

Jan. 12, 1960

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2,920,397

METHOD AND APPARATUS FOR DRYING FIBROUS MATERIAL

Filed June 29, 1955

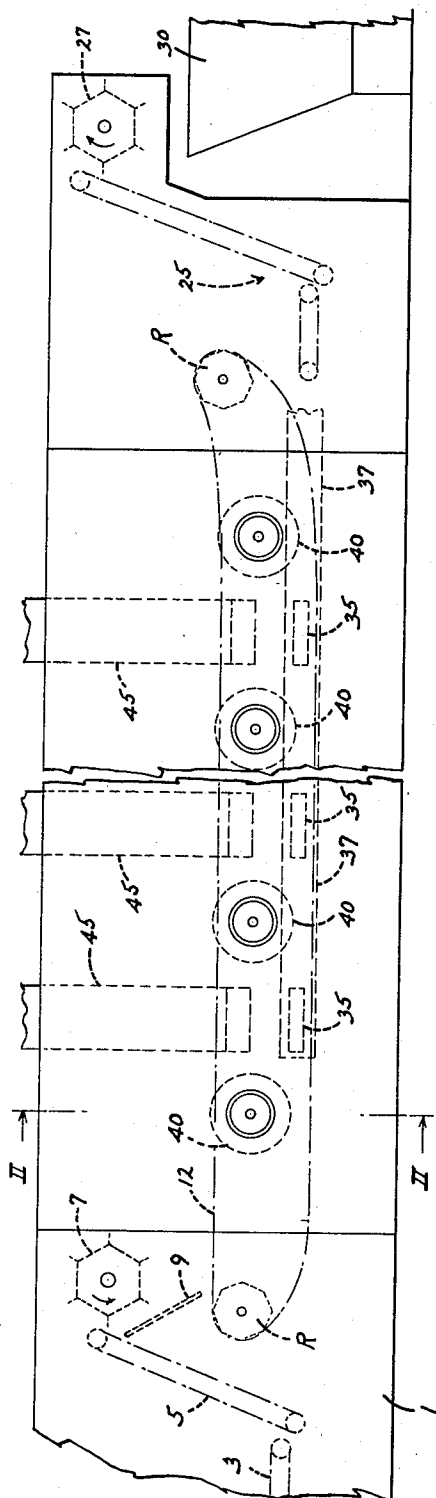


FIG-1

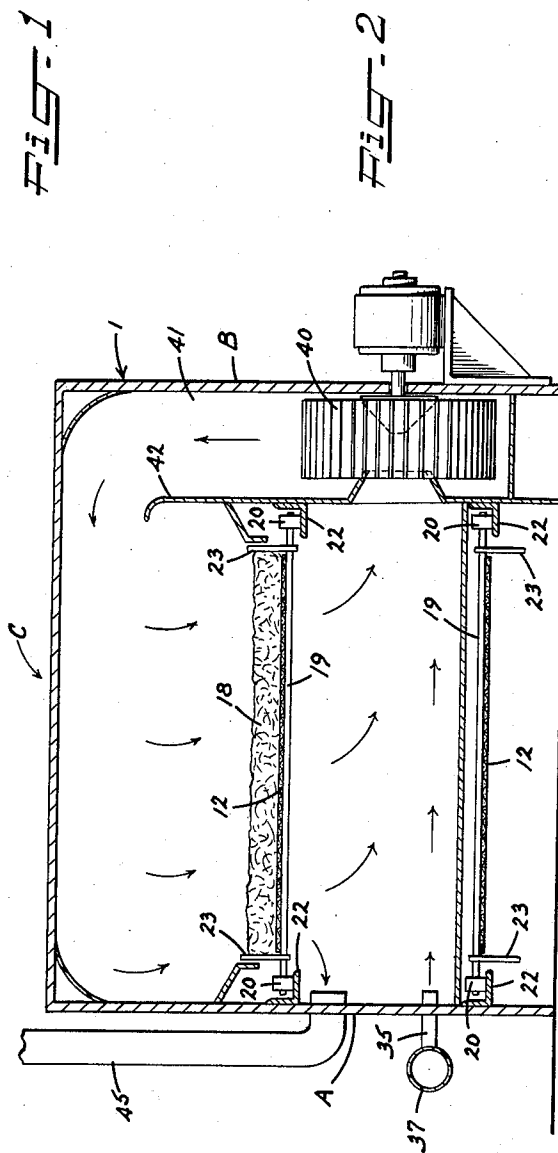


FIG-2

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METHOD AND APPARATUS FOR DRYING FIBROUS MATERIAL

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Application June 29, 1955, Serial No. 518,723

2 Claims. (Cl. 34—28)

The present invention relates to an improved method and apparatus for drying fibrous material such as staple fiber.

The fibrous material driers which are now in use and which have been in use for some time have not proved to be entirely satisfactory. Generally, these driers include an elongated housing with a foraminous conveyor belt mounted therein upon which the fibrous material is conveyed through the housing. By the use of centrifugal fans, air from the atmosphere is drawn within the housing through openings in the housing wall. The air is brought to drying temperature through contact with a series of heating pipes mounted immediately above the path of the fibrous material passing through the housing. The heated air at its point of highest temperature is then circulated by the fans through the fibrous material and then repeatedly recirculated past the heating pipes and through the fibrous material. A portion of the stream is continuously exhausted from the housing.

One of the disadvantages with such method and apparatus briefly described above is that a small amount of the fibers are picked up by the circulating air stream as it passes through the fibrous material. These fibers are usually deposited on the heating pipes and become discolored in view of their long exposure to the high temperature of the heating pipes. Eventually the discolored fibers are sloughed off into the air stream and redeposited in the fiber blanket. The fiber blanket thus becomes contaminated with the discolored fibers and much time, expense, and effort must be expended to remove the discolored fibers from the fiber blanket after it has been dried.

Another disadvantage with this type of drier is found when the drier is used to dry textile fibers, such as staple fiber, which contain volatile finishes such as a softening finish of oleic acid which is often used with rayon fibers. Some of the volatile finish boils off into the hot circulating air as the air passes through the fiber blanket. The temperature of the circulating air stream drops to its lowest point immediately after the stream passes through the fibrous material since the heat from the circulating air is absorbed by the fiber blanket as it passes through the blanket. Before the recirculating air stream contacts the heating pipes positioned within the housing, the yarn finish within the circulating air stream, due to the lowered temperature of the stream, plates out on the walls of the housing, the circulating fans, exhaust ducts, and other surfaces with which the recirculating air comes in contact. This plated out yarn finish then apparently polymerizes and as yet no satisfactory method of cleaning or removing the coating by use of solvents, etc. has been found. To remove this coating, the drier has to be shut down and a crew of workers must then manually scrape off the plated out and polymerized yarn finish. Even then, the interior surfaces of the drier can not be completely cleaned.

In some instances, with the above mentioned apparatus, filter screens are mounted adjacent the heating coils in

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order to trap fibers which have entered the air stream whereby the fiber blanket contamination mentioned above may be eliminated. This arrangement has proved to be unsatisfactory in cases where the fibers contain a volatile conditioning agent in that the conditioning agent plates out and polymerizes on the screen whereby the screen is soon clogged and interferes with the circulation of the air stream through the housing and fibrous material. The plating out on the screen is somewhat heavier than the other sections of the drier since, at this point, the air stream is at its lowest temperature.

It is therefore one object of my invention to provide a novel and improved method and apparatus for drying fibrous material wherein the above mentioned disadvantages are substantially eliminated.

Another object of my invention is to provide a novel and improved method and apparatus for drying fibrous material wherein higher drying capacities may be achieved.

Still another object of my invention is to provide a novel and improved method and apparatus for drying fibrous material wherein the use of heating pipes and filter screens within the housing may be eliminated.

A further object of my invention is to provide a novel and improved method for drying fibrous materials wherein plating out of volatile fiber conditioning agents is substantially eliminated.

An additional object of my invention is to provide a novel and improved method and apparatus for drying fibrous material wherein the drier may be operated for long periods of time without shutting down for cleaning purposes.

Other objects and advantages will become more apparent from a further study of the following description and drawings wherein:

Figure 1 is a side view of my drier for fibrous material; and

Figure 2 is an enlarged section taken along lines II, II of Figure 1.

Briefly, my drier comprises an elongated housing with a foraminous conveyor mounted therein for conveying the fibrous material through the drier. At least one inlet air duct extends through one wall of the housing for continuously feeding preheated drying medium into the housing. At least one circulation fan within the housing continuously circulates and recirculates the drying medium through the fibrous material on the housing conveyor. Exhaust ducts extend through one wall of the housing to remove a portion of the continuously circulating drying medium from the housing.

Generally, my drying method includes the steps of forming a fiber blanket from the fibrous material and conveying the fiber blanket through an elongated housing. Preheated drying medium is continuously fed directly into the housing and is circulated and recirculated within the housing confines and through the fibrous blanket. The incoming preheated drying medium is continuously combined with the circulating drying medium stream to boost and to maintain the temperature of the drying medium at normal drying temperature. A portion of the air stream is continuously being removed from the housing.

Referring now to the drawings, my drying apparatus comprises an elongated housing or shed 1 wherein fibrous material such as staple fiber is dried. The fibrous material enters the housing 1 through one end thereof on conveyor belt 3 and is discharged therefrom onto an elevating pin-type feed belt 5. The fibers are picked off of the discharge end of belt 5 by a beater 7 which separates the fibers and discharges them onto a slide plate 9 from which slide the fibers are dropped onto a foraminous endless conveyor belt 12. The fibers drop upon the conveyor belt 12 forming a fiber blanket 18 thereupon. As

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seen in Figure 2, the belt 12 is supported by end rolls R, R one of which is a drive roll. Cross bars 19, 19 support the belt 12 across its width. Rollers 20, 20 on the ends of the cross bars run along tracks 22, 22. To prevent the fibers from falling off the belt 12, side walls 23, 23 supported by the shafts 19 are provided for the belt. After the fiber blanket 18 has traveled the length of belt 12, it is deposited in a dry condition upon the discharge conveying assembly 25. A second beater 27 breaks up the fiber blanket 18 and deposits the fibers in loose and separated condition into a hopper 30.

The circulation system for the drier comprises a series of inlet ducts 35, 35 which extend through side wall A of the housing 1 along the length of the housing. A suitable drying medium, preferably air, which has been preheated to a temperature above the normal drying temperature for the fibrous material is continuously supplied to the inlet ducts 35, 35 and the interior of housing 1 from the supply headers 37, 37. The preheated drying medium may be heated by direct full firing or with any high temperature medium with which the medium comes in contact such as direct or indirect heat exchanges.

A series of centrifugal fan assemblies 40, 40 are supported externally of the housing 1 and extend through the housing wall B at spaced points along the length of housing 1. The preheated drying medium introduced directly into the housing interior is circulated and re-circulated within the housing confines and through the fiber blanket 18 by the fans 40, 40. As indicated by the arrows in Figure 2, the path of the circulated drying medium initiates at the mouth of the inlet ducts 35, 35 from which point it is drawn through the fans 40, 40 and directed upwardly to the ceiling C through the channel 41 formed by the housing wall B and the baffle wall 42. The drying medium rebounds from the housing ceiling C and passes downwardly through the fiber blanket 18 and the foraminous belt 12. A portion of the circulating stream is then discharged from the housing 1 through exhaust ducts 45, 45 which extend through the housing wall A at spaced points along the housing length immediately below the upper track of the foraminous housing conveyor belt 12. The remainder of the circulating stream is then combined with the incoming preheated air passing into the housing 1 through inlet conduits 35, 35. This circulation cycle is then continuously repeated.

The amount of air which is continuously removed from the stream through the exhaust ducts 45, 45 is equal to the amount of preheated air which is continuously introduced within the chamber housing 1 through inlet ducts 35, 35. The amount of heated make-up air introduced into the housing 1 and the amount exhausted therefrom is determined by the water evaporation rate of the water from the fiber blanket 18 and from established drying conditions.

The temperature of the circulating drying medium stream is lowered as it passes through the fiber blanket 18 since the fiber blanket absorbs heat from the drying medium. Therefore, to maintain the temperature of the circulating drying medium stream at the required drying temperature, the make-up preheated drying medium continuously entering the housing through inlet ducts 35, 35 is of a higher temperature than the required drying temperature. As the make-up preheated drying medium combines with the circulating stream, the temperature of the circulating stream is boosted to normal drying temperature.

My drier is especially proficient when used for drying staple fibers, such as regenerated cellulose fibers, which contain a volatile chemical conditioning agent. An agent of this type is oleic acid which is used to soften the fibers. As mentioned above, the volatile conditioning agent boils off into the drying medium stream circulating through the fiber blanket. If the temperature of

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the stream is lowered below the volatilizing temperature of the conditioning agent, the agent within the stream will plate out on the inner structure of the housing including the circulating fans, the inlet and exhaust ducts, etc. The plated out agent then apparently polymerizes and the inner structure of the housing becomes coated with a sticky mass. This mass must be removed by manual scraping while the drier is shut down.

One important feature of my invention is that any plating out of the conditioning agent is substantially eliminated. As mentioned above, the temperature of the air stream is lowered as it passes through the fiber blanket 18. To prevent plating out of the conditioning agent picked up from the fibers by the air stream at this low temperature area, the inlet ducts 35, 35 are so positioned so that they extend through the side wall A of the drier at points immediately below the upper track of the housing conveyor belt 12 whereby the lowered temperature of the circulating stream at this point is boosted to normal drying temperature which is above the volatilizing temperature of the conditioning agent. The circulating stream is thereby maintained at normal drying temperature until it again passes through the fibrous blanket 18.

The drier housing 1 is approximately 100 feet in length and is divided into four or more sections, each section has its own supply header 37 for supplying preheated drying medium for one or more of the inlets 35 within each of the sections. The amount and temperature of the preheated make-up medium introduced within each section varies as the fiber blanket 18 proceeds from the wet end to the dry end of the housing. The temperature of the preheated make-up drying medium introduced within the housing is gradually decreased beginning with the first section (wet end) and progressing to the last section (dry end). The quantity of medium introduced within each section remains fairly constant in the first two sections, is increased in the third section, and is decreased in the final section or sections. The drying temperature within the housing 1 remains fairly constant within each section. Set forth below is a table indicating the quantity of preheated make-up drying medium, the temperature of the preheated medium, and the overall drying temperature of the circulating drying medium stream within the housing for each of the four drying sections.

Drying Section.....	#1	#2	#3	#4
Make-up Air Quantity (c.f.m.).....	2, 120	2, 120	3, 330	2, 650
Make-up Air Temperature, ° F.....	700	510	360	230
Drying Temperature, ° F.....	250	250	250	200

With my method and apparatus for drying fibrous materials, two extremely vexing disadvantages found with prior driers are eliminated. Plating out of any fiber conditioning agent on the inner structure of the drier is virtually eliminated. Contamination of the fiber blanket with discolored fibers, in the manner described above, is also substantially eliminated in that the use of heating coils within the drier housing is eliminated. My drier may be continuously operated over longer periods of time without being shut down for cleaning and scraping as is required with driers in past and present use.

It is to be understood that changes and variations may be made without departing from the spirit and scope of the present invention as defined in the appended claims.

I claim:

1. The method of drying water wet fibrous material containing a conditioning agent having a volatile, polymerizable component which will evaporate from the fibers upon the application of heat, will plate out on a surface having a lower temperature upon cooling and polymerize in contact with a hot surface, said method

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comprising forming a blanket of the wet fibrous material within a confined space, directing a stream of hot air through the blanket of fibers to remove moisture from the fibers, the temperature of the fibers being raised so as to cause the volatile, polymerizable component of the conditioning agent to volatilize and the temperature of the air stream being reduced to the point where the volatilized component will plate out if the air contacts a relatively cool surface, continuously removing a portion of the reduced temperature air from the confined space, continuously directing a second stream of hot air into the reduced temperature stream and merging the streams to elevate the temperature of the air making up the first stream substantially immediately after passing through the blanket of fibers and before it contacts a surface whereby the volatilized conditioning agent will not plate out, and directing the merged air streams through the blanket of fibers.

2. A drier for drying fibrous material comprising an elongated housing, a foraminous endless conveyor running lengthwise within said housing, said conveyor having an upper working course and a lower idle course, means for loading wet fibers onto the upper course of

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said conveyor for transport thereby through said housing, means for continuously introducing hot air into said housing through one side thereof and directly into the space between the two courses of said conveyor, a fan for circulating the hot air upwardly on one side of the upper course of said conveyor and downwardly through said upper course and through the fibrous material carried thereby, said fan being located on the opposite side of said housing from the point of introduction of the hot air and communicating with said space between the courses of the conveyor, and means for continuously withdrawing a portion of the air from said housing at a point between the two courses of said conveyor.

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