

June 21, 1955

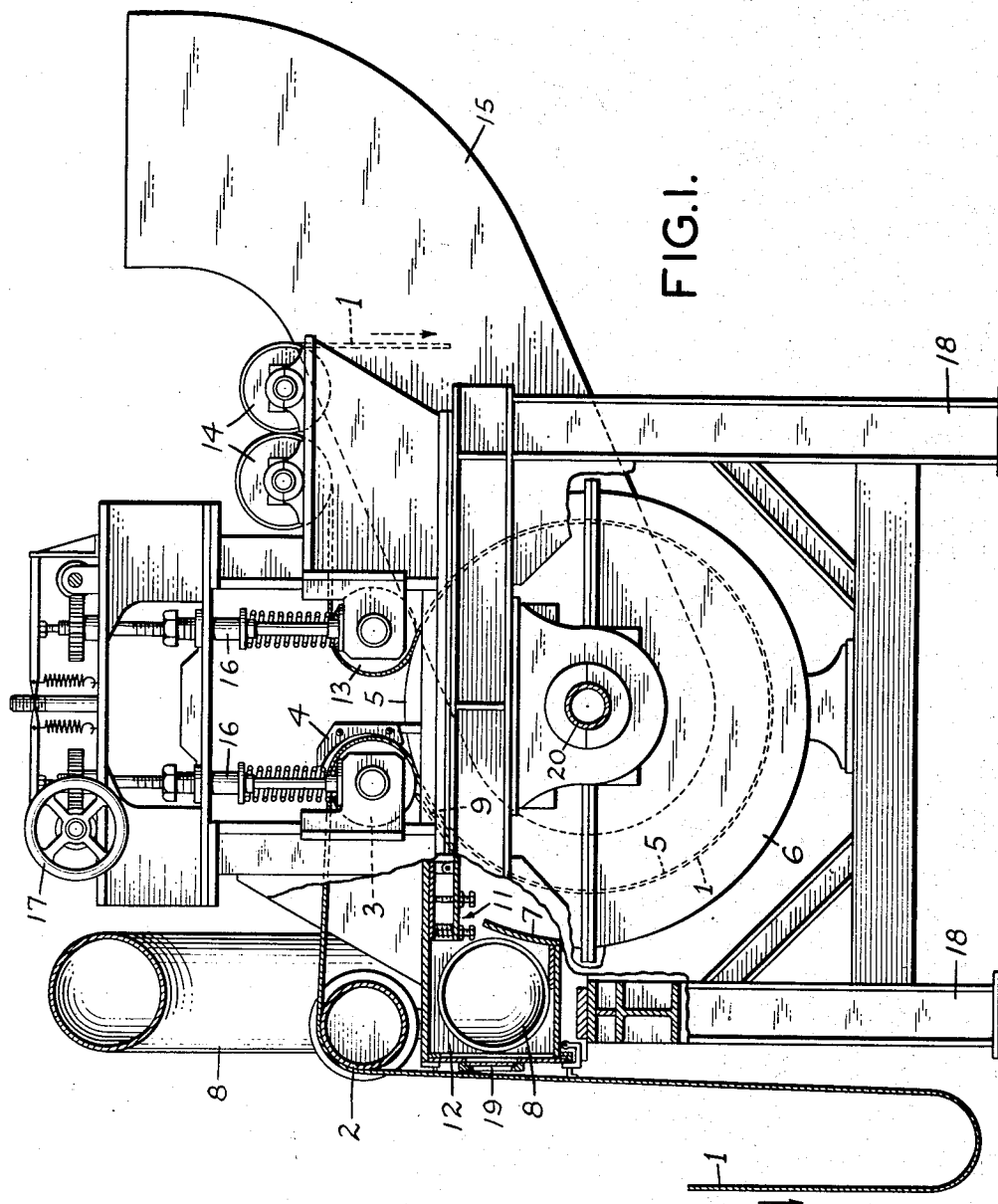
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2,711,032

FELT HEATER AND DRYER

Filed June 3, 1952

4 Sheets-Sheet 1



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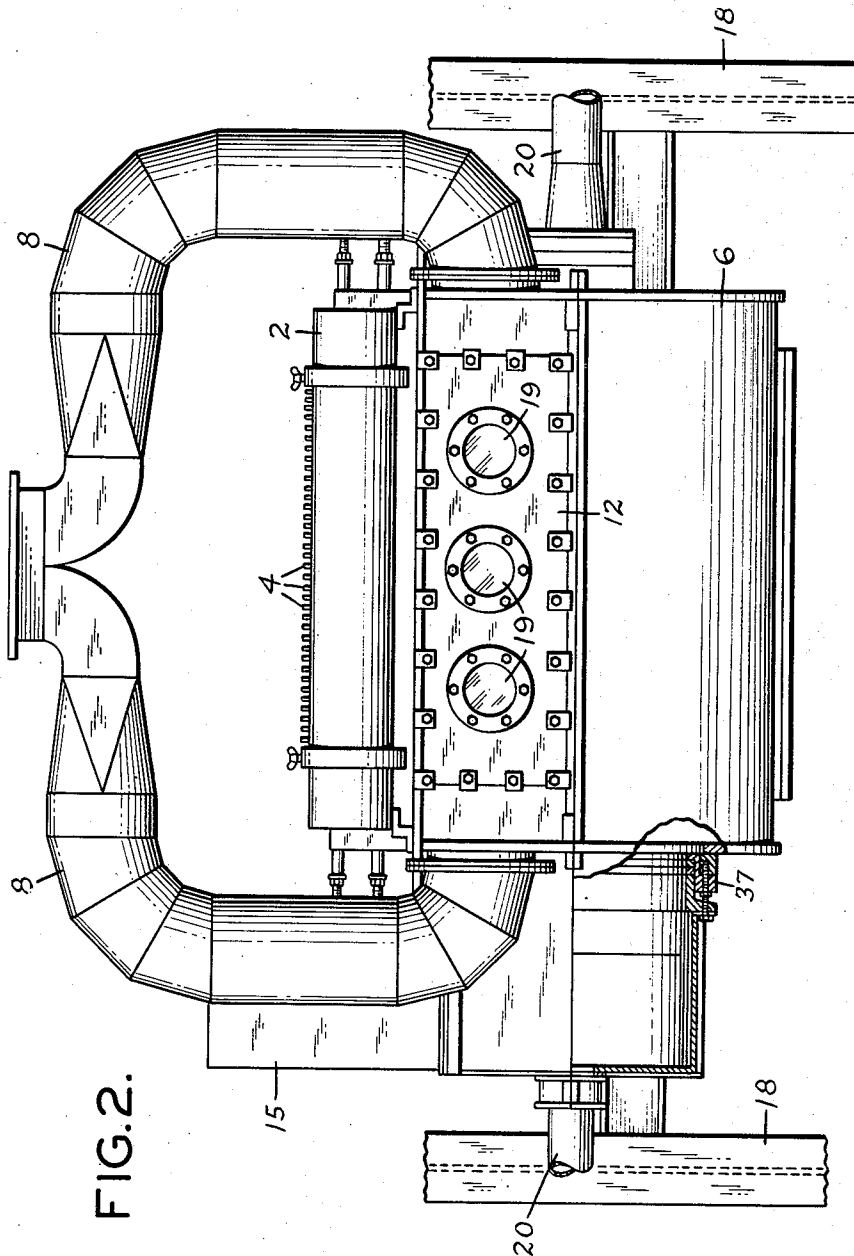


FIG. 2.

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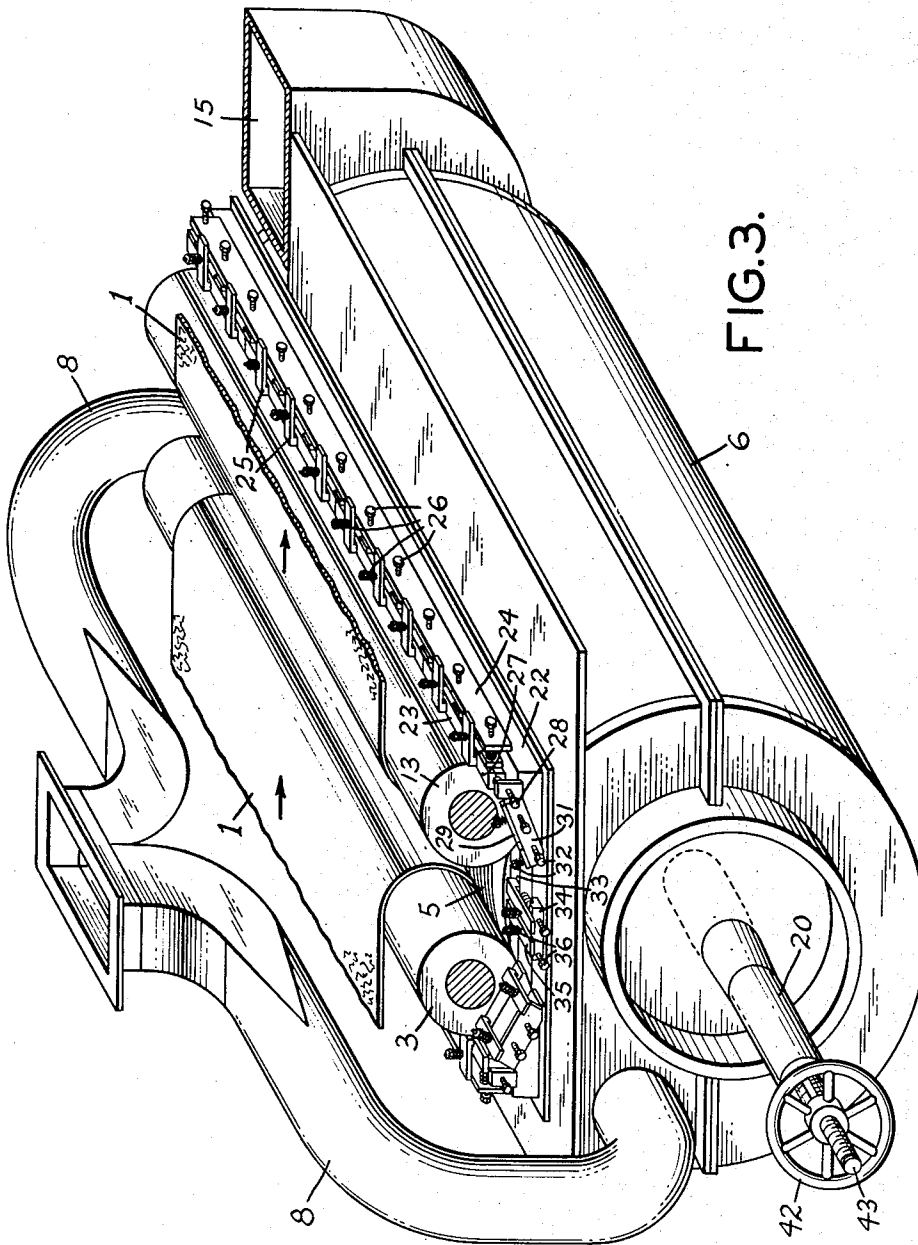


FIG. 3.

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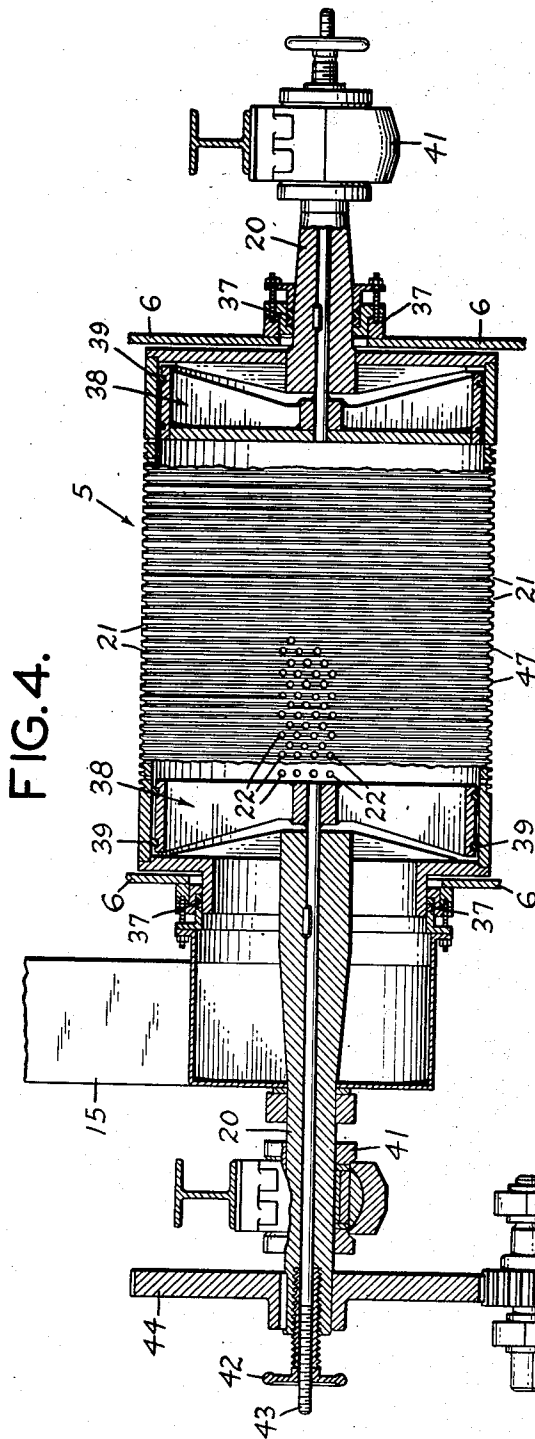
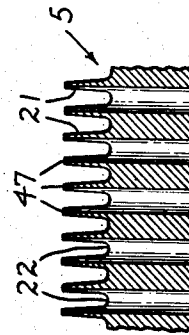
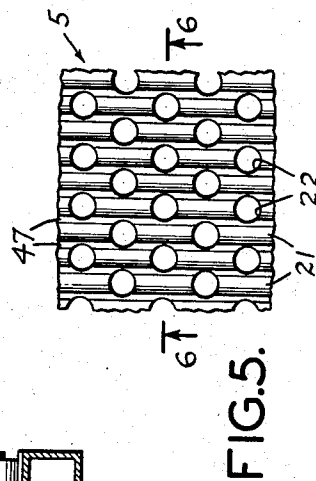
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4 Sheets-Sheet 4



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2,711,032

## FELT HEATER AND DRYER

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Application June 3, 1952, Serial No. 291,529

7 Claims. (Cl. 34—122)

This invention relates to drying and preheating felt and more particularly refers to a new and improved apparatus and method for removing moisture from felt.

Felt or fabric or web, as it is sometimes referred to in industry, is generally composed of a mixture of paper, rags, linen and other cellulose fibrous materials, and this mixture converted into elongated sheets in a manner conventional in the paper industry. The particular felt with which the present invention is concerned is a highly porous material containing a vast number of small voids and is commonly used after saturation with a bituminous material as roofing, insulation, etc. As is conventional in the paper industry the felt sheet is produced by dispersing shredded cellulose fibers in an aqueous medium which are then formed in a continuous sheet which latter, saturated with water, must be dried. Drying of the sheet is generally accomplished in three stages. The first stage is the period in which the moisture content of the sheet is reduced mechanically by the application of vacuum and then by the effect of pressure exerted by conventional press rolls, thus leaving a sheet containing moisture in an amount of roughly 50–60%. Second stage drying of the felt sheet is accomplished by passing it around hot dryer rolls. In the third stage drying, the sheet is continued through the dryer section and moisture removed by the body of felt sheet being heated above the boiling point of water. The rolls which effect drying of the felt sheet must be kept at relatively low temperatures (below about 450–500° F.) to avoid charring and deterioration of the felt. Consequently, in practice the felt must traverse a large number of rolls connected in series to effectuate removal of the moisture from the felt sheet resulting in the drying operation representing a substantial investment cost and a time-consuming operation. Because of the insulating properties of the felt the final percentages of moisture content in the felt are the most difficult to remove with the result that manufacturers of felt do not attempt to produce a bone-dry felt but sell a "dry" felt containing about 3–6% moisture. As pointed out in my coiled application Serial No. 291,530 filed June 3, 1952 entitled "Saturation of Felt," the 3–6% moisture in the commercially "dry" felt constitutes an impediment in the manufacture of saturated felt.

Objects of the present invention are to provide more efficient, rapid means and methods of preheating and removing moisture from the felt, preparatory to saturating.

Further objects of the invention are to provide means and methods of rapidly and efficiently reducing moisture of sheet in paper machine from about 20% to "commercially dry" of 3 to 6%, or down to "bone dry."

Other objects and advantages of the present invention will be apparent from the following description and accompanying drawing.

Figure 1 is a side elevation in partial section of the preheater and dryer.

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Figure 2 is a front elevation of the preheater and dryer.

Figure 3 is an isometric view of the preheater and dryer.

Figure 4 is a partial section of the perforated grooved cylinder roll employed in the preheater and dryer.

Figure 5 is a plan view of a portion of the grooved cylinder roll.

Figure 6 is a front elevation in section taken on line 6–6 of Figure 5 of a portion of the grooved cylinder roll showing in greater detail the construction of the grooves and the perforations.

Referring to Figure 1, a continuous sheet of moist felt 1 passes over stationary (or slowly) turning in reverse direction) guide 2, thence around entrance pressure roll 3, guided by entrance sheet guide 4 during the initial threading operation, between entrance pressure roll 3 and perforated grooved cylinder roll 5, around the perforated grooved cylinder roll 5, emerging between exit pressure roll 13 and cylinder 5 and withdrawn by passing between pull rolls 14. Surrounding perforated grooved cylinder 5 is a spaced outer shell 6 open at its top. An enlarged chamber 12 forming a part of the upper portion of shell 6 including curved wall 7 is provided for the introduction of hot gases through conduit 8 and also to contain doctor blade 9 with support and adjusting screws 11 for the doctor blade. The purpose of doctor blade 9 is to prevent sheet 1 from continuing its passage around roll 3, particularly when threading. Spring loaded rods 16 are provided for pressure application of rolls 3 and 13 against perforated grooved cylinder 5. Vertical adjustment of pressure rolls 3 and 13 may be made by turning wheel 17 (one not shown) connected by conventional gears to rods 16. Windows 19 are provided for obtaining access to chamber 12 and to permit viewing the operation of doctor blade 9 to make certain that it is properly adjusted. The entire apparatus is supported by the usual structural member designated generally by numeral 18.

Threading, a difficult and time-consuming task, may be accomplished with ease and rapidity in the machine of the present invention due to its construction by the following procedure. First, sheet 1 is fed into the nip of roll 3 and drum 5 without air pressure. As soon as this has been done, air pressure is turned on and the machine started up. The air pressure holds the sheet against the drum 5 until it exits at roll 13. During the threading guide 4 functions to guide sheet 1 along roll 3 and thereafter guide 4 serves no purpose. Doctor blade 9 also serves during the threading to guide sheet 1 onto drum 5 and prevent the sheet from continuing its passage around roll 3. The spiral shape of shell 6 results in the formation of an annulus between shell 6 and roll 5 of gradually diminishing cross-sectional area. Consequently, although the volume of gases entering the annulus diminishes as it passes through the annulus due to escape through drum 5, this loss in gas volume normally accompanied by decrease in gas velocity is compensated by the diminishing cross-sectional area of the annulus which tends to increase the velocity of gases. Thus, spiral shell 6, by forming a gradually constricted annulus with drum 5, minimizes loss in gas velocity throughout and thereby materially aids in threading drum 5 by keeping sheet 1 pressed against drum 5 throughout its passage through the annulus. The maintenance of more uniform gas velocities throughout the annulus by means of spiral shell 6 is also beneficial during the drying operation of sheet 1 since it permits more uniform drying conditions of the entire sheet lying on roll 5.

Hot gases such as combustion gas, air or superheated steam, preferably at a temperature below 500° F. to avoid charring of the felt, and under superatmospheric pressure,

about 3-10 p. s. i. gauge, or higher, are introduced into chamber 12 by conduits 8 entering below the sides of chamber 12 (Figure 2) passing into the annulus between perforated grooved drum 5 and spiral shell 6 (Figure 1), thence through felt 1 lying on drum 5 thereby heating the felt and driving its contained moisture converted to steam together with entrapped air out of the felt. The mixture of hot gases, steam and air from the felt escapes through the perforations (Figures 4, 5 and 6) into the interior of drum 5 and is released therefrom through hub exhaust 15. A small portion of the mixture of gases passes through the perforations or along the grooves of cylinder 5 and escapes from the uncovered portion of cylinder 5 protruding above shell 6 and lying between entrance pressure roll 3 and exit pressure roll 13. The pressure of the hot gases, desirably at the maximum temperature permissible without charring the felt, entering chamber 12 holds sheet 1 tight against drum 5 and rotation of this drum provides the necessary pull to carry the sheet through the heater without imposing undue stress on the sheet. Passage of the hot gases through the felt brings the source of heat into minutely intimate contact with the individual fibers of the felt; the felt is heated rapidly, the moisture in the felt is converted to steam and the steam and entrapped air are driven out of the felt so that the felt emerges from the heater substantially free from moisture.

In Figure 2 may be seen conduits 8 for the introduction of hot gases into both sides of chamber 12. Disposed above shell 6 is stationary or reverse running guide 2 and projecting above it may be seen the uppermost portion of the entrance sheet guide 4 for guiding the felt sheet along entrance pressure roll 3 particularly when threading. Exhaust gases from the interior of perforated cylinder 5 are released through hub exhaust 15. Extending from each side of cylinder 5 are journals 20. Windows 19 permit viewing the interior of chamber 12.

The arrangement of seals for maintaining pressure in the preheater and dryer is illustrated in Figure 3. The felt sheet 1 enters the preheater by passing between entrance pressure roll 3 and grooved perforated cylinder 5, around cylinder 5 and emerges by passing between exit pressure roll 13 and cylinder 5. Hot gases are introduced through conduits 8 into the spiral annulus between cylinder 5 and shell 6. Exhaust gases passing into the interior of cylinder 5 through perforations therein escape through hub exhaust 15. Pressure in the interior of the preheater is maintained by means of seals pressing against the sides and ends of pressure roll 3 and 13 as well as the exposed ends of cylinder 5. The seal construction at the side of exit pressure roll 13 comprises a seal supporting block 22 on which is disposed seal 23 which in turn is held in place and urged against pressure roll 13 by means of springs adjustably mounted on pusher bar 24, dogs 25 and vertical and horizontal seal pressure springs 26. Corner seal 27 is held in position by means of spring 28. The end of pressure roll 13 is sealed by seal 29 retained in position by means of springs adjustably mounted on pusher bar 31 and springs 32. A similar sealing spring structure is provided on the opposite end of pressure roll 13. Likewise, the seals on entrance pressure roll 3 are similar in construction to those described in connection with exit pressure roll 13. As seen in the drawing, a portion of grooved cylinder roll 5 extends above shell 6. End seal 33 held in position by springs adjustably mounted on pusher bar 34, dogs 35 and springs 36 prevents leakage at this point. A similar sealing arrangement is provided at the opposite end of cylinder 5.

Figure 4 is a partial section of perforated grooved cylinder 5 showing its construction in detail. The surface of the hollow cylinder 5 is cut to provide a series of parallel circumferential grooves 21. A plurality of holes 22 are drilled in cylinder 5 through which gases from and passing through the felt escape into the interior of the drum 5, thence out through hub exhaust 15. At

both ends of cylinder 5 may be seen the walls, broken away, of shell 6 with the usual packing means 37 for preventing leakage around the ends of the walls of shell 6 surrounding journal 20 extending from cylinder 5. In the interior and at each end of cylinder 5 are pistons 38 provided with piston rings 39 to prevent leakage between the piston wall and inner surface of cylinder 5. Pistons 38 may be moved inwardly toward the center of cylinder 5 and in so doing block off a number of holes 22, thereby providing flexibility to the preheater to accommodate varying widths of felt. Journals 20 extend through and are supported by bearings 41. Horizontal movement of the pistons is accomplished by turning wheel 42 threaded on rod 43 passing through hollow shaft 20 and connected to piston 38. Rotation of cylinder 5 is accomplished by means of gear 44 meshed with intermediate gear 45 which latter is driven by some suitable power means, as for example an electric motor.

Figure 5 is an enlargement of a portion of the perforated grooved cylinder 5 showing grooves 21 and spaced holes 22, about  $\frac{1}{4}$ " diameter, preferably staggered on alternate grooves.

Figure 6 is a sectional enlargement of perforated grooved cylinder 5 showing the arrangement of grooves 21 and staggered holes 22. Desirably, the grooves 21 are constructed to have an opening of about  $\frac{1}{4}$ ", a depth of about  $\frac{5}{16}$ " and a land area, as indicated by numeral 47, of about  $\frac{1}{32}$ ". The overall dimensions of grooved cylinder 5 may be about 2-4 feet in diameter and about 3-12 feet long. One important advantage of employing a grooved cylinder is that the "land area," i. e., the surface 47 supporting the felt, is of uniform elevation and relatively small as compared to a screen cylinder or perforated drums of smooth surface thereby permitting more rapid and uniform discharge of entrapped moisture and gas from the felt subjected to heating.

Although certain preferred embodiments of the invention have been disclosed for purpose of illustration it will be evident that various changes and modifications may be made therein without departing from the scope and spirit of the invention.

I claim:

1. Apparatus adapted for drying and heating felt comprising in combination a rotating hollow perforated cylinder having a series of parallel circumferential grooves, a shell surrounding all but the topmost portion of the grooved perforated cylinder, an inlet pressure roll and an exit pressure roll disposed above and immediately adjacent each side of the perforated grooved cylinder, each said pressure roll being spaced from the perforated grooved cylinder by about the thickness of the felt to permit the passage of felt therebetween, seals surrounding the outer sides and ends of the pressure rolls and the upper exposed ends of the grooved cylinder adapted to maintain pressure on gas introduced into the space between the grooved perforated cylinder and the surrounding shell, an inlet for the introduction of gas into the space between the grooved perforated cylinder and the surrounding shell, and an outlet from the interior of the grooved perforated cylinder for the discharge of gas passing through the perforations into the interior of the cylinder.

2. Apparatus as claimed in claim 1 including a movable piston in the interior of the perforated grooved cylinder adapted to block off a portion of the holes in the grooved cylinder to accommodate felt sheets of varying widths.

3. Apparatus adapted for drying and heating felt comprising in combination a rotating hollow perforated cylinder having a series of parallel circumferential grooves, a shell surrounding all but the topmost portion of the perforated cylinder, an inlet pressure roll and an exit pressure roll disposed above and immediately adjacent each side of the perforated cylinder, each said pressure roll being spaced from the perforated grooved cylinder

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by about the thickness of the felt to permit the passage of felt therebetween, seals surrounding the outer sides and ends of the pressure roll and the upper exposed ends of the perforated cylinder adapted to maintain pressure on gas introduced into the space between the perforated cylinder and the surrounding shell, an inlet for the introduction of gas into the space between the perforated cylinder and the surrounding shell, pistons disposed at each end inside the perforated cylinder adapted to block off a portion of the perforations in the cylinder, means for effecting movement of the pistons in the cylinder, and an outlet from the interior of the perforated cylinder for the discharge of gases passing through the perforations into the interior of the cylinder.

4. Apparatus adapted for drying and heating felt comprising in combination a rotating hollow perforated cylinder having a series of parallel circumferential grooves, a shell surrounding all but the topmost portion of the grooved perforated cylinder, an inlet pressure roll and an exit pressure roll disposed above and immediately adjacent each side of the perforated grooved cylinder, each said pressure roll being spaced from the perforated grooved cylinder by about the thickness of the felt to permit the passage of felt therebetween, seals surrounding the outer sides and ends of the pressure rolls and the upper exposed ends of the grooved cylinder adapted to maintain pressure on gas introduced into the space between the grooved perforated cylinder and the surrounding shell, an inlet for the introduction of gas into the space between the grooved perforated cylinder and the surrounding shell, hollow shafts connected to each end of the cylinder and extending therefrom through the outer shell, pistons disposed at each end inside the perforated grooved cylinder, rods connected to the pistons extending through the hollow shafts, means for moving the rods to effect movement of the pistons in the cylinder, and an outlet in the hub of the cylinder for the discharge of gas from the interior of the cylinder.

5. Apparatus as claimed in claim 4 wherein the perforations in the perforated grooved cylinder are holes of about  $\frac{1}{4}$ " diameter, the grooves have openings of about  $\frac{1}{4}$ " width and the ridges of the grooves have a width of about  $\frac{1}{32}$ ".

6. Apparatus adapted for drying and heating felt comprising in combination a hollow grooved perforated cylinder, a shell surrounding all but the topmost portion of the grooved perforated cylinder, said shell having a curved inner surface to provide an annulus of dimin-

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ishing cross-sectional area between said shell and said cylinder, an inlet pressure roll and an exit pressure roll disposed above on each side of the perforated grooved cylinder, seals surrounding the outer sides and ends of the pressure rolls and the upper exposed ends of the grooved cylinder adapted to maintain pressure on gas introduced into the space between the grooved perforated cylinder and the surrounding shell, an inlet for the introduction of gas into the space between the grooved perforated cylinder and the surrounding shell, and an outlet from the interior of the grooved perforated cylinder for the discharge of gas passing through the perforations into the interior of the cylinder.

7. Apparatus adapted for drying and heating felt comprising in combination a hollow perforated cylinder, a shell surrounding all but the topmost portion of the perforated cylinder, an inlet pressure roll and an exit pressure roll disposed above on each side of the perforated cylinder, a doctor blade adjacent the inlet pressure roll adapted to guide the felt sheet from the inlet pressure roll onto the hollow perforated cylinder, seals surrounding the outer sides and ends of the pressure rolls and the upper exposed ends of the perforated cylinder adapted to maintain pressure on the gas introduced into the space between the perforated cylinder and the surrounding shell, an inlet for the introduction of gas into the space between the perforated cylinder and the surrounding shell, pistons disposed at each end inside the perforated cylinder adapted to block off a portion of the perforations in the cylinder, means for effecting movement of the pistons in the cylinder, and an outlet from the interior of the perforated cylinder for the discharge of gases passing through the perforations into the interior of the cylinder.

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