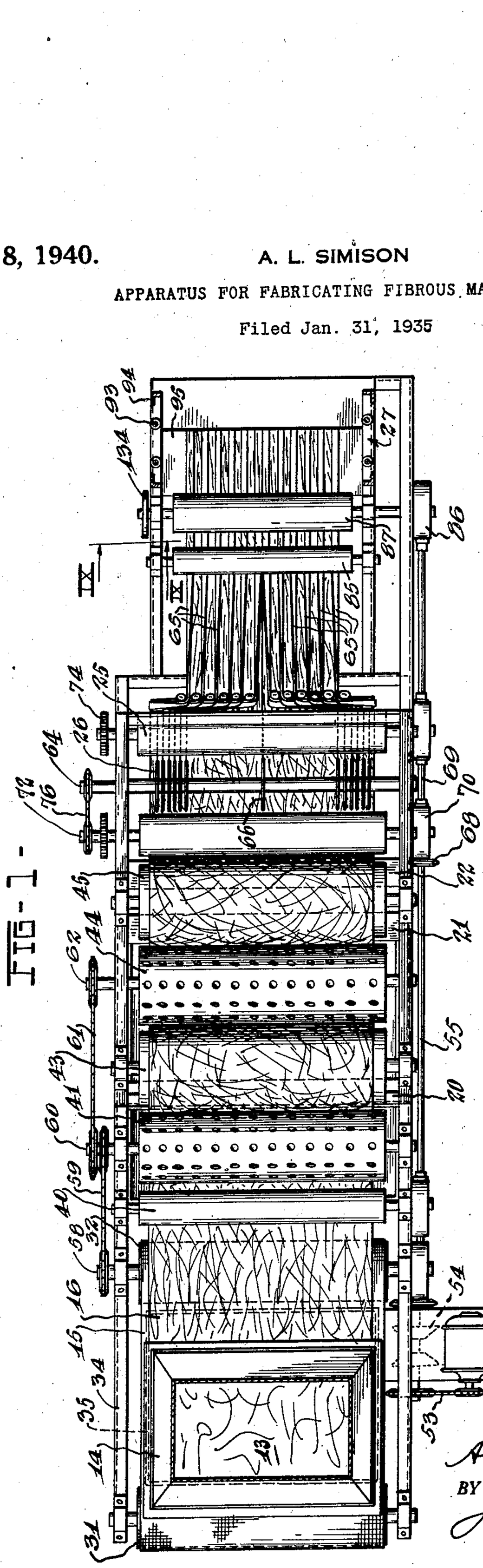
Oct. 8, 1940. A. L. SIMISON 2,216,759

APPARATUS FOR FABRICATING FIBROUS MATERIAL

Filed Jan. 31, 1935 7 Sheets-Sheet 1

FIG-1-



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APPARATUS FOR FABRICATING FIBROUS MATERIAL

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FIG. 2.

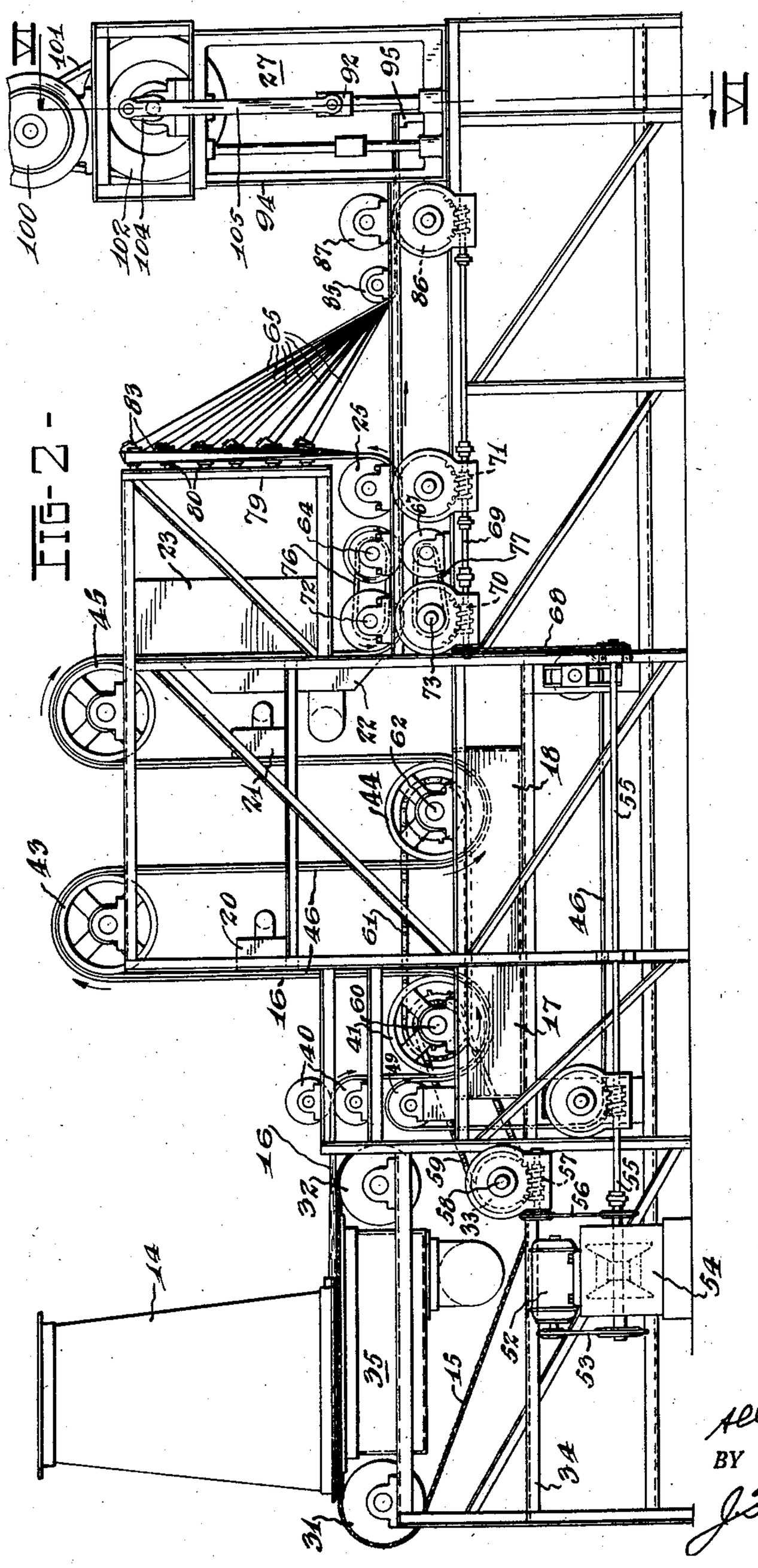

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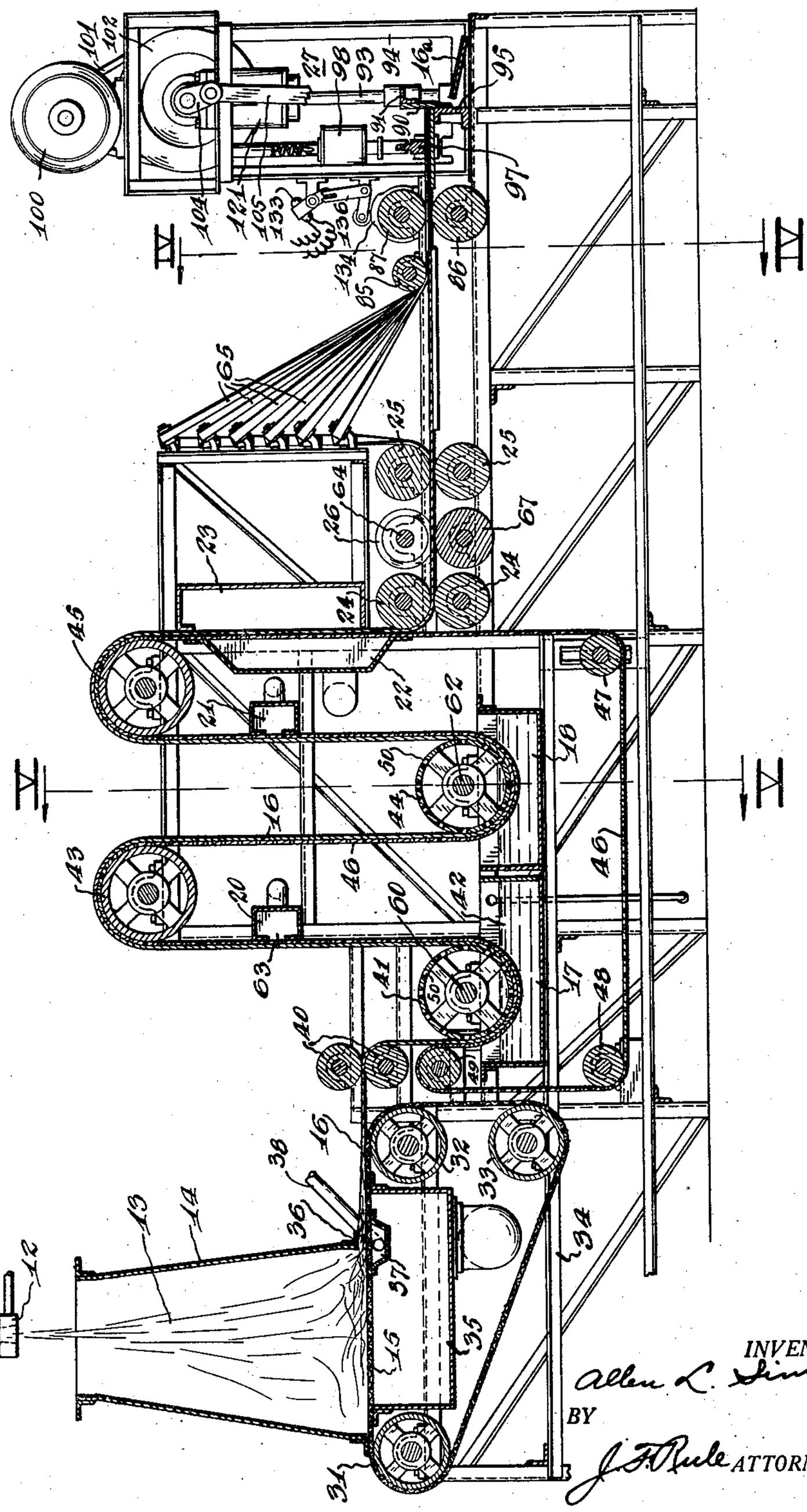
FIG-3-



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APPARATUS FOR FABRICATING FIBROUS MATERIAL

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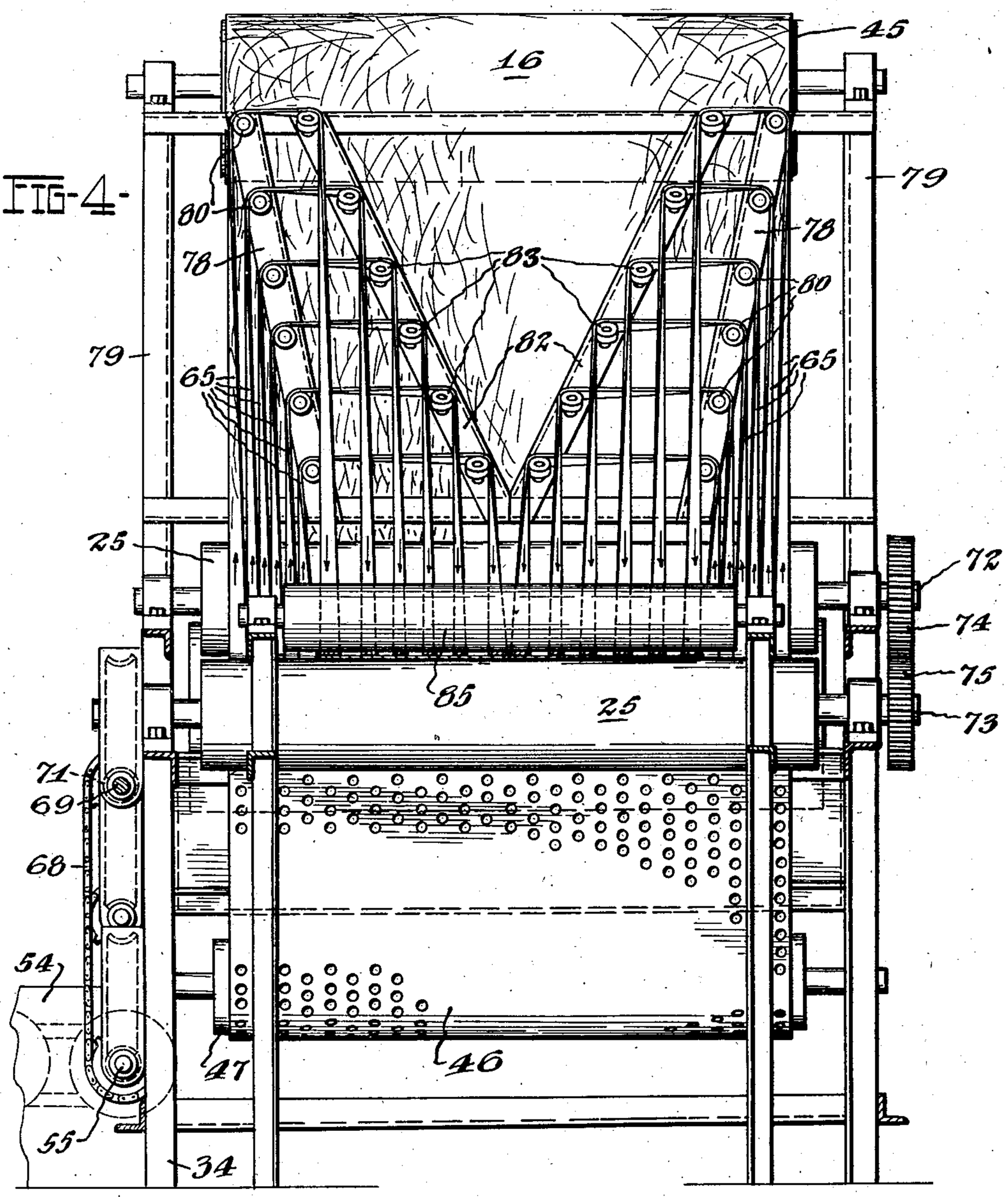
FIG-4-



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APPARATUS FOR FABRICATING FIBROUS MATERIAL

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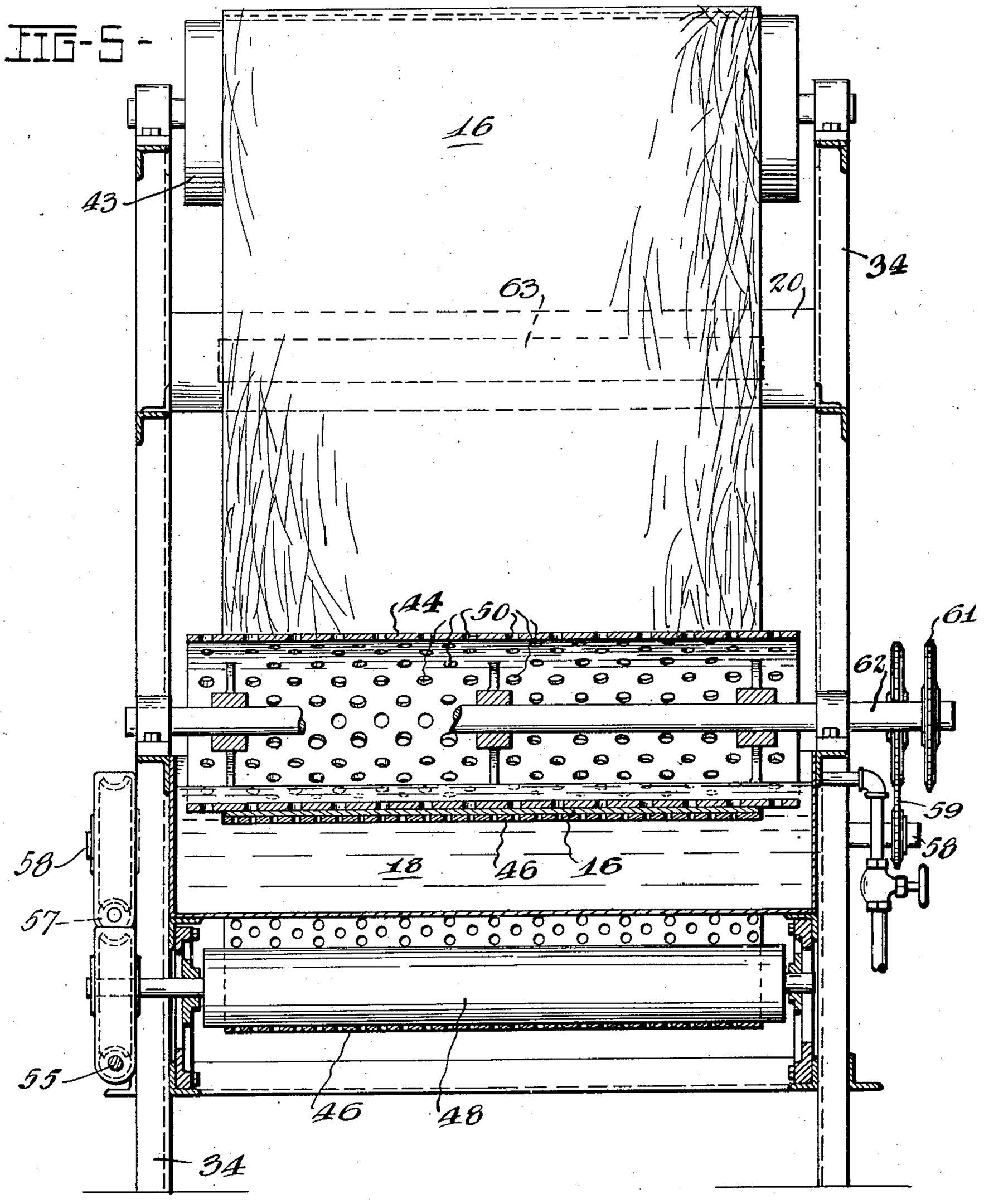
FIG-5-



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APPARATUS FOR FABRICATING FIBROUS MATERIAL

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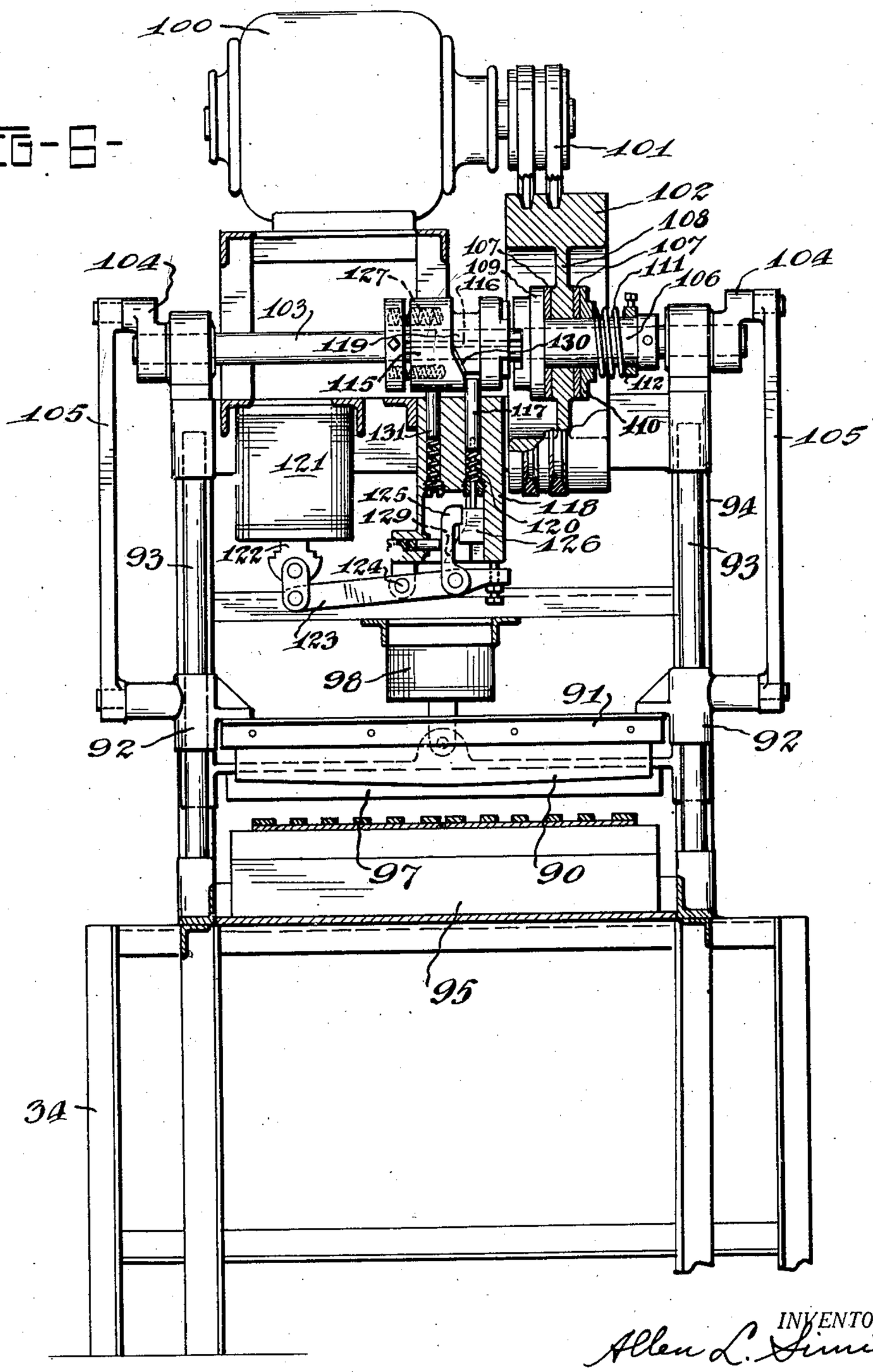
FIG-6-



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APPARATUS FOR FABRICATING FIBROUS MATERIAL

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FIG-7-

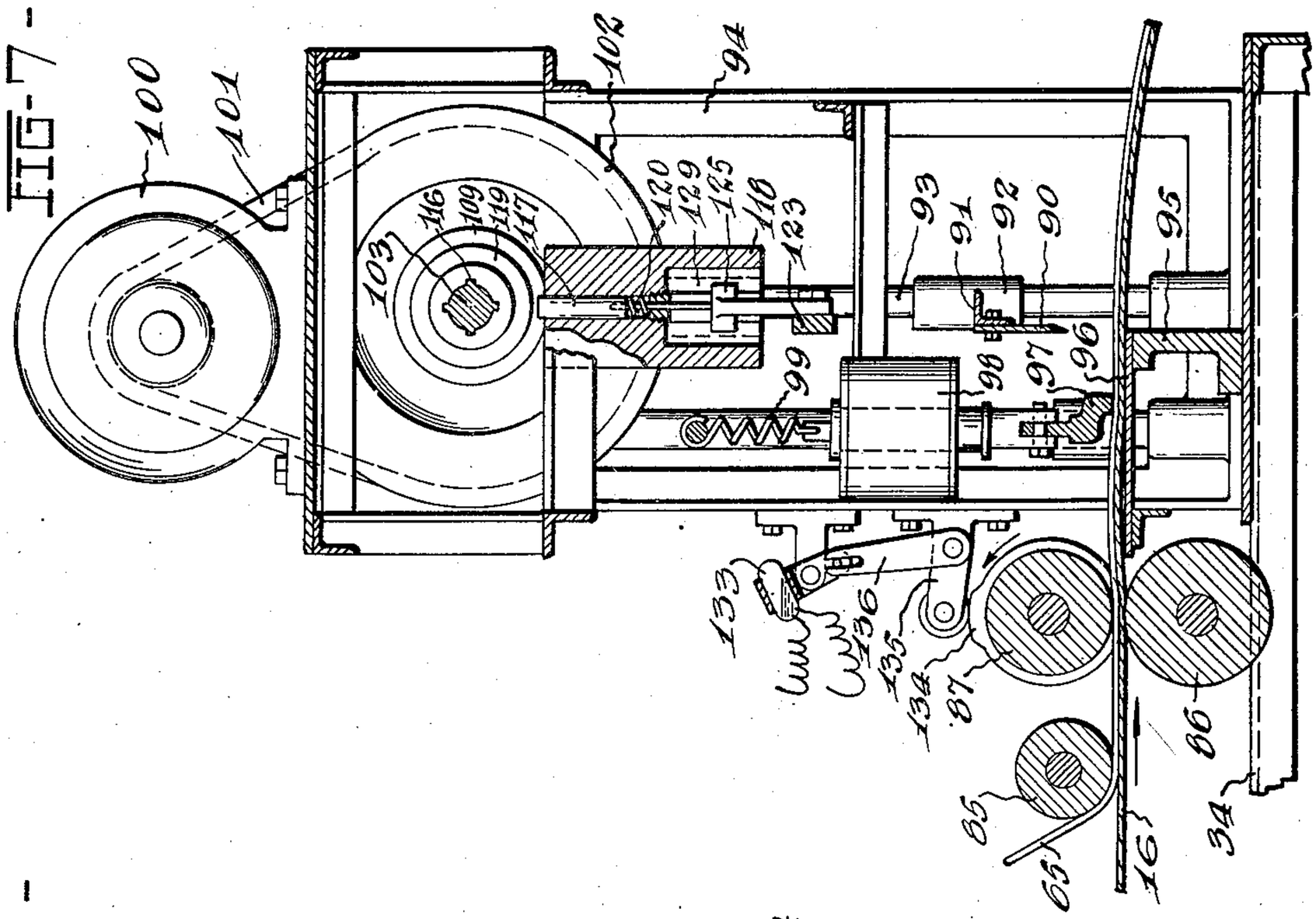

FIG-8-

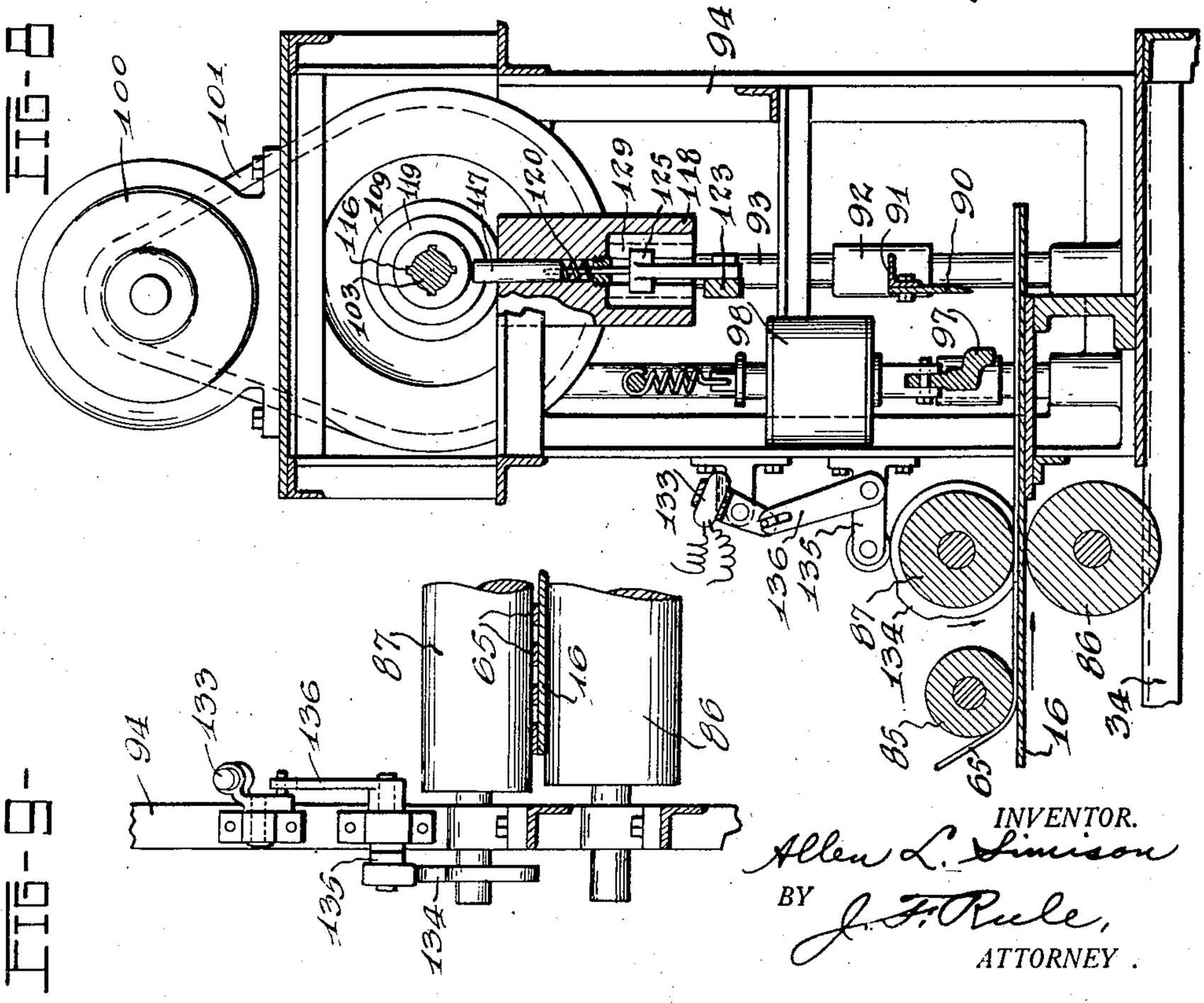

FIG-9-

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UNITED STATES PATENT OFFICE

2,216,759

APPARATUS FOR FABRICATING FIBROUS MATERIAL

Allen L. Simison, Newark, Ohio, assignor, by mesne assignments, to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Application January 31, 1935, Serial No. 4,422

8 Claims. (Cl. 154—28)

My invention relates to a method and apparatus designed for use in the manufacture and fabrication of fibers for the production of material or articles comprising such fibers in felted or matted form. The invention is herein illustrated and embodied in an apparatus adapted for flowing streams of molten glass, reducing said streams to fine fibers or filaments, accumulating the fibers as they solidify, forming them into a continuously advancing web of the matted fibers, treating the web with a suitable binding material, severing narrow strips from the web and attaching them to the face of the web in the form of spaced ribs, and severing the web into individual plates or sections.

An object of the invention is to provide a novel and practical apparatus and method for felting the fibers as they are produced, which method includes blowing the individual fibers, as by means of an air or steam blast, against a screen arranged to extend across the path of the blast, the screen permitting the free passage of the blast of air or other gas while the fibers accumulate and are evenly distributed over the surface of the screen and compacted thereon by the force of the blast.

In the preferred form of the invention, the screen consists of a continuously traveling endless conveyor by which the matted fibers are continuously carried beyond the blast in the form of a web.

Other objects of the invention will appear hereinafter.

Referring to the accompanying drawings:

Fig. 1 is a part sectional plan view of a preferred form of the apparatus.

Fig. 2 is a front elevation of the apparatus.

Fig. 3 is a longitudinal sectional elevation of the same.

Fig. 4 is a cross-sectional elevation at the line IV—IV on Fig. 3.

Fig. 5 is a cross-sectional elevation at the line V—V on Fig. 3.

Fig. 6 is a cross-sectional elevation at the line VI—VI on Fig. 2.

Fig. 7 is a longitudinal sectional elevation showing the chopper mechanism.

Fig. 8 is a similar view, but with the operating parts in the positions assumed at a different period in the cycle of operations.

Fig. 9 is a detail sectional view, the section being taken at the line IX—IX on Fig. 1.

The apparatus in the particular form herein illustrated is adapted for making battery separator plates comprising fine glass fibers or wool matted, felted, cut to desired size, provided with parallel spaced ribs of the same material attached to one face of the plate, and a suitable binding material with which the plate is impregnated and the ribs attached thereto.

The apparatus in general comprises a feeder 10 (Fig. 3) by which streams of molten glass are supplied, blowers 12 which reduce the molten material to fine fibers 13, a hood or conduit 14 through which the fibers are blown downward, a horizontally traveling foraminous or open mesh conveyor 15 on which the material accumulates in the form of a web 16, tanks 17 and 18 which may contain solutions of a binding material or the like through which the web passes in succession, suction devices 20 and 21 by which a portion of the liquid is withdrawn from the web, drying means including a low pressure vacuum chamber 22 and a heat chamber 23, pairs of calender rolls 24 and 25, disk cutters 26 by which narrow strips are severed from the body of the web, mechanism for supporting, guiding and feeding said strips and applying them in parallel spaced relation to the upper face of the web, and cutter mechanism 27 by which the web is severed to form individual articles.

The feeder 10 supplies continuous streams 30 of molten glass which flow vertically downward through the blowers 12. Air, steam or other gas under pressure is supplied to the blowers. The downwardly directed jets or blasts of gas from the blowers engage the streams of glass and draw them out into fine filaments 13. These are carried downward at a high velocity by the force of the gas and deposited on the endless conveyor 15.

The conveyor 15 runs over rolls 31, 32 and 33, mounted on the framework 34 which provides a support for the entire fabricating apparatus. The conveyor 15 is preferably a wire screen conveyor of open mesh, sufficiently fine to prevent the passage of the fibrous material therethrough, but which permits the blast of gas from the blowers to pass freely therethrough at a high velocity so that the glass fibers are closely packed on the screen by the pressure of the gas. The hood 14 confines the blast, prevents scattering of the fibers and causes an even distribution of the air pressure so that the fibers are deposited in an even layer on the conveyor 15. The fibers as they are deposited, are interwoven, felted and matted so that the material is carried forward by the conveyor in the form of a closely matted web 16.

A vacuum chamber 35 is provided beneath the

horizontal lead of the conveyor 15 and underlies the major portion of the hood 14. A partial vacuum maintained in this chamber materially facilitates the movement of the steam or other gas from the hood through the conveyor and the fibers accumulating thereon, and thus increases the effectiveness of the blast in packing, matting and felting the fibrous material as it accumulates and forms a web. A narrow slot 36 between the conveyor 15 and the lower, front edge of the hood, provides a passageway for the web and limits its thickness. Underneath the conveyor 15 and directly beneath said slot is a high vacuum chamber 37 from which the air is exhausted through a pipe 38. This serves to prevent clogging of the material at the outlet 36 and supplements the action of the blowers in compacting the material.

It will be noted that the horizontally traveling conveyor 15 is substantially perpendicular to the blast of air or gas passing therethrough. It will also be noted that the fibers are not accumulated until they have reached a position to be supported on the conveyor, said fibers being separate and free to descend at the high velocity of the blast of gas. In other words, they are free and unobstructed during their rapid descent through the hood.

As the web 16 advances beyond the conveyor 15, it passes between a pair of rolls 40 which serve to crush any lumps or shot which the web may contain. From the rolls 40, the web passes downward to a guide roll 41 which is partially immersed in a bath 42 contained in a tank 17. The bath may consist of a solution of latex, glue or other binder or material, or any liquid, emulsion, or solution with which the web is to be treated. The web passes around the lower surface of the roll 41 and is thereby guided through the bath 42. From the roll 41, the web passes upward to and over an overhead roll 43 and thence downward to a second bath of binding material or the like contained in a tank 18. The web is guided through the second bath by a roll 44 and from thence passes upward to and around a second overhead roll 45.

The web 16 is supported and guided by an endless belt conveyor 46 which is trained over the rolls 41, 43, 44 and 45 and rolls 47, 48 and 49. The web in its passage through the tanks 17 and 18 is interposed between the conveyor 46 and the rolls 41 and 44, and the web as it passes over the rolls 43 and 45 overlies the conveyor 46. Each of the rolls 41 and 44 is in the form of a hollow cylindrical shell or drum provided with a multiplicity of perforations 50 spaced at short intervals to permit free access of the treating solution through the interior of the roll to the inner surface of the web. The conveyor 46 is also made of openwork permitting free access of the solution to the outer surface of the web.

Driving mechanism for the web feeding devices includes an electric motor 52 (Figs. 1 and 2) which operates through a chain belt 53 and a speed changing device 54 to continuously rotate a drive shaft 55. Motion is transmitted from the shaft 55 through a belt 56 to a shaft carrying a worm 57 which drives a worm gear on the shaft 58 of the conveyor roll 33, thereby driving said roll and the conveyor 15. A chain belt 59 running over sprockets on the shaft 58 and the shaft 60 of the roll 41, drives said roll. A chain belt 61 transmits motion from the shaft 60 to the shaft 62 of the roll 44. The rolls 41 and 44 are thus positively driven and serve to drive the endless conveyor 46 and the web 16 which are trained thereover.

The conveyor 46 and web 16 as they emerge from the bath 42 move vertically upward past the suction chamber 20, the latter being provided with a comparatively narrow slot or mouth 63 across which said conveyor and web are moved. A sufficiently high vacuum is maintained within the chamber 20 to cause a strong inward draft of air through the web at the mouth 63. This operates to remove from the web the excess liquid taken up thereby during its passage through the bath 42, and also insures an even distribution and permeation of the liquid throughout the entire web. The amount of liquid withdrawn, or rather the amount which is retained by the web, can be regulated and adjustably varied by regulating the degree of vacuum or suction within the chamber 20. The suction device 21 operates in like manner to withdraw the excess liquid from the web after it passes through the second tank 18.

As the web passes downward from the idler roll 45, it traverses the low vacuum chamber 22. This creates a moderate draft of drying air which, as it passes through the web, dries or partially dries the web. The chamber 22 is of considerable length so that the web in passing thereover is subjected to the drying operation for a sufficient length of time to effect the desired drying. The heat chamber 23 which is positioned opposite the vacuum chamber 22 supplies air or other drying medium which may be heated to any desired degree required, depending upon the kind of liquid or solution with which the web has been treated, and other variable factors.

After the web has traversed the vacuum chamber 22, it passes between the pairs of calender rolls 24 and 25. These may be adjusted to apply considerable pressure to the web, further compacting it and giving it smooth finished surfaces. These rolls may be heated, if desired, for further drying the web and giving it smooth, finished surfaces.

The disk cutters 26 are mounted on a shaft 64 between the pairs of rolls 24 and 25. These cutters, as shown, are arranged to run over the marginal portions of the web and are spaced at short intervals so that they sever narrow strips 65 from the body of the web. A disk cutter 66 is mounted on the shaft 64 in position to cut the web along its center line, dividing it into two halves. A roll 67 is arranged to engage the under surface of the web directly beneath the cutters and cooperates therewith.

The calender rolls and cutters are driven by power transmitted through the drive shaft 55 and a sprocket chain 68 (Figs. 2 and 4), the latter driving a worm shaft 69. The shaft 69 has driving connections through worm gearing 70 with the calender rolls 24, and through worm gearing 71 with the rolls 25. The shafts 72 and 73 of the upper and lower rolls 24 carry intermeshing gears 74 and 75 (Fig. 4). Motion is transmitted from the shaft 72 through a belt 76 to the cutter shaft 64. Motion is transmitted from the lower roll 24 through a belt 77 to the roll 67 for positively driving the latter.

After the web passes beyond the calender rolls, the strips 65 are trained over guide rolls or pulleys by which said strips are spaced at equal intervals transversely of the main web and brought into position to overlie and contact with the web. The means for guiding the strips includes a pair of bars 78 (Fig. 4) supported on a

framework 79 above the calender rolls. Said bars are downwardly and inwardly convergent and carry a series of guide rolls 80 spaced at equal intervals therealong. The strips of webbing 65 after passing the calender rolls extend upwardly to the guide rolls 80 which are individual to said strips.

A second pair of inclined guide bars 82 carry rolls 83. Each strip 65 extends inwardly from its guide roll 80 to the corresponding roll 83 and from thence forwardly and downwardly to a horizontal roll 85 which extends across and directly over the main web. The rolls 83 are so positioned that the strips 65 are uniformly spaced when brought into contact with the main web. The binding material which has been applied to the web may retain sufficient moisture to cause the strips 65 to adhere to the web as they pass beneath the roll 85. A pair of pressure rolls 86 and 87 are positioned in advance of the roll 85. The web with the strips or ribs 65 applied thereto, passes between the rolls 86 and 87, thereby firmly pressing the ribs and main web together and insuring a good bond therebetween.

After the web passes beyond the rolls 86, 87, it is severed into individual plates or pieces by means of the chopper mechanism 27 which will now be described. This mechanism (see Figs. 3 and 6 to 9) comprises a horizontally disposed chopper blade 90 above the path of the web. The blade is mounted on an angle bar 91 secured at its ends to heads 92 formed with bearing sleeves mounted to reciprocate on vertical guide rods 93, said rods being mounted in a frame 94 which carries the chopper mechanism. As the blade moves downward, it shears across the front vertical face of a chopping block 95 and severs a predetermined length of the ribbed mat or web which has been advanced from the rolls 86, 87 over a stationary supporting plate 96.

The advancing web is momentarily held stationary at the chopping position by means of a gripping bar 97 arranged over the plate 96. Said bar is operatively connected to the solenoid of an electromagnet 98 which is periodically energized momentarily, as hereinafter described, and thereby moves the bar 97 downward to the web gripping position (Fig. 7). When the electromagnet is deenergized, the gripping bar is withdrawn by a coil spring 99.

The chopper is actuated by a continuously running electric motor 100 mounted on the frame 94, said motor having a belt connection 101 with a pulley 102 mounted on a drive shaft 103. Crank arms 104 secured to the ends of the drive shaft are connected through links 105 with the heads 92. The shaft 103 is intermittently rotated periodically through one complete rotation in a manner hereinafter described, and thereby periodically reciprocates the chopper blade 90.

The mechanism for controlling the periodic rotations of the drive shaft 103 is as follows: The pulley 102 is mounted on a bearing sleeve 106 which in turn is mounted to rotate freely on the shaft 103. The pulley has a friction driving connection with the sleeve 106 which serves as a safety device permitting the pulley to rotate independently of the sleeve in the event of an excessive load or obstruction which would prevent the sleeve from being normally rotated by the pulley. The friction driving connection comprises a pair of frictional disks 107 on opposite sides of the hub or web 108 of the pulley. One of said disks bears against a flange portion 109 of the sleeve 106. A collar 110 bears against the other disk, being held thereagainst by a coil spring 111 between the collar 110 and a collar 112 keyed to the sleeve 106.

The pulley 102 is periodically connected to the shaft 103 through a clutch comprising a clutch member 115 mounted to slide lengthwise of the drive shaft and held against rotation relative thereto by a spline or key 116. The left hand end of the sleeve 106 is shaped to form the other clutch member. The clutch members are periodically separated and held apart by means of a holding pin 117 mounted in a bearing block 118 and movable into and out of an annular groove 119 formed in the clutch member 115, said holding pin being projected into the groove by a coil spring 120.

The holding pin is periodically withdrawn from the clutch by means of an electromagnet 121 having a core 122 connected to a lever 123 fulcrumed at 124 on the block 118. The lever carries a trigger 125 which engages a shoulder formed on a head 126 attached to the holding pin 117. When the magnet 121 is energized, the lever 123 operates through said trigger to draw the holding pin out of the groove 119. This permits the clutch member 115 to be moved into engagement with the clutch member 109 by means of coil springs 127. When the clutch members are thus engaged, the continuously rotating pulley 102 imparts a rotation to the cutter drive shaft 103 for reciprocating the cutter blade 90. When the electromagnet 121 is energized, the trigger 125 during its downward movement is cammed away from the head 126 by means of a cam 129, thereby releasing the holding pin 117 after it has been withdrawn from the clutch member. The holding pin is prevented from immediately reentering the groove 119, by a cam projection 130 formed on the wall of the cam groove. As soon as the shaft commences to rotate, the projection 130 is carried beyond the holding pin, permitting the latter to reenter the widened portion of the groove. When the shaft 103 has nearly completed its rotation, the cam 130 engages the holding pin 117 so that the clutch sleeve 115 is cammed to its released position and the shaft comes to rest. A spring actuated detent 131 engages a notch in the clutch member 115 and thereby arrests and holds the latter in the same position after each rotation of the shaft.

A mercury switch 133 (Figs. 7 and 8) is connected in the circuits of the electromagnets 98 and 121. The switch is periodically actuated by a cam 134 mounted on the shaft of the roll 87. Said cam operates once during each complete rotation of the roll 87 to rock an arm 135 on a rock shaft carrying an arm 136 operatively connected to the switch. When the magnet circuits are closed, the magnet 98 operates immediately to lower the clamping bar 97 for the purpose heretofore described. The bar 97 reaches its clamping position slightly in advance of the cutting stroke of the knife bar so that the web at the cutting line is held stationary during severance. As the switch 133 is only closed for a very brief interval, the bar 97 is withdrawn before the web can pile up to any objectionable extent between said bar and the feed roll 87.

The width of the individual plates or pieces 16a which are severed from the web may be adjustably varied by replacing the roll 87 by a roll of a different diameter or by providing a plurality of cams 134 so that more than one chopping operation is effected during each rotation of the roll 87.

Modifications may be resorted to within the spirit and scope of my invention.

I claim:

1. The combination of means for flowing molten glass, a blower operable to draw the glass into fine fibers, a hood through which the glass is blown, a foraminous conveyor located at the discharge end of the hood and on which the glass fibers are blown and accumulate to form a matted web, means for continuously advancing said conveyor and thereby carrying the web forward beyond the hood, the latter being spaced from the conveyor a short distance to form a throat at the point of departure of the web from the hood, and a suction box located at the point at which the conveyor traverses said throat on the opposite side of the conveyor from said throat and operable to draw air through the conveyor at said throat, thereby compacting the web and facilitating its movement through said throat, said suction box being of such size and so positioned that it traverses those portions only of the said discharge end of the hood and interposed conveyor which are at or closely adjacent to the said throat, whereby the said compacting force of the draft of air entering the suction box is localized and applied mainly to that portion of the web entering and passing through said throat.

2. The combination of a container for molten glass having an outlet opening through which the glass issues and flows in a continuous stream, blowing means arranged to envelop said stream in a blast of gas moving in the general direction in which the stream is flowing as it enters said blast and thereby drawing the glass to fine fibers or filaments, a flat screen conveyor extending across the path of the flow of gas and substantially perpendicular thereto, means for continuously advancing the conveyor across said path and thereby carrying the material forward beyond the blast in the form of a web comprising fibers compacted and matted by the force of the blast applied thereto when the fibers are arrested on the conveyor, and a hood surrounding and confining the blast, said hood extending into close proximity to the conveyor and defining a predetermined area of the conveyor and causing a substantially uniform distribution of the fibers over said area as they accumulate on the conveyor.

3. The combination of a container for molten glass having an outlet opening through which the glass issues and flows in a continuous stream, blowing means arranged to envelop said stream in a blast of gas moving in the general direction in which the stream is flowing as it enters said blast and thereby drawing the glass to fine fibers or filaments, a flat screen conveyor extending across the path of the flow of gas and substantially perpendicular thereto, means for continuously advancing the conveyor across said path and thereby carrying the material forward beyond the blast in the form of a web comprising fibers compacted and matted by the force of the blast applied thereto when the fibers are arrested on the conveyor, a hood surrounding and confining the blast, said hood extending into close proximity to the conveyor and defining a predetermined area of the conveyor and causing a substantially uniform distribution of the fibers over said area as they accumulate on the conveyor, a suction chamber in the path of flow of the gas and at the opposite side of the conveyor from that on which the mat is formed, and means for withdrawing the gas from said suction chamber and thereby augmenting the force of the blast and its compacting action on the accumulating web.

4. The combination of a container for molten glass having a bottom outlet opening through which the glass flows vertically downward in a continuous stream, blowing means beneath and in alignment with said outlet and arranged to envelop said stream in a blast of gas moving downward with the said stream, thereby drawing the glass to fine fibers or filaments, a flat screen conveyor extending horizontally across the vertical path of flow of gas and fibers, means for continuously advancing the conveyor across said path and thereby carrying the material forward beyond the blast in the form of a web comprising fibers compacted and matted by the force of the blast applied thereto when the fibers are arrested on the conveyor, a hood surrounding and confining the blast, said hood overlying and defining a predetermined area of the conveyor and causing a substantially uniform distribution of the fibers over said area as they accumulate on the conveyor, a suction chamber beneath said hood and conveyor, and means for withdrawing the gas from said suction chamber and thereby augmenting the force of the blast and its compacting action on the accumulating web.

5. The combination of a container for molten glass having a bottom outlet opening through which the glass flows vertically downward in a continuous stream, blowing means beneath and in alignment with said outlet and arranged to envelop said stream in a blast of gas moving downward with the said stream, thereby drawing the glass to fine fibers or filaments, a flat screen conveyor extending horizontally across the vertical path of flow of gas and fibers, means for continuously advancing the conveyor across said path and thereby carrying the material forward beyond the blast in the form of a web comprising fibers compacted and matted by the force of the blast applied thereto when the fibers are arrested on the conveyor, and means for directing and confining the blast to a predetermined area of the conveyor and thereby obtaining a concentrated force sufficient for effecting said compacting and matting of the fibers.

6. Apparatus for forming a matted web of fibers, comprising an open-ended hood or conduit, means for causing movement of a gaseous vehicle through said conduit, means for introducing loose fibers into said vehicle and causing them to be carried therewith through the conduit, a foraminous conveyor positioned at the discharge end of the conduit and on which the fibers are arrested and accumulated to form a matted web, means for continuously advancing said conveyor and thereby carrying the web forward beyond the conduit, the latter having a wall thereof spaced a short distance from the conveyor to form a throat at the point of departure of the web from the conduit, and a suction box located at the point at which the conveyor traverses said throat and on the opposite side of the conveyor from the throat, said suction box being so positioned and of such extent that it traverses that portion only of the conveyor passing directly beneath and closely adjacent to said throat, whereby suction applied within said box operates to draw air or gas through the conveyor at said throat and thereby causes the application of a localized gaseous force to the fibers or portion of the fibrous mat entering and passing through said throat, thus facilitating the movement of the mat through said throat.

7. The combination of a container for molten glass having an outlet opening through which the glass issues and flows in a continuous stream,

blowing means arranged to envelop said stream in a blast of gas moving in the general direction in which the stream is flowing as it enters said blast and thereby drawing the glass to fine fibers or filaments, a flat screen conveyor extending across the path of the flow of gas and substantially perpendicular thereto, means for continuously advancing the conveyor across said path and thereby carrying the material forward beyond the blast in the form of a web comprising fibers compacted and matted by the force of the blast applied thereto when the fibers are arrested on the conveyor, a hood surrounding and confining the blast, said hood extending into close proximity to the conveyor and defining a predetermined area of the conveyor and causing a substantially uniform distribution of the fibers over said area as they accumulate on the conveyor, a suction chamber in the path of flow of the gas and at the opposite side of the conveyor from that on which the mat is formed, means for withdrawing the gas from said suction chamber and thereby augmenting the force of the blast and its compacting action on the accumulating web, and auxiliary suction means arranged to increase the suction applied to the mat over a localized area at the place of departure of the web from beneath the hood.

8. The combination of a container for molten glass having an outlet opening through which the glass issues and flows in a continuous stream, blowing means arranged to envelop said stream in a blast of gas moving in the general direction in which the stream is flowing as it enters said blast and thereby drawing the glass to fine fibers or filaments, a flat screen conveyor extending across the path of the flow of gas and substantially perpendicular thereto, means for continuously advancing the conveyor across said path and thereby carrying the material forward beyond the blast in the form of a web comprising fibers compacted and matted by the force of the blast applied thereto when the fibers are arrested on the conveyor, a suction chamber in the path of flow of the gas and at the opposite side of the conveyor from that on which the mat is formed, means for withdrawing the gas from said suction chamber and thereby augmenting the force of the blast and its compacting action on the accumulating web, and auxiliary suction means arranged to apply an increased suctional force to the mat over a localized area at and in close proximity to the point of departure of the web from the path of the said blast of gas.

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