May 26, 1925. 1,539,542

H. CARMICHAEL

METHOD AND APPARATUS FOR PRODUCING FIBROUS BOARD

Filed Nov. 15, 1921 5 Sheets-Sheet 1

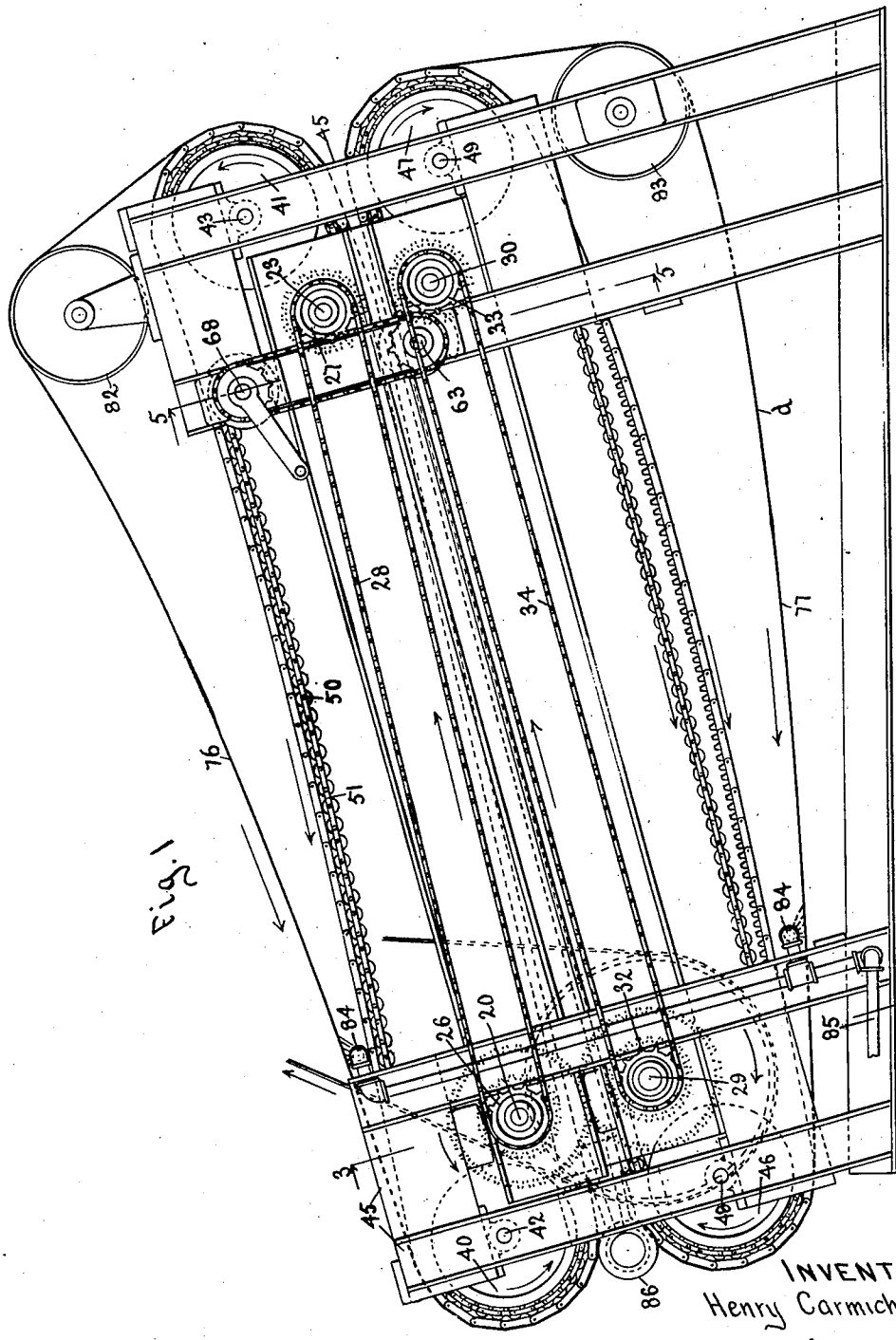


Fig. 1

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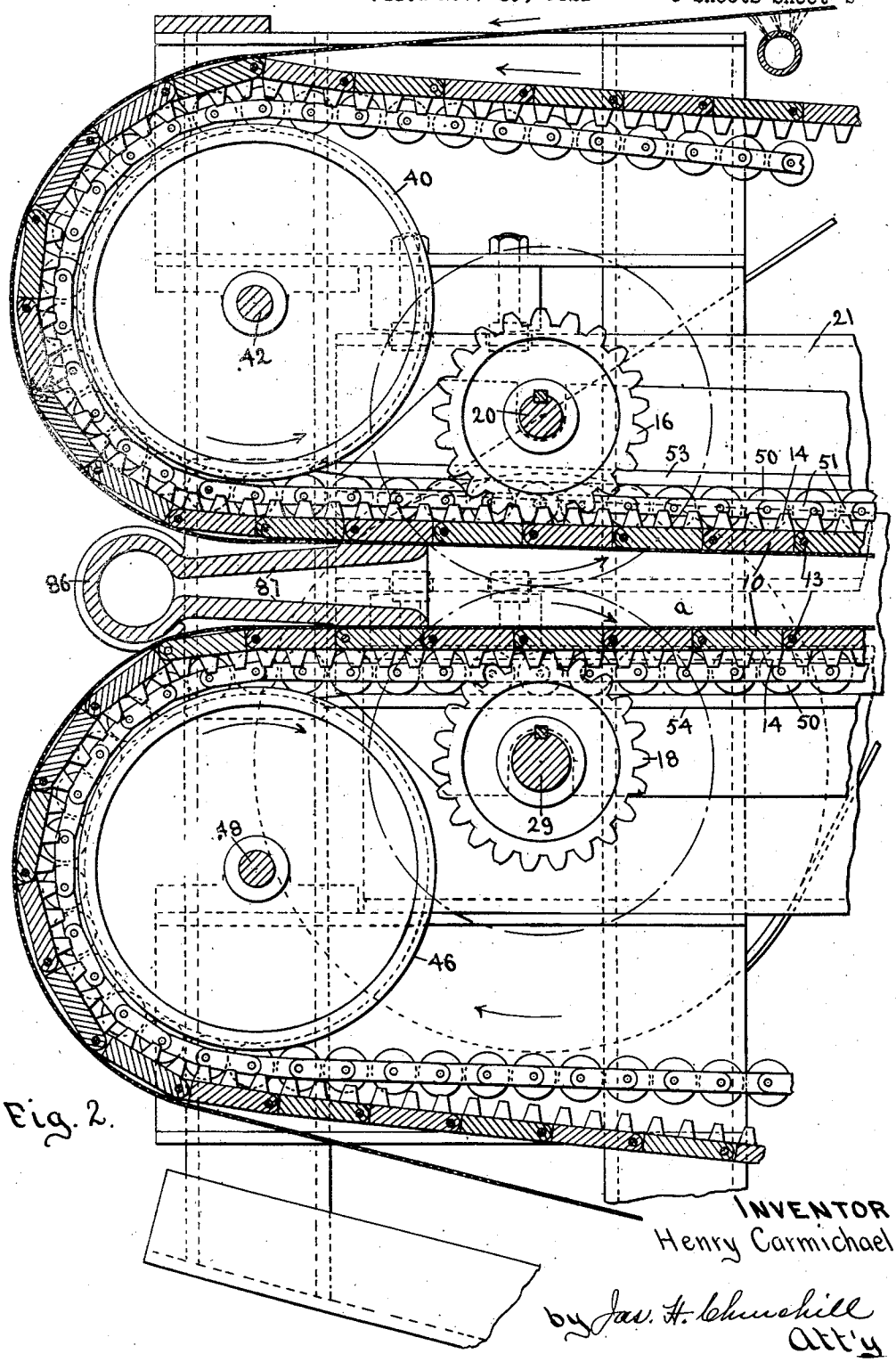


Fig. 2.

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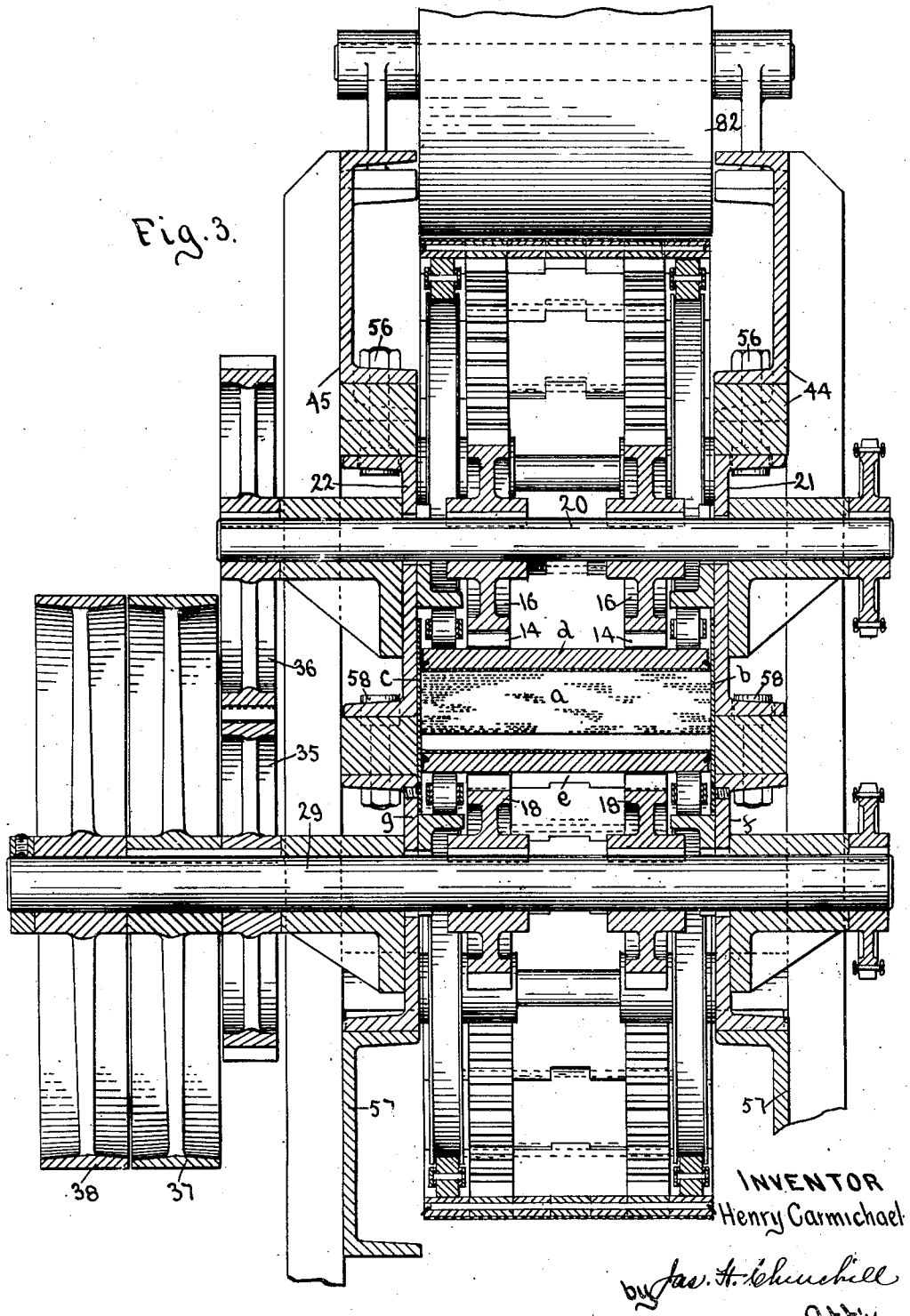
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METHOD AND APPARATUS FOR PRODUCING FIBROUS BOARD

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Fig. 3.



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METHOD AND APPARATUS FOR PRODUCING FIBROUS BOARD

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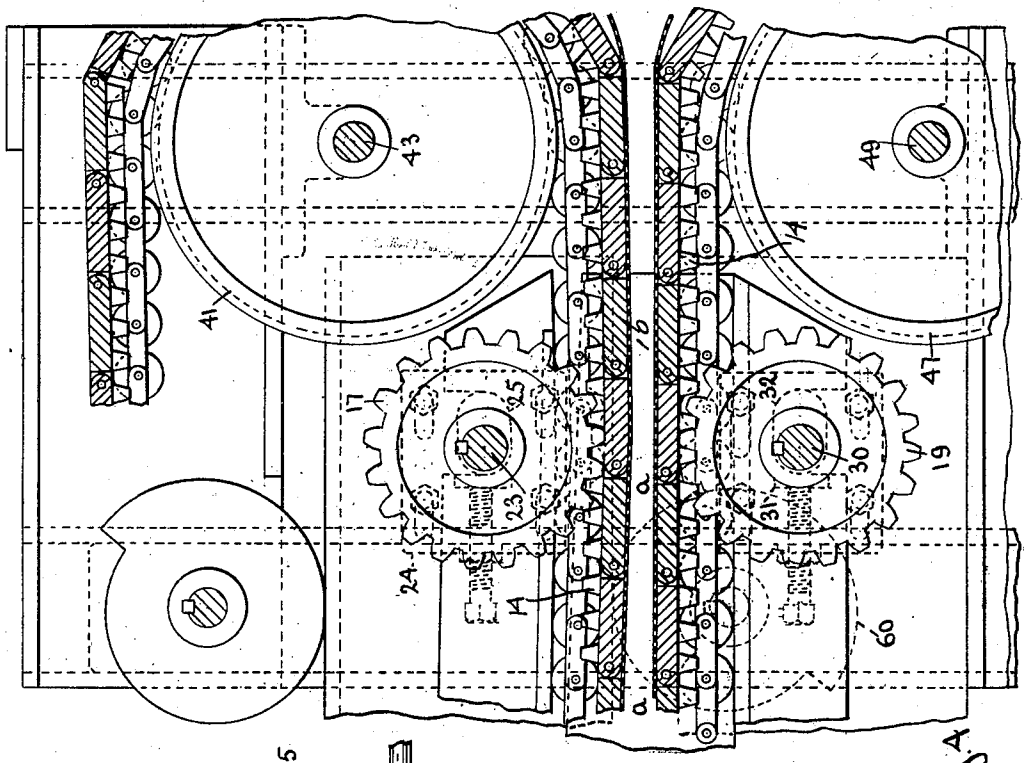


Fig 4

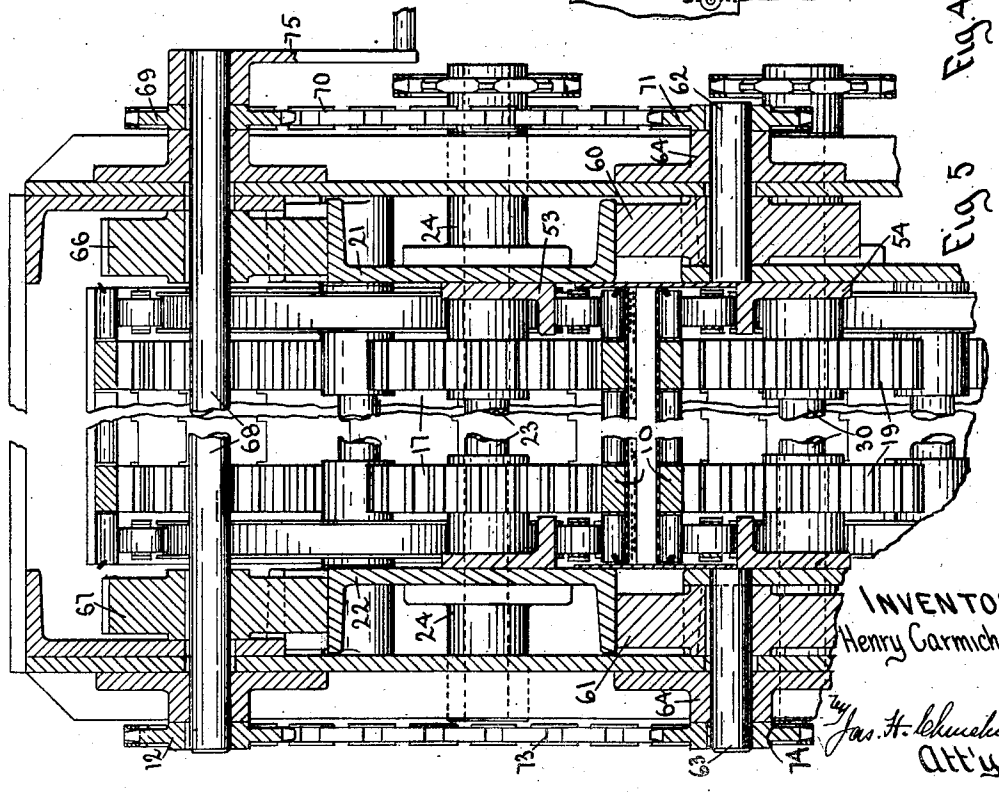


Fig 5

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METHOD AND APPARATUS FOR PRODUCING FIBROUS BOARD

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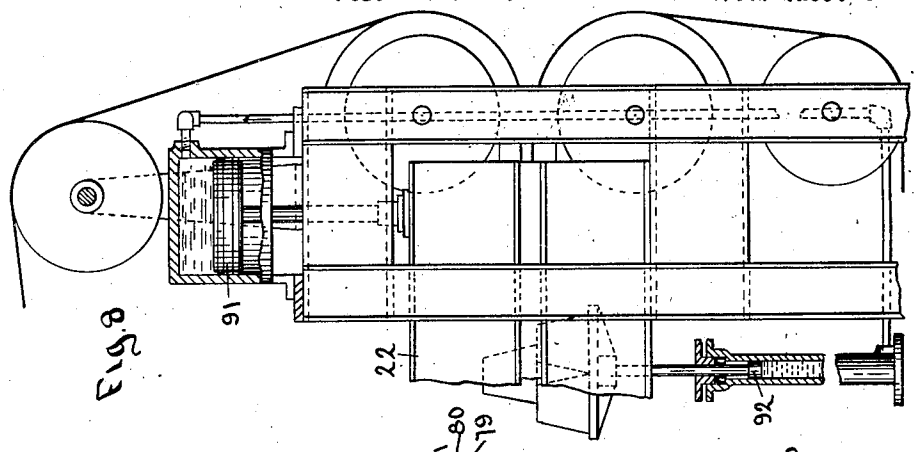


Fig. 8

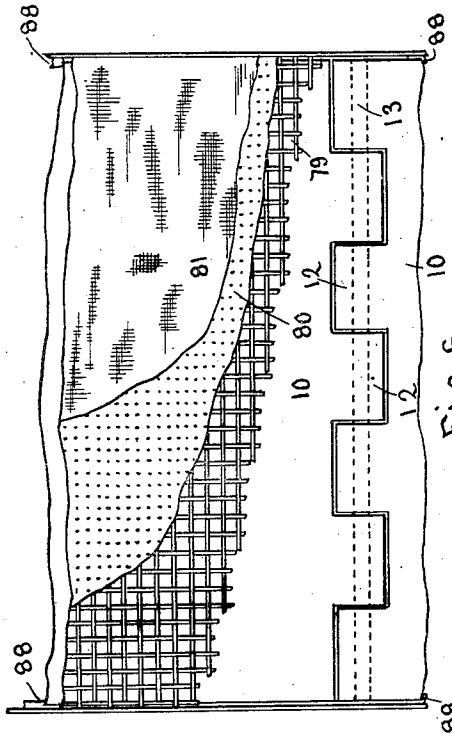


Fig. 6

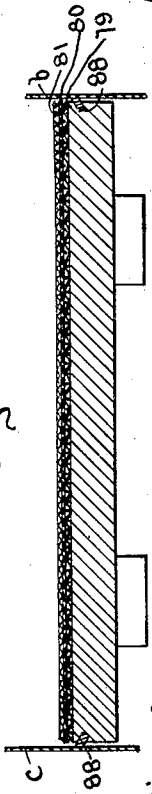


Fig. 7

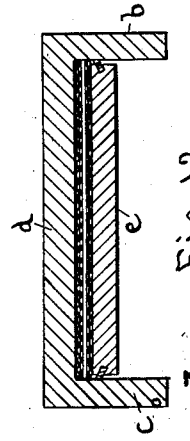


Fig. 12

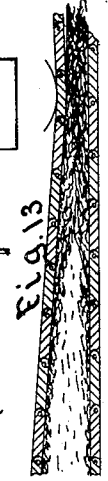


Fig. 13

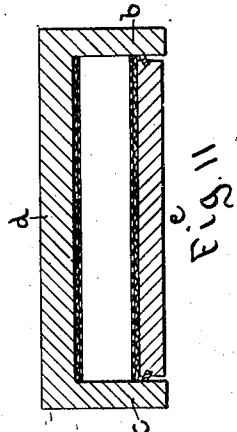


Fig. 11

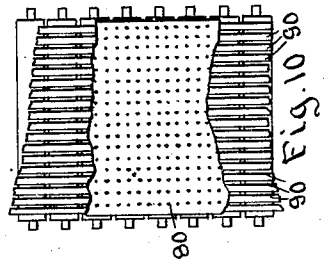


Fig. 10



Fig. 9

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Patented May 26, 1925. 1,539,542

UNITED STATES PATENT OFFICE.

HENRY CARMICHAEL, OF MALDEN, MASSACHUSETTS, ASSIGNOR OF FOURTEEN AND FOUR-TENTHS PER CENT TO IRVING HOLLANDER, OF WINTHROP, MASSACHUSETTS, FIVE AND FOUR-TENTHS PER CENT TO J. W. NOURBOURN, ONE AND EIGHT-TENTHS PER CENT TO HARRY W. COBB, BOTH OF BOSTON, MASSACHUSETTS, AND SIXTY-FOUR PER CENT TO THE UPSON COMPANY, OF LOCKPORT, NEW YORK, A CORPORATION OF NEW YORK.

METHOD AND APPARATUS FOR PRODUCING FIBROUS BOARD.

Application filed November 15, 1921. Serial No. 515,257.

To all whom it may concern:

Be it known that I, HENRY CARMICHAEL, a citizen of the United States, residing in Malden, in the county of Middlesex and State of Massachusetts, have invented an Improvement in Methods and Apparatus for Producing Fibrous Board, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to a method of and apparatus for producing in a continuous manner board, which may be of indeterminate length and of material thickness and preferably of fibrous material, in which the fibers are interlocked or felted with one another.

To this end, the fibrous material admixed with a relatively large volume of water or other fluid to form a fluent pulp or stock is admitted under pressure into a pressure chamber to form therein a homogeneous mass of fibers interlocked in all directions and of substantial thickness; which mass of interlocked fibers is moved continuously through said chamber, and while in motion is subjected on opposing surfaces to pressure without disturbing the relation of the interlocked fibers, which pressure is maintained and increased as the fibrous mass progresses through said chamber to consolidate and felt the fibrous material and form a non-laminated compact board of substantial thickness, of maximum strength and whose fibers are interlocked in all directions.

The passage or chamber is formed in an apparatus provided with a pair of opposing walls which are movable toward the outlet end of said passage or chamber.

In a preferred form of apparatus, the opposing walls may be made as platens and superimposed drainage belts, and said platens may be composed of sections capable of sustaining heavy pressure and pivotally connected together and provided with gear teeth, which cooperate with suitable gears to be driven by the latter.

Provision is made for reducing the friction of the endless platens. Provision is also made for adjusting the sectional upper and lower platens to avoid slack and obtain the proper drive of the same.

Provision is also made for washing the drainage belt, as will be described.

These and other features of this invention will be pointed out in the claims at the end of this specification.

Fig. 1 is a side elevation of one form of apparatus with which to produce compact fiber boards in accordance with my improved method.

Fig. 2, a longitudinal sectional view on an enlarged scale of the left hand end of the apparatus shown in Fig. 1.

Fig. 3, a vertical section on an enlarged scale taken on the line 3—3, Fig. 1.

Fig. 4, a longitudinal sectional view on an enlarged scale of the right hand end of the apparatus shown in Fig. 1.

Fig. 5, a vertical section on an enlarged scale, taken on the line 5—5, Fig. 1.

Figs. 6 and 7, details of the construction of platen and drainage belt shown in Fig. 1.

Fig. 8, a modified construction for adjusting the platens.

Figs. 9, 10, 11 and 12, modifications of platens to be referred to, and

Fig. 13, a diagrammatic view to illustrate the formation of the compact board from the fluent stock.

Referring to the drawings and particularly Figs. 1 to 7 inclusive, *a* represents a passage or chamber into which fibrous material admixed with a relatively large amount of water, or other fluid, and under pressure is admitted, and from which passes the fibrous material substantially free from water and in the compact form of a board of substantial thickness and strength and whose fibers are interlocked.

The passage or chamber *a* is provided with side walls *b*, *c* and with top and bottom walls *d*, *e*, see Fig. 3.

The side walls *b*, *c*, may and preferably will be made of brass plates, suitably secured to supporting members *f*, *g*.

The top and bottom walls *d*, *e*, may and

preferably will be made as endless platens composed of sections or members 10 provided with overlapping fingers 12 through which extend pivot pins 13, see Figs. 2 and 6. Each platen member or section 10 is provided on its inner surface with gear teeth 14, arranged near the opposite sides of said platen member or section, and the gear teeth on adjacent platen members are arranged in alignment to form gear chains, with which cooperate gears for driving them and the endless platens to which they are attached. The teeth 14, on the lower lap of the upper endless platen *d* are engaged with and driven by gears 16, 17, see Figs. 2 and 4, and the teeth 14 on the upper lap of the lower endless platen *e* are engaged with and driven by gears 18, 19. The gears 16, are fast on a shaft 20 journaled in supporting members 21, 22, and the gears 17 are fast on a shaft 23 journaled in boxes 24 which are sildably secured to the supporting members 21, 22 so as to be moved toward and away from the shaft 20 to take up slack in the lower lap of the upper endless platen, and thereby maintain the upper wall *d* of the chamber *a* taut and substantially straight or flat. The supporting members 21, 22 are provided with slots 25, see dotted lines Fig. 4, which permit this adjustment of the shaft 23 and the gears 17 thereon.

The shafts 20, 23, are provided with sprocket wheels 26, 27 which are connected by a link chain 28, see Fig. 1.

The gears 18 are fast on a shaft 29 journaled in the supporting members *f*, *g*, and the gears 19 are fast on a shaft 30 journaled in boxes 31 which are slidably secured to the supporting members *f*, *g*, which have slots 32 to permit adjustment of the shaft 30 and the gears 19 thereon with relation to the shaft 29 and gears 18. The shafts 29, 30 are provided with sprocket wheels 32, 33 which are connected by a link chain 34.

The shaft 20 is driven from the shaft 29 by gears 35, 36, see Fig. 3, and the shaft 29, which constitutes the main shaft, is represented as provided with a fast pulley 37 and with a loose pulley 38. The upper endless platen *d* is passed about pulleys 40, 41, see Fig. 1, mounted on shafts 42, 43 journaled in stationary side frames 44, 45 near the opposite ends of the same, and the lower endless platen *e* is passed about pulleys 46, 47 mounted on shafts 48, 49 journaled in said side frames near the opposite ends of the same, and provision is made for moving the endless platens with the least possible power. To this end, the upper endless platen *d* is supported directly upon roller bearings 50 carried by link chains 51 which are passed about the pulleys 40, 41 between them and the endless platen, and the lower endless platen *e* is likewise supported by roller bearings 50 interposed between it and the pulleys 41, 47. The lower lap of the upper endless platen and the upper lap of the lower endless platen are maintained straight or flat by rigid bearing members 53, 54, see Figs. 2 and 3, with which the roller bearings 50 engage and which are firmly attached to the supporting members 20, 21, *f*, *g*.

The supporting members 20, 21, are shown as channel irons and are arranged to have a pivotal movement, being practically pivoted at one end and adjustable at their other ends toward and from the supporting members *f*, *g*.

In the present instance, the supporting members 21, 22 for the shafts 20, 23 are hung by bolts 56 from the upper portions 44, 45 of the stationary side frames, see Figs. 2 and 3, and sufficient play is allowed between the bolts 56 and the supporting members 21, 22 to permit the latter to pivot on said bolts. The supporting members *f*, *g* for the shafts 29, 30 normally rest upon lower portions 57 of the stationary side frames, as represented in Fig. 3, and are connected by bolts 58 with the supporting members 21, 22.

The opposite or rear end of the upper supporting members 21, 22 rest upon cams 60, 61, see Figs. 4 and 5, which are fast on shafts 62, 63 supported in the lower supporting members *f*, *g* and in bearing hubs 64, attached to the stationary side frames. The cams 60, 61 are suitably shaped to elevate the rear ends of the upper supporting members 21, 22 from the rear ends of the lower supporting members *f*, *g* and thereby vary the depth of the outlet or rear end of the chamber or passage *a* when it is desired to vary the thickness of the board.

The upper supporting members 21, 22 have cooperating with their top surfaces, a second set of cams 66, 67 which are fast on a shaft 68 and serve as abutment members to limit the upward movement of the upper supporting members. The shaft 68 is connected at one end with the shaft 62 by sprocket wheel 69, link chain 70 and sprocket wheel 71, see Fig. 5, and at its opposite end with the shaft 63 by sprocket wheel 72, link chain 73 and sprocket wheel 74, and is provided with a handle 75 for turning it, so as to turn the four cams 60, 61, 66, 67 simultaneously. The upper and lower endless platens have cooperating with them drainage belts 76, 77 through which the water may pass when it is expressed from the fibrous material or stock on the passage of the latter through the board forming chamber *a*. The drainage belts 76, 77 may be of any suitable construction, but it may be preferred to employ the construction illustrated in Figs. 1, 6 and 7, wherein the drainage belt is shown as com-

posed of an endless layer 79 of wire mesh, an endless layer 80 of perforated thin metal, preferably brass, and an endless layer 81 of fabric.

The endless drainage belts 76, 77 are arranged to contact with the lower lap of the upper endless platen *d* and with the upper lap of the lower endless platen *e* and to preferably be separated from the upper lap of the upper platen and from the lower lap of the lower platen so as to afford opportunity for washing any fiber stock which may adhere to the drainage belt. As represented in Fig. 1, the upper drainage belt 76 is passed about a pulley 82 and the lower drainage belt 77 about a pulley 83 located at the rear end of the apparatus, and the said belts have cooperating with them spray nozzles or devices 84, which are supplied with water from a pipe 85 connected in practice with the water main.

The endless platens are arranged on the framework of the apparatus so as to provide the chamber *a* with a greater area at its inlet end and in the present instance the platens are arranged so as to form a board forming chamber which tapers from its inlet toward its outlet end, with the platens forming a pair of opposing walls of said chamber, which converge and are movable toward the outlet end of said chamber.

The inlet end of the board forming chamber *a* is operatively connected with a supply of fiber stock admixed with a relatively large amount of water, or other fluid, which supply is represented herein by a pipe 86 provided with a nozzle 87 which is extended into the chamber *a* at its inlet end. The nozzle 87 is constructed and arranged to make a relatively water-tight fit with the walls of the chamber *a*, and the platens are provided with packing strips 88, see Figs. 6 and 7, which make a watertight joint with the side walls *b*, *c* of the chamber *a*. In operation with the apparatus herein shown and described, the fiber stock admixed with a relatively large amount of water or other fluid and therefore in a fluent condition is admitted into the chamber *a* under pressure and fills the same, and is carried forward toward the relatively narrow outlet end of said chamber by the movable opposing walls *d*, *e* thereof. On the passage of the fibrous stock through the chamber *a*, the greater portion of the water passes out of the chamber *a* through the drainage belts, and the loose fibers are thereby brought together, and form a homogeneous mass of fibers interlocked in all directions of substantial thickness and admixed with fluid, which mass is advanced substantially as fast as formed and is subjected on opposing surfaces to pressure without disturbing the relation of the interlocked fibers, which pressure is maintained and increased as the fibrous mass approaches the outlet end of the chamber, thereby consolidating and compacting the fibrous mass into a board 100 after the manner represented in Fig. 13, which is carried out from the chamber and is carried away therefrom in any suitable manner. It will be observed, that the board 100 formed as above described may be continuous or indeterminate in length, and may be cut up into individual boards of any desired or required length. It will further be observed that the fibrous material in a loose condition is admitted into the chamber in the presence of a relatively large amount of water, or other fluid, is fed forward in said chamber and gradually or progressively consolidated and compacted into a relatively solid mass to form a board of predetermined thickness, and of substantial strength owing to the interlocking of its fibers, which can be subsequently dried, and otherwise treated, and further which can be made rapidly in a continuous manner and at a minimum expense. It will further be observed that with the apparatus herein shown, the homegeneous mass of fibers interlocked in all directions, before being subjected to the maximum pressure on its opposing surfaces, is supported by the side walls of the chamber laterally of the points or area where the maximum pressure is applied, and is also supported at its rear by the fluid pressure within the chamber, and is therefore prevented from being moved laterally and rearwardly while it is being moved forward to the place where it is subjected to the maximum pressure. It will further be observed that the fibers of the portion of the board which is subjected to the maximum pressure, are interlocked with the fibers of the homogeneous mass of greater thickness and which is subjected to lesser pressure, and that the transition from the homogeneous mass of interlocked fibers containing more or less water into a compact homogeneous mass of interlocked fibers containing substantially little water, is gradual and continuous while the fibrous mass is in motion, and is accomplished by the movable platens without rupturing or otherwise disturbing the interlocked relation between the fibers subjected to the maximum pressure and those subjected to a lesser pressure.

In Figs. 6 and 7 the side walls *b*, *c* of the board forming chamber *a* are shown as separate from the endless platens, but if desired the side walls *b*, *c* may be attached to or form part of one of the endless platens as represented in Figs. 11 and 12. So also, it may be preferred to make the endless platens in sections as represented in Fig. 6, but it is not desired to limit the invention in this respect as they may be made in the

form of endless wires, cords, or the like 90, and the drainage belt may be made of the perforated metal 80 alone, as represented in Figs. 9 and 10.

It may be preferred to adjust the upper supporting members 21, 22 by cams, as represented in Figs. 4 and 5, but it is not desired to limit the invention in this respect as they may be adjusted by fluid pressure after the manner shown in Fig. 8, wherein an hydraulic ram 91 is shown as engaged with the top surface of one supporting member as 22, and the hydraulic ram 92 with the lower surface thereof.

In the present instance one construction of apparatus is shown for making a board of an indeterminate or continuous length by feeding fibrous stock through a chamber having a pair of opposing walls which are movable toward the outlet end of the chamber, but it is not desired to limit the invention to the particular construction of apparatus herein shown.

Claims—

1. A method of making fiber board of considerable thickness comprising mixing paper fiber with an excess of water so that the individual fibers interlock with one another in all directions, forcing the water and fiber under great pressure into a forming chamber and conveying it through said chamber with progressively increasing mechanical pressure while permitting the water to escape until the desired thickness of board is attained, the mechanical pressure being laterally applied and the material being compressed thereby while confined against escape or displacement by the formed board at one end and the force feed pressure of the water and fiber at the other.

2. In an apparatus of the character described, in combination, a pair of endless platens composed of sections pivotally connected together and arranged to form substantially flat or straight converging unyielding opposing walls of a chamber, means co-operating with said platens to form side walls of said chamber, means for supplying said chamber with fibrous stock in a fluent condition, and means for moving said endless platens to feed the fibrous stock toward the outlet end of said chamber and progressively separate the fluid therefrom and compact and felt said fibrous stock.

3. In an apparatus of the character described, in combination, a board-forming chamber having a pair of opposing and converging foraminous walls and a pair of walls co-operating with said converging walls to form a chamber having walls at its top, bottom and sides, said converging walls being movable from the inlet toward the outlet end of said chamber, means co-operating with said converging walls to maintain them substantially flat or straight, and a nozzle co-operating with the walls of said chamber at its inlet end to render said chamber relatively fluid-tight at its inlet end and for supplying material mixed with fluid under pressure into said chamber.

4. In an apparatus of the character described, in combination, a board-forming chamber open at its outlet end and substantially fluid-tight at its sides and inlet end and provided with a pair of endless platens arranged to form substantially flat or straight opposing and continuously converging foraminous walls of said chamber, and having side walls co-operating with said converging walls, means for moving said endless platens from the inlet end toward the outlet end of said chamber, and means for supplying said chamber at its inlet end with fibrous material admixed with fluid.

5. In an apparatus of the character described, in combination, a board-forming chamber provided with continuously converging opposing foraminous walls movable toward the outlet end of said chamber to subject a homogeneous mass of interlocked fibers admixed with fluid to a continuously increasing pressure on opposing surfaces and compact and felt said mass into the form of a board and to move the latter out of said chamber, and means for supporting the homogeneous mass of interlocked fibers at the rear and sides of the area of maximum pressure while said mass is being subjected to an initial pressure less than said maximum pressure and means for maintaining said foraminous converging walls substantially flat or straight.

6. In an apparatus of the character described, in combination, a board-forming chamber provided with continuous, substantially straight or flat converging opposing foraminous walls movable toward the outlet end of said chamber, means for supplying a homogeneous mass of fibers interlocked in all directions to said chamber to be engaged with and moved by said converging walls and to be subjected thereby to an increasing pressure, means for solidly supporting said converging walls to maintain them substantially straight or flat against movement away from each other by the interlocked fibrous mass and thereby prevent disturbance of the interlocked condition of its fibers, means for supporting the mass of fibers at the sides of said chamber while being compressed by said converging walls, and means for moving said converging walls toward the outlet end of said chamber.

7. The method of making fibrous board, which consists in forming a homogeneous mass of fibers interlocked in all directions and admixed with fluid, moving said mass through a board-forming chamber; applying an initial pressure to opposing surfaces of successive portions of said mass while the

latter is in motion in said chamber; progressively increasing the pressure upon the successive portions of the mass initially compressed while the initial pressure is being applied to a following uncompressed portion of said mass, and subjecting a substantial length of the fibrous mass to pressure over the entire area of said length with different pressures applied to different portions of said length while the latter is in motion within the board-forming chamber.

In testimony whereof, I have signed my name to this specification.

HENRY CARMICHAEL.