Sept. 7, 1926. 1,598,980

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METHOD OF AND APPARATUS FOR DRYING MOVING MATERIAL

Filed Sept. 12, 1925 4 Sheets-Sheet 1

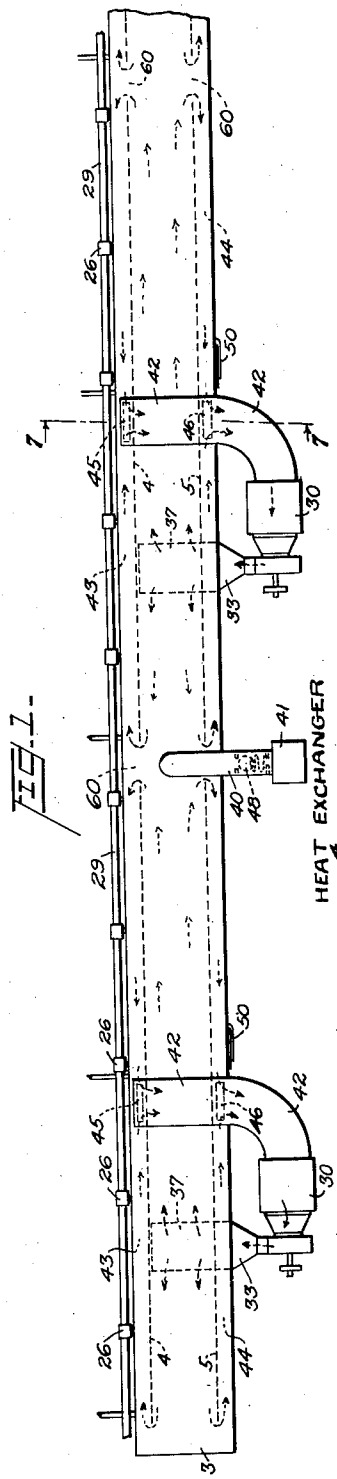


FIG. 1.

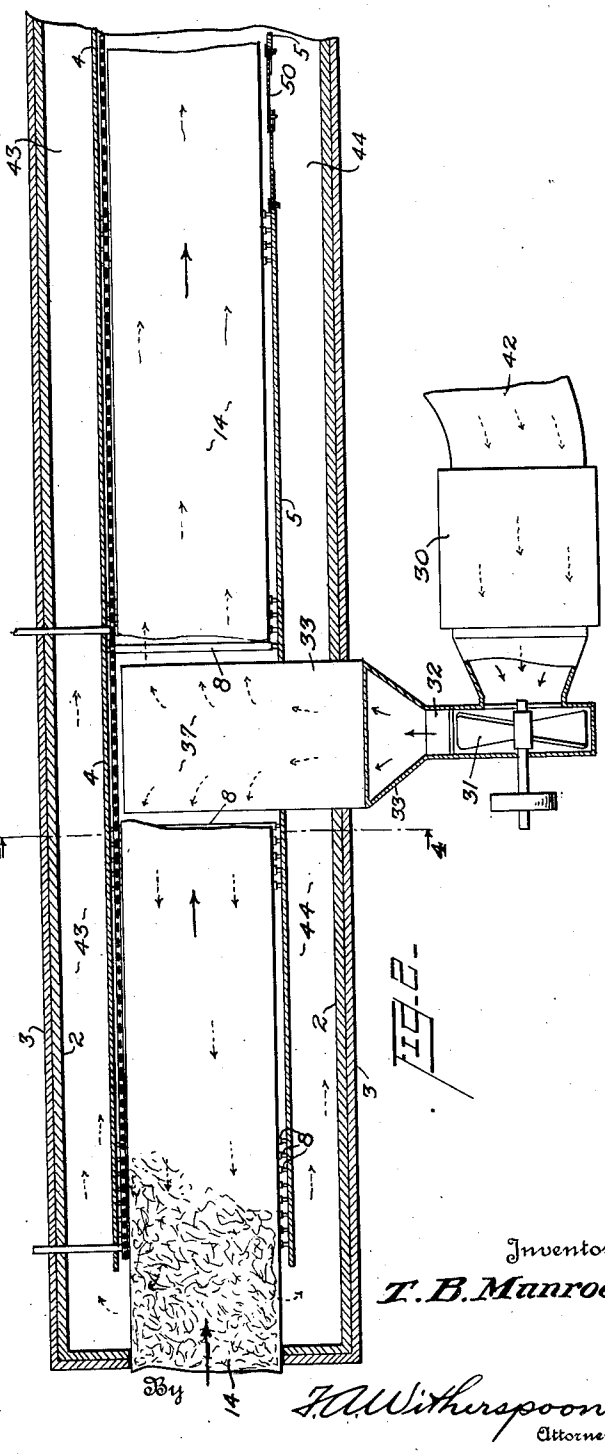


FIG. 2.

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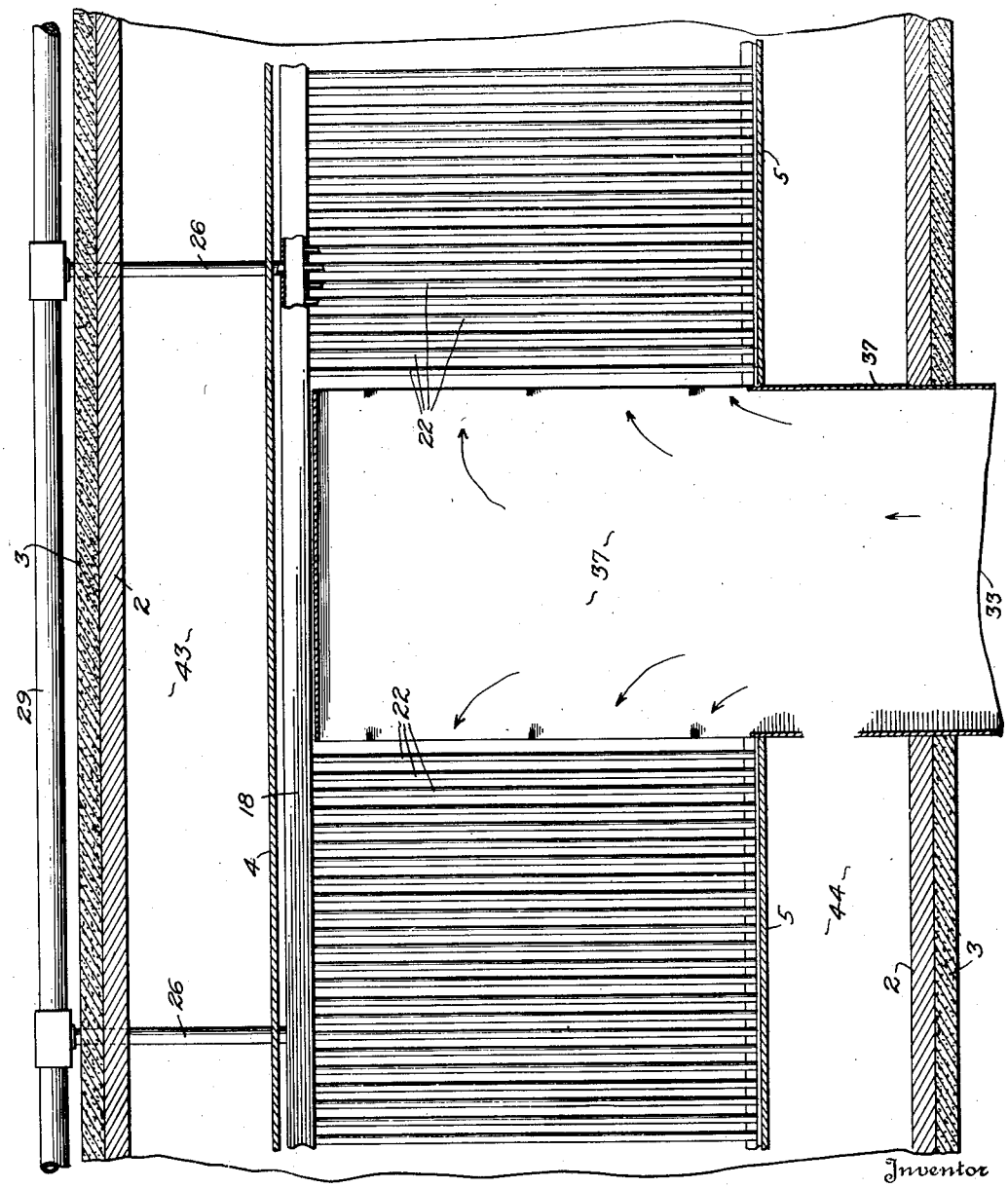


FIG. 3

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Fig. 4

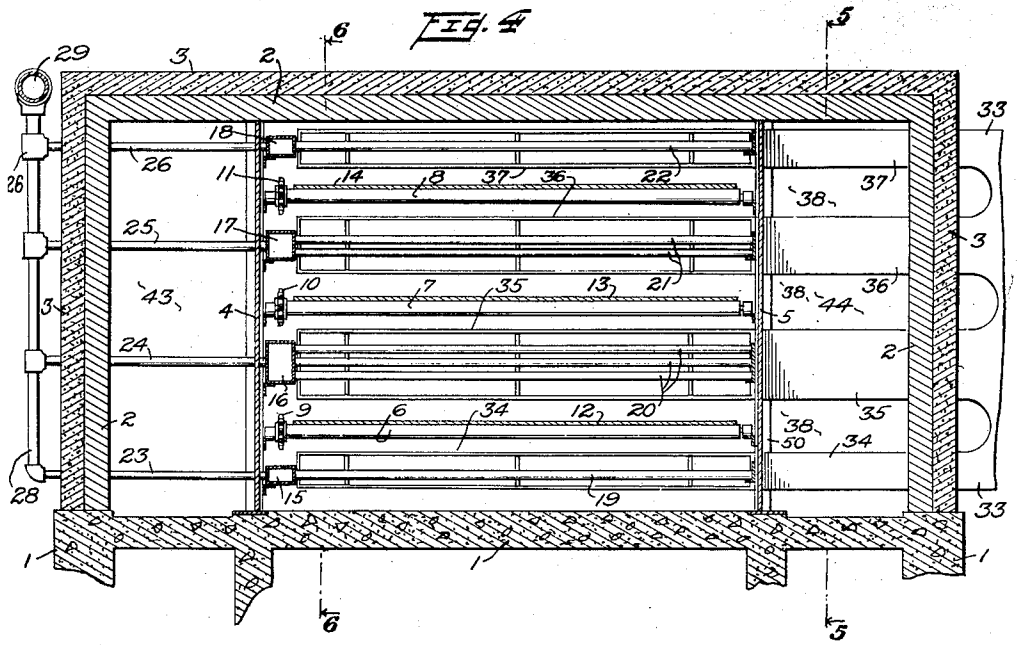
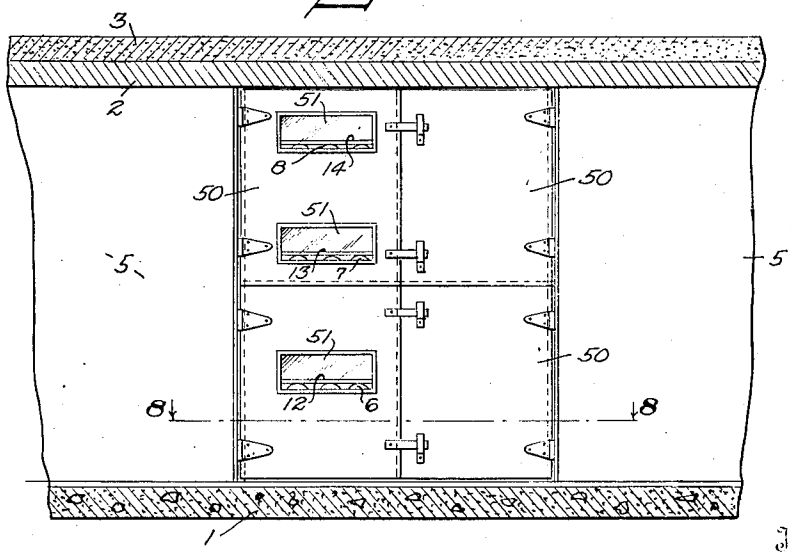


Fig. 5



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METHOD OF AND APPARATUS FOR DRYING MOVING MATERIAL

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Fig. 6

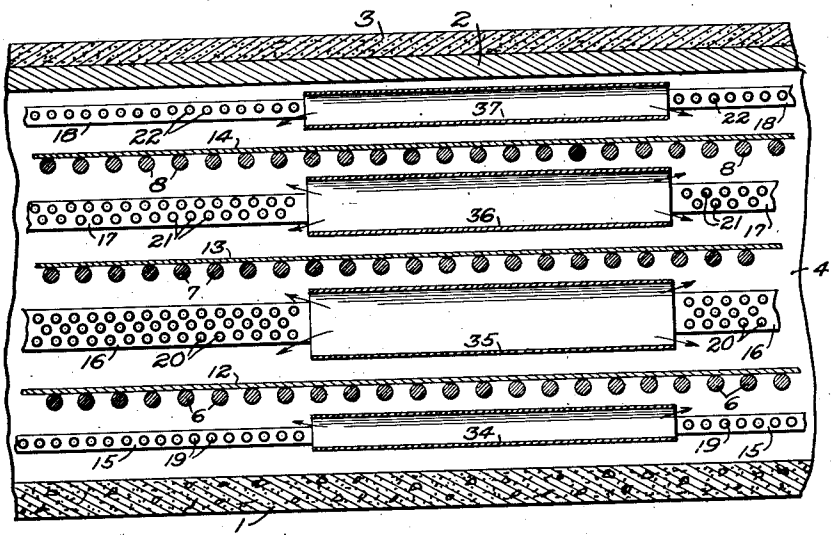


Fig. 7

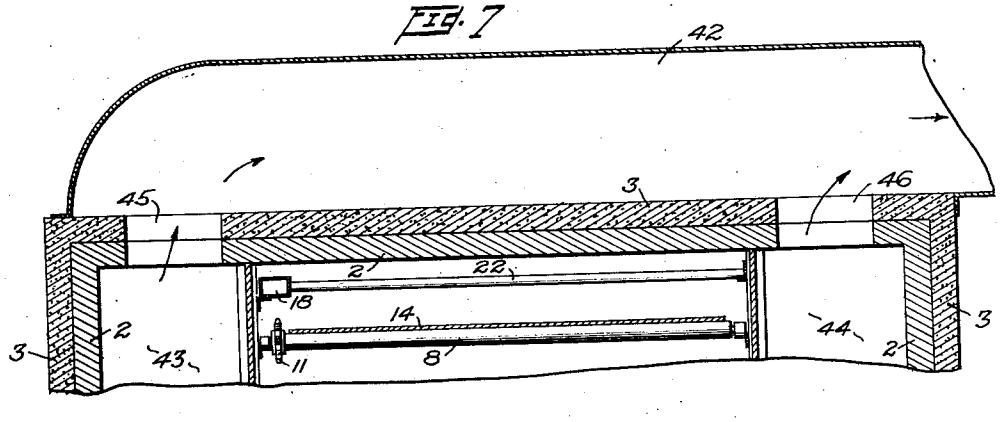


Fig. 8



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR DRYING MOVING MATERIAL.

Application filed September 12, 1925. Serial No. 56,010.

This invention relates to a method of and an apparatus for drying sheets of artificial heat insulating lumber, known on the market as Celotex, and has for its object to improve the procedures heretofore proposed.

With this and other objects in view, the invention consists in the novel steps and combinations of steps constituting the process and in the novel parts and combinations of parts constituting the apparatus, all as will be more fully hereinafter disclosed and particularly pointed out in the claims.

Referring to the accompanying drawings forming a part of this specification in which like numerals designate like parts in all the views.

Fig. 1 is a diagrammatic plan view of two units of the drier constituting the invention;

Fig. 2 is a longitudinal sectional view of a portion of the parts shown in Fig. 1;

Fig. 3 is an enlarged sectional view of a portion of the parts shown in Fig. 2, and illustrating the construction of the drier on each side of a steam duct;

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 2, looking in the direction of the arrows;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4, looking in the direction of the arrows;

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 4, looking in the direction of the arrows;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 1 looking in the direction of the arrows; and

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 5 looking in the direction of the arrows.

In order that the invention may be the better understood, it is said: This invention is especially adapted for drying the wet sheets of heat insulating artificial lumber that are now made from bagasse fibers admixed with fibers derived from wood and known to the trade as Celotex sheets. The mixture of fibers are first passed over a sheet forming machine (not shown) which forms them in widths of about say 10 or 12 feet. The sheets are then passed through the drier of this invention in continuous lengths, and for a distance of, say about 800 or 1000 feet. The thickness of these sheets is about one half inch and after being dried they are cut up into boards of any desired dimensions. In practice, it is found that if the heat insulating artificial lumber or Celotex sheets are made up from bagasse fibers alone, the said sheets are apt to dry unevenly, to warp, and to require a relatively long time in passing a desired product through the drier, thus reducing the output of the mill. If it is attempted, on the other hand, to speed up the commercial production of these sheets, as by increasing the temperature of the air employed in the drier, it is found that before any substantial practical results can be attained, the air will have to be so hot as will unavoidably scorch the outer surfaces of the drying sheets, so that the latter will be injured, and the drying will also be found to be still uneven and to give rise to an objectionable warping of the finished sheets.

In addition to this, Celotex sheets are highly heat insulating in their properties and are provided with greater or less quantities of water resisting or water proofing materials usually in the form of an aluminum resinate or other well known water resisting compound, and when air is employed as the drying fluid it is found heat insulating water resisting layers are readily formed on their outer surfaces in the driers while the interior portions of the sheet have relatively large percentages of their original water still present. In fact, these layers seem to retard the heat in reaching the interior, and to retard the water there present in reaching the exterior of the sheets.

On the other hand, it is found that if the original bagasse fibers are admixed with a percentage of other fibers derived from wood, such for example as the waste wood fibers from a paper mill, or if disintegrated or ground up paper stock, is admixed with the bagasse fibers, the drying action itself becomes even and satisfactory. But so long as air is used as the drying medium even if at a temperature above 250° F., or is heated up to a temperature of say 300° F., 350° F. or higher, which it is very desirable to do, if a high speed of drying is to be attained, the surfaces of the Celotex sheets will still be provided with the objectionable heat insulating and water resisting layers, and will still be scorched to an objectionable extent,

although the drying action may be free from warping. But again, it is found that if the above mixture of bagasse fibers and fibers derived from wood is provided in the first place and if the formed Celotex sheets are subjected to steam at temperatures of say from 215° F. to 350° F. or higher, the sheets are found to dry very rapidly indeed without scorching or warping and a very satisfactory quality and quantity of the product is produced. I am unable to satisfactorily explain the marked advantages of steam over air as a drying medium for these sheets, but have observed that steam especially at high temperatures does not produce the above water resisting layers on the surfaces of the sheets but seems to penetrate throughout the interiors thereof, and to efficiently remove the water present by evaporating the same. In order, however, to employ superheated steam efficiently, air should be substantially excluded from contact with the sheets, for at the temperatures mentioned any free oxygen present is liable to produce an objectionable scorching of the sheets and sometimes a fire in the chamber which is impossible when steam is used.

Accordingly, in carrying out this invention, one first provides a drier construction which is substantially air and steam tight, except at its ends. The drier itself being some 800 or 1000 feet long, or longer, and the Celotex sheets being about one half inch in thickness, it is found not necessary to seal the inlet and exit ends of the drier, although said ends may be more or less sealed by flaps of canvas against the escape of the steam if so desired. In constructing an air-tight drier fulfilling the above requirements, one may proceed as follows:

Referring more particularly to Fig. 4, any suitable concrete or other foundation 1 may be provided, and on this foundation is placed a suitable box-like structure 2 which may extend the entire length of the drier. The outside of the structure 2 may be provided with any suitable heat insulating material 3, such for example as the finished Celotex material above mentioned after it has been cut to the desired dimensions. Inside the structure 2 are provided the vertically disposed partitions 4 and 5, which are disposed say 2 or 3 feet from the vertically disposed walls 2 of the box-like structure, to provide the spaces or passage ways 43 and 44, while inside the partitions 4 and 5 are disposed the various operating parts of the drier itself. That is to say, a plurality of horizontally disposed rows of rollers 6, 7 and 8 are provided and on the ends of these rollers are disposed sprocket wheels 9, 10 and 11, by which the rows of rollers are continually turned so as to move lengthwise of the drier the Celotex sheets 12, 13 and 14. The movement of these sheets is comparatively slow, or say about as fast as one would walk at a slow gait. The actual speed, however, depends of course upon the temperature of the drying medium and the efficiency with which said medium performs its duties. Also disposed inside the drier between the partitions 4 and 5 are a plurality of headers 15, 16, 17 and 18, which feed a plurality of rows of heating coils 19, 20, 21 and 22 extending throughout the length of the drier. The headers lettered from 15 to 18 are fed by the heater pipes 23, 24, 25 and 26 connected to the pipe 28 fed by the main heater supply pipe 29 as shown. It will be understood that each of the coils such as 19, 20, 21 and 22 are made up of a series of coils that are disposed longitudinally of the drier for considerable distances and that they are interrupted by the steam inlet or distributing members 33 as will presently appear. That is to say, the main heat supply pipe 29 feeds a heat carrying medium into the heating coils lettered from 19 to 22, through a plurality of connections such as 23, 24, 25 and 26 at various points, and the function of these coils is to maintain a very high temperature of say from 250° F. to 350° F. or higher inside the drier, while steam preferably in a superheated condition is distributed from the members 33 inside the drier at intervals along its length. Said steam contacts with the traveling Celotex sheets and dries the same as will now be disclosed.

At suitable intervals along the length of the drier and outside of the same there are disposed steam heaters 30, see Figs. 1 and 2, for drying the steam, which latter after being raised to the requisite temperature in said heaters, is sucked by the fan 31 out of said heaters and forced by said fan through the passage 32 into the steam distributors 33. These steam distributors as will be best understood from Fig. 4, are provided with a plurality of branches or forks 34, 35, 36 and 37, which are separated from each other by the spaces 38 and which forks are disposed above and below the Celotex sheets as illustrated. That is, the fork 34 is disposed below the Celotex sheet 12, the fork 35 is disposed above said sheet 12, and below the Celotex sheet 13, while the fork 36 is disposed below the sheet 14 and above the sheet 13 and the fork 37 is disposed above the sheet 14. These steam distributing forks are closed at their outer ends, but open on their side edges as best illustrated in Fig. 6, so that the hot steam carried thereby passes out of the same and reaches the upper and lower traveling surfaces of their adjacent Celotex sheets. The steam thus freed in the drier chamber comes into contact with said sheets, and vaporizes the water therein quite rapidly. In other words, if

said steam is well above the boiling point of water, it rapidly converts the water present into steam, and the heat required to evaporate this water is readily supplied from the heating coils lettered from 19 to 22.

The result is the volume of steam in the drier continuously increases, and therefore some provision has to be made for the excess of steam to escape from the drier. This provision is found in the vent or exit tubes 40 leading into the heat exchange 41 that are disposed along the side of the drier and thus may a portion of the heat in the escaping steam be conserved and utilized for other purposes. In the meantime, the partitions 4 and 5 are provided at intervals with the openings 60 through which the expended steam may escape into the passages 43 and 44, while the fans 31 continue to suck steam through the heaters 30 and thus to create a lesser pressure in the steam return pipes 42 than there is in the fingers or forks lettered from 34 to 37 of the steam conveying members 33. In other words, the conduit 42 extends over into the spaces or passages 43 and 44 that are provided between the outer walls 2 and the partition walls 4 and 5 of the drier construction, and said conduit 42 is also provided with the inlets 45 and 46 permitting the steam that is liberated in the drier to be sucked into said conduit 42 and passed back into the heaters 30, so that the drying fluid or steam is circulated around and around through the drier chamber, and out of the same continuously except for that portion which is taken out of the drier proper through the vent tubes 40. In order to regulate the escape of steam from the drying chamber, a check valve or damper 48 is provided in the vent tube 40. At suitable intervals along the length of the drier there are provided doors 50 by which one may enter the drier proper for repairs, and through these doors are provided windows 51 through which the operator may view the internal operation of the drier and make certain that everything is working properly.

The operation of this drier will be understood from the foregoing, but may be briefly summarized as follows: The Celotex sheets are fed from the sheet forming machine in a wet condition onto the rollers lettered from 6 to 8, these rollers are turned by sprocket chains (not shown) through the medium of the sprocket wheels lettered from 9 to 11, and thus are the sheets propelled continuously from the forming end of the drier to the finishing end of the same some 1000 feet away, where they are cut into suitable dimensions for use. In the meantime, steam or other heating medium is fed from any suitable source (not shown) through the main steam supply 29, and the heating fluid is also fed from this supply throughout the length of the drier to the headers lettered from 15 to 18, which feed numerous sets of heating coils extending lengthwise of the drier and which coils are lettered from 19 to 22. These heating coils are interrupted, however, by the steam feeding members 33 as will be clear from Figs. 4 and 6 of the drawings, while the Celotex sheets continue to travel between the said sets of steam coils and between the individual fingers of the steam distributing members 33. Said fingers are lettered from 34 to 37, as will be clear from Figs. 4 and 6. The steam when used in the heaters is preferably carried at a relatively high temperature of say from 250° F. to 350° F. In the distributors 33, the steam is preferably carried from 250° F. to 350° F., but other temperatures may be used when desired. This steam readily vaporizes the water present in the Celotex sheets, so that the same are dried rapidly and evenly, and especially when they contain a mixture of bagasse and wood fibers. The amount of water carried into the driers by the Celotex sheets may amount to as much as 200 tons daily, so it is important that the extra steam which is derived from evaporating this water should be delivered to a heat exchanger 41 through vent pipes 40, so that the heat contained therein may be conserved. The superheated drying steam which permeates the whole interior of the drier proper is circulated into and out of the drier by means of fans 31 while being re-heated by means of the heaters 30, and is thus used over and over again.

Owing to the presence of a water resisting compound in the fibers, the water derived from the forming machine is held more tenaciously by the sheets when air is used as the drying medium than when steam is used and therefore an air drying process does not seem to so satisfactorily reach the interior of the sheets and dislodge the water retained therein as does a steam drying process. Further, by the substantial exclusion of air from the drier, except at the extreme ends of a very long drier, and by keeping the whole interior of the drying chamber filled with steam as above disclosed, it is found that the water is readily evaporated from the sheets in an expeditious, uniform and satisfactory manner not attainable by the use of air, so that the output of the mill is greatly increased. The heating coils readily resupply any heat that may be extracted from the drying steam when the water is thus evaporated on the interior of the sheets, and they also aid in maintaining a high temperature inside the drying chamber.

The use of waste furnace gases in the heating coils not only enables one to attain higher temperatures in said heating coils, but it furnishes an enormous quantity of

heat that may be carried out of the system by the steam escaping through the vent tubes 40, and utilized for other purposes.

It is obvious that those skilled in the art may vary the details of construction, the arrangement of parts and the mode of operation, without departing from the spirit of this invention, and therefore it is not desired to be limited to the foregoing disclosure except as may be required by the claims.

What is claimed is:

1. The process of drying moving material which consists in causing said material to travel at a controlled rate of speed through a chamber from which air is substantially excluded; admitting superheated steam into said chamber in opposed and codirectional contact with said moving material to evaporate any water present in said material; venting out of said chamber any excess of vapor that may accumulate therein; and continuously passing said steam into and out of said chamber.

2. The process of drying moving material which consists in causing said material to travel at a controlled rate of speed through a chamber from which air is substantially excluded; admitting superheated steam at a temperature above 250° F. into said chamber in opposed and codirectional contact with said moving material to evaporate any water present in said material; venting out of said chamber any excess of vapor that may accumulate therein; reheating said steam after it has evaporated said water; and continuously passing said steam into and out of said chamber.

3. The process of drying moving material which consists in causing said material to travel at a controlled rate of speed through a chamber from which air is substantially excluded; maintaining the interior of said chamber at a temperature above 212° F.; admitting superheated steam into said chamber in opposed and codirectional contact with said moving material to evaporate any water present in said material; venting out of said chamber any excess of vapor that may accumulate therein; and continuously passing said steam into and out of said chamber.

4. The process of drying moving material which consists in causing said material to travel at a controlled rate of speed through a chamber from which air is substantially excluded; maintaining the interior of said chamber at a temperature above 212° F.; admitting superheated steam into said chamber in opposed and codirectional contact with said moving material at a temperature sufficient to evaporate any water present in said material; venting out of said chamber any excess of vapor that may accumulate therein; and continuously passing said steam into and out of said chamber.

5. In a drier the combination of a drying chamber; a set of rollers in said chamber adapted to move wet sheets of material from end to end thereof; means to maintain the temperature inside said chamber above a predetermined point; and means to circulate a drying fluid into and out of said chamber in contact with said material.

6. In a drier the combination of a drying chamber; a set of rollers in said chamber adapted to move wet sheets of material from end to end thereof; means comprising a plurality of steam coils to maintain the temperature inside said chamber above a predetermined point; and means comprising a fluid distributing member and heater therefor to circulate a drying fluid into and out of said chamber in contact with said material.

7. In a drier the combination of a drying chamber; a set of rollers in said chamber adapted to move wet sheets of material from end to end thereof; means comprising a plurality of steam coils to maintain the temperature inside said chamber above a predetermined point; means comprising a fluid distributing member and heater therefor to circulate a drying fluid into and out of said chamber in contact with said material; and means to vent from said chamber any excess of vapor that may be evolved therein.

8. In a drier the combination of a drying chamber; a set of rollers in said chamber adapted to move wet sheets of material from end to end thereof; means comprising a steam supply, a plurality of steam headers connected to said supply, and a plurality of steam coils connected to said headers adapted to maintain the temperature inside said chamber above a predetermined point; and means to circulate a drying fluid into and out of said chamber in contact with said material.

9. The process of drying a fibrous sheet of material containing moisture and provided with a water resisting compound, which consists in heating a chamber above 212° F., and uniformly subjecting said sheet while in said chamber to the drying action of steam above 212° F. to evaporate a portion of the moisture present.

10. The process of drying a fibrous sheet of material containing moisture and provided with a water resisting compound, which consists in heating a chamber above 212° F.; uniformly subjecting said sheet while in said chamber to the drying action of steam above 212° F. to evaporate a portion of the moisture present; re-heating said steam; and circulating the same into and out of said chamber.

11. The process of drying wet fibrous sheets of material provided with a water resisting compound which consists in moving said sheets through a drying chamber; heating said chamber to a degree above 225° F.;

uniformly subjecting the surfaces of the moving sheets to the action of steam above 212° F. to evaporate a portion of the moisture on the interior of said sheets; and circulating said steam into and out of said chamber.

12. The process of drying wet fibrous sheets of material provided with a water resisting compound which consists in moving said sheets through a drying chamber; heating said chamber to a degree above 240° F.; uniformly subjecting the surfaces of the moving sheets to the action of superheated steam to evaporate a portion of the moisture on the interior of said sheets; and reheating and circulating said steam into and of said chamber.

13. The process of drying moist fibrous sheets of material containing bagasse fibres that have been treated with a water resisting compound which consists in moving said sheets continuously through a drying chamber; maintaining the temperature of said chamber above a predetermined point; uniformly subjecting the moving sheets to the action of steam having a temperature sufficient to evaporate a portion of any moisture present on the interior of said sheets; and circulating said steam into and out of said chamber while re-heating the same.

14. The process of drying moist fibrous sheets of material containing a mixture of bagasse and other fibres that have been treated with a water resisting compound which consists in moving said sheets continously through a drying chamber; maintaining the temperature of said chamber above a predetermined point; uniformly subjecting the moving sheets to the action of steam having a temperature sufficient to evaporate a portion of any moisture present on the interior of said sheets; removing any surplus vapor that may be evolved from said sheets; and circulating said steam into and out of said chamber while re-heating the same.

15. The process of drying wet sheets containing bagasse fibres admixed with other fibres derived from wood and with a water resisting compound which consists in moving said sheets through a drying chamber maintained at a temperature above a predetermined point; substantially excluding the air from said chamber; and uniformly subjecting the moving sheet surfaces to the action of steam at a temperature sufficient to extract substantial proportion of the moisture from the interior of said sheets.

16. The process of drying wet sheets containing bagasse fibres admixed with other fibres derived from wood and with a water resisting componnd which consists in moving said sheets through a drying chamber maintained at a temperature above a predetermined point; substantially excluding the air from said chamber; uniformly subjecting the moving sheet surfaces to the action of steam at a temperature sufficient o extract a substantial proportion of the moisture from the interior of said sheets; withdrawing and re-heating the steam thus employed; and returning the re-heated steam to said chamber.

17. The process of drying wet sheets containing bagasse fibres admixed with other fibres derived from wood and with a water resisting compound which consists in moving said sheets through a drying chamber maintained at a temperature above a predetermined point; substantially excluding the air from said chamber; uniformly subjecting the moving sheet surfaces to the action of steam at a temperature sufficient to extract a substantial proportion of the moisture from the interior of said sheets; withdrawing and re-heating the steam thus employed; returning the re-heated steam to said chamber; and removing from said chamber any surplus vapor derived from the moisture in said sheets.

In testimony whereof I affix my signature.

TREADWAY B. MUNROE.