July 7, 1931. W. J. ZIMMERMAN 1,813,523

BUILDING

Filed April 6, 1927 2 Sheets-Sheet 1

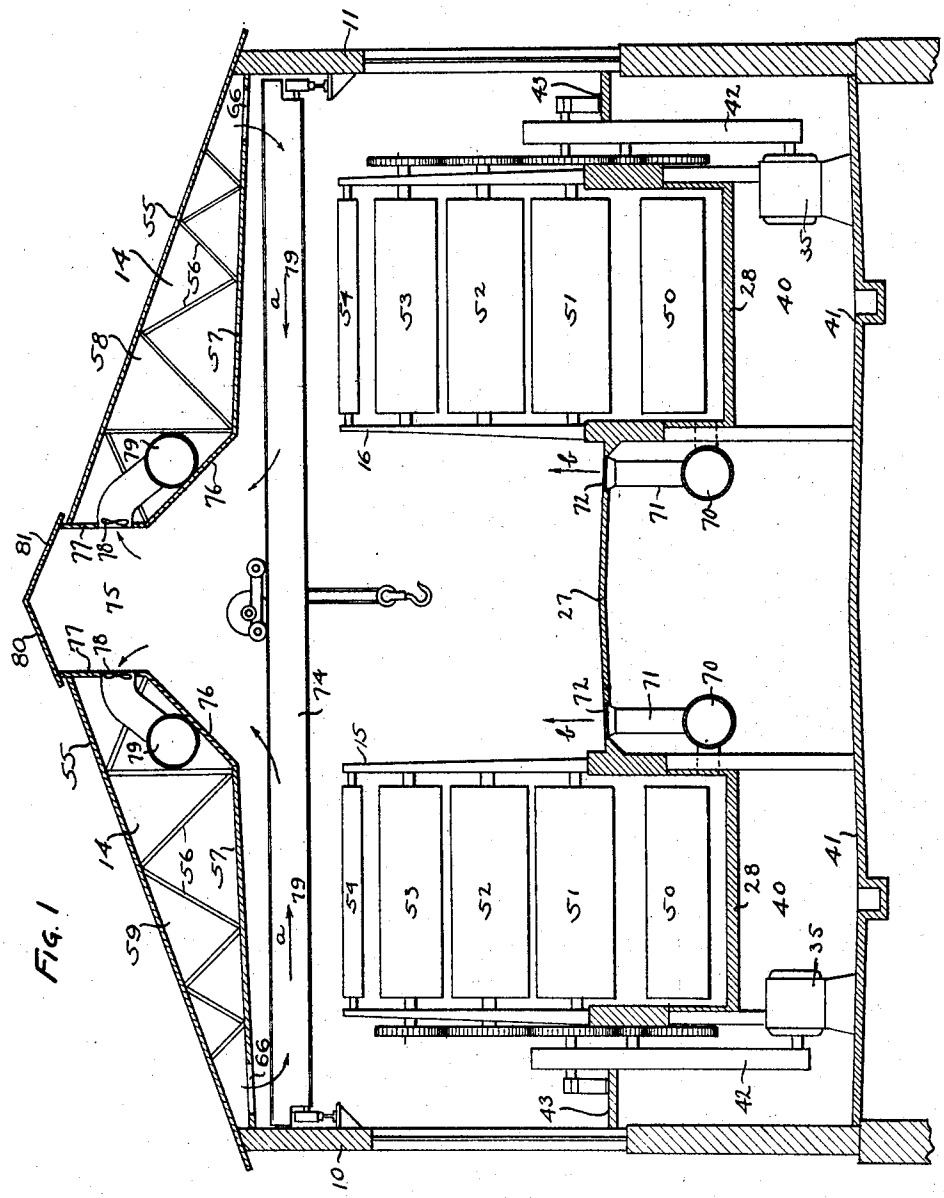


Fig. 1

INVENTOR
Walter J. Zimmerman

BY Maréchal and Noc
ATTORNEY

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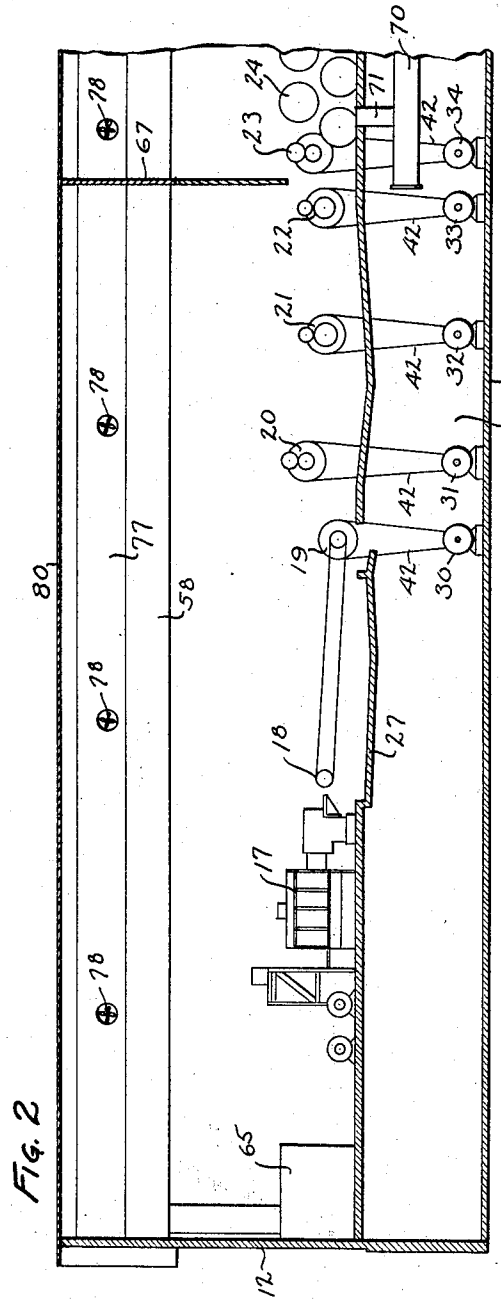


Fig. 2

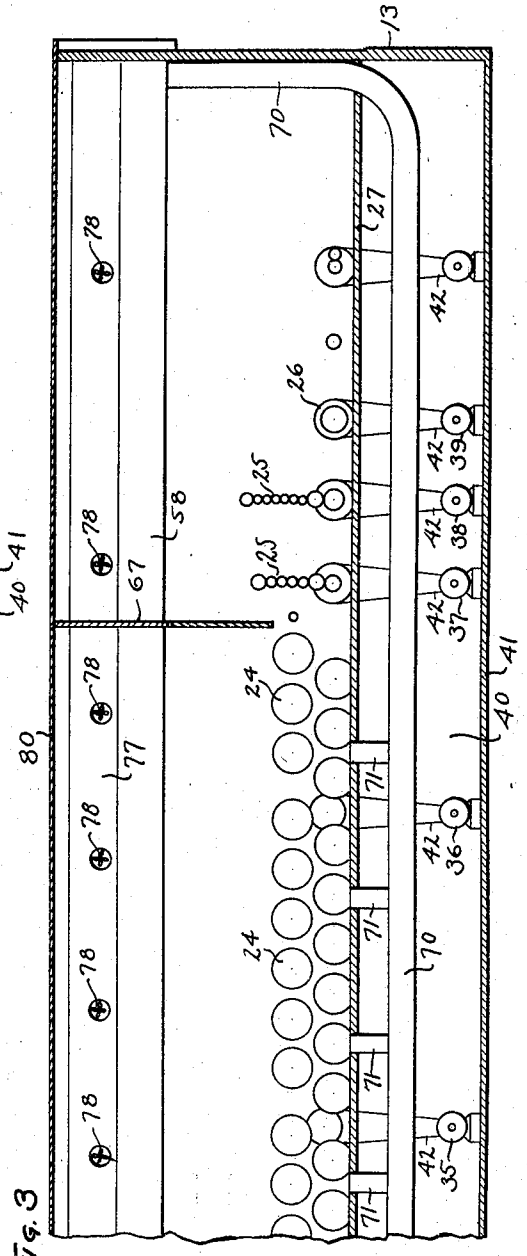


Fig. 3

INVENTOR
Walter J. Zimmerman

BY
Maréchal and Noe
ATTORNEY

Patented July 7, 1931

1,813,523

UNITED STATES PATENT OFFICE

WALTER J. ZIMMERMAN, OF DAYTON, OHIO, ASSIGNOR TO THE MANAGEMENT ENGINEERING AND DEVELOPMENT COMPANY, OF DAYTON, OHIO, A CORPORATION OF OHIO

BUILDING

Application filed April 6, 1927. Serial No. 181,387.

This invention relates to buildings and particularly to a building arrangement for efficiently housing machines of the type such as are used in the manufacture of paper and the like.

One object of the invention is to provide a building which is capable of efficient utilization of the space available, and the more economical and efficient arrangement of the various machines and their accessories, such as the drying machines and accessories of a paper manufacturing establishment.

Further objects and advantages of the invention will be more fully set forth in the following description and in the accompanying claims and drawings.

In the drawings

Fig. 1 is a transverse vertical section through the building;

Fig. 2 is a longitudinal vertical section through part of the building; and

Fig. 3 is a central section forming a continuation of Fig. 2.

Referring more particularly to the drawings by reference numbers, in which like numerals designate corresponding parts in the various views, the building, as shown, is provided with the two vertical spaced side walls 10 and 11 which extend longitudinally along the length of the building. At the ends the building is closed by suitable end walls 12 and 13, and the four walls support the peaked roof designated generally 14. This roof at its center portions is of substantial vertical depth and it progressively decreases in thickness or depth from its center out to the edge portions where it is supported by the two side walls 10 and 11.

The building is quite long as compared with its width and is adapted to house the two rows of machinery designated generally 15 and 16 and herein shown as two complete lines of machines for making paper or the like. A central aisle for the operators is provided between the two rows of machines. Each line of machinery, as shown, comprises the paper pulp mixer 17, a breast roll 18, couch roll 19 with paper forming section between, the three presses 20, 21 and 22, smoothing roll 23, various steam-heated dryers 24, the calenders 25 and the reel 26. These various machines are arranged in succession in the parallel rows as shown in the drawing.

The various machines just mentioned by which the paper is manufactured are mounted upon a main floor 27, having subportions 28 in which a portion of the machinery such as the bottom felt dryers are mounted, these two subportions 28 being continuations of the floor 27 set below the level of the main portions thereof. The various machines are driven from a series of electrical motors which are located below the level of the machines which they drive, the machines 19 to 26 inclusive being shown as driven by the electrical motors 30, 31, 32, 33, 34, 35, 36, 37, 38 and 39. These motors are located below the floor portions 27 and 28, and are positioned in the space 40 above the basement floor 41 in a cool and comparatively dry place where they are not subjected to the heat and moisture around the drying machines. The various motors are interconnected with the machines by means of rope drives or the like, as shown at 42, these drives extending up through suitable slots or holes in the side portions 43 of the main floor. The various rope drives of each row of machinery are positioned closely adjacent the side walls 10 and 11 with the motors located below the machinery and with such an arrangement of the parts the two rows of machinery may be housed within a building in which the side walls 10 and 11 are closer together so that the minimum cubical contents will be required, and the total width of the building reduced from the customary size. Furthermore, the location of the motors within a chamber below the main floor of the building and below the drying and the other machines permits their operation in a comparatively cool space where they are not subjected to the excessive heat of the drying machines. These drying machines, furthermore, cause the atmosphere around them to be always in a humid and water laden condition, which would necessitate the use of larger sized enclosed and protected motors if the motors were to be located on the same floor and in proximity to

the drying machines. The various motors are all electrically connected by a controlling interlock (not particularly shown) so that they may run at different speeds to permit the entire row of machinery to be speeded up or slowed down as desired. The electrical interconnection is such, however, as to compensate for the paper shrinkage which takes place as the web of paper travels from one operation or machine to the next. The various speeds of the different motors are such as to cause the proper speed of operation of the machinery at each operation, and the electrical control or interlock is adapted to compensate for the difference in speeds of the various motors by amounts which are proportionate to the shrinkage in the paper web at the particular station, as a change in speed of the entire line of machines is produced.

By the arrangement of the various machines and their driving motors in the manner just specified, a smaller building may be utilized for housing the machinery due to the decrease in the distance between the side walls of the building. This decreased width as previously stated, is made possible by the location of the electrical motors below the paper machines instead of to one side of the machines. At the same time the efficiency of the motors and their more economical arrangement is permitted by reason of their location in a comparatively cool and dry place instead of adjacent to the moisture-laden and hot air which surrounds the drying machines, the calender, etc. In actual practice it has been found that the side walls of the building may be made from 20% to 25% less than the customary width by reason of the location of the motors as previously mentioned. This decrease in the distance between the side walls of the building permits an immense saving in the cost of the building construction which is ordinarily proportional to its cubical contents. This furthermore has the very important advantage of decreasing the amount of air or space within the building which results in an enormous saving in fuel as this air needs to be heated or maintained at some definite temperature as in the present instance.

It will be understood that in the manufacture of paper a continuous web or strip of the paper stock is led from the mixing machines 17 through the various presses and rolls where the paper is formed into a flat sheet of material which contains a very high percentage of water. The paper web is then passed around a number of dryers as shown at 24, the paper passing from one dryer to the next so that it partly surrounds each of the dryers, which are heated by means of steam, so that the water contained in the paper is driven off by reason of the heat imparted to the dryer rolls. As shown in Fig. 1 the dryers are arranged at different levels, the bottom dryers 51 and the top dryers 52 being located at levels between the bottom felt dryer 50 and the top felt dryer 53. A top idler roll 54 is shown mounted above the level of the top felt dryer. The paper comes from the dryers in a comparatively dry state and is then passed on to the calenders and from there it is supplied to the reel 26. As the paper passes over the dryers the moisture is driven out of the paper into the surrounding air. In order to remove the moisture as fast as it is driven off of the paper forced circulation of heated dry air is provided so that the moisture may be rapidly carried away from the proximity of the paper and from the dryers.

The roof truss construction is such that a comparatively large depth is provided at the central longitudinal portion of the roof. The roof truss which is located below and supports a top roof covering 55 on each side of the center of the roof, is composed of a number of truss members 56, which extend between the upper roof covering 55 and a lower substantially horizontal surface 57. As will be seen in Fig. 1 the truss is of triangular formation, the vertical depth of the truss progressively decreasing from the center outwardly, and the total overall height of the building at its outer side walls does not exceed the height of the wall itself by any very substantial amount. The arrangement of the truss not only decreases the vertical overall height of the building at the outer parts of the building but also permits the provision of plenum chambers or hot air spaces 58 and 59 one on each side of the longitudinal center of the building. The plenum chamber is defined by the top roof covering 55 and the lower surface or wall 57, which constitutes the ceiling for the machine room and is spaced progressively decreasing distances from the roof covering 55 from the inner portions outwardly towards the walls 10 and 11. The two plenum chambers are identical in their construction and each chamber is supplied with air by means of an air ventilating or pressure blower 65 which is preferably located within one end of the building. The outer parts of the lower surface 57 of the chamber are provided with a large number of spaced slots or louvres 66, which are regularly spaced adjacent one another throughout the length of the chamber 58 above the dryers. This chamber as should be noted, extends the entire length of the building although if desired it may be divided into sections by means of partition walls 67 extending across the chambers. The air which is forced into the plenum chamber is supplied in a dry hot state by means of suitable heating apparatus, which operates in conjunction with the blower 65 so as to maintain a supply of hot air within the plenum chambers at a pressure

exceeding atmospheric pressure. The hot dry air of the plenum chambers which is, for example, at a temperature of about 120° F. is forced out of the outlet louvres, and due to its high temperature it clings comparatively close to the ceiling 57 and forms a continuous blanket of hot air between the wall 57 and the upper portions of the dryers. This blanket of air is continuous over the drying machines as the louvres are so spaced apart as to maintain its continuity for the length of the line of dryers. It travels, as shown, at arrow "*a*" towards the center of the building and as it passes over the dryers and the moisture-laden air surrounding them the moisture is absorbed quickly and taken away from the paper and from the air which surrounds it. The top blanket of air is now laden or saturated with moisture and it travels further towards the center of the building being forced along by the pressure of the air behind it coming from the louvres 66. An air passage 70 communicates at one end with the plenum chamber 58 and extends below the floor 27 lengthwise of the building. Various outlet passages 71 extend upwardly from the main horizontally extending passage 70 and gratings 72 are provided in the floor 27 so that blasts or drafts of hot dry air are forced up through these gratings as shown by the arrow "*b*" in Fig. 1. These blasts or drafts of hot dry air travel up parallel to the line of machinery and closely adjacent to the inside or aisle-side of the same, and intermingle above the level of the machinery with the top blanket of moist air so that both of these air currents are forced up into the central reception trough 75, which is defined by the side inclined surfaces 76 and the vertical inside surfaces 77 of the plenum chambers. The air so introduced through the floor forms in effect a screen which prevents the hot burned atmosphere immediately adjacent the drying cylinders from entering the aisle where the operators work, thus greatly ameliorating working conditions. A number of exhaust fans 78, located at intervals along the vertical surface 77 of each plenum chamber draw the moisture-laden air into the exhaust air duct 79, which extends lengthwise of the building inside of the plenum chamber. The moisture-laden air travels through this duct and is then exhausted into the atmosphere through a suitable opening which may be provided in the end of the building.

The use of a double walled roof and the plenum chambers, serves to space the comparatively cold roof surface 55 away from the moisture-laden blanket of air at 79 over the drying machines, and separates this moisture-laden air by a layer of hot dry air within the chamber. Although this layer of hot dry air is in the neighborhood of 120° F. there is no objectionable condensation of water vapor as it contacts with the cold roof surface 55, as the air within the plenum chamber is in a dry state. The customary condensation which in prior constructions of this type of building occurs on the inside of the roof where it is in contact with hot water-laden air above the drying machines is thus avoided. In the construction herein shown, the moisture-laden blanket of air in contact with the lower surface of the plenum chamber 57 is approximately at the same temperature as the surface itself since the air within the chamber is heated to about the same temperature as the moisture-laden hot air below. There is thus a negligible difference in temperature and moisture will not be condensed by contact of the humid air with the surface above it. The continuous blanket of air above the machines coming from the plenum chambers is permitted to come in direct contact with the upper surface of the dryers in an unobstructed manner. No intervening drip collector is provided over the machines as there is no condensation of moisture to be prevented from falling on and wetting the paper being dried. The space between the lower surface 57 of the plenum chamber and the upper portions of the drying machines may therefore be made a minimum and the total height of the building may thus be considerably decreased over a construction in which a drip collector is used over the machines. The space above the top of the dryers need only be sufficient to provide for the traveling crane or hoist 74. The decreased height of the building by reason of the decreased distance which is provided over the drying machines cooperates with the decreased distance between the side walls of the building permitted by the motor drive arrangement so as to permit the use of a building having a reduced volume. This saving in volume of the contents of the building results not only in the decreased cost of the building but it very materially decreases the amount of air which must be heated in order to cause the proper and efficient removal of the moisture. The air may thus be heated to a proper temperature before being supplied to the plenum chambers by an apparatus which has a capacity very materially less than the capacity of the apparatus of this nature which would otherwise be required.

The location of the exhaust ducts 79 within the plenum chambers 58 and 59 further reduces the likelihood of condensation of the moisture contents of the contained air since the moist air within the exhaust duct is substantially at the same temperature as the dry air surrounding it. Consequently the walls of the duct are not chilled and the entire moisture content of the air travels with the air flow to the exhaust into the outer atmosphere.

The construction herein described also

makes for an increase in the lighting effect of the interior of the building. Absence of the dew and drip collectors over the machines has the important advantage of permitting the light to be fully distributed over the upper surface and upper side portions of the machines. The light is supplied through the glass surfaces 80 and 81 which are slightly inclined upwardly towards the center and extend along the full length of the building. These glass surfaces are almost flush with the upper roof surfaces 55 and they extend completely across the center of the building between the two plenum chambers. This permits the light to be supplied from above so as to clearly and efficiently illuminate the entire center aisle between the two rows of machines, and the inclined sides 76 of the plenum chamber permits almost the entire upper surface of the upper rows of the dryers to be illuminated by natural light source. The sides of the machines are supplied with unobstructed lighting, and the entire construction cooperates in permitting a maximum supply of light to the operating parts of the machine where it is needed.

By reason of the arrangement of the building and of the contained machinery and accessories, therefore, as just described, the building and housing arrangement may be far more economical and efficient. The various features of the building cooperate together to produce a greater utilization of space, a greater lighting effect, more efficient heating of the dry air, the complete elimination of dew and drip collectors over the machines with a consequent entire elimination of the fire extinguishing sprinkler heads which are needed if such drip collectors are used due to the liability of fire at the high temperatures involved.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention whch is defined in the appended claims.

What is claimed is:

1. In a building of the class described, a roof portion having spaced upper and lower surfaces providing an air chamber therebetween, an outlet for the air in a lower wall of said air chamber, means for supplying heated air under pressure to said chamber so as to force the air out of said opening, and an air duct within said chamber for conveying moisture-laden hot air from the space below said chamber.

2. In a building of the class described, a roof portion having spaced upper and lower surfaces providing an air chamber therebetween, air outlet passages along one side of said chamber to permit the downward flow of air out of said chamber, means for supplying heated air to said chamber under pressure so that a blanket of moisture-absorbing air is maintained beneath the chamber, and means for creating an updraft of dry air to control the movements of the said moisture-laden blanket of air.

3. In a building of the class described, a roof the major portion of which has an inclined upper surface and a lower surface providing an air chamber therebetween, air outlet passages along one side of said chamber, means for supplying heated air to said chamber so that a laterally moving blanket of moisture-absorbing air is maintained below the said lower surface, a collecting air trough extending longitudinally along the building on the opposite side of said chamber from the said outlet openings, and means for creating an updraft of dry air to meet the said blanket of air and deflect it upwardly into said trough.

4. In a building of the class described, a roof the major portion of which has spaced upper and lower surfaces providing an air chamber therebetween, said chamber having outlet openings spaced continuously along the one side thereof, means for causing air to flow downwardly through said openings to create a laterally moving blanket of air, said building being adapted to house a series of drying machines below said chamber and closely adjacent thereto so as to be exposed to and affected by the said blanket of air, means for creating an updraft of dry air closely along the inner side of said series of machines adapted to deflect said blanket upwardly, said roof having progressively decreasing depth from its center portion to the supporting side walls, said roof portion providing a trough at the center of the building for receiving the moisture-laden air after it has been deflected upwardly by the said updraft of air.

5. In a building of the class described, a pair of spaced vertical side walls, a substantially triangular shaped roof truss supported by said walls, said roof truss having a maximum depth at its center portions, an upper sloping surface at each side of the roof truss and a lower substantially horizontal surface on each side portion of the roof, said upper and lower surfaces providing a pair of plenum air chambers therebetween, a central downwardly flaring trough provided in said roof truss between the said chambers, means for supplying dry air from said chambers so as to create an inwardly moving blanket of moisture-absorbing air below each chamber, means for creating updrafts of air to meet the said blankets of air and deflect them into the said trough, and means for exhausting the air from said trough and conducting the exhausted air through one of the plenum chambers.

6. In a building of the class described, a pair of spaced vertical side walls, a substantially triangular shaped roof truss supported by said walls, said roof truss having maximum depth at its center portions, an upper sloping surface at each side of the roof truss and a lower substantially horizontal surface on each side portion of the roof, said upper and lower surfaces each providing a plenum air chamber therebetween, a central trough provided in said roof truss between the said chambers, a series of openings along each air chamber and means for supplying air to said chambers so as to create an inwardly moving blanket of moisture-absorbing air, means for creating updrafts of air to meet the said blanket of air and deflect it into the said trough, means for conducting the air from said trough, said side walls and roof being adapted to house two series of drying machines arranged one below each plenum chamber, said plenum chambers having their lower surfaces closely adjacent the upper portions of said machines so that the blanket of moisture-absorbing air comes in contact with the upper portions of the machines in an unobstructed manner.

7. In a building of the class described for housing a double row of drying machines, a pair of spaced side walls defining the width of the building, a roof truss supported thereby of substantially triangular shape having a maximum depth substantially at the center of the truss, upper and lower surfaces for said roof providing an air chamber therebetween, means for supplying heated air to said air chamber to cause a laterally moving blanket of moisture-absorbing air beneath the chamber, a floor above which drying machines may be mounted, driving motors for said machines located below the machines, interconnections between the motors and the machines arranged between a side wall and the adjacent driving motors whereby the machines are positioned closely adjacent the side walls of the building and directly beneath the blanket of moisture-absorbing air.

8. In a building of the class described, a pair of side walls, a roof truss supported thereby of substantially triangular shape and having progressively decreased thickness outwardly from its center portion, a plenum chamber provided in said roof and adapted to contain heated dry air said chamber having outlet openings in one side of the same arranged in a continuous series so that a blanket of moisture-absorbing air may be maintained above drying machines or the like contained therein, said building being adapted to contain a double row of drying machines with a central aisle therebetween, and means for creating an updraft of air immediately adjacent the aisle sides of the said machines to control the moisture-laden air and deflect the same upwardly.

9. In a building of the class described for housing a row of drying machines, a pair of side walls, a roof truss supported thereby of substantially triangular form having progresssively decreased thickness from its center outwardly to the said side walls, an upper surface covering for said roof truss, a lower substantially horizontal surface spaced below said upper surface, and inclined central surfaces interconnecting the upper covering and said lower surface so as to provide a pair of hot air chambers separated by a central downwardly flaring open trough, the width of the bottom of the trough being commensurate with the width of each of the lower horizontal surfaces of the hot air chambers, a central illuminating glass surface extending across the center of the building and positioned substantially flush with the said upper coverings, said sloping surfaces cooperating with the said illuminating surfaces so as to permit a complete illumination of the space below the center portions of the roof.

10. A building arrangement of the class described comprising a pair of side walls defining the width of the building, a substantially triangular roof truss supported thereby, said truss having progressively decreasing thickness from its center outwardly to the said walls, an upper covering on each side of said truss, lower surfaces provided on the bottom of said truss, inner sloping surfaces connecting said upper covering and said lower surface so as to provide hot air chambers within the outlines of the roof truss, said sloping surfaces providing a downwardly flaring trough between them adapted to receive moisture-laden air, said building being adapted to house a double series of drying machines beneath the said air chambers, a floor on which said machines may be mounted, driving motors for said machines located below said floor, driving interconnections between said motors and said machines, the driving interconnections being located closely adjacent a side wall of the building and between the wall and the motor, means for supplying heated dry air to the chambers, the lower surface of each chamber having outlet openings adjacent the walls of the building so that a blanket of moisture-absorbing hot air may be created immediately over the machines, means for creating an updraft of air adjacent the inner surfaces of the rows of machines so that the blanket of moisture-laden air may be moved into the flaring trough, and means for removing the air from said trough.

11. A building arrangement of the class described comprising a pair of side walls defining the width of the building, a roof truss supported thereby, an upper covering on each side of said truss, lower surfaces provided on the bottom of said truss, inner sloping surfaces connecting said upper covering and

said lower surface so as to provide side chambers within the outlines of the roof truss, said sloping surfaces providing a downwardly flaring trough adapted to receive air, means for supplying heated dry air to the chambers, the lower surface of the chambers having outlet openings adjacent the walls of the building so that a blanket of hot air may be created below the chambers, means for creating an updraft of air so that the said blanket of air may be moved into the flaring trough, and a center glass surface extending lengthwise centrally of the roof adapted to permit the efficient illumination of the space beneath the chambers.

12. In a building of the class described, side walls, a roof supported thereby and having spaced top and bottom surfaces providing a plenum-air chamber therebetween, a series of drying machines enclosed by said walls and roof, means for supplying heated air to said chamber, said chamber having air outlet openings in one side thereof so that a continuous blanket of moisture-absorbing air is maintained directly over said machines said roof providing a trough at the side of said chamber opposite said outlet openings, said trough having a series of discharge openings along its length, and means for withdrawing air from said trough and forcing it through said discharge openings, whereby condensation of moisture within the building is substantially prevented.

13. In a building of the class described, a pair of spaced vertical side walls, a substantially triangular shaped roof truss supported by said walls, said roof truss having a maximum depth at its center portions, an upper sloping surface at each side of the roof truss and a lower substantially horizontal surface on each side portion of the roof, said upper and lower surfaces providing a pair of plenum air chambers therebetween, a central downwardly flaring trough provided in said roof truss between the said chambers, means for supplying dry air from said chambers so as to create an inwardly moving blanket of moisture-absorbing air below each chamber, said trough having a series of discharge openings therein, and means for withdrawing moisture-laden air from said trough and forcing it through said discharge openings.

14. In a building of the class described, side walls, a roof truss supported thereby, a series of drying machines mounted between said side walls, a plenum chamber provided in said roof truss and adapted to contain heated dry air, said chamber having a continuous series of outlet openings in one side of the same so that a continuous blanket of moisture absorbing air may be maintained in the building immediately beneath said chamber and over the tops of the drying machines, the drying machines being positioned beneath the chamber so as to block any substantial passage of air from the plenum chamber except over the machines transversely of the series, said roof providing a trough for receiving moisture laden air, the trough having a series of discharge openings throughout its length, and means for forcing moisture laden air from said trough.

In testimony whereof I hereunto affix my signature.

WALTER J. ZIMMERMAN.