J. E. ALEXANDER.

DRIER FOR PAPER MAKING MACHINES.

APPLICATION FILED NOV. 26, 1917.

1,330,366.

Patented Feb. 10, 1920.

6 SHEETS—SHEET 1.

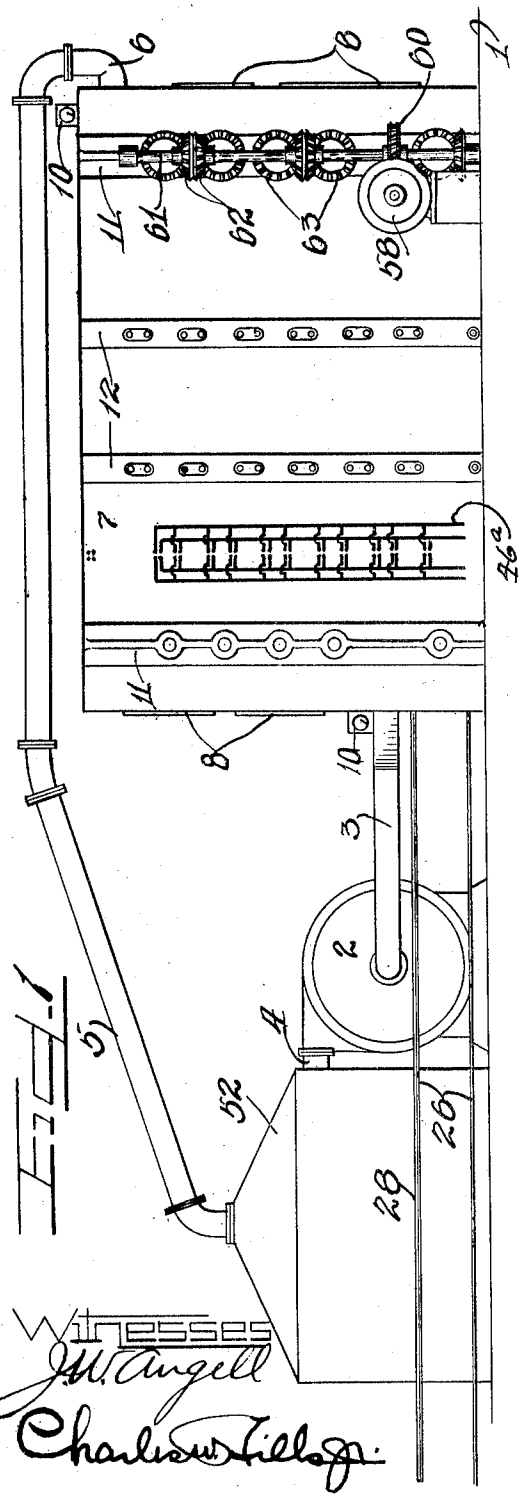

Fig. 1

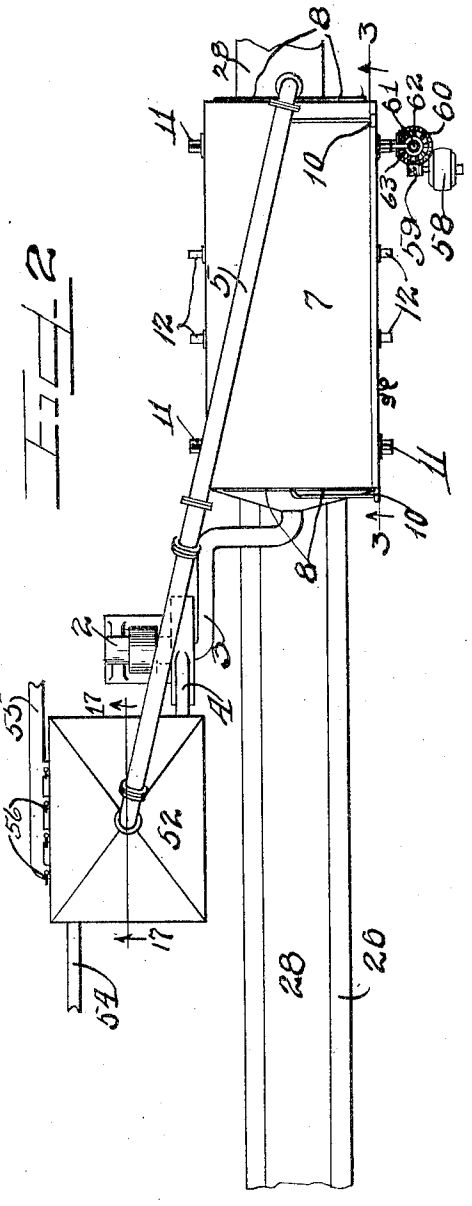

Fig. 2

Witnesses

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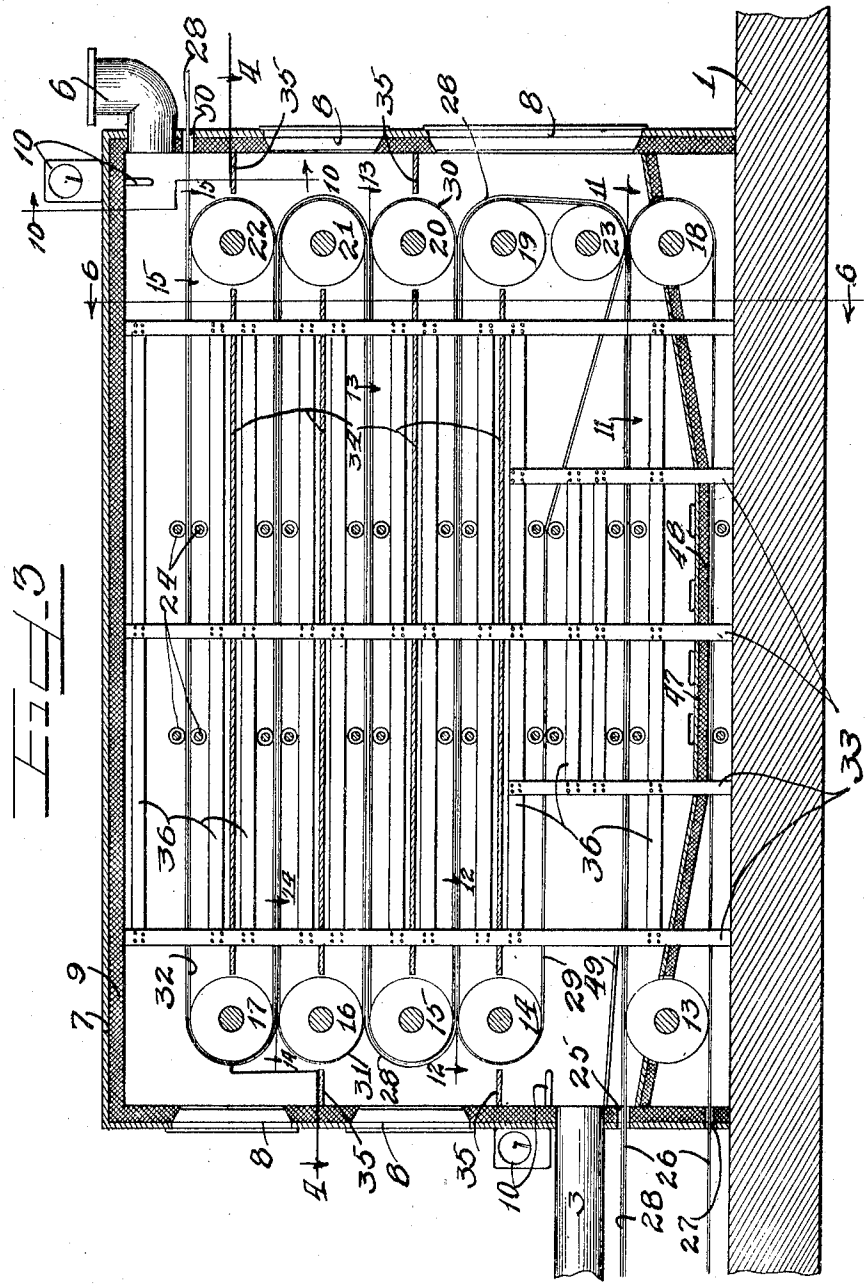

Fig. 2.

Witnesses
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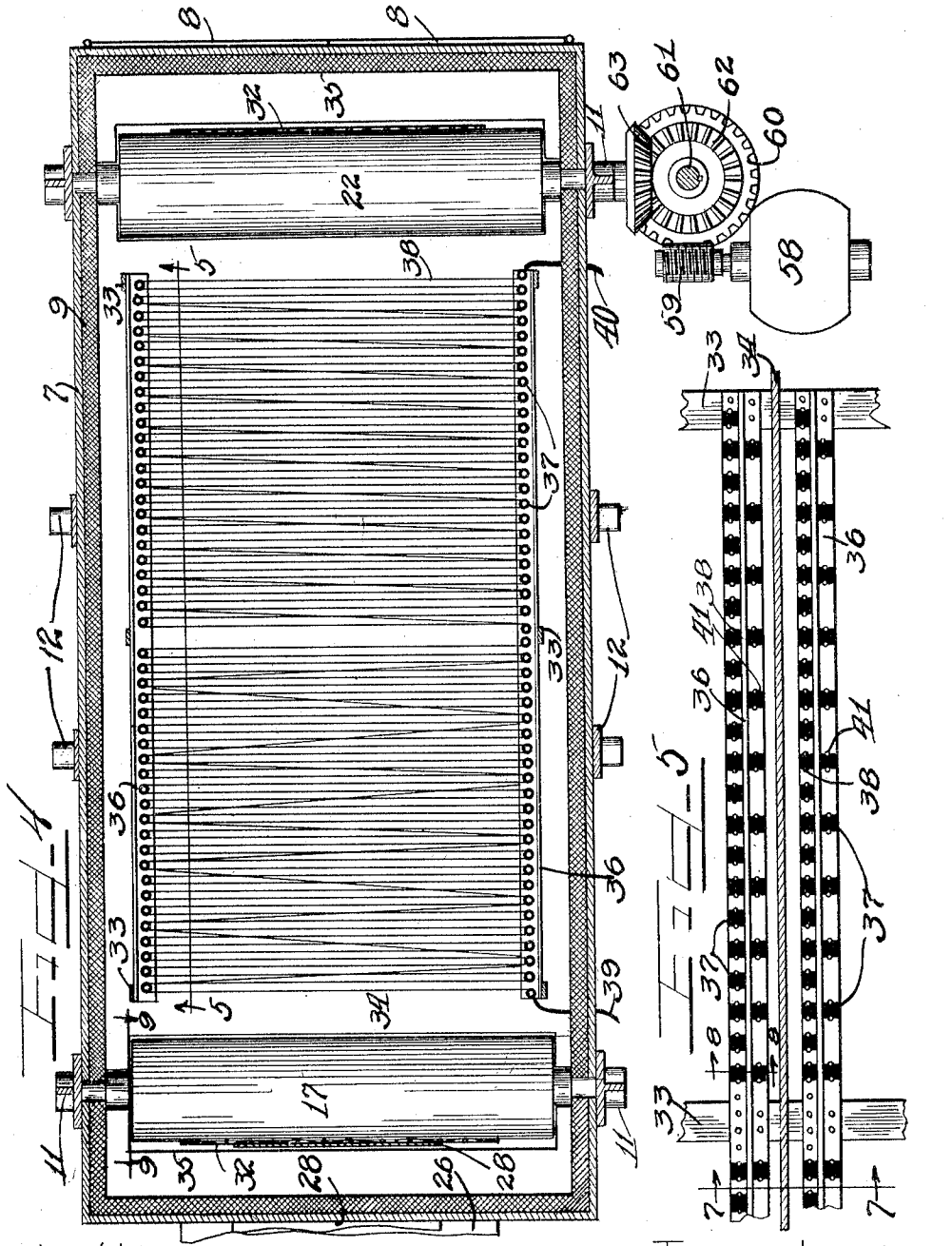

Witnesses

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6 SHEETS—SHEET 4.

FIG. 6

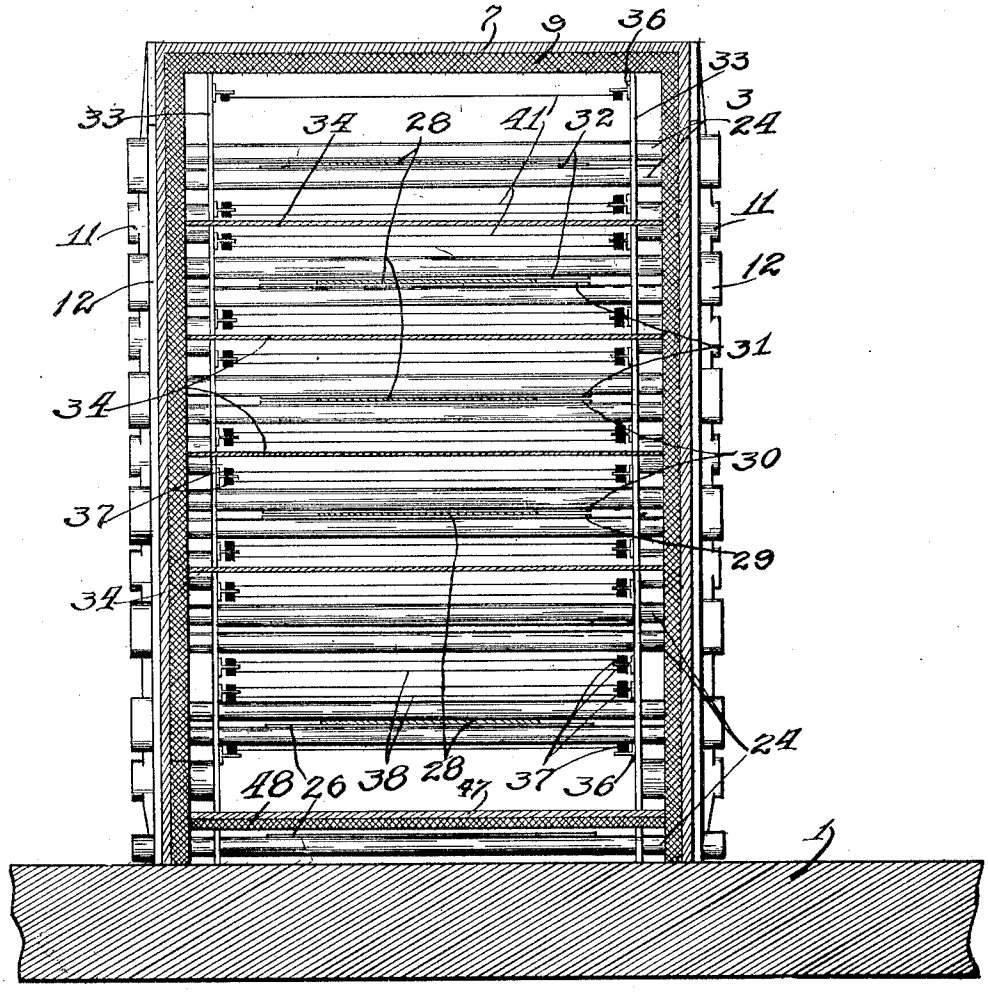


FIG. 7

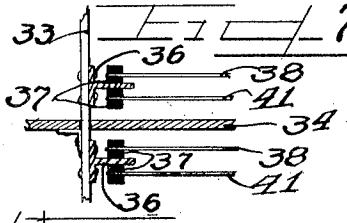
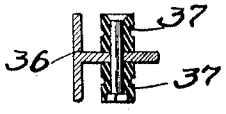


FIG. 8



Witnesses

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6 SHEETS—SHEET 5.

Fig. 16

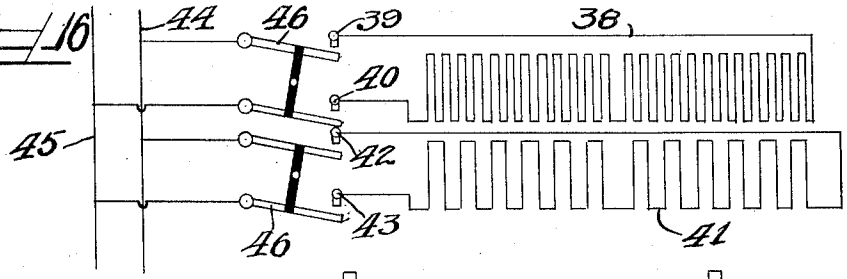


Fig. 11

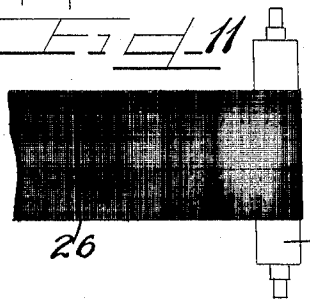


Fig. 12

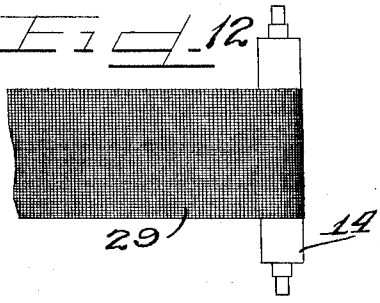


Fig. 13

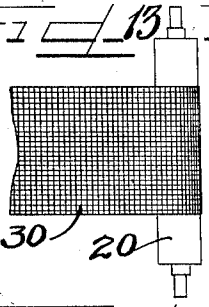


Fig. 14

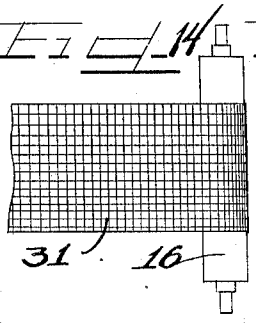


Fig. 15

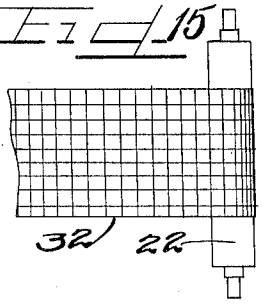


Fig. 9

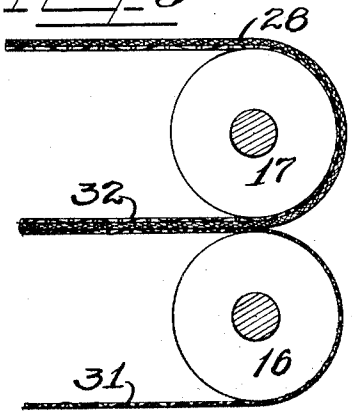
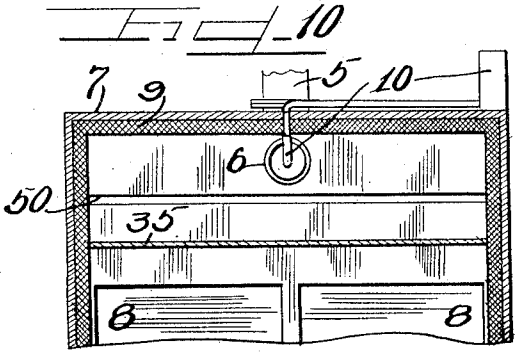


Fig. 10



Witnesses

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6 SHEETS—SHEET 6.

Fig. 17

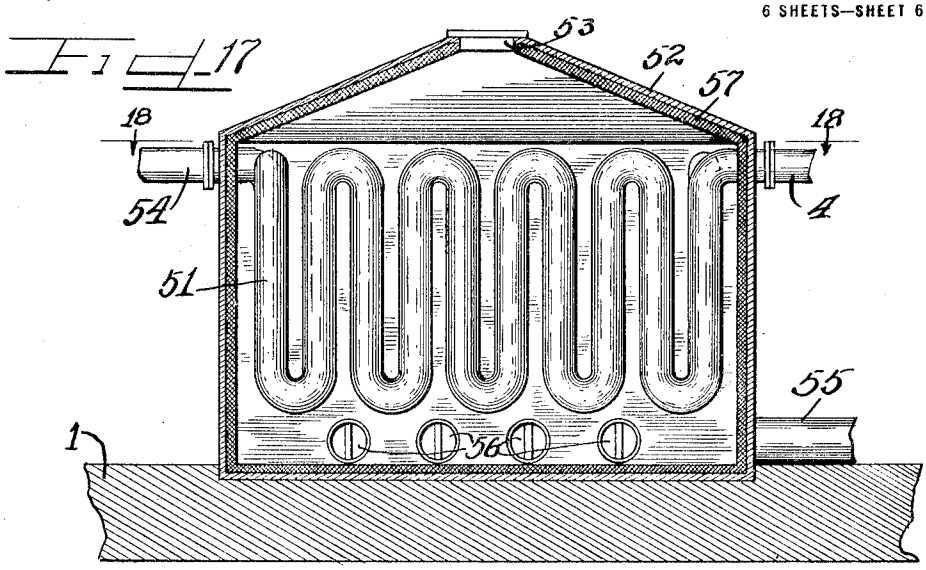
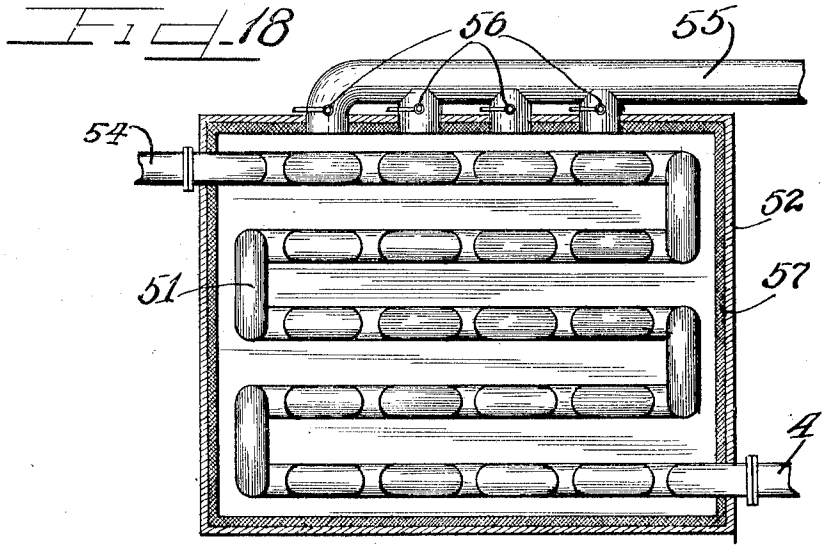


Fig. 18



Witnesses

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UNITED STATES PATENT OFFICE.

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DRIER FOR PAPER-MAKING MACHINES.

1,330,366. Specification of Letters Patent. Patented Feb. 10, 1920.

Application filed November 26, 1917. Serial No. 204,085.

To all whom it may concern:

Be it known that I, JOHN E. ALEXANDER, a citizen of the United States, and a resident of the village of Port Edwards, in the county of Wood and State of Wisconsin, have invented certain new and useful Improvements in Driers for Paper-Making Machines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the numerals of reference marked thereon, which form a part of this specification.

The preheater disclosed in this case is claimed in my application for patent for a "Device for preheating air for use in paper-making machines," filed November 26, 1917, Serial No. 204,087.

In the various types of paper-making machines at present in use the drying of the paper web is accomplished by means of steam heated cylinders or rolls which are not inclosed, and consequently in the process of drying the web the steam, generated by the heated rolls drawing the moisture out of the web, is allowed to be absorbed by the air in the room wherein the machine is assembled thus increasing the humidity of the air in the room and thereby tending to prevent the web from properly drying out in its progress through the machine.

This invention relates to a paper-making machine wherein an inclosed drier unit is employed having electrically heated heating elements disposed therein in superimposed relation and associated with a plurality of web carrying wire belts of varying mesh to permit drying of the web during its upward and circuitous passage through the drying unit, whereby air entering said drying unit is heated by said electrical heating elements and is drawn out of said drying unit by suction through a predetermined passage, thereby thoroughly drying the web and changing the air in the drying unit thus preventing the air, which becomes saturated with the moisture drawn from said web, from hindering the drying process.

It is an object of this invention to construct an inclosed electrically heated drying unit for paper-making machines and similar devices.

Another object of this invention is the construction of a drying unit for paper-making machines, said drying unit having electrically heated heating elements superimposed therein for the purpose of drying a web which is carried by belts of varying wire mesh upwardly between said heating elements and out of the upper portion of the drying unit.

A further object of the invention is the production of a dryer for paper-making machines wherein a paper web is dried by carrying the same upwardly through a winding path and through a current of heated air moving through the drier in a direction opposite to the direction of travel of said web.

It is furthermore an object of this invention to provide a drier unit for paper making machines, wherein a web to be dried is conducted through a heated winding passage between wire belts of different mesh and between rolls which act as presses.

Another object of the invention is the equipping of a paper-making machine with a drying unit through which air is drawn by suction and heated by electrical heaters for the purpose of drying a web during its travel in a circuitous passage between said heaters and through said unit.

It is an important object of the invention to provide an electrically heated drier for use in paper-making machines and similar devices, simple and of effective construction whereby a web is conducted through a circuitous passage and thoroughly dried by means of a heated current of air moving in a direction opposite to that of the web and following a predetermined passage formed by baffle plates secured within said drier.

Another important object of the invention is the construction of a paper-making machine drier comprising a casing adapted to permit a web to be carried therethrough between a series of superimposed belts, presser rolls, heaters and baffle plates for the purpose of thoroughly drying the web before the same is passed between the calender rolls of the paper-making machine.

Other and further important objects of this invention will be evident from the disclosures in the drawings and specification.

The invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a side elevational view of a drier unit and an air supply mechanism of a paper-making machine, said drier unit embodying the principles of this invention.

Fig. 2 is a top plan view thereof.

Fig. 3 is an enlarged section taken on line 3—3 of Fig. 2, showing the interior mechanisms of the drier unit.

Fig. 4 is a section taken on line 4—4 of Fig. 3, with parts shown in elevation.

Fig. 5 is an enlarged fragmentary detail view taken on line 5—5 of Fig. 4, with parts broken away.

Fig. 6 is a section taken on line 6—6 of Fig. 3.

Fig. 7 is a fragmentary detail section taken on line 7—7 of Fig. 5.

Fig. 8 is an enlarged detail section taken on line 8—8 of Fig. 5.

Fig. 9 is an enlarged fragmentary detail view taken on line 9—9 of Fig. 4, with parts omitted.

Fig. 10 is a fragmentary section taken on line 10—10 of Fig. 3, with the web omitted.

Fig. 11 is a fragmentary detail view taken on line 11—11 of Fig. 3, showing the lowermost belt.

Fig. 12 is a fragmentary detail view taken on line 12—12 of Fig. 3.

Fig. 13 is a fragmentary detail view taken on line 13—13 of Fig. 3.

Fig. 14 is a fragmentary detail view taken on line 14—14 of Fig. 3.

Fig. 15 is a fragmentary detail view taken on line 15—15 of Fig. 3, showing the uppermost belt.

Fig. 16 is a detail wiring diagram of the upper and lower coils of one of the electrical heating units, showing the switches for regulating the degree of heat.

Fig. 17 is an enlarged detail section taken on line 17—17 of Fig. 2, with parts shown in elevation.

Fig. 18 is a section taken on line 18—18 of Fig. 17, with the walls shown in section to show certain of the pipes and the inlet valves in elevation.

As shown on the drawings:

The reference numeral 1, designates a floor or foundation upon which are securely mounted parts of a paper-making machine embodying the principles of this invention, and comprising a drier unit, an air intake device for heating air by the exhaust from said drier unit before said air is admitted into said drier unit, a suction pump 2, connected with the drier unit by means of a pipe 3, and connected with the air intake device by a pipe 4. Air from the air intake device is permitted to enter the drier unit through a feed pipe 5, one end of which is attached to the upper portion of the air intake device and the other end of which is connected to an air intake elbow 6, or main outside air intake leading into the upper portion of a box or casing 7, of the drier unit.

The drier unit, the suction pump and the air intake device are adapted to be used in combination with paper-making machines and other similar Fourdrinier devices, said drier unit replacing the steam heated drying cylinders which ordinarily form a part of paper-making machines The drier unit is connected in position between the Fourdrinier and the calender rolls (not shown) of the paper-making machines as hereinafter more clearly described.

The drier unit which embodies the principles of this invention comprises the box or casing 7, which is provided with an air intake aperture near the upper portion of one end thereof through which the intake elbow 6, projects. The other end of the casing 7, is provided with an air outlet or exhaust aperture into which one end of the outlet pipe 3, projects. Each end of the casing 7, is also provided with a plurality of conveniently spaced manholes or openings fitted with removable doors 8, to permit access to the mechanisms within the casing 7, for the purpose of cleaning or adjusting said mechanisms. The casing 7, is provided with an inner wall or lining 9, made of any suitable non-conducting material adapted to prevent the radiation of heat. Mounted upon the casing 7, and projecting therein at a point near the inner end of the air inlet elbow 6, is a thermometer 10, provided with a suitable dial to permit reading of the same. A similar thermometer 10, is mounted on the other end of the casing 7, above the exhaust pipe 3, and also projects into said casing. Said thermometers afford a ready means for indicating the temperature of the incoming and outgoing air in the drier casing.

Securely mounted upon the exterior of each side of the casing 7, and near each end thereof is a vertically disposed apertured bearing bar or upright 11, and also securely mounted upon the exterior of each side of the casing 7, between the bearing bars 11, and spaced from one another are two vertically disposed apertured bearing bars or uprights 12, for a purpose hereinafter described. Disposed laterally within the casing 7, in parallel relation one above the other and near the exhaust end of said casing are a plurality of large rotatable belt rollers numbered 13, 14, 15, 16 and 17, respectively, and having the shafts thereof projecting through suitable openings for the purpose provided in the side walls of the casing and registering with the apertures in two of the oppositely disposed bearing bars 11. Transversely mounted within the casing 7, near the air intake end thereof are a plurality of rotatable belt rollers 18, 19, 20, 21 and 22, disposed parallel to and arranged in superimposed relation one above the other and opposite the respective rollers 13, 14, 15, 16, and 17. The rollers 18 to 22, inclusive, have the shafts thereof

projecting through suitable apertures in the side walls of the casing 7, and bearing in the apertures of two of the bearing bars 11, at the air intake end of the casing. The belt rollers 13 and 14, are separated from one another, as are also the rollers 18 and 19, and rotatably mounted between the rollers 18 and 19, with the shaft ends thereof journaled in the respective bearing bars 11, is a transversely disposed belt roller 23. The respective rollers 13 to 23, inclusive, may be made of metal or any other suitable material, and are arranged as above described and as clearly shown in Fig. 3.

Arranged in parallel relation to one another within the casing 7, and disposed in two vertical rows are a plurality of transversely mounted guide rolls 24, the ends of which are reduced and project through suitable apertures in the side walls of the casing 7, and are rotatably journaled in the apertures of the respective bearing bars 12; said guide rolls are arranged in pairs as shown in Fig. 3, with the exception of the lowermost roll in each of the rows.

Projecting through a suitable slot or opening 25, in the end wall at the exhaust end of the casing, is a portion of a continuous feed belt 26, made of very fine wire mesh or other suitable material. Said belt 26, is conducted over the roller 13, and between the guide rolls 24, of two pairs of said rolls, and then is trained around the roller 18, over the two lowermost guide rolls 24, and contacting the roller 13, passes out of the casing 7, through a suitable slot or opening 27. The feed belt 26, has the outer portion thereof associated with the pulp mixing parts of the paper-making machine and is disposed below the feed apron of the machine (not shown) thereby permitting pulp which is to be formed into paper to be deposited upon the feed belt 26, in the form of a web 28, to be dried by the drier unit as hereinafter described. Trained around the rollers 14, 19 and 23, and between certain of the guide rolls 24, is a continuous belt 29, made of wire or other suitable material, the mesh of which is slightly larger or coarser than that of the feed belt 26. Engaged around the rollers 15 and 20, and conducted between certain of the guide rolls 24, is another continuous belt 30, also made of wire or other suitable material and of a mesh which is coarser than that of the belt 29. Disposed around the rollers 16 and 21, and between certain of the guide rolls 24, is a continuous belt 31, made of wire or other suitable material the mesh of which is coarser than that of the belt 30. Trained around the uppermost rollers 17 and 22, is another continuous belt 32, also made of wire or other suitable material the mesh of which is coarser than that of the belt 31. It will be noted that the various belts are of a different wire mesh grading from a very fine mesh at the bottom of the casing to a coarse or open mesh at the top of the casing as shown in detail in Figs. 11 to 15, inclusive.

Securely mounted within the casing 7, are a plurality of vertical supporting bars 33, disposed between the sets of superimposed rollers. Rigidly secured to said supporting bars and to the interior of the casing 7, are a plurality of longitudinally disposed horizontal baffle plates 34, one of which is mounted between each of the following sets of rollers 14—19, 15—20, 16—21 and 17—22. Also secured upon the inner surfaces of the end walls of the casing 7, are a plurality of horizontal smaller baffle plates 35, arranged in staggered relation with respect to one another on said end walls as clearly shown in Fig. 3, one of said smaller baffle plates 35, being disposed between the respective end walls and each of the rollers 14, 16, 20 and 22, in the planes of the respective larger baffle plates 34, thus dividing the interior of the casing into a plurality of compartments connected with one another to form a continuous passage or channel for the passage of air through the drier unit.

Mounted horizontally in superimposed relation with respect to one another within the casing 7, and rigidly secured to the supporting bars 33, are a plurality of electrical heating elements or units each comprising a pair of oppositely disposed T-bars 36, which are rigidly secured upon the supporting bars 33, with the stem of the T-bars horizontally disposed and directed inwardly toward one another. Secured upon the upper and under sides of the stem of each of the heating element T-bars 36, are a plurality of insulating blocks 37, the number of insulating blocks 37, on the upper side of the respective T-bar stems being twice that of the number secured to the under side of said stems. Connected back and forth between the oppositely disposed upper insulating blocks 37, of each of the heating elements is a wire element 38, provided with terminals 39 and 40, while connected back and forth between the oppositely disposed under or lower insulating block 37, of each of the heating elements is a wire element 41, having half the number of turns or loops contained in the upper wire element. Each of said lower wire elements 41, is provided with terminals 42 and 43, as shown in the wiring diagram of Fig. 16. The main electric circuit wires are designated by the reference numerals 44 and 45, and connected in parallel thereacross are switches 46, one for each of said wire elements 38 and 41. Said switches 46, permit either one or both of said wire elements to be connected in the main electrical circuit as desired, thus providing a means for varying or regulating

the heat radiated by said heating elements within the drier unit. The terminal ends of the wires of the various heating elements may, of course, be run into any suitable type of terminal box 46a, in which the switches 46, and the terminals of the main circuit wires may also be located.

Securely mounted within the lower portion of the casing 7, as shown in Fig. 3, is a floor made of an upper layer 47, of metal and a lower layer 48, of insulating material for the purpose of preventing the radiation of heat from said drier unit. Both ends of the floor are inclined upwardly at an angle with respect to the central portion of the floor to afford a means for draining or accumulating any liquid or waste material resulting from the operation of the drier unit mechanisms. Also rigidly mounted within the casing 7, below the air exhaust opening is a guide plate 49, adapted to prevent the exhaust from leaving the casing through the slots 25 and 27, through which the feed belt 26, enters and leaves the drier unit. As shown in Fig. 10, a slot 50, is provided in the end wall of the casing 7, below the air intake opening, to afford an exit for the web 28, from the drier unit to permit said web to be fed to the calender rolls of the paper-making machine.

As shown in Figs. 1, 2, 17 and 18, the pipe 4, having one end connected with the suction pump 2, has the other end thereof connected up with one end of a pipe coil, radiator or exhaust heater 51, disposed within a casing or box 52, of the auxiliary or air preheating intake device which is rigidly mounted upon the foundation or floor 1, adjacent the suction pump 2. The casing 52, has an opening 53, in the upper end or top thereof for receiving the other end of the feed pipe 5, connected therein. The pipe coil 51, is continuous and may be of any desired form, the other end thereof connecting up with an exhaust pipe 54, which projects through the casing 52. The exhaust pipe 54, may be of any desired length in order that the same may exhaust into the atmosphere at a distance sufficiently remote from the paper-making machine. As shown in Figs. 17 and 18, it will be seen that the interior of the pipe coil 51, disposed within the casing 52, of the air intake device does not communicate with the interior of said casing, but merely affords a continuous passage through said preheating unit for the exhaust from the drier unit. An air intake or inlet pipe 55, provided with a plurality of valves 56, is connected up with the lower portion of the casing 52, to afford an entrance for atmospheric air. The valves 56, project into one of the walls of the casing 52, near the lower end thereof and are adapted to be operated independently of one another to control the flow of air into the preheating unit. The casing 52, is provided with an insulating lining 57, to prevent radiation of heat.

The belts and rollers within the drier unit are operated by means of a motor 58, disposed on the exterior of the casing 7. The shaft of the motor has a worm 59, secured thereon which meshes with a worm gear 60, keyed on a vertical driving shaft 61, rotatably mounted on one side of the casing 7. Secured on the driving shaft 61, are a plurality of bevel gears 62, each of which meshes with a bevel gear 63, one of which is keyed or otherwise secured upon the projecting end of each of the shafts of the rollers 18 to 22, inclusive, thereby permitting the drive from the motor to be transmitted to the rollers, belts and rolls mounted within the drier unit.

The operation is as follows:

When pulp in the form of a web is to be dried in the drier unit embodying the principles of this invention, the motor 58, is started thereby transmitting a rotary motion to the belt rollers within the casing 7, through the bevel gears 62, and 63, thus setting the mechanisms within the drier unit in operation. Pulp to be formed or made into paper is run onto an apron of the paper-making machine and is then deposited upon the feed belt 26, made of a fine wire mesh or other suitable material. The pulp deposited on the feed belt 26, before entering the drier unit is formed into a web 28, which requires drying during the process in which the web is transformed into paper. For the purpose of drying the web 28, the same is carried along in a continuous ribbon or tape form upon the feed belt 26, into the drying unit casing 7, and by opening the doors 8, the web 28, may be properly threaded back and forth upwardly around the belts 29, 30, 31 and 32, passing between the respective belts, the electrical heating elements, and between the guide rolls 24, and finally passing out of the casing 7, through the slot 50, from where the web 28, is conducted to the calender rolls of the paper-making machine.

During the above operation atmospheric air is admitted through the air intake pipe 55, and through the controlling valves 56, which are operatable independently of one another to permit regulation of the amount of air admitted into the device. By the action of the suction pump 2, the air is drawn through the casing 52, through the pipe 5, and then through the drier unit. The baffle plates 34 and 35, are so arranged within the casing 7, so that the air entering at the top of the casing 7, through the inlet elbow 6, will pass in between the electrical heating element 38 and 41, downwardly in a continuous circuitous passage and out through the outlet pipe 3, said air

of course being heated during its passage through the drier unit, thereby tending to thoroughly dry the web 28, not only along its edges, but evenly all the way through, the wire mesh belts permitting the heated air to come into contact with both surfaces of the web, such contact being greater in the upper part of the drier unit and gradually decreasing toward the bottom due to the graded arrangement of the wire mesh used in the web carrying belts.

The heating elements which are preferably electrically heated are independent of one another and may accordingly be regulated to obtain graduated temperatures within the casing 7, if so desired. The air which is used as the drying medium in the drier unit is adapted to be heated by said electrical heating elements, to a temperature, sufficient to draw the moisture out of the web 28, which moisture mixes with the hot air and forms steam. The suction pump 2, which may, of course, be operated by any suitable source of power, acts to suck or draw the steam out of the casing 7, through the outlet pipe 3, the pump 2, and the pipe 4, and then force the exhaust steam and air through the radiator pipes 51, and out through the exhaust pipe 54. The passage of the exhaust steam and air through the radiator pipes 51, tends to heat the same thereby causing a preheating of the atmospheric air in the preheating unit before said air passes through the pipe 5, into the drier unit. From the above description it will be noted that use is made of the exhausted heat units to preheat the atmospheric air entering the paper-making machine before it enters the casing 7, for further heating, and that the constant drawing out of the steam formed in the drier unit affords a circulation of hot air through the circuitous passage in the drier unit which passage of air moves in a direction opposite to the direction of motion of the web 28, and consequently affords a ready means for drying said web, rapidly and uniformly throughout.

It will of course be understood that any suitable type of electric heating units may be used in the drier unit other than the form shown, and that felt or any other suitable material may be used in the conveyer belts in place of wire mesh. Numerous other details of construction may also be varied through a wide range without departing from the principles of this invention, and I therefore do not purpose limiting the patent granted otherwise than necessitated by the prior art.

I claim as my invention:

1. The combination with a paper-making machine, of a drier unit connected therewith comprising a casing, means of different mesh therein for conducting a web to be dried through a circuitous path in said casing, and electric heaters within said casing adapted to thoroughly dry said web during its passage through said casing.

2. The combination with a paper-making machine, of inclosed electrically heated drier means connected with said machine for drying a web to be made into paper, and means connected with said drier means for preheating a drying medium before the same enters said drier means.

3. The combination with a paper-making machine, of inclosed electric heaters associated therewith, and means for drawing air between said heaters whereby said air is heated and dries a web conducted through said machine between said heaters.

4. The combination with a paper-making machine, of an inclosed electrically heated drier unit connected therewith, means connected therewith for drawing air through said drier unit, and auxiliary means connected with said drier unit and with said means for preheating air before the same enters said drier unit for further heating to dry a web conveyed through said drier unit.

5. A drier embracing a plurality of electrical heaters adapted to be regulated independently of one another for obtaining graduated temperatures in the drier, and a mechanism connected with said drier for preheating air and causing a circulation of said preheated air through said drier for drying a paper web conveyed therethrough.

6. A drier comprising a casing, a plurality of means of different mesh therein for conveying a web therethrough, and heater elements within said casing for drying said web in its passage through said casing.

7. A paper-making machine drier unit comprising a casing, movable means therein for conveying a web upwardly through said casing in a circuitous path, electric heaters within said casing for heating the air therein to cause drying of said web in its passage through said casing, and means within said casing affording a continuous circuitous path for the passage of air through said casing.

8. In a drier unit for a paper-making machine, a casing, a plurality of heater elements therein mounted in superimposed relation with respect to one another, a plurality of means within said casing for conveying a web upwardly through a circuitous path between said heater elements, and baffle plates within said casing to afford a continuous circuitous path in said casing for the passage of air which is heated by said heater elements to dry said web in its passage through the casing.

9. A paper-making machine drier comprising a plurality of rigidly mounted heater elements, means for regulating said heater elements independently of each other for obtaining graduated temperatures in

said drier, and endless conveyers of different mesh for conveying a web between said elements in a circuitous path to uniformly dry said web.

10. A paper-making machine drier unit comprising a casing, a plurality of heaters rigidly mounted therein in superimposed relation, a plurality of continuous belts within said casing also mounted in superimposed relation with respect to one another to afford a means for conveying a web through said casing in a circuitous path between said heaters, guide means for said belts, a plurality of baffle plates within said casing affording a continuous circuitous passage in said casing, and means connected with said casing for drawing air through said circuitous passage between said heaters and around said web to cause uniform drying of said web in its passage through said casing.

11. In a drier unit of the class described, a casing, a plurality of electric heaters mounted therein independently of one another, means permitting the use of any number or all of said heaters for regulating the temperature in said casing, a plurality of continuous belts within said casing each of a different wire mesh, and means connected with said casing for causing a circulation of air therethrough to be heated by said heaters to uniformly dry a web carried by said belts in a circuitous path between said heaters through said casing.

12. A paper-making machine drier unit comprising a casing, heaters therein, a plurality of rollers within said casing, belts engaged thereon for carrying a web in a circuitous path through said casing, means for rotating said rollers to operate said belts, guide rolls in said casing for said belts, means within said casing to afford a continuous circuitous passage therein, and suction means connected with said casing adapted to draw air through said passage between said heaters in a direction opposite to the direction of movement of said web to dry said web in its passage through the casing.

13. A drier unit of the class described embracing a casing, a plurality of heaters mounted therein in superimposed relation to one another, a plurality of belts of different wire mesh movably mounted within said casing in a graded superimposed relation to one another with the belt of finest mesh lowermost, means for drawing air through said casing in a circuitous path between said heaters to heat said air to dry a web carried by said belts upwardly in a circuitous passage through said casing.

14. A drier unit embracing an insulated casing, means for causing air to pass therethrough downwardly in a circuitous path, means for heating said air, and means for carrying a web through said casing upwardly in a circuitous path to permit said heated air to dry said web.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

JOHN E. ALEXANDER.

Witnesses:

EARL M. HARDINE,

CHARLES W. HILLS, Jr.