application of heat and pressure in the ranges described herein to surfaced dampened sheet containing vegetable fibers, a toxic agent and a binder that hardens under heat and pressure.

13. The process for producing board like bodies which comprises forming a board from fibers in a water bath having commingled therewith a vegetable drying oil in excess of what is required to bond the fibers together, drying the board, dampening the surface of the board, subjecting to simultaneous application of heat and pressure by rotatable pressing means to harden the oil and bind the fibers together whereby the hard, water proof board is produced.

14. A process for producing hard, stiff, water-resisting panels from fibrous pulp stock which includes the steps of forming a slab from pulp stock, passing the slab through a dryer to remove substantially all the moisture, continuously advancing in a horizontal plane the slab while hot between rotatable pressing members, and applying heat to the slab while pressure is applied.

15. A process of making hard, stiff, water-resisting, board-like bodies which comprises commingling a binder that hardens under heat and pressure, with a vegetable fibrous pulp stock in a water bath, manipulating the mass to form a board, drying the board to remove substantially all the moisture, dampening the major surfaces of the board, and simultaneously heating and pressing the board.

16. A hard, stiff, high surface strength board having great water-resisting properties resulting from simultaneous application of heat and pres-

sure to a pulp board that has a relatively dry core and dampening surfaces, the board containing a binder which sets under heat and pressure.

17. A hard, high surface strength board having great water-resisting properties, resulting from simultaneous application of heat and pressure to a pulp board that has been dried to remove substantially all the moisture and the major surface dampened by water, the board containing a binder of the class described.

18. A hard, high surface strength board resulting from simultaneous application of heat and pressure to a dry core, surface dampened, pulp board containing a binder of the class described within the range herein set forth.

19. A process for producing a hard, dense, synthetic board which consists in forming from fibrous pulp stock a thick sheet, drying the sheet to remove substantially all the moisture, subjecting the sheet to simultaneous application of heat and pressure by means of rotatable members, applying liquid material to the surfaces of the sheet and passing the sheet between heated rotatable members.

20. A process for producing hard, stiff, water-resisting boards comprising forming a board from fibrous pulp stock, passing the board through a dryer to remove substantially all the moisture, simultaneously applying heat and pressure to the board by means of rotatable members, applying liquid material to the major surfaces of the pressed board, passing the board between heated rotatable members and cooling the board.

21. A process for producing hard, fibrous products which includes forming a board from pulp stock having commingled therewith a binder within the range herein described, drying the board to remove substantially all the moisture, subjecting the board to simultaneous application of heat and pressure, applying liquid material to the major surfaces of the board and applying heat and pressure.

22. A process for the production of synthetic bodies which comprises forming a thick sheet from pulp stock having commingled therewith a binder from an extraneous source, drying the sheet to remove substantially all the moisture, subjecting the sheet to simultaneous application of heat and pressure, applying liquid material to the surfaces of the pressed sheet, and passing the sheet between heated rotatable members.

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