

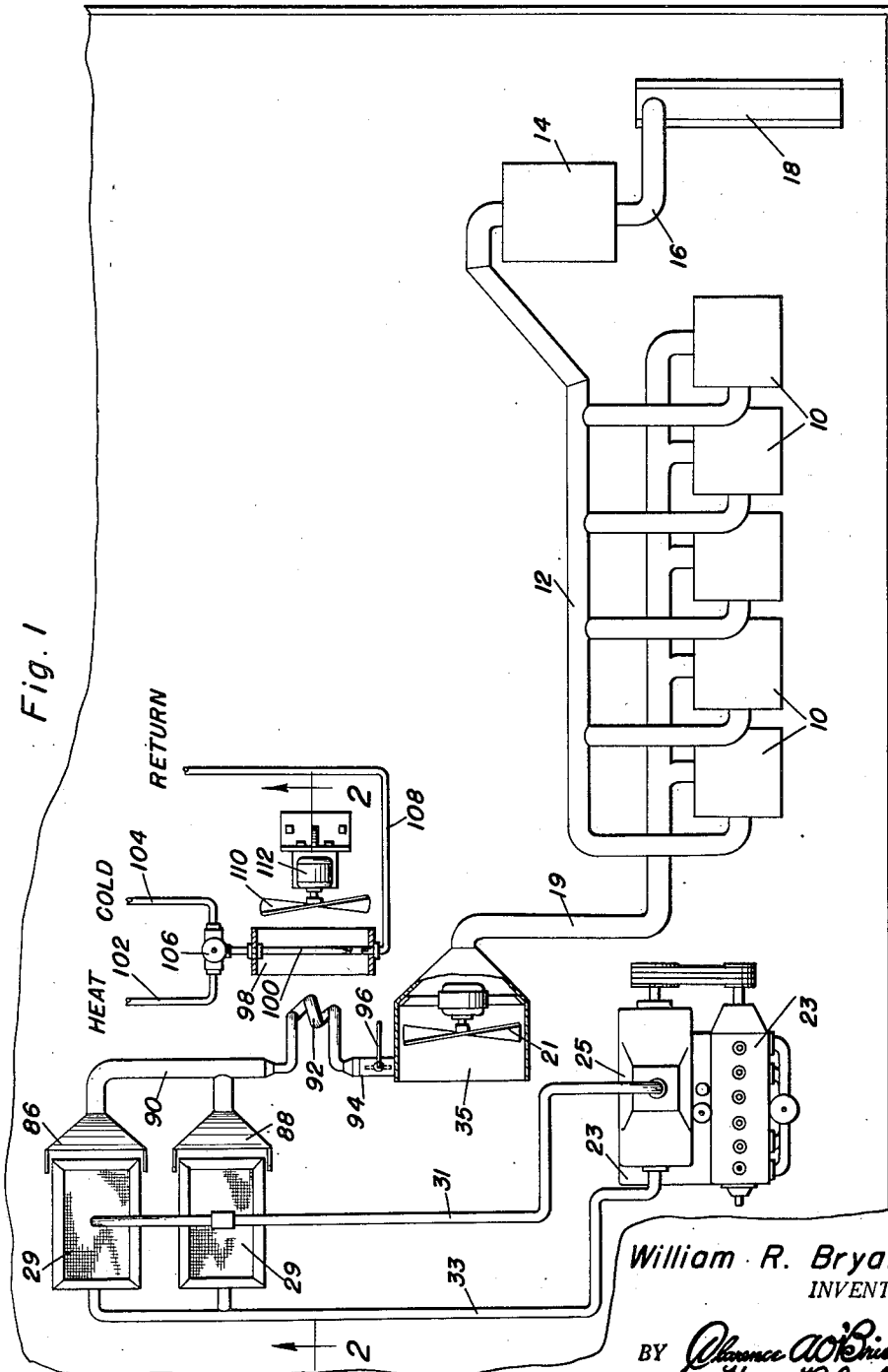
May 13, 1958

W. R. BRYANT
PROCESS AND APPARATUS FOR CONTROLLING THE
MOISTURE CONTENT OF LINT COTTON

2,834,058

Filed Nov. 9, 1954

5 Sheets-Sheet 1



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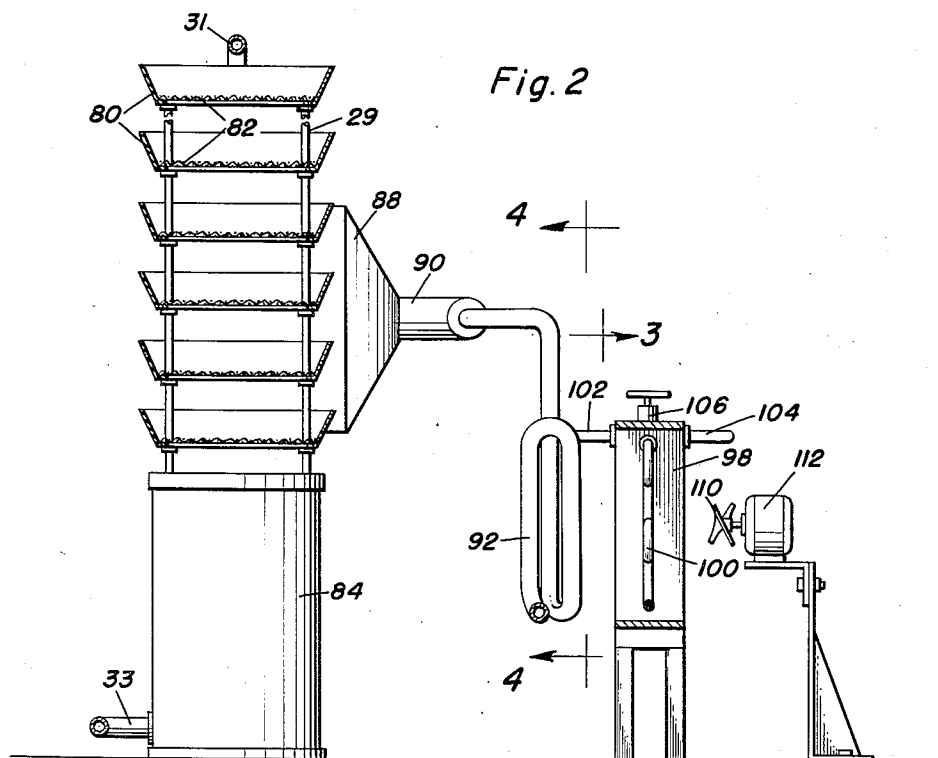
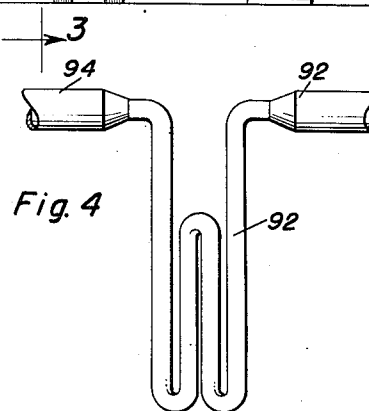
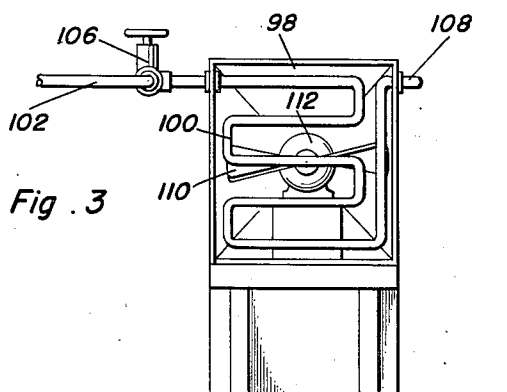
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Fig. 5

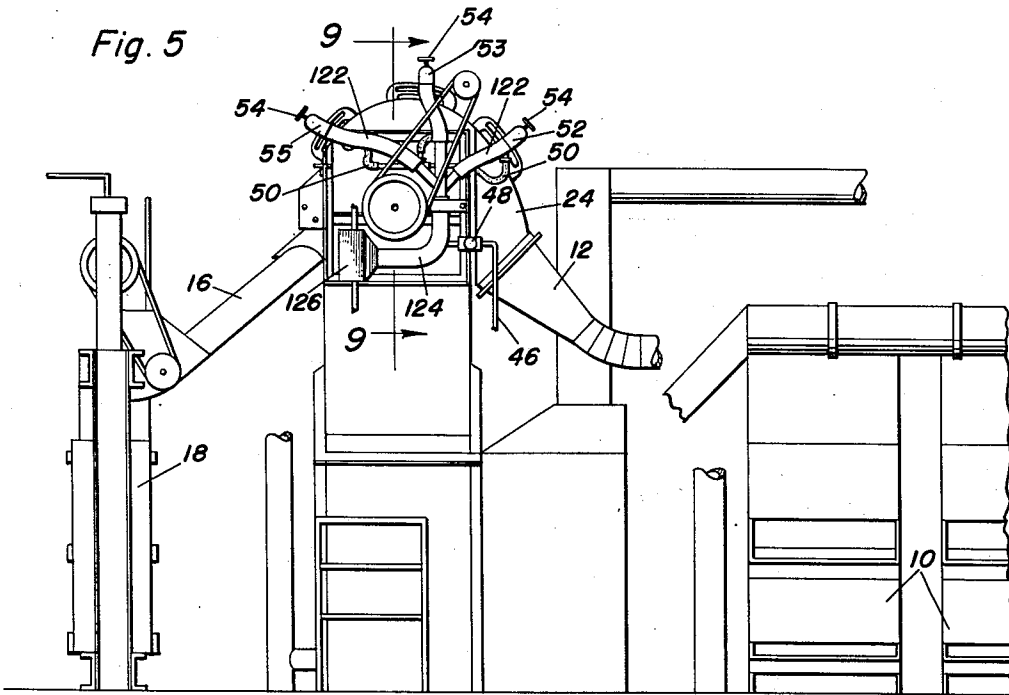


Fig. 6

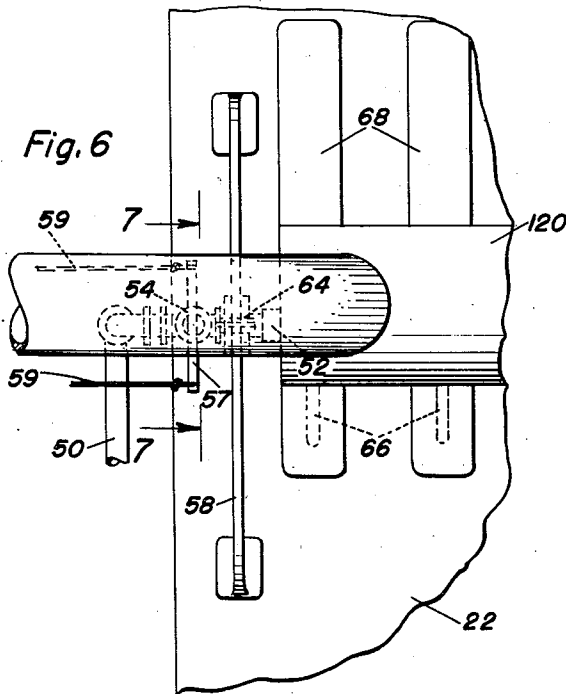


Fig. 7

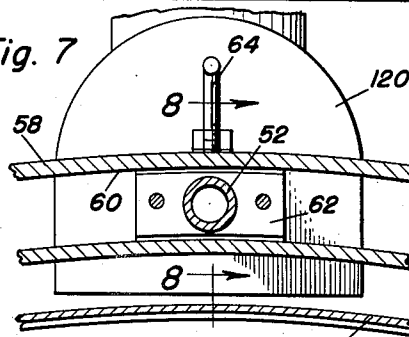
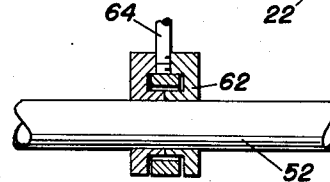


Fig. 8



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Fig. 9

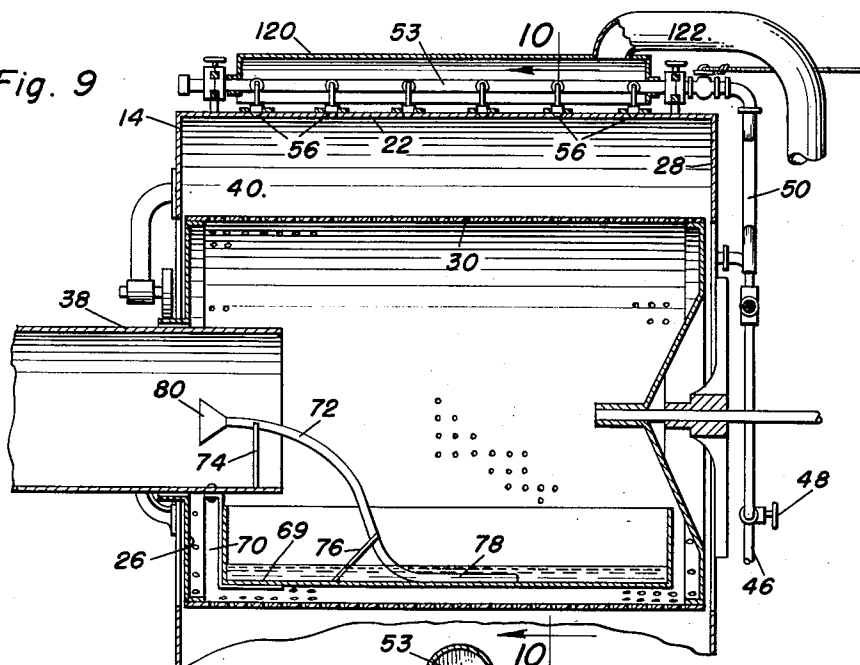
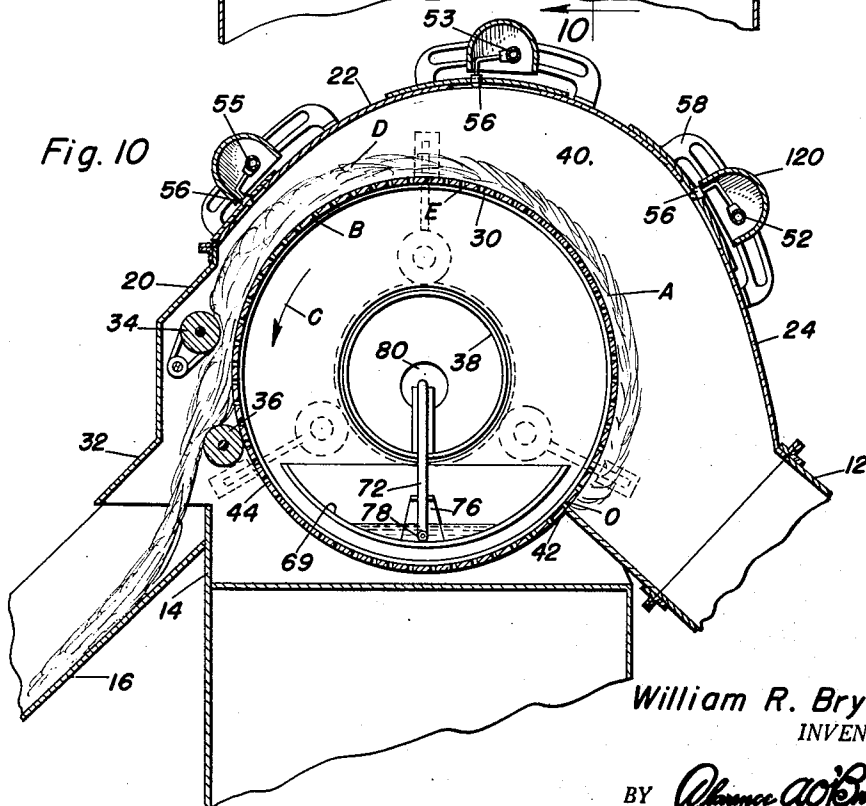


Fig. 10



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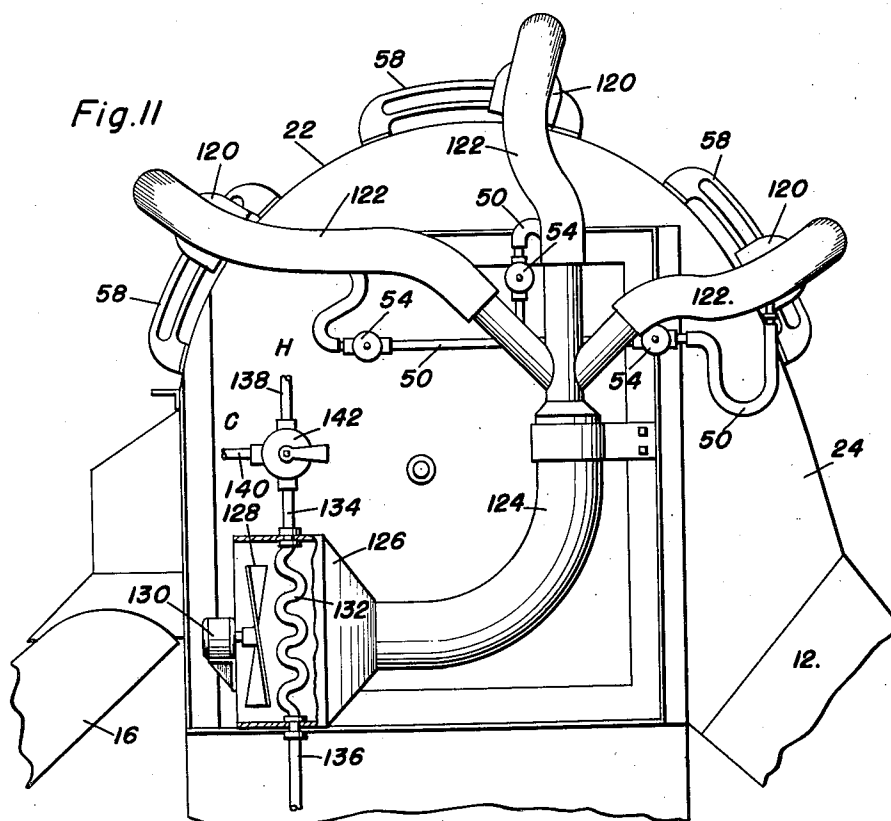
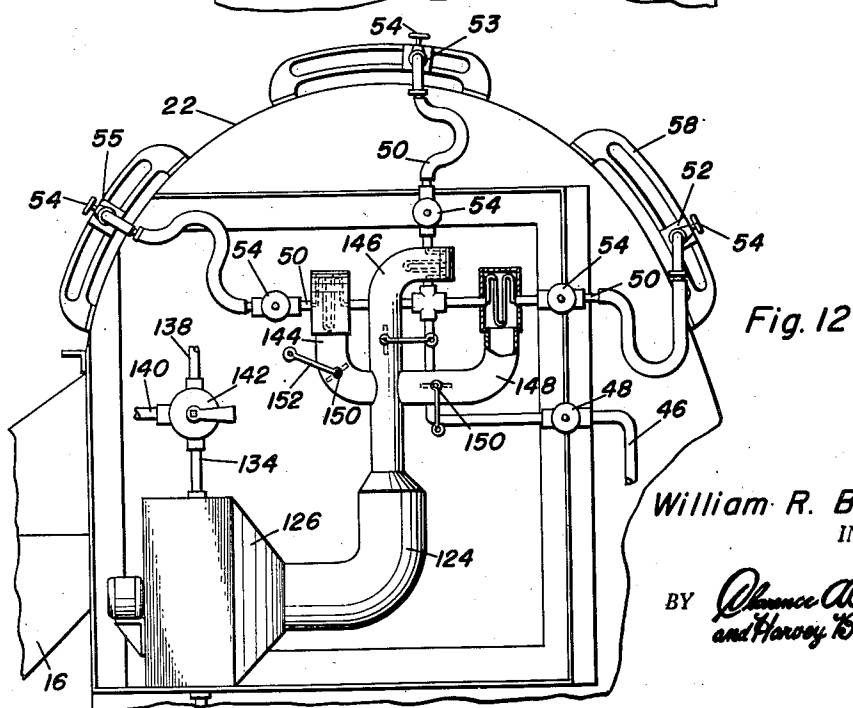
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PROCESS AND APPARATUS FOR CONTROLLING THE MOISTURE CONTENT OF LINT COTTON

William R. Bryant, Jonesboro, Ark.

Application November 9, 1954, Serial No. 467,813

32 Claims. (Cl. 19—66)

This invention comprises novel and useful improvements in a process and apparatus for producing a controlled moisture content of lint cotton, and more specifically has as its object the provision of a method and an apparatus whereby a lint cotton having superior properties and characteristics may be produced by controlling the moisture content thereof and more specifically, by introducing a controlled quantity of moisture into the fibers of the lint cotton after the same have reached the lint condenser and especially while in a lint condenser.

It is well known to those who are familiar with the ginning of cotton and the preparation and treatment of cotton fibers for commercial use that the quality, physical characteristics and therefore the value of lint cotton fibers is largely affected by the moisture content of the same; and that the moisture content lies between relatively narrow and critical limits for the superior and more desirable grades of cotton fibers. It is also well known that in order to satisfactorily clean the seed cotton of trash and foreign matter prior to the ginning of the same, the seed cotton fiber is usually excessively dried prior to the ginning of the seed cotton and to the baling of the lint cotton thereafter, or it sometimes arrives at the gin with subnormal moisture, in this condition, this over-drying or excessive drying of the seed cotton fibers detrimentally affecting the physical qualities of the resultant lint cotton, thus further resulting in a monetary loss to the grower or gin operator. The foregoing is so well known to those skilled in these arts, that a more detailed explanation or consideration of the same is deemed to be unnecessary.

It is therefore the primary object of this invention to overcome the above mentioned defects of present conventional practice as much as possible by introducing any desired, controlled quantity of additional moisture into the lint cotton after the same has been ginned and prior to the baling of the cotton in order to remedy the defective condition of the cotton resulting from the over-drying or the subnormal moisture content of the same, and thereby improve to the optimum the qualities of the lint cotton.

However, it is also known that the introduction of moisture into the lint cotton beyond certain limits adversely affects the desirability and quality of the lint fibers, sometimes resulting in a total loss of the bale. It is therefore a further concomitant and important object of this invention to control and maintain the increase of the moisture content of lint cotton between desired limits; to obtain a precise control of the quantity of the introduced moisture; and to remove excessive moisture thereby preventing adverse effects upon the characteristics of the lint cotton fibers which might arise from excessive moisture content.

To my knowledge, efforts have been made heretofore to improve the fibers of lint cotton by the addition of moisture thereto subsequent to the ginning operation. For example, it has been proposed heretofore to introduce moisture into the lint flue in which the lint fibers are conveyed by an air current from the gin stands after the

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ginning operation into the lint condenser prior to baling of the cotton. It has also been proposed to introduce additional moisture into the lint fibers in the lint condenser; or in the batt of cotton after the same leaves the lint condenser on its way to the baling press, as for example, during the passage of the batt down the lint slide.

In all such prior proposals, however, no adequate provision was made for controlling between the requisite narrow limits the moisture content of the lint cotton to ensure an adequate absorption of moisture by the cotton fibers but guard against an overmoistening of the same. Moreover, since the cotton gin operator is confronted by supplies of seed cotton of greatly varying moisture content during the ginning season, it has heretofore been impossible to obtain with certainty the necessary exact, precise control of the resultant moisture content of the lint cotton.

By exhaustive experiments in practicing this invention in a cotton gin plant, I have found it to be impractical and substantially impossible to produce a desired increase in the moisture content of lint cotton by introducing exactly that quantity of moisture into the lint condenser which it is desired to introduce into the cotton fibers. It appears that the vast volume of blast air passing through the lint condenser will necessarily remove a portion of the moisture introduced into the condenser this removed moisture being directly proportional to the temperature and humidity of the blast air as compared with the atmospheric temperature and humidity. In other words, the drier and/or the hotter the blast air, the greater the amount of the introduced moisture that is removed by the blast air, and consequently the smaller the amount of moisture which can be introduced into the cotton fiber as a sensible moisture increase therein from a given rate of moisture input for the condenser. It therefore appears to be necessary, from a practical standpoint, to at all times introduce into the lint condenser a quantity of moisture considerably in excess of that which it is desired to introduce into the lint cotton fibers; and to control in various ways the amount of this introduced excess moisture which is removed by the blast air and thus effectively control the quantity of the moisture which is introduced into and absorbed by the cotton fibers. This discovery and principle, apparently offers the only feasible way for obtaining an accurate, effective and precise control of the quantity of the additional moisture to be introduced into the cotton fibers.

It is therefore a primary object of this invention to provide a process and an apparatus whereby moisture may be added to lint cotton in accurately controlled quantities to thereby maintain an augmented moisture content of the lint cotton within very precise limits; and wherein the addition of moisture to the cotton fibers may be varied and adjustably controlled in such manner as to ensure the maintaining of a constant moisture content of lint produced from seed cotton having greatly varying moisture contents after the ginning operation.

It is a particular object of this invention to provide a process and an apparatus whereby controlled quantities of moisture may be introduced into the lint fibers in the lint condenser; and wherein provision is made to remove any condensate from the surplus of moisture introduced into the lint condenser.

It is a further and very important object of this invention to provide a process and an apparatus whereby excess quantities of moisture over that desired to be introduced into the lint fibers are introduced into the lint condenser in order that ample moisture may be provided for introduction into the cotton fibers, and wherein a very accurately controlled proportion of the excess introduced moisture may be removed therefrom in order to leave the

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exact desired quantity of additional moisture in the lint fibers in the lint condenser.

A further important object of the invention in accordance with the immediately preceding object is to provide a process and apparatus for controlling the temperature and/or the humidity of the blast air supplied to a lint condenser to thereby regulate and control the proportion of the excess moisture introduced into the lint condenser which may be removed by this blast air and thereby obtain a desired remainder moisture which when introduced into the lint fibers will produce the desired moisture increase therein.

A still further important object of this invention is to provide a process and apparatus wherein the desired regulation of the excess moisture removed from the lint condenser may be controlled in a variety of ways and with great precision and facility.

Another important object of this invention is to provide a process and apparatus in accordance with the preceding object wherein the quantity of moisture absorbed by and adhering to the cotton lint fibers may be readily controlled in order to vary the moisture content of the fibers.

Yet another object is to provide an apparatus and method whereby moisture may be introduced into the lint condenser to dissipate static charges of the fibers and facilitate doffing the batt from the condenser cylinder, thereby preventing "spitting" or the undesirable discharge of portions of the batt through the air exhaust of the condenser.

A still further object of the invention is to provide a process and apparatus wherein the introduction of moisture into the lint fibers in the lint condenser may be at all times under the immediate control of the operator during the operation of the lint condenser and without interfering with the same.

An important ancillary object of the invention is to devise a process and apparatus whereby static charges may be dissipated from the fibers while effecting any and all of the preceding objects.

A still further very important object of the invention is to provide an apparatus and process whereby any fire originating or present in the fibers in the lint condenser may be extinguished with facility and certainty, without interfering with the continued running of the gin, thereby completely preventing passage of such fire into the baler, and reducing to a minimum the loss of cotton from such fire, and loss of continued operation of the gin plant.

Still other important purposes of this invention are to provide an apparatus and method whereby moisture may be added to the cotton fibers in such a manner as to effect a more homogeneous and instantaneous absorption thereof; to reduce to a minimum the dispersion or dilution of the moisture by the conveying air in which the fibers are suspended; to avoid any disturbance of the batt structure or the forming of the batt by the introduced moisture.

Yet another more specific object of this invention resides in the provision of both apparatus and method for varying the quantity and proportions of moisture adhering to and absorbed by the fibers as they are forming a batt by variably controlling the force of impingement and penetration of a batt through control of length of travel of the moisture through the stream of suspended fibers to the surface of the batt; and, to a limited extent, through variation of the position of the moisture introduction with respect to the turbulence of the air-fiber suspension.

A further specific object of this invention is to provide a process and apparatus wherein the blast air for the lint condenser may be pre-conditioned as to temperature and humidity to a controllable varied extent in order to adjustably effect its moisture absorbing characteristics; and wherein the moistening of the blast air

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may be utilized to improve the efficiency of the water cooling system of the power plant of the cotton gin.

A still further object of the invention is to provide a process and apparatus according to the foregoing objects wherein the qualities of the fiber of lint cotton may be improved by the introduction of accurately controlled quantities of moisture or other cotton treating agents, such as either refined or unrefined cottonseed oil or the like, in an improved manner and with a very accurate control of the treating agents or moisture added to the cotton fibers.

A still further object of the invention is to provide a process and an apparatus wherein the fibers or any cotton may be improved and revitalized as, for example, by increasing its resiliency by the addition thereto of moisture and/or cotton fiber treating agents in easily and accurately controlled proportions.

The foregoing objects are generally realized in an apparatus and process in which steam is impinged upon the surface of a batt from nozzles, the quantity of moisture adhering to the batt and being absorbed thereby being regulated by varying the distance of the nozzles from the batt, the area of the batt treated, the position of the nozzles by selecting their location with consideration of the degree of turbulence in the fiber-air stream and to some extent with consideration of the thickness of the batt.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a somewhat diagrammatic view of a cotton gin plant to which the process and apparatus for introducing additional moisture into lint cotton has been applied, this view being partly in plan and partly in elevation;

Figure 2 is a vertical sectional detail view taken substantially upon the plane indicated by the section line 2—2 of Figure 1 and showing in particular the manner in which the blast air for the lint condenser is premoistened and/or preheated for controlling the temperature and humidity thereof;

Figure 3 is a vertical sectional detail view taken substantially upon the plane indicated by the section line 3—3 of Figure 2 and showing one form of temperature controlling means for the blast air which may be practiced in accordance with this invention;

Figure 4 is a detail view taken in vertical section substantially upon the plane indicated by the section line 4—4 of Figure 2 and illustrating the manner in which the blast air supply may be brought into heat exchange relation with the temperature controlling device of Figures 1-3;

Figure 5 is a somewhat diagrammatic elevational view of a cotton gin installation illustrating in particular the lint condenser to which the process and apparatus of the present invention has been applied together with the connection of the lint flue therewith and the lint slide delivering the batt of lint cotton from the condenser to the baling press;

Figure 6 is a fragmentary elevational view of a portion of the exterior of the lint condenser, taken upon an enlarged scale and showing a portion of the moisture introducing means associated therewith;

Figure 7 is a vertical transverse sectional detail view taken on an enlarged scale substantially upon the plane indicated by the section line 7—7 of Figure 6;

Figure 8 is a further detail view taken substantially upon the plane indicated by the section line 8—8 of Figure 7;

Figure 9 is a vertical longitudinal sectional view taken substantially upon the plane indicated by the section line

9—9 of Figure 5 and showing the interior of the lint condenser, and a means which may be provided for the removal of condensed excess moisture from the end discharge type of condenser;

Figure 10 is a vertical transverse sectional view taken substantially upon the plane indicated by the section line 10—10 of Figure 9 and illustrating the manner in which the moisture or cotton treating agents may be introduced into the lint condenser in a controlled manner and in which moisture for extinguishing fires may be introduced;

Figure 11 is an enlarged detail view of a portion of Figure 5 and showing more clearly one form of apparatus whereby the temperature of the introduced moisture may be controlled in order to regulate the proportion of the injected moisture into the lint condenser which is to be introduced into the lint fibers therein; and

Figure 12 is a view similar to Figure 11 but a slightly modified construction for effecting the same general purpose of that of Figure 11.

I desire it to be distinctly understood that the accompanying drawings are to be regarded as illustrative only of the principles of my novel process and apparatus; and that as set forth hereinafter, various steps of the method and various elements of the apparatus may be omitted, altered or rearranged or used independently in accordance with particular treatments to be accorded the cotton and particular apparatuses with which the invention is to be utilized.

Shown diagrammatically in Figure 1, is a typical or conventional cotton gin plant which includes a plurality of gin stands 10 each of which delivers the lint cotton through a common lint flue 12 to any conventional form of lint condenser 14 in which the lint fiber is separated from the conveying air stream, and the lint fibers are then condensed into a batt which, in turn, is delivered by a lint slide 16 to a conventional form of cotton baler and press 18.

The conventional gin plant further includes a blast air supply duct 19 provided with a blast air fan 21 by means of which the necessary volume of air is supplied to the gin stands, and from thence to the lint flue 12. The blast air fan 21 is in turn operated from the engine power plant indicated generally by the numeral 23 and which, for example, may consist of internal combustion or diesel engines, provided with a water jacket 25 for cooling the same. The water in the engine jackets or cooling system is cooled by being circulated through a pair of water cooling towers each designated by the numeral 29 by means of a hot water supply conduit 31 and a cooled water return conduit 33, both communicating with the water jacket of the power plant engines. It will be understood that the power plant 23 is connected with the fan 21 in any desired manner, not shown, and customarily the blast air supply by the fan 21 is taken directly from the atmosphere as by the open inlet 35 of the hood or housing surrounding the air blast fan 21.

As so far described, the foregoing is the conventional cotton gin plant layout and to which the principles of this invention are applied in a manner to be now described.

As regards the practicing of my process and apparatus for producing a controlled moisture content of lint cotton, it is immaterial what form of gin stand or other ginning machinery be employed. Since the construction and operation of the same are well understood, a further illustration or description is deemed to be unnecessary. However, since the principles of this invention are especially applicable to a lint condenser which forms an essential part of each cotton gin plant, it has been deemed advisable to illustrate the construction and operation of one such form of lint condenser to a somewhat greater extent in order to set forth by way of exemplification the manner in which the principles of my process and apparatus may be practiced.

Referring especially to Figures 9 and 10, it will be

seen that the condenser 14 consists of an outer casing 20 having a convex curving top wall 22 which curves downwardly and outwardly, as at 24, to receive a detachable connection with the lint flue 12 whereby the air-borne lint fibers are introduced into the casing. The casing of the lint condenser further includes end walls 26 and 28, and which walls rotatably journal the foraminous cylinder 30 of the lint condenser. This cylinder is rotated in the usual manner which is of no concern with respect to the present invention.

Upon the opposite side of the lint condenser casing 14 from the connection with the lint flue 12, there is provided a discharge passage 32 which opens upon the lint slide or chute 16. Suitably disposed within the lint condenser casing adjacent the lint discharge opening 32 are the usual pressing and doffing rollers 34 and 36, operated in the conventional manner, whereby the batt of lint cotton fiber formed upon the condenser cylinder is stripped therefrom and discharged into the lint slide 16 in the usual manner. As illustrated in Figure 9, the condenser is of a type having an axially disposed air discharge flue 38 by means of which the air is separated from the lint fiber by the action of the condenser cylinder and is discharged from the lint condenser through the end of the condenser cylinder 30. I am, of course aware that there are various other types of lint condensers than that illustrated in Figures 9 and 10, as for example, condensers of the down-draft discharge flue type and the like. The type depicted in Figures 9 and 10, however, is a type requiring provision for excess moisture condensate removal and therefore is deemed satisfactory for the purposes of illustrating the manner in which the principles of this invention are applicable to a lint condenser of either the up-draft or down-draft types, since the natural air flow through these condensers removes any condensate.

In the operation of lint condensers of the rotating cylinder type, the stream of air carrying the lint fibers delivered by the lint flue 12 first impinges upon the surface of the rotating cylinder, which cylinder rotates in the direction indicated by the arrow C, at a point upon its circumference, indicated by the letter O. Upon striking the screen constituting the surface of the foraminous cylinder, the conveying air is separated or extracted from the fibers and passes into the interior of the cylinder through this screen, leaving the lint fibers to collect upon the surface of the cylinder in the form of a batt. The air from the interior of the cylinder escapes through the air discharge flue, this being the axially disposed flue 38 in the form of condenser illustrated. As will be readily understood, the entire interior of the casing between the top walls 22 and 24 of the lint condenser casing and the exterior surface of the cylinder constitutes a lint chamber 40, which is filled with the lint and its carrier air discharged by the lint flue. This chamber extends between the usual seal 42 between the condenser cylinder 30 and the lip of the casing which forms a continuation of the lint flue and to which the lint flue is connected, to a similar seal, not shown, but substantially at the point 44 and just below the lint discharge opening 32 at its connection with the lint slide 16.

It will be understood that as the condenser cylinder rotates, the collection of lint fibers upon the exterior surface of the same forms a batt D which is of progressively increasing thickness from the point O where the batt starts to the point B at which the maximum thickness of the batt has been reached. The batt starts forming at O, where the incoming stream from the lint flue first impinges upon the condenser cylinder, increasing very rapidly in thickness to the point A where the batt has been substantially completed. The point A is the limit point on the condenser at which the incoming stream from the lint flue directly impinges upon the cylinder. As the batt D reaches the pressing and doffing rollers 34 and 36, it is compacted and stripped from the cylinder and dis-

charged into the lint slide 16, passing from thence into the press and baler where it is formed into bales ready for shipment.

I have found that the lint condenser is the first, if not the most satisfactory portion of the gin plant for introducing moisture into the lint fibers since the moisture introduction at this point imposes no problems of conveying the moistened fibers as would arise if the moisture were introduced at any portion of the lint flue. Moreover, the introduction of moisture at this point is an entirely satisfactory means for dissipating the static charges carried by the lint fibers, and for preventing or extinguishing any fire which may have been started in the fibers, and effectively preventing the passage of burning fibers into the bale formed by the lint press and baler. The effectiveness of the introduction of the additional moisture at this precise location in the cotton ginning plant probably arises from the fact that the fibers are concentrated upon the screen of the condenser and the enormous volume of blast air from the lint flue passing through the fibers and through the screen of the condenser cylinder are ideally adapted to secure the maximum rate of application of the moisture particles to the fibers themselves in a uniform manner and in a direct application to the fibers, and since the fibers are deposited to form a batt upon the condenser cylinder, there is no problem created by the application of the moisture to the fibers such as would arise if the moisture were introduced into the air-fiber suspension of the lint flue.

Moreover, in the lint condenser casing, the lint fibers are sufficiently concentrated as to density, and yet sufficiently separated and dispersed by their conveying air to enable the securing of an intimate contact between the moisture and the individual fibers to thus ensure a uniform distribution of the moisture throughout the batt being formed. Still further, at this location, the fibers are compacted into a batt which varies slightly in thickness from the point O to the point B and which has been substantially formed between the points O and A, and thus offers an excellent opportunity for controlling the quantity of moisture adhering to and absorbed by the batt.

It is conventional practice in condenser design to form the chamber 40 of decreasing cross-sectional area and height from the point O to the point B whereby to force the air through the screen of the condenser cylinder. This inherently results in a decrease in the turbulence or volume. I make use of this phenomenon to control the quantity of moisture introduced into the cotton fibers. For example, in a typical well known type of condenser to which this invention has been successfully applied, the height of the chamber 40 at A is eighteen inches with appreciable turbulence and volume; at E, it is twelve inches with very greatly diminished turbulence or volume; and at B, it is about seven inches with substantially no turbulence and a minimum volume.

The introduction of the moisture at A in the form of a stream or spray injected directly towards the batt will be in a region of considerable turbulence or volume, and the spray will to some extent be widened circumferentially of the cylinder, thereby attenuating or dispersing the spray and thus lessening the force of its impingement upon and consequently its penetration of the batt. At the point E, however, the nozzles are much closer to the batt and thus, their sprays are subjected to less attenuation because of the reduced turbulence or volume of the air flow, and therefore have a much greater extent of penetration into the batt, thus being capable of a much greater introduction of moisture into the batt. At this point, therefore, a greater moisture content of the cotton can be secured and a greater homogeneity or uniformity of moistening of the fibers is realized.

It is well to note that apparently some of the moisture introduced will be immediately absorbed by the fiber, while some of the remainder will adhere to the fiber, to be

subsequently absorbed into the fiber after the batt has been formed into a bale. The ultimate or full effects of the treating operation, whether by water or other treating agent, are not subjected to the necessity of being completed in the short time interval when the fiber is in the condenser; although it should be noted that my manner of treatment is such as to more effectively introduce the treating agent in such fashion that it will be retained on substantially all of the fibers for eventual absorption thereby.

It is also evident that changing of the position of the nozzles in order to direct their injection to portions of the batt of different thickness will also tend to vary the quantity of moisture introduced into a unit volume of the batt, assuming that a constant rate of water injection for a unit surface of the batt is maintained. It is believed, however, that the controlling principle as regards the quantity of moisture applied to and retained by the lint fibers is the extent to which the spray or stream of moisture directly impinges upon the surface of the batt. If there is a lack of sufficient pressure for the stream of spray to penetrate the moving stream of air between the nozzles and the batt, because of any loss of pressure of the spray or stream; because of condensation of a part or all of the stream of moisture by virtue of cooling of the same by the air stream; or because of sufficient temperature and humidity characteristics of the air stream, all or a portion of the stream of moisture will be dispersed in the air and evaporated thereby and to that extent will be carried through the batt and cylinder without appreciably moistening the batt and will be discharged with the exhaust air through the exhaust duct 38. However, that portion of the moisture that is not evaporated by the air stream, and which either directly impinges upon the batt, or being dispersed as liquid globules in the air stream is applied to the batt by the air stream passing therethrough, will be retained upon the surface of the batt for subsequent introduction into the lint fibers. In some few instances, it may be found practical to rely solely upon the above mentioned varying of the place of injection between portions of the batt having different thickness in order to control the resultant moisture content of the cotton fibers. In most instances, however, reliance may be had solely upon variation of the distance of the nozzles from the batt, the control of the temperature of the stream or, the control of the temperature and humidity of the air stream to control the quantity of the moisture added to the fibers. In addition, variations of the nozzle pressure will also enable adjustment of the quantity of moisture supplied and also the depth of its penetration into the batt. Still further, a shifting of the position of the nozzle between the points A, E and B with respect to variations in the turbulence or volume of air flow may constitute the sole means for controlling moisture content. Finally, any or all of the above modes of control may be used simultaneously and in correlation.

Moisture is supplied to the interior of the condenser from any suitable source through a conduit 46, under the control of a manually operable gate valve 48. Beyond the gate valve 48, the conduit 46 branches into a plurality of distributing conduits, any desired number being employed, and three such conduits being shown in Figures 5 and 11, as at 50. Each of the branch conduits 50 delivers the moisture to a respective header 52, 53 and 55 which extends exteriorly and transversely across the housing of the lint condenser, there being provided a suitable manually operable control valve 54 for each such branch conduit or header. Each header is connected to a plurality of moisture delivery nozzles 56 by which the moisture is discharged into the condenser as set forth hereinafter.

Moisture for treating the cotton fiber is preferably supplied in the form of superheated or dry steam from any suitable source, such as a boiler or the like, not

shown, whereby moisture may be introduced into the lint fiber within the lint condenser. It is, of course, to be understood that the same apparatus may be employed for delivery moisture in other forms than steam, as for example, humidified air, water spray or mist or even other liquids. Further, other liquids for treating lint cotton fiber, such as refined or unrefined cottonseed oil, may be supplied through this agency.

Each of the manual control valves 54 of the headers 52, 53 and 55 is preferably provided with a remote control means whereby from any convenient position, the gin operator may instantly cut off or regulate the quantity of the treating agent supplied by that header. Although this invention is in no way limited thereto, one suitable control means is illustrated in the drawings.

In the arrangement shown, see Figure 6, each valve has an actuating lever arm 57 extending transversely of the valve stem and secured to the usual manual actuating handle. Cables 59 extend from the opposite ends of the lever 57 through suitable guide pulleys, not shown, to any desired station where they may easily be operated as desired.

In general, it has been found that the increase of about 4% in the moisture content of the lint cotton is sufficient, although the principles of this invention are not limited to any particular range.

It has been found satisfactory to use the header 52 to inject moisture to increase the moisture content by from 0% to 2%, while if additional moisture increase is desired, the header 53 is employed to increase the moisture content by an additional amount of the same range or magnitude. Thus, the two headers 52 and 53 in this particular embodiment can effect an increased moisture content of the batt of from 0% to 4%. Variations within this range are obtained by the previously mentioned adjustments.

Where increases of above 4% are desired, additional headers similar to 52 and 53 may be used between the positions A and B. The header 55 is of the same construction as the headers 52, 53, except that it may have more and/or larger nozzles; and while it can be employed in the same manner as 52 and 53, is primarily intended for use in flooding the lint condenser for smothering and extinguishing fires therein.

The headers 52, 53 and 55 are flexibly connected to the conduit 46, and for this purpose, all or a portion of the branch conduits 50 may be of flexible tubing. This flexible connection permits the headers and the nozzles carried thereby to be moved circumferentially about the curved wall 22 of the lint condenser housing whereby the nozzles carried by the header may be selectively and adjustably positioned at circumferentially spaced locations with respect to the condenser cylinder 30 and consequently at variable distances from the condenser cylinder and batt.

In order to facilitate such arcuate or circumferential movement, see Figures 6-8, each of the headers 52 and 53 is mounted upon arcuate guides 58 which are secured in any convenient manner to the exterior portion of the curved casing 22 of the lint condenser, at conveniently circumferentially spaced locations thereon. Preferably, each bracket 58 is provided with an arcuate slot 60 therein which constitutes a guide track in which is slidably received a block 62 constituting a slide and which block is mounted upon and supports the header 52 for sliding movement in the guide bracket. A thumbscrew 64 secured to the slide 62 engages the bracket 58 to lock the slide 62 and thereby the respective header in adjusted position. By this means, each of the headers may be individually adjusted throughout an arcuate circumferential extent.

Where desired, any two or more of the headers may be interconnected for simultaneous circumferential adjustment by suitable interconnection therebetween.

As aforesaid, a plurality of nozzles 56 are carried by

each header, and the portion of the casing 22 immediately below these nozzles is circumferentially slotted, as at 66, whereby the nozzle will be in registry with its slot throughout its arcuate extent of adjustment. The nozzles are so positioned as to direct a stream of moisture directly against the adjacent surface of a batt D as the latter is formed upon the lint cylinder 30. As will be apparent, the place of impingement of the spray or stream from the nozzle upon the batt is adjustable circumferentially of the condenser cylinder in accordance with the range of movement provided for the header. Thus, the spray or stream from the nozzle impinging upon the batt will be spirally adjusted circumferentially of and also radially from the latter due to the arcuate shape and position of the guide slots of brackets 58 relative to the cylinder 30, as seen in Figure 10, and since the batt is at progressively varying distance from the nozzles between the points A and B as above mentioned, the nozzles may be selectively positioned for directing their moisture upon the batt at different locations of varying distance of travel through the air stream.

In order to prevent the escape of lint cotton from the slots 66, each of the nozzles is provided with an arcuate shield or closure plate 68 which slidably engages the exterior surface of the lint condenser casing wall 22 and closes the slot except for that portion with which the nozzle is in registry. Thus, escape of air and/or lint cotton from the condenser through the moisture injection slots is prevented.

It will be readily appreciated that any selected one or all of the headers may be utilized for moistening the lint cotton; and any or all of the headers may be circumferentially adjusted to locate the nozzles at the precise relation with respect to the batt which will permit absorption of the desired amount of moisture sprayed thereagainst.

Although in the embodiment illustrated, a plurality of headers have been provided and each header is shown as being adjustable, it will be readily understood that the invention also comprehends constructions wherein only a single header may be provided; and/or in which the single header, any one of a plurality of headers or all of a plurality of headers may be arcuately adjusted as above described.

In general, however, I prefer to employ the feature of operating a selecting number of nozzles which are disposed at selected angular intervals about the circumference of the condenser cylinder in order to introduce any desired moisture content into the lint cotton fibers in the condenser; and to vary this introduced moisture by either varying the number of nozzles, their location with respect to their distances from the batt forming upon the condenser cylinder, their spacing from the batt or their position in the chamber 40 with respect to the turbulence or volume of flow or the pressure of injection, or any of these variables in combination.

Referring now more specifically to Figure 9, it will be seen that I have provided a moisture collecting trough 69 of any desired character, and which is mounted in any suitable manner within the rotating condenser cylinder 30, as by being secured by brackets 70 to the exhaust air discharge duct 38. When an excessive quantity of moisture is introduced into the lint condenser of the end discharge type illustrated, the same will be carried by the air stream through the batt forming upon the lint condenser cylinder, and this moisture, which is not carried by the exhaust air through the duct 38 will condense and collect in the trough 69. A moisture aspirating conduit 72 is provided which is suitably mounted, as by brackets 74, upon the duct 38, and 76 upon the moisture collecting trough 69. This conduit has its adit 78 disposed in the trough 69 and has its exit 80 disposed in the air stream in the duct 30 whereby the outflowing air will suck or draw moisture through the tube 72 from the collection trough 69. It will thus be seen that provision has been made for removing any condensed surplus

moisture from the lint condenser which would otherwise produce an over-saturated or unduly wet condition of the lint cotton. By this arrangement, an excess of moisture can be supplied to the lint condenser and the surplus thereof, not absorbed by the lint cotton or the batt under the previously described provision for controlling the amount of moisture absorbed by the cotton, will be discharged.

It will, of course, be apparent that the moisture discharge means will in some instances be unnecessary and may be omitted. Thus, in condensers of the down-draft discharge flue type, the natural downward flow of the discharge air will carry with it the excess moisture requiring no separate moisture discharge means.

It is commonly known that the lint fibers when introduced into the lint condenser have usually acquired static charges of electricity during their previous working in the gin. These charges cause the lint fibers to tenaciously adhere to the metallic screen of the lint condenser which clinging action is further increased by the pressure of the air against the batt as the air passes through the latter into the condenser cylinder during the separation of the air from the fibers. As a result of the static and the air pressure, it sometimes occurs that this adherence of the batt to the condenser cylinder is so great that the doffer roller 36 is unable to strip or doff the batt from the cylinder, and that portion of the batt will pass under the doffer roller.

When this occurs in condensers of the up or down discharge type, or where the air reverses its flow through the condenser cylinder, and the batt surface of the cylinder is exposed to the air discharge flue, the undoffed portion of the batt will then be forced from the cylinder by the air exhausting therefrom and will be blown out of the air discharge duct, producing what is known as "spitting" and effecting a considerable financial loss to the ginner. The introduction of steam or other treating agent into the condenser will entirely dissipate the static charges thus completely eliminating the chief cause of "spitting." This static dissipation is an inherent but extremely desirable function of the previously disclosed moisture injection into the condenser.

It is to be understood that the apparatus and the method described hereinbefore is applicable not only for the introduction of steam or other moisture for increasing the moisture content of lint cotton to a predetermined value, but also for introducing other cotton treating agents, such as unrefined or refined cottonseed oil or other substances for beneficially affecting the characteristics of the lint cotton.

In some particular circumstances, the apparatus as above described will prove to be satisfactory and will introduce a desired increased moisture content to the lint cotton fibers. However, under conditions of considerable variation in the atmospheric temperature and humidity, the effectiveness of the blast air in removing the exact amount of excess moisture in the lint condenser, in order to secure a predetermined, controlled, desired additional moisture content for the lint fibers is of widely varying effectiveness and it has been found that further adjustable controls are necessary. Tests have shown that the additional moisture content which can be introduced into the lint fibers of the batt in the lint condenser from a constant rate and temperature of moisture supply varies inversely with an increase in temperature and a drop in humidity of the blast air. In explanation of this phenomenon, it will be seen that as the air temperature increases or its humidity drops, its ability to absorb moisture from the spray increases. Consequently, a greater percentage of the introduced moisture is evaporated by and absorbed by the blast air, thus leaving a smaller proportion of moisture for introduction to the cotton fibers.

Accordingly, in order to enable the gin operator to compensate for these frequently varying factors, the present invention provides a process and means for controlling

the temperature and/or the humidity of the blast air in order to regulate its ability to remove excess moisture from the lint condenser and thereby facilitate the ability of the apparatus to introduce the desired moisture content into the lint cotton. Referring now more specifically to Figures 1-4, it will be seen that use is made of the cooling towers 29 as an economical and a beneficial source from which moisture may be introduced into the blast air for imparting a controlled increased humidity thereto. Obviously, it is within the concept of this invention to use any other desired source for humidifying or regulating the humidity of this air, where desired. In the conventional type of cooling tower 29, it will be seen that there are provided a plurality of pans or trays 80 disposed in vertically spaced relation, and that the hot water discharge pipe 31 from the cooling jacket 25 of the power plant 23 discharges this heated cooling water at the top of the towers. This heated water cascades from the uppermost pan or tray 80 through the screens 82 forming the bottoms of the same and falls through the air downwardly into a sump or tank 84, to which the water return line 33 is connected.

During its downward flow, the water in a finely divided or spray form is cooled by its passage through the air and then returned to the water jacket of the power plant. In accordance with this invention, a pair of intake hoods 86 and 88 are disposed about a portion of the cooling towers, for receiving air passing through the towers, which air will be moistened by the descending water from the pipe 31 as will be readily apparent from Figure 2. The inlet hoods 86 and 88 are in turn connected to an inlet conduit 90, the latter passing through a heat exchange coil 92 and from thence through a control valve casing 94 and into the hood 35 of the blast air fan 21. Any suitable type of control valve is provided in the casing 94, under the control of a valve actuating rod 96, whereby the proportion of moistened air to the atmospheric air supplied to the open end of the hood 35 may be regulated and controlled. It will also be understood that provision may be made for entirely or partially closing off the atmospheric air to the casing 35 whereby only moistened air from the conduit 90 may be supplied to the blast air fan 21. It will thus be apparent that any desired proportion ranging from all atmospheric air to all moistened air or to any desired proportion of the same may be introduced by the blast air fan 21 into the blast air conduit 19.

It should be observed that since the blast air fan normally supplies over 7000 cubic feet of air per minute to the gin stands, and since the velocity of this air through the blast air flue 19 is extremely high, the introduction of moistened air into the housing 35 is almost instantly followed by the introduction of humidified air into the lint condenser. The device is exceptionally responsive to adjustment of the humidity of the blast air.

It is also possible to control the temperature of the blast air. Conveniently, the temperature of the humidified air supplied to the blast air fan may be beneficially regulated. For this purpose there may be provided a heat exchange radiator 98 disposed in approximate proximity to the heat exchange coil 92 of the humidified blast air supply. As shown more clearly in Figures 2 and 3, the radiator 98 may include a plurality of coils 100 therein through which a fluid medium may be circulated in any desired manner. Thus, hot water, combustion products or any other heating fluid medium is supplied to the coil 100 through the hot fluid supply conduit 102 while alternatively a cooling fluid such as water or some refrigerant may be supplied by the cold fluid supply conduit 104. An alternative or a proportionate supply of these fluids to the coil 100 may be obtained by the regulating valve 106. After passage through the heat exchange coil 100, the hot or cold fluids or the mixture of the same may be discharged as by a conduit 108 for reuse or to any desired place of discharge. There is also provided a fan 110

which may be operated as by an electric motor 112 or any other desired manner, and which blows an air stream or any other desired heat conducting fluid across the heat exchange coil 100 and from thence across the heat exchange coil 92 in the humidified blast air supply conduit. Thus, the humidified blast air may be either heated or cooled in order to regulate its temperature to any desired value.

It will be apparent that by proper manipulation of the temperature controlling means and the humidity controlling means, the blast air supplied by the blast air duct 19 may be precisely regulated as to its temperature and humidity, and thus its efficiency in withdrawing excess moisture from the lint condenser may be very effectively regulated and controlled.

It is also to be understood that the heat controlling arrangement described with reference to the humidified blast air supply duct can also be supplied directly to the blast air duct 19 prior to the discharge of the same into the gin stands whereby when atmospheric air alone is supplied by the blast air fan 21, the temperature of the same may be easily regulated.

It should be observed that the operation of the blast air moistening means not only serves to impart to the blast air any desired humidity, and thus beneficially effect and assist the control of the moistening operation in the lint condenser, but will also by the evaporative effect and the induced flow of air through the cooling towers greatly facilitate and beneficially effect the cooling of the power plant cooling system. It has been found by tests that the operation of the moistening device for the blast air will easily reduce the temperature of the cooling system of the power plant by from eight to ten degrees on a hot day.

As an alternative means, or if desired as a supplemental means for regulating and controlling the proportion of the moisture introduced into the lint condenser which will be discharged therefrom in the exhaust air as surplus moisture, it is possible to heat or cool the steam or moisture being introduced into the lint condenser by the header and nozzle assembly. Thus, if steam is being supplied by the header and nozzle assembly, it is evident that heating or superheating the same will increase the proportion of the moisture which is absorbed into and evaporated by an air stream, and hence is educted from the lint condenser by vapor mixed with the air. On the other hand, if the steam or moisture spray is cooled whereby a "wetter" or more easily condensable steam is injected, a larger proportion of the same will be condensed to particles of moisture in the condenser and will be directly applied as moisture to the batt therein. Under this condition it is obvious that a greater proportion of the moisture will be directly applied to the batt in a condition where it may be absorbed thereby and consequently there will be a larger increase in the quantity of moisture introduced into the lint cotton.

It should be observed that this process and means for controlling the quantity of moisture introduced into the lint cotton is especially beneficial in those installations where it is desirable or necessary to use a relatively low source of pressure of the steam, as for example about fifteen pounds maximum boiler pressure. Under such conditions it is possible to prevent any tendency of the steam to condense during its travel through the conduit system to the nozzles; and also, where desired, to superheat the steam and thereby decrease the proportion of the same absorbed by the lint cotton batt.

For this purpose, as shown more clearly in Figure 11, each of the headers 52, 53 and 55 may be enclosed in a casing 120, which in turn are connected with the flexible housings 122. The three housings 122 communicate with a common supply housing 124 having an inlet hood 126. An air supply fan 128, driven as by an electric motor 130, is mounted in this hood for blowing air through the housing members 124, 122 and 120 and thus against the headers. The temperature of this air stream is controlled

as by a heat exchange coil 132 of any desired character disposed in the housing 126, and through which is passed a heat exchange fluid by means of an inlet conduit 134 and an outlet conduit 136. In order to control the temperature of this fluid a pair of supply conduits as a heating fluid conduit 138 and a cooling fluid conduit 140, connected with any suitable source of hot and cold fluids respectively are supplied to the inlet conduit 134 by means of a proportioning and control valve 142. The latter is capable of supplying either hot or cold fluid or both in any desired proportion to a heat exchange coil 132.

As will now be readily understood, this arrangement permits air in any desired temperature to be flown across the header and supply conduit system of the water injection whereby the injected fluid may be heated or cooled to any desired degree. Thus, the steam injected may be so cooled as to cause a considerable condensation of the same to thereby inject the maximum moisture content into the lint cotton and if desired, even to extinguish fires in the lint condenser. On the other hand, the moisture supply conduit system may be so heated as to cause a variable proportion of the injected moisture to be absorbed as vapor by the airflow and thus discharged from the lint condenser to reduce the quantity of moisture absorbed and introduced into the lint cotton.

As will be more readily apparent from Figure 7, the heat controlling air flow discharged into the casings 120 may be dissipated from the open bottom ends of the same. When desired, however, other arrangements may be provided for the discharge of heat exchange fluid.

In the arrangement of Figure 11, substantially the same heating or cooling effects were applied simultaneously to the plurality of headers. In the modified construction of Figure 12 however, it is possible to control individually the temperature of the individual headers. In this arrangement the same air heating and cooling means and the same air supply duct 124 is provided as that previously described. However, the heating or cooling air delivered by the duct 124 is applied somewhat differently to the moisture injection system. Thus, the conduit 124 is provided with a plurality of discharge branch conduits 144, 146 and 148. Each of these conduits is placed in heat exchange relation with the supply conduit 50 of one of the header injection systems. By means of a control valve 150 in each of the branch conduits, which valves are independently controlled as by control levers 152, the supply of the heating or cooling air may be proportioned as desired to any of the header systems and thus a different extent of heating or cooling may be applied to a selected header system. This arrangement permits great flexibility in the temperature control of the individual systems.

Although in describing the specific heat constituents of Figures 11 and 12 reference has been made to the use of air as the heat exchange medium supplied through the conduit 124, it will be readily apparent that it is within the scope of this invention to employ any other heating fluids desired, as well as various other temperature control means for the headers and/or their supply conduits.

It is not contended that the present invention resides broadly in the provision of a method or apparatus for the introduction of moisture into a lint condenser; but it is contended the present invention carries out the foregoing broad concept in a practical and efficient manner in that it provides both a process and an apparatus whereby moisture or other treating agents can be introduced into the lint cotton fiber in a much more satisfactory and homogeneous manner; that it may be introduced with a much greater precision and accuracy of control; and that the control of the moisture content of the lint cotton may be effected in a variety of ways, as by varying the distance of the nozzles from the batt; varying the injection pressure; controlling and adjusting the various locations upon the batt being formed upon the lint condenser cylinder of such thickness as to give the requisite degree of moisture

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or absorption by the lint cotton; by the provision of means for removing any surplus of moisture admitted to the lint condenser; by adjusting the humidity and temperature of the blast air; and by regulating the temperature and saturations or density of the steam injected.

The present application is a continuation-in-part of my prior copending application, Serial No. 410,553, now abandoned.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

What is claimed as new is as follows:

1. A method of producing in the lint condenser of a seed cotton ginning plant a predetermined percentage by weight moisture content in lint cotton having a percentage by weight deficiency of moisture which comprises; delivering from a gin stand of a seed cotton ginning plant to a lint condenser thereof lint cotton accompanied by an air stream, continuously forming in said lint condenser a batt of lint cotton, continuously introducing into the air stream and within the confines of the lint condenser and applying to said batt a surplus of moisture over that which would produce the said predetermined percentage of moisture content to thereby increase the rate of moisture absorption by the batt, continuously removing from said batt and lint condenser by said air stream said surplus of moisture of said introduced moisture, controlling the relative quantities of moisture introduced and surplus moisture removed and thereby limiting the total moisture content of the lint cotton in said batt to said predetermined percentage by weight moisture content.

2. The method of claim 1 wherein the step of introducing moisture is effected by causing passage of moisture across and into a portion of said accompanying air stream in a direction towards said batt thereby effecting intermingling of the moisture and air prior to contact of the moisture with said batt.

3. The method of claim 2 including the step of controllably varying the length of the passage of the moisture through said portion of the air stream whereby to variably control the proportion of the moisture absorbed and removed by the air stream and the proportion of moisture absorbed by the batt.

4. The method of claim 3 wherein the last mentioned step includes varying the thickness of said portion of the air stream in its direction of flow and varying in the direction of flow of said portion of the air stream the location of said passage of moisture thereacross.

5. The method of claim 1 wherein the step of introducing moisture is effected by spraying moisture across a portion of the accompanying air stream and upon said batt thereby obtaining intermingling of the moisture and air and absorption of a portion of the moisture by the air prior to contact of the moisture and moisture laden air with the batt.

6. The method of claim 5 wherein the step of spraying moisture includes the spraying of moisture by a plurality of streams spaced in the direction of travel of said portion of the air stream.

7. The method of claim 1 wherein the step of introducing moisture is effected by spraying a plurality of streams of moisture across a portion of the accompanying air stream and upon said batt, said plurality of streams being spaced transversely of said batt and of said portion of said air stream.

8. The method of claim 1 including the step of variably controlling the humidity of the air stream and thereby controlling the proportion of moisture absorbed by the air stream.

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9. The method of claim 1 including the step of variably controlling the temperature of the air stream and thereby controlling the proportion of moisture absorbed by the air stream.

10. The method of claim 1 including the step of variably controlling the humidity and temperature of the air stream and thereby controlling the proportion of moisture absorbed by the air stream.

11. The method of claim 1 including the step of variably controlling the proportion of moisture absorbed by the air stream by variably controlling the temperature of the introduced moisture.

12. The method of claim 1 including the step of variably controlling the proportion of moisture absorbed by the air stream by variably controlling the wetness of the introduced moisture.

13. The method of claim 1 including the step of variably controlling the proportion of moisture absorbed by the air stream by variably controlling the temperature and wetness of the introduced moisture.

14. The method of claim 1 wherein the moisture is introduced in the form of steam.

15. The method of claim 14 including the step of variably controlling the temperature of the steam to thereby variably control the wetness of the steam.

16. The method of claim 1 wherein the step of introducing moisture is effected by spraying moisture across a portion of the accompanying air stream and upon said batt thereby obtaining intermingling of the moisture and air and absorption of a portion of the moisture by the air prior to contact of the moisture and moisture laden air with the batt, the moisture being introduced in the form of steam.

17. The method of claim 16 including the step of variably controlling the temperature of the steam during its passage through said portion of said air stream to thereby variably control the wetness of the steam.

18. The method of claim 1 wherein an increase in the moisture content of the lint cotton in the lint batt, by the step of introducing moisture, ranges up to about 2% by weight of the lint cotton.

19. A lint condenser including a casing having a condenser cylinder therein, means for educting air from said casing through said cylinder, means for delivering lint cotton conveyed by an air stream from a gin stand of a seed cotton ginning plant into said casing and circumferentially about said cylinder in contact therewith and forming a lint batt thereon, a nozzle mounted in said casing and positioned for directing a stream of moisture through the adjacent portion of said air stream and towards said cylinder and the batt formed thereon, means for moving said nozzle along a path which is circumferential of and convergent to said cylinder whereby to vary the distance through said adjacent portion of said air stream of said nozzle from said batt.

20. A lint condenser including a casing having a condenser cylinder therein, means for educting air from said casing through said cylinder, means for delivering lint cotton conveyed by an air stream from a gin stand of a seed cotton ginning plant into said casing and circumferentially about said cylinder in contact therewith and forming a lint batt thereon, a pair of nozzles mounted in said casing and each positioned for directing a stream of moisture through an adjacent portion of said air stream and towards said cylinder and the batt formed thereon, means for moving one of said nozzles towards and from said cylinder whereby to controllably vary the length of travel of said streams of moisture from the nozzles and through said adjacent portion of said air stream to said batt.

21. The combination of claim 20 wherein said nozzles are spaced circumferentially of the cylinder from each other by about 30°.

22. The combination of claim 19 including means for variably controlling the temperature of said air stream.

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23. The combination of claim 19 including means for variably controlling the humidity of said air stream.

24. The combination of claim 19 including means for variably controlling temperature and humidity of the air stream.

25. The combination of claim 19 wherein said casing has a slot therein, means on the exterior of said casing for mounting said nozzle, said nozzle extending through said slot into said casing.

26. The combination of claim 20 wherein said casing has slots therein, means on the exterior of said casing for mounting said nozzles, each nozzle extending through a slot into said casing.

27. The combination of claim 19 including an enclosing casing for said nozzle, means for introducing a heat exchange medium into said enclosing casing and in heat exchange relation with said nozzle.

28. The combination of claim 20 including an enclosing casing for each of said nozzles, means for introducing a heat exchange medium into each of said enclosing casings and in heat exchange relation with said nozzle, means for variably controlling the temperature of the heat exchange medium in at least one of said enclosing casings.

29. An apparatus for introducing a predetermined additional moisture content in a lint cotton batt on a condenser cylinder in a lint condenser of a seed cotton ginning plant comprising; means for passing an air stream through said lint condenser across and through said batt, means for supplying moisture in an amount in excess of that which it is desired to introduce into said batt, said supply means including a pair of moisture discharge

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means directing a pair of moisture streams into and across adjacent portions of the air stream and towards said batt along paths of different length in said air stream portions, said moisture discharge means being relatively angularly spaced circumferentially of said condenser cylinder in the order of 30° whereby to afford sufficient time and space for effective moisture absorption by the lint cotton, means for controllably varying the proportion of the moisture absorbed by the air stream from the moisture streams and educted from the condenser by said air stream and the proportion of moisture absorbed by the lint batt to thereby control the quantity of additional moisture absorbed by the lint cotton.

30. The combination of claim 29 wherein said last mentioned means includes means for controlling the temperature of the air stream.

31. The combination of claim 29 wherein said last mentioned means includes means for controlling the humidity of the air stream.

32. The combination of claim 29 wherein said last mentioned means includes means for controlling the temperature and humidity of the air stream.

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