To all whom it may concern:

Be it known that I, JAMES H. CAFFREY, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Fibrous Wall Board and Process for Producing the Same, and I do hereby declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to figures of reference marked thereon, which form part of this specification.

Like figures of reference refer to like parts.

This invention relates to wall boards made of fibrous and cementing materials and to apparatuses and processes for producing the same.

The objects of this invention include the production of a wall board made of flax straw or other long fibrous material and a transparent binding cement, having waterproof and fire resisting qualities providing an inexpensive wall board having considerable strength, one which does not require the use of paper or wood pulp in any form in its construction, and one which is perforated for the purpose of keying on a coating of plastic material, as well as one which is preferably fireproof.

A further object is to produce the perforated holes in a manner to leave the lips of the holes reinforced by the same material, which is crowded in condensed formation at the lips, which serves at the same time to strengthen the wall board about the holes.

With these and other objects, my invention resides in the construction of the wall board, one embodiment of which is herein-after described, the apparatus for making which is illustrated in the drawings, the operation of the apparatus being explained, and what I claim is set forth.

In the drawings,

Figure 1 is a perspective view of a fibrous wall board, embodying my invention, showing perforations therein, as well as a portion of coating thereon.

Figure 2 is an enlarged view of a fragment of the wall board shown in Figure 1, illustrating the reinforcement of the material at the lips of a hole therein.

Figure 3 is a top plan of the apparatus embodying my invention for producing wall board.

Figure 4 is a side elevation of the apparatus shown in Figure 3.

Figure 5 is a side elevation of the apparatus shown in Figure 3, illustrating the reverse side to that which is shown in Figure 4.

Figure 6 is a longitudinal elevation of the device shown in Figure 3, taken on the line X—X thereof.

Figure 7 is a perspective view of the perforating member equipped with a series of specially constructed spikes for the purpose.

Figure 8 is an enlarged horizontal section taken on the line Y—Y of Figure 3.

Figure 9 is a plan view of the perforating members of the apparatus, which are shown in section in Figure 8.

Figure 10 is a sectional elevation taken on the line Z—Z of Figure 9.

Figure 11 is a perspective view of the automatically closable stripping blades, used in connection with the spikes of the perforating member which is shown in perspective in Figure 7.

Figure 12 is a fragmental vertical section taken on the line W—W of Figure 11, illustrating the members which actuate the return of the stripping blades to their normal position, for subsequently receiving the piercing spikes.

Figure 13 is a fragmental perspective view of a special form of conveyor used in this apparatus.

Figure 14 is a perspective view of one of the links forming the sprocket chain of the conveyor which is shown in Figure 13.

In the figures, referring particularly to Figures 1 and 2, the wall board 1, is shown to be composed of long fibers 2 matted together, having holes 3, regularly spaced therein, and having the fibers crowded at the lips 4 of the hole 3. This fibrous material is impregnated with a transparent material, having waterproof and fire resisting qualities, which cementing material is applied in a liquid form, and afterwards solidifies.

Referring now to the remaining figures,
which illustrate an apparatus embodying my invention for making the wall board, the apparatus is shown to consist of a special frame 5, upon which are mounted three sets of conveyors, 6, 7, and 8 respectively, which convey the material in succession to the cement feeding device 9, to the hole piercing device 10, the shearing device 11 thence to the conveyor 12 for carrying the finished product away from the machine.

The shearing device 11 for shearing the finished sheets into desirable lengths, is provided beyond the conveyor 8, and is synchronized with the conveyors to automatically cut off the sheets.

Considering now the specific construction of the apparatus illustrated in the figures, there are shown mounted upon the frame 5 three brackets numbered 13 in which is journaled the long worm shaft 14, having fixed thereon, at various points the respective worms 15, 16, 17 and 18. The conveyor 6 is moved by means of the worm 15, meshing with the hobbled gear 19 which is fixed upon the conveyor shaft 20, which shaft has also fixed thereon, the sprocket wheels 21 which are in mesh with the chains 22, made up of special links 23 to which are fixed the slats 24. On top of each of the slats 24 at each end thereof, is fixed a curb member 25 having a recessed portion 26 and an extension 27, so formed that when the slats 24 are in horizontal position, the curb members 25 interengage one another, forming a continuous curb, for holding the fibrous material distributed thereon, from falling off the edges of the conveyor.

Between the cement feeding device 9, and the conveyor 6, is a narrow table portion 28, which is level with the top surface of the conveyor 6. This table portion 28 is fixed upon the frame 5. A similar table top portion 29 is provided between the conveyor 7 and cement feeding device 9, and is fixed upon the frame 5, besides being a level with the top of the table portion 28. The cement feeding device 9 has two opposed rollers 30 and 31, which are journaled with an extension 32 of the frame 5. Fixed to the shafts 32 and 33 of the respective rollers 30 and 31, are the respective gears 34 and 35 of equal size and in mesh with one another. Fixed at one end of the shaft 33 is the hobbled gear 36, which engages the worm 16 on the shaft 14. The roller 31 revolves within a trough 37, which is shown in section in Figure 6 to contain a liquid cement 38, in which the roller 31 is partly immersed. This liquid is the cementing solution, which is fed up to the under side of fibrous mass forming the body of the wall board 1, when the same comes in contact with the wetted surface of the roller 31. The trough 37 is supported upon the frame 5.

The surface of the roller 30 is wetted with the cementing solution from nozzles 39 fed by a pipe 40, from a source of cementing solution supply. Above and below the table portion 29 are the longitudinal scrapers 41 and 42, which bear against the respective rollers 30 and 31, and which are supported on the framework of the trough 37. These scrapers 41 and 42 are positioned to scrape the surface of the rollers 30 and 31 respectively, after the same have passed beyond contact with fibers of the wall board 1 in formation, and their purpose is to keep clean the surfaces of the rollers 30 and 31.

Considering now the detailed construction of the piercing device 10, there is shown mounted upon the frame 5, a track 43, made up of rails 44 and 45. A carriage 46 is provided with rollers 47 which engage the track 43. One end of the carriage 46 is provided with a recess 48, which is engaged by the finger 49 of the segmental gear 50, which gear is journaled at 51 upon the rail 45. Meshing with the gear segment 50, is another gear segment 52, fixed to the shaft 53 in the frame 5. The shaft 53 has extensions beyond the opposite side of the frame 5, and has fixed to it a segmental gear 54 similar to the gear 50 pivoted at 51 to the rail 44. The gear 54 has a finger 49 engaging a recess 48 in the frame 46 in a manner similar to the engagement of the finger 49 with the recess 48 on the opposite side of the machine. The gear 53 has a finger 54, upon which is journaled the link 55, the opposite end of which is journaled upon the wrist pin 56, of the gear 57, which gear is fixed upon a shaft 58. The gear 57 is in mesh with an idler gear 59, pivoted at 60 to the frame 5, and the idler 59 in turn meshes with the gear 61 fixed upon the shaft 62, to which shaft 62 is fixed the worm gear 63 in mesh with the worm 17, whereby the train of gears and shafts just described, get their motion. The opposite end of the conveyor 7 has gears 64 meshing with the chains of the conveyor 7, fixed upon a shaft 65, journaled in an extension 66 of the frame 5.

The conveyor 8 has a bobbed gear 66, fixed upon the shaft 67, in mesh with the worm 18. At the opposite end of the conveyor 8, is the shaft 68, journaled in the frame 5, as is also the shaft 67. Upon the shaft 68 is fixed a sprocket wheel 69, having in mesh therewith the chain 70, the lower end of which is in mesh with the sprocket wheel 71, fixed upon the shaft 72. Referring now to the opposite side of the machine, following the shaft 72, there is shown fixed there-to, a sprocket wheel 73 which engages chain 74, the upper end of which chain engages a sprocket wheel 75, upon a shaft 76, journaled in the standards 76 of the carriage 46.

Positioned for vertical reciprocation within the carriage 46 is the perforating member 130.
77, having vertical end extensions 78 secured to the body of the perforating member 77 by screws 79. Each of the extensions 78 has a pair of parallel sliding surfaces 80 which are V-shaped in section, and which are in sliding engagement with the guide ways 46 of the carriage 46. The extensions 77 of the perforating member 77 are each provided with vertical slots 81 through which passes the shaft 76. A roller 82 journaled on a pin 83 is positioned on each extension 78 centrally with respect to the vertical slots 81 and below the same, on the outside of the extension 78. Similar rollers 84 journaled upon pins 85 are positioned in line with the slots 81 above the same at the upper ends of the extensions 78.

Returning now to the shaft 76, there is shown (particularly in Figure 10) two sets of cams 86 engaging the rollers 82, while the cams 87 engage the rollers 84. It will be noticed that the cams 86 have an extended portion 86a, while the cams 87 have a notched portion 87a. These cams are so co-ordinated that the distance between any two points on the respective surfaces, in any axial line to the shaft 76 will be of one length, so as to give an absolute control over the movement of the perforating member 77, in its reciprocation within the guide ways 46, of the carriage 46, to prevent any lost motion in the same, giving absolute control of the movement so arranged and synchronized as to fulfill the functional movement of the piercing device relative to the movement of the wall board thereunder, during formation.

The member 77 is provided with a plurality of spikes 88, having tapered ends, equally spaced in two rows but staggered in the rows. These spikes 88 pass down through holes 89 in a stripping plate 90, which is fixed in the carriage 46. Also fixed in the carriage 46 is a similar stripping plate 91 having a series of holes 91a with which the spikes 88 register and are in reciprocation. On the top of the plate 91 rests a pair of stripping blades 92. These stripping blades are shown in perspective in Figure 11 and in plan in Figure 9. The upper 92a of the stripping blades 92, is formed into broad flat teeth 92a, having notches 92b which are positioned to register with one of the rows of spikes 88. At the bottom of the recess between adjacent teeth 92a, are notches 92c which register with the other row of spikes 88. The lower 92b of the stripping blades have broad teeth 92b with notches 92c registering with the notches 92a of the teeth 92a, while there are notches 92d at the bottom of the recesses between adjacent teeth 92c registering with the notches 92b of the teeth 92b. The teeth 92a and 92b overlap one another. The upper blade 92a has end portions 93 which rest upon the top of the end portions 94 of the lower blade 92b. Fixed to the end portions 93 are reinforcing strips 95, having conical holes 96, and slotted holes 97 and 98. On the underside of the stripping blade 92c are reinforcing strips 92d fixed thereto. Referring to Figure 12, the reinforcing strip 92d is shown to have a slotted hole 96a opposite the tapered hole 96b, of the reinforcing strip 95, and a conical hole 98a opposite the slotted hole 98b. There is a slotted hole 97a opposite the slotted hole 97, but positioned in the opposite direction therefrom. Passing up through the holes 97 and 97a is a pin 99, which is anchored in the carriage 46. It will be noticed that the slots 97 and 97a extend in opposite direction to this pin 99, the reason for which will be explained hereinafter.

Passing up through the holes 98 and 98a is a pivoted rod 100, journaled at 101 to the screws 102 (see Figure 10), which screws are fixed in the carriage 46. The lower portion of the rod 100 forms a finger 103, which is long enough to engage a pin 44a fixed in a certain position in the rail 44. Passing up through the holes 98 and 98a is the pivoted rod 104, journaled upon the screws 105, fixed in the carriage 46. Connecting the rods 100 and 104 is the tension spring 106, which serves to cause the rods 100 and 104 to throw the reinforcing strips 95 and 95a, normally positioned to register as shown in the figures in a closed position against the anchored pin 99, at the slots 97 and 97a as shown in Figures 11 and 12, holding the blades 92a and 92c in a position to have the notches 92b and 92d register with one another in a position to form a small hole for engaging the point of a spike 88.

Journaled on the shaft 53 is a roller 53a and journaled on the frame 5 of the machine are rollers 107. Passing around the roller 53a and the rollers 107 are the endless belts 108, which pass over in contact with the top of the stripping blades 92 and are positioned between the spikes 88.

Between the conveyor 8 and the piercing device 10 is a set of rollers 109 and 110 positioned respectively above and below the board in formation. The roller 110 is journaled in an extension 111 of the frame 5, while the roller 109 is journaled in a block 112, positioned in ways 113 and adjustably fixed by bolts 115.

Referring now to the shearing device 11, in the end of the conveyor 8, and adjacent to the conveyor 12, there is shown in section, in Figure 6, a guide block 116 upon a frame 117, which frame 117 is made integral with the frame 5. Journaled in the frame 117 is the shaft 118, upon which is fixed at each end a cam 119 having a tooth 120 extending beyond its circular surface. Positioned directly below the shaft 118 is the piercing blade 121, which is adapted to reciprocate
within the guide block 116. Journaling at the upper ends of the blade 121, upon pin extensions 122, are rollers 123, which are adapted to engage the cams 119, there being tension springs 124, which normally throw the blade 121 upward, bringing the rollers 123 in contact with the cams 119. The blade 121 is adapted to operate in shearing action against the shearing block 125, which is integral with the frame 117. There is a sprocket 126, fixed upon the shaft 118, which engages a sprocket chain 127 and passes around a smaller sprocket wheel 128, fixed to the shaft 67, of the conveyor 8. The difference in diameter being such as needed to actuate the shearing blade 121 at the period which is commensurate with that required for feeding a certain length of board beyond the shearing block 125 to be sheared off and dropped upon the conveyor 13.

In operation, a shaft 110 of the conveyor 6, although not herein shown, this layer of fiber is caused by the conveyor 6 to move on to the narrow table portion 28, and over the same into engagement with the cement feeding device 9, the rollers 30 and 31 of which are covered with a film of cementing solution, preferably of transparent cement having waterproof and fireproof qualities and a toughness like glue and fed upon the rollers by the nozzle 39 and the cement in the trough 37. Both the conveyor 6 and the cementing feeding device 9 receive their motion from the worm shaft 14. The scrapers 41 and 42 keep the surface of the rollers 30 and 31 clean, and prevent the fiber from rolling up onto the rollers. From the rollers 30 and 31, the wetted layer of fiber is pushed over a table portion 29 onto a conveyor 7, which carries it to the hole-piercing device 10; the carriage 46 of which, riding upon a track 43, travels forward with the plastic fiber board during the hole piercing operations and returns for successive hole piercings. This reciprocal traveling of the carriage 46 is caused by the rocking back and forth of the fingers 49 and 49° of the gear segments 50 and 50° which engage the notches 48 and 48° of the carriage 46. At the same time, the piercing operation is actuated through the agency of the sprocket chain 74, connected by a train of mechanism with the conveyors, which train of mechanism, includes the shaft 72 of the conveyor 8, the sprocket wheel 89, the chain 70, the sprocket wheel 71, the shaft 72, the sprocket wheel 73, on the opposite side of the machine, to which is connected the chain 74. The chain 74 turns the sprocket wheel 76, fixed upon the shaft 76. The shaft 76 turns the cams 86 and 87, which give a vertical reciprocating motion to the piercing member 77. The shaft 76 is so synchronized in its movement to that of the conveyor and the rocking gear 77, that the period of time occupied in the piercing action during the forward movement of the carriage 46, and the holding of the piercing member 77 apart from the wall board 1, during the return of the carriage 46, is such as to have piercing actions follow in close enough succession, to have the series of holes formed by the successive piercings, equally spaced.

During the reciprocation of the spikes 88 of the piercing device 77, the rods 100 and 104, normally drawn together by the spring 106 tend to keep the strips 95 and 95° together with stripping blades 92° and 92° in the normally closed position shown in perspective in Figure 11 and in section in Figure 6. Figure 10 illustrates the position of the parts when the spikes 88 are at their lowest limit of reciprocation. It will be noticed that at the 100° of the rod 100 is slightly inclined toward the pin 44° on the rail 44, although spaced therefrom, and this position which is that at the mid portion of the carriage 46 in its forward travel. As the carriage 46 continues on to keep the other half of the forward motion, the cams make a half turn and the piercing device 77 is raised and held raised until the beginning of the next forward movement of the carriage 46 after its return for such forward movement. As the carriage 46 reaches its initial position ready for a forward movement, the finger 103 collides with the pin 44° and forces the upper end of the rod 100 backward, while the bracket 104° collides with the rod 104, pushing the same relatively forward upon the carriage 46, thus causing the stripping blades 92° and 92° to become normally closed, if for any reason the spring 106 is not sufficiently strong to perform this function.

After leaving the piercing device 77, the wall board 1, in a semi-plastic condition with its surface somewhat burred at the holes, is urged forward by means of the metallic bolts 108 and coming in contact with the rollers 109 and 110 the wall board 1, is ironed out, so to speak, and the burrs flattened down at the edges of the holes. The wall board 1, next travels in contact with the conveyor 8, and is fed thereby to the shearing device 11, which being connected with the shaft 106 of the conveyor 8, in the manner above described in connection with the description of the parts of the shearing device 11, the cam finger 120, causes a downward movement of the shearing blade 121, and in connection with the shearing block 125, a portion of the oncoming wall board 1 is sheared off, suddenly, and dropped upon the conveyor 12. The blade 131 afterwards remains in the position shown, until the finger 120 of the cam 119 comes around again and depresses the shearing blade 131, cutting off the next piece of
wall board. The synchronism of movement of the shearing device 11, is such as to cut off the individual pieces of wall board in accordance with the relative diameter of the sprocket gears 126 and 128.

The process involved in connection with the operation of this device includes the following successive steps, which of course, may be carried out upon any other suitable device for the purpose, differing in detail from the machine herein illustrated and above described, but having similar functions:

The first step is the spreading of the fiber in a layer of practically uniform thickness upon the conveyor and means for carrying the same in such layer forward, for the remaining steps of the process. The next step is the coating of the fiber above and below with a fluid cementing substance which is absorbed by the fiber. It may not be necessary, under certain circumstances to coat both sides of the fiber, in which case, one or the other parts of the coating device may be omitted. The next step in the process of forming this wall board, is the carrying of the wetted fiber sheet to a suitable piercing device wherein the holes are formed and the sheet is passed on to another device, which tends to restore the roughened surface to a smooth state. The next step is the carrying forward of the board in formation to a suitable shearing device for cutting the continuously formed sheet into individual lengths and further carrying the same away where they may be disposed of. If it is desired to leave the wall board unperforated, then of course, the piercing device and its accompanying ironing out device may be dispensed with. If it is desired to form the holes in the plastic board and leave the surface roughed as it comes from the piercing device without restoring the surface of the board to an even flatness then, of course, the ironing out device can be dispensed with.

The length of the conveyor between the cement coating device and the piercing device will depend in a large measure upon the rate of time in which the cement liquid between the fibers becomes sufficiently plastic for the piercing operation, as well as upon the rate at which the conveyor travels.

The board herein described forms a new article of manufacture and may with suitable devices not here shown, be formed into shingles, slabs and other forms depending upon the purposes of building construction for which it may be used. The purpose of having holes in the board, is to give a keyed formation to any coating material that is spread upon the surface of the finished board, such as is shown in Figure 1, at 1°.

As modifications of the herein described material, process for making the same, and the device in which it is made, may be made without departing from the spirit and scope of my invention involved therein, I do not wish to be confined to the embodiment thereof illustrated and described, hence I claim—

A process of forming wall board from fibrous material consisting in coating a mat comprising a plurality of loose fibers with a cement in liquid form to cause said fibers to adhere to one another, in separating said fibers at predetermined places in said mat to provide openings therethrough, and in applying pressure to said mat to cause a firm adhesion of said fibers and to compact the separated fibers at said openings.

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